## **Space Program Operations Contract**

# **Shuttle Crew Training Catalog**

November 7, 2008

DRD-1.6.1.3-A
Contract NNJ06VA01C

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## **Shuttle Crew Training Catalog**

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DRD-1.6.1.3-a

#### **REVISION LOG**

Rev. letter	Change no.	Description	Date
Basic		USA Baseline supersedes SFOC-FL0258	06/27/2001
	CPN-1	Change Package Notice-1	01/29/2002
		Lesson Change Requests (LCRs) implemented in CPN-1:	
		NEW ASTRONAUT:	
		01-BASE-01 Add FLT CONT QUAL 21007 01-BASE-03 Revise section	
		CREW SYSTEMS:	
		01-BASE-05 TOXICOLOGY 91001 mandatory 01-BASE-06 Add ERGOMETER 91020 01-BASE-08 Add CSA-CP 31001 01-BASE-09 Add TEPC 31001	
		STS PHOTO/TV:	
		01-BASE-04 Revise section	
		ASCENT/ENTRY FLIGHT OPERATIONS:	
		01-BASE-02 Revise section	
		APPENDIX C:	
		01-BASE-07 Modify flow chart	
Α		Revision A	12/16/2002
		Lesson Change Requests (LCRs) implemented in Revision A:	
		NEW ASTRONAUT:	
		01-BASE/CPN1-1 Add lesson A/E FCS BR 21001, review lesson A/E FCS 21001 and A/E FCS 21006 02-0020 Replace PGSC H/W 21020 with PGSC INTRO 21195	
		02-0034 Delete TIPS 21001	
		CREW SYSTEMS:	
		02-0001 Add CMO REFR 91001 02-0005 Add SUBMAX CYCLE TEST 31001 02-0006 Add PREBREATHE 31001 02-0007 Add CVIS & HRF OPS 31001 02-0008 Add PEAK CYCLE TEST 31001 02-0014 Revise WCS REFR 41065 02-0018 Revise POST LANDING EGRESS 91019	
		02-0027 Revise WATER XFER OPS 91020 02-0028 Revise WATER XFER OPS 91001 02-0030 Revise TEPC 31001 02-0031 Revise CSA CP 31001  STS PHOTO/TV:	
		02-0026 Revise section reflecting new equipment	
		ASCENT/ENTRY FLIGHT OPERATIONS:	
		02-0011 Delete lesson ASC MSN BR 91001 02-0013 Modify control objectives for Ascent Entry	

Rev. letter	Change no.		Description	Date
A (cont)		ORBIT FLIGHT	OPERATIONS:	
A (cont)		02-0003 02-0009 02-0010 02-0012 02-0016 02-0017 02-0021 02-0022	Add STS/ISS COMM PRF 41012 Revise ORB SKL 91001 Revise ORB SKL 91012 Delete TDF RVW BR 31001 Revise RETR NOM T/L 91001, RETR MAL T/L 91012 Revise CONT D/O 32012 Replace media from 31001 to 31195 for lesson OCA/VTS OPS Replace media from 31001 to 31195 for lesson PGSC MAL Replace lesson NETWORK OPS 31001 with PGSC NETWORK OPS 31195	
		02-0024 02-0025	Replace media from 41001 to 41195 for lesson PGSC REVIEW Add APDS 21057	
		EVA TASK OPE		
		02-0019	Revise section	
			/PROXIMITY OPERATIONS:	
		02-0002	Revise section	
		SPACHAB:		
		02-0004	Revise section	
			STS Crew Training:	
		02-0029	Add section	
В		Revision B		12/16/2003
		Lesson Change	Requests (LCRs) implemented in Revision B:	
		NEW ASTRONA	<u>AUT</u> :	
		02-0038	Add OCA/VTS OPS 21195; PGSC NETWORK OPS 21195	
		03-0005 03-0015 03-0020 03-0022 03-0023 03-0024	Modify Study List Revise IFM 21001, IFM PIN KIT 21001 EVA OV 21001 SPOC 21001 Updated P/L OV 21001 FLIGHT PLAN 21001	
		03-0024	CREW HAB 21001, ESC EQ/SYS 21001, ESC PROC 21001, REACH & VIS 21020, WATER SURV 21001, WATER SURV 21027	
		03-0037	P/L COM OPS 21001 with P/L COM/OIU OPS 21001 Remove P/L COM/ISS IF 21001	
		03-0038	Replace P/L COM OPS 21006 with P/L COM/OIU OPS 21006	
		03-0039	Replace P/L COM MAL 21006 with P/L COM/OIU MAL 21006	

Rev. letter	Change no.		Description	Date
B (cont)		CORE SYSTEM	REFRESHER:	
		03-0007	Delete COMI REFR 41001, COMI REFR 41006, PCOM REFR 41001, PCOM REFR 41006 Revise COMM REVIEW 41006	
		03-0018	Revise DPS Q 31001, NAV Q 31001, OGNC QUAL 31006, PASS RECOV 31006	
		03-0033	Revise CCTV REVIEW 41008	
		03-0034	Revise CCTV REFR 41001	
		03-0035	Revise CCTV REFR 41008	
		03-0040	Add PL COM/OIU 41006, Remove PL COM/ISS IF 41006	
		03-0041	Add PL COM/OIU 41001, Remove PL COM/ISS IF 41001	
		03-0050	Revise A MPS S&C Q 31001	
		CREW SYSTEM	<u>S</u> :	
		02-0032	Revise IN/EG TIMELINE 91105	
		03-0008	Revise CO2 31074	
		03-0009	Revise MED DIAG 31001	
		03-0010	Revise SEE OPS 31020	
		03-0011 03-0016	Revise PREBREATHE 31001 Revise IFM PROC 91020, IFM KSC W/T 91031	
		03-0017	Revise IFM REV 41001	
		MEDICAL OPER	ATIONS:	
		03-0026	Removed Medical lessons from CREW SYS Flow to create Medical Operations Section	
		STS PHOTO/TV:		
		02-0037 03-0014	Revise APPR&DOCK TV 91020 Delete ET FILM REV 31001, Revise ET EQ 31001, ET PHO SKILLS 31001	
		ASCENT/ENTRY	/ FLIGHT OPERATIONS:	
		03-0019 03-0048	Update Section 5 Introduction Revise ENT DAP SK 31001, FCS C/O 31006, E SKL 91011, E SKL 92011, E SKL 93011	
		ORBIT FLIGHT (	•	
		03-0002	Change Location SYS PGSC 31001 to SYS PGSC 31195	
		03-0006	Revise FLT COMM PLN BRF 31001, FLT COMM PLN 31020	

Rev. letter	Change no.		Description	Date
B (cont)		ORBIT FLIGHT	OPERATIONS: (concluded)	
		03-0051	Delete APP MAL T/L 91012 Revise FLT COMM PLN 31020, UNL MAL T/L 31020, UNLD MAL T/L 91012, LOAD NOM T/L 91001, LOAD NOM T/L 91001, DPLY NOM T/L 91001, DPLY NOM T/L 91012, RETR NOM T/L 91012, RETR NOM T/L 91012, LOAD MAL T/L 91012, UNDOCK MAL T/L 91012, UNDOCK MAL T/L 91012, RETR MAL T/L 91012, UNDOCK MAL T/L 91012, UNDOCK MAL T/L 91012, RETR MAL T/L 91012, UNDOCK MAL T/L 91012, UNDOCK MAL T/L 91012, UNDOCK MAL T/L 91012, RETR MAL T/L 91012, UNDOCK MAL T/L 91012, UNDOCK MAL T/L 91012, UNLD MAL T/L 91001, ORB SKL 91001, RETR SJ T/L 91012	
		PAYLOAD DEPI	LOYMENT AND RETRIEVAL SYSTEM:	
		02-0033 03-0049	Revise Section Delete PDRS PRF ADV 42001, PDRS PRF ADV 41016 Replace PDRS NBL FAM 31029 with PDRS NBL FAM 31027	
		ISS ECLSS FOR	R STS CREW TRAINING:	
		03-0001	Add O2N2 XFER PROF 41105	
		ADDENDUM:		
		02-0039	Review BENCH REVIEW	
С		Revision C		06/22/2004
		NEW ASTRONA	<u>NUT</u> :	
		04-0006 04-0007 04-0014	Revise DPS lessons Revise Comm lessons Change reference from FDF workbook to FDF CBT	
		04-0015 04-0016	Revise Systems Classes Revise Cont/Prop classes	
		CORE SYSTEM	<u> </u>	
		04-0002 04-0003 04-0011	Add ECL 10.2 ATM 41004 lesson Delete EDO REVIEW 41008 Remove reference to MEDS in DPS Q 31001 and NAV Q 31001	
		CREW SYSTEM		
		04-0009	Change lesson code to 91020 for STOW REVIEW	
		04-0017	Add ODS TNL OPS 91020	

Rev. letter	Change no.		Description	Date
C (cont)		MEDICAL OPE	RATIONS:	
		04-0018 04-0019 04-0020	Change lesson code CMO REFR 41001 and MED REFR 91001 Add MED PROF 41001 Revise flow order and add currency	
			information	
		ASCENT/ENTR	Y FLIGHT OPERATIONS:	
		04-0004 04-0008	Revise ASC SKL 91011, 92011, 93011 Update E SKL 32001 and E SKL 32011 procedures and hardware	
		ORBIT FLIGHT	OPERATIONS:	
		04-0003	Delete EDO OPS/MAL 31001, EDO OPS MAL31008, and EDO REVIEW 41008	
		04-0010	Remove reference to MCDS and CRT in ORB SKL DPS 31006	
		04-0012 04-0013	Editorial to ORB SKL 91012 Clarified objectives in PGSC NETWORK OPS 31195 and PGSC MAL 31195	
		SPACEHAB:		
		04-0017	Deleted SHAB TNL OPS 31020 and moved to Section 3	
		TRANSFER:		
		04-0005	Added new Section 14, renumbered Integrated Simulations Section to Section 15	
D		Revision D		12/20/2004
		Lesson Change	Requests (LCRs) implemented for Revision D:	
		NEW ASTRONA	AUT:	
		04-0028	Minor revision to Introduction; clarification of IA and IP in 20 lessons	
		04-0029	Corrected source group information (4 lessons)	
		04-0030	Editorial changes (6 lessons), renumbering of flow, and modifications to Training Requirements Summary Table	
		04-0034	Prep callouts for COM/IN MAL 21001 and 21006	
		04-0035	Editorial changes to 5 Crew Sys lessons	
		04-0036	Editorial changes to REF DATA USE 21001	
		04-0037 04-0039	Editorial changes to 5 DPS lessons Editorial changes to 13 Cont/Prop lessons	
		04-0041	Split the Self-Study Table to two parts; editorial changes to the Introduction	
		04-0042	Editorial changes to PRDS OV 21001	

Rev. letter	Change no.		Description	Date
D (cont)		NEW ASTRONAL	JT: (concluded)	
		04-0044	Revised facilities for Crew Sys lessons; editorial changes to Tables 1-1, 1-2, and 1-3	
		04-0045	Editorial changes to MPS OV 21001 and Introduction	
		04-0046	2 lessons deleted (OCA/VTS OPS 21195 and PGSC NETWORK OPS 21195) and 1 lesson added (PGSC OPS 21195); changes to flow charts, tables, and lesson numbers	
		04-0047	Objective modifications to P/L & APDS OV 21001	
		MEDICAL OPERA	<u>ATIONS</u> :	
		04-0024 04-0025	Modified MED EVAL DCS 31001 Added MED EVAL DCS EXP 31001 for experienced crew; reduced duration of class	
		STS PHOTO/TV:		
		04-0026	Editorial changes to 2 lessons; added 0.5 hours to ET EQ 31001 for new RTF tasks	
		04-0043	Added ISIS EQ 31001 and ISIS OPS 31019; changes to tables and flow chart	
		ORBIT FLIGHT C	PERATIONS:	
		04-0040	Deleted ISSUES BR 31001; changes to tables, flow chart, and order of lessons	
		RENDEZVOUS/F	ROXIMITY OPERATIONS:	
		04-0031	1 lesson added (DST MAN PH 61025); changed lesson titles and modified hours for SES lessons; changes to flow charts and tables	
		ISS ECLSS FOR	STS CREW TRAINING:	
		04-0023	Deleted section (IUS will no longer be flown). References to IUS deleted from lessons in ORBIT FLIGHT OPERATIONS, RENDEZVOUS/ PROXIMITY OPERATIONS, and INTEGRATED SIMULATIONS. Deletion of acronyms in Appendix D SPACEHAB moved to Section 11.0	
		ISS CORE SYS:	C. ACETAE MOVED to Occion 11.0	
		04-0022	Created new section (CORE STATION SYSTEMS FOR STS CREW TRAINING)	
		04-0032	Removed applicable lessons from ISS ECLSS FOR STS CREW TRAINING and placed into new section	

Rev. letter	Change no.		Description	Date
D (cont)		MOBILE SERVI	CING SYSTEM FOR STS CREW TRAINING:	
. ,		04-0048	Creation of section (67 shared lessons with ISS) with new flow charts	
		TRANSFER OP	ERATIONS:	
		04-0027	Changed TRANS FAM 21001 to TRANS FAM 31001; modifications to flow chart and tables	
		ADDENDUM:		
		04-0038	Added Contingency Landing Training; changes to Table A.1	
		Miscellaneous:		
E		common acrony objectives) for c	ous acronyms in Appendix D and the addition of ms; removal of acronym callouts (synopsis/ommon acronyms in all applicable sections of editorial changes/updates for the Introduction	09/09/2005
_			Requests (LCRs) implemented for Revision E	00,00,00
			le Budget Team (SBT) cycle):	
		NEW ASTRONA	<u>AUT</u> :	
		05-0001	Change in lesson title of IMU 21001 to IMU BR 21001	
		05-0002 05-0003	Addition of NAV QUAL 21001 Revised: C&W OV 21001, MECH OV 21001, MECH OPS 21008, APU/HYD MAL 21001, APU/HYD MAL 21004; ECLSS MAL O 21001, and ECLSS MAL O 21004	
		05-0004	Editing changes to A/E DPS MAL 21001	
		05-0005	Editing changes to DPS HW 21057 and NAV OV BR 21001	
		05-0006 05-0007	Editing changes to IFM PIN KIT 21001 Revised: REF DATA USE 21001, MECH MAL 21001, and ECLSS MAL A/E 21001	
		05-0013	Modifications to Tables 1-3 and 1-4, and revised MPS lessons	
		05-0026	Editing changes to A/E FAM 21001	
		05-0027	Editing changes to G&C SENS BR 21001	
		05-0028	Editing changes to OMS OV 21001, RCS OV 21001, and MPS OV 21001	
		05-0029	Editing changes to ABORT FAM BR 21001	
		05-0031	Addition of HAB EQ & PROC 21020,	
			PI 21020, and DO PREP 21020;	
			lesson number changes for Table 1-1, and modifications to Table 1-2	
		05-0037	Editing changes to UNIV PTG 21001	

Rev. letter	Change no.		Description	Date
E (cont)		CORE SYSTEM	IS REFRESHER:	
, ,		Insertion of new	formatted table from SBT	
		05-0041	Global replacement for DT37 and DT37A to DT37/Communications/Payloads (7 lessons)	
		CREW SYSTEM	<u>//S</u> :	
		Insertion of new	formatted table from SBT	
		05-0015 05-0016 05-0017	Addition of WCS PROC 31065 Addition of ISS HAB HW 31105 Addition of ISS HW FAM 21105; lesson number changes for Table 3-1	
		05-0018	Editing changes to all lessons in section (updated lesson codes, medium, and required equipment, added notes, duration, and made editorial changes)	
		MEDICAL OPER	<del>-</del> ,	
		Insertion of new	formatted table from SBT	
		05-0019	Table and flow changes; revised: TEPC 31001, CO2 31074, MED PROC 31001, and MED DIAG 31001	
		05-0020	Revised: CEVIS & HRM OPS 31001, TOXICOLOGY 91001, MED THER 31001, MED THER 32001, and SEE OPS 31020	
		ASCENT/ENTR	Y FLIGHT OPERATIONS:	
		Insertion of new	formatted table from SBT	
		05-0030	Deleted: ASC SKL 93011, E SKL 93011, APPR/LNDG 91001, and APPR/LNDG 91011; editing changes to lesson flow and table	
		ORBIT FLIGHT		
		Insertion of new	formatted table from SBT	
		05-0008	Addition of UNDOCK MAL T/L 91001; renumber of lesson flow and table; Revised: OCA/VTS OPS 31195, PGSC NETWORK OPS 31195, PRS OPS 31029, ORB NOM OPS 31012, UNDOCK MAL T/L 91012, DPLY SJ T/L 91012, and RMS/PL CONT 91012	
		05-0009	Changed 4 90000-level lessons to 30000-level lessons	
		05-0010	Editing changes to PGSC MAL 31195	
		05-0011 05-0012	Addition of editorial note to 3 lessons Changed the APDS MAL lessons from 30000-level to 20000-level	
		05-0023	Deleted APDS 21057 and APDS OPS 31029 from ORB FO	
		05-0041	Global replacement for DT37 and DT37A to DT37/Communications/Payloads (11 lessons)	

Rev. letter	Change no.	Description	Date
E (cont)		EXTRAVEHICULAR ACTIVITY (EVA) OPERATIONS:	
		Deleted Lessons:	
		PAYLOAD DEPLOYMENT AND RETRIEVAL SYSTEM	
		(PDRS):  05-0022 Removed ORM lessons from the OBSS training flow and created a separate ORM training flow Deleted Lessons: PDRS NOM TSK X 91001 PDRS ELE MAL X 91001 PDRS ELE INT X 91012 PDRS OBSS OPS OV 91001 Replaced Lessons: PDRS OBSS SURVEY 91069 PDRS OBSS SURVEY 93069 PDRS ORM TSK 91069 PDRS TPS OBSS H/O 91121 PDRS UNDK SJ OBSS 91069 PDRS DOCK SJ OBSS 91121 PDRS ORM OPS 91121	

Rev. letter	Change no.		Description	Date
E (cont)		PAYLOAD DEPL (PDRS): (conclu	LOYMENT AND RETRIEVAL SYSTEM Ided)	
			Revised Lessons: PDRS UNDOCK SURVEY 91069 PDRS SURVEY DAY 91012 PDRS NBL FAM 31027 PDRS OPS 91001 PDRS SJ LD 21001	
		RENDEZVOUS/	PDRS SJ RVW 21069 PROXIMITY OPERATIONS:	
		Insertion of new	formatted table from SBT	
		05-0024	Revised: RNDZ MAL 31012, RNDZ MAL 32012, and RNDZ T/L 91012	
		05-0025	Addition of 3 APDS lessons (2 from ORB FO); revisions to lesson flows and table. APDS 21057, APDS FAM 21205, and APDS OPS 21069	
		SPACEHAB:	711 DO 17111 21200, dila 711 DO 01 0 21000	
		<u>SPACEHAB</u> : 05-0014	Flow and table edits; insertion of new formatted table from SBT  Deleted Lessons:  SHAB FAM 31001  SHAB RDM NOM 31029  SHAB RDM COM 31187  SHAB RDM MAL 91187  Replaced Lessons:  SHAB SUBSYSTEM 31001  SHAB NOM OPS 31029  SHAB LM COM 31187  SHAB LM MAL 91187  Revised Lessons:  SHAB EPS MAL 31029  SHAB ECS MAL 31029  SHAB FIRE CC 31001  SHAB FIRE CC 31001  SHAB MANUAL 31002  SHAB RVW 41029  SHAB TNL RVW 41029	
		05-0041	SHAB RVW 41187 Global replacement for DT37 and DT37A to DT37/Communications/Payloads (9 lessons)	
		CORE STATION	· ·	
			formatted table from SBT	
		05-0032	Editing changes made to 5 lessons (with reduction of hours for 2 lessons) and 2 lesson codes replaced to schedule lessons in the SSMTF	

Rev. letter	Change no.		Description	Date
E (cont)		CORE STATION	N SYSTEMS: (concluded)	
			Revised Lessons:  ECG INTRO 11001  O2N2 OPS 21001  O2N2 XFER OPS 21105  ISS EMERGENCY OVW 21105  ISS/STS EMER SCEN 31186  ISS EMERGENCY H/W 11105  MPLM VEST PROC/ACT 31105	
		05-0033	Revised: CAS INC SPEC TASKS 31078 CBM INC SPEC TASKS 31078 CAS/ROBO INSTALL 21178 CAS/ROBO UNINSTALL 21178 CBM/ROBO INSTALL 21178 CBM/ROBO UNINSTALL 21178	
		05-0034	Revised: ISS EPS OV 21078 and EPS HW TASKS 21078	
		05-0035 05-0036	Revised: PCS/C&W OPS 21078 Revised: ISS AUDIO HW 21105 ISS VIDEO OPS 21078	
		05-0039	ISS UHF OPS/MAL 21078 Editing changes to sync up documentation with the ISS Crew Training Catalog: O2N2 OPS 21001, O2N2 XFER OPS 21105, SMALL VOL PRESS OPS 21105, and ISS/STS EMER SCEN 31186	
		ADDENDUM:		
		<ul> <li>Crew Equip</li> </ul>	EW T/U	
		<ul> <li>Dental</li> <li>Flight IPT</li> <li>Flight JOP</li> <li>Vision</li> <li>FPSR</li> <li>Flight Ops F</li> <li>DT/CB T/U</li> <li>RANGE SA</li> </ul>		
		<ul><li>PREFLT MI</li><li>CB FRR</li><li>ELSA Train</li><li>Annual IT S</li></ul>	ENU	

Rev. letter	Change no.	Description	Date
	_	ADDENDUM: (concluded) The following lessons were deleted from the Addendum: Interviews/Presentation Support SCUBA Proficiency Extravehicular Maneuvering Unit (EMU) Proficiency Military Requirements Other CB-Related Duties Lunch/Dinner All tables in Addendum have been changed to SBT format; section has been reorganized to sections based on Flight Support, Aircraft Operations, and Informal lessons Miscellaneous: Insertion of new formatted tables from SBT for PHOTO TV, MOBILE SERVICING SYSTEM FOR STS CREW, TRANSFER OPERATIONS, and INTEGRATED SIMULATIONS sections. Included "Shared – Shuttle" and "Shared – ISS" designation on applicable lessons. Added 1 Appendix (A – Shuttle Budget Team Information) to contents; added acronyms to Appendix E (Acronyms and Abbreviations); updated lesson flows for Appendix D (Payload Specialist Training Flow Chart). Completed editorial changes/updates for the Introduction and Index; added acronym callouts to new lessons; included Shuttle Budget Team information into the LCR process (Introduction) Revision F Lesson Change Requests (LCRs) implemented for Revision F (including Shuttle Budget Team (SBT) cycle):	Date 03/17/2006
		NEW ASTRONAUT:  05-0042 Divides the SYS QUAL 21008 lesson into three separate quals  05-0048 Updated objectives in E NAV 22006  05-0060 Revised Front Matter,  ORB SYS TRNG 21001, CREW DUTY 21001,  SPOC 21001, NAV QUAL 21001,  ENT DP MAL 21006, ORB MAN ATT 21001,  OGNC QUAL 21006, and DPS QUAL 21001  05-0070 COMM class updates  7 lesson codes replaced with Briefing (BR) lessons  AUDIO 21001 split into 2 lessons (plus 1 BR lesson)  Adds AUDIO 21001, AUDIO 21006,  COMM/IN OPS 21001, CCTV OPS 21001,  P/L COM/OIU OPS 21001, and  KU OPS 21001  05-0071 Revised EPS QUAL 21004,  APU/HYD QUAL 21004, and  ECLSS/C&W/MECH QUAL 21008	

Rev. letter	Change no.		Description	Date
F (cont)	110.	NEW ASTRO	NAUT: (concluded)	
. (65.1.5)		05-0072	Revised Tables 1-1 and 1-2 Adds 1.0 hour to ORB SYS 21012 Revised PO INS OPS 21001, ABORT FAM 21001, A/E BFS 21001, ORB SYS 21012, A/E SYS 21001, A/E SYS 21011, PAPER SIM 21001 through 25001, DO PREP BKOT 21001, ASC SKLS 21001, and E SKL 21001	
		05-0073 05-0074	Revised OMS, RCS, MPS, and E GUID lessons. 10 lesson codes replaced with Briefing (BR) lessons. 18 lessons revised Revised EPS, APU/HYD, and ECLSS lessons. 10 lesson codes replaced	
		05-0129	with Briefing (BR) lessons. 10 lessons revised Changes EVA OV 21001 with EVA INTRO 21001	
		CORE SYST	EMS REFRESHER:	
		05-0045	Deleted PL COM/OIU 41001 and PL COM/OIU RVW 41006	
		05-0081 05-0082	Added CONT ABT RVW 21001 Added CONT ABT RVW 21011	
			Added MAN ABT 21001	
		05-0085	Added MAN ABT 21011 Added MAN ASC 21001	
		05-0086 05-0106	Added MAN ASC 21011 A MPS S&C Q 31001 split into two separate Qual lessons: MPS QUAL 31006 and S&C QUAL 31006	
		<b>CREW SYST</b>		
		05-0069	Moved ASC/CAP/DES 91020 from Stage 3 to Stage 2	
		MEDICAL OF	PERATIONS:	
		05-0057 05-0058	Small text changes for clarity to 8 lessons Modified synopsis and objectives for MED CPR 31001 and SEE OPS 31020	
		05-0059	Modified synopsis and objectives for TEPC 31001	
		STS PHOTO	<u>/TV</u> :	
		05-0065	Combined APPR&DOCK TV 91020 (PHO/TV) and PDRS LIGHTING 91019 into one lesson called CCTV LIGHTING 91019	
		05-0107	Deleted 203 and LIN series, EO PHO, and RELOAD OPS Added 760 EVA EQ 31001 and 760 EVA PHO SKL 31031, added EVA IR CAM REQ 31001 and EVA IR CAMR SKL 31019, and added LCS EQ 31001	

Change no.	Description	Date
	STS PHOTO/TV: (concluded)	
	Changed lesson codes for ISIS EQ 31001 (LDRI EQ 31001), ISIS OPS 31019 (LDRI OPS 31019), and SPECIAL PHOTO 31001	
	Revised F5 EQ 31001, F5 EVA EQ 31001, CCTV OPS 31019, PHO/TV PROC 31019, SPECIAL PHOTO 31001, and PHO/TV PROC 91019	
	05-0049 Deleted 5 E AUTOLAND lessons. Revised notes in CONT ABT 91011, D/O BURN 91011, and ASC/ABT SFRM 31011 05-0075 Added MAN ASC 41001 05-0076 Added MAN ASC 41011 05-0077 Added MAN ABT 41001 05-0078 Added MAN ABT 41011 05-0079 Added CONT ABT RVW 41001 05-0080 Added CONT ABT RVW 41011	
	Created a new section (EVA Generic Operations) with a new table and new lesson flow 05-0051 Added ISS EVA P/P 33105 05-0108 Added EVA SCUBA 41027 05-0109 Deleted ISS MOCKUP FAM 21027 05-0110 Deleted EVA SUIT QUAL 21067 05-0111 Deleted ORB CONT 22027 05-0112 Deleted ORB CONT 21027 05-0113 Deleted CONT OPS 21001 05-0114 Added ISS EVA SUIT QUAL 21027 05-0115 Added EVA SCUBA 21027 05-0116 Added EVA TOOLS 21028 05-0117 Added EVA OV 22001 05-0118 Added EVA OPS 21027 05-0119 Added EVA OPS 22027 05-0120 Added EVA OV 21001 05-0121 Added EMU A/L 21020 05-0122 Deleted EVA P/P 21002 05-0123 Added ISS EVA SCUBA 21027 05-0124 Added EVA OPS 1G 21001	
	_	STS PHOTO/TV: (concluded)   Changed lesson codes for ISIS EQ 31001 (LDRI EQ 31001), ISIS OPS 31019 (LDRI EQ 31001), ISIS OPS 31019 (LDRI OPS 31019), and SPECIAL PHOTO 31001 Revised F5 EQ 31001, F5 EVA EQ 31001, CCTV OPS 31019, PHO/TV PROC 31019, SPECIAL PHOTO 31001, and PHO/TV PROC 91019     ASCENT/ENTRY FLIGHT OPERATIONS:

Rev. letter	Change		Description	Date
-	no.	DAYLOADD	EDLOVMENT AND DETDIEVAL SVSTEM	
F (cont)		(PDRS):	EPLOYMENT AND RETRIEVAL SYSTEM	
		05-0047	Corrected student requirement designations	
			for 8 lessons, indicating R1/R2 versus	
			MS position	
		05-0063	Added note to 20000-level lesson flow chart	
		05 0000	about observing Generic Int Sim	
		05-0066	Deleted PDRS LIGHTING 31019 and PDRS LIGHTING 91019	
		RENDEZVO	US/PROXIMITY OPERATIONS:	
		05-0046	Moved APPR & DOCK 31069 from Stage 2	
		00 0040	to Stage 3. Revised	
			RNDZ FS-TRAD BR 31001, RNDZ FAM 21012,	
			RNDZ OPS 21012, RNDZ MAL 21006,	
			TI DELAY 31006, and TRAD OV 21195	
		SPACEHAB/		
		MPLM flow a	dded to SPACEHAB section (5 lessons	
		05 0107	added for MPLM flow)	
		05-0127	Increased durations for SHAB EPSMAL 31029 and	
			SHAB ECS MAL 31029; decreased duration	
			for SVT FAM 31185	
		05-0128	Added the following lessons for the	
			MPLM flow: SHUTTLE MPLM I/F 31001,	
			ASBLY OPS HB 31007, MPLM FACIL 31031,	
			MPLM ROEU/PRS OPS 31029, and MPLM REVIEW 41029	
		COPE STAT	ION SYSTEMS:	
		05-0043		
		05-0050		
			SMALL VOL PRESS OPS 21105	
		05-0068	Reduced duration of ISS UHF OPS/	
			MAL 21078 by 15 minutes	
		05-0087	Reduced duration for MPLM INTRO 31105.	
			Updated lesson code and synopsis for ISS EMERGENCY OVW (21105 to 11105).	
			Updated prerequisites for	
			RACK INSTAL SKL 21105 and	
			ISS/STS EMER SCEN 31186	
		MOBILE SER	RVICING SYSTEM FOR STS CREW TRAINING:	
		05-0052	Redlined synopsis and objectives for	
			MSS SUPT TOOLS 21025	
		05-0053	Decreased duration for	
		05-0054	MSS SPEC TASK 7 21025 Decreased duration for	
		03-0054	ROBOTICS LSN LRND 21001	
		05-0055	Decreased duration for	
			MSS SPN & REF DATA 91001	
		05-0056	Decreased duration for	
			MSS SPEC EVAL 21025	

Rev. letter	Change no.	Description	Date
F (cont)		MOBILE SERVICING SYSTEM FOR STS CREW TRAINING:	
		(concluded)	
		05-0064 Deleted ROBO/MECH I/F SIM 91110 and MRMDF FAM 21175. Added CBM and CAS ROBO INSTALL Sims to lesson flow chart. Changed lesson codes for MSS TPS ORM VIEW 91069 and MSS TPS OBSS H/O 91069. Changed stages for several other lessons	
		TRANSFER OPERATIONS:	
		Updated lesson flow chart and table	
		INTEGRATED SIMULATIONS:	
		Updated table	
		ADDENDUM:	
		Revised all tables 05-0061 Revised Vision lesson in Flight Support section (FS-14)	
		05-0062 Revised Medium for HAT Flights in Flight Support section	
		05-0067 Deleted EMU FITCHECK lesson from Flight Support section	
		Miscellaneous:	
G		Applicable redlines applied to sections to reflect current operating practices. Appendix C and D combined into 1 appendix (Appendix C: Payload Specialist Training Information). Updated Appendix D (Acronyms and Abbreviations). Updated tables in all sections to remove the word "sequence" and replace it with "reference." Reorganized the Introduction and updated all lesson flow charts. Updated the Index. Revised Appendix A with current table information Revision G	10/03/2006
		Lesson Change Requests (LCRs) implemented for Revision G (including Shuttle Budget Team (SBT) cycle):  NEW ASTRONAUT:	
		06-0007 Replaced two lesson codes (DPS 21005 to DPS 21006, and IMU 21005 to IMU FAM 21006) 06-0045 Deleted EPS MAL 21057 and	
		C&W/EMERGENCY ALARM SYSTEMS 21057 Objective revisions for MECH MAL 21008 and C&W MAL 21004 06-0050 Deleted MPS NOM ASC 21057 CBT from Table 1-4	
		06-0078 Revised objectives for E DAP SKL BR 21001	

Rev. letter	Change no.		Description	Date
G (cont)		CORE SYST	EMS REFRESHER:	
			Added multi-system lesson SHUTTLE REVIEW 31006	
		06-0051	Replaced lesson code SYSTEMS Q 31004 with three separate qual lessons (EPS QUAL 31004, APU/HYD QUAL 31004, and ECLSS/C&W/MECH QUAL 31008)	
		CREW SYST	•	
		06-0002	Decreased duration of IFM PROC 91020	
		STS PHOTO		
		06-0049	Deleted F5 OV 31001, F5 PHO SKL 31020, and F5 FILM REV 31001 Added LDRI EQ 21001, 760 EQ 32001, and EXT PHO SKL 31153 Replaced two lesson codes (from LDRI OPS 31019 to LDRI OPS 31012, and from 760 PHO SKL 31020 to INT PHO SKL 31020)	
		ASCENT/EN	TRY FLIGHT OPERATIONS:	
		06-0048 06-0083 06-0084		
		EXTRAVEHI	CULAR ACTIVITY OPERATIONS:	
		06-0012 06-0024 06-0025 06-0032	Decreased duration for FFV 61001	
		06-0034 06-0058		
		06-0059	Deleted EVA MASS OPS 91016; this LCR accompanied LCR 06-0032	
		06-0060 06-0061	Added EVA TPS REPAIR 21002 Added EVA TPS OV 31703	
		06-0062 06-0063 06-0064	Added EVA TILE REPAIR 31703 Added EVA RCC REPAIR 31703 Added EVA TPS INSPECT OV 31706	
		06-0065 06-0066 06-0067	Added EVA TPS WLE INSPECT 31016 Added EVA TPS LOADS 31016 Added EVA TPS OPS 1G 31001	
		06-0068 06-0069 06-0070	Added EVA TPS OPS 91027 Added EVA RCC REPAIR 32703 Added EVA TPS REPAIR SKLS 31703	
		06-0071 06-0073 06-0074	Deleted EVA TOOLS 21028 Added EVA TPS SAFER 91016 Added EVA TPS SAFER RES 91705	

Rev. letter	Change no.		Description	Date
G (cont)		EXTRAVEHI	CULAR ACTIVITY OPERATIONS: (concluded)	
		06-0075 06-0076 06-0077	Added EVA CETA OPS 31028 Deleted ISS EVA LARGE TOOLS 31028	
		06-0085	Revised EVA MASS OPS 92016 to ISS EVA MASS OPS 92016; decreased duration. Revised EVA MASS OPS 91016 to ISS EVA MASS OPS 91016; decreased duration	
		06-0086 06-0087	Revised EVA PGT/TM 33001; decreased	
		06-0088	duration Revised Table 8-3 (EVA Task Operations) for 5 lesson phase changes	
		06-0089	Deleted EVA MASS OPS 93016	
		PAYLOAD D (PDRS):	EPLOYMENT AND RETRIEVAL SYSTEM	
		06-0001	Moved six lessons from RMS/OBSS flow (90000 series) to Generic flow (20000 series)	
		06-0004	Reduced duration of PDRS NOM TSK X 91012 and PDRS ELE MAL X 91012	
		RENDEZVO	JS/PROXIMITY OPERATIONS:	
		06-0003	Changed lesson title from EVA RESCUE 31069 to PROX OPS TOPICS 31069	
		CORE STAT	ION SYSTEMS:	
		06-0005	Revised synopsis and objectives for ISS OPS S/W INTRO 21257	
		06-0013 06-0014	Added CBM OPS TM 21109 Revised lesson title, duration, and synopsis for CBM OPS 21078	
		06-0015	Revised lesson code for CAS SYS INTRO 21001 (from 21105)	
		06-0016	Revised lesson title, duration, synopsis and objectives for CBM MAL PREP 21001	
		06-0017	Revised lesson code of CAS MASTERY 21078 to CAS SPEC MASTERY 21078	
		06-0018	Revised lesson code of CBM MASTERY 21078 to CBM MASTERY 21078	
		06-0019	Revised lesson title, synopsis, and objectives for CBM MAL 21078	
		06-0020	Revised lesson code of CBM INC SPEC TASKS 31078 to CBM MIS SP TASKS 31078	
		06-0021	Revised lesson code of CAS INC SPEC TASKS 31078 to CAS MIS SP TASKS 31078	

Rev. letter	Change no.		Description	Date
G (cont)		CORE STAT	ION SYSTEMS: (concluded)	
		06-0041 06-0042	Revised lesson code of ISS/STS EMER SCEN 31186 to ISS/STS EMER SCEN 31105; increased duration Deleted S&M CAS OV 21102 and S&M CBM OV 21102	
		06-0052 06-0053 06-0054	Added CBM OPS TM 21109 and CBM MAL PREP 21001 Revised lesson codes: - CAS/ROBO INSTALL 21178 and CBM ROBO INSTALL 21178 to MECH/ROBO INSTALL 21178 - CAS/ROBO UNINSTALL 21178 and CBM/ROBO UNINSTALL 21178 to MECH/ROBO UNINSTALL 21178 to MECH/ROBO UNINSTALL 21178 Deleted ISS EMERGENCY H/W 11105 Added STS RSP TO JNT EMER 31208 Revised lesson code of ISS EMERGENCY OVW 11105 to	
		06-0056	ISS EMERGENCY OVW 31105 Added ISS EMERGENCY REFR 41001 Added ISS EMER REVIEW 91105 OPERATIONS:	
		06-0006	Decreased duration of TRANS OV TCLN 2 31040	
		INTEGRATE	D SIMULATIONS:	
		06-0047	Moved FDO/BSE w/prep from Stage 1 to Stage 2	
		ADDENDUM		
		06-0009 06-0010	Decreased duration of L-10 PHYSICAL Reduced durations for Admin, Gym, STA, and T-38 STA	
		06-0035 06-0036 06-0037	Reduced duration of TCDT Deleted FCOD DIR MTG Deleted FCOD/CDR T/U	
		06-0038	Revised lesson code from CB FRR to FCOD FRR Reduced duration of POC REVIEW	
		06-0040  Miscellaneou	Moved CREW PRESS CONF from Stage 1 to Stage 2 s:	
		Applicable re- operating pra tables per ap	dlines applied to sections to reflect current ctices. Stage changes made to various section plicable LCRs. Student designation changes bus lessons to match applicable tables. Revised	
		Appendix A w Appendix C ( Appendix D ( flow charts pe	vith current table information. Updated Payload Specialist Training Information) and Acronyms and Abbreviations). Updated all lessoner applicable LCRs. Updated the Index; the Index ument location, from before Addendum to after	
		the Appendix		

Rev. letter	Change no.	Description	Date
Н		Revision H	07/11/2007
		Lesson Change Requests (LCRs) implemented for Revision H (including 2006 Shuttle Budget Team (SBT) cycle LCRs):	
		NEW ASTRONAUT:  07-0004 Deleted references to ECLSS Malfunction CBT  07-0014 Revised IMU 21006  07-0016 Reduced duration for ESC PROC 21001; added	
		OFF-NOM EG 21020	
		CORE SYSTEMS REFRESHER:  07-0005 Revised lesson code from SHUTTLE REVIEW 31006 to SHUTTLE REVIEW 41006	
		CREW SYSTEMS:	
		06-0008 Revised lesson code from ESC SYS REFR 41020 to ESC SYS REFR 91020	
		06-0011 Added OFF-NOM EG 91020	
		MEDICAL OPERATIONS: 07-0003 Revised TEPC 31001	
		ASCENT/ENTRY FLIGHT OPERATIONS:  07-0006 Revised objectives for:     ASC/ABT SFRM 31001     ASC/ABT SFRM 31011     MAN ASC BR 31001     E SKL 31001     MAN ASC 41001	
		ORBIT FLIGHT OPERATIONS:  07-0001 Deleted STS/ISS COMM PRF 41012  07-0002 Revised CONT D/O 32012  07-0012 Revised ORB SKL 32012  07-0013 Revised CONT D/O 32012	
		EXTRAVEHICULAR ACTIVITY (EVA) OPERATIONS:  06-0022 Added EMU RESIZE 31209; replaced BTA OPS/EMU RESIZE 31001	
		06-0023 Added BTA OPS 31001; replaced BTA OPS/EMU RESIZE 31001 06-0026 Added CLS III MEAS PRF 61001 06-0027 Added CLS III GLV FIT PRF 61001 06-0028 Added CLS III FIT PRF 61001 06-0029 Added CLS I GLV PRF 61001	

Rev. letter	Change no.		Description	Date
H (cont)		EXTRAVEHI	CULAR ACTIVITY (EVA) OPERATIONS:	
(,		(concluded)	<del></del>	
		06-0030	Increased duration for	
			ISS EVA SMALL TOOLS 21001	
		06-0032	Revised title, duration and objectives for EVA MASS OPS 91016	
		06-0033	Increased duration for ISS JNT AL HDW 31105	
		06-0046	Decreased duration for CLS I BOOT FIT PRF 61001	
		06-0057	Reduced CLS III FITCK 61001 from 3.0 to 2.5 hours	
		06-0079	Revised lesson code from EVA SKLS VIDEO 21003 to EVA SKILLS 21003	
		06-0080	Added ISS SUIT QUAL 1G 21001	
		06-0081	Revised lesson code from	
			ISS EVA SUIT QUAL 21027 to	
			ISS SUIT QUAL 21027	
		PAYLOAD D	EPLOYMENT AND RETRIEVAL OPERATIONS:	
		07-0007	Revised PDRS UL SURVEY 21025 and PDRS OPS 91001	
		07-0008	Revised:	
			PDRS UL OPS 91025	
			PDRS N-TSK X 91025 PDRS N-TSK X 91069	
			PDRS N-TSK X 91009 PDRS N-TSK X 92025	
			PDRS N-TSK X 92023	
			PDRS SJ TSK X 91173	
		07-0009	Revised:	
			PDRS ELE MAL X 91012	
			PDRS/EVA DAY X 91016	
			PDRS/EVA OPS X 91069	
			PDRS/EVA TSK 91025 PDRS LSN LRN 91001	
			PDRS NOM TSK X 91012	
			PDRS SJ TSK X 91069	
			PDRS TPS OBSS H/O 91069	
		07-0010	Revised PDRS TPS OBSS H/O 91121	
		07-0011	Revised:	
			PDRS UNDOCK SURVEY 91069	
			PDRS SURVEY DAY 91012	
			PDRS PRF ADV 41025	
		TRANSFER	<u>OPERATIONS</u> :	
		06-0043	Revised HANDS-ON RVW 31105	
			nges to the Index and Appendix D to reflect	
		current docu	mentation	

Rev. letter	Change no.		Description	Date
I		Revision I		12/14/2007
		(including 200 LCRs):	ge Requests (LCRs) implemented for Revision I 06 and 2007 Shuttle Budget Team (SBT) cycle	
		NEW ASTRO		
			Revised E NAV 21001; revised E NAV 21006 EMS REFRESHER:	
		07-0017	Revised lesson code from COMM/IN PL COM RVW 41008 to COM/IN RVW 41008	
		MEDICAL OF	PERATIONS:	
		07-0019	Revised SEE OPS 31020	
		07-0034	Revised lesson code from CSA-CP 31001 to STS TOX OPS 31001	
		STS PHOTO	<u>/TV:</u>	
		07-0023	Revised INT PHO SKL 31020; revised lesson code from EVA IR CAMR SKL 31019 to EVA IR CAMR SKL 31209	
		07-0024	Moved PAO CAMC 31001 and CCTV OPS 31019 to Stage 4; moved LDRI EQ 31001 and LCS EQ 31001 to Stage 3	
		07-0025	Deleted F5 EVA EQ 31001; revised LDRI OPS 31012	
		ASCENT/EN	TRY FLIGHT OPERATIONS:	
		07-0018	(Joint LCR with ORBIT FO Section) Moved FCS CO 31006 to Stage 4	
		07-0033 ORBIT FLIGH	Deleted E SKL 32001; revised E SKL 32011 HT OPERATIONS:	
		07-0018	(Joint LCR with ASCENT/ENTRY FO Section) Revised ORB NOM OPS 31001	
		07-0020	(Joint LCR with RENDEZVOUS/PROXIMITY OPS Section) Moved PROX OPS T/L 91012, UNDOCK MAL T/L 91001, and UNDOCK MAL T/L 91012 to RENDEZVOUS/PROX OPS	
		07-0021	Added WLES FAM BRF 31001, WLES OPS I 91001, WLES OPS II 91020, and WLES RVW 91001	
		07-0032	Revised PRS OPS 31029	
		07-0064	Revised ORB NOM OPS 31001	
		07-0065	Revised ORB NOM OPS 31012	
		07-0066	Revised PO INS MAL 32012	
			CULAR ACTIVITY (EVA) OPERATIONS:	
			Added EVA DECON 31001	
		06-0082 07-0042	Added ISS EVA LARGE TOOLS 21028 Deleted EVA TPS INSPECT OV 31706	

Rev. letter	Change no.		Description	Date
I (cont)		EXTRAVEHI	CULAR ACTIVITY (EVA) OPERATIONS:	
, ,		(concluded)	· · ·	
		07-0043	Added ISS EVA SMALL TOOLS 31001	
		07-0044	Revised EVA REVIEW 41027	
		07-0045		
		07-0046	Added EVA TILE REPAIR 32703	
		07-0047	Changed lesson code from EVA RCC REPAIR 32703 to EVA RCC REPAIR 31703; revised content	
		07-0048	Added EVA RCC REPAIR DGB 61001	
		07-0049	Revised EVA TILE REPAIR 31703	
		07-0050	Deleted EVA TPS WLE INSPECT 31016	
		07-0051	Revised EVA TPS SAFER 91016	
		07-0052	Added EVA SCUBA 91027	
		07-0053	Added CONT OPS 41001	
		07-0054	Changed lesson code from EVA TPS OV 31703 to EVA TPS OV 31706; revised content	
		07-0056	Deleted ET DOORS 31047	
		07-0057	Revised EVA TPS REPAIR SKLS 31703	
		07-0058	Revised EVA TPS OPS 1G 31001	
		07-0069	Deleted EVA RCC REPAIR 31703	
		07-0070	Revised EVA TPS LOADS 31016	
		RENDEZVO	US/PROXIMITY OPERATIONS:	
		07-0020	(Joint LCR with ORBIT FLIGHT OPS) Added PROX OPS T/L 91012, UNDOCK MAL T/L 91001, and UNDOCK MAL T/L 91012 to contents	
			ION SYSTEMS:	
		07-0027	Added CBM OPS PREP 21001, CAS OPS PREP-S 21001, and CAS MAL PREP-S 21001; revised CAS/CBM classes	
		07-0028	Revised O2N2 OPS 21001	
		07-0029	Revised ECLSS JNT AL OPS 21105	
		07-0030	Revised EPS HW TASKS 21105	
		07-0031	Revised ISS VIDEO OPS 21078	
		07-0059	Revised P EXPRESS RACK NOM 21165	
		07-0060	Changed lesson code from P TRANSFER OV 21169 to P TRANSFER OV 21165; revised content	
		07-0061	Added P EXPRESS RACK NOM 21165 to Shuttle lesson flow (CTC and TAMS)	

Rev. letter	Change no.		Description	Date
I (cont)		ADDENDUM	;	
, ,		07-0035	Added OnOrbit Crew Email lesson	
		07-0036	Added Postflight Appearances Planning Meeting lesson	
		07-0037	Added Range Safety Brief at JSC lesson	
		07-0038	Added L - 10 Bench Review lesson	
		07-0039	Added MPLM KSC Bench Review lesson	
		07-0062	Revised A/C-9 HAT Flight lesson	
		Miscellaneou	<u>s</u> :	
		input; editoria Section sourd Index per cur	edlines to Section and Addendum tables per LCR all changes made to Orbit Flight Operations ces, Introduction, Appendices A, B, and D, and crent operating practices	
J		Revision J		11/07/2008
		(including Sh	ge Requests (LCRs) implemented for Revision J uttle Budget Team (SBT) cycle): EMS REFRESHER:	
			Added PRL 21057	
		MEDICAL OF	PERATIONS:	
		08-0019	Revised STS TOX OPS 31001	
		08-0020	Revised CO2 31074	
		08-0021	Added Suit IV/Task IV designation to PREBREATHE 31001, CEVIS & HRM OPS 31001, STS TOX OPS 31001, MED EVAL DCS 31001, and MED EVAL DCS EXP 31001	
		STS PHOTO		
		08-0003	Revised and lesson code change from EVA IR CAMR EQ 31001 to IR CAMR EQ 31001; revised and lesson code change from EVA IR	
		08-0004	CAMR SKL 31209 to IR CAMR SKL 31001 Revised and lesson code change from PD100 EQ CAMC 31001 to G1 EQ CAMC 31001;	
			revised and lesson code change from PD100 OV CAMC 31001 to G1 OV CAMC 31001. Revised PAO CAMC 31001, ET EQ 31001, CCTV OPS 32019, and ET PHO SKL 31001	
		08-0005	Revised and lesson code changes to the following:	
			From 760 EQ 31001 to D2XS EQ 31001 From 760 EQ 32001 to D2XS EQ 32001 From 760 OV 31001 to D2XS OV 31001 From 760 EVA EQ 31001 to D2XS EVA EQ 31001 From 760 EVA PHO SKL 31031 to D2XS	
			EVA PHO SKL 31031 to D2XS	

Rev. letter	Change no.		Description	Date
J (cont)		STS PHOTO	/TV: (concluded)	
			Plus minor redlines to F5 EQ 31001, EXT PHO SKL 31153, ET PHO SKL 31001, INT PHO SKL 31020, ET EQ 31001, and PHO/TV PROC 91019	
		08-0018	Added ISS EXT SRVY 91001	
		ASCENT/EN	TRY FLIGHT OPERATIONS:	
		08-0017	Revised MPS BSE FLT BRF 31001 and PWDN BR 31001	
		ORBIT FLIG	HT OPERATIONS:	
		08-0050	Revised ORB NOM OPS 31001 and ORB NOM OPS 31012	
		<b>EXTRAVEHI</b>	CULAR ACTIVITY OPERATIONS:	
		08-0022	Added EVA PGT/TM 21001 to EVA Generic flow	
		08-0023	Added EVA FLUID QD OPS 21197 to EVA Generic flow	
		08-0039	Lesson code change from EMU SYS 21002 to EMU SYS 21057 in EVA Generic flow; deleted EMU 21057	
		08-0040	Added Suit IV/Task IV designations to various lesson in EVA Systems flow	
		08-0041	Added Suit IV/Task IV designations to various lesson in EVA Task Operations flow	
		PAYLOAD D (PDRS):	EPLOYMENT AND RETRIEVAL SYSTEM	
		08-0014	Lesson code change from PDRS UL SURVEY 21025 to PDRS OBSS INTRO 21065; revised PDRS OBSS SURVEY 21069, PDRS OBSS SURVEY 22069, PDRS OBSS SURVEY 23069, ORB/RMS I/F 31012, and PDRS SURVEY DAY 91012	
		08-0015	Deleted: PDRS DOCK SJ OBSS 21069 Added: PDRS FLT QL 1 31069	
		CORE STAT	ION SYSTEMS:	
		08-0002	Revised and lesson code change from PCS/C&W OPS 21078 to PCS/C&W OPS 21110	
		08-0006	Revised EPS HW TASKS 21105	
		08-0012	Revised ECG INTRO 11001	

Rev. letter	Change no.		Description	Date
J (cont)		CORE STAT	ION SYSTEMS: (concluded)	
		08-0013	Revised ISS OPS S/W INTRO 21257	
		08-0027	Revised and lesson code change from TOOL/REPAIR KITS 21105 to TOOL/REPAIR KITS 21208	
		08-0028	Added ISS AUD/VID RVW 21121	
		08-0042	Revised ISS AUDIO HW 21105	
		08-0051	Revised O2N2 XFER OPS 21105 and O2N2 XFER PROF 41105	
		MOBILE SEI	RVICING SYSTEMS FOR STS CREW TRAINING:	
		08-0030	Added the SPDM Maintenance flow and lessons: SPDM MAINT1 41025 SPDM MAINT2 42025 SPDM MAINT3 43025 SPDM MAINT4 44025 SPDM MAINT5 45025	
		08-0031	Deleted the Additional Element Install flow and the following lessons: ADD EL INSTL1 31025 ADD EL INSTL2 32016 ADD EL VIS MAL 31025 ADD EL TRAJ MOD 91025 ADD EL RVW 31025	
		08-0032	Changed the MSS Main Element flow. Deleted lessons: EL UNBRTH1 31025 EL UNBRTH2 32115 EL TRAJ MOD1 91025 Added lessons: EL NOM INSTL 4 91045 Revised lessons: EL NOM INSTL 1 31025 EL NOM INSTL 2 32115 EL NOM INSTL 3 93016 Revised and lesson code change from EL INST RVW 41025 to EL INSTL RVW 41025 (Stage 1 revision)	
		08-0033	Lesson code change from MSS D&C OV 21065 to SSRMS D&C OV 21065	

Rev. letter	Change no.		Description	Date
J (cont)		(continued)	RVICING SYSTEMS FOR STS CREW TRAINING:	
		08-0034	Changed the MSS TPS Inspection & Repair flow Deleted lessons:  MSS TPS EVA REPAIR 1 91016  MSS TPS EVA REPAIR 2 91016  MSS TPS ORM VIEW 91069  MSS TPS OV 91001  MSS TPS REPAIR OV 91025  Added lessons:  TPS OBSS OPS3 21065  Revised and lesson code change:  From MSS TPS OBSS OPS1 91025 to  TPS OBSS OPS1 91025  From MSS TPS OBSS OPS2 91025 to  TPS OBSS OPS2 91025	
		08-0035	Revised TPS OBSS MISSION 91016 Changed the SSRMS Qual flow Deleted lessons: MSS SPEC TASK 4 21025 MSS SPEC TASK 5 21025 MSS SPEC TASK 6 21065 Added lessons: SSRMS SPEC INTRO 21001 SSRMS SELF 81025	
			SSRMS REFR 21025 Revised and lesson code change: From MSS SUPT TOOLS 21025 to SSRMS SUPT TOOLS 21025 From MSS SPEC TASK 1 21065 to SSRMS SPEC TSK1 21025 From MSS SPEC TASK 2 21025 to SSRMS SPEC TSK2 21025 From MSS SPEC TASK 3 21025 to SSRMS SPEC TSK3 21025 From MSS SPEC TASK 7 21025 to	
		08-0036	SSRMS SPEC PRAC 21025 From MSS SPEC EVAL 21025 to SSRMS SPEC EVAL 21025 Revised MSS/EVA FAM 21025 and MSS OPS COORD 21025 Added five lessons for new SPDM Qual flow: MSS CBT MOD 5/7 21057 SPDM TOOLS/ORU 21217 SPDM MRO PART 1 21512 SPDM PROF1 21025 SPDM MRO PART 2 21512	

Rev. letter	Change no.		Description	Date
J (cont)		MOBILE SER	RVICING SYSTEMS FOR STS CREW TRAINING:	
` ′		(concluded)		
		08-0037	Stage changed from 4 to 3 for the following lessons:	
			MSS/EVAA SUPT1 SOLO 91025	
			MSS/EVAA SUPT2 TEAM 91016	
			MSS/EVAB SUPT1 SOLO 91025	
			Student changed for the following lessons	
			(to M1 only):	
			MSS/EVAA SUPT1 SOLO 91025 MSS/EVAB SUPT1 SOLO 91025	
			MSS/EVAB SUPT2 SOLO 91025	
			MSS/EVAA SUPT3 SOLO 91025	
			MSS/EVAB SUPT3 M1M2 91025	
			MSS/EVAA SUPT4 SOLO 91025	
			MSS/EVAA SUPT5 M1M2 91016	
			MSS/EVAB SUPT5 M1M2 91025 MSS/EVAA SUPT6 M1M2 91025	
			Deleted RWS MAL 21110	
		08-0038	Made changes to create the SSRMS	
		00 0000	Proficiency flow:	
			Deleted lessons:	
			ADD EL INSTL 1 31025	
			ADD EL INSTL 2 32016	
			ADD EL VIS MAL 31025	
			ADD EL TRAJ MOD 91025 ADD EL RVW 31025	
			Revised the following lessons:	
			ROBOTICS LSN LRND 21001	
			MSS SPN & REF DATA 91001	
			Added lessons:	
			SSRMS PROF 1 41025 SSRMS PROF 2 22025	
			SSRMS PROF 2 22025 SSRMS PROF 3 23025	
			MSS LTG OPS 31115	
		08-0052	Revised the following lessons in the Robotics	
			Fundamentals flow with M1 only designation	
			and medium changes as applicable:	
			MSS CBT 21057 RWS SS 21102	
			ISS ROBO ENVIRO 21025	
			RWS S/W OPS 21110	
			MRO PREREQ SUM 21025	
			MRO PART 1 21113	
			MRO1 PROF 1 41025 MRO1 PROF 2 41025	
			MRO1 PROF 3 41025	
			MRO1 PROF 4 41025	
			MRO1 PROF 5 41025	
			MRO1 PROF 6 41025 MRO1 PROF 7 41025	
			MRO PART 2 21113	
			NBL SSRMS FAM 21027	

Rev. letter	Change no.		Description	Date
J (cont)		TRANSFER	OPERATIONS:	
		08-0009	Deleted TRANS OV TLCN 1 31040	
		08-0011	Changed HANDS-ON RVW 31105 from optional to required course	
		08-0043	Duration increased for TRANS PLAN 1 31001	
		08-0044	Duration decrease for TRANS PLAN 2 31001	
		08-0045	Revised TRANS PLAN 3 31001	
		08-0046	Revised TRANS PLAN 4 31001	
		08-0047	Lesson code changed from TRANS OV TLCN 2 31040 to TRANS OV TLCN 31040	
		08-0048	Revised TRANS PLAN 2 31001	
		08-0049	Lesson code changed from HANDS-ON RVW 31105 to TRANS HANDS-ON RVW 31105	
		ADDENDUM	:	
		08-0007	Title change from DT/CB T/U to DA7/CB T/U and addition meeting added at L-6	
		UMBRELLA	(All Sections):	
		08-0001	Completed redlines to all source codes in sections per MOD reorganization	
		Miscellaneou	<u>IS</u> :	
		Stage 3 to cle Revised table Stage 0. Rev	ER SURV 41001 and WATER SURV 41027 to ean up prerequisite problems (Section 3.0). es in SHAB/MPLM section to place lessons in vised Introduction, Appendixes A, C, and D, and rrent operating practices	

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1-1 – 1-260	Rev. J
2-1 – 2-40	Rev. J
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4-1 – 4-20	Rev. J
5-1 – 5-31	Rev. J
6-1 – 6-78	Rev. J
7-1 – 7-54	Rev. J
8-1 – 8-96	Rev. J
9-1 – 9-114	Rev. J
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I-1 — I-16	Rev. J

#### **PREFACE**

The Shuttle Crew Training Catalog, prepared by the United Space Alliance (USA) Training Department's Training Integration Group, documents the formal training requirements for the space shuttle crewmembers.

Questions or comments regarding this document should be addressed to the Training Integration Group, care of:

United Space Alliance 600 Gemini Houston, Texas 77058-2777 Mail Code: USH-492X Telephone: (281) 244-2486

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## INTRODUCTION

# **Purpose**

This catalog documents and describes the formal training provided by the Mission Operations Directorate (MOD) for flight crews operating the Space Transportation System (STS). It is designed to show trainees the proper sequence and content of their training, and contains the facility and lesson information necessary to conduct this training.

The catalog is also used by instructors to develop lesson plans that ensure continuity and minimize redundancy between lessons. Training managers, team leads, long range planners, and other flight operations support personnel use the lesson and facility information to aid them in conducting their assigned duties. In addition, the catalog may be of value to others interested in the STS training program.

## Scope

This catalog lists the formal training requirements for STS flight operations, including lessons currently available and lessons under development. Special training requirements for payloads or technical activities associated with a particular flight may not be included in this catalog, but will be included in the training plan for that particular shuttle flight. This catalog covers all other levels of Flight-Specific STS crew training provided by MOD in detail.

## **Crew Training Overview**

MOD's crew training program is designed to provide the systems familiarization and flight skills required to effectively, efficiently, and safely control and operate the STS orbiter as well as carry out mission tasks. The training documented in this catalog is structured in a building block format, beginning with workbooks and briefings and progressing to lessons using sophisticated trainers and simulators.

Persons selected as Astronaut Candidates (ASCANs) undergo a year-plus program of training and evaluation. During this time period, the astronaut candidates proceed through the New Astronaut training program documented in this catalog and directed by the Flight Crew Operations Directorate (FCOD), while beginning advanced training from the New Astronaut Training Flow documented and directed by MOD.

New astronaut training introduces new crewmembers to generic shuttle systems and flight operations. A good understanding of this material is essential for new crewmembers in both their technical assignments and their other contributions to the Astronaut Office. This training also prepares a student for training as an assigned crewmember. The lessons included in this flow are all those in the Data Processing System (DPS), Guidance, Navigation, and Control (GNC), Systems and Control/Propulsion, and Communications training courses. Upon completion of this new astronaut training flow, the student should possess a functional knowledge of most of

the shuttle systems and flight operations procedures. It is intended that the new astronaut lessons be completed prior to flight assignment so that the new crewmember will be ready for the flight-similar flight operations training.

After this first year, candidates continue the advanced training, which may lead, upon completion, to an assignment to a space shuttle flight crew.

While awaiting flight assignment, flown crewmembers and crewmembers who have completed the new astronaut lessons maintain proficiency in shuttle systems and flight operations by taking recurring proficiency (40000-level) lessons at the SMS. These crewmembers may also elect to take Single System Trainer (SST) refresher lessons in various orbiter systems.

## **Assigned Crew Training**

Upon assignment to a specific flight, crewmembers progress into the flight-similar flight operations (ascent, orbit, and deorbit/entry) lessons and begin the appropriate mission-specific courses such as: Payload Deployment and Retrieval System (PDRS), Mobile Servicing System (MSS), Rendezvous/and Proximity Operations (Rndz/Prox Ops), Extravehicular Activity (EVA), International Space Station (ISS) Core Systems, and Transfer Training.

Assigned crew training is directed by a Shuttle Budget Team (SBT) which includes representation from MOD and FCOD. The SBT monitors, manages, and approves changes to assigned crew training. It is tasked with managing curriculum loading and distribution, as well as curriculum content.

## **Payload Specialist Training**

The Astronaut Office is responsible for outlining the Payload Specialist (PS) training curriculum. Specific training requirements for each PS are determined by the Crew Support Office manager and the crew payload commander. These training requirements are incorporated into the detailed crew training plan developed by the MOD training manager. Training for PSs is composed of generic and flight-specific training. PS training is intended to achieve the following:

- Provide sufficient shuttle systems training so that PS activities onboard the shuttle are conducted in a safe manner.
- Provide sufficient crew interaction and operations training so that the entire crew can operate safely as a disciplined, integrated team.
- Provide sufficient emergency and safety training so that hazardous situations can be handled with speed and skill.
- Provide sufficient time for payload training so that experiment operations proficiency can be maintained.

Lessons which are recommended for PSs are listed throughout the Crew Training Catalog (CTC). Each Crew Training Requirements Table contains crew position columns which define which lessons each crewmember will receive. Payload Specialist lessons will be indicated using the "PS" column. No facility lessons will be scheduled for the backup PS. However, backup PSs are encouraged to attend facility lessons with the prime PS, as an observer, if space is available. Re-designation of the prime PS within 4 months of launch could affect the satisfactory completion of the training requirements.

A list of self study materials and a flow chart depicting the recommended PS training may also be found in the CTC appendix. This flow chart integrates lessons from each CTC section.

Training outlined in the Shuttle CTC will be augmented for a specific mission based on the requirements of the Payload Integration Plan (PIP) Training Annex, and those of the mission Commander, Payload Commander, Simulation Supervisor, and Training Team Lead.

#### **Timeframe**

The training period for assigned crews is divided into timeframe segments called stages. Stages are broad timeframes, each spanning several L-weeks in which the training is divided. Each activity is associated with a particular training stage.

# Stage Breakdown:

- Stage 4 Training start through L-35
   Light training, handing over Astronaut Office jobs, finishing Shuttle Mission Simulator (SMS) qualifications
- Stage 3 L-34 through L-19
   Training heavily across all disciplines
- Stage 2 L-18 through L-5 Start of integrated simulations
- Stage 1 L-4 through "T-38 to KSC" (not launch)
   Protected time, includes Terminal Countdown Demonstration Test (TCDT)

Flight-similar training starts approximately 12 months prior to the published launch date, or at Stage 4. The final phase, load-specific training, typically begins 16-18 weeks before launch (Stage 2), but for a very complex mission, may begin earlier. During this phase, the training facilities are operated with the actual flight software load or mission model.

Integrated training begins approximately 16-18 weeks prior to launch (Stage 2) and brings the flight crew, ground support personnel, and the customer together using the

Shuttle Mission Simulator (SMS), Mission Control Center (MCC), and the customer control facility. Integrated training produces a high-fidelity simulation of the mission and exercises the required coordination between the groups operating and controlling the flight.

#### **Deviations**

Although some lessons require participation of the entire crew, the lessons may have been designed to emphasize training for one or two specific crew positions. In addition, training requirements for some positions (such as mission specialists) may not require that all lessons in the training flow be taken. These special conditions are detailed in the lesson descriptions. A list of the lessons required for a specific flight is generated by the appropriate Training Division training manager after crew assignment.

The Shuttle CTC was developed as a guideline for Astronaut Training. Preservation of Crew Loading, Crew Experience Levels, Mission Content Changes, etc. may necessitate changes to these guidelines. Deviations to the Shuttle CTC and subsequently the Crew Training Plan may be made with concurrence from the Training Manager, Subject Matter Expert, and the Commander (CDR). These deviations shall be documented appropriately in the Crew Training Plan.

Crewmembers desiring further study in a given area may request additional classes.

# **Catalog Organization**

The catalog is divided into sections covering orbiter system ASCAN training, flight operations, specific mission operations, payloads, and integrated simulations. The training courses provide in-depth information on the individual systems and their interactions.

The New Astronaut Flow (Section 1) consists of all lessons required by the Training Division for ASCANs. It contains courses from GNC, the DPS, orbiter systems, propulsion systems, and other crew systems. Section 2 contains the Core Systems Refresher lessons that can be taken to maintain proficiency in orbiter systems. The following sections contain lessons for flight assigned crewmembers. Crew Systems (Section 3) provides knowledge and skills for orbiter habitability and emergency escape. Medical Operations (Section 4) familiarizes the crewmembers with basic medical information for use while onboard the shuttle. Photo/TV (Section 5) teaches the crewmembers how to operate the photo and video equipment onboard the orbiter. Flight operations courses (Sections 6 and 7) are Ascent/Entry Flight Operations and Orbit Flight Operations. Mission operations courses (Sections 8-10) include Extravehicular Activity (EVA), Payload Deployment and Retrieval System (PDRS), and Rendezvous/Proximity Operations (Rndz/Prox Ops). The Payload course (Section 11) covers the Spacehab and Multipurpose Logistics Module (MPLM) lessons. Courses necessary for shuttle crews visiting the ISS can be found in Section 12 for Core Station Systems, Section 13 for Mobile Servicing Systems (MSS), and Section 14 for Transfer Operations. Integrated simulations are covered in Section 15.

Each catalog section includes lesson and flow information in several different formats which may consist of a course introduction, a lesson flow chart, a training requirements table showing the hours and crew positions to be trained, a summary of crew and facility hours, and a description of each individual lesson.

Not every section includes all formats. For example, the Integrated Simulations Training Course (Section 15) includes only an introduction, a summary of the standard integrated simulation requirements, training objectives, and a series of lesson descriptions.

It should also be noted that ISS-related lessons and flows may deviate from the formatting outlined in this section due to differences between the two training programs.

# **Training Level Definition**

Training lessons are designated by levels. Understanding these levels will help the catalog user interpret the lesson coding system. These training level distinctions are necessary to identify training requirements for newly assigned flight crewmembers as well as for those who have previously flown a mission. Training lesson levels are designated as follows:

Level 1:	Basic	Part of the New Astronaut basic training consists of briefings, lectures, T-38 flying, etc. designed as an introduction to the Space Transportation System (STS) program and to flight operations activities. This training is directed by FCOD.
Level 2:	Advanced	Lessons in generic STS and ISS operations.
Level 3:	Flight-Similar	Lessons which require a load or configuration similar to that flight's actual load or configuration.
Level 4:	Proficiency, Review and Refresher	Lessons repeated as needed to brush up on or maintain a given level of skills and knowledge in STS operations.
Level 6:	Operational	The 60000-level code is used for events that are Facility, hardware, or operational prerequisites for training.
Level 9:	Load-Specific	Lessons which require that flight's actual load or configuration (software and/or hardware).

#### **Lesson Codes**

Lessons are identified by a lesson code consisting of up to nineteen alphanumeric characters. The last six characters describe the training level, session number, facility, and revision code.

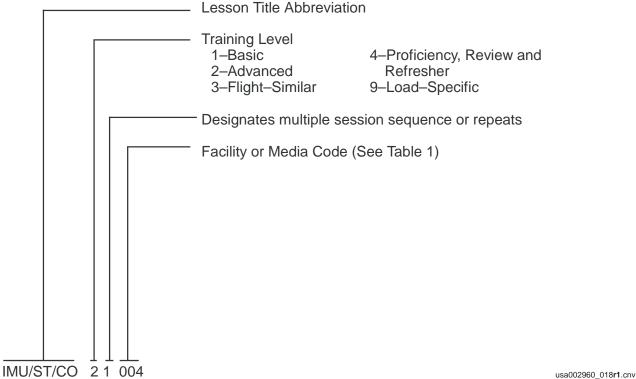


Figure 1. Lesson Code Interpretation

## Proficiency, Review, and Refresher Lessons

There are three types of 40000-level lessons in this catalog: proficiency, review, and refresher.

#### a. Proficiency Lessons

Proficiency lessons within each course are used to maintain a specific level of skills or systems knowledge after a particular phase of training is completed. These lessons are taken on a scheduled, recurring basis as required. The frequency is determined by the individual training course supervisor. The content of the lesson is predefined and is outlined in the lesson descriptions.

The three levels of proficiency lessons correspond with the levels of training: advanced, Flight-Similar (FS), and Load-Specific (LS). Advanced proficiency lessons (designated 'XXXX PRF ADV,' where 'XXXX' indicates the training course) are taken upon completion of that course's advanced (20000-level) training. For the

flight operations courses, this is commonly referred to as 'astronaut pool proficiency'. Flight-similar proficiency lessons (XXXX PRF FS) are taken after all flight-similar (30000-level) training is completed and before the load drop. Load-specific proficiency lessons (XXXX PRF LS) are taken after completion of load-specific (90000-level) training and before actual flight. They are also used to round out the load-specific training in the weeks before flight.

#### Review Lessons

Review lessons are the second type of 40000-level lessons offered. They are used to review specific material in a given course or to cover the highlights of a group of lessons. This may happen, for instance, when an experienced crewmember is in training for a subsequent flight. Review lessons (designated 'XXXXX REVIEW') may be taken at any appropriate time during the course by crew and/or instructor request, and therefore do not have a specified frequency. The content of review lessons is determined in a pre-lesson meeting between the crewmember(s) and instructor(s).

#### c. Refresher Lessons

Refresher lessons are the third type of 40000-level training. They are used to brush-up each crewmember's knowledge of the individual systems, usually prior to the start of 30000-level training. Crewmembers who have been assigned to a flight are required to take these lessons within 12 months of flight unless they have taken the related 20000-level lessons within 2 years of the flight. The content of each lesson is predefined and is outlined in the lesson description. Refresher lessons (designated 'XXXXXXX REFR') may also be taken by other crewmembers upon request.

Table 1. Facility/Media List

	Table 1: Tability/Media List				
	Media				
No.	ID	Media Description	Location		
001	CLR	Classroom (Lecture/Briefing)	-		
002	WBK	Workbook	-		
003	VDT	Videotape	-		
004	SST2	SST 2 (Single System Trainer 2)	4S		
006	SST1	SST 1 (Single System Trainer 1)	4S		
007	TXT	Text (Flight Procedures Handbooks, etc.)	-		
800	SST3	SST 3 (Single System Trainer 3)	4S		
010	GNS	Guidance and Navigation Simulator	35		
011	MB	SMS-MB (Shuttle Mission Simulator-Motion Base)	5N		
012	FB	SMS-FB (Shuttle Mission Simulator-Fixed Base)	5N		
014	EMU	EMU MAL SIM (Extravehicular Mobility Unit Malfunction Simulator)	4S		
015	SESA	SES AFT (Shuttle Engineering Simulator-AFT Station)	16		
016	VR LAB	Virtual Reality Trainer	9C		
017	VMS	Vertical Motion Simulator (Ames Research Center)	AMES		
019	FFT	Full-Fuselage Trainer	9N		
020	CCT	Crew Compartment Trainer	9N		
022	MGNS	MCC/GNS (Mission Control Center and Guidance and Navigation Simulator)	30/35		
023	11FT	ALT Chamber (11 Foot Altitude Chamber)	7		
025	DST1	Dynamic Skills Trainer 1	4S		
027	NBL	Neutral Buoyancy Lab	Sonny		
			Carter		
			(SC)		
028	ABT	Air Bearing Table	9N		
029	PYLD	PYLD Trainer (Payload Trainer)	4S		
030	MCCC	MCC Console (Mission Control Center Console, P-Tube Station, Opaque TV, etc.)	30		
031	KSC	John F. Kennedy Space Center (Florida)	KSC		
032	FCT3	Flight Controller Trainer 3	4S		
038	NGNS	NBL/GNS (Neutral Buoyancy Laboratory and Guidance and Navigation Simulator)	SC/35		
039	MN/G	MCC/NBL/GNS (Mission Control Center and Neutral Buoyancy Laboratory and Guidance and Navigation Simulator)	30/SC/35		
040	MCC	Mission Control Center	30		
042	IFB	MCC/FB (Mission Control Center and Shuttle Mission Simulator – Fixed Base	30/5N		
043	IMB	MCC/MB (Mission Control Center and Shuttle Mission Simulator – Motion Base)	30/5N		
047	ETDT	ET DOORS TRNR (ET Umbilical Doors Trainer)	9A		

Table 1. Facility/Media List (Continued)

	Media		
No.	ID	Media Description	Location
049	M/CG	MCC/CCT/GNS (Mission Control Center and Crew Compartment Trainer and Guidance and Navigation Simulator)	30/9N/35
050	STA	Shuttle Training Aircraft (Ellington Field, Houston, Texas)	EFD
052	38A	T-38A Ellington Field, Houston, Texas	EFD
053	K135	KC-135 Ellington Field, Houston, Texas	EFD
054	7FT	ETA (Environmental Test Article)	7
056	SESF	SES FWD (Shuttle Engineering Simulator – Forward Station)	16
057	CBT	Computer Based Training	-
058	CBTI	CBT IVD (Computer Based Training Interactive Videodisc)	-
061	SMFC	SIMFAC (RMS Simulator Facility) Toronto, Canada	Canada
062	LEQ	Loose Equip (Photographic Equipment)	-
063	ADT	Audio Tape (Cassette Tape)	-
064	CAI	CAIT (Computer Aided Instructional Terminal-Regency)	4
065	WCS	WCS Trainer	5N
068	FCT	Flight Controller Trainer	4S
069	SESD	SES DOME (Shuttle Engineering Simulator – Dome Station)	16
070	DST6	DST 6 (Dynamic Skills Trainer 6)	4S
074	NASA	Other NASA Facilities	-
076	CUST	Customer Facility	-
077	MSFC	Marshall Spaceflight Center (Huntsville, Alabama)	MSFC
078	PTT	Part Task Trainer I	4S
079	MC/C	MCC/CCT (Mission Control Center and Crew Compartment Trainer)	30/9N
080	M/NBLF	MCC/NBL/FB (Mission Control Center and Neutral Buoyancy Laboratory and Shuttle Mission Simulator – Fixed Base)	30/SC/5N
081	M/NBLM	MCC/NBL/MB (Mission Control Center and Neutral Buoyancy Laboratory and Shuttle Mission Simulator – Motion Base)	30/SC/5N
082	NBL/FB	Neutral Buoyancy Laboratory and Shuttle Mission Simulator – Fixed Base	SC/5N
083	NBL/MB	Neutral Buoyancy Laboratory and Shuttle Mission Simulator – Motion Base	SC/5N
084	PBT	Playback Trainer	4S
085	СНВ	CHAMBER B (33 ft.)	32
087	HYPR	Hyperbaric Chamber	32
088	SPPF	Spacehab Payload Processing Facility (KSC)	KSC
089	SHFT	SHIFT (Spacehab Intelligent Familiarization Trainer)	4
090	CAT	Commercial Air Travel	-
091	REMO	Remote OPS	-
092	FS	Flight Support	-

Table 1. Facility/Media List (Continued)

	Media		
No.	ID	Media Description	Location
093	MSTA	Mission Specialist Training Aircraft (MS/TRNG/AIRCRAFT)	EFD
098	INF	Informal	-
099	RFS	Real Time Flight Support	-
101	MOST	Medical Operations Simulation Trainer	8
102	SELF	Self Study	-
103	OJT	On-the-Job Training	-
105	SSMTF	Space Station Mock-up and Training Facility	9N
107	TOUR	Tour	-
108	SG	Study Guide	-
109	TM	Training Manual	-
110	S1	Space Station Training Facility – String 1	5S
114	ISS OBT	ISS On-Board Training	ISS
115	MRMDF	Multiuse Remote Manipulator Development Facility	9N
116	CCTII	CCT II	9N
117	PTT2	Part Task Trainer 2	4S
118	PTT3	Part Task Trainer 3	4S
119	PTT4	Part Task Trainer 4	4S
120	S2	Space Station Training Facility/String 2	5S
121	S1FB	String 1/Fixed Base	5S/5N
122	S2FB	String 2/Fixed Base	5S/5N
123	S1GNS	String 1/Guidance and Navigation Simulator	5S/35
124	S2GNS	String 2/Guidance and Navigation Simulator	5S/35
125	IS1	Mission Control Center/String 1	30/5S
126	IS2	Mission Control Center/String 2	30/5S
127	IS1FB	Mission Control Center/String 1/Fixed Base	30/5S/5N
128	IS2FB	Mission Control Center/String 2/Fixed Base	30/5S/5N
129	MS1GNS	Mission Control Center/String 1/Guidance and Navigation Simulator	30/5S/35
130	MS2GNS	Mission Control Center/String 2/Guidance and Navigation Simulator	30/5\$/35
131	FCT2	Flight Controller Trainer 2	4S
132	S1MB	String 1/Motion Base	5S/5N
133	S2MB	String 2/Motion Base	5S/5N
134	S1NBL	String 1/Neutral Buoyancy Laboratory	5S/SC
135	S2NBL	String 2/Neutral Buoyancy Laboratory	5S/SC
136	S1FBNBL	String 1/Fixed Base/Neutral Buoyancy Laboratory	5S/5N/SC
137	S2FBNBL	String 2/Fixed Base/Neutral Buoyancy Laboratory	5S/5N/SC
138	S1GNSNBL	String 1/GNS/NBL	5S/35/SC
139	S2GNSNBL	String 2/GNS/NBL	5S/35/SC

Table 1. Facility/Media List (Continued)

	Media		
No.	ID	Media Description	Location
140	MS1NBL	MCC/String 1/NBL	30/5S/SC
141	MS2NBL	MCC/String 2/NBL	30/5S/SC
142	MS1FBNBL	MCC/String 1/FB/NBL	30/5S/5N/SC
143	MS2FBNBL	MCC/String 2/FB/NBL	30/5S/5N/SC
144	MS1GNSNBL	MCC/String 1/GNS/NBL	30/5S/35/SC
145	MS2GNSNBL	MCC/String 2/GNS/NBL	30/5S/35/SC
146	INT SIM	Generic Integrated Simulation	-
152	RST	SSTF with RST and Crew Station	5S
153	FT	Field Trip	-
154	SSATA	Space Station Airlock Test Article	5S
155	SMC	Station Management and Control Laboratory	5S
156	PTT1	Part Task Trainer 1	48
157	SSC	Station Support Computer	30
158	PCS	Portable Computer System	5S
159	GALIMAX	Galveston IMAX Theater	-
160	OLMATS	Online Materials	-
161	SSTF USLT	SSTF U.S. Lab Trainer	5S
162	SSTF JEM	SSTF JEM Trainer	5S
163	SSTF COF	SSTF Columbia Operating/Orbiting Facility	5S
164	SSTF SATA	SSTF Stand-Alone Training Area	5S
165	SSTF RBUA	SSTF Rack Build-Up Area	5S
166	SSTF PSSA	SSTF Payload Support Structural Assembly	5S
167	SSMTF SATA	SSMTF Stand-Alone Training Area	9N
168	SSMTF PDL	SSMTF Payload Development Lab	9N
169	SSMTF FCSL	SSMTF Flight Crew Support Laboratory	9N
170	SSCST	EVA Space-to-Space Communication System Trainer	9N
171	DST2	Dynamic Skills Trainer 2	4S
172	DST3	Dynamic Skills Trainer 3	16
173	DST4	Dynamic Skills Trainer 4	16
174	DST5	Dynamic Skills Trainer 5	16
175	OBT/CBT	On-Board Training/Computer Based Trainer	-
176	CR/TTT	Table Top Trainers in a Classroom	-
177	VCONF	Video Conference	-
178	SSTF	Space Station Training Facility	5S
179	S1/SSMTF	Space Station Training Facility/Space Station Mock-Up Training Facility	5S/9N
180	P SIM	Paper Simulation	30

Table 1. Facility/Media List (Continued)

	Media		
No.	ID	Media Description	Location
181	CLR1	Classroom 1	-
182	PTT5	Part Task Trainer 5	4S
184	GITF	GNC Integrated Training Facility	30
185	SVT	Spacehab Volumetric Trainer	5N
186	S2/SSMTF	S2/SSMTF Combined Configuration	5S/9N
187	SVTFB	Spacehab Volumetric Trainer Fixed Base	5N
188	SVTMB	Spacehab Volumetric Trainer Motion Based	5N
189	SVTGNS	Spacehab Volumetric Trainer GNS	5N/35
190	ISVTFB	Integrated Spacehab Volumetric Trainer Fixed Base	30/5N
191	ISVTMB	Integrated Spacehab Volumetric Trainer Motion Based	30/5N
192	ISVTGNS	Integrated Spacehab Volumetric Trainer GNS	30/5N/35
193	S3	SSTF – String 3	5S
194	IS3	MCC/String 3	30/5S
195	PGSC	Payload General Support Computer	5N
196	CLR2	Classroom 2	-
197	FQDT	EVA Fluid QD Trainer	9N
199	ELANG	English	-
200	EVALUATION	Evaluation	-
201	RUSS CR	Russia Classroom	-
202	RUSS WBK	Russia Workbook	-
203	RUSS TRNR	Russian Trainer	-
205	APDS TRNR	Androgynous Peripheral Docking System Trainer	4S
206	DST10	Dynamic Skills Training 10	16
208	B9 SRM	Building 9 Suit Room	9N
209	B9 FLR	Building 9 FLR	9N
212	RSTF	Russian Training Facility	-
227	HYDROLAB	Hydro Lab	-
240	MCC-M	Mission Control Center-Moscow	-
257	DT SSC	DT SSC Lab	-
276	ENERGIA	Energia	-
292	RS FLT SUP	RS Flight Support	-
298	RS INFORM	Russia Inform	-
299	UG	User Guide	-
300	ESA	European Space Agency	-
412	NTF	NASDA Training Facility	-
512	CTF	Canadian Training Facility	-
513	MMLC	Multimedia Learning Center	-
514	MOTS	MSS Operations Training Simulator	-
515	SOSC	Space Operations Support Center	-

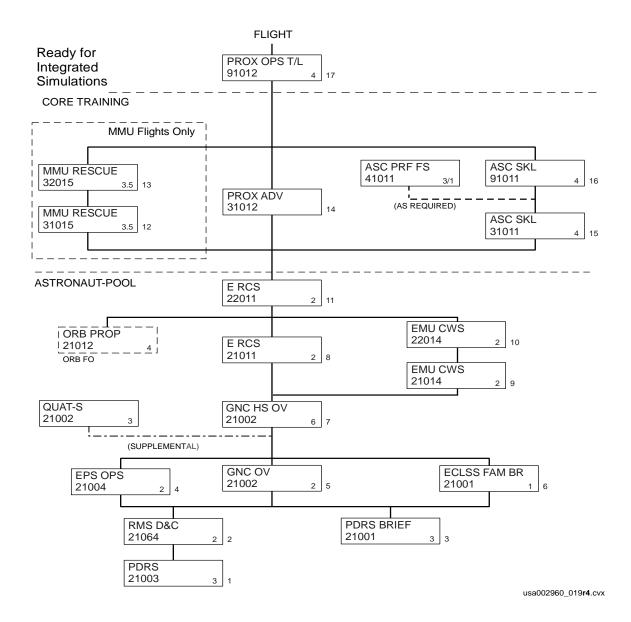
Table 1. Facility/Media List (Concluded)

	Media		
No.	ID	Media Description	Location
516	VOTE	Virtual Operations Training Environment	-
700	SSTF SLAB	SSTF Secondary Lab	5S
701	ORU	Orbiter Replacement Unit	9N
703	TPST	Thermal Protection System Trainer	9N
704	SSMTF and	Space Station Mock-Up and Training Facility and Orbital	9N
	ORU Trainer	Replacement Unit Trainer	
705	VR & PABF	Virtual Reality and Precision Air Bearing Floor	9N
706	TPS & PABF	Thermal Protection System and Precision Air Bearing Floor	9N

#### **Lesson Flow Charts**

The flowchart(s) in each section show the preferred sequence of lessons in that course and indicate any mandatory prerequisites to those lessons. All prerequisites should be met before progressing to the next class. This will ensure that the material has been presented in an effective manner.

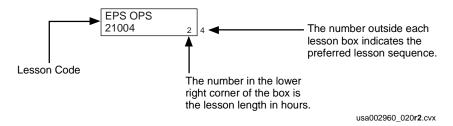
The Lesson Flow Charts in most training courses (the New Astronaut section is an exception) depict lesson sequence from bottom to top. Below is an example of a Lesson Flow Chart. This flow does not necessarily correspond to any specific training course. Please refer to the examples following to understand how to interpret the different formatting elements used in Lesson Flow Charts.



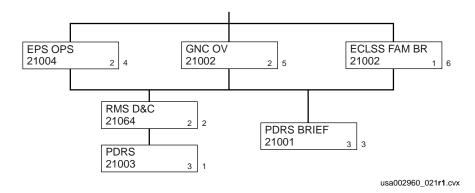
## Typical Lesson

The following example identifies a SST skill development lesson used to teach advanced skills concerning the orbiter electrical power system. It consists of one session lasting 2 hours.

In the flow chart, this lesson would be identified as follows:



All paths to a lesson must be completed before that lesson can be taken. In the example below, a student must complete lessons 1 through 3 before taking lesson 4, 5, or 6. However, lesson 3 could be taken before lessons 1 or 2.



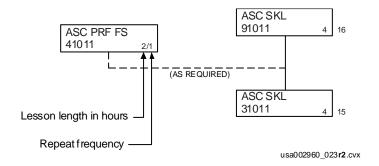
Informational text may be connected to flow charts by a single straight line.



# Proficiency, Refresher, Review Lessons

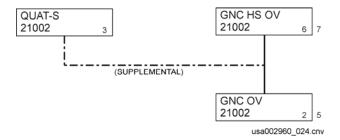
The following example identifies an ascent proficiency lesson used to maintain ascent skills between flight-similar and load-specific training, using the SMS. The example also includes an ascent review lesson which may be used to brush up on ascent skills previously covered. Both lesson codes contain a 40000-level number. The duration and frequency of the proficiency lesson is shown by the numbers before and after the slanted line, respectively. In this example, the lesson lasts 2 hours and should be repeated every week. If it were scheduled on a monthly basis, the number after the

slash would be a 4. The letter F will be used after the slash if training is to be repeated once per flight. The single number shown indicates the lesson length in hours. Both proficiency and review lessons are connected to the flow by dashed lines and are annotated as shown. Refresher lessons are also connected to the flow by dashed lines and are annotated "(AS REQUIRED)". They do not have a repeat frequency specified.



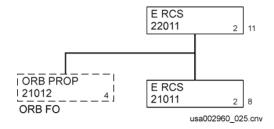
# Supplemental Lessons

When a lesson provides a source of supplemental data, it will be shown and annotated as follows:



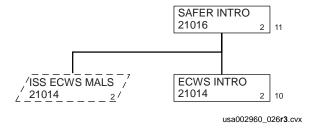
## Lessons From Another Course

A dashed line box indicates that the lesson is from another course and is a prerequisite to the next lesson above it in this course. The name of the course is annotated under the dashed box.



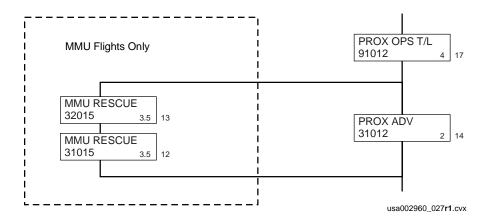
# Lessons From the ISS Crew Training Catalog (CTC)

A dashed parallelogram box indicates that the lesson is from the ISS CTC and is a prerequisite to the next lesson above it in this course.



# Mission-Specific Lessons

When a training flow has lessons that result from a particular STS flight's objective or cargo configuration, lesson flow charts will identify these requirements by lesson(s) and segregate those lesson groups. This will be accomplished using a dashed box or a separate training flow page for each option.



## **Generic Flight Crew Training Requirements Lesson List**

A lesson flow chart is a requirements lesson list in table form. This list is useful as an overview of lessons contained in a training course and for obtaining facility loading baseline data. The table includes the lesson stage, reference number, the lesson code, duration in hours, scheduling code, crew positions to be scheduled, any alternate facility for the lesson, and a comments column.

#### SAMPLE TRAINING REQUIREMENTS TABLE

Crew task assignments as determined by the SBT for both crew rotation and non-crew rotation scenarios are displayed in the requirements table. These task and lesson assignments allow the SBT to assess and manage crew loading for entire crews, as well as for specific crew positions.

The scheduling code defines how many crewmembers will be scheduled at a time for the lesson. A scheduling code of '8' indicates that the entire crew should be scheduled for the lesson.

The crew position requirements column defines which lessons each crewmember will receive during training.

Proficiency and supplemental lessons, which are not necessarily required, are listed as unsequenced lessons in appropriate positions in the table.

Crew position designators in the crew training requirements tables are as follows:

C = Commander

P = Pilot

EV1 = EVA Crewmember 1

EV2 = EVA Crewmember 2

MS1 = Mission Specialist 1

MS2 = Mission Specialist 2-Flight Engineer

MS3 = Mission Specialist 3

MS4 = Mission Specialist 4

PS = Payload Specialist

EV1 = EVA Crewmember 2

Suit IV = EVA Suit Support Crewmember

Task IV = EVA Task Support Crewmember

R1 = RMS Operator 1

R2 = RMS Operator 2

M1 = SSRMS Operator 1

Positions designated are task-related and are assigned by the commander.

A = ASCAN

An alternate facility is indicated in case the planned facility is unavailable. For example, the SST 3 is almost functionally equivalent to SST 1 and SST 2 and usually may be substituted for lessons planned for either.

M2 = SSRMS Operator 2

The comments column is primarily used for additional scheduling information appropriate to the lesson. For example, *a Comments reference* in the Sample Training Requirements Table, "As assigned by CDR," indicates that the crewmembers assigned to this position can be determined by the commander.

# **Training Requirements Summary Tables**

The New Astronaut course has a training requirements summary table included as part of the course description material. This table is used to provide a summary of the training broken out by facility. The Crew Hours column is based on the Highest Loaded Crew Member (HLCM). The Facility Hours column is the length of the class multiplied by the number of times that the class must be taught in the facility (limited by the maximum number of students that can take the class at once).

#### SAMPLE TRAINING REQUIREMENTS SUMMARY

Date Last Modified: 10/05

	CREW HOURS	FACILITY HOURS
	N	N
CLASSROOM (001)	285.0	*
SST (004, 006, 008)	105.5	1055.0***
CST (005)	2.0	40.0
SMS-Motion Base (011)	53.5	374.5**
SMS-Fixed Base (012)	30.0	210.0**
CCT (020)	22.0	*
NBL (027)	3.0	*
CBT (057)	12.5	250.0
WCS (065)	1.0	*
DST (025)	2.0	40.0
PGSC (195)	4.5	*

Based on an ASCAN class of 20.

The non-ASCAN prebriefs are not included in these numbers.

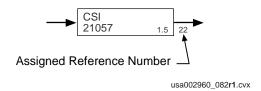
<sup>\*</sup>Facility Hours are not calculated for non-key facilities.

<sup>\*\*</sup>SMS Facility Hours based on the lesson being taught seven times to account for a class of 20.

<sup>\*\*\*</sup>SST Facility Hours based on the lesson being taught 10 times to account for a class of 20.

# **Lesson Description**

Each lesson in a training course has a lesson description consisting of a lesson title, duration, training medium, student position designation, lesson source, effective date, lesson(s) replaced, equipment required, prerequisite lesson(s), preparation, synopsis and lesson objectives. Some descriptions may also include a list of suggested reading. Lesson descriptions are assigned a reference number that corresponds to the number on the lesson flow chart. For example:



# 22 **CSI 21057**

Title: Crew Software Interface

Duration: 1.5 hours
Medium: CBT
Student: ASCAN

Source: DT35/DPS/Navigation and Rendezvous Section

Date: 02/04

Lesson(s) Replaced: CSI 21005 Equipment Required: None

Prerequisite Lesson(s): DPS OV 21001

Preparation: Read:

CSI 21002; Part 1

### Synopsis:

This lesson provides an introduction to basic DPS operations. The lesson focuses primarily on the Primary Avionics Software System (PASS) operations, keyboard operations, and display specifications. PASS structure and General Purpose Computer (GPC) software configurations for flight phases are presented. Keyboard practice is accomplished with Operational Sequence (OPS) and major mode transitions, interaction with the onboard clocks, and DPS display reconfiguration.

## Objectives:

- Describe the PASS software structure and GPC configuration for various flight phases.
- Define the term "unsupported major function."
- Identify the function of the Integrated Display Processor (IDP) power, select, and major function switches.
- Identify the function of each key on the keyboard.
- Perform OPS and major mode transitions.
- Identify the standard format of DPS displays.
- State the significance of special indicators (M, H, L, ↑, ↓, \*, ?) and page nomenclature.

# 22 **CSI 21057 (Concluded)**

- Perform item entries with implied item numbering and multiple entries strung together.
- Identify the source of 'ERR' and 'ILLEGAL ENTRY' messages.
- Explain Fault Summary format and demonstrate page clearing.
- Demonstrate SPEC and Display (DISP) retention.
- Perform onboard clock operations using SPEC 2.
- "Title" identifies the complete lesson title from which the lesson abbreviation code is derived.
- "Duration" is the amount of time required to accomplish the lesson.
- "Medium" identifies the training facility or document used for the lesson. Some
  lessons can be conducted in an alternate facility. If the planned facility is preferred,
  then the alternate facility is shown in parenthesis next to the prime training facility
  [For example: SMS-FB (SMS-MB)]. If the planned facility is not preferred over the
  alternate facility an 'or' is used to separate facilities listed for example: SST 1 or
  SST 3. Acronyms used for the training mediums are shown in the Facility/Media
  List (Table 1).
- "Student" designation is used for scheduling purposes. The lesson is scheduled for crewmembers as a group, unless a notation such as "schedule in pairs" or "schedule individually" follows the student listing. The crew position designators are the same as those used in the Sample Training Requirements Table, and are as follows:

CDR = Commander

Suit IV = EVA Suit Support Crewmember

PLT = Pilot

MS1 = Mission Specialist

Suit IV = EVA Task Support Crewmember

EV1 = EVA Crewmember 1

MS2 = Mission Specialist 2-Flight Engineer

MS3 = Mission Specialist 3

MS = Mission Specialist 3

R1 = RMS Operator 1

R2 = RMS Operator 2

PS = Payload Specialist

M1 = MSS Operator 1 (Section 13)

M2 = MSS Operator 2 (Section 13)

- "Source" identifies the section of MOD responsible for developing the lesson material and for conducting the lesson.
- "Date" indicates the effective date of the lesson.
- "Lessons Replaced" lists obsolete lessons which are preempted by the current lesson.
- "Equipment Required" identifies any unique configuration or ancillary equipment required for lesson conduct and is used for scheduling purposes.

- "Prerequisite Lesson(s)" lists the immediate prerequisite lesson(s).
- Lesson "Preparation" lists tasks that must be accomplished before the lesson is taken.
- "Synopsis" provides the student with additional information about the lesson.
   Included may be one or more scenarios, a summary of points, procedures or rules to be covered, or a discussion of the environment or timeline presented in the lesson.
- "Objectives" indicates what the student is expected to know or be able to do upon completion of the lesson.

## **Catalog Revisions and LCR Approvals**

Changes to the CTC are made via Lesson Change Request (LCR). LCR forms are submitted to the CTC book manager and are reviewed for accuracy and completeness with regard to format, content, and overall curriculum impact by the CTC book manager, lesson group manager, and flow owner. If the LCR includes changes with loading impacts it must be reviewed and approved by the SBT. Figure 2 depicts the LCR submittal process flow.

Each LCR is considered individually and within the scope of the overall budget. The SBT works toward concurrence on the budget, at which point SBT chair and Astronaut Office approvals are obtained for each LCR and for the overall budget.

## **SBT Conflict Resolution**

Every effort must be made to ensure that conflict resolution does not impose undue delay on catalog publication.

Should the conflict resolution process exceed 2 weeks, the LCR approval will be delayed to the next cycle. The SBT Chair may opt at any point in the process to invoke any of the following conflict resolution process options.

- If the issue at hand is strictly a technical issue, then the LCR will be returned to the SBT flow representative for modifications and may then be approved out of board.
- If issues involve loading, the board will re-convene. The flow owner is required to
  present supporting data or a modified LCR at this time. Every effort shall be made
  to resolve conflicts within the board. If the issue remains unresolved, then it will be
  elevated to Spaceflight Training Management at the next Crew Training Control
  Board meeting. All affected SBT representatives must attend. Final direction will
  be determined at this forum.

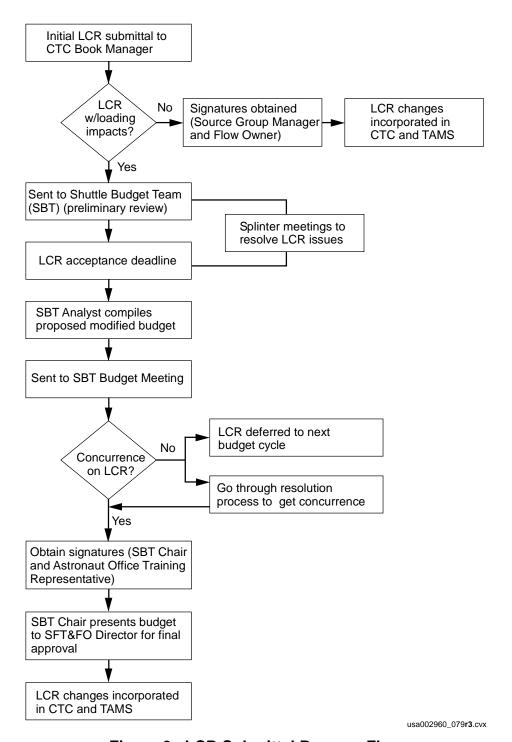


Figure 2. LCR Submittal Process Flow

## Flow Owners' Responsibilities

A course flow owner is responsible and accountable for the content, loading, and lesson time frame information within his flow. Flow owners must review all LCRs for content and loading impacts and are responsible for presenting and providing the SBT with supporting rationale for each LCR written against his section. The flow owner must also inform respective disciplines of changes to the curriculum. In most cases, the flow owner is also the Training Course supervisor, but this task may be delegated to another individual.

# **Training Course Supervisor Responsibilities**

The primary responsibility of the Training Course Supervisor (TCS) is to maintain correct, accurate, and consistent content of a particular training flow. This will include writing LCRs and obtaining the necessary approvals for the LCRs. They will communicate with other TCSs to eliminate gaps and unnecessary repetitions and to maintain content consistency between training flows. A list of the CTC courses and the responsible TCS can be found in Table 2.

**Table 2. Training Course Supervisors** 

Introduction		DA7/ <i>Peggy Levy</i>			
Shuttle Sys	Shuttle Systems				
Section 1:	New Astronaut Training Flow	DA7/Kelsey Berumen			
Section 2:	Core Systems Refresher Training	DA7/Gail Barnett			
Section 3:	Crew Systems	DX45/Rob Tomaro			
Section 4:	Medical Operations	SA/David Stanley			
Section 5:	Photo/TV	DX34/David Williams			
Eliabt Oner	ations	l			
Flight Opera					
Section 6:	Ascent/Entry Flight Operations	DA7/Steve Messersmith			
Section 7:	Orbit Flight Operations	DA7/Juan Garriga			
Mission Op	<u>erations</u>				
Section 8:	Extravehicular Activity Operations	DX3/Tracy Snow and Megan Murphey			
Section 9:	Payload Deployment and Retrieval System	DX25/Jenny Young			
Section 10:	Rendezvous/Proximity Operations	DM34/Alan Fox			
<u>Payloads</u>					
Section 11:	Spacehab/MPLM	DO5/Allen Burge			

# **Table 2. Training Course Supervisors (Concluded)**

# **ISS Systems and Operations**

Section 12:	Core Station Systems for STS Crew Training	DA7/Chris Zajac
Section 13:	Mobile Servicing System for STS Crew Training	DX2/Paul Williamson
Section 14:	Transfer Operations for Shuttle Crews	DO55/Matthew Villaverde

# **Integrated Simulations**

Section 15:	Integrated Simulations	DA7/Gail Barnett
Addendum		DA7/ <i>Peggy Levy</i>

#### SECTION 1.0 NEW ASTRONAUT TRAINING FLOW

The New Astronaut Training courses contain all required Orbiter Systems 20000-level training courses. It does not include 20000-level specialty instruction such as Rendezvous/Proximity Operations, PDRS, Spacehab, or Flight Specific Payload training. Assignments to these courses occurs upon completion of the New Astronaut Flow or flight assignment.

The New Astronaut flow is an integrated flow containing lessons from all orbiter systems along with lessons given by the astronaut office and other MOD personnel. It is organized by tiers. The New Astronaut lesson flow chart, Figure 1-1, is read left to right. As the student progresses through the tiers, the difficulty and complexity of the lessons increase.

Tier 1: Introduction to Shuttle Systems

Tier 2: Orbiter Systems Overviews

Tier 3: Flight Operations

Tier 4: Malfunction Training

Tier 5: Advanced Systems Training

Tier 6: Interdisciplinary Malfunction Training

Tier 7: Qualification

### **Tier Tests**

The Astronaut Candidate (ASCAN) will be tested throughout the New Astronaut Training flow. These tests are called Tier Tests. Listed in the New Astronaut flow are five Tier Tests. They are placed in the flow at the points where the tiers listed above conclude. The latter tiers do not have a tier test associated with them. The knowledge obtained in those tiers is tested in the Qualification Lessons.

The ASCANs could have more Tier Tests than listed in this flow. The tests may not necessarily fall at the conclusion of each Tier. From the beginning of the flow, they are scheduled on a monthly basis and will include the lessons completed up to that point since the last Tier Test.

The most important completion standard associated with Orbiter Systems Training is a measure of the student's understanding of the system and its associated concepts, procedures, and hardware at a "big picture" level. Therefore, these qualification lessons will begin with guided discussions of selected items and, in some cases, without the use of FDF. It is important that the student focus on an overall understanding of the system rather than memorization of the FDF. These lessons are NOT a test of the students'

ability to memorize the FDF. In fact, because procedures are often modified or vary for different phases of flight, memorizing FDF is strongly discouraged.

The primary intent of all qualification lessons is to provide both the instructor and the student with positive feedback that the student is knowledgeable and prepared to begin assigned crew flight specific training. The instructor will use leading questions to help the student focus on the appropriate concepts. FDF will be reviewed in the lesson to tie together the basic concepts discussed in the class and the published procedures.

The following are examples of tasks you may be asked to perform without FDF:

- Configure the DAP to maneuver at a specified rate.
- Configure panel A1 for STDN, TDRS, and SGLS.
- Perform an OMS to RCS interconnect and interconnect return.

Remember that the instructor will provide you with "leads" in performing the task should you need them. We must also clarify that it is not our intention to train you to perform procedures without using FDF. It is imperative to use your checklist when performing tasks or troubleshooting problems onboard the orbiter.

The following are examples of tasks you may be asked to perform with FDF while explaining the major concepts associated with the procedure.

- Perform an IMU reference recovery.
- Perform Ku antenna stow.

You have reached the final tier of your ASCAN training and our intent is for you to recognize your achievements by reviewing the major concepts of orbiter systems through the qualification lessons.

# **Lesson Description**

The Lesson Description sheet for each lesson contains very important information including a synopsis of the lesson and performance objectives. These objectives are to be met upon completion of the lesson. The prerequisites and preparation for each lesson are listed, also. Prerequisites are scheduled lessons that must be completed prior to taking the stated lesson. Preparation consists of material that must be read/reviewed prior to beginning that lesson. Preparation material usually consists of training manuals, briefings or Flight Data File. Computer Based Training (CBT) is often used for preparation of a class. Lists of self-study material for preparation and supplemental preparation are included on Table 1-3 and Table 1-4. Table 1-3 lists the lesson(s) associated with each required self study material. It summarizes the information found in the lesson descriptions. Table 1-4 lists the lessons that have supplemental preparation. This supplemental material information is not found in the lesson descriptions.

## Instructor Astronaut (IA) and Instructor Pilot (IP)

Lessons will sometimes require an IA or IP to be present for the simulation. An IA is an astronaut who has completed new astronaut training previously and who will provide valuable insight into the lesson material. An IA may be either a Mission Specialist or a Pilot/Commander. An IP has the same function, but he or she must be a Pilot or a Commander.

## **Flow Diagrams**

The Flow Diagrams depict the ideal way to schedule the lessons. However, classes may be scheduled out of the flow sequence as long as the prerequisite lessons listed in the lesson description are met.

#### **Non-ASCAN** lessons

The New Astronaut course does contain lessons that are only for non-ASCAN students. These lessons are noted as being Non-ASCAN lessons in Table 1-1 and in the lesson description. ASCANs receive training that has longer and more detailed briefings and higher fidelity trainers. If a non-ASCAN student takes a SST lesson, they typically receive a thirty minute prebrief that covers material that was presented in the ASCAN briefing and is needed prior to taking the SST lesson. Also, the non-ASCAN student might take a lesson in the SST versus a higher fidelity trainer. A non-ASCAN student is defined as an astronaut taking the lesson as a review or other students from MOD and other organizations.

## **Training Requirements Summary Table**

The New Astronaut course has a training requirements summary table included as part of the course description material. This table is used to provide a summary of the training broken out by facility. The Crew Hours column is based on the hours per individual ASCAN. The Facility Hours column is the length of the class multiplied by the number of times that the class must be taught in the facility (limited by the maximum number of students that can take the class at once). The non-ASCAN lessons are not included in this table.

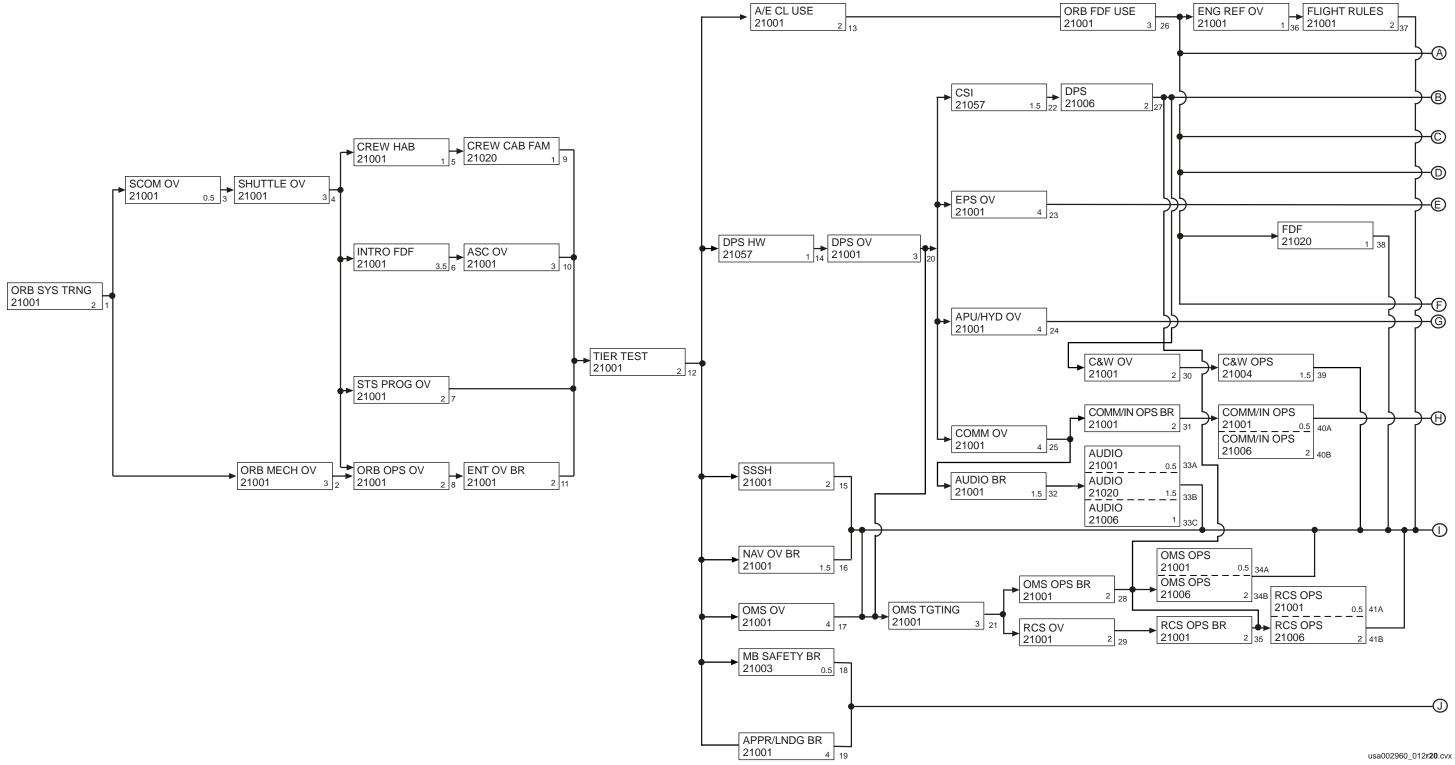
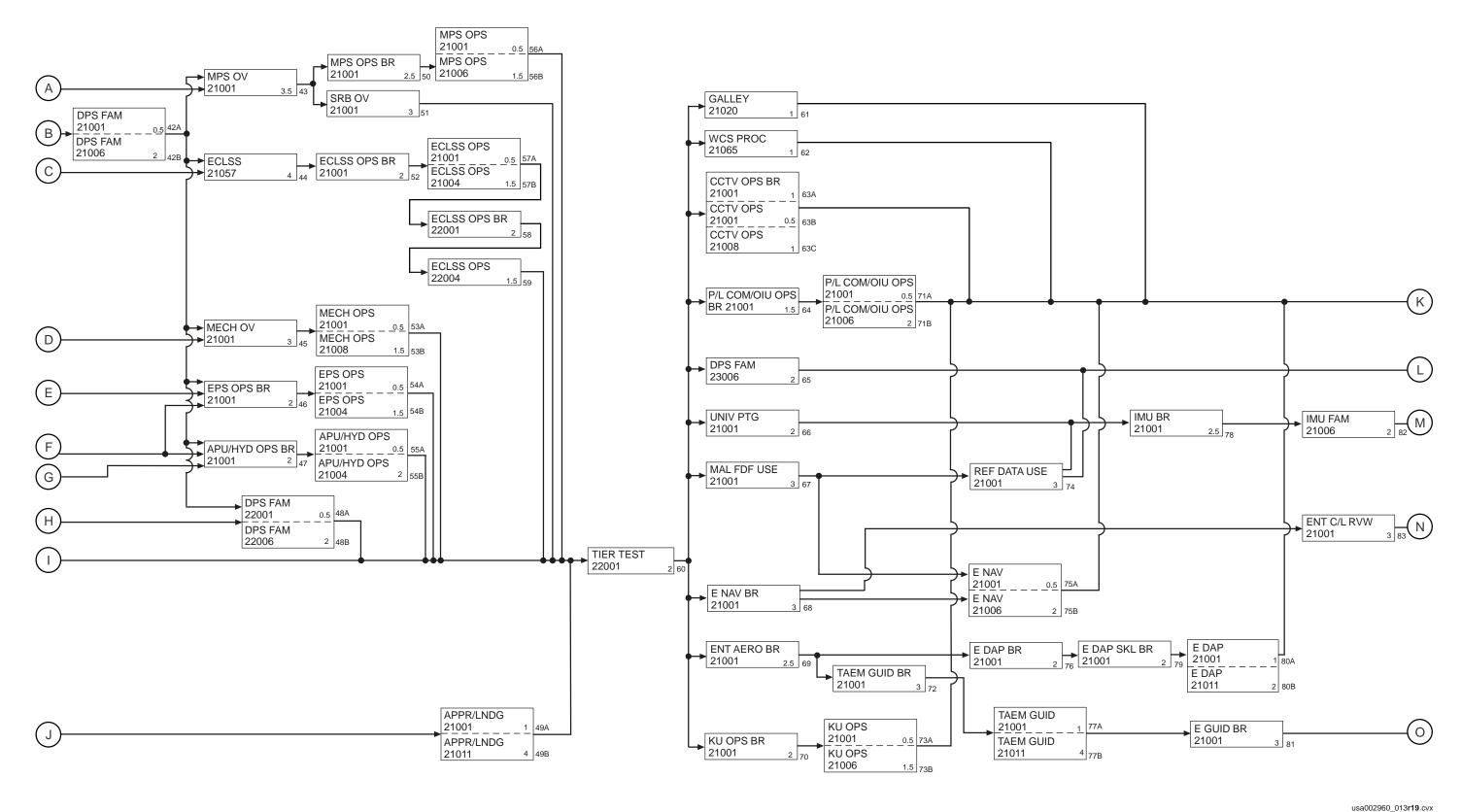
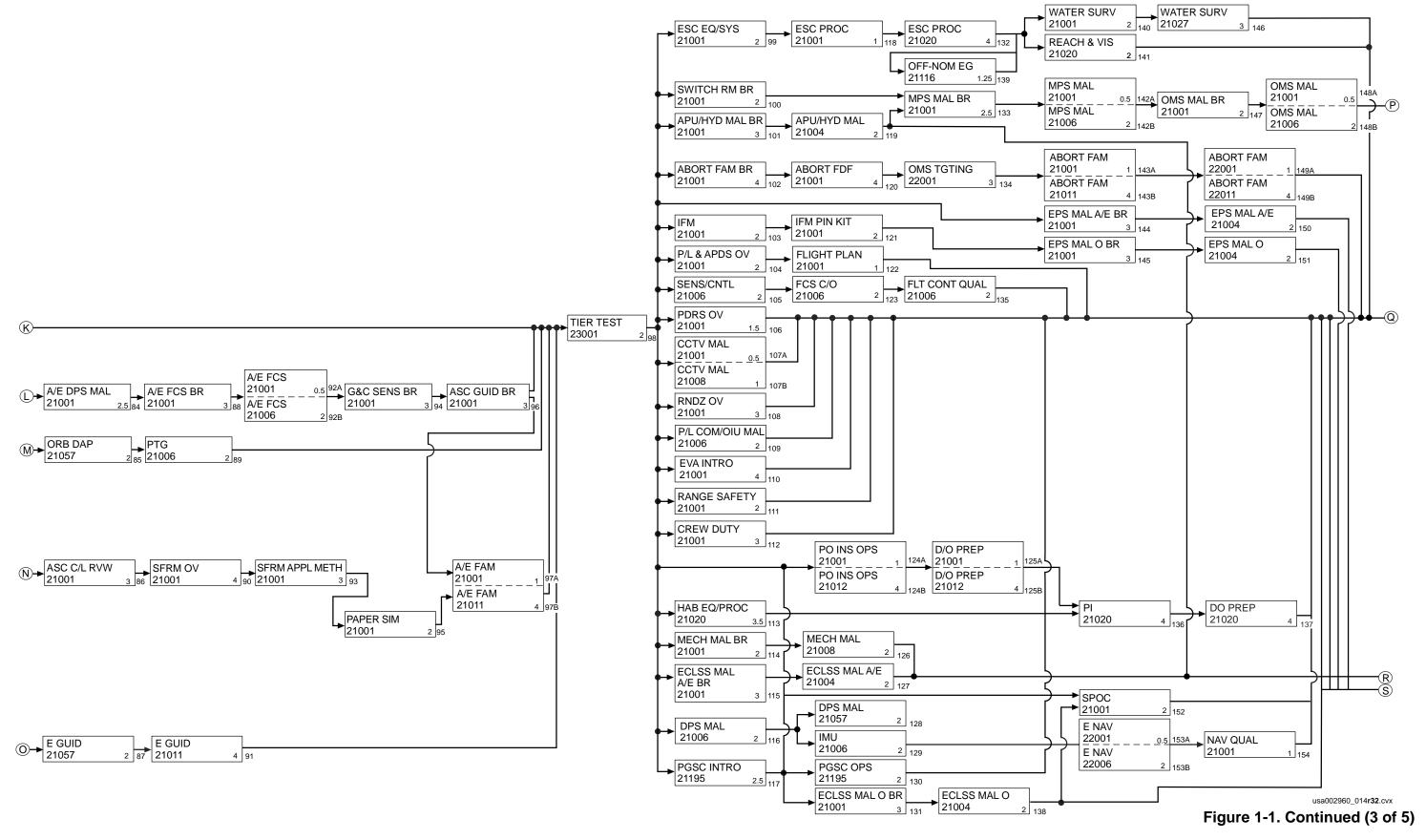


Figure 1–1. New Astronaut Lesson Flow Chart (1 of 5)



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Figure 1-1. Continued (2 of 5)



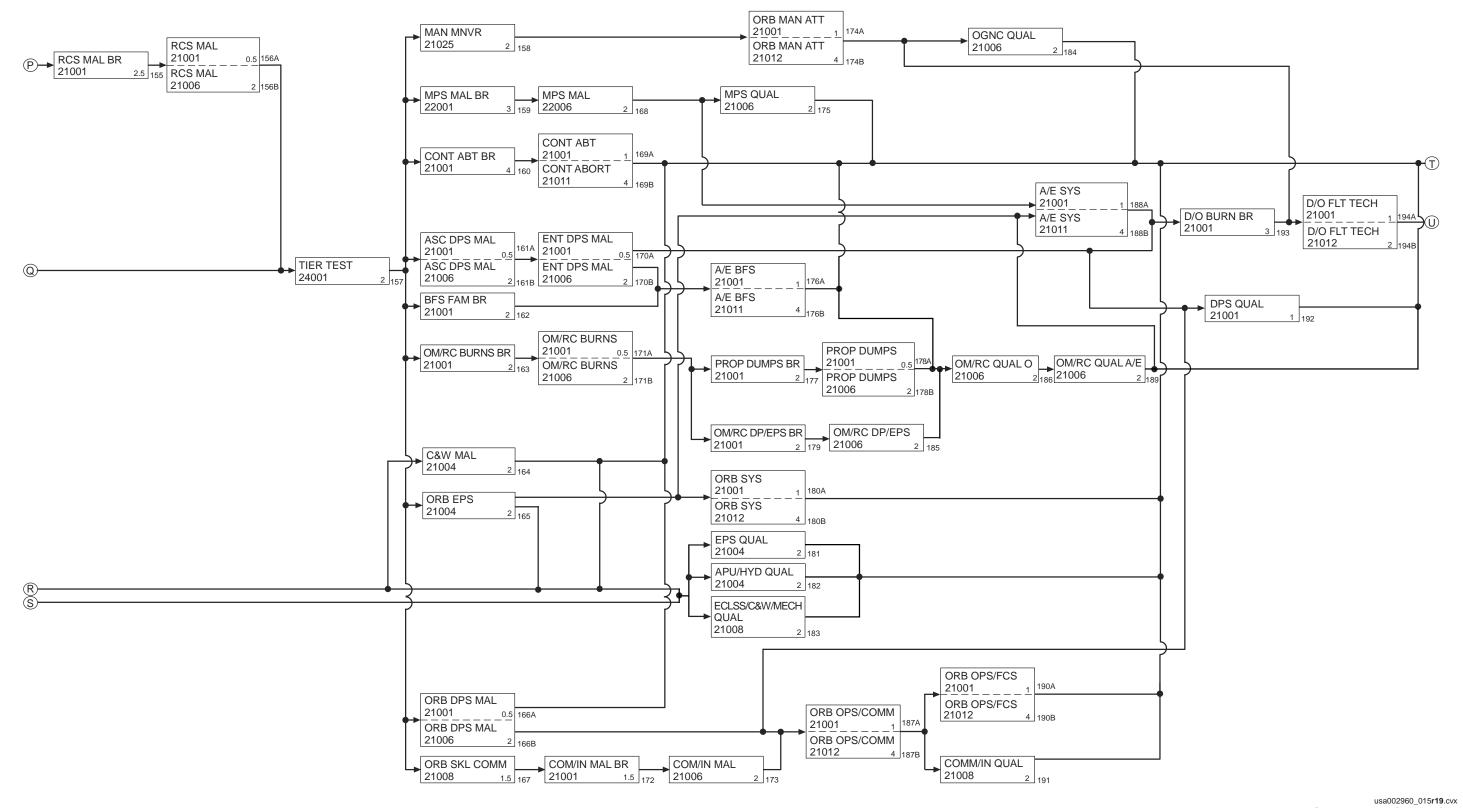
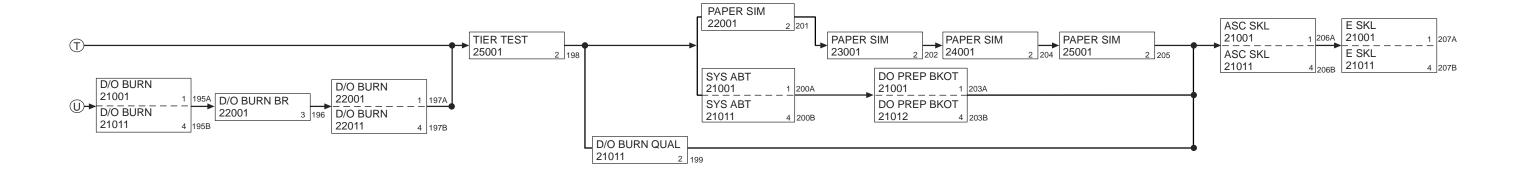


Figure 1-1. Continued (4 of 5)



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Figure 1-1. Concluded (5 of 5)

**Table 1-1. New Astronaut Crew Training Requirements** 

Date Last Modified: 04/06

REF	Lesson Code	Hrs.	Schd code		Crew	Alternate Facility	ate Last Modified: 04/0
1	ORB SYS TRNG 21001	2.0	50	Α			
2	ORB MECH OV 21001	3.0	50	Α			
3	SCOM OV 21001	0.5	50	Α			
4	SHUTTLE OV 21001	3.0	50	Α	PS		
5	CREW HAB 21001	1.0	50	Α	PS		
6	INTRO FDF 21001	3.5	20	Α	PS		
7	STS PROG OV 21001	2.0	50	Α			
8	ORB OPS OV 21001	2.0	20	Α			
9		1.0	5	Α	PS	CCT II or FFT	
10	ASC OV 21001	3.0	30	Α	PS		
11	ENT OV BR 21001	2.0	30	Α	PS		
12	TIER TEST 21001	2.0	50	Α			
13	A/E CL USE 21001	2.0	20	Α			
14	DPS HW 21057	1.0	1	Α	PS	CBT	
15	SSSH 21001	2.0	50	Α			
16	NAV OV BR 21001	1.5	20	Α			
17	OMS OV 21001	4.0	30	Α			
18	MB SAFETY BR 21003	0.5	1	Α	PS		
19	APPR/LNDG BR 21001	4.0	30	Α			
20	DPS OV 21001	3.0	20	Α	PS		
21	OMS TGTING 21001	3.0	30	Α			
22	CSI 21057	1.5	1	Α	PS	CBT	
23	EPS OV 21001	4.0	50	Α			
24	APU/HYD OV 21001	4.0	50	Α			
25	COMM OV 21001	4.0	50	Α	PS		
26	ORB FDF USE 21001	3.0	20	Α			
27	DPS 21006	2.0	1	Α		SST 1, 2, or 3	
28	OMS OPS BR 21001	2.0	15	Α			
29	RCS OV 21001	2.0	30	Α			
30	C&W OV 21001	2.0	50	Α	PS		
31	COMM/IN OPS BR 21001	2.0	50	Α	PS		
32	AUDIO BR 21001	1.5	1-4	Α	PS	CCT or FFT	
33A	AUDIO 21001	0.5	2				Prebrief for non-ASCAN student
33B	AUDIO 21020	1.5	1-4	Α	PS	CCT or FFT	CCT required for ASCANs, preferred for CB
33C	AUDIO 21006	1.0	2				SST for non-ASCAN student
34A	OMS OPS 21001	0.5	2				Prebrief for non-ASCAN student
34B	OMS OPS 21006	2.0	2	Α		SST 1, 2, or 3	
35	RCS OPS BR 21001	2.0	15	Α			
36	ENG REF OV 21001	1.0	20	Α			
37	FLIGHT RULES 21001	2.0	50	Α			
38		1.0	4	Α		CCT II or FFT	Schedule in Building 9 suit room and a trainer
39	C&W OPS 21004	1.5	2	Α	PS	SST 1, 2, or 3	

**Table 1-1. New Astronaut Crew Training Requirements (Continued)** 

Date Last Modified: 04/06

REF	Lesson Code	Hrs.	Schd code	Crew			Alternate Facility	Comments
40A	COMM/IN OPS 21001	0.5	2					Prebrief for non-ASCAN student
40B	COMM/IN OPS 21006	2.0	2	Α	PS		SST 1, 2, or 3	
41A	RCS OPS 21001	0.5	2					Prebrief for non-ASCAN student
41B	RCS OPS 21006	2.0	2	Α			SST 1, 2, or 3	
42A	DPS FAM 21001	0.5	2	Α	PS			
42B	DPS FAM 21006	2.0	2	Α	PS		SST 1, 2, or 3	
43	MPS OV 21001	3.5	30	Α				
44	ECLSS 21057	4.0	1	Α				ECLSS FAM CBT
45	MECH OV 21001	3.0	50	Α				
46	EPS OPS BR 21001	2.0	50	Α				
47	APU/HYD OPS BR 21001	2.0	50	Α				
48A	DPS FAM 22001	0.5	2	Α				
48B	DPS FAM 22006	2.0	2	Α			SST 1, 2, or 3	
49A	APPR/LNDG 21001	1.0	4	Α				Schedule in PILOT simulator room
49B	APPR/LNDG 21011	4.0	4	Α				
50	MPS OPS BR 21001	2.5	15	Α				
51	SRB OV 21001	3.0	50	Α				
52	ECLSS OPS BR 21001	2.0	50	Α				
53A	MECH OPS 21001	0.5	2					Prebrief for non-ASCAN student
53B	MECH OPS 21008	1.5	2	Α			SST 3 only	
54A	EPS OPS 21001	0.5	2					Prebrief for non-ASCAN student
54B	EPS OPS 21004	1.5	2	Α			SST 1, 2, or 3	
55A	APU/HYD OPS 21001	0.5	2					Prebrief for non-ASCAN student
55B	APU/HYD OPS 21004	2.0	2	Α			SST 1, 2, or 3	
56A	MPS OPS 21001	0.5	2					Prebrief for non-ASCAN student
56B	MPS OPS 21006	1.5	2	Α			SST 1, 2, or 3	
57A	ECLSS OPS 21001	0.5	2					Prebrief for non-ASCAN student
57B	ECLSS OPS 21004	1.5	2	Α			SST 1, 2, or 3	
58	ECLSS OPS BR 22001	2.0	50	Α				
59	ECLSS OPS 22004	1.5	2	Α			SST 1, 2, or 3	
60	TIER TEST 22001	2.0	50	Α				
61	GALLEY 21020	1.0	4	Α	PS		CCT II or FFT only	
62	WCS PROC 21065	1.0	3	Α			WCS	

**Table 1-1. New Astronaut Crew Training Requirements (Continued)** 

REF	Lesson Code	Hrs.	Schd code		Crew	Alternate Facility	Oate Last Modified: 04/0
63A		1.0	2	Α	T T	- i demity	Schedule prior to SST
63B	CCTV OPS 21001	0.5	2				Prebrief for non-ASCAN student
63C	CCTV OPS 21008	1.0	2	Α			
64	P/L COM/OIU OPS BR 21001	1.5	50	Α			
65	DPS FAM 23006	2.0	2	Α		SST 1, 2, or 3	
66	UNIV PTG 21001	2.0	20	Α			
67	MAL FDF USE 21001	3.0	20	Α			
68	E NAV BR 21001	3.0	20	Α			
69	ENT AERO BR 21001	2.5	30	Α			
70	KU OPS BR 21001	2.0	50	Α			
71A	P/L COM/OIU OPS 21001	0.5	2				Prebrief for non-ASCAN student
71B	P/L COM/OIU OPS 21006	2.0	2	Α		SST 1, 2, or 3	
72	TAEM GUID BR 21001	3.0	30	Α			
73A	KU OPS 21001	0.5	2				Prebrief for non-ASCAN student
73B	KU OPS 21006	1.5	2	Α		SST 1, 2, or 3	
74	REF DATA USE 21001	3.0	50	Α			
75A	E NAV 21001	0.5	2	Α			
75B	E NAV 21006	2.0	2	Α		SST 1, 2, or 3	
76	E DAP BR 21001	2.0	30	Α			
77A	TAEM GUID 21001	1.0	4	Α			
77B	TAEM GUID 21011	4.0	4	Α			
78	IMU BR 21001	2.5	20	Α			
79	E DAP SKL BR 21001	2.0	15	Α			
80A	E DAP 21001	1.0	4	Α		DST 6	
80B	E DAP 21011	2.0	2	Α		DST 6	
81	E GUID BR 21001	3.0	20	Α			
82	IMU FAM 21006	2.0	1	Α		SST 1, 2, or 3	
83	ENT C/L RVW 21001	3.0	30	Α			
84	A/E DPS MAL 21001	2.5	20	Α			
85	ORB DAP 21057	2.0	1	Α		CBT	
86	ASC C/L RVW 21001	3.0	30	Α			
87	E GUID 21057	2.0	4	Α		CBT	
88	A/E FCS BR 21001	3.0	30	Α			
89	PTG 21006	2.0	2	Α		SST 1, 2, or 3	
90	SFRM OV 21001	4.0	20	Α			
91	E GUID 21011	4.0	2	Α			
92A	A/E FCS 21001	0.5	2	Α			
92B	A/E FCS 21006	2.0	2	Α		SST 1, 2, or 3	
93	SFRM APPL METH 21001	3.0	20	Α			
94	G&C SENS BR 21001	3.0	30	Α			

**Table 1-1. New Astronaut Crew Training Requirements (Continued)** 

							ate Last Modified: 02/07
REF	Lesson Code	Hrs.	Schd code		Crew	Alternate Facility	Comments
95	PAPER SIM 21001	2.0	4	Α			
96	ASC GUID BR 21001	3.0	20	Α			
97A	A/E FAM 21001	1.0	4	Α	PS		
97B		4.0	4	Α	PS		
98		2.0	50	Α			
99	ESC EQ/SYS 21001	2.0	10	Α		CCT, CCT	Schedule in the Building 9 suit room
100	SWITCH RM BR 21001	2.0	30	Α		, -	
	APU/HYD MAL BR 21001	3.0	50	Α			
	ABORT FAM BR 21001	4.0	30	Α			
	IFM 21001	2.0	20	A	PS		
103		2.0	50	A	13		
		_				CCT 4 0	
105	SENS/CNTL 21006	2.0	2	Α		SST 1, 2, or 3	
106	PDRS OV 21001	1.5	50	Α			
107A	CCTV MAL 21001	0.5	2	Α			
107B	CCTV MAL 21008	1.0	2	Α		SST 3	
108	RNDZ OV 21001	3.0	50	Α			
109	P/L COM/OIU MAL 21006	2.0	2	Α		SST 1, 2, or 3	
110	EVA INTRO 21001	4.0	50	Α			
111	RANGE SAFETY 21001	2.0	50	Α			
	CREW DUTY 21001	3.0	50	Α			
	HAB EQ/PROC 21020	3.5	4	Α		CCT II and FFT	
114	MECH MAL BR 21001	2.0	50	Α			
	ECLSS MAL A/E BR 21001	3.0	50	Α			
	DPS MAL 21006	2.0	2	A		SST 1, 2,	
	2. 32 2. 333		_			or 3	
117	PGSC INTRO 21195	2.5	2	Α	PS	5N/PGSC Lab	
118	ESC PROC 21001	1.0	7	Α			Prefer 2 PLTs and 5 MSs
119	APU/HYD MAL 21004	2.0	2	Α		SST 1, 2, or 3	
120	ABORT FDF 21001	4.0	30	Α			
	IFM PIN KIT 21001	2.0	4	Α			
	FLIGHT PLAN 21001	1.0	50	Α			
	FCS C/O 21006	2.0	2	Α		SST 1, 2, or 3	
124A	PO INS OPS 21001	1.0	4	Α		5. 5	
	PO INS OPS 21012	4.0	4	A			
	D/O PREP 21001	1.0	4	A			
	D/O PREP 21012	4.0	4	A			
	MECH MAL 21008	2.0	2	A		SST 3 only	
127	ECLSS MAL A/E 21004	2.0	2	A		SST 1, 2, or 3	
128	DPS MAL 21057	2.0	1	Α		CBT	
129	IMU 21006	2.0	2	A		SST 1, 2,	
130	PGSC OPS 21195	2.0	2	Α		or 3 5N/PGSC Lab	

**Table 1-1. New Astronaut Crew Training Requirements (Continued)** 

REF	Lesson Code	Hrs.	Schd code		Crew	Alternate Facility	Comments
131	ECLSS MAL O BR 21001	3.0	50	Α			
132	ESC PROC 21020	4.0	7	Α		CCT II and FFT	Prefer 2 PLTs and 5 MSs. Requires 2 mockups
133	MPS MAL BR 21001	2.5	15	Α			
134	OMS TGTING 22001	3.0	20	Α			
135	FLT CONT QUAL 21006	2.0	1	Α		SST 1, 2, or 3	
136	PI 21020	4.0	3	Α		CCT II and FFT	Schedule afternoon prior to DO PREP 21020
137	DO PREP 21020	4.0	3	Α		CCT II and FFT	Schedule morning after PI 21020
138	ECLSS MAL O 21004	2.0	2	Α		SST 1, 2, or 3	
139	OFF-NOM EG 21116	1.25	7	Α			CCT II in nose-down attitude
140	WATER SURV 21001	2.0	5	Α			
141	REACH & VIS 21020	2.0	4	Α	PS	CCT II	Prefer 2 PLTs and 2 MSs
142A	MPS MAL 21001	0.5	2				Prebrief for non-ASCAN student
142B	MPS MAL 21006	2.0	2	Α		SST 1, 2, or 3	
143A	ABORT FAM 21001	1.0	4	Α	PS		
143B	ABORT FAM 21011	4.0	4	Α	PS		
144	EPS MAL A/E BR 21001	3.0	50	Α			
145	EPS MAL O BR 21001	3.0	50	Α			
146	WATER SURV 21027	3.0	5	Α		NBL	
147	OMS MAL BR 21001	2.0	15	Α			
148A	OMS MAL 21001	0.5	2				Prebrief for non-ASCAN student
148B	OMS MAL 21006	2.0	2	Α		SST 1, 2, or 3	
149A	ABORT FAM 22001	1.0	4	Α			
	ABORT FAM 22011	4.0	4	Α			
	EPS MAL A/E 21004	2.0	2	Α		SST 1, 2, or 3	
151	EPS MAL O 21004	2.0	2	Α		SST 1, 2, or 3	
152	SPOC 21001	2.0	4	Α	PS		
	E NAV 22001	0.5	2	Α			
153B	E NAV 22006	2.0	2	Α		SST 1, 2, or 3	
154	NAV QUAL 21001	1.0	1	Α			
155	RCS MAL BR 21001	2.5	15	Α			
156A	RCS MAL 21001	0.5	0.5				Prebrief for non-ASCAN student
156B	RCS MAL 21006	2.0	2	Α		SST 1, 2, or 3	
157	TIER TEST 24001	2.0	50	Α			
158	MAN MNVR 21025	2.0	1	Α		DST	
159	MPS MAL BR 22001	3.0	15	Α			
160	CONT ABT BR 21001	4.0	30	Α			
161A	ASC DPS MAL 21001	0.5	2	Α			
161B	ASC DPS MAL 21006	2.0	2	Α		SST 1, 2, or 3	

**Table 1-1. New Astronaut Crew Training Requirements (Continued)** 

	Date Last Modified: 02/07						
REF	Lesson Code	Hrs.	Schd code		Crew	Alternate Facility	Comments
162	BFS FAM BR 21001	2.0	20	Α			
163	OM/RC BURNS BR 21001	2.0	15	Α			
164	C&W MAL 21004	2.0	2	Α		SST 1, 2, or 3	
165	ORB EPS 21004	2.0	2	Α		SST 1, 2, or 3	
166A	ORB DPS MAL 21001	0.5	2	Α			
166B	ORB DPS MAL 21006	2.0	2	Α		SST 1, 2, or 3	
167	ORB SKL COMM 21008	1.5	2	Α		SST 1, 2, or 3	Schedule 30 minutes for set up
168	MPS MAL 22006	2.0	2	Α		SST 1, 2, or 3	
169A	CONT ABT 21001	1.0	4	Α			
169B	CONT ABORT 21011	4.0	4	Α			
170A	ENT DPS MAL 21001	0.5	2	Α			
170B	ENT DPS MAL 21006	2.0	2	Α		SST 1, 2, or 3	
171A	OM/RC BURNS 21001	0.5	2				Prebrief for non-ASCAN student
171B	OM/RC BURNS 21006	2.0	2	Α		SST 1, 2, or 3	
172	COM/IN MAL BR 21001	1.5	50	Α			
173	COM/IN MAL 21006	2.0	2	Α		SST 1, 2, or 3	
174A	ORB MAN ATT 21001	1.0	2	Α			Pilots only
174B	ORB MAN ATT 21012	4.0	2	Α			Pilots only
175	MPS QUAL 21006	2.0	1	Α		SST 1, 2, or 3	
176A	A/E BFS 21001	1.0	4	Α			
176B	A/E BFS 21011	4.0	4	Α			
177	PROP DUMPS BR 21001	2.0	30	Α			
178A	PROP DUMPS 21001	0.5	2				Prebrief for non-ASCAN student
178B	PROP DUMPS 21006	2.0	2	Α			
179	OM/RC DP/EPS BR 21001	2.0	15	Α			
180A	ORB SYS 21001	1.0	3	Α			
180B	ORB SYS 21012	4.0	3	Α			
181	EPS QUAL 21004	2.0	1	Α		SST 1, 2, or 3	
182	APU/HYD QUAL 21004	2.0	1	Α		SST 1, 2, or 3	
183	ECLSS/C&W/MECH QUAL 21008	2.0	1	Α	$\perp$	SST 3 only	
184	OGNC QUAL 21006	2.0	1	Α		SST 1, 2, or 3	
185	OM/RC DP/EPS 21006	2.0	2	Α		SST 1, 2, or 3	
186	OM/RC QUAL O 21006	2.0	1	Α		SST 1, 2, or 3	
187A	ORB OPS/COMM 21001	1.0	3	Α			
187B	ORB OPS/COMM 21012	4.0	3	Α			

**Table 1-1. New Astronaut Crew Training Requirements (Concluded)** 

		Date Last Wodified. Uz					
REF	Lesson Code	Hrs.	Schd code		Crew	Alternate Facility	Comments
188A	A/E SYS 21001	1.0	3	Α			
188B	A/E SYS 21011	4.0	3	Α			
189	OM/RC QUAL A/E 21006	2.0	1	Α		SST 1, 2, or 3	
190A	ORB OPS/FCS 21001	1.0	3	Α			
190B	ORB OPS/FCS 21012	4.0	3	Α			
191	COMM/IN QUAL 21008	2.0	1	Α		SST 1, 2, or 3	
192	DPS QUAL 21001	1.0	1	Α			
193	D/O BURN BR 21001	3.0	20	Α			
194A	D/O FLT TECH 21001	1.0	2-3	Α			MS are optional
194B	D/O FLT TECH 21012	2.0	2-3	Α			PLTs only
195A	D/O BURN 21001	1.0	3	Α			1 ASCAN pilot required
195B	D/O BURN 21011	4.0	3	Α			1 ASCAN pilot required
196	D/O BURN BR 22001	3.0	15	Α			
197A	D/O BURN 22001	1.0	3	Α			1 ASCAN pilot required
197B	D/O BURN 22011	4.0	3	Α			1 ASCAN pilot required
198	TIER TEST 25001	2.0	50	Α			
199	D/O BURN QUAL 21011	2.0	4	Α			1 ASCAN pilot required
200A	SYS ABT 21001	1.0	3	Α			
200B	SYS ABT 21011	4.0	3	Α			
201	PAPER SIM 22001	2.0	4	Α			
202	PAPER SIM 23001	2.0	4	Α			
203A	DO PREP BKOT 21001	1.0	3	Α			
203B	DO PREP BKOT 21012	4.0	3	Α			
204	PAPER SIM 24001	2.0	4	Α			
205	PAPER SIM 25001	2.0	4	Α			
206A	ASC SKL 21001	1.0	3	Α			
206B	ASC SKL 21011	4.0	3	Α			
207A	E SKL 21001	1.0	3	Α			
207B	E SKL 21011	4.0	3	Α			

**Table 1-2. New Astronaut Training Requirements Summary** 

	CREW HOURS	FACILITY HOURS
	N	N
CLASSROOM (001)	284.0	*
SST (004, 006, 008)	109.5	1095.0***
SMS-Motion Base (011)	53.5	374.5**
SMS-Fixed Base (012)	30.0	210.0**
CCT (020)	23.25	*
NBL (027)	3.0	*
CBT (057)	12.5	250.0
WCS (065)	1.0	*
DST (025)	2.0	40.0
PGSC (195)	4.5	*

Based on an ASCAN class of 20.

The non-ASCAN prebriefs are not included in these numbers.

<sup>\*</sup>Facility Hours are not calculated for non-key facilities.
\*\*SMS Facility Hours based on the lesson being taught seven times to account for a class of 20.
\*\*\*SST Facility Hours based on the lesson being taught 10 times to account for a

class of 20.

# **SELF STUDY MATERIAL LISTING**

The attached listings will serve to document all self study materials such as training manuals, study guides, handbooks, and Computer Based Training (CBT) lessons. This material will be used during 20000-level training. Some self study material is required as part of lesson preparation or homework. Other material is supplemental to your training and should be considered additional or reference material.

The list (Table 1-3) is organized by the self study material code. For each self study material, the source, lesson(s) association, and an estimated number of hours required to complete the entire lesson are also displayed. Keep in mind some lessons only require a portion of the self study material to be completed. Read the lesson description for more information.

The list (Table 1-4) displays what supplemental self-study material is available for various lessons. Not all lessons have supplemental material. Table 1-4 is organized by Lesson Association.

**Table 1-3. New Astronaut Self Study Materials List** 

Title	Code	Lesson Association	Source	Hours
Flight Procedure Handbook: A/O/E Pocket C/Ls, AESP, and Cue Cards	JSC-16873	A/E DPS MAL 21001 PROP DUMPS BR 21001	DO	4
Flight Procedure Handbook: Orbit Operations Checklist	USA005499	PROP DUMPS BR 21001	DO	2
Flight Procedures Handbook: Approach, Landing, and Rollout	JSC-23266	APPR/LNDG BR 21001	DO	2
Flight Procedures Handbook: Ascent/Abort	JSC-10559	BFS FAM BR 21001	DO	4
Flight Procedures Handbook: Entry	JSC-11542	E DAP SKL BR 21001	DO	3
Space Flight Resource Management Reference Manual	N/A	SFRM OV 21001	DS66	2
Air Data System Workbook	ADS 21002	E NAV BR 21001 E NAV 21001	DS24	3
APU Operations CBT	APU/HYD OPS 21057	APU/HYD OPS BR 21001	DS45	2
APU/Hydraulic/Water Spray Boiler Systems Training Manual	APU/HYD/WSB 21002	APU/HYD OPS BR 21001 APU/HYD OPS 21004	DS45	4
Ascent Guidance and Flight Control Workbook	ASC G&C 21002	ASC GUID BR 21001 BFS FAM BR 21001	DS66	6
Audio/UHF Training Manual	AUD/UHF 21002	AUDIO BR 21001	DS25	2
Caution and Warning Workbook	C&W 21002	C&W OPS 21004	DS45	2
CCTV Operations Study Guide	CCTV OPS 21108	CCTV OPS 21001	DS25	2
Communications Overview (COMM Overview) CBT	COMM OV 21057	COMM/IN OPS BR 21001	DS25	2
Communications Spec/Display (COMM SPEC) CBT	COMM SPEC 21057	COMM/IN OPS 21006 KU OPS 21006 ORB SKL COMM 21008	DS25	2
Controllers Workbook	CONT 21002	BFS FAM BR 21001	DS66	4
Contingency Aborts	CONT ABT 21007	CONT ABT BR 21001	DS66	4
Crew Escape System Workbook	CREW ESCAPE SYSTEMS 21002	ESC EQ/SYS 21001 ESC PROC 21001 REACH & VIS 21020 WATER SURV 21001 WATER SURV 21027	DX45	2
Crew Software Interface Workbook	CSI 21002	CSI 21057	DS24	2
Crew Software Interface (CSI) CBT	CSI 21057	DPS 21006	DS24	1.5
DPS Familiarization Workbook	DPS FAM 21002	DPS FAM 21001 DPS FAM 22001 DPS FAM 23006	DS24	3
Data Processing System (Hardware & System Software) Workbook	DPS HW/SW 21002	BFS FAM BR 21001	DS24	10
DPS Overview Workbook	DPS OV 21002	DPS 21006	DS24	4
Environmental Control and Life Support System Workbook	ECLSS 21002	ECLSS OPS BR 21001 ECLSS OPS BR 22001 ECLSS OPS 21004 ECLSS OPS 22004	DS45	5
Electrical Power System Training Manual	EPS 21002	EPS OPS BR 21001 EPS OPS 21004	DS45	4

Table 1-3. New Astronaut Self Study Materials List (Continued)

Title	Code	Lesson Association	Source	Hours
Electrical Power System (EPS) CBT	EPS OPS 21057	EPS OPS BR 21001	DS45	2
FCS/Effectors Workbook	FCS/EFF 21002	A/E FCS BR 21001 FCS C/O 21006	DS66	3
Shuttle FDF CBT	FDF 21057	INTRO FDF 21001 A/E CL USE 21001 ORB FDF USE 21001 MAL FDF USE 21001 DPS FAM 23006	DO	2
Food System and Dining Workbook	FOOD SYS 21002	GALLEY 21020	DX45	2
Guidance and Control Insertion/Orbit/Deorbit Workbook	G&C I/O/D 21002	UNIV PTG 21001 OMS TGTING 22001 BFS FAM BR 21001	DS66	2
Guidance-Navigation-and-Control (GNC) Dedicated Displays – 2157 CBT	GNC DED DISP 21057	APPR/LNDG BR 21001 TAEM GUID BR 21001 E NAV 21001 A/E FAM 21001	DS66	2
Head Up Display (HUD) CBT	HUD 21057	APPR/LNDG BR 21001 APPR/LNDG 21001 TAEM GUID BR 21001	DS66	2
Inertial Measurement Unit Workbook	IMU 21002	IMU FAM 21006 BFS FAM BR 21001	DS24	2
Instrumentation CBT	INST 21057	COMM/IN OPS BR 21001	DS25	2
Intact Ascent Aborts Workbook	Intact Ascent Aborts 21002	ABORT FAM BR 21001	DS66	3
Ku-Band Operations Workbook	KU OPS 21002	KU OPS BR 21001 KU OPS 21006	DS25	4
Location Coding Workbook	LOC CODE 21002	CREW CAB FAM 21020	DX45	2
Mechanical Systems Workbook	MECH SYS 21002	MECH MAL BR 21001 MECH OPS 21008	DS45	3
MPS Introduction CBT	MPS INTRO 21057	MPS OV 21001	DS66	3
MPS Workbook 21002	MPS Workbook 21002	MPS OPS BR 21001 MPS MAL BR 21001 MPS MAL 21006 MPS MAL BR 22001 MPS MAL 22006 MPS QUAL 21006 MPS OV 21001 MPS OPS 21006	DS66	6
Navigation Overview Workbook	NAV 21002	E NAV BR 21001 E NAV 21001 E NAV 22001 BFS FAM BR 21001	DS24	4
Navigation Aids Workbook	NAVAIDS 21002	E NAV BR 21001 E NAV 21001	DS24	4
Orbital Maneuvering System Workbook	OMS 21002	OMS OPS BR 21001 OMS MAL BR 21001 OMS MAL 21006 OM/RC BURNS BR 21001 BFS FAM BR 21001 OM/RC DP/EPS BR 21001	DS66	4
Digital Autopilot Universal Pointing (ORB DAP) CBT	ORB DAP 21057	RNDZ OV 21001 MAN MNVR 21025	DS66	2
Orbital Mechanics CBT	ORB MECH 21057	RNDZ OV 21001	DM34	2
Payloads Communication CBT	P/L COM 21057	P/L COM/OIU OPS BR 21001	DS25	2

Table 1-3. New Astronaut Self Study Materials List (Concluded)

Title	Code	Lesson Association	Source	Hours
Payload Communications Workbook	PL COM 21002	P/L COM/OIU OPS BR 21001 P/L COM/OIU OPS 21006 P/L COM/OIU MAL 21006	DS25	3
Payload Bay Doors CBT	PLBD 21057	MECH OV 21001 MECH MAL BR 21001 MECH MAL 21008	DS45	2
Reaction Control System Workbook	RCS 21002	RCS MAL 21006 BFS FAM BR 21001 OM/RC DP/EPS BR 21001	DS66	4
RCS Redundancy Management CBT	RCS RM 21057	RCS OPS BR 21001	DS66	2
Rendezvous Concepts	RNDZ Concepts 21057	RNDZ OV 21001	DM34	2
Star Tracker/Heads-Up Display/Crew Optical Alignment Sight Workbook	S TRK/HUD/COAS 21002	IMU FAM 21006	DS24	2
S-Band Comm/Inst Workbook	S-BND COM/IN 21002	COMM/IN OPS BR 21001 COM/IN MAL BR 21001 COM/IN MAL 21006	DS25	4
Waste Collection System (WCS) CBT	WCS 21057	WCS PROC 21065	DX45	2

**Table 1-4. New Astronaut Supplemental Self Study Material** 

Lesson Association	Title	Code	Source	Hours
N/A	Systems Management Training Manual	SM TM 21002	DS45	3
ABORT FAM 21001	Intact Ascent Aborts Workbook	INTACT ASCENT ABORTS 21002	DS66	4
APPR/LNDG BR 21001	Guidance-Navigation-and-Control (GNC) Dedicated Displays – 2157 CBT	GNC DED DISP 21057	DS66	2
	Head Up Display (HUD) CBT	HUD 21057	DS66	2
CREW CAB FAM 21020	Lighting System Workbook	LIGHTING 21002	DX45	1
DPS FAM 21006	Data Processing System (Hardware & System Software) Workbook	DPS HW/SW 21002	DS24	10
E DAP SKL BR 21001	Entry Digital Autopilot Workbook	ENT DAP 21002	DS66	2
E GUID BR 21001	Entry, TAEM and Approach/Landing Guidance Workbook 21002	Entry, TAEM and Approach/Landing Guidance Workbook 21002	DS66	3
ECLSS 21057	Basic Skills Foundation (shuttle material only)	JSC-36421	DI	2
ENAV 21006	GNC Part 1 – Navigation Overview CBT	GNC Part 1 – Navigation Overview CBT	DS24	2
ENAV BR 21001	Global Positioning System (GPS) CBT – single string	Global Positioning System (GPS) CBT – single string	DS24	1
FCS C/O 21006	Flight Control System Checkout CBT	FCS C/O 21057	DS66	2
G&C SENS BR 21001	Controllers Workbook	CONT 21002	DS66	4
	Guidance & Control Sensors Workbook	SENSORS 21002	DS66	2
MPS MAL BR 21001	Main Propulsion Thrust Vector Control Workbook	MPS TVC 21002	DS66	3
OMS OPS BR 21001	OMS Ops Part 1 CBT	OMS OPS 21057	DS66	2
	OMS Ops Part 2 CBT	OMS OPS 22057	DS66	2
OMS OPS 21006	OMS Controls – Displays - and Indicators CBT	OMS CNTLS DISPS IND 21057	DS66	1
OMS OV 21001	OMS Overview CBT	OMS OV 21057	DS66	1
ORB MECH OV 21001	Orbital Mechanics Concepts CBT	ORB MECH 21057	DM34	2
PTG 21006	Pointing CBT	PTG 21057	DO45	2
RCS OPS BR 21001	RCS Ops Part 1 CBT	RCS OPS 21057	DS66	2
	RCS Ops Part 2 CBT	RCS OPS 22057	DS66	2
RCS OV 21001	Reaction Control System (RCS) Introduction CBT	RCS INTRO 21057	DS66	1
SENS/CNTL 21006	Guidance & Control Sensors Workbook	SENSORS 21002	DS66	2
	Controllers Workbook	CONT 21002	DS66	4

# 1 **ORB SYS TRNG 21001**

Title: Welcome to Orbiter Systems ASCAN Training Briefing

Duration: 2.0 hours
Medium: Classroom
Student: ASCAN

Source: DS24/DPS/Navigation Training Group

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

Synopsis: This briefing is designed to be an introduction to the ASCAN Orbiter

Systems Training to be conducted and coordinated by the Mission

Operations Directorate (MOD) Space Flight Training Division. The briefing will review the flow of lessons, the timetable for these lessons, as well as the tools/simulators that the ASCANs will be using throughout their

training.

Objectives: • Describe how the ASCAN Orbiter Systems Training will be conducted.

- Identify whom to contact if questions/problems arise in the Orbiter Systems Training Flow.
- Describe the use of the Crew Training Catalog.
- Describe the "coding" system for lessons.
- Describe the different facilities that will be used for Orbiter Systems Training.
- Describe the ASCAN evaluation process.
- Describe how Orbiter Systems Training flows into flight-specific training.

# 2 ORB MECH OV 21001

Title: Orbital Mechanics Briefing

Duration: 3.0 hours
Medium: Classroom
Student: ASCAN

Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 02/04

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

#### 2 ORB MECH OV 21001 (Concluded)

# Synopsis:

This lesson introduces the student to the terminology of orbital mechanics and provides basic descriptions of the relationships between different orbit characteristics. The lesson describes the effects of orbital maneuvering and provides some basic rules of thumb in this regard. The lesson presents the basic concepts of some orbital transfer maneuvers, emphasizing the utility of each type. The lesson also presents some of the concerns and constraints of orbital mission design. These restrictions include the location of a particular launch site as well as solar beta angle geometry. The lesson presents the basic concepts of launch window. The lesson explains the basic characteristics of orbital ground track. The lesson describes the two most significant orbit perturbations.

- Objectives: Define the following:
  - Perigee
  - Apogee
  - Ascending/descending nodes
  - Line of apsides
  - Semimajor axis
  - **Eccentricity**
  - Inclination
  - Orbital period
  - Local vertical/local horizontal reference frame
  - Solar beta angle
  - State the relationship between orbital altitude and orbital velocity.
  - State the relationship between orbital velocity and apogee/perigee.
  - State the effect on orbital velocity, altitude, and orbit orientation caused by posigrade, retrograde, radial in, and radial out orbital burns
  - State the premise, restrictions, advantages, and required maneuvers of the following orbital transfers: Hohmann, plane change, and lamberttargeted.
  - State the relationship between launch site latitude and achievable orbital inclinations.
  - State the relationship between launch azimuth and payload-to-orbit performance.
  - State the relationship between launch azimuth and safety concerns.
  - Draw a rough sketch of a mission launch window.
  - State how orbital motion is perturbed by atmospheric drag and the Earth's oblateness.

# 3 **SCOM OV 21001**

Title: Shuttle Crew Operations Manual Overview Briefing

Duration: 0.5 hours
Medium: Classroom
Student: ASCAN

Source: DA72/Training Execution Branch and CB/Astronaut Office

Date: 03/95

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ORB SYS TRNG 21001

Preparation: None

Synopsis: This lesson provides an introduction to the Shuttle Crew Operations

Manual (SCOM). This briefing will review the general purpose of the SCOM, the type of information contained in the SCOM, how it is organized, who is responsible for its upkeep, and how this book will be

used throughout ASCAN training.

Objectives: • Describe the general purpose of the SCOM.

Describe the general types of information contained in the SCOM.

• State the book manager of the SCOM.

# 4 **SHUTTLE OV 21001**

Title: Shuttle Systems Overview

Duration: 3.0 hours
Medium: Classroom
Student: ASCAN, PS

Source: DA72/Training Execution Branch

Date: 03/95

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): SCOM OV 21001

Preparation: Read:

SCOM; Section 1.1, Overview

Synopsis: This lesson is designed to give the student a "big picture" introduction to

the orbiter and some general concepts that the student will need to be familiar with before proceeding into more in-depth study of the shuttle

systems. The lesson is divided into 3 parts:

• A review of the major shuttle systems – The overall purpose and location of each major shuttle system will be discussed.

# 4 SHUTTLE OV 21001 (Concluded)

- The concept of "fault-tolerance" and in particular as it pertains to the design of the orbiter.
- A review of some basic acronyms used in the Shuttle Program.

# Objectives:

- Identify the main shuttle systems and state what their functions are on the orbiter.
- Identify the acronyms for each of the major shuttle systems.
- Explain the concept of "fault-tolerance" and fail operational/fail safe, especially as it pertains to the orbiter design.
- Label the X, Y, Z body axes on the orbiter.
- Define pitch, yaw and roll used on the shuttle to define an attitude.
- Define the terms "attitude" and "state vector."
- Identify and define the following acronyms: Time of Ignition (TIG), CAPCOM, Line Replaceable Unit (LRU), Primary Avionics Software System (PASS), Backup Flight Software (BFS), MET, GMT, Center of Gravity (c.g.).

# 5 **CREW HAB 21001**

Title: Crew Habitability

Duration: 1.0 hour Medium: Classroom Student: ASCAN, PS

Source: DX45/Crew Systems Group and CB/Astronaut Office

Date: 08/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): SHUTTLE OV 21001

Preparation: None

#### Synopsis:

This lesson consists of a classroom briefing and slide presentation on Intravehicular stowage, describing the various locations throughout the orbiter that are used to stow loose equipment including payload hardware.

All major stowage areas will be addressed including the flight deck, middeck, airlock, galley, Waste Collection System (WCS), and subfloor. Additionally, provisions for Wet/Dry trash and temporary stowage will be discussed.

- Describe the general configuration of the crew station (flightdeck, middeck).
- Demonstrate the ability to locate and describe all the stowage areas associated with the crew module.

#### 6 **INTRO FDF 21001**

Title: Introduction to Flight Data File Briefing

3.5 hours Duration: Medium: Classroom Student: ASCAN, PS

DA72/Training Execution Branch Source:

Date:

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): SHUTTLE OV 21001

Preparation: Read:

SCOM; Section 1, Location Codes

Review:

• FDF 21057

Synopsis:

This lesson is designed to introduce the student to the shuttle FDF and the panel location coding scheme. The lesson will review the four types of FDF, what they are used for, and when they are used. In addition, the lesson will review the standard FDF format and the nomenclature and symbology that is used. Finally, the lesson will review the differences between the CDR, PLT, and MS copies of the FDF and the differences between these copies and the published copies within Mission Operations Directorate (MOD).

- Objectives: Identify what items are considered the complement of FDF.
  - List the four different types of FDF.
  - Identify where the following panels are located in the crewstation:
    - L1
    - 014
    - A1
    - ML86B
  - Interpret sample FDF directions that use the standard FDF format, nomenclature, and symbology.
  - Identify the general FDF configurations in the cockpit during ascent, orbit, and entry.
  - Explain why some pieces of FDF are different between the CDR, PLT, and MSs during ascent and entry.
  - Explain the differences between the FDF that is used for training and the bound copies that are actually flown.

# 7 STS PROG OV 21001

Title: Shuttle Program Overview

Duration: 2.0 hours
Medium: Classroom
Student: ASCAN

Source: MA2/Space Shuttle Program Integration

Date: 03/95

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): SHUTTLE OV 21001

Preparation: None

Synopsis: This lesson is designed to give the student an overview of how the Space

Shuttle Program is managed and integrated. It will expose the student to the different NASA centers where the various space shuttle components

are produced, managed, and/or integrated. The briefing will also introduce the student to the current issues facing the Space Shuttle

Program.

Objectives: • Identify the various Space Shuttle Program elements.

• Describe the strategic direction of the Space Shuttle Program.

• Describe the current issues facing the Space Shuttle Program.

### 8 **ORB OPS OV 21001**

Title: Orbit Operations Overview Briefing

Duration: 2.0 hours
Medium: Classroom
Student: ASCAN

Source: DA72/Training Execution Branch and CB/Astronaut Office

Date: 03/95

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ORB MECH OV 21001, SHUTTLE OV 21001

Preparation: None

Synopsis: The purpose of this lesson is to discuss some of the nominal operations

that occur during the orbit phase of flight. The discussion will include operations pertaining to Post-Insertion, Orbit Ops, Deorbit Prep, as well as

orbiter housekeeping and payload operations.

Objectives: • Identify the three parts of orbit flight operations.

• Define the purpose of the post-insertion phase of flight.

• Discuss nominal post-insertion activities.

# 8 ORB OPS OV 21001 (Concluded)

- Discuss the various types of payload operations.
- Discuss orbiter housekeeping activities.
- Discuss Earth observation activities.
- Discuss items that will affect mission duration.
- Define the purpose of the Deorbit Prep phase of flight.
- Discuss nominal Deorbit Prep activities.

# 9 **CREW CAB FAM 21020**

Title: Crew Cabin Familiarization (Shared – Shuttle)

Duration: 1.0 hour

Medium: CCT, CCT II, or FFT

Student: ASCAN, PS (Schedule in groups of 5.)

Source: DX45/Crew Systems Group

Date: 08/04

Lesson(s) Replaced: CREW CAB FAM 31019

Equipment Required: None

Prerequisite Lesson(s): CREW HAB 21001

Preparation: Read:

LOC CODE 21002

Synopsis: This lesson uses the Building 9A trainers to provide an orientation of the

orbiter crew compartment. Emphasis is placed on sleeping

accommodations, lockers, Waste Collection System (WCS), and galley.

Objectives: • Describe the layout of the crew module.

Identify and discuss major features of the middeck and flightdeck.

# 10 **ASC OV 21001**

Title: Ascent Overview Briefing

Duration: 3.0 hours
Medium: Classroom
Student: ASCAN, PS

Source: DS66/G&C/Propulsion Training Group

Date: 08/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): INTRO FDF 21001

Preparation: Read:

SCOM:

Section 6.6, Abort to Orbit

Section 6.5, Abort Once Around (stop at Post MECO

Transoceanic Abort Landing)

# 10 **ASC OV 21001 (Concluded)**

- Section 6.4, TAL (stop at Abort Dump)
- Section 6.3, Return-to-Launch Site (stop at Post-MECO Dumps)
- Section 6.7, Contingency Abort (stop at Powered Flight)
- Section 6.2, Ascent Aborts
- Section 2.7, Dedicated Display Systems (first paragraph only at Alpha Mach Indicator (AMI) and Altitude Vertical Velocity Indicator (AVVI))

### Synopsis:

This is an introductory lecture to familiarize astronauts with the types of ascent/abort trajectories the space shuttle is capable of flying. Major events and milestones of each trajectory are presented to promote the astronaut's ability to monitor the ascent flight phase from the cockpit. The Ascent Checklist (C/L) and cockpit displays are introduced at a very basic level to provide insight on where critical cockpit information is located. This lesson prepares an astronaut to observe trajectory management operations at the SMS.

#### Objectives:

- State the 2 reasons for performing ascent aborts.
- List, in order of preference, based on performance, the major types of ascent aborts.
- State the purpose of the throttle bucket.
- List the major ascent events.
- Describe the profile for each type of ascent abort.

# 11 **ENT OV BR 21001**

Title: Entry Overview Briefing

Duration: 2.0 hours
Medium: Classroom
Student: ASCAN, PS

Source: DS66/G&C/Propulsion Training Group

Date: 01/04

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: Read:

SCOM; Section 5.4, Entry

Synopsis: This class covers the basics of turning a spaceship into a glider. The

sequence of the major entry events will be presented. The class assumes

no prior knowledge of aerodynamics or shuttle entry.

# 11 **ENT OV BR 21001**

Objectives:

- Put the major entry events in correct order given a list.
- State the purpose of the deorbit burn.
- Match the navigation sensor to the altitude where the sensor is first used during entry.
- Name the three guidance algorithms used on entry.
- State the event that causes the transition to the next guidance algorithm.
- Match each of the guidance algorithms to its primary control parameter.

# 12 **TIER TEST 21001**

Title: Tier Test
Duration: 2.0 hours
Medium: Classroom
Student: ASCAN

Source: DS/Space Transportation Vehicle Division

Date: 03/95

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): Determined closer to test time

Preparation: Review all lessons up to this time

Synopsis:

The test will cover all orbiter systems lessons that have been complete up to this point. It is a graded, closed book test that will last for up to two hours. The questions will be: True/False, Multiple Choice, Short Answer Essay, Matching and Fill In the Blank. A review of the test will be scheduled for the entire class after all tests have been graded. If it is determined that a weakness exists in one subject area, proficiency training on this subject will be covered in the appropriate medium, briefing or facility. The best way to study for the test is to review the lesson objectives from the Crew Training Catalog and to review the handout material from the lessons.

- Emphasize, through questions, some of the most important concepts in the orbiter systems training so far.
- Identify any areas of weakness that may need to be reviewed with the student as an individual.
- Identify any areas of weakness that may need to be reviewed with the whole class.

# 13 **A/E CL USE 21001**

Title: Ascent/Entry Checklist Usage Briefing

Duration: 2.0 hours
Medium: Classroom
Student: ASCAN

Source: DA72/Training Execution Branch

Date: 02/04

Lesson(s) Replaced: None

Equipment Required: ASC C/L, ENT C/L Prerequisite Lesson(s): INTRO FDF 21001

Preparation: Review:

FDF 21057

Synopsis:

This lesson is designed to be an introduction to the Ascent Checklist (C/L) and the Entry C/L. It is not intended to be a "line-by-line" review of the procedures but to provide a general overview of what is contained in these C/Ls, when they are used, and how they are used. The different physical configurations and cockpit locations of the C/Ls used by the CDR, PLT, and MS will be discussed as will the format and contents of each C/L.

- Identify the timeframes when the Ascent C/L and the Entry C/L are used.
- Identify what the differences are between the CDR and PLT copies of the Ascent and Entry C/Ls and what is contained in the MS copies of these C/Ls.
- Identify the differences between the Ascent C/L and Entry C/L printed for use as "ground copies" and the copies that fly on the orbiter.
- Explain why there are two different times noted in the prelaunch section in the Ascent C/L.
- Explain how the crew should perform the post-landing procedures in the Entry C/L (i.e., CDR pages versus PLT pages and pages should not be turned until all CDR and PLT procedures are complete).
- Given a sample page of the Ascent and Entry C/Ls, identify which crewmember should perform the procedures, what the CRT configuration should be, and what the procedure is asking the crewmember to do.
- Describe the basic page format (layout) of each C/L (i.e., CRT configuration at top of page, CRT changes called out in boxes, etc.).

# 14 **DPS HW 21057**

Title: Data Processing System Hardware

Duration: 1.0 hour Medium: CBT

Student: ASCAN, PS

Source: DS24/DPS/Navigation Training Group

Date: 03/05

Lesson(s) Replaced: None Equipment Required: PC Prerequisite Lesson(s): None

Preparation: Read:

SCOM; Section 2.6, DPS

Read the initial description.

Skim the Data Processing System Interfacing Hardware diagram.

- Skim through the section's topic titles and diagrams, especially the following figures:
  - Data Bus Network figure
  - GPC/MDM Interfaces figure
  - MEDS Architecture

Synopsis: The DPS Hardware lesson covers all of the major hardware components, such as the following, and their relationship to one another:

- The General Purpose Computers (GPCs)
- The Data Bus Network (DBN)
- Bus Terminal Units and Multiplexers/Demultiplexers (BTUs and MDMs)
- Modular Memory Units (MMUs)
- Multifunction Electronic Display System (MEDS)
- Backup Flight Controller (BFC)
- Master Timing Unit (MTU)

- Identify and describe the functions of the DPS components and explain their relationship to each other.
- For each of the major components of DPS hardware (GPCs, DBN, BTUs, MDMs, MMUs, MEDS, BFC, MTU):
  - Describe its purpose.
  - Name the different subcomponents and/or types.
  - Explain its relationship to other parts of the DPS.
- Define the utilities of MEDS.

# 15 **SSSH 21001**

Title: Space Shuttle Systems Handbook Schematics Briefing

Duration: 2.0 hours
Medium: Classroom
Student: ASCAN

Source: DS45/Shuttle Systems Training Group

Date: 02/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): INTRO FDF 21001

Preparation: None

Synopsis: This class will familiarize the trainee with the Space Shuttle Systems

Handbook (SSSH). Initially, the trainee will be introduced to the Mission

Operations Directorate (MOD) Drafting Standards document as a reference to use in interpreting symbols and nomenclature found in the SSSH. The class will then be familiarized with the breakdown of the

SSSH by system/subsystem. Specific examples of symbology,

nomenclature, and drawing format common to the drawings found in the

SSSH will be presented and discussed.

Objectives:

- State the reference source for symbols and nomenclature for the SSSH.
- Locate a specified system or subsystem within the SSSH.
- Identify drawing notes.
- Interpret technical zone references.
- Identify layout of parallel and/or redundant components (shadowboxing).
- Identify the location of switches and other subsystem components.
- Identify and interpret electrical and mechanical symbols.
- Determine the source of electrical power for a specified subsystem.
- Identify circuit protection.
- Interpret telemetry symbols.
- Determine what data is displayed to the crew, and where it is displayed.

# 16 **NAV OV BR 21001**

Title: Navigation Overview Briefing

Duration: 1.5 hours
Medium: Classroom
Student: ASCAN

Source: DS24/DPS/Navigation Training Group

Date: 03/05

Lesson(s) Replaced: None Equipment Required: None

# 16 NAV OV BR 21001 (Concluded)

Prerequisite Lesson(s): ASC OV 21001, ENT OV BR 21001

Preparation: Skim:

SCOM; Section 2.13, GNC, Description and Navigation Hardware

### Synopsis:

This briefing is an overview briefing of the space shuttle's navigation systems. The M50 inertial coordinate system is defined at the beginning of the briefing. The Inertial Measurement Units (IMUs) are introduced and described. The state vector is introduced and it is shown how IMU data is used along with the gravity model to generate the state vector. Orbit navigation is then discussed. The reasons for IMU alignments and the applicable flight rules are explained. The location and the purpose of the Star Trackers, the Crew Optical Alignment System (COAS), and the Heads-Up Display (HUD) are then presented. Entry navigation is then discussed. The three state vector scheme and its purpose is introduced. The different entry navigation aids, when they are used, what data they provide and, in general, how they are used is discussed briefly. The last section of the briefing provides an overview of how Operational Sequence (OPS) is used on the shuttle.

It should be kept in mind that this is just an introductory briefing. It is intended to merely make the student aware of the sensors the orbiter has available and where and how they are used. This briefing is further broken down into individual sections and detailed in later briefings. It is in these detailed briefings that the student will learn how software uses the data, how faults are detected and how redundancy management works on subjects such as IMUs, Star Trackers, COAS, and all of the Entry Navigation sensors.

- Identify the purpose of navigation.
- Explain the purpose of the IMUs and how they work.
- Define what a state vector is and how it is calculated in ascent, entry, and orbit.
- Explain the purpose of the Star Trackers, the COAS, and the HUD for IMU alignment.
- Explain the purpose of Global Positioning System (GPS) as a navigation system.
- Explain the purpose of the 5 entry navigation sensors (Drag H, Tactical Air Navigation (TACAN), Air Data Transducer Assembly (ADTA), Microwave Landing System (MLS), Radar Altimeter (RA)) and when they are used.

# 17 **OMS OV 21001**

Title: Orbital Maneuvering System Overview Briefing

Duration: 4.0 hours
Medium: Classroom
Student: ASCAN

Source: DS66/G&C/Propulsion Training Group and EP4/Propulsion Systems

Branch

Date: 03/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ASC OV 21001, ORB OPS 21001, ENT OV BR 21001

Preparation: Read:

SCOM;

 Section 1.1, Nominal Mission Profile, Orbit Insertion and Circularization and Deorbit sections only

Section 1.2, OMS/RCS pods

Section 2.18, OMS (omit Fault Detection and Identification)

Synopsis:

This briefing covers the nominal uses of the OMS in all phases of flight, provides an overview of the system hardware along with an introduction to the displays and controls associated with the OMS. Also discussed are the basic mechanics of an OMS burn and the OMS/Reaction Control System (RCS) interface. A detailed discussion of displays and controls and FDF procedures will be covered in the OMS review.

Objectives:

- Explain the purpose of the OMS.
- Identify the subsystems of the OMS (OMS engines, nitrogen, etc.).
- Explain the purposes of the subsystems.
- Explain how the OMS is used during a nominal mission.
- Identify OMS cockpit interfaces (switches, meters, displays).
- Explain how vehicle flight control is achieved during an OMS burn.
- Identify OMS/RCS interfaces.
- State the basics of an OMS burn.

# 18 **MB SAFETY BR 21003**

Title: Motion Base Simulator Safety Training

Duration: 0.5 hours

Medium: Video (Viewed via the computer.)
Student: ASCAN, PS (Schedule individually.)
Source: DS66/G&C/Propulsion Training Group

Date: 01/04

Lesson(s) Replaced: None Equipment Required: None

# 18 MB SAFETY BR 21003 (Concluded)

Prerequisite Lesson(s): None

Preparation: None

Synopsis: This video provides the student with the required safety information

necessary prior to motion operation in the motion base simulator.

Objectives:

 State the action required by all occupants before motion is activated in the motion base simulator.

• State the action required if communication between the crew station and instructor/operator station is lost.

• Describe the location of the Motion Inhibit pushbutton (or "Chicken Switch") and state the conditions under which it should be used.

 Describe the notification procedure for violent motion excursions or other potentially unsafe conditions.

### 19 **APPR/LNDG BR 21001**

Title: Approach and Landing Briefing

Duration: 4.0 hours
Medium: Classroom
Student: ASCAN

Source: DS66/G&C/Propulsion Training Group and CB/Astronaut Office

Date: 01/04

Lesson(s) Replaced: APPR/LAND BR 21001

Equipment Required: None Prerequisite Lesson(s): None

**Note:** Pilots must complete this lesson prior to any Shuttle Training Aircraft

(STA) training. It may be taken out of sequence.

Preparation: Read (in this order):

Flight Procedures Handbook; Approach, Landing, and Rollout

Section 4, pages 4-1 through 4-6

Section 5, pages 5-1 through 5-13

Section 4.8, page 4-41

Section 4.13, page 4-50

Section 2.11, pages 2-13 through 2-28 (should be a review)

Section 2.12, pages 2-29 through 2-35

Section 3, pages 3-4 through 3-12

Section 5, pages 5-34 through 5-37

SCOM:

Section 5.4, Approach and Landing

Section 7.4, Heading Alignment Cone

#### Take:

- GNC DED DISP 21057 (optional)
- HUD 21057 (optional)

#### 19 APPR/LNDG BR 21001 (Concluded)

Synopsis:

This lesson is an introduction to shuttle landings (approach and land transition through rollout). The students will learn about the landing guidance, procedures, and protocol. A visual orientation to cockpit controls, flight instruments, and landing aids will be provided. The students will learn the techniques for landing the shuttle, meaning the flying characteristics and handling qualities. The briefing will include a "pilot's perspective" presented by a current astronaut.

- Objectives: Identify the procedures used for landing.
  - Describe the functions of the Space Shuttle Systems used for approach. landing, and rollout.
  - Explain the purpose of the sub-phases of approach and landing quidance.
  - Identify shuttle displays and external landing aids used for approach, landing, and rollout.
  - Explain pilot techniques for approach, landing, and rollout.

#### 20 **DPS OV 21001**

Title: Data Processing System Overview Briefing

Duration: 3.0 hours Medium: Classroom Student: ASCAN, PS

Source: DS24/DPS/Navigation Training Group

Date: 04/06

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ASC OV 21001, DPS HW 21057, ENT OV BR 21001

Preparation: Read:

SCOM; Section 2.6, DPS

Read the initial description.

Skim through the section's topic titles and diagrams, especially the Orbiter Flight Computer Software figure and the Major Modes figure.

Synopsis:

The DPS Overview Briefing covers the philosophy with which the orbiter computer system was created.

The briefing covers the basics of the orbiter's software structure and finally a review of some nominal operations particularly corresponding to phases of flight.

# 20 **DPS OV 21001 (Concluded)**

Much of the material in this briefing will be repeated in subsequent CBT and SST lessons (through the DPS FAMs). Also, more of the details and off-nominal situations are then discussed. In this initial briefing the student should get a feel for the "big picture" of the DPS and become familiar with the General Purpose Computer (GPC) software and the nominal GPC configurations.

#### Objectives:

- State the requirements for and purpose of the orbiter's DPS.
- Define the subdivisions of orbiter software (System Software, Application Software, Operational Sequence, and Major Mode).
- Define the specific GPC synchronization terms (Redundant Set, Common Set, Simplex).
- State the purpose of the Backup Flight Software (BFS).
- Define a string.
- Describe the nominal GPC configuration and DPS functions throughout each nominal flight phase.

# 21 **OMS TGTING 21001**

Title: Orbital Maneuvering System Targeting Briefing

Duration: 3.0 hours
Medium: Classroom
Student: ASCAN

Source: DS66/G&C/Propulsion Training Group

Date: 01/04

Lesson(s) Replaced: None Equipment Required: ASC C/L

Prerequisite Lesson(s): ASC OV 21001, OMS OV 21001, DPS OV 21001

Preparation: Review:

 SCOM; Section 1.1, Nominal Mission Profile, Launch, Orbit Insertion and Circularization, and Deorbit only

#### Synopsis:

This lesson instructs the student on the task of OMS Targeting for Insertion, Orbit and Deorbit burns. The lesson has 2 main parts. The first part covers definitions, explanations, and concepts used in OMS Targeting. The second part teaches the actual operations of OMS Targeting and focuses on the use of cockpit cues and available FDF.

- Define each item on the Maneuver Execute display and state its operational function.
- Explain how to use the Maneuver Execute Display to load targets for an orbit insertion, orbit transfer, and deorbit burn.

# 21 OMS TGTING 21001 (Concluded)

- Locate and define the function of the OMS-1/2 Targeting Card and the OMS Targets section in the Ascent Checklist.
- Perform OMS-1/2 targeting for a nominal OMS-2 direct insertion burn.

# 22 **CSI 21057**

Title: Crew Software Interface

Duration: 1.5 hours Medium: CBT

Student: ASCAN, PS

Source: DS24/DPS/Navigation Training Group

Date: 02/04

Lesson(s) Replaced: CSI 21005

Equipment Required: None

Prerequisite Lesson(s): DPS OV 21001

Preparation: Read:

CSI 21002; Part 1

### Synopsis:

This lesson provides an introduction to basic DPS operations. The lesson focuses primarily on the Primary Avionics Software System (PASS) operations, keyboard operations, and display specifications. PASS structure and General Purpose Computer (GPC) software configurations for flight phases are presented. Keyboard practice is accomplished with Operational Sequence (OPS) and major mode transitions, interaction with the onboard clocks, and DPS display reconfiguration.

- Describe the PASS software structure and GPC configuration for various flight phases.
- Define the term "unsupported major function."
- Identify the function of the Integrated Display Processor (IDP) power, select, and major function switches.
- Identify the function of each key on the keyboard.
- Perform OPS and major mode transitions.
- Identify the standard format of DPS displays.
- State the significance of special indicators (M, H, L, ↑, ↓, \*, ?) and page nomenclature.
- Perform item entries with implied item numbering and multiple entries strung together.
- Identify the source of 'ERR' and 'ILLEGAL ENTRY' messages.
- Explain Fault Summary format and demonstrate page clearing.
- Demonstrate SPEC and Display (DISP) retention.
- Perform onboard clock operations using SPEC 2.

# 23 **EPS OV 21001**

Title: Electrical Power System Overview Briefing

Duration: 4.0 hours
Medium: Classroom
Student: ASCAN

Source: DS45/Shuttle Systems Training Group

Date: 02/04

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: Read:

SCOM, Section 2.8, EPS

Synopsis: This lesson will cover the components and equipment that make up the

EPS. The briefing will be divided into three subsystems: Power

Reactants Storage and Distribution (PRSD), Fuel Cell Powerplants (FCP),

and Electrical Power Distribution and Control (EPDC).

Objectives: • Identify the functions of the Cryo, Fuel Cell, and EPDC subsystems during all flight phases.

- Identify the major components of each EPS subsystem.
- Describe how the EPS subsystems interface with one another and with other systems.
- Describe how a Remote Power Controller (RPC) operates.
- Identify the power sources of the Main, Essential, Control, and AC buses, and what types of equipment they power.
- Describe how the AC bus sensors function in the Off, Monitor, and Auto Trip switch positions.

# 24 **APU/HYD OV 21001**

Title: Auxiliary Power Unit/Hydraulic Overview Briefing

Duration: 4.0 hours
Medium: Classroom
Student: ASCAN

Source: DS45/ Shuttle Systems Training Group

Date: 02/04

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: Read:

SCOM; Section 2.1, APU/HYD

# 24 APU/HYD OV 21001 (Concluded)

Synopsis:

This lesson will cover the components, functions, and operations of the Auxiliary Power Unit (APU)/Hydraulic (Hyd) systems throughout a typical mission. It will also include time for viewing actual hardware and asking questions.

Objectives:

- Identify the functions of the APU and Hyd subsystems during all flight phases.
- Identify the major components of each APU/Hyd subsystem.
- Describe how the APU/Hyd subsystems interface with one another.
- Identify the APU/Hyd system interfaces with other orbiter systems.
- Identify the main functions of the APU controller.
- Identify which orbiter subsystems receive hydraulic pressure from the Hyd subsystem.

# 25 **COMM OV 21001**

Title: Communications Overview Briefing

Duration: 4.0 hours
Medium: Classroom
Student: ASCAN, PS

Source: DS25/Communications/NSS Training Group and CB/Astronaut Office

Date: 01/04

Lesson(s) Replaced: COMM OV BR 21001, INST BR 21001

Equipment Required: None

Prerequisite Lesson(s): DPS OV 21001

Preparation: Read: SCOM

Section 2.4, Communications

Section 2.3, CCTV

Synopsis:

The purpose of this lesson is to introduce the student to the space shuttle and network communications system. Each communication system will be covered, along with a brief statement of its function, purpose, and relationship to other communication subsystems. The voice, command, and telemetry flow between mission control and the shuttle will be described, along with the space communication network that supports this information transfer. Finally, the communications and network system as it relates to the phases of flight will be discussed.

- State the functions of each of the following communication systems:
  - Voice
  - Data
  - Commanding
  - Closed Circuit TV

# 25 COMM OV 21001 (Concluded)

- Discuss the functions of:
  - Crew Communications Umbilical (CCU)
  - Audio Terminal Unit (ATU)
  - Audio Central Control Unit (ACCU)
- Discuss functions of the Network Signal Processor (NSP).
- Identify the five orbiter Radio Frequency (RF) communications systems and their uses.
- Discuss the capabilities and limitations of the Satellite and Ground Networks.
- State the function of the instrumentation system.
- Discuss the function of the Pulse Code Modulation Master Unit (PCMMU).
- Discuss the function of the Communications Security (COMSEC) system.
- Discuss the function of the Ground Command/Control Interface Logic (GCIL) system.
- Identify the three types of information that are transferred between the orbiter and the MCC.
- Discuss how each of the five communication systems is used during each phase of flight.

# 26 **ORB FDF USE 21001**

Title: Orbit Flight Data File Usage Briefing

Duration: 3.0 hours
Medium: Classroom
Student: ASCAN

Source: DA72/Training Execution Branch

Date: 02/04

Lesson(s) Replaced: None

Equipment Required: PI C/L, D/O PREP C/L, FLT PLN, ORB OPS C/L, REF

DATA, DPS Dictionary

Prerequisite Lesson(s): A/E C/L USE 21001

Preparation: Review:

FDF 21057

Synopsis: This lesson is designed to provide an introduction to the Post-Insertion

Checklist (C/L), De-Orbit (D/O) Prep C/L, and Flight Plan, ORB OPS C/L,

DPS Dictionary, and Ref Data.

The lesson will also review when the C/Ls are used, how they are formatted, and the information contained in each. In addition, a short review of the Systems Data Book and Maps Book will be performed.

# 26 ORB FDF USE 21001 (Concluded)

Objectives:

- Explain when the Post-Insertion C/L, D/O Prep, and Flight Plan are used.
- Explain when the transitions occur between the three C/Ls.
- Explain how the time is referenced for the three C/Ls (i.e., MET, TIG XX).
- Given a specific time (MET), use the Flight Plan to identify:
  - Flight day number
  - Orbit number
  - CDR and MS2 activities
  - Day or night cycle
  - Tracking and Data Relay Satellite (TDRS) coverage
  - Easy activities block (EZ ACTIVITIES)
  - Orbiter attitude
  - Earth trace
- Explain when the Deorbit Prep Backout procedures are used.
- Explain how the Switch List section of the Post-Insertion and Deorbit Prep should be used (Post-Insertion: look at only boxed switches, D/O Prep: look at ALL switches).
- Explain when the Orbit Ops C/L, Ref Data, and the DPS Dictionary might be used, and the type of information contained in each (i.e., procedures, reference material for bus losses, CRT displays, etc.).

# 27 **DPS 21006**

Title: Data Processing System

Duration: 2.0 hours

Medium: SST 1 or SST 2 or SST 3

Student: ASCAN (Schedule individually.)

Source: DS24/DPS/Navigation Training Group

Date: 04/06

Lesson(s) Replaced: DPS 21005, DPS OPS 22006, DPS OPS 21006

Equipment Required: None Prerequisite Lesson(s): CSI 21057

**Note:** This lesson should be scheduled no later than 2 weeks after

completing CSI 21057.

Preparation: Read:

DPS OV 21002; Sections 1-5

Review:

CSI 21057

# 27 <u>DPS 21006 (Continued)</u>

Synopsis:

This lesson provides a review of the DPS software and an introduction to DPS hardware, controls, displays, and concepts. It familiarizes the student with General Purpose Computer (GPC) upper and lower memory, Memory Configurations (MCs), and GPC synchronization. The student is introduced to the function and operation of the GPC switches and talkbacks and performs an Initial Program Load (IPL) of a GPC. The student is also introduced to Multifunction Electronic Display System (MEDS) Hardware including the use of the Multifunction Display Unit (MDU) Edge Keys. The student is introduced to the concept of strings and performs restrings using the Nominal Bus Assignment Table (NBAT). The student performs Operational Sequence (OPS) transitions and a GPC Freeze Dry. The lesson familiarizes the student with the use of the DPS displays: GPC MEMORY, DPS UTILITY, TIME, and GPC/BUS STATUS. The lesson concludes with a demonstration of troubleshooting a basic DPS malfunction and recovery via port moding.

- Define the following terms:
  - Memory configurations
  - GPC upper and lower memory
  - Common set
  - Redundant set
  - Line Replacement Unit (LRU)
  - Bus Terminal Unit (BTU)
  - Multiplexer/Demultiplexer (MDM)
  - Flight-critical data bus
  - Strings
  - GPC commander
  - GPC listener
- Identify the locations and functions of the GPC controls (power, mode, output, IPL Source Select, IPL pushbutton) on Panel O6, and describe their operation and talkback indications.
- State the purpose of an IPL.
- Describe the actions to perform a default option IPL.
- State the purpose of the NBAT.
- Describe the actions necessary to perform Guidance, Navigation, and Control (GNC) and Systems Management (SM) OPS transitions.
- Define the term "GPC Freeze Dry," and describe the actions to perform one.
- Describe how the GPCs keep time using the Master Timing Unit (MTU).
- Explain the purpose of a restring, and the necessary actions to perform one.

# 27 <u>DPS 21006 (Concluded)</u>

- State the purpose of the GPC/BUS STATUS display; state the meaning of the status indicators (\*, blank, ↓, \*↓) on the display.
- State the purpose of port modes and describe the necessary actions to perform one.
- Observe the signature of an MDM port failure and recover it via a port mode.

# 28 **OMS OPS BR 21001**

Title: Orbital Maneuvering System Operations Review

Duration: 2.0 hours Medium: Classroom

Student: ASCAN (Schedule in groups of up to 15.) Source: DS66/G&C/Propulsion Training Group

Date: 10/05

Lesson(s) Replaced: None

Equipment Required: ASC C/L, ORB OPS C/L, ENT C/L

Prerequisite Lesson(s): OMS OV 21001

Preparation: Review:

 SCOM; Section 2.18, OMS, Description through TVC Read:

- SCOM; Section 2.18, OMS, Fault Detection and Identification through OMS Summary Data
- OMS 21002; Sections 1-3 (pay particular attention to the MNVR EXEC display and GNC SYS SUMM 2 display)

### Synopsis:

This lesson will prepare the student for OMS OPS 21006 by reviewing material that was covered in OMS OV 21001 and by introducing material that will be covered in OMS OPS 21006. This lesson will discuss the flow of the FDF as it pertains to OMS procedures.

- Explain the flow of the FDF and the rationale for nominal OMS burn procedures.
- List the five requirements for an OMS burn.
- Explain the three operational considerations for interconnects and crossfeeds.
- Explain the steps and rationale for the FDF procedure for the OMS to Reaction Control System (RCS) interconnect and OMS crossfeed.

# 29 **RCS OV 21001**

Title: Reaction Control System Overview Briefing

Duration: 2.0 hours
Medium: Classroom
Student: ASCAN

Source: DS66/G&C/Propulsion Training Group and EP4/Propulsion Systems

Branch

Date: 03/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ASC OV 21001, ORB OPS OV 21001, ENT OV 21001

Preparation: Read:

SCOM; Section 2.23, RCS

Synopsis: The purpose of the briefing is to describe the purpose of the Reaction

Control System (RCS), and its nominal and off-nominal uses in all phases of flight, provide a general physical description of the system, discuss how propellant quantity is calculated, relate the RCS to the OMS, EPS, and DPS, and provide an overview of the displays and controls relating to the

RCS. The briefing will also discuss software jet Redundancy

Management (RM) and how it relates to the RCS.

Objectives: • State the purpose of the RCS.

Identify the subsystems of the RCS.

• Explain the purpose of each RCS subsystem.

• State the purpose of RCS Jet Redundancy Management (RM).

State the nominal and off-nominal use of the RCS.

Identify the displays and controls associated with the RCS.

# 30 **C&W OV 21001**

Title: Caution and Warning Overview Briefing

Duration: 2.0 hours
Medium: Classroom
Student: ASCAN, PS

Source: DS45/ Shuttle Systems Training Group

Date: 04/06

Lesson(s) Replaced: None
Equipment Required: None
Prerequisite Lesson(s): CSI 21057

Preparation: Read:

SCOM; Section 2.2, Caution & Warning

#### 30 C&W OV 21001 (Concluded)

Synopsis:

This lesson will cover the major purpose of the Caution & Warning (C&W) system and the crew response to alarms, aural and visual annunciation and crew interfaces associated with each of the following alarm classes:

- Emergency: Smoke Detection and Fire Suppression
- Emergency: Rapid Cabin Depressurization
- Primary Caution and Warning
- Backup Caution and Warning
- Alert
- Limit Sensing

- Objectives: List the four alarm classes within the C&W system.
  - List the two subsystems that Class 1 C&W monitors.
  - Describe the Class 1 alarm annunciation (aural and visual cues) for the fire and smoke subsystem.
  - Describe the Class 1 alarm annunciation (aural and visual cues) for the dP/dT subsystem.
  - Explain the differences between the Primary C&W System and the Backup C&W System.
  - Describe the aural and visual cues for a Primary C&W alarm annunciation.
  - Describe the aural and visual cues for a Backup C&W alarm annunciation.
  - Describe which C&W systems the crew can interface with and how they accomplish this.
  - Describe which C&W systems MCC can interface with and how they accomplish this.
  - Describe the aural and visual cues for a Class 3 C&W alarm. annunciation.
  - Define preconditioning for Class 3 C&W.

#### 31 COMM/IN OPS BR 21001

Title: Communication/Instrumentation Operations Review

Duration: 2.0 hours Medium: Classroom Student: ASCAN. PS

Source: DS25/Communications/NSS Training Group

Date:

COM/IN OPS 21001, COM/IN OPS 22001 Lesson(s) Replaced:

Equipment Required: None

Prerequisite Lesson(s): **COMM OV 21001** 

# 31 COMM/IN OPS BR 21001 (Concluded)

Preparation: Read:

- S-BD COM/IN 21002; Section 7, S-Band GMM/INST Operations Review
- SCOM; Section 2.4, for additional information on S-Band Phase Modulation (PM), S-Band Frequency Modulation (FM), Instrumentation, and the Audio Distribution System

Take:

- COMM OV 21057
- INST 21057

Synopsis: This briefing consists of an overview of the Communications and

Operational Instrumentation systems with an introduction to the nominal

procedures and signatures associated with all phases of flight.

Objectives: • Describe orbiter S-Band PM two-way voice communications with MCC.

- Describe orbiter S-Band PM commanding from MCC to the orbiter.
- Describe orbiter S-Band PM and FM telemetry to MCC.
- Describe basic function and location of orbiter S-Band PM/FM Line Replacement Units (LRUs), displays and controls.
- Describe orbiter S-Band PM/FM system redundancy.
- Describe orbiter S-Band PM/FM site/Tracking and Data Relay Satellite (TDRS) coverage per flight phase.
- Recognize S-Band PM/FM FDF procedures.
- List available S-Band PM/FM displays.
- Describe basic function and location of Operational Instrumentation (OI) LRUs, displays and controls.
- Recognize OI procedures in appropriate FDF.

# 32 **AUDIO BR 21001**

Title: Audio Operations Briefing

Duration: 1.5 hours Medium: Classroom

**Note:** Schedule in the Bldg 9A suit room.

Student: ASCAN, PS (Schedule in groups of up to 4.) Source: DS25/Communications/NSS Training Group

Date: 01/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): COMM OV 21001

# 32 AUDIO BR 21001 (Concluded)

Preparation: Read:

- SCOM; Section 2.4, Communications, Audio Distribution System
- AUD/UHF 21002; Sections 1 and 2
  - Answer questions after Sections 2 and 3.

Synopsis: The intent of this lesson is to introduce the student to the orbiter Audio

Distribution System (ADS) and its operation. In addition, the student will be introduced to the loose communications gear used as end items with

the ADS.

Objectives: • Explain the relationship of the orbiter ADS to the voice communications between the orbiter and the MCC.

- Explain the relationship of the orbiter ADS and voice intercommunications in the orbiter.
- Explain the relationship of the orbiter ADS and the Caution and Warning (C&W) system.
- Identify the function of individual loose communications gear.

# 33A **AUDIO 21001**

Title: Audio Operations Prebrief

Duration: 0.5 hours
Medium: Classroom
Student: Non-ASCAN

Source: DS25/Communications/NSS Training Group

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: Read:

SCOM; Section 2.4, Communications, Audio Distribution System

• AUD/UHF 21002

Answer questions after Sections 2 and 3.

**Note:** This lesson replaces the AUDIO BR 21001 lesson for non-ASCAN

students.

Synopsis: The intent of this lesson is to introduce the student to the orbiter Audio

Distribution System (ADS) and its operation. In addition, the student will be introduced to the loose communications gear used as end items with

the ADS.

# 33A <u>AUDIO 21001 (Concluded)</u>

Objectives:

- Explain the relationship of the orbiter ADS to the voice communications between the orbiter and the MCC.
- Explain the relationship of the orbiter ADS and voice intercommunications in the orbiter.
- Explain the relationship of the orbiter ADS and the Caution and Warning (C&W) system.
- Identify the function of individual loose communications gear.

## 33B **AUDIO 21020**

Title: Audio Operations

Duration: 1.5 hours Medium: CCT/FFT

Student: ASCAN, PS (Schedule in groups of up to 4.) Source: DS25/Communications/NSS Training Group

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): AUDIO BR 21001

Preparation: None

Synopsis:

This lesson is a hands-on training exercise utilizing a fully operational, flight configured orbiter prototype audio system installed in the CCT or FFT. Very Lightweight Headsets (VLHSs) handheld microphones, and Battery Powered Speaker Microphone Units (BPSMU) are used to demonstrate interfaces and operational capabilities. This class will also demonstrate the operation of the orbiter audio system to communicate with MCC, EVA crew members, and International Space Station (ISS). Also included in this lesson is the familiarization with the Ultrahigh Frequency (UHF) system operation relative to Air-to-Ground (A/G) and Air-to-Air (A/A) connections to the orbiter audio system made on panel A1R.

- Operate the orbiter audio system from a single audio crew station using a VLHS, handheld microphone/speaker, and BPSMU.
- Operate the orbiter audio system to communicate with EVA crewmembers and to the ISS.

33C AUDIO 21006

Title: Audio Operations

Duration: 1.0 hour Medium: SST

Student: Non-ASCAN

Source: DS25/Communications/NSS Training Group

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): AUDIO 21001

Preparation: None

**Note:** This lesson replaces the AUDIO 21020 lesson for non-ASCAN

students.

Synopsis: This lesson is a hands-on training exercise utilizing an operational, flight

configured orbiter prototype audio system installed in the SST. Very Lightweight Headsets (VLHSs) and handheld microphones will be used to demonstrate interfaces and operational capabilities. Both normal and backup configurations are covered. Also included is familiarization with

the UHF system operations.

Objectives: • Operate the orbiter audio system from a single audio crew station using

a VLHS and/or handheld microphone/speaker during various phases of

flight.

Configure the orbiter audio system to communicate with MCC and other

crewmembers.

# 34A **OMS OPS 21001**

Title: Orbital Maneuvering System Operations Prebrief

Duration: 0.5 hours
Medium: Classroom
Student: Non-ASCAN

Source: DS66/G&C/Propulsion Training Group

Date: 10/05

Lesson(s) Replaced: None

Equipment Required: ASC C/L, ORB OPS C/L, ENT C/L

Prerequisite Lesson(s): None

# 34A OMS OPS 21001 (Concluded)

Preparation: Review:

SCOM; Section 2.18, OMS, Description through TVC

Read:

 SCOM; Section 2.18, OMS, Fault Detection and Identification through OMS Summary Data

OMS 21002; Sections 1-3 (pay particular attention to the MNVR)

EXEC display and GNC SYS SUMM 2 display)

Note: This lesson replaces the OMS OPS BR 21001 lesson for non-ASCAN

students.

Synopsis: This lesson will prepare the student for OMS OPS 21006 by reviewing

material that was covered in OMS OV 21001 and by introducing material that will be covered in OMS OPS 21006. This lesson will discuss the flow

of the FDF as it pertains to OMS procedures.

Objectives: • Explain the flow of the FDF and the rationale for nominal OMS burn procedures.

• List the five requirements for an OMS burn.

 Explain the three operational considerations for interconnects and crossfeeds.

 Explain the steps and rationale for the FDF procedure for the OMS to Reaction Control System (RCS) interconnect and OMS crossfeed.

# 34B **OMS OPS 21006**

Title: Orbital Maneuvering System Operations

Duration: 2.0 hours

Medium: SST 1 or SST 2 or SST 3 Student: ASCAN (Schedule in pairs.)

Source: DS66/G&C/Propulsion Training Group

Date: 04/06

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): OMS OPS BR 21001, CSI 21057, DPS 21006

Preparation: Review:

OMS OPS BR 21001 handouts

Synopsis: Using the FDF, the student will perform all the nominal procedures

associated with the OMS, starting at Main Engine Cutoff (MECO) and ending with the post landing procedures. Throughout the lesson, the student will be required to state the purpose of each procedure and the

rationale of the major steps as the procedure is performed.

# 34B OMS OPS 21006 (Concluded)

Objectives:

- Know the uses of the OMS, the function of OMS switches, and how to monitor critical system temperatures and pressures.
- Match the schematic diagram in the FDF to panel switches, meters, and DPS displays.
- Describe how the parts of the OMS interact to execute an OMS burn.
- Execute and monitor OMS burns using the appropriate FDF as a reference.
- Verify that the proper targets are loaded.
- Configure the switches for the OMS burns.
- Monitor the vital OMS parameters during the burn.
- Describe the use of the burn monitor card.
- Explain the effect of the burn on the vehicle orbit.
- Perform an OMS crossfeed.
- Configure the switches for a crossfeed using the appropriate FDF.
- Explain the difference between a crossfeed performed preburn and a "hot" crossfeed performed during an OMS burn.
- Set up an OMS-to-Reaction Control System (RCS) interconnect.
- Configure the switches for an interconnect using the appropriate FDF.
- Determine the OMS quantity during an interconnect.

# 35 **RCS OPS BR 21001**

Title: Reaction Control System Operations Review

Duration: 2.0 hours Medium: Classroom

Student: ASCAN (Schedule in groups of about 15.)
Source: DS66/G&C/Propulsion Training Group

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): RCS OV 21001

Preparation: Review:

SCOM; Section 2.23

RCS – Propellant System

RCS Redundancy Management and Operations

Take:

RCS RM 21057

# 35 RCS OPS BR 21001 (Concluded)

Synopsis:

This briefing prepares the student for the lesson RCS OPS 21006, which exercises nominal Reaction Control System (RCS) operations in the SST. This briefing begins with a review of RCS OV 21001, highlighting the various hardware and software interfaces for the RCS. The briefing then presents the major nominal procedures associated with the RCS and discusses the rationale behind those procedures.

Objectives:

- Explain the rationale behind the RCS switch configuration for ascent, orbit, and entry.
- Explain the function of the RCS during:
  - Forward window protection
  - Mated coast
  - External Tank (ET) separation
- State the points during a nominal entry when the RCS jets are phased out and replaced by aerosurfaces.
- Explain the mechanics of performing and the rationale behind the following RCS-related procedures:
  - ET PHOTO MANEUVER
  - TAIL ONLY CONTROL
  - CONFIGURE VERNIER CONTROL
  - XFEED: R(L) RCS to L(R) RCS
  - RCS REGULATOR RECONFIG
  - ON-ORBIT MULTI AXIS RCS BURN
  - RCS HOT FIRE TEST
  - FORWARD RCS DUMP
  - RCS, OMS SAFING (RJDs)
  - RCS, OMS VALVE TEST

#### 36 **ENG REF OV 21001**

Title: Introduction to Engineering Reference Material

Duration: 1.0 hour Medium: Classroom Student: ASCAN

Source: DS66/G&C/Propulsion Training Group

Date: 02/04

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

#### 36 **ENG REF OV 21001 (Concluded)**

Synopsis:

This lesson presents the student with the engineering reference documents most commonly used in shuttle training. These reference documents provide invaluable information concerning space shuttle performance data, orbiter subsystem data, and mission operations data. The three types of documents that are addressed during this briefing are orbiter/STS operations, flight software, and mission operations. In addition, the student will be told where these documents can be found. who owns these documents, and how these documents are revised.

- Objectives: Identify the five most commonly used engineering reference documents used in shuttle training.
  - Describe briefly what each document contains.
  - Identify where to find each of these documents.
  - Identify who owns each of these documents.
  - Describe how these documents are revised.

#### 37 FLIGHT RULES 21001

Title: Flight Rules Overview Briefing

Duration: 2.0 hours Medium: Classroom Student: ASCAN

Source: DA8/Flight Director Office

02/04 Date:

Lesson(s) Replaced: None Equipment Required: None

ENG REF OV 21001 Prerequisite Lesson(s):

Preparation: None

Synopsis: This lesson is designed to be an introduction to the STS Operational Flight

Rules book. This briefing will discuss the following topics: book organization, major types of topics in the book, how to read a Go/No-Go

key flight determination terms will be defined.

Objectives:

- Describe the overall organization of the Flight Rules Book.
- Describe the purpose of the Flight Rules Book.
- Describe the major types of topics discussed in the Flight Rules Book.

Criteria table, and the flight rule change approval process. Additionally,

- Define the following terms:
  - First Day Primary Landing Site (PLS)
  - PLS
  - Minimum Duration Flight (MDF)
  - Emergency Landing Site (ELS)

# 37 FLIGHT RULES 21001 (Concluded)

- Given a failure scenario, determine the mission impact using a Go/No-Go Criteria table.
- Discuss the flight rule change approval process.

# 38 **FDF 21020**

Title: Flight Data File

Duration: 1.0 hour

Medium: CCT, CCT II, or FFT

**Note:** Schedule suit room in Bldg. 9.

Student: ASCAN (Schedule in groups of up to 4.)

Source: DX45/Crew Systems Group

Date: 08/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ORB FDF USE 21001

Preparation: None

Synopsis: This lesson is designed to familiarize the student with the onboard

complement of flight-like FDF. A brief overview of Post-Insertion, Flight Plans, and other FDF documents will be given. Emphasis will be placed

on the FDF locations when unstowed/installed and stowed.

Objectives: • Identify the types of FDF flown.

• Discuss the ascent locations and stowage of the FDF.

# 39 **C&W OPS 21004**

Title: Caution and Warning Operations

Duration: 1.5 hours

Medium: SST 2 or SST 1 or SST 3

Student: ASCAN, PS (Schedule in pairs.)

Source: DS45/Shuttle Systems Training Group

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): C&W OV 21001

Preparation: Read:

C&W 21002

# 39 <u>C&W OPS 21004 (Concluded)</u>

Synopsis:

This lesson will present an overview of the Caution and Warning (C&W) system, a description of related panels, displays, and controls, and crew procedures used to operate and interface with the C&W system. The student will also be required to perform certain nominal and off-nominal procedures using the related FDF while explaining the rationale of each step.

Objectives:

- Perform the steps involved in executing certain nominal C&W procedures.
- Identify C&W parameters on the Systems Management (SM) display SPEC 60.
- Locate C&W switches and circuit breakers located on the following panels: C3, R13U.
- Explain the rationale for performing each of the nominal C&W procedures.
- Recognize tones and annunciator lights associated with alarm classes.
- Use the C&W section of Ref Data with panel R13 and SPEC 60 to manipulate hardware and software C&W limits.
- Execute the procedures for extinguishing an avionics bay fire as listed on the Fire/Smoke cue card.

# 40A **COMM/IN OPS 21001**

Title: Communication/Instrumentation Operations Prebrief

Duration: 0.5 hours

Medium: Classroom

Student: Non-ASCAN

Source: DS25/Communications/NSS Training Group

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: Read:

- S-BD COM/IN 21002; Section 7, S-Band GMM/INST Operations Review
- SCOM; Section 2.4, for additional information on S-Band Phase Modulation (PM), S-Band Frequency Modulation (FM), Instrumentation, and the Audio Distribution System

Take:

- COMM OV 21057
- INST 21057

**Note:** This lesson replaces the AUDIO BR 21001 lesson for non-ASCAN

students.

# 40A COMM/IN OPS 21001 (Concluded)

Synopsis: This briefing consists of an overview of the Communications and

Operational Instrumentation systems with an introduction to the nominal

procedures and signatures associated with all phases of flight.

Objectives: • Describe orbiter S-Band PM two-way voice communications with MCC.

• Describe orbiter S-Band PM commanding from MCC to the orbiter.

• Describe orbiter S-Band PM and FM telemetry to MCC.

 Describe basic function and location of orbiter S-Band PM/FM Line Replacement Units (LRUs), displays and controls.

• Describe orbiter S-Band PM/FM system redundancy.

 Describe orbiter S-Band PM/FM site/Tracking and Data Relay Satellite (TDRS) coverage per flight phase.

• Recognize S-Band PM/FM FDF procedures.

• List available S-Band PM/FM displays.

• Describe basic function and location of Operational Instrumentation (OI) LRUs, displays and controls.

• Recognize OI procedures in appropriate FDF.

# 40B **COMM/IN OPS 21006**

Title: Communications/Instrumentation Operations SST Lesson

Duration: 2.0 hours

Medium: SST 1 or SST 2 or SST 3

Student: ASCAN, PS (Schedule in pairs.)

Source: DS25/Communications/NSS Training Group

Date: 10/05

Lesson(s) Replaced: COM/IN OPS 22006, COM/IN OPS 21006A

Equipment Required: None

Prerequisite Lesson(s): COMM/IN OPS BR 21001

Preparation: Take:

COMM SPEC 21057; Segments 1 and 2

Synopsis: This lesson demonstrates the operation, configuration, and redundancy of

the S-band Phase Modulation (PM)/Frequency Modulation (FM) and Operational Instrumentation (OI) subsystems. Emphasis is placed on nominal signature recognition, comm coverage, and MCC operation of the subsystem. Students will periodically explain comm configuration and

status during the lesson using the displays and controls.

Objectives: • Describe S-band audio distribution system interface.

 Configure S-band PM/FM subsystems for all phases of flight, including internal versus panel configuration using Ground Command/Control

Interface Logic (GCIL) panel/command switches.

# 40B COMM/IN OPS 21006 (Concluded)

- Recognize nominal S-band PM/FM display signatures for all phases of flight.
- Explain S-band PM Stored Program Commands (SPCs) and their effects on the system.
- Describe S-band PM comm coverage for all phases of flight.
- Configure OI subsystems for all phases of flight.
- Perform and explain Telemetry Format Loads (TFLs) using Post Insertion and Orbit Ops checklists.
- Recognize nominal OI display signatures.

# 41A RCS OPS 21001

Title: Reaction Control System Operations Prebrief

Duration: 0.5 hours
Medium: Classroom
Student: Non-ASCAN

Source: DS66/G&C/Propulsion Training Group

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: Review:

SCOM; Section 2.23

RCS – Propellant System

RCS Redundancy Management and Operations

Take:

RCS RM 21057

**Note:** This lesson replaces the RCS OPS BR 21001 lesson for non-ASCAN

students.

Synopsis: This briefing prepares the student for the lesson RCS OPS 21006, which

exercises nominal Reaction Control System (RCS) operations in the SST. This briefing begins with a review of RCS OV 21001, highlighting the various hardware and software interfaces for the RCS. The briefing then presents the major nominal procedures associated with the RCS and

discusses the rationale behind those procedures.

Objectives: • Explain the rationale behind the RCS switch configuration for ascent, orbit, and entry.

- Explain the function of the RCS during:
  - Forward window protection
  - Mated coast
  - External Tank (ET) separation

# 41A RCS OPS 21001 (Concluded)

- State the points during a nominal entry when the RCS jets are phased out and replaced by aerosurfaces.
- Explain the mechanics of performing and the rationale behind the following RCS-related procedures:
  - ET PHOTO MANEUVER
  - TAIL ONLY CONTROL
  - CONFIGURE VERNIER CONTROL
  - XFEED: R(L) RCS to L(R) RCS
  - RCS REGULATOR RECONFIG
  - ON-ORBIT MULTI AXIS RCS BURN
  - RCS HOT FIRE TEST
  - FORWARD RCS DUMP
  - RCS, OMS SAFING (RJDs)
  - RCS, OMS VALVE TEST

## 41B **RCS OPS 21006**

Title: Reaction Control System Operations

Duration: 2.0 hours

Medium: SST 1 or SST 2 or SST 3 Student: ASCAN (Schedule in pairs.)

Source: DS66/G&C/Propulsion Training Group

Date: 04/06

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): RCS OPS BR 21001, CSI 21057, DPS 21006

Preparation: Review:

- FDF; Nominal RCS procedures
- DPS Dictionary; SPEC 23 operation and uses

#### Synopsis:

The lesson is designed to concentrate on the basic Reaction Control System (RCS) operational procedures that are performed during a typical mission. The main emphasis of the class is on FDF procedures, DPS displays, and proper switch throws. Flight rules and engineering/design aspects of the RCS are not stressed. This lesson begins with a review of the controls and displays in the flight deck. The class continues with switch position rationale and a discussion of operations and procedures for RCS during Ascent, Orbit, Deorbit Preparation and Entry.

- Perform the nominal RCS operational procedures during all phases of flight.
- Configure the RCS switches and valves through the ascent, orbit, and entry phases of flight.

# 41B RCS OPS 21006 (Concluded)

- Explain the impacts that helium leaks and prolonged jet firings have on the RCS gauging system.
- Use the RCS-related displays and controls to deselect/reselect jets, alter jet firing priorities, and reset jet Redundancy Management (RM).

# 42A **DPS FAM 21001**

Title: Data Processing System Familiarization 1 Prebrief

Duration: 0.5 hours Medium: Classroom

Student: ASCAN, PS (Schedule in pairs.)

Source: DS24/DPS/Navigation Training Group

Date: 04/06

Lesson(s) Replaced: None
Equipment Required: None
Prerequisite Lesson(s): DPS 21006

**Note:** This lesson should be scheduled no later than 3 weeks after

completing DPS 21006.

Preparation: Read:

DPS FAM 21002

#### Synopsis:

This prebrief will start with an overview of the DPS Familiarization (FAM) lessons. The student should have a good understanding of Initial Program Loads (IPLs), Operational Sequence (OPS) transitions, and strings. This lesson will emphasize certain DPS SPECs and the use of the Nominal Bus Assignment Table (NBAT). The information in this prebrief should be a review of DPS 21006. The instructor will show the location and briefly describe the DPS switches. The Backup Flight System (BFS) is then briefly described, including the role of the BFS, BFS tracking, and BFS engage.

- Explain the purpose of an IPL.
- Explain the purpose of an OPS transition.
- Describe a string.
- Explain the main DPS functions of SPEC 0, SPEC 6, SPEC 1, and the Systems Summary (SYS SUMM).
- Describe the memory configuration and the use of the NBAT.
- Identify the DPS switches.
- State the role and function of the BFS.
- Identify the locations and names of the Multifunction Display Units (MDUs).
- Describe the Multifunction Electronic Display System (MEDS) databus network.

# 42B **DPS FAM 21006**

Title: Data Processing System Familiarization 1

Duration: 2.0 hours

Medium: SST 1 or SST 2 or SST 3

Student: ASCAN, PS (Schedule in pairs.)

Source: DS24/DPS/Navigation Training Group

Date: 02/04

Lesson(s) Replaced: DPS OPS 21006

Equipment Required: None

Prerequisite Lesson(s): DPS FAM 21001

Preparation: None

Synopsis:

The overall lesson is done in a semi-chronological order, without real FDF. The purpose is to gain understanding of some basic DPS concepts. The FAM 1 lesson covers operations typically seen prelaunch, on ascent, and during orbit. The first section of the lesson covers switch locations and Initial Program Loads (IPLs) to illustrate some of the DPS operations done prior to crew ingress.

The student should explain the IPL operations as they occur, with instructor assistance. The ascent section will include Operational Sequence (OPS) overlays, Backup Flight Software (BFS) tracking, OUTPUT switch operations, and use of the Computer Annunciation Matrix (CAM). Each of these sections will be taught with diagrams or examples from the ascent phase of flight. The last two sections will include a Post-Insertion DPS reconfiguration and orbit Multifunction Electronic Display System (MEDS) operations. This will prepare the student for further on-orbit operations in FAM 2.

- State the function/purpose of the following DPS controls and displays:
  - General Purpose Computer (GPC)
  - Integrated Display Processor (IDP), Multifunction Display Unit (MDU), and Analog to Digital Converter (ADC)
  - Multiplexer/Demultiplexer (MDM) controls on Panel 06
  - IDP/CRT controls on panel C2
  - Backup Flight Controller (BFC) switches on Panel C3
  - CAM
  - Caution and Warning (C&W) lights
- Perform a default option IPL, aided, and explain its purpose.
- Perform a menu option IPL for Primary Avionics Software System (PASS) and BFS, aided, and explain the purposes for each.

# 42B DPS FAM 21006 (Concluded)

- Explain the difference between a Major Function Base and an OPS Overlay.
- Perform the ascent software reconfiguration, aided and without real FDF.
- Explain how the GPC/CRT key overrides the Nominal Bus Assignment Table (NBAT) for IDP assignments.
- Perform a GPC/CRT assignment (PASS versus BFS), unaided.
- Summarize the process by which BFS tracks PASS and identify the signature for BFS Standalone.
- Explain the difference between the three positions for the OUTPUT switch.
- Explain the signatures (including talkbacks, displays, and the CAM) for a GPC failure.
- List the major steps in the Post Insertion DPS Reconfiguration procedure, aided and without real FDF.
- Explain various methods for assigning/deassigning IDPs (NBAT, GPC/CRT key, Major Function switch, BFC CRT DISP, and SEL switch).
- Explain the purpose of the G3 archive and how it is loaded.
- Identify the nominal signature for a BFS engage.
- Review the output and mode switch functions for PASS and BFS.
- Identify the signature for powering off MDUs and an edgekey failed closed.
- Discuss good DPS habits (IDP power on time constraints, Resume SPECs, distribution of IDPs among different Major Functions, Hands Off for OPS transitions, and PASS GPCs to RUN).

# 43 **MPS OV 21001**

Title: Main Propulsion System Overview Briefing

Duration: 3.5 hours
Medium: Classroom
Student: ASCAN

Source: DS66/G&C/Propulsion Training Group and DS65/Booster Systems

Group

Date: 03/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ASC OV 21001, ENT OV BR 21001, ORB OPS OV 21001

# 43 MPS OV 21001 (Concluded)

Preparation: Read:

- SCOM
  - Section 2.16, MPS (disregard information on malfunctions and failures)
  - Section 1.3, External tank
- MPS Workbook 21002, Sections 1 and 2

Take:

MPS INTRO 21057 (Do CBT after reading SCOM)

Synopsis:

This lesson covers the Main Propulsion System (MPS) hardware and how each respective MPS subsystem works and interfaces with other orbiter systems. For each subsystem, this lesson will cover the controls and displays available on the flight deck, and will introduce how to monitor the subsystem on a nominal ascent.

Objectives:

- Identify the 7 MPS subsystems.
- Given a list of the 7 MPS subsystems and their components:
  - State the purpose of each subsystem relative to the overall MPS.
  - Explain how each subsystem works and identify the subsystem interfaces to other orbiter systems.
  - Identify the subsystem controls and displays available on the flight deck.

#### 44 <u>ECLSS 21057</u>

Title: Environmental Control and Life Support System/Astronaut Path

Duration: 4.0 hours
Medium: CBT
Student: ASCAN

Source: DS45/Shuttle Systems Training Group

Date: 02/04

Lesson(s) Replaced: ECLSS OV 21001

Equipment Required: None Prerequisite Lesson(s): None

Preparation: Read:

 SCOM; Section 2.9, Environmental Control and Life Support System (ECLSS)

Synopsis: This lesson introduces the student to the concepts and equipment used in

the Environmental Control and Life Support Systems (ECLSS) onboard

the shuttle. Equipment is identified and generally described.

# 44 ECLSS 21057 (Concluded)

- Identify the functions of the ECLSS subsystems during all flight phases.
- Identify the major components of each ECLSS subsystem.
- Describe how the ECLSS subsystems interface with each other and with other systems.

## 45 **MECH OV 21001**

Title: Mechanical Systems Overview Briefing

Duration: 3.0 hours
Medium: Classroom
Student: ASCAN

Source: DS45/Shuttle Systems Training Group

Date: 03/05

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: Read:

SCOM; Section 2.17, Mechanical System

Complete:

• PLBD 21057 – Nom Ops

Synopsis:

This lesson will cover the various components and equipment that make up the Mechanical (Mech) Systems. The briefing will discuss the active vent system, external tank umbilical doors, payload bay doors, radiators, and landing/deceleration system.

- Identify the components of a Power Drive Unit (PDU) and state their functions.
- Explain how microswitches affect the PDU motors.
- Explain the difference between single motor drive and dual motor drive.
- Identify the functions of the Active Vent, External Tank (ET) Doors, Payload Bay Doors, Deployable Radiators, and Landing & Deceleration subsystems.
- Identify the major components of each Mech subsystem.
- Describe the vent door configuration during the various mission phases (prelaunch through postlanding).
- Describe the ET door configuration during the various mission phases (prelaunch through postlanding).
- State how many latches are in a payload bay door latch gang.
- Describe the information provided on the Systems Management (SM) displays: SPEC 63 PL BAY DOORS and OPS 202 PL BAY DOORS.

# 45 MECH OV 21001 (Concluded)

- Describe the sequence of events during payload bay door opening and closing.
- State the purpose of radiator deployment.
- Identify the methods available to release the main landing gear and nose landing gear uplock hooks.

## 46 **EPS OPS BR 21001**

Title: Electrical Power System Operations Review

Duration: 2.0 hours
Medium: Classroom
Student: ASCAN

Source: DS45/Shuttle Systems Training Group

Date: 10/05

Lesson(s) Replaced: None

Equipment Required: ASC C/L, PI C/L, ORB OPS C/L, D/O PREP C/L, ENT C/L

Prerequisite Lesson(s): EPS OV 21001

Preparation: Read:

• EPS 21002 Complete:

EPS OPS 21057

#### Synopsis:

This lesson will begin with a short review of the EPS subsystems, focusing on the sensors. The EPS-related displays and controls will be discussed, focusing on the operational uses of the R1 panel, R11U panel, O2 and F9 meters, and the Cryo panels on the Aft Flight Deck. The relationship between the displays, subsystem drawings, and controls will also be discussed. The class will then walk through the nominal timeline and discuss the EPS procedures. During these discussions, the EPS displays and controls will be located, the purpose of the procedure will be discussed, and the rationale behind the steps will be discussed.

- Recognize EPS parameters on the following Systems Management (SM) displays: SYS SUMM 1, SYS SUMM 2, SPEC 67, SPEC 68, and SPEC 69.
- Recognize EPS parameters on the panel O2 and F9 meters.
- Recognize EPS switches and circuit breakers located on the following panels: R1, R11U, A11, A15, O14, O15, O16, and MA73C.
- Identify the nominal EPS procedures performed during a mission (prelaunch through postlanding).
- State the rationale for performing each of the nominal EPS procedures.
- Describe the configuration of the EPS subsystems based on the mission timeline.

# 46 EPS OPS BR 21001 (Concluded)

- Describe the EPS by using the schematic on panel R1.
- Describe dual cryo heater operations.
- Describe the purpose of the Cryo system manifold valves, reactant valves, tank check valves, O2 supply valves, and manifold relief valves.
- Explain how the Cryo heater sensor check causes the heater to trip off.
- Explain the purpose of the fuel cell dual gas regulator.
- Identify the EPS-related reason(s) for a Ground Launch Sequence (GLS) hold prelaunch.
- Explain how to use the Fuel Cell VI (Volts vs. Current) Performance plot.
- Explain the operational constraints for the manual fuel cell purge.
- Describe the significance of the Fuel Cell Stack T, Cool P, and Exit T indications.

# 47 **APU/HYD OPS BR 21001**

Title: Auxiliary Power Unit/Hydraulic Operations Review

Duration: 2.0 hours
Medium: Classroom
Student: ASCAN

Source: DS45/Shuttle Systems Training Group

Date: 10/05

Lesson(s) Replaced: None

Equipment Required: ASC C/L, PI C/L, ORB OPS C/L, D/O PREP C/L, ENT C/L

Prerequisite Lesson(s): APU/HYD OV 21001

Preparation: Read:

APU/HYD/WSB 21002

Complete:

APU/HYD OPS 21057

Synopsis:

During this lesson, there will be a review of the Auxiliary Power Unit (APU)/Hydraulic (Hyd) system hardware, cockpit interface, mission timeline, and FDF procedures. The student will be progressed from the detailed technical aspects of the APU/Hyd system, as covered in the overview core briefing, to an operationally oriented familiarization. This lesson will serve as the conversion to "hands-on" operations of the APU/Hyd system.

Objectives:

 Recognize APU/Hyd parameters on Guidance, Navigation, and Control (GNC) SPEC 51 and the following Systems Management (SM) displays: THERMAL, SYS SUMM 2, SPEC 86, SPEC 87, and SPEC 88.

# 47 APU/HYD OPS BR 21001 (Concluded)

- Recognize APU/Hyd parameters on the Multifunction Electronic Display System (MEDS) displays.
- Recognize APU/Hyd switches and circuit breakers located on the following panels: R2, R4, and A12.
- Describe the configuration of the APU, Hyd, and Water Spray Boiler (WSB) subsystems based on the mission timeline.
- Explain the relationship between data seen on the meters and on the displays.
- Identify the nominal APU/Hyd procedures performed during a mission (prelaunch through postlanding).
- State the rationale for performing each of the nominal APU/Hyd procedures.
- Describe how the following functions are supported by the APU/Hyd system:
  - Engine throttling
  - Engine gimballing (ascent)
  - External tank umbilical plate retraction
  - Engine gimballing (entry)
  - Aerosurface actuation
  - Gear deploy
  - Braking
  - Nose wheel steering
- Describe the APU/Hyd system using the APU/Hyd schematic in the Ascent Pocket Checklist.
- Describe the conditions that would call for "Attempt One APU" vs. "Attempt Two APUs" when performing the SINGLE APU START procedure in the Entry Checklist.
- Identify the prelaunch Ground Launch Sequencer (GLS) constraints.

# 48A **DPS FAM 22001**

Title: Data Processing System Familiarization 2 Prebrief

Duration: 0.5 hours Medium: Classroom

Student: ASCAN (Schedule in pairs.)

Source: DS24/DPS/Navigation Training Group

Date: 02/04

Lesson(s) Replaced: DPS FAM 22001

Equipment Required: None

Prerequisite Lesson(s): COMM/IN OPS 21006, DPS FAM 21006

**Note:** This lesson should be scheduled no later than 3 weeks after

completing DPS FAM 21006.

# 48A DPS FAM 22001 (Concluded)

Preparation: Review:

DPS FAM 21002

Synopsis:

This prebrief will start with an overview of the DPS FAM 2 lesson. The student will then be quizzed about the main objectives from the DPS FAM 1 lesson. With this foundation, the instructor will then lead the student through the five steps of an Operational Sequence (OPS) transition and discuss system redundancy for the Modular Memory Units (MMUs). Redundant set expansions and contractions are defined and the nominal activities associated with them are discussed. Downlist and uplink are also briefly discussed as they relate to orbiter data flow to and from the General Purpose Computers (GPCs). Telemetry Format Loads (TFLs) and the Pulse Code Modulation Master Unit (PCMMU) are also discussed at this time.

Objectives:

- Identify the 5 main steps that occur while GPCs are in an OPS transition.
- Identify the major activities associated with a redundant set contraction.
- Identify the major activities associated with a redundant set expansion.
- Describe what TFLs and PCMMUs are and explain their purpose.
- Discuss how a PCMMU gets and sends its data.
- Describe the path of an uplink/downlink from the ground to the orbiter.

# 48B **DPS FAM 22006**

Title: Data Processing System Familiarization 2

Duration: 2.0 hours

Medium: SST 1 or SST 2 or SST 3 Student: ASCAN (Schedule in pairs.)

Source: DS24/DPS/Navigation Training Group

Date: 02/04

Lesson(s) Replaced: DPS OPS 21006A (last half)

Equipment Required: None

Prerequisite Lesson(s): DPS FAM 22001

Preparation: None

# 48B **DPS FAM 22006 (Concluded)**

### Synopsis:

This lesson will cover various DPS operations using Orbit, Deorbit Prep. Entry, and Post Landing as the chronological basis for the flow. During this lesson, many FAM 1 objectives will be reviewed to better reinforce the concepts and procedures to aid the student in preparation for FAM 3. The first section will cover the power status and commfault indications for Modular Memory Units (MMUs) and Multiplexers/Demultiplexers (MDMs) during powerdown and powerup Input/Output (I/O) recovery. The student will also exercise a redundant set contraction and expansion. While performing the Guidance, Navigation, and Control (GNC) Operational Sequence (OPS) 8 (G8) and GNC OPS 2 (G2) OPS transitions, MMU commanding and assignment logic will be discussed. In the Deorbit Prep section, the student will apply knowledge of the DPS system to produce a Deorbit Prep DPS reconfiguration strategy (with limited instructor assistance) and procedures that will then be executed. In the Entry section, port mode issues will be discussed. The impacts of a General Purpose Computer (GPC) failure on GNC downlist is discussed.

The last section, Post Landing, is optional. This section will be used if there is extra time or if the instructor feels that the student needs another opportunity to review redundant set contractions and GPC operations.

- Perform, aided, a redundant set contraction and a redundant set expansion.
- Explain MMU hardware and its software logic (preposition logic, Modular Memory (MM) bus default logic, and MMU source default logic).
- State examples of various operations requiring MMU access (Telemetry Format Load (TFL), Roll-In SPEC, Systems Management (SM) Checkpoint).
- Perform G2 to G8 and G8 to G2 OPS transitions.
- List the steps in the Deorbit Prep DPS reconfiguration and explain the purpose of each.
- Perform, aided, the Deorbit Prep DPS reconfiguration.
- Perform, aided, a port-mode operation.
- Explain the rationale for the Multifunction Electronic Display System (MEDS) ascent and entry cockpit configuration.
- Explain how the Redundant Set maintains a downlist GPC after a GPC failure.
- Perform, aided, the Post-Landing DPS reconfiguration. (This is optional. Perform, if time permits or as needed, at the end of the class.)

# 49A **APPR/LNDG 21001**

Title: Approach and Landing Prebrief

Duration: 1.0 hour Medium: Classroom

Note: Schedule in PILOT simulator room (Flight Planning Room). Student: ASCAN (Prior to STA: Schedule 1 CB IP, 4 ASCAN PLTs;

After STA: Schedule 1 ASCAN PLT, 4 MSs.)

Source: DS66/G&C/Propulsion Training Group

Date: 02/04

Lesson(s) Replaced: APPR & LAND 21001

Equipment Required: None

Prerequisite Lesson(s): APPR/LNDG BR 21001; MB SAFETY BR 21003

Preparation: Take:

HUD 21057

Review:

APPR/LNDG BR 21001; Cockpit Calls – Procedures

#### Synopsis:

This prebrief is to prepare the student for APPR/LNDG 21011. The flow of APPR/LNDG 21011 will be discussed along with how the class will run. The students will learn basic cockpit resource management and how the tasks are divided among the crewmembers for the landing phase. They will be refreshed on landing aids and instruments used for landing. The students will practice landing on the Portable Inflight Landing Operations Trainer (PILOT) simulators before using the SMS.

Typically, the simulator lesson will be scheduled for 4 hours, with each student receiving one hour of approach and landing training with the instructor pilot. Two students will fly the first two hours of the session; the other two students will fly the last two hours of the session. All four students and the instructor pilot will attend this prebrief.

- State the tasks performed by each crewmember during the landing phase (10K feet to landing rollout and wheel stop).
- Evaluate orbiter position and attitude from pictures of landing aids and orbiter instruments and state the required correction.
- State the nominal landing parameters for heavy and lightweight vehicles and for aborts.
- Use the PILOT simulator to land the shuttle within nominal parameters.

49B **APPR/LNDG 21011** 

Title: Approach and Landing

Duration: 4.0 hours Medium: SMS-MB

Student: ASCAN (Prior to STA: Schedule 1 CB IP, 4 PLTs; After STA:

Schedule 1 ASCAN PLT, 4 MSs. The 4 hour SMS session will be split

into two 2-hour blocks with two students per block.)

Source: DS66/G&C/Propulsion Training Group

Date: 02/04

Lesson(s) Replaced: APPR & LAND 21011

Equipment Required: None

Prerequisite Lesson(s): APPR/LNDG 21001

Preparation: None

Synopsis: The students will begin by learning how to perform a nominal shuttle

landing. They will learn the different techniques for controlling the vehicle in the air and on the runway during rollout. Each student will have a chance to do a number of landings (even the MSs will get to land the vehicle during their lesson). Once the nominal techniques are mastered, the students will then practice landing with a variety of wind conditions, tire fails, and other malfunctions. All runs will start on the Heading Alignment Cone (HAC), so the students can practice the entire Approach and

Landing (A/L) profile from transition on down.

Objectives: • Identify the SMS landing data collection sheets and how to read them.

 Perform a nominal landing starting from above the A/L transition through wheel stop.

 Make crew calls within the cockpit and perform all the other landing tasks.

Execute rollouts with the different steering devices.

• Land with different approach conditions (winds, malfunctions, etc.).

# 50 MPS OPS BR 21001

Title: Main Propulsion System Operations Review

Duration: 2.5 hours Medium: Classroom

Student: ASCAN (Schedule in groups of about 15.)
Source: DS66/G&C/Propulsion Training Group

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): MPS OV 21001

# 50 MPS OPS BR 21001 (Concluded)

Preparation: Read:

MPS Workbook 21002, Section 3

Review:

MPS OV 21001 handout

Abort Mode Boundaries handout

Synopsis:

This lesson will very briefly review the 7 Main Propulsion System (MPS) subsystems discussed in MPS OV 21001. The lesson will then focus on the 7 nominal crew tasks for MPS on ascent and will discuss in detail how to perform each of them. Next, the lesson will cover the rationale and execution of the 9 MPS-related FDF procedures. Finally, the lesson will provide a brief discussion of the abort mode boundary calls provided by MCC to the crew on a nominal ascent.

Objectives:

- Identify the 7 nominal crew tasks for MPS on ascent and explain how to perform each.
- Given a list of the 9 MPS-related FDF procedures:
  - Locate each procedure in the FDF.
  - Explain the rationale for each procedure.
  - Explain how to perform each procedure.
- Explain, in general terms, what each abort mode boundary call means to the crew given a list of the calls.

#### 51 **SRB OV 21001**

Title: Solid Rocket Booster Briefing

Duration: 3.0 hours
Medium: Classroom
Student: ASCAN

Source: CB/Astronaut Office

Date: 03/95

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): MPS OV 21001

Preparation: Read:

SCOM; Section 1.4, Solid Rocket Boosters

# 51 **SRB OV 21001 (Concluded)**

Synopsis:

This lesson will review basic elements of the Solid Rocket Boosters (SRBs). The major components, including solid rocket motors, structure, separation system, recovery system, pyrotechnics thrust vector control, and range safety destruct system, the building, shipping, and stacking process, SRB physical characteristics, including weight, thrust and type of propellant, the SRB use profile, including launch, recovery, refurbish, manufacture, ship, and stack, the deceleration system, the SRB crew-related operations, including twang, thrust profile, sep sequence, and reentry sequence, and 51-L.

Objectives:

- Describe the major components of the SRBs.
- Discuss the basic operating principles of the SRBs.
- Describe the reusability of the SRBs (in general terms).
- Describe the crew interface to the SRBs (in general terms).

# 52 **ECLSS OPS BR 21001**

Title: Environmental Control and Life Support Operations Review (Part 1)

Duration: 2.0 hours
Medium: Classroom
Student: ASCAN

Source: DS45/Shuttle Systems Training Group

Date: 10/05

Lesson(s) Replaced: None

Equipment Required: ASC C/L, PI C/L, ORB OPS C/L

Prerequisite Lesson(s): ECLSS 21057

Preparation: Read:

ECLSS 21002

Synopsis:

The lesson will start with a brief review of Environmental Control and Life Support System (ECLSS) subsystems. Next the lesson will review ECLSS switch panels and displays, focusing on the operational uses of the panels and meters. The nominal subsystem procedures, operations, and configurations will be discussed, from prelaunch through the midpoint of a typical mission timeline. The lesson will conclude with a discussion of the relationship between the displays, subsystem drawings and controls.

- Identify nominal ECLSS procedures and explain their purpose (from prelaunch to postlanding).
- Recognize ECLSS parameters on the following Systems Management (SM) displays: THERMAL, SYS SUMM 1, SYS SUMM 2, SPEC 66, and SPEC 88.
- Recognize ECLSS parameters on the panel O1 meters.

# 52 ECLSS OPS BR 21001 (Concluded)

- Explain the relationship between data seen on the overhead meters (panel O1) and on the displays.
- Recognize ECLSS switches and circuit breakers located on the following panels: L1, L2, L4, C5, C6, C7, R11L, O14, O15, O16, O17, MO10W, MO32M, MO69M, MD44F, ML26C, ML31C, ML86B, and MO51F.
- Identify the nominal ECLSS procedures performed from prelaunch through the midpoint of a typical mission, including:
  - Pre-launch
  - Ascent (liftoff through post OMS-2)
  - Post-Insertion
  - Selected Flight Plan activities [Pressure Control System (PCS)
     Config, Pre/Post-Sleep Activities, Supply/Waste Water Dump]
- State the rationale for performing each of the nominal ECLSS procedures.
- Explain the difference between the three "dP/dT" values on the displays (hardware, backup, equivalent), and state when each is available.
- Identify the mechanism(s) actively cooling the Freon loops during all phases of flight from prelaunch to mid-mission.
- Identify the two supply water system configurations, and explain why the valves are configured as they are for each configuration.
- Explain the radiator startup sequence in terms of the motion and timing of the radiator flow control and bypass valves.
- Describe the following subsystems of ECLSS by using the schematics on associated switch panels (i.e., panel L1, L2, R11L, ML31C, MO10W):
  - Pressure Control System
  - Atmosphere Revitalization Subsystem (ARS)
  - Active Thermal Control System (ATCS)
  - Supply and Waste H<sub>2</sub>O System
- Describe ECLSS subsystem configurations, based on the mission timeline.

53A **MECH OPS 21001** 

Title: Mechanical Systems Operations Prebrief

Duration: 0.5 hours
Medium: Classroom
Student: Non-ASCAN

Source: DS45/Shuttle Systems Training Group

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: Read:

MECH SYS 21002

Note: This lesson replaces the MECH OV 21001 lesson for non-ASCAN

students.

Synopsis: The lesson will provide a brief overview of the Mechanical (Mech)

Systems. The major components of each subsystem will be described, and various hardware models will be used to demonstrate their functions.

Objectives: • Identify the components of a Power Drive Unit (PDU) and state their functions.

• Explain how microswitches affect the PDU motors.

- Explain the difference between single motor drive and dual motor drive.
- Identify the functions of the Active Vent, External Tank (ET) Doors, Payload Bay Doors, Deployable Radiators, and Landing & Deceleration subsystems.
- Identify the major components of each Mech subsystem.

#### 53B **MECH OPS 21008**

Title: Mechanical Systems Operations

Duration: 1.5 hours Medium: SST 3

Student: ASCAN (Schedule in pairs.)

Source: DS45/Shuttle Systems Training Group

Date: 03/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): MECH OV 21001

Preparation: Read:

• MECH SYS 21002

# 53B MECH OPS 21008 (Concluded)

Synopsis:

This lesson familiarizes the student with the nominal procedures associated with active vent system, external tank umbilical doors, payload bay door system, radiator system, and landing and deceleration systems. The lesson flow follows that of a nominal mission starting at post-Main Engine Cutoff (MECO) and ending at rollout.

## Objectives:

- Execute the nominal mechanical system procedures (including radiator deploy/stow procedures) performed during a mission (prelaunch through postlanding).
- Explain the rationale for performing each of the nominal Mechanical system procedures (including radiator deploy/stow procedures).
- Identify Mechanical system parameters on the Guidance, Navigation, and Control (GNC) SPEC 51 OVERRIDE and on the Systems
   Management (SM) displays: SPEC 63 PL BAY DOORS and OPS 202 PL BAY DOORS.
- Locate Mechanical system switches and circuit breakers located on the following panels: R2, R4, R13L, F6, F8, R14, A12, C3.
- Explain auto mode and manual mode payload bay door operations.
- Explain the purpose of the Payload Bay Door Bulkhead Latch Go/No-Go diagram and state when it is used.
- Explain the purpose of the Centerline Latch Extended Guide Roller Trajectory No Go diagram and state when it is used.
- State how the crew interacts with the active vent system.
- Discuss the three external tank umbilical door closure methods.
- State how many radiator panels are located on each payload bay door.
- State how many radiator panels are deployable.
- Explain how and why procedural actions for single radiator deploy/stow operations differ from procedural actions for dual radiator deploy/stow operations.

#### 54A **EPS OPS 21001**

Title: Electrical Power System Operations Prebrief

Duration: 0.5 hours
Medium: Classroom
Student: Non-ASCAN

Source: DS45/Shuttle Systems Training Group

Date: 10/05

Lesson(s) Replaced: None

Equipment Required: ASC C/L, PI C/L, ORB OPS C/L, D/O PREP C/L, ENT C/L

Prerequisite Lesson(s): None

# 54A EPS OPS 21001 (Concluded)

Preparation: Read:

• EPS 21002

Note: This lesson replaces the EPS OPS BR 21001 lesson for non-ASCAN

students.

Synopsis: This lesson will provide a brief overview of the EPS. The major

components of each subsystem will be described, and the subsystem

interfaces will be discussed.

Objectives: • Identify the major components of each EPS subsystem.

 Identify the functions of the Power Reactants Storage and Distribution (PRSD), Fuel Cell Powerplants (FCP), and Electrical Power Distribution

and Control (EPDC) subsystems during all flight phases.

Describe how the EPS subsystems interface with one another and with

other Orbiter systems.

• Identify the power sources of the Main, Essential, Control, and AC

buses.

# 54B **EPS OPS 21004**

Title: Electrical Power System Operations

Duration: 1.5 hours

Medium: SST 2 or SST 1 or SST 3 Student: ASCAN (Schedule in pairs.)

Source: DS45/ Shuttle Systems Training Group

Date: 10/05

Lesson(s) Replaced: EPS OPS 21004

Equipment Required: None

Prerequisite Lesson(s): EPS OPS BR 21001

Preparation: Review:

• EPS 21002

Synopsis: This lesson will start by familiarizing the student with the meters, panels,

and displays. The student will then work through the EPS portions of FDF according to a nominal mission timeline and perform the procedures. During each procedure, the student and instructor will discuss the rationale behind each procedure. If there is time during the session, the student will be asked to discuss the impact, using onboard displays and functional diagrams, of making switch throws such as holding the Control Bus switch in Reset and letting it go, or disconnecting and reconnecting a

phase of AC power.

#### 54B **EPS OPS 21004 (Concluded)**

Objectives:

- Identify the EPS parameters on the following Systems Management (SM) displays: SYS SUMM 1, SYS SUMM 2, SPEC 67, SPEC 68, and SPEC 69.
- Identify EPS parameters on the meters on panels O2 and F9.
- Locate EPS switches and circuit breakers on the following panels: R1, A11, A15, R11U, L4, and C3.
- Execute the nominal EPS procedures performed during a mission (prelaunch through postlanding).
- Explain the rationale for each of the EPS nominal procedures.

#### 55A <u>APU/HYD OPS 21001</u>

Title: Auxiliary Power Unit/Hydraulic Operations Prebrief

Duration: 0.5 hours Classroom Medium: Student: Non-ASCAN

Source: DS45/Shuttle Systems Training Group

Date: 10/05

Lesson(s) Replaced: None **Equipment Required:** None Prerequisite Lesson(s): None

Preparation: Read:

APU/HYD/WSB 21002

This lesson replaces the APU/HYD OPS BR 21001 for non-ASCAN Note:

students.

Synopsis: This lesson will provide a brief overview of the Auxiliary Power Unit

(APU)/Hydraulic (Hyd) system. The major components of each subsystem will be described, and the subsystem interfaces will be

discussed.

- Objectives: Identify the functions of the APU and Hyd subsystems during all flight phases.
  - Identify the major components of each APU/Hyd subsystem.
  - Describe how the APU/Hyd subsystems interface with one another, and with other Orbiter systems.
  - Identify the main functions of the APU controller.

55B **APU/HYD OPS 21004** 

Title: Auxiliary Power Unit/Hydraulic Operations

Duration: 2.0 hours

Medium: SST 2 or SST 1 or SST 3 Student: ASCAN (Schedule in pairs.)

Source: DS45/Shuttle Systems Training Group

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): APU/HYD OPS BR 21001

Preparation: Review:

APU/HYD/WSB 21002

Synopsis: APU/HYD OPS 21004 will require the student to use the classroom skills

developed by APU/HYD/WSB 21002 and APU/HYD OPS BR 21001. The objective is to have the student capable of performing all nominal Auxiliary Power Unit (APU)/Hydraulic (Hyd) operations upon completion of the lesson. The student will learn how panels R2, R4, and A12 are used for nominal operations. Additionally, panels F7, F8, and the various displays

will be used.

Objectives:

- Execute the nominal APU/Hyd procedures performed during a mission (prelaunch through postlanding).
- Identify APU/Hyd parameters on Guidance, Navigation, and Control (GNC) SPEC 51 and the following Systems Management (SM) displays: THERMAL, SYS SUMM 2, SPEC 86, SPEC 87, and SPEC 88.
- Identify APU/Hyd parameters on the Multifunction Electronic Display System (MEDS) displays.
- Locate APU/Hyd switches and circuit breakers located on the following panels: R2, R4, and A12.
- Explain the rationale for performing each of the nominal APU/Hyd procedures.
- List the 8 uses for hydraulic power.

# 56A **MPS OPS 21001**

Title: Main Propulsion System Operations Prebrief

Duration: 0.5 hours
Medium: Classroom
Student: Non-ASCAN

Source: DS66/G&C/Propulsion Training Group

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None

# 56A MPS OPS 21001 (Concluded)

Prerequisite Lesson(s): None

Preparation: Read:

MPS Workbook 21002, Section 3

Note: This lesson replaces the MPS OPS BR 21001 lesson for non-ASCAN

students.

Synopsis: This lesson will very briefly review the 7 Main Propulsion System (MPS)

subsystems discussed in MPS OV 21001. The lesson will then focus on the 7 nominal crew tasks for MPS on ascent and will discuss in detail how to perform each of them. Next, the lesson will cover the rationale and execution of the 9 MPS-related FDF procedures. Finally, the lesson will provide a brief discussion of the abort mode boundary calls provided by

MCC to the crew on a nominal ascent.

Objectives: • Identify the 7 nominal crew tasks for MPS on ascent and explain how to perform each.

• Given a list of the 9 MPS-related FDF procedures:

Locate each procedure in the FDF.

Explain the rationale for each procedure.

Explain how to perform each procedure.

• Explain, in general terms, what each abort mode boundary call means to the crew given a list of the calls.

# 56B **MPS OPS 21006**

Title: Main Propulsion System Operations

Duration: 1.5 hours

Medium: SST 1 or SST 2 or SST 3 Student: ASCAN (Schedule in pairs.)

Source: DS66/G&C/Propulsion Training Group

Date: 04/06

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): MPS OPS BR 21001, CSI 21057, DPS 21006

Preparation: Review:

MPS OPS BR 21001 handoutMPS Workbook 21002, Section 3

# 56B MPS OPS 21006 (Concluded)

Synopsis: This

This lesson will allow the student to practice all of the tasks and procedures discussed in MPS OPS User's Guide 21002. The 7 nominal ascent crew tasks for Main Propulsion System (MPS) will be practiced during 2 full ascents run from T-25 seconds through External Tank Separation (ET SEP). During these runs, the instructor will provide abort mode boundary calls. The student will also perform all 9 MPS-related FDF procedures.

Objectives:

- Perform the 7 nominal crew tasks for MPS on ascent.
- Acknowledge the MCC-provided nominal abort mode boundary calls and explain in general terms what each call means.
- Perform the 9 MPS-related FDF procedures, and explain the rationale for each procedure.

#### 57A **ECLSS OPS 21001**

Title: Environmental Control and Life Support Operations Prebrief

Duration: 0.5 hours
Medium: Classroom
Student: Non-ASCAN

Source: DS45/Shuttle Systems Training Group

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ECLSS 21057

Preparation: Read:

ECLSS 21002

**Note:** This lesson replaces the ECLSS OPS BR 21001 lesson for non-

ASCAN students.

Synopsis: The lesson will provide a brief overview of the Environmental Control and

Life Support System (ECLSS) subsystems. The major components of each subsystem will be described, and the subsystem interfaces will be

discussed.

Objectives: • Identify the major components of each ECLSS subsystem.

Describe how the ECLSS subsystems interface with one another and
with other Orbitar systems.

with other Orbiter systems.

57B **ECLSS OPS 21004** 

Title: Environmental Control and Life Support Operations (Part 1)

Duration: 1.5 hours

Medium: SST 2 or SST 1 or SST 3 Student: ASCAN (Schedule in pairs.)

Source: DS45/Shuttle Systems Training Group

Date: 02/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ECLSS OPS BR 21001

Preparation: Review:

ECLSS 21002

Synopsis: The lesson will start with a very brief review of the switch panels. The

student will perform nominal Environmental Control and Life Support System (ECLSS) procedures from prelaunch to the midpoint of a typical mission. Panel O1 meters and onboard display data will be referenced throughout the lesson to monitor subsystem/component signatures as switches are thrown. Throughout the lesson, the student will be asked to

identify subsystem diagrams on ECLSS panels and how switch

configurations relate to the function of the subsystem.

Objectives: • Execute the nominal ECLSS procedures performed during a mission, from prelaunch through mid-mission of a typical timeline.

 Identify ECLSS parameters on the following Systems Management (SM) displays: THERMAL, SYS SUMM 1, SYS SUMM 2, SPEC 66, and SPEC 88.

- Locate ECLSS switches and circuit breakers located on the following panels: L1, L2, L4, C5, C6, C7, O14, O15, O16, O17, R11L, MO10W, MD44F, ML26C, ML31C, and ML86B.
- Identify ECLSS parameters on the panel O1 meters.
- Explain the rationale for performing each of the nominal ECLSS procedures.

#### 58 **ECLSS OPS BR 22001**

Title: Environmental Control and Life Support Operations Review (Part 2)

Duration: 2.0 hours
Medium: Classroom
Student: ASCAN

Source: DS45/Shuttle Systems Training Group

Date: 10/05

Lesson(s) Replaced: None

Equipment Required: ORB OPS C/L, D/O PREP C/L, ENT C/L

## 58 ECLSS OPS BR 22001 (Continued))

Prerequisite Lesson(s): ECLSS OPS BR 21001

Preparation: Review:

• ECLSS 21002

Synopsis:

The lesson will start with a brief review of Environmental Control and Life Support System (ECLSS) subsystems. Next, the lesson will review ECLSS switch panels and displays, focusing on the operational uses of the panels and meters. The nominal subsystem procedures, operations, and configurations will be discussed, from the midpoint of a typical mission timeline through post-landing. The lesson will conclude with a discussion of the relationship between the displays, subsystem drawings, and controls.

- Identify nominal ECLSS procedures and explain their purpose (from prelaunch to post-landing).
- Recognize ECLSS parameters on the following Systems Management (SM) displays: THERMAL, SYS SUMM 1, SYS SUMM 2, SPEC 66, and SPEC 88.
- Recognize ECLSS parameters on the panel O1 meters.
- Explain the relationship between data seen on the overhead meters (panel O1) and on the displays.
- Recognize ECLSS switches and circuit breakers located on the following panels: L1, L2, L4, C5, C6, C7, R11L, O14, O15, O16, O17, MO10W, MO32M, MO69M, MD44F, ML26C, ML31C, ML86B, and MO51F.
- Identify the nominal ECLSS procedures performed from the midpoint of a typical mission through post-landing, including:
  - Selected Flight Plan activities (mid-mission reconfiguration of various systems)
  - Deorbit Prep
  - Entry
  - Post-Landing
- State the rationale for performing each of the nominal ECLSS procedures.
- Identify the mechanism(s) actively cooling the Freon loops during all phases of flight from mid-mission to post-landing.
- Explain the radiator startup sequence in terms of the motion and timing of the radiator flow control and bypass valves.

# 58 ECLSS OPS BR 22001 (Concluded)

- Describe the following subsystems of ECLSS by using the schematics on associated switch panels (i.e., panel L1, L2, R11L, ML31C, MO10W):
  - Pressure Control System (PCS)
  - Atmosphere Revitalization Subsystem (ARS)
  - Active Thermal Control System (ATCS)
  - Supply and Waste H<sub>2</sub>O System
- Describe ECLSS subsystem configurations, based on the mission timeline.

# 59 **ECLSS OPS 22004**

Title: Environmental Control and Life Support Operations (Part 2)

Duration: 1.5 hours

Medium: SST 1 or SST 2 or SST 3 Student: ASCAN (Schedule in pairs.)

Source: DS45/Shuttle Systems Training Group

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ECLSS OPS BR 22001, ECLSS OPS 21004

Preparation: Review:

• ECLSS 21002

#### Synopsis:

The lesson will start with a very brief review of the switch panels. The student will perform nominal Environmental Control and Life Support System (ECLSS) procedures from the midpoint of a typical mission to post-landing. Panel O1 meters and display data will be referenced throughout the lesson to monitor subsystem/component signatures as switches are thrown. Throughout the lesson, the student will be asked to identify subsystem diagrams on ECLSS panels and how switch configurations relate to the function of the subsystem.

- Execute the nominal ECLSS procedures performed during a mission, from mid-mission of a typical timeline through post-landing.
- Identify ECLSS parameters on the following Systems Management (SM) displays: THERMAL, SYS SUMM 1, SYS SUMM 2, SPEC 66, and SPEC 88.
- Locate ECLSS switches and circuit breakers located on the following panels: L1, L2, L4, C5, C6, C7, O14, O15, O16, O17, R11L, MO10W, MD44F, ML26C, ML31C, and ML86B.
- Identify ECLSS parameters on the panel O1 meters.
- Explain the rationale for performing each of the nominal ECLSS procedures.

# 60 **TIER TEST 22001**

Refer to TIER TEST 21001 for description.

### 61 **GALLEY 21020**

Title: Galley (Shared – Shuttle)

Duration: 1.0 hour

Medium: CCT II or FFT only

Student: ASCAN, PS (Schedule in groups of 4.)

Source: DX45/Crew Systems Group

Date: 08/04

Lesson(s) Replaced: HAB EQ/PROC 21020

Equipment Required: None Prerequisite Lesson(s): None

Preparation: Read:

FOOD SYS 21002

Synopsis: This lesson is designed to familiarize crewmembers with the operations of

the orbiter galley. Information on the types of food available and the preparation of the food items will be covered. In addition, a meal will be

prepared and eaten by the students.

Objectives: • Describe the basic galley operations.

• Describe how food is prepared using the galley.

# 62 **WCS PROC 21065**

Title: Waste Collection System Procedures (Shared – Shuttle)

Duration: 1.0 hour Medium: WCS Trainer

Student: ASCAN (Schedule in groups of up to 3.)

Source: DX45/Crew Systems Group

Date: 08/04

Lesson(s) Replaced: HAB EQ/PROC 21020

Equipment Required: None Prerequisite Lesson(s): None

Preparation: Take:

WCS 21057

Synopsis: This lesson is conducted in the Waste Collection System (WCS) training

facility located in building 5. Students are shown the launch configuration of the WCS and the procedure for configuring the WCS for orbit ops. Normal and contingency procedures are discussed and demonstrated.

# 62 WCS PROC 21065 (Concluded)

Objectives: • Describe the general configuration and operation of the WCS.

- Identify the equipment and quantities of items stowed in the waste management compartment.
- Perform the post-insertion configuration and WCS setup procedures.

### 63A <u>CCTV OPS BR 21001</u>

Title: Closed Circuit Television Operations Briefing

Duration: 1.0 hour Medium: Classroom

Student: ASCAN (Schedule in pairs.)

Source: DS25/Communications/NSS Training Group

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): COMM OV 21001

Preparation: Read:

CCTV OPS 21108

SCOM; Section 2.3, CCTV

Synopsis: The intent of this prebrief is to introduce the student to the CCTV system

and its associated components.

Objectives: • Identify the purpose of the CCTV system.

- Identify the CCTV hardware components and two Radio Frequency destinations where CCTV video is routed.
- Identify the major components of the CCTV system, which comprise the Video Control Unit (VCU).
- Identify the five major functions of the Remote Control Unit (RCU) and the six major functions of the Video Switching Unit (VSU).
- Identify the one true Ground Control Interface Logic (GCIL) switch of the CCTV system.
- Locate and identify the circuit breakers and CCTV switches used to configure the CCTV system.
- Identify the two types of cameras, the camera locations, and camera range of movement.

63B **CCTV OPS 21001** 

Title: Closed Circuit Television Operations Prebrief

0.5 hours Duration: Medium: Classroom Student: Non-ASCAN

DS25/Communications/NSS Training Group Source:

Date:

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: Read:

• CCTV OPS 21108

SCOM; Section 2.3, CCTV

This lesson replaces the CCTV OPS BR 21001 lesson for non-ASCAN Note:

students.

The intent of this prebrief is to introduce the student to the CCTV system Synopsis:

and its associated components.

Objectives: Identify the purpose of the CCTV system.

> • Identify the CCTV hardware components and two Radio Frequency destinations where CCTV video is routed.

• Identify the major components of the CCTV system, which comprise the Video Control Unit (VCU).

 Identify the five major functions of the Remote Control Unit (RCU) and the six major functions of the Video Switching Unit (VSU).

• Identify the one true Ground Control Interface Logic (GCIL) switch of the CCTV system.

 Locate and identify the circuit breakers and CCTV switches used to configure the CCTV system.

• Identify the two types of cameras, the camera locations, and camera range of movement.

#### 63C **CCTV OPS 21008**

Title: **Closed Circuit Television Operations** 

Duration: 1.0 hour SST 3 Medium:

Student: ASCAN (Schedule in pairs.)

DS25/Communications/NSS Training Group Source:

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): CCTV OPS BR 21001

# 63C CCTV OPS 21008 (Concluded)

Preparation: None

Synopsis: This lesson will introduce the student to the functions and operations of

the CCTV system. The student will perform nominal CCTV procedures, which include activating, operating and deactivating the CCTV system using the cue card and associated CCTV panel controls. The lesson will also discuss recorder interfaces to the CCTV system and the basic

configuration to record video.

Objectives: • Activate and deactivate the CCTV system per CCTV cue card.

• Perform the following operations:

Locate panel A6 and A7 CCTV switches.

Power on and off CCTV cameras and monitors.

 Route video to monitors and downlink video to Mission Control Center.

Generate a multiplexed scene on a monitor.

• Operate the 12 menu options on the Color Television Monitors.

• Describe generic record and playback operations associated with a recorder interface to the CCTV system.

# 64 <u>P/L COM/OIU OPS BR 21001</u>

Title: Payload Communications/Orbiter Interface Unit Operations Prebrief

Duration: 1.5 hours
Medium: Classroom
Student: ASCAN

Source: DS25/Communications/NSS Training Group

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): COMM OV 21001

Preparation: Read:

P/L COM 21002

Take:

P/L COM 21057

Synopsis: The purpose of this lesson is to explain the Payload Communications

(P/L COM)/Orbiter Interface Units (OIUs) operations using Payload Signal Processor (PSP) and Payload Data Interleaver (PDI) Line Replaceable Units (LRUs) of the P/L COM system. The lesson will also cover related procedures for Pulse Code Modulation Master Units (PCMMUs), PDI, and

OIU formatting and configurations.

#### 64 P/L COM/OIU OPS BR 21001 (Concluded)

- Objectives: Describe the command and telemetry flow to and from generic attached and deployable payloads.
  - Explain the basic functions and redundancies of the payload communication/OIU system.
  - Review crew procedures and relate the information displayed on SPEC 62 and SPEC 212 to the components of the payload communication/OIU system, for nominal and off-nominal conditions.
  - Locate the switches for the payload communication/OIU system.
  - Identify the generic and flight-specific FDF books related to payload communications/OIU operations.

#### 65 **DPS FAM 23006**

Title: Data Processing System Familiarization 3

2.0 hours Duration:

Medium: SST 1 or SST 2 or SST 3 Student: ASCAN (Schedule in pairs.)

DS24/DPS/Navigation Training Group Source:

Date: 02/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): DPS FAM 22006, ORB FDF USE 21001

Preparation: Review:

DPS FAM 21002

FDF 21057

Synopsis:

This lesson concentrates on the nominal FDF procedures for the DPS. The format of the class is a nominal flight profile. The lesson begins prelaunch, taking the student through Ascent, Post-Insertion, Orbit, Deorbit Prep, and finally Post-Landing. During the lesson, the student will exercise all nominal DPS procedures using FDF. The rationale and concepts discussed in previous Familiarization lessons are brought together in this lesson to demonstrate to the student why the nominal procedures are written as they are. The student is expected to have a basic knowledge of the rationale for the major steps in these procedures.

- Perform, aided, the following prelaunch DPS procedures as specified in the Ascent Checklist (C/L):
  - Post Ingress SW Reconfig
  - PASS/BFS Transfer Prep
  - OPS 1 Load (PASS GPCs to GNC OPS 1)
  - BFS to OPS 1

# 65 DPS FAM 23006 (Concluded)

- Perform, aided, the following Post-Insertion DPS procedures:
  - Config GPCs for OPS 2 (Block 1)
  - PLBD OPS GO/NO GO Criteria
- Perform DPS steps in the Group B Powerdown.
- Perform, aided, a set contraction to configure the GPCs for single G2 Operational Sequence (OPS) using the procedure in the Orbit OPS C/L.
- Perform G2 to G8 and G8 to G2 OPS transition associated with the Flight Control System (FCS) Checkout as specified in the Orbit OPS C/L.
- Perform, aided, the following Deorbit Prep C/L DPS procedures:
  - CRT Timer Setup (Block 1)
  - DPS Config for D/O Prep (Block 4a)
  - Ensure BFS GPC can command an Integrated Display Processor (Block 4b)
  - DPS Entry Config (Block 12)
- Perform, aided, the following post-landing DPS procedures:
  - DPS Transition (to OPS 9 PASS and OPS 0 BFS)
  - G9 Set Contraction in Extended Power Up (as time permits)

## 66 **UNIV PTG 21001**

Title: Universal Pointing Briefing

Duration: 2.0 hours
Medium: Classroom
Student: ASCAN

Source: DS24/DPS/Navigation Training Group

Date: 03/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): NAV OV BR 21001

Preparation: Read:

- G&C I/O/D 21002A; Section 5, UNIV PTG Display
- SCOM
  - Section 2.7, Dedicated Display Systems: ADI subsection (pages 2.7-3 through 2.7-6)
  - Section 2.13, Guidance, Navigation, and Control (GNC):
     Coordinate Systems subsection (pages 2.13-3 through 2.13-4)
  - Section 2.13, Guidance, Navigation, and Control (GNC):
     Orbital DAP Panel Subsection (pages 2.13-48 through 2.13-50)

#### Take:

 GNC DED DISP 21057 (Primary Flight Display – Attitude Direction Indicator section only)

# 66 UNIV PTG 21001 (Concluded)

Synopsis:

This briefing covers topics related to universal pointing. The applicable coordinate systems are introduced at the beginning of this briefing, followed by a discussion of all available targets and body vectors used by Guidance, Navigation, and Control (GNC) software to point the orbiter. The relationship between the Universal Pointing (UNIV PTG) software and the on-orbit Digital Auto Pilot (DAP) will be discussed. Examples are provided on selecting appropriate UNIV PTG commands to establish a desired orbiter attitude in Local Vertical Local Horizontal (LVLH) coordinates. In addition, the student will attempt to visualize each attitude by positioning an orbiter model relative to a predefined LVLH reference frame. The lesson contains additional visual aids, which assist in developing the thought process for orbiter attitude determination.

#### Objectives:

- Describe commonly used coordinate systems (M50 inertial, LVLH, orbiter body) and their application to pointing the orbiter.
- Explain how to read the Attitude Direction Indicator (ADI).
- Explain the basic functions of the DAP (A, B, AUTO, INRTL, LVLH, FREE, PRI, ALT, VERN, DISC RATE, and PULSE (rotation)).
- Identify the GNC software display used for pointing the orbiter (UNIV PTG) and its interface to the DAP.
- Explain how to perform a maneuver (MNVR) to an inertial attitude.
- Explain how to perform a track (TRK), including definition of the target identification (TGT ID), orbiter body vector (BODY VECT), and Omicron (OM).
- Explain how to perform a rotation (ROT).
- Explain the UNIV PTG fields used to monitor vehicle attitude.
- Describe the inputs to the UNIV PTG display and DAP to perform various maneuvers based on a given set of attitude constraints at the present or a future MET.

# 67 **MAL FDF USE 21001**

Title: Malfunction Flight Data File Usage Briefing

Duration: 3.0 hours
Medium: Classroom
Student: ASCAN

Source: DA72/Training Execution Branch

Date: 02/04

Lesson(s) Replaced: None Equipment Required: AESP

Prerequisite Lesson(s): ORB FDF USE 21001

Preparation: Review:

FDF 21057

# 67 MAL FDF USE 21001 (Concluded)

### Synopsis:

This lesson is designed to provide an introduction to the procedures used when an off-nominal event (malfunction) occurs. The briefing reviews the different types of off-nominal FDF as well as when they are used and how they are formatted. Cockpit configurations for ascent, orbit, and entry are reviewed as they relate to the layout of the off-nominal FDF. Extra time is spent reviewing the peculiarities of the A/E Systems Procedures and Malfunction Procedures. The briefing also includes exercises that demonstrate the use of malfunction FDF.

#### Objectives:

- Given a pictorial of a mission, label which pieces of off-nominal FDF are used for each mission phase.
- State what malfunction FDF is used during OMS burns.
- State how the Ascent/Entry Systems Procedures book is organized.
- Define the relationship between the Ascent/Entry Systems Procedures and the CDR Window Flip Book, the PLT Overhead and Window Flip Books, and cue cards.
- Define the flight configuration of the Ascent/Entry Systems Procedures for ascent and entry (i.e., which books are the AESP procedures combined with during these 2 flight phases).
- Given a schematic of the cockpit, identify where certain malfunction FDF books are located during ascent and entry.
- State who uses the Ascent/Entry Systems Procedures in the cockpit.
- Define the meaning of the different symbols used in the Ascent/Entry Systems Procedures and pocket checklists.
- Explain when the Malfunction Procedures are used versus when the Orbit Pocket C/L is used.
- Define the term Super Mal.
- Given a copy of a typical procedure in the Mal Procedure, walk through a failure scenario following the blocks until a "conclusion block" is reached.
- Briefly explain the purpose of the SYS AOA book and the Contingency Deorbit Book.

#### 68 **E NAV BR 21001**

Title: Entry Navigation Briefing

Duration: 3.0 hours
Medium: Classroom
Student: ASCAN

Source: DS24/DPS/Navigation Training Group

Date: 08/04

Lesson(s) Replaced: None Equipment Required: None

# 68 <u>E NAV BR 21001 (Continued)</u>

Prerequisite Lesson(s): A/E CL USE 21001, NAV OV BR 21001

Preparation: Read:

- NAV 21002; with an emphasis on entry navigation topics
- NAVAIDS 21002; for details on Tactical Air Navigation System (TACANS), Microwave Landing System (MLS), Radar Altimeters (RAs), and Global Positioning System (GPS)
- ADS 21002; for details on Air Data System

### Synopsis:

This briefing is an introduction to the navigation system used by the orbiter during the entry phase of flight, with an emphasis on the crew operations in managing the orbiter navigation state vector (NAV state). The briefing begins with an overview of the Operational Sequence (OPS) 3 Entry navigation scheme: three independent Inertial Measurement Unit (IMU) state vectors, NAV filter, and the combination of sensor measurements the shuttle uses to maintain an accurate onboard NAV state. An overview of the various NAV sensors is presented: Drag Altitude, Tactical Air Navigations (TACANs), Air Data, Microwave Scanning Beam Landing System (MSBLS), GPS, and Radar Altimeters (RAs). Emphasis is placed on the crew management of the sensors and sensor data using cockpit resources (FDF, switches, DPS displays, and tapes) and in coordination with the MCC. The Redundancy Management (RM) of each of the sensors is discussed. Corrections to the onboard NAV state via MCC uplinks and GPS updates are discussed. The nominal signatures of the sensor data and signatures of some of the failure modes are described and shown via video filmed in the SMS.

- Explain the concept of the single-state vector scheme and when it is used.
- Explain the concept of the 3-state vector scheme and why it is used in OPS 3.
- Explain the basic function of the General Purpose Computer (GPC) Kalman filter (NAV filter).
- Describe the parameters provided for entry navigation by the various NAVAID sensors: Drag Altitude (DRAG H), TACANS, Microwave Landing System (MLS), Air Data Transducer Assembly (ADTA) units, and RA.
- Discuss GPS and how it is used with respect to navigation.
- Identify the windows of usage for the various NAV sensors (Drag H, TACAN, ADTA, MLS, RA) for a nominal entry profile.
- Explain the use of the NAV filter displays and controls on SPEC 50 (RATIO, Residual (RESID), Auto (AUT), Inhibit (INH), Force (FOR)).

## 68 E NAV BR 21001 (Concluded)

- Identify the crew actions to evaluate data from the various NAV sensors (Drag H, TACAN, MLS, ADTA, RA).
- Describe the procedure for Air Data Probe deploy and deploy verification.
- Describe the switches and circuit breakers for the various NAV sensors (TACAN, MLS, ADTA, RA).
- Describe the interfaces of the DPS and EPS to the various NAV sensors (TACAN, MLS, ADTA, RA).
- Describe the RM for the various NAV sensors (TACAN, ADTA, MLS).
- Describe the nominal MCC calls concerning NAV sensor management during an entry.
- State the various ways to update the state vector and the order of preference (MCC whole state uplink, GPS update, MCC delta state uplink).
- Describe the use of Primary Avionics Software System (PASS) SPEC 50 and SPEC 55 to perform a state vector update.
- Explain IMU re-anchoring in OPS 3.
- Describe how to perform a PASS-to-Backup Flight Software (BFS) state vector transfer and when it is used.

# 69 **ENT AERO BR 21001**

Title: Entry Aerodynamics Briefing

Duration: 2.5 hours
Medium: Classroom
Student: ASCAN

Source: DS66/G&C/Propulsion Training Group

Date: 08/04

Lesson(s) Replaced: E AERO BR 21001

Equipment Required: None

Prerequisite Lesson(s): ENT OV BR 21001

Preparation: Read:

SCOM:

- Section 4.3, Airspeed Limitations
- Section 4.4, Angle of Attack Limitations
- Section 4.5, Sideslip Limitations
- Section 4.6, Landing Weight Limitations
- Section 4.7, Descent Rate Limitations
- Section 4.8, Center of Gravity Limitations
- Section 4.9. Accel. Limitations

# 69 ENT AERO BR 21001 (Continued)

### Synopsis:

This lesson discusses how the orbiter flies and its aerodynamic characteristics starting at Entry Interface (EI) and ending at rollout. The differences between how the orbiter flies and how a conventional aircraft flies will be discussed. This lesson also discusses the limitations of the orbiter, as well as some terms that flight crews need to know.

- Define the following aerodynamic terms used in shuttle entry:
  - Roll
  - Bank
  - Pitch
  - Yaw
  - Beta
  - Alpha
  - Gamma
  - Phi
  - Theta
  - Obar
  - Knots Equivalent Airspeed (KEAS)
  - Inertial Velocity (VI)
  - Relative Velocity (Vrel)
  - Mach number
- Draw a free body diagram of the orbiter during high-speed entry. State how this diagram is different from a conventional glider.
- Describe the control devices used by the orbiter on entry.
- State which of the 3 rotational axes are always highly coupled.
- Explain why an orbiter with forward center of gravity (c.g.) will have less effective roll/yaw control.
- State what DTOs and Programmed Test Inputs (PTIs) are and explain the relationship between the two.
- Sketch the Normal Acceleration (Nz) versus weight limit.
- Sketch the alpha versus Mach limits for Mach 0 to Mach 2.5.
- State the following orbiter entry limits:
  - Pitch up divergence alpha at Mach 1.5 and Mach 0.6
  - C-N-Beta dynamic alpha (hypersonic)
  - Max airspeed
  - G's
- Find the maximum lift over drag (L/D) angles of attack given the appropriate FDF. State which max L/D alpha is not in the FDF.
- Describe what happens when any of the following limits are violated:
  - Max Lift-to-Drag Ratio (L/D) alpha
  - Pitch up divergence alpha
  - C-N-Beta dynamics alpha

## 69 ENT AERO BR 21001 (Concluded)

- Max airspeed
- G's
- Y c.q.
- Forward c.g.
- Aft c.g.

# 70 **KU OPS BR 21001**

Title: Ku-Band Operations Review

Duration: 2.0 hours
Medium: Classroom
Student: ASCAN

Source: DS25/Communications/NSS Training Group

Date: 10/05

Lesson(s) Replaced: None

Equipment Required: ORB OPS C/L
Prerequisite Lesson(s): COMM OV 21001

Preparation: Read:

KU OPS 21002

Review:

- ORB OPS C/L; Section 2, COMM/INST
  - KU-BD ANT DEPLOY
  - KU-BD ACTIVATION
  - KU-BD ANT STOW

Synopsis: This lesson will discuss the purpose of the Ku-Band system, the Ku-Band

components, the Ku-Band displays and switches, and the nominal Ku-Band procedures (KU-BD ANT DEPLOY, ACTIVATION, and ANT

STOW procedures in Section 2 of the Orb Ops C/L).

Objectives: • State the two purposes of the Ku-Band system.

- State what type of information can be in the Ku-Band uplink.
- State the number of Ku-Band channels of downlink.
- Describe the location of the Ku-Band antenna on the orbiter.
- Name the phase of flight in which the Ku-Band antenna can be used.
- Locate all Ku-Band panels/switches in the orbiter and state the function of each of the switches.
- Describe the purpose of each of the Ku-Band related parameters and item entries on SM OPS 201, Antenna Display; SM SPEC 76; and GNC SPEC 33.
- State the two reasons Ku-Band maskings are used.
- Explain the purpose of the major steps in the Ku-Band nominal procedures in Section 2 of the Orb Ops C/L.

### 71A **P/L COM/OIU OPS 21001**

Title: Payload Communications/Orbiter Interface Unit Operations Prebrief

Duration: 0.5 hours
Medium: Classroom
Student: Non-ASCAN

Source: DS25/Communications/NSS Training Group

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: Read:

P/L COM 21002

Take:

P/L COM 21057

**Note:** This lesson replaces the P/L COM/OIU OPS BR 21001 lesson for

non-ASCAN students.

Synopsis: The purpose of this lesson is to explain the Payload Communications

(P/L COM)/Orbiter Interface Units (OIUs) operations using Payload Signal Processor (PSP) and Payload Data Interleaver (PDI) Line Replaceable Units (LRUs) of the P/L COM system. The lesson will also cover related procedures for Pulse Code Modulation Master Units (PCMMUs), PDI, and

OIU formatting and configurations.

Objectives: • Describe the command and telemetry flow to and from generic attached and deployable payloads.

Explain the basic functions and redundancies of the payload

communication/OIU system.

 Review crew procedures and relate the information displayed on SPEC 62 and SPEC 212 to the components of the payload communication/OIU system, for nominal and off-nominal conditions.

• Locate the switches for the payload communication/OIU system.

 Identify the generic and flight-specific FDF books related to payload communications/OIU operations.

### 71B **P/L COM/OIU OPS 21006**

Title: Payload Communications/Orbiter Interface Unit Operations

Duration: 2.0 hours

Medium: SST 1 or SST 2 or SST 3 Student: ASCAN (Schedule in pairs.)

Source: DS25/Communications/NSS Training Group

Date: 10/05

Lesson(s) Replaced: P/L COM OPS 21006

## 71B P/L COM/OIU OPS 21006 (Concluded)

Equipment Required: None

Prerequisite Lesson(s): P/L COM/OIU OPS BR 21001

Preparation: Review:

P/L COM/OIU OPS BR 21001; Handouts

Read:

P/L COM 21002

Synopsis: This lesson introduces the student to the hands-on operation of the

Payload Communication (P/L COM)/Orbiter Interface Unit (OIU) system.

The student will perform related nominal procedures in the same

sequence as in normal flight. The student will review the systems, FDF

use and procedures, and equipment configurations.

Objectives:

- Describe the hardline and Radio Frequency (RF) command and telemetry flow, using the payload communication overview diagram in Section 2 of the Malfunction procedures.
- Describe the components and interfaces of the Payload Communication/ OIU systems.
- Review crew displays and controls for P/L COM, Pulse Code Modulation Master Unit (PCMMU), and OIU.
- Configure the Payload Comm system for hardline mode and also for RF mode.
- Identify both nominal and off-nominal signatures of the Payload Comm system and OIU.

### 72 **TAEM GUID BR 21001**

Title: Terminal Area Energy Management Guidance Briefing

Duration: 3.0 hours
Medium: Classroom
Student: ASCAN

Source: DS66/G&C/Propulsion Training Group

Date: 08/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): APPR/LNDG BR 21001, ENT AERO BR 21001

Preparation: Read:

SCOM; Section 7.4

Take:

GNC DED DISP 21057

HUD 21057

# 72 TAEM GUID BR 21001 (Concluded)

Synopsis:

This lesson covers the Terminal Area Energy Management (TAEM) Guidance algorithm that functions during entry from an earth-relative velocity of 2500 fps to Approach and Landing interface (approximately 10,000 ft altitude). The lesson covers TAEM Guidance outputs, flight instrument and subsystem status displays, and both AUTO and manual techniques of controlling energy.

Objectives:

- Define when TAEM guidance starts and when it stops.
- Describe how the TAEM pitch channel command is generated.
- Describe how the TAEM phase-specific roll commands are generated.
- Describe how the TAEM speedbrake commands are generated.
- Describe the flight instrument and subsystem status displays available during the TAEM phases.
- Describe the methods (both AUTO and manual) available for recovering from both high and low energy.
- State three primary differences between OPS 3 and OPS 6 TAEM Guidance.
- Describe two cases where the TAEM pitch command is bad (pitch error needles are erroneous) due to sensor failures.
- Describe Theta Limits and their use.
- Explain the energy and glide slope calls made by the MCC and crew reaction to each.

### 73A **KU OPS 21001**

Title: Ku-Band Operations Prebrief

Duration: 0.5 hours
Medium: Classroom
Student: Non-ASCAN

Source: DS25/Communications/NSS Training Group

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: Read:

KU OPS 21002

Review:

ORB OPS C/L; Section 2, COMM/INST

KU-BD ANT DEPLOY

KU-BD ACTIVATION

KU-BD ANT STOW

# 73A <u>KU OPS 21001 (Concluded)</u>

**Note:** This lesson replaces the KU OPS BR 21001 lesson for non-ASCAN

students.

Synopsis: This lesson will discuss the purpose of the Ku-Band system, the Ku-Band

components, the Ku-Band displays and switches, and the nominal Ku-Band procedures (KU-BD ANT DEPLOY, ACTIVATION, and ANT

STOW in Section 2 of the Orb Ops C/L).

Objectives: • State the two purposes of the Ku-Band system.

State what type of information can be in the Ku-Band uplink.

State the number of Ku-Band channels of downlink.

Describe the location of the Ku-Band antenna on the orbiter.

• Name the phase of flight in which the Ku-Band antenna can be used.

• Locate all Ku-Band panels/switches in the orbiter and state the function of each of the switches.

 Describe the purpose of each of the Ku-Band related parameters and item entries on SM OPS 201, Antenna Display; SM SPEC 76; and GNC SPEC 33.

• State the two reasons Ku-Band maskings are used.

• Explain the purpose of the major steps in the Ku-Band nominal procedures in Section 2 of the Orb Ops C/L.

### 73B **KU OPS 21006**

Title: Ku-Band Operations

Duration: 1.5 hours

Medium: SST 1 or SST 2 or SST 3 Student: ASCAN (Schedule in pairs.)

Source: DS25/Communications/NSS Training Group

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): KU OPS BR 21001

Preparation: Review:

COMM SPEC 21057; Segment 4, Ku-Band

Orbit Ops C/L

KU-BD ANT DEPLOY

ACTIVATIONANT STOW

KU-BD MANUAL ACQUISITION (COMM)

KU-BD ANT JETTISON

Mal Proc; MECH Section, SSR-5

# 73B **KU OPS 21006 (Concluded)**

Read:

KU OPS 21002

Synopsis:

The lesson will start with a review of panel/switch locations/functions and Ku-Band display information. The Ku-Band antenna heaters will be discussed and activated. The student will perform procedures such as KU-BD ANT DEPLOY, ACTIVATION, and ANT STOW. The student will be required to explain the purpose of each procedure step as it is performed. There will also be a brief review of radar operations and discussion and/or performance of contingency operations (i.e., Ku jettison).

Objectives:

- Perform, aided, and explain the major steps of the following nominal procedures:
  - KU-BD ANT DEPLOY
  - KU-BD ACTIVATION
  - KU-BD ANT STOW
- Perform, aided, COMM and radar mode antenna operations.
- Perform, aided, the following malfunction procedures:
  - KU-BD MANUAL ACQUISITION
  - KU-BD ANT DIRECT STOW
  - KU-BD ANT JETTISON (if time permits)
- State the 2 purposes of Ku-Band in the radar mode.

## 74 **REF DATA USE 21001**

Title: Reference Data Usage Briefing

Duration: 3.0 hours
Medium: Classroom
Student: ASCAN

Source: DS45/Shuttle Systems Training Group and CB/Astronaut Office

Date: 03/05

Lesson(s) Replaced: None

Equipment Required: REF DATA

Prerequisite Lesson(s): MAL FDF USE 21001

Preparation: None

# 74 REF DATA USE 21001 (Concluded)

Synopsis:

This lesson is designed to be presented in 3 parts. There is an explanation of the types of information contained in the Reference (Ref) Data Book, an explanation of when Ref Data is used, and the completion of exercises that work all sections of the Ref Data book. In addition, the lesson will review which crewmember is responsible for this book during ascent and entry, and how it is used during each phase of flight.

Objectives:

- State the major sections of the Ref Data Book.
- Use Ref Data to identify equipment lost when given an electrical, databus, and Operational Instrumentation Dedicated Signal Conditioner (OI DSC) failure.
- Use Ref Data to determine how to reset the hardware and software Caution & Warning (C&W) limit for a given parameter.
- Use Ref Data to determine which parameter(s) may be out of limit(s) when provided with a particular fault message or F7 C&W Matrix light.
- Use Ref Data to identify Navigation stars and associated information given a Star ID.
- Use Ref Data to identify various Program Notes, and how and when those Notes apply.
- Use Ref Data to locate a given stowage item (i.e., identify locker that it is stowed in).

#### 75A **E NAV 21001**

Title: Entry Navigation 1 Prebrief

Duration: 0.5 hours Medium: Classroom

Student: ASCAN (Schedule in pairs.)

Source: DS24/DPS/Navigation Training Group

Date: 07/07

Lesson(s) Replaced: E NAV 21011 (partial)

Equipment Required: None

Prerequisite Lesson(s): E NAV BR 21001, MAL FDF USE 21001

Preparation: Review:

- NAV 21002; with an emphasis on entry navigation topics
- NAVAIDS 21002
- ADS 21002

Take:

GNC DED DISP 21057

# 75A <u>E NAV 21001 (Concluded)</u>

#### Read:

- AESP (Glided Flight); COMM/GNC and DPS
  - RM FAIL ADTA
  - RM DLMA ADTA
  - RM FAIL TAC
  - RM DLMA TAC
  - FA/FF MDM I/O ERROR and PORT MODE

#### Synopsis:

This prebrief takes a "what-you-need-to-know-onboard" approach to the entry Navigation Aids (NAVAIDs), with primary emphasis on Tactical Air Navigation Units (TACANs) and air data. Procedures for monitoring the state vector on entry, evaluating sensors, and incorporating them, with MCC concurrence, will be introduced sequentially while talking through a desktop entry simulation. This includes all expected ground calls as well as procedures for deploying the air data probes at the appropriate time. The ENTRY MANEUVERS cue card will be discussed in detail.

Pertinent information on Guidance, Navigation, and Control (GNC) SPECs 50 and 51 will be reviewed for working with the NAVAID data. TACAN and air data systems details and software interface (Redundancy Management (RM) and Fault Detection, Identification, and Reconfiguration (FDIR)) will be reviewed as they pertain to understanding and successfully troubleshooting malfunctions.

- Identify the function and availability of each of the NAVAIDs (Drag Attitude (Drag H), Global Positioning System (GPS), TACAN, air data, Microwave Landing System (MLS), Radar Altimeter (RA)) in a typical entry flight profile.
- Explain procedures for evaluating and/or incorporating NAVAIDs (Drag H, GPS, TACAN, air data, MLS, RA) using onboard instruments and displays.
- Explain SPEC 50 residuals and ratios for DRAG H, TACAN, and Air Data Transducer Assembly (ADTA) Altitude (H).
- Explain TACAN and air data RM and selection filter.
- Identify differences between Primary Avionics Software System (PASS) and Backup Flight Software (BFS) use of TACAN and Air Data.
- Explain each NAVAID callout on the Entry MNVR Cue Card.

### 75B **E NAV 21006**

Title: Entry Navigation 1

Duration: 2.0 hours

Medium: SST 1 or SST 2 or SST 3 Student: ASCAN (Schedule in pairs.)

Source: DS24/DPS/Navigation Training Group

Date: 07/07

Lesson(s) Replaced: E NAV 21011 (partial)

Equipment Required: None

Prerequisite Lesson(s): E NAV 21001

Preparation: None

Synopsis: This lesson acquaints the student with Navigation Aids (NAVAIDs)

management during entry, including coordination with MCC. The student will associate Tactical Area Navigation (TACAN) and Air Data Transducer Assembly (ADTA) Redundancy Management (RM) schemes with various malfunction signatures. Procedures will be executed from both the Entry cue cards and Ascent/Entry Systems Procedures. Backup Flight Software (BFS) actions and indications will be discussed where applicable. The following runs will exercise the objectives listed below:

- Run 1: Nominal 210 Kft to landing.
- Run 2: TACAN RM failures and dilemma with self-test.
- Run 3: TACAN unresolved dilemma.
- Run 4: ADTA RM fail and dilemma.
- Run 5: Probe deploy problem and dilemma.
- Run 6: Combined TACAN and air data malfunction case (210 Kft to landing).

- Exercise all onboard tasks associated with navigation and sensor management in a nominal end-of-mission entry trajectory starting from 210 Kft and using the Entry MNVR Cue Card.
- Identify nominal Global Positioning System (GPS), TACAN, Air Data System (ADS), Microwave Landing System (MLS), and Radar Altimeter (RA) feedback from onboard displays.
- Use the ENTRY MANEUVERS cue card to identify TACAN and air data incorporation boundaries.
- Identify a TACAN/RA Multiplexer/Demultiplexer (MDM) card failure and exercise the appropriate procedure.
- Discuss the interfaces of NAVAIDs with DPS and EPS.
- Identify and resolve a failure to meet the Primary Avionics Software System (PASS) two-lock requirement for TACANs.

# 75B **E NAV 21006 (Concluded)**

- Identify a TACAN dilemma with PASS auto self-test and exercise the correct procedure.
- Evaluate and troubleshoot an unresolved TACAN dilemma.
- Explain the BFS reasonableness test for TACAN.
- Identify all positions of the TACAN rotary switch on Panel (PNL) O7 and identify SPEC 50 signature.
- Identify a TACAN RM failure and exercise the correct procedure.
- Identify an Air Data Transducer Assembly (ADTA) RM failure and exercise the correct procedure.
- Evaluate and resolve an ADTA RM dilemma.
- Evaluate and resolve an air data probe dilemma.
- Discuss the impacts of an ADTA Built-In Test Equipment (BITE) for PASS and BFS.
- Identify and resolve an air data probe deployment failure.
- Identify the scenarios when flying Theta Limits is required and how to fly them.
- Explain the Flight Rule implications pertaining to a single ADTA.
- Prioritize malfunction procedures with nominal activities in order to execute all entry tasks on time.

### 76 **E DAP BR 21001**

Title: Entry Digital Autopilot Briefing

Duration: 2.0 hours
Medium: Classroom
Student: ASCAN

Source: DS66/G&C/Propulsion Training Group

Date: 08/04

Lesson(s) Replaced: None Equipment Required: ENT C/L

Prerequisite Lesson(s): ENT AERO BR 21001

Preparation: Read:

SCOM

Section 2.13, Aerojet DAP portion only

# 76 <u>E DAP BR 21001 (Concluded)</u>

Synopsis:

This lesson describes how the DAP flies the orbiter through the atmosphere to a landing. It relies heavily on the information taught in the Entry Aerodynamics class. It is also operator based – DAP issues and concepts that are transparent to flight crews will not be emphasized. The class will focus on how the orbiter is controlled in the pitch, roll, and yaw axes. Flight control system effectors and sensors used by entry DAP to fly the vehicle will be discussed, as well as the cockpit displays and controls available to the crew. Nominal procedures relating to entry DAP will also be presented.

Objectives:

- Define the orbiter stability axes and state their effect on entry DAP.
- For the pitch channel, state the following:
  - On what is the pitch command based.
  - The devices used for control and trim.
  - The two pitch channel features that operationally affect the crew.
  - How the crew can manually trim pitch.
- For the roll/yaw channel, state the following:
  - On what is the roll/yaw command based.
  - The devices used for control and trim.
  - The meaning of "reverse aileron."
  - The operational differences between Baseline DAP, No Yaw Jet DAP, and Wraparound DAP.
  - How the crew can manually trim roll/yaw.
- State the function of each of the DAP displays and controls.
- Match the significant entry DAP changes to the event that causes the changes.
- State the differences between Primary Avionics Software System (PASS) and Backup Flight System (BFS) entry DAP.

## 77A **TAEM GUID 21001**

Title: Terminal Area Energy Management Guidance Prebrief

Duration: 1.0 hour Medium: Classroom

Student: ASCAN (Schedule 3 ASCANs.)

Source: DS66/G&C/Propulsion Training Group

Date: 07/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): TAEM GUID BR 21001

Preparation: Read:

ENT GUID 21002; TAEM Guidance Section

# 77A TAEM GUID 21001 (Concluded)

Synopsis: This lesson prepares the studer

This lesson prepares the student for the SMS class TAEM GUID 21011. Emphasis will be placed on cockpit displays and Space Flight Resource Management (SFRM), while reviewing the cases to be run in the SMS.

Objectives:

- Discuss the impact of a large Heading Alignment Cone (HAC) turn angle – energy dump/pullup maneuver, glide slope and airspeed impacts, and HAC predictor activity.
- Discuss how the energy dump/pullup maneuver, glide slope and airspeed, and HAC predictor activity are impacted by large winds on the HAC.
- Discuss cockpit cues for high energy Energy Over Weight (EOW) scale, orbiter bug movement, and Terminal Area Energy Management (TAEM) Guidance reaction.
- Discuss the impact of large HAC with no Air Data.
- Discuss how to fly theta limits.
- Discuss the impact of multiple Accelerometer Assembly (AA) failures.
- Discuss techniques of flying Area Navigation by using raw Tactical Air Navigation data.

### 77B **TAEM GUID 21011**

Title: Terminal Area Energy Management Guidance

Duration: 4.0 hours Medium: SMS-MB

Student: ASCAN (Schedule 3 ASCANs.)

Source: DS66/G&C/Propulsion Training Group

Date: 07/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): TAEM GUID 21001

Preparation: None

Synopsis: This is a hands-on flying lesson that teaches crew Space Flight Resource

Management (SFRM) and use of the Terminal Area Energy Management

(TAEM)-related onboard displays.

- Demonstrate a large Heading Alignment Cone (HAC) turn angle while pointing out the energy dump/pullup maneuver, glide slope and airspeed impacts, and HAC predictor activity.
- Demonstrate how the energy dump/pullup maneuver, glide slope and airspeed, and HAC predictor activity are impacted by large winds on the HAC.

# 77B TAEM GUID 21011 (Concluded)

- Demonstrate cockpit cues for high energy Energy Over Weight (EOW) scale, orbiter bug movement, and TAEM Guidance reaction.
- Demonstrate cockpit cues for low energy Energy Over Weight (EOW) scale, orbiter bug movement, and TAEM Guidance reaction.
- Demonstrate the impact of large HAC with no Air Data.
- Demonstrate how to fly theta limits.
- Demonstrate the impact of multiple Accelerometer Assembly (AA) failures.
- Demonstrate flying Area Navigation using raw Tactical Air Navigation (TACAN) data.

# 78 **IMU BR 21001**

Title: Inertial Measurement Unit Briefing

Duration: 2.5 hours
Medium: Classroom
Student: ASCAN

Source: DS24/DPS/Navigation Training Group

Date: 03/05

Lesson(s) Replaced: IMU/ST/COAS 21001

Equipment Required: None

Prerequisite Lesson(s): REF DATA USE 21001, UNIV PTG 21001

Preparation: Read:

- SCOM; Section 2.13
- Inertial Measurement Units (IMUs)
- Star Trackers
- Crew Optical Alignment Sight (COAS)

#### Synopsis:

This briefing reviews Inertial Measurement Unit (IMU), Star Tracker, and Crew Optical Alignment Sight (COAS) functions, procedures, and displays. Emphasis is placed on IMU alignment procedures and the associated Orbit Operations (Ops) Checklist (C/L) data. IMU redundancy management will also be reviewed. The Head-Up Display (HUD) calibration will be discussed along with the COAS calibration.

- Describe the basic IMU, Star Tracker, and COAS/HUD hardware.
- Describe IMU, Star Tracker, and COAS General Purpose Computer (GPC) interface.
- Explain the two modes of operation for an IMU.
- Define the IMU Built-In Test Equipment (BITE) and its impact on Primary Avionics Software System (PASS) and Backup Flight Software (BFS).

# 78 <u>IMU BR 21001 (Concluded)</u>

- State the operational functions of the IMUs, Star Trackers, and COAS/HUD.
- Summarize the nominal align procedures for the IMUs and Star Trackers.
- Describe the star tracker door hardware and operations.
- Summarize the calibration and sight mode procedures for the HUD.
- Explain the differences between the 3 IMU alignments: Matrix align, IMU/IMU align, and star align.
- State the two ways to move an IMU's platform.
- Name the three Reference Stable Member Matrices (REFSMMATs) and state their purpose.
- Explain basic IMU attitude and velocity redundancy management schemes for PASS and BFS.
- Explain the purpose of IMU skewing.
- Explain PASS and BFS state vector schemes for ascent, orbit, and entry.

### 79 **E DAP SKL BR 21001**

Title: Entry Digital Autopilot Skills Briefing

Duration: 2.0 hours Medium: Classroom

Student: ASCAN (Schedule in groups of about 15.)
Source: DS66/G&C/Propulsion Training Group

Date: 04/06

Lesson(s) Replaced: None Equipment Required: ENT C/L

Prerequisite Lesson(s): E DAP BR 21001

Preparation: Read:

- Entry Flight Procedures Handbook
- 5.1.9, Off-Nominal Procedures
  - 5.1.9.1, High Frequency Oscillators
  - 5.1.9.3, Aileron Trim Saturation
  - 5.1.9.4, RCS Critical Entry
- SCOM
  - Section 7.3, Entry Takeover through Backup Flight System
  - Section 7.4, Handling Qualities

### 79 E DAP SKL BR 21001 (Concluded)

Synopsis:

This class covers DAP performance in off-nominal situations. Presented will be Reaction Control System (RCS) and aerosurface failures that impact entry DAP. Rationale of the off-nominal procedures will be discussed, but the student will be expected to perform the procedure only in later lessons. The rationale discussion will build student confidence in the procedures. A list of DAP-related caution and warning messages and crew actions will be presented. A review of the Flight Control System (FCS) airspeed and alpha limitations, with emphasis on the consequences of violating these limitations, will also be presented. Lastly, situations in which entry DAP can contribute to a loss of vehicle control will be discussed.

#### Objectives:

- State when the No Yaw Jet mode is certified.
- Explain the mechanics of flying the No Yaw Jet mode.
- State the minimum number of RCS jets required for certified flight.
- Explain how to perform the ARCS QTY <10% procedure on the ENTRY CONTROL cue card given a copy of the procedure.
- Explain how to perform the HIGH-FREQ OSC OR SURF/JET CYCLE procedure given a copy of the procedure.
- Explain how to perform the AIL TRIM ≥3° procedure on the ENTRY CONTROL cue card given a copy of the procedure.
- State the expected aileron trim given a Y center of gravity (c.g.).
- State the orbiter angle of attack vs. Mach number limits established by the FCS and the consequences of exceeding these limits.
- State the signature of an adverse aileron trim and what crew actions are required.
- State the adverse impacts the Beta Washout Filter can have on flight control and what crew actions are required.

### 80A **E DAP 21001**

Title: Entry Digital Autopilot Prebrief

Duration: 1.0 hour

Medium: Classroom or DST 6 (Ascent/Entry Trainer)

Student: ASCAN (Schedule 4 ASCANs.)

Source: DS66/G&C/Propulsion Training Group

Date: 02/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): E DAP SKL BR 21001

# 80A <u>E DAP 21001 (Concluded)</u>

Preparation: Review:

• Entry Checklist (C/L)

Entry Control cue card

Entry Maneuvers cue card

Synopsis: This prebrief prepares the student for E DAP 21011. A copy of the SMS

script will be provided to the student. Flight demonstrations to be

accomplished during the lesson will be discussed. Crew procedures for monitoring nominal DAP performance (Entry DAP Briefing) and actions for DAP-related failures (Entry DAP Skills Briefing) will be reviewed. The prebrief will emphasize recognition and performance of the procedures,

not the rationale for the procedure.

Objectives: State the crew actions for both nominal and off-nominal entry DAP

conditions using an Entry Checklist (C/L).

80B **E DAP 21011** 

Title: Entry Digital Autopilot

Duration: 2.0 hours

Medium: SMS-MB or DST 6 (Ascent/Entry Trainer)

Student: ASCAN (Schedule 2 ASCANs. A 4-hour SMS session will be split into

two 2-hour blocks with two students per block. A Pilot is not required

for each session.)

Source: DS66/G&C/Propulsion Training Group

Date: 10/05

Lesson(s) Replaced: E FCS 22011

Equipment Required: None

Prerequisite Lesson(s): E DAP 21001

Preparation: None

Synopsis: This lesson covers nominal and off-nominal DAP performance. Nominal

DAP reconfiguration and handling characteristics will be covered. All nominal and off-nominal procedures that are related to DAP will be covered. The student will explore the airspeed and alpha limits of the Flight Control System (FCS) and see the consequence of violating these

limits.

Objectives: • While performing a nominal entry, state the major events in DAP reconfiguration.

 Accomplish scripted flight demonstrations and explain the vehicle response to:

- Zero angle of attack while hypersonic
- No vaw jet at gbar > 10

# 80B **E DAP 21011 (Concluded)**

- Wraparound DAP at qbar > 10
- Effect of panel trim switches
- Auto vs. fixed elevon schedule
- Various body flap positions
- Various speed brake positions
- Recognize and respond to the following off-nominal conditions:
  - Aileron trim due to Center of Gravity (c.g.)
  - DAP Caution and Warning (C&W) messages
  - Critical Reaction Control System (RCS) propellant quantity

#### 81 **E GUID BR 21001**

Title: Entry Guidance Briefing

Duration: 3.0 hours
Medium: Classroom
Student: ASCAN

Source: DS66/G&C/Propulsion Training Group

Date: 08/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): TAEM GUID 21011

Preparation: Read:

SCOM; Section 7.3

#### Synopsis:

This lesson covers the Entry Guidance algorithm that functions from five minutes prior to atmospheric reentry (Entry Interface-5 (EI-5)) to Terminal Area Energy Management (TAEM) interface (earth relative velocity = 2500 fps). Entry Guidance control of downrange and crossrange will be explained. Manual calculations that emulate Entry Guidance will also be introduced. The focus will be on end-of-mission entries, although Transatlantic Abort Landing (TAL) entries will also be covered. The TAL unique aspects of Entry Guidance will be covered in the abort classes.

- Determine desired hdot, reference hdot, desired drag, and current drag given an Entry TRAJ display.
- Identify on an ENTRY TRAJ display the parameters supplied by Entry Guidance.
- Using the ENTRY TRAJ display, determine maximum drag and whether or not Entry Guidance will violate it.
- Define high and low energy states and state how Entry Guidance reacts to each.
- State the two types of prebank and when each is used.

## 81 <u>E GUID BR 21001 (Concluded)</u>

- Explain why large bank angles are not necessarily more thermally severe at high Mach numbers.
- Describe how Entry Guidance controls crossrange.
- State the conditions for performing a roll reversal.
- Describe how a Ground Controlled Approach (GCA) is performed during entry.

### 82 **IMU FAM 21006**

Title: Inertial Measurement Unit Familiarization

Duration: 2.0 hours

Medium: SST 1 or SST2 or SST 3

Student: ASCAN (Schedule individually.)

Source: DS24/DPS/Navigation Training Group

Date: 04/06

Lesson(s) Replaced: IMU 21005, IMU/ST/CO 21005X

Equipment Required: None

Prerequisite Lesson(s): IMU BR 21001

Preparation: Skim:

STRK/HUD/COAS 21002

Read:

IMU 21002

#### Synopsis:

This lesson gives the student the opportunity to use an orbiter-type keyboard to perform nominal procedures involving Inertial Measurement Units (IMUs), Star Trackers (STRK), and Crew Optical Alignment Sight (COAS)/Heads-Up Display (HUD). The IMU ALIGN and S TRK/COAS Control (CNTL) Specialist Functions (SPECs) are discussed in detail and are used to perform the procedures. The student will complete a HUD calibration although neither the COAS nor HUD will be available. The student will be able to monitor the effects and results of the above actions on the appropriate DPS displays. The student will also perform a reference recovery for an IMU that has lost its inertial reference, aided and with FDF.

- Describe the purpose of the IMUs, Star Trackers, and HUD/COAS.
- State the location of the IMUs, Star Trackers, and HUD/COAS.
- Identify the control switches for the IMU, Star Trackers, and HUD/COAS.
- Activate the Star Trackers and open the doors using the Post-Insertion FDF.
- Explain the Star Tracker information and star table on SPEC 22.
- Explain the information and options available on SPEC 21.

# 82 <u>IMU FAM 21006 (Concluded)</u>

- Perform a nominal IMU ALIGN-S TRK after maneuvering to the required attitude.
- Describe the information and options available for the COAS/HUD on SPEC 22.
- Perform, aided, a nominal HUD Calibration (CAL) after maneuvering to the required attitude.
- Describe the differences between a COAS and HUD CAL.
- Explain the operational differences in the Standby (STBY) and Operate mode for an IMU.
- Perform the IMU reference recovery align procedure when a good IMU reference exists.

### 83 **ENT C/L RVW 21001**

Title: Entry Checklist Review Briefing

Duration: 3.0 hours
Medium: Classroom
Student: ASCAN

Source: DS66/G&C/Propulsion Training Group

Date: 07/04

Lesson(s) Replaced: None

Equipment Required: ENT C/L, D/O PREP C/L

Prerequisite Lesson(s): E NAV BR 21001

Preparation: Read:

 SCOM; Sections 5.4 and 5.5, Normal Procedures, Entry and Normal Procedures, Post-landing

Synopsis:

This lesson is designed to prepare the student for A/E FAM 21011, and to be a review of the Entry Checklist (C/L) procedures and the cue cards used during entry. The following Entry C/L procedures will be reviewed in detail:

- Deorbit Burn
- Deorbit Flight Rules
- 1-Orbit Late
- Post Burn
- Entry No-Go C/L
- Entry Maneuvers
- Mach/Alpha
- Post Landing

#### 83 ENT C/L RVW 21001 (Concluded)

- Objectives: Show the flow through the Entry C/L for given scenarios.
  - Explain the rationale behind the bolded, capitalized procedures in the Entry C/L.

#### 84 A/E DPS MAL 21001

Title: Ascent/Entry Data Processing System Malfunctions

2.5 hours Duration: Classroom Medium: Student: ASCAN

Source: DS24/DPS/Navigation Training Group

Date: 03/05

Lesson(s) Replaced: DPS I/O BRF 21001

Equipment Required: None

Prerequisite Lesson(s): DPS FAM 23006, REF DATA USE 21001

Preparation: Review:

- SCOM
  - Section 6.8, System Failures, DPS except Set Splits
  - Appendix D, DPS Rules of Thumb
  - Appendix C, DPS Study Notes, except Set Splits
- A/O/E Pocket C/Ls, AESP, and Cue Cards FPH
  - DPS DATA PROCESSING SYSTEM OVERVIEW, MULTI DATA PATH LOSS, RESTRING (Cue Cards)

## Synopsis:

This briefing reviews the functional operation of the DPS, presents failure modes and the associated signatures, and discusses specific procedures. This class emphasizes ascent and entry DPS. There will be a general discussion of several DPS procedures and a few will be covered line by line. The Multiplexer/Demultiplexer (MDM) section of Ref Data, Multi Data Path Loss procedure, and Restring Cue Cards will be covered in detail. Exercises for the student are included to emphasize particular points in the material.

- Explain the purpose of each of the seven types of data buses.
- Describe the methods by which the Backup Flight Software (BFS) obtains data from the Primary Avionics Software System (PASS).
- Differentiate the signatures for the various PASS General Purpose Computer (GPC) failures (Fail to Sync (FTS), Fail to Halt (FTH), Power, Quit, Input/Output (I/O) Terminate (Term) B, I/O Term A).
- Differentiate the signatures for the various BFS GPC failures (FTH. Power, Quit, FTH Transient, Power Transient, Standalone, Standby (STBY), I/O Term A).
- Define the functional components of an MDM.

# 84 A/E DPS MAL 21001 (Concluded)

- Explain the impact of a total and a partial bypass of an MDM and be able to identify the respective signatures.
- Describe how a port mode works, and when Flight Rules will allow one.
- Identify the signature and discuss the implications of a non-universal I/O Error.
- Identify the signature and explain the impact of a Flight Critical (FC) databus failure at the PASS and BFS GPC.
- Identify the losses associated with a total or partial MDM failure using Ref Data.
- Identify DPS failure modes when given various signatures.
- Describe how and when to apply the ascent and entry restring procedures.
- Identify the impacts of multiple data path losses and explain steps to handle the losses.

#### 85 **ORB DAP 21057**

Title: Orbit Digital Autopilot

Duration: 2.0 hours
Medium: CBT
Student: ASCAN

Source: DS66/G&C/Propulsion Training Group

Date: 02/04

Lesson(s) Replaced: ORB DAP 21064

Equipment Required: None

Prerequisite Lesson(s): ORB OPS OV 21001

Preparation: None

Synopsis: This lesson is designed as an introductory exercise to familiarize the

student with the displays, controls, and crew procedures associated with the orbit Reaction Control System (RCS) DAP. After some sections,

exercises are provided to review the material presented.

Objectives: • Describe the principal DAP functions.

Identify the tools used to reconfigure the DAP.

• Select DAP functions based on flight-specific requirements.

# 86 **ASC C/L RVW 21001**

Title: Ascent Checklist Review Briefing

Duration: 3.0 hours
Medium: Classroom
Student: ASCAN

Source: DS66/G&C/Propulsion Training Group

Date: 07/04

Lesson(s) Replaced: None Equipment Required: ASC C/L

Prerequisite Lesson(s): ENT C/L RVW 21001

Preparation: None

Synopsis: This lesson is designed to be a review of the Ascent Checklist (C/L)

procedures that are used for a nominal ascent. The review will start with prelaunch and go through post Orbital Maneuvering System-2 (OMS-2). The review will include an in-depth discussion of the following Ascent C/L procedures:

- Prelaunch
- Recycle
- Ascent Procedures
- No COMM Mode Boundary
- Systems Flight Rules
- OMS-1/2 Targeting
- OMS TGTS

In addition, the Landing Site Table and Communication Coverage chart will be briefly discussed. This lesson is designed to prepare the student for A/E FAM 21011. ABORT FDF 21001 will cover the procedures used for abort cases (Return-To-Launch Site (RTLS), Transatlantic Abort Landing (TAL), Abort to Orbit (ATO), and Abort Once Around (AOA)).

Objectives:

- Show the flow through the Ascent C/L for given scenarios.
- Explain the rationale behind the bolded, capitalized procedures in the Ascent C/L.

#### 87 **E GUID 21057**

Title: Entry Guidance

Duration: 2.0 hours Medium: CBT

Student: ASCAN (Schedule in pairs or groups of 4.) Source: DS66/G&C/Propulsion Training Group

Date: 10/05

Lesson(s) Replaced: None

#### 87 E GUID 21057 (Concluded)

Equipment Required: None

Prerequisite Lesson(s): E GUID BR 21001

Preparation: None

Synopsis: Space Flight Resource Management (SFRM) manual flying techniques

and monitoring Entry Guidance will be emphasized. The manual flying techniques taught in this class are designed to teach the student how Entry Guidance works. This CBT is not available for self study. The instructor will lead the student through several cases via the CBT in a

classroom.

Objectives: • Fly from the top of TRAJ 1 to Terminal Area Energy Management (TAEM) interface using desired altitude rate.

- Fly the orbiter through TRAJ 1 and TRAJ 2 after delaying the first nonzero roll command (active control will start at an Hdot of + 180 fps).
- Contrast a Transatlantic Abort Landing (TAL) entry trajectory to that of a nominal Entry.
- Fly a low energy/high crossrange entry to demonstrate the difficulty of Delta Azimuth (DEL AZ) control under these conditions.
- Achieve and maintain 2.5 G's using the Entry Displays and Entry Alpha Cue Card.

#### 88 A/E FCS BR 21001

Title: Ascent/Entry Flight Control System Briefing

Duration: 3.0 hours Medium: Classroom Student: **ASCAN** 

Source: DS66/G&C/Propulsion Training Group

Date: 02/04

Lesson(s) Replaced: None Equipment Required: **AESP** 

Prerequisite Lesson(s): A/E DPS MAL 21001

Preparation: Read:

FCS/EFF 21002

SCOM; Section 2.13, Aerosurface Servo Amplifiers through Ascent

Thrust Vector Control

# 88 A/E FCS BR 21001 (Concluded)

Synopsis:

This lesson is designed to prepare students for A/E FCS 21006. This lesson is divided into five basic parts:

- Command/data flow from the General Purpose Computers (GPCs) to the aerosurfaces
- Aerosurface Servo Amplifier (ASA) feedback
- Ascent Thrust Vector Control (ATVC) and ASA hardware components
- Crew interfaces (SYS SUMM 1, GNC SPEC 53 and GNC SPEC 1)
- Failure scenarios

Objectives:

- Trace the flow from the Flight Control System (FCS) command source through the Multiplexer/Demultiplexer (MDM) to the specific actuators.
- Describe the basic components of the ATVC and ASA actuator hardware including servovalve, isolation valve, and bypassing a port.
- Explain the events that cause a port to bypass and the mission impacts of the port bypass.
- Describe the Redundancy Management (RM) scheme of aerosurface actuator feedback.
- Identify malfunctions using the following cockpit signatures SYS SUMM 1, SPEC 53, F7 Caution and Warning (C&W) lights, and GPC Fault messages.
- Describe how the body flap differs from the other actuators.

## 89 **PTG 21006**

Title: Pointing Duration: 2.0 hours

Medium: SST 1 or SST 2 or SST 3 Student: ASCAN (Schedule in pairs.)

Source: DS24/DPS/Navigation Training Group

Date: 02/04

Lesson(s) Replaced: DAP 21012

Equipment Required: None

Prerequisite Lesson(s): ORB DAP 21057

Preparation: Review:

UNIV PTG 21001

# 89 **PTG 21006 (Concluded)**

## Synopsis:

During this lesson, the student will exercise every available option for maneuvering the orbiter using the Universal Pointing (UNIV PTG) display. The first maneuvers will stress proper execution of item entries and identify how to monitor a maneuver from start to finish. Each maneuvering option will then be demonstrated along with a realistic mission application. Some exercises require multiple maneuvers in order to achieve a given mission objective or complete a procedure. The student will be asked to perform maneuvers with and without FDF, and to execute more of the maneuvers without instructor assistance as the lesson progresses. An orbiter model will be used in the lesson to visualize each maneuver before it is commanded. As an end-of-lesson quiz, the student will be given a set of constraints and asked to perform the maneuver(s) necessary to satisfy them.

- Describe how to setup, execute, and monitor vehicle maneuvers with the UNIV PTG page for M50 attitudes and for tracking a specified target with a body vector.
- Modify the commanded discrete maneuver rate on the SPEC 20 DAP page.
- Perform, aided, a maneuver to track the center of the Earth with the -Z body axis and an omicron optimized for maintaining air-to-ground communications.
- Perform, aided, an M50 (pitch-yaw-roll) maneuver to an attitude specified in the Orbit Operations Checklist (ORB OPS C/L) STAR PAIRS Preliminary Advisory Data (PAD) for acquiring star data with the Star Trackers.
- Compare inertial and LVLH attitude-hold options using M50 maneuver, target tracking maneuver, and manual DAP.
- Perform additional maneuvers and maneuver sequences, which exercise every other available option on the UNIV PTG display except reboost.
- Identify constant orbital rate while in Earth-center track attitude hold.
- Identify varying orbital rate while in Earth-surface track attitude hold.
- Develop and execute a maneuver sequence for passive thermal control.
- Command a maneuver to be executed at a time in the future.
- Demonstrate different UNIV PTG methods to perform multiple maneuvers for single Star Tracker Inertial Measurement Unit (IMU) align operations.
- Demonstrate UNIV PTG display errors caused by mathematical singularity points.

# 90 **SFRM OV 21001**

Title: Space Flight Resource Management Overview

Duration: 4.0 hours
Medium: Classroom
Student: ASCAN

Source: DS66/G&C/Propulsion Training Group

Date: 01/04

Lesson(s) Replaced: SFRM 21001

Equipment Required: None

Prerequisite Lesson(s): ASC OV 21001

Preparation: Read:

Space Flight Resource Management Reference Manual

Synopsis: This lesson introduces the student to Space Flight Resource Management

(SFRM) concepts, and standardizes SFRM vocabulary and methodology.

Concepts are defined, including those for SFRM and Windows of

Awareness. The six performance elements of SFRM, the skills associated

with each element, and the relationships between the elements are discussed. Students then practice identifying SFRM philosophy and methodology, and using a standardized SFRM vocabulary, with selected

video clips.

Objectives: • Define SFRM.

Define the concept of Windows of Awareness.

• Explain each of the six SFRM performance elements.

Identify SFRM skills while observing selected video clips.

## 91 **E GUID 21011**

Title: Entry Guidance

Duration: 4.0 hours Medium: SMS-MB

Student: ASCAN (Schedule 2 ASCANs, no CB IA. A Pilot is not required for

each session.)

Source: DS66/G&C/Propulsion Training Group

Date: 07/04

Lesson(s) Replaced: E GUID 21001

Equipment Required: None

Prerequisite Lesson(s): E GUID 21057

Preparation: None

# 91 **E GUID 21011 (Concluded)**

Synopsis:

This is a hands-on flying lesson. Most cases will be high energy, where the student must take Control Stick Steering (CSS) and fly desired Hdot to avoid over-temping/over-Ging the vehicle. Emphasis will be placed on good Space Flight Resource Management (SFRM) and monitoring AUTO guidance. A short demonstration of a prebank, the phugoid damper, "ROLL REF" alert, and minimum roll is included.

Objectives:

- Fly the orbiter through TRAJ1 and TRAJ 2 after delaying the first non zero roll command (active control to start at an Hdot of +180 fps).
- Achieve and maintain 2 G's using the Entry Displays and Entry Alpha Cue Card.
- Identify Entry Guidance information on the TRAJ display.
- Fly the phugoid damper successfully.
- Fly a prebank successfully.
- Identify Entry Guidance reaction to a density shear.

## 92A **A/E FCS 21001**

Title: Ascent/Entry Flight Control Surfaces Prebrief

Duration: 0.5 hours Medium: Classroom

Student: ASCAN (Schedule in pairs.)

Source: DS66/G&C/Propulsion Training Group

Date: 02/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): A/E FCS BR 21001

Preparation: None

Synopsis: This prebrief will review the Flight Control System (FCS) operations for the

Ascent and Entry flight phases.

- Identify FCS channel failures using available DPS displays, GPC Fault messages, master alarm, and Systems Management (SM) alert.
- State when Fault Detection, Identification, and Reconfiguration (FDIR) quits and the selection filter downmodes for FCS position feedback errors.
- Define aerosurface positions and moments.
- Explain when manual port bypassing is necessary.
- Explain prioritization as it relates to FCS channel management.
- Explain FCS channel actions in General Purpose Computer (GPC) and Flight Aft Multiplexer/Demultiplexer (FA MDM) failure scenarios.
- Define bodyflap Caution and Warning (C&W).

## 92B **A/E FCS 21006**

Title: Ascent/Entry Flight Control System

Duration: 2.0 hours

Medium: SST 1 or SST 2 or SST 3 Student: ASCAN (Schedule in pairs.)

Source: DS66/G&C/Propulsion Training Group

Date: 02/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): A/E FCS 21001

Preparation: None

Synopsis:

The focus of this lesson is on Flight Control System (FCS) channel management. This lesson will allow students to practice identifying various types of failures using the fault messages, Caution and Warning (C&W) lights and DPS displays. The FCS CH 1 (2,3,4) (2nd FAIL) procedures will be executed, and the associated rationale will be discussed. The instructor will provide a discussion about SPEC 53, allowing students to practice bypassing and resetting aerosurface ports. The instructor will also point out the limited crew insight as compared to mission control. The student will also concentrate on procedures, which involve the FCS. Many of the failures are DPS related, such as the PASS GPC FAIL procedure. The instructor will limit discussion to FCS-related steps of the DPS procedures. In conclusion, various body flap messages will be examined, and differences between the body flap and the other aerosurfaces will be discussed.

- Identify the following FCS Channel signatures for both Aerosurface Servo Amplifier (ASA) and Ascent Thrust Vector Control (ATVC) systems using SPEC 53, SYS SUMM 1, F7 C&W lights, and fault messages:
  - Port bypass
  - Command bias
  - Feedback bias
  - General Purpose Computer (GPC)/Multiplexer/Demultiplexer (MDM) failures
  - ASA/ATVC power failures
- Describe the function of the FCS Channel override switch position.
- Identify why a 2-second delay is required between FCS switch throws.
- Bypass and reset a port using SPEC 53.
- Execute the following procedures and describe the rationale as it concerns FCS:
  - FCS CH 1 (2,3,4) (2nd FAIL)
  - PASS GPC FAIL

# 92B **A/E FCS 21006 (Concluded)**

- FA/FF MDM I/O ERROR
- POST OPS 3/GRTLS TRANSITION RESTRING
- BCE STRING D (optional)
- Identify the causes of the FCS SAT POS, and the FCS SAT MOM fault messages.
- State the priority between ATVC malfunctions and ASA malfunctions for ascent and entry.
- Describe how an Auxiliary Power Unit (APU) failure effects the body flap.
- Identify the cause of the following body flap fault messages:
  - BODY FLAP FAIL
  - BODY FLAP CYCLE
  - BODY FLAP HOLD

## 93 **SFRM APPL METH 21001**

Title: Space Flight Resource Management Applied Methods

Duration: 3.0 hours
Medium: Classroom
Student: ASCAN

Source: DS66/G&C/Propulsion Training Group

Date: 02/04

Lesson(s) Replaced: SFRM 21001

Equipment Required: None

Prerequisite Lesson(s): SFRM OV 21001

Preparation: None

Synopsis:

This second lesson in Space Flight Resource Management (SFRM) will stress how the SFRM concepts can be applied to future Shuttle and Station training and missions. The students will practice their SFRM performance observation and critiquing skills during a simulated SMS session. A review of the roles and responsibilities of both the crew and training team with respect to SFRM training will be discussed.

- Explain how the various SFRM performance elements relate to one another.
- Identify SFRM skills while observing two actual flight examples.
- Given the criteria for effective SFRM debriefs, evaluate the SFRM debrief during two training examples.

## 94 **G&C SENS BR 21001**

Title: Guidance and Control Sensors and Controllers Briefing

Duration: 3.0 hours
Medium: Classroom
Student: ASCAN

Source: DS66/G&C/Propulsion Training Group

Date: 03/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): A/E FCS BR 21001

Preparation: Read:

 SCOM; Section 2.13, Flight Control System Hardware up to, but not including, Trim Switches

Synopsis:

This briefing includes principles of operation, power sources, data flow, and redundancy management for the following sensors and controllers: Orbiter Rate Gyro Assemblies (RGAs), Solid Rocket Booster (SRB) RGAs, Accelerometer Assemblies (AAs), Rotational Hand Controller (RHC), Translational Hand Controller (THC), Rudder Pedal Transducer Assembly (RPTA), Speed Brake Thrust Controller (SBTC). Impacts due to DPS and EPS failures on these sensors and controllers are examined in detail, as well as their impacts on the vehicle's control capability.

- State the Guidance and Control (G&C) sensors used by flight control.
- Explain how the G&C sensors are used during ascent and entry.
- State the parameter(s) that each G&C sensor supplies, its power source(s), and data bus channelization.
- Describe the Redundancy Management (RM) schemes used for the G&C sensors.
- Describe how the crew interacts with the G&C sensors.
- Describe what happens when the G&C sensor feedback into the General Purpose Computers (GPCs) is bad.
- State the G&C controllers available in the cockpit.
- Describe when each G&C controller is available and how the crew uses them.
- State the G&C controller power sources and data bus channelization for each controller.
- Describe the RM schemes for the G&C controllers.
- Describe the available crew interfaces for the G&C controllers.
- Find the applicable procedure in the FDF given G&C controller failure scenarios.

## 95 **PAPER SIM 21001**

Title: Paper Simulation

Duration: 2.0 hours Medium: Classroom

Student: ASCAN (Schedule 4 ASCANs.)

Source: DA7/Assigned SMS Team

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): SFRM APPL METH 21001

Preparation: Review:

Ascent C/L

OMS Failures cue card

OMS Targeting

AESP

Glided Flight; DPS Section, Restring Procedures

- Powered Flight and Glided Flight; DPS Section, Multi Data Path
   Loss
- Powered Flight and Glided Flight; EPS Section, Electrical Bus loss procedures
- Ref Data
  - Electrical Bus Loss Tables
  - MDM Bus Loss Tables

## Synopsis:

This lesson is designed to prepare the student for multisystem malfunction ascent, abort, and entry cases. This lesson is conducted like a sim, but without the high-fidelity simulator. The student will be presented with an ascent or entry scenario that has a set of failures. The cockpit signatures associated with these failures will be provided to the student. The student is allowed to ask the instructors for any information that would normally be available to the crew at that time. The students will then be required to identify the failure (based on the provided signatures), make the appropriate MCC call, determine the FDF procedure to be worked (if required), and determine the system/mission impacts. In several cases, the students will also be asked to state what the next worst failure would be. This class emphasizes those failures that affect multiple orbiter systems (e.g., EPS, DPS failures).

# 95 PAPER SIM 21001 (Concluded)

Objectives: • Based on the cockpit signature provided by the instructor, perform the following:

- Identify malfunction.
- Make the appropriate MCC call.
- Identify appropriate procedure to be used for the failure (if required).
- Identify the multi-discipline effects for the given failure.
- Identify the system/mission impacts of the given failure during the selected phase of flight.
- Identify the "next worse failure."

# 96 **ASC GUID BR 21001**

Title: Ascent Guidance Briefing

Duration: 3.0 hours
Medium: Classroom
Student: ASCAN

Source: DS66/G&C/Propulsion Training Group

Date: 08/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): NAV OV BR 21001, G&C SENS BR 21001,

A/E FCS BR 21001

Preparation: Read:

- ASC G&C 21002
  - Section 1.0, Overview
  - Section 2.0, First Stage Guidance
  - Section 3.0, Second Stage Guidance
- Optional reading:
  - Section 6.0, Cockpit Displays and Controls

### Synopsis:

This lesson is a functional introduction to the software algorithms of automatic guidance as applied to the operational environment. A discussion of ascent aerodynamics and vehicle limitations as related to guidance is provided to familiarize astronauts with operational nomenclature. Major events and moding of each guidance phase is presented to promote the astronaut's ability to monitor guidance functions from the cockpit. The Ascent Checklist and cockpit displays are re-introduced to provide insights to guidance-related information in the cockpit. A brief discussion on manual guidance is included. This lesson is one in a series that prepares an astronaut candidate for a Shuttle Avionics Integration Laboratory (SAIL) assignment.

# 96 ASC GUID BR 21001 (Concluded)

Objectives: • Identify guidance functions and moding using observable cockpit cues.

- Identify the vehicle limitations that drive the guidance design.
- State how guidance issues throttle and steering commands for each flight phase.
- Identify the differences between nominal and abort guidance.
- Compare OMS burn guidance to main stage guidance.
- Demonstrate how to initiate and terminate manual guidance.

# 97A **A/E FAM 21001**

Title: Ascent/Entry Familiarization Prebrief

Duration: 1.0 hour Medium: Classroom

Student: ASCAN, PS (Schedule 3 ASCANs, 1 CB IA.)

Source: DA7/Assigned SMS Team

Date: 03/05

Lesson(s) Replaced: ASC FAM 21001

Equipment Required: None

Prerequisite Lesson(s): SFRM APPL METH 21001

Preparation: Complete:

GNC DED DISP 21057

Review:

- Ascent C/L
  - Prelaunch, starting at T-9:00
  - ASC
  - POST OMS-1
  - OMS-2 Burn cue cards
  - POST OMS-2
- Entry C/L
  - D/O BURN
  - Post BURN
  - Entry Maneuvers cue card
  - Post Landing
- SCOM
  - Section 5.1, Pre-Launch starting at T-9:00
  - Section 5.2, Ascent, through OMS-2
  - Section 5.4, Entry, start at TIG-15 minutes
  - Section 5.5, Post-Landing

# 97A **A/E FAM 21001 (Concluded)**

Synopsis:

This lesson is designed to prepare the student for A/E FAM 21011. Because the students will have had several entry SMS lessons prior to this one, this prebrief will emphasize the ascent phase of flight. This lesson will review the information displayed on the Ascent CRT TRAJ displays. In addition, this lesson will discuss typical CRT/Dedicated Display scan patterns for ascent and entry. An ascent flight deck video will be shown to support a discussion about the responsibilities and tasks of each flight deck position.

Objectives:

- Recognize and respond to all nominal ascent and entry MCC calls.
- Describe how the Ascent TRAJ displays are used to monitor the orbiter's performance and guidance.
- Describe how the dedicated displays are used to monitor the orbiter's performance and guidance.
- Determine crewmember seating assignments, responsibilities, and tasks.

# 97B **A/E FAM 21011**

Title: Ascent/Entry Familiarization

Duration: 4.0 hours Medium: SMS-MB

Student: ASCAN, PS (Schedule 3 ASCANs, 1 CB IA.)

Source: DA7/Assigned SMS Team

Date: 07/04

Lesson(s) Replaced: ASC FAM 21011

Equipment Required: None

Prerequisite Lesson(s): A/E FAM 21001

Preparation: None

Synopsis:

This lesson pulls together information from ascent and entry briefings, entry SMS lessons, and system-specific SST lessons. This lesson provides the opportunity for the students to execute all of the nominal ascent and entry FDF procedures in a realistic cockpit environment. Two ascents will be performed. The first ascent will be performed from T-9 minutes to post OMS-2, and the second ascent will be performed from T-2 through ET SEP. The entry will be performed from D/O-15 minutes through post-landing. The crew should switch seating assignments between runs.

#### 97B A/E FAM 21011 (Concluded)

- Objectives: Perform a nominal ascent from T-9 through the OMS-2 burn using the FDF.
  - Perform a nominal entry from Deorbit-15 min through the post-landing procedures using the FDF.
  - Coordinate the required nominal tasks among the flight deck crewmembers.

#### 98 **TIER TEST 23001**

Refer to TIER TEST 21001 for description.

#### 99 **ESC EQ/SYS 21001**

Title: Escape Equipment/Systems Briefing (Shared – Shuttle)

**Duration:** 2.0 hours Medium: Classroom

Note: Schedule suitroom in Bldg. 9, and CCT, CCT II, or FFT for last

30 minutes of lesson.

Student: ASCAN (Schedule in groups of up to 10.)

DX45/Crew Systems Group Source:

Date: 08/04

Lesson(s) Replaced: None **Equipment Required:** None

Prerequisite Lesson(s): CREW CAB FAM 21020

Preparation: Read:

CREW ESCAPE SYSTEMS 21002

Synopsis:

This lesson introduces the student to crew-worn equipment, orbiter equipment, and systems associated with emergency egress. Material presented will include the ACES, helmet, harness, parachute, cabin vent, hatch jettison, escape panel pyrotechnics, escape pole, egress slide, Sky Genie, survival gear, orbiter seats, and egress assists.

In addition to these, a brief discussion of the launch pad egress systems and slidewire baskets is presented. A video will be shown on crew-worn equipment, orbiter equipment, and launch pad equipment and systems. The last 30 minutes of the class will be spent in the CCT, CCT II, or FFT, looking at the orbiter equipment, and deploying the engineering escape pole mockup.

#### 99 ESC EQ/SYS 21001 (Concluded)

- Objectives: Describe the crew-worn equipment and associated systems, their function, and their purpose.
  - Describe the orbiter escape equipment and systems, their function, and their purpose.
  - Describe the emergency equipment located at the launch pad, its function, and its purpose.

#### 100 SWITCH RM BR 21001

Title: Switch Redundancy Management Briefing

Duration: 2.0 hours Medium: Classroom Student: **ASCAN** 

Source: DS66/G&C/Propulsion Training Group

Date: 02/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): **G&C SENS BR 21001** 

Preparation: None

Synopsis:

This lesson introduces the student to switch Redundancy Management (RM). The lesson will identify the reasons for multiple contact switches and will also describe the common failures that can impact the operation of orbiter switches. Finally, the lesson will identify the General Purpose Computer (GPC) Fault messages that are generated by the aforementioned failure and will discuss the impact of the failure.

- Recognize that some cockpit switches control hardware and some cockpit switches provide input into GPCs.
- Identify the potential impact of control bus failures on switches.
- Identify the potential impact of Multiplexer/Demultiplexer (MDM) failures on switches.
- Identify the impact of the following GPC Fault messages:
  - BDY FLAP SW L(R)
  - DISPLAY SW L(R,A)
  - ET SEP MAN/ET SEP AUTO
  - ME SHDN SW
  - PNL TRIM L(R)
  - G51 RL MODE SW
  - SENSE SW

# 100 SWITCH RM BR 21001 (Concluded)

- Identify which GPC Fault message is associated with the term "green dot."
- State why some switches are single contact and some switches have multiple contacts.
- Define the term "switch teasing."

## 101 **APU/HYD MAL BR 21001**

Title: Auxiliary Power Unit/Hydraulic Malfunction Review

Duration: 3.0 hours
Medium: Classroom
Student: ASCAN

Source: DS45/Shuttle Systems Training Group

Date: 10/05

Lesson(s) Replaced: None

Equipment Required: AESP, ORB PKT C/L Prerequisite Lesson(s): APU/HYD OPS 21004

Preparation: Review:

SCOM; Section 2.1

## Synopsis:

This lesson is a review of Main Propulsion System (MPS) interface, essential nominal operations, cockpit interface, and FDF procedures for the Auxiliary Power Units (APUs) and Hydraulic (Hyd) systems. Also covered is the Flight Rule rationale for critical procedures, and an FDF procedure location exercise is included.

The student will progress from the detailed technical aspects of the APU/Hyd system, as covered in the consolidated core briefing and nominal operations briefing, to operationally identifying and compensating for malfunctions.

- Identify the signatures of the following APU/Hyd malfunctions on ascent and/or entry via displays, meters, and other cockpit cues:
  - APU shift to high speed
  - APU overspeed
  - APU underspeed
  - APU oil overtemp
  - Hvd leak
  - Hyd pump failure
  - WSB leak
- Explain the guidelines, constraints, and rationale associated with the APU/Hyd malfunctions discussed in this class.

# 101 APU/HYD MAL BR 21001 (Concluded)

- Use Flight Rule rationale to explain when to shutdown an APU during powered flight.
- Explain the importance of performing the APU Shutdown procedure in the correct sequence.
- Describe the impacts of one and two failed Hyd systems on the MPS on ascent.
- Describe the impacts of one and two Hyd failed systems on gear deploy, braking, and nose wheel steering.
- List the reasons for restarting an APU during glided flight.

## 102 **ABORT FAM BR 21001**

Title: Abort Familiarization Briefing

Duration: 4.0 hours
Medium: Classroom
Student: ASCAN

Source: DS66/G&C/Propulsion Training Group

Date: 10/05

Lesson(s) Replaced: ABORT BR 21001

Equipment Required: None

Prerequisite Lesson(s): A/E FAM 21001

Preparation: Read:

SCOM; Sections 6.1 to 6.6Intact Ascent Aborts 21002

## Synopsis:

This lesson prepares the student for ABORT FAM 21011 SMS session, where the aborts described in the class will be practiced. The lesson describes the intact abort modes that could occur during the ascent flight phase, including Abort to Orbit (ATO), Abort Once Around (AOA), Transatlantic Abort Landing (TAL), and Return-To-Launch Site (RTLS). High energy TAL is considered a contingency abort, but will be discussed briefly in this class. At the end of the class, the student will be able to recognize, initiate, and assist in executing any of the intact aborts.

- List the four intact aborts.
- Describe the conditions that would cause the various intact aborts to be executed.
- Describe the trajectory of each of the intact aborts.
- Select the proper abort mode for a given set of conditions.

103 **IFM 21001** 

Title: In-Flight Maintenance Overview Briefing

Duration: 2.0 hours
Medium: Classroom
Student: ASCAN, PS

Source: DX44/In-Flight Maintenance Group

Date: 03/95

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

Synopsis: This lesson consists of a classroom briefing on the orbiter In-Flight

Maintenance (IFM) capabilities from within the crew module. Photographs and a limited amount of hardware will be utilized to discuss IFM tasks, the location and accessibility of avionics, the tools required, and the IFM C/L

procedures.

Objectives: • Describe IFM, the responsibilities of the IFM console operators, and the capabilities and constraints for the crew to perform IFM.

• State the major types of information contained in the IFM C/L (general information, tools, component locations, and IFM procedures).

• Describe representative IFM procedures from the IFM C/L that illustrate the types of procedures the crew may be expected to perform.

• Describe some of the more interesting IFM procedures that have been performed in previous missions.

## 104 **P/L & APDS OV 21001**

Title: Payload and Androgynous Peripheral Docking System Overview

Briefing

Duration: 2.0 hours
Medium: Classroom
Student: ASCAN

Source: DS45/Shuttle Systems Training Group and DO5/Cargo Integration and

**Operations Branch** 

Date: 09/04

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

# 104 <u>P/L & APDS OV 21001 (Concluded)</u>

## Synopsis:

The purpose of this briefing is to give the student an introduction to different types of payloads flown on the orbiter, interfaces to the payloads, and carriers. Payload operations and use of the FDF are briefly discussed.

In addition, the student will be provided with a top level familiarization of the APDS including hardware, crew interfaces, and nominal operation scenarios.

## Objectives:

- State the different types of payloads and their interfaces flown on the orbiter.
- Identify the payload operations FDF documents.
- Explain how crewmembers and ground controllers interface with payloads.
- Describe a nominal docking and undocking sequence.
- Explain how crewmembers and ground controllers interface with the APDS.

# 105 **SENS/CNTL 21006**

Title: Sensors and Controllers

Duration: 2.0 hours

Medium: SST 1 or SST 2 or SST 3 Student: ASCAN (Schedule in pairs.)

Source: DS66/G&C/Propulsion Training Group

Date: 02/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): G&C SENS BR 21001

Preparation: None

## Synopsis:

During this lesson, the student will have the opportunity to study various malfunctions including Rate Gyro Assembly (RGA), Accelerometer Assembly (AA) and controller failures. In addition, the instructor will discuss controller operations and will provide students with the opportunity to operate the controllers. The runs will allow students to practice identifying various types of failures using the fault messages, Caution and Warning (C&W) lights, and DPS displays. The RM FAIL IMU, RGA, AA and RHC L(R) (2nd FAIL) procedures will be executed, and the associated rationale will be discussed. DPS malfunctions will also be presented, but the discussion will be limited to sensor-related steps of the procedures.

# 105 SENS/CNTL 21006 (Concluded)

Objectives:

- Identify AA, RGA, and controller malfunctions using SPEC 51, SYS SUMM 1, F7 C&W lights, and fault messages.
- Describe the Redundancy Management (RM) scheme for RGAs, AAs, and controllers in the Primary Avionics Software System (PASS) and Backup Flight System (BFS).
- Demonstrate the ability to operate the controllers by:
  - Using the Speed Brake Thrust Controller (SBTC) to open and close the speedbrake.
  - Taking Control Stick Steering (CSS) using either the CSS pushbuttons or by using a hot stick downmode.
  - Using the SBTC to throttle the main engines.
- Execute the following procedures and describe the rationale as it concerns Flight Control System (FCS):
  - RM FAIL RGA
  - RM FAIL AA
  - RHC L(R) (2nd FAIL)

### 106 **PDRS OV 21001**

Title: Payload Deployment and Retrieval System Overview Briefing

Duration: 1.5 hours
Medium: Classroom
Student: ASCAN

Source: DX25/Robotics Shuttle Training Group, CB/Astronaut Office, and

ER3/Flight Robotics Systems Branch

Date: 08/04

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

Synopsis:

This briefing will be presented in a Flight Plan format. The Summary Timeline will give the introduction and outline, and the Detailed Timeline will cover all RMS activities that occur prelaunch through post-landing inspection, including details on crew training, how the RMS works, RMS support equipment, and applications of the RMS in space flight.

The Ref Data section will cover specifics on the design of the RMS and safety considerations. The lesson will conclude with questions and answers and a video of past flights.

# 106 **PDRS OV 21001 (Concluded)**

Objectives:

- State the possible applications of the RMS in shuttle operations.
- Identify the RMS activities in each phase of flight (prelaunch to postlanding).
- Describe the need for different RMS modes of operation.
- Recall high-level design characteristics and safety considerations for the RMS.

# 107A **CCTV MAL 21001**

Title: Closed Circuit Television Malfunction Prebrief

Duration: 0.5 hours Medium: Classroom

Student: ASCAN (Schedule in pairs.)

Source: DS25/Communications/NSS Training Group

Date: 01/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): CCTV OPS 21008

Preparation: Review:

SCOM; Section 2.3, CCTV

Synopsis:

This prebrief will introduce the student to some basic troubleshooting techniques for the CCTV system as well as the use of FDF to aid in resolving the malfunctions. The briefing will begin with an operations review of the CCTV system and will allow the students to concentrate on malfunction recognition and resolution of failures in the SST.

- List the major steps involved in activating the CCTV system per the cue card.
- Identify the procedures corresponding to given CCTV signatures.
- Identify cues to assist in determining the location of the failure (e.g., nominal configuration, monitor, panel A7, and alert messages).

# 107B **CCTV MAL 21008**

Title: Closed Circuit Television Malfunction

Duration: 1.0 hour Medium: SST 3

Student: ASCAN (Schedule in pairs.)

Source: DS25/Communications/NSS Training Group

Date: 01/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): CCTV MAL 21001

Preparation: None

Synopsis: This lesson introduces the student to CCTV malfunction procedures while

configuring for nominal operations. The student will be required to recognize and resolve CCTV monitor, camera, and power failures

affecting the CCTV system using FDF.

Objectives: • Perform the following for each malfunction listed below:

Identify the associated signatures.

Perform the applicable malfunction procedure.

Explain the rationale for each step and the impact of the failure.

Malfunctions:

- Monitor failures
- Camera overtemp
- Loss of exterior camera video
- Sync generator failure
- Main power failure

108 **RNDZ OV 21001** 

Title: Rendezvous and Proximity Operations Overview Briefing

Duration: 3.0 hours
Medium: Classroom
Student: ASCAN

Source: DM34/Rendezvous Guidance, Procedures and Training and

**CB/Astronaut Office** 

Date: 02/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PTG 21006

Preparation: Take:

RNDZ Concepts 21057

Review:

ORB MECH 21057ORB DAP 21057

### Synopsis:

The purpose of this lesson is to introduce the student to the principles of Rendezvous and Proximity Operations. This lesson is designed to be a solid introduction to the basic profile, the use of onboard targeting, the use of sensors, and ultimately the manual phase, which culminates in either grapple of the target or docking to ISS. This lesson will also include a brief history of Rendezvous missions and some examples of future rendezvous missions.

- Define Rendezvous (RNDZ) terms.
  - Describe the roles of the chaser and target vehicles.
  - Describe the two types and two phases of RNDZ.
- Define Proximity Operations (Prox Ops) terms.
  - Describe the following Prox Ops tasks: manual phase, approach, docking, grappling, station-keeping, separations, flyaround, and transition.
- Know the standard RNDZ profile.
  - Read a relative motion plot.
  - Describe the basic burn types and how they shape the orbit.
  - Describe the placement of burns in the standard profile.
  - Describe the three RNDZ sensors and the data they provide.
  - Describe the three RNDZ state vectors.
  - Describe the placement of sensor passes in the standard profile.
  - Discuss Lambert targeting and which burns use it.

# 108 **RNDZ OV 21001 (Concluded)**

- Know the standard Prox Ops profile.
  - Describe the timeline of manual takeover/manual phase.
  - Describe the basic Prox Ops piloting task.
  - Describe the three main Prox Ops approaches and orbital mechanics effects of each.
  - Describe the onboard tools used during Prox Ops.

# 109 **P/L COM/OIU MAL 21006**

Title: Payload Communications/Orbiter Interface Unit Malfunction

Duration: 2.0 hours

Medium: SST 1 or SST 2 or SST 3 Student: ASCAN (Schedule in pairs.)

Source: DS25/Communications/NSS Training Group

Date: 08/03

Lesson(s) Replaced: P/L COM MAL 21006

Equipment Required: None

Prerequisite Lesson(s): P/L COM/OIU OPS 21006

Preparation: Review:

- Payload Communication Workbook; PL COM 21002, Sections 6, 7, and 8
- Malfunction Procedures: Sections 2.4, 2.5, and 5.5A
- Systems Operations Data File (SODF) Assembly Ops: Comm Malfunction Points Diagram; OIU Malfunction Procedures

Synopsis:

In this lesson, the student will be introduced to the Malfunction Procedures pertaining to the payload communications system and the Assembly Operations Procedures pertaining to Orbiter Interface Unit (OIU) fault messages. The student will practice these procedures in response to P/L Comm system Line Replaceable Unit (LRU) and OIU failures.

Objectives: Given malfunctions to the P/L Comm system and OIU.

- Identify the associated signatures and confirming cues.
- Perform the applicable malfunction procedure and explain the rationale behind the steps of the procedure.
- Explain the impact of the failure.

# 110 **EVA INTRO 21001**

Title: Extravehicular Activity Introduction

Duration: 4.0 hours
Medium: Classroom
Student: ASCAN

Source: DX32/EVA Task Group, DX35/EVA Systems Group

Date: 05/03

Lesson(s) Replaced: None

Equipment Required: EVA Tools and Equipment

Prerequisite Lesson(s): None

Preparation: None

Synopsis: A historical overview of EVA will be discussed, highlighting

accomplishments in the Gemini, Apollo, and Skylab programs. The history of EVA will be presented in a short video, then EVA requirements and constraints will be discussed. An introduction to the EMU, SAFER, and airlocks will be given. Some generic EVA tools will be demonstrated, and the flow of mission EVA events will be discussed. Finally, the EVA training facilities and EVA training flow for the ASCANs will be presented.

Objectives:

- Identify the reasons for conducting an EVA, and the role that EVA has played in previous and current space programs.
- Identify the types of EVAs that are trained and may be performed on orbit.
- Identify the roles that the EMU, SAFER, airlock, external airlock, and Station airlock accomplish in EVA operations.
- Identify the roles that different equipment and tools fulfill during an EVA.
- Identify the purpose of pre-EVA, EVA, and post-EVA operations.
- Identify the role that different training facilities play in EVA training, and comprehend the EVA training flow.

## 111 **RANGE SAFETY 21001**

Title: Range Safety Briefing

Duration: 2.0 hours
Medium: Classroom
Student: ASCAN

Source: CB/Astronaut Office

Date: 03/95

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

# 111 RANGE SAFETY 21001 (Concluded)

Preparation: Read:

- SCOM; Section 1.4, Range Safety System paragraph and General Overview
  - Solid Rocket Boosters

Synopsis: This lesson will review the basics of the Eastern Range at Cape

Canaveral Air Force Station. The organization and responsibilities of the Eastern Range will be discussed as they relate to the Shuttle Program as well as other programs. In addition, the following topics will be reviewed:

- Role of the Range Safety Officer (RSO)
- Range clearance
- Range tracking (hardware, software, displays)
- Flight Termination System (FTS)
  - Philosophy
  - Significance to crew
  - Launch Commit Criteria
  - Flight rules
- Current issues

Objectives:

- Explain the function of the Eastern Range as it applies to the shuttle and other programs.
- Explain what the FTS is.
- Explain the operational significance to the crew of the FTS.

## 112 **CREW DUTY 21001**

Title: Crew Duties Briefing

Duration: 3.0 hours
Medium: Classroom
Student: ASCAN

Source: CB/Astronaut Office

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

# 112 CREW DUTY 21001 (Concluded)

Synopsis:

CB representative will provide the students with descriptions and insight into crew assignments, both onboard the orbiter and within the astronaut office. This class can be broken down into two separate briefings. One where representatives from the different branches discuss what jobs within their branches are like. The other class would have crew members discuss the roles and responsibilities for the pilot and mission specialists in the cockpit.

Objectives: Objectives provided by CB office.

## 113 **HAB EQ/PROC 21020**

Title: Habitability Equipment and Procedures

Duration: 3.5 hours

Medium: CCT (CCT II or FFT)

Student: ASCAN (Schedule in groups up to 4.)

Source: DX45/Crew Systems Group

Date: 03/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): CREW CAB FAM 21020, WCS PROC 21065

Preparation: None

Synopsis:

During this lesson, the student will perform the procedures related to orbiter habitability in a flight-configured trainer with the appropriate equipment. The equipment used and the procedures performed include those associated with sleep, exercise, crew personal clothing, trash management, trash overboard vent, atmospheric samples, acoustic measurements, crew compartment cleaning, restraints/mobility aids, and window shades/filters. The crew will remove the equipment from launch stowage locations, perform on-orbit operations, and restow the equipment in the entry configuration.

- Become familiar with the operational use of all nominal crew equipment.
- Be able to determine the locations of the wet and dry trash.
- Become familiar with the on-board exercise equipment.

# 114 **MECH MAL BR 21001**

Title: Mechanical Malfunction Review

Duration: 2.0 hours
Medium: Classroom
Student: ASCAN

Source: DS45/Shuttle Systems Training Group

Date: 03/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): MECH OPS 21004

Preparation: Review:

MECH SYS 21002, Section 4 (PLBD System)

Complete:

PLBD 21057 – Basic malfunctions

Synopsis:

This lesson is designed to prepare the student for MECH MAL 21004. The lesson begins with a review of the Payload Bay Doors display and nominal payload bay door operations. The lesson discusses the malfunctions that cause "PBD CONFIG" and "PBD SEQ FAIL" fault messages during auto payload bay door operations. It also discusses microswitch configurations that can cause a dilemma during payload bay door operations.

- Define the terms "active group" and "end of travel" in relation to the Payload Bay Doors.
- Describe how payload bay door auto mode operations work in the Primary Avionics Subsystem Software (PASS) and Backup Flight Software (BFS).
- Describe the malfunctions that will cause a "PBD CONFIG" fault message.
- Describe the malfunctions that will cause a "PBD SEQ FAIL" fault message.
- Describe the malfunctions that will cause a dilemma.
- Given specific microswitch malfunctions, identify what, if any, fault messages will be generated.

## 115 **ECLSS MAL A/E BR 21001**

Title: Ascent/Entry Environmental Control and Life Support System

Malfunction Review

Duration: 3.0 hours
Medium: Classroom
Student: ASCAN

Source: DS45/Shuttle Systems Training Group

Date: 12/06

Lesson(s) Replaced: None

Equipment Required: ASC PKT C/L, ENT PKT C/L, AESP

Prerequisite Lesson(s): ECLSS OPS 22004

Preparation: Review:

SCOM; Section 2.9, ECLSS

Synopsis:

The lesson will start with a review of Environmental Control and Life Support System (ECLSS) subsystems and their respective configurations for ascent and entry. Next, subsystem redundancy and mission impact of ECLSS malfunctions will be discussed. The signatures of selected ECLSS component failures will be covered, using ECLSS ascent/entry displays and panel O1 meters. Malfunction prioritizing will follow, with discussion on probable cause of selected malfunctions. Next, FDF malfunction procedure flow will be covered, with a focus on transition from powered flight to unpowered flight procedures. The lesson will conclude with a discussion of operational guidelines and the steps involved in selected ECLSS ascent/entry malfunctions.

- Identify the signatures of the following ECLSS malfunctions on ascent and/or entry via displays, meters, and other cockpit cues:
  - Avionics bay fan degrade
  - Cabin leak
  - H<sub>2</sub>O loop pump failure
  - Flash Evaporator System freeze-up
  - Internal N<sub>2</sub> leak
  - Freon loop leak
  - Freon loop blockage
  - NH<sub>3</sub> leak onto Freon loops
  - H<sub>2</sub>O loop leak
  - Avionics bay fire
- Describe the sequence of FDF usage for the above ECLSS ascent/entry malfunctions.
- Explain the guidelines/constraints and rationale associated with the procedures for the above ECLSS ascent/entry malfunctions.

# 115 ECLSS MAL A/E BR 21001 (Concluded)

- Identify how ECLSS malfunctions are prioritized, and given a series of malfunctions from the list above, determine which procedures should be worked immediately and which can be delayed.
- Determine whether or not an ascent abort is required for a given ECLSS malfunction (using FDF).
- State the mission impacts of losing the following systems during the ascent/entry time frame: cabin pressure, single or both Freon loops, single or both water coolant loops, single or multiple Flash Evaporator System controllers.

## 116 **DPS MAL 21006**

Title: Data Processing System Malfunctions

Duration: 2.0 hours

Medium: SST 1 or SST 2 or SST 3 Student: ASCAN (Schedule in pairs.)

Source: DS24/DPS/Navigation Training Group

Date: 02/04

Lesson(s) Replaced: DPS OPS 21006A

Equipment Required: None

Prerequisite Lesson(s): A/E DPS MAL 21001

Preparation: Review:

MAL PROC; Section 5, DPS; Table of Contents

## Synopsis:

This lesson exercises the nominal timeline from post-OMS-1 through the entry configuration with DPS malfunctions. Malfunctions in General Purpose Computers (GPCs), Multiplexer/Demultiplexers (MDMs), and Modular Memory Units (MMUs) are presented to show expected annunciations and other indications (e.g., GPC status matrix, Caution and Warning (C&W) light matrix, Systems Maintenance (SM) alert light and tone, master alarm, and GPC fault message line). FDF recovery procedures and rationale are presented. At the conclusion of the lesson, the student will be given the Major GPC Failures Summary and the MDM Failure Recognition prebrief text handouts to review prior to taking DPS MAL 21057.

- Perform, aided, the appropriate procedures to safe and recover from a GPC 4 Fail to HALT malfunction during Major Mode (MM)104.
- Perform, aided, the Post-Insertion DPS reconfiguration with GPC 4 failed.
- Perform, aided, the appropriate procedures to recover GPC 4, including a software dump, a hardware dump, and an Initial Program Load (IPL) of GPC 4.

# 116 **DPS MAL 21006 (Concluded)**

- Perform, aided, the appropriate procedures to recover from an Flight Forward (FF) 1 primary port failure on orbit, by moding flight-critical string 1 to secondary ports.
- Perform, aided, the appropriate procedures to recover from an MMU 1 power failure during an orbit Operational Sequence (OPS) transition.
- Perform, aided, the appropriate procedures to safe and recover from a GPC 1 Fail to Sync malfunction during the entry time-frame.
- List the short and long range impacts of a GPC failure during MM104.
- Describe the impacts and Flight Rule implications for an MMU failure.
- Explain the Radiator/Payload Bay Door (RAD/PLBD) NO-GO criteria and Flight Rule impacts of the GPC and MDM failures.
- Identify and recover from the failure of an Integrated Display Processor (IDP) and understand the In-Flight Maintenance (IFM) impacts.
- Identify and recover from an edge key failure.
- Describe the impacts of a GPC failure Pre-Time of Ignition (TIG) and Post Burn.

## 117 **PGSC INTRO 21195**

Title: Payload and General Support Computer Orbiter Communication

Adapter Familiarization

Duration: 2.5 hours Medium: PGSC Lab

Student: ASCAN, PS (Schedule in groups of 2.)

Source: DO5/Cargo Integration and Operations Branch

Date: 10/01

Lesson(s) Replaced: PGSC H/W 21020

Equipment Required: PGSC Lab Prerequisite Lesson(s): None

Preparation: None

Synopsis:

The purpose of this class is to introduce the student to PGSC hardware and applications that they will use for Orbit simulations at the SMS. The lesson will require the latest flown flight-specific configuration, flight software, usage chart, Chapter 12 "ORB OPS," late-updates, sample web, and messages. After this class, the student will be able to use the generic PGSC load for any orbit sim, and configure the PGSC network accordingly.

- Set up a flight-specific PGSC configuration with the ORB OPS Checklist and flight-specific usage chart.
- Understand the IBM 760 XD and the Selectadock I hardware and ports use.

# 117 PGSC INTRO 21195 (Concluded)

- Perform and understand the PGSC late-update procedure.
- Understand the high-level use of all the cables, and PC cards: quatech, Etherlink III, RFLan, Manipulator Controller Interface Unit (MCIU), and hard disk.
- Understand and verify the peer-to-peer network with Pingmaster and Windows Explorer.
- Perform EPSON Network printer procedures.
- Launch and understand the following apps: WorldMap, WinDecom, RMS Situational Awareness Display (RSAD), Dynamic Onboard Ubiquitous Display (DOUG).

## 118 **ESC PROC 21001**

Title: Escape Procedures Briefing (Shared – Shuttle)

Duration: 1.0 hour Medium: Classroom

Student: ASCAN (Schedule in groups of up to 7; 2 PLTs and 5 MSs.)

Source: DX45/Crew Systems Group

Date: 12/06

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ESC EQ/SYS 21001

**Note:** ESC PROC 21001 should be no more than 2 days before ESC

PROC 21020. Suit Fit Check is required before this lesson may be

scheduled.

Preparation: Review:

CREW ESCAPE SYSTEMS 21002; Section 4

Synopsis: This lesson introduces the student to procedures associated with the

different emergency egress modes. Material presented will include the

following:

- Launch pad emergencies
  - Emergency egress Modes 1 through 4
- Post-landing emergencies
  - Modes 5 through 7
- Bailout
  - Mode 8

A video will be shown on emergency egress procedures.

## 118 **ESC PROC 21001 (Concluded)**

Objectives: • Describe the following emergency egress Modes:

- Mode 1 Unassisted Pad Egress.
- Modes 2 through 4 Assisted Pad Egress.
- Mode 5 Unassisted Postlanding Egress.
- Modes 6 and 7 Assisted Postlanding Egress.
- Mode 8 Bailout.
- Describe orbiter egress and escape from the launch pad.
- Describe egress slide deployment (both hatch on and hatch jettisoned modes).
- Describe the backup procedure if the slide fails to deploy.
- Describe the procedures of the escape panel and Sky Genie usage.
- Describe the deployment of the escape pole, hook up, and bailout.

## 119 **APU/HYD MAL 21004**

Title: Auxiliary Power Unit/Hydraulic Malfunction

Duration: 2.0 hours

Medium: SST 2 or SST 1 or SST 3 Student: ASCAN (Schedule in pairs.)

Source: DS45/Shuttle Systems Training Group

Date: 03/05

Lesson(s) Replaced: AP/HY MAL 21004

Equipment Required: None

Prerequisite Lesson(s): APU/HYD MAL BR 21001

Preparation: None

Synopsis:

This lesson will take the student beyond nominal operations to the level of minimum proficiency in off-nominal operations of the Auxiliary Power Unit (APU)/Hydraulic (Hyd) systems. As a minimum, the student will be exposed to cases requiring the shutting down of the APU during both powered and glided flight. Discussion of the impacts will be incorporated into these procedures. Additionally, the critical skills of cooling and restarting the APU will be performed. Additional malfunctions listed above, or otherwise, will be included as permitted by student performance.

- Identify the following APU/Hyd malfunctions on ascent and/or entry via displays, meters, and other cockpit cues:
  - APU 10.5 second timer fail
  - APU fuel/H<sub>2</sub>O line heater fail
  - APU oil overtemp
  - APU overspeed
  - APU speed control shift
  - APU underspeed

# 119 APU/HYD MAL 21004 (Concluded)

- Hyd Pressure sensor
- Hyd pump degrade
- Hyd reservoir leak
- Water Spray Boiler (WSB) tank pressure sensor fail
- Execute the appropriate FDF procedure for each of the malfunctions listed above.
- Explain the rationale for the FDF procedures associated with each of the malfunctions listed above.
- State the mission impact for each of the APU/Hyd malfunctions discussed in this class.

## 120 **ABORT FDF 21001**

Title: Abort Flight Data File Review Briefing

Duration: 4.0 hours
Medium: Classroom
Student: ASCAN

Source: DS66/G&C/Propulsion Training Group

Date: 07/04

Lesson(s) Replaced: None

Equipment Required: ASC C/L, ENT C/L Prerequisite Lesson(s): ABORT FAM BR 21001

Preparation: None

Synopsis: This lesson is designed to be a line-by-line review of the Ascent Checklist

(C/L) procedures used to perform a Return-To-Launch Site (RTLS), a Transatlantic Abort Landing (TAL) (pre- and post-Main Engine Cut-off (MECO)), an Abort to Orbit (ATO), and an Abort Once Around (AOA)

abort.

An in-depth review of OMS 1/2 TGTING, OMS1 BRN, OMS2 TGTING, RTLS, TAL, TAL Redesignate, ABORT DUMPS, AOA, POST D/O BURN, and OMS TGTS will be performed. While each procedure is reviewed, the major events of the abort and the crew tasks required for each abort will be discussed. This lesson is designed to prepare the student for ABORT FAM 21011 and ABORT FAM 22011.

#### 120 ABORT FDF 21001 (Concluded)

- Objectives: Identify where the procedures for the following aborts are located in both the CDR/PLT C/Ls and the MS C/Ls.
  - **RTLS**
  - TAL/TAL Delay
  - ATO
  - AOA
  - Identify the abort required, using the Orbital Maneuvering System 1/2 (OMS-1/2) targeting page, the ATO page, the OMS Targets section, and the OMS-2 targeting page given a set of post-MECO conditions.
  - Using the appropriate procedures, state how to initiate an RTLS, a TAL. an ATO, and an AOA.

#### 121 **IFM PIN KIT 21001**

Title: In-Flight Maintenance Pin Kit Briefing

Duration: 2.0 hours Medium: Classroom

Student: ASCAN (Schedule in groups of up to 4.) DX44/In-Flight Maintenance Group Source:

Date:

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): IFM 21001

Preparation: None

Synopsis:

This lesson includes a detailed study of each element of the In-Flight Maintenance (IFM) pin kit (such as cables, pins, alligator clips, sockets, minigrabbers, crimping tools, strippers, etc.) and how to use each. Instruction on the use of the IFM Digital Multimeter (DMM), circuit breaker (cb) retention device, transducer modules, and IFM Breakout Box (BOB) will also be provided. Emphasis is on hands-on practical application, and involves actual manufacturing of cables as might be done in flight.

- Identify the different types of electrically related IFM procedures.
- Describe orbiter electrical components and be familiar with how they are labeled/identified.
- Describe and understand IFM C/L electrical schematics.

# 121 **IFM PIN KIT 21001 (Concluded)**

- Describe the purpose, basic function, and stowage location of the following items:
  - cb retention device
  - IFM DMM
  - Temperature and pressure transducer modules
  - IFM BOB and DC cable
  - IFM Pin Kit and its contents
- Perform, aided, the setup and demonstrate use of the DMM, transducer modules, IFM BOB, and cable.
- Demonstrate the use of the IFM pin kit to manufacture a typical jumper wire/cable that might be used in flight, including wire stripping, attaching pins and sockets, and splicing.

# 122 **FLIGHT PLAN 21001**

Title: Flight Planning Overview Briefing

Duration: 1.0 hour
Medium: Classroom
Student: ASCAN

Source: DO4/Flight Planning *Branch* 

Date: 05/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): P/L & APDS OV 21001

Preparation: None

## Synopsis:

This lesson is designed to familiarize the student with the flight planning process. The briefing will review the development process by which a mission-specific Flight Plan is developed. Some of the topics to be discussed are parties involved with the development process, crew scheduling constraints, payload and orbiter constraints, and how real-time mission replanning is accomplished.

- Describe the development process that is used to design and create a mission-specific Flight Plan.
- Identify the different parties that contribute to the development of a Flight Plan
- Identify some of the general scheduling rules that are must be adhered to when designing a Flight Plan (crew, payload, and orbiter-related).
- Describe the role and responsibilities of the Flight Activities Officer (FAO) in the MCC.
- Explain how replanning is performed real time.
- Familiarization with products produced by FAO team.

## 123 **FCS C/O 21006**

Title: Flight Control System Checkout

Duration: 2.0 hours

Medium: SST 1 or SST 2 or SST 3 Student: ASCAN (Schedule in pairs.)

Source: DS66/G&C/Propulsion Training Group

Date: 02/04

Lesson(s) Replaced: VEH UTIL 21002

Equipment Required: None

Prerequisite Lesson(s): SENS/CNTL 21006

Preparation: Read:

SCOM: Section 5.3

Last Full Day On-Orbit

 FCS/EFF 21002; Section 10, Surface Drive Checks and Hydraulic Warmup

## Synopsis:

This lesson will focus on performing the FCS CHECKOUT crew procedures. The student is expected to already have a basic understanding of the FCS equipment. The student will perform the FCS Checkout procedure with the exception of Auxiliary Power Unit (APU) start/shutdown, which is covered in APU/HYD OPS 21004. Simple malfunctions will give the student practice in malfunction identification and reconfiguration. Translational Hand Controller (THC) and Rotational Hand Controller (RHC) Redundancy Management (RM) will be discussed during the controller checkout. This class will have an operational focus and provide inputs to the student about expected noises, vibrations, and movements that may occur during the checkout.

- State the purpose of the procedure.
- State when the procedure is performed during the mission.
- Locate the procedure in the FDF.
- State what OPS mode is required and why.
- List basic equipment tested in Parts 1 and 2 of procedure.
- Explain what occurs during the Aerosurface Drive Test.
- Identify the noise associated with the secondary actuator check.
- Perform the FCS CHECKOUT crew procedures as listed in the FDF.
- Identify malfunctions and work the applicable FCS CHECKOUT procedures to resolve them.
- Explain the difference between THC and RHC RM.
- Explain the procedure differences if Secondary Actuator Checkout is performed with a circulation pump.

## 124A **PO INS OPS 21001**

Title: Post-Insertion Operations Prebrief

Duration: 1.0 hour Medium: Classroom

Student: ASCAN (Schedule 3 ASCANs, 1 CB IA.)

Source: DA7/Assigned SMS Team

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): A/E FAM 21011, PGSC INTRO 21195

Preparation: Review:

Post-Insertion C/L: Overview Timeline Section

Synopsis: This prebrief is designed to prepare the student for PO INS OPS 21012.

The prebrief will review the Post-Insertion timeline, identifying parallel and serial procedures and the rationale for each of the major steps. The prebrief also provides the students with an opportunity to define their individual roles as crewmembers and determine the procedures for which

each person will be responsible in PO INS OPS 21012.

Objectives: • Identify the three sections of the Post-Insertion C/L.

- Identify the major events of Post-Insertion using the annotated Summary Timeline.
- Identify the tasks that must be performed in serial and which ones can be performed in parallel.
- Identify which crewmembers are responsible for each of the major activities.
- Discuss the purpose of the "PLBD Open Go/No-Go" block of the Post Insertion.
- Discuss the criteria required to activate the vernier RCS jets.
- Identify each student's roles and responsibilities for PO INS OPS 21012.

#### 124B **PO INS OPS 21012**

Title: Post-Insertion Operations

Duration: 4.0 hours Medium: SMS-FB

Student: ASCAN (Schedule 3 ASCANs, 1 CB IA.)

Source: DA7/Assigned SMS Team

Date: 07/04

Lesson(s) Replaced: None Equipment Required: None

## 124B **PO INS OPS 21012 (Concluded)**

Prerequisite Lesson(s): PO INS OPS 21001

Preparation: None

Synopsis: This lesson provides the first opportunity for the students to exercise all of

the Post-Insertion activities per the timeline in full cockpit environment. The lesson pulls together many of the nominal procedures that have been exercised individually in SST lessons, and allows the students to work each of them together in a nominal timeline. The lesson consists of one run starting at L/O-9 minutes and continuing through the first part of the Flight Plan. The students will be required to perform all of the nominal ascent, Post-Insertion, and Flight Plan activities as well as unstow and stow the appropriate FDF.

Objectives:

- Perform the nominal ascent and post-insertion procedures.
- Identify which procedures can be performed in parallel and which must be performed in serial and execute accordingly.
- Perform an IMU align using the Star Trackers and Star Pairs PAD.
- Set up and activate the PGSC to run the WorldMap program Space Operations Computing (SpOC).
- Perform the following Flight Plan activities from the Orbit Ops C/L:
  - PCS Config
  - LAMP TEST
  - SMOKE DETN CKT TEST
  - CRYO 02 CURRENT SENSOR TEST
  - Ku deploy/activation
  - CCTV activation and checkout

## 125A **D/O PREP 21001**

Title: Deorbit Preparation Operations Prebrief

Duration: 1.0 hour Medium: Classroom

Student: ASCAN (Schedule 3 ASCANs, 1 CB IA.)

Source: DA7/Assigned SMS Team

Date: 07/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PO INS OPS 21012

Preparation: Review:

Deorbit Prep C/L; Overview Timeline

## 125A **D/O PREP 21001 (Concluded)**

Synopsis:

This prebrief is designed to prepare the student for D/O PREP 21012. The prebrief will review the D/O Prep timeline, identifying parallel and serial procedures, and the rationale for each of the major steps. The prebrief also provides the students with an opportunity to define their individual roles as crewmembers and determine the procedures for which each person will be responsible in D/O PREP 21012.

Objectives:

- Identify the purpose of the seven sections of the D/O Prep C/L.
- Using the Nominal Deorbit Prep Summary Timeline, identify the purpose of each major timeline activity and which crewmember is normally responsible for executing the activity.
- Identify which activities must be performed serially and which can be performed in parallel.
- Identify each student's roles and responsibilities for D/O PREP 21012.

## 125B **D/O PREP 21012**

Title: Deorbit Preparation Operations

Duration: 4.0 hours Medium: SMS-FB

Student: ASCAN (Schedule 3 ASCANs, 1 CB IA.)

Source: DA7/Assigned SMS Team

Date: 07/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): D/O PREP 21001

Preparation: None

Synopsis:

This lesson provides the first opportunity for the students to exercise all of the Deorbit Preparation activities per the timeline in a full cockpit environment. The lesson pulls together many of the nominal procedures that have been exercised individually in SST lessons and allows the students to work each of them together in a nominal timeline. The lesson consists of one run starting at D/O-4 hours and continuing through at least D/O-15 minutes. The students will be required to perform all of the Deorbit Prep and deorbit burn preparation activities as well as unstowing and stowing the appropriate FDF. Lastly, the students will use the Space Operations Computing (SpOC) program to determine the deorbit burn targets to burn.

#### 125B D/O PREP 21012 (Concluded)

- Objectives: Perform the nominal Deorbit Prep and deorbit burn preparation procedures.
  - Identify which procedures must be performed serially and which can be performed in parallel and execute accordingly.
  - Using the SpOC, determine the deorbit burn target set to be burned.

#### 126 **MECH MAL 21008**

Title: Mechanical Malfunction

Duration: 2.0 hours Medium: SST 3

Student: ASCAN (Schedule in pairs.)

DS45/Shuttle Systems Training Group Source:

Date:

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): MECH MAL BR 21001

Preparation: Review:

PLBD 21057 – Basic malfunctions

#### Synopsis:

This lesson introduces the student to off-nominal procedures associated with the external tank umbilical doors, payload bay door system, and radiator system. For each failure, the following will be reviewed: cockpit cues, procedures to be performed and the rationale for major steps, and the impacts of the failure on the system itself, the other orbiter systems, and the mission.

- Identify the following Mechanical system malfunctions via displays and other available cockpit cues:
  - Two external tank (ET) umbilical door ready-to-latch microswitches failed off
  - Microswitch failure(s) which cause a PBD CONFIG or PBD SEQ FAIL message or a dilemma
  - Payload bay door jam in the Open direction
  - Radiator talkback failure
- Execute the appropriate FDF procedure for each of the malfunctions discussed in this class.
- Explain the rationale for the FDF procedures associated with each of the malfunctions discussed in this class.
- State the mission impact for each of the malfunctions discussed in this class.
- Explain the purpose of the Payload Bay Door Bulkhead Latch Go/No-Go diagram and state when it is used.

## 126 MECH MAL 21008 (Concluded)

- Explain the purpose of the Centerline Latch Extended Guide Roller Trajectory No-Go diagram and state when it is used.
- Recognize when the Emergency Payload Bay Door Opening procedure is required, and execute the procedure.
- Execute the procedure to deploy a single radiator panel.

### 127 **ECLSS MAL A/E 21004**

Title: Ascent/Entry Environmental Control and Life Support System

Malfunction

Duration: 2.0 hours

Medium: SST 2 or SST 1 or SST 3 Student: ASCAN (Schedule in pairs.)

Source: DS45/Shuttle Systems Training Group

Date: 12/06

Lesson(s) Replaced: ECLSS MAL A 21004, ECLSS MAL E 21004

Equipment Required: None

Prerequisite Lesson(s): ECLSS MAL A/E BR 21001

Preparation: None

Synopsis:

The lesson will start with a brief review of the Environmental Control and Life Support System (ECLSS) subsystems and their configurations for ascent/entry (using ECLSS panel schematics). The lesson will consist of three runs. Two will start at prelaunch in the mission timeline and end at post OMS-1, and one will start at post deorbit burn and end after rollout. A variety of ECLSS malfunctions will be shown and the student will be required to identify and confirm the failure, execute malfunction recovery procedures using appropriate FDF, explain rationale for steps in the procedures, and state the system/mission impact of failures.

- Identify the following ECLSS malfunctions during the ascent/entry timeframe via displays and other available cockpit cues:
  - Avionics bay fan degrade
  - Avionics bay fire
  - Avionics bay signal conditioner
  - Cabin fan degrade
  - Cabin leak
  - Flash Evaporator System freeze-up
  - Freon loop leak
  - Freon loop pump failure
  - H<sub>2</sub>O loop leak
  - H<sub>2</sub>O loop pump failure
  - Internal N<sub>2</sub> leak

## 127 ECLSS MAL A/E 21004 (Concluded)

- NH<sub>3</sub> leak onto Freon loops
- O<sub>2</sub>/N<sub>2</sub> controller failure
- Radiator undertemp sensor failure
- Execute the appropriate FDF procedure for each of the malfunctions listed above.
- Explain the rationale for the FDF procedures associated with each of the malfunctions listed above.
- State the mission impact for each of the malfunctions listed above.

#### 128 **DPS MAL 21057**

Title: Data Processing System Failure Recognition

Duration: 2.0 hours
Medium: CBT
Student: ASCAN

Source: DS24/DPS/Navigation Training Group

Date: 02/04

Lesson(s) Replaced: DPS MAL 22006

Equipment Required: None

Prerequisite Lesson(s): DPS MAL 21006

Preparation: Review:

DPS MAL 21006

Major GPC Failure Handout

MDM Failure Recognition Handout

MAL PROC; Section 5, DPS, 5.1a, Block 4

### Synopsis:

This lesson stresses the differing indications and causes for various single-point General Purpose Computer (GPC), Multiplexer/Demultiplexer (MDM), Multifunction Electronic Display System (MEDS), Modular Memory Unit (MMU), and Line Replaceable Unit/Bus Terminal Unit (LRU/BTU) failure modes. Many single-point failure cases are presented to reinforce DPS failure recognition. No multiple-layer-deep failure scenarios are discussed because each malfunction is presented one at a time. This lesson is primarily failure signature recognition and diagnosis of probable causes, and no procedures will be worked by the student. Some discussion of the probable causes will be presented after the student has correctly diagnosed the failure mode. The students may be directed to take certain diagnostic steps if they are having problems with a particular failure diagnosis or to reinforce the effects of a particular failure. There will be an option available to see a subset of the available failure indications in a random order for review purposes after the student has taken the lesson for credit.

#### 128 DPS MAL 21057 (Concluded)

- Objectives: Identify selected failures within the DPS during the orbit and the ascent/entry timeframe by:
  - Monitoring display cues.
  - Monitoring panels.
  - State the probable cause and mission impacts of a given DPS malfunction.

#### 129 **IMU 21006**

Title: Inertial Measurement Unit

Duration: 2.0 hours

SST 1 or SST 2 or SST 3 Medium: Student: ASCAN (Schedule in pairs.)

Source: DS24/DPS/Navigation Training Group

Date: 05/07

IMU/ST/COAS 21006, IMU/ST/COAS 21012 Lesson(s) Replaced:

Equipment Required: None

Prerequisite Lesson(s): DPS MAL 21006, PTG 21006

Preparation: Review:

- Orbit Ops C/L; GNC
  - IMU Align S TRK
  - IMU Alignment IMU/IMU
- Mal Procs; GNC
  - FRP 2, IMU Reference Recovery
  - FRP 3, IMU Recovery with at least one IMU as good reference

#### Synopsis:

During this lesson the student will follow a standard Flight Plan, Post Insertion, and Orbit Ops Checklist (C/L) to perform nominal Inertial Measurement Unit (IMU) and Star Tracker (STRK) actions. The student will be required to perform three different types of IMU aligns (star align, IMU/IMU align, and matrix align), aided and with FDF. To bring out some points about how the system operates, several malfunctions will be introduced which should direct the student to the Orbit Pocket C/L and Malfunction Procedures (Mal Proc). During this process, the instructor will be able to help the student develop troubleshooting skills.

- Activate the star trackers and open the doors.
- Identify and recover from the loss of IMU 3 and the -Y star tracker data path due to a Flight Forward (FF) 3 Multiplexer/Demultiplexer (MDM) primary port failure.
- Identify and recover from the loss of the -Z STRK power source.
- Identify the loss of power to an IMU and recognize that this IMU will be caged upon recovery of power.

# 129 <u>IMU 21006 (Concluded)</u>

- Perform the IMU Reference Recovery with at least one IMU as a good reference procedure for the caged IMU.
- Identify a biased star tracker and perform a single star tracker align.
- Identify an IMU Built-In Test Equipment (BITE) and mask that BITE.
- Identify an IMU Redundancy Management (RM) failure due to attitude misalignment.
- Identify an IMU dilemma due to an accelerometer problem.
- Perform an IMU reference recovery given no inertial reference.

## 130 **PGSC OPS 21195**

Title: Payload General Support Computer Operations

Duration: 2.0 hours

Medium: Payload General Support Computer (Building 5 PGSC Lab)
Student: ASCAN (Schedule no more than 2 students per class.)

Source: DO5/Cargo Integration and Operations Branch

Date: 08/04

Lesson(s) Replaced: OCA/VTS OPS 21195 and PGSC NETWORK OPS 21195

Equipment Required: Latest PGSC flight load and hardware

Prerequisite Lesson(s): PGSC INTRO 21195

Preparation: None

Synopsis:

The purpose of this class is to configure the Orbiter Communication Adapter (OCA) router for use with Modem File Transfer (MFX) Operations and Ku-Band File Transfer (KFX) Operations, as well as to setup the network using the latest PGSC usage chart. Upon completion of the class, the student will be able to use the generic PGSC load for any orbit simulation, configure the PGSC network accordingly, and perform a video teleconference. In addition, the student will be able to understand data flow to the different applications being used.

#### Objectives:

Upon the completion of the lesson, the student(s) should be able to:

- Understand the purpose of the OCA router and how to configure it for MFX Operations and KFX Operations.
- Assemble the network using the PGSC usage chart.
- Setup the Network printer and perform a warm-up and self-test.
- Understand the capabilities and the limitations associated with using Outlook.
- Understand the PGSC's ProShare unique features for Video Teleconferencing System (VTS).
- Perform a video teleconference.
- Launch and understand Windows DeCommutator (WinDecom).

## 131 **ECLSS MAL O BR 21001**

Title: Orbit Environmental Control and Life Support System

Malfunction Review

Duration: 3.0 hours
Medium: Classroom
Student: ASCAN

Source: DS45/Shuttle Systems Training Group

Date: 12/06

Lesson(s) Replaced: None

Equipment Required: ORB PKT C/L, MAL PROC (Volume 1)
Prerequisite Lesson(s): ECLSS OPS 21004, PGSC INTRO 21195

Preparation: Review:

SCOM; Section 2.9, ECLSS

#### Synopsis:

The lesson will start with a review of Environmental Control and Life Support System (ECLSS) subsystems and their respective configurations for orbit. Next, subsystem redundancy and mission impact of ECLSS malfunctions will be discussed. The signatures of selected ECLSS component failures will be covered using ECLSS orbit displays and meters. Malfunction prioritizing will follow, with discussion on probable cause of selected malfunctions. Next, malfunction procedure flow will be covered, with a focus on Orbit Pocket Checklist and Malfunction procedures. The lesson will conclude with a discussion of constraints/guidelines and rationale of the steps involved in selected ECLSS orbit malfunctions.

- Identify the signatures of the following ECLSS malfunctions on orbit via displays, meters, and other cockpit cues:
  - Freon loop leak
  - Cabin leak
  - Partial Pressure of Oxygen (PPO<sub>2</sub>) sensor failure
  - Supply water leak
  - H<sub>2</sub>O loop pump failure
- State the mission impacts for the ECLSS orbit malfunctions discussed in this class.
- Describe the sequence of FDF usage for selected ECLSS orbit malfunctions.
- Explain the constraints/guidelines and rationale associated with the procedures for the ECLSS orbit malfunctions discussed in this class.
- Identify how ECLSS malfunctions are prioritized, and given a series of malfunctions, determine which procedures should be worked immediately and which can be delayed.

## 132 **ESC PROC 21020**

Title: Escape Procedures

Duration: 4.0 hours

Medium: CCT or CCT II and FFT

Student: ASCAN (Schedule in groups of up to 7; 2 PLTs and 5 MSs.)

Source: DX45/Crew Systems Group

Date: 08/04

Lesson(s) Replaced: None

Equipment Required: ACES required Prerequisite Lesson(s): ESC PROC 21001

**Note:** Suited. Notify medical and safety. This lesson should be scheduled

no later than 2 days after completing ESC PROC 21001.

Preparation: None

Synopsis: This lesson provides hands-on experience for a suited bailout and post-

landing emergency egress. All aspects of bailout will be simulated, including cabin vent, side hatch jettison, seat egress, escape pole

deployment, and bailout. Students will also perform a post-landing egress

using the emergency egress slide system, and escape through the

emergency escape panel (window 8) using the Sky Genie descent device. The students will have an opportunity to practice descent procedures over a mattress prior to exiting from window 8 and the side hatch. All of the

above activities are performed in the ACES.

Objectives:

- Perform seat ingress and strap in the horizontal position with and without assistance from the suit technician.
- Perform egress procedures for Mode 8 bailout.
- Perform egress procedures for Mode 5 slide egress (hatch on).
- Perform contingency egress procedures for slide failure.
- Perform egress procedures for Mode 5 escape panel egress (window 8) using the Sky Genie descent device.

## 133 MPS MAL BR 21001

Title: Main Propulsion System Malfunctions 1 Review

Duration: 2.5 hours Medium: Classroom

Student: ASCAN (Schedule in groups of up to 15.)
Source: DS66/G&C/Propulsion Training Group

Date: 10/05

Lesson(s) Replaced: None

Equipment Required: ASC C/L, ASC PKT C/L, and AESP Prerequisite Lesson(s): APU/HYD MAL 21004, MPS OPS 21006,

SWITCH RM BR 21001

## 133 MPS MAL BR 21001 (Concluded)

Preparation: Review:

MPS OPS BR 21001 handouts

Read:

MPS Workbook 21002, Sections 4.1 – 4.4

Synopsis:

This lesson will present a general problem-solving strategy model and specific guidelines for using the FDF procedures for Main Propulsion System (MPS) malfunctions. The malfunction cases covered in the class re:

- Space Shuttle Main Engine (SSME) Fail/Shutdown
- SSME Redline Limits and the Limit Switch
- Hydraulic or Electric Lockup
- · Command Path Fail
- Data Path Fail
- Main Engine Helium Leak
- Pneumatic Helium Leak
- External Tank (ET) SEP Inhibit
- Low ET LH2 Ullage Pressure

This lesson will cover the following for the malfunction cases listed:

- The cause of each malfunction.
- Recognition of each malfunction.
- Locating the applicable procedure.
- Rationale for each procedure.

Objectives: Given MPS-related malfunctions:

- Explain the cause of each malfunction.
- State the cues to identify each malfunction.
- Locate the applicable procedure.
- Explain the rationale for each procedure.
- Explain the steps of the problem solving strategy.

#### 134 **OMS TGTING 22001**

Title: Orbital Maneuvering System Targeting Briefing, Part 2

Duration: 3.0 hours
Medium: Classroom
Student: ASCAN

Source: DS66/G&C/Propulsion Training Group

Date: 02/04

Lesson(s) Replaced: None Equipment Required: ASC C/L

## 134 OMS TGTING 22001 (Concluded)

Prerequisite Lesson(s): A/E FAM 21011, OMS TGTING 21001, ABORT FDF 21001

Preparation: Read:

SCOM

Section 6.5, Abort Once Around (AOA)

Section 6.7, Abort to Orbit (ATO)

• G&C I/O/D 21002, Section 4

Synopsis: The emphasis of this lesson is on Orbital Maneuvering System – 1/2

(OMS-1/2) Targeting. The lesson is composed of two parts. The first part covers the definitions, rationale, and philosophies applied to OMS-1/2 Targeting and, specifically, the definitions and limitations of the FDF used to perform OMS-1/2 Targeting. The second part develops the student's ability to determine targets and evaluate solutions by prioritizing targeting data, cross checking solutions, and applying rules of thumb. The second part of the lesson is focused on crew operations and has hands-on exercises for the student to practice OMS-1/2 targeting for a variety of performance and systems cases.

Objectives:

- Describe all the boundaries on the OMS-1/2 Targeting Card and state their importance.
- Demonstrate the use of the:
  - OMS-1/2 Targeting Card
  - OMS-2 Targeting Card
  - ATO Card
  - OMS Targets
- Utilize and prioritize the use of all the cockpit resources used for OMS-1/2 Targeting.
- Determine and explain how to correctly load OMS-1/2 targets for a variety of cases.

#### 135 **FLT CONT QUAL 21006**

Title: Flight Control Qualification

Duration: 2.0 hours

Medium: SST 1 or SST 2 or SST 3

Student: ASCAN (Schedule individually.)

Source: DS66/G&C/Propulsion Training Group

Date: 02/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): SENS/CNTL 21006

## 135 FLT CONT QUAL 21006 (Concluded)

Preparation: Review:

- A/E FCS BR 21001 Handout
- G&C SENS BR 21001 Handout
- AESP; FCS CH (2nd FAIL)
- AESP; RM FAIL RGA, AA
- AESP; FA/FF MDM I/O ERROR (FCS Steps)
- AESP; FA/FF PORT MODE (FCS, RGA, AA Steps)
- AESP; Powered, OPS 1/6/TAL TRANSITION RESTRING
- AESP; Glided, POST OPS 3/GRTLS TRANSITION RESTRING (FCS Steps)

#### Synopsis:

This lesson will verify completion of the Ascent/Entry Flight Control System (A/E FCS) and Sensors and Controllers flow by testing the student's operational knowledge of the FCS and Guidance and Control Sensors and Controllers. The lesson tests the student's ability to identify a problem via cockpit signatures, locate the correct procedure, and to evaluate the impact of the failure. The instructor will question the student to test knowledge of system operation, including rationale for procedures and functioning of redundancy management. The lesson also tests the student's ability to determine the impacts of a DPS failure on the FCS, Sensors, and Controllers.

The class is composed of four runs, two ascents and two entries. The instructor will play MCC and answer questions and direct the student as necessary. Initially, the student will configure the Orbiter for ascent and monitor the FCS, Sensors, and Controllers. The student will perform all nominal procedures as well as malfunction identification, resolution, and evaluation for the ascent and entry runs. The student will use FDF and cockpit displays to identify problems and take actions.

- Recognize failures in the FCS and flight control sensors and controllers.
- Demonstrate familiarity with the SPEC 53 and BFS SPEC 51 displays.
- Perform FDF procedures for FCS, Accelerometer Assembly (AA), Rate Gyro Assembly (RGA), and controller failures and explain the rationale for these procedures.
- Configure FCS channels per the OPS 1/6/TAL Transition Restring Cue Card and explain the rationale for the configuration.
- Manually bypass an aerosurface port.
- Manually deselect an AA, RGA, and FCS surface feedback.
- Perform the FCS, AA, and RGA steps in PASS GPC FAIL and FA/FF MDM I/O ERROR FDF procedures.
- Demonstrate an understanding of Redundancy Management (RM) for FCS, AAs, RGAs, and controllers.

136 **PI 21020** 

Title: Post Insertion Timeline in Shuttle Mockup

Duration: 4.0 hours

Medium: CCT (CCT II or FFT)

Student: ASCAN (Schedule in groups of up to 3.)

Source: DX45/Crew Systems Group

Date: 03/05

Lesson(s) Replaced: None Equipment Required: ACES

Prerequisite Lesson(s): HAB EQ/PROC 21020

**Note:** This lesson should be taught the day prior to DO PREP 21020. These

lessons will be covered over a consecutive two-day period. The first session, PI 21020, will be covered in a 4-hour period on the afternoon of day 1, and the second session, DO PREP 21020, will be covered in

a 4-hour period in the morning of day 2.

Preparation: None

Synopsis: During this lesson, the student will perform the integrated crew station

post-insertion and on-orbit procedures. The activities performed during this lesson include all nominal crew actions required to configure the crew station for orbit operations. (Includes crew worn equipment, specialist seat operations, communications equipment, FDF, and miscellaneous

loose equipment.)

Objectives: • Exercise the Post-Insertion timeline focusing on switch configuration,

reconfiguration of the middeck for on-orbit operations, and stowage.

Locate the fire extinguishers and practice donning the Quick Don Masks

(QDMs).

## 137 **DO PREP 21020**

Title: Deorbit Prep Timeline in Shuttle Mockup

Duration: 4.0 hours

Medium: CCT (CCT II or FFT)

Student: ASCAN (Schedule in groups of up to 3.)

Source: DX45/Crew Systems Group

Date: 03/05

Lesson(s) Replaced: None Equipment Required: ACES

Prerequisite Lesson(s): PI 21020, HAB EQ/PROC 21020

#### 137 **DO PREP 21020 (Concluded)**

Note: This lesson should be taught the day after PI 21020. These lessons

> will be covered over a consecutive two-day period. The first session, PI 21020, will be covered in a 4-hour period on the afternoon of day 1, and the second session, DO PREP 21020, will be covered in a 4-hour

period in the morning of day 2.

None Preparation:

Synopsis: During this lesson, the student will perform the integrated crew station

deorbit procedures. The activities performed during this lesson include all

nominal crew actions required to configure the crew station for entry. (Includes crew worn equipment, specialist seat operations,

communications equipment, FDF, and miscellaneous loose equipment.)

Objectives: Exercise the Deorbit Prep timeline focusing on switch configuration, seat

setup, and donning of the ACES.

#### 138 **ECLSS MAL O 21004**

Title: Orbit Environmental Control and Life Support System Malfunction

Duration: 2.0 hours

Medium: SST 2 or SST 1 or SST 3 Student: ASCAN (Schedule in pairs.)

Source: DS45/Shuttle Systems Training Group

Date:

Lesson(s) Replaced: ECLSS MAL O 21004, ECLSS MAL 21004

Equipment Required: None

Prerequisite Lesson(s): ECLSS MAL O BR 21001, PGSC INTRO 21195

Preparation: None

The lesson will start with a brief review of the Environmental Control and Synopsis:

> Life Support System (ECLSS) subsystems and their configurations for orbit (using ECLSS panel schematics). The lesson will consist of 2 runs, both in an orbit configuration. A variety of ECLSS malfunctions will be shown and the student will be required to identify and confirm the failure. execute malfunction recovery procedures using appropriate FDF, explain rationale for steps in the procedures, and state the system/mission impact

of failures.

Objectives:

 Identify the following ECLSS malfunctions during the orbit timeframe via displays and other available cockpit cues:

- Cabin leak
- Freon loop leak
- H<sub>2</sub>O loop controller fail
- H<sub>2</sub>O loop pump fail

## 138 ECLSS MAL O 21004 (Concluded)

- O<sub>2</sub> regulator shift
- PPO<sub>2</sub> sensor bias
- Radiator controller fail
- Supply water leak
- Execute the appropriate FDF procedure for each of the ECLSS orbit malfunctions discussed in this class.
- Explain the rationale for the FDF procedures associated with each of the ECLSS orbit malfunctions discussed in this class.
- State the mission impact for each of the ECLSS orbit malfunctions discussed in this class.

## 139 **OFF-NOM EG 21116**

Title: Off-Nominal Egress

Duration: 1.25 hours Medium: CCTII

Student: ASCAN (Schedule in groups of up to 7; 2 PLTs and 5 MSs.)

Source: DX45/Crew Systems Group

Date: 12/06

Lesson(s) Replaced: None

Equipment Required: CCTII in nose-down orientation

Prerequisite Lesson(s): ESC PROC 21020

Preparation: None

#### Synopsis:

This lesson discusses the procedures associated with the different offnominal egress procedures such as a Launch Scrub, Space Shuttle Main Engine (SSME) shutdown, Break-up/Loss of Control, and Crew Worn/Carry-On contingencies. Additionally, the student has the opportunity to experience the crew module environment in the nose-down attitude. Students will be allowed to crawl around in the CCTII and strap-in to the seats (if desired) to help comprehend the actions necessary to egress the vehicle in the event of an in-flight vehicle breakup.

- Describe the major steps in the procedures for a launch scrub and a SSME shutdown.
- Describe the egress procedures associated with the vehicle Break-up/Loss of Control scenario.
- Describe post-landing loss of COMM procedures (including light signals).
- Describes the procedures for Crew Worn/Carry-On equipment contingencies.

## 140 **WATER SURV 21001**

Title: Water Survival Briefing

Duration: 2.0 hours Medium: Classroom

Student: ASCAN (Schedule in groups of 5.)

Source: DX45/Crew Systems Group

Date: 05/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ESC PROC 21020

Note: WATER SURV 21027 should be scheduled no later than 2 days after

WATER SURV 21001.

Preparation: Review:

CREW ESCAPE SYSTEMS 21002

Section 2.5
 Section 2.6
 Section 3.6
 Section 4.7

Synopsis:

- The parachute, harness, raft, and survival equipment are discussed in great detail.
- Inflation of the Life Preserver Unit (LPU) and life raft are performed.
- A full complement of survival gear will be available for the students to see and handle.
- The procedures for using the parachute, LPU, raft and survival equipment are discussed. Included in the discussion are: capabilities and limitation of the equipment, recommended procedures, and Search and Rescue (SAR) operations.
- The procedures for the NBL session are discussed, including safety precautions.

- Describe both automatic and manual parachute operation.
- Describe under-canopy/LPU-inflation and water-entry techniques.
- Describe survival equipment and its usage.
- Describe Search and Rescue (SAR) operations.
- Describe procedures for NBL session.

## 141 **REACH & VIS 21020**

Title: Reach and Visibility

Duration: 2.0 hours
Medium: CCT or CCT II

Student: ASCAN, PS (Schedule in groups of 4, preferably 2 PLTs and 2 MSs,

suited.)

Source: DX45/Crew Systems Group

Date: 08/04

Lesson(s) Replaced: REACH & VIS 31020
Equipment Required: ACES required
Prerequisite Lesson(s): ESC PROC 21020

Preparation: Review:

CREW ESCAPE SYSTEMS 21002

Section 2.2
Section 2.3
Section 3.2
Section 3.3
Section 4.3

#### Synopsis:

This lesson is designed to familiarize the students with orbiter ingress and egress in the vertical position while suited. It allows each crewmember to know his or her limitations for reach and visibility envelopes, while in the ACES. In addition, it provides information on techniques that will compensate for these limitations. The reach and visibility portion of the lesson will be performed both pressurized and unpressurized. While the ACES is at a "hard press," the crewmembers will experience a decrease in their reach and visibility envelopes. This information can then be used in their SMS exercises, where crew coordination is developed. Time is allotted to the suit technicians so that they can document specific crewworn equipment that is necessary to improve crew comfort, reach, and visibility. At the end of the lesson, a Mode 1 egress will be performed.

- Perform seat ingress and strap-in while vertical.
- Describe the limitations to reach and visibility while the suit is pressurized and unpressurized.
- Describe various techniques of improving the personal reach and visibility envelopes while in the vertical.
- Describe techniques that will enhance coordination of procedures during powered flight.
- Perform Mode 1 egress.

## 142A **MPS MAL 21001**

Title: Main Propulsion System Malfunctions Prebrief

Duration: 0.5 hours
Medium: Classroom
Student: Non-ASCAN

Source: DS66/G&C/Propulsion Training Group

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): APU/HYD MAL 21004, MPS OPS 21006

Preparation: Read:

MPS Workbook 21002, Sections 4.1 – 4.4

**Note:** This lesson replaces the MPS MAL BR 21001 lesson for non-ASCAN

students.

Synopsis: This lesson will present a general problem-solving strategy model and

specific guidelines for using the FDF procedures for Main Propulsion System (MPS) malfunctions. The malfunction cases covered in the class

are:

Space Shuttle Main Engine (SSME) Fail/Shutdown

- SSME Redline Limits and the Limit Switch
- Hydraulic or Electric Lockup
- · Command Path Fail
- Data Path Fail
- Main Engine Helium Leak
- Pneumatic Helium Leak
- External Tank (ET) SEP Inhibit
- Low ET LH2 Ullage Pressure

This lesson will cover the following for the malfunction cases listed:

- The cause of each malfunction.
- Recognition of each malfunction.
- · Locating the applicable procedure.
- Rationale for each procedure.

Objectives: Given MPS-related malfunctions:

- Explain the cause of each malfunction.
- State the cues to identify each malfunction.
- Locate the applicable procedure.
- Explain the rationale for each procedure.
- Explain the steps of the problem solving strategy.

## 142B **MPS MAL 21006**

Title: Main Propulsion System Malfunctions 1

Duration: 2.0 hours

Medium: SST 1 or SST 2 or SST 3 Student: ASCAN (Schedule in pairs.)

Source: DS66/G&C/Propulsion Training Group

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): MPS MAL BR 21001

Preparation: Review:

MPS Workbook 21002, Sections 4.1 – 4.4

Synopsis: This lesson will provide 5-6 ascent runs for the student to practice

resolving the Main Propulsion System (MPS) malfunctions listed below. Following each run, the instructor will review with the student the cause of

each malfunction, the recognition cues, and the rationale for each

procedure.

Objectives: • Apply the problem solving strategy to resolve the following malfunctions in the MPS system:

Space Shuttle Main Engine (SSME) Fail/Shutdown

SSME Redline Limits and the Limit Switch

Hydraulic or Electric Lockup

Command Path Failure

Data Path Failure

Main Engine Helium Leak

Pneumatic Helium Leak

Low External Tank (ET) LH2 Ullage Pressure

#### 143A **ABORT FAM 21001**

Title: Abort Familiarization 1 Prebrief

Duration: 1.0 hour Medium: Classroom

Student: ASCAN, PS (Schedule 3 ASCANs, 1 CB IP.)

Source: DA7/Assigned SMS Team

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ABORT FDF 21001, PAPER SIM 21001

## 143A ABORT FAM 21001 (Concluded)

Preparation: Review:

Ascent C/L

OMS1/2 TGTINGOMS1 BURNOMS2 TGTING

– RTLS

TAL/TAL Delay

– AOA

POST D/O BURN

OMS TGTS

Synopsis: This prebrief will prepare the student for ABORT FAM 21011. During the

prebriefing, the major events and FDF flow of an Abort to Orbit (ATO), an Abort Once Around (AOA), a 2-engine Return-To-Launch Site (RTLS), and a Transatlantic Abort Landing (TAL)/TAL Delay will be reviewed. In addition, the students will review the cockpit indications that should be monitored during each of the abort cases and the crewmember(s)

responsible for the monitoring task.

Objectives: • Identify the flow of the FDF associated with each abort case.

• Identify the major tasks associated with each abort case and the crewmember responsible for the task.

• Identify the cockpit indications that should be monitored during each major event of each abort case.

#### 143B **ABORT FAM 21011**

Title: Abort Familiarization 1

Duration: 4.0 hours Medium: SMS-MB

Student: ASCAN, PS (Schedule 3 ASCANs, 1 CB IP.)

Source: DA7/Assigned SMS Team

Date: 02/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ABORT FAM 21001

Preparation: None

Synopsis: This lesson is designed to introduce the students to several intact abort

scenarios in a cockpit environment. During each abort case, the students will be required to follow the appropriate FDF procedures, perform the tasks called out in the FDF, and identify the cockpit indicators that each

crewmember is monitoring throughout the abort.

## 143B **ABORT FAM 21011 (Concluded)**

Objectives: • Using the FDF, perform the following intact aborts:

- Abort to Orbit (ATO) to OMS 2 targeting
- Abort Once Around (AOA) to landing (systems)
- 2-engine Return-To-Launch Site (RTLS) to landing
- Transatlantic Abort Landing (TAL)/TAL Delay to landing (landing optional)
- Perform the appropriate monitoring tasks associated with each of the abort cases.
- Debrief the major cockpit cues (aural, visual, etc.) associated with each abort case.

## 144 **EPS MAL A/E BR 21001**

Title: Ascent/Entry Electrical Power System Malfunction Review

Duration: 3.0 hours
Medium: Classroom
Student: ASCAN

Source: DS45/Shuttle Systems Training Group

Date: 04/06

Lesson(s) Replaced: None

Equipment Required: ASC PKT C/L, ENT PKT C/L, AESP, REF DATA

Prerequisite Lesson(s): EPS OPS 21004

Preparation: Review:

SCOM; Section 2.8, EPS

#### Synopsis:

Using materials from previous EPS lessons, this review class will begin with a brief overview of the EPS subsystems and then an overview of the FDF, including the Ascent/Entry Systems Procedures, Ascent Pocket Checklist, Entry Pocket Checklist, and Reference Data from an EPS point of view. Next, there will be a discussion of the fuel cell shutdown and bus tie procedures. The remainder of the class will be working through the malfunctions listed in the performance objectives using the display, meter, and panel information with the FDF to identify the problem, confirm the problem, safe the system, reconfigure the system, and determine the impact of the problem on the remainder of the mission.

- Identify the signatures of the following EPS malfunctions on ascent and/or entry via displays, meters, and other cockpit cues:
  - 3 phase motor stop
  - AC single phase inverter fail
  - AC single phase volts high
  - Essential Bus (ESS) short
  - Forward Power Controller (FPC)

## 144 EPS MAL A/E BR 21001 (Concluded)

- Fuel Cell pH
- Main bus or Fuel Cell short
- O<sub>2</sub> manifold leak
- Reactant valve fail closed
- Describe the sequence of FDF usage for the EPS ascent/entry malfunctions discussed in this class.
- Explain the guidelines/constraints and rationale associated with the procedures for the EPS ascent/entry malfunctions discussed in this class.
- State the mission impact for each of the EPS ascent/entry malfunctions discussed in this class.
- Explain the difference between the long and short form bus tie, and when each would be used.
- Identify the difference in signatures between a fuel cell short and a main bus short.
- Describe the function of the AC bus sensors on ascent/entry.
- Explain the failure that leads to a 3-phase motor shop.

## 145 **EPS MAL O BR 21001**

Title: Orbit Electrical Power System Review

Duration: 3.0 hours
Medium: Classroom
Student: ASCAN

Source: DS45/Shuttle Systems Training Group

Date: 04/06

Lesson(s) Replaced: None

Equipment Required: ORB PKT C/L, MAL PROC (Volume 2), REF DATA, IFM C/L

Prerequisite Lesson(s): EPS OPS 21004, IFM PIN KIT 21001

Preparation: Review:

SCOM; Section 2.8, EPS

Synopsis:

Using materials from previous EPS classes, this review class will begin with a brief overview of the EPS subsystems and then an overview of the FDF (Orbit Pocket Checklist, Malfunction Procedures) from an EPS point of view. Next, there will be a detailed discussion of the Fuel Cell Shutdown and Bus Tie procedures. The remainder of the class will be working through the malfunctions listed in the performance objectives using the onboard display, meter, and panel information with the FDF to identify the problem, confirm the problem, safe the system, reconfigure the system, and determine the impact of the problem on the remainder of the mission.

## 145 EPS MAL O BR 21001 (Concluded)

Objectives Identify the simpet

- Objectives: Identify the signatures of the following EPS malfunctions on orbit via displays and other available cockpit cues:
  - AC Inverter Failure
  - AC Single Phase Short
  - Control Bus Short
  - Cryo O<sub>2</sub> Tank Heater Trip
  - Forward Power Controller (FPC) Short
  - Fuel Cell Coolant Pump Delta P Sensor Failure
  - Fuel Cell H<sub>2</sub> Pump Failure
  - Fuel Cell pH Indication
  - State the mission impact for each of the EPS orbit malfunctions discussed in this class.
  - Explain the guidelines, constraints, rationale, and FDF sequence associated with EPS orbit malfunction procedures.
  - Explain the concept of "induced voltage."
  - Identify when "bus isolation" steps in the Malfunction procedures are needed, and when they are not needed.
  - Explain how a short on a control bus will fail part (but not all) of the bus.
  - Explain the concept of the AC Transfer Cable.
  - Describe the function of the AC bus sensors on orbit.

## 146 **WATER SURV 21027**

Title: Water Survival Duration: 3.0 hours

Medium: Neutral Buoyancy Lab

Student: ASCAN (Schedule in groups of up to 5.)

Source: DX45/Crew Systems Group

Date: 08/04

Lesson(s) Replaced: None

Equipment Required: ACES required

Prerequisite Lesson(s): WATER SURV 21001

**Note:** Swim Test required before this lesson may be scheduled. This lesson

should be scheduled no later than 2 days after WATER SURV 21001.

Preparation: Review:

• CREW ESCAPE SYSTEMS 21002

Section 2.5

Section 2.6

Section 3.6

Section 4.7

#### 146 WATER SURV 21027 (Concluded)

Synopsis:

This lesson enables the crewmembers to experience bailout, water entry, and survival techniques. It is in 2 parts.

#### Part 1:

- Each of the crewmembers will hang from parachute risers, inflate their Life Preserver Unit (LPU), close and lock their visor, and pull their green apple.
- They will then be released and enter the water.
- Divers will place the crewmember under the canopy and they will extricate themselves from underneath it.
- The student will experience a back drag and a front drag to practice proper body positioning and Frost fitting release.
- They will then enter the raft and perform survival procedures, including radio ops using the PRC-112 and Search and Recovery Satellite Aided Tracking (SARSAT), signaling equipment, and bailing devices.
- The student will perform the procedures associated with the Forest Penetrator rescue seat.

#### Part 2:

- They will enter a mockup of the orbiter side hatch, attach themselves to the escape pole, and perform a bailout into the pool.
- A video will be replayed to show how well they have performed.
- Additional bailouts can be performed to improve technique.

- Objectives: Perform parachute descent techniques and water entry procedures.
  - Perform parachute drag and canopy extraction.
  - Perform life raft entry and reentry procedures.
  - Perform survival equipment use, radio protocol, and signaling techniques.
  - Perform rescue hoist operations.
  - Perform orbiter side hatch bailout procedures into pool.

#### 147 **OMS MAL BR 21001**

Title: Orbital Maneuvering System Malfunction Review

Duration: 2.0 hours Medium: Classroom

ASCAN (Schedule in groups of up to 15.) Student: Source: DS66/G&C/Propulsion Training Group

10/05 Date:

Lesson(s) Replaced: None Equipment Required: None

## 147 <u>OMS MAL BR 21001 (Concluded)</u>

Prerequisite Lesson(s): OMS OPS 21006

Preparation: Read:

OMS 21002; Chapter 4

Synopsis: This lesson will prepare the students for OMS MAL 21006, and will be the

foundation for all future OMS troubleshooting operations. The lesson will begin with a review of the OMS and its nominal operations. A discussion

of OMS failure modes and resolution techniques will be the main

component of the briefing. Malfunction troubleshooting methods and use

of the FDF will be covered. The OMS leaking Propellant/Helium

procedures on orbit will be covered in detail.

Objectives: • Use OMS cockpit cues and FDF to identify single-failure-deep OMS malfunctions and determine the appropriate actions required to place

the system in a safe configuration.

• The types of malfunctions covered will include:

Transducer failures (temperature, pressure)

Leaks (helium, propellant, nitrogen)

Regulator failures (helium, nitrogen)

Gimbal failures

Probe failures

Switch and valve failures

Thermal failures

## 148A **OMS MAL 21001**

Title: Orbital Maneuvering System Malfunction Prebrief

Duration: 0.5 hours
Medium: Classroom
Student: Non-ASCAN

Source: DS66/G&C/Propulsion Training Group

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): OMS OPS 21006

Preparation: Read:

OMS 21002; Chapter 4

Note: This lesson replaces the OMS MAL BR 21001 lesson for non-ASCAN

students.

## 148A OMS MAL 21001 (Concluded)

Synopsis:

This lesson will prepare the students for OMS MAL 21006, and will be the foundation for all future OMS troubleshooting operations. The lesson will begin with a review of the OMS and its nominal operations. A discussion of OMS failure modes and resolution techniques will be the main component of the briefing. Malfunction troubleshooting methods and use of the FDF will be covered. The OMS leaking Propellant/Helium procedures on orbit will be covered in detail.

Objectives:

- Use OMS cockpit cues and FDF to identify single-failure-deep OMS malfunctions and determine the appropriate actions required to place the system in a safe configuration.
- The types of malfunctions covered will include:
  - Transducer failures (temperature, pressure)
  - Leaks (helium, propellant, nitrogen)
  - Regulator failures (helium, nitrogen)
  - Gimbal failures
  - Probe failures
  - Switch and valve failures
  - Thermal failures

## 148B **OMS MAL 21006**

Title: Orbital Maneuvering System Malfunction

Duration: 2.0 hours

Medium: SST 1 or SST 2 or SST 3 Student: ASCAN (Schedule in pairs.)

Source: DS66/G&C/Propulsion Training Group

Date: 02/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): OMS MAL BR 21001

Preparation: Review:

OMS 21002; Section 4

Synopsis:

This lesson is designed to allow the student to practice malfunctions discussed in OMS MAL BR 21001. The lesson will present one-failure-deep OMS malfunctions from the Ascent, Orbit, and Entry phases of flight. The class is designed to reinforce basic OMS subsystem knowledge, teach the use of FDF, and form the basis of analytical thinking in troubleshooting subsystem problems. Students will be actively involved and are encouraged to engage their instructors with questions. Students will work an OMS Helium tank leak on-orbit to completion.

## 148B OMS MAL 21006 (Concluded)

Objectives: • Perform the following actions for given one-failure-deep OMS malfunctions:

- Recognize (identify) that a malfunction has occurred with primary and secondary cues.
- Identify the FDF procedure to be worked.
- Notify MCC and perform the actions required.
- Correctly identify the malfunction on the appropriate FDF schematic.
- Evaluate if the actions were effective and determine the impacts to the system/mission.

## 149A **ABORT FAM 22001**

Title: Abort Familiarization 2 Prebrief

Duration: 1.0 hour Medium: Classroom

Student: ASCAN (Schedule 3 ASCANs, 1 CB IP.)

Source: DA7/Assigned SMS Team

Date: 03/95

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ABORT FAM 21011

Preparation: Review:

- Ascent C/L
  - OMS 1/2 TGTING, Look specifically at ATO OMS1 burn required portion of the card
  - OMS1 BURN
  - OMS2 TGTING
  - TAL, Look specifically at Post-MECO TAL steps
  - TAL Redesignate cue card

#### Synopsis:

This prebrief will prepare the student for ABORT FAM 22011. During the prebrief, the major events and FDF flow of the following aborts will be reviewed:

- ATO with OMS-1
- Post-MECO TAL
- 3-ENG RTLS
- TAL Redesignate

In addition, the students will review the cockpit indications that should be monitored during each of the abort cases and the crewmember(s) responsible for the monitoring task.

## 149A ABORT FAM 22001 (Concluded)

Objectives: • Identify the major tasks associated with each abort case.

Identify the flow of FDF associated with each abort case.

 Identify the cockpit indications that should be monitored during each major event of each abort case.

### 149B **ABORT FAM 22011**

Title: Abort Familiarization 2

Duration: 4.0 hours Medium: SMS-MB

Student: ASCAN (Schedule 3 ASCANs, 1 CB IP.)

Source: DA7/Assigned SMS Team

Date: 03/95

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ABORT FAM 22001

Preparation: None

Synopsis: This lesson is designed to introduce the students to several intact abort

scenarios in a cockpit environment. During each abort case, the students will be required to follow the appropriate FDF procedure, perform the tasks

called out in the FDF, and identify the cockpit indicators that each

crewmember is monitoring throughout the abort.

Objectives: • Using the FDF, perform the following intact aborts:

ATO with OMS-1 burn required

Post-MECO TAL

3-engine RTLS to landing

TAL Redesignate through OPS 3 (landing optional)

- Perform the appropriate monitoring tasks associated with each of the abort cases.
- Discuss the major cockpit cues (aural, visual, etc.) associated with each abort case.

## 150 **EPS MAL A/E 21004**

Title: Ascent/Entry Electrical Power System Malfunction

Duration: 2.0 hours

Medium: SST 2 or SST 1 or SST 3 Student: ASCAN (Schedule in pairs.)

Source: DS45/Shuttle Systems Training Group

Date: 04/06

Lesson(s) Replaced: EPS MAL 21004

## 150 **EPS MAL A/E 21004 (Concluded)**

Equipment Required: None

Prerequisite Lesson(s): EPS MAL A/E BR 21001

Preparation: None

Synopsis: This lesson will present the student with a variety of malfunctions in the

Power Reactants Storage and Distribution (PRSD) subsystem, fuel cell, and Electrical Power Distribution and Control (EPDC) subsystem. The students will use their EPS knowledge with the onboard displays, meter, panel information, and FDF to identify the problem, confirm the problem, safe the system, reconfigure the system, and determine the impact of the

problem on the remainder of the mission.

Objectives: • Identify the following EPS malfunctions during the ascent/entry timeframe via displays and other available cockpit cues:

- 3 phase motor stall
- AC inverter failure
- AC inverter shift
- Bus tie switch failure
- Cryo manifold leak
- Essential bus short
- Forward Power Controller (FPC) short
- Fuel cell pH sensor fail
- Fuel cell reactant valve failed closed
- Fuel cell short
- Main bus short
- Execute the appropriate FDF procedure for each of the EPS ascent/entry malfunctions discussed in this class.
- Explain the rationale for the FDF procedures associated with each of the EPS ascent/entry malfunctions discussed in this class.
- State the mission impact for each of the EPS ascent/entry malfunctions discussed in this class.

## 151 **EPS MAL O 21004**

Title: Orbit Electrical Power System Malfunction

Duration: 2.0 hours

Medium: SST 2 or SST 1 or SST 3 Student: ASCAN (Schedule in pairs.)

Source: DS45/Shuttle Systems Training Group

Date: 04/06

Lesson(s) Replaced: EPS OPS 21004

Equipment Required: None

## 151 **EPS MAL O 21004 (Concluded)**

Prerequisite Lesson(s): EPS MAL O BR 21001

Preparation: None

Synopsis: This lesson will present the student with a variety of malfunctions in the

Power Reactant Storage and Distribution (PRSD) subsystem, Fuel Cell, and Electrical Power Distribution and Control (EPDC) subsystem. The students will use their EPS knowledge with the onboard displays, meter, panel information, and FDF to identify the problem, confirm the problem, safe the system, reconfigure the system, and determine the impact of the

problem on the remainder of the mission.

Objectives:

- Identify the following EPS malfunctions during the orbit timeframe via displays and other available cockpit cues:
  - AC inverter failure
  - AC overload
  - Control bus short
  - Cryo O<sub>2</sub> heater current sensor trip
  - FPC short
  - Fuel cell H<sub>2</sub> pump
  - Fuel cell delta-P sensor failure
  - Fuel cell pH sensor
- Execute the appropriate FDF procedure for each of the EPS orbit malfunctions discussed in this class.
- Explain the rationale for the FDF procedures associated with each of the EPS orbit malfunctions discussed in this class.
- State the mission impact for each of the EPS orbit malfunctions discussed in this class.

#### 152 **SPOC 21001**

Title: SpOC Familiarization Briefing

Duration: 2.0 hours Medium: Classroom

Student: ASCAN, PS (Schedule in groups of up to 4.)

Source: MS4/Flight Software Office

Date: 10/05

Lesson(s) Replaced: SpOC/HP48SX 21001

Equipment Required: ORB OPS C/L, ORB PKT C/L

Prerequisite Lesson(s): ECLSS MAL O 21004, PGSC INTRO 21195

Preparation: Review:

Orbit Ops C/L; PGSC section

#### 152 SPOC 21001 (Concluded)

Synopsis:

This lesson is designed to familiarize the students with the standard Space Operations Computing (SpOC) software applications flown on the PGSC for every mission. This class is a "hands-on" software and hardware class. The students will learn how to use and interface with the SpOC applications. Additionally, students will be presented with the overall ops concepts for PGSC software (i.e., how each application affects the suite of tools on the PGSC). Students will be given operational scenarios and asked to respond using the software to generate solutions.

- Objectives: Describe the functions provided by the SpOC software.
  - Demonstrate effective uses of the SpOC software and PGSC hardware.
  - Describe the relationships (i.e., cause and effect) of data to the software suite.
  - Describe the operational concept of the PGSC as it relates to Shuttle ops.

#### 153A **E NAV 22001**

Title: **Entry Navigation 2 Prebrief** 

0.5 hours Duration: Medium: Classroom

Student: ASCAN (Schedule in pairs.)

Source: DS24/DPS/Navigation Training Group

02/04 Date:

Lesson(s) Replaced: E NAV 21011

Equipment Required: None

Prerequisite Lesson(s): E NAV 21006, IMU 21006

Preparation: Review:

• NAV 21002; with an emphasis on entry navigation topics

Read:

- AESP (Glided Flight); COMM/GNC and DPS
  - RM FAIL IMU
  - RM DILEMMA IMU
  - POST BFS ENGAGE

Synopsis:

This prebrief will review entry Inertial Measurement Unit (IMU) and state vector management and introduce associated FDF. Differences between Primary Avionics Software System (PASS) and Backup Flight Software (BFS) usage of Tactical Air Navigation (TACAN) and air data sensors will be reviewed as well. This will include a detailed discussion of the BFS probe deployment and verification procedures. The Microwave Landing System (MLS) and its use during landing phase will be discussed,

including identification of failure modes.

## 153A **E NAV 22001 (Concluded)**

Objectives:

- Discuss the IMU attitude and velocity selection filter for PASS and BFS.
- Discuss entry state vector management for PASS and BFS, including the procedure for PASS-to-BFS state vector transfer.
- Explain how TACAN and air data sensor management is different in PASS versus BFS.
- Discuss elements of the POST BFS ENGAGE procedure pertaining to IMUs and air data.
- Describe BFS air data probe deploy and verification.
- Discuss the MLS and its management during entry.
- Summarize the method for troubleshooting MLS Redundancy Management (RM) dilemmas.
- Discuss IMU re-anchoring in PASS Operational Sequence (OPS) 3.

#### 153B **E NAV 22006**

Title: Entry Navigation 2

Duration: 2.0 hours

Medium: SST 1 or SST 2 or SST 3 Student: ASCAN (Schedule in pairs.)

Source: DS24/DPS/Navigation Training Group

Date: 02/04

Lesson(s) Replaced: E NAV 21011 (partial)

Equipment Required: None

Prerequisite Lesson(s): E NAV 22001

Preparation: None

Synopsis:

This lesson, a continuation of E NAV 21006, concentrates on entry Inertial Measurement Unit (IMU) and state vector management, including identification, safing, and recovery, when possible. Flight-critical Multiplexer/Demultiplexer (MDM) problems will be used to demonstrate the effects of DPS problems on IMU and state vector selection in both the Primary Avionics Software System (PASS) and Backup Flight Software (BFS). On one run, the BFS will be engaged and BFS-unique entry procedures will be performed. The evaluation and resolution of a Microwave Landing System (MLS) malfunction will be performed at the end of an entry run. The following runs will be used to exercise the training objectives:

- Run 1: Tactical Air Navigation (TACAN), air data, and MLS case from 210K to landing.
- Run 2: IMU management (Redundancy Management (RM) and data paths).

## 153B **E NAV 22006 (Concluded)**

- Run 3: IMU management (IMU/IMU align).
- Run 4: BFS-engage entry (TACAN and air data procedures).
- Run 5: Bad onboard NAV/incorporate Global Positioning System (GPS).

#### Objectives:

- Identify TACAN and air data failures and execute recovery/safing procedures.
- Identify and resolve an MLS dilemma using the Horizontal Situation Indicator (HSI).
- Identify and resolve IMU RM fail and dilemma using the appropriate procedures.
- Describe PASS and BFS IMU RM.
- Explain IMU re-anchoring in PASS Operational Sequence (OPS) 3.
- Identify the impact of DPS failures on PASS and BFS IMU selection.
- Identify the signature of an IMU power failure.
- Perform the IMU/IMU align procedure to recover a caged IMU.
- Perform a PASS/BFS state vector transfer.
- Perform a BFS engage and work the post-engage procedures.
- Identify a silent TACAN dilemma in the BFS.
- Perform BFS probe deploy and verification.
- Identify and resolve an Air Data Transducer Assembly (ADTA) malfunction while BFS-engaged.
- Discuss onboard evaluation of bad nav.
- Discuss GPS and its usage.
- Incorporate GPS to correct a bad NAV state.

## 154 **NAV QUAL 21001**

Title: Navigation Qualification

Duration: 1.0 hour Medium: Classroom

Student: ASCAN (Schedule individually.)

Source: DS24/DPS/Navigation Training Group

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): E NAV 22006, A/E BFS 21011

Preparation: None

Synopsis: This lesson will verify completion standards of Navigation (NAV) training

by having the student answer some general questions about NAV

operations.

#### 154 NAV QUAL 21001 (Concluded)

- Objectives: Describe the data that the sensor provides to the software, the timeframes used, the Redundancy Management (RM) (selection filter and downmode conditions) for Primary Avionics Software System (PASS) and Backup Flight System (BFS), and the procedures for RM failures and dilemmas, as applicable, for the following sensors: Inertial Measuring Unit (IMU), Tactical Air Navigation (TACAN), the air data system, Microwave Landing System (MLS), and Radar Altimeters (RAs).
  - Describe the IMU failure signatures (Fail, Dilemma (DLMA), Power) and the actions required for each, as applicable.
  - Describe IMU reanchoring and when it will occur.
  - Describe air data probe deployment and verification for PASS and BFS.
  - Describe residual, ratio, and the filter controls (Auto, Inhibit, Force) as seen on PASS and BFS SPEC 50.
  - Describe the single-state and three-state vector schemes, when they are used, and their advantages/disadvantages.

#### 155 **RCS MAL BR 21001**

Title: Reaction Control System Malfunction Review

Duration: 2.5 hours Medium: Classroom

Student: ASCAN (Schedule in groups of about 15.) Source: DS66/G&C/Propulsion Training Group

10/05 Date:

Lesson(s) Replaced: None

Equipment Required: AESP, ASC PKT C/L, ORB PKT C/L

Prerequisite Lesson(s): OMS MAL 21006

Preparation: Review:

> SCOM: Section 2.20 RCS OV 21001 materials

Synopsis:

This lesson is a refresher on the Reaction Control System (RCS), including nominal operations, relevant DPS displays, switch, and meter locations. This lesson is also an introduction into malfunction recognition and resolution. This will include schematic references. FDF selection and manipulation, and techniques for crewmembers. FDF procedures will be examined in a generic overview fashion. Line by line reviews, when required, are reserved for the SST. This lesson leads directly into RCS MAL 21006. The RCS leaking Propellant/Helium procedures will be covered in detail.

## 155 RCS MAL BR 21001 (Concluded)

Objectives:

- State the four steps in resolving a malfunction.
- Determine the appropriate FDF book and procedure title for given RCS failures based on the phase of flight and message annunciated.
- Identify the technique for "securing" the RCS.
- Identify the technique used to reopen a secured RCS.
- Identify on an FDF schematic the bounded location of the following:
  - A helium tank leak
  - A helium line leak
  - A propellant tank leak
  - A propellant leg leak
  - A manifold leak
  - A crossfeed line leak
- Define the following malfunctions and state how each is monitored:
  - Jet Fail LEAK
  - Jet Fail ON
  - Jet Fail OFF

## 156A **RCS MAL 21001**

Title: Reaction Control System Malfunction Prebrief

Duration: 0.5 hours
Medium: Classroom
Student: Non-ASCAN

Source: DS66/G&C/Propulsion Training Group

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): OMS MAL 21006

Preparation: Review:

SCOM; Section 2.20

RCS 21002

**Note:** This lesson replaces the RCS MAL BR 21001 lesson for non-ASCAN

students.

Synopsis: This lesson is a refresher on the Reaction Control System (RCS),

including nominal operations, relevant DPS displays, switch, and meter locations. This lesson is also an introduction into malfunction recognition and resolution. This will include schematic references, FDF selection and manipulation, and techniques for crewmembers. FDF procedures will be examined in a generic overview fashion. Line by line reviews, when required, are reserved for the SST. This lesson leads directly into RCS MAL 21006. The RCS leaking Propellant/Helium procedures will be

covered in detail.

## 156A RCS MAL 21001 (Concluded)

Objectives:

- State the four steps in resolving a malfunction.
- Determine the appropriate FDF book and procedure title for given RCS failures based on the phase of flight and message annunciated.
- Identify the technique for "securing" the RCS.
- Identify the technique used to reopen a secured RCS.
- Identify on an FDF schematic the bounded location of the following:
  - A helium tank leak
  - A helium line leak
  - A propellant tank leak
  - A propellant leg leak
  - A manifold leak
  - A crossfeed line leak
- Define the following malfunctions and state how each is monitored:
  - Jet Fail LEAK
  - Jet Fail ON
  - Jet Fail OFF

## 156B **RCS MAL 21006**

Title: Reaction Control System Malfunction

Duration: 2.0 hours

Medium: SST 1 or SST 2 or SST 3 Student: ASCAN (Schedule in pairs.)

Source: DS66/G&C/Propulsion Training Group

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): RCS MAL BR 21001

Preparation: Review:

RCS 21002; Chapter 4

• SCOM; Section 6.8, OMS, RCS

Synopsis:

This lesson will present malfunctions from Ascent, Orbit, and Entry phases of flight. The lesson is designed to reinforce basic Reaction Control System (RCS) subsystem knowledge, teach the use of FDF, and form the basis of analytical thinking in troubleshooting subsystem problems. A majority of procedures from each checklist (C/L) will be exercised. The lesson will allow hands-on practice for the student. Students will be actively involved, and are encouraged to engage their instructors with questions. Student will work through the orbit leaking Helium burn procedures.

#### 156B RCS MAL 21006 (Concluded)

- Objectives: Demonstrate an ability to use the appropriate FDF to correctly identify, confirm, and reconfigure in response to single failures of the RCS subsystem.
  - Use instrumentation cross checks to identify real and false failure annunciations.
  - Perform isolation/securing of the leaking system from the bottom to the
  - Identify, on a schematic, the following:
    - A helium tank leak
    - A helium leg leak
    - A propellant tank leak
    - A manifold leak
    - A tank leg leak
  - Define, for both Primary Avionics Software System (PASS) and Backup Flight Software (BFS), the causes and signatures of the following:
    - Jet Fail OFF
    - Jet Fail ON
    - Jet Fail LEAK
  - Execute the RCS He tank leak procedure on-orbit to completion.

#### 157 **TIER TEST 24001**

Refer to TIER TEST 21001 for description.

#### 158 **MAN MNVR 21025**

**Orbit Manual Maneuvers** Title:

Duration: 2.0 hours

Dynamic Skills Trainer 1 Medium:

ASCAN (Schedule individually.) Student:

DM34/Rendezvous Guidance, Procedures and Training Source:

02/04 Date:

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PTG 21006

Preparation: Review:

• ORB DAP 21057

## 158 **MAN MNVR 21025 (Concluded)**

Synopsis:

This lesson contains exercises for developing the skills required to manually maneuver the shuttle (translation and rotation) on orbit. The emphasis of the lesson is on configuration of the orbit DAP using both the Guidance, Navigation, and Control (GNC) SPEC 20 DAP CONFIG display and the DAP pushbuttons (located on either Panel C3 or A6). The lesson will also allow the student to observe the effects of rotational and translational cross-coupling on the orbiter from the visuals, Attitude Direction Indicator (ADI), and the Universal Pointing (UNIV PTG) display. The exercises will contain maneuvers to both M50-stabilized and LVLH-stabilized attitudes, and will require the student to execute them in the +X orbiter body sense.

Objectives:

- State the function of each DAP pushbutton.
- State the function of all reconfigurable DAP parameters on SPEC 20.
- Perform a DAP EDIT reconfiguration and a temporary DAP change on SPEC 20.
- Describe and observe the cross-coupling effects in each axis for rotational and translational maneuvers.
- Perform INRTL and LVLH manual maneuvers with various orbiter body axes in Discrete (DISC) (attitude hold) and PULSE (free drift).
- Describe the information provided by the ADI and the four switches that affect this information.

## 159 **MPS MAL BR 22001**

Title: Main Propulsion System Malfunction Review 2

Duration: 3.0 hours Medium: Classroom

Student: ASCAN (Schedule in groups of about 15.) Source: DS66/G&C/Propulsion Training Group

Date: 10/05

Lesson(s) Replaced: None

Equipment Required: ASC C/L, ASC PKT C/L, and AESP Prerequisite Lesson(s): MPS MAL 21006, ABORT FAM 22011

Preparation: Read:

MPS Workbook 21002, Section 4.5

Review:

- MPS MAL BR 21001 handouts
- MPS Workbook 21002, Sections 4.1 4.4

#### 159 MPS MAL BR 22001 (Concluded)

## Synopsis:

This lesson builds on MPS MAL 21006, and will first review the general problem-solving strategy model and the specific guidelines for using the FDF cue cards for Main Propulsion System (MPS) malfunctions. The malfunction cases covered in the class are:

- 2 Stuck Throttles
- 2 Hydraulic Systems Failed
- Space Shuttle Main Engine (SSME) Stuck in the Bucket
- Single SSME Completion (2 SSMEs Failed/Shutdown)
- Multiple SSME Data Path Failures
- SSME Pushbuttons
- Main Engine He Leak and Aft Load Controller (ALC) Bus Failed
- DPS and EPS Fail Impacts to SSME Powered Flight
- MPS Helium Leak (Post External Tank Separation (ET SEP))
- ET SEP MAN/AUTO
- MPS Dump Inhibit
- Single DPS or EPS Fail: Impacts to MPS Dump/Vacuum Inerting
- DPS Multi-Data Path Loss Impacts to MPS
- High LH<sub>2</sub>/LO<sub>2</sub> Manifold Pressure (Post-Main Engine Cut-off (MECO))
- MPS Helium Regulator Fail During Entry

This lesson will cover the following for the malfunction cases listed:

- The cause of each malfunction.
- Recognition of each malfunction.
- Locating the applicable procedure.
- The rationale for each procedure.

- Objectives: Given MPS-related malfunction:
  - Explain the cause of each malfunction.
  - State the cues to identify each malfunction.
  - Locate the applicable procedure.
  - Explain the rationale for each procedure.

#### 160 **CONT ABT BR 21001**

Title: Contingency Abort Briefing

Duration: 4.0 hours Medium: Classroom Student: **ASCAN** 

Source: DS66/G&C/Propulsion Training Group

02/04 Date:

Lesson(s) Replaced: None Equipment Required: None

## 160 CONT ABT BR 21001 (Concluded)

Prerequisite Lesson(s): ABORT FAM 22011

Preparation: Read:

CONT ABT 21007

Synopsis:

The briefing describes what contingency aborts are, when they are required, and how to fly them. At the end of the briefing, the student will have a basic understanding of contingency aborts, and will be able to use and understand the contingency abort cue card. The student will be prepared to practice contingency abort procedures in the SMS. Due to time constraints, not all contingency abort procedures on the cue card will be taught in this lesson. More contingency abort training occurs early in the assigned crew training flow.

- State when a contingency abort is required.
- Describe the basic maneuvers and events that occur during contingency aborts.
- State where the generic contingency aborts black zones are located.
- Explain how the automated contingency guidance is engaged.
- Explain how the following orbiter features are used in contingency aborts: Control Stick Steering (CSS) flight controls; max throttles; SPEC 51 OMS dump; fast External Tank (ET) separation; single engine roll control; flight instruments and displays; speed brake and body flap; bailout autopilot.
- Describe the suggested Space Flight Resource Management (SFRM) and cockpit techniques for flying contingency aborts, including the typical division of responsibilities among crewmembers.
- Explain the basic differences between the two engine out and three engine out procedures.
- State how the crew uses the droop guidance display in the cockpit.
- Explain the format and use of the contingency abort cue card.
- Explain how to execute selected contingency abort procedures, using the contingency abort cue card.
  - Contingency 2 out blue
  - Contingency 3 out blue
  - Return-To-Launch Site (RTLS) 2 out yellow
  - RTLS 3 out orange
  - Bermuda/East Coast Abort Landing (ECAL)
  - Stuck procedures

## 161A **ASC DPS MAL 21001**

Title: Ascent Data Processing Systems Malfunction Procedures Prebrief

Duration: 0.5 hours Medium: Classroom

Student: ASCAN (Schedule in pairs.)

Source: DS24/DPS/Navigation Training Group

Date: 02/04

Lesson(s) Replaced: ASC DPS 21001

Equipment Required: None

Prerequisite Lesson(s): A/E DPS MAL 21001

Preparation: Review:

AESP (Powered Flight); DPS FDF procedures

Skim:

Ascent Pocket C/L; DPS FDF procedures

Read:

Flight Rules

Ascent String Reassignment (Section 2)

- Regain RCS Jets for RTLS ET Separation (Section 2)
- PASS DPS Failure (Section 7)
- Redundant Set Failure (Section 7)
- Redundant Set Split (Section 7)
- GPC Failure (Section 7, Paragraph A)
- Data Path Failure (Section 7, Paragraph A)
- PASS Data Bus Assignment Criteria (Section 7)
- MDM Port Moding (Section 7)

#### Synopsis:

This prebrief will introduce the student to various DPS failure signatures and procedures used during ascent. It will also be a review of the material presented in A/E DPS MAL 21001. The discussion will center on the malfunctions that will be introduced in ASC DPS MAL 21006. It is intended to ensure that the student has a good understanding of the procedures prior to exercising them in the SST.

- Identify signatures and the procedures to be run during ascent for the following DPS situations:
  - Flight Aft (FA) and Flight Forward (FF) Multiplexer/Demultiplexer (MDM) failure (either at the General Purpose Computer (GPC) or at the MDM)
  - Partial FA or FF MDM failure (A/B or C/D)
  - Backup Flight Software (BFS) Engage
  - Multi Data Path Loss
  - Explain the rationale for ascent restring and port mode cases.

## 161B **ASC DPS MAL 21006**

Title: Ascent Data Processing System Malfunction Procedures

Duration: 2.0 hours

Medium: SST 1 or SST 2 or SST 3 Student: ASCAN (Schedule in pairs.)

Source: DS24/DPS/Navigation Training Group

Date: 02/04

Lesson(s) Replaced: ASC DPS 21011

Equipment Required: None

Prerequisite Lesson(s): ASC DPS MAL 21001

Preparation: None

Synopsis: In this lesson, the student will practice exercising the procedures and

signature recognition associated with ascent DPS failures. Procedures will be executed from both the Ascent/Entry Systems Procedures (AESP) (Powered and Glided) and Ascent Pocket (ASC PKT) Checklist (C/L). Backup Flight Software (BFS) actions will be discussed where applicable.

Four runs will be used to exercise the following procedures:

- BCE STRG X
- PASS GPC FAIL
- MULTI-DATA PATH
- BFS GPC FAIL
- I/O ERROR CRT/DPS DISPLAY ANOMALY
- FA/FF MDM I/O ERROR
- FA/FF MDM PORT MODE
- PL MDM I/O ERROR
- POST BFS ENGAGE
- RESTRING CUE CARD

Objectives: • Identify the DPS failure based on cockpit cues.

- Perform appropriate procedures in the AESP and/or the ASC PKT C/L.
- Explain the steps and rationale behind each procedure worked.
- Optimize final DPS configuration for ascent.
- Identify mission impacts of the failures.

## 162 **BFS FAM BR 21001**

Title: Backup Flight System Familiarization Briefing

Duration: 2.0 hours
Medium: Classroom
Student: ASCAN

Source: DS24/DPS/Navigation Training Group and DS66/G&C/Propulsion

**Training Group** 

Date: 02/04

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: Review:

SCOM; Section 2.6, Software, Backup Flight System

DPS HW/SW 21002; Section 4, Backup Flight Software

• IMU 21002; Section 5, Differences in the BFS

NAV 21002; Section 5.8, BFS Differences

OMS 21002; Section 5, Differences in the BFS

RCS 21002; Section 5, Differences in the BFS

Ascent/Abort FPH; Section 5, Backup Flight System

ASC G&C 21002; Section 7, BFS Differences

CONT 21002; Section 7, Backup Flight System Controllers

G&C I/O/D 21002; BFS portions of Sections 3, 4, 5, 6, 7, and 8

Flight Rules

Data Path Fail/Engine-On Limit Shutdown Control (Section 5)

PASS/BFS Redundancy (Section 7)

GNC GPC Reactivation Priority (Section 7)

BFS DPS Failure (Section 7)

GPC Major Function Configuration (Section 7, Paragraph A, D, E)

Constraints on Port Moding or I/O Resets (Section 7)

Loss of BFS (Section 8)

#### Synopsis:

This briefing explains the hardware and software aspects of the Backup Flight System (BFS). It will discuss the primary purpose of the BFS, its limitations and its uses during various phases of flight. The briefing also discusses when and how to engage the BFS. Flight Rules pertaining to the management of the BFS will also be discussed. The briefing also focuses on the operational difference between the Primary Avionics Software System (PASS) and BFS (pre and post BFS engage).

- Explain the primary purpose of the BFS and its major limitations.
- Explain how the BFS is normally used for the various phases of flight.
- Explain how to perform a successful BFS engage.

# 162 BFS FAM BR 21001 (Concluded)

- Differentiate the requirements for PASS and BFS to recognize a BFS engage.
- Identify situations which may/will require a BFS engage.
- Identify situations when the BFS is no-go for engage.
- Identify situations when the BFS is suspect for engage.
- Describe a BFS self-engage and its signature.
- Explain the operational differences between PASS and BFS (pre and post BFS engage).

## 163 **OM/RC BURNS BR 21001**

Title: Orbital Maneuvering/Reaction Control System Burns Review

Duration: 2.0 hours Medium: Classroom

Student: ASCAN (Schedule in groups of about 15.)
Source: DS66/G&C/Propulsion Training Group

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): OMS MAL 21006, RCS MAL 21006, OMS TGTING 22001

Preparation: Review:

OMS 21002

 Section 4, Engine Failures, Leaks and other Propellant System Failures; Nitrogen System Failures, and Gimbal Failures

SCOM

Section 2.19, Fault Detection and Identification

#### Synopsis:

This lesson will provide the student the background for diagnosing failures during OMS and Reaction Control System (RCS) burns and prepare the student for OM/RC BURNS 21006 SST lessons. The procedures on the OMS BURN and OMS BURN MONITOR cards, and the fundamental concepts of OMS "engine failures" and "propellant failures" will be discussed. The prebrief will define OMS engine and propellant failures and teach how to diagnose engine fail and propellant fail during an OMS burn. This lesson will explain the rationale of the OMS ENG FAIL and OMS PRPLT FAIL procedures for OMS 2 and On Orbit OMS burns, during which the student will resolve malfunctions that occur during the OMS 1, OMS 2, and Orbit burns. This lesson will also introduce the "hot" OMS XFEED and other burn specific propellant management procedures. Lastly, this class will introduce the Space Flight Resource Management (SFRM) associated with monitoring burns, diagnosing failures, and working procedures.

#### 163 OM/RC BURNS BR 21001 (Concluded)

- Objectives: Use OMS and RCS cockpit cues and OMS BURN MONITOR card to diagnose OMS engine and propellant failures due to propellant blockages, He line blockages, He leaks, propellant leaks, and Nitrogen leaks.
  - Diagnose an OMS ENG FAIL due to gimbal failures.
  - State the cockpit cue and system impact differences between an OMS engine fail and an OMS propellant fail.
  - Explain the rationale of the OMS ENG FAIL and OMS PRPLT FAIL procedure on the OMS 2/ORBIT OMS BURNS card.

#### 164 **C&W MAL 21004**

Title: Caution & Warning Malfunction 2

Duration: 2.0 hours

SST 2 or SST 1 or SST 3 Medium: Student: ASCAN (Schedule in pairs.)

DS45/Shuttle Systems Training Group Source:

Date: 04/06

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): C&W OPS 21004

Preparation: None

Synopsis: Review the Caution & Warning (C&W) hardware systems, learn to

recognize failures in these systems, and diagnose the problem using crew

procedures.

- Identify the following C&W malfunctions during the orbit timeframe via displays and other cockpit cues:
  - Power supply A fail
  - Power supply B transient
  - Primary C&W memory fail
  - C&W systems self-test failure
  - C&W parameter inhibited inadvertently
  - C&W multiplexer (MUX) failure
  - Smoke detection/fire suppression circuitry failure
  - C&W system A klaxon trigger circuit fail on
- Execute the appropriate FDF procedure for each of the C&W malfunctions discussed in this class.
- Explain the rationale for the FDF procedures associated with each of the C&W malfunctions discussed in this class.
- State the mission impact for each of the C&W malfunctions discussed in this class.

## 165 **ORB EPS 21004**

Title: Orbit Electrical Power System Advanced Malfunction

Duration: 2.0 hours

Medium: SST 2 or SST 1 or SST 3 Student: ASCAN (Schedule in pairs.)

Source: DS45/Shuttle Systems Training Group

Date: 04/06

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): EPS MAL O 21004

Preparation: None

Synopsis: This lesson will cover Orbit EPS malfunctions. These malfunctions are

more complicated than those presented in EPS MAL O 21004. The students will use their EPS systems knowledge with the FDF, onboard display, meter, and panel information to identify and confirm the problem, safe and reconfigure the system, and determine the impact of the problem

on the remainder of the mission.

- Identify the following EPS malfunctions during the orbit timeframe via displays and other available cockpit cues:
  - Fuel Cell H<sub>2</sub> Pump Stall
  - Fuel Stack Temp transducer bias
  - Fuel Cell Internal Cryo Leak
  - Cryo Tank heater fail on
  - Cryo Tank Controller Pressure sensor fail Off Scale Low
  - AC False Overload
  - Forward Power Controller (FPC) Failure
  - Essential Bus Loss
  - Partial Control Bus Loss
- Execute the appropriate FDF procedure for each of the EPS orbit malfunctions discussed in this class.
- Explain the rationale for the FDF procedures associated with each of the EPS orbit malfunctions discussed in this class.
- State the mission impact for each of the EPS orbit malfunctions discussed in this class.
- Explain the concept and limitations of the AC Transfer Cable.

## 166A **ORB DPS MAL 21001**

Title: Orbit Data Processing System Malfunction Procedures Prebrief

Duration: 0.5 hours Medium: Classroom

Student: ASCAN (Schedule in pairs.)

Source: DS24/DPS/Navigation Training Group

Date: 02/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): A/E DPS MAL 21001

Preparation: Review:

Flight Rules

DPS Redundancy Requirements (Section 7)

Transient GPC (Section 7)GPC Failure (Section 7)

GPC Major Function Configuration (Section 7)

Powered Off GPC Action (101S) (Section 7)

GNC 3 Archive Management (Section 7)

GNC GPC Reactivation Requirements (Section 7)

PASS/BFS Redundancy (Section 7)

DPS GO/NO-GO Matrix (Section 7)

OOCL

PRE-SLEEP ACTIVITY, Step 8

OPCL

PASS GNC GPC (1st FAIL)

PASS SM GPC FAIL

MALFUNCTION PROCEDURE

- GPC, 5.1a, CS SPLIT

MMU/MTU, 5.2a, I/O ERROR MMU, 5.2b, OFF/BSY MMU

DPS, SSR-8, GPC IPL-PASS

Synopsis: This briefing is designed to prepare the student for ORB DPS MAL 21006.

The failures in this lesson are designed to exercise the associated procedures and to examine the operational impacts of the failures.

This briefing familiarizes the student with the following On-Orbit DPS failures and malfunction procedures. The briefing focuses on the failure signatures, the operational and flight rule impacts, the recovery procedures, and the procedural philosophies.

#### 166A ORB DPS MAL 21001 (Concluded)

- Objectives: Identify signatures and the procedures to be run during orbit for the following DPS situations:
  - Common Set (CS) split with single G2 configuration
  - Integrated Display Processor (IDP) Critical Built-In Test Equipment (BITE)
  - Modular Memory Unit (MMU) Power Failure
  - Operational Sequence (OPS) transition with both MMUs failed and stuck in OPS 0
  - Multifunction Display Unit (MDU) Anomaly (if time permits)
  - Discuss the Multifunction Electronic Display System (MEDS) actions in the Pre-sleep procedure of the Orbit Operations (OPS) Checklist (if time permits).

#### 166B ORB DPS MAL 21006

Title: Orbit Data Processing System Malfunction Procedures 1

Duration: 2.0 hours

Medium: SST 1 or SST 2 or SST 3 ASCAN (Schedule in pairs.) Student:

Source: DS24/DPS/Navigation Training Group

Date: 02/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ORB DPS MAL 21001

Preparation: None

Synopsis:

The lesson begins with a single G2 configuration, and is designed to expose the student to on-orbit DPS failures. The failures are designed to have the student exercise the appropriate procedures and examine the operational impacts of the failures.

- For the malfunctions listed below:
  - Identify the failure (primary cue).
  - Confirm the failure (secondary cue).
  - Make appropriate call to MCC.
  - Execute the appropriate FDF procedure.
  - Explain the steps and rationale behind the procedure.
  - Identify system/mission impacts.
  - Optimize final DPS configuration for orbit or entry, as required.
  - Configure Operational Sequence (OPS) for single G2.

## 166B ORB DPS MAL 21006 (Concluded)

- Malfunctions to be exercised:
  - Common Set (CS) split with single G2 config
  - Critical Integrated Display Processor (IDP) Built-In Test Equipment (BITE)
  - Modular Memory Unit (MMU) Power Failure
  - OPS transition with both MMUs failed and stuck in OPS 0
  - Multifunction Display Unit (MDU) Built-In Test (BIT) Error (if time permits)
- Perform the Multifunction Electronic Display System (MEDS) portion of Pre-Sleep procedure (if time permits)

## 167 **ORB SKL COMM 21008**

Title: Orbit Communication Skills

Duration: 1.5 hours

**Note:** Schedule 30 minutes for setup.

Medium: SST 1 or SST 2 or SST 3 Student: ASCAN (Schedule in pairs.)

Source: DS25/Communications/NSS Training Group

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PGSC INTRO 21195

Preparation: Review:

COMM SPEC 21057; Segments 1, 2, and 4

Synopsis: The lesson will develop the students' skill in recognizing both nominal and

off-nominal communication signatures. This will be performed with the aid

of S/Ku-Band signal strength meters, orbiter SPEC 201 (ANTENNA),

SPEC 76 (COMMUNICATIONS), and the WorldMap program.

Objectives: • Identify orbiter communication status using the displayed signatures.

• Determine if COMM LOST situations require application of malfunction procedures (no malfunction procedures are done in this lesson).

168 **MPS MAL 22006** 

Title: Main Propulsion System Malfunctions 2

Duration: 2.0 hours

Medium: SST 1 or SST 2 or SST 3 Student: ASCAN (Schedule in pairs.)

Source: DS66/G&C/Propulsion Training Group

Date: 10/05

Lesson(s) Replaced: MPS MAL A 21006

Equipment Required: None

Prerequisite Lesson(s): MPS MAL BR 22001

Preparation: Review:

MPS MAL BR 22001 handoutsMPS Workbook 21002, Section 4

Synopsis: This lesson will provide five to six ascent runs for the student to practice

resolving the Main Propulsion System (MPS) malfunctions listed.

Following each run, the instructor will review with the student the cause of

each malfunction, the recognition cues, and the rationale for each

procedure.

Objectives: • Apply the problem-solving strategy to resolve the following malfunctions in the MPS:

2 Stuck Throttles

- 2 Hydraulic Systems Failed
- Space Shuttle Main Engine (SSME) Stuck in the Bucket
- Single SSME Completion (2 SSMEs Failed/Shutdown)
- Multiple SSME Data Path Failures
- SSME Pushbuttons
- Main Engine He Leak and Aft Load Controller (ALC) Bus Failed
- MPS Helium Leak (Post External Tank Separation (ET SEP))
- ET SEP MAN/AUTO
- MPS Dump Inhibit
- MPS Helium Regulator Fail During Entry
- Apply the problem-solving strategy to resolve DPS and EPS failures that impact the MPS.

## 169A **CONT ABT 21001**

Title: Contingency Abort Prebrief

Duration: 1.0 hour Medium: Classroom

Student: ASCAN (2 PLTs, 2 MSs)

Source: DS66/G&C/Propulsion Training Group

Date: 02/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): CONT ABT BR 21001

Preparation: Review:

Ascent Checklist Contingency Abort cue card;

Contingency 2 out blue
Contingency 3 out blue
RTLS 2 out yellow
RTLS 3 out orange

Bermuda/ECAL

Stuck RTLS and DROOP

Synopsis: This prebrief is designed to prepare the student for CONT ABORT 21011.

All procedures listed below under Performance Objectives will be

discussed. The prebrief will consist of a brief review of contingency abort principles, a discussion of the steps involved in each of the procedures to be flower and appropriate appoints.

be flown, and answers to specific questions.

Objectives: • Given the contingency abort cue card, identify what each of the

following procedures steps means, who performs the step, and why it is

done:

Contingency 2 out blue

Contingency 3 out blue

RTLS 2 out yellow

RTLS 3 out orange

Bermuda/East Coast Abort Landing (ECAL)

Stuck RTLS and DROOP

## 169B **CONT ABORT 21011**

Title: Contingency Abort

Duration: 4.0 hours Medium: SMS-MB

Student: ASCAN (2 PLTs, 2 MSs)

Source: DS66/G&C/Propulsion Training Group

Date: 02/04

Lesson(s) Replaced: None

## 169B CONT ABORT 21011 (Concluded)

Equipment Required: None

Prerequisite Lesson(s): CONT ABT 21001

Preparation: None

Synopsis: In this lesson, the student will perform contingency abort procedures.

Proficiency is not required. Students are encouraged to see the

procedures multiple times during the lesson, time permitting. Students may elect to fly the procedures from different cockpit positions, as desired.

Objectives: • Perform, aided, the following contingency abort procedures:

Contingency 2 out blue

Contingency 3 out blue

RTLS 2 out yellow

RTLS 3 out orange

Bermuda/ECAL

Stuck RTLS and DROOP

## 170A **ENT DPS MAL 21001**

Title: Entry Data Processing System Malfunction Procedures Prebrief

Duration: 0.5 hours Medium: Classroom

Student: ASCAN (Schedule in pairs.)

Source: DS24/DPS/Navigation Training Group

Date: 02/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ASC DPS MAL 21006

Preparation: Review:

AESP (Glided Flight); DPS FDF procedures

Skim:

Entry Pocket C/L; DPS FDF procedures

Read:

Flight Rules

Entry String Reassignment (Section 2)

I/O Reset (Section 7)

PASS GPC BCE Failure Management (Section 7)

Non-universal I/O Error Action (Section 7)

## 170A ENT DPS MAL 21001 (Concluded)

Synopsis:

This prebrief will introduce the student to various DPS failure signatures and procedures used during entry. It will also be a review of the material presented in A/E DPS MAL 21001. The discussion will center around the malfunctions that will be introduced in ENT DPS MAL 21006. It is intended to ensure that the student has a good understanding of the procedures prior to exercising them in the SST.

Objectives:

- Identify signatures and the procedures to be run prior to the Deorbit (D/O) burn Time to Ignition (TIG) for the following DPS situations:
  - Primary Avionics Software System (PASS) General Purpose Computer (GPC) failure
  - Flight Aft (FA) Multiplexer/Demultiplexer (MDM) failure
  - Backup Flight Software (BFS) GPC failure
- Discuss the DPS portions of the D/O Burn Monitor Cue Card.
- Explain the rationale for entry restring and port mode cases.

## 170B **ENT DPS MAL 21006**

Title: Entry Data Processing System Malfunction Procedures

Duration: 2.0 hours

Medium: SST 1 or SST 2 or SST 3 Student: ASCAN (Schedule in pairs.)

Source: DS24/DPS/Navigation Training Group

Date: 10/05

Lesson(s) Replaced: E DPS 21011A

Equipment Required: None

Prerequisite Lesson(s): ENT DPS MAL 21001

Preparation: None

Synopsis:

In this lesson, the student will practice exercising the procedures and signature recognition associated with Entry DPS failures. Procedures will be exercised from both the Entry Pocket (ENT PK) Checklist (C/L) and the Ascent/Entry Systems Procedures (AESP). Backup Flight Software (BFS) actions will be discussed where applicable. Four runs will be used to exercise the following procedures:

- BCE STRG X
- PASS GPC FAIL
- MULTI-DATA PATH LOSS
- BFS GPC FAIL
- I/O ERROR CRT/DPS DISPLAY ANOMALY
- FA/FF MDM I/O ERROR
- FA/FF MDM PORT MODE

## 170B ENT DPS MAL 21006 (Concluded)

- DEORBIT BURN MONITOR CUE CARD
- SUBSYSTEM STATUS DISPLAY ANOMALY
- FF/FA MDM OUTPUT

Objectives:

- Identify the DPS failure based on cockpit cues.
- Perform appropriate procedures in the ENT PKT C/L or the AESP.
- Explain the steps and rationale behind each procedure worked.
- Optimize final DPS configuration for entry.
- Identify the signature and actions to be performed for a non-universal Input/Output (I/O) error and an Analog to Digital Converter (ADC) failure.

## 171A **OM/RC BURNS 21001**

Title: Orbital Maneuvering/Reaction Control System Burns Prebrief

Duration: 0.5 hours
Medium: Classroom
Student: Non-ASCAN

Source: DS66/G&C/Propulsion Training Group

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): OMS MAL 21006, RCS MAL 21006

Preparation: Review:

- OMS 21002
  - Section 4, Engine Failures, Leaks and other Propellant System Failures; Nitrogen System Failures, and Gimbal Failures
- SCOM

Section 2.19, Fault Detection and Identification

**Note:** This lesson replaces the OM/RC BURNS BR 21001 lesson for

non-ASCAN students.

Synopsis:

This lesson will provide the student the background for diagnosing failures during OMS and Reaction Control System (RCS) burns and prepare the student for OM/RC BURNS 21006 SST lessons. The procedures on the OMS BURN and OMS BURN MONITOR cards, and the fundamental concepts of OMS "engine failures" and "propellant failures" will be discussed. The prebrief will define OMS engine and propellant failures and teach how to diagnose engine fail and propellant fail during an OMS burn. This lesson will explain the rationale of the OMS ENG FAIL and OMS PRPLT FAIL procedures for OMS 2 and On-Orbit OMS burns, during which the student will resolve malfunctions that occur during the

## 171A OM/RC BURNS 21001 (Concluded)

OMS 1, OMS 2, and Orbit burns. This lesson will also introduce the "hot" OMS XFEED and other burn specific propellant management procedures. Lastly, this class will introduce the Space Flight Resource Management (SFRM) associated with monitoring burns, diagnosing failures, and working procedures.

#### Objectives:

- Use OMS and RCS cockpit cues and OMS BURN MONITOR card to diagnose OMS engine and propellant failures due to propellant blockages, He line blockages, He leaks, propellant leaks, and Nitrogen leaks.
- Diagnose an OMS ENG FAIL due to gimbal failures.
- State the cockpit cue and system impact differences between an OMS engine fail and an OMS propellant fail.
- Explain the rationale of the OMS ENG FAIL and OMS PRPLT FAIL procedure on the OMS 2/ORBIT OMS BURNS card.

## 171B **OM/RC BURNS 21006**

Title: Orbital Maneuvering/Reaction Control System Burns

Duration: 2.0 hours

Medium: SST 1 or SST 2 or SST 3 Student: ASCAN (Schedule in pairs.)

Source: DS66/G&C/Propulsion Training Group

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): OM/RC BURNS BR 21001

Preparation: None

#### Synopsis:

This lesson will prepare the student for diagnosing failures that occur during an OMS or Reaction Control System (RCS) burn using the Burn Monitor Card, and following the appropriate procedures on the Burn Card. It will concentrate on malfunctions during OMS 1, OMS 2, and On-Orbit burns. The student will be given the opportunity to resolve failures including, OMS engine failures, OMS propellant failures, sensors failures, Helium blockages, Helium regulator failures, OMS gimbal failures, and RCS jet failures.

- Set up and perform OMS burns (OMS 1, OMS 2, and On-Orbit burns).
- Diagnose OMS engine, OMS propellant, and OMS Sensor failures using system signatures and BURN MONITOR criteria.
- Perform appropriate Burn Card procedures based on failure diagnosis.

## 171B OM/RC BURNS 21006 (Concluded)

- Correctly identify the malfunction on the FDF OMS schematic.
- Evaluate if the actions were effective and determine system/mission impacts.

## 172 **COM/IN MAL BR 21001**

Title: Communications/Instrumentation Malfunction Procedures Review

Duration: 1.5 hours
Medium: Classroom
Student: ASCAN

Source: DS25/Communications/NSS Training Group

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ORB SKL COMM 21008

Preparation: Review:

S-Bd Comm/Inst. 21002, Section 1-6

• AESP (Ascent Comm and DPS); APCL, COMM LOST (Multi-pnls)

• OPCL, COMM Procedures

MALF PROC, Section 2.1-2.4; COMM Drawing; SSR-1 and 12

• IFM, ACCU Bypass procedure

Complete:

S-Bd Comm/Inst. 21002, Section 7

Synopsis:

This lesson will review the communication cockpit cues and procedures to identify communication capabilities and troubleshooting techniques for ascent and orbit phases of a Shuttle flight.

- Identify the communication cockpit cues used to determine and monitor voice and data communications with MCC-H.
- Troubleshoot and correct communication problems using cockpit cues and appropriate FDF procedures: AESP, APCL, OPCL, MALF PROC, etc.
- Explain basic philosophy/rationale for communication pocket checklist procedures using the APCL or OPCL as an example.
- Explain basic steps in the MAL PROC Comm SSR-1 (LOSS OF ALL VOICE COMM) and IFM (ACCU BYPASS CONNECTOR INSTALLATION) – to be continued in SST.

#### 173 **COM/IN MAL 21006**

Title: Communications/Instrumentation Malfunction Procedures

Duration: 2.0 hours

Medium: SST 1 or SST 2 or SST 3 Student: ASCAN (Schedule in pairs.)

DS25/Communications/NSS Training Group Source:

Date:

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): COM/IN MAL BR 21001

Preparation: Review:

S-Bd Comm/Inst. 21002, Section 1-6

AESP (Ascent Comm and DPS); APCL, COMM LOST (Multi-Pnls)

• OPCL, Comm Procedures

• MALF PROC, Section 2.1-24, Comm Drawing; SSR-1 and 12

• IFM, ACCU Bypass Procedure

Complete:

S-Bd Comm/Inst. 21002, Section 7

Synopsis: This lesson will practice using the communication cockpit cues and

procedures to identify communication capabilities and troubleshooting

techniques for ascent and orbit phases of a Shuttle flight.

• Use cockpit cues and perform appropriate steps in FDF, as necessary, Objectives:

to regain voice and/or command/data with MCC. Specifically:

**ASCENT PHASE:** 

- S-Band PM LRU failure
- NSP problem
- Audio System problem, including SSR and IFM review
- **ORBIT PHASE:** 
  - GCIL problem
  - PCMMU failure(s)
  - S-Band PM system failure
  - RTC practice
  - S-Band PM Antenna select problem
  - COMSEC problem
  - Use MALF PROC Comm drawing to trace forward link and return link for High Power Mode through appropriate LRUs, using COMM related displays and controls

## 174A **ORB MAN ATT 21001**

Title: Orbit Manual Attitude Control Techniques Prebrief

Duration: 1.0 hour Medium: Classroom

Student: ASCAN (Schedule ASCAN PLTs in pairs, no CB IA.)
Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): IMU 21006, MAN MNVR 21025

Preparation: Review:

UNIV PTG 21001
 ORB DAP 21057
 ORB OPS C/L

 HUD CAL

Synopsis:

This prebrief will cover orbit manual attitude control procedures as well as techniques that will be practiced in ORB MAN ATT 21012. It will start with a review of Universal Pointing (UNIV PTG) and the DAP. Several manual flying techniques will also be discussed.

Objectives:

- Describe the options for the DAP available on SPEC 20.
- Discuss how each parameter of the attitude monitor section of the UNIV PTG display is used to monitor the attitude of the orbiter.
- Explain the rationale associated with Manual Minimum Impulse (MMI).
- Describe how to fly Manual Minimum Impulse.
- Describe the rationale for each step of the Heads-Up Display (HUD) calibration procedure.
- Discuss the two maneuvering techniques available for the HUD calibration.
- Describe how to read the Attitude Direction Indicator (ADI).
- Discuss the four rules of thumb for maneuvering to an M50 burn attitude using Velocity to Go (VGOs).

# 174B **ORB MAN ATT 21012**

Title: Orbit Manual Attitude Control Techniques

Duration: 4.0 hours Medium: SMS-FB, GNS

Student: ASCAN (Schedule ASCAN PLTs in pairs, no CB IA.)
Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 07/04

Lesson(s) Replaced: IMU/ST/COAS 21012

Equipment Required: None

#### 174B **ORB MAN ATT 21012 (Concluded)**

**ORB MAN ATT 21001** Prerequisite Lesson(s):

Preparation: None

Synopsis:

The student will perform a number of manual piloting procedures in order to demonstrate attitude control techniques and orbiter handling qualities under a variety of on-orbit conditions. The procedures include a Heads-Up Display (HUD) calibration, Manual Minimum Impulse (MMI) maneuver, and a manual vernier Reaction Control System (RCS) maneuver, all requiring Rotational Hand Controller (RHC) input. Possible scan patterns, control inputs and 3-D situational awareness should be emphasized over specific procedures or rationale.

Objectives:

- Perform MMI maneuvers using Primary (PRI) and VERN DAP.
- Calibrate the HUD.
- Perform maneuver using Translational (TRANS) DAP.
- Perform maneuver using aft RHC and Attitude Direction Indicator (ADI) in both the -x and -z sense.
- Perform maneuver to M50 attitude using ADI.
- Perform maneuver to M50 attitude using Velocity to Go (VGOs).
- Perform maneuver using RHC Accelerated (ACCEL) mode.

#### 175 **MPS QUAL 21006**

Title: Main Propulsion System Qualification

Duration: 2.0 hours

Medium: SST 1 or SST 2 or SST 3

Student: ASCAN (Schedule individually.)

Source: DS66/G&C/Propulsion Training Group

Date: 03/05

Lesson(s) Replaced: **MPS QUAL 21001** 

Equipment Required: None

Prerequisite Lesson(s): MPS MAL 22006

Preparation: Review:

• MPS Workbook 21002

This lesson will present a series of scenarios for the student. Each Synopsis:

> scenario presents both nominal or malfunction conditions that the student must analyze and then determine what crew actions are required based

on FDF procedures.

## 175 MPS QUAL 21006 (Concluded)

Objectives:

- Demonstrate the ability to perform the 7 nominal crew tasks for the Main Propulsion System (MPS) on ascent.
- Demonstrate the ability to identify malfunctions, locate the appropriate FDF procedures, and perform the required actions on ascent.
- Explain the cause of the malfunctions observed and the rationale for the actions taken for each scenario presented.

## 176A **A/E BFS 21001**

Title: Ascent/Entry Backup Flight Software Prebrief

Duration: 1.0 hour Medium: Classroom

Student: ASCAN (Schedule 3 ASCANs, 1 CB IA.)

Source: DA7/Assigned SMS Team

Date: 10/05

Lesson(s) Replaced: ASC BFS 21001, E BFS 21001

Equipment Required: None

Prerequisite Lesson(s): BFS FAM BR 21001, ENT DPS MAL 21006, E NAV 22006

Preparation: Review:

BFS FAM BR 21001

Synopsis: During this prebrief, the differences between PASS and BFS will be

reviewed. This prebrief should prepare the student to perform the ascents

and entries in A/E BFS 21011.

Objectives: • Identify the major differences between PASS and BFS.

• Identify the major limitations of the BFS.

#### 176B **A/E BFS 21011**

Title: Ascent/Entry Backup Flight Software

Duration: 4.0 hours Medium: SMS-MB

Student: ASCAN (Schedule 3 ASCANs, 1 CB IA.)

Source: DA7/Assigned SMS Team

Date: 07/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): A/E BFS 21001

Preparation: None

Synopsis: During this lesson, the students will perform several ascents and entries.

They will be required to complete each of the runs and consider the health

of the PASS and the BFS after various malfunctions.

## 176B **A/E BFS 21011 (Concluded)**

Objectives: • Identify conditions that warrant BFS engage and perform the engage.

• Perform an entry while BFS engaged.

• Identify the major differences between the PASS and BFS.

• Perform appropriate flight techniques under BFS engage conditions.

## 177 **PROP DUMPS BR 21001**

Title: Propellant Dumps Briefing

Duration: 2.0 hours

Medium: Classroom (Schedule in groups of up to 30.)

Student: ASCAN

Source: DS66/G&C/Propulsion Training Group

Date: 10/05

Lesson(s) Replaced: ASC PROP 21001

Equipment Required: None

Prerequisite Lesson(s): ABORT FAM 22011, OM/RC BURNS 21006

Preparation: Read:

SCOM; Section 6.8-15, OMS Engine/Propellant Failure

Review:

 Flight Procedures Handbook; Ascent/Orbit/Entry Systems Procedures, and Cue Cards with Rationale

OMS Pc LOW

OMS TEMP

OMS He TK P LOW, AESP

OMS TK P (FU or OX) LOW, ASC PKT C/L

Synopsis: The purpose of this prebrief is to review abort dumps, and to discuss

engine failures during abort dumps.

Objectives: • Identify the DPS display used to control ascent abort dumps.

• Explain the purpose of smart interconnect.

• State the impact of an OMS engine and/or prop failure.

• Identify the procedures required for an engine or prop failure during an abort dump.

 Explain the major steps in the Ascent portion of the Ascent/Entry Systems Procedure (AESP) for the OMS He Tank P Low and OMS Tank P Low procedures.

## 178A **PROP DUMPS 21001**

Title: Propellant Dumps Prebrief

Duration: 0.5 hours
Medium: Classroom
Student: Non-ASCAN

Source: DS66/G&C/Propulsion Training Group

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): OM/RC BURNS 21006

Preparation: Read:

SCOM; Section 6.8-15, OMS Engine/Propellant Failure

Review:

Flight Procedures Handbook; Ascent/Orbit/Entry Systems

Procedures, and Cue Cards with Rationale

OMS Pc LOWOMS TEMP

- OMS He TK P LOW, AESP

OMS TK P (FU or OX) LOW, ASC PKT C/L

Note: This lesson replaces the PROP DUMP BR 21001 lesson for

non-ASCAN students.

Synopsis: The purpose of this prebrief is to review abort dumps, and to discuss

engine failures during abort dumps.

Objectives: • Identify the DPS display used to control ascent abort dumps.

• Explain the purpose of smart interconnect.

State the impact of an OMS engine and/or prop failure.

Identify the procedures required for an engine or prop failure during an

abort dump.

• Explain the major steps in the Ascent portion of the Ascent/Entry

Systems Procedure (AESP) for the OMS He Tank P Low and OMS

Tank P Low procedures.

## 178B **PROP DUMPS 21006**

Title: Propellant Dumps SST

Duration: 2.0 hours Medium: SST 1

Student: ASCAN (Schedule in pairs.)

Source: DS66/G&C/Propulsion Training Group

Date: 10/05

Lesson(s) Replaced: ASC PROP 21011

Equipment Required: Special FDF provided by instructor

## 178B PROP DUMPS 21006 (Concluded)

Prerequisite Lesson(s): PROP DUMPS BR 21001

Preparation: None

Synopsis: This lesson will prepare the student for subsequent standalone and

integrated ascent and entry training in the SMS. The goal of the lesson is to strengthen the student's skill in leak resolution and failures during

ascent propellant dumps.

Objectives:

- Using SPEC 51 and the Ascent Checklist (ASC C/L), determine the total percent OMS propellant to be dumped during a given abort dump and estimate the time and percent OMS propellant to be dumped.
- Given an ascent run with all OMS quantity gauging failed, estimate post-Main Engine Cut-off (MECO) the amount of OMS propellant dumped during an Abort to Orbit (ATO) dump.
- Identify and perform the procedure required for OMS engine failures, propellant failures, and injector temperature biases during abort dumps.
- Identify a smart interconnect reconfiguration.
- Perform the leaking OMS He propellant dump.
- Perform the leaking OMS propellant out-of-plane burn (ASC C/L).
- Perform leaking OMS Perigee adjust burn on-orbit.

## 179 **OM/RC DP/EPS BR 21001**

Title: Orbital Maneuvering/Reaction Control System Data Processing

System/Electrical Power System Review

Duration: 2.0 hours Medium: Classroom

Student: ASCAN (Schedule in groups of about 15.) Source: DS66/G&C/Propulsion Training Group

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): OMS MAL 21006, RCS MAL 21006, EPS MAL A/E 21004,

EPS MAL O 21004, DPS MAL 21006

Preparation: Review:

OMS 21002; Section 4, Electrical and Data Path Failures
RCS 21002; Section 4, Electrical and Data Path Failures

## 179 OM/RC DP/EPS BR 21001 (Concluded)

Synopsis:

This lesson will prepare the student for OM/RC DP/EPS 21006. The review will include a discussion of Reference Data, the OMS Failures cue card, and the OMS and Reaction Control System (RCS) Configuration Screen (ORCS).

Objectives:

- State the generic impacts of the EPS, DPS, and Instrumentation (INST) systems on the OMS and RCS.
- Use Ref Data to determine the capabilities of the OMS and RCS after DPS and EPS failures.
- Use the OMS Failures cue card to determine the capability of the OMS engines with DPS and EPS failures.
- Use the ORCS program to determine the capability of the OMS/RCS valves after the occurrence of DPS and EPS failures.
- Explain OMS and RCS callouts in the EPS, DPS, and INST malfunction procedures.

## 180A **ORB SYS 21001**

Title: Orbit Systems Prebrief

Duration: 1.0 hour Medium: Classroom

Student: ASCAN (Schedule 3 ASCANs, no CB IA.)

Source: DA7/Assigned SMS Team

Date: 07/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ORB EPS 21004

Preparation: None

Synopsis:

This prebrief is designed to prepare the student for ORB SYS 21012 and includes a discussion of priority powerdowns on orbit (numbered and lettered), control bus shorts and powerdowns, and the AC transfer cable In-Flight Maintenance (IFM) procedure.

- Explain when and why a priority powerdown is to be performed (nominally and off-nominally).
- Explain the difference between the numbered and lettered priority powerdown procedures.
- Identify where the kilowatt usage of certain equipment is located in the FDF.

#### 180A ORB SYS 21001 (Concluded)

- Identify the FDF procedure that can be used to confirm a control bus short.
- Explain how a shorted control bus is unpowered using the IFM procedure.
- Identify failures that would result in the crew having to perform the AC Power Transfer Cable IFM.
- Identify the major steps performed in the AC Power Transfer Cable IFM.
- Identify the limitations and the capabilities recovered once the AC power transfer cable has been installed.

#### 180B **ORB SYS 21012**

Title: Orbit Systems **Duration:** 4.0 hours Medium: SMS-FB, GNS

Student: ASCAN (Schedule 3 ASCANs, no CB IA.)

Source: DA7/Assigned SMS Team

Date: 10/05

Lesson(s) Replaced: None **Equipment Required:** None

Prerequisite Lesson(s): **ORB SYS 21001** 

Preparation: None

## Synopsis:

This lesson provides a hands-on environment for the student to perform the following tasks:

- Priority Group B Powerdown and Powerup.
- Shorted control bus powerdown.
- AC Power Transfer Cable installation.

Throughout the lesson, the student will be required to explain the rationale of the major steps of each procedure while performing the procedure.

- Objectives: Perform a Priority Group B Powerdown and Powerup.
  - Identify the signature of a control bus short.
  - Perform the "CNTL BUS V LOW/CNTL BUS RPC" (Orbit Pocket Checklist) procedure while stating the rationale for each major step.
  - Perform the In-Flight Maintenance (IFM) procedure "AC Power Transfer Cable" (Malfunction Checklist, EPS SSR-200) while stating the rationale for each major step.

## 181 **EPS QUAL 21004**

Title: Electrical Power Systems Qualification

Duration: 2.0 hours

Medium: SST 1 or SST 2 or SST 3

Student: ASCAN (Schedule individually.)

Source: DS45/Shuttle Systems Training Group

Date: 10/05

Lesson(s) Replaced: SYS QUAL 21008

Equipment Required: None

Prerequisite Lesson(s): Completion of all 20000-level EPS, ECLSS, MECH, C&W,

and APU/HYD SST lessons

Preparation: Review FDF and EPS reference materials to prepare for the objectives

listed below.

Synopsis:

This lesson will verify that the student meets the required standards for systems knowledge and FDF usage for the Shuttle EPS. This lesson tests the student's ability to recognize signatures and execute the appropriate FDF procedure for various EPS malfunctions. In addition to off-nominal procedures, the student will perform selected nominal procedures (including starred blocks when applicable). Throughout the lesson, the instructor will ask questions in order to test the student's knowledge of hardware, operations, procedure rationale, and concepts associated with EPS.

- Identify various EPS malfunctions during the ascent/entry and orbit timeframes via displays and other available cockpit cues.
- Execute the appropriate FDF procedure for each of the malfunctions presented.
- Explain the rationale for the FDF procedures associated with each of the malfunctions presented.
- State the power sources for the Main, Essential, Control, and AC buses.
- Describe how the AC bus sensors function in the Off, Monitor, and Auto Trip switch positions.
- Explain the "two finger trick" associated with Control buses.
- Recognize which buses require a fuel cell shutdown when lost, and explain why.
- Explain the difference between a fuel cell shutdown and fuel cell safing.
- Explain how to confirm if a fuel cell has been "safed."
- Recognize which fuel cell malfunctions cause the fuel cell stack temperature reading to be invalid.
- Explain the difference between the long and short form bus tie, and state when each should be used.
- Perform a back door bus tie, when required.

#### 181 **EPS QUAL 21004 (Concluded)**

- Explain the difference in signatures between a fuel cell short and a main bus short.
- Explain the purpose of performing a fuel cell purge.
- Explain the operational constraints for the manual fuel cell purge.
- Perform the manual fuel cell purge procedure, including starred blocks (when applicable).

#### 182 APU/HYD QUAL 21004

Title: Auxiliary Power Unit/Hydraulic Qualification

**Duration:** 2.0 hours

Medium: SST 1 or SST 2 or SST 3 Student: ASCAN (Schedule individually.)

DS45/Shuttle Systems Training Group Source:

Date: 10/05

Lesson(s) Replaced: **SYS QUAL 21008** 

**Equipment Required:** None

Prerequisite Lesson(s): Completion of all 20000-level EPS, ECLSS, MECH, C&W,

and APU/HYD SST lessons.

Preparation: Review FDF and APU/Hyd reference materials to prepare for the

objectives listed below.

Synopsis: This lesson will verify that the student meets the required standards for

systems knowledge and FDF usage for the Shuttle Auxiliary Power Unit (APU)/Hydraulic (Hyd) Systems. This lesson tests the student's ability to recognize signatures and execute the appropriate FDF procedure for various APU/Hyd malfunctions. In addition to off-nominal procedures, the student will perform selected nominal procedures (including starred blocks when applicable). Throughout the lesson, the instructor will ask questions

in order to test the student's knowledge of hardware, operations,

procedure rationale, and concepts associated with the APU/Hyd Systems.

- Identify various Auxiliary Power Unit (APU)/Hydraulic (Hyd) malfunctions during the ascent and/or entry timeframes via displays and other available cockpit cues.
- Execute the appropriate FDF procedure for each of the malfunctions presented.
- Explain the rationale for the FDF procedures associated with each of the malfunctions presented.
- When required, report the F7 APU Underspeed or Overspeed light to MCC correctly.

## 182 APU/HYD QUAL 21004 (Concluded)

- Describe how the following functions are supported by the APU/Hyd system:
  - Engine throttling
  - Engine gimballing (ascent and entry)
  - Landing gear deploy
  - Braking
  - Nose Wheel Steering
- Locate the Systems Flight Rules in FDF.
- Determine whether an ascent abort is required for a given APU/Hyd malfunction scenario (using FDF).
- Locate the APU ready-to-start criteria in FDF.
- Perform the APU Pre Start and APU Start procedures in the Ascent Checklist, and explain the procedure rationale.
- Perform the APU Pre Start and Single APU Start procedures in the Entry Checklist, and explain the procedure rationale.
- Describe the conditions that would call for "Attempt One APU" versus "Attempt Two APUs" when performing the Single APU Start procedure in the Entry Checklist.
- Describe how the APU primary and secondary control valves operate.
- Describe what happens when the APU Speed Select switch is taken to High.
- State the four reasons for restarting an APU.
- Recognize when an APU that has been shutdown is a candidate for a cooldown and/or a restart.
- Given an APU/Hyd malfunction scenario, determine impacts on the landing gear, brakes, and Nose Wheel Steering (NWS) systems (using the Landing Gear diagram).
- Given an APU/Hyd malfunction scenario, determine impacts to main engine throttling and gimballing (using cue card).
- Describe WSB spray mode and pool mode, and state when each mode is used.
- Explain why the WSB controllers are not swapped prior to Main Engine Cutoff (MECO).
- Explain Priority Rate Limiting (PRL).
- State where each of the three hydraulic pressure sensor readings can be seen in the cockpit.

## 183 **ECLSS/C&W/MECH QUAL 21008**

Title: Environmental Control and Life Support Systems/Caution &

Warning/Mechanical Qualification

Duration: 2.0 hours Medium: SST 3 only

Student: ASCAN (Schedule individually.)

Source: DS45/Shuttle Systems Training Group

Date: 10/05

Lesson(s) Replaced: SYS QUAL 21008

Equipment Required: None

Prerequisite Lesson(s): Completion of all 20000-level EPS, ECLSS, MECH, C&W,

and APU/HYD SST lessons.

Preparation: Review FDF and ECLSS, C&W, and Mechanical Systems reference

materials to prepare for the objectives listed below.

Synopsis: This lesson will verify that the student meets the required standards for

systems knowledge and FDF usage for the Shuttle Environmental Control and Life Support Systems (ECLSS), Caution and Warning (C&W), and Mechanical Systems. This lesson tests the student's ability to recognize signatures and execute the appropriate FDF procedure for various ECLSS and Mechanical malfunctions. In addition to off-nominal procedures, the student will perform selected nominal procedures (including starred blocks when applicable) for each system. Throughout the lesson, the instructor will ask questions in order to test the student's knowledge of hardware, operations, procedure rationale, and concepts associated with the ECLSS,

C&W, and Mechanical Systems.

- Identify various Environmental Control and Life Support Systems (ECLSS) malfunctions during the ascent/entry and orbit timeframes via displays and other available cockpit cues.
- Execute the appropriate FDF procedure for each of the malfunctions presented.
- Explain the rationale for the FDF procedures associated with each of the malfunctions presented.
- Locate the Systems Flight Rules in FDF.
- Determine whether an ascent abort is required for a given ECLSS malfunction scenario (using FDF).
- Explain why alternating current (AC) powered equipment is not swapped prior to Main Engine Cutoff (MECO).
- Locate the PCS diagram in FDF.
- Describe the PCS configuration during ascent, entry, and orbit.
- Explain how to distinguish between an oxygen (O2) and nitrogen (N2) leak into the cabin.

## 183 ECLSS/C&W/MECH QUAL 21008 (Continued)

- Explain the difference between the three "dP/dT" values on the displays (hardware, backup, equivalent), and state when each is available.
- Explain the Av Bay temperature signature associated with an Av Bay fan that has been turned off (or is completely failed).
- Describe the H<sub>2</sub>O loop configuration during ascent, entry, and orbit.
- Explain the difference in signature between an external H<sub>2</sub>O loop leak, internal H<sub>2</sub>O loop leak, and a H<sub>2</sub>O loop pump failure.
- State what the Panel L4 H<sub>2</sub>O Loop Pump 1A/2 circuit breakers power.
- Recognize when the Panel L4 H<sub>2</sub>O Loop Pump 1A/2 circuit breakers should be pushed in.
- State the mechanism(s) actively cooling the Freon loops during all phases of flight from pre-launch through post-landing.
- Explain the differences between the FES primary controllers and the FES secondary controller.
- State the temperature control point for the FES controllers (primary and secondary), radiator controllers (in norm and high), and NH3 controllers.
- Explain the purpose of a FES core flush.
- Explain the Freon loop radiator isolation hardware.
- Explain the radiator startup sequence in terms of the motion and timing of the radiator flow control and bypass valves.
- Explain the purpose of the radiator controller startup sequence.
- Explain the rule for configuring NH3 systems according to Freon flow rates.
- Perform the supply water dump procedure, including starred blocks (when applicable), and explain the procedure rationale.
- Explain the differences between the Primary Caution and Warning (C&W) System and the Backup C&W System.
- Given a parameter name, locate the software identification number in Reference (Ref) Data.
- Given a parameter name, locate the hardware channel number in Ref Data or on the C&W Cue Card.
- Demonstrate how to use the Primary to Backup C&W Analog Parameter Calibration table to change a hardware limit for a given parameter.
- Explain how the state of microswitches affects the operation of a mechanism.
- Execute the procedures for a manual and/or auto mode payload bay door opening and/or closing.
- Describe the malfunctions that will cause a "PBD SEQ FAIL" fault message during payload bay door opening/closing.
- Describe the malfunctions that will cause a "PBD CONFIG FAIL" fault message during payload bay door opening/closing.

## 183 <u>ECLSS/C&W/MECH QUAL 21008 (Concluded)</u>

- Describe the malfunctions that will cause a dilemma during payload bay door opening/closing.
- Given a microswitch malfunction, identify what, if any, fault messages will be generated during payload bay door opening/closing.
- Explain the purpose of the Centerline Latch Extended Guide Roller Trajectory No-Go diagram.

## 184 **OGNC QUAL 21006**

Title: Orbit Guidance Navigation and Control Qualification

Duration: 2.0 hours

Medium: SST 1 or SST 2 or SST 3

Student: ASCAN (Schedule individually.)

Source: DS24/DPS/Navigation Training Group

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): IMU 21006, MAN MNVR 21025,

ORB MAN ATT 21012 (PLTs only)

Preparation: Review:

Post Insertion; Star Tracker Activation/Door Open

- Orbit OPS
  - IMU Align STRK, GNC 201, 202, 301
  - IMU/IMU ALIGNMENT
  - HUD Calibration
  - DAP Tables
- Mal Proc, Vol. II
  - GNC FRP-3, IMU Recovery with at least one IMU as good reference
  - GNC FRP-2, IMU Reference Recovery

# 184 OGNC QUAL 21006 (Concluded)

## Synopsis:

This lesson will verify completion standards of orbit Guidance, Navigation, and Control (GNC) training by executing some GNC orbit operations with limited use of FDF. The student should have a basic understanding of the systems in order to perform the operations. There is no need to memorize FDF. The student will start the class by configuring the star trackers for orbit. Nominal orbit operations are then performed, including an Inertial Measurement Unit (IMU) alignment and a Heads-Up Display (HUD) calibration. Several different pointing maneuvers are also performed to exercise the Universal Pointing (UNIV PTG) display. A manual flying exercise will be performed to demonstrate comprehension of the relationship between the DAP and UNIV PTG functions.

The student will also exercise the IMU Reference Recovery procedure as a review of the three different types of alignments. This exercise is optional and is not evaluated for the Qual.

- Configure the DAP to maneuver at a specified rate.
- Perform nominal star tracker activation and door opening, without FDF.
- Perform a dual star tracker IMU align using only the Star Pairs
   Preliminary Advisory Data (PAD) (located in the Orbit Operations (OPS)
   Checklist (C/L), Flight Supplement (Flt Supp)) and the Flight Plan.
- Perform the steps for a HUD calibration, without FDF.
- Perform a single star tracker IMU align using the Star Pair PAD, without FDF.
- Perform various pointing maneuvers using the UNIV PTG display.
- Maneuver manually by flying a single axis while the other axes maintain LVLH attitude hold.
- Recover an IMU that has lost its inertial reference with an IMU/IMU alignment, without FDF.
- Identify the bad IMU in a velocity dilemma situation.
- Perform the tasks for a total IMU Reference Recovery; i.e., loss of on orbit attitude reference using FDF (optional).

## 185 **OM/RC DP/EPS 21006**

Title: Orbital Maneuvering/Reaction Control System, and Data

Processing/Electrical Power System

Duration: 2.0 hours

Medium: SST 1 or SST 2 or SST 3 Student: ASCAN (Schedule in pairs.)

Source: DS66/G&C/Propulsion Training Group

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): OM/RC DP/EPS BR 21001

Preparation: None

Synopsis: This lesson will prepare the student for multi-discipline and multi-failure

work in subsequent training at the SMS. The goal of the lesson is to strengthen the student's knowledge of the OMS and Reaction Control System (RCS) and introduce the student to the impacts of DPS and EPS failures on these systems. Ref Data, the OMS Failures cue card, and the OMS and RCS Configuration Screen (ORCS) will be used by the student to determine failure impacts. Another goal of the lesson is to build on the

student's ability to prioritize malfunction resolution.

Objectives: • l

- Use the FDF, including the OMS Failures cue card, Reference Data, and the ORCS to resolve two failure deep OMS and RCS malfunctions of the following types:
  - Leaks with an Multiplexer/Demultiplexer (MDM) or EPS bus down
  - OMS burn anomalies with MDMs and EPS buses failed
  - Jet failures with MDMs or EPS buses failed
- Given a combination of OMS and RCS failures, assess their priorities and resolve them according to this prioritization.

## 186 **OM/RC QUAL O 21006**

Title: Orbital Maneuvering System/Reaction Control Systems for Orbit

Qualification

Duration: 2.0 hours

Medium: SST 1 or SST 2 or SST 3
Student: ASCAN (Schedule individually.)

Source: DS66/G&C/Propulsion Training Group

Date: 10/05

Lesson(s) Replaced: BURN QUAL 21006

Equipment Required: None

Prerequisite Lesson(s): OM/RC QUAL A/E 21006

## 186 OM/RC QUAL O 21006 (Concluded)

Synopsis: Review the FDF and related reference materials to prepare for the

objectives listed below.

Synopsis: This lesson

This lesson will verify the completion of the OM/RC flow by testing the student's operational knowledge of the OMS and Reaction Control System (RCS). The lesson tests the student's ability to configure the orbiter for nominal orbit operations and to perform nominal on orbit procedures. The lesson also tests the student's ability to locate and work orbit malfunction procedures and to evaluate the impact of the failure on the mission. Lastly this lesson tests the student's ability to determine the big picture impacts of an EPS, DPS, or Instrumentation (INST) failure on the OMS and RCS.

The class is composed of one continuous run. The instructor will play MCC and answer questions and direct the student as necessary. The student will configure the orbiter for on orbit OPS then sit in the right seat and monitor the RCS and OMS systems. The student will have available to them the use of all FDF and tools which are typically available in the cockpit.

- Configure the OMS and RCS switches for orbit.
- Perform OMS and RCS callouts in the Post Insertion Checklist.
- Perform the Group B powerdown.
- Perform an OMS to RCS Interconnect.
- Monitor the OMS and RCS on orbit.
- Perform an OMS orbit adjust burn.
- Distinguish the required actions for the following MCC calls:
  - Deselect Jet XXX
  - Reselect Jet XXX
  - Reprioritize Jet XXX
  - Reset Redundancy Management (RM)
  - Toggle RM on Jet XXX
- Use available tools to evaluate impacts of a DPS, EPS or INST failures.
- Determine when you are Loss of Verns and work the procedure.
- Perform failure identification, resolution and evaluation for failures in the OMS and RCS.

## 187A **ORB OPS/COMM 21001**

Title: Orbit Operations/Communication Prebrief

Duration: 1.0 hour Medium: Classroom

Student: ASCAN (Schedule 3 ASCANs, no CB IA.)

Source: DA7/Assigned SMS Team

Date: 07/04

Lesson(s) Replaced: ORB EVA/COMM 21001

Equipment Required: None

Prerequisite Lesson(s): COM/IN MAL 21006, ORB DPS MAL 21006

Preparation: Review:

DPS DictionarySM SPEC 76

SM OPS 201, Antenna Display

#### Synopsis:

This prebrief is designed to prepare the student for ORB OPS/COMM 21012, where the student will be required to perform nominal on-orbit procedures while dealing with malfunctions. This prebrief covers a review of the process for diagnosing loss of COMM situations, the cockpit signatures, diagnostic process, and reconfiguration for various Pulse Code Modulation Master Unit (PCMMU) failures, and cockpit signatures and system impacts for Operational Instrumentation Dedicated Signal Conditioner (OI DSC) and Operational Instrumentation Multiplexer/Demultiplexer (OI MDM) failures.

- Describe the process that should be used when diagnosing a loss of COMM situation.
- Describe the signatures and recovery steps associated with various PCMMU failures.
- Describe the cockpit signatures of an OI DSC failure and an OI MDM failure.
- Identify the cockpit interfaces for the Payload General Support Computers (PGSCs) that are used to run the WinDecom and WorldMap applications.

## 187B **ORB OPS/COMM 21012**

Title: Orbit Operations/Communication

Duration: 4.0 hours Medium: SMS-FB, GNS

Student: ASCAN (Schedule 3 ASCANs, no CB IA.)

Source: DA7/Assigned SMS Team

Date: 07/04

Lesson(s) Replaced: ORB EVA/COMM 21012

Equipment Required: None

Prerequisite Lesson(s): ORB OPS/COMM 21001

Preparation: None

Synopsis: This lesson is designed to exercise both nominal and off-nominal orbit

procedures. The student will be provided with a simulated flight plan. While performing the nominal procedure, the student will be exposed to a variety of failures that may require changes to the nominal procedure and/or timeline. This lesson also emphasizes the effect of certain DPS

failures on the communications system. Lastly, signatures and

malfunction procedures for Operational Instrumentation Dedicated Signal

Conditioner (OI DSC) and Operational Instrumentation

Multiplexer/Demultiplexer (OI MDM) failures will be reviewed.

- Follow a simulated on-orbit timeline and perform the following nominal procedures at the specified time:
  - Ku Deploy and Activation
  - PGSC ACT, WinDecom OPS and WorldMap Initialization
  - CCTV Activation
  - Supply H<sub>2</sub>O Dump using the FES and using the supply dump line
  - Fuel Cell Purge (manual)
  - RCS Regulator Reconfiguration
  - Heater Reconfiguration
  - L OMS to RCS Interconnect
- Identify, safe, and reconfigure from the following failures while performing the above procedures:
  - Ku TB problems during deploy
  - CCTV camera failure
  - Pulse Code Modulation Master Unit (PCMMU) failure at the SM GPC
  - Fuel cell purge valve failure
  - Supply H<sub>2</sub>O dump valve problem
  - PL MDM failure
  - S-Band component failure
  - DSC failure
  - OI MDM failure

188A **A/E SYS 21001** 

Title: Ascent/Entry Systems Prebrief

Duration: 1.0 hour Medium: Classroom

Student: ASCAN (Schedule 3 ASCANs, no CB IA.)

Source: DA7/Assigned SMS Team

Date: 04/06

Lesson(s) Replaced: ASC SYS 21001, E SYS 21001

Equipment Required: None

Prerequisite Lesson(s): MPS MAL 22006, OM/RC DP/EPS 21006,

EPS MAL A/E 21004

Preparation: None

Synopsis: In order to prepare the student for A/E SYS 21012, this prebrief will

discuss electrical bus loss signatures during ascent/entry and aborts, the effects of electrical bus loss on critical equipment, and the landing gear

and nose wheel steering systems.

Objectives: • Identify the primary cockpit signatures for various electrical bus losses.

 Using Reference Data, identify what critical equipment and instrumentation for ascent/entry is lost with certain electrical bus failures.

• Explain how the landing gear is deployed with and without hydraulics.

• Explain the impacts on the landing gear system (gear deploy, braking, and nose wheel steering) from Auxiliary Power Unit (APU)/Hydraulic failures and from various electrical and flight critical data bus failures.

#### 188B **A/E SYS 21011**

Title: Ascent/Entry Systems

Duration: 4.0 hours Medium: SMS-MB

Student: ASCAN (Schedule 3 ASCANs, no CB IA.)

Source: DA7/Assigned SMS Team

Date: 10/05

Lesson(s) Replaced: ASC SYS 21011, E SYS 21011

Equipment Required: None

Prerequisite Lesson(s): A/E SYS 21001

Preparation: None

Synopsis: This lesson consists of the following 5 runs:

• Uphill through OMS 2 burn – Electrical bus loss signature review.

 Uphill – Reaction Control System (RCS) fuel leak with electrical bus failure.

• Return-To-Launch Site (RTLS) – Loss of Main C during ascent.

# 188B **A/E SYS 21011 (Concluded)**

- RTLS Manage Auxiliary Power Units (APUs) to maintain landing gear deploy redundancy.
- Transoceanic Abort Landing (TAL) Systems failures with loss of the Backup Flight Software (BFS) (secondary cockpit cues).

Objectives: At the end of this lesson, the student will be able to:

- Identify the electrical buses lost, based on cockpit cues.
- Identify the impact of the electrical bus losses on the main engines, OMS engines, RCS jets, and landing gear deploy redundancy.
- Isolate an RCS fuel leak that is complicated by an electrical bus failure.
- Work through the nominal RTLS procedures while also working the loss of Main C.
- Perform an APU restart to maintain landing gear deploy redundancy.
- Discuss the secondary cues (other than onboard displays) that can be used to diagnose an electrical bus loss, APU/Hydraulic failure, and a Freon cooling loop failure.

# 189 **OM/RC QUAL A/E 21006**

Title: Orbital Maneuvering System/Reaction Control System for Ascent and

**Entry Qualification** 

Duration: 2.0 hours

Medium: SST 1 or SST 2 or SST 3

Student: ASCAN (Schedule individually.)

Source: DS66/G&C/Propulsion Training Group

Date: 02/04

Lesson(s) Replaced: OM/RC QUAL 21006

Equipment Required: None

Prerequisite Lesson(s): PROP DUMPS 21006, OM/RC DP/EPS 21006

Preparation: Review:

- ASC C/L; Nominal procedures
- ASC PKT C/L; RCS LEAK ISOL
- AESP, Ascent; AFT RCS LEAK
- AESP, Ascent: OMS HE Tk P LOW
- AESP, Entry; AFT RCS LEAK (304/305/GRTLS)
- ENT C/L; 2 Engine Deorbit Burn and Burn Monitor Card
- ENT C/L FORWARD RCS DUMP

## 189 OM/RC QUAL A/E 21006 (Concluded)

## Synopsis:

This lesson will verify completion of the Orbital Maneuvering/Reaction Control (OM/RC) flow by testing the students' operational knowledge of the OMS and Reaction Control System (RCS). The lesson tests the student's ability to perform nominal OMS and RCS procedures, the ability to identify a problem via cockpit signatures, locate the correct procedure, and to evaluate the impact of the failure. The lesson also tests the student's ability to determine the big picture impacts of an EPS, DPS, or Instrumentation (INST) failure on the OMS and RCS.

The class is composed of three runs, two ascents and one entry. The instructor will play MCC and answer questions and direct the student as necessary. The student will configure the orbiter for ascent then sit in the right seat and monitor the RCS and OMS systems. The student will perform all nominal procedures as well as malfunction identification, resolution and evaluation for the ascent and entry runs. The student will have available to them the use of all FDF and tools which are typically available in the cockpit.

- Configure the OMS and RCS switches for ascent and entry.
- Monitor the OMS and RCS on ascent and entry.
- Perform OMS 1/2 Targeting.
- Perform an Insertion Burn.
- Perform a Deorbit (D/O) Burn.
- Perform a Forward Reaction Control System (FRCS) Dump.
- Secure and Reopen the RCS.
- Diagnose an engine or propellant failure during a burn and work the appropriate procedure.
- Use the Burn Monitor and OMS Failure Cue Cards.
- Manage Jet Availability and Redundancy Management (RM) via SPEC 23.
- Use the D/O burn Flight Rules.
- Perform a 'hot' crossfeed or interconnect.
- Use available tools to evaluate impacts of DPS, EPS and INST failures on the OMS and RCS.
- Perform failure identification, resolution, and evaluation for failures in the OMS and RCS.

190A **ORB OPS/FCS 21001** 

Title: Orbit Operations and Flight Control System Prebrief

Duration: 1.0 hour Medium: Classroom

Student: ASCAN (Schedule 3 ASCANs, no CB IA.)

Source: DA7/Assigned SMS Team

Date: 07/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ORB OPS/COMM 21012

Preparation: Review:

Orbit OPS C/L

G2 to G8 transitionG8 to G2 transitionRCS HOT FIRE

FCS checkout parts 1 and 2

PRE- and POST-Sleep activities (single shift)

PGSC activationAft controller checkout

Synopsis: The purpose of this prebrief is to review several of the Orbit Ops C/L

procedures that will be performed in ORB OPS/FCS 21012.

Objectives: • State the purpose of the RCS Hot Fire Test, aft controller checkout,

FCS checkout, and pre- and post-sleep activities.

• State when each of the above procedures is nominally performed.

Identify the two major parts of the FCS checkout.

## 190B **ORB OPS/FCS 21012**

Title: Orbit Operations and Flight Control System Checkout

Duration: 4.0 hours Medium: SMS-FB, GNS

Student: ASCAN (Schedule 3 ASCANs, no CB IA.)

Source: DA7/Assigned SMS Team

Date: 07/04

Lesson(s) Replaced: CAP 21012

Equipment Required: None

Prerequisite Lesson(s): ORB OPS/FCS 21001

Preparation: None

Synopsis: This purpose of this lesson is to introduce the student to some of the Orbit

OPS C/L procedures, as well as to the importance of staying on a timeline.

## 190B ORB OPS/FCS 21012 (Concluded)

Objectives: • Perform the following Orbit Ops C/L procedures, using the FDF, and staying on the provided timeline:

G2 to G8 transitionG8 to G2 transition

RCS HOT FIRE

FCS Checkout, parts 1 and 2PRE- and POST-Sleep activities

PGSC activation

Aft controller checkout

IMU align

Activate WorldMap and manually enter time and vector data.

# 191 **COMM/IN QUAL 21008**

Title: Communication/Instrumentation Qualification

Duration: 2.0 hours Medium: SST 3

Student: ASCAN (Schedule individually.)

Source: DS25/Communications/NSS Training Group

Date: 01/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): Completion of all 20000-level COMM lessons

Preparation: Review:

FDF procedures related to the objectivesDPS displays related to the objectives

Synopsis: This lesson will verify completion standards of orbiter communication

training. The student will be asked to explain the major concepts of each

operation. Then the student will be asked to execute these

communication operations.

Objectives: • Perform the following tasks, and be able to explain concepts related to these tasks:

- Configure the orbiter communication systems for on-orbit operations including Telemetry Format Load (TFL)/Decommutator Format Load (DFL) loading and speaker/handheld microphone operations.
- Configure Panel A1 for Spaceflight Tracking and Data Network (STDN), Space Ground Link System (SGLS), and Tracking and Data Relay Satellite (TDRS) operations.
- Deploy, activate, and stow the Ku-Band.
- Activate and operate the Closed Circuit TV system.

## 191 COMM/IN QUAL 21008 (Concluded)

- Use available resources to analyze and explain communication situations.
- Use available resources to identify communication system failures.
- Set up orbiter communication systems for entry.

## 192 **DPS QUAL 21001**

Title: Data Processing System Qualification

Duration: 1.0 hour Medium: Classroom

Student: ASCAN (Schedule individually.)

Source: DS24/DPS/Navigation Training Group

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ENT DPS MAL 21006, ORB DPS MAL 21006,

A/E BFS 21011

Preparation: None

Synopsis: This lesson will verify completion standards of DPS training by having the

student answer some general questions about DPS operations with limited use of FDF. After this lesson, the student and instructor will determine if

any additional study or lessons are required.

Objectives: • During this lesson, the student will be asked to:

- Describe the nominal DPS configuration during ascent, orbit, and entry.
- Describe the main differences between a Menu Option Initial Program Load (IPL) and a Default Option IPL.
- Describe the signatures of the different PASS General Purpose Computer (GPC) failures (Halt, Power, Quit, Fail to Sync, Input/Output (I/O) Terminate (Term) B, I/O Term A).
- Describe the signature of a BFS failure (Halt, Power, Quit, Power and Halt Transients, Standalone, Fail to Standby, I/O Term A).
- Explain the signatures of Multiplexer/Demultiplexer (MDM) (at the GPC and at the MDM) failures.
- Identify scenarios that require a restring and explain how to perform a restring.
- Discuss BFS engage scenarios, how to verify a successful engage, and identify the post engage procedure.
- List good DPS habits.
- Explain the "big picture" DPS actions during Post Insertion.
- Explain how to perform a redundant set expansion.

# 192 **DPS QUAL 21001 (Concluded)**

- Describe the two methods of contracting the redundant set and how each method impacts the Rendezvous (RNDZ) Navigation (NAV) software.
- Explain the "big picture" actions required for an SM GPC failure on-orbit (Orbit Pocket Checklist (OPCL) and Malfunction Procedures (MAL PROC) procedures), using FDF.

## 193 **D/O BURN BR 21001**

Title: Deorbit Burn Briefing 1

Duration: 3.0 hours
Medium: Classroom
Student: ASCAN

Source: DS66/G&C/Propulsion Training Group

Date: 10/05

Lesson(s) Replaced: D BURN BR 21001, D/O BURN BR 23001

Equipment Required: ENT C/L, D/O BURN BR 21001 Prerequisite Lesson(s): A/E SYS 21011, DPS MAL 21006,

OM/RC DP/EPS 21006

Preparation: Read:

 D/O BURN BR 21001 (This briefing handout will be supplied 2 weeks prior to the briefing. The student is not expected to understand all of the materials but to have a basic knowledge of the terminology and rationale.)

Synopsis:

This briefing demonstrates how the information on the maneuver (MNVR) Preliminary Advisory Data (PAD), Deorbit, Entry, and Landing (DEL) PAD, and Propellant (PRPLT) PAD is relayed between MCC and the crew. It also defines the deorbit entries of the DEL PAD and PRPLT PAD, defines the use of the Deorbit (D/O) Burn Flight Rules cue card, reviews how to diagnose engine and propellant failures, explains the procedures on the Deorbit Burn Monitor card and 2 Engine burn card, and reviews the use of the OMS Failures card. Definition and Methods of the Deorbit Burn and burn rules of thumb are also discussed.

- Enter the information read by the instructor into the appropriate blocks on the MNVR PAD, DEL PAD, and PRPLT PAD.
- Transfer the information on the DEL PAD and PRPLT PAD to the appropriate blocks on the 2 Engine burn card.
- State the burn completion methods for failures that occur at the different milestones on the DEL PAD.
- Determine if a waveoff is required using the D/O Burn Flight Rules cue card given a failure.

## 193 **D/O BURN BR 21001 (Concluded)**

- State the signatures of an oxidizer/fuel blockage upstream and downstream of the inlet pressure sensor.
- Define the effect of an engine failure (ENG FAIL) and propellant failure (PRPLT FAIL) on oxidizer and fuel inlet pressures.
- Define the rationale for the procedures on the Deorbit Burn Monitor card.
- Define the rationale for the nominal procedures on the 2 Engine burn card.
- Determine the corresponding Reaction Control System (RCS) burn time using the OMS He PRESS/V/BURN TIME table given an OMS quantity.
- Given a failure, identify if an ignition path still exists, what additional failures would take the ignition path (what failure the system is critical to), and if a manual shutdown is required, using the OMS Failures cue card (Deorbit Burn).
- State the two conditions required to generate the OMS down arrow.
- State the three conditions required to mode guidance.

# 194A **D/O FLT TECH 21001**

Title: Deorbit Burn Flight Techniques Prebrief

Duration: 1.0 hour Medium: Classroom

Student: ASCAN (Schedule ASCANs in groups of 2 or 3, no CB IA, no more

than 2 PLTs per group. MS are optional. May schedule 2 groups for

same prebrief.)

Source: DS66/G&C/Propulsion Training Group

Date: 08/04

Lesson(s) Replaced: None Equipment Required: ENT C/L

Prerequisite Lesson(s): D/O BURN BR 21001, ORB MAN ATT 21012

Preparation: Read:

 SCOM; Page 7.3-1 to 7.3-6, Deorbit Burn Monitoring, Takeover and Manual Control

Synopsis: This prebrief will review the techniques and cockpit indications required to

fly with no OMS guidance downmode, monitor and perform the Patterson maneuver, and monitor and perform the Forward Reaction Control System

(FRCS) completion.

Objectives: • State the proper VGO x,y,z ratios for a 2 OMS, 1 OMS, AFT RCS, and FRCS burn.

• State the software requirements for OMS guidance downmode.

# 194A **D/O FLT TECH 21001 (Concluded)**

- State cockpit indications and effects on flight control for:
  - An 1 OMS engine burn, when guidance thinks 2 OMS are burning
  - An RCS burn, when guidance thinks an OMS engine is burning
- State the purpose of the Patterson maneuver.
- Explain how to perform and monitor the Patterson maneuver from the flight deck, including:
  - Applicable FDF
  - Maneuvering rate and techniques of using the Rotational Hand Controller (RHC)
  - Vehicle dynamics during the burn
  - Vehicle attitude at maneuver completion
- Explain how to perform and monitor a FRCS completion from the flight deck, including:
  - Applicable FDF
  - Pre-maneuver attitude
  - Maneuvering rate and techniques of using the RHC
  - Maneuver completion indications (prior to burn)
  - Vehicle dynamics during the burn

#### 194B **D/O FLT TECH 21012**

Title: Deorbit Burn Flight Techniques

Duration: 2.0 hours

Medium: SMS-FB, SMS-MB, GNS

Student: ASCAN (Schedule ASCANs in groups of 2 or 3, no CB IA, no more

than 2 PLTs per group. PLTs only.)

Source: DS66/G&C/Propulsion Training Group

Date: 08/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): D/O FLT TECH 21001

Preparation: None

Synopsis: This lesson will allow the students to practice skills required for advanced

deorbit burns. Each student will practice manual flying for a 2 OMS burn, performing the Patterson maneuver, flying 4+X with no OMS guidance downmode, and Forward Reaction Control System (FRCS) completion.

Objectives: • Perform a manual 2 OMS burn from the flight deck, including:

- Maneuvering rate and techniques of using the Rotational Hand Controller (RHC)
- Vehicle dynamics during the burn

## 194B **D/O FLT TECH 21012 (Concluded)**

- Monitor an OMS engine failure with no guidance downmode from 2 OMS to 1 OMS from the flight deck.
- Perform and monitor the Patterson maneuver from the flight deck, including:
  - Maneuvering rate and techniques of using the RHC
  - Vehicle dynamics during the burn
  - Vehicle attitude at maneuver completion
- Perform and monitor a 4+X RCS burn with no OMS guidance downmode from the flight deck, including:
  - Maneuvering rate and techniques of using the RHC
  - Vehicle dynamics during the burn
- Perform and monitor a FRCS completion from the flight deck, including:
  - Pre-maneuver attitude
  - Maneuvering rate and techniques of using the RHC
  - Maneuver completion prior to burn
  - Vehicle dynamics during the burn

#### 195A **D/O BURN 21001**

Title: Deorbit Burn 1 Prebrief

Duration: 1.0 hour Medium: Classroom

Student: ASCAN (Schedule 3 ASCANs, no CB IA; at least 1 ASCAN PLT.)

Source: DS66/G&C/Propulsion Training Group

Date: 07/04

Lesson(s) Replaced: None Equipment Required: ENT C/L

Prerequisite Lesson(s): D/O FLT TECH 21012

Preparation: Review:

D/O BURN BR 21001 handouts

Section on Pages 5-8, DEL PAD definitions

Section on Pages 15-18, Deorbit burn monitor rationale

Section on Pages 25-38, Deorbit Burn (2 Eng) cue card

rationale

Synopsis:

The purpose of this prebrief is to prepare the student to diagnose deorbit burn failures and work the proper procedures using the DEORBIT BURN MONITOR card and DEORBIT BURN (2 ENG) cue card. This lesson will also review how to transfer the data from the Deorbit, Entry, and Landing (DEL) Preliminary Advisory Data (PAD) and Propellant (PRPLT) PAD to the Deorbit Burn (2 Eng) cue card.

#### 195A D/O BURN 21001 (Concluded)

- Objectives: Transfer the information on the DEL and PRPLT PADS to the D/O Burn 2 Eng cue card.
  - State the difference between an engine failure (ENG FAIL) and a propellant failure (PRPLT FAIL) relating to availability of the engine and propellant.
  - State the implications of a PRPLT FAIL.
  - Identify the type of failure, ENG or PRPLT, given the loss of an OMS engine and loss of the associated OX or FU IN P.
  - Using the training video, diagnose an ENG FAIL, PRPLT FAIL, and sensor failures.
  - Identify and describe the appropriate off-nominal procedures to perform (PRPLT FAIL, ENG FAIL, 2nd OMS FAIL, and RCS COMPLETION procedures on the burn cue card) given a failure scenario.

#### 195B D/O BURN 21011

Title: Deorbit Burn Duration: 4.0 hours SMS-MB Medium:

Student: ASCAN (Schedule 3 ASCANs, no CB IA; at least 1 ASCAN PLT.)

Source: DS66/G&C/Propulsion Training Group

07/04 Date:

Lesson(s) Replaced: D/O BURN 21010

Equipment Required: None

Prerequisite Lesson(s): D/O BURN 21001

Preparation: None

Synopsis:

The intent of the lesson is to exercise all nominal and off-nominal procedures on the DEORBIT BURN (2 ENG) cue card and to use the DEORBIT BURN MONITOR and OMS FAILURES cue cards to recognize and resolve the various malfunctions. This lesson consists of 8 runs with the first run starting at Deorbit (D/O) -15 minutes and the remaining runs starting from D/O -4 minutes. The landing site is KSC with One Orbit Late available.

- Transfer the information from the Deorbit, Entry, and Landing (DEL) Preliminary Advisory Data (PAD) and Propellant (PRPLT) PAD to the appropriate blocks on the 2 Engine burn card.
- Perform the procedures for a nominal 2 engine deorbit burn.
- Identify an engine failure (ENG FAIL) versus a propellant failure (PRPLT FAIL), using the Deorbit Burn Monitor cue card.
- Identify and resolve the various failures covered on the Deorbit Burn Monitor cue card.

# 195B **D/O BURN 21011 (Concluded)**

- Determine if a waveoff is required using the D/O Burn Flight Rules cue card given a failure before ignition.
- Perform the proper actions for completing the burn using the Deorbit Burn 2 Eng cue card given the following failures or combination of failures:
  - ENG FAIL
  - PRPLT FAIL
- Identify manual shutdown requirements using the OMS FAILURES cue card.
- Given an EPS or DPS failure, identify if an ignition path still exists and what additional failures would take the remaining ignition path (what failure the system is critical to) using the OMS Failures cue card.
- Perform all required manual flight techniques for Reaction Control System (RCS) completion and Prebank/Forward Reaction Control System (FRCS) completion (PLTs only).

#### 196 **D/O BURN BR 22001**

Title: Deorbit Burn 2 Briefing

Duration: 3.0 hours Medium: Classroom

Student: ASCAN (Schedule in groups of about 15.) Source: DS66/G&C/Propulsion Training Group

Date: 10/05

Lesson(s) Replaced: D BURN BR 22001

Equipment Required: ENT C/L

Prerequisite Lesson(s): D/O BURN 21011

Preparation: Review:

D/O BURN BR 21001

Read:

 D/O BURN BR 22001 (This handout will be supplied 2 weeks prior to the briefing. The student is not expected to understand all of the material but to have a basic knowledge of the terminology and rationale. Bring this handout to the briefing.)

Synopsis:

This briefing defines the entries of the Propellant (PRPLT) Preliminary Advisory Data (PAD) for the 4 off-nominal types of burns, reviews the diagnosis of engine and propellant failures, and explains the procedures on the 1 Engine, Reaction Control System (RCS), Unbalanced, and Mixed Crossfeed burn cards.

#### 196 D/O BURN BR 22001 (Concluded)

- Objectives: Transfer the information from the Deorbit, Entry, Landing (DEL) PAD and PRPLT PAD to the 1 Engine, RCS, Unbalanced, and Mixed Crossfeed burn cards.
  - Determine which burn card should be used given an initial condition.
  - Define the rationale for the nominal procedures on the four off-nominal burn cards.
  - Describe how the burn will be completed as stated in the steps of the burn cards given an engine or propellant failure.

#### 197A **D/O BURN 22001**

Title: Deorbit Burn 2 Prebrief

**Duration:** 1.0 hour Medium: Classroom

Student: ASCAN (Schedule 3 ASCANs, no CB IA; at least 1 ASCAN PLT.)

Source: DS66/G&C/Propulsion Training Group

Date: 07/04

Lesson(s) Replaced: None Equipment Required: ENT C/L

Prerequisite Lesson(s): D/O BURN BR 22001

Preparation: Complete:

D/O BURN BR 22001; Burn Monitor Failure Diagnosis Quiz

Review:

D/O BURN BR 22001 handout

Synopsis:

This lesson is a continuation of D/O BURN 21001 and D/O BURN 21011. This prebrief will prepare the student for exercising 1 engine, Reaction Control System (RCS), Unbalanced, and Mixed Crossfeed deorbit burns in D/O BURN 22011. First, the Burn Monitor Failure Diagnosis Quiz will be reviewed. The remainder of the prebrief will be conducted like a paper sim in which the student will be given a set of initial conditions and will have to determine what type of burn to execute. In addition, a subsequent failure scenario will be given and the student will be required to identify and describe the appropriate procedures to perform, using the chosen burn card and the Deorbit Burn Monitor cue card. Also, the student will be required to transfer the information on the Propellant (PRPLT) and Deorbit, Entry, and Landing (DEL) Preliminary Advisory Data (PAD) to the appropriate burn cue card.

#### 197A D/O BURN 22001 (Concluded)

- Objectives: Transfer the information from the DEL and PRPLT PADs to the DEORBIT BURN (1 ENG, RCS, UNBALANCED, MIXED XFEED) cue cards.
  - Given an initial condition and subsequent failure scenario, identify which burn card should be used and then identify and describe the appropriate procedures to perform based on the failures presented.

#### 197B **D/O BURN 22011**

Title: Deorbit Burn 2

**Duration:** 4.0 hours SMS-MB Medium:

Student: ASCAN (Schedule 3 ASCANs, no CB IA; at least 1 ASCAN PLT.)

Source: DS66/G&C/Propulsion Training Group

Date: 07/04

D/O BURN 22010 Lesson(s) Replaced:

Equipment Required: None

Prerequisite Lesson(s): D/O BURN 22001

Preparation: None

Synopsis:

The intent of this lesson is to exercise all nominal and off-nominal procedures on the DEORBIT BURN (1 ENG, RCS, UNBALANCED, and MIXED XFEED) cue cards, and to use the DEORBIT BURN MONITOR and OMS FAILURES cue cards to recognize and resolve the various malfunctions. This lesson consists of 8 runs and 1 optional run, using the 4 off-nominal deorbit burn cue cards. The first run of each card will be a nominal run; the second run of each card will present various failures.

- Transfer the information on the Deorbit, Entry, and Landing (DEL) Preliminary Advisory Data (PAD) and Propellant (PRPLT) PAD to the appropriate blocks on the DEORBIT BURN (1 ENG. RCS. UNBALANCED, and MIXED XFEED) cue cards.
- Perform the procedures for a nominal 1 engine, RCS, Unbalanced, and Mixed Xfeed deorbit burn.
- Perform Malfunction Procedures OMS SSR-1 MIXED XFD: OMS PRPLT FAILURE in order to establish the desired OMS configuration for the Mixed Xfeed Deorbit Burn.
- Identify an ENG FAIL versus a PRPLT FAIL using the Deorbit Burn Monitor cue card.
- Identify and resolve the various failures covered on the Deorbit Burn Monitor cue card.

# 197B **D/O BURN 22011 (Concluded)**

- Determine if a waveoff is required using the Deorbit (D/O) Burn Flight Rules cue card given a failure before ignition.
- Given the following failures or combination of failures, perform the proper actions for completing the burn using the given Deorbit Burn cue card:
  - ENG FAIL
  - PRPLT FAIL
- Given an EPS or DPS failure, identify if an ignition path still exists and what additional failures would take the ignition path (what failure the system is critical to), using the OMS Failures cue card.
- Perform all required manual flight techniques for RCS completion and Forward Reaction Control System (FRCS) completion (PLTs only).

## 198 **TIER TEST 25001**

Refer to TIER TEST 21001 for description.

#### 199 **D/O BURN QUAL 21011**

Title: Deorbit Burn Qualification

Duration: 2.0 hours

Medium: SMS-MB, SMS-FB

Student: ASCAN (Schedule 4 ASCANs; at least 1 ASCAN PLT.)

Source: DS66/G&C/Propulsion Training Group

Date: 02/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): Completion of all 20000-level OMS, RCS and D/O BURN

lessons.

Preparation: Review:

Entry Checklist Deorbit Burn (2 Eng) cue card
Entry Checklist Deorbit Burn Monitor cue card

Synopsis: The purpose of this lesson is to verify that the student can complete a 2

engine deorbit burn using the appropriate procedures for the given failures. The FDF will be used during the lesson, and any manual flying required will be performed by the instructor unless otherwise requested by the student (PLTs only). Manual flying is not considered a performance

objective of the lesson.

## 199 **D/O BURN QUAL 21011 (Concluded)**

Objectives:

- Perform a 2-engine deorbit burn.
- With the given failures, perform and explain the steps required to complete the burn.
- Determine the amount of prebank (if required) that is needed to reach the landing site.
- Explain when and how a prebank is performed.

## 200A **SYS ABT 21001**

Title: Systems Aborts Prebrief

Duration: 1.0 hour Medium: Classroom

Student: ASCAN (Schedule 3 ASCANs, no CB IA.)

Source: DA7/Assigned SMS Team

Date: 07/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PAPER SIM 25001

Preparation: None

Synopsis:

This prebrief will review "systems aborts," including reasons for performing the abort based on ascent Flight Rules and the rationale for each of those criteria.

- Define the term "systems abort" and explain how a systems abort differs from a performance abort.
- State the type of abort that should be selected for a systems failure that
  occurs in the overlap between 2 Engine (2-ENG) Transoceanic Abort
  Landing (TAL) capability and Negative Return, and the rationale for
  choosing that abort.
- State the type of abort that should be selected for a performance problem when in the overlap between 2-ENG TAL capability and negative return, and the rationale for choosing that abort.
- Discuss some of the failures that require a pre-Main Engine Cut-Off (MECO) abort.
- Discuss some of the failures that require a post-MECO abort.
- Explain why a TAL is not performed for a thermal window pane failure.
- Explain the FDF flow for Loss of 2 H2O Loops when an Abort Once Around (AOA) has been declared.

200B **SYS ABT 21011** 

Title: Systems Aborts

Duration: 4.0 hours Medium: SMS-MB

Student: ASCAN (Schedule 3 ASCANs, no CB IA.)

Source: DA7/Assigned SMS Team

Date: 07/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): SYS ABT 21001

Preparation: None

Synopsis: This lesson consists of 5 ascent runs, each exercising a different type of

systems abort. The cases to be exercised are the following:

• Transoceanic Abort Landing (TAL) for cabin leak

• Return-To-Launch Site (RTLS) for loss of two Freon loops

Abort Once Around (AOA) for impending loss of cryo

• TAL for two Auxiliary Power Units (APUs) down and one failing

TAL for one oxidizer and one fuel tank leak (different pods)

Objectives: • Identify the malfunction, determine if an abort is required, and if so,

what type of abort to perform for each failure scenario presented.

 Perform the nominal procedures for each abort case while simultaneously performing the appropriate malfunction

procedure/powerdown.

• Describe the impact of the loss of two Freon loops procedure on the DPS, COMM, and Guidance, Navigation, and Control (GNC) systems.

• Describe the impact of the loss of two Auxiliary Power Units (APUs) on the main engines, landing gear systems, body flap, brakes, and nose

wheel steering systems.

## 201 **PAPER SIM 22001**

Title: Paper Simulation 2

Duration: 2.0 hours Medium: Classroom

Student: ASCAN (Schedule 4 ASCANs.)

Source: DA7/Assigned SMS Team

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): A/E SYS 21011, D/O BURN 22011, A/E BFS 21011

# 201 PAPER SIM 22001 (Concluded)

Preparation: Review:

- Ascent C/L
  - OMS Failures cue card
  - OMS Targeting
- AESP
  - Glided Flight; DPS Section, Restring Procedures
  - Powered Flight and Glided Flight; DPS Section, Multi Data Path Loss
  - Powered Flight and Glided Flight; EPS Section, Electrical Bus loss procedures
- Ref Data
  - Electrical Bus Loss Tables
  - MDM Bus Loss Tables

#### Synopsis:

This lesson is designed to prepare the student for multisystem malfunction ascent, abort, and entry cases. This lesson is conducted like a sim, but without the high-fidelity simulator. The student will be presented with an ascent or entry scenario that has a set of failures. The cockpit signatures associated with these failures will be provided to the student. The student is allowed to ask the instructors for any information that would normally be available to the crew at that time. The students will then be required to identify the failure (based on the provided signatures), make the appropriate MCC call, determine the FDF procedure to be worked (if required), and determine the system/mission impacts. In several cases, the students will also be asked to state what the next worst failure would be. This class emphasizes those failures that affect multiple orbiter systems (e.g., EPS, DPS failures).

- Based on the cockpit signature provided by the instructor, perform the following:
  - Identify malfunction.
  - Make the appropriate MCC call.
  - Identify appropriate procedure to be used for the failure (if required).
  - Identify the multi-discipline effects for the given failure.
  - Identify the system/mission impacts of the given failure during the selected phase of flight.
  - Identify the "next worse failure."

# 202 **PAPER SIM 23001**

Refer to PAPER SIM 22001 for description.

#### 203A **DO PREP BKOT 21001**

Title: Deorbit Preparation Backout Prebrief

Duration: 1.0 hour Medium: Classroom

Student: ASCAN (Schedule 3 ASCANs, no CB IA.)

Source: DA7/Assigned SMS Team

Date: 07/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): D/O BURN 22011

Preparation: Review:

D/O Prep C/L; D/O Prep Backout Section

Synopsis: This lesson will familiarize the student with the timeline and procedures in

the Deorbit Prep Backout section of the D/O Prep C/L. It will review when this procedure is used and the FDF paths leading up to the procedure. In

addition, the deorbit burn flight rules card will be discussed.

Objectives: • Locate the D/O Prep Backout section of the C/L.

• Define the elapsed time concept of the C/L.

- Describe the FDF path to the D/O Prep Backout procedure.
- Review the annotated timeline in preparation for DO PREP BKOT 21012.
- Review the GO-NO GO cue card.
- Describe the events that would cause a D/O Prep backout.
- Describe the philosophy difference between a 1 orbit and a 1 day waveoff and when each is used.
- Identify the powerdown that is usually required following a waveoff.

## 203B **DO PREP BKOT 21012**

Title: Deorbit Preparation Backout

Duration: 4.0 hours Medium: SMS-FB, GNS

Student: ASCAN (Schedule 3 ASCANs, no CB IA.)

Source: DA7/Assigned SMS Team

Date: 07/04

Lesson(s) Replaced: None Equipment Required: None

## 203B DO PREP BKOT 21012 (Concluded)

Prerequisite Lesson(s): DO PREP BKOT 21001

Preparation: None

Synopsis: This lesson will familiarize the students with the timeline and allow them to

perform the procedures in the D/O Prep Backout section of the D/O Prep C/L. This lesson will start at D/O -15 minutes with all systems nominal. Due to particular events, the D/O Burn will not be performed and a 1 day waveoff will be required. The students will perform the D/O Prep Backout

procedures, including a Priority Group C powerdown.

Objectives: • Identify when a deorbit burn should not be performed, based on a given failure.

• Use the D/O Prep Backout procedure to perform the D/O Prep Backout Timeline.

 Identify the tasks in the D/O Backout procedure that should be delayed due to earlier failures.

## 204 **PAPER SIM 24001**

Refer to PAPER SIM 22001 for description.

## 205 **PAPER SIM 25001**

Refer to PAPER SIM 22001 for description.

#### 206A **ASC SKL 21001**

Title: Ascent Skills Prebrief

Duration: 1.0 hour Medium: Classroom

Student: ASCAN (Schedule 3 ASCANs, no CB IA.)

Source: DA7/Assigned SMS Team

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): DO PREP BKOT 21012

Preparation: None

Synopsis: This prebrief is run in a paper sim format. The paper sim that is exercised

in this prebrief is performed in ASC SKL 21011. The paper sim

emphasizes 2-failure-deep malfunction scenarios and failures that affect

multiple orbiter disciplines.

## 206A ASC SKL 21001 (Concluded)

Objectives: Complete the following tasks for each failure:

- Identify the failure.
- Make the correct MCC call.
- Identify the FDF procedure to be performed.
- Discuss the general purpose of the FDF procedure.
- Identify the mission/system impacts.

## 206B **ASC SKL 21011**

Title: Ascent Skills
Duration: 4.0 hours
Medium: SMS-MB

Student: ASCAN (Schedule 3 ASCANs, no CB IA.)

Source: DA7/Assigned SMS Team

Date: 07/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ASC SKL 21001

Preparation: None

#### Synopsis:

This SMS lesson is designed to expose the students to a multi-discipline malfunction environment. The students will be required to work through failure scenarios while performing nominal ascent/abort procedures. The failures presented are multi-discipline in nature, and are often more than 1-failure-deep. It is very important that the students understand the impact of each failure on the other orbiter systems and its priority compared to other failures and nominal tasks. This lesson contains 2 uphill runs, 1 RTLS, and 1 TAL.

- Perform the following tasks for the malfunctions presented for each of the required ascent runs:
  - Identify the failure.
  - Make the appropriate MCC call.
  - Execute the correct FDF procedure.
  - State the mission/system impact.
  - Adjust nominal and/or subsequent malfunction procedures to account for the failure.
- Prioritize the malfunctions to be worked, and divide the tasks among the appropriate crewmembers.
- Perform the nominal procedures on time.

207A **E SKL 21001** 

Title: Entry Skills Prebrief

Duration: 1.0 hour Medium: Classroom

Student: ASCAN (Schedule 3 ASCANs, no CB IA.)

Source: DA7/Assigned SMS Team

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ASC SKL 21011

Preparation: None

Synopsis: This prebrief is run in a paper sim format. The paper sim that is exercised

in this prebrief is performed in E SKL 21011. The paper sim emphasizes 2-failure-deep malfunction scenarios and failures that affect multiple

orbiter disciplines.

Objectives: • Identify the failure.

Make the correct MCC call.

• Identify the FDF procedure to be performed.

• Discuss the general purpose of the FDF procedure.

• Identify the mission/system impacts.

207B **E SKL 21011** 

Title: Entry Skills
Duration: 4.0 hours
Medium: SMS-MB

Student: ASCAN (Schedule 3 ASCANs, no CB IA.)

Source: DA7/Assigned SMS Team

Date: 07/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): E SKL 21001

Preparation: None

## 207B **E SKL 21011 (Concluded)**

## Synopsis:

This lesson is designed to expose the students to a multi-discipline malfunction environment. The students will be required to work through failure scenarios while performing nominal entry procedures. The failures presented are multi-discipline in nature and are often more than 1-failure-deep. It is very important that the students understand the impact of each failure on the other orbiter systems and its priority compared to other failures and nominal tasks. This lesson contains 1 D/O - 15 to landing run, and 2 200K to landing runs, with post-landing procedures exercised on the last 200K run.

- Perform the following tasks for the malfunctions presented for each of the required entry runs:
  - Identify the failure.
  - Make the appropriate MCC call.
  - Execute the correct FDF procedure.
  - State the mission/system impact.
  - Adjust nominal and/or subsequent malfunction procedures to account for the failure.
- Prioritize the malfunctions to be worked, and divide the tasks among the appropriate crewmembers.
- Perform the nominal procedures on time.

#### SECTION 2.0 CORE SYSTEMS REFRESHER TRAINING

The Core Systems Refresher Training Section contains lessons that may be requested by the student or instructor as part of proficiency training. These lessons are often used to refamiliarize the assigned crewmember with systems knowledge prior to beginning 30000-level training.

The Core Systems Refresher Training Course also contains the Qualification (Qual) lessons which selected crewmembers must successfully complete in order to begin the 30000-level Ascent/Entry training flow. The assigned crewmember should review their position-specific sections of the Assigned Crew Study Guide prior to taking the Qual lessons. The concept of completing the Assigned Crew Study Guide and passing the Qual lessons was designed to eliminate the "every 12 month" requirement for all Refresher lessons and to ensure that all crewmembers were at the same knowledgebase level prior to starting their 30000-level Ascent/Entry training flow. The student should avoid using the Refresher lessons as a substitute for the Assigned Crew Study Guide lessons in preparation for the Quals. The Assigned Crew Study Guide lessons are procedure-based whereas the Qual lessons are primarily knowledge-based. Satisfactory Qual lesson completion will be determined by the Instructor/Team Lead. If minimum knowledge is not demonstrated, the Instructor/Team Lead will determine the appropriate remedial instruction required to bring the student to the appropriate level and retaking of the entire Qual is not necessary. A crewmember who is not required to take a specific Qual lesson per Table 2-1 may take the lesson at their discretion. Upon completion of all required Qual lessons, 30000-level training may begin.

Table 2-1. Core Systems Refresher Training Requirements

																	Date	Last Modified: 06/08
						Non-Crew Rotation						(	rew R	otatio	n			
	Ref				Sched													
Stage	Num	Lesson Code	Media	Hrs	Code	С	P	MS1	MS2	MS3	MS4	PS	С	Р	MS1	MS2	Alt Fac	Comments
4	1	MPS QUAL 31006	SST	2	3	2	2		2				2	2		2		MS 1 Optional
4	2	S&C QUAL 31006	SST	1	3	1	1		1				1	1		1		MS 1 Optional
4	3	EPS QUAL 31004	SST	2	1	2	2		2				2	2		2		MS1, MS3 Optional
4	4	APU/HYD QUAL 31004	SST	2	1	2	2		2				2	2		2		MS1, MS3 Optional
4	6	ECLSS/C&W/MECH QUAL 31008	SST 3	2	1	2	2		2				2	2		2		MS1, MS3 Optional
4	12	COMM/IN QUAL 31008	SST 3	2	1	2	2	2	2	2			2	2	2	2		CDR Opt'l
																		See Notes 1, 2, 3, & 4.
4	15	DPS Q 31001	CLR	1	3	1	1		1				1	1		1		DPS Classroom Qual
4	25	NAV Q 31001	CLR	1	3	1	1		1				1	1		1		See Notes 1, 2, 3, & 4
4	26	OGNC QUAL 31006	SST	2	1	2	2		2				2	2		2		See Note 4
4	27	OM/RC A/E Q 31006	SST	2	2		2		2					2		2		
4	31	OM/RC Q O 31006	SST	2	1		2		2					2		2		
4		Sub To	tal for Stage	tage Stage Totals			rewmer	nber:										
4				19		15	19	2	19	2	0	0	15	19	2	19		
0	5	PRL 21057	CBT	1	1	1	1	1	1	1			1	1	1	1		
0	7A	APU REFR 41001	CLR	0.5	1	0.5	0.5	0.5	0.5	0.5			0.5	0.5	0.5	0.5		
0	7B	APU REFR 41004	SST	2	1	2	2	2	2	2			2	2	2	2		
0	8	APU REVIEW 41004	SST	2	1	2	2	2	2	2			2	2	2	2		
0	9	C&W REFR 41004	SST	1	1	1	1	1	1	1			1	1	1	1		
0	10A	CCTV REFR 41001	CLR	0.5	1	0.5	0.5	0.5	0.5	0.5			0.5	0.5	0.5	0.5		
0	10B	CCTV REFR 41008	SST 3	1.5	1	1.5	1.5	1.5	1.5	1.5			1.5	1.5	1.5	1.5		
0	11	CCTV REVIEW 41008	SST 3	1	1	1	1	1	1	1			1	1	1	1		
0	13	COM/IN RVW 41008	SST	2	1	2	2	2	2	2			2	2	2	2		
0	14	DPS REVIEW 41006	SST	2	1	2	2	2	2	2			2	2	2	2		

- NOTE: 1. At the discretion of the CDR/Crew, this Qual lesson can be scheduled with the Entire Crew listed at the same time.
  - 2. At the discretion of the CDR/Crew, this Qual lesson can be scheduled on an individual Crewmember basis.
  - Where Notes 1 & 2 are both listed, scheduling the Qual lesson per Note 1 is preferable but any Crewmember's request for Note 2 should be honored upon receiving the CDR's permission.
  - 4. Credit for the Quals will be given on a case-by-case basis for a recently flown Crewmember who will be starting 30000-level SMS training within 9 months of his/her previous flight's landing date. Credit may also be given if the student has completed the 20000-level ASCAN flow within the past 9-months. Evaluation of the crediting of these Quals will be performed by the assigned SMS Team Lead and associated discipline-specific SMS instructors upon review of the previous flight Quals with that flight's SMS Team Lead and instructors.
  - 5. Any Crewmember:
    - 1) Who has not been assigned to a flight,
    - 2) Who opts to take any of the Quals before getting assigned, and
    - 3) Who receives a passing grade.
    - Will retain credit for that specific Qual for one year from its date of completion.
  - 6. The concept of completing the Assigned Crew Study Guide and passing the subsequent required Qual lessons was designed to eliminate the "every 12 month requirement" for all Refresher lessons. Any crewmember may still request any Review or Refresher lesson at any time.
  - 7. Please note the prerequisites for this class.

Table 2-1. Core Systems Refresher Training Requirements (Concluded)

	Date Last Modified: 0													Last Modified: 06/08				
						Non-Crew Rotation								Crew F	Rotatio	n		
	Ref				Sched													
Stage	Num	Lesson Code	Media	Hrs	Code	С	Р	MS1	MS2	MS3	MS4	PS	С	Р	MS1	MS2	Alt Fac	Comments
0	16A	ECLSS REFR 41001	CLR	0.5	1	0.5	0.5	0.5	0.5	0.5			0.5	0.5	0.5	0.5		
0	16B	ECLSS REFR 41004	SST	2	1	2	2	2	2	2			2	2	2	2		
0	17	ECLSS REVIEW 41004	SST	2	1	2	2	2	2	2			2	2	2	2		
0	18A	EPS REFR 41001	CLR	0.5	1	0.5	0.5	0.5	0.5	0.5			0.5	0.5	0.5	0.5		
0	18B	EPS REFR 41004	SST	2	1	2	2	2	2	2			2	2	2	2		
0	19	EPS REVIEW 41004	SST	2	1	2	2	2	2	2			2	2	2	2		
0	20A	MECH REFR 41001	CLR	0.5	1	0.5	0.5	0.5	0.5	0.5			0.5	0.5	0.5	0.5		
0	20B	MECH REFR 41004	SST	2	1	2	2	2	2	2			2	2	2	2		SST 3 only
0	21	MECH REVIEW 41004	SST	2	1	2	2	2	2	2			2	2	2	2		SST 3 only
0	22	MPS REFR 41006	SST	2	1	2	2	2	2	2			2	2	2	2		
0	23	MPS REVIEW 41006	SST	2	1	2	2	2	2	2			2	2	2	2		
0	24	NAV REVIEW 41006	SST	2	1	2	2	2	2	2			2	2	2	2		
0	28	OM/RC REVIEW 41008	SST	2	1	2	2	2	2	2			2	2	2	2		
0	29	OMRC REFR 41008	SST	2	2	2	2	2	2	2			2	2	2	2		
0	30	OMRC REFR 42008	SST	2	2	2	2	2	2	2			2	2	2	2		
																		This lesson is optional for crewmembers with a
0	32	ECL 10.2 ATM 41004	SST	1.5	1	1.5	1.5	1.5	1.5	1.5			1.5	1.5	1.5	1.5		shuttle-based EVA
0	33A	MAN ASC 21001	CLR	2	1 - 3	2	2		2				2	2		2		
0	33B	MAN ASC 21011	SMS/MB	4	1	4	4		4				4	4		4		
0	34A	MAN ABT 21001	CLR	2	1 - 3	2	2		2				2	2		2		See Note 7
0	34B	MAN ABT 21011	SMS/MB	4	1	4	4		4				4	4		4		See Note 7
0	35A	CONT ABT RVW 21001	CLR	2	1 - 3	2	2	2	2				2	2	2	2		See Note 7
0	35B	CONT ABT RVW 21011	SMS/MB	4	1	4	4	4	4				4	4	4	4		See Note 7
																	SST1, SST	
0	36	SHUTTLE REVIEW 41006	SST	2	3	2	2		2				2	2		2	2, SST 3	
0		Sub To	otal for Stage		Stage Totals	Per Crewmemb		mber:										
0				60.5		60.5	60.5	46.5	60.5	40.5	0	0	60.5	60.5	46.5	60.5		

- NOTE: 1. At the discretion of the CDR/Crew, this Qual lesson can be scheduled with the Entire Crew listed at the same time.
  - 2. At the discretion of the CDR/Crew, this Qual lesson can be scheduled on an individual Crewmember basis.
  - 3. Where Notes 1 & 2 are both listed, scheduling the Qual lesson per Note 1 is preferable but any Crewmember's request for Note 2 should be honored upon receiving the CDR's permission.
  - 4. Credit for the Quals will be given on a case-by-case basis for a recently flown Crewmember who will be starting 30000-level SMS training within 9 months of his/her previous flight's landing date. Credit may also be given if the student has completed the 20000-level ASCAN flow within the past 9-months. Evaluation of the crediting of these Quals will be performed by the assigned SMS Team Lead and associated discipline-specific SMS instructors upon review of the previous flight Quals with that flight's SMS Team Lead and instructors.
  - 5. Any Crewmember:
    - 1) Who has not been assigned to a flight,
    - 2) Who opts to take any of the Quals before getting assigned, and
    - 3) Who receives a passing grade.
    - Will retain credit for that specific Qual for one year from its date of completion.
  - 6. The concept of completing the Assigned Crew Study Guide and passing the subsequent required Qual lessons was designed to eliminate the "every 12 month requirement" for all Refresher lessons. Any crewmember may still request any Review or Refresher lesson at any time.
  - 7. Please note the prerequisites for this class

#### 1 **MPS QUAL 31006**

Title: Main Propulsion System Qualification

Duration: 2.0 hours Medium: SST

Student: COMMANDER, MS 2, PILOT (MS 1 optional.)

DS66/G&C/Propulsion Training Group Source:

Date:

A MPS S&C Q 31001 Lesson(s) Replaced:

Equipment Required: None

Prerequisite Lesson(s): Completion of ASCAN MPS Training Flow

Preparation: Read:

> Main Propulsion System Workbook; Section 4 Assigned Crew Study Guide; Section 2.8 MPS

Synopsis: This lesson will present a series of scenarios for the student. Each

> scenario presents both nominal or malfunction conditions that the student must analyze and then determine what crew actions are required based

on FDF procedures.

Objectives: • Demonstrate the ability to perform the 7 nominal crew tasks for the

Main Propulsion System (MPS) on ascent.

• Demonstrate the ability to identify malfunctions, locate the appropriate FDF procedures, and perform the required actions on ascent.

 Explain the cause of the malfunctions observed and the rationale for the actions taken for each scenario presented.

#### 2 **S&C QUAL 31006**

Title: Sensors and Controllers Qualification

Duration: 1.0 hour Medium: SST

Student: COMMANDER, MS 2, PILOT (MS 1 optional.)

Source: DS66/G&C/Propulsion Training Group

10/05 Date:

Lesson(s) Replaced: A MPS S&C Q 31001

Equipment Required: None

Prerequisite Lesson(s): Completion of ASCAN FCS and Sensors & Controllers

Training Flows

Preparation: Assigned Crew Study Guide; Section 2.12 Sensors and Controllers

# 2 S&C QUAL 31006 (Concluded)

Synopsis:

This lesson will test the student's operational knowledge of the flight control sensors and controllers. The lesson tests the student's ability to identify a problem via cockpit signatures, locate the correct procedure, and to evaluate the impact of the failure. The instructor will question the student to test knowledge of the system operation, including rationale for procedures and functioning of redundancy management. The lesson also tests the student's ability to determine the impacts of DPS failures on the flight control sensors and controllers.

The class is composed of two runs, one entry and one orbit. The instructor will play MCC and answer questions and direct the student as necessary. Initially, the student will configure the orbiter for entry and monitor the flight control sensors and controllers. The student will perform all nominal procedures as well as malfunction identification, resolution, and evaluation for the entry and orbit runs. The student will use FDF and cockpit displays to identify problems and take actions.

Objectives:

- Recognize failures in the flight control sensors and controllers.
- Demonstrate familiarity with displays containing flight control sensor and controller information.
- Perform flight data file procedures with flight control sensors' and controllers' steps and explain the rationale for the steps.
- Manually deselect flight control sensors and controllers.
- Explain flight control sensors and controllers redundancy management.
- Demonstrate proper operation of controllers.

## 3 **EPS QUAL 31004**

Title: Electrical Power Systems Qualification

Duration: 2.0 hours Medium: SST

Student: COMMANDER, MS 2, PILOT (Schedule individually.) MS 1, MS 3

optional.

Source: DS45/Shuttle Systems Training Group

Date: 04/06

Lesson(s) Replaced: SYSTEMS Q 31004

Equipment Required: None Prerequisite Lesson(s): None

Preparation: Review FDF and EPS reference materials to prepare for the objectives

listed below.

# 3 EPS QUAL 31004 (Concluded)

## Synopsis:

This lesson will verify that the student meets the required standards for systems knowledge and FDF usage for the Shuttle EPS. This lesson tests the student's ability to recognize signatures and execute the appropriate FDF procedure for various EPS malfunctions. In addition to off-nominal procedures, the student will perform selected nominal procedures (including starred blocks when applicable). Throughout the lesson, the instructor will ask questions in order to test the student's knowledge of hardware, operations, procedure rationale, and concepts associated with EPS.

- Identify various EPS malfunctions during the ascent/entry and orbit timeframes via displays and other available cockpit cues.
- Execute the appropriate FDF procedure for each of the malfunctions presented.
- Explain the rationale for the FDF procedures associated with each of the malfunctions presented.
- State the power sources for the Main, Essential, Control, and AC buses.
- Describe how the AC bus sensors function in the Off, Monitor, and Auto Trip switch positions.
- Explain the "two finger trick" associated with Control buses.
- Recognize which buses require a fuel cell shutdown when lost, and explain why.
- Explain the difference between a fuel cell shutdown and fuel cell safing.
- Explain how to confirm if a fuel cell has been "safed."
- Recognize which fuel cell malfunctions cause the fuel cell stack temperature reading to be invalid.
- Explain the difference between the long and short form bus tie, and state when each should be used.
- Perform a back door bus tie, when required.
- Explain the difference in signatures between a fuel cell short and a main bus short.
- Explain the purpose of performing a fuel cell purge.
- Explain the operational constraints for the manual fuel cell purge.
- Perform the manual fuel cell purge procedure, including starred blocks (when applicable).

## 4 **APU/HYD QUAL 31004**

Title: Auxiliary Power Unit/Hydraulic Qualification

Duration: 2.0 hours Medium: SST

Student: COMMANDER, MS 2, PILOT (Schedule individually.) MS 1, MS 3

optional.

Source: DS45/Shuttle Systems Training Group

Date: 04/06

Lesson(s) Replaced: SYSTEMS Q 31004

Equipment Required: None Prerequisite Lesson(s): None

Preparation: Review FDF and APU/Hyd reference materials to prepare for the

objectives listed below.

Synopsis:

This lesson will verify that the student meets the required standards for systems knowledge and FDF usage for the Shuttle Auxiliary Power Unit (APU)/Hydraulic (Hyd) Systems. This lesson tests the student's ability to recognize signatures and execute the appropriate FDF procedure for various APU/Hyd malfunctions. In addition to off-nominal procedures, the student will perform selected nominal procedures (including starred blocks when applicable). Throughout the lesson, the instructor will ask questions in order to test the student's knowledge of hardware, operations, procedure rationale, and concepts associated with the APU/Hyd Systems.

- Identify various Auxiliary Power Unit (APU)/Hydraulic (Hyd)
  malfunctions during the ascent and/or entry timeframes via displays and
  other available cockpit cues.
- Execute the appropriate FDF procedure for each of the malfunctions presented.
- Explain the rationale for the FDF procedures associated with each of the malfunctions presented.
- When required, report the F7 APU Underspeed or Overspeed light to MCC correctly.
- Describe how the following functions are supported by the APU/Hyd system:
  - Engine throttling
  - Engine gimballing (ascent and entry)
  - Landing gear deploy
  - Braking
  - Nose Wheel Steering
- Locate the Systems Flight Rules in FDF.
- Determine whether an ascent abort is required for a given APU/Hyd malfunction scenario (using FDF).

# 4 APU/HYD QUAL 31004 (Concluded)

- Locate the APU ready-to-start criteria in FDF.
- Perform the APU Pre Start and APU Start procedures in the Ascent Checklist, and explain the procedure rationale.
- Perform the APU Pre Start and Single APU Start procedures in the Entry Checklist, and explain the procedure rationale.
- Describe the conditions that would call for "Attempt One APU" versus "Attempt Two APUs" when performing the Single APU Start procedure in the Entry Checklist.
- Describe how the APU primary and secondary control valves operate.
- Describe what happens when the APU Speed Select switch is taken to High.
- State the four reasons for restarting an APU.
- Recognize when an APU that has been shutdown is a candidate for a cooldown and/or a restart.
- Given an APU/Hyd malfunction scenario, determine impacts on the landing gear, brakes, and Nose Wheel Steering (NWS) systems (using the Landing Gear diagram).
- Given an APU/Hyd malfunction scenario, determine impacts to main engine throttling and gimballing (using cue card).
- Describe Water Spray Boiler (WSB) spray mode and pool mode, and state when each mode is used.
- Explain why the WSB controllers are not swapped prior to Main Engine Cutoff (MECO).
- Explain Priority Rate Limiting (PRL).
- State where each of the three hydraulic pressure sensor readings can be seen in the cockpit.

## 5 **PRL 21057**

Title: Priority Rate Limiting CBT

Duration: 1.0 hour Medium: CBT

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT (Schedule individually.)

Source: DS45/Shuttle Systems Training Group

Date: 06/08

Lesson(s) Replaced: None

Equipment Required: Personal Computer; access to NASA CBT Web site

Prerequisite Lesson(s): None

Preparation: None

# 5 **PRL 21057 (Concluded)**

Synopsis: This CBT lesson provides the student with Priority Rate Limiting (PRL)

background information, as well as student practice with basic PRL exercises and PRL case studies. It allows the student to choose which

information or exercises are presented.

Objectives: To receive credit for the lesson, the student must successfully complete at

least 5 of the 7 case studies.

#### 6 ECLSS/C&W/MECH QUAL 31008

Title: Environmental Control and Life Support Systems/Caution &

Warning/Mechanical Qualification

Duration: 2.0 hours Medium: SST 3

Student: COMMANDER, MS 2, PILOT (Schedule individually.) MS 1, MS 3

optional.

Source: DS45/Shuttle Systems Training Group

Date: 04/06

Lesson(s) Replaced: SYSTEMS Q 31004

Equipment Required: None Prerequisite Lesson(s): None

Preparation: Review FDF and ECLSS, C&W, and Mechanical Systems reference

materials to prepare for the objectives listed below.

Synopsis: This lesson will verify that the student meets the required standards for

systems knowledge and FDF usage for the Shuttle Environmental Control and Life Support Systems (ECLSS), Caution and Warning (C&W), and Mechanical Systems. This lesson tests the student's ability to recognize signatures and execute the appropriate FDF procedure for various ECLSS and Mechanical malfunctions. In addition to off-nominal procedures, the student will perform selected nominal procedures (including starred blocks when applicable) for each system. Throughout the lesson, the instructor will ask questions in order to test the student's knowledge of hardware, operations, procedure rationale, and concepts associated with the ECLSS, C&W, and Mechanical Systems.

- Identify various ECLSS malfunctions during the ascent/entry and orbit timeframes via displays and other available cockpit cues.
- Execute the appropriate FDF procedure for each of the malfunctions presented.
- Explain the rationale for the FDF procedures associated with each of the malfunctions presented.

# 6 ECLSS/C&W/MECH QUAL 31008 (Continued)

- Locate the Systems Flight Rules in FDF.
- Determine whether an ascent abort is required for a given ECLSS malfunction scenario (using FDF).
- Explain why Alternating Current (AC) powered equipment is not swapped prior to Main Engine Cutoff (MECO).
- Locate the Portable Computer System (PCS) diagram in FDF.
- Describe the PCS configuration during ascent, entry, and orbit.
- Explain how to distinguish between an oxygen (O<sub>2</sub>) and nitrogen (N<sub>2</sub>) leak into the cabin.
- Explain the difference between the three "dP/dT" values on the displays (hardware, backup, equivalent), and state when each is available.
- Explain the av bay temperature signature associated with an av bay fan that has been turned off (or is completely failed).
- Describe the H<sub>2</sub>O loop configuration during ascent, entry, and orbit.
- Explain the difference in signature between an external H<sub>2</sub>O loop leak, internal H<sub>2</sub>O loop leak, and a H<sub>2</sub>O loop pump failure.
- State what the Panel L4 H<sub>2</sub>O Loop Pump 1A/2 circuit breakers power.
- Recognize when the Panel L4 H<sub>2</sub>O Loop Pump 1A/2 circuit breakers should be pushed in.
- State the mechanism(s) actively cooling the Freon loops during all phases of flight from pre-launch through post-landing.
- Explain the differences between the Flash Evaporator System (FES) primary controllers and the FES secondary controller.
- State the temperature control point for the FES controllers (primary and secondary), radiator controllers (in norm and high), and NH<sub>3</sub> controllers.
- Explain the purpose of the FES core flush.
- Explain the Freon loop radiator isolation hardware.
- Explain the radiator startup sequence in terms of the motion and timing of the radiator flow control and bypass valves.
- Explain the purpose of the radiator controller startup sequence.
- Explain the rule for configuring NH<sub>3</sub> systems according to Freon flow rates.
- Perform the supply water dump procedure, including starred blocks (when applicable), and explain the procedure rationale.
- Explain the differences between the Primary Caution and Warning (C&W) System and the Backup C&W System.
- Given a parameter name, locate the software identification number in Reference (Ref) Data.
- Given a parameter name, locate the hardware channel number in Ref Data or on the C&W cue card.

# 6 ECLSS/C&W/MECH QUAL 31008 (Concluded)

- Demonstrate how to use the Primary to Backup C&W Analog Parameter Calibration table to change a hardware limit for a given parameter.
- Explain how the state of microswitches affects the operation of a mechanism.
- Execute the procedures for a manual and/or auto mode payload bay door opening and/or closing.
- Describe the malfunctions that will cause a "PBD SEQ FAIL" fault message during payload bay door opening/closing.
- Describe the malfunctions that will cause a "PBD CONFIG FAIL" fault message during payload bay door opening/closing.
- Describe the malfunctions that will cause a dilemma during payload bay door opening/closing.
- Given a microswitch malfunction, identify what, if any, fault messages will be generated during payload bay door opening/closing.
- Explain the purpose of the Centerline Latch Extended Guide Roller Trajectory No-Go diagram.

#### **7A** APU REFR 41001

Title: Auxiliary Power Unit/Hydraulic Systems Operations Refresher Prebrief

Duration: 0.5 hours Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT (Schedule individually.)

Source: DS45/Shuttle Systems Training Group

Date: 05/99

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PRL 21057

Preparation: None

Synopsis: This prebrief will include a review of nominal and off-nominal Auxiliary

Power Unit/Hydraulic (APU/HYD) and Water Spray Boiler (WSB) systems

operations. Recent APU/HYD and WSB procedure and hardware/software changes will also be discussed.

- Review the hydraulically driven components, and identify their location throughout the vehicle.
- Show illustrations/pictures to identify and locate the APUs, fuel tanks, water spray boiler, and other miscellaneous equipment.

# 7A APU REFR 41001 (Concluded)

- Review the APU/HYD schematic shown in the PKT Checklists (C/Ls) and MAL PROC. As a minimum, review the following:
  - APU fuel tank and plumbing system
  - APU hardware
  - APU controllers, including caution & warning, and auto shutdown features
  - HYD pump and plumbing
  - Accumulator/bootstrap system and purpose
  - HYD circ pump package and operation
  - WSB equipment and operation
  - Gas Generator (GG) bed injector cooling equipment and operation
- Review the hydraulic scheme for nose wheel steering and main & nose gear deployment.
- Review appropriate malfunction scenarios, based upon student requirements (i.e., flight-specific details).
- Time permitting, review the Backup Flight System (BFS) and Primary Avionic Software System (PASS) CRT displays that are available.

# **APU REFR 41004**

Title: Auxiliary Power Unit Refresher

Duration: 2.0 hours

Medium: SST 1 or SST 2 or SST 3

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT (Schedule individually.)

Source: DS45/Shuttle Systems Training Group

Date: 05/99

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): APU REFR 41001

Preparation: None

Synopsis: This lesson provides refresher training in Auxiliary Power Unit/

Hydraulic/Water Spray Boiler (APU/HYD/WSB) components and their

functions, and provides insight into recent FDF procedural and

hardware/software changes. Several scenarios are presented to provide hands-on training in nominal and off-nominal APU/HYD/WSB operations.

- Identify all controls and displays related to the APU/HYD/WSB systems for each flight phase.
- Explain the rationale behind the nominal and off-nominal APU/HYD/WSB systems procedures.
- Perform quick recognition of nominal and off-nominal system signatures in all flight phases.

# 7B APU REFR 41004 (Concluded)

- Perform APU/HYD/WSB system management during all flight phases including Priority Rate Limiting (PRL), APU start and shutdown.
- Identify calls that need to be made by both crew and ground.
- Determine and state the rationale behind malfunction impact on the APU/HYD/WSB systems and flight duration.
- Describe basic APU operation of the following:
  - APU controller logic
  - Ready-to-start talkback
  - Start sequence
  - Speed control logic
  - Auto shutdown
- Describe basic HYD operation of the following:
  - HYD main pump operation
  - Circ pump operation
  - System redundancy
  - Accumulator system
  - Switching valves
- Describe basic WSB operation of the following:
  - WSB controller logic
  - Pool mode
  - Spray mode
  - Bypass valve logic
  - Ready indicators
- Explain the interfaces between the APU/HYD systems and the following:
  - Space Shuttle Main Engines (SSMEs)
  - Aerosurfaces
  - Landing gear
  - Brakes
  - Nose Wheel Steering (NWS)

#### **8** APU REVIEW 41004

Title: Auxiliary Power Unit/Hydraulic Systems Review

Duration: 2.0 hours

Medium: SST 1 or SST 2 or SST 3

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT (Schedule individually.)

Source: DS45/Shuttle Systems Training Group

Date: 05/99

Lesson(s) Replaced: AP/HY REVIEW 41004

Equipment Required: None Prerequisite Lesson(s): PRL 21057

## 8 APU REVIEW 41004 (Concluded)

Preparation: None

Synopsis: This lesson provides the medium for an in-depth discussion or review of

the system and/or associated FDF procedures. It is primarily tailored to a

crewmember's individual needs, and is scheduled as desired.

Objectives: Discuss specific topics predetermined by the instructor and student.

#### 9 <u>C&W REFR 41004</u>

Title: Caution & Warning Refresher

Duration: 1.0 hour

Medium: SST 1 or SST 2 or SST 3

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT (Schedule individually.)

Source: DS45/Shuttle Systems Training Group

Date: 05/99

Lesson(s) Replaced: None Equipment Required: FDF

Prerequisite Lesson(s): C&W MAL 21004

Preparation: None

Synopsis: This lesson provides practice in system configuration, panel R13 and F7

functions, Systems Management (SM) TABLE MAINT SPEC operations, fault summary display operations, and fire and smoke systems switch operations.

- Recognize visual and aural cues for hardware and software Caution and Warning (C&W).
- · Recognize visual and aural cues for an SM alert.
- Utilize primary C&W matrix cue card to locate parameters and/or channel numbers.
- Inhibit and enable hardware C&W parameter using panel R13 and the reference data book.
- Read and change limits for a hardware C&W parameter using panel R13 and the Reference Data book.
- Perform lamp test for hardware C&W light matrix.
- Inhibit and enable software C&W parameter using SPEC 60.
- Change software C&W parameter limit using SPEC 60.
- Utilize fault messages to recognize failures.
- Change the SM tone duration using SPEC 2.
- Write checkpoint using SPEC 60.
- · Identify location of fire holes in cabin.

# 9 C&W REFR 41004 (Concluded)

- Identify location of smoke detectors.
- Perform SMOKE DETN CKT TEST using Orbit Ops Checklist (C/L).
- Identify and perform the correct procedure for an avionics bay fire.
- Recognize the signatures that indicate cabin depressurization.

#### **10A CCTV REFR 41001**

Title: Closed Circuit Television Refresher Prebrief

Duration: 0.5 hours Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT (Schedule individually.)

Source: DS25/Shuttle Comm Training

Date: 08/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): CCTV MAL 21008

Preparation: None

Synopsis: This lesson is to strengthen the student's knowledge of the CCTV system.

The CCTV system, associated components, TV Cue Card, and the

appropriate FDF procedures will be discussed.

- Identify the five major functions of the Remote Control Unit (RCU) and the six major functions of the Video Switching Unit (VSU).
- Identify the two types of cameras, the camera locations, and camera range movement.
- Identify the one true Ground Control Interface Logic (GCIL) switch of the CCTV system.
- List the major steps involved in activating the CCTV system.
- Identify the procedures corresponding to given CCTV signatures.
- Identify cues to assist in determining the location of the failure (e.g., nominal configuration, monitor and panel A7 and Systems Management (SM) alert message).

# **10B CCTV REFR 41008**

Title: Closed Circuit Television Refresher

Duration: 1.5 hours Medium: SST 3

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT (Schedule individually.)

Source: DS25/Shuttle Comm Training

Date: 08/03

Lesson(s) Replaced: None

Equipment Required: FDF, Color Television Monitors

Prerequisite Lesson(s): CCTV REFR 41001

Preparation: None

Synopsis: This lesson reinforces the student's knowledge of the CCTV system. The

student will perform nominal CCTV procedures that include activating, operating, and deactivating the CCTV system with the TV cue card and

associated panel controls. The student will also be required to

troubleshoot CCTV malfunctions using FDF.

Objectives: • Operate the CCTV system by activating, operating, and deactivating.

Locate, explain, and use CCTV monitor controls and Panel A6 and A7
 CCTV switches to exercise the system

CCTV switches to operate the system.

 Demonstrate downlinking a video scene and viewing the downlinked video on a Color Television Monitor.

• Recognize and resolve a CCTV monitor, a camera, and an overtemp failure using FDF, if applicable.

#### **11 CCTV REVIEW 41008**

Title: Closed Circuit Television Review

Duration: 1.0 hour Medium: SST 3

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT (Schedule individually.)

Source: DS25/Shuttle Comm Training

Date: 08/03

Lesson(s) Replaced: CCTV MAL 21004

Equipment Required: FDF, Color Television Monitors

Prerequisite Lesson(s): CCTV MAL 21008

Preparation: None

Synopsis: This lesson is primarily tailored to a crewmember's individual needs;

therefore, it is recommended that the student coordinate the subject areas

to be reviewed with the assigned instructor. This lesson is to be

scheduled as desired.

## 11 CCTV REVIEW 41008 (Concluded)

Objectives: • Operate the CCTV system by activating, operating, and deactivating.

Employ the students requested CCTV activities.

#### **12** COMM/IN QUAL 31008

Title: Communication/Instrumentation Qualification

Duration: 2.0 hours Medium: SST 3

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT (CDR optional.)

(Schedule individually.)

Source: DS25/Shuttle Comm Training

Date: 04/96

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): Complete all Comm Study Guides

Preparation: Review:

FDF procedures related to the objectives
 CDT displays related to the objectives.

• CRT displays related to the objectives

Synopsis: This lesson will verify completion standards of orbiter communication

training. The student will be asked to explain the major concepts of each operation. The student will then be asked to execute these

communication operations.

- Perform the following tasks, and be able to explain concepts related to these tasks:
  - Load Telemetry Format Loads (TFLs) and Decom Format Loads (DFLs).
  - Deploy, activate, and stow the Ku-band.
  - Configure panel A1 for Space Flight Tracking and Data Network (STDN), Tracking and Data Relay Satellite (TDRS), and Space-Ground Link System (SGLS).
  - Use available resources (displays and controls) to identify COMM coverage.
  - Use available resources to analyze and explain comm situations.
  - Use available resources to identify comm failures.
  - Configure audio system for speaker/handheld microphone operations.
  - Perform CCTV activation and operation.

# 13 <u>COM/IN RVW 41008</u>

Title: Communications/Instrumentation Review

Duration: 2.0 hours

Medium: SST 1 or SST 2 or SST 3

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT (Schedule individually or as

requested by CDR.)

Source: DS25/Shuttle Comm Training

Date: 04/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): New Astronaut Training Flow completed

Preparation: S-BD COMM/IN 21002

Synopsis: This lesson provides the medium for basic or in-depth discussion or

review of the Shuttle communications, instrumentation, and/or the

associated cockpit cue/FDF procedures. It is tailored to a crewmember's individual or 'flight crews' need(s); therefore, it is recommended that the student(s) coordinate the subject areas to be reviewed with the assigned

instructor. This lesson is to be scheduled as desired.

Objectives: • Familiarize the student with the appropriate communications signatures

during the Ascent and Post Insertion phases of flight.

 Familiarize the student with appropriate SPEC displays, Ku-Band system, and CCTV system while on-orbit.

• Familiarize the student with nominal and off-nominal Ground Control Interface Logic (GCIL) signatures.

• Identify selected off-nominal communications and Operational Instrumentation (OI) signatures while in an orbit configuration.

• Identify appropriate FDFs for use by student during ascent, orbit, and entry phases of flight.

#### **14** DPS REVIEW 41006

Title: Data Processing System Review

Duration: 2.0 hours

Medium: SST 1 or SST 2 or SST 3

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT (Schedule individually.)

Source: DM34/Rendezvous Guidance, Procedures and Training

DS24/DPS/Navigation Training Group

Date: 05/99

Lesson(s) Replaced: DPS REFR 41006

Equipment Required: None

Prerequisite Lesson(s): ORB DPS MAL 21006

Preparation: None

## 14 DPS REVIEW 41006 (Concluded)

Synopsis:

This lesson provides the medium for an in-depth discussion or review of the DPS and FDF procedures. The student should coordinate with the DPS/Navigation (NAV) instructor about the subject areas to be reviewed. This lesson is to be scheduled as desired. If the student desires a 30 minute prebrief prior to the lesson, they can coordinate this with the DPS/NAV instructor.

Objectives: Objectives will be determined by the instructor and/or student.

## 15 DPS Q 31001

Title: Data Processing System Qualification

Duration: 1.0 hour Medium: Classroom

Student: COMMANDER, MS 2, PILOT (Schedule in groups of up to 3.)

Source: DM34/Rendezvous Guidance, Procedures and Training

DS24/DPS/Navigation Training Group

Date: 02/04

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: Read:

Assigned Crew Study Guide Orbiter Systems; Section 3: DPS

Synopsis:

This lesson will verify completion standards of DPS training by having the student answer some general questions about DPS operations. The CDR, PLT, and MS2 will each take this qual prior to the start of 30000-level training. This lesson can be scheduled either individually or as a group, crew choice. There will be limited FDF use. At the completion of this lesson, the student and the instructor will determine if any additional studying or lessons are required.

- Describe the nominal DPS configuration during ascent, orbit, and entry.
- Describe the operational differences between Primary Avionics Software System (PASS) and Backup Flight System (BFS).
- Describe the signatures of a BFS engage, BFS self-engage, and BFS disengage.
- Describe the signature of a BFS failure (Halt, Power, Quit, Power and Halt Transients, Standalone, Fail to Standby, Input/Output Terminate A (I/O TERM A)) and identify the procedure that should be worked.

# 15 DPS Q 31001 (Concluded)

- Explain the "big picture" rationale for the steps in nominal DPS procedures (Post Insertion, Deorbit Prep, Post Landing, Redundant Set (RS) Contraction, RS Expansion, Pre/Post Sleep Activities, Systems Management (SM) Checkpoint).
- Describe the main differences between a Menu Option Initial Program Load (IPL) and a Default Option IPL.
- Describe the signature of a Flight Critical (FC) Multiplexer/Demultiplexer (MDM) (at the MDM, at the General Purpose Computer (GPC), Card).
- Describe the signatures of the different PASS GPC failures (Halt, Power, Quit, Fail to Sync, I/O TERM B, I/O TERM A).
- Identify the scenarios that allow a restring and explain how to perform a restring.
- Discuss good DPS habits.
- Explain how to troubleshoot basic Multifunction Electronic Display Subsystem (MEDS) failures.

## 16A <u>ECLSS REFR 41001</u>

Title: Environmental Control and Life Support Systems Operations Refresher

Prebrief

Duration: 0.5 hours Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT (Schedule individually.)

Source: DS45/Shuttle Systems Training Group

Date: 05/99

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ECL 10.2 ATM 21004, ECLSS MAL AE 21004,

ECLSS MAL O 21004

Preparation: None

Synopsis: This prebrief will include a review of nominal and off-nominal

Environmental Control and Life Support System (ECLSS) operations.

Objectives: • Identify f

• Identify flight rules for ECLSS systems aborts in the Ascent Checklist (C/L).

- Identify major points for LOSS OF CABIN PRESSURE, LOSS OF 2 WATER LOOPS, and LOSS OF 2 FREON LOOPS procedures.
- Identify and explain recent ECLSS-related hardware/software and procedural changes.

# **16B ECLSS REFR 41004**

Title: Environmental Control and Life Support Systems Refresher

Duration: 2.0 hours

Medium: SST 1 or SST 2 or SST 3

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT (Schedule individually.)

Source: DS45/Shuttle Systems Training Group

Date: 05/99

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ECLSS REFR 41001

Preparation: None

Synopsis: This lesson provides refresher training in Environmental Control and Life

Support System (ECLSS) components and their functions, and provides insight into recent FDF hardware/software and procedural changes. Several scenarios are presented to provide hands on training in

nominal/off-nominal ECLSS operations.

Objectives:

- Explain the rationale behind the nominal/off-nominal ECLSS system procedures.
- Perform quick recognition of nominal/off-nominal system signatures in all flight phases.
- Configure and explain switch and display configuration for all flight phases.
- Describe the Supply H<sub>2</sub>O system and perform appropriate leak isolation procedures.
- Identify a cabin leak and perform associated procedures in a timely manner.
- Explain the Active Thermal Control System (ATCS) and Atmosphere Revitalization System (ARS) cooling systems and their relation to the various flight phases.
- Discuss the rationale for ECLSS-driven aborts.

#### **17 ECLSS REVIEW 41004**

Title: Environmental Control and Life Support System Review

Duration: 2.0 hours

Medium: SST 1 or SST 2 or SST 3

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT (Schedule individually.)

Source: DS45/Shuttle Systems Training Group

Date: 05/99

Lesson(s) Replaced: ECLSS MAL 21004

Equipment Required: FDF

## 17 ECLSS REVIEW 41004 (Concluded)

Prerequisite Lesson(s): ECL 10.2 ATM 21004, ECLSS MAL AE 21004,

ECLSS MAL O 21004

Preparation: None

Synopsis: This lesson is designed for the crewmember as a review of the

Environmental Control and Life Support System (ECLSS) in order to cover items in question and to maintain proficiency in the FDF procedures. This session is primarily tailored to a crewmember's individual needs, and is to

be scheduled as desired.

Objectives: Discuss specific topics predetermined by the instructor and student.

## 18A EPS REFR 41001

Title: Electrical Power System Refresher Prebrief

Duration: 0.5 hours Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT (Schedule individually.)

Source: DS45/Shuttle Systems Training Group

Date: 05/99

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): EPS MAL A/E 21004

Preparation: None

Synopsis: This prebrief will include a review of nominal and off-nominal EPS

operations.

Objectives: • Review systems schematics for Power Reactants Storage and

Distribution (PRSD) and fuel cell subsystems.

• Discuss recent vehicle hardware changes, as applicable.

• Discuss appropriate vehicle-specific information.

 Discuss recent Primary Avionics Software System (PASS) and Backup Flight System (BFS) software changes that pertain to EPS.

• Review any significant changes in nominal and malfunction procedures, and discuss the rationale for the changes.

# 18B EPS REFR 41004

Title: Electrical Power System Refresher

Duration: 2.0 hours

Medium: SST 1 or SST 2 or SST 3

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT (Schedule individually.)

Source: DS45/Shuttle Systems Training Group

Date: 05/99

Lesson(s) Replaced: None Equipment Required: FDF

Prerequisite Lesson(s): EPS REFR 41001

Preparation: None

Synopsis: This lesson allows the student to practice EPS-related nominal and off

nominal procedures. The student will configure EPS switches for various flight phases using the FDF. During this lesson, EPS-related malfunctions will be presented, and the student will have an opportunity to recognize

the malfunctions and perform corrective procedures.

Objectives: • Configure Cryogenic (CRYO) heaters for various flight phases.

 Perform O<sub>2</sub> heater current sensor test using the Orbit Ops Checklist (C/L).

- Configure AC bus sensors and essential (ESS) buses for various phases of flight.
- Perform manual and auto fuel cell purge using the cue card and plot fuel cell amps and volts on the back of the cue card.
- Utilize F7 panel, CRT displays, panel meters, and fault messages to identify various EPS malfunctions.
- Recognize AC bus failures, understand their effect on other systems, and reconfigure the orbiter.
- Perform the correct procedure for AC bus failures using the Orbit Pocket C/L and the malfunction procedures.
- Recognize an AC phase shift and utilize the Orbit Pocket C/L to identify the phase, which caused the failure.
- Distinguish between AC overload and AC over/under voltage condition.
- Identify and perform the correct procedure for a Forward Power Controller (FPC) bus loss.
- Identify and perform the correct procedure for a main bus undervolt.
- Distinguish between a Fuel Cell (FC) short and a main bus short.
- Identify an O<sub>2</sub> or H<sub>2</sub> reactant valve fail closed, and perform the correct procedure for an O<sub>2</sub> reactant valve failure within 2 minutes, or, for an H<sub>2</sub> reactant valve, within 30 seconds.
- Identify an ESS bus failure and perform the correct procedure.

# 18B EPS REFR 41004 (Concluded)

- Identify a FC PUMP failure and perform the correct procedure within 6 minutes.
- Utilize the fuel cell shutdown cue card whenever it is necessary to shut down the fuel cell, or to bus tie.
- Identify a cryo O<sub>2</sub> or H<sub>2</sub> leak in a tank, manifold, or fuel cell, and perform the correct procedure.

#### <u>19</u> <u>EPS REVIEW 41004</u>

Title: Electrical Power System Review

Duration: 2.0 hours

Medium: SST 1 or SST 2 or SST 3

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT (Schedule individually.)

Source: DS45/Shuttle Systems Training Group

Date: 05/99

Lesson(s) Replaced: EPS MAL 21004

Equipment Required: None

Prerequisite Lesson(s): EPS MAL A/E 21004

Preparation: None

Synopsis: This lesson provides the medium for an in-depth discussion or review of

the system and/or associated FDF procedures. It is primarily tailored to a crewmember's individual needs; therefore, it is recommended that the student coordinate with the assigned instructor regarding the subject areas to be reviewed. This lesson is to be scheduled as desired.

Objectives: Discuss specific topics predetermined by the instructor and student.

#### **20A** MECH REFR 41001

Title: Mechanical Systems Operations Refresher Prebrief

Duration: 0.5 hours Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT (Schedule individually.)

Source: DS45/Shuttle Systems Training Group

Date: 05/99

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): MECH MAL 21004

Preparation: None

Synopsis: This prebrief will include a review of nominal and off-nominal mechanical

systems operations, utilizing actual hands-on manipulation of mechanical

component models in the mechanical model classroom.

# 20A MECH REFR 41001 (Concluded)

Objectives:

- Discuss the payload bay door display (OPS 202 base page, or SPEC 63) in detail.
- Describe the opening and closing of the Payload Bay Doors (PLBDs), and the associated FDF/figures in detail.
- Explain the meaning of 3 possible software malfunction indications.
- Construe the difference between auto and manual PLBD operations.

#### **MECH REFR 41004**

Title: Mechanical Refresher

Duration: 2.0 hours Medium: SST 3 only

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT (Schedule individually.)

Source: DS45/Shuttle Systems Training Group

Date: 05/99

Lesson(s) Replaced: None Equipment Required: FDF

Prerequisite Lesson(s): MECH REFR 41001

Preparation: None

Synopsis:

This lesson allows the student to demonstrate knowledge of the various mechanical systems. This lesson will cover External Tank (ET) umbilical door, Payload Bay Door (PLBD), and landing gear deploy operations. These operations will include various malfunctions.

- Identify configuration of vent doors during prelaunch, ascent, orbit, entry, and post-landing.
- Perform the ET umbilical door opening/closing procedures.
- Recognize and perform actions associated with a failed ET door.
- Perform the emergency PLBD opening procedures.
- Recognize and perform actions for PLBD SEQ FAIL and PLBD CONFIG messages.
- Perform an off-nominal PLBD closing.
- Locate and explain PLBD visual aids.
- Perform landing gear deployment.

#### **MECH REVIEW 41004**

Title: Mechanical Review

Duration: 2.0 hours Medium: SST 3 only

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT (Schedule individually.)

Source: DS45/Shuttle Systems Training Group

Date: 05/99

Lesson(s) Replaced: None Equipment Required: FDF

Prerequisite Lesson(s): MECH MAL 21004

Preparation: None

Synopsis: This lesson provides the medium for an in-depth discussion or review of

the basic mechanical systems, Payload Bay Door (PLBD), External Tank (ET) doors, vent doors, the landing deceleration system, and/or FDF procedures. This lesson is primarily tailored to a crewmember's individual

needs and is to be scheduled as desired.

Objectives: Discuss specific topics predetermined by the instructor and student.

#### **MPS REFR 41006**

Title: Main Propulsion System Refresher

Duration: 2.0 hours

Medium: SST 1 or SST 2 or SST 3

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT Source: DS66/G&C/Propulsion Training Group

Date: 01/95

Lesson(s) Replaced: None Equipment Required: FDF

Prerequisite Lesson(s): MPS MAL 22006

Preparation: None

Synopsis: This lesson is designed to ensure that the student completely understands

all nominal actions involving the Main Propulsion System (MPS). It will also cover a variety of problems involving the MPS in order to ensure that the student understands their nature and all appropriate actions involved

therein.

Objectives: • Monitor the MPS.

 Perform nominal and off nominal MPS procedures in the checklists and cue cards.

 Resolve (Identify, Solve, and Discuss) selected MPS-related problems caused by both MPS and orbiter system failures.

## **MPS REVIEW 41006**

Title: Main Propulsion System Review

Duration: 2.0 hours

Medium: SST 1 or SST 2 or SST 3

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT Source: DS66/G&C/Propulsion Training Group

Date: 05/92

Lesson(s) Replaced: MPS MAL A 21006

Equipment Required: FDF

Prerequisite Lesson(s): MPS MAL 21006

Preparation: None

Synopsis: Refer to MPS MAL 21006, New Astronaut Flow, for synopsis. More

malfunctions will be used per run, and the overall problems are more

complex. This lesson is to be scheduled as desired.

Objectives: Refer to MPS MAL 21006, New Astronaut Flow, for objectives, with

particular emphasis upon malfunctions requested by the crewmember.

#### **24** NAV REVIEW 41006

Title: Navigation Review

Duration: 2.0 hours

Medium: SST 1 or SST 2 or SST 3

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT (Schedule individually.)

Source: DM34/Rendezvous Guidance, Procedures and Training

DS24/DPS/Navigation Training Group

Date: 05/99

Lesson(s) Replaced: OGNC REFR 41006, OGNC REVIEW 41006

Equipment Required: None

Prerequisite Lesson(s): E NAV 22006, IMU 21006

Preparation: None

Synopsis: This lesson provides the medium for an in-depth discussion or review of

the shuttle navigation systems and FDF procedures. The student should coordinate with the DPS/Navigation (NAV) instructor about the subject areas to be reviewed. This lesson is to be scheduled as desired. If the

student desires a 30-minute prebrief prior to the lesson, they can

coordinate this with the DPS/NAV instructor.

Objectives: Objectives will be determined by the instructor and/or student.

#### 25 NAV Q 31001

Title: Navigation Qualification

Duration: 1.0 hour Medium: Classroom

Student: COMMANDER, MS 2, PILOT (Schedule in groups of up to 3.)

Source: DM34/Rendezvous Guidance, Procedures and Training

DS24/DPS/Navigation Training Group

Date: 02/04

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: Read:

 Assigned Crew Study Guide Orbiter Systems; Sections 3: NAV – Air Data System, Dedicated Displays, Entry NAVAIDs Overview, Inertial Measurement Units (IMUs), MLS/RA, Nav Overview, Tactical Air Navigations (TACANs)

#### Synopsis:

This lesson will verify completion standards of Navigation (NAV) training by having the student answer some general questions about NAV operations. The CDR, PLT, and MS2 will each take this qualification lesson prior to the start of 30000-level training. This lesson can be scheduled either individually or as a group, crew choice. There will be limited FDF use. At the completion of this lesson, the student and the instructor will determine if any additional study or lessons are required.

- Describe the data the sensor provides to the navigation software, the Redundancy Management (RM) (selection filter and downmode conditions) for Primary Avionics Software System (PASS) and Backup Flight System (BFS), and the procedures for RM failures and dilemmas for the following sensors: IMUs, TACANs, the air data system, Microwave Landing System (MLS), and Radar Altimeters (RAs).
- Describe air data probe deployment and verification for PASS and BFS.
- Describe the Heads-Up Display (HUD) data bus selection switch.
- Describe residual, ratio, and the filter controls (Auto, Inhibit, Force) as seen on PASS and BFS SPEC 50.
- Describe what data the IMUs provide the General Purpose Computer (GPC) software.
- Describe the IMU failure signatures (Fail, Dilemma (DLMA), H/W and S/W Built-In Test Equipment (BITE), Power) and the actions required for each.
- Describe the single-state and three-state vector schemes, when they are used, and their advantages/disadvantages.

# **26** OGNC QUAL 31006

Title: Orbit Guidance Navigation and Control Qualification

Duration: 2.0 hours

Medium: SST 1 or SST 2 or SST 3

Student: COMMANDER, MS 2, PILOT (Schedule individually.)
Source: DM34/Rendezvous Guidance, Procedures and Training

DS24/DPS/Navigation Training Group

Date: 05/03

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: Read:

 Assigned Crew Study Guide Orbiter Systems; Sections 3: NAV – IMUs, Nav Overview, Nominal Nav Procedures, Star Tracker

#### Review:

- Post-Insertion; Star Tracker Activation/Door Open
- Orbit Ops C/L;
  - IMU Align STRK
  - GNC 201, 202, 301
  - IMU/IMU ALIGNMENT
  - HUD Calibration
- Mal Proc, Vol. II;
  - GNC FRP-3, IMU Recovery with at least one IMU as good reference
  - GNC FRP-2, IMU Reference Recovery

#### Synopsis:

This lesson will verify completion standards of orbit Guidance, Navigation, and Control (GNC) training by executing some GNC orbit operations with limited use of FDF. The student should have a basic understanding of the systems in order to perform the operations. There is no need to memorize the FDF. The student will start the lesson by configuring the star trackers for orbit. Nominal orbit operations are then performed, including an Inertial Measurement Unit (IMU) alignment and a Heads-Up Display (HUD) calibration. Several different pointing maneuvers are also performed to exercise the Universal Pointing (UNIV PTG) display. A manual flying exercise will be performed to demonstrate comprehension of the relationship between the DAP and UNIV PTG functions. The student will also exercise the IMU Reference Recovery procedure as a review of the three different types of alignments.

#### 26 OGNC QUAL 31006 (Concluded)

Objectives:

- Configure the DAP to maneuver at a specified rate.
- Perform nominal star tracker activation and door opening, without FDF.
- Perform a dual star tracker IMU align using only the Star Pairs
   Preliminary Advisory Data (PAD) (Orbit Ops Checklist (C/L), Flt Supp)
   and the Flight Plan.
- Perform the steps for a HUD calibration, without FDF.
- Perform a single star tracker IMU align using the Star Pairs PAD, without FDF.
- Perform various pointing maneuvers using the UNIV PTG display.
- Manually maneuver by flying a single axis while the other axes maintain LVLH attitude hold.
- Recover an IMU that has lost its internal reference with an IMU/IMU alignment, without FDF.
- Identify the bad IMU in a velocity dilemma situation.
- Perform the tasks for a total IMU Reference Recovery; i.e., loss of on orbit attitude reference using FDF.

#### 27 OM/RC A/E Q 31006

Title: Orbital Maneuvering/Reaction Control System Ascent/Entry

Qualification

Duration: 2.0 hours

Medium: SST 1 or SST 2 or SST 3

Student: MS 2, PILOT

Source: DS66/G&C/Propulsion Training Group

Date: 04/96

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): Study Guide

Preparation: Review:

FDF and related reference materials

Synopsis:

This lesson tests the crew's ability to perform nominal OMS and Reaction Control System (RCS) procedures, identify a problem via cockpit signatures, locate the correct procedure, evaluate the impact of the failure, and determine the big picture impacts of an EPS, DPS, or Instrumentation (INST) failure on the OMS and RCS. The crew is expected to verbalize their actions and thoughts regarding the procedures and malfunctions as much as possible during this lesson.

# 27 OM/RC A/E Q 31006 (Concluded)

This lesson is composed of 2 ascent runs and 1 entry run. The instructor will assume the role of MCC by answering questions and directing the student as necessary. The crew will configure the orbiter for ascent. The crew will perform all nominal procedures and will identify, evaluate, and resolve malfunction scenarios for the ascent and entry runs. The FDF and other tools which are typically available in the cockpit will be available for use during this lesson.

#### Objectives:

- Configure the OMS and RCS switches for ascent and entry.
- Monitor the OMS and RCS on ascent and entry.
- Perform OMS-1/2 Targeting.
- Perform an Insertion Burn.
- Perform a Deorbit (D/O) Burn.
- Perform a Forward Reaction Control System (FRCS) Dump.
- Secure and Re-Open the RCS.
- Diagnose an Engine (ENG) or Propellant (PRPLT) failure during a burn and work the appropriate procedure.
- Use the Burn Monitor and OMS Failure Cue Cards.
- Manage Jet Availability and Redundancy Management (RM) via SPEC 23.
- Use the D/O burn Flight Rules.
- Perform a hot XFEED or INCNCT.
- Use available tools to evaluate impacts of DPS, EPS and INST failures on the OMS and RCS.
- Perform failure identification, resolution, and evaluation for failures in the OMS and RCS.

#### **28 OM/RC REVIEW 41008**

Title: Orbital Maneuvering/Reaction Control System Review

Duration: 2.0 hours

Medium: SST 1 or SST 2 or SST 3

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT (Schedule individually.)

Source: DS66/G&C/Propulsion Training Group

Date: 08/84

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

#### 28 OM/RC REVIEW 41008 (Concluded)

Synopsis: This lesson provides the medium for an in-depth discussion or review of

the OMS, Reaction Control System (RCS), and/or FDF procedures. The student should coordinate with the assigned instructor about subject areas

to be reviewed. This lesson is to be scheduled as desired.

Objectives: Discuss specific topics predetermined by the instructor and student.

#### 29 <u>OMRC REFR 41008</u>

Title: Orbital Maneuvering/Reaction Control System Refresher

Duration: 2.0 hours

Medium: SST 1 or SST 2 or SST 3

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT (Schedule individually or

in pairs.)

Source: DS66/G&C/Propulsion Training Group

Date: 09/89

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

Synopsis: This lesson provides the student with practice in performance of the OMS

and Reaction Control System (RCS) procedures associated with normal and malfunction system operations through the ascent and entry flight

phases.

- Identify and use the proper procedures for OMS and RCS. Propellant or gas leaks in any part of the system(s) during ascent and entry phases of flight.
- Understand the use of the FDF to target or re-target and perform an OMS or RCS burn for any reason.
- Be able to recognize and work with system sensor failures.
- Understand the OMS/RCS Redundancy Management (RM) system, how it works, and the use of the SPEC displays and FDF associated with it.
- Learn to recognize OMS engine and RCS jet failures, both real and false, and take the necessary corrective action.
- Understand the use of the SPECs and their OPS modes used to operate and troubleshoot the OMS and RCS systems.

# **30** OMRC REFR 42008

Title: Orbital Maneuvering/Reaction Control System Refresher

Duration: 2.0 hours

Medium: SST 1 or SST 2 or SST 3

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT (Schedule individually or

in pairs.)

Source: DS66/G&C/Propulsion Training Group

Date: 09/89

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

Synopsis: This lesson provides the student with practice in performance of the OMS

and Reaction Control System (RCS) procedures associated with normal and malfunction system operations through the orbit phase of flight.

Objectives: • Identify and use the proper procedures for OMS and RCS propellant or gas leaks in any part of the system(s) during the orbit phase of flight.

• Understand the use of the FDF to target or re-target and perform an OMS or RCS burn for any reason.

- Be able to recognize and work with system sensor failures.
- Understand the OMS/RCS Redundancy Management (RM) system, how it works, and the use of SPECs and the FDF associated with it.
- Learn to recognize OMS engine and RCS jet failures, both real and false, and take the necessary corrective action.
- Understand the use of the SPECs and their OPS modes used to operate and troubleshoot the OMS and RCS systems.

# 31 OM/RC Q O 31006

Title: Orbital Maneuvering System and Reaction Control System

Qualification for Orbit

Duration: 2.0 hours

Medium: SST 1 or SST 2 or SST 3

Student: MS 2, PILOT (Schedule individually.)
Source: DS66/G&C/Propulsion Training Group

Date: 04/96

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): Study Guide

Preparation: Review:

FDF and related reference materials

# 31 OM/RC Q O 31006 (Concluded)

#### Synopsis:

This lesson will verify the student's operational knowledge of the OMS and Reaction Control System (RCS). The lesson tests the student's ability to configure the Orbiter for nominal orbit operations and to perform nominal on-orbit procedures. This lesson also tests the student's ability to locate and work orbit malfunction procedures and to evaluate the impact of the failure on the mission. Lastly, this lesson tests the student's ability to determine the big picture impacts of an EPS, DPS, or Instrumentation (INST) failure on the OMS and RCS. The student is expected to verbalize their actions and thinking with regards to procedures/malfunctions. The instructor will assume the role of MCC and answer questions and direct the crew as necessary. The student will configure the orbiter for on orbit OPS, and monitor the RCS and OMS systems. The FDF and all standard cockpit tools will be available during this lesson.

#### Objectives:

- Configure the OMS and RCS switches for orbit.
- Perform OMS and RCS callouts in the Post-Insertion Checklist (C/L).
- Perform the Group B powerdown.
- Perform an OMS to RCS Interconnect.
- Monitor the OMS and RCS on orbit.
- Perform an OMS orbit adjust burn.
- Distinguish the required actions for the following MCC calls:
  - Deselect Jet XXX.
  - Reselect Jet XXX.
  - Reprioritize Jet XXX.
  - Reset Redundancy Management (RM).
  - Toggle RM on Jet XXX.
- Use available tools to evaluate impacts of a DPS, EPS, or INST failures.
- Determine if you are "Loss of Verns," and work the procedure.
- Perform failure identification, resolution, and evaluation for the OMS and RCS.

#### 32 ECL 10.2 ATM 41004

Title: Environmental Control Life Support System 10.2 Atmosphere

Duration: 1.5 hours

Medium: SST 1 or SST 2 or SST 3

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT (Schedule individually.)

Note: This lesson is optional for crewmembers with a scheduled, shuttle-

based EVA.

Source: DS45/Shuttle Systems Training Group

Date: 12/03

# 32 ECL 10.2 ATM 41004 (Concluded)

Equipment Required: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: Review 10.2 psia Cabin section of ECLSS 21002. Review PCS

instrumentation diagram in ECLSS 21002.

Synopsis: The lesson will start with a nominal 14.7 psia Pressure Control System

(PCS) configuration and have the student perform the nominal EVA Checklist procedures for 10.2 psia depress, maintenance, and repress. Rationale for PCS configuration changes will be discussed throughout the lesson. The lesson will conclude with a review of PCS configurations for 14.7 psia operations, cabin depress, 10.2 psia maintenance, and cabin

repress.

Objectives:

- Perform the steps involved in executing nominal Environmental Control and Life Support System (ECLSS) 10.2 atmosphere procedures.
- Explain the rationale and constraints associated with 10.2 psia operations.
- Describe the PCS configuration for 14.7 psia operations during cabin depress, during 10.2 psia maintenance, and during cabin repress using a PCS schematic.
- Explain the rationale of the PCS configurations during cabin depress, 10.2 psia maintenance, and cabin repress.

#### 33A MAN ASC 21001

Title: Manual Ascent Prebrief

Duration: 2.0 hours Medium: Classroom

Student: Post ASCAN and pre-assigned Crew Members, Proficiency Crew

Members, DS66 Instructors

Source: DS66/Ascent Procedures Specialists

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

Synopsis: This briefing is the first in a series of 2 briefings. They are both designed

to review the cockpit indications and techniques used to fly the nominal, Abort To Orbit (ATO), and Transatlantic Abort Landing (TAL) trajectories manually. A discussion of cockpit indications and techniques used during manual control is discussed to prepare for Manual Ascent 21011. A

review of guidance anomaly recognition, manual control, flight

# 33A MAN ASC 21001 (Concluded)

instruments, CRT displays, FDF, and flight techniques is presented. This lesson covers trajectories similar in nature to normal insertions to orbit, and includes manual entry techniques for TAL aborts. The following trajectories are discussed: nominal ascent, ATO caused by Space Shuttle Main Engine (SSME) failure, dual simultaneous SSME failure during ascent with Single Engine Roll Control (SERC), and a two-engine out-of-plane TAL to landing.

#### Objectives:

- Develop the crews skills to recognize when a manual takeover is required.
- Be able to fly the vehicle to Main Engine Cutoff (MECO) conditions, using navigation-derived information only:
  - Allow for orbital insertion and/or a runway landing without structural exceedances.

## 33B MAN ASC 21011

Title: Manual Ascent Introduction

Duration: 4.0 hours Medium: SMS/MB

Student: Post ASCAN and pre-assigned Crew Members, Proficiency Crew

Members. **DS66** Instructors

Source: DS66/Ascent Procedures Specialists

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): MAN ASC 21001 or MAN ASC BR 31001 or

MAN ASC 41001

Preparation: None

Synopsis: This lesson reinforces the material covered in MAN ASC 21001 through

practical application in the SMS.

Objectives: At the end of this lesson, the student will be able to perform the following objectives:

- Recognize when a manual takeover is required.
- Establish manual control.
- Use navigation-derived information to fly the vehicle to Main Engine Cutoff (MECO) conditions:
  - Allow for orbital insertion and/or a runway landing without structural exceedances.

#### 34A MAN ABT 21001

Title: Manual Abort Prebrief

Duration: 2.0 hours Medium: Classroom

Student: Post ASCAN and pre-assigned Crew Members, Proficiency Crew

Members, **DS66** Instructors

Source: DS66/Ascent Procedures Specialists

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): MAN ASC 21011 or MAN ASC 31011 or MAN ASC 41011

Preparation: None

Synopsis: This lecture is the second in a series of 2. These lessons are designed to

review cockpit indications and techniques used flying Transatlantic Abort Landing (TAL) and Return-To-Launch Site (RTLS) trajectories manually. A discussion of cockpit indications and techniques used during manual control is provided to prepare for MAN ABORT 21011. Topics to be reviewed: TAL redesignation, low energy TAL, post-MECO TAL, high energy TAL, high energy YQX, and RTLS flight techniques. Included is a discussion of abnormal entry energy management techniques for TAL and RTLS. The following are discussed: TAL Redesignation to low energy flight techniques, post-MECO TALs leading to high energy TAL to in-plane and out of plane sites flight techniques, two-engine RTLS including TAEM flight techniques, and three-engine RTLS including TAEM flight

techniques.

Objectives:

- Develop skills required to recognize when a manual takeover is required.
- Be able to fly the vehicle to MECO conditions, using navigation-derived information only:
  - Allow for orbital insertion and/or a runway landing without structural exceedances.

#### 34B MAN ABT 21011

Title: Manual Abort Introduction

Duration: 4.0 hours Medium: SMS/MB

Student: Post ASCAN and pre-assigned Crew Members, Proficiency Crew

Members, **DS66** Instructors

Source: DS66/Ascent Procedures Specialists

Date: 10/05

Lesson(s) Replaced: None

# 34B MAN ABT 21011 (Concluded)

Equipment Required: None

Prerequisite Lesson(s): MAN ABT 21001 or MAN ABT BR 31001 or

**MAN ABT 41001** 

Preparation: None

Synopsis: This lesson reinforces the material covered in MAN ABT 21001 through

practical application in the SMS.

Objectives: At the end of this lesson, the student will be able to perform the following

objectives:

Recognize when a manual takeover is required.

· Establish manual control.

 Use navigation-derived information to fly the vehicle to acceptable Main Engine Cutoff (MECO)/External Tank (ET) Separation (SEP) conditions.

• Fly the vehicle on entry to allow for a runway landing without structural exceedances.

#### **35A CONT ABT RVW 21001**

Title: Contingency Abort Review Prebrief

Duration: 2.0 hours Medium: Classroom

Student: Post ASCAN and pre-assigned Crew Members, Proficiency Crew

Members, *DS66* Instructors

Source: DS66/Ascent Procedures Specialists

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): MAN ABT 21011 or MAN ABT BR 31001 or

MAN ABT 41011

Preparation: None

Synopsis: This lecture will discuss contingency abort procedures in preparation for

the CONT ABT RVW 21011 SMS lesson. Crews will receive instruction on contingency abort maneuvering and trajectory profiles, cockpit indications, procedural rationale and execution, techniques, displays, controls, and cockpit resources used to initiate contingency abort maneuvering. The instruction will address both powered flight and entry

procedures to either landing or bailout. A review of flight software

capability and relevant orbiter hardware limitations is also provided. The lesson covers all of the Ascent Checklist (C/L) procedural regions for two and three engine failure scenarios occurring in either OPS 1 (contingency

## 35A CONT ABT RVW 21001 (Concluded)

abort) or OPS 6 (Return-To-Launch Site (RTLS) contingency abort). A representative sampling of contingency abort maneuvers (not regions) are presented during this lesson.

Objectives: To develop crew skills to:

- Recognize and recover from multiple Space Shuttle Main Engine (SSME) malfunctions, when intact abort capability is nonexistent.
- Locate and execute the published procedure applicable to the contingency abort region in which the engine malfunctions occurred.

#### 35B CONT ABT RVW 21011

Title: Contingency Abort Review

Duration: 4.0 hours Medium: SMS/MB

Student: Post ASCAN and pre-assigned Crew Members, Proficiency Crew

Members, **DS66** Instructors

Source: DS66/Ascent Procedures Specialists

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): CONT ABT RVW 21001 or CONT ABT 31001 or

CONT ABT RVW 41001

Preparation: None

Synopsis: This lesson reinforces the material discussed in CONT ABT RVW 21001

through practical application using flight software at the SMS. A

representative sampling of contingency abort maneuvers (not regions) are

presented during this lesson.

Objectives: The crew will:

- Recognize and recover from multiple Space Shuttle Main Engine (SSME) malfunctions where intact abort capability is nonexistent.
- Locate the published procedure in FDF applicable to the contingency abort region in which the engine malfunctions occurred.
- Execute published contingency abort procedures without exceeding structural limitations (or to the most benign conclusion).
- Recognize and avoid specific flight envelopes that will cause a loss of control or vehicle overstress (where applicable).

## 36 SHUTTLE REVIEW 41006

Title: Shuttle Multidiscipline Systems Review

Duration: 2.0 hours

Medium: SST 1 or SST 2 or SST 3

Student: COMMANDER, MS 2, PILOT (Schedule in groups of up to 3.)

Source: DS12/Shuttle Training

Date: 12/06

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

Synopsis: This lesson provides the medium for an in-depth discussion or review of

the shuttle multidiscipline systems and FDF procedures. The student(s) should coordinate with the instructors about the phase of flight. This

lesson is to be scheduled as desired.

Objectives: Objectives will be determined by the instructor and/or student.

#### SECTION 3.0 CREW SYSTEMS TRAINING COURSE

The Crew Systems Training Course provides the flight crew and selected flight operations support personnel the knowledge and skills necessary for activation, operation, and deactivation of the onboard crew systems equipment. Using these systems, the crew maintains a viable living environment on the orbiter, and performs in flight maintenance and emergency egress from the orbiter.

Upon completion of the Crew Systems Training Course, the student will be able to:

- Perform crew systems pre-launch operations and emergency egress
- Operate crew systems during on-orbit activities
- Perform procedures for crew station lighting
- Perform orbiter habitability procedures (waste collection, dining, personal hygiene, sleep, trash management, etc.)
- Perform stowage operations for orbiter loose equipment
- Respond to emergencies (loss of cabin pressure, fire/smoke, contaminated atmosphere, etc.)
- Perform crew and crew station preparation for post insertion and de-orbit
- Perform post-landing normal and emergency egress

The trainer media/facilities used for the Crew Systems Training Course include classroom, workbooks, the mock ups (CCT, CCTII, FFT) and other facilities as necessary to conduct ingress/egress and survival training.

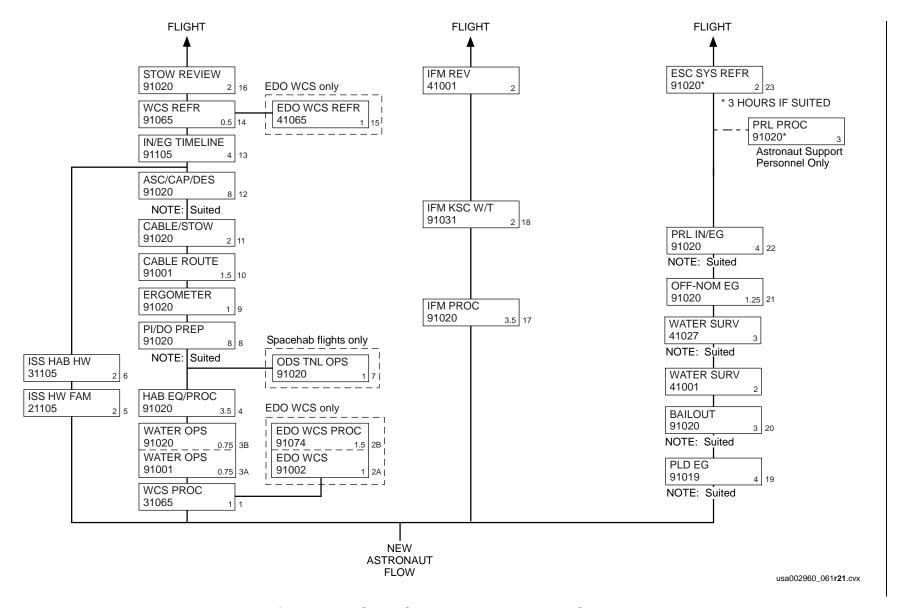


Figure 3-1. Crew Systems Lesson Flow Chart

**Table 3-1. Crew Systems Training Requirements** 

																	Date	Last Modified: 06/08
								Non-C	rew Ro	tation				Crew R	otation			
Stage	Ref Num	Lesson Code	Media	Hrs	Sched Code	C	Р	MS1	MS2	MS3	MS4	PS	С	Р	MS1	MS2	Alt Fac	Comments
4	1	WCS PROC 31065	WCS	1	3	1	1	1	1	1	1	1	1	1	1	1		
4	3A	WATER OPS 91001	CLR	0.75	7			0.75	0.75						0.75	0.75		As assigned by CDR
4	3B	WATER OPS 91020	CCT II	0.75	7			0.75	0.75						0.75	0.75	FFT	As assigned by CDR
4	5	ISS HW FAM 21105	SSMTF	2	7	2	2	2	2	2	2	2	2	2	2	2		
4	6	ISS HAB HW 31105	SSMTF	2	7	2	2	2	2	2	2	2	2	2	2	2		
4	9	ERGOMETER 91020	CCT	1	3			1	1						1	1	CCT II, FFT	As assigned by CDR
4	17	IFM PROC 91020	ССТ	3.5	2			3.5	3.5						3.5	3.5	CCT II	As assigned by CDR; See Note 3
4			otal for Stage		Stage Tota	ls Per Cr	ewmemb	er:										
4				11	0	5	5	11	11	5	5	5	5	5	11	11		
																		4.0 hrs for ISS crew
3	4	HAB/EQ PROC 91020	CCT	3.5	8	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	CCT II, FFT	rotation mission
3	8	PI/DO PREP 91020	CCT	8	8	8	8	8	8	8	8	8	8	8	8	8	CCT II, FFT	Suited; See Note 2
3	19	PLD EG 91019	FFT	4	8	4	4	4	4	4	4	4	4	4	4	4		Suited
3	20	BAILOUT 91020	CCT	3	8	3	3	3	3	3	3	3	3	3	3	3	CCT II	Suited; See Note 4
3	21	OFF-NOM EG 91020	CCT II	1.25	8	1.25	1.25	1.25	1.25	1.25		1.25	1.25	1.25	1.25	1.25		
3		WATER SURV 41001	CLR	2	5	2	2	2	2	2	2	2	2	2	2	2		
3		WATER SURV 41027	NBL	3	5	3	3	3	3	3	3	3	3	3	3	3		Suited
3		Sub T	otal for Stage		Stage Tota	ls Per Cr	ewmemb											
3				24.75		24.75	24.75	24.75	24.75	24.75	23.5	24.75	24.75	24.75	24.75	24.75		
2	10	CABLE ROUTE 91001	CLR	1.5	8			1.5	1.5						1.5	1.5		As assigned by CDR
2	11	CABLE/STOW 91020	ССТ	2	8			2	2						2	2	CCT II, FFT	As assigned by CDR
2	12	ASC/CAP/DES 91020	ССТ	8	8	8	8	8	8	8	8	8	8	8	8	8	CCT II, FFT	Suited
2	13	IN/EG TIMELINE 91105	SSMTF	4	8	4	4	4	4	4	4	4	4	4	4	4	CCT II	Schedule full crew for ISS Mission
2	14	WCS REFR 91065	wcs	0.5	3	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		
2	22	PRL IN/EG 91020	ССТ	4	8	4	4	4	4	4	4	4	4	4	4	4		Suited,3 wk prior to TCDT; See Notes 1 & 2
2		Sub T	otal for Stage		Stage Tota													
2				20		16.5	16.5	20	20	16.5	16.5	16.5	16.5	16.5	20	20		

NOTE: 1. Should be scheduled before TCDT and, if possible, in conjunction with PRL PROC 91020. PRL PROC 91020 may be waived if student has supported launch within

<sup>2.</sup> A dry run is required for this lesson for PSs within one week of the full-crew lesson. Astronaut crewmembers who have not previously flown may request a dry run.

Applies to crewmember responsible for IFM support.
 Prior to taking PLD EG 91019 and BAILOUT 91020, PSs and APS must take ESC EQ/SYS 21001, ESC PROC 21001, and ESC PROC 21020.

**Table 3-1. Crew Systems Training Requirements** 

Date	Last	Modified:	02/07

			Non-Crew Rotation								Crew R	otation						
Stage	Ref Num	Lesson Code	Media	Hrs	Sched Code	С	Р	MS1	MS2	MS3	MS4	PS	С	Р	MS1	MS2	Alt Fac	Comments
1	16	STOW REVIEW 91020	сст	2	8	2	2	2	2	2	2	2	2	2	2	2	CCT II, FFT	
1	23	ESC SYS REFR 91020	CCT	2	8	2	2	2	2	2	2	2	2	2	2	2	CCT II, FFT	
1		Sub Tot	al for Stage	<u> </u>	Stage Tota	ls Per C	rewmem	ber:						,		,		
1				4		4	4	4	4	4	4	4	4	4	4	4		
0	2A	EDO WCS 91002	WBK	1	1	1	1	1	1	1	1	1	1	1	1	1		EDO WCS flights only
0	2B	EDO WCS PROC 91074	NASA	1.5	2	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5		EDO WCS flights only
0	7	ODS TNL OPS 91020	CCTII	1	1			1	1						1	1	FFT	SpaceHab missions only. Prime and backup as assigned
0	15	EDO WCS REFR 41065	wcs	1	2	1	1	1	1	1	1	1	1	1	1	1		EDO WCS flights only
0	18	IFM KSC W/T 91031	KSC	3	2			3	3						3	3		As assigned by CDR; See Note 3
0		IFM REV 41001 PRL PROC 91020	CLR CCT	2 3	2 2			2	2						2	2	CCTII	As assigned by CDR. See Note 3 ASP only
0		Sub Tot	al for Stage		Stage Tota													
0				12.5		3.5	3.5	9.5	9.5	3.5	3.5	3.5	3.5	3.5	9.5	9.5		

- NOTE: 1. Should be scheduled before TCDT and, if possible, in conjunction with PRL PROC 91020. PRL PROC 91020 may be waived if student has supported launch within a
  - 2. A dry run is required for this lesson for PSs within one week of the full-crew lesson. Astronaut crewmembers who have not previously flown may request a dry run.
  - 3. Applies to crewmember responsible for IFM support.
  - 4. Prior to taking PLD EG 91019 and BAILOUT 91020, PSs and APS must take ESC EQ/SYS 21001, ESC PROC 21001, and ESC PROC 21020.

# 1 <u>WCS PROC 31065</u>

Title: Waste Collection System Procedures

Duration: 1.0 hour Medium: WCS Trainer

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, MS 5, PILOT, PS 1

(Schedule full Shuttle crew for ISS missions.)

Source: DX45/Crew Systems Group

Date: 03/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): New Astronaut Flow

Preparation: None

Synopsis: This lesson is conducted in the Waste Collection System (WCS) training

facility located in building 5. Students are shown the launch configuration of the WCS and the procedure for configuring the WCS for orbit ops. Normal and contingency procedures are discussed and demonstrated.

Objectives: • Describe the general configuration and operation of the WCS.

Identify the equipment and quantities of items stowed in the Waste

Management Compartment

Management Compartment.

• Perform the Post-Insertion configuration and WCS setup procedures.

#### 2A **EDO WCS 91002**

Title: Extended Duration Orbiter Waste Collection System

Duration: 1.0 hour Medium: Workbook

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS 1 (Schedule

individually.)

Source: DX45/Crew Systems Group

Date: 10/01

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

**Note:** EDO flights only.

Synopsis: This workbook contains information on the major components of the

Extended Duration Orbiter (EDO) Waste Collection System (WCS) hardware as well as the controls, restraints, and accessories used in

conjunction with this system.

Objectives: Become familiar with the operations and the components of the EDO

WCS.

## 2B **EDO WCS PROC 91074**

Title: Extended Duration Orbiter Waste Collection System Procedures

Duration: 1.5 hours

Medium: NASA (EDO WCS Flight Unit)

**Note:** Since a training unit is currently not available, this class will be

conducted during times when the flight unit is available.

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS 1 (Schedule

individually or in pairs.)

Source: DX45/Crew Systems Group

Date: 10/01

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): EDO WCS 91002

Preparation: None

**Note:** EDO flights only.

Synopsis: This lesson covers the major components of the Extended Duration

Orbiter (EDO) Waste Collection System (WCS), procedures for activation and deactivation, and instructs the student on the procedures for urination

and defecation. In addition, a briefing on consumables used in

conjunction with the EDO WCS, trash stowage, and potential malfunctions

are discussed.

Objectives: Become familiar with the components and operation of the EDO WCS.

## 3A **WATER OPS 91001**

Title: Water Operations

Duration: 0.75 hours Medium: Classroom

Student: As assigned by CDR.

Source: DX45/Crew Systems Group

Date: 03/05

Lesson(s) Replaced: None

Equipment Required: See Facility Utilization Request.

Prerequisite Lesson(s): N ASTRO (ASCAN) flow

Preparation: None

Synopsis: This lesson will utilize training hardware to familiarize the student with

each component. Emphasis will be placed on nomenclature and technical function of each component. Galley Iodine Removal Assembly (GIRA) water transfer equipment, FDF procedures, protocol, training schedule, and mission-specific game plans will be discussed. Additional on-orbit activities (Contingency Water Dispense set up, DSO/DTO ops, etc.) may

be performed at crew request.

#### 3A WATER OPS 91001 (Concluded)

- Objectives: Review all the procedures and hardware associated with transferring water from the shuttle to the ISS.
  - Review all FDF procedures related to nominal Water Operations.
  - Review stowage, setup, and operation of all Water Transfer hardware.

#### 3B **WATER OPS 91020**

Title: Water Operations

Duration: 0.75 hours Medium: CCTII or FFT

Student: As assigned by CDR.

Source: DX45/Crew Systems Group

03/05 Date:

Lesson(s) Replaced: None

Equipment Required: See Facility Utilization Request.

Prerequisite Lesson(s): **WATER OPS 91001** 

Preparation: None

Synopsis:

This lesson will utilize training hardware, mock-ups, and FDF procedures to familiarize the student with each component and how they interface with the galley, Condensate Quick Disconnect (QD), and Contingency Cross Tie. A step-by-step review of FDF procedures will be performed. Additional on-orbit activities (Contingency Water Dispense set up, DSO/DTO ops, etc.) may be performed at crew request.

#### Objectives:

- Review all water transfer hardware and procedures. Actual installation of hardware will be performed. Filling and dumping of Contingency Waste Container (CWC) and Payload Water Reservoirs (PWRs) will be demonstrated, as well as condensate collection procedures. Review temporary CWC stowage locations and hands-on training for the
- Proficiency performing Galley Iodine Removal Assembly (GIRA) setup and configuration.
- Proficiency executing CWC and PWR filling procedures.
- Proficiency executing consecutive CWC and PWR dumping procedures.
- Proficiency performing Condensate Collection setup.

## 4 **HAB/EQ PROC 91020**

Title: Habitability Equipment and Procedures

Duration: 3.5 hours (Schedule 4.0 hours for ISS crew rotation mission)

Medium: CCT, CCTII, or FFT

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS 1

Source: DX45/Crew Systems Group

Date: 03/05

Lesson(s) Replaced: HAB EQ/PROC 31020

Equipment Required: See Facility Utilization Request

Prerequisite Lesson(s): CREW CAB FAM 21020

Preparation: None

Synopsis: This lesson consists of the performance of procedures in a flight-

configured trainer with equipment related to orbiter habitability. The equipment used, and the procedures performed include those associated with sleep, exercise, crew personal clothing, trash management, trash overboard vent, atmospheric samples, acoustic measurements, crew compartment cleaning, restraints/mobility aids, and window shades/filters. The equipment is removed from launch stowage locations, on-orbit operations are performed, and the equipment is restowed in the entry

configuration.

Objectives: • Become familiar with the operational use of all nominal crew equipment.

• Be able to determine the locations of the wet and dry trash.

• Become familiar with the on-board exercise equipment.

## 5 **ISS HW FAM 21105**

Title: ISS Hardware Familiarization (Shared – Shuttle)

Duration: 2.0 hours Medium: SSMTF

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS 1

Source: DX45/Crew Systems Group

Date: 03/05

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

Synopsis: This lesson is targeted for those who are unfamiliar with the internal and

external configuration of the ISS modules and the internal hardware associated with day-to-day ISS activities. A description of each module will be provided to the students, with emphasis on basic internal hardware

locations and operations.

#### 5 **ISS HW FAM 21105 (Concluded)**

- Objectives: Be able to identify individual ISS elements through the most current flight configuration.
  - Understand ISS internal location coding and module internal layout.
  - Know where internal light controls are located and their function.
  - Become familiar with basic loose hardware locations and functions.
  - Become familiar with Russian segment locations, layout, and basic loose hardware.
  - Comprehend the layout of the ISS internal volume.

#### 6 **ISS HAB HW 31105**

Title: ISS Habitability Hardware

Duration: 2.0 hours Medium: SSMTF

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS 1

Source: DX45/Crew Systems Group

Date: 03/05

Lesson(s) Replaced: None

Lesson not needed for crewmembers who have had ISS HAB EQ & Note:

PROC 21105.

Equipment Required: None

Prerequisite Lesson(s): **ISS HW FAM 21105** 

Preparation: None

Synopsis:

This lesson utilizes the SSMTF to introduce ISS Habitability hardware and procedures to the student. Upon lesson completion, the student will be familiar with the functionality, operational use, and location of selected hardware and habitability items, such as Restraints & Mobility Aids (R&MA), trash management, stowage hardware, internal lighting, crew support and loose equipment, racks, and nominal hatch operations. The student will also receive general information about related Russian hardware.

#### Objectives:

- Understand ISS internal location coding and module internal layout.
- Understand and conduct the procedures associated with the nominal operations of selected U.S. habitability items.
- Understand locations of Portable Emergency Provisions (PEPs).
- Understand trash management procedures.
- Understand and conduct stowage operations and comprehend stowage constraints.
- Conduct nominal hatch operations.

# 7 ODS TNL OPS 91020

Title: Orbiter Docking System Tunnel Operations

Duration: 1.0 hour Medium: CCTII or FFT

Student: As assigned by CDR (Schedule individually.)

**Note:** Spacehab missions only. (Prime and backup as assigned.)

Source: DX45/Crew Systems Group

Date: 03/05

Lesson(s) Replaced: None

Equipment Required: Tunnel (TNL) Adapter mockup with Tunnel

Prerequisite Lesson(s): HAB/EQ PROC 91020

Preparation: None

Synopsis: This lesson begins with a briefing to familiarize the student with all

hardware associated with the tunnel extension, airlock, tunnel adapter, tunnel, and hatch types. Hands-on training in the mockup using the

appropriate FDF procedures will follow the briefing.

Objectives: • Become familiar with the flight configurations for the tunnel extension, airlock, tunnel adapter, and the tunnel.

 Perform nominal operations for configuring the ducting, stowage hardware, centerline-camera/bracket, docking lights, cross-hairs, target/baseplate; for the launch/post-insertion/docking/undocking and entry phases of a mission will be reviewed.

• Perform the Spacehab Activation and Entry Preparation procedures that include tunnel configuration operations, if Spacehab flown.

#### 8 **PI/DO PREP 91020**

Title: Post-Insertion/De-orbit Preparation Timeline

Duration: 8.0 hours

**Note:** This lesson is to be covered over a consecutive two-day period. The

first session, Post-Insertion, will be covered in a 4-hour period on the afternoon of day 1, and the second session, Deorbit Prep, will be

covered in a 4 hour period in the morning of day 2.

**Note:** Schedule with the Expedition crew if crew rotation mission.

**Note:** A dry run of this lesson may be held for all PS and first time fliers if

Commander deems necessary. Contact Crew Systems Mission Lead

for duration required.

Medium: CCT, CCTII, or FFT

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS 1

Source: DX45/Crew Systems Group

Date: 03/05

Lesson(s) Replaced: PI/DO PREP 31020

## 8 PI/DO PREP 91020 (Concluded)

Equipment Required: See Facility Utilization Request, ACES

**Note:** This is a suited run.

Prerequisite Lesson(s): HAB/EQ PROC 91020

Preparation: None

Synopsis: This lesson consists of the performance of integrated crew station post-

insertion, on-orbit, and deorbit procedures. The activities performed during this lesson include all nominal crew actions required to configure the crew station for orbit operations or entry. (Includes crew worn equipment, specialist seat operations, communications equipment, flight

data file, and miscellaneous loose equipment.)

Objectives:

- Become more proficient with the Post-Insertion timeline concentrating on switch configuration, reconfiguration of the middeck for on-orbit operations, and stowage.
- Be able to exercise the Deorbit Prep timeline focusing on switch configuration, seat setup, and donning of the ACESs.
- Be able to locate the fire extinguishers and practice donning the Quick Don Masks.

## 9 **ERGOMETER 91020**

Title: Ergometer Operations

Duration: 1.0 hour

Medium: CCT, CCTII, or FFT Student: As assigned by CDR.

Source: DX45/Crew Systems Group

Date: 03/05

Lesson(s) Replaced: None

Equipment Required: Ergometer with Accessory Bag and Frame from USA

Prerequisite Lesson(s): None

Preparation: None

Synopsis: This lesson outlines the assembly and installation of the Ergometer and

associated exercise equipment. Instruction is given for both powered and manual operations as well as malfunction recovery. Locations for on-orbit use are covered, as well as the proper configuration for launch and return.

Flight procedures are utilized where necessary.

Objectives: • Familiarity with Ergometer assembly.

• Familiarity of exercise options associated with the Ergometer.

Familiarity with most common malfunctions and their recovery.

# 9 **ERGOMETER 91020 (Concluded)**

- Ability to successfully assemble and operate the Ergometer in both manual and powered modes.
- Ability to recognize Ergometer malfunction conditions and recover operations.

# 10 **CABLE ROUTE 91001**

Title: Cable Routing
Duration: 1.5 hours
Medium: Classroom

Student: As assigned by CDR.

Source: DX45/Crew Systems Group

Date: 03/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): New Astronaut Flow

Preparation: None

Synopsis: The crew and other personnel will discuss pre-routing and labeling of

photo/TV, PGSC, and secondary cables for launch. This meeting will be followed by CCT, CCTII, or FFT exercise which will route all pre-routed

cables for the crew to review.

Objectives: Discuss pre-routing PGSC, photo/TV, secondary, and other miscellaneous

cables prior to flight.

# 11 **CABLE/STOW 91020**

Title: Cable Routing and Stowage Review

Duration: 2.0 hours

Medium: CCT, CCTII, or FFT Student: As assigned by CDR.

Source: DX45/Crew Systems Group

Date: 03/05

Lesson(s) Replaced: None

Equipment Required: See Facility Utilization Request (FUR)

Prerequisite Lesson(s): CABLE ROUTE 91001

Preparation: None

Synopsis: All Photo/TV, PGSC, secondary, and other miscellaneous cables will be

pre-routed and labeled for the crew to review. In addition, stowage as currently baselined will be discussed so any changes can be made to the manifest prior to Crew Compartment Configuration Review (CCCR).

## 11 CABLE/STOW 91020 (Concluded)

Objectives: • Review flight deck and middeck pre-routed cables.

Review stowage configuration prior to L-60 day CCCR.

# 12 **ASC/CAP/DES 91020**

Title: Ascent/Crew Activity Plan/Descent Timeline Walkthrough

Duration: 8.0 hours (Schedule in 4 hour blocks over two consecutive days)

Medium: CCT, CCTII, or FFT

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS 1

Source: DX45/Crew Systems Group

Date: 09/02

Lesson(s) Replaced: ASC/CAP/DES 31020

Equipment Required: See Facility Utilization Request; ACES required.

**Note:** This is a suited run.

Prerequisite Lesson(s): PHO/TV PROC 92020, PI/DO PREP 91020

Preparation: None

Synopsis: This lesson consists of a fast-time walkthrough of timeline activity covering

the period between launch and landing. Display and control functions will be exercised for reach, visibility, and sequence familiarity only (Crew Compartment Trainer does not respond to control inputs). While the major highlights of the on-orbit timeline will be exercised in its entirety, major emphasis will be placed on crew systems-related activities. DSOs requiring loose equipment within the cabin will be exercised, if available.

Objectives:

- Become proficient with the activities covered in the Post Insertion and Deorbit Prep timeline, concentrating on the middeck activities that cannot be performed realistically in the SMS.
- Review setup, stowage, and operation of the Secondary Payloads and DSOs.
- Review photo/TV equipment and setup procedures.

#### 13 **IN/EG TIMELINE 91105**

Title: Ingress/Egress Timeline (Shared – Shuttle)

Duration: 4.0 hours

Medium: SSMTF and CCTII

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, MS 5, PILOT, PS 1

(Schedule full Shuttle crew for ISS missions.)

Source: DX45/Crew Systems Group

Date: 03/05

Lesson(s) Replaced: None

Equipment Required: See Facility Utilization Request.

# 13 <u>IN/EG TIMELINE 91105 (Concluded)</u>

Prerequisite Lesson(s): ISS HAB HW 31105

Preparation: None

Synopsis:

This lesson will allow assigned Shuttle flight crews to practice performing all nominal Shuttle-to-ISS and ISS-to-Shuttle egress operations using procedures found in the flight-specific ISS/Shuttle Joint Operations Book, JSC-48503. The lesson includes a discussion of the Shuttle Arrival configuration, the on-orbit configurations, and the orbiter departure configurations of the ISS, and a general overview of the ISS ingress timeline. Using the CCTII and the SSMTF, the students will configure middeck, airlock, and Orbiter Docking System (ODS) hardware into the appropriate configurations and work through the procedures associated with their mission.

In addition to the ingress and egress activities, the students have the opportunity to review hardware transfer procedures and any other flight-specific Shuttle/ISS operations requested by the crew.

\*\*The length of the lesson will vary depending on the number and complexity of operations conducted during the specific mission.

#### Objectives:

- Conduct flight-specific Shuttle-to-ISS ingress and egress operations including:
  - Nominal ODS, Pressurized Mating Adapter (PMA), and Lab hatch operations.
  - Shuttle-to-ISS vent configuration.
  - N<sub>2</sub> and O<sub>2</sub> transfer hose configuration.
  - Review and/or practice hardware transfer protocol and procedures.
  - Review and/or practice vestibule ops and procedures (as required for MPLM).
  - Review and/or practice Photo TV ops and procedures.

## 14 **WCS REFR 91065**

Title: Waste Collection System Procedures Refresher (Shared – Shuttle)

Duration: 0.5 hours
Medium: WCS Trainer

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS 1 (Schedule in

groups of up to 3.)

Source: DX45/Crew Systems Group

Date: 10/01

Lesson(s) Replaced: WCS REFR 41065 Equipment Required: WCS System

Prerequisite Lesson(s): WCS PROC 21065

## 14 WCS REFR 91065 (Concluded)

Preparation: None

Synopsis: Refer to WCS PROC 21065, New Astronaut Flow, for synopsis.

Objectives: • Review general configuration and operation of the Waste Collection

System (WCS).

• Review equipment and quantities of items stowed in the waste

management compartment.

Review post-insertion configuration and WCS setup procedures.

#### 15 **EDO WCS REFR 41065**

Title: Extended Duration Orbiter Waste Collection System Refresher

Duration: 1.0 hour

Medium: EDO WCS Flight Unit @ KSC (during CEIT)

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS 1 (Schedule

individually or in pairs.)

Source: DX45/Crew Systems Group

Date: 10/01

Lesson(s) Replaced: None Equipment Required: EDO WCS

Prerequisite Lesson(s): New Astronaut Flow

Preparation: None

**Note:** EDO flights only.

Synopsis: An Extended Duration Orbiter (EDO) Waste Collection System (WCS)

refresher will be conducted on the flight unit during the Crew Equipment Interface Test (CEIT). This review will include reviewing the components of the EDO WCS, as well as the In-Flight Maintenance (IFM) procedures

and malfunctions.

Objectives: Become refamiliarized with the EDO WCS and the procedures.

## 16 **STOW REVIEW 91020**

Title: Stowage Review (Shared – Shuttle)

Duration: 2.0 hours

Medium: CCT, CCTII, or FFT

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS 1

Source: DX45/Crew Systems Group

Date: 02/04

Lesson(s) Replaced: None

Equipment Required: Full stowage complement for each flight

Prerequisite Lesson(s): ASC/CAP/DES 91020

# 16 STOW REVIEW 91020 (Concluded)

Preparation: None

Synopsis: This class will be given to the flight crew while they are in quarantine. It is

a flight-specific stowage review of all middeck and flight deck lockers. In

addition, cable routing will be addressed.

Objectives: • Be able to locate and configure all locker-stowed items.

Review cable routing and switch configuration.

• Review fire/smoke procedures and equipment.

## 17 **IFM PROC 91020**

Title: In-Flight Maintenance Procedures

Duration: 3.5 hours
Medium: CCT or CCTII

Student: As assigned by CDR.

Source: DX44/In-Flight Maintenance Group

Date: 03/05

Lesson(s) Replaced: IFM PROC 31020

Equipment Required: See Facility Utilization Request.

Prerequisite Lesson(s): New Astronaut Flow

Preparation: None

Synopsis: This lesson is a hands-on exercise using the In-Flight Maintenance (IFM)

tools in a vehicle environment. Component location/access and removal/installation procedures are reviewed (and performed where

possible).

Objectives: • Become familiar with IFM tools.

 Become familiar with IFM procedures within a flight-configured environment.

Gain knowledge of orbiter hardware accessibility.

Gain hands-on experience with tools and procedures.

#### 18 **IFM KSC W/T 91031**

Title: In-Flight Maintenance Kennedy Space Center Walkthrough

Duration: 3.0 hours Medium: KSC

**Note:** Schedule in the Orbiter Processing Facility (OPF).

Student: As assigned by CDR.

Source: DX44/In-Flight Maintenance Group

Date: 05/03

Lesson(s) Replaced: IFM KSC W/T 31031

# 18 IFM KSC W/T 91031 (Concluded)

Equipment Required: None

Prerequisite Lesson(s): IFM PROC 91020

Preparation: None

Synopsis: This lesson familiarizes the student with detailed configurations of In-Flight

Maintenance (IFM)-related hardware and vehicle-specific constraints on IFM tasks. The required degree of fidelity is available only in the flight vehicle. Selected closeout panels will be removed to provide the necessary access to hardware (generally done by KSC personnel prior to

lesson conduct). Although actual hardware changeout/modification will not be performed, IFM procedures will be simulated and tool fit checks will

be performed.

Objectives: • Fit-check tools to vehicle.

Become more familiar with IFM procedures.

## 19 **PLD EG 91019**

Title: Post-landing Egress (Shared – Shuttle)

Duration: 4.0 hours

Medium: FFT

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS 1

**Note:** Alternate Payload Specialists will observe the full crew exercise. PSs

and APSs must take ESC EQ/SYS 21001, ESC PROC 21001, and

ESC PROC 21020 before taking this lesson.

Source: DX45/Crew Systems Group

Date: 03/05

Lesson(s) Replaced: None

Equipment Required: See Facility Utilization Request; ACES required.

**Note:** This is a suited run.

Prerequisite Lesson(s): ESC PROC 21020

Preparation: None

Synopsis: Assigned flight crews will practice crew coordination and skills required for

post-landing emergency egress. Crew skills will include seat egress, and emergency egress slide configuration for hatch on and hatch jettison scenarios. The crew will master sky genie descent device technique for self rescue exit through the side hatch and through the Window 8 overhead escape panel. The crew will demonstrate proper emergency

egress slide descent technique.

Objectives: • Practice crew egress coordination for post-landing emergencies.

• Conduct proper Emergency Egress Slide (EES) configuration and

inflation.

Demonstrate proficiency in sky genie descent techniques.

## 19 **PLD EG 91019 (Concluded)**

- Demonstrate proficiency in EES descent techniques.
- Discuss post-landing emergency scenarios and actions.

#### 20 **BAILOUT 91020**

Title: Bailout System (Shared – Shuttle)

Duration: 3.0 hours
Medium: CCT or CCTII

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS 1

Source: DX45/Crew Systems Group

Date: 03/05

Lesson(s) Replaced: BAILOUT 31020

Equipment Required: See Facility Utilization Request; ACES required.

**Note:** This is a suited run.

Prerequisite Lesson(s): New Astronaut Flow

Note: PSs and APS must take ESC EQ/SYS 21001, ESC PROC 21001 and

ESC PROC 21020 before taking this lesson. APS should observe full

crew exercise.

Preparation: None

Synopsis: This lesson provides a more detailed experience on procedures used for

in-flight bailout emphasizing teamwork. All aspects of the bailout will be simulated including cabin vent, side hatch jettison, seat egress, escape

pole deployment and bailout. Two "runs" will be performed; one

simulating a bailout during ascent and another during entry. During the second run, the G-suits will be inflated and the emergency oxygen system

used.

Objectives: • Become familiar with in-flight bailout procedures.

Understand and experience seat egress techniques during bailout.

 Become familiar with the operation of cabin vent and hatch jettison system.

Practice pole deployment techniques.

## 21 **OFF-NOM EG 91020**

Title: Off-Nominal Egress (Shared – Shuttle)

Duration: 1.25 hours Medium: CCTII

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT, PS 1

Source: DX45/Crew Systems Group

Date: 02/07

Lesson(s) Replaced: None

**Note:** This is not a suited lesson.

# 21 OFF-NOM EG 91020 (Concluded)

Equipment Required: Computer and projector

Prerequisite Lesson(s): PLD EG 91019, BAILOUT 91020

Preparation: None

Synopsis: The lesson begins with a classroom session discussing several off-

nominal egress conditions. These include launch scrub, main engine shut-down, loss of comm post-landing, and vehicle break up/loss of control. After the classroom session, the crew will perform a shirt-sleeve

walkthrough with the CCTII in a nose-down configuration.

Objectives: • Discuss launch scrub

Discuss main engine shut-down on launch pad

Discuss loss of comm post-landing

Discuss loss of control/break-up dynamics

Discuss egress procedures during loss of control/break-up

## 22 PRL IN/EG 91020

Title: Prelaunch Ingress/Egress (Shared – Shuttle)

Duration: 4.0 hours
Medium: CCT or CCTII

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS 1

**Note:** The Payload Specialist (PS) will perform this lesson twice. Optimum

separation between the PS run and the full-crew run is one week. Alternate PSs will observe the full crew exercise. This lesson is

required prior to TCDT.

Source: DX45/Crew Systems Group

Date: 03/05

Lesson(s) Replaced: PRL IN/EG 31020

Equipment Required: Refer to Facility Utilization Request, ACES

**Note:** This is a suited run.

Prerequisite Lesson(s): New Astronaut Flow, PRL PROC 91020 (ASP only)

Preparation: None

Synopsis: With the CCT/CCTII in the vertical position, students perform nominal

ingress procedures assisted by the Astronaut Support Personnel (ASP) and suit technicians. A Mode I Egress is performed allowing the crew to practice an unaided egress on the pad. Included in this lesson are the crew, NASA Test Director (NTD), and Orbiter Test Conductor (OTC) and MCC COMM checks. This class is performed in conjunction with PRL PROC 91020 in which the ASP practices configuring the Orbiter for crew

ingress.

#### 22 PRL IN/EG 91020 (Concluded)

- Objectives: Become familiar with best technique for egressing the orbiter prelaunch.
  - The ASP and crew will become proficient with the prelaunch ingress procedures.

#### 23 ESC SYS REFR 91020

Title: Escape System Refresher (Shared – Shuttle)

Duration: 2.0 hours

Note: Schedule 3 hours, if suited.

Medium: CCT, CCTII, or FFT

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS 1

DX45/Crew Systems Group Source:

Date: 03/99

Lesson(s) Replaced: **BAILOUT 32020** 

This is not a suited lesson, but the crew may request it. Note:

Video: Escape Systems Review Equipment Required:

Prerequisite Lesson(s): BAILOUT 91020, PLD EG 91019, PRL IN/EG 91020

Preparation: None

Synopsis:

This is the last egress lesson the crew performs prior to launch. The lesson begins with a classroom session which covers the major escape systems and procedures for prelaunch, bailout and post-landing emergencies. Discussions will stress the procedures needed to successfully deploy and operate the various crew worn and orbiter systems. Procedures to egress the vehicle during a break up/Loss of Control, and some in-flight maintenance/repair of suit equipment and systems will be presented. Launch commit criteria and minimum equipment items will be monitored as they relate to escape equipment and systems. After the classroom session, the crew will perform a shirt-sleeve walkthrough in the CCT, CCTII, or FFT and review the egress systems/equipment. If requested, crewmembers may deploy the escape pole mockup.

#### Objectives:

- Review and practice in-flight bailout procedures.
- Review and practice seat egress techniques during bailout.
- Review and practice the operation of cabin vent and hatch jettison system.
- Review and practice pole deployment techniques.
- Review and discuss bailout procedures during loss of control.

#### **WATER SURV 41001**

Title: Water Survival (Shared – Shuttle)

Duration: 2.0 hours Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS 1 (Schedule in

groups of up to 5.)

Source: DX45/Crew Systems Group

Date: 03/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): New Astronaut Flow

Preparation: None

**Note:** This lesson should be scheduled no later than 2-3 days after WATER

SURV 41027.

Synopsis: This classroom lesson is a review of WATER SURV 21001. Discussion

includes more detail of the Mode VIII in-flight bailout procedures including parachute operations, survival/rescue gear usage, and the Search and Rescue (SAR) posture. A full complement of survival gear will be

available for the students to see and handle. The procedures for the NBL session are discussed, including safety precautions. Emphasis will be

placed on techniques and what to-expect situations.

Objectives: • Review both automatic and manual parachute operation.

 Review under-canopy/Life Preserver Unit (LPU)-inflation and waterentry techniques.

- Review survival equipment and its usage.
- Review SAR operations.
- Review procedures for NBL session.

#### WATER SURV 41027

Title: Water Survival (Shared – Shuttle)

Duration: 3.0 hours

Medium: Neutral Buoyancy Lab

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS 1 (Schedule in

groups of up to 5.)

Source: DX45/Crew Systems Group

Date: 03/05

Lesson(s) Replaced: None

Equipment Required: ACES required

**Note:** This is a suited lesson in the water. This lesson must be scheduled

within 2-3 days of WATER SURV 41001.

Prerequisite Lesson(s): New Astronaut Flow, WATER SURV 41001

## WATER SURV 41027 (Concluded)

Preparation: None

This lesson is a review of WATER SURV 21027. It is performed at the Synopsis:

NBL to enable the crewmembers to experience bailout and water entry and survival techniques. It is in 2 parts.

• Part 1:

- Each of the crewmembers will hang from parachute risers, inflate their Life Preserver Unit (LPU), close and lock their visor, and pull their green apple.
- They will then be released and enter the water.
- Divers will place the crewmember under the canopy and they will extricate themselves from underneath it.
- The student will experience a back drag and a front drag to practice proper body positioning and Frost fitting release.
- They will then enter the raft and perform survival procedures, including radio ops using the PRC-112 and Search and Recovery Satellite Aided Tracking (SARSAT), signaling equipment, and bailing devices.
- The student will perform the procedures associated with the Forest Penetrator rescue seat.

#### Part 2:

- They will enter a mockup of the orbiter side hatch, attach themselves to the escape pole, and perform a bailout into the pool.
- A video will be replayed to show how well they have performed.
- Additional bailouts can be performed to improve technique.

#### Objectives:

- Perform parachute descent techniques and water entry procedures.
- Perform parachute drag and canopy extraction.
- Perform life raft entry and reentry procedures.
- Perform survival equipment use, radio protocol, and signaling techniques.
- Perform rescue hoist operations.
- Perform orbiter side hatch bailout procedures into the pool.

# **IFM REV 41001**

Title: In-Flight Maintenance Review

Duration: 2.0 hours

**Note:** This lesson is recommended at L-14 weeks and at L-1 week.

Medium: Classroom

Student: IFM Crewmembers as assigned by CDR.

Source: DX44/In-Flight Maintenance Group

Date: 03/05

Lesson(s) Replaced: None

Equipment Required: See instructor lesson plan

Prerequisite Lesson(s): New Astronaut Flow,

IFM PROC 91020, IFM KSC W/T 91031

Preparation: None

Synopsis: This lesson is a review of pilot pool In-Flight Maintenance (IFM) training,

with emphasis on recent changes to the IFM checklist, recent flight history,

and electrical IFM procedures.

Objectives: • Review IFM checklist procedures.

• Become proficient in the use of the following IFM electrical equipment:

Pin Kit

Digital Multimeter

Thermal Temp Module

Pressure Sensor Module

IFM Breakout Box

#### **PRL PROC 91020**

Title: Pre-launch Procedures

Duration: 3.0 hours

**Note:** Contact ASP to verify the amount of time required. Some setups do

not require the full time.

Medium: CCT or CCTII

Student: ASP

Source: DX45/Crew Systems Group

Date: 11/02

Lesson(s) Replaced: None

Equipment Required: See Facility Utilization Request

**Note:** This is not a suited lesson.

Prerequisite Lesson(s): None Preparation: Read and Review:

Astronaut Support Personnel (ASP) book, JSC-20392; Procedures

## PRL PROC 91020 (Concluded)

Synopsis:

With the CCT/CCTII in the vertical position, the Astronaut Support Personnel (ASP) and the students (if any) perform nominal pre-crew ingress procedures. These procedures include installation of FDF, installation of window shades (as appropriate), MS bags at seats, installation of headrest cushion, performing loose item inspection, performing air sample of crew module, removing Rotational Hand Control (RHC) covers, and verifying location of crew preference switch guards, yellow booties, decals, etc.

- Objectives: Review pre-launch orbiter preparation and perform switch configuration.
  - Practice locking/unlocking side hatch.

#### SECTION 4.0 MEDICAL OPERATIONS TRAINING COURSE

The Medical Operations training curriculum familiarizes crewmembers with the medical support available to them while onboard the space shuttle. The information presented in these lessons includes space physiology, onboard medical equipment, onboard environmental-monitoring hardware, flight surgeon support, and toxicological concerns.

Two crewmembers per mission will receive training as a Crew Medical Officer (CMO). The CMOs begin their training with Medical Diagnostics 31001, scheduled at L-16 weeks.

Upon completion of their training, the CMOs will be able to:

- Perform physical examination procedures
- Perform medical diagnostic procedures, including
  - Vital Signs
  - Eye/ear/nose/throat examination
  - Heart and lung examination
  - Abdominal, musculoskeletal, and neurological examination
- Perform medical therapeutic procedures, including
  - Eye foreign body removal
  - Nosebleed treatment
  - Medications administration
  - Airway Management
  - Intravenous fluid infusion
  - Wound management
  - Urinary catheterization
- Perform basic diagnostic and therapeutic dental procedures

The trainer/facilities used for the Medical Operations training curriculum include classroom, Crew Compartment Trainer (CCT), and the JSC clinic.

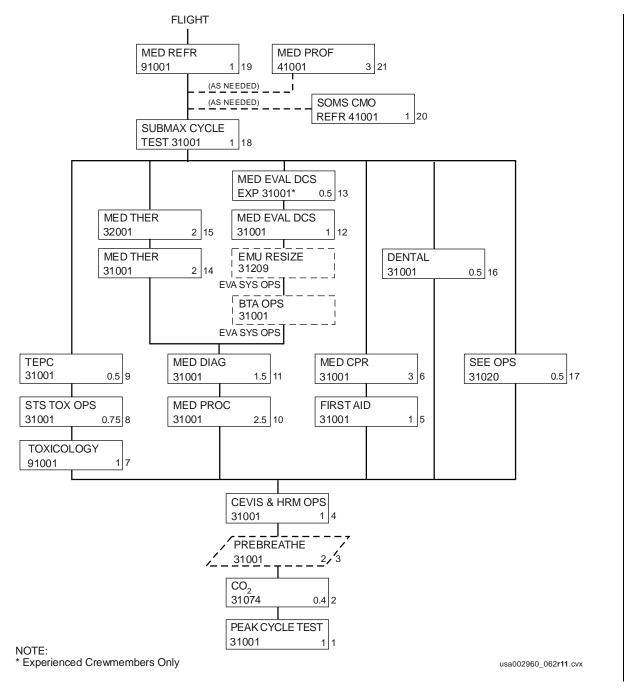


Figure 4-1. Medical Operations Lesson Flow Chart

**Table 4-1. Medical Operations Training Requirements** 

Date Last Modified: 06/08

							Non-Crew Rotation								Rotation			
Stage	Ref Num	Lesson Code	Media	Hrs	Sched Code	SUIT IV CDR	P	TASK IV MS1	EV MS2	EV MS3	CMO MS4	PS	CMO	IV P	EV MS1	EV MS2	Alt Fac	Comments
4		PEAK CYCLE TEST 31001	CLR	1	1	CDIX	-		1	1			<b>32.</b> (	-	1	1	7 110 7 010	36 month currency
4		CO2 31074	NASA	0.4	7	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4		3 year currency. Schedule 20 min for 1 crewmember
4		Sub Tota	l for Stage		Stage Tot													
4				1.4		0.4	0.4	0.4	1.4	1.4	0.4	0.4	0.4	0.4	1.4	1.4		
3	3	PREBREATHE 31001	CLR	2	3	2		2	2	2				2	2	2		Schedule 1 hr for 1 crewmember. See Note 1
3	4	CEVIS & HRM OPS 31001	CLR	1	3	1		1	1	1				1	1	1		12 month currency
3	5	FIRST AID 31001	CLR	1	8	1	1	1	1	1	1	1	1	1	1	1		12 month currency
3	6	MED CPR 31001	CLR	3	8	3	3	3	3	3	3	3	3	3	3	3		12 month currency
3	7	TOXICOLOGY 91001	CLR	1	8	1	1	1	1	1	1	1	1	1	1	1		12 month currency
3	8	STS TOX OPS 31001	CLR	0.75	1	0.75		0.75	0.75	0.75					0.75			As assigned by CDR. 12 month currency
																		As assigned by CDR. 12
3	9	TEPC 31001	CLR	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5			month currency
3	10	MED PROC 31001	CLR	2.5	8 Otens Test	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5		10 month currency
3		Sub 10ta	I for Stage	11.75	Stage 1 ot	tals Per Crewmen			11.25	11.25	8.0	7.5	7.5	10.5	11.75	10.5		
3				11./5		11./5	7.5	11.25	11.25	11.25	8.0	7.5	7.5	10.5	11./5	10.5		
2	11	MED DIAG 31001	CLR	1.5	2	1.5					1.5				1.5			As assigned by CDR. 6-8 month currency
2	12	MED EVAL DCS 31001	CLR	1	5	1		1	1	1	1		1	1	1	1		10 month currency
2	14	MED THER 31001	CLR	2	2	2					2				2			As assigned by CDR. 6-8 month currency
2	15	MED THER 32001	CLR	2	2	2					2				2			As assigned by CDR. 6-8 month currency
2	16	DENTAL 31001	CLR	0.5	2	0.5					0.5				0.5			As assigned by CDR. 8 month currency
2		SEE OPS 31020	CCT II	0.5	2	0.5					0.5				0.5		FFT	As assigned by CDR. 8 month currency
2	18	SUBMAX CYCLE TEST 31001	CLR	1	1				1	1					1	1		3 month currency
2		Sub Tota	I for Stage		Stage Tot			mber:										
2				8.5		7.5	0	1	2	2	7.5	0	1	1	8.5	2		

NOTE: 1. The exercise portion of this lesson must be repeated if more than 9 months have elapsed between PEAK CYCLE TEST 31001 or SUBMAX CYCLE TEST 31001 course completion (whichever is appropriate) and flight. Repeat of the lecture portion of this lesson will be at the discretion of the crew flight surgeon and the crewmembers.

2. Required if more than 6 months but less than 8 months have elapsed between MED DIAG 31001, MED THER 31001, and MED THER 32001 completion dates and flight.

**Table 4-1. Medical Operations Training Requirements (Concluded)** 

Date Last Modified														e Last Modified: 06/08				
							Non-Crew Rotation							Crew	Rotation			
Stage	Ref Num	Lesson Code	Media	Hrs	Sched Code	SUIT IV CDR	P	TASK IV MS1	EV MS2	EV MS3	CMO MS4	PS	CMO CDR	IV F	EV MS1	EV MS2	Alt Fac	Comments
1	19	MED REFR 91001	CLR	1	2	1	1	1	1	1	1	1	1	1	1	1		As needed; schedule any support personnel requiring this lesson separately from the prime crew
1		Sub Total for Stage Stage Total				als Per C	rewme	mber:										
1				1		1	1	1	1	1	1	1	1	1	1	1		
0	13	MED EVAL DCS EXP 31001	CLR	0.5	2	0.5		0.5	0.5	0.5	0.5		0.5	0.5	0.5	0.5		Experienced crewmember only
0	20	SOMS CMO REFR 41001	CLR	1	2	1					1		1					As assigned by CDR. Requested by CMO
0	21	MED PROF 41001	CLR	3	2	3					3		3					As assigned by CDR. See Note 2. 4 month currency
0		Sub Total for Stage Stage Total					rewme	mber:										
0				4.5		4.5	0	0.5	0.5	0.5	4.5	0	4.5	0.5	0.5	0.5		

NOTE: 1. The exercise portion of this lesson must be repeated if more than 9 months have elapsed between PEAK CYCLE TEST 31001 or SUBMAX CYCLE TEST 31001 course completion (whichever is appropriate) and flight. Repeat of the lecture portion of this lesson will be at the discretion of the crew flight surgeon and the crewmembers.

<sup>2.</sup> Required if more than 6 months but less than 8 months have elapsed between MED DIAG 31001, MED THER 31001, and MED THER 32001 completion dates and flight.

# 1 PEAK CYCLE TEST 31001

Title: Peak Cycle Test

Duration: 1.0 hour Medium: Classroom

Student: Shuttle EVA crewmembers that will use the ISS Airlock (Schedule

individually.)

Source: SK/HACO Date: 03/04

Lesson(s) Replaced: None

Equipment Required: EXL (B 261/room 122), LODE Electronic Cycle Ergometer,

Three-lead EKG, Metabolic Gas Analyzer (accessories and

consumables) and Defibrillator.

Prerequisite Lesson(s): None

Preparation: It is recommended that no strenuous exercise occur 24 hours prior to

testing; no NBL training within 48-72 hours prior to testing; no meals permitted 2 hours prior to testing, no alcohol or other vasoactive

substances or medications 24 hours prior to testing; and no caffeine or

nicotine 8 hours prior to testing.

**Note:** This lesson must be repeated if more than 36 months have elapsed

between course completion and flight. This class may be repeated at

an earlier date if requested by the flight surgeon.

Synopsis: Crewmembers will receive a brief introduction to the EVA Exercise

Prebreathe Protocol testing and training process. A measure of crewmember peak exercise capacity for use in the development of the exercise prescription will be obtained during PEAK CYCLE TEST 31001 for the EVA Exercise Prebreathe Protocol. One individual training session will be scheduled per EVA crewmember trained for the exercise EVA

Exercise Prebreathe Protocol.

Objectives: • To obtain a measure of crewmember exercise capacity.

Be familiar with the EVA Exercise Prebreathe Protocol testing and

training.

# **CO2 31074**

Title: Carbon Dioxide Exposure Training

Duration: 0.4 hours

Medium: NASA/Schedule in JSC Clinic Cardiopulmonary Laboratory, Bldg. 8,

Rm. 150

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS1

**Note:** Schedule students individually, one after another.

Source: SD2/Medical Operations

Date: 06/08

Lesson(s) Replaced: None

Equipment Required: Cardiopulmonary Laboratory

Prerequisite Lesson(s): None

Preparation: None

**Note:** This lesson has a validation period of 36 months.

Synopsis: Crewmembers are exposed to increased levels of CO<sub>2</sub> gas in order to

experience their unique symptoms of hypercapnia. Crewmembers are monitored for oxygen status and concentration of inhaled CO<sub>2</sub> and O<sub>2</sub>. Testing ceases when the crewmember experiences symptoms or when levels reach a certain concentration, whichever comes first. Crewmember symptoms are recorded and given to the crew surgeon as a reference

while on console.

Objectives: • Experience individual responses/symptoms to hypercapnia in a

controlled environment.

• Document individual symptoms to be used on console by the Flight

Surgeon.

Be able to recognize a potential CO<sub>2</sub> contingency.

# 3 PREBREATHE 31001

Title: EVA Prebreathe Familiarization and Exercise Prescription Verification

(Shared – ISS)

Duration: 2.0 hours
Medium: Classroom

Student: Shuttle EVA crewmembers that will use the ISS Airlock, Suit IV

**Note:** Schedule EVA pairs together with the IV.

Source: SK/HACO Date: 03/04

Lesson(s) Replaced: PREBREATHE C 31001

Equipment Required: EXL (B261/122), LODE Electronic Cycle Ergometer, Heart

Rate Monitor or EKG, Metabolic Gas Analyzer Accessories

and Consumables), Defibrillator.

Prerequisite Lesson(s): PEAK CYCLE TEST 31001 for STS EVA crewmembers

# 3 PREBREATHE 31001 (Concluded)

Preparation: It is recommended that no strenuous exercise occur 24 hours prior to

testing; no NBL training within 48-72 hours prior to testing; no meals permitted 2 hours prior to testing; no alcohol or other vasoactive substances or medications 24 hours prior to testing; no caffeine or

nicotine 8 hours prior to testing.

**Note:** The exercise portion of this lesson must be repeated if more than 9

months have elapsed between PEAK CYCLE TEST 31001 or SUBMAX CYCLE TEST 31001 course completion (whichever is appropriate) and flight. Repeat of the lecture portion of this lesson will be at the discretion of the crew flight surgeon and the crewmembers.

Synopsis: This lesson covers the procedures and exercise hardware for the EVA

Exercise Prebreathe Protocol. The background and history of the

prebreathe protocol are discussed followed by performance of the protocol to verify each crewmember's in-flight prescription. Crewmembers will also receive an introduction to the procedures for the Cycle Ergometer with Vibration Isolation System (CEVIS) and Heart Rate Monitor (HRM).

Objectives: • Explain the prebreathe exercise countermeasure and procedures.

Perform and verify the exercise prescription (EV crewmember).

 Perform exercise intensity on CEVIS appropriate for exercise prescription and proactive heart rate monitoring to ensure safety controls.

## 4 <u>CEVIS & HRM OPS 31001</u>

Title: Cycle Ergometer with Vibration Isolation System and Heart Rate

**Monitor Operations** 

Duration: 1.0 hour Medium: Classroom

Student: Shuttle EVA crewmembers that will use ISS Airlock, *Suit* IV

Source: SD2/Medical Operations

Date: 03/05

Lesson(s) Replaced: None

Equipment Required: HRM and CEVIS

Prerequisite Lesson(s): PEAK CYCLE TEST 31001, PREBREATHE 31001

Preparation: None

**Note:** This lesson must be repeated if more than 12 months have elapsed

between course completion and flight.

## 4 CEVIS & HRM OPS 31001 (Concluded)

Synopsis: This lesson introduces crewmembers to the Cycle Ergometer with

Vibration Isolation System (CEVIS) and Heart Rate Monitor (HRM). The information obtained in the lesson will be used as part of the EVA Exercise Prebreathe Protocol. The first part of the lesson concentrates on the purpose and operation of the components. This is followed by hands-on

procedures using the hardware.

Objectives: • Explain HRM and CEVIS hardware operation procedures.

• Identify the location of the hardware.

 Explain EV and IV crewmember responsibilities in regards to the protocol.

Operate the HRM and CEVIS without instructor assistance.

## 5 FIRST AID 31001

Title: Basic First Aid

Duration: 1.0 hour Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS 1

Source: SD37/Occupational Health

Date: 03/04

Lesson(s) Replaced: FIRST AID 21001 Equipment Required: Videotape player

Prerequisite Lesson(s): None

Preparation: None

**Note:** This lesson will need to be repeated if more than 12 months have

elapsed between course completion and flight.

Synopsis: The lesson will demonstrate how to administer basic first aid. The course

emphasizes the four priorities of first aid:

1. Get the victim away from the source of danger.

2. Check for breathing.

3. Give CPR if necessary.

4. Control bleeding and treat for shock.

Objectives: Be able to perform basic first aid procedures.

## 6 MED CPR 31001

Title: Medical Cardiopulmonary Resuscitation

Duration: 3.0 hours Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS 1

Source: SD37/Occupational Health

Date: 03/04

Lesson(s) Replaced: MED CPR 21001

Equipment Required: CPR training mannequin(s)

Prerequisite Lesson(s): None

Preparation: None

**Note:** This lesson will need to be repeated if more than 12 months have

elapsed between course completion and flight as the Crew Medical

Officer (CMO).

Synopsis: The Medical Cardiopulmonary Resuscitation (CPR) course will train

crewmembers in one- and two-rescuer CPR according to the American Heart Association standards. Use of the in-flight patient restraint system will be demonstrated. Emergency treatment of a choking victim will also be covered. The crewmembers will practice correct CPR technique on

training mannequin(s).

Objectives: • Be able to perform CPR and airway obstruction procedures.

Be able to use the shuttle restraint systems.

#### 7 TOXICOLOGY 91001

Title: Toxicology
Duration: 1.0 hour
Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS 1

Source: SD2/Medical Operations

Date: 03/05

Lesson(s) Replaced: TOXICOLOGY 31001

Equipment Required: CCK, Medical Checklist, HazMat Database

Prerequisite Lesson(s): None

Preparation: None

**Note:** This lesson must be repeated if more than 12 months have elapsed

between course completion and flight.

# 7 TOXICOLOGY 91001 (Concluded)

Synopsis:

Crewmembers will be instructed in the protocols and equipment required to clean and contain any hazards associated with an orbiter toxicological contingency. Specific topics include medical procedures for decontamination, the contents and usage of the Contaminant Cleanup Kit (CCK), and utilizing the Hazardous Material (HazMat) Online Database.

Objectives:

- Be able to use the Medical Checklist and the contents of the CCK.
- Understand the uses of the HazMat Database.
- Be able to treat medical problems that result from a toxicological contingency.
- Become familiar with mission-specific toxicological concerns, and the procedures associated with their containment, cleanup, and treatment.
- Be familiar with the post-flight exposure limits for orbit egress.

## 8 STS TOX OPS 31001

Title: Shuttle Toxicology Operations

Duration: 0.75 hours Medium: Classroom

Student: EV, Suit IV, and as assigned by CDR.

Source: SD2/Medical Operations

Date: 07/07

Lesson(s) Replaced: CSA-CP 31001

Equipment Required: CSA-CP, CSA-O2, CDM, IVA Ammonia Detection Kit,

GSC & FMK trainer units, and Operating Procedures

Prerequisite Lesson(s): TOXICOLOGY 91001

Preparation: None

**Note:** This lesson must be repeated if more than 12 months have elapsed

between course completion and flight.

Synopsis: This lesson introduces the crewmembers to the Compound Specific

Analyzer-Combustion Products (CSA-CP), Compound Specific Analyzer-

Oxygen (CSA-O2), Carbon Dioxide Monitor (CDM), Grab Sample

Container (GSC), Intravehicular Activity (IVA) Ammonia Detection Kit, and

Formaldehyde Monitoring Kit (FMK) (when flown on shuttle flights) hardware and procedures. The location and function of the CSA-CP, CSA-O2, CDM, IVA Ammonia Detection Kit, GSC, and FMK (if flown) are

discussed, followed by hands-on training of the individual units.

#### 8 STS TOX OPS 31001 (Concluded)

- Objectives: Summarize the purpose of the CSA-CP, CSA-O2, CDM, GSC, IVA Ammonia Detection Kit, and FMK.
  - Understand what the CSA-CP, CSA-O2, CDM, GSC, IVA Ammonia Detection Kit, and FMK are monitoring.
  - Identify the location of the CSA-CP, CSA-O2, CDM, GSC, IVA Ammonia Detection Kit. and FMK.
  - Perform sampling and monitoring procedures without instructor assistance for the CSA-CP, CSA-O2, CDM, and IVA Ammonia Detection Kit.
  - Perform sampling procedures without instructor assistance for the GSC and FMK.

#### 9 **TEPC 31001**

Title: Tissue Equivalent Proportional Counter

**Duration:** 0.5 hours Medium: Classroom

As assigned by CDR. Student: SD2/Medical Operations Source:

Date: 03/05

None Lesson(s) Replaced:

Equipment Required: CPDs, HRDs, and RAM training units and the TEPC flight

unit and Operating Procedures

None Prerequisite Lesson(s):

Preparation: None

Note: This lesson must be repeated if more than 12 months have elapsed

between course completion and flight.

Synopsis:

The crewmember will be taught the procedures for powering up the Tissue Equivalent Proportional Counter (TEPC) unit. The crewmember will be taught to recognize the normal operating displays on the TEPC. The TEPC is a passive device and nominally requires a "Power On" and "Power Off" procedure to be completed by the crewmember on-orbit. Malfunction procedures will be covered with the crewmember during the class as well as contingency procedures for recording readings from the TEPC in the case of a solar event. Current solar activity/space weather is covered with the crewmember and radiation dose projections for the mission are discussed. The crew is taught the procedure to deploy the Radiation Area Monitors (RAMs) as well as the importance of always wearing the Crew Personal Dosimeter (CPD). The crew is taught procedures for the High Rate Dosimeters (HRDs).

## 9 TEPC 31001 (Concluded)

Objectives:

- Identify the important switches and interfaces on the TEPC.
- Power up and power down the TEPC using procedures.
- Using the malfunction procedures, perform tasks in the event of a hardware failure.
- Obtain information on current solar activity and projected conditions for the mission.
- Perform monitoring procedures for RAM hardware.
- Perform monitoring procedures for the HRD hardware.

# 10 **MED PROC 31001**

Title: Medical Procedures

Duration: 2.5 hours Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS 1

Source: SD2/Medical Operations

Date: 03/05

Lesson(s) Replaced: MED PROC 21001A

Equipment Required: SOMS Hardware and MED C/L

Prerequisite Lesson(s): New Astronaut Flow

Preparation: None

**Note:** This lesson must be repeated if more than 10 months have elapsed

between course completion and flight.

Synopsis: This lesson provides a detailed briefing on the medical aspects of

spaceflight, medical equipment, and checklist procedures associated with diagnosis and treatment on orbit. This lesson also covers the spaceflight medical training program, operational counter measures, and post-flight readaptation. The Shuttle Orbiter Medical System (SOMS) and the

Medical Checklist are presented.

Objectives:

- Become familiar with space medicine, physiology, and medical support for the shuttle.
- Issues covered include the following:
  - Emergency Medical Services (EMS) at launch and landing
  - Health Stabilization Program (HSP)
  - Preflight medical support
  - In-flight medical concerns
  - Medical equipment onboard the Shuttle and FDF review
  - In-flight environmental concerns
  - Post-flight medical issues

# 11 **MED DIAG 31001**

Title: Medical Diagnostics

Duration: 1.5 hours Medium: Classroom

Student: CMOs as assigned by CDR (Schedule in pairs.)

Source: SD2/Medical Operations

Date: 03/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): MED PROC 31001

Preparation: None

**Note:** MED PROF 41001 will be required if more than 6 months and less

than 8 months have elapsed between MED DIAG 31001 course

completion and flight as the crew medical officer(s).

Synopsis: The Crew Medical Officers (CMOs) will be instructed in the use of the

diagnostic equipment available in the Shuttle Orbiter Medical

System (SOMS). Techniques of evaluating and recording blood pressure and heart rate, as well as lung and bowel sounds will be covered. Eye

and ear examination techniques will be demonstrated.

Objectives: • Be able to recognize simple medical problems which may develop in

flight.

Be able to use the Medical Checklist and the SOMS.

• Be able to obtain vital signs and perform a physical exam.

• Be able to recognize medical problems with the assistance of the MCC Surgeon during the Private Medical Conference (PMC).

# 12 <u>MED EVAL DCS 31001</u>

Title: Medical Evaluation of Decompression Sickness

Duration: 1.0 hour Medium: Classroom

Student: CMO, EV1, EV2, Suit and Task IV

Source: SD2/Medical Operations

Date: 04/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): BTA OPS 31001 (EVA SYS OPS),

EMU RESIZE 31209 (EVA SYS OPS),

MED DIAG 31001 (CMOs ONLY)

## 12 MED EVAL DCS 31001 (Concluded)

Preparation: None

**Note:** This lesson is given to inexperienced crewmembers, and it will need to

be repeated if more than 36 months have elapsed between course

completion and flight.

Synopsis: Inexperienced crewmembers are introduced to the Decompression

Sickness (DCS) Cuff Classifications, including symptoms and

classification criteria. A brief overview of DCS physiology, symptoms, and risks included is given. The techniques required to perform the in-suit and

out-of-suit physical examinations are presented.

Objectives: • Explain DCS physiology, symptoms, and risk.

Define the symptoms and criteria for distinguishing DCS Cuff Class 1, 2,

3, and 4.

• Explain the decision process for following DCS Treatment protocols.

• Demonstrate the in-suit physical exam.

• Explain the out-of-suit physical examination.

Explain post-symptomatic treatment and care.

## 13 <u>MED EVAL DCS EXP 31001</u>

Title: Medical Evaluation of Decompression Sickness Cuff for Experienced

Crewmembers

Duration: 0.5 hours Medium: Classroom

Student: CMOs, EV1, EV2, Suit and Task IV

Source: SD2/Medical Operations

Date: 04/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): BTA OPS 31001 (EVA SYS OPS)

EMU RESIZE 31209 (EVA SYS OPS),

MED DIAG 31001 (CMO ONLY)

Preparation: None

**Note:** This lesson is given to experienced crewmembers and will need to be

repeated if more than 36 months have elapsed between course

completion and flight.

Synopsis: Crewmembers are given a brief overview of Decompression Sickness

(DCS) Cuff Classifications, including symptoms and classification criteria. DCS physiology, symptoms, and risks are also given in a brief overview.

This class is conducted by a NASA Flight Surgeon.

## 13 MED EVAL DCS EXP 31001 (Concluded)

Objectives: • Review DCS physiology, symptoms, and risk.

- Define the symptoms and criteria for distinguishing DCS Cuff Class 1, 2, 3, and 4.
- Cover the decision process for following the DCS Treatment Protocol.
- Review post-symptomatic treatment and care.
- Review the in-suit and out-of-suit physical examinations.

## 14 **MED THER 31001**

Title: Medical Therapeutics

Duration: 2.0 hours Medium: Classroom

Student: CMOs as assigned by CDR (Schedule in pairs.)

Source: SD2/Medical Operations

Date: 03/05

Lesson(s) Replaced: MED THER 21001

Equipment Required: None

Prerequisite Lesson(s): MED PROC 31001

Preparation: None

**Note:** MED PROF 41001 will be required if more than 6 months and less

than 8 months have elapsed between MED THER 31001 course

completion and flight as the crew medical officer(s).

Synopsis: The Crew Medical Officers (CMOs) will be instructed in the treatment of

routine and emergency in flight illnesses and injuries including lacerations, burns, eye trauma, fractures, and airway trauma. The dosing of oral, intramuscular, and intravenous medications as well as the indications for their use will be covered. Routine medications for common in-flight

illnesses will be emphasized. Airway management and intubation will be

practiced.

Objectives: • Be able to perform intramuscular and subcutaneous injections.

- Be able to gain IV access, treat eye injuries, and treat simple and complex nosebleeds.
- Be able to perform various airway management techniques:
  - Oral Airway
  - Intubating Laryngeal Mask Airway (ILMA)
  - Endotracheal (ET) Intubation
  - Cricothyrotomy
- Be able to perform a needle thoracentesis to treat a collapsed lung.

# 15 **MED THER 32001**

Title: Medical Therapeutics

Duration: 2.0 hours Medium: Classroom

Student: CMOs as assigned by CDR (Schedule in pairs.)

Source: SD2/Medical Operations

Date: 03/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): MED THER 31001

Preparation: None

**Note:** MED PROF 41001 will be required if more than 6 months and less

than 8 months have elapsed between MED THER 32001 course

completion and flight as the crew medical officer(s).

Synopsis: Refer to MED THER 31001 for synopsis.

Objectives: • Be able to perform available wound closure techniques.

Be able to perform evaluation and treatment of the following

musculoskeletal injuries:

Sprains/Strains

Fractures/Dislocations

• Be able to treat urinary retention through urinary catheterization using

straight and Foley catheters.

#### 16 **DENTAL 31001**

Title: Dental
Duration: 0.5 hours
Medium: Classroom

**Note:** Schedule in the Bldg. 8 Dental Office.

Student: CMOs as assigned by CDR (Schedule in pairs.)

Source: SD32/Space Medicine

Date: 03/04

Lesson(s) Replaced: None

Equipment Required: EENT Subpack Prerequisite Lesson(s): MED PROC 31001

Preparation: None

**Note:** This lesson must be repeated if more than 8 months have elapsed

between course completion and flight.

Synopsis: This lesson will demonstrate the equipment and the techniques to be used

in the treatment of in-flight dental emergencies.

#### 16 **DENTAL 31001 (Concluded)**

- Objectives: 
   Become familiar with the use of the items contained in the dental portion of the Eye, Ear, Nose, and Throat (EENT) Subpack.
  - Become familiar with the intra-oral injection technique.
  - Be able to place a temporary filling.
  - Be able to re-cement dislodged crowns.
  - Be able to treat chipped/fractured teeth or fillings.

#### 17 **SEE OPS 31020**

Title: Shuttle Emergency Eyewash Operations

Duration: 0.5 hours Medium: CCT II. FFT

Student: CMOs as assigned by CDR (Schedule in pairs.)

SD2/Medical Operations Source:

Date: 03/05

Lesson(s) Replaced: None

Equipment Required: Contaminant Cleanup Kit, Shuttle Resuscitator, and

Operational Bioinstrumentation System (OBS)

Prerequisite Lesson(s): None

Preparation: None

This lesson must be repeated if more than 8 months have elapsed Note:

between course completion and flight.

Synopsis:

This lesson will provide the Crew Medical Officers (CMOs) with Shuttle Emergency Eyewash (SEE) deployment procedures and the procedures needed to activate water flow through the SEE, which will enable a crewmember to flush the eyes in the event of exposure to toxins and irritants. Connection ports and procedures for utilizing the Operational Bioinstrumentation System (OBS) and the Shuttle Resuscitator will also be covered.

Objectives:

- Be able to perform emergency eyewash procedures in the Shuttle.
- Using the Cardiac Monitoring procedures, perform a mock setup of the OBS for Intravehicular Activity (IVA) monitoring.
- Identify O<sub>2</sub> connection ports for the Shuttle Resuscitator.

# 18 **SUBMAX CYCLE TEST 31001**

Title: Submaximal Cycle Test

Duration: 1.0 hour Medium: Classroom

Student: Shuttle EVA crewmembers who will use the ISS Airlock (Schedule

individually.)

Source: SK/HACO Date: 03/04

Lesson(s) Replaced: None

Equipment Required: EXL (B 261/room 122), LODE Electronic Cycle Ergometer,

Three-lead EKG, Metabolic Gas Analyzer (accessories and

consumables), and Defibrillator.

Prerequisite Lesson(s): CEVIS & HRM OPS 31001, PEAK CYCLE TEST 31001,

PREBREATHE 31001

Preparation: It is recommended that no strenuous exercise occur 24 hours prior to

testing; no NBL training within 48-72 hours prior to testing; no meals permitted 2 hours prior to testing; no alcohol or other vasoactive

substances or medications 24 hours prior to testing; and no caffeine or

nicotine 8 hours prior to testing.

**Note:** This lesson must be repeated if more than 3 months have elapsed

between course completion and flight.

Synopsis: A measure of crewmember exercise capacity for use in the possible

modification of the exercise prescription will be obtained during SUBMAX CYCLE TEST 31001 for the EVA Exercise Prebreathe Protocol. One individual training session will be scheduled per EVA crewmember trained

for the EVA Exercise Prebreathe Protocol.

Objectives: • Measure crewmember exercise capacity prior to flight to determine

need to modify exercise prescription.

Review EVA Exercise Prebreathe Protocol procedures as necessary.

#### 19 **MED REFR 91001**

Title: Medical Procedures Refresher

Duration: 1.0 hour Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS 1

**Note:** Schedule any support personnel requiring this lesson separately from

the prime crew.

Source: SD2/Medical Operations

Date: 03/04

Lesson(s) Replaced: None

Equipment Required: SOMS Hardware and MED C/L

# 19 MED REFR 91001 (Concluded)

Prerequisite Lesson(s): CO2 31074, DENTAL 31001, FIRST AID 31001,

MED CPR 31001, MED DIAG 31001, MED THER 32001,

SEE OPS 31020, TOXICOLOGY 91001

Preparation: None

Synopsis: This lesson will be given at approximately L-10 days. A review of the

Shuttle Orbiter Medical System (SOMS), physical examination and treatment procedures, shuttle propellant toxicology, exposure to environmental temperature extremes, and emergency treatment procedures will be covered. In addition, space motion sickness, private medical communications, and EVAs will be discussed. This lesson is given to prime crews with instructor and flight surgeons present.

Objectives: • Review the following:

Emergency Medical Services (EMS) at launch and landing

Health Stabilization Program (HSP)

Preflight medical supportIn-flight medical concerns

Medical equipment onboard shuttle

In-flight environmental issues

Expected radiation exposure rates

Post-flight medical issues

# 20 **SOMS CMO REFR 41001**

Title: Shuttle Orbiter Medical System Crew Medical Officer Refresher

Duration: 1.0 hour Medium: Classroom

Student: CMOs as assigned by CDR (Schedule in pairs.)

Source: SD2/Medical Operations

Date: 03/04

Lesson(s) Replaced: None Equipment Required: SOMS

Prerequisite Lesson(s): MED THER 31001, MED THER 32001

Preparation: None

**Note:** This lesson is CMO request only.

Synopsis: Same as for MED THER 31001 and MED THER 32001.

Objectives: Same as for MED THER 31001 and MED THER 32001.

# 21 **MED PROF 41001**

Title: Medical Proficiency

Duration: 3.0 hours Medium: Classroom

Student: CMOs as assigned by CDR (Schedule in pairs.)

Source: SD2/Medical Operations

Date: 03/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): MED DIAG 31001, MED THER 31001, MED THER 32001

Preparation: None

**Note:** This course will be given to the CMOs if more than 6 months and less

than 8 months have elapsed between MED DIAG 31001,

MED THER 31001, and MED THER 32001 completion dates and flight. This class will validate the CMOs for 4 months from the date of

course completion.

Synopsis:

The Crew Medical Officers (CMOs) will review treatments of routine and emergency in-flight illnesses and injuries, including lacerations, burns, eye trauma, and fractures. The dosing of oral, intramuscular, and intravenous medications as well as the indications for their use will be reviewed. Airway management and intubation will be practiced. Routine medications for common in-flight illnesses will also be emphasized.

#### Objectives:

- Be able to demonstrate skills learned in training sessions.
- Be able to use the Medical Checklist and the Shuttle Orbiter Medical System (SOMS).
- Be able to treat medical problems, which are likely to develop in-flight.
- Be able to treat more difficult medical problems under the guidance of the MCC Surgeon.
- Be able to perform advanced therapeutic procedures, including airway management during emergencies using endotracheal intubation and cricothyrotomy, and intravenous technique using insertion of intracatheter needle with intravenous fluids.
- Be able to perform alternate methods of laceration closure.
- Be able to discuss medical scenarios that could occur during flight, and how they would be managed.

#### SECTION 5.0 STS PHO/TV TRAINING COURSE

Throughout the U.S. Space Program, photos, film and video have played an important role in preserving history and documenting technological advances. The STS PHO/TV Training Course applies techniques developed throughout the years of manned space flight to Space Shuttle scenarios using modern photographic and video technologies.

The STS PHO/TV Training Course provides the flight crew with the knowledge necessary to operate the Orbiter integrated TV system, video devices, film cameras, still cameras and associated photographic accessories. In addition to hardware training, courses are included that provide photography and video skills unique to daily life on orbit. Classes are also provided for highly specialized phases of flight that utilize Photo/TV devices such as ascent/entry, External Tank (ET) separation, ISS docking and EVA.

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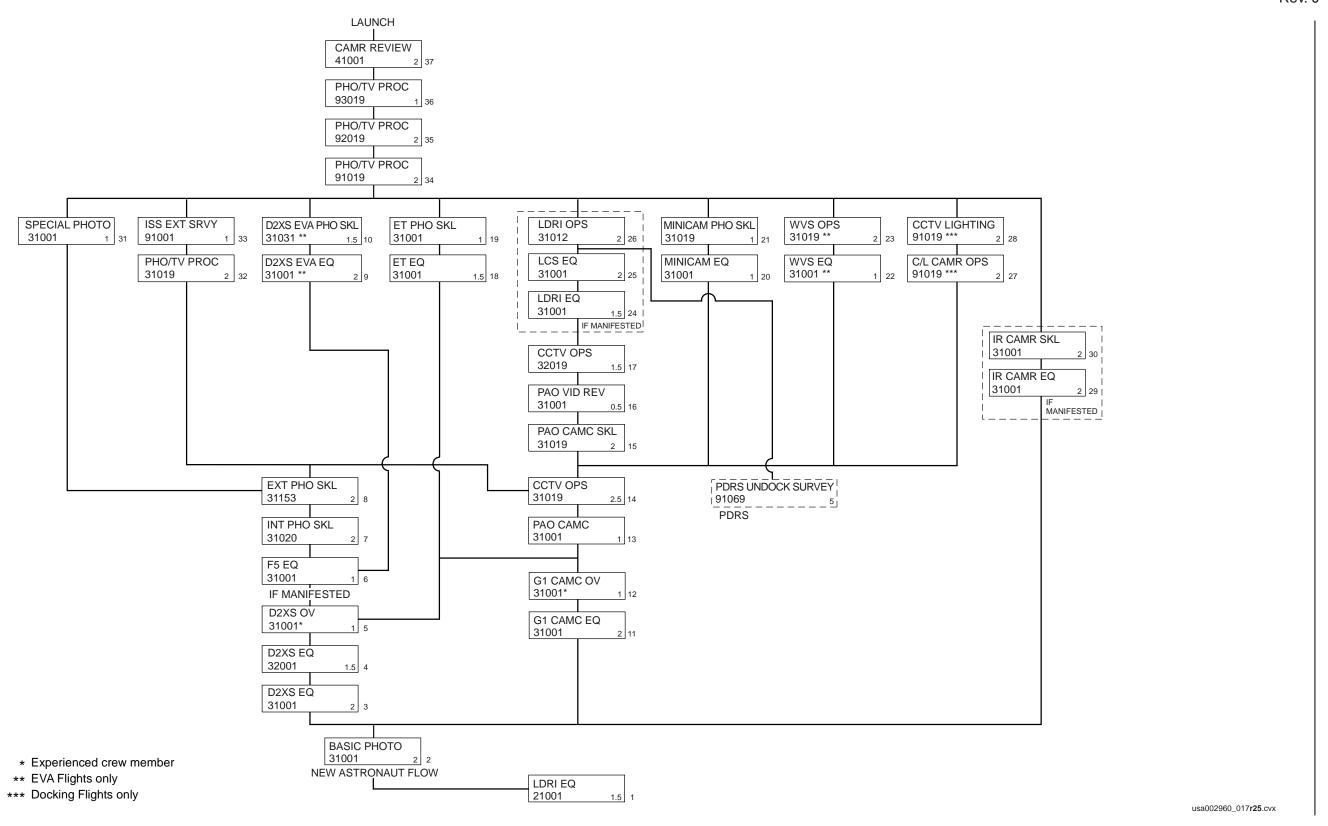


Figure 5–1. PHOTO/TV Lesson Flow Chart

Table 5-1. STS PHO/TV Crew Training Requirements

																	Date La	ast Modified: 06/08
						Non-Crew Rotation								Crew F	Rotation			
Stage	Ref Num	Lesson Code	Media	Hrs	Sched Code	С	Р	MS1	MS2	MS3	MS4	PS	С	Р	MS1	MS2	Alt Fac	Comments
4	2	BASIC PHOTO 31001	CLR	2	8	2	2	2	2	2	2	2	2	2	2	2		-
4	3	<b>D2XS</b> EQ 31001	CLR	2	2	2	2	2	2	2	2	2	2	2	2	2		
4	4	<b>D2XS</b> EQ 32001	CLR	1.5	2	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5		
4	6	F5 EQ 31001	CLR	1	2	1	1	1	1	1	1	1	1	1	1	1		
4	7	INT PHO SKL 31020	CCT	2	2	2	2	2	2	2	2	2	2	2	2	2	CCTII/FFT	
4	8	EXT PHO SKL 31153	Outside	2	2	2	2	2	2	2	2	2	2	2	2	2		
4	9	<b>D2XS</b> EVA EQ 31001	CLR	2	3	2	2	2	2	2	2	2	2	2	2	2		
4	11	<b>G1</b> CAMC EQ 31001	CLR	2	2	2	2	2	2	2	2	2	2	2	2	2		
4	13	PAO CAMC 31001	CLR	1	8	1	1	1	1	1	1	1	1	1	1	1		
4	14	CCTV OPS 31019	FFT	2.5	2	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	CCT	
4	29	IR CAMR EQ 31001	CLR	2	3	2	2	2	2	2	2	2	2	2	2	2		
4	30	IR CAMR SKL 31001	CLR	2	3	2	2	2	2	2	2	2	2	2	2	2		
4		Sub <sup>-</sup>	Total for Stage		Stage Totals													
4				22		22	22	22	22	22	22	22	22	22	22	22		
3	15	PAO CAMC SKL 31019	FFT	2	2	2	2	2	2	2	2	2	2	2	2	2	CCT	
3	16	PAO VID REV 31001	CLR	0.5	8	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		
3	17	CCTV OPS 32019	FFT	1.5	2	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	CCT	
3	18	ET EQ 31001	CLR	1.5	2			1.5	1.5						1.5	1.5		As assigned by CDR
3	19 20	ET PHO SKL 31001 MINICAM EQ 31001	CLR CLR	1	2 8	1	1	1	1	1	1	1	1		1	1		As assigned by CDR
3	21	MINICAM PHO SKL 31019	FFT	1	3	1	1	1	1	1	1	-	1				CCT	
3	22	WVS EQ 31001	CLR	1	8	1	1	1	1	1	1	1	1				CCT	
3	22	W V3 EQ 31001	CLK		0	'	1		-	-	1		'					
3	23	WVS OPS 31019	FFT	2	4			2	2						2	2		As assigned by CDR
3	24	LDRI EQ 31001	CLR	1.5	8	1.5	1.5	1.5	1.5	1.5	1.5		1.5	1.5	1.5	1.5		Required when OBSS manifested
3	25	LCS EQ 31001	CLR	2	8	2	2	2	2	2	2							
3	26	LDRI OPS 31012	FB	2	3			2	2						2	2	ССТ	As assigned by CDR. Required when OBSS manifested
3	27	C/L CAMR OPS 91019	FFT	2	2			2	2						2	2		As assigned by CDR
3	28	CCTV LIGHTING 91019	FFT	2	4			2	2						2	2		Lights out session; as assigned by CDR
2	24	SPECIAL PHOTO 24004	CLR	1	8	1	4	1	1	1	1	4	1	4	4	1		
3	31	SPECIAL PHOTO 31001				2	1					1	2	1	1		CCT	
3	32	PHO/TV PROC 31019	FFT	2	2-3	2	2	2	2	2	2	2	2	2	2	2	CCT	
3	33	ISS EXT SRVY 91001	CLR	1	8	1	1	1	1	1	1	1	1	1	1	1		Attendance per CDR
3		Sub	Total for Stage		Stage Totals													
3				25.0		14.5	14.5	25.0	25.0	14.5	14.5	10.0	12.5	9.5	20.0	20.0		

Table 5-1. STS PHO/TV Crew Training Requirements (Concluded)

	Date Last Modified: 06													ast Modified: 06/08				
						Non-Crew Rotation								Crew F	Rotation			
	Ref				Sched													
Stage	Num	Lesson Code	Media	Hrs	Code	С	Р	MS1	MS2	MS3	MS4	PS	С	Р	MS1	MS2	Alt Fac	Comments
2	34	PHO/TV PROC 91019	FFT	2	4	2	2	2	2	2	2		2	2	2	2	CCT	
2	35	PHO/TV PROC 92019	FFT	2	4	2	2	2	2	2	2		2	2	2	2	CCT	
2	36	PHO/TV PROC 93019	FFT	1	4	1	1	1	1	1	1		1	1	1	1	CCT	Optional session
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0	1	LDRI EQ 21001	CLR	1.5	8			1.5	1.5									R2
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0	5	<b>D2XS</b> OV 31001	CLR	1	2	1	1	1	1	1	1		1	1	1	1		Crewmembers only
0	10	D2XS EVA PHO SKL 31031	KSC	1.5	3	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	Outdoors	
																		Experienced
0	12	G1 CAMC OV 31001	CLR	1	2	1	1	1	1	1	1		1	1	1	1		Crewmembers only
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0				5		3.5	3.5	5	5	3.5	3.5	1.5	3.5	3.5	3.5	3.5		

### 1 **LDRI EQ 21001**

Title: Laser Dynamic Range Imager Equipment

Duration: 1.5 hours
Medium: Classroom
Student: R1. R2

Source: DX46/Photo/TV Section

Date: 04/06

Lesson(s) Replaced: None

Equipment Required: Computer, Projector Prerequisite Lesson(s): CCTV OPS 21008

Preparation: None

Synopsis: This lesson will introduce the crew to the Laser Dynamic Range Imager

(LDRI) instruments used on the Orbiter Boom Sensor System (OBSS) for Shuttle Thermal Protection System (TPS) inspection. LDRI is mounted on the end of the OBSS boom. Discussed topics will include sensor design, power requirements, system control, data transfer and storage, shuttle integration and inspection method/timeline. This lesson will prepare the crew to operate the LDRI hardware in the subsequent PDRS OBSS

SURVEY 21069, 22069, 23069 lessons.

Objectives: • Understand the LDRI instrument design and capabilities.

 Understand the power and data interfaces between LDRI and the Shuttle.

Understand how LDRI is controlled.

Understand how to collect and downlink LDRI instrument video.

Understand how LDRI will be used with the Shuttle RMS for TPS inspection.

### 2 **BASIC PHOTO 31001**

Title: Basic Photo
Duration: 2.0 hours
Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS 1

Source: DX46/Photo/TV Section

Date: 02/01

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): New Astronaut Flow, LDRI EQ 21001

# 2 BASIC PHOTO 31001 (Concluded)

Synopsis:

This lesson is the first in the series of photo classes given to the crewmembers. This lesson will prepare students to better comprehend the information contained in classes to follow. The class will be presented with a multi-projector slide program as the primary source of visuals. The instructor will provide real-time narration for the class during the slide presentation.

Objectives:

- Gain basic understanding of fundamental photographic principles needed prior to hardware classes.
- Become familiar with the following:
  - Photo subjects
  - Cameras
  - Lenses
  - Film
  - Light
  - Filters
  - Exposure concepts
  - Exposure problems
  - Composition

#### 3 **D2XS EQ 31001**

Title: Nikon D2Xs Equipment

Duration: 2.0 hours Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS 1 (Schedule in

pairs.)

Source: DX46/Photo/TV Section

Date: 06/08

Lesson(s) Replaced: 760 EQ 31001

Equipment Required: Nikon D2Xs Hardware Prerequisite Lesson(s): BASIC PHOTO 31001

Preparation: None

Synopsis: During the two hour lesson, the student will be briefed on the *Nikon D2Xs* 

camera displays and controls, lenses, flash, nominal operation and related

Generic Photo/TV information.

Objectives: • Upon completion, the student will be familiar with the *Nikon D2Xs* 

camera and be able to correctly operate the *Nikon D2Xs* camera for nominal operations.

 Prepare the camera for operation and take a photograph using existing light.

• Prepare the camera for operation and take a photograph using flash.

### 4 **D2XS EQ 32001**

Title: Nikon D2Xs Equipment

Duration: 1.5 hours Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS 1 (Schedule in

pairs.)

Source: DX46/Photo/TV Section

Date: 06/08

Lesson(s) Replaced: 760 EQ 32001

Equipment Required: Nikon D2Xs Hardware, A31p laptop computer

Prerequisite Lesson(s): D2XS EQ 31001

Preparation: None

Synopsis: During the 1.5 hour lesson, the student will be briefed on the *Nikon D2Xs* 

menu system, camera configuration and use of the A31p laptop.

Objectives: • Upon completion, the student will be able to correctly operate the

Nikon D2Xs camera menus and digital features as well as the viewing

software on the A31p.

Prepare the camera for operation and take a photograph using flash.

Quick format the card.

• View images with the computer viewing software.

• Save a compressed image file.

#### 5 **D2XS OV 31001**

Title: Nikon D2Xs Overview

Duration: 1.0 hour Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT (Schedule in pairs.)

**Note:** Schedule experienced crewmembers only.

Source: DX46/Photo/TV Section

Date: 06/08

Lesson(s) Replaced: 760 OV 31001

Equipment Required: Nikon D2Xs Hardware, A31p laptop computer

Prerequisite Lesson(s): D2XS EQ 32001

5 <u>D2XS OV 31001 (Concluded)</u>

Synopsis: This class is an overview of D2XS EQ 31001 and 32001. Normal camera

operations and malfunction diagnosis will be covered.

Objectives: • Overview of the *Nikon D2Xs* camera system.

Gain camera proficiency.

6 **F5 EQ 31001** 

Title: Nikon F5 Equipment

Duration: 1.0 hour Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS 1 (Schedule in

pairs.)

**Note:** Schedule if manifested. Source: DX46/Photo/TV Section

Date: 04/06

Lesson(s) Replaced: None

Equipment Required: Nikon F5 35mm Camera System

Prerequisite Lesson(s): D2XS EQ 32001, D2XS OV 31001 (Experienced

crewmembers only)

Preparation: None

Synopsis: This lesson is a hands-on training exercise that familiarizes crewmembers

with the operation and usage of the Nikon F5 35mm camera system. Nominal camera operations and malfunction diagnosis will be discussed.

Objectives: • Understand the Nikon F5 35mm camera system.

Gain the ability to operate the F5 camera.

7 **INT PHO SKL 31020** 

Title: Interior Photo Skills

Duration: 2.0 hours

Medium: CCT, CCTII or FFT

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS 1 (Schedule in

pairs.)

Source: DX46/Photo/TV Section

Date: 04/06

Lesson(s) Replaced: 760 PHO SKL 31020

Equipment Required: Nikon D2Xs Hardware, Nikon F5 Hardware (If manifested)

Prerequisite Lesson(s): D2XS EQ 32001, D2XS OV 31001 (Experienced

crewmembers only), F5 EQ 31001 (If manifested)

# 7 INT PHO SKL 31020 (Concluded)

Synopsis: This lesson will provide an opportunity for hands-on operation of the

camera hardware in a flight-like environment with training supervision.

The images will be reviewed with each crewmember.

Objectives: • Obtain a reinforced understanding of the still camera system.

Practice advanced operational techniques with flight cameras.

• Gains hands-on experience with the camera.

Review lessons objectives utilizing images obtained in the orbiter

mock up.Critique images obtained in the orbiter mock-up.

# 8 **EXT PHO SKL 31153**

Title: Exterior Photo Skills

Duration: 2.0 hours

Medium: Outside (JSC Mall Area)

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS 1 (Schedule in

pairs.)

Source: DX46/Photo/TV Section

Date: 04/06

Lesson(s) Replaced: None

Equipment Required: Nikon D2Xs Hardware Prerequisite Lesson(s): INT PHO SKL 31020

Preparation: None

Synopsis: This lesson will provide an opportunity for hands-on operation of the digital

still camera hardware outside. The images will be reviewed with each

crewmember at the end of the class.

Objectives: • Know and understand operations for the *Nikon D2Xs* system.

• Demonstrate an understanding of the digital still camera system.

 Perform advanced operational techniques with the digital still camera system.

9 **D2XS EVA EQ 31001** 

Title: Nikon D2Xs EVA Equipment

Duration: 2.0 hours Medium: Classroom

Student: EVA and IVA crewmembers Source: DX46/Photo/TV Section

Date: 06/08

Lesson(s) Replaced: 760 EVA EQ 31001

Equipment Required: D2Xs EVA camera, flash, brackets and associated hardware

Prerequisite Lesson(s): D2XS EQ 32001 or D2XS OV 31001 (experienced

crewmembers only)

Preparation: None

Synopsis: This lesson instructs the crewmembers on how to properly configure and

use the *Nikon D2Xs* camera for EVA use. The crewmembers will learn how to configure the camera for existing light and flash photography.

Objectives: • Understand the *Nikon D2Xs* EVA camera hardware.

• Properly assemble the *Nikon D2Xs* camera for EVA use with and without

the flash.

Understand the Nikon D2Xs EVA camera FDF procedures.

10 <u>D2XS EVA PHO SKL 31031</u>

Title: Nikon D2Xs EVA Photo Skills

Duration: 1.5 hours

Medium: KSC (during Crew Equipment Interface Test (CEIT))

Student: EVA and IVA crewmembers Source: DX46/Photo/TV Section

Date: 06/08

Lesson(s) Replaced: 760 EVA PHO SKL 31031

Equipment Required: Nikon D2Xs camera, EVA flash, EVA camera accessories,

Shuttle TPS, floodlight, laptop computer

Prerequisite Lesson(s): D2XS EVA EQ 31001

Preparation: None

Synopsis: This lesson teaches the crew how to properly use the *Nikon D2Xs* EVA

camera to photograph the Thermal Protection System (TPS) on the real

vehicle under different lighting conditions.

Objectives: • Configure the camera for EVA operations.

Photograph the different types of Shuttle TPS under various lighting

conditions.

Review imagery at the end of the lesson.

### 11 **G1 CAMC EQ 31001**

Title: Canon G1 Camcorder Equipment

Duration: 2.0 hours Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS 1 (Schedule in

pairs.)

Source: DX46/Photo/TV Section

Date: 06/08

Lesson(s) Replaced: PD100 CAMC EQ 31001

Equipment Required: Canon G1 Camcorder and accessories

Prerequisite Lesson(s): BASIC PHOTO 31001

Preparation: None

Synopsis: This lesson is a hands-on training exercise that familiarizes crewmembers

with the operation and usage of the camcorder. Normal operations and

diagnosis of problems will be explained.

Objectives: • Become familiar with and understand the entire camcorder system,

including the operation and the malfunction procedures.

Gain the ability to independently operate the camcorder system.

# 12 **G1 CAMC OV 31001**

Title: Canon G1 Camcorder Overview

Duration: 1.0 hour Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT (Schedule in pairs.)

**Note:** Schedule experienced crewmembers only.

Source: DX46/Photo/TV Section

Date: 06/08

Lesson(s) Replaced: PD100 CAMC OV 31001

Equipment Required: Canon G1 Camcorder and accessories

Prerequisite Lesson(s): G1 CAMC EQ 31001

Preparation: None

Synopsis: This lesson is a hands-on review of the camcorder equipment. Normal

operations and diagnosis of problems will be explained.

Objectives: • Obtain a review on camcorder system operations.

• Gain camcorder proficiency through independent use of the camcorder

system.

#### 13 **PAO CAMC 31001**

Title: Public Affairs Office Camcorder Skills

Duration: 1.0 hour Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS 1

Source: DX46/Photo/TV Section

Date: 02/01

Lesson(s) Replaced: PAO CAMCORD 91001 Equipment Required: Camcorder hardware

Prerequisite Lesson(s): G1 CAMC EQ 31001, G1 CAMC OV 31001 (Experienced

crewmembers only)

Preparation: None

Synopsis: This lesson is a hands-on training exercise that familiarizes crewmembers

with the operation and usage of the camcorder video/audio systems. This lesson goes beyond the standard camcorder lesson, concentrating on

advanced video techniques.

Objectives: • Obtain a reinforced understanding of camera controls, as well as audio

controls.

Obtain a basic understanding of the general types of Public Affairs Office
 (DAO) vides and agreement type to be a second of the general types of Public Affairs Office

(PAO) video and corresponding hardware considerations.

• Obtain an understanding of scene, personal, prop and wardrobe preparations/considerations.

• View video from past missions.

# 14 **CCTV OPS 31019**

Title: Closed Circuit Television Operations

Duration: 2.5 hours
Medium: FFT or CCT

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS 1 (Schedule in

pairs.)

Source: DX46/Photo/TV Section

Date: 02/01

Lesson(s) Replaced: CCTV OPS 21020

Equipment Required: See Facility Utilization Request.

Prerequisite Lesson(s): PAO CAMC 31001

# 14 <u>CCTV OPS 31019 (Concluded)</u>

Synopsis:

This lesson is a hands-on training exercise utilizing a fully functional, flight prototype television system. The student will be briefed on system operation, including activation/deactivation, display and control functions, camera features, Video Tape Recorder (VTR) operation, system limitations and constraints, and any necessary assembly/disassembly of equipment.

Utilizing the appropriate FDF checklists, television procedures will be performed and the proper responses to scene variables will be demonstrated and discussed.

Objectives:

- Understand CCTV/Orbiter system configuration, operations, and malfunction procedures.
- Be able to exercise Photo/TV FDF checklist procedures for CCTV, VTR, and Camcorder.
- Gain the ability to operate the CCTV system.

### 15 **PAO CAMC SKL 31019**

Title: Public Affairs Office Camcorder Skills

Duration: 2.0 hours
Medium: FFT or CCT

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS 1 (Schedule in

pairs.)

Source: DX46/Photo/TV Section

Date: 02/01

Lesson(s) Replaced: PAO CAMCORD 91019
Equipment Required: Camcorder hardware
Prerequisite Lesson(s): CCTV OPS 31019

Preparation: None

Synopsis: This lesson will provide an opportunity for hands-on operation of the

camcorder hardware in a flight-like environment with training supervision.

Normal operations and diagnosis of problems will be covered.

Objectives:

 Obtain a reinforced understanding of the individual flight system via hands-on camcorder operations.

 Practice the different types of on-orbit video situations related to Public Affairs Office (PAO) situations.

# 16 **PAO VID REV 31001**

Title: Public Affairs Office Camcorder Video Review

Duration: 0.5 hours Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS 1

Source: DX46/Photo/TV Section

Date: 02/01

Lesson(s) Replaced: VID REV 31001

Equipment Required: None

Prerequisite Lesson(s): PAO CAMC SKL 31019

Preparation: None

Synopsis: This lesson is a review of videotape footage taken by each crewmember

during PAO CAMC SKL 31019. Video and audio tracks will be critiqued by lead instructor and crewmembers for proper techniques and hardware

operations.

Objectives: • Identify problems and solutions within the video footage.

 Review lesson objectives of PAO CAMC 31001 and PAO CAMC SKL 31019 utilizing video obtained in the orbiter mock-up.

# 17 **CCTV OPS 32019**

Title: Closed Circuit Television Operations

Duration: 1.5 hours Medium: FFT or CCT

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS 1 (Schedule in

pairs.)

Source: DX46/Photo/TV Section

Date: 06/05

Lesson(s) Replaced: None

Equipment Required: See Facility Utilization Request.

Prerequisite Lesson(s): PAO VID REV 31001

Preparation: None

Synopsis: This lesson will serve as Part 2 of CCTV OPS 31019 to cover Digital

Television (DTV), Sequential Still Video (SSV), and video

routing/recording/playback utilizing the Shuttle TV system and in-cabin

hardware.

#### 17 CCTV OPS 32019 (Concluded)

- Objectives: Understand the DTV hardware components and their functions.
  - Configure and route a video signal through the DTV system.
  - Configure the SSV hardware for on-orbit operations.
  - Configure and record video with the DTV VTR, the Sony V10 VTR, and the Canon G1 camcorder.
  - Configure and play back video with the DTV VTR, the Sony V10 VTR, and the Canon G1 camcorder for on-board viewing and analog/digital downlink to MCC.

#### 18 ET EQ 31001

Title: External Tank Photography Equipment

Duration: 1.5 hours Medium: Classroom

Student: As assigned by CDR. DX46/Photo/TV Section Source:

Date: 04/06

Lesson(s) Replaced: None

Equipment Required: Canon G1 Camcorder, Nikon D2Xs Digital Still Camera,

IEEE 1394 converter and cables, A31p PGSC

D2XS EQ 32001, G1 CAMC EQ 31001, D2XS OV 31001 Prerequisite Lesson(s):

(Experienced crewmembers only), G1 CAMC OV 31001

(Experienced crewmembers only)

Preparation: None

Synopsis:

This lesson familiarizes the crewmember(s) with the External Tank (ET) photographic requirements as presented by a representative of the Imaging Science and Analysis Group (IS&AG). The related hardware to be used for the task will be presented and configured per procedures. The umbilical well ET Thermal Protection System (TPS) camera system and imagery downloading will also be discussed.

Objectives:

- Understand ET photography objectives, techniques, and configuration procedures.
- Configure the camera hardware per procedures to obtain ET images.
- Understand the umbilical well ET TPS camera system and image downloading hardware, software, and procedures.

### 19 **ET PHO SKL 31001**

Title: External Tank Photo Skills

Duration: 1.0 hour Medium: Classroom

Student: As assigned by CDR. Source: DX46/Photo/TV Section

Date: 07/04

Lesson(s) Replaced: None

Equipment Required: Canon G1 camcorder, Nikon D2Xs digital still camera, IEEE

1394 converter and cables, A31p PGSC

Prerequisite Lesson(s): ET EQ 31001

Preparation: None

Synopsis: This lesson will provide an opportunity for hands-on operation of the

camera configurations for External Tank (ET) photography. Once the cameras are configured, the crewmembers will go outside to practice focusing and shooting assorted moving targets. The images and video will be reviewed back in the classroom at the end of the session as part of a critique. Computer software to download the umbilical well ET Thermal Protection System (TPS) camera images will be exercised during the

critique portion of the class.

Objectives: • Configure the camera hardware per procedures to obtain ET images.

• Take pictures and video of various targets to practice focus and exposure techniques required for ET photography.

 Use the Kodak Camera Manager software to download images from a DCS 760 camera.

### 20 **MINICAM EQ 31001**

Title: Minicam Equipment

Duration: 1.0 hour Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS 1

Source: DX46/Photo/TV Section

Date: 02/01

Lesson(s) Replaced: None

Equipment Required: Mini-cam camera system

Prerequisite Lesson(s): CCTV OPS 31019

# 20 MINICAM EQ 31001 (Concluded)

Synopsis: This lesson is a hands-on training exercise that familiarizes crewmembers

with the operation and usage of the mini-cam camera system. Ascent, entry and on-orbit camera configurations will be discussed. Mini-cam

video from past missions will be reviewed.

Objectives: • Understand the entire mini-cam camera system, including camera

mounting options.

Gain the ability to operate the camera.

### 21 **MINICAM PHO SKL 31019**

Title: Minicam Photo Skills

Duration: 1.0 hour Medium: FFT or CCT

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT (Schedule in

groups of 3.)

Source: DX46/Photo/TV Section

Date: 02/01

Lesson(s) Replaced: None

Equipment Required: Minicam camera system Prerequisite Lesson(s): MINICAM EQ 31001

Preparation: None

Synopsis: This lesson is a hands-on training exercise in a flight-like environment that

familiarizes crewmembers with the minicam camera system integrated into

the Orbiter CCTV system. Ascent, entry and on-orbit camera

configurations will be rehearsed.

Objectives: • Obtain a reinforced understanding of the minicam camera system.

• Gain hands-on experience with the minicam system.

 Obtain an understanding of minicam system configuration as determined by phase of flight.

# 22 **WVS EQ 31001**

Title: Wireless Video System Equipment

Duration: 1.0 hour Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS 1

Source: DX46/Photo/TV Section

Date: 02/01

Lesson(s) Replaced: None

Equipment Required: PGSC, Overhead projector

# 22 <u>WVS EQ 31001 (Concluded)</u>

Prerequisite Lesson(s): CCTV OPS 31019

Preparation: None

Synopsis: This one-hour lesson will cover the overall design of the Wireless Video

System (WVS), components, and basic operations of the PGSC-based

software.

Objectives: • Know the main components of the Orbiter WVS.

 Understand the main function that each Orbiter WVS component performs.

 Understand how commands and telemetry/video are routed through the WVS components.

Know the crew interfaces to the Orbiter WVS.

• Know how to configure and start the WVS PGSC and software.

• Understand the WVS PGSC software information page layout design.

Know how to activate and deactivate the Orbiter WVS.

• Understand how the WVS PGSC software is to be used.

Activate the Orbiter WVS PGSC software.

Maneuver through the WVS PGSC software displays.

# 23 **WVS OPS 31019**

Title: Wireless Video System Operations

Duration: 2.0 hours

Medium: FFT

Student: As assigned by CDR. Source: DX46/Photo/TV Section

Date: 02/01

Lesson(s) Replaced: None

Equipment Required: See Facility Utilization Requirement.

Prerequisite Lesson(s): WVS EQ 31001

Preparation: None

Synopsis: This two-hour lesson will cover Wireless Video System (WVS)

Intravehicular Activity (IVA) hardware setup and operations. Fully

integrated system test, operation, malfunctions, and deactivation utilizing

available crew procedures will be the main goal of the lesson.

# 23 <u>WVS OPS 31019 (Concluded)</u>

Objectives:

- Know the flight-specific video hardware configuration for WVS support.
- Understand the purpose of WVS switches and PGSC commands and telemetry.
- Understand the purpose of the WVS checkout and nominal activation.
- Understand how to determine what camera is being sent to the V10 recorders.
- Understand how to troubleshoot WVS problems based on signal conditions and error messages.
- Configure the WVS PGSC and video hardware to conduct WVS operations.
- Perform WVS checkout utilizing crew procedures.
- Perform WVS nominal activation utilizing crew procedures.
- Perform nominal WVS camera image improvement based on varying lighting conditions.
- Perform WVS malfunction procedures based on given problems.
- Conduct task monitoring, closeout documentation, and problem resolution via IVA/EVA communication and camera selection.
- Route and record WVS video signals to PL3/monitor and V10s for recording.
- Record and playback WVS video.
- Properly deactivate the WVS.

# 24 **LDRI EQ 31001**

Title: Laser Dynamic Range Imager Equipment

Duration: 1.5 hours Medium: Classroom

Note: This lesson required only if OBSS is manifested. Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT

Source: DX46/Photo/TV Section

Date: 06/05

Lesson(s) Replaced: ISIS EQ 31001 Equipment Required: Computer, projector Prerequisite Lesson(s): CCTV OPS 32019

#### 24 LDRI EQ 31001 (Concluded)

Synopsis:

This lesson will introduce the crew to the Laser Dynamic Range Imager (LDRI) instruments used on the Orbiter Boom Sensor System (OBSS) boom for Shuttle Thermal Protection System (TPS) inspection. LDRI is mounted on the end of the OBSS boom. Discussed topics will include sensor design, power requirements, system control, data transfer and storage. Shuttle integration and inspection method/timeline. This lesson will prepare the crew to operate the LDRI hardware in the subsequent LDRI OPS 31012 lesson.

Objectives:

- Understand the LDRI instrument design and capabilities.
- Understand the power and data interfaces between LDRI and the Shuttle.
- Understand how LDRI is controlled.
- Understand how to collect and downlink LDRI instrument video.
- Understand how LDRI will be used with the Shuttle RMS for TPS inspection.

#### 25 **LCS EQ 31001**

Title: Laser Camera System Equipment

2.0 hours Duration: Medium: Classroom

Note: This lesson only reg'd if OBSS manifested.

COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT Student:

DX46/Photo/TV Section Source:

Date: 06/05

Lesson(s) Replaced: None

**Equipment Required:** Computer, projector, A31p laptop with LCS software

Prerequisite Lesson(s): LDRI EQ 31001

Preparation: None

Synopsis:

This lesson will introduce the crew to Sensor Package 2 used on the OBSS boom for Shuttle Thermal Protection System (TPS) inspection. Sensor Package 2 is the Laser Camera System (LCS) with Integrated Sensor Inspection System (ISIS) Digital Camera (IDC) and is statically mounted on the end of the OBSS boom. Discussed topics will include sensor design, power requirements, system control, data transfer and storage, shuttle integration, inspection method/timeline and IDC operations. This lesson will prepare the crew to operate Sensor Package 2 from the A31p laptop in subsequent inspection training

sessions in the SMS.

#### 25 LCS EQ 31001 (Concluded)

- Objectives: Understand the Sensor Package 2 instrument design and capabilities.
  - Understand the power and data interfaces between Sensor Package 2 and the Shuttle.
  - Understand how Sensor Package 2 is controlled.
  - Understand how to collect and downlink Sensor Package 2 data.
  - Understand how Sensor Package 2 will be used with the Shuttle RMS for TPS inspection.

#### 26 **LDRI OPS 31012**

Title: Laser Dynamic Range Imager Operations

Duration: 2.0 hours

FFT or CCT or SMS FB or SMS GNS Medium:

Note: This lesson required only if OBSS is manifested.

As assigned by CDR. Student: DX46/Photo/TV Section Source:

04/06 Date:

Lesson(s) Replaced: **LDRI OPS 31019** 

Equipment Required: See Facility Utilization Request.

Prerequisite Lesson(s): LCS EQ 31001, PDRS UNDOCK SURVEY 91069

Preparation: None

Synopsis:

This lesson will give the crew a chance to perform hands-on procedures with the actual or simulated Laser Dynamic Range Imager (LDRI) hardware while in the flight deck environment of the FFT. This will allow them to understand the panel interfaces to LDRI hardware and be able to properly route video as required within the flight deck.

#### Objectives:

- Understand the flight deck panel interfaces to LDRI hardware.
- Identify individual LDRI system switches and understand their function.
- Understand the procedures involved with LDRI and the interrelationships between checklists.
- Perform LDRI activation, operation, and deactivation procedures.
- Understand LDRI malfunction procedures.

# 27 **C/L CAMR OPS 91019**

Title: Centerline Camera Operations

Duration: 2.0 hours

Medium: FFT

Student: As assigned by CDR. Source: DX46/Photo/TV Section

Date: 02/01

Lesson(s) Replaced: None

Equipment Required: See Facility Utilization Request.

Prerequisite Lesson(s): CCTV OPS 31019

Preparation: None

Synopsis: During this two-hour lesson, the student will perform the setup and

operation of the Battery Speaker Microphone (BPSMU), Camcorder, and Centerline camera. The lesson will conclude with a setup and operation of

Video Switching Unit (VSU) failure associated hardware to perform

Centerline camera operations.

Objectives: • Understand the H/W and signal routing required to perform BPSMU audio-only operations.

- Understand the H/W and signal routing required to perform BPSMU with Camcorder operations.
- Understand the H/W and signal routing required to perform Centerline camera operations.
- Understand the H/W and signal routing required to control the Centerline camera with a VSU Failure configuration.
- Configure and operate the BPSMU in an audio-only configuration from the Orbiter Docking System (ODS).
- Configure and operate the BPSMU and Camcorder from the ODS.
- Configure and operate the Centerline camera. Perform Centerline camera alignment verification.
- Configure the flight deck for VSU failure operation. Operate the Centerline camera with the VSU Failure H/W.

#### 28 **CCTV LIGHTING 91019**

Title: CCTV Lighting

Duration: 2.0 hours

Medium: FFT

Student: As assigned by CDR.

**Note:** This lesson may be performed out of sequence in preparation for

integrated simulations if deemed necessary. Lesson must be

scheduled after hours for lights-out operation.

Source: DX46/Photo/TV Section

Date: 10/05

Lesson(s) Replaced: APPR&DOCK TV 91020

Equipment Required: See Facility Utilization Request.

Prerequisite Lesson(s): C/L CAMR OPS 91019

Preparation: None

Synopsis:

In this lights-out lesson, the crewmember will start off looking at centerline camera views of a docking target under various lighting conditions. They will learn what camera settings work best for each situation and understand what auxiliary lighting options work best. A simulated docking to the target will be performed. The crewmember will then learn to control and evaluate the capabilities of Videospection and Payload Bay Camera illuminator lights while also learning about the low light capabilities of the different cameras.

#### Objectives:

- Properly mount the centerline camera monitor overlay.
- Understand centerline camera exposure settings for video of a docking target under a range of lighting conditions.
- Change the camera focus in a timely fashion to maintain a sharp picture of the docking target during the final phases of the docking.
- Understand auxiliary lighting configurations for a range of different lighting conditions.
- Know how to activate/deactivate the payload bay camera and Videospection camera illuminators.
- Understand the low light capabilities of the payload bay cameras.
- Understand the capabilities of the camera illuminators under different lighting conditions.

### 29 **IR CAMR EQ 31001**

Title: Infrared Camera Equipment

Duration: 2.0 hours Medium: Classroom

Student: EVA and IVA crewmembers Source: DX46/Photo/TV Section

Date: 06/08

Lesson(s) Replaced: EVA IR CAMR EQ 31001

Equipment Required: IR camera, computer, projector

Prerequisite Lesson(s): BASIC PHOTO 31001

Preparation: None

Synopsis: This lesson will introduce the crew to the Infrared (IR) camera that will be

used for Thermal Protection System (TPS) or other thermal related inspections. The topics will cover camera assembly and operations.

Objectives: • Understand basic thermography concepts and applications.

• Understand the Infrared (IR) camera design and capabilities.

• Understand the Remote Control Unit (RCU) keypad and menus.

• Understand how movies are collected and transferred to a PGSC.

Understand how the camera will be used for TPS inspection.

### 30 IR CAMR SKL 31001

Title: Infrared Camera Skills

Duration: 2.0 hours Medium: Classroom

Student: EVA and IVA crewmembers Source: DX46/Photo/TV Section

Date: 06/08

Lesson(s) Replaced: EVA IR CAMR SKL 31209

Equipment Required: IR camera, TPS samples, PGSC

Prerequisite Lesson(s): IR CAMR EQ 31001

Preparation: None

Synopsis: This lesson will allow the crewmembers to use the camera to image

Reinforced Carbon Carbon (RCC) targets and practice techniques for capturing the desired imagery. The topics will cover camera assembly,

operations and imagery downloading to the laptop.

Objectives: • Understand the Infrared (IR) camera hardware.

Understand how to operate the camera.

Record movies and transfer them from Random Access Memory (RAM)
 to the Compact Flack (CF) cord

to the Compact Flash (CF) card.

# 30 IR CAMR SKL 31001 (Concluded)

- Understand how the camera will be used for Thermal Protection System (TPS) inspection.
- Understand how movies are collected and transferred to a PGSC.

#### 31 **SPECIAL PHOTO 31001**

Title: Special Photo Operations

Duration: 1.0 hour Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS 1

Source: DX46/Photo/TV Section

Date: 04/06

Lesson(s) Replaced: SPECIAL PHO 31001

Equipment Required: Camera system hardware, slide projector, FDF

Prerequisite Lesson(s): EXT PHO SKL 31153

Preparation: None

Synopsis: The crew will receive a briefing including a slide presentation for special

photographic opportunities. The unique photographic situations during EVA, payload deploy, OMS burns, lighting, night operations, etc., will be

discussed.

Objectives: • Gain an in-depth understanding of various pieces of specialized

hardware such as night scopes, nocturnal lenses, and high speed

emulsions.

Gain basic knowledge needed to photograph a multitude of space

images.

### 32 **PHO/TV PROC 31019**

Title: Generic Photo/Television Procedures

Duration: 2.0 hours Medium: FFT or CCT

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS 1 (Schedule in

groups of 2-3.)

Source: DX46/Photo/TV Section

Date: 04/06

Lesson(s) Replaced: PHO/TV PROC 21020

Equipment Required: See Facility Utilization Request, FDF Prerequisite Lesson(s): EXT PHO SKL 31153, CCTV OPS 31019

# 32 PHO/TV PROC 31019 (Concluded)

Synopsis:

This lesson consists of the performance of integrated photo and CCTV procedures including unstowage, assembly, operation, disassembly, and stowage using the appropriate FDF documents. Flight-specific documentation is desirable, but not required.

After a short classroom briefing on Photo/TV Checklist organization, the students will set up typical scenes involving the use of in-cabin photo and CCTV cameras as well as payload bay CCTV cameras. Student performance using the CCTV system can be evaluated by observing the onboard monitors. In the case of photo, film may be exposed during the lesson and used to evaluate student performance.

Objectives:

- Gain a basic understanding of Photo and TV systems in relation to specific flight scene requirements within the orbiter environment.
- Be able to utilize the generic FDF procedures to setup and activate Photo/TV scene requirements.

# 33 **ISS EXT SRVY 91001**

Title: International Space Station (ISS) External Survey

Duration: 1.0 hours
Medium: Classroom

Student: COMMANDER, Pilot, MS 1, MS 2, MS 3, MS 4, MS 5, ISS

Crewmember Going Up (Attendance per CDR.)

Source: KX/Image Science and Analysis Group (IS&AG)

Date: 06/08

Lesson(s) Replaced: None

Equipment Required: Computer, projector, screen, photographs

Prerequisite Lesson(s): PHO/TV PROC 31019

Preparation: Review Photo/TV checklist listed ISS external survey requirements and

procedures.

Synopsis:

During this 1.0 hour lesson, the student will be instructed on the acquisition of ISS external still and video imagery through a review by KX personnel of previous mission imagery acquired during the various phases of a Shuttle flight to the ISS (approach, docking, docked, backaway, and fly-around). The usefulness of various lighting conditions will be reviewed along with a brief overview of how ISS External Survey imagery has been used to access the condition of ISS external surfaces. DX personnel will review the sections of the P/TV Checklist associated with ISS External Survey imagery acquisition. In addition to instruction on the collection of still and video imagery of the ISS external surfaces, there will be instruction by KX on the procedures for video acquisition of ISS appendage motion during dedicated structural dynamics tests or other

# 33 <u>ISS EXT SRVY 91001 (Concluded)</u>

opportunities such as Reboost or Collision Avoidance maneuvers. There will also be a review of the ISS Exterior Images CD which is flown as a reference in the FDF. This lesson will prepare the crew to meet the ISS External Survey imagery requirements listed in IDRD Annex 3 tables.

#### Objectives:

- Understand the ISS external survey photographic and video requirements.
- Understand the importance of the ISS external survey imagery for change detection and trouble-shooting through review of existing areas of concern on the ISS external surface.
- Understand the types of debris that can be seen through Shuttle windows by reviewing previous anomalies and be sensitized that much of this debris is expected and usually not of major concern.
- Understand proper camera settings for acquisition of imagery of any anomalous debris seen through the windows.
- Understand the periods in which ISS survey targets should be acquired.
- Understand proper camera configurations and lighting situations for photographing or video taping ISS.
- Know where the ISS external survey procedures and requirements are listed in the Photo/TV checklist.
- Understand the video set-up for the Structural Dynamics tests.
- Understand where the ISS Exterior Images CD is stowed and what images are available on the CD.
- Understand the major components of the ISS configuration for their mission.

#### 34 PHO/TV PROC 91019

Title: Flight-Specific Photo/Television Procedures

Duration: 2.0 hours
Medium: FFT or CCT

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT (Schedule in groups

of up to 4.)

Source: DX46/Photo/TV Section

Date: 04/06

Lesson(s) Replaced: PHO/TV PROC 21020

Equipment Required: See Facility Utilization Request, Flight-specific Photo/TV

Checklist

Prerequisite Lesson(s): MINICAM PHO SKL 31019, PHO/TV PROC 31019,

SPECIAL PHOTO 31001, LDRI OPS 31012, WVS OPS 31019, CCTV LIGHTING 91019, ET PHO SKL 31001, IR CAMR SKL 31001,

D2XS EVA PHO SKL 31031

# 34 PHO/TV PROC 91019 (Concluded)

Preparation: None

Synopsis: This lesson consists of the performance of photo and TV procedures in a

flight-configured trainer. The student will set up selected flight-specific in cabin photo and TV scenes utilizing flight-specific Photo/TV Checklist. Additionally, the payload bay will be properly configured with payload mockups allowing the student to evaluate CCTV camera fields-of-view,

blockages, etc.

Objectives: • Gain understanding of photo and TV systems in support of scene

requirements in the flight-configured orbiter environment.

Be able to use the flight-specific FDF procedures to set up and activate
 the able to TV herebooks.

the photo/TV hardware.

# 35 PHO/TV PROC 92019

Title: Flight-Similar Photo/Television Procedures

Duration: 2.0 hours Medium: FFT or CCT

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT (Schedule in groups

of up to 4.)

Source: DX46/Photo/TV Section

Date: 02/01

Lesson(s) Replaced: None

Equipment Required: See Facility Utilization Requirement, Flight-specific Photo/TV

checklist

Prerequisite Lesson(s): PHO/TV PROC 91019

Preparation: None

Synopsis: Refer to PHO/TV PROC 91019 for synopsis.

Objectives: Refer to PHO/TV PROC 91019 for objectives.

# 36 PHO/TV PROC 93019

Title: Flight-Similar Photo/Television Procedures

Duration: 1.0 hour Medium: FFT or CCT

**Note:** This is an optional session.

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT (Schedule is groups

of up to 4.)

Source: DX46/Photo/TV Section

Date: 02/01

Lesson(s) Replaced: PHO/TV PROC 33020

Equipment Required: See Facility Utilization Request; flight-specific Photo/TV

checklist

Prerequisite Lesson(s): PHO/TV PROC 92019

Preparation: None

Synopsis: This is a final photo/TV procedures lesson covering late hardware and

procedure changes.

Objectives: Refer to PHO/TV PROC 91019 for objectives.

### **37 CAMR REVIEW 41001**

Title: Camera Review

Duration: 2.0 hours Medium: Classroom

**Note:** This class may be scheduled in crew quarters during quarantine.

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS 1

Source: DX46/Photo/TV Section

Date: 02/01

Lesson(s) Replaced: None

Equipment Required: Camera systems manifested, FDF

Prerequisite Lesson(s): All PHOTO/TV lessons deemed necessary for the specific

mission. This should be the last PHOTO/TV class prior to

flight.

Preparation: None

Synopsis: This lesson will provide the student with a review of the hands-on

operation of any camera hardware system with instructor supervision.

Objectives: • Obtain a reinforced understanding of any camera system.

Obtain a briefing on last minute updates and changes to hardware

and/or procedures.

# SECTION 6.0 ASCENT/ENTRY FLIGHT OPERATIONS TRAINING COURSE

Ascent/Entry Flight Operations training prepares orbiter crewmembers for flight operations for the period from crew ingress to orbital insertion and deorbit burn through landing. The majority of this training is accomplished in the SMS. All necessary 20000-level lessons, including Qual lessons for all required crewmembers, must be completed prior to starting Ascent/Entry Flight Operations Training.

30000-level lessons are intended for assigned crews. All these lessons would be taken by assigned crews once before their flight and some might be repeated prior to subsequent flights. The number of lessons to be repeated depends on the time elapsed since the crew's last flight and on the time required for a new combination of experienced crewmembers to achieve an adequate level of cockpit coordination.

Those lessons with code numbers beginning with a 9 are intended for assigned crews and require the use of a simulator software load that closely resembles the flight software and vehicle configuration to be used by the crew on their assigned flight. These lessons are repeated by a crew prior to each flight regardless of previous flight assignments. The 30000-level and 90000-level lessons should be conducted with the CDR, PLT, MS 2, and any other crewmembers, who will have an active role in the ascent or entry phase.

Manual flying techniques are covered in several lessons. All CDRs should be proficient in manual skills for nominal ascents, aborts, and entries, at the beginning of assigned crew training. Proficiency in manual control during first stage is not a requirement for this training course.

Prior to each SMS lesson the crew may meet with the instructors for an informal briefing as necessary. Also, there are several briefings, which are a formal part of the ascent/entry course. The purpose of these briefings is to discuss what will be occurring during the subsequent lessons and to cover any questions, which the crewmembers may have. The lesson descriptions list all reading material and checklists, which should be reviewed prior to the briefing.

Space Flight Resource Management (SFRM) lessons are included in this course to enhance team effectiveness and to ensure mission safety and success. A flow chart diagram depicting the entire SFRM flow may be found in Appendix B of the catalog.

Detailed descriptions of the objectives for each of the lessons along with information on the conduct of these lessons are included in this section of the catalog.

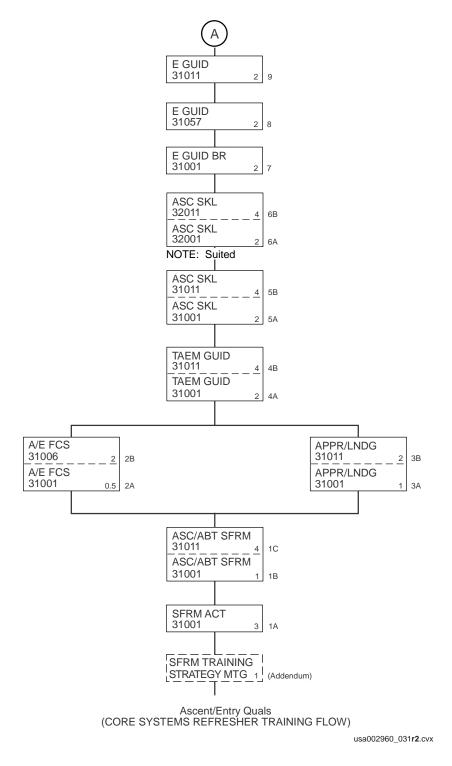


Figure 6-1. Ascent/Entry Flight Operations Lesson Flow Chart (Sheet 1 of 3)

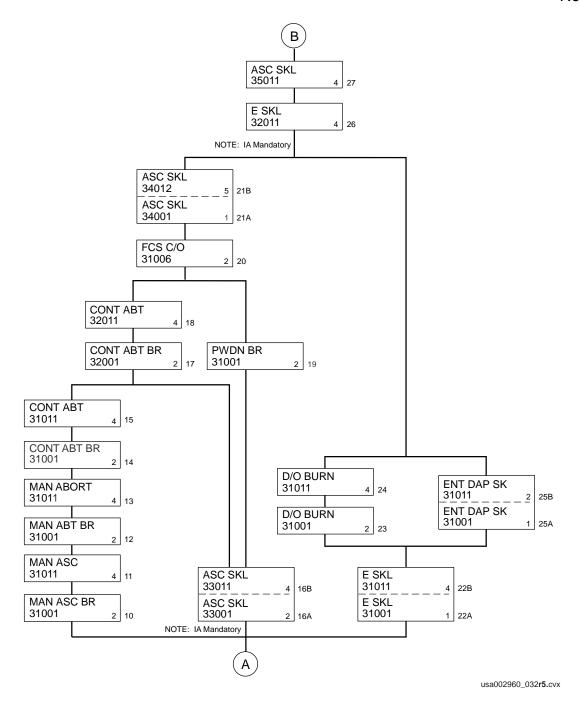


Figure 6-1. Ascent/Entry Flight Operations Lesson Flow Chart (Sheet 2 of 3)

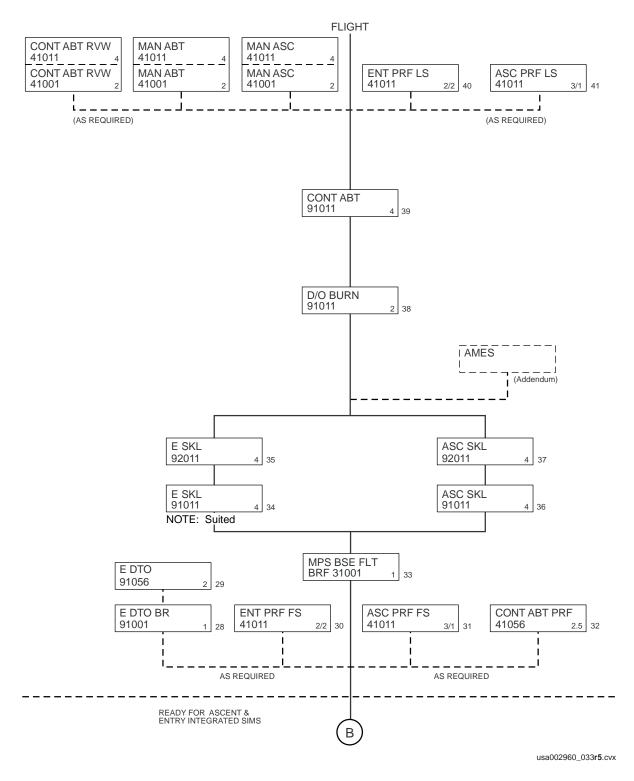


Figure 6-1. Ascent/Entry Flight Operations Lesson Flow Chart (Sheet 3 of 3)

Table 6-1. Ascent/Entry Flight Operations Crew Training Requirements

Date Last Modified: 06/08 **Non-Crew Rotation Crew Rotation** Ref Sched **Lesson Code** Media С MS3 MS4 PS MS2 Alt Fac Stage Num Hrs Code MS1 MS2 С MS1 Comments Schedule assigned SFRM ACT 31001 CLR IA if possible Ascent MSs ASC/ABT SFRM 31001 CLR required 1B Ascent MSs ASC/ABT SFRM 31011 MB GNS, FB required CLR 0.5 0.5 0.5 0.5 0.5 0.5 2A A/E FCS 31001 0.5 Asc/Ent MSs opt'l 2B A/E FCS 31006 SST Asc/Ent MSs opt'l 3A APPR/LNDG 31001 CLR Entry MS opt'l MB APPR/LNDG 31011 GNS, FB Entry MS opt'l TAEM GUID 31001 CLR Entry MS opt'l TAEM GUID 31011 MB GNS, FB Entry MS opt'l ASC SKL 31001 CLR Ascent MS opt'l МВ ASC SKL 31011 GNS, FB Ascent MS opt'l ASC SKL 32001 CLR Ascent MS opt'l Suited; Ascent MS ASC SKL 32011 MB GNS, FB opt'l E GUID BR 31001 CLR E GUID 31057 CBT Entry MS opt'l MB Entry MS opt'l E GUID 31011 GNS, FB MAN ASC BR 31001 CLR MAN ASC 31011 MB GNS, FB Ascent MS opt'l MAN ABT BR 31001 CLR Ascent MS opt'l MAN ABORT 31011 MB GNS, FB Ascent MS opt'l CONT ABT BR 31001 CLR MB GNS, FB CONT ABT 31011 ASC SKL 33001 CLR Ascent MS opt'l Ascent MS opt'l, IA ASC SKL 33011 МВ GNS, FB mandatory CONT ABT BR 32001 CI R MB GNS, FB **CONT ABT 32011** FCS C/O 31006 SST Entry MS opt'l E SKL 31001 CLR Entry MS opt'l 22A E SKL 31011 MB GNS, FB Entry MS opt'l D/O BURN 31001 CLR Entry MS opt'l MB D/O BURN 31011 GNS, FB Entry MS opt'l **ENT DAP SK 31001** CLR Entry MS opt'l **ENT DAP SK 31011** MB GNS, FB Entry MS opt'l Sub Total for Stage Stage Totals Per Crewmember: 83.5 83.5 83.5 22 83.5 83.5 83.5 83.5

Table 6-1. Ascent/Entry Flight Operations Crew Training Requirements (Continued)

																	Date La	st Modified: 06/08
						Non-Crew Rotation								Crew R	otatior	1		
	Ref				Sched													
Stage	Num	Lesson Code	Media	Hrs	Code	С	P	MS1	MS2	MS3	MS4	PS	С	Р	MS1	MS2	Alt Fac	Comments
3	19	PWDN BR 31001	CLR	2	5	2	2	2	2	2			2	2	2	2		
3	21A	ASC SKL 34001	CLR	1	4	1	1		1				1	1		1		Ascent MS opt'l
																		MS1 and MS2
																		required for first 2
3	21B	ASC SKL 34012	FB	5	5	5	5	5	5	5			5	5	5	5	GNS	hours
																		Entry MS opt'l, IA
3		E SKL 32011	MB	4	4	4	4		4				4	4		4	GNS, FB	mandatory
3	27	ASC SKL 35011	MB	4	4	4	4		4				4	4		4	GNS, FB	Ascent MS opt'l
																		Includes Flight
																		Director,
																		CAPCOM, and
_	00	MDO DOE ELT DDE 04004	OL D						1					,		1		assigned Booster
3	33	MPS BSE FLT BRF 31001	CLR	1	3	D O	1		1				1	1		1		Flight Controller
3		Sub	Total for Stage	17	Stage Totals	17	17	7	17	7	0	0	17	17	7	17		
3				17		17	17		17	,	U	U	17	17		17		
																		Suited; Entry MS
2	34	E SKL 91011	мв	4	4	4	4		4				4	4		4	GNS, FB	opt'l
2	35	E SKL 92011	MB	4	4	4	4		4				4	4		4	GNS, FB	Entry MS opt'l
2	36	ASC SKL 91011	MB	4	4	4	4		4				4	4		4	GNS, FB	Ascent MS opt'l
2	37	ASC SKL 92011	МВ	4	4	4	4		4				4	4		4	GNS, FB	Ascent MS opt'l
2	38	D/O BURN 91011	MB	2	4	2	2		2				2	2		2	GNS, FB	Entry MS opt'l
2		Sub	Total for Stage		Stage Totals	Per Crewmember:												
2				18		18	18	0	18	0	0	0	18	18	0	18		
1	39	CONT ABT 91011	MB	4	4	4	4	4	4				4	4	4	4	GNS, FB	
1		Sub	Total for Stage		Stage Totals	Per Cre	ewmemb	er:										
1				4		4	4	4	4	0	0	0	4	4	4	4		

Table 6-1. Ascent/Entry Flight Operations Crew Training Requirements (Concluded)

Date Last Modified: 07/07

							Non-Crew Rotation								otatior	1		
	Ref				Sched													
Stage	Num	Lesson Code	Media	Hrs	Code	С	Р	MS1	MS2	MS3	MS4	PS	С	Р	MS1	MS2	Alt Fac	Comments
0	28	E DTO BR 91001	CLR	1	4	1	1		1				1	1		1		Entry MS opt'l
0	29	E DTO 91056	SESF	2	4	2	2		2				2	2		2		Entry MS opt'l
0	30	ENT PRF FS 41011	MB	2	4	2	2		2				2	2		2	GNS, FB	As needed
0	31	ASC PRF FS 41011	MB	3	4	3	3		3				3	3		3	GNS, FB	As needed
0	32	CONT ABT PRF 41056	SESF	2.5	4	2.5	2.5	2.5	2.5				2.5	2.5	2.5	2.5		
0	40	ENT PRF LS 41011	MB	2	4	2	2		2				2	2		2	GNS, FB	As needed
0	41	ASC PRF LS 41011	MB	3	4	3	3		3				3	3		3	GNS, FB	As needed
0		MAN ASC 41001	CLR	2	1 - 3	2	2		2				2	2		2		As needed
0		MAN ASC 41011	SMS/MB	4	1	4	4		4				4	4		4		As needed
0		MAN ABT 41001	CLR	2	1 - 3	2	2		2				2	2		2		As needed
0		MAN ABT 41011	SMS/MB	4	1	4	4		4				4	4		4		As needed
0		CONT ABT RVW 41001	CLR	2	1 - 3	2	2	2	2				2	2	2	2		As needed
0		CONT ABT RVW 41011	SMS/MB	4	1	4	4	4	4				4	4	4	4		As needed
0		Sub	Total for Stage		Stage Totals	Per Crewmember:												
0				33.5		33.5	33.5	8.5	33.5	0	0	0	33.5	33.5	8.5	33.5		

Additional Objective Content for 30000-Level Extra Runs & 40000-90000-Level Ascent Skills, Entry Skills, and Proficiency Lessons

The purpose of this objective list is to document those objectives deemed important for crew training, but that are not covered in the scripted 30000-level Ascent and Entry Skills lessons. The new QUEST training philosophy deems it unnecessary to train every documented procedure/failure, and this list complies with that philosophy. This philosophy presumes that a trained crew will still be able to perform all procedures, including all nominal mission success activities, even though they may not have seen all of those procedures during training. At no time should safety be compromised. An adequate margin of safety (both in the scripts themselves and during the sims), as defined by the combined experience of all participants, should be maintained.

These objectives are to be used by the Team Lead and SMS Team to develop scripts, as needed, for any 30000-level extra runs, as well as any 40000-level/90000-level Ascent Skills, Entry Skills and Proficiency lessons. Some training templates will include as few as zero 40000-level lessons (this is an acceptable level). All objectives listed can be accomplished in the 30000-level and 90000-level lessons. Multiple-discipline systems and crew interaction should be built into the scripts in order to exercise Space Flight Resource Management (SFRM). SFRM interaction is inherent in the 30000-level scripted cases. Individual SMS Teams are responsible for SFRM training, utilizing opportunities as they present themselves.

It is the responsibility of the Team Lead and SMS Team to script runs to cover all of the additional objectives listed here, as well as any missed objectives from the 30000-level scripted lessons. Any listed objective with the "{x times}" notation following it is to be scripted the number of times listed in order to maintain proficiency. All other objectives are to be scripted at least once.

#### 30000-Level Skills:

Four runs have been scripted for each of the Ascent and Entry Skills 30000-level lessons. In some lessons (with a very proficient crew, where runs went extremely well with short debriefs, with no simulator problems, etc.), there may be extra time available to perform an additional run. Thus, the Team Lead and SMS Team should plan for and script an additional run for each of the 30000-level skills lessons. Objectives from this list should be scripted into any extra run developed.

#### 40000/90000-Level Ascent Skills, Entry Skills, and Proficiency Lessons:

The Team Lead and SMS Team will use these objectives to script all 40000-level (if any) and 90000-Level Ascent Skills, Entry Skills, and Proficiency Lessons. The SMS Team should also periodically introduce failures (first utilizing objectives from the available list, then adding supplementary objectives, if necessary) in all systems to

stress crew understanding of vehicle-specific problems and Launch Commit Criteria (LCC) for both GO and NO-GO scenarios.

### **DPS/NAV Objectives**

#### DPS

- 1. Crew-initiated Launch Hold (Discussion only)
- 2. DK bus fail at a PASS GPC
- 3. Dual commanders
- 4. SUMWORD ICC message on a TAL
- 5. BFS power transient
- 6. BFS fail to STBY (for COMM)\*
- 7. One failure away from BFS self-engage
- 8. BFS self-engage
- 9. BFS disengage
- 10. Engage for RS split close to MECO
- 11. Engage for no Roll Program
- 12. Pad Abort with BFS in MM102
- 13. Post-Landing procedures

#### NAV

- 1. IMU reanchoring
- 2. NAV DELTA ZERO around 200K (reanchoring conditions not met)
- BFS silent TACAN dilemma
- 4. MLS RM FAIL
- 5. MLS RM DLMA in elevation

<sup>\*</sup> Denotes an objective listed in multiple disciplines. Scripting the objective once will accomplish that objective for all disciplines.

### **Systems Objectives**

### APU/HYD/MECH

- 1. APU Shift to High Speed
- 2. Late APU Start
- 3. NWS Loss\*
- 4. Water Spray Boiler Leak
- Manual/Software ET Door Closure
- 6. Hydraulic Accumulator Leak
- 7. APU Fuel Leak unisolatable/isolatable
- 8. Gearbox Friction

#### **EPS**

- 1. FC Coolant Pump Fail
- 2. FC Stack T High
- Reac Valve Fail Closed
- 4. Essential Bus with Main Controller circuit breaker popped
- 5. Main Bus Disconnect (recoverable)
- 6. 3-Phase Motor failure
- 7. CRYO Leaks

#### **ECLSS**

- 1. RTLS for Cabin Leak
- No FES Command due to PL Bus Loss
- 3. False Fire
- 4. O<sub>2</sub>/N<sub>2</sub> Leak into the cabin
- 5. Fan Degrades
- 6. H<sub>2</sub>O Loop Controller Fail
- 7. Use of the GPC position of the H<sub>2</sub>O Loop switch
- \* Denotes an objective listed in multiple disciplines. Scripting the objective once will accomplish that objective for all disciplines.

## **COMM Objectives**

### Audio/UHF

- 1. ICOM loss
- 2. Loss of all voice with command capability
- 3. Loss of all voice without command (Rev 2)
- 4. UHF power filter - exercise guard frequency
- 5. UHF pwr amp

### Antenna Management

1. BFS fail to STBY\*

### S-band PM/GCIL

- 1. Loss of uplink voice and command (Pre-Amp)
- 2. Loss of downlink voice and data (Pwr Amp)
- 3. Transponder mode with OF 3 before TDRS

#### FDF Procedures

- 1. Comm Lost (multi-pnls) all the way through Mal Proc
- 2. Post-Landing (Loss of Comm)

#### Post-Landing

- 1. No S-band Comm, use UHF
- 2. No command (ant. pointing and Ops Recorders)
- \* Denotes an objective listed in multiple disciplines. Scripting the objective once will accomplish that objective for all disciplines.

### **CONTROL Objectives**

#### <u>Ascent</u>

- 1. Launch Abort/Recycle
- 2. TAL Redesignation
- 3. Post-MECO TAL
- 4. Alternate TAL Site
- 5. FRCS OMS-2
- 6. Single Engine OMS-2
- 7. OMS Helium Tank P Low (either a Sensor Fail, Prop Tk Lk, He Tk Lk, or He Line Lk)
- 8. APUs failed, ATVC Impact
- 9. BFS No-Go (either no SERC, 2 SRB RGAs failed, or BFS RM actions not complete)
- 10. Off-nominal Bucket (hot/cold SRBs) {2 times}

#### Ascent or Entry

- 1. Select Short Field Speedbrake
- 2. Crosswind Limits (calm to 15 kts) {2 times}
- 3. Tailwinds/Headwinds
- 4. Select Close-In aimpoint
- NWS fail\*
- 6. Visibility/Clouds {2 times}
- 7. Tire Failure {2 times}
- 8. Expedited Powerdown due to OMS/RCS Fu Leak
- 9. Green Dot
- 10. Uncommanded Drag Chute Deploy/Jettison {2 times}
- 11. Single APU Landing
- \* Denotes an objective listed in multiple disciplines. Scripting the objective once will accomplish that objective for all disciplines.

# **Entry**

- 1. NWS Fail light at WONG {2 times}
- 2. Lakebed Required

#### 1A **SFRM ACT 31001**

Title: Space Flight Resource Management Assigned Crew Training

Duration: 3.0 hours Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS 1 (CB IA

recommended)

Training Team members encouraged to attend. Note:

DS66/G&C/Propulson Training Group Source:

07/99 Date:

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): Ascent/Entry Quals (CORE SYS), SFRM Training Strategy

Mtg (Addendum)

Preparation: None

Synopsis: This interactive course is designed as an introduction to the philosophies

and application of Space Flight Resource Management (SFRM). It briefly

covers the definition of SFRM, Windows of Awareness, and the six

Performance Elements. A video tape is shown to the crew demonstrating

poor performance in these elements. The crew is introduced to

observable skills relating to the Performance Elements. They are then given an opportunity to assess the performance of a Shuttle crew in a Return-To-Launch Site (RTLS) simulation utilizing the SFRM Crew Debrief Facilitation Guide. They are shown a second RTLS and are allowed to compare and contrast crew actions with that of the first. Finally, recent

SFRM-related events are discussed.

Following this course, the crew will understand the basic philosophies of Objectives:

> SFRM and the application to the training and operational environments. They will be familiar with the SFRM Crew Debrief Facilitation Guide and

how it will be applied.

#### 1B ASC/ABT SFRM 31001

Title: Ascent Trajectory/Abort Space Flight Resource Management Prebrief

Duration: 1.0 hour Medium: Classroom

Student: COMMANDER, MS 1, MS 2, PILOT Source: DS66/G&C/Propulsion Training Group

Date: 12/06

Lesson(s) Replaced: None Equipment Required: None

**SFRM ACT 31001** Prerequisite Lesson(s):

### 1B ASC/ABT SFRM 31001 (Concluded)

Preparation: Review:

Crew-Specific Cockpit responsibilities

Abort Mode Boundary definitions

Synopsis: This prebrief is designed to allow a new crew to determine their

crewmember roles as would be utilized during the Ascent flight phase. In addition, the definitions of all abort mode boundary calls are included in handout material, and Space Flight Resource Management (SFRM)

elements are reviewed.

Objectives: At the end of this prebrief, the student will be able to perform the following objectives:

• Determine the crew roles, both prime and backup SFRM, with respect to:

- Nominal uphill
- Abort To Orbit (ATO) (OMS 1 required)
- Transatlantic Abort Landing (TAL)
- Return-To-Launch Site (RTLS)
- Identify crew-specific preferences during ascent (i.e., Integrated Display Processor (IDP) Display management, Space Shuttle Main Engine (SSME) shutdown, abort verification, etc.).
- Discuss the chain of command for the execution of abort decisions.
- List the Abort Mode Boundary Calls, in the proper sequence, for each abort scenario.
- Discuss the immediate actions following an engine failure in relation to each Abort Mode Boundary Call.
- Identify the expected nominal trajectory/guidance cues for the above listed runs.
- Identify the various timeframes for nominal Global Positioning System (GPS) incorporation.

### 1C **ASC/ABT SFRM 31011**

Title: Ascent Trajectory/Abort Space Flight Resource Management

Duration: 4.0 hours

Medium: SMS-MB (SMS-FB, GNS)

Student: COMMANDER, MS 1, MS 2, PILOT (Schedule ascent MSs only.)

Source: DS66/G&C/Propulsion Training Group

Date: 12/06

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ASC/ABT SFRM 31001

Preparation: None

## 1C ASC/ABT SFRM 31011 (Concluded)

Synopsis:

This lesson is designed to allow a new crew to exercise (and adjust to, if needed) their crewmember roles, as would be utilized during the Ascent flight phase. The CDR, PLT, and the ascent MSs will experience Ascent/Abort scenarios in the Ascent flight phase, during which they will be able to facilitate Crew coordination and recognition of trajectory cues for each Ascent/Abort scenario.

Objectives:

At the end of this lesson, the student will be able to perform the following objectives:

- Coordinate the performance of crew roles, both prime and backup Space Flight Resource Management (SFRM), with respect to:
  - Nominal uphill
  - Abort To Orbit (ATO) (OMS 1 required)
  - Transatlantic Abort Landing (TAL)
  - Return-To-Launch Site (RTLS)
- Exercise crew-specific preferences during ascent (i.e., Integrated Display Processor (IDP) DPS Display management, Space Shuttle Main Engine (SSME) shutdown, abort verification, etc.).
- Demonstrate crew coordination and execution of abort decisions (chain of command).
- Make each Abort Mode Boundary Call.
- Identify nominal trajectory/guidance cues for an Uphill, ATO with OMS 1, TAL and RTLS.
- Demonstrate usage of appropriate FDF (Nominal & Off-Nominal).

### 2A **A/E FCS 31001**

Title: Ascent/Entry Flight Control Surfaces Prebrief

Duration: 0.5 hours Medium: Classroom

Student: COMMANDER, MS 2, PILOT (Ascent/Entry MS optional.)

Source: DS66/G&C/Propulsion Training Group

Date: 04/96

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ASC/ABT SFRM 31011

Preparation: None

Synopsis: This prebrief will review the Flight Control System (FCS) operations for the

Ascent and Entry flight phases.

### 2A A/E FCS 31001 (Concluded)

Objectives: At the end of this prebrief, the student will be able to perform the following objectives:

- Identify FCS channel failures using available CRT displays, CRT messages, master alarm and Systems Management (SM) alert.
- State when Fault Detection, Isolation, and Recovery (FDIR) quits and the selection filter downmodes for FCS position feedback errors.
- Define aerosurface positions and moments.
- Explain when manual port bypassing is necessary.
- Explain prioritization as it relates to FCS channel management.
- Explain FCS channel actions in General Purpose Computer (GPC) and Flight Aft Multiplexer/Demultiplexer (FA MDM) failure scenarios.
- Define bodyflap caution and warning.

### 2B **A/E FCS 31006**

Title: Ascent/Entry Flight Control Surfaces

Duration: 2.0 hours Medium: SST 1

Student: COMMANDER, MS 2, PILOT (Ascent/Entry MS optional.)

Source: DS66/G&C/Propulsion Training Group

Date: 04/96

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): A/E FCS 31001

Preparation: None

Synopsis:

This lesson covers the operation of the Flight Control System (FCS) for the Ascent and Entry phases of flight as well as the associated FDF procedures. The crewmembers will be expected to monitor the FCS system throughout the lesson and respond to system failures as they occur.

Objectives:

At the end of this lesson, the student will be able to perform the following objectives:

- Identify FCS channel failures using available CRT displays, CRT messages, master alarm and Systems Management (SM) alert.
- State when Fault Detection, Isolation, and Recovery (FDIR) quits and the selection filter downmodes for FCS position feedback errors.
- Define aerosurface positions and moments.
- Explain when manual port bypassing is necessary.
- Explain prioritization as it relates to FCS channel management.

### 2B A/E FCS 31006 (Concluded)

- Explain FCS channel actions in General Purpose Computer (GPC) and Flight Aft (FA) Multiplexer/Demultiplexer (MDM) failure scenarios.
- Define bodyflap caution and warning.

#### 3A **APPR/LNDG 31001**

Title: Approach and Landing Prebrief

Duration: 1.0 hour Medium: Classroom

Student: COMMANDER, MS 2, PILOT (Entry MS optional.)

Source: DS66/G&C/Propulsion Training Group

Date: 03/96

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ASC/ABT SFRM 31011

Preparation: None

Synopsis: This prebrief is a discussion of Space Flight Resource Management

(SFRM) for approach and landing, landing-specific Flight Rules, and

orbiter systems-related failures.

Objectives: At the end of this prebrief, the student will be able to perform the following

objectives:

- Identify the crew-specific responsibilities required for approach and landing related to the nominal landing timeline duties.
- Describe the impacts to landing with respect to the following:
  - Single Auxiliary Power Unit (APU) landings
  - Braking
  - Short field speedbrake
  - Backup Flight System (BFS) landings
  - Off-nominal wind profiles
  - Drag chute deploys
- Describe expected landing parameters.

#### 3B **APPR/LNDG 31011**

Title: Approach and Landing

Duration: 2.0 hours Medium: SMS-MB

Student: COMMANDER, MS 2, PILOT (Entry MS optional.)

Source: DS66/G&C/Propulsion Training Group

Date: 12/95

Lesson(s) Replaced: None

## 3B APPR/LNDG 31011 (Concluded)

Prerequisite Lesson(s): None

Prerequisite Lesson(s): APPR/LNDG 31001

Preparation: None

Synopsis: This lesson consists of runs that exercise landing Flight Rules and

systems failures.

Objectives: At the end of this lesson, the student will be able to perform the following

objectives:

 Perform nominal landing timeline duties associated with assigned cockpit position.

 Perform single Auxiliary Power Unit (APU) landings, steering tasks, and drag chute deploys.

• Perform a safe landing given any of the following situations:

Crosswinds

Backup Flight System (BFS) landings

Short field speedbrake

Tire failures

### 4A **TAEM GUID 31001**

Title: Terminal Area Energy Management Guidance Prebrief

Duration: 2.0 hours Medium: Classroom

Student: COMMANDER, MS 2, PILOT (Entry MS optional.)

Source: DS66/G&C/Propulsion Training Group

Date: 04/96

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): A/E FCS 31006, APPR/LNDG 31011

Preparation: None

Synopsis: This prebrief will review the basics of Terminal Area Energy Management

(TAEM) guidance including cockpit cues, energy downmode/upmode options, and hardware requirements for TAEM guidance. Other issues relative to TAEM guidance such as high winds and large Heading

Alignment Cone (HAC) turns are also discussed.

Objectives: At the end of this prebrief, the student will be able to perform the following objectives:

 Recognize and explain the following issues associated with large HAC turn angles:

Horizontal Situation Indicator (HSI) HAC errors

Energy dump, pull-up, and pull-up recovery maneuvers

### 4A TAEM GUID 31001 (Concluded)

- Recognize and explain the effect of high winds on the HAC.
- Recognize automatic energy downmodes and upmodes.
- Recognize the need for and execute manual energy downmodes and upmodes.
- Recognize the situation where theta limits must be used for pitch reference in lieu of TAEM guidance, and configure the system accordingly.
- Safely fly throughout TAEM using the theta limits for a pitch reference.
- Safely fly throughout TAEM with a loss of normal Z accelerometer redundancy.

## 4B **TAEM GUID 31011**

Title: Terminal Area Energy Management Guidance

Duration: 4.0 hours Medium: SMS-MB

Student: COMMANDER, MS 2, PILOT (Entry MS optional.)

Source: DS66/G&C/Propulsion Training Group

Date: 04/96

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): TAEM GUID 31001

Preparation: None

Synopsis:

This lesson is designed to demonstrate large Heading Alignment Cone (HAC) turns, high winds on the HAC, a high energy case, a low energy case, loss of Accelerometer Assembly (AA) redundancy, loss of air data redundancy, and the use of Horizontal Situation Indicator (HSI) HAC for bad nay state.

Each run will start at approximately Mach 2.6 and be flown to approach and landing interface. Both CDR and PLT will be given the opportunity to fly each scenario.

#### Objectives:

At the end of this lesson, the student will be able to perform the following objectives:

- Recognize the effects of a large HAC turn angle on Terminal Area Energy Management (TAEM) guidance.
- Safely fly TAEM with an abnormally high energy state.
- Safely fly TAEM with an abnormally low energy state.
- Safely fly TAEM with no AA redundancy.

### 4B **TAEM GUID 31011 (Concluded)**

- Reconfigure the system as required and safely fly TAEM using theta limits, with the loss of air data redundancy.
- Fly the Area Navigation HAC using the HSI for reference.

### 5A **ASC SKL 31001**

Title: Ascent Skills Prebrief

Duration: 2.0 hours Medium: Classroom

Student: COMMANDER, MS 2, PILOT (Ascent MS optional.)

Source: DA72/QUEST

Date: 01/96

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): TAEM GUID 31011

Preparation: Read:

APU Cooldowns/Restarts Prebrief

S-Band PM Nominal Comm Coverage Prebrief

OMS Targeting Prebrief

• 3-phase Motors Stopped Handout

IMU & Entry NAVAID Failures Handout

#### Synopsis:

This is a 3-part prebrief. The topics are OMS Targeting, S-Band Phase Modulation (PM) Nominal COMM Coverage, and Auxiliary Power Unit (APU) Cooldowns/Restarts. This prebrief allows a new crew to determine and develop their crewmember roles and coordination of activities regarding OMS-1/2 Targeting. Secondary emphasis will be placed on the management of OMS-1/2 target determination. The S-Band PM Nominal COMM Coverage Prebrief reviews the nominal ascent COMM coverage along with the high/low freq and high/low data rate relationship. The APU Cooldowns/Restarts prebrief reviews the APU COOLDOWN and RESTART procedures, as well as the reasons/justification for performing an APU Restart.

#### Objectives:

At the end of each discipline-specific prebrief, the student will be able to perform the following objectives:

- OMS Targeting Prebrief:
  - Determine the prime and backup crewmember responsible for performing OMS-1/2 Targeting.
  - State what priority OMS-1/2 Targeting will take in the event of a failure scenario.

## 5A ASC SKL 31001 (Concluded)

- State which other nominal activities will be performed simultaneously with OMS-1/2 Targeting.
- Walk through the post-Main Engine Cutoff (MECO) procedures, given the post-MECO conditions and the required FDF, and practice crew-specific Space Flight Resource Management (SFRM) plan for OMS-1/2 Targeting.
- S-Band PM Nominal COMM Coverage Prebrief:
  - Determine Orbiter COMM coverage per the Ascent Checklist (ASC C/L).
  - Discuss the COMM system configuration (panel A1) per expected COMM coverage.
  - Discuss failure indications associated with the Network Signal Processor (NSP), Transponder, and Communications Security (COMSEC) systems.
  - Explain contingency COMM coverage utilized during a Transatlantic Abort Landing (TAL) and Return-To-Launch Site (RTLS).
- APU Cooldowns/Restarts Prebrief:
  - State why a cooldown is required before restarting a hot APU.
  - Discuss how much cooling time is available.
  - Explain how to verify that a cooldown is working properly.
  - Discuss APU failures that would require a cooldown.
  - Identify those situations where an attempted restart is appropriate.
  - State when the COOLDOWN and RESTART should take place for an APU that:
    - Has suffered an oil overtemp.
    - Is "suspect."
    - Has suffered an unexplained underspeed.
    - Has picked up an unisolable fuel leak.
  - Discuss when a Diagnostic Restart is required.
  - Discuss the likelihood of a successful restart for the above types of failures.

#### 5B **ASC SKL 31011**

Title: Ascent Skills
Duration: 4.0 hours
Medium: SMS-MB

Student: COMMANDER, MS 2, PILOT (Ascent MS optional.)

Source: DA72/QUEST

Date: 01/96

Lesson(s) Replaced: None Equipment Required: None

## 5B ASC SKL 31011 (Concluded)

Prerequisite Lesson(s): ASC SKL 31001

Preparation: None

Synopsis: This is the first 30000-level Ascent Skills lesson in a series of 5 and it is

designed to allow a new crew to determine and develop their crewmember roles and coordination of activities. Primary emphasis is on crew coordination of ascent calls, abort determination and initiation activities, and OMS targeting tasks. Secondary emphasis is on management of basic EPS, DPS, and Main Propulsion System (MPS) failures. Auxiliary Power Unit/Hydraulic (APU/HYD) system management, communication coverage, and Flight Control System (FCS) channel management are also

emphasized.

Objectives:

At the end of this lesson, the student will be able to perform the following objectives:

- Coordinate performance of crew roles with respect to the following:
  - Nominal ascent procedures (from liftoff through OMS-2 burn)
  - Performance boundary calls
  - Abort determination
  - Abort procedures (Abort To Orbit (ATO), Transatlantic Abort Landing (TAL), Return-To-Launch Site (RTLS))
- Identify electrical bus losses without aid from MCC.
- Demonstrate proficiency in the use of Reference Data by identifying equipment losses associated with AC/DC bus losses.
- Select and perform actions necessary to support External Tank (ET)
   Separation (SEP) following Reaction Control System (RCS) jet failures.
- Configure orbiter COMM systems for nominal ascent.
- Identify and recover from S-band Phase Modulation (PM) (voice/ telemetry/command) COMM value based on expected COMM coverage as identified in the Ascent (ASC) Checklist (C/L).
- Manage the following failures to maintain critical systems and capabilities:
  - Space Shuttle Main Engine (SSME) failures
  - Data path failures
  - MPS He leaks
  - Electrical bus failures
  - Fuel cell failures
  - Selected General Purpose Computer (GPC) and Multiplexer/ Demultiplexer (MDM) failures (identify and manage with limited MCC help)
  - APU/HYD system failures
  - Reaction Control System (RCS) leaks and jet failures (identify and manage)
  - FCS channel failures (identify and manage)

### 6A **ASC SKL 32001**

Title: Ascent Skills Prebrief

Duration: 2.0 hours Medium: Classroom

Student: COMMANDER, MS 2, PILOT (Ascent MS optional.)

Source: DA72/QUEST

Date: 03/96

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ASC SKL 31011

Preparation: Read:

Ascent/Entry Restring Rules of Thumb Prebrief

• ET Umbilical Door Prebrief

Abort Dump Failures Prebrief

Flight Critical & GPC DPS Failures Handout

IMU & Entry NAVAID Failures Handout

Audio System Handout

Ascent/Entry Restringing Handout

• Abort Dump Failures Handout

Av Bay Fires Handout

#### Synopsis:

This is a 3-part prebrief. The topics cover Ascent/Entry Restring Rules of Thumb, External Tank (ET) Umbilical Doors, and Abort Dump Failures. The Ascent/Entry Restring Rules of Thumb Prebrief reviews the restring flight rules and FDF procedures for ascent and entry, and examines the "Rules of Thumb" for the best way to approach restringing. The ET Umbilical Door Prebrief reviews the nominal operations of the ET doors during the different ascent trajectories, and the actions required to correct malfunctions that may affect them. The Abort Dump Failures Prebrief discusses the failures that may occur during abort dumps and the rationale for the OMS/Reaction Control System (RCS) procedures pertaining to them.

#### Objectives:

At the end of each discipline-specific prebrief, the student will be able to perform the following objectives:

- Ascent/Entry Restring Rules of Thumb Prebrief:
  - Identify the times and reasons when a restring is allowed per the flight rules.
  - Summarize the rationale for choosing a particular Nominal Bus Assignment Table (NBAT).
  - Discuss the rationale for the steps of the ascent and entry restring FDF procedures.

### 6A ASC SKL 32001 (Concluded)

- ET Umbilical Door Prebrief:
  - Identify the different operations of the ET doors based on the ascent trajectory.
  - Identify crew actions needed when malfunctions occur during ET door operations.
- Abort Dump Failures Prebrief:
  - Explain the purpose of an Abort To Orbit (ATO) dump.
  - Identify the SPEC used to control and time ascent abort dumps.
  - Explain the purpose of smart interconnect.
  - Explain the purpose of mirror image logic.
  - Determine impacts of the following failures during an abort dump:
    - EPS
    - DPS
    - OMS
    - RCS

#### 6B **ASC SKL 32011**

Title: Ascent Skills
Duration: 4.0 hours
Medium: SMS-MB

Student: COMMANDER, MS 2, PILOT (Ascent MS optional.)

Source: DA72/QUEST

Date: 01/96

Lesson(s) Replaced: None Equipment Required: ACESs

Prerequisite Lesson(s): ASC SKL 32001

Preparation: None

#### Synopsis:

This is the second 30000-level Ascent Skills lesson in the series of 5. The crewmembers will be suited for this lesson. The primary goal of the lesson is to familiarize the crewmembers with the limitations of the suits, primarily the gloves and helmets. By having a suited lesson early in the ascent/entry training flow, the crew will be able to make informed decisions about performance capabilities during the remainder of their training, due to the understood limitations of the suits. The lesson emphasis focuses on crew coordination of ascent and abort tasks including the performance of an OMS-1 burn, the application of restring flight rules, and Auxiliary Power Unit (APU) management. Secondary emphasis is placed on Flight Control System (FCS) management, resolution of abort dump failures, and COMM system failures (mainly audio) during aborts.

### 6B ASC SKL 32011 (Concluded)

Objectives: At the end of this lesson, the student will be able to perform the following objectives:

- Coordinate performance of crew roles with respect to the following:
  - Nominal ascent procedures (liftoff through targeting), and performance of an OMS-1 Burn
  - Performance boundary calls
  - Abort determination
  - Abort procedures (Abort To Orbit (ATO), Transatlantic Abort Landing (TAL), and Return-To-Launch Site (RTLS))
- Given the following selected scenarios:
  - Identify General Purpose Computer (GPC) and Multiplexer/
     Demultiplexer (MDM) failure modes for the given signatures.
  - Determine whether a restring is allowed per the flight rules.
  - Using ascent & entry restring procedures, set up and execute a restring at the appropriate time.
- Given hot and cold Solid Rocket Booster (SRB) scenarios, analyze throttle settings and differentiate among nominal, shallow, and two stage buckets.
- Given selected OMS failures during abort dumps, do the following:
  - Diagnose the failure.
  - Perform the appropriate procedure.
- Given selected FCS Channel failures in combination with DPS failures, manage the FCS system.
- Given restring configuration and up to one additional FCS channel failure, determine appropriate FCS configuration, verify planned FCS actions with MCC, and perform.
- Given selected abort scenarios, analyze available cockpit data to do the following:
  - Diagnose loss of data and voice communication.
  - Determine source of loss.
  - Select and perform appropriate procedures to regain or maintain capabilities.
- Manage the following failures to maintain critical systems and capabilities:
  - APU/Hydraulic (HYD) System failures
  - Main Propulsion System (MPS) He leaks

## 7 **E GUID BR 31001**

Title: Entry Guidance Briefing

Duration: 2.0 hours Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT Source: DS66/G&C/Propulsion Training Group

Date: 12/95

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ASC SKL 32011

Preparation: Read:

SCOM; Section 7.3

#### Synopsis:

This lesson covers the guidance algorithm that functions from very high in the atmosphere (Entry Interface) to Mach 2.5 (Terminal Area Energy Management (TAEM) Interface). The orbiter aerodynamic characteristics are reviewed to better understand Entry Guidance. Detailed discussions on how to use the cockpit displays are included. Entry Guidance during a Transatlantic Abort Landing (TAL) abort will be covered very briefly. The TAL-unique aspects of Entry Guidance will be covered in the abort lessons.

#### Objectives:

At the end of this lesson, the student will be able to perform the following objectives:

- Determine desired altitude rate using Trajectory (TRAJ) Displays.
- Describe how Entry guidance controls cross-range.
- Given a TRAJ display, explain which information is derived by Guidance versus the information derived by navigation.
- Use a TRAJ display to identify conditions where the orbiter is violating a high drag boundary.
- Define a high and a low energy, and state what Guidance does in each case.
- State the two different situations where prebank is required.
- State which prebank case is worse, thermally, and explain why.
- Explain why large bank angles are not an aggressive maneuver in early Entry.

### 8 **E GUID 31057**

Title: Entry Guidance

Duration: 2.0 hours Medium: CBT

Student: COMMANDER, MS 2, PILOT (Schedule in groups of 2-4, including

instructor, entry MS optional.)

Source: DS66/G&C/Propulsion Training Group

Date: 12/95

Lesson(s) Replaced: None

Equipment Required: Computer with joystick highly desirable

Prerequisite Lesson(s): E GUID BR 31001

Preparation: None

Synopsis: This CBT is taught with an instructor and at least 2 students. Space Flight

Resource Management (SFRM) techniques and manual entry flying will be

emphasized. The manual flying techniques taught in this class are

designed to explain how Entry Guidance works.

Objectives: At the end of this lesson, the student will be able to perform the following

objectives:

• Fly from the top of Trajectory (TRAJ) 1 to Terminal Area Energy Management (TAEM) interface using desired altitude rate.

- Fly through TRAJ 1 and TRAJ 2 after an "accidental" downmode to Control Stick Steering (CSS) at the first roll command (active control will start at an H dot of +180fps).
- Use a TRAJ display to determine when the orbiter is violating a high drag boundary.
- Fly low energy TRAJ 2 with high DEL AZ (22 deg).
- From the top of TRAJ 2, fly max. NZ and Knots Equivalent Airspeed (KEAS) to TAEM interface. State when this skill is needed.

### 9 **E GUID 31011**

Title: Entry Guidance

Duration: 2.0 hours Medium: SMS-MB

Student: COMMANDER, MS 2, PILOT (Entry MS optional.)

Source: DS66/G&C/Propulsion Training Group

Date: 03/95

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): E GUID 31057

Preparation: None

### 9 **E GUID 31011 (Concluded)**

Synopsis:

This is a hands-on lesson for a CDR and his/her crew. Most runs will be high-energy cases, where the crew must take Control Stick Steering (CSS) and fly the desired Altitude Rate (H\_dot) to avoid over-temping the vehicle. The emphasis will be placed on good Space Flight Resource Management (SFRM), and monitoring AUTO guidance. The crew will get a chance to fly the phugoid damper in this class.

Objectives:

At the end of this lesson, the student will be able to perform the following objectives:

- Successfully fly, under the following conditions, from 350K feet to Terminal Area Energy Management (TAEM) interface, using desired altitude rate:
  - Nominal energy
  - High energy
  - Low energy
- Successfully fly the orbiter through TRAJ 1 and TRAJ 2 after an "accidental" downmode to CSS at the first roll command.
- Monitor the guidance on the Trajectory (TRAJ) displays.
- Use the TRAJ display to determine the following:
  - If the orbiter is violating a high drag boundary
  - If the desired drag is violating a high drag boundary
- Identify when guidance is commanding a minimum bank angle.
- Identify a density shear while in AUTO.
- Successfully fly the phugoid damper.

### 10 **MAN ASC BR 31001**

Title: Manual Ascent Techniques Briefing

Duration: 2.0 hours Medium: Classroom

Student: COMMANDER, MS 2, PILOT (Ascent MS optional.)

Source: DS66/G&C/Propulsion Training Group

Date: 12/06

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): E GUID 31011

Preparation: Read:

MAN ASC BR 31001 handout; received 2 days prior to briefing

### 10 MAN ASC BR 31001 (Concluded)

Synopsis:

This briefing is the first in a series of 2 briefings. They are both designed to review the cockpit indications and techniques used to fly nominal, Abort To Orbit (ATO), and Transatlantic Abort Landing (TAL) trajectories manually. A discussion of cockpit indications and techniques used during manual control is provided to prepare an assigned crew for Manual Ascent 31011. A review of guidance anomaly recognition, manual control, flight instruments, Integrated Display Processor (IDP) DPS Displays, FDF, and flight techniques is presented. This lesson covers trajectories similar in nature to a normal insertion to orbit, and includes manual entry techniques for TAL aborts. The following trajectories are discussed: Nominal ascent, without use of the Ascent Attitude Direction Indicator (ADI) Cue Card, ATO caused by Space Shuttle Main Engine (SSME) failure, Dual simultaneous SSME failure during ascent Single Engine Roll Control (SERC), and Two engine out-of-plane TAL to landing.

Objectives:

- Develop the crew skills to recognize when a manual takeover is required.
- Be able to fly the vehicle to Main Engine Cutoff (MECO) conditions, using navigation-derived information only:
  - Allow for orbital insertion and/or a runway landing without structural exceedances.

#### 11 **MAN ASC 31011**

Title: Manual Ascent Techniques

Duration: 4.0 hours Medium: SMS-MB

Student: COMMANDER, MS 2, PILOT (Ascent MS optional.)

Source: DS66/G&C/Propulsion Training Group

Date: 12/95

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): MAN ASC BR 31001

Preparation: None

Synopsis: This lesson reinforces the material covered in MAN ASC BR 31001

through practical application in the SMS.

Objectives: At the end of this lesson, the student will be able to perform the following

objectives:

Recognize when a manual takeover is required.

Establish manual control.

## 11 <u>MAN ASC 31011 (Concluded)</u>

- Use navigation-derived information to fly the vehicle to Main Engine Cutoff (MECO) conditions:
  - Allow for orbital insertion and/or a runway landing without structural exceedances.

### 12 **MAN ABT BR 31001**

Title: Manual Abort Techniques Briefing

Duration: 2.0 hours Medium: Classroom

Student: COMMANDER, MS 2, PILOT (Ascent MS optional.)

Source: DS66/G&C/Propulsion Training Group

Date: 12/95

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): MAN ASC 31011

Preparation: Read:

MAN ABT BR 31001 handout; received 2 days prior to briefing

#### Synopsis:

This lecture is the second in a series of 2. These lessons are designed to review the cockpit indications and techniques used to fly Transatlantic Abort Landing (TAL) and Return-To-Launch Site (RTLS) trajectories manually. A discussion of cockpit indications and techniques used during manual control is provided to prepare an assigned crew for MAN ABORT 31011. The following topics are reviewed: TAL redesignation, low energy TAL, post-Main Engine Cutoff (MECO) TAL, high energy TAL, and RTLS flight techniques.

Included in this lesson is a discussion of abnormal entry energy management techniques for TAL and RTLS aborts. The following trajectories are discussed: TAL Redesignation leading to low energy flight techniques, post-MECO TAL leading to high energy TAL flight techniques, two-engine RTLS, including Terminal Area Energy Management (TAEM) flight techniques, and three-engine RTLS, including TAEM flight techniques.

#### Objectives:

- Develop the crew skills to recognize when a manual takeover is required.
- Be able to fly the vehicle to MECO conditions, using navigation-derived information only:
  - Allow for orbital insertion and/or a runway landing without structural exceedances.

### 13 **MAN ABORT 31011**

Title: Manual Abort Techniques

Duration: 4.0 hours Medium: SMS-MB

Student: COMMANDER, MS 2, PILOT (Ascent MS optional.)

Source: DS66/G&C/Propulsion Training Group

Date: 12/95

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): MAN ABT BR 31001

Preparation: None

Synopsis: This lesson reinforces the material covered in MAN ABT BR 31001

through practical application in the SMS.

Objectives: At the end of this lesson, the student will be able to perform the following

objectives:

Recognize when a manual takeover is required.

Establish manual control.

 Use navigation-derived information to fly the vehicle to acceptable Main Engine Cutoff (MECO)/External Tank (ET) Separation (SEP) conditions.

 Fly the vehicle on entry to allow for a runway landing without structural exceedances.

### 14 **CONT ABT BR 31001**

Title: Contingency Abort Briefing (Part 1)

Duration: 2.0 hours Medium: Classroom

Student: COMMANDER, MS 1, MS 2, PILOT Source: DS66/G&C/Propulsion Training Group

Date: 02/97

Lesson(s) Replaced: None

Equipment Required: Overhead slides, overhead projector, space shuttle model,

inclination-specific FDF, dry erase markers and board, Horizontal Situation Indicator (HSI) training aid, 5 extra handouts, Contingency Abort videotape, charts, recent 482s

Prerequisite Lesson(s): MAN ABT 31011

Preparation: Read:

 CONT ABT BR 31001 handout (handed out a minimum of 2 days prior to scheduled briefing date)

## 14 CONT ABT BR 31001 (Concluded)

Synopsis:

This lecture is the first in a series of 2 briefings to discuss crew and inclination-specific aspects of contingency abort procedures in preparation for CONT ABT 31011 SMS lesson. Assigned flight crews will receive instruction on contingency abort maneuvering and trajectory profiles, cockpit indications, procedural rationale and execution, techniques, displays, controls, and cockpit resources used to initiate contingency abort maneuvering. The instruction will address both powered flight and entry procedures to either landing or bailout. A review of flight software capability and relevant orbiter hardware limitations is also provided. The lesson covers roughly half of the Ascent Checklist (C/L) procedural regions for two and three engine failure scenarios occurring in either OPS 1 (contingency abort) or OPS 6 (Return-To-Launch Site (RTLS) contingency abort). The remaining regions are covered during the second half of this series of briefing and SMS training. A representative sampling of 10 out of the 69 major contingency abort maneuvers (not regions) is presented during this lesson. The rationale for this sampling is explained at the end of this section. The following regions will be discussed:

- TWO OUT FIRST-BLUE
- TWO OUT SECOND-GREEN
- RTLS TWO OUT COLOR-BLUE
- RTLS TWO OUT COLOR-YELLOW
- THREE OUT FIRST-BLUE
- THREE OUT SECOND-GREEN
- RTLS THREE OUT COLOR-GREEN
- 2 Engine Out (E/O) and 3 E/O Bermuda or East Coast Abort Landing (ECAL), RTLS ECAL (Particular emphasis is placed on Bermuda or ECAL procedures to develop the manual crew skills necessary to avoid bailout.)

#### Objectives:

To develop crew skills to:

- Recognize and recover from multiple Space Shuttle Main Engine (SSME) malfunctions, where intact abort capability is nonexistent.
- Locate and execute the published procedure applicable to the contingency abort region in which the engine malfunctions occurred.

### 15 **CONT ABT 31011**

Title: Contingency Aborts Familiarization (Part 1)

Duration: 4.0 hours Medium: SMS-MB

Student: COMMANDER, MS 1, MS 2, PILOT Source: DS66/G&C/Propulsion Training Group

Date: 02/97

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): CONT ABT BR 31001

Preparation: Review:

CONT ABT BR 31001 notes and handout

#### Synopsis:

This lesson reinforces the material discussed in CONT ABT BR 31001 through practical application using the flight software at the SMS. The following contingency abort regions are mandatory for lesson completion:

- TWO OUT FIRST-BLUE
- RTLS TWO OUT COLOR-YELLOW
- THREE OUT FIRST-BLUE
- 2 Engine Out (E/O) Bermuda or East Coast Abort Landing (ECAL)
- 3 E/O Bermuda or ECAL (For inclinations not allowing a ECAL, a THREE OUT SECOND-GREEN must be performed instead of Bermuda)
- RTLS THREE OUT COLOR-GREEN (Post-Power Pitch Around (PPA), pre Vrel 0)
- THREE OUT FIRST-BLUE demonstrating marginal flight control
- Three out downmode from two out second stage green (pre-mode 2 maneuver) demonstrating stagger capability for almost any abort

Time permitting, the following optional regions should be demonstrated:

- Paperwork verification where one engine is failed at 30 seconds MET and the remaining engines fail before RTLS abort declaration
- Three out at RTLS PPA to demonstrate software capability with rates on the vehicle as well as what the signature of a black zone might look like
- RTLS THREE OUT COLOR-GREEN (Post Vrel 0)

### Objectives: The crew will:

- Recognize and recover from multiple Space Shuttle Main Engine (SSME) malfunctions where intact abort capability is nonexistent.
- Locate the published procedure in the FDF, which is applicable to the contingency abort region in which the engine malfunctions occurred.

### 15 **CONT ABT 31011 (Concluded)**

- Execute published contingency abort procedures without exceeding structural limitations.
- Recognize and avoid specific flight envelopes that will cause a loss of control or vehicle overstress.

### 16A **ASC SKL 33001**

Title: Ascent Skills Prebrief

Duration: 2.0 hours Medium: Classroom

Student: COMMANDER, MS 2, PILOT (Ascent MS optional.)

Source: DA72/QUEST

Date: 01/96

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): E GUID 31011

Preparation: Read:

- Ascent Powerdowns Prebrief
- BFS Engage Prebrief
- ATVC Prebrief
- Flight Critical & GPC DPS Failures Handout
- IMU & Entry NAVAID Failures Handout
- High/Low COMM Handout
- Payload Powerdowns Handout

#### Synopsis:

This is a 3-part prebrief. The topics covered are Ascent Powerdowns, Backup Flight System (BFS) Engages, and the Ascent Thrust Vector Control (ATVC) system. The Ascent Powerdowns Prebrief covers the powerdown steps associated with the Loss of 2 Freon Loops and the Loss of 2 Fuel Cells during ascent. The BFS Engage Prebrief reviews some of the more common scenarios that require a BFS engage, those times when the BFS is NO-GO for engage, and the signature of a self-engage. The ATVC Prebrief familiarizes the students with the ascent thrust vector control system.

#### Objectives:

At the end of each discipline-specific prebrief, the student will be able to perform the following objectives:

- Ascent Powerdowns Prebrief:
  - Identify the procedures required to safe the systems, given the Loss of 2 Freon Loops or the Loss of 2 Fuel Cells malfunctions.
  - Discuss the rationale behind the major steps in the Loss of 2 Freon Loops and the Loss of 2 Fuel Cells procedures.

## 16A ASC SKL 33001 (Concluded)

- BFS Engage Prebrief:
  - Identify the times when a BFS engage is required or desired.
  - Discuss crew preferences for a 2-on-2 set split and a 2-on-1-on-1 set split.
  - Identify the times when the BFS is NO-GO for engage.
  - Discuss the signature of a successful engage.
  - Discuss the signature of a self-engage, and describe the appropriate actions.
  - Explain the rationale for the steps in the POST BFS ENGAGE procedure.
- ATVC Prebrief:
  - State names of the 10 ATVC actuators by memory.
  - Use SPEC 53 to identify bypassed Space Shuttle Main Engine (SSME) ports.
  - State the proper action to take for 2 port bypasses on the same ATVC actuator during ascent or entry.
  - Given 2 hydraulic system failures, use the Main Propulsion System (MPS) cue card to identify the non-gimballing SSME and shut down the non-gimballer at the proper time (if required).

#### 16B **ASC SKL 33011**

Title: Ascent Skills
Duration: 4.0 hours
Medium: SMS-MB

Student: COMMANDER, MS 2, PILOT (Ascent MS optional. CB Instructor

Astronaut (IA) attendance mandatory.)

Source: DA72/QUEST

Date: 01/96

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ASC SKL 33001

Preparation: None

Synopsis:

This is the third 30000-level Ascent Skills lesson in a series of 5. The primary emphasis of this lesson is the crew coordination that is associated with both the performance of Powerdown Procedures, and the determination of the need for BFS Engage. "Loss of Two Freon Coolant Loops" and "Loss of Two Fuel Cells" procedures will be performed. Performance of the ascent and entry phases of flight with the Backup Flight System (BFS) engaged will also be exercised. This lesson is more

## 16B ASC SKL 33011 (Concluded)

challenging than the previous ascent skills lessons, as it involves advanced single system failures, as well as a greater amount of multiple system failures.

#### Objectives:

- Given the added complication of a Loss of 2 Fuel Cells Powerdown, a Loss of 2 Freon Coolant Loops Powerdown, or a BFS Engage, coordinate performance of crew roles with respect to the following:
  - Nominal ascent procedures from liftoff through OMS-2
  - Performance boundary calls
  - Abort determination
  - Abort procedures (Abort To Orbit (ATO), Transatlantic Abort Landing (TAL), and Return-To-Launch Site (RTLS))
  - Procedures modified for the Powerdowns
- Given the Loss of 2 Freon Loops, Loss of 2 Fuel Cells, or a Cabin Fire, perform the following actions during powered flight:
  - Safe the system.
  - Perform the associated Powerdown procedures, including all DPS reconfigurations (on MCC call for 2 Freon Loops down).
  - Status other crewmembers as to the remaining equipment and capabilities.
  - Recover from any critical system impacts.
- Identify the situations that make the BFS suspect or NO-GO for engage.
- Identify a situation that requires an engage of the BFS.
- Then, coordinate and execute the engage at the appropriate time.
- Given a BFS engage, and selected failures:
  - Determine and perform appropriate actions regarding Flight Control System (FCS) management.
  - Perform actions regarding Rate Gyro Assembly (RGA) and Accelerometer Assembly (AA) management on MCC call.
- Manage Space Shuttle Main Engine (SSME) stuck throttle cases to maintain critical systems and capabilities.
- Given selected Reaction Control System (RCS) leaks, manage the RCS system.
- Given a "no command" scenario, manage the COMM system, and maintain good voice and data with MCC.

### 17 **CONT ABT BR 32001**

Title: Contingency Abort Briefing (Part 2)

Duration: 2.0 hours Medium: Classroom

Student: COMMANDER, MS 1, MS 2, PILOT Source: DS66/G&C/Propulsion Training Group

Date: 02/97

Lesson(s) Replaced: None

Equipment Required: Overhead slides, overhead projector, space shuttle model,

inclination-specific FDF, dry erase markers and board, Horizontal Situation Indicator (HSI) training aid, 5 extra handouts, Contingency Abort videotape, charts, recent 482s

Prerequisite Lesson(s): ASC SKL 33011, CONT ABT 31011

Preparation: Read:

 CONT ABT BR 32001 handout (handed out a minimum of 2 days prior to the scheduled briefing date)

### Synopsis:

This lecture is the second in a series of two briefings to discuss crew and inclination-specific aspects of contingency abort procedures in preparation for CONT ABT 32011. Assigned flight crews will receive instruction on contingency abort maneuvering and trajectory profiles, cockpit indications, procedural rationale and execution, techniques, displays, controls, and cockpit resources used to initiate contingency abort maneuvering. The instruction will address both powered flight and entry procedures to either landing or bailout. A review of flight software capability and relevant orbiter hardware limitations is also provided. This lesson covers the remaining Ascent Checklist (C/L) procedural regions for two and three engine failure scenarios occurring in either OPS 1 (contingency abort) or OPS 6 (Return-To-Launch Site (RTLS) contingency abort). A representative sampling of 12 out of the 69 major contingency abort maneuvers (not regions) is presented during this lesson. The rationale for this sampling is explained at the end of this section. The following regions will be discussed:

- TWO OUT DROOP
- STUCK THROTTLE contingency abort procedures
- RTLS TWO OUT COLOR-ORANGE
- RTLS TWO OUT COLOR-GREEN
- RTLS TWO OUT COLOR-RED
- RTLS THREE OUT COLOR-ORANGE
- RTLS THREE OUT COLOR-YELLOW
- RTLS THREE OUT COLOR-RED
- THREE OUT BLANK & RTLS THREE OUT BLANK

#### 17 CONT ABT BR 32001 (Concluded)

Objectives: To develop the crew skills to:

- Recognize and recover from multiple Space Shuttle Main Engine (SSME) malfunctions where intact abort capability is nonexistent.
- Locate and execute the published procedure applicable to the contingency abort region in which the engine malfunctions occurred.

#### 18 **CONT ABT 32011**

Title: Contingency Abort Familiarization (Part 2)

Duration: 4.0 hours Medium: SMS-MB

Student: COMMANDER, MS 1, MS 2, PILOT Source: DS66/G&C/Propulsion Training Group

Date: 02/97

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): CONT ABT BR 32001

Preparation: Review:

CONT ABT BR 32001, notes and handout

#### Synopsis:

This lesson reinforces the material discussed in CONT ABT BR 32001 through practical application using the flight software at the SMS. The following contingency abort regions are mandatory for lesson completion:

- TWO OUT DROOP
- TWO OUT DROOP back-out to TWO OUT SECOND-GREEN
- STUCK FIRST
- STUCK RTLS and STUCK DROOP if applicable
- RTLS TWO OUT COLOR-ORANGE
- RTLS THREE OUT COLOR-ORANGE
- RTLS TWO OUT COLOR-GREEN
- RTLS THREE OUT COLOR-YELLOW
- RTLS THREE OUT COLOR-RED
- RTLS TWO OUT COLOR-RED
- RTLS THREE OUT BLANK
- THREE OUT BLANK

Time permitting, the following optional regions should be demonstrated:

- Bermuda or East Coast Abort Landing (ECAL) review
- STUCK DROOP
- Items requiring additional proficiency

### 18 **CONT ABT 32011 (Concluded)**

- Any of the remaining 47 contingency abort maneuvers not exercised during the contingency abort series of lessons
- Black zone demonstration

Objectives: The crew will:

- Recognize and recover from multiple Space Shuttle Main Engine (SSME) malfunctions where intact abort capability is nonexistent.
- Locate the published procedure in the FDF, which is applicable to the selected contingency abort region in which the engine malfunctions occurred.
- Execute published contingency abort procedures without exceeding structural limitations.
- Recognize and avoid specific flight envelopes that will cause a loss of control or vehicle overstress.

#### 19 **PWDN BR 31001**

Title: Powerdown Briefing

Duration: 2.0 hours Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT

Source: DA72/QUEST

Date: 02/96

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ASC SKL 33011

Preparation: Read/Review:

- SYSTEMS AOA book;
  - "LOSS OF 2 FREON LOOPS" procedure
  - "LOSS OF 2 H2O LOOPS" procedure
  - ASC SKL 33001 prebrief

#### Establish:

 Cockpit management plan, with regards to the above listed procedures, assigning specific procedural actions to each crewmember.

#### Synopsis:

This briefing is designed to supplement ASC SKL 34001. A detailed review of the "LOSS OF 2 FREON LOOPS" and "LOSS OF 2 H20 LOOPS" procedures in the SYSTEMS Abort Once Around (AOA) book will be conducted. The flight-specific SMS team will be present during this prebrief to answer technical and procedural questions. Procedural rationale and major differences between the two procedures will also be discussed.

# 19 PWDN BR 31001 (Concluded)

Objectives: At the end of this prebrief, the student will be able to:

- Refine crew-specific roles and responsibilities that will make each procedure go more smoothly.
- Identify areas within the two procedures where crew actions must be performed serially, and when they can be completed in parallel.
- Discuss the rationale behind the two procedures.

#### 20 **FCS C/O 31006**

Title: Flight Control System Checkout

Duration: 2.0 hours Medium: SST 1

Student: COMMANDER, MS 2, PILOT (Entry MS optional.)

Source: DS66/G&C/Propulsion Training Group

Date: 04/96

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: Read:

Orbit Operations Checklist FCS Checkout Procedure

Synopsis: Emphasis in this lesson is on malfunction resolution during the Flight

Control System (FCS) checkout. The FCS checkout procedures are contained in the ORBIT Operations (OPS) Checklist (C/L). Guidance,

Navigation, and Control (GNC) procedures will be followed.

Objectives: At the end of this lesson, the student will be able to perform the following:

- State the purpose of the FCS checkout.
- Identify, evaluate, and resolve malfunctions that may occur during FCS checkout.
- Explain the differences between Rotational Hand Control(ler) (RHC) and Translation(al) Hand Controller (THC) redundancy management.

#### 21A **ASC SKL 34001**

Title: Ascent Skills Prebrief

Duration: 1.0 hour Medium: Classroom

Student: COMMANDER, MS 2, PILOT (Ascent MS optional.)

Source: DA72/QUEST

Date: 01/96

Lesson(s) Replaced: None Equipment Required: None

### 21A ASC SKL 34001 (Concluded)

Prerequisite Lesson(s): CONT ABT 32011, PWDN BR 31001

Preparation: Read:

- Ascent Systems Flight Rules Prebrief
- AOA Deorbit Burns Prebrief
- Flight Critical & GPC DPS Failures Handout
- IMU & Entry NAVAID Failures Handout
- Systems Secondary Cockpit Cues Handout

Synopsis:

This is a 2-part prebrief. The topics to be covered are Ascent Systems Flight Rules and Abort Once Around (AOA) Deorbit Burns. The Ascent Systems Flight Rules Prebrief reviews the systems failures that require an abort declaration pre Main Engine Cutoff (MECO) or pre-OMS-2. The AOA Deorbit Burns Prebrief discusses the differences between nominal End of Mission (EOM) deorbit burns, OMS 1 required AOA deorbit burns, and direct insertion AOA deorbit burns.

Objectives:

At the end of each discipline-specific prebrief, the student will be able to perform the following objectives:

- Ascent Systems Flight Rules Prebrief:
  - Identify the systems failures that require an abort, and the type of abort that is required.
  - Discuss how systems aborts differ from performance aborts.
- AOA Deorbit Burns Prebrief:
  - Describe the effect of a retrograde burn on the perigee.
  - Describe the effect of a radial burn on the line of apsides.
  - Use the computed PEG 7 targets to determine if the deorbit burn will be primarily retrograde, radial, or out-of-plane.
  - Describe the impact of an over-burn or under-burn during a radial deorbit burn.
- Given an AOA deorbit burn and flight profile, identify the correct completion cue (Height of perigee (HP) or DV).

#### 21B **ASC SKL 34012**

Title: Ascent Skills Duration: 5.0 hours

Medium: SMS-FB or GNS

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT (MS1 and MS3 required for

first two hours.)

Source: DA72/QUEST

Date: 01/96

Lesson(s) Replaced: None Equipment Required: None

# 21B ASC SKL 34012 (Continued)

Prerequisite Lesson(s): ASC SKL 34001

Preparation: None

Synopsis:

This is the fourth 30000-level Ascent Skills lesson in a series of 5. The primary emphasis of this lesson is the crew coordination associated with the performance of systems aborts. The fixed base will be used to allow the crew to perform aft cockpit and middeck powerdown procedures. The crew will be required to analyze cockpit signatures and determine the need to abort for cabin leaks, Freon loops, and OMS leaks.

The performance of the above tasks are further complicated by multiple system failures, exercising the applications of the "Multi-Data Path Fail" cue card, Main Propulsion System (MPS) He anomalies, and Backup Flight System (BFS) failures.

- Coordinate performance of crew roles with respect to:
  - Nominal ascent procedures from liftoff through OMS targeting
  - Performance boundary calls
  - Abort determination
  - Abort procedures (Transatlantic Abort Landing (TAL), Return-To-Launch Site (RTLS), and Abort Once Around (AOA))
- Given a cabin leak or loss of 2 freon loops:
  - Select the appropriate FDF.
  - Select and perform the appropriate abort.
  - Determine the leak magnitude (cabin leak only).
- Given selected conditions, use the OMS-2 targeting card to determine the appropriate off-nominal OMS-2 targets and burn cutoff conditions.
- Manage MPS He leaks and Space Shuttle Main Engine (SSME) failures in conjunction with EPS failures to maintain critical systems and capabilities.
- Manage DPS failures to maintain critical MPS dump and vacuum inert capabilities.
- Given selected OMS and Reaction Control System (RCS) leaks:
  - Manage the OMS and RCS systems.
  - Orally status crew and MCC.
  - State the mission impacts.
- Given selected DPS and EPS failures and the OMS Failures Cue Card, determine the impacts to OMS ignition and take appropriate actions.
- Perform the DPS and Navigation (NAV) reconfiguration associated with a major electrical powerdown.
- Identify and manage a partial failure of the BFS.

### 21B ASC SKL 34012 (Concluded)

- Identify and manage selected DPS and Inertial Measurement Unit (IMU) failures without MCC help.
- Discriminate among probable causes of loss of signal strength, and perform recovery procedures as appropriate.
- Given selected DPS failures, predict the possible loss of S-band antenna selection, and maintain pointing when necessary.
- Coordinate antenna management activities with MCC and other crewmembers.
- Coordinate a COMM Plan with MCC before all COMM is powered down.

#### 22A **E SKL 31001**

Title: Entry Skills Prebrief

Duration: 1.0 hour Medium: Classroom

Student: COMMANDER, MS 2, PILOT (Entry MS optional.)

Source: DA72/QUEST

Date: 12/06

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): E GUID 31011

Preparation: Read:

- SSME Repositioning Prebrief
- D/O APU Start Prebrief
- Entry IMU Aligns Prebrief
- Entry COMM Handout
- Drag Chute Handout
- Post-Landing Powerdowns
- Flight-Critical & GPC DPS Failures Handout
- IMU & Entry NAVAID Failures Handout

#### Synopsis:

This is a 3-part prebrief, which will cover Space Shuttle Main Engine (SSME) Repositioning, Deorbit (D/O) Auxiliary Power Unit (APU) Start, and Entry Inertial Measurement Unit (IMU) Aligns. The SSME Repositioning Prebrief reviews the potential problems with SSME repositioning for the drag chute deploy. The D/O APU Start Prebrief reviews the 2 SINGLE APU START procedures and the rationale for selecting the correct procedure. The Entry IMU Aligns prebrief reviews scenarios that require an IMU align during entry, and the steps to take should one be required (no procedures exist in the entry FDF).

### 22A **E SKL 31001 (Concluded)**

Objectives: At the end of each discipline-specific prebrief, the student will be able to perform the following objectives:

- SSME Repositioning Prebrief:
  - Identify Mach window for SSME repositioning.
  - Explain constraints associated with the restart of the SSME repositioning sequence.
  - Identify the 2 reasons for an "SSME REPOS FAIL" message, and the impact of this message.
  - Identify the impact of a failed Flight Aft (FA) Multiplexer/
     Demultiplexer (MDM) on SSME repositioning.
  - Identify the reasons to perform a drag chute deploy without the SSMEs repositioned.
  - State the name for this type of drag chute deploy.
- D/O APU Start Prebrief:
  - Identify why only 1 APU is to be started prior to the deorbit burn.
  - Explain why 2 procedures exist for starting a single APU prior to deorbit burn, and recognize that only 1 of the 2 procedures is used.
  - Explain the criteria used to decide when it is correct to select the ATTEMPT 1 APU procedure.
  - Explain the criteria used to decide when it is correct to select the ATTEMPT 2 APUs procedure.
- Entry IMU Aligns Prebrief:
  - Identify the times during entry when an IMU align is desired.
  - Identify the method for performing an IMU align.
  - Define IMU reanchoring.

#### 22B **E SKL 31011**

Title: Entry Skills
Duration: 4.0 hours
Medium: SMS-MB

Student: COMMANDER, MS 2, PILOT (Entry MS optional.)

Source: DA72/QUEST

Date: 12/06

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): E SKL 31001

Preparation: None

Synopsis: This is the first 30000-level Entry Skills lesson in a series of 2. Its primary

emphasis is the crew coordination of entry activities from Deorbit (D/O)
- 15 through wheel stop. The lesson also emphasizes Post-Landing
Powerdown procedures (Expedited and Emergency), as well as Inertial

# 22B **E SKL 31011 (Continued)**

Measurement Unit (IMU) and Navigation Aid (NAVAID) management. Secondary topics include Flight Control System (FCS) and Reaction Control System (RCS) management, as well as Space Shuttle Main Engine (SSME) repositioning.

- Coordinate performance of crew roles, with respect to nominal entry procedures:
  - From D/O 15 through wheel stop
  - From 200K through wheel stop
- Identify the loss of power to an IMU and recover this IMU with an IMU/IMU align.
- Identify a Redundancy Management (RM) failed IMU and safe the Backup Flight System (BFS).
- With limited MCC help, manage the navigation sensors for various failures, including the following:
  - Sensor biases
  - No-lock cases
  - No-deploy cases
- Given selected electrical bus losses, perform the following steps:
  - Identify communication hardware loss.
  - Reconfigure to regain communication capabilities.
  - Select and perform appropriate procedures to regain or maintain capabilities.
- Given selected entry scenarios, analyze available cockpit data to do the following tasks:
  - Diagnose loss of data and voice communication.
  - Determine source of loss.
- Given wind, weather, energy, runway, and vehicle landing hardware conditions, determine impacts to vehicle landing, select a responsive technique, and perform landing and roll-out.
- Given the failure of a single Auxiliary Power Unit (APU) before, during, or after D/O burn, select and perform appropriate response.
- Given selected FCS Channel failures in combination with DPS failures, manage the FCS system.
- Following a restring and up to one additional FCS channel failure, perform the following actions:
  - Determine appropriate FCS configuration.
  - Verify planned FCS actions with MCC.
  - Perform planned actions.
- Given selected RCS jet failures and leaks, manage the RCS system, and select and perform the appropriate post-landing actions.

### 22B **E SKL 31011 (Concluded)**

- Given an APU leak, select and perform the appropriate post-landing actions.
- Given intolerable cabin conditions post-landing, select and perform the appropriate powerdown.
- Given an MCC call, inhibit or enable SSME repositioning, and perform appropriate drag chute deploy.
- Identify an Rotational Hand Controller (RHC) failure, state fault tolerance of the system after the failure, and perform the procedure in the Ascent/Entry Systems Procedure (AESP).
- Configure orbiter COMM system for nominal entry.
- Analyze vehicle performance indications and available cockpit data to:
  - Identify situations, which require flying theta limits.
  - Fly theta limits as appropriate.

#### 23 **D/O BURN 31001**

Title: Deorbit Burn Prebrief

Duration: 2.0 hours Medium: Classroom

Student: COMMANDER, MS 2, PILOT (Entry MS optional.)

Source: DS66/G&C/Propulsion Training Group

Date: 12/95

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): E SKL 31011

Preparation: Review:

- D/O BURN 31001 handout
  - SMS load description
  - Lesson outline
  - MNVR PAD
  - DEL PAD
  - PRPLT PAD

### Synopsis:

This lesson is a review of nominal and off-nominal procedures on the 5 deorbit burn cue cards (2 Engine, 1 Engine, Reaction Control System (RCS), Unbalanced, and Mixed Xfeed), definitions of the entries on the Propellant (PRPLT) and Deorbit, Entry, and Landing (DEL) Preliminary Advisory Data (PADs), transfer of information from the PRPLT PAD and DEL PAD to each card, PRPLT FAIL and ENG FAIL diagnosis, manual flight techniques for RCS completion and forward RCS completion, rationale for procedures on the Deorbit Burn Monitor cue card, use of the OMS Failures cue card, and use of the Deorbit Burn Flight Rules cue card.

# 23 **D/O BURN 31001 (Concluded)**

This briefing will also establish crewmember responsibilities and crewspecific Space Flight Resource Management (SFRM).

#### Objectives:

- Transfer the information on the PRPLT PAD and DEL PAD to the appropriate blocks on the 5 burn cards; 2 Engine, 1 Engine, RCS, Unbalanced, and Mixed Xfeed.
- State the burn completion methods for failures that occur at the different milestones on the DEL PAD.
- Given a failure, determine if a waveoff is required using the Deorbit (D/O) Burn Flight Rules cue card.
- State the signatures and the type of failure (ENG or PRPLT) of an oxidizer/fuel blockage upstream and downstream of the inlet pressure sensor.
- Define the rationale for the procedures on the Deorbit Burn Monitor cue card
- Define the rationale for the nominal and off-nominal procedures on the 5 deorbit burn cue cards; 2 Engine, 1 Engine, RCS, Unbalanced, and Mixed Xfeed.
- Given an OMS quantity, determine the corresponding RCS burn time using the OMS He PRESS/Delta V/BURN TIME table.
- Given a failure, identify if an ignition path still exists, what additional failure would take the ignition path (what failure the system is critical to), and if a manual shutdown is required, using the OMS Failures cue card.
- State the 2 conditions required to generate the OMS down arrow on the Maneuver (MNVR) display.
- State the 3 conditions required to mode guidance.
- Define the role of each crewmember during the deorbit burn.

#### 24 **D/O BURN 31011**

Title: Deorbit Burn
Duration: 4.0 hours
Medium: SMS-MB

Student: COMMANDER, MS 2, PILOT (Entry MS optional.)

Source: DS66/G&C/Propulsion Training Group

Date: 12/95

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): D/O BURN 31001

Preparation: None

# 24 **D/O BURN 31011 (Concluded)**

#### Synopsis:

The intent of this lesson is to exercise all nominal and a few off-nominal procedures on the Deorbit Burn 2 Engine, 1 Engine, Unbalanced, and Mixed Xfeed cue cards. The lesson will also exercise the use of the Deorbit Burn Monitor and OMS Failures cue cards to recognize and resolve various malfunctions. The Deorbit Burn Flight Rules cue card will be used to determine if a waveoff is required due to a failure that occurs preburn. Finally, this lesson will reinforce the crewmember responsibilities and Space Flight Resource Management (SFRM) that was established in the deorbit burn briefing.

- Transfer the information on the Propellant (PRPLT) Preliminary
  Advisory Data (PAD) and Deorbit, Entry, and Landing (DEL) PAD to the
  appropriate blocks on the Deorbit Burn 2 Engine, 1 Engine,
  Unbalanced, and Mixed Xfeed cue cards.
- Perform the procedures for a nominal 2 Engine, 1 Engine, Unbalanced, and Mixed Xfeed burn.
- Identify an ENG FAIL and a PRPLT FAIL.
- Identify and resolve the various failures covered on the Deorbit Burn Monitor cue card.
- Given a failure before ignition, determine if a waveoff is required using the Deorbit (D/O) Burn Flight Rules cue card.
- Given the following failures or combination of failures, perform the proper actions for completing the burn using the given burn card (2 Engine, 1 Engine, Unbalanced, or Mixed Xfeed):
  - ENG FAIL
  - PRPLT FAIL
- Determine the amount of prebank (if required) that is needed to reach the landing site, also stating the required prebank maneuver time and rate.
- Identify and perform appropriate actions for manual shutdown requirements using the OMS Failures cue card.
- Identify when guidance has not downmoded.
- Given an EPS or DPS failure, identify if an ignition path still exists, and what additional failures would take the ignition path (what failure the system is critical to) using the OMS Failures cue card.
- Perform all required crewmember responsibilities.

### 25A **ENT DAP SK 31001**

Title: Entry Digital Autopilot Skills Prebrief

Duration: 1.0 hour Medium: Classroom

Student: COMMANDER, MS 2, PILOT (Entry MS optional.)

Source: DS66/G&C/Propulsion Training Group

Date: 04/00

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): E SKL 31011

Preparation: None

Synopsis: This lesson covers DAP performance in both nominal operations and off

nominal situations. A review of Entry DAP operational modes will be presented. Reaction Control System (RCS) and aerosurface failures that

impact entry DAP will be presented. Rationale of the off-nominal procedures will be discussed. Lastly, situations in which entry DAP can

contribute to a loss of vehicle control will be discussed.

- State the primary control effectors, RCS or aerosurfaces, for each Entry DAP operational mode.
- State the transition points for RCS to aerosurface control, when applicable for the DAP mode selected.
- Explain the impacts of RCS failures on entry DAP, including:
  - 3 yaw jets failed on the same pod
  - No Yaw Jet (NYJ) entry mode
- State the minimum number of yaw jets required for certified flight.
- Given a copy of the following procedures, explain how to perform them:
  - AFT Reaction Control System (ARCS) QTY (L+R) < 10% cue card procedures
  - High Frequency Oscillation or Surface/Jet Limit Cycle procedure
  - Aileron Trim <sup>3</sup> 3° procedure
- Given a Y Center of Gravity (c.g.), state the expected aileron trim.
- Identify ascent/abort situations in which entry DAP may cause loss of control.

### 25B **ENT DAP SK 31011**

Title: Entry Digital Autopilot Skills

Duration: 2.0 hours Medium: SMS-MB

Student: COMMANDER, MS 2, PILOT (Entry MS optional.)

Source: DS66/G&C/Propulsion Training Group

Date: 04/00

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ENT DAP SK 31001

Preparation: None

Synopsis: This lesson covers nominal and off-nominal DAP performance. Nominal

DAP reconfiguration and handling characteristics will be covered. All nominal and off-nominal procedures that are related to DAP will be covered. The student will explore airspeed and alpha limits of the Flight Control System (FCS), and see the consequence of violating these limits.

Objectives: At the end of this lesson, the student will be able to perform the following objectives:

- State the major events in DAP reconfiguration while performing a nominal entry.
- Accomplish scripted flight demonstrations and explain the vehicle response to:
  - Zero angle of attack while hypersonic
  - No Reaction Control System (RCS) at q-Bar < 10</li>
  - No Yaw Jet (NYJ) at q-Bar < 10</li>
  - Aileron trim due to Center of Gravity (c.g.)
  - Effect of panel trim switches
  - Body flap cycling
  - Speedbrake cycling
  - Auto versus Fixed elevon schedule
- Identify and respond to the following off-nominal conditions:
  - 3-yaw jets failed on the same side
  - RCS propellant quantity critical
  - Aileron Trim Saturation
- Explain how the Backup Flight System (BFS) Entry DAP differs from the Primary Avionics Software System (PASS) Entry DAP.

#### 26 **E SKL 32011**

Title: Entry Skills
Duration: 4.0 hours
Medium: SMS-MB

Student: COMMANDER, MS 2, PILOT (Entry MS optional. CB Instructor

Astronaut (IA) attendance mandatory.)

Source: DA72/QUEST

Date: 12/06

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ASC SKL 34012, D/O BURN 31011,

**ENT DAP SK 31011** 

Preparation: None

Synopsis:

This is the second 30000-level Entry Skills lesson in a series of 2. The first run of the lesson provides the crew with the opportunity to practice the coordination of entry tasks from Deorbit (D/O) - 30 minutes to wheel stop. Advanced entry cases, including an incorporation of Global Positioning System (GPS), a Backup Flight System (BFS) entry, no yaw jet flying, theta limits, and stuck speedbrake, will be performed during this lesson. The class will also emphasize D/O Auxiliary Power Unit (APU) starts, Inertial Measurement Unit (IMU) alignments, management of Navigation Aids (NAVAIDs), and entry command configuration.

- With or without the BFS engaged, coordinate performance of crew roles with respect to:
  - Nominal entry procedures from D/O 30 through wheel stop
  - Nominal entry procedures from 200K through wheel stop
- Identify the need for a state vector update, and perform an incorporation of GPS.
- Given wind, weather, energy, runway, and vehicle landing hardware conditions, determine their impact to the vehicle landing, select a responsive technique, and perform landing and roll-out.
- Given selected yaw jet and Accelerometer Assembly (AA) failure scenarios, determine and take appropriate actions.
- Given failures of multiple landing gear deploy methods, keep track of remaining redundancy level, and maintain at least 1 method of gear deploy.
- Identify OMS anomalies during the deorbit burn, and manage the OMS system to maintain system and vehicle control.

### 26 **E SKL 32011 (Concluded)**

- Analyze vehicle performance indications and available cockpit data to:
  - Identify a Rotational Hand Control(ler) (RHC) failure.
  - State the fault tolerance of the system after the failure.
  - Perform the procedure in the Ascent/Entry Systems Procedure (AESP).
  - Determine whether to handover/takeover.
  - Coordinate handover/takeover.
  - Perform piloting functions.
- Given selected Reaction Control System (RCS) leaks complicated by DPS and/or EPS failures, select and perform appropriate procedures in response, and orally status the crew and MCC.
- Given an MCC call concerning wind shears, select a responsive technique, perform landing, and describe how guidance is responding to the shears.
- Without an MCC call, identify a high altitude density shear, select a responsive technique, and perform landing.
- Given an MCC call of required runway (i.e., NO item entries), use the Entry Checklist (ENT C/L) to redesignate to the correct runway.
- Identify an Nose Wheel Steering (NWS) failure and take corrective actions during rollout.
- Given failure of single APU before, during, or after D/O burn, select and perform the appropriate response.
- Manage the navigation sensors for various failures without MCC help (including the determination to fly theta limits).
- Recover from the loss of S-band communications as a result of selected EPS failures.
- Identify and coordinate recovery steps from selected Audio Terminal Unit failures with MCC and other crewmembers.

### 27 **ASC SKL 35011**

Title: Ascent Skills
Duration: 4.0 hours
Medium: SMS-MB

Student: COMMANDER, MS 2, PILOT (Ascent MS optional.)

Source: DA72/QUEST

Date: 09/02

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): E SKL 32011

### 27 **ASC SKL 35011 (Continued)**

Preparation: Review: Ascent Skills 35001 Handout (USA008316)

- Essential Bus and Main Controller
- Flight Critical & GPC DPS Failures
- IMU & Entry NAVAID Failures

#### Synopsis:

This is the fifth 30000-level Ascent Skills lesson in a series of 5. This lesson provides the crew with the opportunity to practice crew roles and coordination of activities during aborts and contingency aborts that are complicated with multiple system failures. The runs are designed to be highly challenging, and involve complex cases as well as combinations of many malfunctions. This lesson emphasizes performance of single main engine completion ascents and advanced DPS and EPS failure cases.

- Coordinate performance of crew roles with respect to:
  - Nominal ascent procedures from liftoff through OMS targeting and performance of an OMS-1 burn
  - Performance boundary calls
  - Abort determination
  - Abort procedures (DROOP, East Coast Abort Landing (ECAL), and Return-To-Launch Site (RTLS))
- Manage the failure of 2 Space Shuttle Main Engines (SSMEs), and take appropriate abort moding, throttling, and Single Engine Roll Control (SERC) actions.
- Given selected OMS failures during abort dumps, diagnose the failures and perform the appropriate procedures.
- Following a restring, and up to 1 additional Flight Control System (FCS) channel failure:
  - Determine the appropriate FCS configuration.
  - Verify planned FCS actions with MCC.
  - Perform the planned actions.
- Given a total loss of the Flash Evaporator System (FES), manage orbiter cooling.
- Manage EPS and multi-system Auxiliary Power Unit (APU)/Hydraulics failures to maintain system and vehicle control.
- Given the loss of multiple Multiplexer/Demultiplexer (MDM) data paths, coordinate the performance of "Multi Data Path Failure" Cue Card actions with other crewmembers.
- Manage data system to maintain critical data.
- Identify the need for and perform an Initial Program Load (IPL) of the Backup Flight System (BFS) post-Main Engine Cutoff (MECO).
- Identify and recover from prelaunch non-Launch Commit Criteria (LCC) violation failures.

# 27 ASC SKL 35011 (Concluded)

- Maintain a good state vector in the BFS, following various failures.
- Given selected DPS failures, determine and perform corrective action to regain voice/telemetry/commands.
- Manage the S-band Phase Modulation (PM) system to maintain voice/ telemetry/command.
- Identify and recover from a keyboard failing to two Integrated Display Processors (IDPs)/Display Electronics Units (DEUs) (Critical Items List (CIL) mitigation).

### 28 **E DTO BR 91001**

Title: Entry Detailed Test Objectives Briefing

Duration: 1.0 hour Medium: Classroom

Student: COMMANDER, MS 2, PILOT (Entry MS optional.)

Source: DA7/Assigned SMS team

Date: 11/89

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): FCS C/O 31006

Preparation: None

**Note:** This class is optional. It is required only if any of the following ENTRY

DTOs are scheduled: 251, 252, 254, 517, or 521. This lesson requires concurrence of the Ascent/Entry Flight Operations Course

Supervisor.

Synopsis: This briefing informs the crew of what they must do to meet the

requirements of any DTOs for their flight, to include Programmed Test Inputs (PTIs). Emphasis will also be placed on the special procedures and conditions that require abandonment of the DTOs for flight safety. The team lead or the appropriate instructor should seek assistance from

outside DT (DF, DM, EH, DTO Sponsor, etc.), if required.

Objectives: • Understand the objectives of the DTOs.

- Understand the nominal procedures for the DTOs.
- Understand the malfunction procedures for the DTOs (if any).
- Understand the flight rules involving the DTOs, especially those requiring abandonment of them for flight safety.
- Understand backout procedures (if any).

#### 29 **E DTO 91056**

Title: Entry Detailed Test Objectives

Duration: 2.0 hours Medium: SES FWD

Student: COMMANDER, MS 2, PILOT (Entry MS optional.)

Source: DS66/G&C/Propulsion Training Group

Date: 06/93

Lesson(s) Replaced: None

Equipment Required: DTO FDF Procedures Prerequisite Lesson(s): E DTO BR 91001

Preparation: None

**Note:** This is an optional lesson. It is required only if any of the following

ENTRY DTOs are scheduled: 251, 252, 254, 517, or 521. This lesson requires the concurrence of the Ascent/Entry Flight Operations Course

Supervisor.

Synopsis: This lesson should only be scheduled if the SMS team and/or the crew

desires to practice entry DTO/Programmed Test Input (PTI) procedures prior to flight cycle training in the SMS. Required runs and content will be

determined by team and crew. Recommend DTO sponsor and

appropriate flight controller(s) be invited by the team/crew to support this

lesson.

Objectives: • Practice DTO/PTI nominal procedures.

Practice DTO/PTI malfunction procedures (if any).

Apply appropriate flight rules to DTO/PTI operations (if any).

Review other procedures and information as required.

#### 30 **ENT PRF FS 41011**

Title: Flight-Similar Entry Proficiency

Duration: 2.0 hours/biweekly

**Note:** Schedule 1 hour weekly in conjunction with ASC PRF FS 41011.

Medium: SMS-MB

Student: COMMANDER, MS 2, PILOT (Entry MS optional.)

Source: DA7/Assigned SMS team

Date: 11/89

Lesson(s) Replaced: ENT PRF ADV 41011

Equipment Required: None

Prerequisite Lesson(s): FCS C/O 31006

Preparation: None

# 30 ENT PRF FS 41011 (Concluded)

Synopsis: Lesson mainta

Lesson maintains proficiency in entry operations for assigned crews until their flight software load is delivered for training. The lesson should cover those procedures that the crew has not seen for some time or that they have not seen in their 30000-level E SKL sessions. Completion of E SKL 3X011 or an integrated generic entry simulation fulfills the

proficiency requirement.

Objectives: The student will be able to:

Correctly perform all nominal procedures.

- Understand the required malfunction procedures.
  Understand the ramifications of the malfunctions.
- Prioritize and coordinate crewmember actions during malfunctions.
- Safely land or perform bailout procedures.

### 31 **ASC PRF FS 41011**

Title: Flight-Similar Ascent Proficiency

Duration: 3.0 hours/week

**Note:** Schedule in conjunction with 1 hour of ENT PRF FS 41011.

Medium: SMS-MB (SMS-FB)

Student: COMMANDER, MS 2, PILOT (Ascent MS optional.)

Source: DA7/Assigned SMS team

Date: Prepare as needed

Lesson(s) Replaced: ASC PRF ADV 41011

Equipment Required: None

Prerequisite Lesson(s): FCS C/O 31006

Preparation: None

Synopsis: The purpose of this lesson is to maintain proficiency in ascent flight

operations for crews who have completed all ascents except those that are load-specific. Cases should utilize the failures from the additional objectives list preceding 30000-level lesson descriptions. Each lesson should include a variety of ascent scenarios and include Control Stick Steering (CSS) control and a variety of winds and weather as desired. This lesson is not required if the crew has participated in any ascent integrated sim or a 30000-level Ascent Skills within the past week.

Objectives: Demonstrate proficiency in ascent flight operations.

# 32 **CONT ABT PRF 41056**

Title: Contingency Abort Proficiency

Duration: 2.5 hours Medium: SES FWD

Student: COMMANDER, MS 1, MS 2, PILOT Source: DS66/G&C/Propulsion Training Group

Date: 02/97

Lesson(s) Replaced: None

Equipment Required: Load-specific MS1 and MS2 Ascent Checklists (C/Ls), all 4

contingency abort cue cards, Transatlantic Abort Landing (TAL) Redesignation cue cards, lesson plan, writing utensil,

notebook, instructor's copy of FDF

Prerequisite Lesson(s): FCS C/O 31006

Preparation: None

Synopsis: This optional lesson is requested by individual astronauts or assigned

flight crews to allow review and practice of contingency abort procedures.

Objectives: • To increase contingency abort procedural proficiency for non-assigned

astronauts.

 To improve crew coordination of contingency abort procedures and techniques to realize proficiency by the time CONT ABT 91011 is

scheduled.

#### 33 MPS BSE FLT BRF 31001

Title: Main Propulsion System Booster Systems Engineer Flight Briefing

Duration: 1.0 hour Medium: Classroom

Student: FLIGHT DIRECTOR, COMMANDER, PILOT, MS 2, CAPCOM, and

assigned Booster Flight Controller (BSE)

Source: DS66/G&C/Propulsion Training Group

Date: 06/08

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ASC/ABT SFRM 31011

Preparation: None

Synopsis: This lesson will serve as a forum for the crew, *CAPCOM*, Booster, and

*Flight* to review procedure changes and to discuss flight-specific details.

The lesson will be led by the assigned Booster Flight Controller.

# 33 MPS BSE FLT BRF 31001 (Concluded)

Objectives: The crew, *Flight Director*, BSE, and CAPCOM discuss malfunction

scenarios, focusing on the Main Propulsion System (MPS) system alone. *This lesson* also establishes communication and builds a relationship between the BSE, CAPCOM, and the crew, and answers any flight-

specific questions prior to integrated training.

### 34 **E SKL 91011**

Title: Entry Skills
Duration: 4.0 hours
Medium: SMS-MB

Student: COMMANDER, MS 2, PILOT (Entry MS optional.)

Source: DA7/Assigned SMS team

Date: 10/92

Lesson(s) Replaced: None

Equipment Required: Advanced Crew Escape Suits (ACESs)

Prerequisite Lesson(s): MPS BSE FLT BRF 31001

Preparation: None

Synopsis: Lesson exercises the crewmembers' knowledge of malfunction

procedures, their ability to prioritize, and their ability to understand the impacts that a malfunction (in one area) has on the other shuttle systems.

This lesson will be suited.

Objectives: The student will be able to:

- Correctly perform all nominal procedures.
- Understand the ramifications of the malfunctions.
- Prioritize and coordinate crewmember actions during malfunctions.
- Safely land or perform bailout procedures.
- Practice nominal and off-nominal procedures while suited.
- Correctly perform Payload/Spacehab Entry off-nominal procedures (if applicable).

#### 35 **E SKL 92011**

Title: Entry Skills
Duration: 4.0 hours
Medium: SMS-MB

Student: COMMANDER, MS 2, PILOT (Entry MS optional.)

Source: DA7/Assigned SMS team

Date: 11/89

Lesson(s) Replaced: None Equipment Required: None

# 35 **E SKL 92011 (Concluded)**

Prerequisite Lesson(s): E SKL 91011

Preparation: None

Synopsis: Lesson exercises the crewmembers' knowledge of malfunction

procedures, their ability to prioritize, and their ability to understand the impacts that a malfunction (in one area) has on the other shuttle systems. Cases stressing flying theta limits with off-nominal energy and/or high tailwinds or headwinds on the Heading Alignment Cone (HAC) will be

emphasized on E SKL 92011.

Objectives: The student will be able to:

Correctly perform all nominal procedures.

• Understand the required malfunction procedures.

• Understand the ramifications of the malfunctions.

Prioritize and coordinate crewmember actions during malfunctions.

• Safely land or perform bailout procedures.

### 36 **ASC SKL 91011**

Title: Ascent Skills
Duration: 4.0 hours
Medium: SMS-MB

Student: COMMANDER, MS 2, PILOT (Ascent MS optional.)

Source: DA7/Assigned SMS team

Date: 01/96

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): MPS BSE FLT BRF 31001

Preparation: None

Synopsis: This is the first of two required flight-specific ascent lessons. These

lessons concentrate on flight-specific ascent procedures, new Operational Instrumentation (OI) updates, flight-specific model updates to the SMS, new 482s approved for this flight, payload-unique requirements, and areas

requiring additional proficiency as noted from prior ascent training.

Specific cases are not listed for these lessons, but cases from the Ascent Skills or Ascent Proficiency contents list can be used. The Team Lead will check with the Commander prior to scripting these lessons to get his or

her input into the content of these lessons.

# 36 ASC SKL 91011 (Concluded)

Objectives: The student will be able to:

- Correctly perform all nominal ascent procedures.
- Understand the required malfunction procedures.
- Understand the ramifications of the malfunctions.
- Prioritize and coordinate crewmember actions during malfunctions.
- Safely go to orbit or perform the correct abort scenario.

#### 37 **ASC SKL 92011**

Title: Ascent Skills
Duration: 4.0 hours
Medium: SMS-MB

Student: COMMANDER, MS 2, PILOT (Ascent MS optional.)

Source: DA7/Assigned SMS team

Date: 01/96

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ASC SKL 91011

Preparation: None

#### Synopsis:

This is the second of two required flight-specific ascent lessons. These lessons concentrate on flight-specific ascent procedures, new Operational Instrumentation (OI) updates, flight-specific model updates to the SMS, new 482s approved for this flight, payload-unique requirements, and areas requiring additional proficiency as noted from prior ascent training. Specific cases are not listed for these lessons, but cases from the Ascent Skills or Ascent Proficiency contents list can be used. The Team Lead will check with the Commander prior to scripting these lessons to get his or her input into the content of these lessons.

#### Objectives:

The student will be able to:

- Correctly perform all nominal procedures.
- Understand the required malfunction procedures.
- Understand the ramifications of the malfunctions.
- Prioritize and coordinate crewmember actions during malfunctions.
- Safely go to orbit or perform the correct abort scenario.

### 38 **D/O BURN 91011**

Title: Flight-Specific Deorbit Burn

Duration: 2.0 hours Medium: SMS-MB

Student: COMMANDER, MS 2, PILOT (Entry MS optional.)

Source: DS66/G&C/Propulsion Training Group

Date: 12/95

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ASC SKL 92011

Preparation: None

Synopsis: This lesson is a review of the nominal and off-nominal procedures on the

Deorbit Burn 2 Engine, 1 Engine, and Unbalanced cue cards using the flight-specific load. Some of the basic failures covered on the Deorbit Burn Monitor cue card will also be exercised. This lesson is also intended to allow the crew to get a feel for what their flight-specific deorbit burn will possibly look like, including expected propellant quantities, propellant

wasting, and targets.

- Transfer the information on the Propellant (PRPLT) Preliminary
  Advisory Data (PAD) and Deorbit, Entry, and Landing (DEL) PAD to the
  appropriate blocks on the Deorbit Burn 2 Engine, 1 Engine, and
  Unbalanced cue cards.
- Perform a 2 Engine, 1 Engine, and Unbalanced deorbit burn.
- Identify an ENG FAIL and a PRPLT FAIL.
- Identify and resolve the various failures covered on the Deorbit Burn Monitor cue card.
- Given a failure before ignition, determine if a waveoff is required using the Deorbit (D/O) Burn Flight Rules cue card.
- Given various failures, perform the steps required to complete the burn with each crewmember performing their specific duties.
- Determine the amount of prebank (if required) that is needed to reach the landing site, also stating the required prebank maneuver time and rate.

### 39 **CONT ABT 91011**

Title: Contingency Abort Refresher

Duration: 4.0 hours Medium: SMS-MB

Student: COMMANDER, MS 1, MS 2, PILOT Source: DS66/G&C/Propulsion Training Group

Date: 02/97

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): D/O BURN 91011

Preparation: Exposure to at least one contingency abort procedure during all ascent

flight operations training prior to this lesson.

Synopsis:

This lesson is a contingency abort refresher to be conducted in the SMS within two weeks of flight. This lesson concentrates on flight-specific contingency abort procedures not exercised within the last 60 days, BDA (Bermuda)/East Coast Abort Landing (ECAL) procedures, and areas requiring additional proficiency as noted from prior ascent training. Upon crew arrival at the SMS, the commander will be asked if there are any specific procedures they wish to exercise; if not already planned, contingency abort scenarios will be added to the lesson plan to exercise the requested procedures. Assuming black zones are avoided by the instructor, it is mandatory that the following scenarios be performed without overstressing the vehicle:

- Two BDA or ECAL aborts (a high energy and a nominal energy trajectory)
  - Inclination allowing, one ECAL must be a two out scenario.
  - Inclination allowing, the other ECAL must be a Canadian ECAL.
- A high energy Transatlantic Abort Landing (TAL) until automatic nominal energy has been established in OPS 3.
- A two out contingency abort.
- A three out contingency abort.
- A two out Return-To-Launch Site (RTLS) contingency abort.
- A three out RTLS contingency abort.
- Avoidance of the transonic pitch-up divergence.
- Avoidance of the alpha trap logic (manual calculation and verification of target Nz).

Note:

For efficient simulation, the last two bulletized items may be incorporated into bullets 3 through 6. Bullets 3 through 6 should encompass procedures requiring additional proficiency or that have not been exercised within the last 60 days.

### 39 **CONT ABT 91011 (Concluded)**

Objectives: In a coordinated crew effort, the crew will:

- Recognize and recover from multiple Space Shuttle Main Engine (SSME) malfunctions where intact abort capability is nonexistent.
- Locate the published procedure in the FDF that is applicable to the selected contingency abort region in which the engine malfunctions occurred.
- Execute published contingency abort procedures without exceeding structural limitations.
- Recognize and avoid specific flight envelopes that will cause a loss of control or vehicle overstress.

#### 40 **ENT PRF LS 41011**

Title: Load-Specific Entry Proficiency

Duration: 2.0 hours/biweekly

**Note:** Schedule 1 hour/weekly in conjunction with ASC PRF LS 41011.

Medium: SMS-MB

Student: COMMANDER, MS 2, PILOT (Entry MS optional.)

Source: DA7/Assigned SMS team

Date: 11/89

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): CONT ABT 91011

Preparation: None

Synopsis: Lesson maintains proficiency in entry operations for assigned crews until

they leave for their flight. The lesson should cover those procedures that they have not seen for some time or have not seen in 30000-level or 90000-level E SKL sessions. Completion of E SKL 9X011 or an

integrated load-specific entry simulation fulfills the proficiency requirement.

Objectives: The student will be able to:

- Correctly perform all nominal procedures.
- Understand the required malfunction procedures.
- Understand the ramifications of the malfunctions.
- Prioritize and coordinate crewmember actions during malfunctions.
- Safely land or perform bailout procedures.
- Correctly perform Payload/Spacehab Entry off-nominal procedures (if applicable).

# 41 **ASC PRF LS 41011**

Title: Load-Specific Ascent Proficiency

Duration: 3.0 hours/week

**Note:** Schedule in conjunction with 1 hour of ENT PRF LS 41011.

Medium: SMS-MB (SMS-FB)

Student: COMMANDER, MS 2, PILOT (Ascent MS optional.)

Source: DA7/Assigned SMS team

Date: Prepare as needed Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): CONT ABT 91011

Preparation: None

Synopsis: The lesson is load-specific ascent proficiency training which will be

utilized, when necessary, in the time period between completion of all previous ascent training and flight. It is similar to ASC PRF FS 41011, except that it should use a simulator software load and FDF which is identical to the flight software and vehicle configuration to be used by the crew on their assigned flight. Specific cases are not listed for this lesson, but cases from the Ascent Skills or Ascent Proficiency content list can be used. This lesson is not required if the crew has participated in a load-specific integrated ascent sim or a 90000-level Ascent Skills lesson within

the last week.

Objectives: The student should maintain proficiency in the following:

• Ascent procedures

Abort mode selection

Response to system failures

Flying techniques

#### MAN ASC 41001

Title: Manual Ascent Proficiency Prebrief

Duration: 2.0 hours Medium: Classroom

Student: Post ASCAN and pre-assigned Crew Members, Proficiency Crew

Members, DS66 Instructors

Source: DS66/Ascent Procedures Specialists

Date: 12/06

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

# MAN ASC 41001 (Concluded)

Synopsis:

This briefing is the first in a series of 2 briefings. They are both designed to review the cockpit indications and techniques used to fly nominal, Abort To Orbit (ATO), and Transatlantic Abort Landing (TAL) trajectories manually. A discussion of cockpit indications and techniques used during manual control is discussed to prepare for MAN ASC 41011. A review of guidance anomaly recognition, manual control, flight instruments, Integrated Display Processor (IDP) DPS Displays, FDF, and flight techniques is presented. This lesson covers trajectories similar in nature to normal insertions to orbit, and includes manual entry techniques for TAL aborts. The following trajectories are discussed: Nominal ascent, ATO caused by Space Shuttle Main Engine (SSME) failure, Dual simultaneous SSME failure during ascent Single Engine Roll Control (SERC), and Two engine out-of-plane TAL to landing.

Objectives:

Develop the crew skills to recognize when a manual takeover is required.

- Be able to fly the vehicle to Main Engine Cutoff (MECO) conditions, using navigation-derived information only:
  - Allow for orbital insertion and/or a runway landing without structural exceedances.

### **MAN ASC 41011**

Title: Manual Ascent Proficiency

Duration: 4.0 hours Medium: SMS/MB

Student: Post ASCAN and pre-assigned Crew Members, Proficiency Crew

Members, **DS66** Instructors

Source: DS66/Ascent Procedures Specialists

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): MAN ASC 21001 or MAN ASC BR 31001 or

MAN ASC 41001

Preparation: None

Synopsis: This lesson reinforces the material covered in MAN ASC BR 41001

through practical application in the SMS.

# MAN ASC 41011 (Concluded)

Objectives: At the end of this lesson, the student will be able to perform the following objectives:

- Recognize when a manual takeover is required.
- Establish manual control.
- Use navigation-derived information to fly the vehicle to Main Engine Cutoff (MECO) conditions:
  - Allow for orbital insertion and/or a runway landing without structural exceedances.

#### **MAN ABT 41001**

Title: Manual Abort Proficiency Prebrief

Duration: 2.0 hours Medium: Classroom

Student: Post ASCAN and pre-assigned Crew Members, Proficiency Crew

Members, **DS66** Instructors

Source: DS66/Ascent Procedures Specialists

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): MAN ASC 21011 or MAN ASC 31011 or MAN ASC 41011

Preparation: None

Synopsis:

This lecture is the second in a series of 2. These lessons are designed to review cockpit indications and techniques used flying Transatlantic Abort Landing (TAL) and Return-To-Launch Site (RTLS) trajectories manually. A discussion of cockpit indications and techniques used during manual control is provided to prepare for MAN ABT 41011. Topics to be reviewed: TAL redesignation, low energy TAL, post-MECO TAL, high energy TAL, high energy YQX, and RTLS flight techniques. Included is a discussion of abnormal entry energy management techniques for TAL and RTLS. The following are discussed: TAL Redesignation to low energy flight techniques, post-MECO TALs leading to high energy TAL to in-plane and out-of-plane sights, flight techniques, two-engine RTLS, including TAEM flight techniques.

- Develop skills required to recognize when a manual takeover is required.
- Be able to fly the vehicle to Main Engine Cutoff (MECO) conditions, using navigation-derived information only:
  - Allow for orbital insertion and/or a runway landing without structural exceedances.

# **MAN ABT 41011**

Title: Manual Abort Proficiency

Duration: 4.0 hours Medium: SMS/MB

Student: Post ASCAN and pre-assigned Crew Members, Proficiency Crew

Members, **DS66** Instructors

Source: DS66/Ascent Procedures Specialists

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): MAN ABT 21001 or MAN ABT BR 31001 or

MAN ABT 41001

Preparation: None

Synopsis: This lesson reinforces the material covered in MAN ABT BR 41001

through practical application in the SMS.

Objectives: At the end of this lesson, the student will be able to perform the following

objectives:

Recognize when a manual takeover is required.

Establish manual control.

 Use navigation-derived information to fly the vehicle to acceptable Main Engine Cutoff (MECO)/External Tank (ET) Separation (SEP) conditions.

 Fly the vehicle on entry to allow for a runway landing without structural exceedances.

### **CONT ABT RVW 41001**

Title: Contingency Abort Proficiency Prebrief

Duration: 2.0 hours Medium: Classroom

Student: Post ASCAN and pre-assigned Crew Members, Proficiency Crew

Members, **DS66** Instructors

Source: DS66/Ascent Procedures Specialists

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): MAN ABT 21011 or MAN ABT 31011 or MAN ABT 41011

Preparation: None

Synopsis: This lecture will discuss contingency abort procedures in preparation for

the CONT ABT RVW 41011 SMS lesson. Crews will receive instruction

on contingency abort maneuvering and trajectory profiles, cockpit indications, procedural rationale and execution, techniques, displays,

# CONT ABT RVW 41001 (Concluded)

controls, and cockpit resources used to initiate contingency abort maneuvering. The instruction will address both powered flight and entry procedures to either landing or bailout. A review of flight software capability and relevant orbiter hardware limitations is also provided. The lesson covers all of the Ascent Checklist (C/L) procedural regions for two and three engine failure scenarios occurring in either OPS 1 (contingency abort) or OPS 6 (Return-To-Launch Site (RTLS) contingency abort). A representative sampling of contingency abort maneuvers (not regions) are presented during this lesson.

Objectives: To develop crew skills to:

- Recognize and recover from multiple Space Shuttle Main Engine (SSME) malfunctions, where intact abort capability is nonexistent.
- Locate and execute the published procedure applicable to the contingency abort region in which the engine malfunctions occurred.

#### **CONT ABT RVW 41011**

Title: Contingency Abort Proficiency

Duration: 4.0 hours Medium: SMS-MB

Student: Post ASCAN and pre-assigned Crew Members, Proficiency Crew

Members, **DS66** Instructors

Source: DS66/Ascent Procedures Specialists

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): CONT ABT RVW 21001 or CONT ABT 31001 or

CONT ABT RVW 41001

Preparation: None

Synopsis: This lesson reinforces the material discussed in CONT ABT RVW 41001

through practical application using flight software at the SMS. A

representative sampling of contingency abort maneuvers (not regions) are

presented during this lesson.

# **CONT ABT RVW 41011 (Concluded)**

Objectives: The crew will:

- Recognize and recover from multiple Space Shuttle Main Engine (SSME) malfunctions where intact abort capability is nonexistent.
- Locate the published procedure in FDF applicable to the contingency abort region in which the engine malfunctions occurred.
- Execute published contingency abort procedures without exceeding structural limitations (or to the most benign conclusion).
- Recognize and avoid specific flight envelopes that will cause a loss of control or vehicle overstress (where applicable).

#### CONTINGENCY ABORT SAMPLING RATIONALE

Listed below are the 66 different major types of contingency abort maneuvers that create unique training concerns. Other maneuvers can occur; however, they are considered remote for window of exposure and/or failure timing reasons. All of the following are two failure scenarios (or less) with the exception of three out downmodes from two out and one of the stuck throttle maneuvers.

	CONTINGENCY ABORT MANEUVERS						
1.	Early three out blue (MM602) maneuver)	_	Two out second stage ECAL site overlap				
2.	Late three out blue (MM601 maneuver)		Droop simultaneous failures				
3.	Early three out green (pre heads-up roll)	23.	'				
4.	Late three out green (post heads-up roll)	24.	Droop back-out to two out second stage				
5.	Three out green Canadian ECAL	25.	Early droop (ELS result)				
6.	Three out orange from two out simultaneously	26.	Late droop (TAL result)				
7.	Three out orange from two out staggered	27.	Stuck first where good engine fails in first stage				
8.	Three out orange change to green	28.	Stuck first where good engine fails in second stage				
9.	Three out yellow from two out simultaneously	29.	Stuck first blue				
10.	Three out yellow from two out staggered	30.	Stuck first green				
11.	Three out yellow heads down	31.	Early stuck RTLS (wait for ADI PPA indication)				
12.	Three out yellow heads up	32.	Late stuck RTLS (past ADI PPA indication)				
13.	Two out first stage blue	33.	"N/A" stuck RTLS				
14.	Two out first stage green (rare, but possible)	34.	Stuck with two good engines failed				
15.	Two out second stage blue	35.	Stuck droop (with erroneous droop				
16.	Two out second stage green		altitude displayed)				
17.	Two out second stage green pre mode 2 maneuver	36.	Stuck TAL (to alternate TAL site)				
	Two out second stage BDA/ECAL	37.	High energy post-MECO TAL				
19.	Two out second stage BDA no yaw	38.	Low energy post-MECO TAL				
20.	Two out second stage BDA/ECAL no site (bailout)	39.	42 (40 & 37)/Man 37 post-MECO TAL				

# CONTINGENCY ABORT SAMPLING RATIONALE

	RTLS CONTINGENCY ABORT MANEUVERS					
40.	RTLS two out from systems RTLS	58.	RTLS two out green early (x-sonic pitch-up demo)			
41.	RTLS three out from systems RTLS	59.	RTLS two out green late			
42.	RTLS three out green (pre PPA)	60.	RTLS two out red center engine running			
43.	RTLS three out green (post PPA, pre Vrel 0) early	61.	RTLS two out red side engine running (SERC issue)			
44.	RTLS three out green (post Vrel 0), (x-sonic pitch up)	62.	RTLS completion after fine count			
45.	RTLS three out orange early (x-sonic pitch-up demo)	63.	Black zone demonstration (LOC, g's, or EAS)			
46.	RTLS three out orange late (x-sonic pitch-up demo)	64.	High pull-out EAS avoidance techniques			
47.	RTLS three out orange change to green	65.	Two out downmode to three out demonstration			
48.	RTLS three out yellow early (x-sonic pitch-up demo)	66.	Bail-out DAP engagement difficulty			
49.	RTLS three out yellow to red					
50.	RTLS three out yellow/red stagger vs. simo failures (trap demo)					
51.	RTLS three out blank simultaneous failures					
52.	RTLS three out blank staggered failures trap demo)					
53.	RTLS two out blue					
54.	RTLS two out yellow (pre PPA)					
55.	RTLS ECAL					
56.	RTLS two out orange early (x-sonic pitch-up demo)					
57.	RTLS two out orange late (immediate MECO)					

#### CONTINGENCY ABORT SAMPLING RATIONALE

Only 22 of the maneuvers listed previously are presented during the CONT ABT 31001, 31011, 32001, and 32011 series of assigned crew lessons. This representative sample along with ascent skills and 91011 contingency abort training optimizes maneuver/procedural exposure. This is the absolute minimum training in preparation for a safe STS mission.

#### RATIONALE FOR THE CONT ABT 31011 SCENARIOS

The first three scenarios must start at T-2 minutes to develop crew procedural cadence. Other data stores/reset points can be used once the first three scenarios have been completed. Discussed below is additional rationale for each of the mandatory scenarios exercised during this lesson:

1. Contingency 2 out blue Simultaneous dual engine failure around 1 minute MET. This is

a relatively simple first run allowing the crew time to exercise

the procedures in a methodical fashion.

2. RTLS 2 out yellow Staggered dual engine failure scenario. First engine fails

around 1 minute MET to verify the crew's management of procedural paperwork. The second engine fails well past PPA to demonstrate two out automated maneuvering while the vehicle is traveling backwards. This scenario allows the crew ample time to prepare for a staggered engine failure scenario.

A pre PPA maneuver is not required because it is nearly

identical to two out second stage green.

3. Contingency 3 out blue Staggered triple engine failure scenario. One-second stagger

simulates a single failure scenario and prevents MECO confirmed, forcing the crew to take action to initiate three out automated maneuvering. Failure timing is chosen to avoid a black zone and force a MM601 maneuver to entry attitude such

that all procedural steps are exercised.

4. BDA/ECAL Simultaneous dual engine failure within the BDA\*/ECAL

window. This is the most simplistic BDA/ECAL scenario for the crew's first attempt at this procedure. If ECAL, and Otis scenario is presented because a moderate amount of time is available to exercise the procedure. Multiple BDA/ECAL scenarios follow as they require more training because of the

lack of software automation.

\* There is no choice but to stagger the engine failures for 28.45\_ inclination BDA aborts. The first 28.45\_ BDA is performed off of a previous BEN TAL declaration.

#### CONTINGENCY ABORT SAMPLING RATIONALE

5. BDA/ECAL

Staggered dual engine failure within the BDA/ECAL window. A stagger is chosen because it exercises all additional FDF required for successful BDA/ECAL aborts if ECAL, a Cherry Point RTLS scenario is presented to demonstrate time compression associated with an earlier abort. If 28.45\_BDA, the abort is performed off of a previous MRN TAL to allow the crew to correlate entry energy conditions as a function of TAL trajectory differences.

6. BDA/Canadian ECAL

If BDA, any dual engine failure scenario is presented to further practice BDA techniques. If high inclination, all three engines fail nearly simultaneously within the Shearwater Canadian ECAL window. Timing for the triple engine failure scenario only allows Shearwater capability to simplify complexity for a first Canadian attempt. The Canadian ECAL provides an opportunity to further practice MM602 energy management techniques while exercising the unique procedures to Canadian sites.

7. Three out green/ Canadian ECAL A nearly simultaneous failure of all three engines to exercise three out green procedures for low and mid inclination flights. For high inclination a Canadian ECAL is performed in a region where the crew is forced to decide which of three sites to fly towards. This is the most complicated Canadian ECAL, requiring the highest degree of situational awareness and crew coordination.

Engine failure timing for all BDA/ECALs above will vary to present high, nominal, and low energy situations in MM602. This will allow exposure to off-nominal energy management techniques for runway capability.

8. RTLS three out green

A left engine failure forcing RTLS followed by post PPA – pre Vrel 0 failures of the remaining engines one second apart. Pre PPA RTLS green is not required because the maneuver is nearly identical to the three out green scenarios in 6 and 7 above. The second and third engine failure timing is chosen to demonstrate a maximum yaw around maneuver to entry attitude.

9. Contingency three out blue

A nearly simultaneous failure of all three engines with relatively high q to demonstrate limitations of the 3 out automated software. This is a recoverable loss of control scenario. This develops crew ability to discriminate between commanded and uncommanded maneuvering to know when to stay out of the control loop.

#### CONTINGENCY ABORT SAMPLING RATIONALE

10. Three out from two out

The last engine is failed during a two out second stage green maneuver to demonstrate automated contingency abort software switching capability from two out to three out with low q. This develops crew confidence to stay out of the control loop. A downmode from two out second stage green (pre mode 2) allows exposure to this maneuver prior to failure of the last engine.

The RTLS two out blue maneuver is not performed during any training because the window of exposure is too narrow. Lack of training should not be a problem if this region is experienced in flight because it is nearly identical to the contingency two out blue maneuver.

Facility time permitting, three optional scenarios will be added:

- a) A paperwork verification scenario
- b) Three out at RTLS PPA
- c) RTLS three out green post Vrel 0.

The paperwork verification scenario ensures the crew has developed good FDF habit patterns. A three out scenario during PPA further demonstrates three out automation capability with rates on the vehicle at low q, thereby developing the crew's FCS decision-making capability. A black zone signature may result as well. The RTLS three out green post Vrel 0 further develops the crew's ability to read the cue card in this region.

# **CONTINGENCY ABORT SAMPLING RATIONALE**

#### RATIONALE FOR THE CONT ABT 32011 SCENARIOS

1. Droop A staggered dual engine failure scenario. The first engine is

failed within the TAL window followed by a second engine failure at SE OPS 3. This forces maximum FDF utilization and develops insights to the assumptions comprising the SE OPS 3

boundary.

2. Droop back-out A simultaneous dual engine failure scenario wherein the

minimum droop altitude is violated, necessitating a downmode to two out second stage green. This will develop the ability to follow the cue card flow and provide exposure to the droop simultaneous failure scenario. A slight insight to SE OPS 3

assumptions may be realized as well.

3. Stuck first A one and two-thirds scenario in second stage. This provides

exposure to the subtle and unique procedures of stuck throttle contingency aborts in regions where runway capability is non-existent. Additionally, this scenario demonstrates that this procedure applies to failures occurring in second stage as well

as first stage.

4. Stuck RTLS A one and two-thirds scenario within the one and two-thirds

RTLS window. This provides exposure to the completely

unique stuck RTLS procedures.

5. RTLS two out orange A second engine failure shortly after Vrel 0 after a previous

engine failure forcing the RTLS trajectory. This demonstrates an almost immediate MECO along with the techniques associated with avoiding a powered flight LOC and transonic pitch-up divergence during entry. This scenario increases procedural execution speed and accuracy. This scenario

includes a SERC toggle procedure.

6. RTLS three out orange A two-second stagger of the remaining engines shortly after

Vrel 0 after a previous engine failure forcing the RTLS trajectory. Exposure to this region further increases three engine out proficiency, allowing practice of techniques and procedural execution speed. The engine failure stagger

develops contingency abort SFRM.

7. RTLS two out green A second engine failure after a previous engine failure forcing

the RTLS trajectory. This provides exposure to the RTLS green region as well as further procedural, technique and SFRM

practice.

#### CONTINGENCY ABORT SAMPLING RATIONALE

A 1 second stagger of the remaining engines after a previous 8. RTLS three out yellow

engine failure forcing the RTLS trajectory. This provides exposure to the marginally controllable RTLS three out yellow region. Further procedural, technique, and SFRM practice is

realized. This scenario includes a decision not to toggle SERC.

9. RTLS three out yellow/red

A high q simultaneous failure of the remaining engines after a previous engine failure forcing the RTLS trajectory. This provides exposure to the completely unique and marginally controllable RTLS three out red maneuver. An alpha trap situation may develop forcing the crew to use all of the techniques previously practiced in an extremely timely fashion. This is the most confusing and dangerous contingency abort

maneuver requiring the utmost SFRM.

10. RTLS two out red A second engine failure after a previous engine failure forcing

> the RTLS trajectory. This provides exposure to unique procedures associated with this marginally controllable region. Further procedural, technique, and SFRM practice is realized.

A decision to toggle SERC is included in this scenario.

11. RTLS three out blank A simultaneous failure of the remaining engines after the color

> field has blanked on the RTLS Traj display. This provides exposure to the unique and undocumented techniques to safely

complete the RTLS trajectory.

12. Contingency three out

blank

Either a failure of the last remaining engine after two previous engine failures or a nearly simultaneous failure of all three engines after the color field has blanked on the Traj display. This provides exposure to the unique and undocumented techniques to safely complete the RTLS trajectory.

Facility time permitting, optional scenarios will be added to:

- a) Review BDA/ECAL techniques
- Increase proficiency in any area observed to be deficient b)
- Exercise a stuck droop procedure c)
- d) Perform any of the remaining 46 major contingency abort maneuvers.
- Demonstrate a black zone signature. e)

The rationale for b and d above is self-explanatory. BDA/ECAL maneuver may require review because of the extensive manual techniques involved. The stuck droop procedure is exercised to provide exposure to erroneous display of droop altitude as well as the subtle and unique procedural differences. A black zone demonstration is desirable to complete the crew's knowledge of the contingency abort trajectory such that its signature can be recognized for situational awareness.

**Note:** Different combinations/sequences of engine failures are provided throughout this training for maximum exposure to unique aerodynamic asymmetry issues. Data path, red-line limit exceedance, or system failure situations can be added to any scenario above; however, this should be the exception rather than the rule to allow full concentration on contingency abort procedures, maneuvering, techniques, and SFRM.

# **CONTINGENCY ABORT SAMPLING RATIONALE**

#### RATIONALE FOR THE CONT ABT 91011 SCENARIOS

The rationale for this 90K level lesson is straightforward. The intent of this lesson is to provide flight specific contingency abort review emphasizing:

- 1. Procedures not performed during recent ascent simulation (or have never been performed during simulation)
- 2. Procedures requiring manual intervention
- 3. Areas requiring additional proficiency as noted from previous ascent simulations

# SECTION 7.0 ORBIT FLIGHT OPERATIONS TRAINING COURSE

The primary goal of the Orbit Flight Operations Training Course (see Figure 7-1) is to ensure that the student has been exposed to those Flight Data File (FDF) items related to on-orbit orbiter operations, which can be exercised at the SMS. These FDF items include:

- Post-Insertion Checklist
- Flight Plan
- Orbit OPS Checklist
- Orbit Pocket Checklist
- EVA OPS Checklist
- STS Systems Malfunction Procedures
- Reference Data Book

Although the FDF and Flight Plan include flight specific activities, certain aspects are standard. These will be emphasized and include the nominal, Primary Avionics Software System (PASS), General Purpose Computer (GPC), failed, and Backup Flight System (BFS) post-insertion activities. It also includes PGSC computer with Space Operations Computing (SpOC) software use, site coverage, stowage, Orbit Operations (Orb Ops) Checklist (C/L) activities, attitude maneuvers, alignments and minimum Reaction Control System (RCS) usage procedures. Orbit Pocket C/L activities are emphasized. Due to time constraints, all long-form malfunction procedures will not be exercised at the SMS. Single System Trainers (SSTs) are used in the Systems, COMM, Control/Propulsion (PROP), and DPS training flows to cover many of these procedures. The Orbit Flight Operations Training Course also includes part-task training in Star Tracker Crew Optical Alignment Sight (ST/COAS) star sightings, Inertial Measurement Unit (IMU) alignments, and the orbit DAP (as used for orbit manual attitude control), as well as the Electrical Power System (EPS) and COMM systems.

Through the non-load specific (20000-level and 30000-level) orbit training, the crew is prepared to enter integrated orbit simulations or to begin orbit skills training in which they will be exposed to multiple systems failures. The orbit skills lessons will be coordinated by the crew-assigned SMS team lead and SST instructors to cycle the students through FDF items previously covered. In addition, some major powerdowns leading to contingency deorbit preps will be covered. (These procedures were originally taught as part of the Deorbit and Entry Flight Operations Training Course.) The orbit skills lessons may also be utilized by a crew for timeline operations.

Load specific (90000-level) training for a crew begins when the FDF and simulator training load are correct for the assigned flight. This training includes one post-insertion run. Major payload and PDRS activities are covered in their respective training flows.

When each member of a crew has previously flown within 2 years, training will begin at the 30000-level. The specific 30000-level lessons required for an experienced crew are a function of how recently the crew has flown.

Load Specific (90000-Level) RNDZ/PDRS missions:

There are 4 different flows for PDRS depending on the mission tasks: Unloaded, Loaded, Deploy, Retrieve. These flows are only required for Deploy and Retrieve missions, NOT ISS flights, as the PDRS flow will cover all required PDRS objectives.

The Loaded flow will be required if there are excessive loaded operations in the Flight Plan. Minimal Loaded operations may be timelined before the deploy or after the retrieve lessons.

For a Deploy and Retrieve mission, both the Deploy and Retrieve flows will be required.

Not all lessons in each flow may be required. For example, the Single Joint and Contingency lessons will be required only if Single Joint and Contingency procedures are published.

Load Specific (90000-Level) Deploy or Retrieve missions:

PROX OPS T/L 91012 will be required to support any proximity operations that may be required for a Deploy or Retrieve mission.

Load Specific (90000-Level) Docking missions:

UNDOCK MAL T/L 91012 and PROX OPS T/L 91012 will be required to support docking and undocking operations.

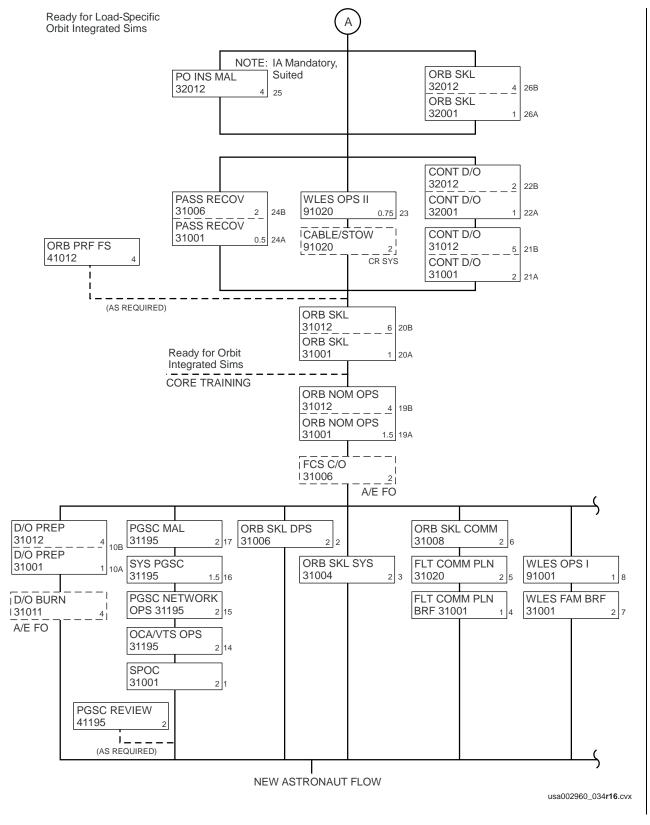


Figure 7-1. Orbit Flight Operations Lesson Flow Chart (Sheet 1 of 3)

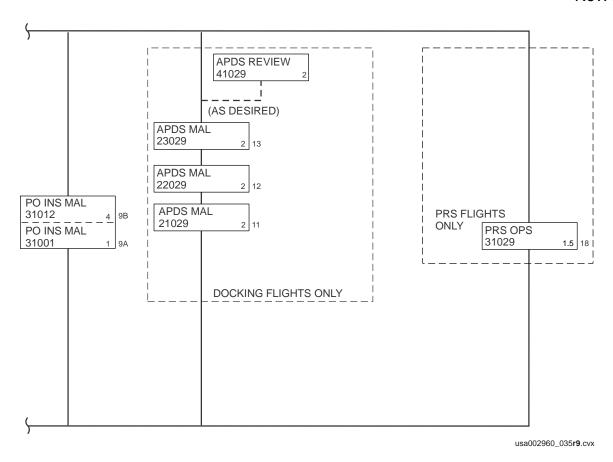


Figure 7-1. Orbit Flight Operations Lesson Flow Chart (Sheet 2 of 3)

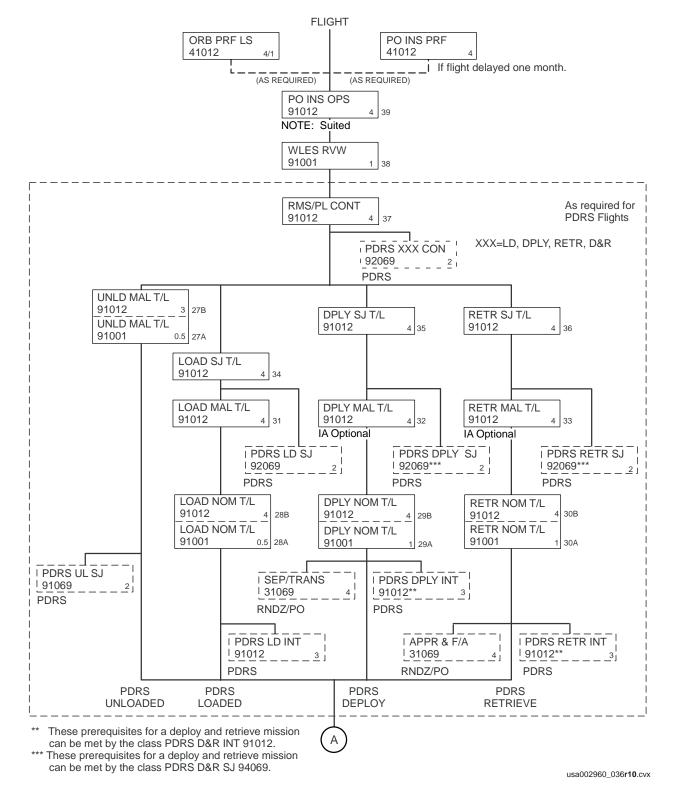


Figure 7-1. Orbit Flight Operations Lesson Flow Chart (Sheet 3 of 3)

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# **Table 7-1. Orbit Flight Operations Crew Training Requirements**

Date Last Modified: 06/08 Non-Crew Rotation **Crew Rotation** Ref Sched Code MS4 PS С MS2 Alt Fac Stage Num Lesson Code Media Hrs С Ρ MS1 MS2 MS3 Р MS1 Comments SPOC 31001 CLR 2 3 2 2 2 2 2 2 2 2 2 ORB SKL DPS 31006 2 3 2 2 2 2 2 2 See Notes 4 and 5 ORB SKL SYS 31004 2 2 2 2 2 2 2 2 See Note 1. Others designated by FLT COMM PLN BRF 31001 CLR FLT COMM PLN 31020 See Note 2 4 CCT 8 2 2 2 4 6 ORB SKL COMM 31008 2 2 2 See Note 1 SST 9A PO INS MAL 31001 4 CLR 8 9B PO INS MAL 31012 GNS FB 8 4 4 4 4 4 PS optional (highly 4 10A D/O PREP 31001 CLR desirable) PS optional (highly 4 10B D/O PREP 31012 GNS desirable) FB Docking flights only. As 4 APDS MAL 21029 PYLD assigned by CDR 2 4 12 APDS MAL 22029 PYLD 2 2 2 2 2 2 2 As assigned by CDR 4 13 APDS MAL 23029 PYLD 2 2 2 2 2 2 2 2 As assigned by CDR 2 2 2 4 OCA/VTS OPS 31195 **PGSC** 2 15 PGSC NETWORK OPS 31195 **PGSC** 4 2 2 2 2 2 2 2 2 2 1.5 16 SYS PGSC 31195 **PGSC** 4 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 PGSC 2 PGSC MAL 31195 As assigned by CDR See Note 6; as assigned PRS OPS 31029 PYLD 1.5 1.5 1.5 See Note 4; 1.0 hour for 19A ORB NOM OPS 31001 missions on OV-104 CLR 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5 4 19B ORB NOM OPS 31012 4 4 4 4 4 4 4 GNS See Note 4 4 4 Sub Total for Stage Stage Totals Per Crewmember:

40.0 40.0 38.5 NOTE: 1. Schedule in pairs from crew CDRs list of crew duty assignments. Schedule the prime and backup crewmembers together in one of the following SST lessons. Instructors should be selected from the SMS team assigned to the flight, if possible. (Contact the instructor or SMS team lead before scheduling.)

ORB SKL SYS 31004 ORB SKL COMM 31008

4

- 2. This lesson should be scheduled a minimum of 2 weeks after FLT COMM PLN BRF 31001.
- 3. As required, the SMS should be scheduled for one hour of PGSC and photo/TV setup training prior to the start of the lesson. This should be scheduled for all flights with complicated PGSC or photo/TV setups or Flight Day 1 deploy.

35.5

32.5

40.0 40.0

- 4. If dual shift flight, this should be scheduled separately for the RED Shift Crew and the BLUE Shift Crew.
- 5. Commander may request other MS to take the lesson. Only C, P, and MS2 required. At the discretion of the CDR/crew, this lesson can be scheduled with the entire crew listed at the same time or in multiple classes.
- 6. If MPLM is on-board the flight, disregard PRS OPS 31029 and enter MPLM flow.

# Table 7-1. Orbit Flight Operations Crew Training Requirements (Continued)

Date Last Modified: 07/07

						Non-Crew Rotation								Crew I	Rotation	า		
	Ref				Sched													
Stage	Num	Lesson Code	Media	Hrs	Code	С	Р	MS1	MS2	MS3	MS4	PS	С	Р	MS1	MS2	Alt Fac	Comments
3	7	WLES FAM BRF 31001	CLR	2	8	2	2	2	2	2			2	2	2	2		
3	8	WLES OPS I 91001	CLR	1	2			1		1					1			As assigned by CDR; at B49 WLES Lab
3	20A	ORB SKL 31001	CLR	1	8	1	1	1	1	1			1	1	1	1		
3	20B	ORB SKL 31012	FB	6	8	6	6	6	6	6			6	6	6	6	GNS	
3	21A	CONT D/O 31001	CLR	2	8	2	2	2	2	2			2	2	2	2		
3	21B	CONT D/O 31012	FB	5	8	5	5	5	5	5			5	5	5	5	GNS	
3	22A	CONT D/O 32001	CLR	1	8	1	1	1	1	1			1	1	1	1		
3	22B	CONT D/O 32012	FB	2	8	2	2	2	2	2			2	2	2	2	GNS	
3	24A	PASS RECOV 31001	CLR	0.5	3	0.5	0.5		0.5				0.5	0.5		0.5		See Notes 4 and 5
3	24B	PASS RECOV 31006	SST	2	3	2	2		2				2	2		2		See Notes 4 and 5
																		Suited; CB IA
3	25	PO INS MAL 32012	FB	4	8	4	4	4	4	4		4	4	4	4	4	GNS	Mandatory
3	26A	ORB SKL 32001	CLR	1	8	1	1	1	1	1			1	1	1	1		
3	26B	ORB SKL 32012	FB	4	8	4	4	4	4	4			4	4	4	4	GNS	
3		Sub To	otal for Stage		Stage Totals	Per C	rewmer	nber:										
3				31.5		30.5	30.5	29	30.5	29	0	4	30.5	30.5	29	30.5		
2	23	WLES OPS II 91020	сст	0.75	2			0.75		0.75					0.75			As assigned by CDR
2	38	WLES RVW 91001	PGSC	1	2			1		1					1			As assigned by CDR
2	39	PO INS OPS 91012	FB	4	8	4	4	4	4	4			4	4	4	4	GNS	Suited
2		Sub To	otal for Stage		Stage Totals F		rewmer											
2				5.75		4	4	5.75	4	5.75	0	0	4	4	5.75	4		

NOTE: 1. Schedule in pairs from crew CDRs list of crew duty assignments. Schedule the prime and backup crewmembers together in one of the following SST lessons. Instructors should be selected from the SMS team assigned to the flight, if possible. (Contact the instructor or SMS team lead before scheduling.)

ORB SKL SYS 31004 ORB SKL COMM 31008

- 2. This lesson should be scheduled a minimum of 2 weeks after FLT COMM PLN BRF 31001.
- 3. As required, the SMS should be scheduled for one hour of PGSC and photo/TV setup training prior to the start of the lesson. This should be scheduled for all flights with complicated PGSC or photo/TV setups or Flight Day 1 deploy.
- 4. If dual shift flight, this should be scheduled separately for the RED Shift Crew and the BLUE Shift Crew.
- 5. Commander may request other MS to take the lesson. Only C, P, and MS2 required. At the discretion of the CDR/crew, this lesson can be scheduled with the entire crew listed at the same time or in multiple classes.
- 6. If MPLM is on-board the flight, disregard PRS OPS 31029 and enter MPLM flow.

# Table 7-1. Orbit Flight Operations Crew Training Requirements (Concluded)

Date Last Modified: 07/07

								Non-C	rew Ro	otation				Crew	Rotatio	n		
	Ref				Sched													
Stage	Num	Lesson Code	Media	Hrs	Code	С	Р	MS1	MS2	MS3	MS4	PS	С	Р	MS1	MS2	Alt Fac	Comments
0	27A	UNLD MAL T/L 91001	CLR	0.5	8	0.5	0.5	0.5	0.5	0.5			0.5	0.5	0.5	0.5		
0	27B	UNLD MAL T/L 91012	FB	3	8	3	3	3	3	3			3	3	3	3		See Note 3
0	28A	LOAD NOM T/L 91001	CLR	0.5	8	0.5	0.5	0.5	0.5	0.5			0.5	0.5	0.5	0.5		
0	28B	LOAD NOM T/L 91012	FB	4	8	4	4	4	4	4			4	4	4	4	NBL/FB	See Note 3
0	29A	DPLY NOM T/L 91001	CLR	1	8	1	1	1	1	1			1	1	1	1		
0	29B	DPLY NOM T/L 91012	FB	4	8	4	4	4	4	4			4	4	4	4	NBL/FB	See Note 3
0	30A	RETR NOM T/L 91001	CLR	1	8	1	1	1	1	1			1	1	1	1		
0	30B	RETR NOM T/L 91012	FB	4	8	4	4	4	4	4			4	4	4	4	NBL/FB	See Note 3
0	31	LOAD MAL T/L 91012	FB	4	8	4	4	4	4	4			4	4	4	4	NBL/FB	See Note 3
0	32	DPLY MAL T/L 91012	FB	4	8	4	4	4	4	4			4	4	4	4	NBL/FB	CB IA optional
																		Docking Flights. See
0	33	RETR MAL T/L 91012	FB	4	8	4	4	4	4	4			4	4	4	4	NBL/FB	Note 3. CB IA optional
0	34	LOAD SJ T/L 91012	FB	4	8	4	4	4	4	4			4	4	4	4	NBL/FB	See Note 3
0	35	DPLY SJ T/L 91012	FB	4	8	4	4	4	4	4			4	4	4	4	NBL/FB	See Note 3
0	36	RETR SJ T/L 91012	FB	4	8	4	4	4	4	4			4	4	4	4	NBL/FB	See Note 3
0	37	RMS/PL CONT 91012	FB	4	8	4	4	4	4	4			4	4	4	4	NBL/FB	
0		PGSC REVIEW 41195	PGSC	2	2	2	2	2	2	2			2	2	2	2		
0		APDS REVIEW 41029	PYLD	2	2	2	2	2	2	2			2	2	2	2		Docking Flights Only
																		As required to maintain
																		skills or cap
0		ORB PRF FS 41012	FB	4	8	4	4	4	4	4			4	4	4	4	GNS	development
		01011111012	- 10		0		-	•						•			0110	As required to maintain
																		skills or cap
0		ORB PRF LS 41012	FB	4	8	4	4	4	4	4			4	4	4	4	GNS	development
U		OND FRF L3 41012	ГВ	4	0	4	4	4	4	4			4	4	4	4	GNO	
																		Only required if launch
																		slips by minimum of
0		PO INS PRF 41012	FB	4	8	4	4	4	4	4			4	4	4	4	GNS	one month
0		Sul	b Total for Stage		Stage Totals													
0				62		62	62	62	62	62	0	0	62	62	62	62		

NOTE: 1. Schedule in pairs from crew CDRs list of crew duty assignments. Schedule the prime and backup crewmembers together in one of the following SST lessons. Instructors should be selected from the SMS team assigned to the flight, if possible.

(Contact the instructor or SMS team lead before scheduling.)

ORB SKL SYS 31004 ORB SKL COMM 31008

- 2. This lesson should be scheduled a minimum of 2 weeks after FLT COMM PLN BRF 31001.
- 3. As required, the SMS should be scheduled for one hour of PGSC and photo/TV setup training prior to the start of the lesson. This should be scheduled for all flights with complicated PGSC or photo/TV setups or Flight Day 1 deploy.
- 4. If dual shift flight, this should be scheduled separately for the RED Shift Crew and the BLUE Shift Crew.
- 5. Commander may request other MS to take the lesson. Only C, P, and MS2 required. At the discretion of the CDR/crew, this lesson can be scheduled with the entire crew listed at the same time or in multiple classes.
- 6. If MPLM is on-board the flight, disregard PRS OPS 31029 and enter MPLM flow.

#### 1 **SPOC 31001**

Title: Space Operations Computing Software Briefing

Duration: 2.0 hours Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT (Schedule in groups of 3.)

Source: MS4/Flight Software Office

Date: 04/95

Lesson(s) Replaced: None

Equipment Required: PGSC per student with generic flight load

Prerequisite Lesson(s): New Astronaut Flow

Preparation: None

Synopsis: This briefing covers the basic operations of Space Operations Computing

(SpOC) PGSC applications primarily focusing on WorldMap and Deorbit Manager. Additional applications covered during the class include 3D Orbiter, Capture Master, Hazardous Materials (HazMat), Locker Stow, OMS Reaction Control System (RCS), Packet Display Program, Portable

Onboard Computer (POC) Plot, and Time Utilities. Class includes discussion of SpOC data updates via orbiter telemetry and ground

sources.

Objectives:

 Demonstrate proficiency in using the SpOC software and PGSC hardware for each of the programs listed above.

Demonstrate an understanding of the onboard PGSC telemetry

distribution system.

#### 2 ORB SKL DPS 31006

Title: Orbit Data Processing System Skills

Duration: 2.0 hours

Medium: SST 1, SST 2, or SST 3

Student: COMMANDER, MS 2, PILOT (If dual shift flight, schedule Red Shift

and Blue Shift separately. Commander may request other MS to take the lesson. Only C, P, and MS2 required. At the discretion of the CDR/crew, this lesson can be scheduled with the entire crew listed at

the same time or in multiple classes.)

Source: DS24/DPS/Navigation Training Group

Date: 02/04

Lesson(s) Replaced: ORB SKL 32012, ORB SKL 33012

Equipment Required: None

Prerequisite Lesson(s): DPS Q 31001

Preparation: None

### 2 ORB SKL DPS 31006 (Concluded)

Synopsis: This lesson covers nominal and malfunction DPS procedures. It will be

used to prepare the astronauts (prime and backup) who were selected by

the CDR to be responsible for DPS.

Objectives: This lesson covers the following objectives:

- Recognize all Primary Avionics Software System (PASS) Guidance, Navigation and Control (GNC) General Purpose Computers (GPCs) failing and work GNC Recovery via G2FD GPC activate procedures
- Recognize and recover from loss of PASS Multifunction Electronic Display System (MEDS) interface via:
  - Systems Management (SM) GPC fail
  - Freeze Dried (FD) GPC activate
  - DPS, MAL PROC, GPC FRP-1 (optional)
  - Modular Memory Unit (MMU) failure during IPL process (optional)
- Recognize and recover from a Flight Critical (FC) X at GPC Y transmitter problem
- Recognize and recover from a Redundant set split with an off-nominal string assignment
- Perform the Operational Sequence (OPS) 2 to OPS 8 transition with MMU problems
- Recognize and recover from a critical Built-In Test Equipment (BITE) in the MEDS
- Discuss pertinent Operations Program System (OPS) notes and good DPS practices

#### 3 **ORB SKL SYS 31004**

Title: Orbit Systems Skills

Duration: 2.0 hours Medium: SST 2

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT (Schedule in pairs as

assigned by CDR.)

Source: DS45/Shuttle Systems Training Group

Date: 01/94

Lesson(s) Replaced: ORB SKL 32012, ORB SKL 33012

Equipment Required: None

Prerequisite Lesson(s): New Astronaut Flow

Preparation: None

Synopsis: This lesson covers nominal and malfunction procedures in the subject

area. It will be used to prepare the astronauts (prime and backup) who

were selected by the CDR to be responsible for these systems.

### 3 ORB SKL SYS 31004 (Concluded)

Objectives: The following malfunctions will be resolved using the appropriate FDF.

- Environmental Control and Life Support System (ECLSS):
  - Avionics (AV) Bay smoke detector failure
  - Humidity separator speed sensor failure
  - Cabin fan delta P high
  - Inertial Measurement Unit (IMU) fan delta P low
  - Pressure Control System (PCS) Partial Pressure of Oxygen
    - (PPO<sub>2</sub>) controller failure
  - Freon loop evap out temp high
  - Freon flow low
  - H<sub>2</sub>O loop accumulator quantity low

#### EPS:

- Cryo O<sub>2</sub> current sensor failure
- Fuel cell stack sensor failure
- Fuel cell pH indication
- Cryo leak
- Auxiliary Power Unit (APU):
  - APU fuel line heater failure
  - Hydraulic accumulator leak with circ pump failure
  - Water Spray Boiler (WSB) leak
  - Hydraulic temperature sensor failure

#### 4 <u>FLT COMM PLN BRF 31001</u>

Title: Flight Communications Plan Briefing

Duration: 1.0 hour Medium: Classroom

Student: COMMANDER, MS 2, PILOT and other crewmembers designated

hy CDR

**Note:** MSs should be designated COMM specialists.

Source: DS25/Shuttle Comm Training

Date: 02/03

Lesson(s) Replaced: AUDIO 31001

Equipment Required: None

Prerequisite Lesson(s): New Astronaut Flow

Preparation: None

# 4 FLT COMM PLN BRF 31001 (Concluded)

Synopsis: This lesson is required to discuss the use of the audio and

communications systems during on-orbit activities. Different options for the audio configurations will be discussed, and the agreed upon audio configurations will be evaluated with the whole crew in the flight-specific

COMM lesson FLT COMM PLN 31020.

Objectives: • Discuss flight-specific requirements and crew preferences for each

on-orbit activity audio configuration.

• Finalize Flight-Specific Audio Plan for each activity discussed.

## 5 **FLT COMM PLN 31020**

Title: Flight Communication Plan

Duration: 2.0 hours Medium: CCT

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT

Source: DS25/Shuttle Comm Training

Date: 02/03

Lesson(s) Replaced: AUDIO 31020

Equipment Required: See Facility Utilization Request. Prerequisite Lesson(s): FLT COMM PLN BRF 31001

**Note:** This lesson should be scheduled a minimum of 2 weeks after

FLT COMM PLN BRF 31001.

Preparation: None

Synopsis: This lesson will enable the crew to set up and use the flight-similar audio

equipment for each phase of flight and for flight-specific on orbit activities per the Flight-Specific Audio Plan established during the FLT COMM PLN

BRF.

Objectives: Configure the flight-similar Audio equipment for each flight-specific activity

per the Flight-Specific Audio Plan.

#### 6 **ORB SKL COMM 31008**

Title: Orbit Communication Skills

Duration: 2.0 hours

Medium: SST 1 or SST 2 or SST 3

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT (Schedule in pairs as

assigned by CDR.)

Source: DS25/Shuttle Comm Training

Date: 01/94

Lesson(s) Replaced: ORB SKL 32012, ORB SKL 33012

Equipment Required: None

# 6 ORB SKL COMM 31008 (Concluded)

Prerequisite Lesson(s): FLT COMM PLN 31020

Preparation: None

Synopsis: This lesson covers nominal and malfunction procedures in the subject

area. It will be used to prepare the astronauts (prime and backup) that were selected by the CDR to be responsible for these systems for their

flight assignments.

Objectives:

- Identify and perform the proper steps, per FDF, to recover from the following:
  - COMM SKL 31006
  - AUDIO problems (Audio Central Control Unit (ACCU), Audio Terminal Unit (ATU))
  - Load Telemetry Format Loads (TFLs)/fail
  - Pulse Code Modulation Master Unit (PCMMU) fail
  - PAYLOAD COMM system problems (Payload Data Interleaver (PDI), Payload Signal Processor (PSP))
  - Network Signal Processor (NSP) failure
  - PF #1 Multiplexer/Demultiplexer (MDM) failure
  - MS/PLT ATU failure
  - K-band problems (overtemp, single motor, direct stow, man acq)
  - Manual antenna
  - Downlink playback/realtime CCTV
  - R15 MNC
  - SPEC 76 familiarization (encryption bypass, loss 1 Air-to-Ground (A/G) voice, Panel (PNL)/Command (CMD))
- Recognize that the loss of COMM between crewmembers, and between crew and MCC, is due to AUDIO system problems.

# 7 **WLES FAM BRF 31001**

Title: Wing Leading Edge Sensor Familiarization Briefing

Duration: 2.0 hours Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT

Source: DO5/EB Date: 07/07

Lesson(s) Replaced: None

Equipment Required: Classroom, Projector, Computer

Prerequisite Lesson(s): None

Preparation: None

# 7 WLES FAM BRF 31001 (Concluded)

Synopsis: Build familiarization to the Wing Leading Edge (WLE) System. This

briefing will be co-instructed by DO5 and EB personnel to give the entire Shuttle crew an overview to the Wing Leading Edge Sensor (WLES)

system.

Objectives: Provide the complete crew with an understanding to the Wing Leading

Edge Sensor system.

#### 8 **WLES OPS I 91001**

Title: Wing Leading Edge Sensor Operations I

Duration: 1.0 hour

Medium: Classroom (Building 49 Wireless Instrumentation System Lab)

Student: As assigned by CDR.

Source: DO5 Date: 07/07

Lesson(s) Replaced: None

Equipment Required: A31p laptop

Prerequisite Lesson(s): WLES FAM BRF 31001

Preparation: None

Synopsis: Provide a hands-on lesson with the Wing Leading Edge Sensor (WLES)

software and representative hardware.

Objectives: Familiarize prime WLES crew with the WLES procedures and hardware,

including the A31p laptop that the software is resident upon.

#### 9A **PO INS MAL 31001**

Title: Post-Insertion Malfunction Prebrief

Duration: 1.0 hour Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT

Source: DA72/QUEST

Date: 01/95

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): New Astronaut Flow

Preparation: None

# 9A PO INS MAL 31001 (Concluded)

Synopsis: This prebrief covers the Post Insertion Checklist (C/L) that will be worked

during PO INS MAL 31012. Roles and responsibilities of each

crewmember will be discussed.

Objectives: Obtain advanced information required to successfully complete the

objectives listed in PO INS MAL 31012.

# 9B **PO INS MAL 31012**

Title: Post-Insertion Malfunction

Duration: 4.0 hours Medium: SMS-FB

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT

Source: DA72/QUEST

Date: 01/95

Lesson(s) Replaced: PO INS OPS 22012 (partial)

Equipment Required: Stowage, hardline COMM connected for use by crew,

wireless headsets, MS seats installed, PGSC/SpOC.

Crew Optical Alignment Sight (COAS)

Prerequisite Lesson(s): PO INS MAL 31001

Preparation: None

Synopsis: This lesson goes through the post-insertion timeframe, beginning at L/O-2

minutes with one General Purpose Computer (GPC) failed during the Operations (OPS) transition. Additional malfunctions included will be

limited to the starred block in the Post Insertion Checklist.

Objectives: • Exercise the post-insertion timeline while successfully working the

starred block procedures.

Resolve all problems and achieve stable orbit configuration that would

allow continued mission success.

#### 10A **D/O PREP 31001**

Title: Deorbit Preparation Prebrief

Duration: 1.0 hour Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT, PS 1 optional

(Highly desirable.)

Source: DA72/QUEST

Date: 07/00

Lesson(s) Replaced: D/O N-NOM BR 31001

Equipment Required: None

### 10A **D/O PREP 31001 (Concluded)**

Prerequisite Lesson(s): D/O BURN 31011 (A/E FO), New Astronaut Flow

Preparation: None

Synopsis: This briefing details the nominal deorbit preparation procedures from

Time of Ignition (TIG) minus 4 hours through deorbit TIG, then backout for a 24 hour stay on-orbit. The major and critical procedures will be pointed out, along with an explanation of the purpose of the procedures. The CDR

can also use this lesson to work on crew coordination, timing, and

responsibilities.

Objectives: • Understand the sequence of events during deorbit prep.

Understand the responsibilities of the crewmembers and how to

coordinate them.

Understand the major timeline events (Payload Bay Door (PLBD)

closure, DPS reconfiguration, stowage, etc.).

# 10B **D/O PREP 31012**

Title: Deorbit Preparation

Duration: 4.0 hours Medium: SMS-FB

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT, PS 1 optional

(Highly desirable.)

Source: DA72/QUEST

Date: 07/00

Lesson(s) Replaced: None

Equipment Required: Stowage, MS seats installed, wireless headsets, standard

Deorbit and entry FDF stowed, orbit FDF setup

Prerequisite Lesson(s): D/O PREP 31001

Preparation: None

Synopsis: This lesson exercises the nominal End of Mission (EOM) deorbit

preparation procedures beginning with the start of the Deorbit (D/O) Prep Checklist (C/L) through the D/O burn Time of Ignition (TIG). The crew should also work on coordination, timing, and responsibilities. All Preliminary Advisory Data (PAD) should be available. Malfunctions that

do not distract from the timeline may be input.

Objectives: • Be able to complete the deorbit preparation procedures according to the timeline in the D/O Prep C/L.

• Exercise the Deorbit Burn Flight Rules cue card.

#### 11 **APDS MAL 21029**

Title: Androgynous Peripheral Docking System Malfunctions (1 of 3)

Duration: 2.0 hours Medium: PYLD Trainer

Student: COMMANDER, MS 1, PILOT

Note: Schedule for Docking Flights only.

Source: DS45/Shuttle Systems Training Group

Date: 03/05

Lesson(s) Replaced: APDS MAL 31029

Equipment Required: None

Prerequisite Lesson(s): APDS OPS 21029

Preparation: Review APDS Nominal Procedures in Rendezvous Checklist

Synopsis: This lesson provides a detailed description of Androgynous Peripheral

Docking System (APDS) malfunction operations. Emphasis will be placed

on star block procedures located in the Rendezvous Checklist.

Objectives: Upon completion of the lesson, the student will be able to:

 Perform docking and undocking procedures, including: Docking Mechanism Initialization, Docking Mechanism Powerup, Docking Ring Extension, Docking Mechanism Powerdown, Docking Prep, Approach

Cue Card, Docking Sequence Cue Card, and Undocking.

 Recognize and respond to malfunctions using appropriate starred blocks in the above procedures.

• Demonstrate understanding of rationale for starred blocks.

 Identify and explain switches and circuit breaker capabilities on panel A7L and panel A6U.

## 12 **APDS MAL 22029**

Title: Androgynous Peripheral Docking System Malfunctions (2 of 3)

Duration: 2.0 hours
Medium: PYLD Trainer

Student: COMMANDER, MS, PILOT

Source: DS45/Shuttle Systems Training Group

Date: 03/05

Lesson(s) Replaced: APDS MAL 32029

Equipment Required: None

Prerequisite Lesson(s): APDS MAL 21029

Preparation: Review APDS Off-Nominal Procedures in Rendezvous Checklist

Synopsis: This lesson introduces and implements Androgynous Peripheral Docking

System (APDS) malfunction procedures. Emphasis will be placed on

off-nominal procedures located in the Rendezvous Checklist.

### 12 APDS MAL 22029 (Concluded)

Objectives: Upon completion of this lesson, the student will be able to:

- Perform docking and undocking sequences, including: Docking Mechanism Powerup, Docking Ring Extension, Docking Mechanism Powerdown, Docking Prep, Approach Cue Card, Docking Sequence Cue Card, and Undocking with the addition of malfunctions.
- Recognize and respond to anomalies within 30 ft and review Go/No-Go scenarios in the Docking Sequence Cue Card.
- Recognize and respond to malfunctions using appropriate off-nominal procedures, including the PMA 2/3 HOOKS CLOSE procedure.
- Demonstrate understanding of the rationale for off-nominal procedures.

#### 13 **APDS MAL 23029**

Title: Androgynous Peripheral Docking System Malfunctions (3 of 3)

Duration: 2.0 hours Medium: PYLD Trainer

Student: COMMANDER, MS, PILOT

Source: DS45/Shuttle Systems Training Group

Date: 03/05

Lesson(s) Replaced: APDS MAL 33029

Equipment Required: None

Prerequisite Lesson(s): APDS MAL 22029

Preparation: Review Off-Nominal Procedures in the Rendezvous Checklist

Synopsis: This lesson introduces and implements Androgynous Peripheral Docking

System (APDS) malfunction procedures. Emphasis will be placed on

off-nominal procedures located in the Rendezvous Checklist.

Objectives: Upon completion of this lesson, the student will be able to:

- Perform docking and undocking sequences, including: Docking Mechanism Powerup, Docking Mechanism Powerdown, Docking Prep, Approach Cue Card, Docking Sequence Cue Card, and Undocking with the addition of malfunctions.
- Recognize and respond to anomalies within 30 ft and review Go/No-Go scenarios in the Docking Sequence Cue Card.
- Recognize and respond to malfunctions with appropriate off-nominal procedures, including Failed Capture, Force Ring Alignment procedure, and the ODS HOOKS-OPEN contingency procedure.
- Demonstrate understanding of the rationale for off-nominal procedures.

# 14 **OCA/VTS OPS 31195**

Title: Orbiter Communications Adapter/Video Teleconference System

Operations

Duration: 2.0 hours

Medium: Payload General Support Computer

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT, PS 1 (Schedule individually

or in pairs.)

Source: DO5/Cargo Integration and Operations Branch

Date: 03/02

Lesson(s) Replaced: OCA/VTS OPS 31001

Equipment Required: 2 IBM 760 ThinkPads on expansion chassis with Orbiter

Communications Adapter (OCA) and ProShare cards, 1 OCA-to-OCA cable, 2 video mini cameras and cables, 1 VTS audio cable with headset, 2 Direct Current (DC) utility power

cables, Epson Printer

Prerequisite Lesson(s): PGSC INTRO 21195

Preparation: Know:

Basic PGSC hardware

Ku-Band and Audio system knowledge

Synopsis: The purpose of this class is to properly configure the Orbiter

Communications Adapter (OCA) router for use with Modem File Transfer

(MFX) ops and Ku-Band File Transfer (KFX) ops.

**Note:** Schedule PGSC INTRO 21195 only if requested by crewmember.

Objectives: After this lesson, the student will be able to:

- Locate appropriate OCA and Video Teleconference System (VTS) procedures.
- Identify an Expansion chassis configured with OCA ProShare cards.
- Identify an OCA cable and explain its different uses.
- Identify proper OCA software after PGSC boot-up.
- Understand Outlook limitations.
- Use KFX and MFX.
- Launch the OCA and ProShare applications.
- Initiate a Video Teleconference.
- Launch applications to share with MCC.
- Understand the OCA router purpose and how to configure it for MFX ops and KFX ops.
- Understand the ProShare PGSC's unique features for VTS and Outlook.
- Set up the Network printer and perform a warm-up and self-test.
- Perform a video teleconference.

### 14 OCA/VTS OPS 31195 (Concluded)

- Understand KFX and view demonstration of uplink.
- Understand the directory structure as it applies to uplinking and downlinking files.
- Understand MFX and view demonstration of uplink.

#### 15 **PGSC NETWORK OPS 31195**

Title: Payload General Support Computer Network Operations

Duration: 2.0 hours

Medium: Payload General Support Computer

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT, PS 1 (Schedule individually

or in pairs.)

Source: DO5/Cargo Integration and Operations Branch

Date: 03/02

Lesson(s) Replaced: NETWORK OPS 31001

Equipment Required: Standard PGSC Lab equipment

Prerequisite Lesson(s): OCA/VTS OPS 31195

Preparation: None

Synopsis:

The purpose of this class is to introduce the student to PGSC network and procedures that can be used to verify a "good" network connection. The lesson will require the latest flown flight-specific configuration, flight software, usage chart, Chapter 12 "ORB OPS," and late-updates. After this class, the student will be able to use the generic PGSC load for any orbit sim, and configure the PGSC network accordingly.

Objectives: After this lesson, the student will be able to:

- Locate appropriate network procedures.
- Identify all associated network equipment.
- Set up, activate, and deactivate a PGSC network.
- Verify a proper network connection and configuration.
- Change PGSC network names.
- Use Explorer to verify drive mapping.
- Set up the WinDecom Ops-Network and serial cable ops.
- Perform Time-Vector (TV) server operations.
- Perform Telemetry server operations.
- Identify and understand Space Operations Computing (SpOC) updates.
- Verify a successful network has been established via Pingmaster and Windows Explorer.
- Understand how to recover possible network malfunctions: Loss of drive mapping, bad network card, or a loss of the Radio Frequency (RF) access point.

#### 16 **SYS PGSC 31195**

Title: Systems Payload General Support Computer Applications

Duration: 1.5 hours

Medium: Payload General Support Computer

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT (Schedule in groups of no

more than 4.)

Source: DS45/Shuttle Systems Training Group

Date: 02/03

Lesson(s) Replaced: None

Equipment Required: Standard PGSC Lab equipment Prerequisite Lesson(s): PGSC NETWORK OPS 31195

Preparation: None

Synopsis: This lesson is designed to introduce students to the PGSC applications

that relate to subject matter covered by the DS45 Shuttle Systems section.

Objectives: After this lesson, the student(s) will be able to:

Locate and operate the following PGSC applications. The optional

applications are at crew discretion.

10.2 Depress (Optional)

Cabin Leak

Fuel Cell Monitoring System (FCMS)

Water Dump (Optional)

#### 17 **PGSC MAL 31195**

Title: PGSC Malfunctions

Duration: 2.0 hours

Medium: Payload General Support Computer

Student: As assigned by CDR.

Source: DO5/Cargo Integration and Operations Branch

Date: 03/02

Lesson(s) Replaced: PGSC MAL 31001

Equipment Required: Standard PGSC Lab equipment

Prerequisite Lesson(s): SYS PGSC 31195

Preparation: None

Synopsis: The purpose of this class is to train crews to recover from potential PGSC

malfunctions and identify malfunction signatures. The class will cover Complementary Metal Oxide Semi-conductor (CMOS) settings loss, network connectivity problems, Hard disk swap out, PGSC software

recovery, and Operations (OPS) notes.

# 17 PGSC MAL 31195 (Concluded)

Objectives: After this lesson, the student will be able to:

- Perform the Orbiter Communications Adapter (OCA) internal and external loop back test. Demonstrate the use of the Windows NT event viewer.
- Review off nominal Network procedures.
- Review off nominal PGSC operations.
- Perform (aided) appropriate FDF procedures depending on malfunction.
- Review In-Flight Maintenance (IFM) PGSC data card changeout procedures.
- Perform an Auto check/boot up.
- Use AUTO XD floppy to recover CMOS settings.
- Swap bad/unseated network card.
- Swap bad hard drive.
- Understand International Business Machines (IBM) post error codes 174, 163, 161, and 301.
- Review ops notes.
- Understand how a corrupted CMOS impacts Windows 98.
- Reload software via reload Compact Disk (CD).
- Configure for serial cable ops (if Local Area Network (LAN) failure).

#### 18 **PRS OPS 31029**

Title: Payload Retention System Operations

Duration: 1.5 hours
Medium: PYLD Trainer

Student: As assigned by CDR.

Source: DS45/Shuttle Systems Training Group

Date: 04/94

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

Synopsis: This lesson provides a detailed description of the Payload Retention

System (PRS), including the Payload Retention Latch Assembly (PRLA) and the Active Keel Actuator (AKA). The class will explain the PRS

equipment, logic, crew interfaces, operating procedures, malfunctions, and

generic flight rules.

#### 18 PRS OPS 31029 (Concluded)

- Objectives: State the purpose of the PRS.
  - Identify the different types of PRLAs and explain their purpose, plus the AKA.
  - Describe the payload retention latch talkbacks, payload retention logic power, Motor Controller Assembly (MCA) logic circuit breakers, and payload mech power.
  - Explain the latch, release, and ready-to-latch indications displays on SPEC 97.
  - Given the appropriate FDF, perform the following procedures:

<u>SETUP FOR UNBERTH</u> SETUP FOR BERTH

Activate latches Activate latches

AKA release AKA latch

PRLA release PRLA latch

Deactivate latches Deactivate latches

- Recognize and resolve payload retention system malfunctions using the appropriate PRLA/AKA malfunction procedures.
- State the rationale for the generic PRLA and AKA Flight Rules.

#### 19A **ORB NOM OPS 31001**

Title: **Orbit Nominal Operations Prebrief** 

**Duration:** 1.5 hours for missions on OV-103/105, 1.0 hour for missions on OV-104

Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT

Taught twice for dual shift flights. Note:

DA72/QUEST Source:

Date: 06/08

Lesson(s) Replaced: None **Equipment Required:** None

Prerequisite Lesson(s): APDS MAL 31029 (Docking Flights Only), D/O PREP 31012,

ORB SKL COMM 31008, ORB SKL DPS 31006,

ORB SKL SYS 31004, PGSC MAL 31195, PO INS MAL 31012, FCS C/O 31006

Preparation: None

During this lesson, the Team Lead will review the flight plan for ORB NOM Synopsis:

> OPS 31012. This will allow the students an opportunity to discuss tasks and get answers to questions on the procedures identified for this lesson.

#### 19A ORB NOM OPS 31001 (Concluded)

Objectives:

- Review the timeline to be used during ORB NOM OPS 31012.
- Review the procedures identified in the timeline.
- Assign crew tasks when required.
- Locate and configure Station to Shuttle Power Transfer System (SSPTS) and Assembly Power Converter Unit (APCU) switches and displays per procedures.
- Explain how power is transferred from the ISS to the Shuttle and from the Shuttle to the various payloads. (OV-103/105 flights only)

#### 19B **ORB NOM OPS 31012**

Title: Orbit Nominal Operations

Duration: 4.0 hours

**Note:** Schedule twice for dual shift flights.

Medium: SMS-FB

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT

Source: DA72/QUEST

Date: 06/08

Lesson(s) Replaced: None

Equipment Required: Stowage, Standard PGSC setup

Prerequisite Lesson(s): ORB NOM OPS 31001

Preparation: None

Synopsis:

This lesson allows the students to practice the nominal procedures found in the Orbit Ops Checklist (C/L) without the distraction of major malfunctions. These procedures include hydraulic thermal conditioning, Ku-Band antenna deploy and activation, Ku-Band cable positioning and stow, Ku-Band manual acquisition, all pre-sleep and post-sleep activity, supply water dump using Flash Evaporator System (FES), Station to Shuttle Power Transfer System (SSPTS) and Assembly Power Converter Unit (APCU) activation, lamp & fire suppression test, manual fuel cell purge, Inertial Measurement Unit (IMU) alignment, Flight Control System (FCS) checkout (parts 1 and 2), and Reaction Control System (RCS) hot fire test.

#### Objectives:

- Practice and become familiar with nominal orbit operations and procedures.
- Complete the scripted nominal procedures in a timely manner.
- Coordinate crew actions during the execution of multiple nominal orbit procedures.
- Use Windows DeCommutator (WinDecom) to initialize Time and State vector applications to enable auto feed of vector and time to required applications.

#### 19B ORB NOM OPS 31012 (Concluded)

- Activate and use the PGSC applications Fuel Cell Monitoring System (FCMS) and Water Dump during the appropriate procedure.
- Perform SSPTS and APCU activation as appropriate.

#### 20A **ORB SKL 31001**

Title: Orbit Skills Prebrief

Duration: 1.0 hour

**Note:** Schedule twice for dual shift flights.

Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT

Source: DA7/Assigned SMS Team

Date: 04/93

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ORB NOM OPS 31012

Preparation: None

Synopsis: This prebrief covers Orbiter-only procedures that will be worked during

ORB SKL 31012.

Objectives: Refer to ORB SKL 31012 for objectives.

#### 20B **ORB SKL 31012**

Title: Orbit Skills
Duration: 6.0 hours

**Note:** Scheduled as two 6-hour sessions for dual shift flight, with crew

handover at the 3-hour point of each session. Schedule red team to

blue team, then blue team to red team.

Medium: SMS-FB

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT

Source: DA72/QUEST

Date: 07/00

Lesson(s) Replaced: ORB SKL 32012, ORB SKL 33012

Equipment Required: Wireless headsets, stowage, Standard PGSC setup and

COAS

Prerequisite Lesson(s): ORB SKL 31001

Preparation: None

#### 20B ORB SKL 31012 (Concluded)

Synopsis: The

The purpose of this orbit skills lesson is to increase crew awareness of orbiter system interfaces by interweaving nominal and malfunction procedures learned in previous lessons in the Orbit Training Flow. Orbit skills lessons will contain scenarios that concentrate on the impacts of interacting multiple system failures, but still have a good mix of nominal procedures from the Orbit Ops Checklist (C/L).

Note:

These lessons will be run against the timeline found in the standard lesson plan. Standard scripts can be obtained from QUEST script file. Payload and PDRS-related activities are not present in the generic scripts.

Objectives:

Work the following nominal procedures:

- Post-sleep
- CCTV activation
- Ku-band deploy and activation
- Teleprinter activation
- Orbiter Communications Adapter (OCA) setup
- Group B powerdown
- Presleep
- PGSC use
- COAS/Heads-up Display (HUD) Calibration (CAL)
- Systems Management (SM) checkpoint
- Star tracker align (single star tracker)
- Aft controller checkout
- DTO: Fuel cell shutdown and restart
- Handover (dual shift only)
- Perform Cabin depress to 10.2 PSI using 10.2 Depress PGSC application as an aid. (If EVA scheduled only.)
- Use Orbit data to manually initialize Time and State vector applications to enable auto feed of vector and time to required applications.

#### 21A **CONT D/O 31001**

Title: Contingency Deorbit Preparation Prebrief

Duration: 2.0 hours Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT

Source: DA72/QUEST

Date: 05/99

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ORB SKL 31012

### 21A **CONT D/O 31001 (Concluded)**

Preparation: Establish:

 Preliminary crew task assignments to execute the Loss of 2 H<sub>2</sub>O Loops procedure.

Synopsis: During this prebrief, the Team Lead will give an overview of the failures

that would require a crew to enter the Contingency Deorbit (D/O) Checklist (C/L). The FDF path for the Loss of 2 H<sub>2</sub>O Loops failure will be reviewed with the primary emphasis being placed on the procedural flow.

Objectives: At the end of this lesson, the student will be able to:

- Identify failures (and aborts) that require the use of the Contingency D/O Prep C/L.
- Identify the major impacts caused by each of the failures.
- Describe orbiter powerdown and cooling requirements based on equipment location.
- For each procedure, describe the following:
  - When the procedure would be used.
  - The mission phase, assumptions, and time to deorbit.
  - The orbiter configuration after the procedure has been executed.
- Perform the LOSS OF 2 H<sub>2</sub>O LOOPS and AV BAY FIRE procedures.
- Outline the FDF flow through the associated checklists.
- Determine which portions of the FDF should be performed in parallel, and which should be performed in series.
- State the rationale for the steps in the procedures.

#### 21B **CONT D/O 31012**

Title: Contingency Deorbit Preparation

Duration: 5.0 hours Medium: SMS-FB

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT

Source: DA72/QUEST

Date: 05/99

Lesson(s) Replaced: D/O N-NOM 31012

Equipment Required: None

Prerequisite Lesson(s): CONT D/O 31001

Preparation: Review:

CONT D/O 31001

Synopsis: During this lesson, the crew will exercise the LOSS OF 2 H<sub>2</sub>O LOOPS

procedures.

### 21B **CONT D/O 31012 (Concluded)**

Objectives: At the end of this lesson, the student will be able to:

- Demonstrate an understanding of the FDF flow associated with the loss of two H<sub>2</sub>O loops failure.
- Perform the LOSS OF 2 H<sub>2</sub>O LOOPS procedure including the on-orbit wait and on-orbit wait back-out steps through Entry Interface (EI).
- Use Windows DeCommutator (WinDecom) to initialize Time and State vector applications to enable auto feed of vector and time to required applications.
- Time permitting, use Orbit data to manually initialize Time and State vector applications to enable auto feed of vector and time to required applications.
- Use Deorbit/Center of Gravity (c.g.) application to generate deorbit targets.

The CDR will coordinate the execution of these procedures. The crew will inform the CDR when each step has been completed.

## 22A **CONT D/O 32001**

Title: Contingency Deorbit Preparation Prebrief

Duration: 1.0 hour Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT

Source: DA72/QUEST

Date: 05/99

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): CONT D/O 31001, CONT D/O 31012

Preparation: Review:

CONT D/O 31001

Establish:

Preliminary crew task assignments to execute the AV BAY FIRE procedure.

Synopsis: During this prebrief, the FDF paths for the AV BAY FIRE failure will be

reviewed with the primary emphasis being placed on the procedural flow.

Objectives: At the end of this lesson, the student will be able to:

- Perform the AV BAY FIRE procedure.
- Outline the FDF flow through the associated checklists.
- Determine which portions of the FDF should be performed in parallel, and which should be performed in series.
- State the rationale for the steps in the procedures.

# 22B **CONT D/O 32012**

Title: Contingency Deorbit Preparation

Duration: 2.0 hours Medium: SMS-FB

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT

Source: DA72/QUEST

Date: 05/99

Lesson(s) Replaced: D/O N-NOM 31012

Equipment Required: PGSC with WORLD MAP and DEORBIT Manager

Applications, Compound Specific Analyzer-Combustion Products (CSA-CP), Quick Don Masks (Quick Don Mask equipment is based on hardware availability), Contingency

Hose Kit

Prerequisite Lesson(s): CONT D/O 32001

Preparation: Review:

CONT D/O 31001, CONT D/O 32001

Synopsis: During this lesson, the crew will exercise the AV BAY FIRE procedure.

Objectives: At the end of this lesson, the student will be able to:

- Demonstrate an understanding of the FDF flow associated with the AV BAY FIRE failure.
- Perform the AV BAY FIRE procedure through Contingency D/O Prep.
- Use Windows DeCommutator (WinDecom) to initialize Time and State vector applications to enable auto feed of vector and time to required applications.
- Time permitting, use Orbit data to manually initialize Time and State vector applications to enable auto feed of vector and time to required applications.
- Use Deorbit/Center of Gravity (c.g.) application to generate deorbit targets.

The CDR will coordinate the execution of these procedures. The crew will inform the CDR when a step has been completed.

# 23 WLES OPS II 91020

Title: Wing Leading Edge Sensor Operations II

Duration: 0.75 hours

Medium: CCT

Student: As assigned by CDR.

Source: DO5 Date: 07/07

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): To save Facility and crew time, this lesson should be

scheduled to immediately follow CABLE/STOW 91020.

Preparation: None

Synopsis: In a "flight like" environment, the crew will setup the Wing Leading Edge

Sensor (WLES) hardware in the crew cable as it will occur during the post insertion portion of their flight. The crew will also perform WLES activation steps required for the hardware setup. Flight history lessons learned,

including off-nominal procedures, will be discussed.

Objectives: • Complete unassisted Setup and Activation of the WLES crew cabin

hardware and software by the crew.

• Discuss off-nominal events associated with the WLES system.

Discuss recent WLES flight experiences.

# 24A **PASS RECOV 31001**

Title: Primary Avionics Software System Recovery after Backup Flight

System Engage Prebrief

Duration: 0.5 hours Medium: Classroom

Student: COMMANDER, MS 2, PILOT (If dual shift flight, this should be

scheduled separately for the RED Shift Crew and the BLUE Shift Crew. Commander may request other MS to take the lesson. Only C, P, and MS2 required. At the discretion of the CDR/crew, this lesson can be scheduled with the entire crew listed at the same time or in

multiple classes.)

Source: DS24/DPS/Navigation Training Group

Date: 05/95

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ORB SKL 31012

Preparation: None

# 24A PASS RECOV 31001 (Concluded)

Synopsis: The crew will be familiarized with the FDF used in PASS RECOVERY

and IMU REFERENCE RECOVERY.

Objectives: • Review the General Purpose Computer (GPC) FRP-4 procedure.

Review the annotated timeline for the big picture events.

#### 24B **PASS RECOV 31006**

Title: Primary Avionics Software System Recovery after Backup Flight

System Engage

Duration: 2.0 hours

Medium: SST 1 or SST 2 or SST 3

Student: COMMANDER, MS 2, PILOT (If dual shift flight, this should be

scheduled separately for the RED Shift Crew and the BLUE Shift Crew. Commander may request other MS to take the lesson. Only C, P, and MS2 required. At the discretion of the CDR/crew, this lesson can be scheduled with the entire crew listed at the same time or in

multiple classes.)

Source: DS24/DPS/Navigation Training Group

Date: 05/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PASS RECOV 31001

Preparation: None

Synopsis: Student(s) will engage Backup Flight System (BFS) in Operational

Sequence (OPS) 301 and work the Primary Avionics Software System (PASS) Recovery procedure, General Purpose Computer (GPC) FRP-4.

Objectives: • Recover the PASS set using FRP-4.

• Recover the Inertial Measurement Unit (IMU) reference using simulated

MCC uplinks.

#### 25 **PO INS MAL 32012**

Title: Post Insertion Malfunction

Duration: 4.0 hours Medium: SMS-FB

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT, PS 1, CB Instructor

Astronaut (IA) attendance mandatory

Source: DA7/Assigned SMS Team

Date: 03/05

Lesson(s) Replaced: PO INS OPS 91012

# 25 PO INS MAL 32012 (Concluded)

Equipment Required: Middeck stowage, PGSC/SpOC, Advanced Crew Escape

Suit (ACES), MS seats installed

Prerequisite Lesson(s): CONT D/O 31012, ORB SKL 31012, PASS RECOV 31006

Preparation: None

Synopsis: This lesson will be scripted by the assigned SMS training team and covers

the first 4 hours of flight. Orbiter operations and their effects on payload-

related activities should be stressed as appropriate.

**Note:** This lesson may be credited with Team Lead and CDR concurrence.

Objectives: • Gain proficiency exercising the post-insertion timeline.

Reinforce crew reach limitations while in the suits.

Review payload/orbiter interface procedures and restrictions such as

Ku-Band, Payload bay flood lights.

Practice crew coordination.

#### 26A **ORB SKL 32001**

Title: Orbit Skills Prebrief

Duration: 1.0 hour

**Note:** Do not schedule on the same day as ORB SKL 32012, but schedule

within a week of completion of this prebrief.

Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT

Source: DA72/QUEST

Date: 03/05

Lesson(s) Replaced: ORB SKL 91001
Equipment Required: Standard PGSC setup
Prerequisite Lesson(s): CONT D/O 32012

Preparation: Review:

CONT D/O BR 31001 handout

• ORB SKL 32001 handout

Establish:

 Preliminary crew task assignments to execute the Loss of Cabin Pressure Deorbit (D/O) preparation.

Synopsis: During this prebrief, the FDF paths for the Loss of Cabin Pressure and the

Quick Response Jettison will be reviewed, with the primary emphasis being placed on the procedural flow. If an ISS flight, the FDF paths for the Joint Expedited Undocking and Separation (JEUS) and the Loss of Cabin Press D/O Prep will be reviewed, with the primary emphasis on procedural

flow and coordination.

# 26A ORB SKL 32001 (Concluded)

Objectives: At the end of this prebrief, the student will be able to:

- Activate and use the Cabin Leak PGSC application.
- Perform the Loss of Cabin Pressure and Quick Response/Jettison procedures in the SMS.
- Outline the FDF flow through the associated checklists.
- Determine which portions of the FDF should be performed in parallel, and which should be performed in series.
- State the rationale for the steps in the procedures.
- Review the JEUS procedure, if an ISS flight.

# 26B **ORB SKL 32012**

Title: Orbit Skills
Duration: 4.0 hours

**Note:** Do not schedule on the same day as ORB SKL 32001, but schedule

within a week following completion of the prebrief.

Medium: SMS-FB

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT

Source: DA72/QUEST

Date: 03/05

Lesson(s) Replaced: ORB SKL 91012

Equipment Required: None

Prerequisite Lesson(s): ORB SKL 32001

Preparation: Review:

CONT D/O OV 31001

#### Synopsis:

During the first part of this session, the crew will exercise malfunction procedures determined by the SMS Team. The CDR will coordinate the execution of procedures with the crew utilizing solid Space Flight Resource Management (SFRM) habits. The majority of the lesson will be devoted to performing a Contingency Deorbit (D/O) Prep for a Cabin leak.

## Objectives: At the end of this lesson, the student will be able to:

- Demonstrate an understanding of the FDF flow associated with the Loss of Cabin Pressure deorbit preparation procedures.
- Perform the Loss of Cabin Pressure procedure, including the Quick Response/Jettison steps through bailout.
- Perform the phugoid damping technique as required.
- The CDR will coordinate the execution of these procedures. The crew will inform the CDR when each step has been completed.

# 26B ORB SKL 32012 (Concluded)

- Use PGSC application Cabin Leak to calculate maximum on-orbit time before the Deorbit burn.
- Use Windows DeCommutator (WinDecom) to initialize Time and State vector applications to enable auto feed of vector and time to required applications.
- Use Deorbit/Center of Gravity (c.g.) application to generate deorbit targets.

## 27A **UNLD MAL T/L 91001**

Title: Unloaded Malfunction Timeline Prebrief

Duration: 0.5 hours Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT

Source: DA7/Assigned SMS Team

Date: 07/00

Lesson(s) Replaced: UNL ORB SKL 91012 (partial)

Equipment Required: None

Prerequisite Lesson(s): PDRS UL SJ 91069 (PDRS flow), PO INS OPS 91012

Preparation: None

Synopsis: This lesson will provide the students with the timeline to be executed

during the UNLD MAL T/L 91012. Malfunctions and actions for recovery

will be discussed.

Objectives: The following will be discussed during this prebrief:

- Nominal unloaded timeline with malfunctions
- Flight Plan:
  - RMS Powerup
  - Unloaded operations
  - RMS Powerdown

27B **UNLD MAL T/L 91012** 

Title: Unloaded Malfunction Timeline

Duration: 3.0 hours

**Note:** As required the SMS should be scheduled for one hour of PGSC and

photo/TV setup training prior to the start of the lesson. This should be

scheduled for all flights with complicated PGSC and/or photo/TV

setups or those with Flight Day 1 deploys.

Medium: SMS-FB

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT

Source: DA7/Assigned SMS Team

Date: 07/00

Lesson(s) Replaced: UNL ORB SKL 91012 (partial)

Equipment Required: Standard PGSC setup Prerequisite Lesson(s): UNLD MAL T/L 91001

Preparation: None

Synopsis: This lesson will allow the students to exercise the timeline previously

discussed in UNLD MAL T/L 91001 while dealing with various

malfunctions.

Objectives: • The following events in the flight plan will be covered during this lesson:

RMS Powerup

Unloaded operations

RMS Powerdown

# 28A **LOAD NOM T/L 91001**

Title: Loaded Nominal Timeline Prebrief

Duration: 0.5 hours
Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT

Source: DA7/Assigned SMS Team

Date: 07/00

Lesson(s) Replaced: PDRS LD NOM 91012 (partial)

Equipment Required: None

Prerequisite Lesson(s): PDRS LD INT 91012 (PDRS flow), PO INS OPS 91012

Preparation: None

Synopsis: This lesson will provide the students with the timeline to be executed

during the following lesson, LOAD NOM T/L 91012.

# 28A LOAD NOM T/L 91001 (Concluded)

Objectives: The following will be discussed during this prebrief:

- Nominal loaded timeline
- Flight Plan:
  - Payload powerup/activation/checkout
  - Pre-release payload commanding
  - Payload grapple
  - Umbilical demate
  - Payload unberth
  - Loaded operations (critical parts)
  - Payload commanding
  - Payload berthing
  - Umbilical mate
  - Post-berth payload commanding
  - Payload powerdown/deactivation

## 28B **LOAD NOM T/L 91012**

Title: Loaded Nominal Timeline

Duration: 4.0 hours

**Note:** Schedule 6 hours if integrated with the NBL. As required the SMS

should be scheduled for one hour of PGSC and photo/TV setup

training prior to the start of the lesson. This should be scheduled for all flights with complicated PGSC and/or photo/TV setups or those with

Flight Day 1 deploys.

Medium: SMS-FB (NBL/FB, as requested.)

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT

Source: DA7/Assigned SMS Team

Date: 07/00

Lesson(s) Replaced: PDRS LD NOM 91012 (partial)

Equipment Required: PGSC

Prerequisite Lesson(s): LOAD NOM T/L 91001

Preparation: None

Synopsis: This lesson will allow the students to exercise the timeline previously

discussed in LOAD NOM T/L 91001 for nominal payload and RMS

activities.

# 28B LOAD NOM T/L 91012 (Concluded)

Objectives: • Perform nominal loaded timeline.

- Exercise the following events in the flight plan:
  - Payload powerup/activation/checkout
  - Pre-release payload commanding
  - Payload grapple
  - Umbilical demate
  - Payload unberth
  - Loaded operations (critical parts)
  - Payload commanding
  - Payload berthing
  - Umbilical mate
  - Post-berth payload commanding
  - Payload powerdown/deactivation

# 29A **DPLY NOM T/L 91001**

Title: Deploy Nominal Timeline Prebrief

Duration: 1.0 hour Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT

Source: DA7/Assigned SMS Team

Date: 07/00

Lesson(s) Replaced: PDRS DEP NOM 91012

Equipment Required: None

Prerequisite Lesson(s): SEP/TRANS 31069 (RNDZ PO flow), PO INS OPS 91012,

PDRS DEP INT 91012 (PDRS flow), or PDRS D&R INT 91012 (PDRS flow)

Preparation: None

Synopsis: This lesson will provide the students with the timeline to be executed

during the following lesson, DPLY NOM T/L 91012.

Guidelines for coordination between crewmembers should be discussed. Secondary tasks are prioritized as to not interfere with the primary task. Review the RMS/Rendezvous (RNDZ) DAP constraints for this timeline.

# 29A DPLY NOM T/L 91001 (Concluded)

Objectives: Discuss the following:

- Nominal deploy timeline
- Flight Plan:
  - Payload powerup/activation/checkout
  - Pre-release payload commanding
  - Payload grapple
  - Umbilical demate
  - Payload unberth
  - Loaded operations required prior to deploy
  - Payload release
  - Separation (SEP) 1 (SEP 2, as time permits.)
  - Post-release payload commanding

# 29B **DPLY NOM T/L 91012**

Title: Deploy Nominal Timeline

Duration: 4.0 hours

**Note:** Schedule 6 hours if integrated with the NBL.

Medium: SMS-FB (NBL/FB, as requested.)

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT

Source: DA7/Assigned SMS Team

Date: 07/00

Lesson(s) Replaced: DPLY ORB SKL 91012, DPLY ORB SKL 92012

Equipment Required: PGSC, COAS

Prerequisite Lesson(s): DPLY NOM T/L 91001

Preparation: None

Synopsis: This lesson exercises the deploy/separation timeline, integrating all

Rendezvous (RNDZ), PDRS, and Payloads tasks, as the crew will perform

them in flight.

Special attention should be paid to coordination between crewmembers and prioritization of tasks. The CDR should coordinate the flight deck activities to establish a proper balance between command and

crewmember participation, and act decisively when the situation requires.

## 29B DPLY NOM T/L 91012 (Concluded)

Objectives: • Perform deploy timeline with selected malfunctions:

- Payload (PL) Power interface problem
- Loss of safety inhibits
- Standard Switch Panel (SSP) Malfunctions
- Loss of VERNs
- Systems Management (SM) General Purpose Computer (GPC)
   Failure
- RMS Handcontroller failure
- CCTV Failure
- End Effector (EE) Malfunctions
- Cover the following events in the Flight Plan:
  - Payload powerup/activation/checkout
  - Pre-release payload commanding
  - Payload grapple
  - Umbilical demate
  - Payload unberth
  - Loaded operations required prior to deploy
  - Payload release
  - Separation (SEP) burn 1 (SEP 2 as time permits)
  - Post-release payload commanding

#### 30A **RETR NOM T/L 91001**

Title: Retrieve Nominal Timeline Prebrief

Duration: 1.0 hour Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT

Source: DA7/Assigned SMS Team

Date: 07/00

Lesson(s) Replaced: PDRS RET NOM 91012 (partial)

Equipment Required: None

Prerequisite Lesson(s): APPR & F/A 31069 (RNDZ/PO flow), PO INS OPS 91012,

PDRS RET INT 91012 (PDRS flow) or PDRS D&R INT 91012 (PDRS flow)

Preparation: None

Synopsis: This lesson will provide the students with the timeline to be executed

during the following lesson, RETR NOM T/L 91012.

# 30A RETR NOM T/L 91001 (Concluded

Special attention should be paid to coordination between crewmembers and prioritization of tasks. The Tools for Rendezvous and Docking (TRAD) system should effectively be used to increase situational awareness. If working with the TRAD system interferes with the primary task, its use should be discontinued. The CDR should coordinate the flight deck activities to establish a proper balance between command and crewmember participation, and act decisively when the situation requires.

Objectives:

- Review the nominal retrieve timeline
- Review the following events in the Flight Plan:
  - Initial Condition: RMS is poised for capture
  - Initial Condition: 400 foot approach
  - Pre-capture payload commanding
  - Payload capture
  - Loaded operations required prior to berthing
  - Payload commanding
  - Payload berthing
  - Umbilical mate
  - Post-berth payload commanding
  - Payload powerdown/deactivation

## 30B **RETR NOM T/L 91012**

Title: Retrieve Nominal Timeline

Duration: 4.0 hours

**Note:** Schedule 6 hours if integrated with the NBL. As required the SMS

should be scheduled for one hour of PGSC and photo/TV setup

training prior to the start of the lesson. This should be scheduled for all flights with complicated PGSC and/or photo/TV setups or those with

Flight Day 1 deploys.

Medium: SMS-FB (NBL/FB, as requested.)

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT

Source: DA7/Assigned SMS Team

Date: 07/00

Lesson(s) Replaced: PDRS RET NOM 91012 (partial)

Equipment Required: COAS, PGSC

Prerequisite Lesson(s): RETR NOM T/L 91001

Preparation: None

## 30B RETR NOM T/L 91012 (Concluded)

Synopsis:

This lesson exercises the proximity operations (prox ops) and retrieve timeline, integrating all Rendezvous (RNDZ), PDRS, and Payload tasks, as the crew will perform them in flight.

Special attention should be paid to coordination between crewmembers and the prioritization of tasks. The CDR should coordinate the flight deck activities to establish a proper balance between command and crewmember participation, and acts decisively when the situation requires.

Objectives:

- Perform nominal retrieve timeline.
- Cover the following events in the Flight Plan:
  - Initial Condition: RMS is poised for capture
  - Initial Condition: 400 foot approachPre-capture payload commanding
  - Payload capture
  - Loaded operations required prior to berthing
  - Payload commanding
  - Payload berthing
  - Umbilical mate
  - Post-berth payload commanding
  - Payload powerdown/deactivation

#### 31 **LOAD MAL T/L 91012**

Title: Loaded Malfunction Timeline

Duration: 4.0 hours

**Note:** Schedule 6 hours if integrated with the NBL. As required, the SMS

should be scheduled for one hour of PGSC and photo/TV setup

training prior to the start of the lesson. This should be scheduled for all flights with complicated PGSC and/or photo/TV setups or those with

Flight Day 1 deploys.

Medium: SMS-FB (NBL/FB, as requested.)

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT

Source: DA7/Assigned SMS Team

Date: 07/00

Lesson(s) Replaced: LOAD ORB SKL 91012 and LOAD ORB SKL 92012 (partial)

Equipment Required: PGSC

Prerequisite Lesson(s): LOAD NOM T/L 91012

Preparation: None

Synopsis: This lesson will allow the students to execute the loaded timeline while

dealing with various payload and RMS malfunctions.

# 31 LOAD MAL T/L 91012 (Concluded)

Objectives: • Perform nominal loaded timeline with the following malfunctions:

- Payload Thermal Issues
- Payload COMM Problems
- Payload Retention Latch Assembly (PRLA) System Failures
- PGSC Loss
- End Effector (EE) Malfunction
- Hand Controller Failures
- CCTV Failures
- Systems Management (SM) General Purpose Computer (GPC) Failure
- Cover the following events in the Flight Plan:
  - Payload powerup/activation/checkout
  - Pre-release payload commanding
  - Payload grapple
  - Umbilical demate
  - Payload unberth
  - Loaded operations (critical parts)
  - Payload commanding
  - Payload berthing
  - Umbilical mate
  - Post-berth payload commanding
  - Payload powerdown/deactivation

## 32 **DPLY MAL T/L 91012**

Title: Deploy Malfunction Timeline

Duration: 4.0 hours

**Note:** Schedule 6 hours if integrated with the NBL. As required, the SMS

should be scheduled for one hour of PGSC and photo/TV setup

training prior to the start of the lesson. This should be scheduled for all flights with complicated PGSC and/or photo/TV setups or those with

Flight Day 1 deploys.

Medium: SMS-FB (NBL/FB, as requested.)

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT (CB Instructor

Astronaut (IA) attendance optional.)

Source: DA7/Assigned SMS Team

Date: 07/00

Lesson(s) Replaced: DPLY ORB SKL 91012 and DPLY ORB SKL 92012

Equipment Required: PGSC, COAS

Prerequisite Lesson(s): DPLY NOM T/L 91012

Preparation: None

# 32 DPLY MAL T/L 91012 (Concluded)

Synopsis:

This lesson will allow the students to execute the deploy timeline while dealing with various payload, RMS, and Rendezvous (RNDZ) malfunctions.

Special attention should be paid to coordination between crewmembers and prioritization of tasks. This lesson exercises the Deploy/Separation timeline, integrating all RNDZ, PDRS, and Payload tasks, as the crew will perform them in flight. The CDR should coordinate the flight deck activities to establish a proper balance between command and crewmember participation, and act decisively when the situation requires.

- Perform deploy timeline with the following malfunctions:
  - Payload (PL) Power interface problem
  - Loss of safety inhibits
  - Standard Switch Panel (SSP) Malfunctions
  - Loss of VERNs
  - Systems Management (SM) General Purpose Computer (GPC)
     Failure
  - RMS Hand Controller Failure
  - CCTV Failure
  - End Effector (EE) Malfunctions
- Cover the following events in the Flight Plan:
  - Payload powerup/activation/checkout
  - Pre-release payload commanding
  - Payload grapple
  - Umbilical demate
  - Payload unberth
  - Loaded operations required prior to deploy
  - Payload release
  - Separation (SEP 1 (SEP 2 as time permits))
  - Post-release payload commanding

# 33 **RETR MAL T/L 91012**

Title: Retrieve Malfunction Timeline

Duration: 4.0 hours

**Note:** Schedule 6 hours if integrated with the NBL. As required, the SMS

should be scheduled for one hour of PGSC and photo/TV setup

training prior to the start of the lesson. This should be scheduled for all flights with complicated PGSC and/or photo/TV setups or those with

Flight Day 1 deploys.

Medium: SMS-FB (NBL/FB, as requested.)

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT (CB Instructor

Astronaut (IA) attendance optional.)

Source: DA7/Assigned SMS Team

Date: 07/00

Lesson(s) Replaced: RETR ORB SKL 92012, RETR ORB SKL 93012

Equipment Required: PGSC, COAS

Prerequisite Lesson(s): RETR NOM T/L 91012

Preparation: None

Synopsis: This lesson will allow the students to execute the retrieve timeline while

dealing with various payload, RMS, and Rendezvous (RNDZ)

malfunctions.

Special attention should be paid to coordination between crewmembers and prioritization of tasks. This lesson exercises the PROX OPS retrieve timeline, integrating all RNDZ, PDRS, and Payload tasks, as the crew will perform in flight. The CDR should coordinate the flight deck activities to establish a proper balance between command and crewmember participation, and act decisively when the situation requires.

- Perform retrieve timeline with selected malfunctions:
  - Systems Management (SM) General Purpose Computer (GPC)
     Failure
  - RMS Handcontroller Failure
  - CCTV Failure
  - End Effector (EE) Malfunctions
  - Payload Attitude Control problem
  - Flyaround
  - Payload Communication problem
  - Loss of PGSC
  - Standard Switch Panel (SSP) Malfunction
  - RADAR Fail
  - Post-berth payload commanding powerdown/deactivation

34 **LOAD SJ T/L 91012** 

Title: Loaded Single Joint Timeline

Duration: 4.0 hours

Note: Schedule 6 hours if integrated with the NBL. As required, the SMS

should be scheduled for one hour of PGSC and photo/TV setup

training prior to the start of the lesson. This should be scheduled for all flights with complicated PGSC and/or photo/TV setups or those with

Flight Day 1 deploys.

SMS-FB (NBL/FB, as requested.) Medium:

COMMANDER, MS 1, MS 2, MS 3, PILOT Student:

Source: DA7/Assigned SMS Team

07/00 Date:

Lesson(s) Replaced: LOAD ORB SKL 92012 (partial), LOAD ORB SKL 93012

Equipment Required: **PGSC** 

Prerequisite Lesson(s): LOAD MAL T/L 91012, PDRS LD SJ 92069 (PDRS flow)

Preparation: None

Synopsis: This lesson will allow the students to execute the nominal loaded timeline

while dealing with malfunctions forcing use of RMS Single Joint (SJ)

operations.

- Perform nominal loaded timeline, using RMS Single Joint operations. with the following malfunctions:
  - Standard Switch Panel (SSP) Problems
  - Loss of Safety Inhibits
  - **Umbilical Malfunctions**
  - Manipulator Positioning Mechanism (MPM)/Manipulator Restraint Latch (MRL) Problems
  - Manipulator Controller Interface Unit (MCIU) Built-In Test Equipment (BITE)

  - Panel A8 Problem
  - RMS Arm-Based Electronics (ABE) Failure
- Cover the following events in the Flight Plan:
  - Payload powerup/activation/checkout
  - Pre-release payload commanding
  - Payload grapple
  - Umbilical demate
  - Payload unberth
  - Loaded operations (critical parts)
  - Payload commanding
  - Payload berthing
  - Umbilical mate
  - Post-berth payload commanding
  - Payload powerdown/deactivation

# 35 **DPLY SJ T/L 91012**

Title: Deploy Single Joint Timeline

Duration: 4.0 hours

**Note:** Schedule 6 hours if integrated with the NBL. As required, the SMS

should be scheduled for one hour of PGSC and photo/TV setup

training prior to the start of the lesson. This should be scheduled for all flights with complicated PGSC and/or photo/TV setups or those with

Flight Day 1 deploys.

Medium: SMS-FB (NBL/FB, as requested.)

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT

Source: DA7/Assigned SMS Team

Date: 07/00

Lesson(s) Replaced: DPLY ORB SKL 93012, DPLY ORB SKL 92012 (partial)

Equipment Required: PGSC, COAS

Prerequisite Lesson(s): DPLY MAL T/L 91012, PDRS DEP SJ 92069 (PDRS flow),

or PDRS D&R SJ 94069 (PDRS flow)

Preparation: None

Synopsis: This lesson will allow the students to execute the deploy timeline while

dealing with malfunctions, forcing use of RMS Single Joint (SJ)

operations.

- Perform nominal loaded timeline using RMS Single Joint operations, with the following malfunctions:
  - RMS Arm-Based Electronics (ABE) Failure (to achieve Single Joint (SJ) ops)
  - Manipulator Positioning Mechanism (MPM)/Manipulator Retention Latch (MRL) Power Problem (System Mal)
  - Manipulator Controller Interface Unit (MCIU) Built-In Test Equipment (BITE)
  - End Effector (EE) Talkback Failure
  - Panel A8 Switch Failure
  - Payload (PL) Multiplexer/Demultiplexer (MDM) Fail (Total or Recoverable)
  - Umbilical Malfunction
  - Thermal Issue
  - LOW Z Problem (e.g., jet thrust degrade)
- Cover the following events in the Flight Plan:
  - Payload powerup/activation/checkout
  - Pre-release payload commanding
  - Payload grapple
  - Umbilical demate
  - Payload unberth

# 35 DPLY SJ T/L 91012 (Concluded)

Loaded operations required prior to deploy

Payload release

Separation (SEP) 1 (SEP 2 as time permits)

Post-release payload commanding

## 36 **RETR SJ T/L 91012**

Title: Retrieve Single Joint Timeline

Duration: 4.0 hours

**Note:** Schedule 6 hours if integrated with the NBL. As required, the SMS

should be scheduled for one hour of PGSC and photo/TV setup

training prior to the start of the lesson. This should be scheduled for all flights with complicated PGSC and/or photo/TV setups or those with

Flight Day 1 deploys.

Medium: SMS-FB (NBL/FB, as requested.)

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT

Source: DA7/Assigned SMS Team

Date: 07/00

Lesson(s) Replaced: RETR ORB SKL 92012 (partial),

RETR ORB SKL 93012 (partial)

Equipment Required: PGSC, COAS

Prerequisite Lesson(s): RETR MAL T/L 91012, PDRS RETR SJ 92069 (PDRS flow)

or PDRS D&R SJ 94069 (PDRS flow)

Preparation: None

Synopsis: This lesson will allow the students to execute the retrieve timeline while

dealing with malfunctions forcing the use of RMS Single Joint (SJ)

operations.

Objectives: • Perform retrieve timeline, using RMS SJ operations, with the following malfunctions:

mailunctions

RMS Arm-Based Electronics (ABE) Failure (to achieve single joint ops)

Manipulator Positioning Mechanism (MPM)/Manipulator Retention Latch (MRL) Power Problem (System Mal)

Manipulator Controller Interface Unit (MCIU) Built-In Test

Equipment (BITE)

End Effector (EE) Talkback Failure

Panel A8 Switch Failure

Backoff and Approach

Orbiter Translational Hand Controller (THC) Problem

Power Interface Problem

Hardline COMM Problem

# 36 RETR SJ T/L 91012 (Concluded)

- Payload Retention Latch Assembly (PRLA) System Problem
- Loss of VERNs
- Guidance, Navigation, and Control (GNC) General Purpose Computer (GPC) Fail
- Cover the following events from the Flight Plan:
  - Initial Condition: RMS is poised for capture
  - Initial Condition: 400 foot approach
  - Pre-capture payload commanding
  - Payload capture
  - Loaded operations required prior to berthing
  - Payload commanding
  - Payload berthing
  - Umbilical mate
  - Post-berth payload commanding
  - Payload powerdown/deactivation

# 37 **RMS/PL CONT 91012**

Title: Remote Manipulator System/Payload Contingencies

Duration: 4.0 hours

**Note:** Schedule 6 hours integrated with the NBL.

Medium: SMS-FB (NBL/FB, as requested.)

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT

Source: DA7/Assigned SMS Team

Date: 07/00

Lesson(s) Replaced: PDRS LD CON 91012, PDRS DEP CON 91012,

PDRS RET CON 91012

Equipment Required: PGSC, COAS

Prerequisite Lesson(s): LOAD SJ T/L 91012, DPLY SJ T/L 91012,

UNLD MAL T/L 91012, RETR SJ T/L 91012,

PDRS XXX CON 92069 (XXX = LD, DPLY, RETR, D&R)

(PDRS flow)

Preparation: None

Synopsis: During this lesson, the crew will execute a RMS/Payload (PL) contingency

timeline agreed to in advance. Emphasis shall be placed on overall crew

coordination aspects as well as RMS/EVA/IV/Payload Coordinator.

Objectives: • This lesson may include Loaded, Deploy or Retrieve operations.

Objectives will be determined based on mission-planned contingencies.

• Perform contingency retrieve timeline with malfunctions:

## 37 RMS/PL CONT 91012 (Concluded)

#### **EXAMPLES**:

EVA assisted retrieve

Back-away deploy

EVA assisted deploy (Prebrief)

Jettison (Emergency Deploy)

EVA rescue (tool chasing)

Unplanned deploy

Equipment jettison

#### 38 WLES RVW 91001

Title: Wing Leading Edge Sensor Review

Duration: 1.0 hour

Medium: Building 30 PGSC Lab Student: As assigned by CDR.

Source: DO5 Date: 07/07

Lesson(s) Replaced: None

Equipment Required: A31p laptop

Prerequisite Lesson(s): WLES OPS II 91020

Preparation: None

Synopsis: Review previously provided Wing Leading Edge Sensor (WLES) training.

This is a hands-on lesson with the WLES software and representative

hardware.

Objectives: • Provide crew with any last minute updates to the WLES system.

• Activate the WLES system again and answer any final questions prior

to flight.

## 39 **PO INS OPS 91012**

Title: Post Insertion Operations

Duration: 4.0 hours Medium: SMS-FB

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT

Source: DA7/Assigned SMS Team and DF/Crew Systems Representative

Date: 07/00

Lesson(s) Replaced: PO INS OPS 92012

Equipment Required: Middeck stowage, Wireless headsets stowed on table in

middeck, Complete mission stowage, Advanced Crew Escape Suits (ACESs), PGSC/SpOC, MS seats installed:

Reset point: T-2

# 39 PO INS OPS 91012 (Concluded)

Prerequisite Lesson(s): RMS/PL CONT 91012

Preparation: None

Synopsis: This lesson covers the first 4 hours of flight on the flight-specific training

load. It should cover all nominal procedures during the launch and post-insertion phases of flight. This includes FDF configuration, suit doffing, and setup of stowed equipment appropriate for this phase of flight. Malfunctions should be minimized to allow a nominal rehearsal of this

timeline. For RMS flights, RMS checkout must be completed.

Objectives: • Complete the first 4 hours of the flight timeline.

Complete all nominal procedures through post-insertion.

• Complete suit doffing.

• Complete setup of stowed equipment.

Complete RMS checkout, for RMS flights.

## **PGSC REVIEW 41195**

Title: Payload General Support Computer Review

Duration: 2.0 hours

**Note:** Duration will vary depending on objectives predetermined by student(s)

and instructor.

Medium: Payload General Support Computer

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT (Schedule individually or

in pairs.)

Source: DO5/Cargo Integration and Operations Branch

Date: 08/02

Lesson(s) Replaced: PGSC REVIEW 41001

Equipment Required: Standard PGSC Lab equipment

Prerequisite Lesson(s): OCA/VTS OPS 31195, PGSC MAL 31195,

PGSC NETWORK OPS 31195

Preparation: None

Synopsis: The crew will setup and activate a complete PGSC configuration.

Objectives: • Perform a complete PGSC setup.

• Configure for different operations: Propulsion (Prop) and RMS.

The student will drive the direction of the class and may ask any

questions.

# **APDS REVIEW 41029**

Title: Androgynous Peripheral Docking System Review

Duration: 2.0 hours Medium: PYLD Trainer

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT (Schedule individually or

in pairs.)

**Note:** Schedule for Docking Flights only. Source: DS45/Shuttle Systems Training Group

Date: 03/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): APDS MAL 23029

Preparation: Review APDS Nominal and Off-Nominal procedures as required.

Synopsis: This lesson provides a detailed review of APDS operations, both nominal

and with malfunctions. Emphasis will be placed on areas selected by the

student.

Objectives: Upon completion of this lesson, the student will be able to understand and

perform docking and undocking sequences, both nominal and with

malfunctions.

# **ORB PRF FS 41012**

Title: Flight-Similar Orbit Proficiency

Duration: 4.0 hours/week

Medium: SMS-FB

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT

Source: DA7/Assigned SMS Team

Date: 02/93

Lesson(s) Replaced: ORB PRF ADV 41012

Equipment Required: Wireless headsets, HP48SX, COAS, full stowage,

PGSC/SpOC

Prerequisite Lesson(s): ORB SKL 31012

Preparation: None

Synopsis: This lesson is a continuation of ORB SKL 31012. It can be taken after

credit for PASS RECOV 31006 is received, and may be used by a crew for crew flight plan development of orbit skills proficiency. This lesson may be scheduled prior to delivery of the crew's flight-specific training load. The assigned SMS team will determine the content of this lesson.

**Note:** This lesson is not included in the amount of mandatory orbit standalone

SMS training for a crew.

# **ORB PRF FS 41012 (Concluded)**

Objectives: • Maintain orbit proficiency.

• Practice following flight plan.

- Use Windows DeCommutator (WinDecom) to initialize Time and State vector applications to enable auto feed of vector and time to required applications.
- Use Deorbit/Center of Gravity (c.g.) application to generate deorbit targets.

## **ORB PRF LS 41012**

Title: Load-Specific Orbit Proficiency

Duration: 4.0 hours/week

Medium: SMS-FB

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT

Source: DA7/Assigned SMS Team

Date: 02/93

Lesson(s) Replaced: ORB PRF FS 41012

Equipment Required: Wireless headsets, COAS, PGSC/SpOC stowage

Prerequisite Lesson(s): RMS/PL CONT 91012

Preparation: None

Synopsis: This lesson may be used by a crew for flight plan development or orbit

skills proficiency. It is scheduled after the crew's load-specific training has been completed. This could happen, for example, if a launch slips. The

assigned SMS team will determine the content of this lesson.

**Note:** This lesson is not included in the amount of mandatory orbit standalone

SMS training for a crew.

Objectives: • Develop proficiency with crew flight plan.

Practice following flight plan.

# **PO INS PRF 41012**

Title: Post-Insertion Operations Proficiency

Duration: 4.0 hours Medium: SMS-FB

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT, PS 1

Source: DA7/Assigned SMS Team

Date: 12/93

Lesson(s) Replaced: None

Equipment Required: Middeck stowage, Wireless headsets stowed on table in

middeck, Complete mission stowage, PGSC/SpOC, MS

seats installed

Prerequisite Lesson(s): RMS/PL CONT 91012

Preparation: None

Synopsis: This lesson covers the first 4 hours on the flight-specific training load. It

should cover all nominal procedures during the launch and post-insertion phases of flight. This includes FDF configuration and setup of stowed equipment appropriate for this phase of flight. Malfunctions should be minimized to allow a nominal rehearsal of this timeline. For RMS flights,

RMS checkout must be completed.

Objectives: • Complete the first 4 hours of the flight timeline.

• Complete all nominal procedures through post-insertion.

• Complete setup of stowed equipment.

• Complete RMS checkout for RMS flights.

Maintain proficiency in post-insertion operations.

# SECTION 8.0 EXTRAVEHICULAR ACTIVITY (EVA) OPERATIONS TRAINING COURSE

The Extravehicular Activity (EVA) Operations Training Course presents the training required to prepare future EVA crewmembers for a flight. The EVA training course instructs not only system functions and processes, but techniques and the skills to use them. Performing an EVA is more than executing procedures; knowledge and skill is required. It requires development and practice and is payload and task-specific. Techniques practiced early on may be used differently as timelines are refined throughout the mission training flow progression.

The EVA training course is sub-divided into three sections:

<u>Generic</u> – Crewmembers are trained given a foundation in both EVA Systems and

EVA Task classes.

Systems - Crewmembers are trained to understand and use the EMU and

associated interfaces.

Task – Crewmembers are trained to perform the necessary EVA tasks for a

particular mission.

EVAs are categorized as the following:

Contingency: EVA required affecting the safe return of the crew and vehicle.

Unscheduled: EVA not included in the nominal scheduled mission activities but which

may be required to achieve mission success.

Scheduled: EVA scheduled prior to launch and included in the nominal mission

timeline.

The EVA training course is divided between the systems and task disciplines. Within each discipline, the flows are further defined between generic and flight-specific training.

#### The flow types are:

Generic/ASCAN

Pilot/ASCAN

Orbiter Contingency

Payload Contingency

EVA Assembly (with Shuttle Airlock)

EVA Assembly (with Station Airlock)

Station Expedition Crewmember

At the NBL, Sonny Carter Training Facility, NBL events are also conducted to satisfy hardware and development evaluations and EVA proficiency or EVA skills review training. The EVA skills-based training program provides crewmembers the excellent opportunity to practice EVA skills in a part-task setting or in a timeline-specific configuration based on the pool configuration at the time of the NBL event.

The EVA crewmember assignments are based on several factors, and designators are assigned as follows: Extravehicular 1 (EV1), EV2, and Intravehicular (IV) crewmember. When missions require more than one EVA team, designators will also be assigned for the other EVA team as: EV3, EV4, and IV crewmember (generally EV1 or EV2). A SRMS and/or a SSRMS operator(s) for the EVAs are also assigned.

Upon completion of the EVA Operations Training Course, the crewmember will be able to perform the following in support of an EVA for both payload and orbiter operations:

- Don/doff and operate the EMU.
- Evaluate and respond to EMU malfunctions.
- Operate the airlock systems and orbiter interfaces.
- Perform orbiter contingency, unscheduled payload, and scheduled EVA procedures.
- Be familiar with EVA tools and stowage locations.
- Be familiar with EVA documentation.

The main facilities used for EVA training are:

- NBL
- CCT and CCTII
- FFT
- Virtual Reality (VR) Lab
- PABF
- Bldg. 7/Environmental Test Article (ETA)
- Bldg. 7/Space Station Airlock Test Article (SSATA)
- United Space Alliance/Flight Crew Equipment (USA/FCE)

For scheduled EVA training flows, CB or DA may also require wet integrated simulations, with SMS/NBL. The Crew Equipment Interface Test (CEIT) at KSC, and the Bench Review at USA/FCE are valuable informal training sessions. (See Crew Training Catalog Addendum for informal session descriptions.)

EVA training flows are reviewed periodically throughout the crew training cycle. Some training may be added or not required due to crew's skill, procedural or requirements changes, and/or flight launch slips or flight manifest changes.

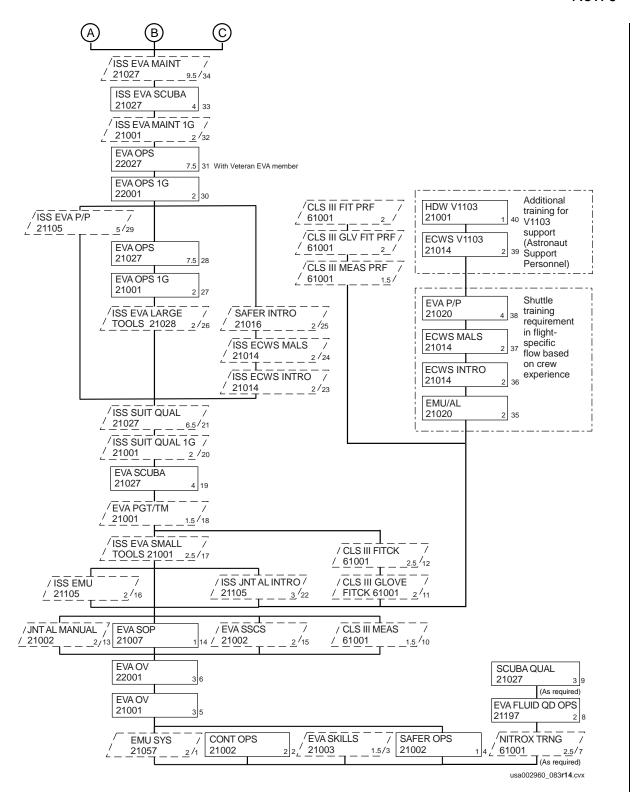


Figure 8-1. EVA Systems Operations Training Flow (Generic)

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Table 8-1. EVA Generic Operations
Training Requirements

															Date Last Modified: 06/08			
						Non-Crew Rotation							Crew Rotation					
Stage	Ref Num	Lesson Code	Media	Hrs	Sched Code	С	Р	IV MS1	EV1	EV2	MS4	PS	С	IV	EV1	EV2	Alt Fac	Comments
0	1	EMU SYS <b>21057</b>	CBT	2	1	2			2	2			2		2	2		
0	2	CONT OPS 21002	WBK	2	1			2	2	2				2	2	2		
0	3	EVA SKILLS 21003	VDT	1.5	4				1.5	1.5					1.5	1.5		
0	4	SAFER OPS 21002	WBK	1	1			1	1	1				1	1	1		
0	5	EVA OV 21001	CLR	3	2 - 10			3	3	3				3	3	3		Suit and IP CB
0	6	EVA OV 22001	CLR	3	2 - 10			3	3	3				3	3	3		Suit and IP CB
0	7	NITROX TRNG 61001	CLR EVA FLUID QD TRGN	2.5	1 - 2			2.5	2.5	2.5				2.5	2.5	2.5		0730 - 1000
0	8	EVA FLUID QD OPS 21197	(B9)	2	3			2	2	2				2	2	2		*D. ( t. D.)/10 0000
0	9	SCUBA QUAL 21027	NBL	3	1			3	3	3				3	3	3		*Refer to DX12-0003 NBL Training Plan
0	10	CLS III MEAS 61001	CLR	1.5	1			1.5	1.5	1.5				1.5	1.5	1.5		FCE Bldg.
0	11	CLS III GLOVE FITCK 61001	CLR	2	1			2	2	2				2	2	2		FCE Bldg.
0	12	CLS III FITCK 61001	CLR	2.5	1			2.5	2.5	2.5				2.5	2.5	2.5		FCE Bldg.
0	13	JNT AL MANUAL 21002	WBK	2	1			2	2	2				2	2	2		
0	14	EVA SOP 21007	TXT	1	1			1	1	1				1	1	1		
0	15	EVA SSCS 21002	WBK	2	1			2	2	2				2	2	2		
0	16	ISS EMU 21105	SSMTF	2	2			2	2	2				2	2	2	FFT	Requires CLS III EMU
0	17	ISS EVA SMALL TOOLS 21001	CLR	2.5	2			2.5	2.5	2.5				2.5	2.5	2.5		
0	18	EVA PGT/TM 21001	CLR	1.5	3			1.5	1.5	1.5				1.5	1.5	1.5		
0	19 20	EVA SCUBA 21027 ISS SUIT QUAL 1G 21001	NBL CLR	2	1-2			2	2	2				4	2	2		
0	21	ISS SUIT QUAL 21027	NBL	6.5	2			6.5	6.5	6.5				6.5	6.5	6.5		*Refer to DX12-0003 NBL Training Plan
0	22	ISS JNT AL INTRO 21105	SSMTF	3	4			3	3	3				3	3	3		TTDE TTGITTING TTGIT
0	23	ISS ECWS INTRO 21014	EMU	2	1			2	2	2				2	2	2		
0	24	ISS ECWS MALS 21014	EMU	2	1			2	2	2				2	2	2		
0	25	SAFER INTRO 21016	VR LAB	2	1			2	2	2				2	2	2		
0	26	ISS EVA LARGE TOOLS 21028	AB TBL	2	4			2	2	2				2	2	2		
0	27	EVA OPS 1G 21001	NBL/MU-S	2	2			2	2	2				2	2	2		
0	28	EVA OPS 21027	NBL	7.5	2				7.5	7.5					7.5	7.5		
0	29	ISS EVA P/P 21105	SSMTF	5	2				5	5					5	5		
0	30	EVA OPS 1G 22001	NBL/MU-S	2	2				2	2					2	2		
0	31 32	EVA OPS 22027 ISS EVA MAINT 1G 21001	NBL/MU-S	7.5 2	2				7.5 2	7.5 2					7.5 2	7.5 2		
0	33	ISS EVA SCUBA 21027	NBL/MU-S	4	2				4	4					4	4		
0	34	ISS EVA SCOBA 21027	NBL	9.5	2				9.5	9.5					9.5	9.5		
0	35	EMU/AL 21020	FFT	9.5	2			2	2	9.5				2	2	9.5	CCT II	Requires CLS III EMU
0	36	ECWS INTRO 21014	EMU	2	1			2	2	2				2	2	2		
0	37	ECWS MALS 21014	EMU	2	1			2	2	2				2	2	2		
0	38	EVA P/P 21020	FFT	4	2				4	4					4	4	CCT II	Only required for
0	39	ECWS V1103 21014	EMU	2	1													Astronaut Support Personnel (ASP)
0	40	HDW V1103 21001	CLR	1	1													Only required for ASP
0		CLS III MEAS PRF 61001	CLR	1.5	1			1.5	1.5	1.5				1.5	1.5	1.5		
0		CLS III GLV FIT PRF 61001	CLR	2	1			2	2	2				2	2	2		
0		CLS III FIT PRF 61001	CLR	2	1			2	2	2				2	2	2		
0		Sub T	otal for Stage	440.5	Stage Tota		wmemb		445.5	445.5	^	^	_	70.5	445.5	445.5		
0				118.5		2		70.5	115.5	115.5	0	0	2	70.5	115.5	115.5		

# 1 <u>EMU SYS 21057</u>

Title: Extravehicular Mobility Unit Systems and Components (Shared – ISS)

Duration: 2.0 hours Medium: CBT

Student: COMMANDER, EV1, EV2, IV (Schedule individually.)

Source: DX35 Date: 06/08

Lesson(s) Replaced: EMU SYS 21002

Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

Synopsis: This CBT includes training on all subsystems and components of the

EMU. It provides an overview of the EMU including the primary and secondary life support systems, the electrical system, the communications

system, and the Caution and Warning System (CWS).

Objectives: 
• Become familiar with the EMU Space Suit Assembly (SSA) and

ancillary equipment.

• *Understand* the *operations of the* Life Support System (LSS) subsystems and *Secondary Oxygen Package (SOP)*.

Understand the EMU CWS and interfaces.

#### 2 CONT OPS 21002

Title: Extravehicular Activity Payload Bay Contingency Operations

Duration: 2.0 hours Medium: Workbook

Student: EV1, EV2, IV (Schedule individually.)

Source: DX32 Date: 03/02

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

Synopsis: This lesson includes a description of the entire contingency EVA support

equipment and orbiter EVA hardware available to the EVA crewmember, a

description of each orbiter contingency EVA task, and its related hardware. This lesson will also include EVA mission rules related to orbiter contingency EVAs and training hardware configurations.

Objectives: Become familiar with generic EVA tools and orbiter contingency tasks.

# **EVA SKILLS 21003**

Title: Extravehicular Activity Skills (Shared – ISS)

Duration: 1.5 hours
Medium: Video Tape
Student: EV1, EV2, IV

Source: DX32 Date: 02/07

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

Synopsis: This lesson provides the student with a detailed overview briefing on

acceptable EVA skills related to EVA operations.

Objectives: • Become familiar with airlock operations.

· Become familiar with translation techniques.

• Become familiar with various EVA hardware operations.

 Become familiar with the proper techniques and skills of conducting EVA Operations.

# **4** SAFER OPS 21002

Title: Simplified Aid for Extravehicular Activity Rescue Operations

(Shared – Shuttle)

Duration: 1.0 hour Medium: Workbook

Student: EV1, EV2, IV (Schedule individually.)

Source: DX35 Date: 03/02

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

Synopsis: This training manual provides an overview of SAFER functions and

operations. The student will learn the basic operations and controls of SAFER including SAFER checkout, software, and donning and doffing.

Objectives: • Comprehend the functionality of SAFER:

Describe the functions of SAFER subsystems.

Define the component of SAFER.

# 4 SAFER OPS 21002 (Concluded)

- Know SAFER controls and operations:
  - Describe the systems operations.
  - Describe checkout operations.
  - Describe maintenance operations such as battery replacement.
  - Describe rescue operations.

## **EVA OV 21001**

Title: Extravehicular Activity Overview

Duration: 3.0 hours
Medium: Classroom
Student: EV1, EV2, IV

Source: DX32 Date: 10/04

Lesson(s) Replaced: None

Equipment Required: EMU, EVA tools and equipment

Prerequisite Lesson(s): EMU SYS 21057, CONT OPS 21002, EVA SKILLS 21003,

SAFER OPS 21002

Preparation: None

Synopsis: This is a classroom setting with a mixture of hands-on tools, overview

presentations, hardware briefing, and open discussions. The goal of this class is to orient the student with the big picture world of EVA. The class will give a brief overview of the Shuttle and Station EVA interfaces and why these interfaces are important to EVA. An EMU suit overview will be given, combined with a hands-on briefing of the use of general EVA tools. After this session the student should have a big picture overview of the complexity involved with planning, training, and executing an EVA.

- Become familiar with Shuttle EVA interfaces
- Become familiar with Station EVA interfaces
- Become familiar with EMU
- Become familiar with EVA tools
- Become familiar with Shuttle contingency tasks
- Become familiar with Station maintenance tasks

## 6 **EVA OV 22001**

Title: Extravehicular Activity Overview

Duration: 3.0 hours
Medium: Classroom
Student: EV1, EV2, IV

Source: DX32 Date: 10/05

Lesson(s) Replaced: None

Equipment Required: EMU, EVA tools and equipment

Prerequisite Lesson(s): EVA OV 21001

Preparation: None

Synopsis: This is a continuation of EVA OV 21001 including a mixture of hands-on

tools, overview presentations, hardware briefing, and open discussions. The goal of this class is to orient the student with the big picture world of EVA. The class will give a brief overview of the Shuttle and Station EVA interfaces and why these interfaces are important to EVA. An EMU suit overview will be given, combined with a hands-on briefing of the use of general EVA tools. After this session the student should have a big picture overview of the complexity involved with planning, training, and

executing an EVA.

Objectives: • Continue familiarization with Shuttle and Station EVA interfaces

Continue familiarization with EMU and EVA tools

 Continue familiarization with Shuttle contingency and Station maintenance tasks

Become familiar with potential EMU injuries during EVA training

# 7 NITROX TRNG 61001

Title: Nitrox Training (Shared – ISS)

Duration: 2.5 hours Medium: Classroom

Student: Required of anyone prior to SCUBA or suited run at NBL

(Schedule individually or in pairs.)

Source: DX12 Date: 03/02

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

# 7 NITROX TRNG 61001 (Concluded)

Synopsis: This event will provide the student with information regarding use of

breathing Nitrox gas during NBL SCUBA and suited operations. The student will receive a facility orientation, receive a classroom briefing, and

must take a written exam after the briefing.

Objectives: Become familiar with use of Nitrox gas at the NBL facility.

## 8 EVA FLUID QD OPS 21197

Title: Extravehicular Activity Fluid Quick Disconnect Operations

(Shared – Shuttle)

Duration: 2.0 hours

Medium: EVA Fluid QD Trainer (in Building 9)

Student: EV1, EV2, IV

Source: DX32 Date: 06/08

Lesson(s) Replaced: None

Equipment Required: EVA tools and equipment

Prerequisite Lesson(s): None

Preparation: None

Synopsis: The lesson provides the student with a detailed knowledge of EVA fluid

connector operations. The student will operate the connectors under

pressurized conditions.

Objectives: • Become familiar with proper operations of an EVA fluid connector.

Become familiar with EVA tools used to operate EVA fluid connector

functions.

#### 9 SCUBA QUAL 21027

Title: SCUBA Qualification (Shared – Shuttle)

Duration: 3.0 hours

Medium: Neutral Buoyancy Lab

Student: EV1, EV2, IV (Schedule individually.)

**Note:** Student must be a certified diver with SCUBA card and have a Class III

physical.

Source: DX12 Date: 03/02

Lesson(s) Replaced: None

Equipment Required: Scuba gear provided by the NBL Facility

Prerequisite Lesson(s): NITROX TRNG 61001

# 9 SCUBA QUAL 21027 (Concluded)

Preparation: None

**Note:** This lesson is nominally scheduled same day as NITROX

TRNG 61001.

Synopsis: This lesson provides the student with an overview of the NBL safety

procedures and review of SCUBA gear and its use. The student then performs proper SCUBA skills in the water. (Refer to NBL Training Plan,

DX12-0003, for currency requirements.)

The student must take a written SCUBA test and Nitrox class prior to this

lesson, approximately 6 hours at NBL.

Objectives: • Know NBL Facility safety procedures.

• Demonstrate familiarity with SCUBA gear.

Perform SCUBA skills in water (as required by NBL Training Plan).

## 10 CLS III MEAS 61001

Title: Class III Measurements (Shared – ISS)

Duration: 1.5 hours Medium: Classroom

Student: EV1, EV2, IV1 (Schedule individually.)

Source: DX35 (USA/FCE)

Date: 03/02

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

Synopsis: This event will provide Flight Crew Equipment (FCE) EMU suit

measurements necessary to build up an EMU for a particular student. This event must be done prior to an EMU Class III Fit Check. The

crewmember will report to the FCE facility for detailed measurements that

are obtained by the FCE EMU engineer. The data will be used to determine the sizing requirements. Nominally, Mission Operations

Directorate (MOD) personnel do not attend this activity.

Objectives: None

# 11 CLS III GLOVE FITCK 61001

Title: Class III Glove Fit Check

Duration: 2.0 hours Medium: Classroom

Student: EV1, EV2, IV1 (Schedule individually.)

Source: DX35 (USA/FCE)

Date: 03/02

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

Synopsis: This event will provide Flight Crew Equipment (FCE) a fit check

verification, as required, of the student's Class III EMU gloves. The class III gloves (no other suits, or hardware required) are provided at the FCE facility with student and engineer using the FCE Glove Box for verification

of proper fit.

Objectives: None

## 12 CLS III FITCK 61001

Title: Class III Fit Check (Shared – ISS)

Duration: 2.5 hours Medium: Classroom

Student: EV1, EV2, IV1 (Schedule individually.)

Source: DX35 (USA/FCE)

Date: 02/07

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

Synopsis: This event will provide Flight Crew Equipment (FCE) a fit check

verification of the student's Class III EMU suit and Class III gloves. Two EMUs (baseline and enhanced) will be provided for the fit check so that FCE will have correct sizing information to build up for either an enhanced or baseline unit for the student's upcoming EVA lessons. This event will provide FCE a fit check verification of the student's Class III EMU gloves. The class III gloves are provided at the FCE facility with student and engineer using the FCE Glove Box for verification of proper fit. The crewmember will report to the FCE facility for the fit checks with the

assistance of the FCE suit technician.

Objectives: None

# **13 JNT AL MANUAL 21002**

Title: ISS Joint Airlock Systems Training Manual (Shared – ISS)

Duration: 2.0 hours Medium: Workbook

Student: EV1, EV2, IV (Schedule individually.)

Source: DX35 Date: 03/02

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

Synopsis: This workbook provides an overview of the ISS Joint Airlock modules,

their nominal configuration, capabilities, functions, and EMU interfaces.

Objectives: As listed in each chapter of the workbook.

## 14 EVA SOP 21007

Title: Extravehicular Activity Standard Operating Procedures

(Shared – Shuttle)

Duration: 1.0 hour Medium: Text

Student: EV1, EV2, IV (Schedule individually.)

Source: DX32 (CB) Date: 03/02

Lesson(s) Replaced: EVA LSN LRND 21007

Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

Synopsis: This lesson provides students the opportunity to benefit from the

accumulated experience of present and past EVA crewmembers, flight controllers, and engineers. It presents valuable insight to facilitate activities related to EMU operations, EVA task techniques, safety, EVA hardware, etc. This will also be required during flight-specific training.

Objectives: • Become familiar with acceptable EVA techniques.

• Become familiar with EVA hardware operational constraints.

Become familiar with various EVA operational concepts.

# 15 EVA SSCS 21002

Title: Extravehicular Activity Space-to-Space Communication System

(Shared – ISS)

Duration: 2.0 hours Medium: Workbook

Student: EV1, EV2, IV (Schedule individually.)

Source: DX35 Date: 03/02

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

Synopsis: This workbook will provide the student with a complete overview of the

Space-to-Space Communication System (SSCS) as it pertains to EVA on Shuttle and on ISS. Topics include: controls of the Space-to-Space EMU Radio (SSER), the Space-to-Space Orbiter Radio (SSOR), and the Space

to-Space Station Radio (SSSR); configuration of these controls for hardline and Radio Frequency (RF) EVA communication; and flight rules

associated with EVA communication.

Objectives: • Identify the SSER and the Communications Carrier Assembly (CCA).

• Identify the controls associated with the SSER, SSOR, and SSSR.

• Explain the nominal and back-up communications configurations.

• State the flight rules associated with the SSER.

Summarize the EVA communication procedures for Shuttle and ISS.

Respond to malfunctions of the SSCS.

## 16 ISS EMU 21105

Title: ISS Extravehicular Mobility Unit Familiarization (Shared – ISS)

Duration: 2.0 hours

Medium: Space Station Mock-Up And Training Facility Student: EV1, EV2, IV (Schedule individually or in pairs.)

Source: DX35 Date: 03/05

Lesson(s) Replaced: None

Equipment Required: EMU and ancillary equipment

Prerequisite Lesson(s): None

Preparation: None

Synopsis: This EMU familiarization lesson provides a description of, and hands-on

experience with the major EMU components, configuration/procedures,

and ancillary EVA equipment.

### **16 ISS EMU 21105 (Concluded)**

Objectives: • Know and identify EMU physical features.

- Be familiar with and identify physical features with which the crewmember interfaces during EVA operations (switches, airlock panels, valves, umbilicals, display locations, and hatch configurations).
- Perform component mating/demating procedures.
- Perform airlock hatch operations and launch/on-orbit/re-entry stowage of EVA equipment.
- Know stowage locations of ancillary EVA hardware.

#### 17 ISS EVA SMALL TOOLS 21001

Title: ISS Extravehicular Activity Small Tools (Shared – ISS)

Duration: 2.5 hours

Medium: Classroom (at NBL)

Student: EV1, EV2, IV

Source: DX32 Date: 02/07

Lesson(s) Replaced: EVA ST TOOLS C 21001

Equipment Required: EVA tools and equipment, EMU gloves

Prerequisite Lesson(s): EVA SOP 21007

Preparation: None

Synopsis: This lesson includes a description of the EVA tools used during ISS EVA

operations. This lesson consists of a classroom briefing and hands-on

applications of the EVA hardware.

Objectives: • Be familiar with and operate EVA tools.

• Be familiar with EVA tool operational constraints.

#### 18 **EVA PGT/TM 21001**

Title: Extravehicular Activity Piston Grip Tool/Torque Multiplier Operations

(Shared – ISS)

Duration: 1.5 hours
Medium: Classroom

Student: EV1, EV2, IV (Schedule in groups of up to 3.)

Source: DX32 Date: 06/08

Lesson(s) Replaced: None

Equipment Required: EVA tools and equipment
Prerequisite Lesson(s): ISS EVA SMALL TOOLS 21001

Preparation: None

#### 18 EVA PGT/TM 21001 (Concluded)

This lesson provides the student with a detailed description of the Pistol Synopsis:

Grip Tool (PGT) and Torque Multiplier (TM) operations. The student gets

hands-on application of the EVA hardware.

Objectives: Become familiar with PGT operations.

Become familiar with TM operations.

• Become familiar with re-programming capability of the PGT software using a computer.

#### 19 **EVA SCUBA 21027**

Title: Extravehicular Activity Scuba

Duration: 4.0 hours

Neutral Buoyancy Lab Medium:

Student: EV1, EV2, IV

Source: DX32 Date: 10/05

Lesson(s) Replaced: None

Equipment Required: Swimming suit, EVA tools and equipment

Prerequisite Lesson(s): ISS EVA SMALL TOOLS 21001

Preparation: None

Synopsis:

This lesson will provide the students with their first exposure to Shuttle and Station EVAs prior to their upcoming suited runs. This class includes a pre-brief, 2 hours on SCUBA, and debrief while waiting for the 1-hour medical observation period to pass. The student will gain general Shuttle EVA knowledge and EVA skills such as translation and foot restraint operations while being exposed to Shuttle and Station. It is highly recommended that the instructor use Surface Supplied Diving System (SSDS) to communicate with the students and the utility divers.

- Review Shuttle coordinate system
- Practice various translation techniques
- Review Shuttle A/L operations
- Translate to a few contingency worksites and on Station
- Review Station coordinate system
- While swimming, point out all of the Station trusses and elements
- Review Station A/L

### **20 ISS SUIT QUAL 1G 21001**

Title: ISS Suit Qualification 1G (Shared – ISS)

Duration: 2.0 hours
Medium: Classroom
Student: EV1, EV2, IV

Source: DX32 Date: 02/07

Lesson(s) Replaced: None

Equipment Required: EVA tools and equipment

Prerequisite Lesson(s): None

Preparation: None

Synopsis: This lesson is a walk-through/briefing on the objectives and techniques

involved with the ISS SUIT QUAL 21027 NBL run.

Objectives: • Discuss schedule of NBL day.

• Step through suit qualification tasks.

Review tools and hardware utilized.

• Brief students on NBL general tips and safety concerns.

### **21 ISS SUIT QUAL 21027**

Title: ISS Suit Qualification (Shared – ISS)

Duration: 6.5 hours

Medium: Neutral Buoyancy Lab

Student: EV1, EV2, IV

Source: DX32 Date: 02/07

Lesson(s) Replaced: None

Equipment Required: EMUs, EVA tools and equipment

Prerequisite Lesson(s): ISS SUIT QUAL 1G 21001

Preparation: None

Synopsis: This lesson instructs the students of suit qualification and translation

objectives.

The lesson begins with a physical, prebrief and EMU donning. The lesson concludes with EMU doffing and a lesson debrief. (The student must remain at the Neutral Buoyancy Laboratory one hour post-run for safety/medical requirements.)

### 21 ISS SUIT QUAL 21027 (Concluded)

Objectives:

- Perform translation adaptation on ISS.
- Perform Body Restraint Tether (BRT) Operations.
- Perform reach limitations evaluation and Mini-Workstation (MWS) activities.
- Perform Pistol Grip Tool (PGT) Operations.
- Perform Articulating Portable Foot Restraint (APFR) and Translational Foot Restraint (TFR) on Crew Equipment Translation Aid (CETA) cart operations.
- Perform EMU glove pop.
- Become familiar with Neutral Buoyancy Lab (NBL) general tips.
- Become familiar with applicable hardware Operational Control Agreement Document (OCADs – Ops Constraints).

### **22** ISS JNT AL INTRO 21105

Title: ISS Joint Airlock Introduction (Shared – ISS)

Duration: 3.0 hours

Medium: Space Station Mock-Up And Training Facility

Student: EV1, EV2, IV

Source: DX35 Date: 03/02

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): JNT AL MANUAL 21002

Preparation: None

Synopsis:

This lesson provides an overview of the Joint Airlock and the EVA support equipment contained therein. It provides a hands-on opportunity for the student to operate Joint Airlock Systems including the Service, Performance and Checkout Equipment (SPCE).

- Know and describe the Joint Airlock including the SPCE.
- Understand the function of each SPCE component.
- Understand the interfaces between the Joint Airlock and the EMU.
- Exercise Joint Airlock hardware and controls.

### **23 ISS ECWS INTRO 21014**

Title: ISS Extravehicular Mobility Unit Caution and Warning System

Introduction (Shared – ISS)

Duration: 2.0 hours
Medium: EMU Mal Sim

Student: EV1, EV2, IV (Schedule individually.)

Source: DX35 Date: 03/02

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ISS EMU 21105

Preparation: None

Synopsis: This lesson provides an overview of the ISS EMU Caution and Warning

System (CWS) operational procedures and introduces the student to the

operation of the EMU Malfunction Simulator.

Objectives: • Know the EMU and Joint Airlock fluid/electrical systems (EMU

Schematic Review).

• Be familiar with the EMU CWS and the ISS Airlock flight procedures.

Exercise EMU and ISS Airlock interfaces and controls.

### **24** ISS ECWS MALS 21014

Title: ISS Extravehicular Mobility Unit Caution and Warning System

Malfunctions (Shared – ISS)

Duration: 2.0 hours
Medium: EMU Mal Sim

Student: EV1, EV2, IV (Schedule individually.)

Source: DX35 Date: 03/02

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ISS ECWS INTRO 21014

Preparation: None

Synopsis: This lesson provides an exercise of nominal and malfunction procedures

in the EMU Caution and Warning System (CWS) simulator. The student, aided by the instructor, will walk through standard procedures displayed in the simulator. The instructor will insert malfunctions for the student to

resolve.

### 24 ISS ECWS MALS 21014 (Concluded)

Objectives: • Review EMU and airlock support systems.

• Exercise the EMU CWS and the ISS EMU/Joint Airlock flight

procedures.

Perform limited EMU malfunction procedures.

### **25 SAFER INTRO 21016**

Title: Simplified Aid for EVA Rescue Introduction (Shared – ISS)

Duration: 2.0 hours

Medium: Virtual Reality Trainer

Student: EV1, EV2, IV (Schedule individually.)

Source: DX35 Date: 03/02

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): SAFER OPS 21002

Preparation: None

Synopsis: This lesson familiarizes the student with SAFER systems and controls.

The student will be instructed on basic piloting procedures and techniques, and then be asked to incorporate the information by

performing unaided simple rescue scenarios.

**Note:** For crewmembers, pupil measurement is highly desired prior to taking this

class, and can be completed at the JSC Clinic. It takes approximately

5-10 minutes.

Objectives: • Know SAFER systems and controls.

Perform unaided basic piloting procedures.

Perform unaided simple rescue scenarios.

### 26 ISS EVA LARGE TOOLS 21028

Title: ISS EVA Large Tools (Shared – ISS)

Duration: 2.0 hours
Medium: AB Table
Student: EV1, EV2, IV

Source: DX32 Date: 07/07

Lesson(s) Replaced: None

Equipment Required: EVA tools and equipment

Prerequisite Lesson(s): None

Preparation: None

### 26 ISS EVA LARGE TOOLS 21028 (Concluded)

Synopsis: This lesson includes a description of the large EVA tools used during

ISS EVA assembly and maintenance operations. This lesson consists

of a briefing and hands-on application of the EVA hardware.

Objectives: • Become familiar with articulating portable foot restraint, tool stanchion,

and Orbital Replacement Unit (ORU) stanchion operations.

• Become familiar with EVA crane operations.

• Become familiar with crew equipment translation aid cart operations.

### **EVA OPS 1G 21001**

Title: Extravehicular Activity Operations 1G

Duration: 2.0 hours

Medium: Classroom-NBL/Mockup South (NBL/MU-S)

Student: EV1, EV2, IV

Source: DX32 Date: 10/05

Lesson(s) Replaced: None

Equipment Required: EVA tools and equipment Prerequisite Lesson(s): ISS SUIT QUAL 21027

Preparation: None

Synopsis: Students will become familiar with Shuttle and Station Airlock (A/L) egress

scenarios. Suit fit for buoyancy control will be discussed at length.

Specific EVA task will also be discussed with the students.

Objectives: Students will become familiar with:

- Buoyancy control in all orientations (vertical, horizontal, heads down, translation up/down the water column, etc.)
- Shuttle A/L egress (install safety tethers)
- Shuttle payload bay translation techniques
- Shuttle worksite familiarization including translating by KU band, radiator, winch, door drive linkages
- Station A/L egress (install safety tethers)
- Station worksite familiarization including translating of primary translation paths, Crew Equipment Translation Aid (CETA), Spur, Face1, P6, and aft of S1 and P1
- Station Toolbox orientation
- Articulating Portable Foot Restraint (APFR) operations
- Body Restraint Tether (BRT) operations

### **EVA OPS 21027**

Title: Extravehicular Activity Operations

Duration: 7.5 hours

Medium: Neutral Buoyancy Lab

Student: EV1, EV2 Source: DX32 Date: 10/05

Lesson(s) Replaced: None

Equipment Required: EMUs, EVA tools and equipment

Prerequisite Lesson(s): EVA OPS 1G 21001

Preparation: None

Synopsis: Students will perform both a Shuttle and a Station Airlock (A/L) egress.

The emphasis of this lesson will be to optimize suit fit for buoyancy control. The main difference will be the introduction of the A/L tasks along with a brief introduction of tools usage. Throughout the run the student will be asked for areas of suit concerns, suit discomfort, buoyancy issues, proper elevation in suit, etc. Tether protocol should be a secondary

emphasis and should be maintained throughout all translations. (After this

run, another suit fit should be performed if required.)

Objectives: Students will become familiar with:

- Buoyancy control in all orientations (vertical, horizontal, heads down, translation up/down the water column, etc.)
- Shuttle A/L egress (install safety tethers)
- Shuttle payload bay translation techniques
- Shuttle worksite familiarization including translating by KU band, radiator, winch, door drive linkages
- Station A/L egress (install safety tethers)
- Station worksite familiarization including translating of primary translation paths, Crew Equipment Translation Aid (CETA), Spur, Face1, P6, and aft of S1 and P1
- Station Toolbox orientation
- Articulating Portable Foot Restraint (APFR) operations
- Body Restraint Tether (BRT) operations

### 29 <u>ISS EVA P/P 21105</u>

Title: ISS EVA Prep and Post (Shared – ISS)

Duration: 5.0 hours

Medium: Space Station Mock-Up And Training Facility

Student: EV1, EV2 Source: DX35 Date: 03/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): SAFER INTRO 21016

Preparation: None

Synopsis: This lesson provides a suited exercise of flight EVA preparation and post

EVA procedures in the ISS joint airlock. Students perform all timelined steps required for Airlock (A/L) Prep, EMU Resize, EMU Checkout, EVA Prep, Suit donning, A/L Depress, Repress, Post-EVA, EMU maintenance, A/L maintenance, and stowage configuration. During this class, the instructor may aid the crew to complete the objectives. This class will be repeated in the flight-specific flow with the goal that the crewmembers will perform all procedures with no instructor assistance during the final lesson. (The student is required to have an EMU suit fit check with all

hardware fitting properly prior to this exercise).

**Note:** Core objectives listed; may vary in repeated sessions.

Objectives: • Perform aided EMU Checkout, EVA Prep, Prebreathe protocol and suit

donning.

- Perform aided depress/repress (simulated).
- Perform unaided reach evaluations (all Display and Control Module (DCM) controls, visors, tethers, cuff checklist) at simulated EVA conditions.
- Perform aided battery recharge (helmet light, power tool, Rechargeable EVA Battery Assembly (REBA), EMU) procedures.
- Perform aided don/doff procedures.

#### 30 EVA OPS 1G 22001

Title: Extravehicular Activity Operations 1G

Duration: 2.0 hours

Medium: Classroom-NBL/Mockup South (NBL/MU-S)

Student: EV1, EV2 Source: DX32 Date: 10/05

Lesson(s) Replaced: None

### **30** EVA OPS 1G 22001 (Concluded)

Equipment Required: EVA tools and equipment

Prerequisite Lesson(s): EVA OPS 21027

Preparation: None

Synopsis: Students will become familiar with specific EVA tasks, including Shuttle

contingency tasks, and basic Station tasks.

Objectives: Students will become familiar with:

Tool Stowage Assembly (TSA) operations

Shuttle Radiator disconnect

Shuttle KU Band Stow

• Shuttle Winch operations

Station Articulating Portable Foot Restraint (APFR) translation and installation

• Station Crew Equipment Translation Air (CETA) Cart translation

• Station Worksite setup with APFR

Station Tool Retrieval from toolbox

 Removal of Orbital Replacement Unit (ORU) on Face1 while on CETA Cart

### 31 **EVA OPS 22027**

Title: Extravehicular Activity Operations

Duration: 7.5 hours

Medium: Neutral Buoyancy Lab

Student: EV1, EV2 Source: DX32 Date: 10/05

Lesson(s) Replaced: None

**Note:** With Veteran EVA crewmember

Equipment Required: EMUs, EVA tools and equipment

Prerequisite Lesson(s): EVA OPS 1G 22001

Preparation: None

Synopsis: This lesson is a continuation of working in the EMU. Students will extend

their knowledge of the skill of translating and working at worksites while in the EMU. The emphasis during this run will begin to shift from only concern with suit fit to the ability to perform specific EVA tasks. The lesson will be divided between Shuttle and Station tasks. Airlock egress

may or may not be performed depending on NBL configuration.

### 31 EVA OPS 22027 (Concluded)

Objectives: Student will become familiar with:

- Tool Stowage Assembly (TSA) operations
- Shuttle Radiator disconnect
- Shuttle KU Band Stow
- Shuttle Winch operations
- Station Articulating Portable Foot Restraint (APFR) translation and installation
- Station Crew Equipment Translation Aid (CETA) Cart translation
- Station Worksite setup with APFR
- Station Tool Retrieval from toolbox
- Removal of Orbital Replacement Unit (ORU) on Face1 while on CETA Cart

### 32 **ISS EVA MAINT 1G 21001**

Title: ISS Extravehicular Activity Maintenance 1G (Shared – ISS)

Duration: 2.0 hours

Medium: Classroom (NBL/MU-S (NBL, Mockup South))

Student: EV1, EV2 Source: DX32 Date: 03/02

Lesson(s) Replaced: P/L EVA 1G 31001

Equipment Required: EVA tools and equipment

Prerequisite Lesson(s): ISS EVA SMALL TOOLS 21001, ISS JNT AL INTRO 21105,

**EVA OPS 22027** 

Preparation: None

Synopsis: This lesson is a walk-through/briefing on the objectives and techniques

involved with EVA operations for ISS maintenance. An overview of potential failures is presented as well as EVA techniques to perform ISS

maintenance.

Objectives: • Review operations of hardware pertaining to particular NBL configuration.

 Discuss and perform possible EVA techniques needed for ISS maintenance.

### 33 **ISS EVA SCUBA 21027**

Title: ISS Extravehicular Activity SCUBA

Duration: 4.0 hours

Medium: Neutral Buoyancy Lab

Student: EV1, EV2 Source: DX32 Date: 10/05

Lesson(s) Replaced: None

Equipment Required: Swimming suit, EVA tools and equipment

Prerequisite Lesson(s): ISS EVA MAINT 1G 21001

Preparation: None

Synopsis: This lesson will provide the students with exposure to Station EVA tasks

prior to their upcoming suited runs. This class includes a pre-brief, 2 hours on SCUBA, and debrief while waiting for the 1-hour medical observation period to pass. The student will gain general Station EVA knowledge and EVA skills. It is highly recommended that the instructor use the Surface Supplied Diving System (SSDS) to communicate with the

students and the utility divers.

Objectives: • Perform Station Airlock operations

Perform safety tether swaps

Perform foot restraint and body restraint tether operations

 Perform EVA maintenance tasks (utilizing various EVA tools and CETA Cart)

### **155 EVA MAINT 21027**

Title: ISS Extravehicular Activity Maintenance Operations (Shared – ISS)

Duration: 9.5 hours

Medium: Neutral Buoyancy Lab

Student: EV1, EV2 Source: DX32 Date: 03/05

Lesson(s) Replaced: P/L EVA 21027

Equipment Required: EMUs, EVA tools and equipment

Prerequisite Lesson(s): ISS EVA SMALL TOOLS 21001, ISS JNT AL INTRO 21105,

**EVA OPS 22027** 

Preparation: None

Synopsis: This lesson begins with the 1G portion which includes physical, prebrief,

Extravehicular Mobility Unit (EMU) donning, EMU doffing, and ends with the lesson debrief, after the NBL session. (The student must remain at the NBL one hour post-run for NBL safety/medical requirements.)

#### 34 **ISS EVA MAINT 21027 (Concluded)**

This lesson provides the student with objectives and techniques involved with EVA operations for ISS maintenance.

- Objectives: Airlock Egress/Ingress (Station).
  - Translation path familiarization.
  - Safety tether swaps.
  - Articulating Portable Foot Restraint (APFR)/tool stanchion familiarization.
  - ISS EVA toolbox familiarization.
  - Small/large Orbital Replacement Unit (ORU) changeout.
  - EVA crane familiarization.
  - Electrical/fluid connector operations.
  - Node bag access.

#### 35 **EMU/AL 21020**

Title: Extravehicular Activity Mobility Unit/Airlock

Duration: 2.0 hours

Medium: FFT

Student: EV1, EV2, IV

Source: DX35 10/05 Date:

Lesson(s) Replaced: None

Equipment Required: EMU, EVA tools and equipment

Prerequisite Lesson(s): None

Preparation: None

#### Synopsis:

This EMU familiarization lesson provides a description of, and hands-on experience with the major EMU components, configuration/procedures. and ancillary EVA equipment.

- Know and identify EMU physical features.
- Be familiar with and identify physical features with which the crewmember interfaces during EVA operations (switches, airlock panels, valves, umbilicals, display locations, and hatch configurations).
- Perform component mating/demating procedures.
- Perform airlock hatch operations and launch/on-orbit/re-entry stowage of EVA equipment.
- Know stowage locations of ancillary EVA hardware.

### 36 **ECWS INTRO 21014**

Title: Extravehicular Mobility Unit Caution and Warning System Introduction

Duration: 2.0 hours Medium: EMU Mal Sim

Student: EV1, EV2, IV (Schedule individually.)

Source: DX35 Date: 03/02

Lesson(s) Replaced: EMU CWS 21014

Equipment Required: None

Prerequisite Lesson(s): EMU/AL 21020 (Generic flow)

Preparation: None

Synopsis: This lesson provides an overview of the EMU Caution and Warning

System (CWS) operational procedures and introduces the student to the

operation of the EMU malfunction simulator.

Objectives: • Know the EMU and shuttle airlock fluid/electrical systems (schematic

review).

• Be familiar with the EMU CWS and the EMU airlock flight procedures.

• Exercise EMU and shuttle airlock controls and interfaces.

• If required for V1103 support, know V1103 procedures and hardware.

### **37** ECWS MALS 21014

Title: Extravehicular Mobility Unit Caution and Warning System Malfunctions

Duration: 2.0 hours Medium: EMU Mal Sim

Student: EV1, EV2, IV (Schedule individually.)

Source: DX35 Date: 03/02

Lesson(s) Replaced: EMU CWS 22014

Equipment Required: None

Prerequisite Lesson(s): ECWS INTRO 21014

Preparation: None

Synopsis: This lesson provides an exercise of nominal and malfunction procedures

on the EMU Caution and Warning System (CWS) simulator. The student, aided by the instructor, will walk through the standard procedures. The instructor will insert malfunctions into the standard procedures for the

student to resolve.

Objectives: • Review EMU and airlock fluid and electrical systems.

• Exercise the EMU CWS and the EMU airlock flight procedures.

Perform limited EMU malfunction procedures.

### 38 EVA P/P 21020

Title: Extravehicular Activity Prep and Post

Duration: 4.0 hours

Medium: CCT, FFT, or CCT II

Student: EV1, EV2 Source: DX35 Date: 03/02

Lesson(s) Replaced: EVA P/P 1 21020

Equipment Required: EMU and ancillary equipment

Prerequisite Lesson(s): ECWS INTRO 21014

Preparation: None

Synopsis: This lesson provides an EMU suited end to end exercise of flight EVA

preparation and post procedures. This lesson starts with equipment preparation and continues through post-EVA entry preparation. (The student is required to have an informal EMU suit fit check, all hardware

fitting properly, prior to this exercise.)

Objectives: • Be familiar with EMU and STS airlock procedures for flight EVA preparation and post activities.

• Perform pre-EVA equipment preparation for single crewmember.

 Perform EVA procedures through post-EVA servicing and entry preparation.

Practice EMU don/doff in shuttle airlock.

### 39 ECWS V1103 21014

Title: Extravehicular Mobility Unit Caution and Warning System V1103

**Operations** 

Duration: 2.0 hours Medium: EMU Mal Sim

Student: ASP Source: DX35 Date: 03/02

Lesson(s) Replaced: None

Equipment Required: Current V1103 procedures

Prerequisite Lesson(s): ECWS MALS 21014

Preparation: None

Synopsis: This lesson is used for the Astronaut Support Personnel (ASP) who

travels to KSC for preflight orbiter EMU functional hardware checkout. It must be completed so that flight-critical testing may be performed safely and successfully. This minimizes the risk of impacting KSC processing schedules, damaging EVA hardware, or injuring test personnel. CB

# 39 ECWS V1103 21014 (Concluded)

participants should have completed the 20000-level EMU systems lessons portion of the generic training flow. A minimum 1-year proficiency is required for this lesson before supporting V1103.

#### Objectives:

- Review V1103 procedures and hardware handling protocol.
- Discuss procedure rationale and impacts to EMU systems.
- Discuss test-unique hardware, operations, constraints, and lessons learned.
- Prepare new personnel for handling and operation of critical flight hardware.

# <u>40</u> <u>HDW V1103 21001</u>

Title: Class I Hardware V1103 Operations

Duration: 1.0 hour

Medium: Classroom (at USA/FCE)

Student: ASP Source: DX35 Date: 03/02

Lesson(s) Replaced: None

Equipment Required: Class I EMU, V1103 Ground Support Equipment

Prerequisite Lesson(s): ECWS V1103 21014

Preparation: None

**Note:** ECWS V1103 21014 should be scheduled prior to this lesson.

#### Synopsis:

This lesson is used for the Astronaut Support Personnel (ASP) who travels to KSC for preflight EMU functional hardware checkout. It must be completed so that flight-critical testing is performed safely and successfully. This minimizes the risk of impacting KSC processing schedules, damaging EVA hardware or injuring test personnel. CB participants should have completed the 20000-level EMU systems lessons portion of the generic training flow. A minimum 1 year proficiency is required for this lesson before supporting V1103.

- Become familiar with flight interfaces and operation.
- Discuss ground support equipment and its operation.
- Handle V1103 unique test support equipment.
- Identify critical flight hardware interfaces and operating constraints.
- Train new personnel for performing procedures with critical flight hardware.

# **CLS III MEAS PRF 61001**

Title: Class III Measurements Proficiency (Shared – ISS)

Duration: 1.5 hours
Medium: Classroom
Student: EV1, EV2, IV

Source: DX35 Date: 02/07

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): CLS III MEAS 61001

Preparation: None

**Note:** Needs to be scheduled at least five days prior

CLS III GLOVE FIT PRF.

Synopsis: This lesson provides the student and Flight Crew Equipment (FCE)

opportunity for proficiency of EMU measurements.

Objectives: None

### **CLS III GLV FIT PRF 61001**

Title: Class III Glove Fit Check Proficiency (Shared – ISS)

Duration: 2.0 hours
Medium: Classroom
Student: EV1, EV2, IV

Source: DX35 Date: 02/07

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): CLS III GLOVE FITCK 61001

Preparation: None

**Note:** Needs to be scheduled at least five days prior CLS III FIT PRF.

Synopsis: This lesson provides the student and Flight Crew Equipment (FCE) a

proficiency fit check verification of the student's CLS III gloves.

Objectives: None

# **CLS III FIT PRF 61001**

Title: Class III Fit Check Proficiency (Shared – ISS)

Duration: 2.0 hours
Medium: Classroom
Student: EV1, EV2, IV

Source: DX35 Date: 02/07

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): CLS III FITCK 61001

Preparation: None

**Note:** Needs to be scheduled at least two days prior NBL or Prep/Post (P/P)

suited event.

Synopsis: This lesson provides the student and Flight Crew Equipment (FCE) a

proficiency fit check of the student's CLS III EMU suit.

Objectives: None

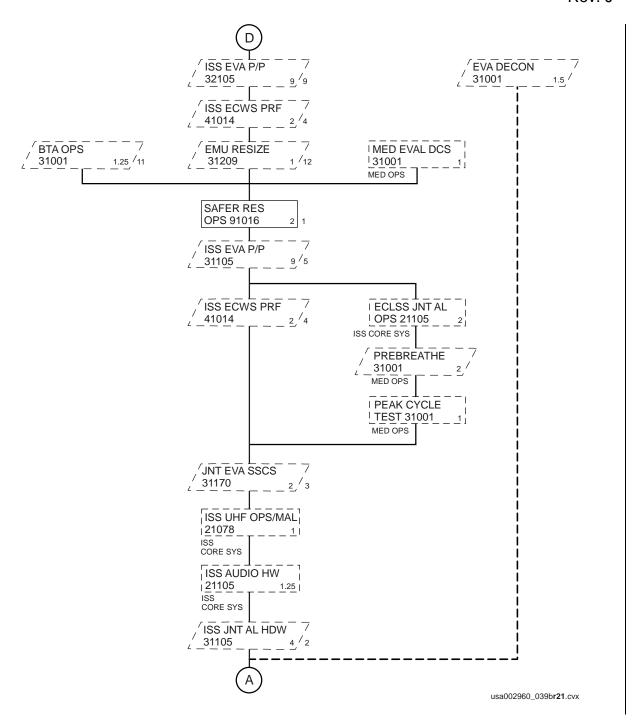


Figure 8-2. EVA Systems Operations Training Flow (Assembly from Station Airlock)

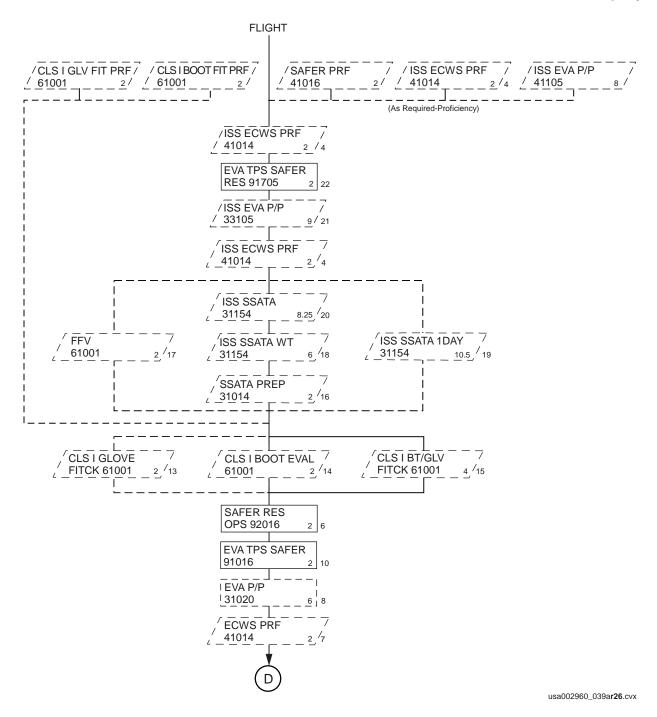


Figure 8-2. EVA Systems Operations Training Flow (Assembly from Station Airlock) (Concluded)

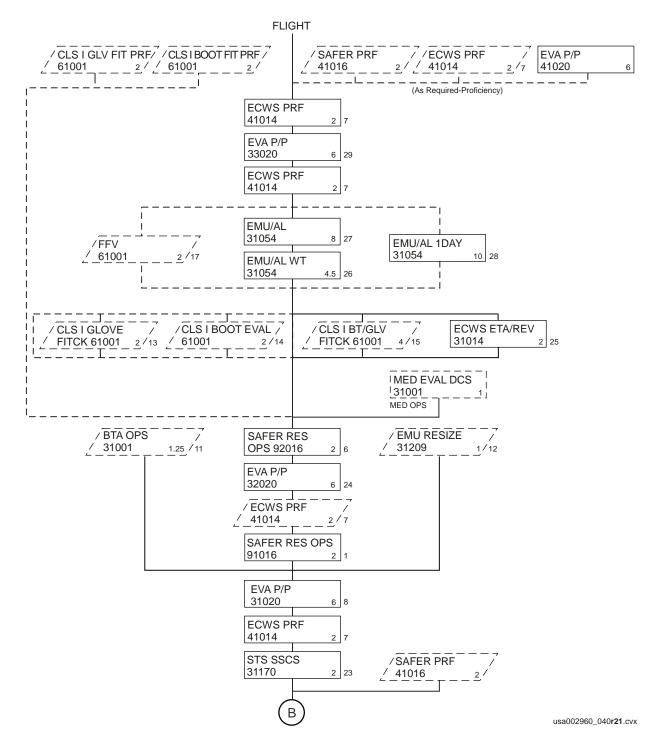


Figure 8-3. EVA Systems Operations Training Flow (Shuttle EVA)

Table 8-2. EVA Systems Operations Training Requirements

Date Last Modified: 06/08 Non-Crew Rotation **Crew Rotation** (Task (Suit Ref Sched IV) Р EV MS2 EV MS3 MS4 EV MS1 EV MS2 Alt Fac Stage Num **Lesson Code** Media Hrs Code С MS1 PS С Comments 'R LAB SS JNT AL HDW 31105 4 S-IV/T-IV JNT EVA SSCS 31170 4 2 2 2 2 S-IV/T-IV SCST ISS ECWS PRF 41014 EMU Prior P/P; S-IV/T-IV Stow time 3 hrs. prior, 1 hr lunch, destow time 2 ISS EVA P/P 31105 SSMTF Stage Totals Per Crewmember: 4 Sub Total for Stage 4 19 19 19 19 19 ISS ECWS PRF 41014 EMU 2 Prior P/P; S-IV/T-IV SAFER RES OPS 92016 3 VR LAB 2 2 2 2 2 2 2 T-IV observes ECWS PRF 41014 2 2 2 2 2 2 Prior P/P 3 1 2 3 EVA P/P 31020 CCT 4 6 6 6 6 CCTII, FFT S-IV Stow time 3 hrs prior, 1 hr lunch, destow time 2 hrs. Task IV attends only the first hour for tool ISS EVA P/P 32105 SSMTF configuration 3 EVA TPS SAFER 91016 VR LAB 2 2-3 2 2 2 2 2 2 T-IV 3 BTA OPS 31001 1.25 1.25 1.25 1.25 1.25 1.25 1.25 11 CLR 1-3 S-IV BLDG 9 EMU RESIZE 31209 **FLOOR** Sub Total for Stage Stage Totals Per Crewmember: 3 25.25 **21.25** 0 25.25 25.25 0 25.25 25.25 25.25 3 ISS ECWS PRF 41014 Prior P/P: S-IV/T-IV 2 **EMU** 2 2 2 2 CLS I BT/GLV FITCK 61001 CLR FCE Bldg. 2 4 4 4 4 4 Prior to Chamber SSATA PREP 31014 EMU Walkthrough 2 ISS SSATA WT 31154 SSATA 1-2 6 6 IV attends WT 6 6 6 6 6 20 ISS SSATA 31154 SSATA 8.25 1.5 8.25 8.25 Suit IV attends donning 8.25 8.25 Task IV attends only the first hour for tool 2 21 ISS EVA P/P 33105 SSMTF 9 configuration VR LAB/ PABF **EVA TPS SAFER RES 91705** 2 Sub Total for Stage Stage Totals Per Crewmember: 2 33.25 **20.5** 0 33.25 33.25 0 0 19 33.25 33.25 4 ISS ECWS PRF 41014 (Finals) EMU 2 Prior P/P; **T-IV** Sub Total for Stage Stage Totals Per Crewmember: 0 0

Note: In the event that a flight decides not to use both a Suit and Task IV, the IV crewmember will complete the combined columns so that all classes are covered.

Table 8-2. EVA Systems Operations Training Requirements (Concluded)

Date Last Modified: 06/08

						Non-Crew Rotation							Crew Rotation					
Stage	Ref Num	Lesson Code	Media	Hrs	Sched Code	(Suit IV) C	Р	(Task IV) MS1	EV MS2	EV MS3	MS4	PS	С	IV P	EV MS1	EV MS2	Alt Fac	Comments
0		ISS ECWS PRF 41014	EMU	2	1	2		2	2	2				2	2	2		
0	7	ECWS PRF 41014	EMU	2	1	2			2	2				2	2	2		
	40		OL D															FCE Bldg., requires CLS
0		CLS I GLOVE FITCK 61001 CLS I BOOT EVAL 61001	CLR CLR	2	1				2	2					2	2		FCE Bldg.
0	17	FFV 61001	CLR	2	1				2	2					2	2		experience
0	19	ISS SSATA 1DAY 31154	SSATA	10.5	1	6.5			10.5	10.5					10.5	10.5		EV crew with ETA/SSATA experience take ISS SSATA 1DAY, not ISS SSATA/ISS SSATA WT. IV follows EV crew
0		STS SSCS 31170	SSCST	2	4	2			2	2				2	2	2		L V CIEW
0 0	24 25 26	EVA P/P 32020 ECWS ETA/REV 31014 EMU/AL WT 31054	CCT EMU ETA	6 2 4.5	4 1 1-2	6 2 4.5			6 2 4.5	6 2 4.5				6 2 4.5	6 2 4.5	6 2 4.5	CCT II or FFT	IV attends WT
0		EMU/AL 31054	ETA	8	1				8	8					8	8		
0	28	EMU/AL 1DAY 31054	ETA	10	1				10	10					10	10		experience
0	29	EVA P/P 33020	сст	6	4	6			6	6				6	6	6	CCT II or FFT	
0		EVA DECON 31001	CLR	1.5	4	1.5			1.5	1.5				1.5	1.5	1.5		Based on mission content
0		SAFER PRF 41016	VR LAB	2	1	1.0			2	2				1.0	2	2		Non-TPS assigned EV
0		ISS EVA P/P 41105	SSMTF	8	4	8		1	8	8				8	8	8		Stow time 3 hrs prior, 1 hr lunch, destow time 2 hrs.
		ECWS PRF 41014	EMU	2	3	2			2	2							CCT II or	
0		EVA P/P 41020	ССТ	6	4	6			6	6				6	6	6	CCT II or FFT	
0		CLS I GLV FIT PRF 61001	CLR	2	1	°			2	2				0	2	2		
0		CLS I BOOT FIT PRF 61001	CLR	2	1				2	2					2	2		
0			Total for Stage	_	Stage Totals	s Per Crev	vmemb	er:										
0				82.5		48.5	0	3	82.5	82.5	0	0	0	40	80.5	80.5		

Note: In the event that a flight decides not to use both a Suit and Task IV, the IV crewmember will complete the combined columns so that all classes are covered.

### 1 **SAFER RES OPS 91016**

Title: Simplified Aid for Extravehicular Activity Rescue (Shared – Shuttle)

Duration: 2.0 hours

Medium: Virtual Reality Trainer

Student: EV1, EV2, Suit IV (Schedule individually.)

Source: DX35 Date: 06/08

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): SAFER INTRO 21016

Preparation: None

Synopsis: This lesson provides hands-on experience in a virtual reality environment

using SAFER to perform self-rescue operations.

Objectives: • Perform unaided self-rescue operations:

Demonstrate the ability to control SAFER.

Demonstrate the ability to recover from a series of tumbles and

return to Orbiter/ISS safely.

# 2 **ISS JNT AL HDW 31105**

Title: ISS Joint Airlock Hardware (Shared – ISS)

Duration: 4.0 hours

Medium: Space Station Mock-Up And Training Facility

Student: EV1, EV2, Suit IV, Task IV

Source: DX35 Date: 06/08

Lesson(s) Replaced: ISS JNT AL HDW C 31105

Equipment Required: None

Prerequisite Lesson(s): ISS JNT AL INTRO 21105

Preparation: None

Synopsis: This lesson re-familiarizes the crewmember with the Joint Airlock

hardware interfaces/controls and allows the crewmember to work through various Airlock hardware malfunctions and off-nominal EVA-related and

Joint Airlock maintenance procedures.

### 2 ISS JNT AL HDW 31105 (Concluded)

Objectives:

- Explain Airlock hardware interfaces and the status of various indicators under nominal operational conditions.
- Identify and respond to In-flight Refill Unit (IRU) malfunctions.
- Identify and respond to Power Supply Assembly (PSA) malfunctions.
- Identify and respond to Metox Regenerator malfunctions.
- Identify and respond to Battery Charger Assembly (BCA) and Battery Stowage Assembly (BSA) malfunctions.
- Perform Umbilical Interface Assembly (UIA) water flushing connections and Service and Cooling Umbilical (SCU) swap.
- Perform UIA biocode filter changeout.
- Identify requirements for UIA replacement and remote Equipment Lock location installation.
- Perform Emergency Repress procedures with instructor assistance.
- Perform Contingency Water Container (CWC) dump.

#### 3 **JNT EVA SSCS 31170**

Title: ISS Space-to-Space Communication System (Shared – ISS)

Duration: 2.0 hours

Medium: EVA Space To Space Communication System Trainer

Student: EV1, EV2, Suit IV, Task IV

Source: DX35 Date: 06/08

Lesson(s) Replaced: ISS SSCS C 31170

Equipment Required: None

Prerequisite Lesson(s): EVA SSCS 21002

Preparation: None

Synopsis:

This lesson consists of a 60-minute briefing to discuss the operation of nominal and back-up EVA communication configurations for Shuttle, ISS, and docked operations. The second half of the class is spent reviewing nominal and off-nominal procedures and troubleshooting communication malfunctions.

- Identify the Space-to-Space EMU Radio (SSER) controls and the Communications Carrier Assembly (CCA).
- Identify and operate the Display and Control Module (DCM) controls associated with the SSER.
- Explain the nominal communications configuration rationale.
- Know the flight rules associated with the SSER.
- Perform nominal and off-nominal ISS communication procedures and understand the rationale behind these procedures.
- Identify symptoms of various communication failures.

### 4 <u>ISS ECWS PRF 41014</u>

Title: ISS EVA Caution and Warning System Proficiency (Shared – ISS)

Duration: 2.0 hours Medium: EMU Mal Sim

Student: EV1, EV2, Suit IV, Task IV (Schedule individually.)

Source: DX35 Date: 06/08

Lesson(s) Replaced: ISS ECWS PRF C 41014

Equipment Required: None

Prerequisite Lesson(s): ISS ECWS MALS 21014

Preparation: None

Synopsis: This is the first lesson in a series of three reviews of the EMU Caution and

Warning System (CWS) operational procedures and the ISS airlock procedures. The student will be asked to respond to various EMU

malfunctions put in by the instructor.

Objectives: • Describe the architecture and operations of the EMU Life Support

System (LSS).

• Explain the rationale for malfunction procedures for the EMU.

• Perform, unaided, the nominal procedures.

Respond to EMU CWS alarms with instructor assistance.

### 5 **ISS EVA P/P 31105**

Title: ISS EVA Prep and Post (Shared – ISS)

Duration: 9.0 hours

Medium: Space Station Mock-Up And Training Facility

Student: EV1, EV2, Suit IV, Task IV

**Note:** See Table 8-2 for specific IV hours.

Source: DX35 Date: 06/08

Lesson(s) Replaced: ISS EVA P/P C 31105

Equipment Required: Exercise bike (not Cycle Ergometer with Vibration Isolation

System (CEVIS))

Prerequisite Lesson(s): ISS ECWS PRF 41014

Preparation: None

### 5 ISS EVA P/P 31105 (Concluded)

Synopsis:

This lesson provides a suited exercise of flight EVA preparation and post EVA procedures in the ISS Joint Airlock (A/L). Students perform all timeline steps required for Airlock Prep, EMU resize, EMU Checkout, EVA Prep, suit donning, A/L Depress/Repress, Post-EVA, EMU maintenance, A/L maintenance, and EMU stowage procedures. IV/EV interaction is emphasized. In subsequent classes, tool stowage and configuration is covered. During this class, the instructor may aid the crew to complete the objectives. During the final prep and post lesson, the crewmembers will perform all procedures with no instructor assistance. (The student is required to have an EMU suit fit check with all hardware fitting properly prior to this exercise.)

Core objectives listed; may vary in repeated sessions.

Objectives:

Note:

- Perform aided EMU checkout, A/L prep, EVA prep, and suit donning.
- Perform aided Depress/Repress (simulated).
- Perform unaided reach evaluations (all Display and Control Module (DCM) controls, visors, tethers, Cuff Checklist) at simulated EVA conditions.
- Perform aided battery recharge (helmet light, power tool, EMU).
- Perform aided EMU doffing procedures.

### 6 **SAFER RES OPS 92016**

(Shared – Shuttle)

Refer to SAFER RES OPS 91016 for description. *Task IV attends SAFER RES OPS 92016 in lieu of Suit IV.* 

### 7 **ECWS PRF 41014**

Title: Extravehicular Mobility Unit Caution and Warning System Proficiency

(Shared – ISS)

Duration: 2.0 hours Medium: EMU Mal Sim

Student: EV1, EV2, *Suit* IV (Schedule individually.)

Source: DX35 Date: 06/08

Lesson(s) Replaced: ECWS PRF ADV 41014

Equipment Required: None

Prerequisite Lesson(s): ECWS MALS 21014

Preparation: None

# 7 ECWS PRF 41014 (Concluded)

Synopsis: This lesson provides an exercise of nominal and malfunction procedures

on the EMU malfunction simulator.

Objectives: • Know nominal and malfunction procedures for the EMU and airlock.

Perform nominal EVA prep/post procedures and malfunctions.

### 8 **EVA P/P 31020**

Title: Extravehicular Activity Prep and Post

Duration: 6.0 hours

Medium: CCT, FFT, or CCT II Student: EV1, EV2, *Suit* IV

Source: DX35 Date: 06/08

Lesson(s) Replaced: None

Equipment Required: EMUs (sized), various EVA tools and equipment

Prerequisite Lesson(s): ECWS PRF 41014

Preparation: None

Synopsis: This lesson provides a suited exercise of flight EVA preparation and post

procedures in the shuttle airlock.

Objectives: • Know end-to-end flight EVA preparation and post procedures for EVA.

• Coordinate EVA preparation/post tasks with the EV crewmember and

IV support.

Practice EMU don/doff in the airlock.

• Execute EVA Checklist (C/L) (generic and flight-specific).

### 9 **ISS EVA P/P 32105**

Title: ISS EVA Prep and Post (Shared – ISS)

Duration: 9.0 hours

Medium: Space Station Mock-Up And Training Facility

Student: EV1, EV2, Suit IV, Task IV

**Note:** See Table 8-2 for specific IV hours.

Source: DX35 Date: 06/08

Lesson(s) Replaced: ISS EVA P/P C 32105

Equipment Required: Cycle Ergometer with Vibration Isolation System (CEVIS)

Prerequisite Lesson(s): ISS EVA P/P 31105

Preparation: None

**Note:** PREBREATHE 31001 is a mandatory requirement for

ISS EVA P/P 32105 if not completed for ISS EVA P/P 31105.

# 9 ISS EVA P/P 32105 (Concluded)

Synopsis:

This lesson is a repeat of ISS EVA P/P 31105. The student will perform a suited exercise of flight EVA preparation and post-EVA procedures in the ISS joint airlock. Students perform all timeline steps required for Airlock (A/L) Prep, EMU resize, EMU Checkout, EVA Prep, suit donning, A/L Depress/Repress, post-EVA, EMU maintenance, A/L maintenance, and EMU stowage procedures. IV/EV interaction is emphasized. During this class, the instructor may aid the crew to complete the objectives. During the final prep and post lesson, the crewmembers will perform all procedures with no instructor assistance.

**Note:** Core objectives listed; may vary in repeated sessions.

Objectives:

- Perform aided EMU Checkout, A/L Prep, EVA Prep, and suit donning.
- Perform aided depress/repress (simulated).
- Perform unaided reach evaluations (all Display and Control Module (DCM) controls, visors, tethers, Cuff Checklist) at simulated EVA conditions.
- Perform aided battery recharge (helmet light, power tool, EMU).
- Perform aided EMU doffing procedures.
- Perform aided EMU maintenance/recharge procedures.
- Conduct joint airlock power down.
- Perform aided EMU resize.
- Conduct tool configuration.

### 10 **EVA TPS SAFER 91016**

Title: EVA Thermal Protection System Simplified Aid for EVA Rescue

Duration: 2.0 hours

Medium: Virtual Reality Trainer Student: EV1, EV2, *Task* IV

Source: DX35 Date: 06/08

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): SAFER RES OPS 91016

Preparation: None

**Note:** Each EV member assigned for Thermal Protection System (TPS)

contingency will perform this lesson twice; once as one performs fly practice and the other performs Ground Control Assist (GCA), and then reverse roles in the second class. Task IV should attend the first

lesson only for tabletop discussion portion of the lesson.

### 10 **EVA TPS SAFER 91016 (Concluded)**

Synopsis: This lesson includes a tabletop discussion of SAFER TPS inspection

scenarios, configuration, and hardware modifications. Inspection simulations are then performed using the virtual reality simulator.

Objectives: • Discuss scenarios that would necessitate a SAFER inspection.

SAFER inspection hardware overview.Review SAFER inspection procedure.

• Fly SAFER inspection cases in Virtual Reality environment.

### 11 **BTA OPS 31001**

Title: Bends Treatment Adapter Operations (Shared – ISS)

Duration: 1.25 hours Medium: Classroom

Student: EV1, EV2, Suit IV

Source: DX35 Date: 06/08

Lesson(s) Replaced: BTA OPS/EMU RESIZE 31001

Equipment Required: None

Prerequisite Lesson(s): ISS EVA P/P 31105, EVA P/P 31020

Preparation: None

Synopsis: This lesson provides the crewmember with a basic understanding of

Bends Treatment Adapter (BTA) operations and the associated procedures. These procedures would be used to treat an EV

crewmember suffering from decompression sickness. The crewmember will have the opportunity to see the Secondary Oxygen Package (SOP) and Primary Life Support System (PLSS) with the Thermal Model

Generator (TMG) removed and performs BTA procedures.

Objectives: • Learn the procedures for use of the BTA.

Perform BTA operations.

Recognize the SOP, PLSS, and other EMU hardware.

 Perform Contaminant Control Cartridge (CCC) and battery component changeouts.

### 12 **EMU RESIZE 31209**

Title: Extravehicular Mobility Unit Resize (Shared – ISS)

Duration: 1.0 hour Medium: Bldg 9 Floor

**Note:** This lesson is held at building 9N floor.

Student: EV1, EV2, Suit IV

Source: DX35 Date: 06/08

Lesson(s) Replaced: BTA OPS/EMU RESIZE 31001

Equipment Required: None

Prerequisite Lesson(s): ISS EVA P/P 31105, EVA P/P 31020

Preparation: None

Synopsis: This lesson provides crewmembers with the opportunity to perform

EMU resizing procedures.

Objectives: • Perform Space Suit Assembly (SSA) components changeouts.

· Perform suit hardware interchange.

• Discuss suit assembly and possible sizing workarounds.

 Identify the procedures necessary for arm and leg resizing and component changeout.

Perform unaided arm and leg resizing using sizing rings and cams.

• Perform unaided any necessary component changeouts.

#### 13 **CLS I GLOVE FITCK 61001**

Title: Class I Glove Fit Check (Shared – ISS)

Duration: 2.0 hours Medium: Classroom

Student: EV1, EV2 (Schedule individually.)

Source: DX35 (USA/FCE)

Date: 03/02

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

Synopsis: This event will provide Flight Crew Equipment (FCE) a fit check

verification of the student's Class I (flight) EMU gloves. The class I gloves (no other suits, or hardware required) are provided at the FCE facility with student and engineer using the FCE Glove Box for verification of proper fit. This fit check is designed to ensure good fit of the Class I gloves prior to the student's vacuum chamber run. Mission Operations Directorate

(MOD) personnel should attend this activity if possible.

Objectives: None

### 14 <u>CLS I BOOT EVAL 61001</u>

Title: Class I Boot Evaluation (Shared – ISS)

Duration: 2.0 hours Medium: Classroom

Student: EV1, EV2 (Schedule individually.)

Source: DX35 (USA/FCE)

Date: 03/05

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

Synopsis: The Class I boot evaluation is conducted at the Flight Crew Equipment

(FCE) facility. The boot fit evaluation, conducted by the suit engineer, has been designed to ensure comfortable boot fit using the sock and boot

configuration preferred by the crewmember. Adjustments to the

configuration will be made as required to be assured that the fit is usable. In addition, the suit technicians will demonstrate methods to adjust the boot bladder to improve fit. Mission Operations Directorate (MOD)

personnel may or may not attend either activity.

Objectives: None

### 15 **CLS I BT/GLV FITCK 61001**

Title: Class I Boot/Glove Fitcheck (Shared – ISS)

Duration: 4.0 hours Medium: Classroom

Student: EV1, EV2 (Schedule individually.)

Source: DX35 (USA/FCE)

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

Synopsis: The Class I (flight) boot and glove fit check is conducted at the Flight Crew

Equipment (FCE) facility. The boot fit evaluation, conducted by the suit engineer, has been designed to ensure comfortable boot fit using the sock and boot configuration preferred by the crewmember. Adjustments to the configuration will be made as required to be assured that the fit is usable. In addition, the suit technicians will demonstrate methods to adjust the boot bladder to improve fit. The Class I glove fit check will provide FCE a fit check verification of the student's Class I (flight) EMU gloves. The Class I gloves are provided with student and engineer using the FCE

### 15 CLS I BT/GLV FITCK 61001 (Concluded)

Glove Box for verification of proper fit. This fit check is designed to ensure good fit of the Class I gloves prior to the student's vacuum chamber run. Mission Operations Directorate (MOD) personnel should attend this activity if possible.

Objectives: None

#### 16 **SSATA PREP 31014**

Title: Space Station Airlock Test Article Preparation (Shared – ISS)

Duration: 2.0 hours
Medium: EMU Mal Sim

Student: EV1, EV2, Suit IV (Schedule individually.)

Source: DX35 Date: 06/08

Lesson(s) Replaced: SSATA PREP C 31014

Equipment Required: None

Prerequisite Lesson(s): ISS EVA P/P 31105

Preparation: None

Synopsis:

This lesson provides an exercise of both nominal and malfunction procedures in the EMU malfunction simulator to prepare an EV crewmember to do a chamber run. The crewmember will step through chamber procedures prior to performing the Space Station Airlock Test Article (SSATA) walk-through and chamber run (ISS EMU/AL WT 31154, ISS EMU/AL 31154). In this class, the crewmember will have the opportunity to ask any generic or flight-specific EMU questions prior to launch.

- Know EVA Vacuum Chamber-specific objectives.
- Review and perform EMU Checkout, EVA Prep, Depress/Repress, and Post EVA procedures for the ISS Joint Airlock.
- Review and perform malfunction procedures at vacuum using the Cuff Checklist.
- Review flight-specific EMU configuration/operation.

#### 17 FFV 61001

Title: Flight Fit Verification (Shared – ISS)

Duration: 2.0 hours Medium: Classroom

Student: EV1, EV2 (Schedule individually.)

DX35 (USA/FCE) Source:

Date: 03/02

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

This verification uses a Class III Hard Upper Torso (HUT) with Class I Synopsis:

> gloves, and associated hardware to ensure proper fit. This activity is necessary if a Class I glove reach evaluation (for either prime or backup Class I gloves) cannot be performed or are not available during the crewperson's vacuum chamber run. Mission Operations Directorate

(MOD) personnel may or may not attend this activity.

Objectives: None

#### 18 ISS SSATA WT 31154

Title: ISS Space Station Airlock Test Article Chamber Walk-Through

(Shared – ISS)

6.0 hours Duration:

Space Station Airlock Test Article Medium:

EV1, EV2, Suit IV (Schedule individually or in pairs with IV.) Student:

Source: DX35 Date: 06/08

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): SSATA PREP 31014

Preparation: None

Synopsis: This lesson is comprised of a briefing on ISS SSATA 31154, a walk-

> through of the facility systems, and a pressurized suit donning exercise in the Space Station Airlock Test Article (SSATA) vacuum chamber. IV attends the second hour through the end of the lesson to exercise flightspecific EVA procedures with the EV crewmembers. This is the first part of a two-day event for crewmembers that have never performed an

SSATA chamber run.

### 18 **ISS SSATA WT 31154 (Concluded)**

Objectives: • Be familiar with facility procedures used in the SSATA.

· Perform suit fit and proper EMU function.

- Perform ISS Joint Airlock and EMU operations using flight hardware.
- Perform suit donning and pressurization in the chamber.
- · Be familiar with prebreathe mask objectives.

### 19 **ISS SSATA 1DAY 31154**

Title: ISS Space Station Airlock Test Article One-Day Chamber Run

(Shared – ISS)

Duration: 10.5 hours

Medium: Space Station Airlock Test Article

Student: EV1, EV2, Suit IV (Schedule individually.)

**Note:** See Table 8-2 for specific IV hours.

Source: DX35 Date: 06/08

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): SSATA PREP 31014

Preparation: None

Synopsis:

As in the two-day event, this lesson provides the objectives of both ISS SSATA WT 31154 and ISS SSATA 31154 in a one-day event. This lesson provides an exercise of the ISS joint airlock and EMU flight integrated procedures at simulated flight environment pressures in a flight-configured airlock. Students perform EMU Checkout, EVA Prep, and Airlock Depress. Students then respond to simulated malfunction procedures at vacuum using the Cuff Checklist. The student then represses and finishes with post-EVA procedures, including battery recharge and Metox regeneration. This class is an option for experienced EVA crewmembers that have completed other chamber runs prior.

- Configure Airlock.
- Conduct EMU checkout, airlock prep, and prebreathe demonstration.
- Perform aided donning and pressurization of Class I EMU in the chamber.
- Perform unaided depress/repress.
- Perform reach tests to ensure adequate suit mobility to reach all EMU and airlock controls.
- Perform aided procedures as called for using the Cuff Checklist.
- Respond to the fit, feel and sound of the EMU at vacuum.
- Evaluate flight-specific hardware.

### 20 **ISS SSATA 31154**

Title: ISS Space Station Airlock Test Article Chamber Run (Shared – ISS)

Duration: 8.25 hours

Medium: Space Station Airlock Test Article

Student: EV1, EV2, Suit IV (Schedule individually.)

**Note:** See Table 8-2 for specific IV hours.

Source: DX35 Date: 06/08

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ISS EMU/AL WT C 31154

Preparation: None

Synopsis: This lesson provides an exercise of the ISS joint airlock and EMU flight

integrated procedures at simulated flight environment pressures in a flight-configured airlock. Students perform EMU Checkout, EVA Prep, and Airlock (A/L) Depress. Students then respond to simulated malfunction procedures at vacuum using the Cuff Checklist. The student then represses and finishes with post-EVA procedures, including battery

recharge and Metox regeneration.

Objectives: • Configure airlock.

- Conduct EMU checkout, A/L prep, and prebreathe demonstration.
- Perform aided donning and doffing of Class I EMU.
- Perform unaided depress/repress.
- Perform reach tests to ensure adequate suit mobility to reach all EMU and airlock controls.
- Perform aided procedures as called for using the Cuff Checklist.
- Respond to the fit, feel and sound of the EMU at vacuum.
- Evaluate flight-specific hardware.

### 21 **ISS EVA P/P 33105**

Title: ISS EVA Prep and Post (Shared – ISS)

Duration: 9.0 hours

Medium: Space Station Mock-Up and Training Facility

Student: EV1, EV2, Suit IV, Task IV

**Note:** See Table 8-2 for specific IV hours.

Source: DX35 Date: 06/08

Lesson(s) Replaced: None

Equipment Required: Cycle Ergometer with Vibration Isolation System (CEVIS)

Prerequisite Lesson(s): ISS EVA P/P 32105; ISS ECWS PRF 41014

Preparation: None

# 21 <u>ISS EVA P/P 33105 (Concluded)</u>

Synopsis:

This lesson provides a suited exercise of flight EVA preparation and post EVA procedures in the ISS Joint Airlock (A/L). Students perform all timeline steps required for Airlock Prep, EMU resize, EMU Checkout, EVA Prep, suit donning, A/L Depress/Repress, Post-EVA, EMU maintenance, A/L maintenance, and EMU stowage procedures. IV/EV interaction is emphasized. In subsequent classes, tool stowage and configuration is covered. During this class, the instructor may aid the crew to complete the objectives. During the final prep and post lesson, the crewmembers will perform all procedures with no instructor assistance. (The student is required to have an EMU suit fit check with all hardware fitting properly prior to this exercise.)

**Note:** Core objectives listed; may vary in repeated sessions.

Objectives:

- Perform unaided EMU checkout, A/L prep, EVA Prep, and suit donning.
- Perform unaided Depress/Repress (simulated).
- Perform unaided reach evaluations (all Display and Control Module (DCM) controls, visors, tethers, Cuff Checklist) at simulated EVA conditions.
- Perform unaided donning and doffing of Simplified Aid for EVA Rescue (SAFER).
- Perform aided battery recharge (helmet light, power tool, EMU).
- Perform unaided EMU doffing procedures.
- Perform unaided EMU maintenance/recharge procedures.
- Conduct joint airlock power down.
- Perform unaided EMU resize (when applicable).
- Conduct tool configuration.

#### 22 **EVA TPS SAFER RES 91705**

Title: EVA Thermal Protection System Simplified Aid for EVA Rescue

Duration: 2.0 hours

Medium: Virtual Reality Trainer and Precision Air Bearing Floor

Student: EV1, EV2 Source: DX35 Date: 04/06

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): EVA TPS SAFER 91016

Preparation: None

### 22 EVA TPS SAFER RES 91705 (Concluded)

Synopsis:

This class is the final review of the SAFER flying techniques involved in performing both a self rescue and a tile inspection. It also serves as the final review of the contingency safety tether used during a SAFER tile inspection.

Objectives:

- Perform unaided SAFER rescue cert run at 1.0 ft/s.
- Perform SAFER inspection case.
- Perform contingency safety tether rescue on the Precision Air Bearing Floor (PABF).
- As time allows, additional SAFER rescue and/or tile inspection runs may be performed.

# 23 **STS SSCS 31170**

Title: STS Space-to-Space Communications System

Duration: 2.0 hours

Medium: EVA Space To Space Communication System Trainer

Student: EV1, EV2, Suit IV

Source: DX35 Date: 06/08

Lesson(s) Replaced: EVA COMM 31001 Equipment Required: EVA Comm Caps Prerequisite Lesson(s): EVA SSCS 21002

Preparation: None

Synopsis:

This lesson consists of a 30-minute briefing to discuss the operation of the nominal and back-up EVA communication configurations for Shuttle. The second half of the class is spent reviewing nominal and off-nominal procedures and troubleshooting communication malfunctions.

Objectives:

- Identify the Space-to-Space EMU Radio (SSER) controls and the Communications Carrier Assembly (CCA).
- Identify and operate the Display and Control Module (DCM) controls associated with the SSER.
- Explain the nominal communications configuration rationale.
- Know the flight rules associated with the SSER.
- Perform nominal and off-nominal Shuttle procedures and understand the rationale behind these procedures.
- Identify symptoms of various communication failures.
- Respond to malfunctions of the STS Space-to-Space Communication System (SSCS).

#### 24 **EVA P/P 32020**

Title: Extravehicular Activity Prep and Post

Duration: 6.0 hours

Medium: CCT, FFT, or CCT II Student: EV1, EV2, *Suit* IV

Source: DX35 Date: 06/08

Lesson(s) Replaced: None

Equipment Required: EMUs (sized), various EVA tools and equipment

Prerequisite Lesson(s): EVA P/P 31020

Preparation: None

Synopsis: This lesson provides a suited exercise of flight EVA preparation and post

procedures.

Objectives: • Know the EMU water recharge procedure, the battery changeout procedure, and the LiOH canister changeout procedure.

Perform equipment preparation for EVA utilizing flight-similar stowage.

• Perform post-EVA entry preparation using EV and IV crewmembers.

Perform EMU maintenance and recharge procedures.

• Know end-to-end flight EVA preparation and post procedures for EVA.

 Coordinate EVA preparation/post tasks with the EV crewmember and IV support.

Practice EMU donn/doff in the airlock.

Execute EVA Checklist (generic and flight-specific).

• Perform prebreathe mask procedures.

#### 25 **ECWS ETA/REV 31014**

Title: Extravehicular Mobility Unit Caution and Warning System for

Environmental Test Article and Preflight Review

Duration: 2.0 hours
Medium: EMU Mal Sim

Student: EV1, EV2, *Suit* IV (Schedule individually.)

Source: DX35 Date: 06/08

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): EVA P/P 32020

Preparation: None

**Note:** This lesson should be scheduled one day to one week prior to

EMU/AL WT 31054.

# 25 ECWS ETA/REV 31014 (Concluded)

Synopsis: This lesson provides an exercise of nominal and malfunction procedures

in the EMU Caution and Warning System (CWS) simulator. The crewmember will step through the chamber procedures prior to the Environmental Test Article (ETA) walk-through and chamber run (EMU/AL WT 31054, EMU/AL 31054), and have the opportunity to ask

any generic or flight-specific EMU questions prior to launch.

Objectives: • Know EVA Vacuum Chamber-specific objectives and procedures.

• Review flight-specific EMU configuration/operation.

• Review crew/flight controller coordination protocol for EVA operations.

Review MCC EMU telemetry capability.

#### 26 **EMU/AL WT 31054**

Title: Extravehicular Mobility Unit Airlock/Altitude Chamber Walk-Through

Duration: 4.5 hours Medium: ETA

Student: EV1, EV2, Suit IV (Schedule individually or in pairs with IV.)

Source: DX35 Date: 06/08

Lesson(s) Replaced: None

Equipment Required: Flight EMU (Class I) and ancillary equipment

Prerequisite Lesson(s): ECWS ETA/REV 31014

Preparation: None

**Note:** Extensive advance planning is necessary for this lesson. ECWS

ETA/REV 31014 is to be taken one day to one week prior to the

chamber walk-through.

Synopsis: This lesson consists of a briefing of EMU/AL 31054, a walk-through of the

facility systems, and suit donning and pressurization in the Environmental

Test Article (ETA) Vacuum Chamber.

Objectives: • Be familiar with the procedures to be used in the ETA chamber.

Perform suit fit and EMU system verification.

• Perform airlock/EMU operations using flight hardware.

• Perform suit donning and pressurization of Class I EMU in the airlock.

• Cover prebreathe mask objectives if an overnight prebreathe is not scheduled.

#### 27 **EMU/AL 31054**

Title: Extravehicular Mobility Unit Airlock Altitude Chamber Run

Duration: 8.0 hours Medium: ETA

Student: EV1, EV2 (Schedule individually.)

Source: DX35 Date: 03/02

Lesson(s) Replaced: None

Equipment Required: Flight EMU (Class I) and ancillary equipment

Prerequisite Lesson(s): EMU/AL WT 31054

Preparation: None

**Note:** Extensive advance planning is necessary for this lesson.

Synopsis: This lesson provides an exercise of orbiter/airlock and EMU flight-

integrated procedures at simulated flight environment pressures in a flight

configured airlock.

Objectives: • Perform 4 hour in-suit prebreathe protocol.

• Be familiar with flight crew specific EMU.

Perform nominal malfunctions of EMU.

• Perform EMU hardware verification prior to flight.

Perform airlock-to-EMU life support transfers, airlock depress/repress,

and EMU servicing.

#### 28 **EMU/AL 1DAY 31054**

Title: Extravehicular Mobility Unit/Airlock One Day Chamber Run

Duration: 10.0 hours

Medium: ETA

Student: EV1, EV2 (Schedule individually.)

Source: DX35 Date: 03/02

Lesson(s) Replaced: None

Equipment Required: Flight EMU (Class I) and ancillary equipment

Prerequisite Lesson(s): ECWS ETA/REV 31014; previous vacuum chamber run

(ETA, SSATA)

Preparation: None

Synopsis: This lesson provides a one-day exercise of orbiter/airlock and EMU flight

integrated procedures at simulated flight environment pressures in a flight

configured airlock. This class is optional for experienced EVA crewmembers that have completed other chamber runs prior.

# 28 EMU/AL 1DAY 31054 (Concluded)

Objectives: • Perform 4 hr in-suit prebreathe protocol.

- Be familiar with flight crew specific EMU.
- Perform nominal malfunctions of EMU.
- Perform EMU hardware verification prior to flight.
- Perform airlock-to-EMU life support transfers, airlock depress/repress, and EMU servicing.

#### 29 **EVA P/P 33020**

Title: Extravehicular Activity Prep and Post

Duration: 6.0 hours

Medium: CCT, FFT, or CCT II Student: EV1, EV2, *Suit* IV

Source: DX35 Date: 06/08

Lesson(s) Replaced: None

Equipment Required: EMUs (sized), various EVA tools and equipment

Prerequisite Lesson(s): EVA P/P 32020

Preparation: None

Synopsis: This lesson provides a suited exercise of flight EVA preparation and post

procedures. Crewmembers have opportunity for questions and review

prior to launch.

Objectives: • Know the EMU water recharge procedure, the battery changeout procedure, and the LiOH canister changeout procedure.

- Perform equipment preparation for EVA utilizing flight-similar stowage.
- Perform post-EVA entry preparation using EV and IV crewmembers.
- Know end-to-end flight EVA preparation and post procedures for EVA.
- Coordinate EVA preparation/post tasks with the EV crewmember and IV support.
- Practice EMU donn/doff in the airlock.
- Execute EVA Checklist (generic and flight-specific).

# 40000-Level Lessons (Proficiency, Refresher)

#### **EVA DECON 31001**

Title: Extravehicular Activity Decontamination (Shared – ISS)

Duration: 1.5 hours Medium: Classroom

Student: EV1, EV2, Suit IV

Source: DX35 Date: 06/08

Lesson(s) Replaced: None

Equipment Required: EVA Tools, VCR, TV, PC, projector

Prerequisite Lesson(s): ISS ECWS MALS 21014

Preparation: None

Synopsis: This lesson includes a classroom presentation covering sources of

EVA contamination, hazards, and contingency responses. EVA hardware

used for chemical detection will be introduced, and the long form

malfunction will be summarized.

Objectives: • Understand types and sources of contamination on ISS and Space

Transportation System (STS).

 Understand hazards and risks of introducing contamination to the IV environment.

- Introduce EVA hardware used to remove and test for contamination.
- Perform overview of long form malfunction procedure.

#### **SAFER PRF 41016**

Title: Simplified Aid for Extravehicular Activity Rescue Proficiency

(Shared - ISS)

Duration: 2.0 hours

Medium: Virtual Reality Trainer

Student: EV1, EV2 (Schedule individually.)

Source: DX35 Date: 03/02

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): SAFER INTRO 21016

Preparation: None

Synopsis: This lesson provides a review of the SAFER components and procedures.

The crewmember will have the opportunity to practice basic SAFER

piloting techniques.

# SAFER PRF 41016 (Concluded)

Objectives: • Know SAFER systems and controls.

Perform unaided basic piloting procedures.Perform unaided simple rescue scenarios.

#### **ISS ECWS PRF 41014**

Title: ISS EVA Caution and Warning System Proficiency (Shared – ISS)

Duration: 2.0 hours
Medium: EMU Mal Sim

Student: EV1, EV2, Suit IV, Task IV (Schedule individually.)

Source: DX35 Date: 06/08

Lesson(s) Replaced: ISS ECWS PRF C 41014

Equipment Required: None

Prerequisite Lesson(s): ISS ECWS MALS 21014

Preparation: None

Synopsis: This is three reviews of the EMU Caution and Warning System (CWS)

operational procedures and the ISS airlock procedures. The student will be asked to respond to various EMU malfunctions put in by the instructor.

Objectives:

- Describe the architecture and operations of the EMU Life Support System (LSS).
- Explain the rationale for malfunction procedures for the EMU.
- Perform, unaided, the nominal procedures.
- Respond to EMU CWS alarms with instructor assistance.

#### <u>ISS EVA P/P 41105</u>

(Shared – ISS)

Refer to ISS EVA P/P 32105 for description.

# **ECWS PRF 41014**

Title: Extravehicular Mobility Unit Caution and Warning System Proficiency

(Shared – ISS)

Duration: 2.0 hours Medium: EMU Mal Sim

Student: EV1, EV2, *Suit* IV (Schedule individually.)

Source: DX35 Date: 06/08

Lesson(s) Replaced: ECWS PRF ADV 41014

Equipment Required: None

Prerequisite Lesson(s): ECWS MALS 21014

Preparation: None

Synopsis: This lesson provides an exercise of nominal and malfunction procedures

on the EMU malfunction simulator.

Objectives: • Know nominal and malfunction procedures for the EMU and airlock.

Perform nominal EVA prep/post procedures and malfunctions.

#### **EVA P/P 41020**

Refer to EVA P/P 33020 for description.

#### **CLS I GLV FIT PRF 61001**

Title: Class I Glove Fit Check Proficiency (Shared – ISS)

Duration: 2.0 hours Medium: Classroom

Student: EV1, EV2 (Schedule individually.)

Source: DX35 (USA/FCE)

Date: 02/07

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): CLS I GLOVE FITCK 61001

Preparation: None

Synopsis: This lesson provides the student and Flight Crew Equipment (FCE) a

proficiency fit check verification of the student's CLS I gloves.

Preparation: None

# **CLS I BOOT FIT PRF 61001**

Title: Class I Boot Fit Check Proficiency (Shared – ISS)

Duration: 2.0 hours Medium: Classroom

Student: EV1, EV2 (Schedule individually.)

Source: DX35 (USA/FCE)

Date: 02/07

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): CLS I BOOT EVAL 61001

Preparation: None

Synopsis: This lesson provides the student and Flight Crew Equipment (FCE) a

proficiency fit check verification of the student's CLS I boots.

Objectives: None

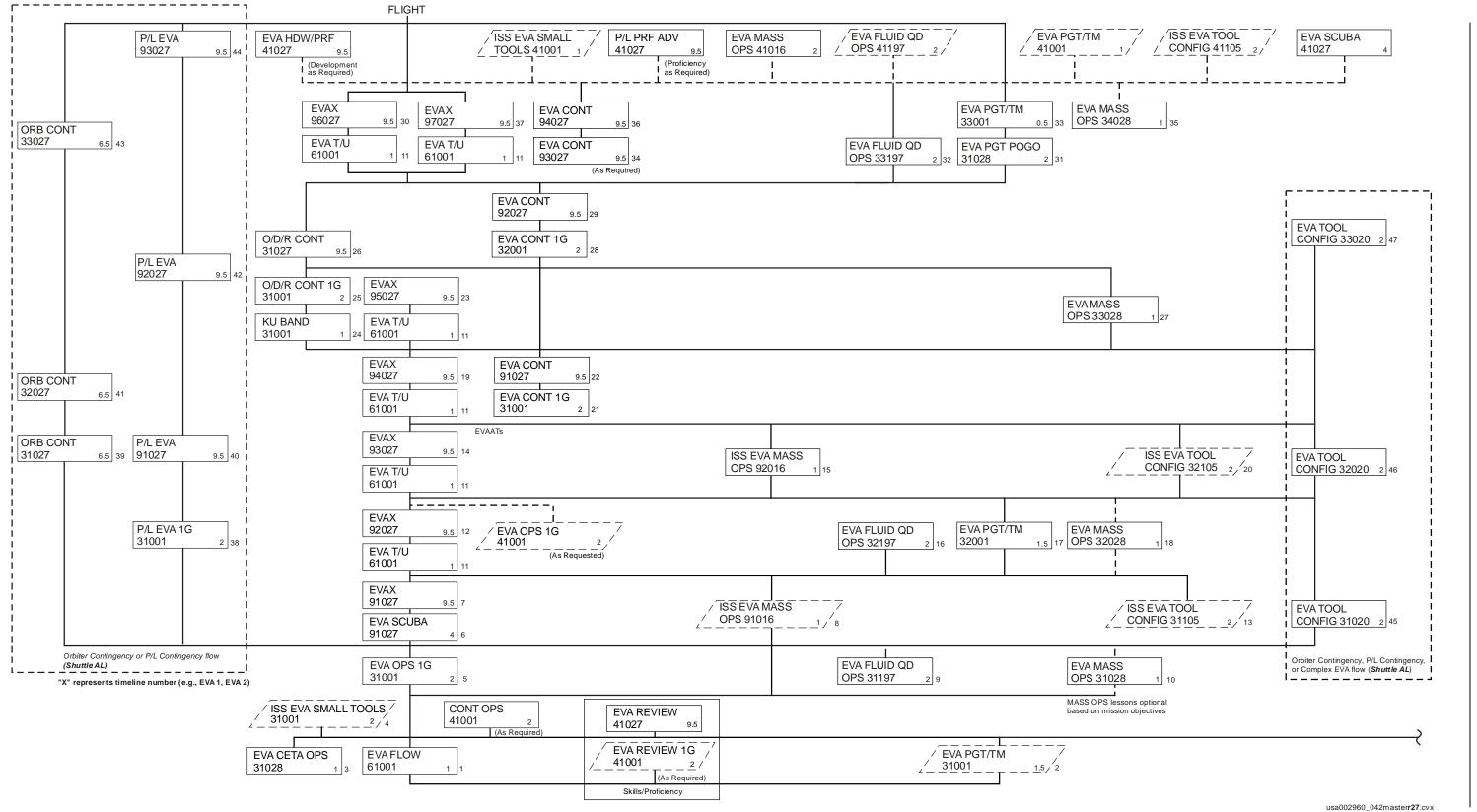


Figure 8–4. EVA Task Operations
Training Flow

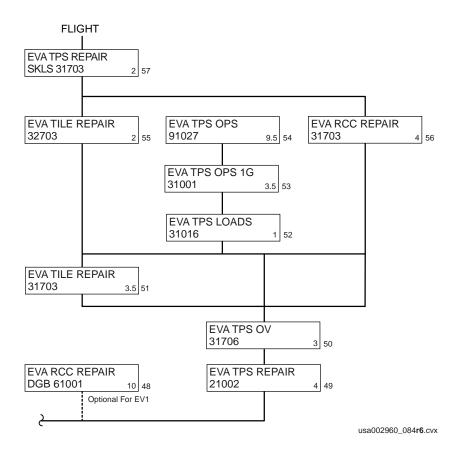


Figure 8-4. EVA Task Operations Training Flow (Concluded)

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# Table 8-3. EVA Task Operations Training Requirements

Date Last Modified: 06/08

								Non-	-Crew R	otation				Crew Ro	tation			
01	D. ( N	Lancer Onda	Maratia.		Sched	(Suit IV)	M4 B	(Task IV)	EV	EV	MOA	<b>DO</b>	M1	n, 5	EV	EV	Alt 5	
Stage	Ref Num		Media	Hrs	Code	С	M1 P	MS1	MS2	MS3	MS4	PS	С	IV P	MS1	MS2	Alt Fac	Comments
4		EVA FLOW 61001	CLR	11	8	1	1	1	1	1			1	1	1	1		
4		EVA PGT/TM 31001	CLR	1.5	1-3			1.5	1.5	1.5				1.5	1.5	1.5		T-IV
4		EVA CETA OPS 31028	PABF	1	2-3			1	1	1				1	1	1		T-IV
4			CLR	2	1-4			2	2	2				2	2	2	At NBL	T-IV
4		EVA OPS 1G 31001 (EVA 1 910)		2	4			2	2	2				2	2	2		Poolside; <b>T-IV</b>
4		EVA SCUBA 91027	NBL	4	2-4			4	4	4				4	4	4		T-IV
4		EVA 1 91027	NBL	9.5	5	1.5		9.5	9.5	9.5			9.5	9.5	9.5	9.5		S-IV, T-IV
4		EVA OPS 1G 31001	CLR	2	1-4			2	2	2				2	2	2		EVA 2 91027
4		EVA 2 91027	NBL	9.5	5	1.5		9.5	9.5	9.5			9.5	9.5	9.5	9.5		S-IV, T-IV
4		EVA OPS 1G 31001	CLR	2	1-4			2	2	2				2	2	2		EVA 3 91027
4		EVA 3 91027	NBL	9.5	5	1.5		9.5	9.5	9.5			9.5	9.5	9.5	9.5		S-IV, T-IV
4		ISS EVA MASS OPS 91016	VR LAB	1	4			1	1	1				1	1	1		T-IV
4			CLR	1	4			1	1	1				1	1	1		EVA 1 92027
4		EVA 1 92027	NBL	9.5	5	1.5		9.5	9.5	9.5			9.5	9.5	9.5	9.5		S-IV, T-IV
4		EVA PGT POGO 31028	ABT	2	4			2	2	2				2	2	2		T-IV Optional
4		EVA 2 92027	NBL	9.5	5	1.5		9.5	9.5	9.5			9.5	9.5	9.5	9.5		S-IV, T-IV
4	11	EVA T/U 61001	CLR	1	4			1	1	1				1	1	1		EVA 2 92027
4	49	EVA TPS REPAIR 21002	WKBK	4	5	4	4	4	4	4			4	4	4	4		
4	50	EVA TPS OV 31706	TPST & PABF	3	5	3	3	3	3	3			3	3	3	3		
4	30		otal for Stage		Stage Tota	,	_	,										
4			l	75	3, 3,	15.5	8	75	75	75	0	0	55.5	75	75	75		

Note 1: For 7:1 ratio, M1 attends third (EVAX 93027), fourth (EVAX 94027) and final NBL run (EVAX 97027). M2 (if assigned) attends fifth NBL run (EVAX 95027). For 5:1 ratio, M1 attends third (EVAX 93027) and final NBL run (EVAX 95027). M2 (if assigned) attends fourth NBL run (EVAX 94027).

# Table 8-3. EVA Task Operations Training Requirements (Continued)

Date Last Modified: 06/08

								Non	-Crew R	otation				Crew Ro	tation			
						(Suit		(Task										
					Sched	IV)		IV)	EV	EV			M1		EV	EV		
Stage	Ref Num	Lesson Code	Media	Hrs	Code	С	M1 P	MS1	MS2	MS3	MS4	PS	С	IV P	MS1	MS2	Alt Fac	Comments
3	-	EVA FLUID QD OPS 31197	FQDT	2	4			2	2	2				2	2	2		T-IV
3		EVA T/U 61001	CLR	1	4			1	1	1				1	1	1		EVA 3 92027
3	12	EVA 3 92027	NBL	9.5	5	1.5		9.5	9.5	9.5			9.5	9.5	9.5	9.5		
3	13	ISS EVA TOOL CONFIG 31105	SSMTF	2	4			2	2	2				2	2	2		T-IV
3	11	EVA T/U 61001	CLR	1	4			1	1	1				1	1	1		EVA 1 93027
3	14	EVA 1 93027	NBL	9.5	5	1.5	9.5	9.5	9.5	9.5			9.5	9.5	9.5	9.5		See Note 1 & 2
3	11	EVA T/U 61001	CLR	1	4			1	1	1				1	1	1		EVA 3 93027
3	14	EVA 2 93027	NBL	9.5	5	1.5	9.5	9.5	9.5	9.5			9.5	9.5	9.5	9.5		See Note 1 & 2
3	11	EVA T/U 61001	CLR	1	4			1	1	1				1	1	1		EVA 2 93027
3	14	EVA 3 93027	NBL	9.5	5	1.5	9.5	9.5	9.5	9.5			9.5	9.5	9.5	9.5		See Note 1 & 2
3	11	EVA T/U 61001	CLR	1	4			1	1	1				1	1	1		EVA 1 94027
3	19	EVA 1 94027	NBL	9.5	5	1.5	9.5	9.5	9.5	9.5			9.5	9.5	9.5	9.5		See Note 1 & 2
3	21	EVA CONT 1G 31001	CLR	2	4			2	2	2				2	2	2		Poolside; T-IV
3	22	EVA CONT 91027	NBL	9.5	5			9.5	9.5	9.5			9.5	9.5	9.5	9.5		T-IV; S-IV optional
3	11	EVA T/U 61001	CLR	1	4			1	1	1				1	1	1		EVA 1 95027
3	23	EVA 1 95027	NBL	9.5	5	1.5		9.5	9.5	9.5			9.5	9.5	9.5	9.5		See Note 1 & 2
3	24	KU BAND 31001	CLR	1	2-4			1	1	1				1	1	1		Building 44; T-IV
3	11	EVA T/U 61001	CLR	1	4			1	1	1				1	1	1		EVA 2 94027
3	19	EVA 2 94027	NBL	9.5	5	1.5		9.5	9.5	9.5			9.5	9.5	9.5	9.5		See Note 1
3	51	EVA TILE REPAIR 31703	TPST	3.5	3			3.5	3.5	3.5				3.5	3.5	3.5		T-IV
																		Schedule with PDRS WLE:
3	52	EVA TPS LOADS 31016	VR LAB	1	3			1	1	1				1	1	1	1	T-IV
3		EVA TPS OPS 1G 31001	NBL/MU-S	3.5	3			3.5	3.5	3.5				3.5	3.5	3.5		T-IV
3		EVA T/U 61001	CLR	3.5 1	4			3.0	3.3	3.5				3.5	3.3	3.5 1		EVA 2 95027
3		EVA 1/0 61001	NBL	9.5	5	1.5	9.5	9.5	9.5	9.5			9.5	9.5	9.5	9.5		See Note 1 & 2
3		EVA TPS OPS 91027	NBL	9.5	3		0.0	9.5	9.5	9.5			3.3	9.5	9.5	9.5		T-IV; S-IV optional
			TPST		3													
3	55	EVA TILE REPAIR 32703		2	•	- D 0		2	2	2				2	2	2		T-IV
3		Sub 10	otal for Stage		Stage Tota				400.0	400.0	0.0			400.0	100.0	400.0		
3				120		12.0	47.5	120.0	120.0	120.0	0.0	0.0	85.5	120.0	120.0	120.0		

Note 1: For 7:1 ratio, M1 attends third (EVAX 93027), fourth (EVAX 94027) and final NBL run (EVAX 97027). M2 (if assigned) attends fifth NBL run (EVAX 95027). For 5:1 ratio, M1 attends third (EVAX 93027) and final NBL run (EVAX 95027). M2 (if assigned) attends fourth NBL run (EVAX 94027).

# Table 8-3. EVA Task Operations Training Requirements (Continued)

Date Last Modified: 06/08

					Non	-Crew R	otation				Crew Ro	ntation			Last Woallica. 00/00			
						(Suit		(Task	J	l				T TOWN	lation	I		
					Sched	IV)		IV)	EV	EV			M1		EV	EV		
Ctomo	Daf Norm	Lancau Carla	Madia			,	M1 P	,		MS3	MS4	PS	C	IV P			A14 F	0
	Ref Num		Media	Hrs	Code	C	IVIT P	MS1	MS2		IVI 54	P3	C		MS1	MS2	Alt Fac	Comments
2		ISS EVA MASS OPS 92016	VR LAB	1	4			1	1	1				1	1	1		T-IV
2			FQDT	2	4			2	2	2				2	2	2		T-IV
2			CLR	1.5	1-3			1.5	1.5	1.5				1.5	1.5	1.5		T-IV
2		EVA T/U 61001	CLR	11	4			1	1	1				11	1	1		EVA 3 94027
2	19	EVA 3 94027	NBL	9.5	5	1.5		9.5	9.5	9.5			9.5	9.5	9.5	9.5		See Note 1 & 2
2		ISS EVA TOOL CONFIG 32105		2	4			2	2	2				2	2	2		T-IV
2	25	O/D/R CONT 1G 31001	CLR	2	4			2	2	2				2	2	2		T-IV
2	26		NBL	9.5	4			9.5	9.5	9.5				9.5	9.5	9.5		T-IV; S-IV optional
2			CLR	2	4			2	2	2				2	2	2		T-IV
2	29	EVA CONT 92027	NBL	9.5	5			9.5	9.5	9.5			9.5	9.5	9.5	9.5		T-IV; S-IV optional
2	11	EVA T/U 61001	CLR	1	4			1	1	1				1	1	1		EVA 1 96027
2	30	EVA 1 96027	NBL	9.5	5	1.5		9.5	9.5	9.5			9.5	9.5	9.5	9.5		See Note 1 & 2
2	56	EVA RCC REPAIR 31703	TPST	4	3			4	4	4				4	4	4		T-IV
2	57	EVA TPS REPAIR SKLS 31703	TPST	2	3			2	2	2				2	2	2		L-6 weeks; T-IV
2	11	EVA T/U 61001	CLR	2	4			2	2	2				2	2	2		EVA 2 96027
2	30	EVA 2 96027	NBL	9.5	5	1.5		9.5	9.5	9.5			9.5	9.5	9.5	9.5		See Note 1 & 2
2		Sub To	otal for Stage		Stage Tota		rewmen											
2				68.0		4.5	0	68	68	68	0	0	38	68	68	68		
1	11	EVA T/U 61001	CLR	1	4			1	1	1				1	1	1		EVA 3 95027
1	23	EVA 3 95027	NBL	9.5	5	1.5	6	9.5	9.5	9.5			9.5	6	9.5	9.5		See Note 1 & 2
1	33	EVA PGT/TM 33001	CLR	0.5	1-3			0.5	0.5	0.5				0.5	0.5	0.5		T-IV
1	11	EVA T/U 61001	CLR	1	4			1	1	1				1	1	1		EVA 1 97027
1	37	EVA 1 97027	NBL	9.5	5	1.5	6	9.5	9.5	9.5			9.5	6	9.5	9.5		See Note 1 & 2
1	11	EVA T/U 61001	CLR	1	4			1	1	1				1	1	1		EVA 2 97027
1	37	EVA 2 97027	NBL	9.5	5	1.5	6	9.5	9.5	9.5			9.5	6	9.5	9.5		See Note 1 & 2
1		Sub To	otal for Stage		Stage Tota	ls Per Cı	rewmen	nber:										
1				32		4.5	18	32	32	32	0	0	28.5	21.5	32	32		

Note 1: For 7:1 ratio, M1 attends third (EVAX 93027), fourth (EVAX 94027) and final NBL run (EVAX 97027). M2 (if assigned) attends fifth NBL run (EVAX 95027). For 5:1 ratio, M1 attends third (EVAX 93027) and final NBL run (EVAX 95027). M2 (if assigned) attends fourth NBL run (EVAX 94027).

Table 8-3. EVA Task Operations Training Requirements (Concluded)

Date Last Modified: 06/08

								Non	-Crew R	otation				Crew Ro	otation				
					Sched	(Suit IV)		(Task IV)	EV	EV			M1		EV	EV			
Stage	Ref Num	Lesson Code	Media	Hrs	Code	С	M1 P	MS1	MS2	MS3	MS4	PS	С	IV P	MS1	MS2	Alt Fac	Comments	
0	7	EVAX 91027	NBL	9.5	5	1.5	9.5	9.5	9.5	9.5			9.5	9.5	9.5	9.5		Schedule RMS Operator	
0	10	EVA MASS OPS 31028	ABT	1	4			1	1	1				1	1	1		T-IV	
0		EVA T/U 61001	CLR	1	4			1	1	1				1	1	1		EVA 92027	
0		EVAX 92027	NBL	9.5	5	1.5	9.5	9.5	9.5	9.5			9.5	9.5	9.5	9.5			
0		EVAX 93027	NBL	9.5	5	1.5	9.5	9.5	9.5	9.5			9.5	9.5	9.5	9.5		See Note 1	
0		EVA MASS OPS 32028	ABT	1	4		1	1	1	1			1	1	1	1		See Note 1	
0		EVAX 94027	NBL	9.5	5	1.5	9.5	9.5	9.5	9.5			9.5	9.5	9.5	9.5		See Note 1	
0		EVAX 95027	NBL	9.5	5	1.5	9.5	9.5	9.5	9.5			9.5	9.5	9.5	9.5		See Note 1	
0	27	EVA MASS OPS 33028	ABT	1	4			1	1	1				1	1	1		T-IV	
0	30	EVAX 96027	NBL	9.5	5	1.5	9.5	9.5	9.5	9.5			9.5	9.5	9.5	9.5			
0	32	EVA FLUID QD OPS 33197	FQDT	2	4			2	2	2				2	2	2		T-IV	
0		EVA CONT 93027	NBL	9.5	5		9.5	9.5	9.5	9.5			9.5	9.5	9.5	9.5			
0			ABT	1	4		0.0	1	1	1				1	1	1		T-IV	
0		EVA CONT 94027	NBL	9.5	5		9.5	9.5	9.5	9.5			9.5	9.5	9.5	9.5			
0		EVAX 97027	NBL	9.5	5	1.5	9.5	9.5	9.5	9.5			9.5	9.5	9.5	9.5		See Note 1	
0			CLR	2	4		0.0	2	2	2			0.0	2	2	2	NBL/MU-S	T-IV	
0		ORB CONT 31027	NBL	6.5	4			6.5	6.5	6.5				6.5	6.5	6.5	INDE/INIO-O	T-IV; S-IV optional	
0		P/L EVA 91027	NBL	9.5	4			9.5	9.5	9.5				9.5	9.5	9.5		T-IV; S-IV optional	
0		ORB CONT 32027	NBL	6.5	4			6.5	6.5	6.5				6.5	6.5	6.5		T-IV; S-IV optional	
0		P/L EVA 92027	NBL	9.5	4			9.5	9.5	9.5				9.5	9.5	9.5		T-IV; S-IV optional	
0		ORB CONT 33027	NBL	6.5	4			6.5	6.5	6.5				6.5	6.5	6.5		T-IV; S-IV optional	
0		P/L EVA 93027	NBL	9.5	4			9.5	9.5	9.5				9.5	9.5	9.5		T-IV; S-IV optional	
0		EVA TOOL CONFIG 31020	CCT	2	4			2	2	9.5				2	2	2		T-IV	
			CCT	2	4			2		2				2	2	2		T-IV	
0		EVA TOOL CONFIG 32020 EVA TOOL CONFIG 33020	CCT	2	4			2	2					2	2		CCT II or FFT		
0	47	EVA TOOL CONFIG 33020	CCT		4			2	2	2				2	2	2	CCTHOFFE	1-IV	
	40	5)// DOO DEDAID DOD 04004	DI DO -	40					4.0									0 // 14 5/4	
0			BLDG 7	10	1				10								A. NE	Optional for EV1	
0		CONT OPS 41001	CLR	2	1-4			2	2	2				2	2	2	At NBL	As required; T-IV	
0			CLR	2	1-4			2	2	2				2	2	2		T-IV	
0			CLR	2	2				2	2					2	2	NBL/MU-S		
0		EVA REVIEW 41027	NBL	9.5	2				9.5	9.5					9.5	9.5			
0		EVA SCUBA 41027	NBL	4	3			4	4	4				4	4	4		As required; T-IV	
0		EVA OPS 1G 41001	CLR	2	2-3			2	2	2				2	2	2	NBL/MU-S	T-IV	
0		EVA HDW/PRF 41027	NBL	9.5	4			9.5	9.5	9.5				9.5	9.5	9.5		T-IV; S-IV optional	
0		P/L PRF ADV 41027	NBL	9.5	4			9.5	9.5	9.5				9.5	9.5	9.5		T-IV; S-IV optional	
0			VR LAB	2	4			2	2	2				2	2	2		T-IV	
0			FQDT	2	4			2	2	2				2	2	2		T-IV	
0			CLR	1	1-3			1	1	1				1	1	1		T-IV	
0		ISS EVA TOOL CONFIG 41105	SSMTF	2	4			2	2	2				2	2	2		T-IV	
0		Sub To	tal for Stage		Stage Tota	ls Per Cr	ewmen	nber:											
0				206		10.5	86.5	184.5	206.0	196.0	0	0	86.5	184.5	196	196			

Note 1: For 7:1 ratio, M1 attends third (EVAX 93027), fourth (EVAX 94027) and final NBL run (EVAX 97027). M2 (if assigned) attends fifth NBL run (EVAX 95027). For 5:1 ratio, M1 attends third (EVAX 93027) and final NBL run (EVAX 95027). M2 (if assigned) attends fourth NBL run (EVAX 94027).

# 1 **EVA FLOW 61001**

Title: Extravehicular Activity Flow/Requirements Overview (Shared – ISS)

Duration: 1.0 hour Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT

Source: DX32/DX35

Date: 03/02

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

Synopsis: This lesson is the initial meeting with crew, DT/Training Manager (and

Increment Training Integrator, as required), EVA Training Schedulers,

EVA Systems and EVA Task leads, to discuss the EVA training

requirements and flow.

Objectives: Discuss EVA training requirements with crew.

#### 2 **EVA PGT/TM 31001**

Title: Extravehicular Activity Piston Grip Tool/Torque Multiplier Operations

(Shared – ISS)

Duration: 1.5 hours Medium: Classroom

Student: EV1, EV2, *Task* IV (Schedule in groups of up to 3.)

Source: DX32 Date: 06/08

Lesson(s) Replaced: EVA PGT/TM C 31001 Equipment Required: EVA tools and equipment

Prerequisite Lesson(s): ISS EVA SMALL TOOLS 21001

Preparation: None

Synopsis: This lesson provides the student with a detailed description of the Pistol

Grip Tool (PGT) and Torque Multiplier (TM) operations. The student gets

hands-on application of the EVA hardware.

Objectives: • Become familiar with PGT operations.

Become familiar with TM operations.

Become familiar with re-programming capability of the PGT software

using a computer.

#### **EVA CETA OPS 31028** 3

Title: **EVA Crew Equipment Translation Aid Operations** 

Duration: 1.0 hour

Medium: Air Bearing Table Student: EV1, EV2, *Task* IV

DX32 Source: Date: 06/08

Lesson(s) Replaced: None

Equipment Required: EVA tools and equipment

**EVA SOP 21007** Prerequisite Lesson(s):

Preparation: None

This lesson familiarizes student with Crew Equipment Translation Aid Synopsis:

(CETA) cart objectives.

Become familiar with CETA cart hardware and operations.

#### 4 **ISS EVA SMALL TOOLS 31001**

Title: ISS Extravehicular Activity Small Tools

Duration: 2.0 hours

Medium: Classroom (at NBL) Student: EV1, EV2, *Task* IV

Source: DX32 Date: 06/08

Lesson(s) Replaced: None

Equipment Required: EVA tools and equipment

Prerequisite Lesson(s): **EVA PGT/TM 31001** 

Preparation: None

Synopsis: This lesson includes a description of the EVA tools used during ISS EVA

operations. This lesson consists of a classroom briefing and hands-on

applications of the EVA hardware.

Objectives: • Be familiar with and operate EVA tools.

• Be familiar with EVA tool operational constraints.

# 5 **EVA OPS 1G 31001**

Title: Extravehicular Activity Operations 1G

Duration: 2.0 hours

Medium: Classroom (NBL/MU-S (NBL, Mockup South))

Student: EV1, EV2, *Task* IV

Source: DX32 Date: 06/08

Lesson(s) Replaced: None

Equipment Required: EVA tools and equipment

Prerequisite Lesson(s): None

Preparation: None

Synopsis: This lesson provides the crew with a detailed knowledge of mission

specific tasks. The crew performs mission specific procedures using

mockups and EVA hardware.

Objectives: • Become familiar with EVA mission-specific tasks.

• Become familiar with EVA hardware-specific to those tasks.

#### 6 **EVA SCUBA 91027**

Title: Extravehicular Activity SCUBA

Duration: 4.0 hours

Medium: Neutral Buoyancy Lab Student: EV1, EV2, *Task* IV

Source: DX32 Date: 06/08

Lesson(s) Replaced: None

Equipment Required: Swimming suit, EVA tools, and equipment

Prerequisite Lesson(s): EVA OPS 1G 31001

Preparation: None

Synopsis: This lesson will provide the students with proficiency and exposure to

Shuttle/Station EVAs prior to their upcoming suited runs. This class includes a pre-brief, 2 hours on SCUBA, and debrief while waiting for the 1-hour medical observation period to pass. The student will review

general Shuttle EVA knowledge and EVA skills, such as translation and foot restraint operations while being exposed to Shuttle and Station. It is highly recommended that the instructor use the Surface Supplied Diving System (SSDS) to communicate with the students and the utility divers.

Objectives:

Review Shuttle coordinate system.

• Review Shuttle Airlock (A/L) operations.

• Translate to a few contingency worksites and on Station.

### 6 **EVA SCUBA 91027 (Concluded)**

- Review the Station coordinate system.
- Review the Station trusses and elements.
- Review the Station A/L.
- Introduce hardware locations and tasks associated with assigned EVA(s).

#### 7 **EVAX 91027**

Title: Extravehicular Activity Mission-Specific Tasks and Timeline Operations

Duration: 9.5 hours

Medium: Neutral Buoyancy Lab

Student: EV1, EV2, Suit IV, Task IV, R1 or M1 (RMS operator should attend

50% of total number of timeline runs when RMS is used for EVA

operations)

**Note:** See Table 8-3 for specific IV hours.

Source: DX32 Date: 06/08

Lesson(s) Replaced: None

Equipment Required: EMUs, EVA tools and equipment

Prerequisite Lesson(s): EVA OPS 1G 31001

Preparation: None

Synopsis: This lesson begins with the 1G portion which includes physical, prebrief,

Extravehicular Mobility Unit (EMU) donning, EMU doffing, and ends with the lesson debrief, after the NBL session. (The student must remain at the NBL one hour post-run for NBL safety/medical requirements.)

This lesson instructs the students of the mission-specific EVA tasks for an EVA timeline.

#### Objectives:

- Perform EVA mission-specific tasks.
- Perform steps to egress/ingress the airlock.
- Translate to tool stowage areas.
- Perform worksite setup/cleanup.
- Perform team plan and/or technique for accomplishment of EVA tasks.
- Coordinate tasks with SRMS or SSRMS operator.
- Practice EVA timeline choreography.

# 8 <u>ISS EVA MASS OPS 91016</u>

Title: ISS Extravehicular Activity Mass Handling (Shared – ISS)

Duration: 1.0 hour

Medium: Virtual Reality Trainer Student: EV1, EV2, *Task* IV

Source: DX32 Date: 06/08

Lesson(s) Replaced: None

Equipment Required: Virtual Reality Simulator

Prerequisite Lesson(s): EVAX 91027

Preparation: None

Synopsis: This lesson provides an environment that allows the crew to determine

body positions, along with the level of work required to perform various EVA operations. This class is taught in the Virtual Reality (VR) simulator

which provides a six degrees-of-freedom virtual environment.

Crewmembers will be provided with the opportunity to perform and

evaluate mass handling related tasks.

Objectives: • Perform and evaluate mass handling activities.

Evaluate various body positions and work loads to determine the most

effective method of task completion.

#### 9 **EVA FLUID QD OPS 31197**

Title: Extravehicular Activity Fluid Quick Disconnect Operations

(Shared – Shuttle)

Duration: 2.0 hours

Medium: EVA Fluid QD Trainer (in Building 9)

Student: EV1, EV2, *Task* IV

Source: DX32 Date: 06/08

Lesson(s) Replaced: None

Equipment Required: EVA tools and equipment

Prerequisite Lesson(s): EVAX 91027

Preparation: None

Synopsis: The lesson provides the student with a detailed knowledge of EVA fluid

connector operations. The student will operate the connectors under

pressurized conditions.

Objectives: • Become familiar with proper operations of an EVA fluid connector.

• Become familiar with EVA tools used to operate EVA fluid connector

functions.

# 10 **EVA MASS OPS 31028**

Title: Precision Air Bearing Floor Mass Handling

Duration: 1.0 hour

Medium: AB Table (9N/PABF) Student: EV1, EV2, *Task* IV

Source: DX32 Date: 06/08

Lesson(s) Replaced: EVA OPS 31028

Equipment Required: EVA tools and equipment; EMU as required

Prerequisite Lesson(s): EVAX 91027

Preparation: None

Synopsis: This lesson provides an environment that allows the crew to determine

body positions, along with the level of work required to perform various EVA operations. With the class taught at the PABF, the crew will be allowed three degrees-of-freedom to perform their tasks, while the Virtual Reality (VR) simulator will provide a six degrees-of-freedom virtual

environment. Crewmembers will be provided with the opportunity to

perform and evaluate mass handling related tasks.

Objectives: • Perform and evaluate mass handling activities.

• Evaluate various body positions and work loads to determine the most effective method of task completion.

• Perform and evaluate loaded and unloaded Crew and Equipment Translation Aid (CETA) cart translations.

# 11 **EVA T/U 61001**

Title: Extravehicular Activity Tag-up

Duration: 1.0 hour Medium: Classroom

Student: EV1, EV2, *Task* IV (as required)

Source: DX32 Date: 06/08

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

Synopsis: This event provides EVA crew and instructors the opportunity to discuss

any EVA related topics. Topics can include EVA timelines, new EVA tasks, EVA training plan, etc. (Requirement is optional per crew.)

Objectives: Discuss EVA-related topics.

#### 12 **EVAX 92027**

Refer to EVAX 91027 in Crew Training Catalog.

# 13 **ISS EVA TOOL CONFIG 31105**

Title: ISS Extravehicular Activity Tool Configuration (Shared – ISS)

Duration: 2.0 hours

Medium: Space Station Mock-Up And Training Facility

Student: EV1, EV2, *Task* IV

Source: DX32 Date: 06/08

Lesson(s) Replaced: EVA TOOL CONFIG 1 C 91105

Equipment Required: EVA tools and equipment

Prerequisite Lesson(s): EVAX 92027

Preparation: None

Synopsis: This lesson is the first of three that are provided for the crew to go through

the tool configuration of the prep and post procedures of their EVA timeline. The crew will practice retrieving the necessary tools from the stowed locations, and place them where required prior to their EVA.

Objectives: • Perform EVA prep and post tool configuration timeline.

• Identify optimal stowage locations for EVA hardware in the airlock.

#### 14 **EVAX 93027**

Refer to EVAX 91027 in Crew Training Catalog. This is also an EVA Assessment Team (EVAAT) NBL run whereby a veteran EVA member participates:

- · as a third suited member
- or SCUBAs on the Single-Surface Diving System (SSDS)
- or from the Test Conductor console area.

(During EVAAT events, the crewmembers will perform a SAFER Reach Evaluation to ensure that the SAFER Hand Control Module is accessible.)

#### 15 **ISS EVA MASS OPS 92016**

Refer to ISS EVA MASS OPS 91016 in Crew Training Catalog.

#### 16 **EVA FLUID QD OPS 32197**

(Shared – Shuttle)

Refer to EVA FLUID QD OPS 31197 in Crew Training Catalog.

# 17 **EVA PGT/TM 32001**

Refer to EVA PGT/TM 31001 in Crew Training Catalog.

#### 18 **EVA MASS OPS 32028**

Refer to EVA MASS OPS 31028 in Crew Training Catalog. Only schedule if required by the crew.

#### 19 **EVAX 94027**

Refer to EVAX 91027 in Crew Training Catalog. This is also an EVA Assessment Team (EVAAT) NBL run whereby a veteran EVA member participates:

- as a third suited member
- or SCUBAs on the Single-Surface Diving System (SSDS)
- or from the Test Conductor console area.

(During EVAAT events, the crewmembers will perform a SAFER Reach Evaluation to ensure that the SAFER Hand Control Module is accessible.)

#### 20 **ISS EVA TOOL CONFIG 32105**

(Shared – ISS)

Refer to ISS EVA TOOL CONFIG 31105 in Crew Training Catalog.

#### 21 **EVA CONT 1G 31001**

Title: Extravehicular Activity Contingency 1G

Duration: 2.0 hours

Medium: Classroom (NBL/MU-S (NBL, Mockup – South))

Student: EV1, EV2, *Task* IV

Source: DX32 Date: 06/08

Lesson(s) Replaced: None

Equipment Required: EVA tools and equipment

Prerequisite Lesson(s): EVAX 91027

Preparation: None

Synopsis: This lesson provides the crewmember with a walk-through briefing of the

mission-specific contingency tasks. The crew performs mission-specific

contingency procedures using mockups and EVA hardware.

Objectives: Perform EVA-specific timeline contingency procedures.

# 22 **EVA CONT 91027**

Title: Extravehicular Activity Contingency Operations

Duration: 9.5 hours

Medium: Neutral Buoyancy Lab

Student: EV1, EV2, *Task* IV, *Suit IV* (optional), R1 (as required)

Source: DX32 Date: 06/08

Lesson(s) Replaced: None

Equipment Required: EMUs, EVA tools and equipment

Prerequisite Lesson(s): EVAX 91027

Preparation: None

Synopsis: This lesson begins with the 1G portion which includes physical, prebrief,

Extravehicular Mobility Unit (EMU) donning, EMU doffing, and ends with the lesson debrief, after the NBL session. (The student must remain at the NBL one hour post-run for NBL safety/medical requirements.)

This lesson provides the crewmember an opportunity to perform mission specific contingency tasks in the NBL. The crew performs mission-specific contingency procedures using mockups and EVA hardware.

Objectives: • Perform EVA-specific timeline contingency procedures.

Formulate a plan to resolve contingency situations via EVA.

#### 23 **EVAX 95027**

Refer to EVAX 91027 in Crew Training Catalog.

#### 24 **KU BAND 31001**

Title: Ku-Band Antenna Extravehicular Activity Operations

Duration: 1.0 hour

Medium: Classroom (at Bldg. 44)

Student: EV1, EV2, *Task* IV

Source: DX32 Date: 06/08

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): CONT OPS 21002

Preparation: None

# 24 **KU BAND 31001 (Concluded)**

Synopsis: T

This lesson provides crewmembers with the opportunity for a walk-through briefing on the objectives and techniques involved with EVA operations of the Ku-Band antenna. An overview of the hardware, potential failures, and EVA procedures are presented.

Objectives:

- Familiarize crew with Ku-Band antenna.
- Review potential Ku-Band hardware failures.
- Know EVA procedures for Ku-Band antenna gimbal align.

#### 25 **O/D/R CONT 1G 31001**

Title: Orbiter, Docking and Remote Manipulator System Contingency 1G

Duration: 2.0 hours

Medium: Classroom (NBL/MU-S (NBL, Mockup-South))

Student: EV1, EV2, *Task* IV

Source: DX32 Date: 06/08

Lesson(s) Replaced: RMS CONT 31001

Equipment Required: EVA tools and equipment

Prerequisite Lesson(s): KU BAND 31001

Preparation: None

Synopsis:

This lesson is a walk-through briefing for orbiter, docking, and SRMS contingency operations. A briefing on the failure conditions is presented, followed by a discussion of EVA procedures to be used for contingency operations.

#### Objectives:

- Discuss orbiter contingency procedures (reference generic flow orbiter contingency class objectives).
- Discuss orbiter docking system contingency procedures.
- Discuss SRMS contingency procedures (shoulder brace release, tie down, manipulator positioning mechanism deploy/stow, joint alignment).
- Discuss flight-specific orbiter/SRMS contingency procedures (i.e., Payload Retention Latch Actuator (PRLA), Remotely Operated Electrical Umbilical (ROEU), grapple fixture release, etc.).

### 26 **O/D/R CONT 31027**

Title: Orbiter, Docking, and Remote Manipulator System Contingency

Operations

Duration: 9.5 hours

Medium: Neutral Buoyancy Lab

Student: EV1, EV2, Task IV, Suit IV (optional)

Source: DX32 Date: 06/08

Lesson(s) Replaced: DOOR CONT 2 31027, LATCH CONT 2 31027,

ORB CONT 31027, and RMS CONT 31027

Equipment Required: EMUs, EVA tools and equipment

Prerequisite Lesson(s): O/D/R CONT 1G 31001

Preparation: None

Synopsis:

This lesson begins with the 1G portion which includes physical, prebrief, Extravehicular Mobility Unit (EMU) donning, EMU doffing, and ends with the lesson debrief, after the NBL session. (The student must remain at the NBL one hour post-run for NBL safety/medical requirements.)

This lesson provides the crewmember an exercise to perform orbiter, docking, and SRMS contingency operations. The exercise will include manually closing the payload bay doors and radiators and performing payload bay centerline latch and bulkhead latch tool installation. This lesson provides the crewmember an exercise to perform end-to-end EVA SRMS contingency operations. This lesson also provides the crewmember an exercise to perform orbiter docking system contingency operations.

#### Objectives:

- Discuss orbiter contingency procedures (reference generic flow orbiter contingency class objectives).
- Discuss orbiter docking system contingency procedures.
- Discuss SRMS contingency procedures (shoulder brace release, tie down, manipulator positioning mechanism deploy/stow, joint alignment).
- Discuss flight-specific orbiter/SRMS contingency procedures (i.e., Payload Retention Latch Actuator (PRLA), Remotely Operated Electrical Umbilical (ROEU), grapple fixture release, etc.).

### 27 **EVA MASS OPS 33028**

Refer to EVA MASS OPS 31028 in Crew Training Catalog. Only schedule if required by the crew.

#### 28 **EVA CONT 1G 32001**

Refer to EVA CONT 1G 31001 in Crew Training Catalog.

# 29 **EVA CONT 92027**

Refer to EVA CONT 91027 in Crew Training Catalog.

#### 30 **EVAX 96027**

Refer to EVAX 91027 in Crew Training Catalog.

#### 31 **EVA PGT POGO 31028**

Title: Extravehicular Activity Pistol Grip Tool Pogo Operations

Duration: 2.0 hours

Medium: AB Table (in Building 9)
Student: EV1, EV2 (*Task* IV optional)

Source: DX32 Date: 06/08

Lesson(s) Replaced: None

Equipment Required: EVA tools, equipment and EMU gloves

Prerequisite Lesson(s): EVA PGT/TM 31001

Preparation: None

Synopsis: This lesson provides the student an opportunity to become familiar with

Pistol Grip Tool (PGT) operations under torque-loaded conditions.

Objectives: Become familiar with PGT operations under torque-loaded conditions.

#### 32 **EVA FLUID QD OPS 33197**

(Shared – Shuttle)

Refer to EVA FLUID QD OPS 31197 in Crew Training Catalog.

#### 33 **EVA PGT/TM 33001**

Title: Extravehicular Activity Piston Grip Tool/Torque Multiplier Operations

(Shared – ISS)

Duration: 0.5 hours Medium: Classroom

Student: EV1, EV2, *Task* IV (Schedule in groups of up to 3.)

Source: DX32 Date: 06/08

Lesson(s) Replaced: EVA/PGT/TM C 31001
Equipment Required: EVA tools and equipment
Prerequisite Lesson(s): ISS EVA SMALL TOOLS 21001

Preparation: None

### 33 EVA PGT/TM 33001 (Concluded)

Synopsis: This lesson provides the student with a detailed description of the Pistol

Grip Tool (PGT) and Torque Multiplier (TM) operations. The student gets

hands-on application of the EVA hardware.

Objectives: • Review PGT operations.

Review TM operations.

 Review re-programming capability of the PGT software using a computer.

### 34 **EVA CONT 93027**

Refer to EVA CONT 91027 in Crew Training Catalog.

#### 35 **EVA MASS OPS 34028**

Refer to EVA MASS OPS 31028 in Crew Training Catalog. Only schedule if required by the crew.

#### 36 **EVA CONT 94027**

Refer to EVA CONT 91027 in Crew Training Catalog.

#### 37 **EVAX 97027**

Refer to EVAX 91027 in Crew Training Catalog. This is the final set of EVA timeline runs.

#### 38 **P/L EVA 1G 31001**

Title: Payload Extravehicular Activity 1G

Duration: 2.0 hours

Medium: Classroom (NBL/MU-S (NBL, Mockup South))

Student: EV1, EV2, Task IV

Source: DX32 Date: 06/08

Lesson(s) Replaced: P/L EVA 31001

Equipment Required: EVA tools and equipment Prerequisite Lesson(s): ISS EVA MAINT 21027

Preparation: None

Synopsis: This lesson is a walk-through briefing of the mockup and tools in support

of objectives and techniques involved with EVA operations of the payload.

an overview of mechanisms, procedures, and potential failures is presented, as well as EVA techniques to deal with scheduled,

unscheduled, and contingency scenarios.

# 38 **P/L EVA 1G 31001 (Concluded)**

Objectives:

- Walk-through briefing of mockup and tools review.
- Review mechanisms and operations of hardware pertaining to particular flight.
- Discuss and perform possible EVA techniques needed for scheduled, unscheduled, and contingency payload scenarios.

#### 39 **ORB CONT 31027**

Title: Orbiter Contingency Operations

Duration: 6.5 hours

Medium: Neutral Buoyancy Lab

Student: EV1, EV2, Task IV, Suit IV (optional)

Source: DX32 Date: 06/08

Lesson(s) Replaced: DOOR CONT 2 31027, LATCH CONT 2 31027

Equipment Required: EMUs, EVA tools and equipment

Prerequisite Lesson(s): ISS EVA MAINT 21027

Preparation: None

Synopsis:

This lesson begins with the 1G portion which includes physical, prebrief, Extravehicular Mobility Unit (EMU) donning, EMU doffing, and ends with the lesson debrief, after the NBL session. (The student must remain at the NBL one hour post-run for NBL safety/medical requirements.)

This lesson familiarizes the student with EVA orbiter contingency operations. The student continues to develop EMU familiarity (mobility, positioning, etc.). The primary focus of this class is door contingency operations.

#### Objectives:

- Know Shuttle airlock egress.
- Know Portable Foot Restraint (PFR) ingress.
- Know door drive linkage cut.
- Know door drive linkage disconnect.
- Know electrical crossover disconnect.
- Know proper body positioning at the worksite.
- Know EV1 installation on bulkhead and centerline latches.
- Know EV2 installation of bulkhead and centerline latches.
- Know Shuttle airlock ingress.

#### 40 **P/L EVA 91027**

Title: Payload Extravehicular Activity Operations

Duration: 9.5 hours

**Note:** Length of lesson may be shorter depending upon mission specific

requirements.

Medium: Neutral Buoyancy Lab

Student: EV1, EV2, Task IV, Suit IV (optional)

Source: DX32 Date: 06/08

Lesson(s) Replaced: None

Equipment Required: EMUs, EVA tools and equipment

Prerequisite Lesson(s): P/L EVA 1G 31001

Preparation: None

Synopsis: This lesson begins with the 1G portion which includes physical, prebrief,

Extravehicular Mobility Unit (EMU) donning, EMU doffing, and ends with the lesson debrief, after the NBL session. (The student must remain at the NBL one hour post-run for NBL safety/medical requirements.)

This lesson provides the crewmember an exercise to perform EVA procedures for contingency scheduled and unscheduled payload-related operations. Crewmembers may perform part-task or end-to-end payload flight-related EVA operations. Objectives of other lessons may be covered to ensure that crewmembers maintain proficiency in payload EVA tasks.

Objectives: Perform mission-specific EVA procedures for any payload-related

operations.

#### 41 **ORB CONT 32027**

Refer to ORB CONT 31027 in Crew Training Catalog.

#### 42 **P/L EVA 92027**

Refer to P/L EVA 91027 in Crew Training Catalog.

#### 43 **ORB CONT 33027**

Refer to ORB CONT 31027 in Crew Training Catalog.

#### 44 **P/L EVA 93027**

Refer to P/L EVA 91027 in Crew Training Catalog.

#### 45 **EVA TOOL CONFIG 31020**

Title: Extravehicular Activity Tool Configuration

Duration: 2.0 hours

Medium: CCT, FFT, or CCT II Student: EV1, EV2, *Task* IV

Source: DX32 Date: 06/08

Lesson(s) Replaced: None

Equipment Required: EVA tools and equipment

Prerequisite Lesson(s): EVAX 97027

Preparation: None

**Note:** This lesson is scheduled in conjunction EVA P/P 31020.

Synopsis: This lesson is the first of three that are provided for the crew to go

through the tool configuration of the prep and post procedures of their EVA timeline. The crew will practice retrieving the necessary tools from the stowed locations, and place them where required prior to their EVA.

Objectives: • Perform EVA prep and post tool configuration timeline.

• Identify optimal stowage locations for EVA hardware in the airlock.

#### 46 **EVA TOOL CONFIG 32020**

Refer to EVA TOOL CONFIG 31020 in Crew Training Catalog.

#### 47 **EVA TOOL CONFIG 33020**

Refer to EVA TOOL CONFIG 31020 in Crew Training Catalog.

#### 48 EVA RCC REPAIR DGB 61001

Title: Extravehicular Activity Reinforced Carbon-Carbon Dual Glove Box

Duration: 10.0 hours

Medium: Bldg 7 Glovebox

Student: EV1 Source: DX32 Date: 07/07

Lesson(s) Replaced: None

Equipment Required: EVA tools and equipment

Prerequisite Lesson(s): None

Preparation: None

Synopsis: This lesson reviews the skills required to enact Reinforced Carbon-Carbon

(RCC) repairs in the glovebox environment.

# 48 **EVA RCC REPAIR DGB 61001 (Concluded)**

Objectives: • Review detailed EVA procedures, tools, and techniques for RCC repair.

• Perform repairs on RCC samples with repair material at vacuum to gain experience with the material properties.

#### 49 **EVA TPS REPAIR 21002**

Title: EVA Thermal Protection System Repair

Duration: 4.0 hours Medium: Workbook

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT

Source: DX32 Date: 09/05

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

Synopsis: This lesson provides an overview of the Thermal Protection System (TPS)

components on the Space Shuttle, historical TPS damage, and EVA

inspection and repair methods.

Objectives: • Become familiar with the TPS components on Orbiter (blankets, tile,

Reinforced Carbon-Carbon (RCC)).

• Identify different tile types and tile damage (historical and testing).

- Identify RCC components and RCC damage (historical and testing).
- Describe tile and RCC repair materials, tools, and methods.
- Become familiar with boom hardware and operations.
- Describe nominal and EVA inspection operations.
- Become familiar with EVA access to Orbiter TPS areas.

#### 50 **EVA TPS OV 31706**

Title: EVA Thermal Protection System Overview

Duration: 3.0 hours

Medium: Thermal Protection System Trainer

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT

Source: DX32 Date: 07/07

Lesson(s) Replaced: None

Equipment Required: TPS components, Thermal Protection System Trainer, and

Precision Air Bearing Floor

Prerequisite Lesson(s): None

Preparation: EVA TPS REPAIR 21002

# 50 EVA TPS OV 31706 (Concluded)

Synopsis:

This lesson is intended to familiarize Shuttle crewmembers with the Orbiter Thermal Protection System (TPS) as it relates to EVA inspection and EVA repair. This lesson explains the principle design function of the TPS during entry and points out the location of tiles, blankets, and Reinforced Carbon-Carbon (RCC) components. This includes TPS nomenclature and familiarization with the sub-components of tile and RCC layups. The students will handle samples of the various TPS sub-components. Examples of tile and RCC damage and repairs are also discussed at a high level. This lesson includes a discussion of EVA inspection locations, requirements, and methods. It concludes with development of techniques on the Precision Air Bearing Floor (PABF) for contingency safety tether use during SAFER TPS inspection.

Objectives:

- Understand the various TPS components on the Orbiter.
- Understand TPS sub-component nomenclature.
- Understand what typical TPS damage may look like.
- Gain a high level understanding of TPS repair materials and their functionality.
- Gain a basic understanding of EVA access to TPS.
- Understand inspection resolution requirements.
- Introduce inspection activities in a typical flight plan.
- Understand failures that lead to EVA inspection.
- Understand EVA inspection tools and timelines.
- Develop skills required for contingency safety tether retrieval during SAFER inspection.

#### 51 **EVA TILE REPAIR 31703**

Title: EVA Tile Repair

Duration: 3.5 hours

Medium: Thermal Protection System Trainer

Student: EV1, EV2, *Task* IV

Source: DX32 Date: 06/08

Lesson(s) Replaced: None

Equipment Required: EVA Tools and Equipment

Prerequisite Lesson(s): EVA TPS OV 31706

Preparation: None

#### 51 **EVA TILE REPAIR 31703 (Concluded)**

Synopsis:

This lesson provides the information and skills required to enact Space Shuttle Thermal Protection System (TPS) tile repairs. The lesson discusses the required tools for the repairs and the material properties of the systems. Hands-on procedures and techniques practice is the focus of the lesson.

- Objectives: Discuss detailed EVA procedures, tools, and techniques for TPS tile repairs, including tile overlay and Emittance Wash (EW) repair.
  - Practice TPS tile repair methods.
  - Introduce Tile Repair Ablator Dispenser (TRAD).

#### 52 **EVA TPS LOADS 31016**

Title: **EVA Thermal Protection System Loads** 

Duration: 1.0 hour

Medium: Virtual Reality Trainer EV1, EV2, Task IV Student:

Source: DX32 Date: 06/08

Lesson(s) Replaced: None

Equipment Required: **EVA Tools and equipment EVA TILE REPAIR 31703** Prerequisite Lesson(s):

Preparation: None

Synopsis:

This lesson familiarizes EV/IV crewmembers with the movements of the robotic systems, boom, and Orbiter during Thermal Protection System (TPS) inspection and repair operations. The Virtual Reality (VR) simulator and equipment provide a high fidelity platform to simulate the movements from the robotic arms and boom when EV crewmembers impact forces and moments (loads) into a dynamic system. Crewmembers will perform TCS repair operations using EVA repair tools and discuss cautions and warnings associated with the dynamic system.

Note:

This class will be scheduled immediately prior to PDRS EVA Wing Leading Edge Mapping class in the Virtual Reality Lab.

Objectives:

- Discuss historical dynamic system movement experience.
- Impart forces into simulator to understand the resultant reaction of the systems.
- Discuss and practice recommended techniques for enacting inspection or repair with a dynamic system.
- Become familiar with the constraints, cautions, and warnings for TPS procedures with a dynamic system.

# 53 **EVA TPS OPS 1G 31001**

Title: EVA Thermal Protection System Repair 1G

Duration: 3.5 hours

Medium: Classroom (NBL/MU-S (NBL, Mockup-South))

Student: EV1, EV2, *Task* IV

Source: DX32 Date: 06/08

Lesson(s) Replaced: None

Equipment Required: EVA tools and equipment Prerequisite Lesson(s): EVA TPS LOADS 31016

Preparation: None

Synopsis: This lesson is a 1G session to prebrief the details of the Neutral Buoyancy

Lab (NBL) class, EVA TPS OPS 91027. This lesson familiarizes Shuttle

crewmembers with the EVA procedures associated with Thermal Protection System (TPS) inspection and repair methods. Students will configure EVA tools for various repair methods. Translation paths, worksite familiarity, and body positioning with respect to a TPS damage

area will be discussed.

Objectives: • Configure Tools for SSRMS and Boom-based TPS repairs and inspection:

Tile Repair methods

Reinforced Carbon-Carbon (RCC) Repair methods

Inspection

Discuss translation paths and body positioning.

# 54 **EVA TPS OPS 91027**

Title: EVA Thermal Protection System Repair

Duration: 9.5 hours

Medium: Neutral Buoyancy Lab

Student: EV1, EV2, Task IV, Suit IV (optional)

Source: DX32 Date: 06/08

Lesson(s) Replaced: None

Equipment Required: EMUs, EVA tools and equipment

Prerequisite Lesson(s): EVA TPS OPS 1G 31001

Preparation: None

Synopsis: This lesson familiarizes Shuttle crewmembers with the EVA procedures

associated with Thermal Protection System (TPS) inspection repair methods. Students will configure EVA tools, set up worksites, and perform operations for various TPS inspection repair methods.

# 54 **EVA TPS OPS 91027 (Concluded)**

Objectives:

- Perform handling and translation of required tools for the various repair methods.
- Perform worksite setup/cleanup techniques for SSRMS and Boombased EVA.
- Perform repair operations at TPS worksite:
  - Tile Repair methods
  - Reinforced Carbon-Carbon (RCC) Repair methods
- Perform boom contingencies as time allows.

### 55 **EVA TILE REPAIR 32703**

Title: EVA Tile Repair II

Duration: 2.0 hours

Medium: Thermal Protection System Trainer

Student: EV1, EV2, *Task* IV

Source: DX32 Date: 06/08

Lesson(s) Replaced: None

Equipment Required: EVA tools and equipment Prerequisite Lesson(s): EVA TILE REPAIR 31703

Preparation: None

Synopsis:

This lesson provides the information and skills required to enact Space Shuttle Tile Protection (TPS) tile repairs. The lesson discusses the required tools for the repairs and material properties. Hands-on procedures and techniques practice is the focus of this lesson. This lesson also discusses the External Tank (ET) umbilical doors mechanisms, procedures, translation, ET centerline latch operations, and ET door jam/debris removal.

Objectives:

- Discuss detailed EVA procedures, tools, and techniques for TPS tile repairs.
- Practice TPS tile repair methods, including Tile Repair Ablator Dispenser (TRAD).
- Explain ET door mechanisms and operation.
- Explain the ET centerline latch tool function/operation.
- Discuss jam and debris removal tools.

# 56 **EVA RCC REPAIR 31703**

Title: EVA Reinforced Carbon-Carbon Repair

Duration: 4.0 hours

Medium: Thermal Protection System Trainer

Student: EV1, EV2, *Task* IV

Source: DX32 Date: 06/08

Lesson(s) Replaced: None

Equipment Required: EVA tools and equipment Prerequisite Lesson(s): EVA TPS OV 31706

Preparation: None

Synopsis: This class provides a walkthrough of EVA repair procedures and hands-on

experience with Reinforced Carbon-Carbon (RCC) repair tools, materials,

and repair techniques.

Objectives: • Review RCC composition and damage types.

Understand RCC repair materials properties.

• Understand RCC repair tools operations and constraints.

• Perform RCC repairs (hands-on demonstrations).

• Perform procedures for IV tool assembly.

• Perform detailed EVA repair procedures with repair tools and materials.

• Perform post-EVA cleanup and tool stowage procedure.

### 57 **EVA TPS REPAIR SKLS 31703**

Title: EVA Thermal Protection System Repair Skills

Duration: 2.0 hours

Medium: Thermal Protection System Trainer

Student: EV1, EV2, *Task* IV

Source: DX32 Date: 06/08

Lesson(s) Replaced: None

Equipment Required: EVA tools and equipment

Prerequisite Lesson(s): EVA TILE REPAIR 32703, EVA RCC REPAIR 31703

Preparation: None

Synopsis: This lesson reviews the skills required to enact Thermal Protection System

(TPS) repairs. Hands-on procedures and techniques practice is the focus

of the lesson.

Objectives: • Review detailed EVA procedures, tools, and techniques for Reinforced

Carbon-Carbon (RCC) repair.

• Review detailed EVA procedures, tools, and techniques for tile repair.

# 40000-Level Lessons (Proficiency, Refresher)

### **CONT OPS 41001**

Title: Contingency Operations

Duration: 2.0 hours

Medium: Classroom (at NBL) Student: EV1, EV2, *Task* IV

Source: DX32 Date: 06/08

Lesson(s) Replaced: None

Equipment Required: EVA tools and equipment

Prerequisite Lesson(s): CONT OPS 21002

Preparation: None

Synopsis: This lesson provides an overview to the baseline EVA shuttle support

equipment. The class will familiarize the students with the EVA equipment and the procedures to operate them. EVA NBL training tools and slides of the interfaces are used during this classroom session. Students will receive some hands-on application of the tools to orbiter interfaces at

42B mockup in the high bay.

Objectives:

- Identify/describe the nominal and contingency Shuttle EVA support equipment.
- Describe the purpose and stowage locations of Shuttle EVA tools.
- Operate all of the Shuttle EVA tools.
- Review hardware locations and tasks associated with Shuttle EVA(s).

### ISS EVA SMALL TOOLS 41001

Title: ISS Extravehicular Activity Small Tools Refresher (Shared – ISS)

Duration: 2.0 hours

Medium: Classroom (at NBL) Student: EV1, EV2, *Task* IV

Source: DX32 Date: 06/08

Lesson(s) Replaced: None

Equipment Required: EVA tools and equipment

Prerequisite Lesson(s): None

Preparation: None

### **ISS EVA SMALL TOOLS 41001 (Concluded)**

Synopsis: This lesson provides the student a refresher of the EVA tools used during

ISS EVA operations. The student will get hands-on application of the EVA

hardware.

Objectives: Become familiar with the operations of EVA tools, including any

operational constraints.

### **EVA REVIEW 1G 41001**

Title: Extravehicular Activity Review 1G (Shared – ISS)

Duration: 2.0 hours

Medium: Classroom (NBL, Mockup South)

Student: EV1, EV2 Source: DX32 Date: 07/07

Lesson(s) Replaced: None

Equipment Required: EVA tools and equipment

Prerequisite Lesson(s): ISS EVA MAINT 21027 (completed ASCAN flow)

Preparation: None

Synopsis: This lesson provides the student with a detailed knowledge of EVA skills/

tasks. The student performs EVA skills procedures using mockups and

EVA hardware.

Objectives: 
• Become familiar with EVA skills/tasks.

Become familiar with EVA hardware specific to these tasks.

### **EVA REVIEW 41027**

Title: Extravehicular Activity Review (Shared – STS)

Duration: 9.5 hours

Medium: Neutral Buoyancy Lab

Student: EV1, EV2 Source: DX32 Date: 07/07

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): EMUs, EVA tools and equipment

Preparation: None

Synopsis: This lesson begins with the 1G portion which includes physical, prebrief,

Extravehicular Mobility Unit (EMU) donning, EMU doffing, and ends with the lesson debrief, after the NBL session. (The student must remain at

the NBL one hour post-run for NBL safety/medical requirements.)

### **EVA REVIEW 41027 (Concluded)**

This lesson provides proficiency/skills-based training for EVA crewmembers who have completed the generic EVA training flow. The students will revisit general EVA operations required to perform contingency tasks in the payload bay. (This lesson is intended to have minimum impact on other NBL operations.)

Objectives: Perform tasks that will develop the student's EVA skills.

# **EVA SCUBA 41027**

Title: Extravehicular Activity SCUBA

Duration: 4.0 hours

Medium: Neutral Buoyancy Lab Student: EV1, EV2, *Task* IV

Source: DX32 Date: 06/08

Lesson(s) Replaced: None

Equipment Required: Swimming suit, EVA tools and equipment

Prerequisite Lesson(s): ISS EVA SMALL TOOLS 21001

Preparation: None

Synopsis:

This lesson will provide the students with proficiency and exposure to Shuttle/Station EVAs prior to their upcoming suited runs. This class includes a pre-brief, 2 hours on SCUBA, and debrief while waiting for the 1-hour medical observation period to pass. The student will regain general Shuttle EVA knowledge and EVA skills, such as translation and foot restraint operations while being exposed to Shuttle and Station. It is highly recommended that the instructor use Surface Supplied Diving System (SSDS) to communicate with the students and the utility divers.

#### Objectives:

- Review Shuttle coordinate system.
- Practice various translation techniques.
- Review Shuttle A/L operations.
- Translate to a few contingency worksites and on Station.
- Review Station coordinate system.
- While swimming, point out all the Station trusses and elements.
- Review Station A/L.

### **EVA OPS 1G 41001**

Title: Extravehicular Activity Operations 1G (Shared – ISS)

Duration: 2.0 hours

Medium: Classroom (NBL/MU-S (NBL poolside, Mockup South))

Student: EV1, EV2, *Task* IV

Source: DX32 Date: 06/08

Lesson(s) Replaced: None

Equipment Required: EVA tools and equipment

Prerequisite Lesson(s): EVAX 91027

Preparation: None

Synopsis: This lesson provides the student a refresher of mission-specific tasks.

The crew performs mission-specific procedures using mockups and EVA

hardware.

 Refresh knowledge of mission-specific tasks. Objectives:

Refresh knowledge of mission-specific EVA hardware.

### **EVA HDW/PRF 41027**

Title: Extravehicular Activity Hardware/Proficiency Evaluations

Duration: 9.5 hours

Medium: Neutral Buoyancy Lab

Student: EV1, EV2, Task IV, Suit IV (optional)

Source: DX32 06/08 Date:

Lesson(s) Replaced: None

Equipment Required: EMUs, EVA tools and equipment

Prerequisite Lesson(s): **EVA OPS 1G 41001** 

Preparation: None

Synopsis: This lesson begins with the 1G portion which includes physical, prebrief,

Extravehicular Mobility Unit (EMU) donning, EMU doffing, and ends with the lesson debrief, after the NBL session. (The student must remain at the NBL one hour post-run for NBL safety/medical requirements.)

This lesson is used for hardware development/evaluations and procedures validation (both mission-specific and other programs). EVA proficiency may also be satisfied within this lesson.

Objectives:

Evaluate/develop payload EVA hardware designs/concepts.

Validate EVA procedures.

Remain proficient in EVA tasks.

### **P/L PRF ADV 41027**

Title: Payload Extravehicular Activity Proficiency

Duration: 9.5 hours

Medium: Neutral Buoyancy Lab

Student: EV1, EV2, *Task* IV, *Suit IV* (optional)

Source: DX32 Date: 06/08

Lesson(s) Replaced: None

Equipment Required: EMUs, EVA tools and equipment

Prerequisite Lesson(s): P/L EVA 1G 31001

Preparation: None

Synopsis: This lesson begins with the 1G portion which includes physical, prebrief,

Extravehicular Mobility Unit (EMU) donning, EMU doffing, and ends with the lesson debrief, after the NBL session. (The student must remain at the NBL one hour post-run for NBL safety/medical requirements.)

In this lesson, EVA crewmembers perform unscheduled contingency or scheduled end-to-end payload flight-related EVA tasks. This lesson is used specifically for launch slip proficiency and/or crew/instructor requested runs. Objectives of other lessons may be covered to ensure that crewmembers maintain proficiency in payload EVA tasks. If time permits, any of the orbiter contingency EVA tasks may be covered.

Objectives: Perform mission-specific EVA procedures.

#### **EVA MASS OPS 41016**

Refer to ISS EVA MASS OPS 91016 in Crew Training Catalog.

### **EVA FLUID QD OPS 41197**

(Shared – ISS)

Refer to EVA FLUID QD OPS 31197 in Crew Training Catalog.

# **EVA PGT/TM 41001**

(Shared - ISS)

Refer to EVA PGT/TM 31001 in Crew Training Catalog.

# **ISS EVA TOOL CONFIG 41105**

(Shared – Shuttle)

Refer to ISS EVA TOOL CONFIG 31105 in Crew Training Catalog.

# SECTION 9.0 PAYLOAD DEPLOYMENT AND RETRIEVAL SYSTEM TRAINING COURSE

The PDRS Training Course presents the training required to prepare future RMS operators for a flight. The basic philosophy of the PDRS curriculum uses a spiral learning curve, which allows knowledge application to begin at the earliest levels of learning and to continue through increasingly complex topics and skills.

The PDRS training course teaches not only system functions and processes, but also techniques and the skill to use them. "Flying the arm" is not a procedure, but a skill analogous to flying the orbiter. As such, it requires development and practice. It is furthermore payload- and task-specific; techniques learned in early training will be applied differently to different payloads and payload bay configurations.

Since PDRS operators need to develop and refine the skill of flying the arm, the generic (20000-level) lessons have been developed to provide formal qualification status for each operator. This process guarantees that all operators who achieve qualification are competent RMS operators, and should be able to handle any flight-specific RMS tasks. If lesson objectives are not completed then the lesson will be repeated. The qualification lessons are intended to pull the various skills together at one time and identify those areas in which the student excels or may need improvement.

The generic (20000) PDRS Orbiter Boom Sensor System (OBSS) lessons provide an introduction to OBSS survey skills and concepts. The generic OBSS classes may be taken as part of the generic PDRS flow or separately if the student has already completed the generic PDRS flow.

Following qualification and crew assignment, each RMS operator will go through assigned crew (30000-level) and load specific (90000-level) lessons. The concepts taught at each level of learning are listed below:

### Generic Training (20000-level)

**PDRS Basics** 

PDRS Unloaded Nominal Operations

**PDRS Loaded Nominal Operations** 

PDRS Single Joint Operations

**PDRS Advanced Operations** 

Formal Qualification

**Generic Operational Proficiency** 

Generic OBSS

### Assigned Crew Training (30000-level)

Orbiter/RMS Interfaces

PDRS Neutral Buoyancy Lab (NBL) Familiarization

### Load-specific Assigned Crew Training (90000-level)

**PDRS Nominal Operations** 

PDRS Nominal Operations, Single Joint Arm

**PDRS Contingency Operations** 

PDRS Contingency Operations, Single Joint Arm (if applicable)

PDRS Malfunction Response and Workaround

Load-specific Operational Proficiency

Once a 20000-level qualified student is scheduled for generic simulation (sim) support, a familiarization is required unless qualification was achieved in the last six months and the student is familiar with the generic timeline. Requalification for flight assignment must be achieved prior to the start of 30000-level training. However, students may schedule refresher lessons at any time and are encouraged to do so.

Although RMS operations are unique to each particular flight, the skills necessary to perform a task are universal. Skills are applied to mission-unique operations. There are nine basic descriptions under which RMS operations may fall: Contingency-only unloaded RMS operations, Unloaded RMS operations, Loaded RMS operations, Deployment RMS operations, Retrieval RMS operations, Deployment and Retrieval RMS operations, Station Build RMS operations, RMS/EVA operations, and RMS/OBSS operations. The load-specific flow is therefore divided into nine branches. Each class will be designated with a branch-specific lesson code. The planned RMS operations for each flight will determine which branch of the flow will be required. Each RMS flight could also have more than one RMS payload or more than one set of operations. This would then require use of multiple branches or portions of multiple branches of the flow for flight training. For a Station Build mission, the Station Build RMS operations branch will be required for each station element. Additionally, several lessons, as noted in this branch, will be required for each task performed. Lastly, if the mission requires RMS/EVA operations, the RMS/EVA operations branch will be required for each EVA day. The PDRS training flow supervisor will be responsible for determining which flows are applicable for each flight, as well as defining the element and task definitions for Station Build flights. In addition, an Instructor Astronaut (IA) will be invited to observe at least one lesson during each flow.

RMS is unique in that a 2-person team will usually conduct all RMS operations. For flight planning, these operators will be designated as R1 and R2. The operator actually designated to manipulate the arm for each task will be selected after the flight assignment is made. The same arm operator does not have to be the arm manipulator for all tasks.

Some of the ORB SKL lessons have the provision to run in a combined Fixed Base (FB)/NBL environment. The flight-assigned RMS and EVA instructors will determine whether this configuration is required.

There are 4 main facilities used for hands-on RMS training: Shuttle Engineering Simulator (SES), DST, Virtual Reality Trainer (VR LAB), and SMS. The SES has a high-fidelity visual simulation plus a dynamic model of the arm, and is therefore the facility used to actually train techniques, procedures, and arm/payload responses. It can also simulate a limited number of malfunctions. There is also a part-task trainer, the DST, that is utilized during training. The DST is a high-fidelity visual simulator with a dynamic model of the arm. The VR LAB is similar to the DST but has the additional capability to use virtual reality to help train for EVA. The SMS has only a rigid dynamic arm (booms are not flexible, but rigid members; servo loop dynamics are correctly modeled). However, it does allow the full range of RMS operations, malfunctions, orbiter interfaces, and most importantly, operator coordination. Each facility is used to its maximum potential in the flow.

During training, the PDRS flow will address all PDRS criticality 1/1 and criticality 2/1R Failure Mode and Effects Analysis (FMEA) categories for which training is listed as acceptance rationale. Training cannot be used as real-time safety rationale for contingency situations not covered during training. Also, PDRS flight rules will be addressed during training.

A one-hour robotics aptitude assessment, including a pre-brief and video explaining the tasks to be performed, have been added to the beginning of the PDRS 20000-level flow. The assessment is designed to provide insight into robotic aptitude for astronaut interviewees and is currently in the verification stage. Scores from the assessment will be compared to qualification scores at the outcome of the PDRS flow to determine if a direct correlation can be drawn. The aptitude assessment, pre-brief, and video are only required once per student and if they were completed in the student's interview process, they are not required prior to entering into the 20000-level PDRS flow.

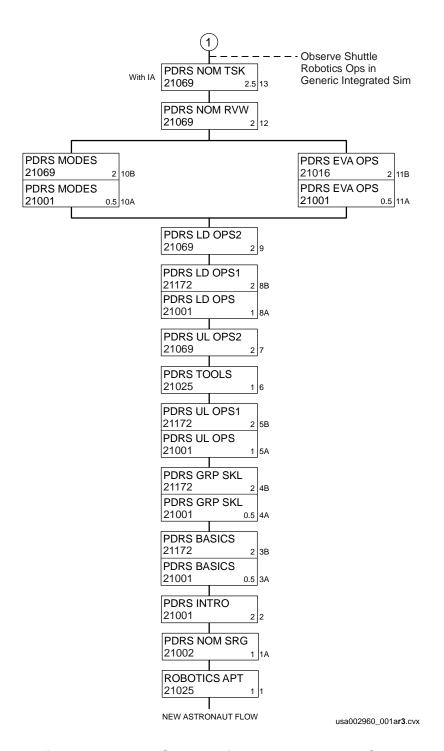


Figure 9-1. PDRS Operations Lesson Flow Chart (Sheet 1 of 13)

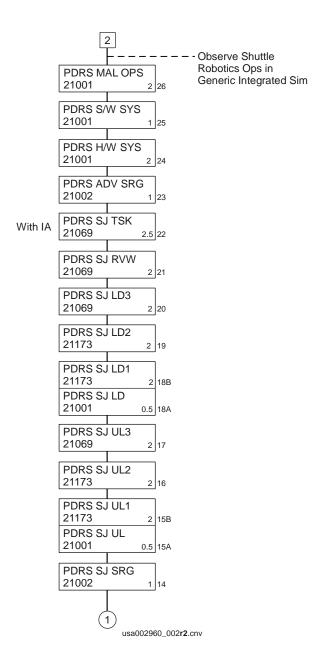


Figure 9-1. PDRS Operations Lesson Flow Chart (Sheet 2 of 13)

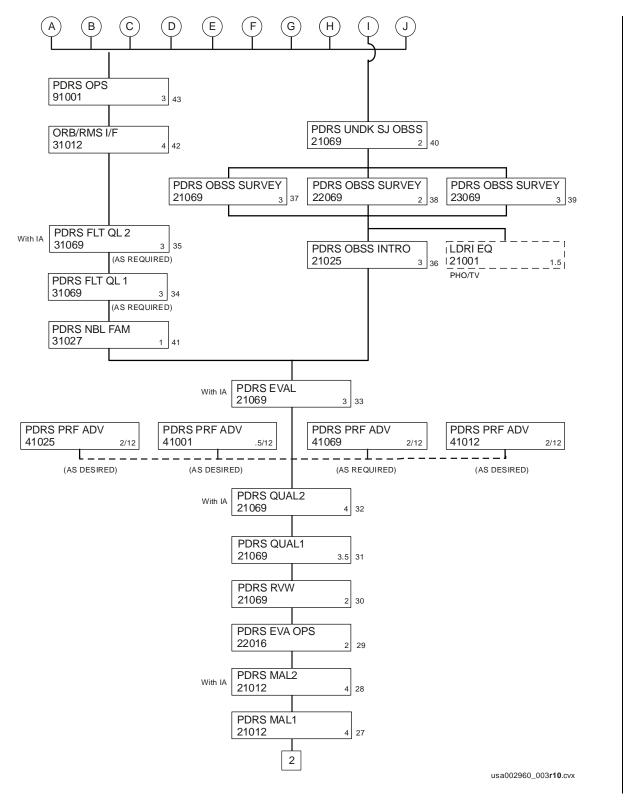


Figure 9-1. PDRS Operations Lesson Flow Chart (Sheet 3 of 13)

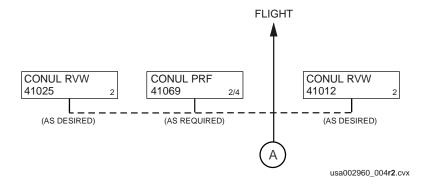


Figure 9-1. PDRS Operations Lesson Flow Chart (Sheet 4 of 13) Contingency-only Unloaded

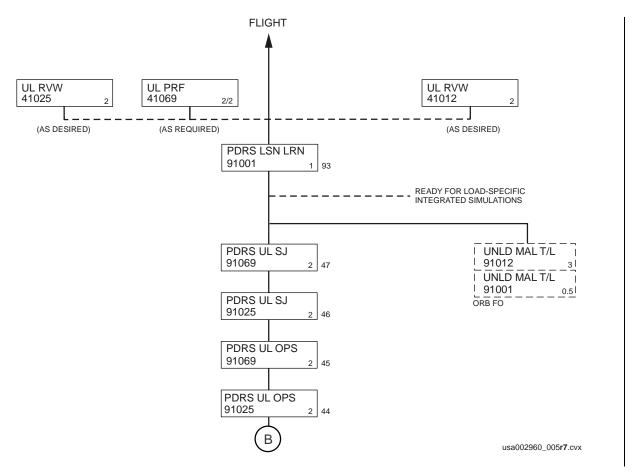


Figure 9-1. PDRS Operations Lesson Flow Chart (Sheet 5 of 13) Unloaded

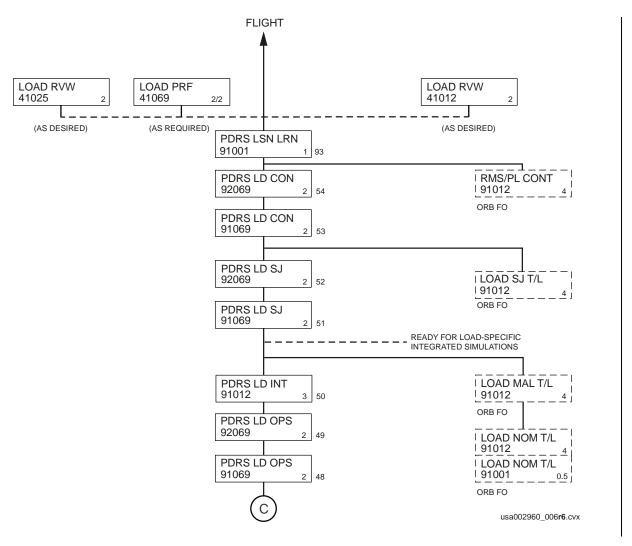


Figure 9-1. PDRS Operations Lesson Flow Chart (Sheet 6 of 13) Loaded

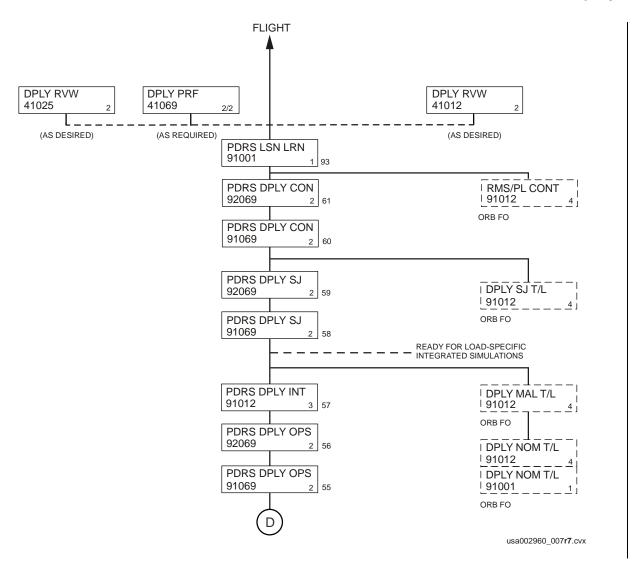


Figure 9-1. PDRS Operations Lesson Flow Chart (Sheet 7 of 13)
Deploy

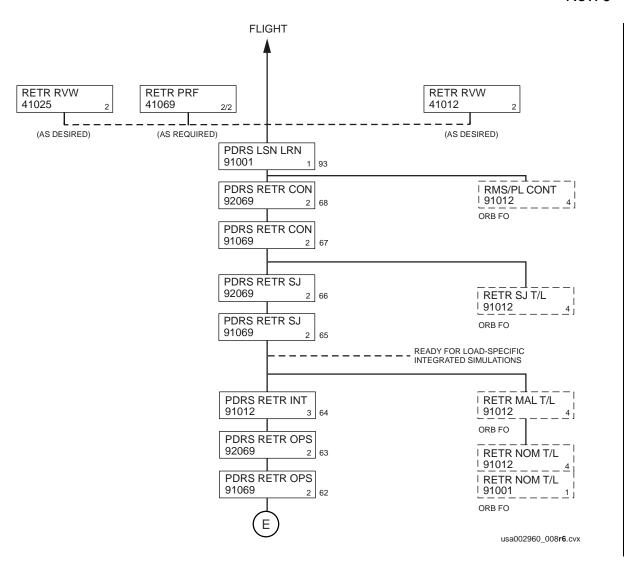


Figure 9-1. PDRS Operations Lesson Flow Chart (Sheet 8 of 13) Retrieve

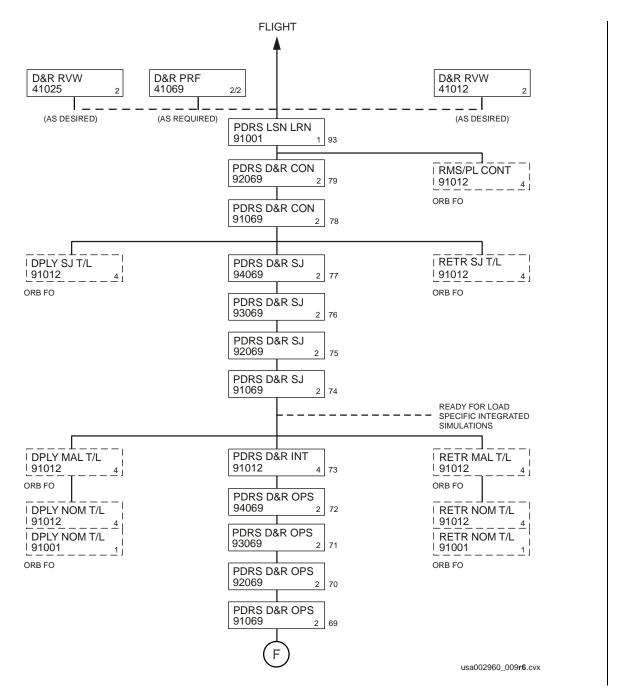


Figure 9-1. PDRS Operations Lesson Flow Chart (Sheet 9 of 13)
Deploy and Retrieve

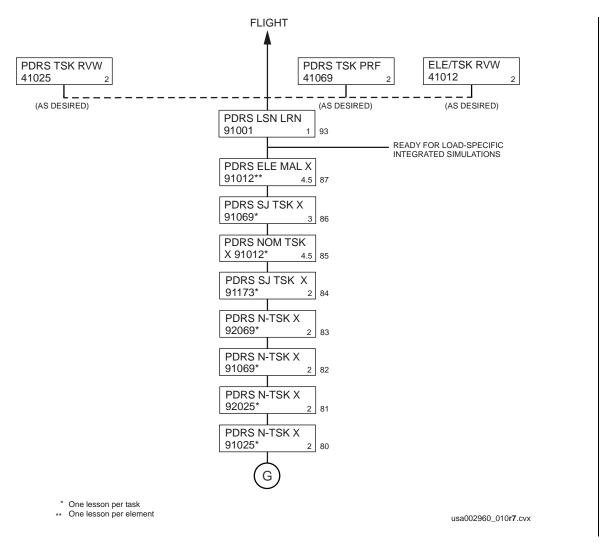


Figure 9-1. PDRS Operations Lesson Flow Chart (Sheet 10 of 13) Station Build

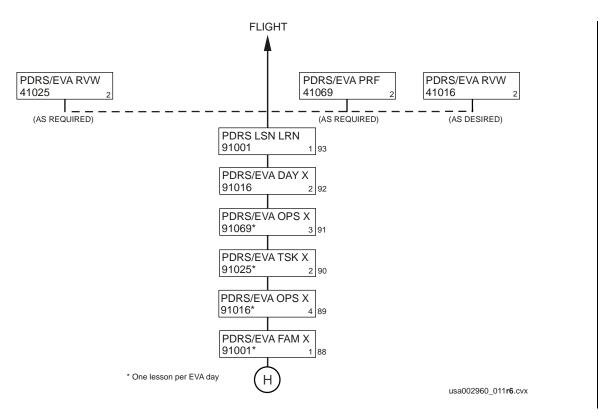


Figure 9-1. PDRS Operations Lesson Flow Chart (Sheet 11 of 13) RMS/EVA

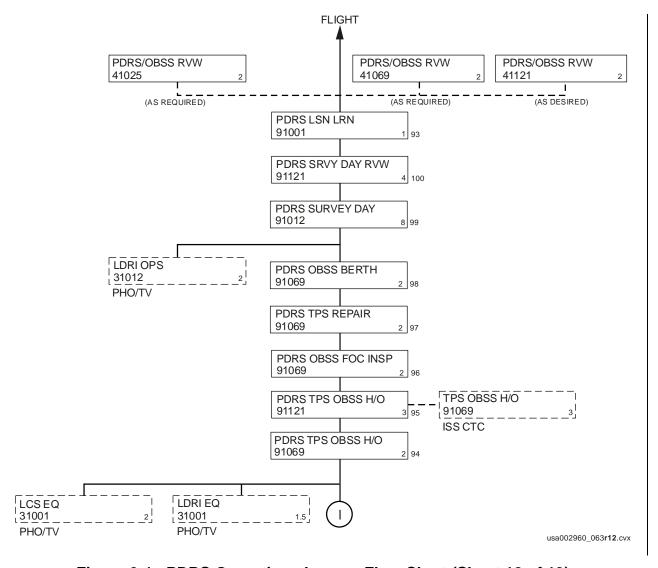


Figure 9-1. PDRS Operations Lesson Flow Chart (Sheet 12 of 13) RMS/OBSS

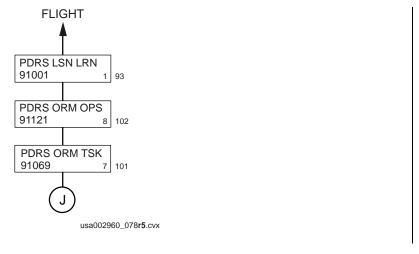


Figure 9-1. PDRS Operations Lesson Flow Chart (Sheet 13 of 13) RMS/ORM

Table 9-1. Payload Deployment and Retrieval System Crew Training Requirements

Date Last Modified: 06/08 **Crew Rotation** Non-Crew Rotation Ref R2 Sched R1 MS1 MS2 MS3 MS4 MS1 MS2 Stage Num **Lesson Code** Media Hrs Code С Ρ PS R1 C Р Alt Fac Comments PDRS NBL FAM 31027 NBL As required 4 ORB/RMS I/F 31012 FB 4 8 4 4 4 4 4 GNS 4 4 4 4 Scheduled through PDRS OPS 91001 CLR 8 3 3 3 3 3 DX22. Invite CAPCOM 4 PDRS UL OPS 91025 DST 1 DST 2,3,4,5 NET L-20 weeks 4 2 1 2 2 2 4 PDRS UL OPS 91069 SESD 2 2 2 2 2 NET L-20 weeks 2 2 2 4 PDRS N-TSK X 91025 DST 1 2 DST 2,3,4,5 1 lesson per task 4 Sub Total for Stage Stage Totals Per Crewmember: 14 4 14 14 PDRS UL SJ 91025 DST 1 2 2 2 2 DST 2,3,4,5 3 2 2 3 PDRS UL SJ 91069 **SESD** 2 2 2 3 PDRS N-TSK X 92025 DST 1 2 2 2 2 DST 2,3,4,5 1 lesson per task 3 PDRS N-TSK X 91069 SESD 2 2 2 2 2 3 PDRS N-TSK X 92069 SESD 2 2 2 2 2 2 DST 4 2 2 2 PDRS SJ TSK X 91173 1 lesson per task 3 PDRS TPS OBSS H/O 91069 SESD 2 2 2 2 Schedule with ISS SESD/ Robotics crew and 3 3 3 3 3 DX23 3 PDRS TPS OBSS H/O 91121 S1FB 8 3 3 3 Cupola 3 PDRS **OBSS FOC INSP** 91069 SESD 2 2 2 2 2 Includes EV1. EV2. Schedule this lesson with EVA BOOM OPS PDRS TPS REPAIR 91069 SESD 2 2 VR LAB TBD lesson 3 3 PDRS OBSS BERTH 91069 SESD 2 2 2 2 2 SESD/ FΒ PDRS SURVEY DAY 91012 3 8 8 8 8 8 8 8 8 Cupola This lesson should be scheduled no earlier than L-21 3 PDRS SRVY DAY RVW 91121 S1FB 8 4 weeks PDRS ORM TSK 91069 SESD 7 7 7 7 3 101 2 Schedule with ISS SESD/ Robotics crew and S1FB 8 3 PDRS ORM OPS 91121 8 8 8 8 Cupola DX23 3 Sub Total for Stage Stage Totals Per Crewmember: 50 **23 50** 0 23 50 23 3 0 50

Table 9-1. Payload Deployment and Retrieval System Crew Training Requirements (Continued)

																Date	Last Modified: 06/08	
						Non-Crew Rotation							Crew Rotation					
	Ref				Sched		R1			R2								
Stage	Num	Lesson Code	Media	Hrs	Code	С	Р	MS1	MS2	MS3	MS4	PS	R1 C	Р	MS1	MS2	Alt Fac	Comments
2	85	PDRS NOM TSK X 91012	S1FB	4.5	8	4.5	4.5		4.5		4.5		4.5	4.5		4.5	GNS/SSTF	1 lesson per task
2	86	PDRS SJ TSK X 91069	SESD	3	1		3				3		3					1 lesson per task
																		1 lesson per element.
																		Reg'd prior to element
2	87	PDRS ELE MAL X 91012	FB	4.5	8	4.5	4.5		4.5		4.5		4.5	4.5		4.5	GNS	JIS
2	93	PDRS LSN LRN 91001	CLR	1	8	1	1		1		1		1	1		1		NET L-10 weeks
2		Sub	Total for Stage		Stage Totals	Per C	rewmem	ber:										
2				13		10	13	0	10	0	13	0	13	10	0	10		
																		Schedule once. If
																		taken in interview
0		ROBOTICS APT 21025	DST 1	1	1		1				1		1					process, then N/R
0		PDRS NOM SRG 21002	WBK	1	1		1				1		1					
0		PDRS INTRO 21001	CLR	2	2		2				2		2					
0	3A	PDRS BASICS 21001	CLR	0.5	2		0.5				0.5		0.5					
0	-	PDRS BASICS 21172	DST 3	2	1		2				2		2				DST 1,2,4,5	
0	4A	PDRS GRP SKL 21001	CLR	0.5	2		0.5				0.5		0.5				5071015	
0	4B	PDRS GRP SKL 21172	DST 3	2	1		2				2		2				DST 1,2,4,5	
0	5A 5B	PDRS UL OPS 21001 PDRS UL OPS1 21172	CLR DST 3	2	1		1 2				2		1 2				DST 1,2,4,5	
0	6	PDRS TOOLS 21025	DST 1	1	1		1				1		1				DST 1,2,4,5	
0	7	PDRS UL OPS2 21069	SESD	2	1		2				2		2					
0	8A	PDRS LD OPS 21009	CLR	1	2		1				1		1					
0	8B	PDRS LD OPS1 21172	DST 3	2	1		2				2		2				DST 1,2,4,5	
0	9	PDRS LD OPS2 21069	SESD	2	1		2				2		2				DOT 1,2,4,0	
0	10A	PDRS MODES 21001	CLR	0.5	2		0.5				0.5		0.5					
0	10B	PDRS MODES 21069	SESD	2	1		2				2		2					
0	11A	PDRS EVA OPS 21001	CLR	0.5	2		0.5				0.5		0.5					
0	11B	PDRS EVA OPS 21016	VR LAB	2	1		2				2		2					
0	12	PDRS NOM RVW 21069	SESD	2	1		2				2		2					
																		Schedule Robotics IA
0		PDRS NOM TSK 21069	SESD	2.5	1		2.5				2.5		2.5					for session
0	14	PDRS SJ SRG 21002	WBK	1	1		1				1		1					
0	15A	PDRS SJ UL 21001	CLR	0.5	2		0.5				0.5		0.5					
0	15B	PDRS SJ UL1 21173	DST4	2	1		2				2		2					
0	16	PDRS SJ UL2 21173	DST 4	2	1		2				2		2					
0	17	PDRS SJ UL3 21069	SESD	2	1		2				2		2					
0	18A	PDRS SJ LD 21001	CLR	0.5	2		0.5				0.5		0.5					
0	18B	PDRS SJ LD1 21173	DST 4	2	1		2				2		2					

Table 9-1. Payload Deployment and Retrieval System Crew Training Requirements (Continued)

Date Last Modified: 06/08 Non-Crew Rotation **Crew Rotation** Ref Sched R2 Stage Num **Lesson Code** Media Code С Ρ MS1 MS2 MS3 MS4 PS R1 C MS1 MS2 Alt Fac Hrs Comments 19 PDRS SJ LD2 21173 DST 4 2 2 2 2 PDRS SJ LD3 21069 SESD 2 2 2 2 PDRS SJ RVW 21069 SESD 0 2 2 2 2 Schedule Robotics IA PDRS SJ TSK 21069 SESD 2.5 2.5 2.5 for session PDRS ADV SRG 21002 WBK 0 0 PDRS H/W SYS 21001 CLR 2 PDRS S/W SYS 21001 CLR 0 0 PDRS MAL OPS 21001 CLR 2 2 2 2 2 0 PDRS MAL1 21012 FB 4 4 4 4 GNS Schedule Robotics IA 0 PDRS MAL2 21012 4 GNS for session 2 2 2 0 PDRS EVA OPS 22016 VR LAB 2 0 PDRS RVW 21069 SESD 2 2 2 2 SESD 3.5 0 31 PDRS QUAL1 21069 3.5 3.5 3.5 Schedule Robotics IA SESD 4 4 0 PDRS QUAL2 21069 for session Schedule Robotics IA SESD PDRS EVAL 21069 3 3 for session 0 PDRS FLT QL 1 31069 SESD 3 3 3 3 As required As required. Schedule Robotics IA SESD 0 PDRS FLT QL 2 31069 for session 3 0 PDRS OBSS INTRO 21025 DST 1 3 3 3 DST 2,3,4,5 SESD 0 PDRS OBSS SURVEY 21069 3 3 3 PDRS OBSS SURVEY 22069 SESD 2 0 SESD 0 PDRS OBSS SURVEY 23069 3 2 3 3 3 PDRS UNDK SJ OBSS 21069 SESD 2 2 2 2 0 SESD 0 PDRS LD OPS 91069 2 2 2 2 0 PDRS LD OPS 92069 **SESD** 2 2 2 2 0 PDRS LD INT 91012 FB 3 3 3 3 GNS SESD 2 2 2 0 PDRS LD SJ 91069 2 2 PDRS LD SJ 92069 SESD 2 2 2 0 PDRS LD CON 91069 SESD

Table 9-1. Payload Deployment and Retrieval System Crew Training Requirements (Continued)

Date Last Modified: 06/08 Non-Crew Rotation **Crew Rotation** Ref Sched R2 Stage **Lesson Code** Media Code С Ρ MS1 MS2 MS3 MS4 PS R1 C MS1 MS2 Alt Fac Num Hrs Comments PDRS LD CON 92069 SESD 2 2 2 PDRS DPLY OPS 91069 **SESD** 2 2 2 SESD 2 PDRS DPLY OPS 92069 2 2 2 0 FB 3 3 3 3 3 0 PDRS DPLY INT 91012 GNS SESD 2 0 PDRS DPLY SJ 91069 2 2 2 SESD 0 PDRS DPLY SJ 92069 PDRS DPLY CON 91069 SESD 2 2 2 2 0 2 SESD 0 PDRS DPLY CON 92069 2 2 2 2 2 0 PDRS RETR OPS 91069 **SESD** 2 2 2 2 0 PDRS RETR OPS 92069 SESD 2 2 2 2 3 3 3 FB 3 3 GNS 0 PDRS RETR INT 91012 SESD 2 2 2 0 PDRS RETR SJ 91069 2 SESD 2 2 0 PDRS RETR SJ 92069 2 2 2 0 67 SESD 2 2 2 2 2 PDRS RETR CON 91069 SESD 0 PDRS RETR CON 92069 2 2 2 2 SESD 0 PDRS D&R OPS 91069 2 2 2 2 PDRS D&R OPS 92069 SESD 2 2 2 2 0 SESD 2 2 2 2 0 71 PDRS D&R OPS 93069 2 0 PDRS D&R OPS 94069 SESD 2 2 2 2 FB 4 4 GNS 0 PDRS D&R INT 91012 4 PDRS D&R SJ 91069 SESD 0 PDRS D&R SJ 92069 SESD 0 2 2 2 2 SESD PDRS D&R SJ 93069 2 2 2 2 2 0 SESD 0 PDRS D&R SJ 94069 2 2 2 2 2 0 PDRS D&R CON 91069 SESD 2 2 2 2 2 0 79 PDRS D&R CON 92069 SESD 2 2 2 2 1 Lesson per RMS/EVA day\*; EV PDRS/EVA FAM X 91001 CLR Crew req'd 0 1 Lesson per RMS/EVA day\*; EV VR LAB 0 PDRS/EVA OPS X 91016 8 4 Crew reg'd 1 Lesson per PDRS/EVA TSK X 91025 DST 2,3,4,5 RMS/EVA day

\*Note 1: Required students are EV1, EV2, IV, R1, and R2.

Table 9-1. Payload Deployment and Retrieval System Crew Training Requirements (Concluded)

Date Last Modified: 06/08 Non-Crew Rotation Crew Rotation Ref Sched R2 Stage Num **Lesson Code** Media Code С Ρ MS1 MS2 MS3 MS4 PS R1 C MS1 MS2 Alt Fac Hrs Comments 1 Lesson per SESD RMS/EVA day PDRS/EVA OPS X 91069 3 3 0 1-2 3 RMS/EVA day\*; EV VR LAB 2 Crew req'd 0 PDRS/EVA DAY X 91016 0 PDRS PRF ADV 41025 DST 1 2 2 2 2 DST 2,3,4,5 0 PDRS PRF ADV 41001 CLR 0.5 1-2 0.5 0.5 0.5 SESD 0 PDRS PRF ADV 41069 2 2 2 2 As required 0 PDRS PRF ADV 41012 FB 2 1-2 2 2 2 GNS (SSTF) DST 1 DST 2,3,4,5 0 CONUL RVW 41025 2 2 2 2 0 CONUL PRF 41069 **SESD** 2 2 2 2 As needed 0 CONUL RVW 41012 FΒ 2 3 2 2 2 2 GNS DST 1 2 2 2 0 UL RVW 41025 2 DST 2,3,4,5 0 UL PRF 41069 SESD 2 2 2 2 As needed UL RVW 41012 FΒ 2 3 2 2 2 GNS 0 0 **LOAD RVW 41025** DST 1 2 2 2 2 DST 2,3,4,5 0 **LOAD RVW 41012** FB 2 3 2 2 2 GNS 2 2 As needed 0 LOAD PRF 41069 SESD 2 2 DST 1 2 2 2 2 DST 2,3,4,5 0 **DPLY RVW 41025** SESD FB 2 2 0 **DPLY PRF 41069** 2 2 As needed GNS 0 **DPLY RVW 41012** 2 2 2 2 0 RETR RVW 41025 DST 1 2 2 2 DST 2,3,4,5 As needed SESD 2 2 2 **RETR PRF 41069** 2 0 FB GNS 0 **RETR RVW 41012** 2 2 2 2 2 0 D&R RVW 41025 DST 1 2 2 2 2 DST 2,3,4,5 D&R PRF 41069 SESD 2 2 2 As needed 0 2 0 D&R RVW 41012 FB 2 2 2 2 DST 1 2 2 DST 2,3,4,5 0 PDRS TSK RVW 41025 2 As needed PDRS TSK PRF 41069 SESD 2 0 2 0 ELE/TSK RVW 41012 FB 2 2 2 GNS (SSTF) 0 PDRS/EVA RVW 41025 DST 1 2 2 2 2 DST 2,3,4,5 0 PDRS/EVA PRF 41069 SESD 2 2 2 2 0 PDRS/EVA RVW 41016 VR LAB 2 8 2 2 2 2 DST 2,3,4,5 0 PDRS/OBSS RVW 41025 DST 1 2 2 2 PDRS/OBSS RVW 41069 SESD 2 2 2 2 2 0 As needed SESD/ Schedule with ISS 0 PDRS/OBSS RVW 41121 S1FB 2 Cupola Robotics Crew Stage Totals Per Crewmember: 0 Sub Total for Stage 33 237 0 237 237 0 0 0

### 1 **ROBOTICS APT 21025**

Title: Robotics Aptitude Assessment

Duration: 1.0 hour

Medium: Dynamic Skills Trainer 1

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 03/04

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: Read 14 page Robotic Aptitude Assessment pre-brief and view

22 minute video obtained from Astronaut Scheduling Office.

Synopsis: This session will assess the aptitude a student has for robotics. The

lesson is in the validation stage and the scores will be compared to the qualification scores attained at the end of the robotics training flows to

determine if a direct correlation can be made.

Objectives: Demonstrate the robotic skill basics.

### 1A **PDRS NOM SRG 21002**

Title: Payload Deployment and Retrieval System Nominal Student

Reference Guide

Duration: 1.0 hour

Medium: Workbook (PDRS Student Reference Guide)

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: PDRS OV 21002

Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

Synopsis: This document contains information on PDRS systems and operations.

The Nominal section introduces the student to the PDRS displays and

controls, operating modes, and operating constraints.

Objectives: • Comprehend the displays and controls associated with PDRS

operations.

Comprehend the PDRS operating modes.

• Comprehend the PDRS operating constraints.

### 2 **PDRS INTRO 21001**

Title: Payload Deployment and Retrieval System Introduction

Duration: 2.0 hours
Medium: Classroom
Student: R1, R2

Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS NOM SRG 21002

Preparation: None

Synopsis: This lesson contains an overview of the PDRS training flow, training

facilities, and FDF. The lesson also introduces the PDRS displays and

controls including PDRS-related SPECs and Panel A8.

Objectives: • Know the scope and purpose of the PDRS 20000 level flow.

Identify RMS training facilities capabilities and constraints.

 Know the FDF, reference documentation, and resources associated with RMS operations.

Know the role of displays and controls associated with PDRS operations.

• Identify the generic PDRS procedures.

 Comprehend the Task Standards and Evaluation Criteria for the PDRS flow.

### 3A **PDRS BASICS 21001**

Title: Payload Deployment and Retrieval System Basics

Duration: 0.5 hours
Medium: Classroom
Student: R1, R2

Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: PDRS UNL OPS 21001

Equipment Required: None

Prerequisite Lesson(s): PDRS INTRO 21001

Preparation: None

Synopsis: The student will learn the coordinate frames and the use of Euler

Sequences. Correct hand controller techniques will be introduced. The

grapple target will also be explained.

# 3A PDRS BASICS 21001 (Concluded)

Objectives: • Comprehend the coordinate systems used in RMS Operations.

- Comprehend the RMS unloaded operating modes.
- Comprehend the available cameras to support tasks.
- Comprehend correct Hand Controller (HC) techniques.
- Comprehend the skills associated with grapple fixture target alignment.

# 3B **PDRS BASICS 21172**

Title: Payload Deployment and Retrieval System Basics

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 3 or DST 1, 2, 4 or 5

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: PDRS BASICS 21025, PDRS UNL OPS 21024

Equipment Required: None

Prerequisite Lesson(s): PDRS BASICS 21001

Preparation: None

Synopsis: The student will be shown the operation of the DST by an instructor. The

student will also demonstrate knowledge and utilization of RMS coordinate

systems and modes. The student will practice good hand controller

techniques and understand how to read a grapple target.

Objectives: • Demonstrate DST facility operations.

- Comprehend the coordinate systems used in RMS Operations.
- Demonstrate the skills associated with maneuvering an unloaded RMS.
- Demonstrate the proper use of camera views to support tasks.
- Demonstrate correct hand controller techniques.
- Demonstrate the skills associated with grapple fixture target alignment.

### 4A **PDRS GRP SKL 21001**

Title: Payload Deployment and Retrieval System Grapple Skills

Duration: 0.5 hours
Medium: Classroom
Student: R1, R2

Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: PDRS UNL OPS 21001

Equipment Required: None

Prerequisite Lesson(s): PDRS BASICS 21172

Preparation: None

# 4A PDRS GRP SKL 21001 (Concluded)

Synopsis: The student will learn the correct use of the grapple target overlay. The

student will learn End Effector (EE) operations and hardware limitations.

Objectives: • Comprehend correct use of the Grapple Target Overlay.

Comprehend EE Operations.

• Comprehend the correct response to a missed grapple (constrained).

• Comprehend the cues corresponding with the grapple envelope.

# 4B **PDRS GRP SKL 21172**

Title: Payload Deployment and Retrieval System Grapple Skills

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 3 or DST 1, 2, 4 or 5

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: PDRS UNL OPS 21024, PDRS D&C MAL 21024

Equipment Required: None

Prerequisite Lesson(s): PDRS GRP SKL 21001

Preparation: None

Synopsis: The student will practice grapple approaches with varying alignment and

demonstrate understanding of grapple target errors and End Effector (EE)

operations.

Objectives: • Demonstrate the skills associated with maneuvering an unloaded RMS.

Demonstrate the proper use of camera views to support tasks.

• Demonstrate the skills associated with grapple target alignment.

Perform payload grapple and ungrapple.

• Demonstrate proper use of grapple target overlay.

• Demonstrate skills associated with alternate mode grapple approaches.

• Demonstrate skills associated with No EE camera grapple approaches.

# 5A **PDRS UL OPS 21001**

Title: Payload Deployment and Retrieval System Unloaded Operations

Duration: 1.0 hour Medium: Classroom Student: R1, R2

Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: PDRS UNL OPS 21001, PDRS LD OPS 21001

Equipment Required: None

Prerequisite Lesson(s): PDRS GRP SKL 21172

Preparation: None

Synopsis: This prebrief will provide a discussion of the material to be covered in the

associated lesson. The material includes arm capabilities and constraints and Auto modes. Space Flight Resource Management (SFRM) as it

pertains to arm operations will also be discussed.

Objectives: • Comprehend singularities and reach limits of RMS.

• Comprehend the function of Position Orientation Hold Submode (POHS) in RMS Ops.

Comprehend the use of Relative (REL) Display Mode in RMS Ops.

Comprehend SFRM techniques associated with RMS tasks.

• Comprehend the correct response to a missed grapple (free flyer).

### 5B **PDRS UL OPS1 21172**

Title: Payload Deployment and Retrieval System Unloaded Operations 1

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 3 or DST 1, 2, 4 or 5

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: PDRS NOM TSK 21024, PDRS UNL OPS 21024

Equipment Required: None

Prerequisite Lesson(s): PDRS UL OPS 21001

Preparation: None

Synopsis: The student will practice avoiding Reach Limits and singularities while

maneuvering the RMS and learn how to get out of singularities. Auto

modes, rate hold, and relative coordinates will also be covered.

### 5B PDRS UL OPS1 21172 (Concluded)

Objectives: • Demonstrate skills associated with unloaded RMS operations.

- Demonstrate the skills associated with performing an Operator Commanded Auto Sequence (OCAS) and Automatically Commanded Auto Sequence (ACAS).
- Comprehend RMS Singularity Regions.
- Demonstrate avoidance of Reach Limits and Singularities.
- Demonstrate skills associated with using Relative (REL) Display Mode.
- Demonstrate skills associated with using Rate Hold.

# 6 **PDRS TOOLS 21025**

Title: Payload Deployment and Retrieval System Tools

Duration: 1.0 hour

Medium: Dynamic Skills Trainer 1

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None

Equipment Required: Payload General Support Computer (PGSC)

Prerequisite Lesson(s): PDRS UL OPS1 21172

Preparation: None

Synopsis: The student will learn the software tools used with the RMS.

Objectives: • Comprehend the use of RMS Software Tools.

Demonstrate proper use of RMS Software Tools.

### 7 PDRS UL OPS2 21069

Title: Payload Deployment and Retrieval System Unloaded Operations 2

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome Student: R1, R2 (Schedule individually.) Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: PDRS UNL OPS 21024, PDRS LD OPS 21024,

PDRS LD SKL 21069

Equipment Required: Payload General Support Computer (PGSC)

Prerequisite Lesson(s): PDRS TOOLS 21025

Preparation: None

## 7 PDRS UL OPS2 21069 (Concluded)

Synopsis: The student will demonstrate skills associated with maneuvering the RMS

using RMS tools. Grapple approaches and capture/release skills

associated with Free Flyer are also practiced.

Objectives: • Demonstrate skills associated with unloaded RMS operations.

 Perform translations and rotations simultaneously while using correct hand controller techniques.

• Demonstrate the skills associated with grapple target alignment.

Perform payload grapple and ungrapple.

 Perform Space Flight Resource Management (SFRM) techniques associated with unloaded RMS tasks.

• Demonstrate the skills associated with payload release.

Demonstrate the skills associated with payload track and capture.

## 8A **PDRS LD OPS 21001**

Title: Payload Deployment and Retrieval System Loaded Operations

Duration: 1.0 hour Medium: Classroom Student: R1, R2

Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS UL OPS2 21069

Preparation: None

Synopsis: The student will learn about various loaded modes and associated

information, including Payload (PL) Identification (ID) and mass effects. Unberthing/berthing targets will also be discussed. The End Effector (EE)

Cue Card is covered as it applies to loaded operations.

Objectives: • Comprehend the RMS loaded operating modes.

Comprehend how alignment aids are utilized for RMS operations.

Comprehend Keel and Mirror target cues.

 Comprehend the use of digital readouts with respect to mode and PL ID.

## 8B **PDRS LD OPS1 21172**

Title: Payload Deployment and Retrieval System Loaded Operations 1

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 3 or DST 1, 2, 4, or 5

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: PDRS LD OPS 21024, PDRS LD SKL 21069

Equipment Required: None

Prerequisite Lesson(s): PDRS LD OPS 21001

Preparation: None

Synopsis: The student will perform payload unberthing and berthing using the Mirror

and Keel targets.

Objectives: • Demonstrate skills associated with maneuvering in Loaded RMS

modes.

Demonstrate the skills associated with payload berthing and unberthing.

• Demonstrate the skills associated with Keel and Mirror target alignment.

## 9 PDRS LD OPS2 21069

Title: Payload Deployment and Retrieval System Loaded Operations 2

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: PDRS LD OPS 21024, PDRS LD SKL 21069
Equipment Required: Payload General Support Computer (PGSC)

Prerequisite Lesson(s): PDRS LD OPS1 21172

Preparation: None

Synopsis: The student will perform unberth and berth operations. Loaded RMS

maneuvering skills are demonstrated.

Objectives: • Demonstrate Space Flight Resource Management (SFRM) techniques

associated with loaded RMS tasks.

Demonstrate the skills associated with payload grapple, unberth, and

berth.

Demonstrate the skills associated with payload maneuvering.

10A **PDRS MODES 21001** 

Title: Payload Deployment and Retrieval System Modes

Duration: 0.5 hours
Medium: Classroom
Student: R1, R2

Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS LD OPS2 21069

Preparation: None

Synopsis: The lesson reviews the relationship between Mode, Payload (PL)

Identification (ID), and digital displays. The concepts of Fly-Camera and Fly-Payload modes are introduced as well as the strategies and

techniques involved in Keel and Mirror target alignment.

Objectives: • Comprehend the relationship between Mode, PL ID, and digitals.

• Comprehend the concepts of Fly-Camera and Fly-Payload modes.

• Comprehend strategies and techniques involved in Keel/Mirror target alignment.

 Comprehend Space Flight Resource Management (SFRM) techniques associated with Fly-Camera and Fly-Payload.

 Comprehend the use of Relative (REL) Display Mode with Fly Camera and Fly-Payload modes.

#### 10B **PDRS MODES 21069**

Title: Payload Deployment and Retrieval System Modes

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS MODES 21001

Preparation: None

Synopsis: The student will unberth and berth payloads in Fly-Camera and

Fly Payload modes using the Mirror and Keel targets and Relative (REL)

Display Mode.

#### 10B PDRS MODES 21069 (Concluded)

- Objectives: Demonstrate strategies and techniques involved in Keel and Mirror target alignment.
  - Demonstrate Space Flight Resource Management (SFRM) techniques associated with Fly-Camera and Fly-Payload.
  - Demonstrate the use of REL.
  - Demonstrate skills associated with payload unberth/berth using Fly-Camera and Fly-Payload modes.

#### 11A **PDRS EVA OPS 21001**

Title: Payload Deployment and Retrieval System Extravehicular

**Activity Operations** 

Duration: 0.5 hours Medium: Classroom Student: R1, R2

Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

PDRS LD OPS2 21069 Prerequisite Lesson(s):

Preparation: None

Synopsis:

The lesson introduces the hardware associated with RMS/EVA operations. RMS-to-EVA interaction will be discussed, including voice protocol between the RMS operator and the EVA crewmember on the arm.

Objectives:

- Comprehend RMS EVA Voice Protocol.
- Identify the hardware associated with RMS EVA operations.
- Comprehend the use of digital readouts, Payload (PL) Identification (ID), and operating modes for EVA operations.
- Comprehend Space Flight Resource Management (SFRM) techniques associated with RMS EVA operations.

11B **PDRS EVA OPS 21016** 

Title: Payload Deployment and Retrieval System Extravehicular

**Activity Operations** 

Duration: 2.0 hours

Medium: Virtual Reality Trainer

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None

Equipment Required: Payload General Support Computer (PGSC)

Prerequisite Lesson(s): PDRS EVA OPS 21001

Preparation: None

Synopsis: This lesson will introduce the student to the Virtual Reality (VR) Lab.

The student will perform RMS EVA operations and tasks. There is an emphasis on communication between the RMS operator and EVA

crewmembers.

Objectives: • Demonstrate correct RMS/EVA Voice Protocol.

Demonstrate mode optimization during RMS/EVA maneuvers.

Demonstrate use of cameras to constantly view EVA crewmember.

Demonstrate awareness of joint reach limits during RMS EVA operations.

## 12 **PDRS NOM RVW 21069**

Title: Payload Deployment and Retrieval System Nominal Review

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS EVA OPS 21016, PDRS MODES 21069

Preparation: None

Synopsis: The student will practice tasks to prepare for the PDRS NOM TSK class.

Objectives: • Demonstrate skills associated with nominal unloaded and loaded RMS operations.

Demonstrate skills associated with Free Flyer Release and Capture.

 Demonstrate skills associated with Space Flight Resource Management (SFRM).

## 13 **PDRS NOM TSK 21069**

Title: Payload Deployment and Retrieval System Nominal Task

Duration: 2.5 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: PDRS NOM TSK 21024

Equipment Required: Instructor Astronaut (IA), Payload General Support

Computer (PGSC)

Prerequisite Lesson(s): PDRS NOM RVW 21069

Preparation: None

Synopsis: The student will perform nominal RMS tasks. A PDRS Checklist (C/L) and

RMS software tools will be available. This includes loaded/unloaded operations, End Effector (EE) operations, Free Flyer Track and Capture/Release, and Fly-Camera/Fly-Payload operations. An Instructor Astronaut (IA) will observe this class and provide oral and written feedback of the

student's progress.

Objectives: • Demonstrate skills associated with Payload grapple, unberth, and

maneuvering.

Demonstrate skills associated with Free Flyer Release and Capture.

Demonstrate skills associated with Space Flight Resource Management

(SFRM).

## 14 **PDRS SJ SRG 21002**

Title: Payload Deployment and Retrieval System Single Joint Student

Reference Guide

Duration: 1.0 hour

Medium: Workbook (PDRS Student Reference Guide)

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: PDRS OV 21002

Equipment Required: None

Prerequisite Lesson(s): PDRS NOM TSK 21069

# 14 PDRS SJ SRG 21002 (Concluded)

Synopsis: This document will compare and contrast the three Single Joint operating

modes of the PDRS. The Single Joint section of this document will introduce the student to Single Joint operating techniques and strategies.

Objectives: • Comprehend the three Single Joint PDRS modes.

Comprehend the strategies for Single Joint PDRS operations.

# 15A **PDRS SJ UL 21001**

Title: Payload Deployment and Retrieval System Single Joint Unloaded

Duration: 0.5 hours
Medium: Classroom
Student: R1, R2

Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: PDRS SJ UNL 21001

Equipment Required: None

Prerequisite Lesson(s): PDRS NOM TSK 21069, PDRS SJ SRG 21002

Preparation: None

Synopsis: This lesson is a discussion of single joint strategies and techniques. This

includes unloaded maneuvering and capture/release of a free flyer.

Objectives: • Comprehend visualization techniques associated with unloaded Single

Joint (SJ) operations.

• Comprehend strategies and operational techniques involved in unloaded

SJ operations.

Comprehend strategies and operational techniques as applied to

unloaded SJ dynamics.

#### 15B **PDRS SJ UL1 21173**

Title: Payload Deployment and Retrieval System Single Joint Unloaded 1

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 4

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: PDRS SJ UNL 21024, PDRS SJ SKL 21069

Equipment Required: None

Prerequisite Lesson(s): PDRS SJ UL 21001

# 15B PDRS SJ UL1 21173 (Concluded)

Synopsis: The student will perform single joint unloaded maneuvering, including

grapple approaches with and without digitals.

Objectives: • Demonstrate visualization techniques associated with unloaded single joint operations.

Demonstrate strategies and operational techniques involved in unloaded

single joint operations.

• Demonstrate strategies and operational techniques as applied to unloaded single joint dynamics.

## 16 **PDRS SJ UL2 21173**

Title: Payload Deployment and Retrieval System Single Joint Unloaded 2

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 4

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: PDRS SJ UNL 21024, PDRS SJ SKL 21069

Equipment Required: None

Prerequisite Lesson(s): PDRS SJ UL1 21173

Preparation: None

Synopsis: The student will perform grapple approaches in both single and direct

mode.

Objectives: • Demonstrate visualization techniques associated with unloaded single

joint operations.

• Demonstrate strategies and operational techniques involved in unloaded

single joint operations.

Demonstrate strategies and operational techniques as applied

to unloaded single joint dynamics.

## 17 PDRS SJ UL3 21069

Title: Payload Deployment and Retrieval System Single Joint Unloaded 3

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: PDRS SJ UNL 21024, PDRS SJ SKL 21069

Equipment Required: None

Prerequisite Lesson(s): PDRS SJ UL2 21173

Preparation: None

Synopsis: The student will practice cradling/uncradling the RMS in primary and

backup modes. Track and captures will also be performed.

Objectives: • Demonstrate skills associated with single joint unloaded operations in

Single and Direct modes.

Demonstrate skills associated with unloaded single joint dynamics.

## 18A **PDRS SJ LD 21001**

Title: Payload Deployment and Retrieval System Single Joint Loaded

Duration: 0.5 hours
Medium: Classroom
Student: R1, R2

Source: DX25/Robotics Shuttle Training

Date: 11/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS SJ UL3 21069

Preparation: None

Synopsis: This discussion will introduce arm dynamics associated with loaded single

joint RMS operations. The student will be introduced to methods of

minimizing and counteracting arm oscillations.

Objectives: • Comprehend visualization techniques associated with loaded single joint operations.

• Comprehend strategies and operational techniques involved in loaded single joint operations.

 Comprehend strategies and techniques as applied to loaded single joint dynamics.

#### 18B **PDRS SJ LD1 21173**

Title: Payload Deployment and Retrieval System Single Joint Loaded 1

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 4

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: PDRS SJ LD 21024, PDRS SJ SKL 22069

Equipment Required: None

Prerequisite Lesson(s): PDRS SJ LD 21001

Preparation: None

Synopsis: The student will perform single joint unberth and berth of a payload with

digitals.

Objectives: • Demonstrate skills associated with loaded single joint operations in

single and direct modes.

• Demonstrate skills associated with loaded single joint dynamics.

# 19 **PDRS SJ LD2 21173**

Title: Payload Deployment and Retrieval System Single Joint Loaded 2

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 4

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: PDRS SJ LD 21024, PDRS SJ SKL 22069

Equipment Required: None

Prerequisite Lesson(s): PDRS SJ LD1 21173

Preparation: None

Synopsis: The student will perform single joint unberth and berth of a payload with

and without digitals.

Objectives: • Demonstrate visualization techniques associated with loaded single

joint operations.

• Demonstrate strategies and operational techniques involved in loaded

single joint operations.

• Demonstrate strategies and operational techniques as applied to

loaded single joint dynamics.

## 20 **PDRS SJ LD3 21069**

Title: Payload Deployment and Retrieval System Single Joint Loaded 3

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: PDRS SJ LD 21024, PDRS SJ SKL 22069

Equipment Required: None

Prerequisite Lesson(s): PDRS SJ LD2 21173

Preparation: None

Synopsis: The student will perform single joint unberth and berth of a payload with

and without digitals.

Objectives: • Demonstrate visualization techniques associated with loaded single

joint operations.

• Demonstrate strategies and operational techniques involved in loaded

single joint operations.

Demonstrate strategies and operational techniques as applied to

loaded single joint dynamics.

# 21 **PDRS SJ RVW 21069**

Title: Payload Deployment and Retrieval System Single Joint Review

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS SJ LD3 21069

Preparation: None

Synopsis: The student will practice tasks to prepare for PDRS SJ TSK.

Objectives: • Demonstrate the skills associated with Single Joint (SJ) payload

grapple and unberth/berth.

• Demonstrate Space Flight Resource Management (SFRM).

## 22 PDRS SJ TSK 21069

Title: Payload Deployment and Retrieval System Single Joint Task

Duration: 2.5 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 11/04

Lesson(s) Replaced: PDRS SJ TSK 21024
Equipment Required: Instructor Astronaut (IA)
Prerequisite Lesson(s): PDRS SJ RVW 21069

Preparation: None

Synopsis: The student will perform tasks learned throughout Single Joint (SJ)

Operations. This includes loaded/unloaded single joint operations and End Effector (EE) operations. An Instructor Astronaut (IA) will observe this class and provide oral and written feedback of the student's progress.

Objectives: • Demonstrate the skills associated with SJ grapple.

• Demonstrate the skills associated with SJ payload unberth/berth.

## 23 **PDRS ADV SRG 21002**

Title: Payload Deployment and Retrieval System Advanced Student

Reference Guide

Duration: 1.0 hour

Medium: Workbook (PDRS Student Reference Guide)

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: PDRS OV 21002, PDRS MAL 21002

Equipment Required: None

Prerequisite Lesson(s): PDRS SJ TSK 21069

Preparation: None

Synopsis: This document contains details of the PDRS hardware and software. The

Advanced section of this document will also introduce the student to

PDRS failures, malfunctions, and workarounds.

Objectives: • Comprehend the PDRS components.

Comprehend the PDRS power and data flows.

• Comprehend PDRS failure indications, malfunctions, and workarounds.

## 24 **PDRS H/W SYS 21001**

Title: Payload Deployment and Retrieval System Hardware Systems

Duration: 2.0 hours
Medium: Classroom
Student: R1, R2

Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS SJ TSK 21069, PDRS ADV SRG 21002

Preparation: None

Synopsis: This lesson discusses PDRS hardware systems and components at an

advanced level. The student is introduced to the hardware and

malfunction signatures of possible component failures.

Objectives: • Describe the PDRS components and command/data flow.

• Explain the command paths for manual augmented, single, direct, and

backup modes.

Know the redundancy level of Manipulator Positioning Mechanism

(MDM) and Manipulator Potential Later (MDL) assessments.

(MPM) and Manipulator Retention Latch (MRL) components.

 Comprehend the operational impact due to the loss of RMS-related components.

## 25 **PDRS S/W SYS 21001**

Title: Payload Deployment and Retrieval System Software Systems

Duration: 1.0 hour
Medium: Classroom
Student: R1, R2

Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS H/W SYS 21001

Preparation: None

Synopsis: This lesson introduces the student to the RMS software. The software

modes will be discussed along with system health checks and Fault

Detection performed by the software.

## 25 PDRS S/W SYS 21001 (Concluded)

Objectives: • Explain the functions of the RMS software.

- Describe the software checks utilized in the RMS software.
- Describe the Fault Detection in the RMS software.

Explain the functions of the Manipulator Controller Interface Unit (MCIU) firmware.

### 26 **PDRS MAL OPS 21001**

Title: Payload Deployment and Retrieval System Malfunction Operations

Duration: 2.0 hours
Medium: Classroom
Student: R1, R2

Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS S/W SYS 21001

Preparation: None

Synopsis: This briefing will cover the End Effector (EE) Cue Card in detail.

Malfunction response and workarounds are discussed including SPEC 95,

EVA, In-Flight Maintenance (IFM), and jettison options.

Objectives: • Comprehend how the EE cue card is utilized in RMS operations.

- Comprehend the skills and techniques associated with display and control failure workarounds.
- Explain how IFMs are used to regain RMS capabilities.
- Explain how EVA activities support RMS failure resolution.
- Comprehend RMS jettison operations.
- Comprehend RMS failure monitoring at a functional level.

## 27 **PDRS MAL1 21012**

Title: Payload Deployment and Retrieval System Malfunction 1

Duration: 4.0 hours

Medium: SMS-FB (GNS)

Student: R1, R2

Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: PDRS MAL 21012, PDRS D&C MAL 21024

Equipment Required: RMS D&C Kit from IFM locker

Prerequisite Lesson(s): PDRS MAL OPS 21001

Preparation: None

Synopsis: This lesson will present various PDRS malfunction scenarios related to the

Manipulator Positioning Mechanism (MPM), Hand Controller (HC), Display and Control (D&C) panel including the installation and use of the D&C Kit. Most malfunctions will be removed after the proper procedure is complete.

SPEC 95 overrides will be used.

Objectives: • Comprehend RMS failure impacts to the D&C, HC and RMS Joints, and MPMs.

- Demonstrate proficiency in correctly responding to system failures associated with the PDRS.
- Demonstrate skills and techniques associated with D&C, HC, RMS Joints, and MPM failure workarounds.
- Demonstrate the use of PDRS D&C In-Flight Maintenance (IFM) kit and associated FDF.
- Comprehend the rationale for the D&C kit checkout.
- Demonstrate skills associated with alternate grapple approaches (HC axis swap).
- Demonstrate skills associated with Space Flight Resource Management (SFRM).
- Perform RMS On-Orbit Init, RMS Powerup, and RMS Checkout.

## 28 **PDRS MAL2 21012**

Title: Payload Deployment and Retrieval System Malfunction 2

Duration: 4.0 hours

Medium: SMS-FB (GNS)

Student: R1, R2

Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: PDRS MAL 21012

Equipment Required: Instructor Astronaut (IA), PGSC

Prerequisite Lesson(s): PDRS MAL1 21012

Preparation: None

Synopsis: This lesson will present various PDRS malfunction scenarios related to the

Manipulator Controller Interface Unit (MCIU), Arm-Based Electronics (ABE), and other systems. Most malfunctions will be removed after the proper procedure is complete. An Instructor Astronaut (IA) will observe this class and provide oral and written feedback of the student's progress.

Objectives:

- Comprehend RMS failure impacts to the Display and Control (D&C), MCIU, ABE, End Effector (EE), and Manipulator Retention Latches (MRLs).
- Demonstrate proficiency in correctly responding to system failures associated with the PDRS.
- Demonstrate skills and techniques associated with D&C failure workarounds.
- Demonstrate skills associated with Space Flight Resource Management (SFRM).
- · Perform a Station Build task.

#### 29 **PDRS EVA OPS 22016**

Title: Payload Deployment and Retrieval System Extravehicular Activity

Operations

Duration: 2.0 hours

Medium: Virtual Reality Trainer

Student: R1, R2 (Scheduled individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS MAL2 21012

# 29 PDRS EVA OPS 22016 (Concluded)

Synopsis: This lesson will continue to demonstrate the need for clear concise

communication between the RMS operator and EVA crewmember.

Objectives: • Demonstrate correct RMS/EVA Voice Protocol.

Demonstrate mode optimization during RMS/EVA maneuvers.

• Demonstrate use of cameras to constantly view EVA crewmember.

Demonstrate awareness of joint reach limits during RMS EVA

operations.

# 30 **PDRS RVW 21069**

Title: Payload Deployment and Retrieval System Review

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: PDRS RVW 21016

Equipment Required: None

Prerequisite Lesson(s): PDRS EVA OPS 22016

Preparation: None

Synopsis: The student will perform tasks learned throughout the PDRS flow. This

class is an opportunity for the student to review all RMS operations with

an instructor prior to the PDRS QUALs.

Objectives: • Demonstrate proficiency in the skills associated with maneuvering an

unloaded and loaded RMS.

Demonstrate proficiency in the skills associated with unloaded and

loaded Single Joint RMS operations.

# 31 **PDRS QUAL1 21069**

Title: Payload Deployment and Retrieval System Qualification 1

Duration: 3.5 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: PDRS QUAL 21024, PDRS QUAL 21069

Equipment Required: None

Prerequisite Lesson(s): PDRS RVW 21069

Preparation: None

Synopsis: This will be one of two operator qualification sequence lessons. Manual

augmented maneuvering skills and single joint operations will be stressed. Along with skill evaluation, the operator will be evaluated on Space Flight Resource Management (SFRM), operating within applicable flight rules,

and utilizing defined safe operational techniques.

Objectives: Demonstrate proficiency in all skills associated with RMS tasks.

## 32 **PDRS QUAL2 21069**

Title: Payload Deployment and Retrieval System Qualification 2

Duration: 4.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: PDRS QUAL 21024, PDRS QUAL 21069

Equipment Required: Instructor Astronaut (IA)
Prerequisite Lesson(s): PDRS QUAL1 21069

Preparation: None

Synopsis: This will be one of two operator qualification sequence lessons. Manual

augmented maneuvering skills and single joint operations will be stressed. Along with skill evaluation, the operator will be evaluated on Space Flight Resource Management (SFRM), operating within applicable flight rules, and utilizing defined safe operational techniques. An Instructor Astronaut

(IA) will observe this class and evaluate the student along with the

instructor.

Objectives: Demonstrate proficiency in all skills associated with RMS tasks in

configurations previously unseen.

# 33 **PDRS EVAL 21069**

Title: Payload Deployment and Retrieval System Evaluation

Duration: 3.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None

Equipment Required: Instructor Astronaut (IA)
Prerequisite Lesson(s): PDRS QUAL2 21069

Preparation: Self Study and PDRS proficiency lessons

Synopsis: The student should take this class annually to assess the retention of

RMS skills. Manual augmented maneuvering skills and single joint operations will be evaluated. Along with skill evaluation, the operator will be evaluated on Space Flight Resource Management (SFRM), operating within applicable flight rules, and utilizing defined safe operational

techniques. An Instructor Astronaut (IA) will observe this class and

evaluate the student along with the instructor.

Objectives: Demonstrate proficiency in skills associated with nominal and Single Joint

RMS operations.

#### 34 **PDRS FLT QL 1 31069**

Title: Payload Deployment and Retrieval System Flight Qualification 1

Duration: 3 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 06/08

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS QUAL 2 21069

Preparation: Self Study and PDRS proficiency lessons

Synopsis: This will be the first of two operator qualification sequence lessons.

Manual augmented maneuvering skills and single joint operations will be stressed. Along with skill evaluation, the operator will be evaluated on Space Flight Resource Management (SFRM), operating within applicable

flight rules, and utilizing defined safe operational techniques.

Objectives: Demonstrate proficiency in all skills associated with RMS tasks.

35 **PDRS FLT QL 2 31069** 

Title: Payload Deployment and Retrieval System Flight Qualification 2

Duration: 3.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2 (Schedule individually.)

Source: DX25 Date: 06/08

Lesson(s) Replaced: None

Equipment Required: Instructor Astronaut (IA)
Prerequisite Lesson(s): PDRS FLT QL 1 31069

Preparation: None

Synopsis: This will be the second of two operator qualification sequence lessons.

Manual augmented maneuvering skills and single joint operations will be stressed. Along with skill evaluation, the operator will be evaluated on Space Flight Resource Management (SFRM), operating within applicable flight rules, and utilizing defined safe operational techniques. An Instructor Astronaut (IA) will observe this class and evaluate the student along with

the instructor.

Objectives: Demonstrate proficiency in all skills associated with RMS tasks in

configurations previously unseen.

36 PDRS *OBSS INTRO* 21025

Title: Payload Deployment and Retrieval System OBSS Introduction

Duration: 3.0 hours

Medium: Dynamic Skills Trainer 1 or DST 2, 3, 4, or 5

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 06/08

Lesson(s) Replaced: PDRS UL SURVEY 91025, PDRS UL SURVEY 21025
Equipment Required: Payload General Support Computers (PGSCs) w/RSAD &

**DOUG** 

Prerequisite Lesson(s): PDRS EVAL 21069 or PDRS QUAL2 21069

Preparation: None

Synopsis: This lesson permits the arm operator to practice the exterior crew cabin

survey and PDRS procedures pertaining to the OBSS grapple, unberth,

and berth procedures.

#### 36 PDRS OBSS INTRO 21025 (Concluded)

- Objectives: Demonstrate appropriate use of Remote Manipulator System (RMS) Situational Awareness Display (RSAD) and Dynamic Onboard Ubiquitous Graphics (DOUG) for each task.
  - Perform berthed Orbiter Boom Sensor System (OBSS) grapple, unberth, berth, and release.
  - Perform the PDRS Exterior Crew Cabin Survey per the PDRS Operations (OPS) Checklist (C/L) procedures.
  - Perform OBSS berth thermal cases as time permits.
  - Demonstrate appropriate use of Dynamic Skills Trainer (DST) for future self study.

#### 37 PDRS OBSS SURVEY 21069

Title: Payload Deployment and Retrieval System OBSS Survey

3.0 hours Duration:

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2 (Schedule together.) Source: DX25/Robotics Shuttle Training

Date: 02/06

Lesson(s) Replaced: PDRS OBSS SURVEY 91069

Equipment Required: Payload General Support Computers (PGSCs) w/RSAD &

DOUG

Prerequisite Lesson(s): PDRS *OBSS INTRO* 21025, LDRI EQ 21001

Preparation: None

This lesson focuses on the undocked PDRS procedures pertaining to the Synopsis:

Orbiter Boom Sensor System (OBSS) scan operations for the starboard

wing.

Objectives:

- Integrate Remote Manipulator System (RMS) Situational Awareness Display (RSAD) and Dynamic Onboard Ubiquitous Graphics (DOUG) PGSCs into survey operations scan pattern.
- Perform OBSS grapple, unberth, and starboard wing scan.
- Perform undocked loaded PDRS/OBSS survey of the starboard wing per the PDRS Operations (OPS) Checklist (C/L) Flight Supplement (FS) procedures.

## 38 PDRS OBSS SURVEY 22069

Title: Payload Deployment and Retrieval System OBSS Survey

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2 (Schedule together.)
Source: DX25/Robotics Shuttle Training

Date: 02/06

Lesson(s) Replaced: PDRS OBSS SURVEY 92069

Equipment Required: Payload General Support Computers (PGSCs) w/RSAD and

DOUG

Prerequisite Lesson(s): PDRS OBSS INTRO 21025, LDRI EQ 21001

Preparation: None

Synopsis: This lesson focuses on the undocked PDRS procedures pertaining to the

Orbiter Boom Sensor System (OBSS) scan operations for the nose and

surrounding area.

Objectives: • Integrate Remote Manipulator System (RMS) Situational Awareness
Display (RSAD) and Dynamic Onboard Ubiquitous Graphics (DOUG)

PGSCs into survey operations scan pattern.

• Perform maneuver from the end of the starboard scan to the start

position for the nose scan, and then scan the nose.

 Perform undocked loaded PDRS/OBSS survey of the nose and surrounding area per the PDRS Operations (OPS) Checklist (C/L) Flight

Supplement (FS) procedures.

## 39 PDRS OBSS SURVEY 23069

Title: Payload Deployment and Retrieval System OBSS Survey

Duration: 3.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2 (Schedule together.)
Source: DX25/Robotics Shuttle Training

Date: 02/06

Lesson(s) Replaced: PDRS OBSS SURVEY 93069

Equipment Required: Payload General Support Computers (PGSCs) w/RSAD &

**DOUG** 

Prerequisite Lesson(s): PDRS OBSS INTRO 21025, LDRI EQ 21001

Preparation: None

Synopsis: This lesson focuses on the undocked PDRS procedures pertaining to the

Orbiter Boom Sensor System (OBSS) scan operations for the port wing.

# 39 PDRS OBSS SURVEY 23069 (Concluded)

Objectives:

- Integrate Remote Manipulator System (RMS) Situational Awareness Display (RSAD) and Dynamic Onboard Ubiquitous Graphics (DOUG) PGSCs into survey operations scan pattern.
- Perform maneuver from the end of the nose scan to the start position for the port wing scan, and then scan the port wing. After the scan is complete, berth OBSS, SRMS release, and backaway.
- Perform undocked loaded PDRS/OBSS survey of the port wing per the PDRS Operations (OPS) Checklist (C/L) Flight Supplement (FS) procedures.

## 40 PDRS UNDK SJ OBSS 21069

Title: Payload Deployment and Retrieval System Undocked Single

Joint OBSS

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2 (Schedule together.)
Source: DX25/Robotics Shuttle Training

Date: 06/08

Lesson(s) Replaced: PDRS UNDK SJ OBSS 91069

Equipment Required: Payload General Support Computers (PGSCs) w/RSAD &

DOUG

Prerequisite Lesson(s): PDRS OBSS SURVEY 21069,

PDRS OBSS SURVEY 22069, PDRS OBSS SURVEY 23069

Preparation: None

Synopsis: This lesson focuses on undocked PDRS single joint Orbiter Boom Sensor

System (OBSS) operations.

Objectives:

- Integrate Remote Manipulator System (RMS) Situational Awareness Display (RSAD) and Dynamic Onboard Ubiquitous Graphics (DOUG) PGSCs into survey operations scan pattern.
- Perform undocked single joint grapple of OBSS.
- Perform single joint unberth of OBSS with and without digitals ending at a hover position.
- Perform single joint berth of OBSS with and without digitals starting from a hover position.

**41** PDRS NBL FAM 31027

Title: Payload Deployment and Retrieval System Neutral Buoyancy Lab

Familiarization

Duration: 1.0 hour

Medium: Neutral Buoyancy Lab

Student: R1, R2 (Schedule individually.)

Source: DX25/Robotics Shuttle Training, DX/NBL RMS operator

Date: 06/08

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS QUAL2 21069 or PDRS FLT QL 2 31069

Preparation: None

Synopsis: This lesson should be scheduled after the student completes the PDRS

QUAL2 21069, *PDRS FLT QL 2 31069*, *or* upon request. The student will be briefed by NBL operators on the safety and operation of the NBL RMS. The student will learn how to operate the controls and practice safety

involved with working in the NBL.

Objectives: Know how to operate the controls in the NBL RMS workstation.

## 42 ORB/RMS I/F 31012

Title: Orbiter and Remote Manipulator System Interfaces

Duration: 4.0 hours

Medium: SMS-FB (GNS)

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT, R1, R2

Source: DX25/Robotics Shuttle Training

Date: 11/04

Lesson(s) Replaced: ORB/RMS I/F 21001, ORB/RMS I/F 21012

Equipment Required: None

Prerequisite Lesson(s): PDRS QUAL2 21069 or PDRS FLT QL 2 31069

Preparation: None

Synopsis: This lesson introduces the crew to orbiter malfunctions and procedures

that affect the RMS, and to PDRS malfunctions and procedures that affect the orbiter. This lesson also introduces the concept of the arm operators working together with the orbiter operators to complete a particular task. The lesson includes some nominal and some malfunction aspects of the EPS, DPS, Reaction Control System (RCS), CCTV system, payload deployment, proximity operations, and payload retrieval. The lesson will start with the arm in the launch configuration. The PDRS OPS C/L

## 42 ORB/RMS I/F 31012 (Concluded)

using the appropriate PDRS Operations (OPS) Checklist (C/L) Flight Supplement (FS), will grapple, unlatch, unberth, and release the payload, back off approximately 100 feet, and approach and regrapple the payload. All applicable generic flight rules will be discussed during the course of the lesson.

#### Objectives:

- Perform the generic and flight-specific portions of the PDRS OPS C/L, as required to get the arm configured for payload grapple, unberth, release, recapture, and powerdown.
- Recognize various systems malfunctions and troubleshoot per the appropriate procedures while continuing with scheduled arm operations.
- Coordinate malfunctions and symptoms between the arm operators and orbiter operators to correctly diagnose malfunction effects and determine workarounds.
- State the generic PDRS flight rules applicable to the operations contained in this lesson.

## 43 PDRS OPS 91001

Title: Payload Deployment and Retrieval System Flight-Specific

**Operations Briefing** 

Duration: 3.0 hours Medium: Classroom

Student: COMMANDER, MS 2, PILOT, R1, R2

**Note:** Invite flight-specific CAPCOM(s)

Source: DX25/Robotics Shuttle Training, DX22/Robotics Systems

Date: 02/07

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ORB/RMS I/F 31012

Preparation: None

Synopsis:

This briefing, presented by the Flight Controllers and Instructors, is designed to introduce the student to all flight-specific PDRS operations that will be conducted for the mission. It will also describe the Orbiter Boom Sensor System (OBSS) and surveys, payload(s) and retention systems, payload bay and camera configuration, and any preliminary flight rules that may be known at the time. In addition, the instructors will discuss the PDRS Training Flow and lessons learned.

# 43 PDRS OPS 91001 (Concluded)

Objectives:

- Describe the mission operations at an overview level.
- Discuss the survey operations, autosequences, and Payload Identification (PL ID) information.
- Discuss the payload configuration(s), if applicable, and the payload bay and camera layout.
- Discuss any applicable flight rules known at this time.
- Discuss layout of PDRS Checklist (C/L).
- Discuss controlling documents.
- Discuss PDRS training flows.
- Discuss PDRS lessons learned using the checklist in the presentation.

## 44 PDRS UL OPS 91025

Title: Payload Deployment and Retrieval System Unloaded Nominal

Operations

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 1 or DST 2, 3, 4, or 5

Student: R1, R2 (Schedule individually.)

Note: Schedule NET L-20 weeks.

Source: DX25/Robotics Shuttle Training

Date: 02/07

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS OPS 91001

Preparation: None

Synopsis:

This lesson provides the student with an introduction to flight-specific payload bay configurations. The student will perform a free form payload bay survey, noting locations of payload bay features and any visual obstructions of those features. The arm will start in the cradled position, and the operator will perform the ON-ORBIT INIT and RMS POWERUP from the generic PDRS Operations (Ops) Checklist (C/L), followed by the nominal RMS procedures listed in the PDRS OPS C/L Flight Supplement (FS). Time permitting, the student will perform the RMS Checkout (C/O), RMS powerdown, and RMS Deactivate procedures from the generic PDRS OPS C/L. The student will become familiar with visual cues for each major stopping point in the procedures along the way. Visual cue determination will encompass CCTV and window views. Applicable RMS flight rules will be described during the lesson.

## 44 PDRS UL OPS 91025 (Concluded)

Objectives:

- Describe the locations of payload bay features and any visual obstructions of those features.
- Be familiar with window and camera views for each phase of the nominal procedures.
- Perform arm uncradle per the generic PDRS OPS C/L.
- Discuss flight rules that apply to various RMS operations.
- Demonstrate appropriate use of Dynamic Skills Trainer (DST) for future self study.

## 45 PDRS UL OPS 91069

Title: Payload Deployment and Retrieval System Unloaded Nominal and

**Contingency Operations** 

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2

**Note:** Schedule NET L-20 weeks. Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS UL OPS 91025

Preparation: None

Synopsis:

This lesson permits the arm operator to determine the payload bay survey and revisit PDRS procedures. The class will start with a payload bay survey, during which the location of various payload bay features will be noted. Window and CCTV views will be determined, and any visual obstructions will also be noted. The arm will then be cradled in BACKUP. Emphasis will be placed on the use of out-the-window and CCTV views rather than the use of digitals. Full-up arm nominal procedures will be performed per the PDRS Operations (OPS) Checklist (C/L) Flight Supplement (FS) procedures.

#### Objectives:

- Note the location of payload bay features and visual obstructions during payload bay survey and window/CCTV view familiarization.
- Perform arm uncradle per the generic PDRS OPS C/L.
- Perform the full-up arm nominal and contingency procedures per the PDRS OPS C/L FS, as applicable, and as the facility permits.
- Cradle the arm in BACKUP per the generic PDRS OPS C/L.

# 46 PDRS UL SJ 91025

Title: Payload Deployment and Retrieval System Unloaded Single

**Joint Operations** 

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 1 or DST 2, 3, 4, or 5

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS UL OPS 91069

Preparation: None

Synopsis: This lesson allows the arm operator to perform nominal and contingency

procedures (if applicable) with a Single Joint (SJ) arm. Emphasis will be placed on RMS dynamics. The arm will start out in the cradled position. The arm will be uncradled, and then the applicable SJ procedures will be performed. After the nominal and contingency operations have been

performed, the operator will cradle the arm.

Objectives: • Uncradle and cradle the arm visually.

Perform the nominal and any applicable contingency flight-specific

procedures with a SJ arm.

#### 47 PDRS UL SJ 91069

Title: Payload Deployment and Retrieval System Unloaded Single

**Joint Operations** 

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2

Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS UL SJ 91025

# 47 PDRS UL SJ 91069 (Concluded)

Synopsis:

This lesson will allow the arm operator to perform single joint operations with the flight-specific payload bay configuration. All operations will be visual only -- No digitals will be used. The arm will be uncradled, maneuvered to the flight-specific configurations, and then cradled in BACKUP. Proper elbow camera alignment will be demonstrated. All applicable visual cues will be noted, and relevant flight rules will be discussed.

Objectives:

- Uncradle the arm visually.
- Perform the flight-specific arm maneuvers, confirming all relevant visual cues
- Cradle arm in BACKUP and correctly stow the elbow camera.

## 48 PDRS LD OPS 91069

Title: Payload Deployment and Retrieval System Loaded Nominal

Operations

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS OPS 91001

Preparation: None

Synopsis:

This lesson provides the student with an introduction to flight-specific payload and payload bay configurations. The student will perform a free-form payload bay survey, noting locations of trunnions, V-guides, grapple fixtures, and any visual obstructions of those features. The arm will start in the cradled position, and the operator will perform the RMS POWERUP from the generic PDRS Operations (OPS) Checklist (C/L). The student will then proceed to perform the nominal RMS procedures listed in the PDRS OPS C/L Flight Supplement (FS). Cross-coupling effects will be carefully examined. The student will become familiar with visual cues for each major stopping point in the procedures (e.g., low hover, high hover, etc.) along the way. Visual cue determination will encompass CCTV and window views.

# 48 PDRS LD OPS 91069 (Concluded)

The operator will also cycle through all Payload (PL) Identifications (IDs) while grappled to the berthed payload to become familiar with the PL IDs. Applicable RMS flight rules will be described during the lesson.

#### Objectives:

- Describe the locations of the trunnions, V-guides (or other payload retention devices and alignment guides), grapple fixtures, and any visual obstructions of those features.
- Be familiar with window and camera views for each phase of the nominal procedures.
- Determine cross-coupling effects and correctly compensate for them during RMS operations.
- Describe each PL ID while grappled to the berthed payload.
- Discuss flight rules that apply to various RMS operations.

#### 49 PDRS LD OPS 92069

Title: Payload Deployment and Retrieval System Loaded Nominal

Operations

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS LD OPS 91069

Preparation: None

## Synopsis:

The lesson will start with a payload bay survey, during which the location of grapple fixtures and payload retention system/alignment guides will be noted. Window and CCTV views will be determined, and any visual obstructions will also be noted. The arm will be uncradled via the generic PDRS Operations (OPS) Checklist (C/L) procedures, followed by payload grapple and unlatch per the Flight Supplement (FS) procedures. The payload will be unberthed to low hover. As time permits, loaded ops will also be performed. The payload will then be berthed and latched, and the arm will be ungrappled. The arm will then be cradled in BACKUP and the elbow camera will be stowed. Emphasis will be placed on the use of out-the-window and CCTV views rather than the use of digitals.

## 49 PDRS LD OPS 92069 (Concluded)

#### Objectives:

- Describe the location of grapple fixtures, payload retention latches/alignment guides, keel targets, or other unberthing/berthing aids, and any visual obstructions during payload survey and window/CCTV view familiarization.
- Perform arm uncradle per the generic PDRS OPS C/L.
- Perform payload grapple, unlatch, unberth to low hover, loaded maneuvers as time permits, reberth, latch, and ungrapple per the PDRS OPS C/L FS, as applicable.
- Cradle the arm in BACKUP per the generic PDRS OPS C/L and correctly stow the elbow camera.

## 50 PDRS LD INT 91012

Title: Payload Deployment and Retrieval System Loaded Introduction

Duration: 3.0 hours

Medium: SMS-FB (GNS)

Student: COMMANDER, R1, R2

Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS LD OPS 92069

Preparation: None

#### Synopsis:

This lesson will allow the arm operators to perform the nominal full-up RMS procedures in the controlling Checklist (C/L) (FLIGHT PLAN, EVA C/L, etc.). It will also introduce coordination of duties between the 2 arm operators and the orbiter operator. The class will not be run on a strict timeline. The procedures will be run slowly and methodically, during which the arm operators will try various camera views, C/L and task management techniques, verbal communication coordination, orbiter operator coordination, etc. For heavy payloads, if time permits, manual minimum impulse flying may be briefly introduced.

#### Objectives:

- Perform nominal timeline procedures with a full-up arm.
- Coordinate duties between the 2 arm operators, and with the orbiter operator, during nominal timeline operations.
- Demonstrate basic mechanics of manual minimum impulse flying if required for this payload.

# 51 PDRS LD SJ 91069

Title: Payload Deployment and Retrieval System Loaded Single Joint

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): LOAD MAL T/L 91012 (ORB FO),

PDRS LD INT 91012

Preparation: None

Synopsis: This lesson allows the arm operator to perform nominal procedures with a

Single Joint (SJ) arm. Emphasis will be placed on RMS dynamics. The arm will start out in the cradled position. The arm will be uncradled, and then the following SJ procedures will be performed: grapple, unberth to low hover, loaded operations, berth from low hover, ungrapple, and cradle. For loaded operations above the low hover position, the operator will use the Checklist (C/L) procedures and establish the visual cues for each joint

movement.

Objectives: • Uncradle, grapple, ungrapple, and cradle the arm visually.

Perform the nominal flight-specific procedures with a SJ arm.

 Describe the visual cues for each joint movement above the low hover position.

#### 52 PDRS LD SJ 92069

Title: Payload Deployment and Retrieval System Loaded Single Joint

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1. R2

Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS LD SJ 91069

# 52 PDRS LD SJ 92069 (Concluded)

Synopsis:

This lesson will allow the arm operator to perform single joint operations. All operations will be visual only -- no digitals will be used. The arm will be uncradled, the payload will be grappled and unberthed to low hover. As time permits, loaded maneuvers will be performed. The Payload (PL) will then be reberthed. After ungrapple, the arm will be cradled in BACKUP.

Objectives:

- Uncradle the arm visually.
- Grapple the payload in single joint without using digitals.
- Unberth to low hover, maneuver, and reberth the payload visually.
- Ungrapple payload, cradle arm in BACKUP.

#### 53 PDRS LD CON 91069

Title: Payload Deployment and Retrieval System Loaded Contingency

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2

Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): LOAD SJ T/L 91012 (ORB FO),

PDRS LD SJ 92069

Preparation: None

Synopsis:

This lesson will introduce the student to contingency operations for a full-up arm, contained in the PDRS Operations (OPS) Checklist (C/L) Flight Supplement (FS). Some of these procedures may include, but are not limited to, EVA/appendage deploy procedures, secondary grapple fixture procedures, and contingency (possibly designated secondary) loaded operations. The operator will note all visual cues during the procedures, and determine the best CCTV coverage of each operation. Any applicable RMS flight rules will be discussed during the lesson. This lesson will be scheduled as needed to meet mission-specific requirements.

Objectives:

- Perform all contingency or secondary full-up arm RMS procedures contained in the PDRS OPS C/L FS. State under what conditions each would be used.
- Determine the correct visual cues during each procedure.
- Describe RMS flight rules applicable to these procedures.

## 54 PDRS LD CON 92069

Title: Payload Deployment and Retrieval System Loaded Contingency

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2

Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS LD CON 91069

Preparation: None

Synopsis: This lesson will allow the student to perform contingency operations,

contained in the PDRS Operations (OPS) Checklist (C/L) Flight

Supplement (FS), for a full-up arm, as the facility permits. Some of these procedures may include, but are not limited to, EVA/appendage deploy procedures, secondary grapple fixture procedures, and contingency (possibly designated secondary) loaded operations. The operator will note all visual cues during the procedures, and determine the best CCTV coverage of each operation. Any applicable RMS flight rules will be discussed during the lesson. This lesson will be scheduled as needed to

meet mission-specific requirements.

Objectives:

- Perform all contingency or secondary full-up arm RMS procedures contained in the PDRS OPS C/L FS, as the facility permits. State under which conditions each would be used.
- Determine correct visual cues during each procedure.
- Describe RMS flight rules applicable to these procedures.

#### 55 PDRS DPLY OPS 91069

Title: Payload Deployment and Retrieval System Deploy Operations

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS OPS 91001

# 55 PDRS DPLY OPS 91069 (Concluded)

#### Synopsis:

This lesson provides an introduction to flight-specific payload and payload bay configurations. The student will perform a free-form payload bay survey, noting locations of trunnions, V-guides, grapple fixtures, and any visual obstructions of these features. The arm will start in the cradled position, and the operator will perform the RMS POWERUP from the generic PDRS Operations (OPS) Checklist (C/L). Nominal RMS procedures listed in the PDRS OPS C/L Flight Supplement (FS) will then be performed. Cross-coupling effects will be carefully examined. The student will become familiar with visual cues for each major stopping point in the procedures (e.g., low hover, high hover, etc.) along the way. Visual cue determination will encompass CCTV and window views. The operator will also cycle through all Payload (PL) Identifications (IDs) while grappled to the berthed payload to become familiar with the PL IDs. Applicable RMS flight rules will be described during the lesson.

#### Objectives:

- Describe the locations of the trunnions, V-guides (or other payload retention devices and alignment guides), grapple fixtures, and any visual obstructions of those features.
- Be familiar with window and camera views for each phase of the nominal procedures.
- Determine cross-coupling effects and correctly compensate for them during RMS operations.
- Describe each PL ID while grappled to the berthed payload.
- Discuss flight rules that apply to various RMS operations.

#### 56 PDRS DPLY OPS 92069

Title: Payload Deployment and Retrieval System Deploy Operations

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS DPLY OPS 91069

# 56 PDRS DPLY OPS 92069 (Concluded)

#### Synopsis:

The class will start with a payload bay survey, during which the location of grapple fixtures and payload retention system/alignment guides will be noted. Window and CCTV views will be determined, and any visual obstructions will also be noted. The arm will be uncradled via the generic PDRS Operations (OPS) Checklist (C/L) procedures. Payload grapple and unlatch will then be performed per the Flight Supplement (FS) procedures, and the payload will be unberthed to low hover. As time permits, deploy operations will also be performed. The payload will then be berthed and latched, and the arm will be ungrappled. The arm will then be cradled in BACKUP and the elbow camera will be stowed. Emphasis will be placed on the use of out-the-window and CCTV views rather than the use of digitals.

#### Objectives:

- Discuss the location of grapple fixtures, payload retention latches/ alignment guides, keel targets, or other unberthing/berthing aids, and visual obstructions during payload survey and window/CCTV view familiarization.
- Perform arm uncradle per the generic PDRS OPS C/L.
- Perform payload grapple, unlatch, unberth to low hover, reberth, latch, and ungrapple per the PDRS OPS C/L FS, as applicable.
- Cradle the arm in BACKUP per the generic PDRS OPS C/L and correctly stow the elbow camera.

#### 57 PDRS DPLY INT 91012

Title: Payload Deployment and Retrieval System Deploy Introduction

Duration: 3.0 hours

Medium: SMS-FB (GNS)

Student: COMMANDER, R1, R2

Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS DPLY OPS 92069

# 57 PDRS DPLY INT 91012 (Concluded)

#### Synopsis:

This lesson allows the performance of nominal full-up arm procedures in the controlling Checklist (C/L) (DEPLOY, FLIGHT PLAN, etc.). It will also introduce coordination of duties between the 2 arm operators and the orbiter operator. This lesson will not be run on a strict timeline. The procedures will be run slowly and methodically, during which the arm operators will try various camera views, C/L and task management techniques, verbal communication coordination, orbiter operator coordination, etc. For heavy payloads, if time permits, manual minimum impulse flying may be briefly introduced.

#### Objectives:

- Perform nominal timeline procedures with a full-up arm.
- Coordinate duties between the 2 arm operators and with the orbit operator during nominal timeline operations.
- Demonstrate the basic mechanics of manual minimum impulse flying if required for this payload.

#### 58 PDRS DPLY SJ 91069

Title: Payload Deployment and Retrieval System Deploy Single Joint

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): DPLY MAL T/L 91012 (ORB FO), PDRS DPLY INT 91012

Preparation: None

# Synopsis:

This lesson allows the arm operator to perform nominal procedures with a Single Joint (SJ) arm. Emphasis will be placed on RMS dynamics. The arm will start out in the cradled position. The arm will be uncradled, and then the following SJ procedures will be performed: grapple, unberth to low hover, deploy, and cradle. For deploy operations above the low hover position, the operator will use the Checklist (C/L) procedures and establish the visual cues for each joint movement.

- Uncradle, grapple, ungrapple, and cradle the arm visually.
- Perform the nominal flight-specific procedures with a single joint arm.
- Describe visual cues for each joint movement above the low hover position.

## 59 PDRS DPLY SJ 92069

Title: Payload Deployment and Retrieval System Deploy Single Joint

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2

Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS DPLY SJ 91069

Preparation: None

Synopsis: This lesson will allow the arm operator to perform single joint operations.

All operations will be visual only -- no digitals will be used. The arm will be uncradled, the payload will be grappled and unberthed to low hover. As time permits, deploy operations above low hover will be attempted. The payload will then be returned to low hover and reberthed. After ungrapple,

the arm will be cradled in BACKUP.

Objectives: • Uncradle the arm visually.

• Grapple the payload in single joint without using digitals.

• Unberth to low hover and reberth the payload visually.

Perform deploy maneuvers.

Ungrapple payload, cradle arm in BACKUP.

# 60 PDRS DPLY CON 91069

Title: Payload Deployment and Retrieval System Deploy Contingency

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2

Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): DPLY SJ T/L 91012 (ORB FO), PDRS DPLY SJ 92069

## 60 PDRS DPLY CON 91069 (Concluded)

#### Synopsis:

This lesson will introduce the student to contingency operations for a full-up arm, which are contained in the PDRS Operations (OPS) Checklist (C/L) Flight Supplement (FS). Some of these procedures may include, but are not limited to, EVA/appendage deploy procedures, secondary grapple fixture procedures, and contingency (possibly designated secondary) loaded operations. The operator will note all visual cues during the procedures, and determine the best CCTV coverage of each operation. Any applicable RMS flight rules will be discussed during the lesson. This lesson will be scheduled, as needed, to meet mission-specific requirements.

#### Objectives:

- Perform all contingency or secondary full-up arm RMS procedures contained in the PDRS OPS C/L FS. State under what conditions each would be used.
- Determine correct visual cues during each procedure.
- Describe RMS flight rules applicable to these procedures.

### 61 PDRS DPLY CON 92069

Title: Payload Deployment and Retrieval System Deploy Contingency

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2

Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS DPLY CON 91069

Preparation: None

#### Synopsis:

This lesson will allow the student to perform, as time permits, contingency operations for a full-up arm, which are contained in the PDRS Operations (OPS) Checklist (C/L) Flight Supplement (FS). Some of these procedures may include, but are not limited to, EVA/appendage deploy procedures, secondary grapple fixture procedures, and contingency (possibly designated secondary) loaded operations. The operator will note all visual cues during the procedures, and determine the best CCTV coverage of each operation. Any applicable RMS flight rules will be discussed during the lesson. This lesson will be scheduled, as needed, to meet mission-specific requirements.

## 61 PDRS DPLY CON 92069 (Concluded)

Objectives:

- Perform all contingency or secondary full-up arm RMS procedures contained in the PDRS OPS C/L FS. State under what conditions each would be used.
- Determine correct visual cues during each procedure.
- Describe RMS flight rules applicable to these procedures.
- State in which controlling document the procedures are also located.

## 62 PDRS RETR OPS 91069

Title: Payload Deployment and Retrieval System Retrieve Operations

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS OPS 91001

Preparation: None

Synopsis:

This lesson is an introduction to flight-specific payload and payload bay configurations. The student will perform a free-form payload and payload bay survey, noting locations of trunnions, V-guides, grapple fixtures, and any visual obstructions of those features. The arm will start in the cradled position, and the operator will perform the RMS POWERUP from the generic PDRS Operations (OPS) Checklist (C/L). Nominal RMS procedures, listed in the PDRS OPS C/L Flight Supplement (FS), will then be performed. Cross-coupling effects will be carefully examined. The student will become familiar with visual cues for each major stopping point in the procedures (e.g., low hover, high hover, etc.) along the way. Visual cue determination will encompass CCTV and window views. The operator will also cycle through all Payload (PL) Identifications (IDs) while grappled to the berthed payload to become familiar with the PL IDs. Applicable RMS flight rules will be described during the lesson.

- Describe the locations of the trunnions, V-guides (or other payload retention devices and alignment guides), grapple fixtures, and any visual obstructions of those features.
- Be familiar with window and camera views for each phase of the nominal procedures.

# 62 PDRS RETR OPS 91069 (Concluded)

- Determine cross-coupling effects and correctly compensate for them during RMS operations.
- Describe each PL ID while grappled to the berthed payload.
- Discuss flight rules that apply to various RMS operations.
- Comprehend the correct response to a missed grapple.

### 63 PDRS RETR OPS 92069

Title: Payload Deployment and Retrieval System Retrieve Operations

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS RETR OPS 91069

Preparation: None

Synopsis:

The lesson will start with a payload bay survey, during which the location of grapple fixtures and payload retention system/alignment guides will be noted. Window and CCTV views will be determined, and any visual obstructions will also be noted. The arm will be uncradled via the generic PDRS Operations (OPS) Checklist (C/L) procedures. Payload grapple and unlatch will then be performed per the Flight Supplement (FS) procedures, and the payload will be unberthed to low hover. As time permits, retrieve operations will also be performed. The payload will then be berthed and latched, and the arm will be ungrappled. The arm will then be cradled in BACKUP and the elbow camera will be stowed. Emphasis will be placed on the use of out-the-window and CCTV views, as well as the use of digitals.

- Describe the location of grapple fixtures, payload retention latches/ alignment guides, keel targets, or other unberthing/berthing aids and any visual obstructions during payload survey and window CCTV view familiarization.
- Perform arm uncradle per the generic PDRS OPS C/L.
- Perform payload grapple, unlatch, unberth to low hover, reberth, latch, and ungrapple per the PDRS OPS C/L FS, as applicable.
- Cradle the arm in BACKUP per the generic PDRS OPS C/L, and correctly stow the elbow camera.

# 64 PDRS RETR INT 91012

Title: Payload Deployment and Retrieval System Retrieve Introduction

Duration: 3.0 hours

Medium: SMS-FB (GNS)

Student: COMMANDER, R1, R2

Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS RETR OPS 92069

Preparation: None

Synopsis: This lesson will allow the arm operators to perform the nominal full-up

RMS procedures in the controlling Checklist (C/L) (FLIGHT PLAN, EVA C/L, etc.). It will also introduce coordination of duties between the 2 arm operators and the orbiter operator. The lesson will not be run on a strict timeline. The procedures will be run slowly and methodically, during which the arm operators will try various camera views, C/L and task management techniques, verbal communication coordination, orbiter operator coordination, etc. For heavy payloads, if time permits, manual

minimum impulse flying may be briefly introduced.

Objectives: • Perform nominal timeline procedures with a full-up arm.

• Coordinate duties between the 2 arm operators and with the orbiter operator during nominal timeline operations.

 Demonstrate basic mechanics of manual minimum impulse flying if required for this payload.

### 65 PDRS RETR SJ 91069

Title: Payload Deployment and Retrieval System Retrieve Single Joint

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): RETR MAL T/L 91012 (ORB FO), PDRS RETR INT 91012

# 65 PDRS RETR SJ 91069 (Concluded)

#### Synopsis:

This lesson allows the arm operator to perform nominal procedures with a Single Joint (SJ) arm. Emphasis will be placed on RMS dynamics. The arm will start out in the cradled position. The arm will be uncradled, and then the following SJ procedures will be performed: Maneuver to poised-for-capture orientation, payload capture, maneuver to low hover, berth from low hover, ungrapple, and cradle. For maneuvers above the low hover position, the operator will use the Checklist (C/L) procedures and establish the visual cues for each joint movement.

#### Objectives:

- Uncradle, ungrapple, and cradle the arm visually.
- Perform the nominal flight-specific procedures with a SJ arm.
- Describe visual cues for each joint movement above the low hover position.

# 66 PDRS RETR SJ 92069

Title: Payload Deployment and Retrieval System Retrieve Single Joint

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2

Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS RETR SJ 91069

Preparation: None

#### Synopsis:

This lesson will allow the arm operator to perform single joint operations with the flight-specific payload mockup. All operations will be visual only -- no digitals will be used. The arm will be uncradled, the payload will be grappled and unberthed to low hover. Retrieve maneuvers will be performed as time permits. The Payload (PL) will then be reberthed. After ungrapple, the arm will be cradled in BACKUP.

- Uncradle the arm visually.
- Grapple the payload in single joint without using digitals.
- Unberth to low hover, maneuver, and reberth the payload visually.
- Perform retrieve maneuvers.
- Ungrapple payload, cradle arm in BACKUP.

# 67 PDRS RETR CON 91069

Title: Payload Deployment and Retrieval System Retrieve Contingency

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2

Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS RETR SJ 92069, RETR SJ T/L 91012 (ORB FO)

Preparation: None

Synopsis: This lesson will introduce the student to contingency operations for a

full-up arm contained in the PDRS Operations (OPS) Checklist (C/L) Flight Supplement (FS). Some of these procedures may include, but are not limited to, EVA/appendage stow procedures, secondary grapple fixture procedures, and contingency (possibly designated secondary) loaded operations. The operator will note all visual cues during the procedures, and determine the best CCTV coverage of each operation. Any applicable RMS flight rules will be discussed during the lesson. This lesson will be

scheduled as needed to meet mission-specific requirements.

Objectives: • Perform all contingency or secondary full-up arm RMS procedures

contained in the PDRS OPS C/L FS. State under which conditions

each would be used.

• Determine correct visual cues during each procedure.

• Describe RMS flight rules applicable to these procedures.

# 68 PDRS RETR CON 92069

Title: Payload Deployment and Retrieval System Retrieve Contingency

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2

Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS RETR CON 91069

# 68 PDRS RETR CON 92069 (Concluded)

#### Synopsis:

This lesson will allow the student to perform contingency operations, contained in the PDRS Operations (OPS) Checklist (C/L) Flight Supplement (FS), for a full-up arm as the facility permits. Some of these procedures may include, but are not limited to, EVA/appendage stow procedures, secondary grapple fixture procedures, and contingency (possibly designated secondary) loaded operations. The operator will note all visual cues during the procedures, and determine the best CCTV coverage of each operation. Any applicable RMS flight rules will be discussed during the lesson. This lesson will be scheduled as needed to meet mission-specific requirements.

#### Objectives:

- Perform all contingency or secondary full-up arm RMS procedures contained in the PDRS OPS C/L FS. State under what conditions each would be used.
- Determine correct visual cues during each procedure.
- Describe RMS flight rules applicable to these procedures.

### 69 PDRS D&R OPS 91069

Title: Payload Deployment and Retrieval System Deploy and Retrieve

**Operations** 

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS OPS 91001

# 69 PDRS D&R OPS 91069 (Concluded)

#### Synopsis:

This lesson provides an introduction to flight-specific payload and payload bay configurations. The student will perform a free-form payload bay survey, noting locations of trunnions, V-guides, and grapple fixtures, and any visual obstructions of those features. The arm will start in the cradled position, and the operator will perform the RMS POWERUP from the generic PDRS Operations (OPS) Checklist (C/L). Nominal RMS procedures, listed in the PDRS OPS C/L Flight Supplement (FS), will then be performed. Cross-coupling effects will be carefully examined. The student will become familiar with visual cues for each major stopping point in the procedures (e.g., low hover, high hover, etc.) along the way. Visual cue determination will encompass CCTV and window views. The operator will also cycle through all Payload (PL) Identifications (IDs) while grappled to the berthed payload to become familiar with the PL IDs. Applicable RMS flight rules will be described during the lesson.

#### Objectives:

- Describe the locations of the trunnions, V-guides (or other payload retention devices and alignment guides), grapple fixtures, and any visual obstructions of these features.
- Be familiar with window and camera views for each phase of the nominal procedures.
- Determine cross-coupling effects and correctly compensate for them during RMS operations.
- Describe each PL ID while grappled to the berthed payload.
- Discuss flight rules that apply to various RMS operations.

## 70 PDRS D&R OPS 92069

Title: Payload Deployment and Retrieval System Deploy and Retrieve

Operations

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS D&R OPS 91069

# 70 PDRS D&R OPS 92069 (Concluded)

#### Synopsis:

This lesson provides an introduction to flight-specific payload and payload bay configurations. The student will perform a free-form payload and payload bay survey, noting locations of trunnions, V-guides, grapple fixtures, and any visual obstructions of those features. The arm will start in the cradled position, and the operator will perform the RMS POWERUP from the generic PDRS Operations (OPS) Checklist (C/L). Nominal RMS procedures, listed in the PDRS OPS C/L Flight Supplement (FS), will then be performed. Cross-coupling effects will be carefully examined. The student will become familiar with visual cues for each major stopping point in the procedures (e.g., low hover, high hover, etc.) along the way. Visual cue determination will encompass CCTV and window views. The operator will also cycle through all Payload (PL) Identifications (IDs) while grappled to the berthed payload to become familiar with the PL IDs. Applicable RMS flight rules will be described during the lesson.

#### Objectives:

- Describe the locations of the trunnions, V-guides (or other payload retention devices and alignment guides), grapple fixtures, and any visual obstructions of those features.
- Be familiar with window and camera views for each phase of the nominal procedures.
- Determine cross-coupling effects and correctly compensate for them during RMS operations.
- Note each PL ID while grappled to the berthed payload.
- Discuss flight rules that apply to various RMS operations.
- Comprehend the correct response to a missed grapple.

## 71 PDRS D&R OPS 93069

Title: Payload Deployment and Retrieval System Deploy and

**Retrieve Operations** 

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2

Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS D&R OPS 92069

## 71 PDRS D&R OPS 93069 (Concluded)

Synopsis:

The lesson will start with a payload bay survey, during which the location of grapple fixtures and payload retention system/alignment guides will be noted. Window and CCTV views will be determined, and any visual obstructions will also be noted. The arm will be uncradled via the generic PDRS Operations (OPS) Checklist (C/L) procedures. Payload grapple and unlatch will then be performed per the Flight Supplement (FS) procedures, and the payload will be unberthed to low hover. As time permits, deploy operations will also be performed. The payload will then be berthed and latched, and the arm will be ungrappled. Emphasis will be placed on the use of out-the-window and CCTV views rather than the use of digitals.

Objectives:

- Discuss the location of grapple fixtures, payload retention latches/ alignment guides, keel targets or other unberthing/berthing aids, and visual obstructions during payload survey and window/CCTV view familiarization.
- Perform arm uncradle per the generic PDRS OPS C/L.
- Perform payload grapple, unlatch, unberth to low hover, reberth, latch, and ungrapple per the PDRS OPS C/L FS, as applicable.

# 72 PDRS D&R OPS 94069

Title: Payload Deployment and Retrieval System Deploy and Retrieve

Operations

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2

Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS D&R OPS 93069

Preparation: None

Synopsis:

The lesson will start with a payload bay survey, during which the location of grapple fixtures and payload retention system/alignment guides will be noted. Window and CCTV views will be determined, and any visual obstructions will also be noted. The arm will be uncradled via the generic PDRS Operations (OPS) Checklist (C/L) procedures. Payload grapple and unlatch will then be performed per the Flight Supplement (FS) procedures, and the payload will be unberthed to low hover. As time permits, retrieve operations will also be performed.

# 72 PDRS D&R OPS 94069 (Concluded)

The payload will then be berthed and latched, and the arm will be ungrappled. Emphasis will be placed on the use of out-the-window and CCTV views as well as the use of digitals.

### Objectives:

- Note the location of grapple fixtures, payload retention latches/ alignment guides, keel targets or other unberthing/berthing aids, and visual obstructions during payload survey and window/CCTV view familiarization.
- Perform arm uncradle per the generic PDRS OPS C/L.
- Perform payload grapple, unlatch, unberth to low hover, reberth, latch, and ungrapple per the PDRS OPS C/L FS, as applicable.

## 73 PDRS D&R INT 91012

Title: Payload Deployment and Retrieval System Deploy and Retrieve

Introduction

Duration: 4.0 hours

Medium: SMS-FB (GNS)

Student: COMMANDER, R1, R2

Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS D&R OPS 94069

Preparation: None

#### Synopsis:

This lesson will allow the arm operator to perform the nominal full-up arm procedures in the controlling Checklist (C/L) (DEPLOY, FLIGHT PLAN, etc.). It will also introduce coordination of duties between the 2 arm operators and the prime orbiter operator. The lesson will not be run on a strict timeline. The procedures will be run slowly and methodically, during which the arm operators will try various camera views, C/L and task management techniques, verbal communication coordination, orbiter operator coordination, etc. For heavy payloads, if time permits, manual minimum impulse flying may be briefly introduced.

- Perform nominal timeline procedures with a full-up arm.
- Coordinate duties between the 2 arm operators and with the orbit operator during nominal timeline operations.
- Demonstrate basic mechanics of manual minimum impulse flying if required for this payload.

# 74 PDRS D&R SJ 91069

Title: Payload Deployment and Retrieval System Deploy and Retrieve

Single Joint

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): DPLY MAL T/L 91012 (ORB FO), PDRS D&R INT 91012,

RETR MAL T/L 91012 (ORB FO)

Preparation: None

Synopsis: This lesson allows the arm operator to perform nominal procedures with a

Single Joint (SJ) arm. Emphasis will be placed on RMS dynamics. The arm will start out in the cradled position. The arm will be uncradled, and then the following SJ procedures will be performed: Grapple, unberth to low hover, deploy, and cradle. For deploy operations above the low hover position, the operator will use the Checklist (C/L) procedures and establish

the visual cues for each joint movement.

Any deploy contingency operations that have SJ procedures will also be

performed in this lesson.

Objectives: • Uncradle, grapple, ungrapple, and cradle the arm visually.

Perform the nominal flight-specific procedures with a SJ arm.

 Describe visual cues for each joint movement above the low hover position.

Perform any deploy contingency SJ operations.

# 75 PDRS D&R SJ 92069

Title: Payload Deployment and Retrieval System Deploy and Retrieve

Single Joint

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS D&R SJ 91069

Preparation: None

Synopsis: This lesson allows the arm operator to perform nominal procedures with a

Single Joint (SJ) arm. Emphasis will be placed on RMS dynamics. The arm will start out in the cradled position. The arm will be uncradled, and then the following SJ procedures will be performed: Maneuver to poised-for-capture orientation, payload capture, maneuver to low hover, berth from low hover, ungrapple, and cradle. For maneuvers above the low hover position, the operator will use the Checklist (C/L) procedures and

establish the visual cues for each joint movement.

Any retrieve contingency operations that have SJ procedures will also be

performed in this lesson.

Objectives: • Uncradle, ungrapple, and cradle the arm visually.

Perform the nominal flight-specific procedures with a SJ arm.

 Describe visual cues for each joint movement above the low hover position.

Perform any retrieve contingency SJ operations.

## 76 PDRS D&R SJ 93069

Title: Payload Deployment and Retrieval System Deploy and Retrieve

Single Joint

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2

Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS D&R SJ 92069

# 76 PDRS D&R SJ 93069 (Concluded)

Synopsis:

This lesson will allow the arm operator to perform Single Joint (SJ) operations. All operations will be visual only; no digitals will be used. The arm will be uncradled, the payload will be grappled and unberthed to low hover. Deploy operations above low hover will be attempted as time permits. The payload will then be returned to low hover and reberthed. After ungrapple, the arm will be cradled in BACKUP. Any deploy contingency operations that have single joint procedures will also be performed in this lesson.

Objectives:

- Uncradle the arm visually.
- Grapple the payload in single joint without using digitals.
- Unberth to low hover and reberth the payload visually.
- Perform deploy maneuvers.
- Ungrapple payload, cradle arm in BACKUP.
- Perform deploy contingency single joint procedures.

# 77 PDRS D&R SJ 94069

Title: Payload Deployment and Retrieval System Deploy and Retrieve

Single Joint

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2

Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS D&R SJ 93069

Preparation: None

Synopsis:

This lesson will allow the arm operator to perform Single Joint (SJ) operations. All operations will be visual only; no digitals will be used. The arm will be uncradled, the payload will be grappled and unberthed to low hover. Retrieve maneuvers will be performed as time permits. The Payload (PL) will then be reberthed. Any retrieve contingency operations that have SJ procedures will also be performed in this lesson.

- Uncradle the arm visually.
- Grapple the payload in SJ without using digitals.
- Unberth to low hover, maneuver, and reberth the payload visually.
- Perform retrieve maneuvers as time permits.
- Perform retrieve contingency SJ procedures.

## 78 PDRS D&R CON 91069

Title: Payload Deployment and Retrieval System Deploy and Retrieve

Contingency

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2

Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): DPLY SJ T/L 91012 (ORB FO), PDRS D&R SJ 94069,

RETR SJ T/L 91012 (ORB FO)

Preparation: None

Synopsis: This lesson is an introduction to deploy and retrieve contingency

operations, contained in the PDRS Operations (OPS) Checklist (C/L) Flight Supplement (FS), for a full-up arm. Some of these procedures may include, but are not limited to, EVA/appendage deploy procedures, secondary grapple fixture procedures, and contingency (possibly designated secondary) loaded operations. The operator will note all visual cues during the procedures, and determine the best CCTV coverage of each operation. Any applicable RMS flight rules will be discussed during the lesson. This lesson will be scheduled as needed

to meet mission-specific requirements.

Objectives: • Perform all deploy and retrieve contingency or other off-nominal RMS

procedures contained in the PDRS OPS C/L FS. State under what

conditions each would be used.

Determine correct visual cues during each procedure.

• Describe RMS flight rules applicable to these procedures.

## 79 PDRS D&R CON 92069

Title: Payload Deployment and Retrieval System Deploy and Retrieve

Contingency

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1. R2

Source: DX25/Robotics Shuttle Training

Date: 03/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS D&R CON 91069

# 79 PDRS D&R CON 92069 (Concluded)

#### Synopsis:

This lesson will allow the student to perform deploy and retrieve contingency operations, contained in the PDRS Operations (OPS) Checklist (C/L) Flight Supplement (FS). Some of these procedures may include, but are not limited to, EVA/appendage deploy procedures, secondary grapple fixture procedures, and contingency (possibly designated secondary) loaded operations. The operator will note all visual cues during the procedures, and determine the best CCTV coverage of each operation. Any applicable RMS flight rules will be discussed during the lesson.

This lesson will be scheduled as needed to meet mission-specific requirements.

#### Objectives:

- Perform, as time permits, all deploy and retrieve contingency or other off-nominal RMS procedures contained in the PDRS OPS C/L FS.
   State under which conditions each would be used.
- Determine correct visual cues during each procedure.
- Describe RMS flight rules applicable to these procedures.

## 80 PDRS N-TSK X 91025

Title: Payload Deployment and Retrieval System Nominal (Station Element

Build) Task X

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 1 or DST 2, 3, 4, or 5

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 02/07

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS OPS 91001

Preparation: None

#### Synopsis:

This lesson introduces the arm operator to the flight-specific Station element and will be executed for each Station element task. The student will be shown a Bird's Eye View during which the location of the grapple fixtures and payload retention system/alignment guides will be noted. The arm will be configured for the start of the task as noted by the PDRS Operations (OPS) Checklist (C/L) Flight Supplement (FS) procedures. The Station element will be maneuvered to its appropriate position for the specific task. As time permits, the Station element may be berthed and latched if applicable, and the arm may be ungrappled.

## 80 PDRS N-TSK X 91025 (Concluded)

Emphasis will be placed on the use of out-the-window and CCTV views rather than the use of digitals.

#### Objectives:

- Emphasis will be placed on the instructor demonstrating Station element clearance issues, limitations of the SRMS, and complications associated with each element task.
- Describe the location of grapple fixtures, payload retention latches/alignment guides, keel targets, or other unberthing/berthing aids, Ready-To-Latch (RTL), and any visual obstructions during payload bay familiarization and window/CCTV view familiarization.
- Perform Station element task as defined in the PDRS OPS C/L FS.
- Perform berth, latch, and ungrapple, as applicable.
- Describe the Station element Payload (PL) Identification (ID).
- Be familiar with window and camera views for each phase of the nominal procedures.
- Demonstrate appropriate use of Dynamic Skills Trainer (DST) for future self study.
- Demonstrate appropriate use of Remote Manipulator System (RMS) Situational Awareness Display (RSAD) and Dynamic Onboard Ubiquitous Graphics (DOUG) for each task.

## 81 PDRS N-TSK X 92025

Title: Payload Deployment and Retrieval System Nominal (Station Element

Build) Task X

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 1 or DST 2, 3, 4, or 5

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 02/07

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS N-TSK X 91025

Preparation: None

Synopsis:

This lesson will be scheduled for each task to provide the student further exercise in optimizing the Station element task avoiding reach limits and singularities. As time permits, the Station element may be berthed, latched, and ungrappled, if applicable.

Emphasis will be placed on the use of out-the-window and CCTV views rather than the use of digitals.

#### 81 PDRS N-TSK X 92025 (Concluded)

- Objectives: Perform the Station element task, avoiding reach limits and singularities, as defined in the PDRS Operations (OPS) Checklist (C/L) Flight Supplement (FS).
  - Perform berth, latch, and ungrapple per the PDRS OPS C/L FS, as applicable.
  - Demonstrate appropriate use of Remote Manipulator System (RMS) Situational Awareness Display (RSAD) and Dynamic Onboard Ubiquitous Graphics (DOUG) for each task.

#### 82 **PDRS N-TSK X 91069**

Title: Payload Deployment and Retrieval System Nominal (Station Element

Build) Task X

2.0 hours Duration:

Medium: Shuttle Engineering Simulator Dome

Student: R1. R2

Source: DX25/Robotics Shuttle Training

02/07 Date:

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS N-TSK X 92025

Preparation: None

Synopsis:

The arm will be configured for the start of the task as defined in the PDRS Operations (OPS) Checklist (C/L) Flight Supplement (FS) and the student will perform the nominal RMS task. Cross-coupling effects will be carefully examined. The student will become familiar with visual cues for each major stopping point in the procedures (e.g., low hover, pre install, etc.) along the way. Visual cue determination will encompass CCTV and window views. The operator will also cycle through all Payload (PL) Identifications (IDs) while grappled to the element to become familiar with the PL IDs. Applicable RMS flight rules will be described during the lesson.

# 82 PDRS N-TSK X 91069 (Concluded)

Objectives:

- Determine cross-coupling effects and correctly compensate for them during RMS operations.
- Discuss flight rules that apply to various RMS operations.
- Perform the Station element task, avoiding reach limits and singularities, as defined in the PDRS OPS C/L FS.
- Develop Space Flight Resource Management (SFRM) between the 2 arm operators.
- Demonstrate appropriate use of Remote Manipulator System (RMS) Situational Awareness Display (RSAD) and Dynamic Onboard Ubiquitous Graphics (DOUG) for each task.

## 83 PDRS N-TSK X 92069

Title: Payload Deployment and Retrieval System Nominal (Station Element

Build) Task X

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2

Source: DX25/Robotics Shuttle Training

Date: 02/07

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS N-TSK X 91069

Preparation: None

Synopsis:

This lesson will be scheduled for each task to provide the student further exercise in optimizing the Station element task avoiding reach limits and singularities. Cross-coupling effects will be carefully examined. Applicable RMS flight rules will be described during the lesson. If desired, combine this class with the Cupola station for SSRMS activities.

- Perform the Station element task, avoiding reach limits and singularities, as defined in the PDRS Operations (OPS) Checklist (C/L) Flight Supplement (FS).
- Perform berth, latch, and ungrapple per the PDRS OPS C/L FS, as applicable.
- Discuss flight rules that apply to various RMS operations.
- Demonstrate appropriate use of Remote Manipulator System (RMS) Situational Awareness Display (RSAD) and Dynamic Onboard Ubiquitous Graphics (DOUG) for each task.

# 84 PDRS SJ TSK X 91173

Title: Payload Deployment and Retrieval System Single Joint

(Station Element Build) Task X

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 4

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 02/07

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS N-TSK X 92069

Preparation: None

Synopsis: This lesson will be scheduled for each Station element task. The lessons

will allow the arm operator to perform a Single Joint (SJ) Station element task with the flight-specific Station element. All operations will be visual only -- no digitals will be used. The arm will begin in the position as determined by the task, and the operator will perform the PDRS

operations in SJ.

Objectives: • Perform the SJ Station element task as specified in the PDRS Operations (OPS) Checklist (C/L) Flight Supplement (FS).

 Demonstrate appropriate use of Remote Manipulator System (RMS) Situational Awareness Display (RSAD) and Dynamic Onboard

Ubiquitous Graphics (DOUG) for each task.

#### 85 PDRS NOM TSK X 91012

Title: Payload Deployment and Retrieval System Nominal (Station Build)

Task X

Duration: 4.5 hours

Medium: SMS-FB (GNS), SSTF (Check with instructor if required.)

Student: COMMANDER, MS 2, PILOT, R1, R2

Source: DX25/Robotics Shuttle Training

Date: 02/07

Lesson(s) Replaced: None

Equipment Required: Equipment to support mission timeline exercised; request

the SSTF crew station, visuals, and TRICK model anytime a

combined session using the SSRMS is planned.

Prerequisite Lesson(s): PDRS NOM TSK X 91001

# 85 PDRS NOM TSK X 91012 (Concluded)

Synopsis:

During this lesson, the crewmembers will perform the flight-specific PDRS Station build task on the Station element, with an emphasis on the use of FDF and Flight Rules. This lesson will be scheduled for each Station element task. Some malfunctions may be introduced on a review basis. The emphasis should be on Space Flight Resource Management (SFRM). A script meeting may be required to determine the specific objectives and insert malfunctions into the timeline, if necessary.

Objectives:

- Perform all PDRS operations of the Station build task as called out in the timeline while performing other timelined activities.
- Demonstrate appropriate use of Remote Manipulator System (RMS) Situational Awareness Display (RSAD) and Dynamic Onboard Ubiquitous Graphics (DOUG) for each task.

## 86 PDRS SJ TSK X 91069

Title: Payload Deployment and Retrieval System Single Joint

(Station Element Build) Task X

Duration: 3.0 hours

Medium: Shuttle Engineering Simulator Dome Student: R1, R2 (Schedule individually.) Source: DX25/Robotics Shuttle Training

Date: 02/07

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS NOM TSK X 91012

Preparation: None

Synopsis:

This lesson will be scheduled for each Station element task. The lessons will allow the arm operator to perform a Single Joint (SJ) arm. Emphasis will be placed on RMS dynamics. At the start of the lesson, the arm will be positioned at the beginning of the Station element task. The arm will be maneuvered via the SJ procedures in the flight-specific PDRS Operations (OPS) Checklist (C/L) Flight Supplement (FS).

- Perform the flight-specific Station element task with a SJ arm.
- Demonstrate appropriate use of Remote Manipulator System (RMS) Situational Awareness Display (RSAD) and Dynamic Onboard Ubiquitous Graphics (DOUG) for each task.

#### 87 PDRS ELE MAL X 91012

Title: Payload Deployment and Retrieval System (Station) Element

Malfunction X

4.5 hours Duration:

SMS-FB (GNS), SSTF (Check with instructor if required.) Medium:

COMMANDER, MS 2, PILOT, R1, R2 Student:

DX25/Robotics Shuttle Training Source:

Date: 02/07

Lesson(s) Replaced: None

Equipment Required: Equipment to support mission timeline exercised; request

SSTF crew station, visuals, and TRICK model anytime a

combined session using the SSRMS is planned.

PDRS ELE MAL X 91001 Prerequisite Lesson(s):

Preparation: None

Synopsis: This lesson will be scheduled for each Station element. During the lesson,

the crewmembers will perform the flight-specific Station element PDRS operations as impacted by the malfunctions and/or instructor-provided scenario, with an emphasis on the use of FDF and Flight Rules. The emphasis should be on Space Flight Resource Management (SFRM).

A script meeting will be required to determine the specific objectives and insert malfunctions into the timeline.

Objectives: Perform the Station element tasks impacted by PDRS malfunctions.

This may include execution of contingency operations for the Station

element as determined by Flight Rules and CAPCOM calls.

 Demonstrate appropriate use of Remote Manipulator System (RMS) Situational Awareness Display (RSAD) and Dynamic Onboard

Ubiquitous Graphics (DOUG) for each task.

#### 88 PDRS/EVA FAM X 91001

Title: Payload Deployment and Retrieval System/Extravehicular Activity

Familiarization X

Duration: 1.0 hour Medium: Classroom

Student: EV1, EV2, IV, R1, R2

Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): **PDRS OPS 91001** 

# 88 PDRS/EVA FAM X 91001 (Concluded)

Synopsis: During this lesson, the RMS and EVA operators will sit down with the

PDRS Operations (OPS) Checklist (C/L) Flight Supplement (FS) and EVA C/L FS and instructors to discuss the flow of the EVA from the RMS position perspective. During this discussion, the crew will gain a more

in-depth awareness of the operations from both sides.

Objectives: Describe the RMS/EVA task positions.

### 89 PDRS/EVA OPS X 91016

Title: Payload Deployment and Retrieval System/Extravehicular Activity

Operations X

Duration: 4.0 hours

Medium: Virtual Reality Trainer Student: EV1, EV2, IV, R1, R2

Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS/EVA FAM X 91001

Preparation: None

Synopsis: During this session, the whole crew will exercise an entire day of RMS/

EVA operations per the flight-specific PDRS Operations (OPS) Checklist (C/L) Flight Supplement (FS). During execution, the RMS/EVA positions and attitudes will be assessed from an RMS operator and EVA point of view for efficiency and accessibility. Voice protocol for Ground Controlled Approach (GCA) and high situational awareness will be emphasized. Off-nominal EVA positions close to the final position values and close to structure will be used to emphasize the need for high situational

structure will be used to emphasize the need for hig

awareness.

Objectives: • Perform the flight-specific PDRS OPS C/L FS procedures for the EVA

day.

Demonstrate proper voice protocol.

**Note:** Class credit can be given for NBL simulation time.

## 90 PDRS/EVA TSK X 91025

Title: Payload Deployment and Retrieval System/Extravehicular Activity

Task X

Duration: 2.0 hours

Medium: Dynamics Skills Trainer 1 or DST 2, 3, 4 or 5

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 02/07

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS/EVA OPS X 91016

Preparation: None

Synopsis:

This lesson will be scheduled for each EVA day utilizing the RMS. This lesson will allow the operator to perform simulated RMS/EVA operations for the flight-specific payload tasks utilizing flight-like EVA hardware. During this lesson, the operator will perform RMS/EVA maneuvers as noted in the PDRS Operations (OPS) Checklist (C/L) Flight Supplement (FS). Close attention shall be given to peculiar maneuvers that may come close to reach limits and singularities. Window and CCTV views will be determined, and any visual obstructions will also be noted. Voice protocol for Ground Controlled Approach (GCA) and high situation awareness will be emphasized. Off-nominal EVA positions close to the final position values and close to structure will be used to emphasize the need for high situational awareness.

- Describe the RMS/EVA task positions.
- Describe visual obstructions and window/CCTV view familiarization.
- Perform RMS/EVA flight-specific payload tasks per the PDRS OPS C/L FS.
- Recognize reach limit and singularity constraints, as applicable.
- Demonstrate appropriate use of Dynamic Skills Trainer (DST) for future self study.

## 91 PDRS/EVA OPS X 91069

Title: Payload Deployment and Retrieval System/Extravehicular Activity

Operations X

Duration: 3.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2 (Schedule individually or together.)

Source: DX25/Robotics Shuttle Training

Date: 02/07

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS/EVA TSK X 91025

Preparation: None

Synopsis:

This lesson will allow the operator to perform simulated RMS/EVA operations for the flight-specific payload tasks with simulated RMS dynamics. During this lesson, the operator will perform the RMS/EVA maneuvers as noted in the PDRS Operations (OPS) Checklist (C/L) Flight Supplement (FS). Off-nominal modes may be utilized to prepare the student for possible failure scenarios (e.g., Single Joint (SJ) operations). Close attention shall be given to peculiar maneuvers that may come close to reach limits and singularities. Window and CCTV views will be determined, and any visual obstructions will also be noted. Voice protocol for Ground Controlled Approach (GCA) and high situational awareness will be emphasized. Off nominal EVA positions close to the final position values and close to structure will be used to emphasize the need for high situational awareness.

- Describe visual obstructions and window/CCTV view familiarization.
- Perform RMS/EVA flight-specific payload tasks per the PDRS OPS C/L FS.
- Recognize reach limit and singularity constraints, as applicable.
- Demonstrate appropriate use of Remote Manipulator System (RMS) Situational Awareness Display (RSAD) and Dynamic Onboard Ubiquitous Graphics (DOUG) for each task.

# 92 PDRS/EVA DAY X 91016

Title: Payload Deployment and Retrieval System/Extravehicular Activity

Day X

Duration: 2.0 hours

Medium: Virtual Reality Trainer Student: EV1, EV2, IV, R1, R2

Source: DX25/Robotics Shuttle Training

Date: 02/07

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS/EVA OPS X 91069

Preparation: None

Synopsis: During this session, the whole crew will exercise the RMS/EVA positions

and attitudes for the flight-specific EVA day. The crew will perform the RMS/EVA operations per the flight-specific PDRS Operations (OPS) Checklist (C/L) Flight Supplement (FS). Voice protocol for Ground Controlled Approach (GCA) and high situational awareness will be emphasized. Off-nominal EVA positions close to the final position values and close to structure will be used to emphasize the need for high

situational awareness. Last minute changes to procedures are suggested to be practical during this session if applicable.

suggested to be practical during this session if applicable.

Objectives: • Perform the flight-specific PDRS OPS C/L FS procedures for the

EVA day.

• Demonstrate proper voice protocol.

• Demonstrate appropriate use of Remote Manipulator System (RMS) Situational Awareness Display (RSAD) and Dynamic Onboard

Ubiquitous Graphics (DOUG) for each task.

**Note:** Class credit may be given for NBL simulation time.

## 93 PDRS LSN LRN 91001

Title: Payload Deployment and Retrieval System Lessons Learned

Duration: 1.0 hour Medium: Classroom

Student: COMMANDER, MS 2, PILOT, R1, R2

**Note:** Schedule NET L-10 weeks Source: DX25/Robotics Shuttle Training

Date: 02/07

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

## 93 PDRS LSN LRN 91001 (Concluded)

Synopsis: This briefing is designed to discuss lessons learned from previous

missions involving PDRS operations. It will be used as a forum to brief the

student(s) on items of interest and last minute "what-if" scenarios.

Objectives: • Discuss PDRS/EVA lessons learned from previous mission operations including malfunctions.

• Describe PDRS techniques used on previous missions.

 Review PDRS Lessons Learned Checklist from PDRS OPS 91001 briefing and any other recent flight lessons learned.

## 94 PDRS TPS OBSS H/O 91069

Title: Payload Deployment and Retrieval System TPS OBSS Handoff

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2 (Schedule together.)
Source: DX25/Robotics Shuttle Training

Date: 06/08

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS UNDK SJ OBSS 21069, LCS EQ 31001.

LDRI EQ 31001

Preparation: None

Synopsis: This lesson focuses on the docked PDRS procedures pertaining to the

Orbiter Boom Sensor System (OBSS) nominal and single joint handoff

operations.

Objectives: • Perform docked SSRMS handoff of the OBSS to the SRMS. This is to

be performed using SRMS nominal and single joint procedures.

 Perform docked SRMS handoff of the OBSS to the SSRMS. This is to be performed using SRMS nominal and single joint procedures.

• Demonstrate appropriate use of Remote Manipulator System (RMS)

Situational Awareness Display (RSAD) and Dynamic Onboard

Ubiquitous Graphics (DOUG) for each task.

95 PDRS TPS OBSS H/O 91121

Title: Payload Deployment and Retrieval System TPS OBSS Handoff

Duration: 3.0 hours

Medium: SMS-FB/SSTF (SESD/Cupola)

Student: COMMANDER, MS 2, PILOT, R1, R2, M1, M2

Source: DX25/Robotics Shuttle Training, DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: PDRS DOCK SURVEY 91121

Equipment Required: Request the SSTF crew station, visuals, and TRICK model

anytime a combined session using the SSRMS is planned.

Prerequisite Lesson(s): PDRS TPS OBSS H/O 91069

Preparation: None

**Note:** This lesson should be scheduled in conjunction with the Mobile

Servicing System (MSS) Thermal Protection System (TPS) Orbiter Boom Sensor System (OBSS) Handoff (H/O) 91069 listed in the ISS

Crew Training Catalog (CTC).

Synopsis: This lesson focuses on the docked PDRS procedures pertaining to the

Orbiter Boom Sensor System (OBSS) scan operations.

Objectives: • Perform docked SSRMS grapple of OBSS, and handoff the OBSS to

the SRMS.

SRMS perform a docked focused inspection with the OBSS.

SRMS handoff the OBSS to SSRMS and SSRMS berth OBSS.

Demonstrate appropriate use of Remote Manipulator System (RMS)
 Situational Awareness Display (RSAD) and Dynamic Onboard

Ubiquitous Graphics (DOUG) for each task.

#### 96 PDRS *OBSS FOC INSP* 91069

Title: Payload Deployment and Retrieval System OBSS Focused Inspection

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2 (Schedule together.)
Source: DX25/Robotics Shuttle Training

Date: 06/08

Lesson(s) Replaced: PDRS UNDOCK SURVEY 91069

Equipment Required: None

Prerequisite Lesson(s): PDRS TPS OBSS H/O 91121

Preparation: None

Synopsis: This lesson focuses on PDRS focused inspection procedures with the

Orbiter Boom Sensor System (OBSS).

#### 96 PDRS OBSS FOC INSP 91069 (Concluded)

- Objectives: Perform Remote Manipulator System (RMS) Situational Awareness Display (RSAD) and Dynamic Onboard Ubiquitous Graphics (DOUG) review using setup checklist with DOUG target file.
  - Perform a focused inspection using focused inspection procedures from a previous flight.
  - Demonstrate appropriate use of RSAD and DOUG for each task.

#### 97 PDRS TPS REPAIR 91069

Title: Payload Deployment and Retrieval System Thermal Protection

System (TPS) Repair

2.0 hours **Duration:** 

Medium: Shuttle Engineering Simulator Dome

Note: This lesson can be done in the SES-D (or VR Lab).

R1, R2, EV1, EV2 (Schedule together.) Student:

DX25/Robotics Shuttle Training Source:

Date: 06/08

Lesson(s) Replaced: None Equipment Required: None

PDRS OBSS FOC INSP 91069 Prerequisite Lesson(s):

Preparation: None

Note: Scheduling this lesson with the EVA BOOM OPS TBD lesson should

be considered.

Synopsis: This lesson focuses on PDRS contingency TPS repair with EV1 based on

the Orbiter Boom Sensor System (OBSS).

Objectives: Perform a contingency TPS repair with EV1 based on the OBSS

including EV ingress, maneuver to repair position, and maneuver back

to egress.

Demonstrate appropriate Ground Control Assist (GCA) in support of

TPS repair.

Demonstrate appropriate use of Remote Manipulator System (RMS)

Situational Awareness Display (RSAD) and Dynamic Onboard

Ubiquitous Graphics (DOUG) for each task.

98 **PDRS OBSS BERTH 91069** 

Title: Payload Deployment and Retrieval System Orbiter Boom Sensor

System (OBSS) Berth

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2 (Schedule together.)
Source: DX25/Robotics Shuttle Training

Date: 06/08

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS TPS REPAIR 91069

Preparation: None

Synopsis: This lesson focuses on PDRS Orbiter Boom Sensor System (OBSS)

berthing operations.

Objectives: • Perform several OBSS berths using the thermal model distortion

models developed during STS-114.

 Demonstrate appropriate use of T markings taking into account parallax between the OBSS and starboard manipulator positioning mechanisms.

• Demonstrate appropriate use of Remote Manipulator System (RMS) Situational Awareness Display (RSAD) and Dynamic Onboard

Ubiquitous Graphics (DOUG) for each task.

#### 99 PDRS SURVEY DAY 91012

Title: Payload Deployment and Retrieval System Survey Day

Duration: 8.0 hours Medium: SMS-FB

Student: COMMANDER, MS 2, PILOT, R1, R2

Source: DX25/Robotics Shuttle Training

Date: 02/07

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS OBSS BERTH 91069, LDRI OPS 31012

Preparation: None

Synopsis: This lesson focuses on PDRS flight day two operations. Flight Day One

operations may also be used if desired.

#### 99 PDRS SURVEY DAY 91012 (Concluded)

- Objectives: Perform PDRS Operations (OPS) Checklist (C/L) Flight Supplement (FS) procedures pertaining to flight day two.
  - Perform Orbiter Boom Sensor System (OBSS) grapple and unberth.
  - Perform OBSS survey.
  - Perform OBSS berth and release.
  - Demonstrate appropriate use of Remote Manipulator System (RMS) Situational Awareness Display (RSAD) and Dynamic Onboard Ubiquitous Graphics (DOUG) for each task.

#### 100 PDRS SRVY DAY RVW 91121

Title: Payload Deployment and Retrieval System Survey Day Review

**Duration:** 4.0 hours

SMS-FB/SSTF (SESD/Cupola) Medium:

COMMANDER, MS 2, PILOT, R1, R2 Student:

Source: DX25/Robotics Shuttle Training

Date: 06/08

Lesson(s) Replaced: None Equipment Required: None

PDRS SURVEY DAY 91012 *Prerequisite Lesson(s):* 

Preparation: None

This lesson provides a review and focuses on PDRS flight day two Synopsis:

operations. Flight Day One operations may also be used if desired.

- Perform PDRS Operations (OPS) Checklist (C/L) Flight Supplement (FS) procedures pertaining to flight day two.
- Perform Orbiter Boom Sensor System (OBSS) grapple and unberth.
- Perform OBSS starboard survey.
- Perform/Discuss pan/tilt crosshair operation communication with Thermal Protection System (TPS) Imagery Coordinator/Instrumentation and Communications Officer/Payload Deployment and Retrieval System/Capsule Communication (TIC/INCO/PDRS/CAPCOM).
- Perform OBSS berth and release as time permits.
- Demonstrate appropriate use of Remote Manipulator System (RMS) Situational Awareness Display (RSAD) and Dynamic Onboard Ubiquitous Graphics (DOUG) for each task.

## **101** PDRS ORM TSK 91069

Title: Payload Deployment and Retrieval System ORM Task

Duration: 7.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2 (Schedule together.)
Source: DX25/Robotics Shuttle Training

Date: 11/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS OPS 91001

Preparation: None

Synopsis: This lesson focuses on the docked PDRS procedures pertaining to the

Orbiter Repair Maneuver (ORM) task and/or the Shuttle Development Test

Objective (DTO) pertaining to the ORM.

Objectives: • Perform docked grapple of the Pressurized Mating Adapter (PMA),

undock, and perform auto sequence maneuver from the undocked

position to the repair position.

Discuss the situational awareness cues needed from ISS.

• Discuss the repair procedure.

Perform auto sequence from the repair position to the pre-docked

position.

# 102 PDRS ORM OPS 91121

Title: Payload Deployment and Retrieval System ORM Operations

Duration: 8.0 hours

Medium: SMS-FB/SSTF (SESD/Cupola)

Student: COMMANDER, MS 2, PILOT, R1, R2, M1, M2

Source: DX25/Robotics Shuttle Training, DX23/Station Mechanical & Robotic

Systems Training

Date: 11/04

Lesson(s) Replaced: None

Equipment Required: Request the SSTF crew station, visuals, and TRICK model

anytime a combined session using the SSRMS is planned.

Prerequisite Lesson(s): PDRS ORM TSK 91069

Preparation: None

**Note:** This lesson should be scheduled in conjunction with the Mobile

Servicing System (MSS) Thermal Protection System (TPS) Orbiter Repair Maneuver (ORM) VIEW 91025 lesson listed in the ISS Crew

Training Catalog (CTC).

## 102 PDRS ORM OPS 91121 (Concluded)

Synopsis: This lesson is a full dress rehearsal for the docked PDRS procedures

pertaining to the Orbiter Repair Maneuver (ORM) operation and/or the

Shuttle DTO pertaining to the ORM.

Objectives: • Perform docked grapple of the Pressurized Mating Adapter (PMA),

undock, and perform auto sequence maneuver from the undocked position to the repair position.

• Demonstrate the coordination of the situational awareness cues needed

from ISS.

• Discuss the repair procedure.

 Perform auto sequence from the repair position to the pre-docked position, dock the orbiter to the ISS, and ungrapple the PMA.

# PDRS PRF ADV 41025

Title: Payload Deployment and Retrieval System Proficiency Advanced

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 1 or DST 2, 3, 4 or 5

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 02/07

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

Synopsis: This lesson provides a review of those RMS operations supported by the

DST. The student will determine which operations to review and may

repeat this lesson as desired without instructor involvement.

Objectives: • The objectives for this lesson will be determined by the student and instructor on a case-by-case basis.

 Demonstrate appropriate use of Remote Manipulator System (RMS) Situational Awareness Display (RSAD) and Dynamic Onboard Ubiquitous Graphics (DOUG) for each task.

 Demonstrate appropriate use of Dynamic Skills Trainer (DST) for future self study.

## PDRS PRF ADV 41001

Title: Payload Deployment and Retrieval System Proficiency Advanced

Duration: 0.5 hours Medium: Classroom

Student: R1, R2 (Schedule individually or in pairs.)

Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

Synopsis: This lesson provides a review of systems and operations best covered in a

classroom environment. The specific content of the lesson will be

determined by the student and instructor. The lesson may be repeated as

desired.

Objectives: The objectives for this lesson will be determined by the student and the

instructor on a case-by-case basis.

### PDRS PRF ADV 41069

Title: Payload Deployment and Retrieval System Proficiency Advanced

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

Synopsis: This lesson provides a review of those RMS operations that are best

supported by the SES. It is recommended that this lesson be taken on a

periodic basis to maintain the proficiency of RMS operators. The

instructor will select items for review prior to the session. This lesson may be repeated as desired, on an availability basis, but is recommended at least once every 3 months after qualification, on an alternating basis with

PDRS PRF ADV 41025 and PDRS PRF ADV 41012.

Objectives: The objectives for this lesson will be assessed on a case-by-case basis by

the RMS flight instructor, or by the PDRS training flow supervisor or

lesson instructor should there be no assigned flight instructor.

# PDRS PRF ADV 41012

Title: Payload Deployment and Retrieval System Proficiency Advanced

Duration: 2.0 hours

Medium: SMS-FB (GNS), SSTF (Check with instructor if required.) Student: COMMANDER, R1, R2 (Schedule individually or in pairs.)

Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None

Equipment Required: Request SSTF crew station, visuals, TRICK model anytime a

combined session using SSRMS is planned.

Prerequisite Lesson(s): None

Preparation: None

Synopsis: This lesson provides for a review of those RMS operations requiring crew

coordination and orbiter interfaces. It is recommended that this lesson be taken on a periodic basis to maintain the proficiency of RMS operators. The instructor and students will select items for review prior to the session. This lesson may be scheduled as desired on an availability basis, but is recommended at least once every 3 months, on an alternating basis with

PDRS PRF ADV 41025 and PDRS PRF ADV 41069.

Objectives: The objectives for this lesson will be assessed on a case-by-case basis by

the RMS flight instructor, or by the PDRS training flow supervisor or

lesson instructor should there be no assigned flight instructor.

#### **CONUL RVW 41025**

Title: Contingency-Only Unloaded Payload Deployment and Retrieval

System Review

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 1 or DST 2, 3, 4 or 5

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

# CONUL RVW 41025 (Concluded)

Synopsis: This lesson provides a review of those contingency-only unloaded RMS

operations supported by the DST. The student will determine which operations to review, and may repeat this lesson as desired without

instructor involvement.

Objectives: The objectives for this lesson will be determined by the student and

instructor on a case-by-case basis.

### **CONUL PRF 41069**

Title: Contingency-Only Unloaded Payload Deployment and Retrieval

System Proficiency

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: COMMANDER, R1, R2 (Schedule individually.)

Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

Synopsis: This lesson provides for a review of those contingency-only unloaded

RMS operations that are best supported by the SES. The instructor and student will select items for review prior to the session. This lesson may be repeated as desired on an availability basis, but is recommended at

least once every month.

Objectives: The objectives for this lesson will be determined by the instructor and

student on a case-by-case basis.

#### **CONUL RVW 41012**

Title: Contingency-Only Unloaded Payload Deployment and Retrieval

System Review

Duration: 2.0 hours

Medium: SMS-FB (GNS)

Student: COMMANDER, R1, R2

Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

# **CONUL RVW 41012 (Concluded)**

Synopsis: This lesson provides a review of those contingency-only unloaded RMS

operations requiring crew coordination and orbiter interfaces. The instructor and students will select items for review prior to the session. This lesson may be scheduled as desired on an availability basis.

Objectives: The objectives for this lesson will be determined by the instructor and

students on a case-by-case basis.

#### **UL RVW 41025**

Title: Unloaded Payload Deployment and Retrieval System Review

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 1 or DST 2, 3, 4 or 5

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS UL SJ 91069, UNLD MAL T/L 91012 (ORB FO)

Preparation: None

Synopsis: This lesson provides a review of those unloaded RMS operations

supported by the DST. The student will determine which operations to

review, and may repeat this lesson as desired without instructor

involvement.

Objectives: The objectives for this lesson will be determined by the student and

instructor on a case-by-case basis.

#### **UL PRF 41069**

Title: Unloaded Payload Deployment and Retrieval System Proficiency

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS UL SJ 91016, UNLD MAL T/L 91012 (ORB FO)

# **UL PRF 41069 (Concluded)**

Synopsis: This lesson provides a review of those unloaded RMS operations that are

best supported by the SES. The instructor and student will select items for review prior to the session. This lesson may be repeated as desired on an availability basis, but is recommended at least once every 2 weeks

after completion of scheduled flight-specific SES training.

Objectives: The objectives for this lesson will be determined by the instructor and

student on a case-by-case basis.

### **UL RVW 41012**

Title: Unloaded Payload Deployment and Retrieval System Review

Duration: 2.0 hours

Medium: SMS-FB (GNS)

Student: COMMANDER, R1, R2

Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS UL SJ 91016, UNLD MAL T/L 91012 (ORB FO)

Preparation: None

Synopsis: This lesson provides a review of those unloaded RMS operations requiring

crew coordination and orbiter interfaces. The instructor and students will select items for review prior to the session. This lesson may be scheduled

as desired, on an availability basis.

Objectives: The objectives for this lesson will be determined by the instructor and

students on a case-by-case basis.

### **LOAD RVW 41025**

Title: Loaded Payload Deployment and Retrieval System Review

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 1 or DST 2, 3, 4 or 5

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS LD CON 92069, RMS/PL CONT 91012 (ORB FO)

# LOAD RVW 41025 (Concluded)

Synopsis: This lesson provides a review of those loaded RMS operations that are

best supported by the DST. The student will determine which operations

to review, and may repeat this lesson as desired without instructor

involvement.

Objectives: The objectives for this lesson will be determined by the student and

instructor on a case-by-case basis.

# **LOAD PRF 41069**

Title: Loaded Payload Deployment and Retrieval System Proficiency

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS LD CON 92069, RMS/PL CONT 91012 (ORB FO)

Preparation: None

Synopsis: This lesson provides for a review of those loaded RMS operations that are

best supported by the SES. The instructor and student will select items for review prior to the session. This lesson may be repeated as desired on an availability basis, but is recommended at least once every 2 weeks

after completion of the last scheduled SES lesson.

Objectives: The objectives for this lesson will be determined by the instructor and

student on a case-by-case basis.

#### **LOAD RVW 41012**

Title: Loaded Payload Deployment and Retrieval System Review

Duration: 2.0 hours Medium: SMS-FB (GNS)

Student: COMMANDER, R1, R2

Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS LD CON 92069, RMS/PL CONT 91012 (ORB FO)

# LOAD RVW 41012 (Concluded)

Synopsis: This lesson provides a review of those loaded RMS operations requiring

crew coordination and orbiter interfaces. The instructor and students will select items for review prior to the session. This lesson may be scheduled

as desired on an availability basis.

Objectives: The objectives for this lesson will be determined by the instructor and

students on a case-by-case basis.

#### **DPLY RVW 41025**

Title: Deploy Payload Deployment and Retrieval System Review

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 1 or DST 2, 3, 4 or 5

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS DPLY CON 92069, RMS/PL CONT 91012 (ORB FO)

Preparation: None

Synopsis: This lesson provides a review of those deploy RMS operations supported

by the DST. The student will determine which operations to review, and

may repeat this lesson as desired without instructor involvement.

Objectives: The objectives for this lesson will be determined by the student and

instructor on a case-by-case basis.

#### **DPLY PRF 41069**

Title: Deploy Payload Deployment and Retrieval System Proficiency

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS DPLY CON 92069, RMS/PL CONT 91012 (ORB FO)

# **DPLY PRF 41069 (Concluded)**

Synopsis: This lesson provides a review of those deploy RMS operations that are

best supported by the SES. The instructor and student will select items for review prior to the session. This lesson may be repeated as desired on an availability basis, but is recommended at least once every 2 weeks

after the completion of the last scheduled SES lesson.

Objectives: The objectives for the lesson will be determined by the instructor and

student on a case-by-case basis.

#### **DPLY RVW 41012**

Title: Deploy Payload Deployment and Retrieval System Review

Duration: 2.0 hours

Medium: SMS-FB (GNS)

Student: COMMANDER, R1, R2

Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS DPLY CON 92069, RMS/PL CONT 91012 (ORB FO)

Preparation: None

Synopsis: This lesson provides a review of those deploy RMS operations requiring

crew coordination and orbiter interfaces. The instructor and students will select items for review prior to the session. This lesson may be scheduled

as desired on an availability basis.

Objectives: The objectives for this lesson will be determined by the instructor and

students on a case-by-case basis.

#### **RETR RVW 41025**

Title: Retrieve Payload Deployment and Retrieval System Review

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 1 or DST 2, 3, 4 or 5

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS RETR CON 92069, RMS/PL CONT 91012 (ORB FO)

### **RETR RVW 41025 (Concluded)**

Synopsis: This lesson provides a review of those retrieve RMS operations that are

best supported by the DST. The student will determine which operations

to review, and may repeat this lesson as desired without instructor

involvement.

Objectives: The objectives for this lesson will be determined by the student and

instructor on a case-by-case basis.

# **RETR PRF 41069**

Title: Retrieve Payload Deployment and Retrieval System Proficiency

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS RETR CON 92069, RMS/PL CONT 91012 (ORB FO)

Preparation: None

Synopsis: This lesson provides a review of those retrieve RMS operations that are

best supported by the SES. The instructor and student will select items for review prior to the session. This lesson may be repeated as desired on an availability basis, but is recommended at least once every 2 weeks

after the last scheduled SES lesson.

Objectives: The objectives for this lesson will be determined by the instructor and

student on a case-by-case basis.

# **RETR RVW 41012**

Title: Retrieve Payload Deployment and Retrieval System Review

Duration: 2.0 hours Medium: SMS-FB (GNS)

Student: COMMANDER, R1, R2

Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS RETR CON 92069, RMS/PL CONT 91012 (ORB FO)

### **RETR RVW 41012 (Concluded)**

Synopsis: This lesson provides a review of those retrieve RMS operations requiring

crew coordination and orbiter interfaces. The instructor and students will select items for review prior to the session. This lesson may be scheduled

as desired on an availability basis.

Objectives: The objectives for this lesson will be determined by the instructor and

students on a case-by-case basis.

#### **D&R RVW 41025**

Title: Deploy and Retrieve Payload Deployment and Retrieval System

Review

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 1 or DST 2, 3, 4 or 5

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS D&R CON 92069, RMS/PL CONT 91012 (ORB FO)

Preparation: None

Synopsis: This lesson provides a review of those deploy and retrieve RMS

operations that are best supported by the DST. The student will determine which operations to review, and may repeat this lesson as

desired without instructor involvement.

Objectives: The objectives for this lesson will be determined by the student and

instructor on a case-by-case basis.

#### **D&R PRF 41069**

Title: Deploy and Retrieve Payload Deployment and Retrieval System

Proficiency

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS D&R CON 92069, RMS/PL CONT 91012 (ORB FO)

### **D&R PRF 41069 (Concluded)**

Synopsis: This lesson provides a review of those deploy and retrieve RMS

operations that are best supported by the SES. The instructor and student

will select items for review prior to the session. This lesson may be

repeated as desired on an availability basis, but is recommended at least once every 2 weeks after completion of the last scheduled SES lesson.

Objectives: The objectives for this lesson will be determined by instructor and student

on a case-by-case basis.

### **D&R RVW 41012**

Title: Deploy and Retrieve Payload Deployment and Retrieval System

Review

Duration: 2.0 hours

Medium: SMS-FB (GNS)

Student: COMMANDER, R1, R2

Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS D&R CON 92069, RMS/PL CONT 91012 (ORB FO)

Preparation: None

Synopsis: This lesson provides a review of those deploy and retrieve RMS

operations requiring crew coordination and orbiter interfaces. The instructor and students will select items for review prior to the session. This lesson may be scheduled as desired on an availability basis.

Objectives: The objectives for this lesson will be determined by the instructor and

students on a case-by-case basis.

#### PDRS TSK RVW 41025

Title: Payload Deployment and Retrieval System (Station Element) Task

Review

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 1 or DST 2, 3, 4 or 5

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS ELE MAL X 91012

# PDRS TSK RVW 41025 (Concluded)

Synopsis: This lesson provides a review of those Station element RMS tasks that are

best supported by the DST. The student will determine which operations

to review, and may repeat this lesson as desired without instructor

involvement.

Objectives: The objectives for this lesson will be determined by the student and

instructor on a case-by-case basis.

#### PDRS TSK PRF 41069

Title: Payload Deployment and Retrieval System (Station Element) Task

Proficiency

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS ELE MAL X 91012

Preparation: None

Synopsis: This lesson provides for a review of those Station element RMS tasks that

are best supported by the SES. The instructor and student will select items for review prior to the session. This lesson may be repeated as desired on an availability basis, but is recommended at least once every

2 weeks after completion of the last scheduled SES lesson.

Objectives: The objectives for this lesson will be determined by the instructor and

student on a case-by-case basis.

#### **ELE/TSK RVW 41012**

Title: (Station) Element/Task Review

Duration: 2.0 hours

Medium: SMS-FB (GNS), SSTF (Check with instructor if required.)

Student: COMMANDER, R1, R2

Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None

Equipment Required: Request the SSTF crew station, visuals, and TRICK model

anytime a combined session using the SSRMS is planned.

Prerequisite Lesson(s): PDRS ELE MAL X 91012

# **ELE/TSK RVW 41012 (Concluded)**

Synopsis: This lesson provides a review of those Station element RMS tasks

requiring crew coordination and orbiter interfaces. The instructor and students will select items for review prior to the session. This lesson may

be scheduled as desired on an availability basis.

Objectives: The objectives for this lesson will be determined by the instructor and

student(s) on a case-by-case basis.

# PDRS/EVA RVW 41025

Title: Payload Deployment and Retrieval System/Extravehicular Activity

Review

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 1 or DST 2, 3, 4 or 5

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS/EVA DAY X 91016

Preparation: None

Synopsis: This lesson provides a review of those RMS/EVA operations that are best

supported by the DST. The student will determine which operations to

review, and may repeat this lesson as desired without instructor

involvement.

Objectives: The objectives for this lesson will be determined by the student and

instructor on a case-by-case basis.

## PDRS/EVA PRF 41069

Title: Payload Deployment and Retrieval System/Extravehicular Activity

Proficiency

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS/EVA DAY X 91016

Preparation: None

Synopsis: This lesson provides a review of those RMS/EVA operations that are best

supported by the SES. The instructor and student will select items for review prior to the session. This lesson may be repeated as desired on an availability basis, but is recommended at least once every 2 weeks after

completion of the last scheduled SES lesson.

Objectives: The objectives for this lesson will be determined by the instructor and

students on a case-by-case basis.

#### PDRS/EVA RVW 41016

Title: Payload Deployment and Retrieval System/Extravehicular Activity

Review

Duration: 2.0 hours

Medium: Virtual Reality Trainer Student: EV1, EV2, IV, R1, R2

Source: DX25/Robotics Shuttle Training

Date: 09/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS/EVA DAY X 91016

Preparation: None

Synopsis: This lesson provides a review of those RMS/EVA operations requiring full

crew coordination. The instructor and students will select items for review prior to the session. This lesson may be scheduled as desired on an

availability basis.

Objectives: The objectives for this lesson will be determined by the instructor and

students on a case-by-case basis.

#### PDRS/OBSS RVW 41025

Title: Payload Deployment and Retrieval System/Orbiter Boom Sensor

System Review

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 1 or DST 2, 3, 4 or 5

Student: R1, R2 (Schedule individually.)
Source: DX25/Robotics Shuttle Training

Date: 03/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS SURVEY DAY 91012

Preparation: None

Synopsis: This lesson provides a review of those RMS/Orbiter Boom Sensor System

(OBSS) operations that are best supported by the DST. The student will determine which operations to review, and may repeat this lesson as

desired without instructor involvement.

Objectives: The objectives for this lesson will be determined by the instructor and

student on a case-by-case basis.

# **PDRS/OBSS RVW 41069**

Title: Payload Deployment and Retrieval System/Orbiter Boom Sensor

System Review

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome

Student: R1, R2 (Schedule together.)
Source: DX25/Robotics Shuttle Training

Date: 03/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PDRS SURVEY DAY 91012

Preparation: None

Synopsis: This lesson provides a review of those RMS/Orbiter Boom Sensor System

(OBSS) operations that are best supported by the SES. The instructor and student will select items for review prior to the session. This lesson may be repeated as desired on an availability basis, but is recommended at least once every 2 weeks after completion of the last scheduled SES

lesson.

Objectives: The objectives for this lesson will be determined by the instructor and

student on a case-by-case basis.

# PDRS/OBSS RVW 41121

Title: Payload Deployment and Retrieval System/Orbiter Boom Sensor

System Review

Duration: 2.0 hours (or more if desired)
Medium: SMS-FB/SSTF (SESD/Cupola)
Student: R1, R2 (Schedule together.)
Source: DX25/Robotics Shuttle Training

Date: 03/04

Lesson(s) Replaced: None

Equipment Required: Request the SSTF crew station, visuals, and TRICK model

anytime a combined session using the SSRMS is planned.

Prerequisite Lesson(s): PDRS SURVEY DAY 91012

Preparation: None

Synopsis: This lesson provides a review of those RMS/Orbiter Boom Sensor System

(OBSS) operations requiring crew coordination and orbiter interfaces. The instructor and students will select items for review prior to the session. This lesson may be scheduled as desired on an availability basis.

Objectives: The objectives for this lesson will be determined by the instructor and

students on a case-by-case basis.

# SECTION 10.0 RENDEZVOUS/PROXIMITY OPERATIONS TRAINING COURSE

The Rendezvous/Proximity Operations Training Course documents the training required for the CDR, PLT, and MS for Planned Rendezvous (Rndz), Deploy only, Deploy plus Proximity Operations (Prox Ops), and EVA Rescue. A core Rendezvous flow is included for CAPCOMs and Pilot Pool crews. The CDR will select the MS responsible for Rendezvous and Prox Ops support. An EVA crewmember should be avoided for this selection. A transfer crewmember for Station shall not be assigned to any rendezvous task.

Prior to starting rendezvous training, a student should consider taking MAN MNVR 21025 and the ORBIT DAP CBT lesson.

The training required consists of the following:

PLANNED or Planned Contingency Rendezvous (i.e., Station, HST): Take the entire flow (20000 + 30000 + 90000)

CORE Rendezvous Flow ("CAPCOM" or "Pilot Pool" Flow): Take 20000-level DEPLOY and RNDZ CORE Flow only

DEPLOY; planned or contingency PROX OPS return (i.e., EURECA):

Take: "DEPLOY CORE"

APPR & F/A 31069 PO APPR 31069

DEPLOY ONLY (no planned return) (i.e., IUS):

Take: "DEPLOY CORE"

Orbit FO: PROX OPS T/L 91012 (may be deleted if objectives are met

in another session)

**EVA Rescue:** 

Take: PROX INTRO 21001

PROX INTRO 21069

EVA RESCUE 21001/21069

A crewmember is qualified to support a generic rendezvous integrated simulation upon completion of core training (20000-level) in the Rendezvous training flow, as long as proficiency is maintained at the advanced level. RNDZ PRF ADV 41006, R/PO PRF ADV 41069, and a sim-pack briefing need to have been taken within one month of the integrated simulation. This requirement can be waived if a crewmember supported an integrated simulation within the past 3 months.

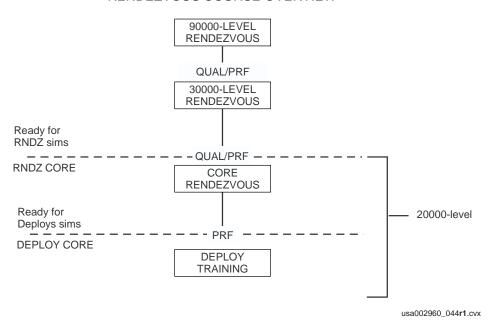
After completion of the Planned Rendezvous Training or Contingency Rendezvous training, proficiency is maintained at the advanced level by taking R/PO PRF ADV 41069 and RNDZ PRF ADV 41006 every 6 months.

If a crewmember is qualified at the advanced level, the flight requirements for the core Rendezvous training can be met by taking RNDZ PRF ADV 41006 and EVA RESCUE 21069, and R/PO PRF ADV 41069, and then taking RNDZ QUAL 41006 and R/PO QUAL 41069. These lessons should be taken within one month of each other and need to be completed no sooner than L-12 weeks.

Lapsed proficiency may be regained by taking the following lessons:

- RNDZ PRF ADV 41006
- R/PO PRF ADV 41069
- RNDZ QUAL 41006
- R/PO QUAL 41069

#### RENDEZVOUS COURSE OVERVIEW



PLANNED or Planned Contingency Rendezvous (i.e., HST): Take the entire flow (20000 + 30000 + 90000)

The 30000-Level training is set up to start at L-6 months and should proceed at one session/week.

The 90000-Level training is set up to include integrated simulations to support the 1 session/week guideline. Standalone training has been reduced since the crew will practice the techniques required by the Flight Requirements Document during integrated simulations. Therefore, these simulations are required to cover tasks such as flyarounds, separations, and breakouts. The proficiency requirement is a minimum of 1 session every 2 weeks, which can include DST, Shuttle Engineering Simulator (SES), or SMS sessions.

The DPLY and RETR lessons from the Orbit flow may be taken during the same week as a Rendezvous/Prox ops lesson. If this plan is followed, proficiency lessons should not be required unless the launch date slips. The Rendezvous Training Philosophy is documented in the Rendezvous Instructor Handbook and should be followed for this training course.

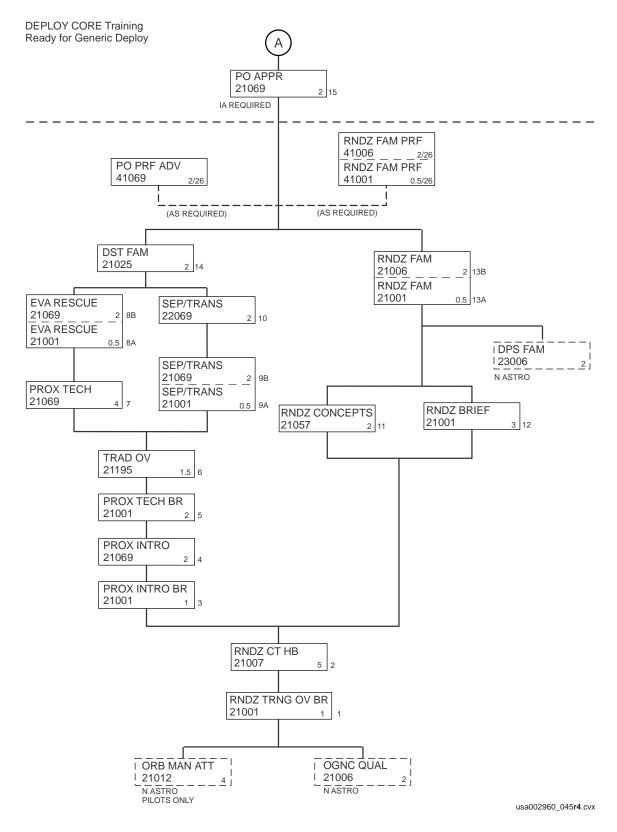


Figure 10-1. Planned Rendezvous/Prox Ops Training Flow Chart (Sheet 1 of 3)

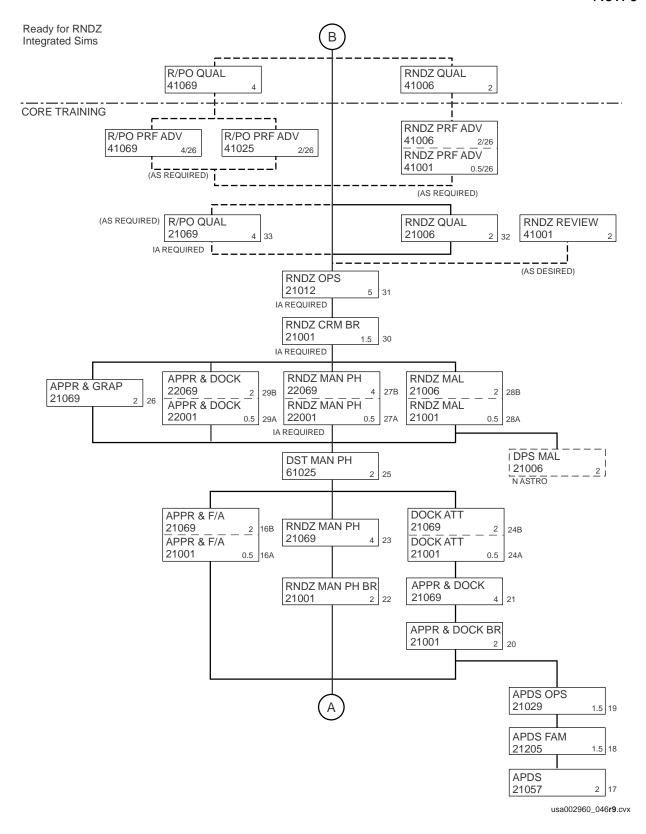


Figure 10-1. Planned Rendezvous/Prox Ops Training Flow Chart (Sheet 2 of 3)

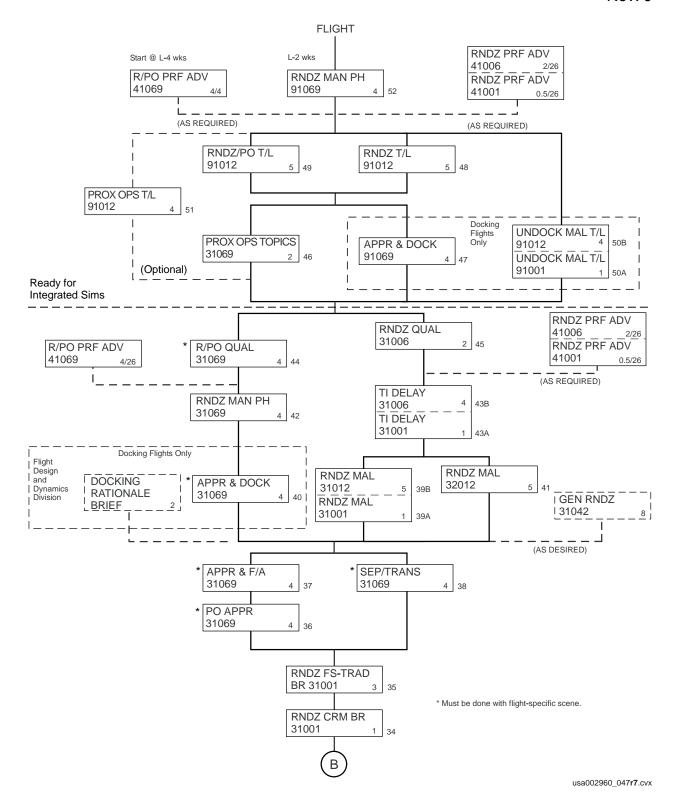


Figure 10-1. Planned Rendezvous/Prox Ops Training Flow Chart (Sheet 3 of 3)

Table 10-1. Rendezvous/Proximity Operations **Crew Training Requirements** 

Date Last Modified: 07/07

						Non-Crew Rotation								rew R	otatio			iodifica. 07/07
	Ref Sched							1			_							
Stage	Num	Lesson Code	Media	Hrs	Code	С	Р	MS1	MS2	MS3	MSA	PS	С	Р	MS1	MS2	Alt Fac	Comments
4	Italii	RNDZ QUAL 41006	SST 1	2	1	2	2	2	2	IVIOS	IVIOT	1 3	2	2	2	2	SST 2. 3	Comments
-		THIRD QUIL 41000	0011														001 2, 0	Schedule in pairs:
																		CDR + MS and
4		R/PO QUAL 41069	SESD	4	2	4	4	4	4				4	4	4	4	SESA	PLT + MS
4	34	RNDZ CRM BR 31001	CLR	1	1	1		<u> </u>					1				<u> CEO, (</u>	PLT, MS optional
4			tal for Stage		Stage Totals	Per C	rewmer	mber:										
4				7		7	6	6	6	0	0	0	7	6	6	6		
3	35	RNDZ FS-TRAD BR 31001	CLR	3	8	3	3	3	3				3	3	3	3		
3	36	PO APPR 31069	SESD	4	8	4	4	4	4				4	4	4	4	SESA	
3	37	APPR & F/A 31069	SESD	4	8	4	4	4	4				4	4	4	4	SESA	
3	38	SEP/TRANS 31069	SESD	4	8	4	4	4	4				4	4	4	4	SESA	
3	39A	RNDZ MAL 31001	CLR	1	8	1	1	1	1				1	1	1	1		
3	39B	RNDZ MAL 31012	FB	5	8	5	5	5	5				5	5	5	5		See Note 2
3	40	APPR & DOCK 31069	SESD	4	8	4	4	4	4				4	4	4	4	SESA	Docking Flight
3	41	RNDZ MAL 32012	FB	5	8	5	5	5	5				5	5	5	5		See Note 2
3	42	RNDZ MAN PH 31069	SESD	4	8	4	4	4	4				4	4	4	4	SESA	
3	43A	TI DELAY 31001	CLR	0.5	1	0.5	0.5	0.5	0.5				0.5	0.5	0.5	0.5		
3	43B	TI DELAY 31006	SST 1	2	1	2	2	2	2				2	2	2	2	SST 2, 3	
3		Sub To	tal for Stage		Stage Totals													
3				36.5		36.5	36.5	36.5	36.5	0	0	0	36.5	36.5	36.5	36.5		
2	44	R/PO QUAL 31069	SESD	4	8	4	4	4	4				4	4	4	4	SESA	
2	45	RNDZ QUAL 31006	SST 1	2	1	2	2	2	2				2	2	2	2	SST 2, 3	
2	46	PROX OPS TOPICS 31069	SESD	2	3	2	2	2					2	2	2		SESA	
2		APPR & DOCK 91069	SESD	4	8	4	4	4	4				4	4	4	4	SMS-FB	Docking Flight
2	48	RNDZ T/L 91012	FB	5	8	5	5	5	5	_			5	5	5	5		
2	49	RNDZ/PO T/L 91012	FB	5	8	5	5	5	5	5			5	5	5	5		
2	50A	UNDOCK MAL T/L 91001	CLR	1	8	1	1	1	1	1			1	1	1	1		Docking Flights
																		Docking Flights.
	500	UNDOOK MAL TIL 04043	ED														ONO	CB IA optional.
2	50B	UNDOCK MAL T/L 91012	FB	4	8	4	4	4	4	4		4	4	4	4	4	GNS	See Note 3
																		Dep, Retr, and
•	E4	PROX OPS T/L 91012	FB	4	8	4	4	4	4	4			4	4	4	4	GNS	Docking Flights. See Note 3
2	51			-				_	4	4			4	4	4	4	GNS	See Note 3
2		Sub 10	tal for Stage	31	Stage Totals	31	rewmer 31	mber: 31	29	14	0	4	31	31	31	29		
				31		31	31	31	29	14	U	4	31	31	31	29		

- NOTE: 1. MS assigned to RNDZ should not be an EVA MS. 2. Gen RNDZ 31042 can substitute for RNDZ MAL 31012 or 32012.
  - 3. As required, the SMS should be scheduled for one hour of PGSC and photo/TV setup training prior to the start of the lesson. This should be scheduled for all flights with complicated PGSC or photo/TV setups or Flight Day 1 deploy.

Table 10-1. Rendezvous/Proximity Operations Crew Training Requirements (Continued)

Date Last Modified: 07/07

								Non-C	rew R	otation	1		C	rew R	otatio	n	Last Medilled: 07707		
Store	Ref Num	Lesson Code	Media		Sched			1104				<b>DO</b>			M04		Alt Fac	0	
Stage	Num	Lesson Code	wedia	Hrs	Code	С	Р	MS1	WI52	MS3	W54	PS	С	Р	MS1	MS2	Alt Fac	Comments	
1	52	RNDZ MAN PH 91069	SESD	4	4	4	4	4	4				4	4	4	4	SESA	< L-2 wk.	
1	V_		tal for Stage		Stage Totals												020/1	C L L WIG	
1		Gus 10	larror otago	4	orago roran	4	4	4	4	0	0	0	4	4	4	4			
0	1	RNDZ TRNG OV BR 21001	CLR	1	8	1	1	1					1	1	1				
0		RNDZ CT HB 21007	TXT	5	1	5	5	5	5				5	5	5	5			
0		PROX INTRO BR 21001	CLR	1	8	1	1	1	1				1	1	1	1			
0	_	PROX INTRO 21069	SESD	2	2	2	2	2	2				2	2	2	2	SESA		
0		PROX TECH BR 21001	CLR	2	8	2	2	2	2				2	2	2	2	020/(		
0	6	TRAD OV 21195	PGSC	1.5	8	1.5	1.5	1.5	1.5				1.5	1.5	1.5	1.5	CLR		
0	7	PROX TECH 21069	SESD	4	2	4	4	4	4				4	4	4	4	SESA		
0	8A	EVA RESCUE 21001	CLR	0.5	2	0.5	0.5	0.5	0.5				0.5	0.5	0.5	0.5			
0	8B	EVA RESCUE 21069	SESD	2	2	2	2	2	2				2	2	2	2	SESA		
0	9A	SEP/TRANS 21001	CLR	0.5	2	0.5	0.5	0.5	0.5				0.5	0.5	0.5	0.5			
0	9B	SEP/TRANS 21069	SESD	2	2	2	2	2	2				2	2	2	2	SESA		
0		SEP/TRANS 22069	SESD	2	2	2	2	2	2				2	2	2	2	SESA		
0		RNDZ CONCEPTS 21057	CBT	2	1	2	2	2	2				2	2	2	2			
0		RNDZ BRIEF 21001	CLR	3	8	3	3	3	3				3	3	3	3			
0		RNDZ FAM 21001	CLR	0.5	1	0.5	0.5	0.5	0.5				0.5	0.5	0.5	0.5			
0	13B	RNDZ FAM 21006	SST 1	2	1	2	2	2	2				2	2	2	2	SST 2, 3		
0		DST FAM 21025	DST 1	2	2	2	2	2	2				2	2	2	2	DST 2, 6		
0	_	PO APPR 21069	SESD	2	2	2	2	2	2				2	2	2	2	SESA	IA Required	
0	-	APPR & F/A 21001	CLR	0.5	2	0.5	0.5	0.5	0.5				0.5	0.5	0.5	0.5			
0		APPR & F/A 21069	SESD	2	2	2	2	2	2				2	2	2	2	SESA		
0		APDS 21057	CBT	2	1	2	2	2	2				2	2	2	2			
0		APDS FAM 21205	APDS	1.5	8	1.5	1.5	1.5	1.5				1.5	1.5	1.5	1.5		Building 9	
0		APDS OPS 21029	PYLD	1.5	2	1.5	1.5	1.5	1.5				1.5	1.5	1.5	1.5			
0		APPR & DOCK BR 21001	CLR	2	8	2	2	2	2				2	2	2	2			
0		APPR & DOCK 21069	SESD	4	2	4	4	4	4				4	4	4	4	SESA		
0	22	RNDZ MAN PH BR 21001	CLR	2	8	2	2	2	2				2	2	2	2			

NOTE: 1. MS assigned to RNDZ should not be an EVA MS.

<sup>2.</sup> Gen RNDZ 31042 can substitute for RNDZ MAL 31012 or 32012.

<sup>3.</sup> As required, the SMS should be scheduled for one hour of PGSC and photo/TV setup training prior to the start of the lesson. This should be scheduled for all flights with complicated PGSC or photo/TV setups or Flight Day 1 deploy.

Table 10-1. Rendezvous/Proximity Operations Crew Training Requirements (Concluded)

Date Last Modified: 07/07

						Non-Crew Rotation							(	rew R	otatio	n		
	Ref				Sched													
Stage	Num	Lesson Code	Media	Hrs	Code	С	Р	MS1	MS2	MS3	MS4	PS	С	Р	MS1	MS2	Alt Fac	Comments
0	23	RNDZ MAN PH 21069	SESD	4	2	4	4	4	4				4	4	4	4	SESA	
0	24A	DOCK ATT 21001	CLR	0.5	2	0.5	0.5	0.5	0.5				0.5	0.5	0.5	0.5		
0	24B	DOCK ATT 21069	SESD	2	2	2	2	2	2				2	2	2	2	SESA	
0	25	DST MAN PH 61025	DST 1	2	2	2	2	2	2				2	2	2	2	DST 2, 6	
0	26	APPR & GRAP 21069	SESD	2	2	2	2	2	2				2	2	2	2	SESA	
0	27A	RNDZ MAN PH 22001	CLR	0.5	2	0.5	0.5	0.5	0.5				0.5	0.5	0.5	0.5		IA Required
0	27B	RNDZ MAN PH 22069	SESD	4	2	4	4	4	4				4	4	4	4	SESA	IA Required
0	28A	RNDZ MAL 21001	CLR	0.5	1	0.5	0.5	0.5	0.5				0.5	0.5	0.5	0.5		
0	28B	RNDZ MAL 21006	SST 1	2	1	2	2	2	2				2	2	2	2	SST 2, 3	
0	29A	APPR & DOCK 22001	CLR	0.5	2	0.5	0.5	0.5	0.5				0.5	0.5	0.5	0.5		
0	29B	APPR & DOCK 22069	SESD	2	2	2	2	2	2				2	2	2	2	SESA	
0	30	RNDZ CRM BR 21001	CLR	1.5	8	1.5	1.5	1.5	1.5				1.5	1.5	1.5	1.5		IA Required
0	31	RNDZ OPS 21012	FB	5	8	5	5	5	5				5	5	5	5		IA Required
0	32	RNDZ QUAL 21006	SST 1	2	1	2	2	2	2				2	2	2	2	SST 2, 3	
0	33	R/PO QUAL 21069	SESD	4	2	4	4	4	4				4	4	4	4		IA required
0		RNDZ FAM PRF 41001	CLR	0.5	1	0.5	0.5	0.5	0.5				0.5	0.5	0.5	0.5		
0		RNDZ FAM PRF 41006	SST 1	2	1	2	2	2	2				2	2	2	2	SST 2, 3	
0		PO PRF ADV 41069	SESD	2	2	2	2	2	2				2	2	2	2	SESA	
0		RNDZ PRF ADV 41001	CLR	0.5	1	0.5	0.5	0.5	0.5				0.5	0.5	0.5	0.5		
0		RNDZ PRF ADV 41006	SST 1	2	1	2	2	2	2				2	2	2	2	SST 2, 3	
0		R/PO PRF ADV 41069	SESD	4	2	4	4	4	4				4	4	4	4	SESA	
0		R/PO PRF ADV 41025	DST 1	2	1	2	2	2	2				2	2	2	2		
0		GEN RNDZ 31042	IFB	8	8	8	8	8	8				8	8	8	8		As desired
0		Sub To	tal for Stage		Stage Totals	Per Ci	ewme	mber:										
0				104		104.0	104.0	104.0	103.0	0	0	0	104.0	104.0	104.0	103.0		

NOTE: 1. MS assigned to RNDZ should not be an EVA MS.

<sup>2.</sup> Gen RNDZ 31042 can substitute for RNDZ MAL 31012 or 32012.

<sup>3.</sup> As required, the SMS should be scheduled for one hour of PGSC and photo/TV setup training prior to the start of the lesson. This should be scheduled for all flights with complicated PGSC or photo/TV setups or Flight Day 1 deploy.

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# 1 **RNDZ TRNG OV BR 21001**

Title: Rendezvous/Proximity Operations Training Overview Briefing

Duration: 1.0 hour Medium: Classroom

Student: COMMANDER, MS, PILOT

Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 07/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): OGNC QUAL 21006 (N ASTRO),

ORB MAN ATT 21012 (N ASTRO)

Preparation: None

Synopsis: This briefing identifies the facilities used, organization and the philosophy

of the Rendezvous/Proximity Operations (Prox Ops) training flow.

Objectives: • Prepare student to start the rendezvous training flow.

Identify training and reference sources.

# 2 **RNDZ CT HB 21007**

Title: Rendezvous Crew Training Handbook

Duration: 5.0 hours Medium: Text

Student: COMMANDER, MS, PILOT (Other crewmembers may read.)

(Schedule individually.)

Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 09/01

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

Synopsis: The Rendezvous Crew Training Handbook is a collection of student

handouts, briefings, and lessons in the Rendezvous/Prox Ops training flow. The material should be reviewed prior to attending each lesson, and

should be brought to the lesson itself.

Objectives: • Review the outline of the Rendezvous/Prox Ops crew training flow.

Bring this book to all sessions.

• Review all briefings and simulator (SST/SES/SMS) lesson objectives supplied by instructor prior to each session.

• Prior to each session, the student will be expected to review the section in this book that summarizes the lesson objectives.

# 3 **PROX INTRO BR 21001**

Title: Proximity Operations Introduction Brief

Duration: 1.0 hour Medium: Classroom

Student: COMMANDER, MS, PILOT (Other crewmembers may attend.)

Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 07/04

Lesson(s) Replaced: None

Equipment Required: Orbiter Model for each student

Prerequisite Lesson(s): RNDZ CT HB 21007

Preparation: None

Synopsis: This briefing will introduce the terms, techniques, and hardware used to

perform proximity operations.

Objectives: • Define proximity operations (prox ops) and describe its characteristics and concerns.

• Define the following prox ops tasks: approach, separation, stationkeeping, transition, and flyaround.

• Describe the use of the DAP and Universal Pointing (UNIV PTG) in prox ops.

• Define the following terms: body vector, omicron, and Low Z.

• Relate aft Translation Hand Controller and Rotational Hand Controller (THC/RHC) inputs to the corresponding orbiter motion.

- Describe Attitude Direction Indicator (ADI) attitudes in +X and -Z sense.
- Describe the use of the following tools in prox ops:
  - Rendezvous Radar (RR)
  - Crew Optical Alignment Sight (COAS)
  - CCTV
- Describe the RR coordinate system.

#### Completion Standards:

 The student should be able to describe orbiter attitude and motion using a model, based on instructor-specified THC, RHC, ADI, or UNIV PTG inputs.

# 4 **PROX INTRO 21069**

Title: Proximity Operations Introduction

Duration: 2.0 hours

**Note:** Schedule 3 hours if in SMS-FB.

Medium: Shuttle Engineering Simulator Dome (SES AFT)

Student: COMMANDER, MS, PILOT (Schedule CDR and PLT separately,

with MS attending one session.)

Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 07/04

Lesson(s) Replaced: PROX INTRO 21015

Equipment Required: None

Prerequisite Lesson(s): PROX INTRO BR 21001

Preparation: None

Synopsis: In this lesson, the student is introduced to the aft station hardware and

Guidance, Navigation, and Control (GNC) software used in prox ops. The student performs maneuvers using the Rotational Hand Controller (RHC), Translation Hand Controller (THC), radar, aft Attitude Direction Indicator (ADI), DAP, and prox ops displays, and will become familiar with the corresponding target movement in the Crew Optical Alignment Sight (COAS). This lesson will also review basic prox ops techniques. The MS

should fly one segment of each run.

Objectives:

- Demonstrate an understanding of the use of the following in proximity operations applications:
  - ADI
  - Sense Switch
  - DAP
  - COAS
  - Universal Pointing (UNIV PTG)
  - Ku Radar
  - CCTV
- Use flight controls (THC, RHC, DAP) for proximity operations, and identify the proper target movement and position in the COAS.
- Demonstrate a basic understanding of the following proximity operations techniques:
  - Vbar approach
  - In-plane flyaround (transition)
- Use the CCTV and COAS ranging charts to determine range and range rate when radar is not available (< 100 ft).
- Choose the correct DAP (Low Z vs. Norm Z) based on the range to the target.
- Develop cockpit scan in the aft station.

# 4 PROX INTRO 21069 (Concluded)

Completion Standards:

• The student should be able to locate and correctly use the displays and controls in the aft station.

# 5 **PROX TECH BR 21001**

Title: Proximity Operations Techniques Brief

Duration: 2.0 hours Medium: Classroom

Student: COMMANDER, MS, PILOT (Other MSs as assigned.)
Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 07/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PROX INTRO 21069

Preparation: None

Synopsis:

This briefing introduces the student to proximity operations - the piloting techniques, the crew insight into the orbiter/payload relative motion, and the expected relative motion based on relative position and Translation Hand Controller (THC) inputs. The briefing prepares the student for which cues to monitor during PROX TECH 21069. Rendezvous Tools are also introduced in this lesson. The students will be given the Rendezvous/Prox Ops Program Simulation (RPOPSIM) disk to install on their Personal Computer (PC).

#### Objectives:

- Define and explain the use of three types of stationkeeping: Vbar, Rbar, and inertial.
- Explain the use of the flight controls and navigation sensors in stationkeeping.
- Define separation and list some concerns regarding: Low Z and crew visibility.
- Define transitions and their use in proximity operations.
- Discuss Vbar, Rbar, and inertial approaches.
- Describe the short-term relative motion resulting from given initial conditions.
- Describe the short-term relative motion resulting from Orbiter Reaction Control System (RCS) cross-coupling.

# 6 **TRAD OV 21195**

Title: Tools for Rendezvous and Docking Overview

Duration: 1.5 hours

Medium: Payload General Support Computer (SMS conference room)

Student: COMMANDER, MS, PILOT (Other MSs as assigned.)
Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 07/04

Lesson(s) Replaced: None

Equipment Required: 2 PGSCs, HHL, Cables, RPOPSIM Disk, HHL & TCS users

guides

**Note:** Stowage should be called to deliver the required equipment.

Prerequisite Lesson(s): PROX TECH BR 21001

Preparation: None

Synopsis: This briefing introduces the student to the basic Tools for Rendezvous and

Docking (TRAD) system. The students should set up this system using the FDF in the Rendezvous Book. The TRAD system for docking flights

will be introduced in this lesson.

Objectives: • Introduce the generic TRAD system.

- Introduce the Trajectory Control Sensor (TCS) system and the use of the Command and Display (CAD) software.
- Identify other tools used in rendezvous and docking.
- Identify and connect the major cables, PGSC and Hand-Held Lidar (HHL) in the flight configuration using FDF and handouts.
- Demonstrate the proper use of the HHL.
- Demonstrate the RPOP:
  - Cable connections.
  - Trajectory and function keys.
  - Views, Tgt/Orb, Point of Reference (POR).
  - Basic operations and display information.
  - HHL modes.
- The HHL User Guide should be given to the students as a guide for self-practice.
- The TCS User Guide should be given to the students.

### Completion Standards:

- By the end of rendezvous training, the student should be able to:
  - Define the basic TRAD set-up.
  - Describe the basic use of RPOP and TCS CAD.
  - Define the Modes and use the HHL to get range and range rate.
  - Describe proper aiming and shooting techniques for the HHL.

# 7 **PROX TECH 21069**

Title: Proximity Operations Techniques

Duration: 4.0 hours

Medium: Shuttle Engineering Simulator Dome (SES AFT)

Student: COMMANDER, MS, PILOT (Schedule CDR and PLT separately,

with MS attending one session.)

Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 07/04

Lesson(s) Replaced: PROX TECH 21015

Equipment Required: PGSC

Prerequisite Lesson(s): PROX TECH BR 21001, TRAD OV 21195

Preparation: None

Synopsis: This lesson introduces the student to several Prox Ops techniques: Vbar

and Rbar approaches, separations, transitions, and stationkeeping. The necessary cues and piloting skills required to execute the Prox Ops successfully are practiced for each. The PGSC will be used during the second part of this lesson. The MS should fly one segment of each run.

#### Objectives: PART 1:

- Use flight controls (Translation Hand Controller (THC), Rotational Hand Controller (RHC), DAP) for proximity operations and identify the proper target movement in the Crew Optical Alignment Sight (COAS).
- Demonstrate a basic understanding of the following proximity operations techniques:
  - Approaches
  - Separations
  - Transitions
  - Stationkeeping
- Demonstrate an understanding of the short term relative motion resulting from given initial conditions.

#### PART 2:

- Perform the Part 1 objectives using the Tools for Rendezvous and Docking (TRAD) system.
- Demonstrate and use the TRAD system to aid in situational awareness during Prox Ops using the following automatic and manual modes:
  - Pulse Code Modulator (PCM) Modes (Auto SV and Auto Rendezvous Radar (RR), Views, Tgt/Orb, Point of Reference (POR))
  - Hand-Held Lidar (HHL) modes
  - Trajectory Control Sensor (TCS) operation
  - Add the TRAD system to the cockpit scan developed earlier

# 7 PROX TECH 21069 (Concluded)

#### HOMEWORK:

- Review the RPOP Playback Trainer on the Personal Computer (PC).
- Review the HHL and TCS User Guides.

#### 8A **EVA RESCUE 21001**

Title: Extravehicular Activity Rescue Prebrief

Duration: 0.5 hours Medium: Classroom

**Note:** Schedule at SES Dome Prebrief Table.

Student: COMMANDER, MS, PILOT (Schedule CDR and PLT separately,

with MS attending one session.)

Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 09/01

Lesson(s) Replaced: EV RES/P-SEP 21001

Equipment Required: None

Prerequisite Lesson(s): PROX TECH 21069

Preparation: None

Synopsis: This lesson introduces prox ops concepts that can be applied to EVA

rescue and the EVA rescue FDF (EVA Checklist (C/L)).

Objectives: • Discuss the EVA Rescue FDF to be able to perform an EVA rescue in

the SES.

#### Completion Standards:

• The student(s) should be able to explain the basic procedures and concerns associated with rescue of an incapacitated EVA crewmember.

#### 8B **EVA RESCUE 21069**

Title: Extravehicular Activity Rescue

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome (SES AFT)

Student: COMMANDER, MS, PILOT (Schedule CDR and PLT separately,

with MS attending one session.)

Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 07/04

Lesson(s) Replaced: EV RES/P-SEP 21069

Equipment Required: None

Prerequisite Lesson(s): EVA RESCUE 21001

# 8B **EVA RESCUE 21069 (Concluded)**

Synopsis: In this lesson, the student(s) will perform multiple rescues of an

incapacitated EVA crewmember. The DAP is reconfigured as required to

ensure his/her safety.

Objectives: • Reconfigure the DAP, as required, based on the EVA crewmember's

position.

Translate the orbiter towards the EVA crewmember.

 Rotate the orbiter, if necessary, to maintain visibility of the EVA crewmember.

Perform three EVA rescues.

Review the use of MUXed (multiplexed) CCTVs during prox ops.

# Completion Standards:

The student(s) shall meet the following conditions:

 Exercise appropriate actions to perform a safe rescue of an incapacitated EVA crewmember.

 Utilize the DAP, Translation Hand Controller (THC), Rotational Hand Controller (RHC), Universal Pointing (UNIV PTG) and Attitude Direction Indicator (ADI) as appropriate for orbiter control and situational awareness.

# 9A **SEP/TRANS 21001**

Title: Separation and Transition Prebrief

Duration: 0.5 hours Medium: Classroom

**Note:** Schedule in SES briefing area.

Student: COMMANDER, MS, PILOT (Schedule CDR and PLT separately,

with MS attending one session.)

Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 09/01

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PROX TECH 21069

Preparation: None

Synopsis: In this lesson, the student(s) will practice techniques to separate from an

RMS-deployed payload and transition to a specified stationkeeping

distance/altitude.

# 9A SEP/TRANS 21001 (Concluded)

Objectives: • Position the target in the end effector camera for separation.

- Perform +Vbar and +Rbar separations.
- Perform an AUTO transition from the +Vbar to the -Rbar.
- Perform manual and inertial transitions from the +Rbar to the +Vbar.
- Observe and describe the orbital mechanics effects during transitions.
- Observe and quantify the change in size of the target in the Crew Optical Alignment Sight (COAS) with range.

#### Completion Standards:

The student(s) shall meet the following conditions during each run:

- Correctly anticipate and describe target motion resulting from Translation Hand Controller (THC)/Rotational Hand Controller (RHC)/ DAP inputs and orbital mechanics effects.
- Maintain the desired Rdot profile ±0.1 fps during separations.
- Maintain the desired range ±10% during stationkeeping and transitions.

# 9B **SEP/TRANS 21069**

Title: Separation and Transition

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome (SES AFT)

Student: COMMANDER, MS, PILOT (Schedule CDR and PLT separately,

with MS attending one session.)

Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 07/04

Lesson(s) Replaced: SEP/TRANS 21015

Equipment Required: None

Prerequisite Lesson(s): SEP/TRANS 21001

Preparation: None

Synopsis: See SEP/TRANS 21001

Objectives: See SEP/TRANS 21001

# 10 **SEP/TRANS 22069**

Title: Separation and Transition 2

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome (SES AFT)

Student: COMMANDER, MS, PILOT (Schedule CDR and PLT separately,

with MS attending one session.)

Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 07/04

Lesson(s) Replaced: SEP/TRANS 22015

Equipment Required: None

Prerequisite Lesson(s): SEP/TRANS 21069

Preparation: None

Synopsis: In this lesson, the student(s) will apply previously learned proximity

operations techniques to perform +Rbar separations and transitions to

the +Vbar.

Objectives: • Perform the separations and transitions from SEP/TRANS 21069 using

alternate ranging techniques.

• Use the PGSC with Hand-Held Lidar (HHL) as appropriate to aid in

situational awareness.

Use CCTV and Crew Optical Alignment Sight (COAS) charts to

determine range and range rate for Radar-failed cases.

#### Completion Standards:

 Correctly anticipate and describe target motion resulting from Translation Hand Controller (THC)/Rotational Hand Controller (RHC)/ DAP inputs and orbital mechanics effects.

#### 11 **RNDZ CONCEPTS 21057**

Title: Rendezvous Concepts

Duration: 2.0 hours Medium: CBT

Student: COMMANDER, MS, PILOT (Schedule individually.)
Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 05/97

Lesson(s) Replaced: RNDZ CONCEPT 21057

Equipment Required: None

Prerequisite Lesson(s): RNDZ CT HB 21007

Preparation: Introduction to Rendezvous GN&C (JSC-49686) or

DM34/Rendezvous Guidance and Procedures

#### 11 RNDZ CONCEPTS 21057 (Concluded)

This CBT is designed to be an overview of orbital mechanics, orbit Synopsis:

navigation, and orbit targeting as applied to the rendezvous profile. The lesson also reviews the onboard SPECs used during a rendezvous.

Objectives: Please refer to RNDZ BRIEF 21001 for objectives.

#### 12 **RNDZ BRIEF 21001**

Title: Rendezvous Briefing

Duration: 3.0 hours Medium: Classroom

Student: COMMANDER, MS, PILOT (Other MSs as assigned.) DM34/Rendezvous Guidance, Procedures and Training Source:

Date: 05/97

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): RNDZ CT HB 21007 Preparation: **RNDZ CONCEPTS 21057** 

Synopsis: This briefing is designed to be a complete and thorough overview of the

rendezvous profile. Orbit navigation, orbital mechanics, the flight profile, orbit targeting, rendezvous procedures, and the dedicated software

SPECs are all reviewed in detail.

Objectives:

 Define the 3 state vectors used in rendezvous and what is used in their propagation.

- Explain the effects of the 4 types of burns in both the inertial and LVLH frames.
- Describe the rendezvous profile with respect to burns, sensor passes, and orbiter attitude.
- Describe the use of orbiter displays for the following operations:
  - Star Tracker Navigation
  - Radar Navigation
  - Crew Optical Alignment Sight (COAS) Navigation
  - Targeting
- Explain the use of the burn display(s) and identify the different guidance modes.
- Define the rendezvous software operational constraints.
- Identify the major procedural steps in a rendezvous.

## 13A **RNDZ FAM 21001**

Title: Rendezvous Familiarization Prebrief

Duration: 0.5 hours Medium: Classroom

**Note:** Schedule in prebrief room.

Student: COMMANDER, MS, PILOT (Schedule individually.)
Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 04/93

Lesson(s) Replaced: None

Equipment Required: Rendezvous Checklist

Prerequisite Lesson(s): DPS FAM 23006 (N ASTRO), RNDZ CONCEPTS 21057
Preparation: Review the RNDZ BRIEF 21001, and any flight's Rendezvous checklist

Synopsis: Refer to RNDZ FAM 21006 for synopsis.

Objectives: Refer to RNDZ FAM 21006 for objectives.

#### 13B **RNDZ FAM 21006**

Title: Rendezvous Familiarization 1

Duration: 2.0 hours

Medium: SST 1, SST 2, or SST 3

Student: COMMANDER, MS, PILOT (Schedule individually.)
Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 09/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): RNDZ FAM 21001

Preparation: None

Synopsis: In this lesson, the student will perform the nominal timeline from the start

of the Rendezvous book to the MC2 burn. The use of rendezvous displays and sensor data will be stressed. The student will also use the annotated procedures found in the Rendezvous Crew Training Handbook.

Objectives: • Perform the nominal rendezvous timeline.

• Configure orbiter software and crew station switches for rendezvous operations.

Evaluate and incorporate navigation sensor data.

Target, evaluate and execute various rendezvous burns.

## 14 **DST FAM 21025**

Title: Dynamic Skills Trainer Familiarization

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 1 (DST 2, DST 6)

Student: COMMANDER, MS, PILOT

Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 07/04

Lesson(s) Replaced: None Equipment Required: PGSC

Prerequisite Lesson(s): EVA RESCUE 21069, SEP/TRANS 22069

Preparation: None

Synopsis: In this lesson, the students will learn how to log on to the DST desktop

simulator. This will include PGSC set-up specific to the DST.

Objectives: • Log on to the DST and call up the desired initial condition to run.

Perform at least one proximity operations run.

Completion Standards:

• The students should be able to start up the trainer and select and run an initial condition unassisted by the instructor.

#### 15 **PO APPR 21069**

Title: Proximity Operations Approaches

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome (SES AFT)

Student: COMMANDER, MS, PILOT (Schedule CDR and PLT separately with

MS attending one session. CB Instructor Astronaut (IA) required.)

Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 07/04

Lesson(s) Replaced: PO APPR 21015

Equipment Required: PGSC

Prerequisite Lesson(s): DST FAM 21025

Preparation: None

Synopsis: In this lesson, the student(s) will perform +Vbar, -Rbar and inertial

approaches using Radar, the Crew Optical Alignment Sight (COAS) subtended angle chart, CCTVs and camera angle ranging chart, and visual cues. Orbital mechanics effects and observation of braking gates are stressed. Fuel usage will be recorded for comparison later. This

class can be considered as a progress check.

#### 15 PO APPR 21069 (Concluded)

- Objectives: Perform Vbar, Rbar and inertial approaches unaided.
  - Use the PGSC and Hand-Held Lidar (HHL) to aid in situational awareness.
  - Perform one Vern fail run.

#### Completion Standards:

The student(s) shall meet the following conditions:

- Perform a Vbar approach (400 ft to stable in end effector camera, Low Z at 200 ft) within 35 minutes and a total fuel usage of less than 100 lbs.
- Perform an Rbar approach (400 ft to stable in end effector camera, Low Z at 200 ft) within 35 minutes and a total fuel usage of less than 150 lbs.
- Perform an inertial approach (400 ft to stable in end effector camera, Low Z at 200 ft) within 35 minutes and a total fuel usage of less than 150 lbs.

#### 16A APPR & F/A 21001

Title: Approach, and Flyaround Prebrief

0.5 hours Duration: Medium: Classroom

Note: Schedule in SES Prebrief area.

COMMANDER, MS, PILOT (Schedule CDR and PLT separately, Student:

with the MS attending one session.)

Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 10/01

APP/GRAP 21001 Lesson(s) Replaced:

Equipment Required: None

Prerequisite Lesson(s): PO APPR 21069

Preparation: None

This briefing reviews the tasks involved in an approach, such as Synopsis:

determining range, range rate, orientation of the payload, and the division

of tasks between the PLT and MS. The briefing also reviews the

coordination of tasks and teamwork required for a successful grapple.

- Discuss tasks and teamwork to accomplish an approach and grapple.
- Define pilot tasks.
- Define RMS operator tasks.
- Define approach and flyaround tasks.
- Define grapple tasks.
- Discuss contingency operations.

# 16A **APPR & F/A 21001 (Concluded)**

#### Completion Standards:

The student(s) should be able to:

- Explain the basic tasks and teamwork required to accomplish a payload approach, flyaround, and grapple.
- Explain the crew actions required for a failed grapple attempt.

## 16B **APPR & F/A 21069**

Title: Approach and Flyaround

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome (SES AFT)

Student: COMMANDER, MS, PILOT (Schedule CDR and PLT separately,

with the MS attending one session.)

Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 07/04

Lesson(s) Replaced: APPR & F/A 21015

Equipment Required: None

Prerequisite Lesson(s): APPR & F/A 21001

Preparation: None

Synopsis:

In this lesson, the student(s) will perform +Vbar or +Rbar approaches and evaluate the position of the payload's grapple fixture relative to the RMS end effector. The student(s) will perform the flyaround maneuver by two different methods -- AUTO and manual. Piloting skills and pilot/MS coordination are stressed. The PGSC will not be used in this lesson. The MS should fly one run.

#### Objectives:

- Perform Vbar and Rbar approaches from 200 feet to stable in the end effector.
- Evaluate orientation of grapple fixture and estimate flyaround axis.
- Perform appropriate Translation Hand Controller (THC) inputs to maintain target position relative to RMS end effector.
- Perform AUTO flyarounds using Universal Pointing (UNIV PTG).
- Perform manual flyarounds using Rotational Hand Controller (RHC) inputs.

#### Completion Standards:

 Complete the flyaround(s) with the target not leaving the field of view of both the end effector and A (or B) cameras.

## 17 **APDS 21057**

Title: Androgynous Peripheral Docking System

Duration: 2.0 hours

Medium: Computer-Based Trainer (CBT) Student: COMMANDER, MS, PILOT

Source: DS45/Shuttle Systems Training Group

Date: 03/05

Lesson(s) Replaced: None

Equipment Required: Personal Computer (PC)

Prerequisite Lesson(s): None

Preparation: Read:

 Shuttle Crew Operations Manual (SCOM); Section 2.20, Orbiter Docking System

#### Synopsis:

Shuttle/ISS docking missions are accomplished using the Orbital Docking System (ODS). This lesson covers the Androgynous Peripheral Docking System (APDS), a component of the ODS. The major components of the APDS, their functions, and associated controls and displays are discussed. Additionally, the major operational sequences associated with docking and undocking are explained. Only nominal operations (OPS) will be presented. Off-nominal procedures will be covered in subsequent APDS classes. For illustration purposes, the animations in this lesson depict component movement at an accelerated rate. In reality, the components move at a much slower rate.

- Locate the APDS in the orbiter.
- Name the major components of the APDS and identify their functions.
- Recognize the various APDS avionics boxes and identify their functions.
- Recognize the controls and displays associated with the APDS and identify the purpose of each.
- Describe the operational positions of the active docking ring.
- Associate display status lights and SPEC 167 indicators with hardware operations.
- Identify the events associated with the following APDS operational sequences: Initialization, Power-up, Ring Extension, Docking, and Undocking.

## 18 **APDS FAM 21205**

Title: APDS Familiarization

Duration: 1.5 hours

Medium: Androgynous Peripheral Docking System (APDS) Trainer

Student: COMMANDER, MS, PILOT

Source: DS45/Shuttle Systems Training Group

Date: 03/05

Lesson(s) Replaced: None

Equipment Required: APDS Trainer in Space Vehicle Mockup Facility, Building 9,

Video Cassette Recorder player with monitor, flip charts, video tape, enlargements, wireless microphone, laser

pointer, two easels, table and chairs

Prerequisite Lesson(s): APDS 21057

Preparation: When scheduling lesson, reference generic Facilities Utilization

Request for APDS FAM 21205.

Synopsis: Students will receive a briefing on the docking sequence, the APDS

components, and a hands-on familiarization with the APDS mechanisms

and components.

Objectives: After completion of this lesson, the students will be able to:

Identify and locate major APDS components

• Describe how components work together

Demonstrate six Degrees of Freedom (DOFs)

Explain the docking sequence

Manually open latches

Locate sensors

## 19 **APDS OPS 21029**

Title: APDS Operations

Duration: 1.5 hours

Medium: Payload Trainer (PYLD)
Student: COMMANDER, MS, PILOT

Source: DS45/Shuttle Systems Training Group

Date: 03/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): APDS FAM 21205

Preparation: None

## 19 APDS OPS 21029 (Concluded)

Synopsis: This lesson includes a prebrief on interpreting SPEC 167 telemetry data

and use of Docking System Power (A6) panel and APDS Control Panel (A7) push-buttons and sensor lights. The student(s) will exercise all nominal operations for the APDS, including initialization, power up, prepare for docking, dock and undocking, and powerdown.

Objectives: Upon completion of this lesson, the student will be able to:

Understand and perform nominal docking and undocking sequences.

• Interpret telemetry on SPEC 167 and indicator light on A7.

 Correctly configure A6 and A7 panels to support pre-docking, initialization, power up, docking, and undocking activities.

• Explain which sensors drive which illuminator lights on A7 and drive telemetry on SPEC 167.

# 20 **APPR & DOCK BR 21001**

Title: Approach and Docking Brief

Duration: 2.0 hours Medium: Classroom

Student: COMMANDER, MS, PILOT

Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 07/04

Lesson(s) Replaced: None

Equipment Required: Orbiter and Station models

Prerequisite Lesson(s): APDS OPS 21029

Preparation: None

Synopsis: During this briefing, the students will discuss prox ops techniques,

concepts, constraints and tools used in docking with another spacecraft.

Objectives: • Introduce the following approach and docking techniques and concepts:

Approach Corridor.

- Docking Targets and CCTVs used.
- Low Z/NORM Z transition point.
- Post Contact Thrusting (PCT) execution and constraints.
- Contact and capture indications.
- Unsuccessful capture (bounce-off).
- Review Undocking and separations.

#### Completion Standards:

- List the four major goals of approach and docking in order of priority.
- List the contact condition limits for orbiter/ISS approach and docking.

## 21 **APPR & DOCK 21069**

Title: Approach and Docking 1

Duration: 4.0 hours

Medium: Shuttle Engineering Simulator Dome (SES AFT)

Student: COMMANDER, MS, PILOT (Schedule CDR and PLT separately,

with MS attending one session.)

Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 07/04

Lesson(s) Replaced: APPR & DOCK 21015

Equipment Required: PGSC

Prerequisite Lesson(s): APPR & DOCK BR 21001

Preparation: None

Synopsis: During this lesson, the student will demonstrate an understanding of the

prox ops techniques and tools, as applied to docking with another

spacecraft. The PGSC will be used in this session.

Objectives: • Perform (aided) at least three approaches to docking.

• Perform (aided) the initial steps of the FAILED CAPTURE procedure.

• Demonstrate effective Cockpit Resource Management (CRM) habits and Tools for Rendezvous and Docking (TRAD) usage.

## Completion Standards:

The student(s) must meet these conditions for all approaches:

- Docking contact conditions:
  - RDOT = -0.10±0.03 fps
  - Lateral misalignment < 3 inches</li>
  - Angular misalignment < 2 degrees</li>
- NORM Z braking = 0.1 fps.
- Maintain prescribed approach corridor and Rdot profile ±0.05 fps.
- The following propellant consumption standards are for reference only:
  - < 100 lb for Vbar approach from 300 ft, or Rbar approach from 170 ft.
  - < 200 lb for Twice Orbit Rate to a Vbar Approach (TORVA) from 600 ft through docking.

## 22 **RNDZ MAN PH BR 21001**

Title: Rendezvous Manual Phase Brief

Duration: 2.0 hours Medium: Classroom

Student: COMMANDER, MS, PILOT

Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 07/04

Lesson(s) Replaced: None

Equipment Required: RNDZ Checklist, PGSC

Prerequisite Lesson(s): RNDZ FAM 21006, SEP/TRANS 21069

Preparation: None

Synopsis: This briefing introduces procedures and skills required during the

transition from the midcourse correction burns (SST training) to the final

approach (SES training).

Objectives: • Review the post Ti trajectory.

• Identify the major events in the rendezvous manual phase:

MC3 and MC4

MC2 ET timeline

Rdot gates

- Config for Rbar
- Establish Rbar
- Discuss the use of the Tools for Rendezvous and Docking (TRAD) system during this timeline (Hand-Held Lidar (HHL), Trajectory Control Sensor (TCS)).
- Discuss the concept of long and short trajectories.
- Discuss piloting cues:
  - Expected motion in the Crew Optical Alignment Sight (COAS).
  - Techniques for controlling out of plane motion.
  - Standard CCTV angles for range approximation.
  - Standard COAS subtended angle.
- Introduce the Radar Fail procedure using the FDF.
- Discuss some of the Rendezvous Rules of Thumb.

#### 23 **RNDZ MAN PH 21069**

Title: Rendezvous Manual Phase 1

Duration: 4.0 hours

Medium: Shuttle Engineering Simulator Dome (SES AFT)

Student: COMMANDER, MS, PILOT (Schedule CDR and PLT separately

with the MS attending one.)

Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 07/04

Lesson(s) Replaced: RNDZ MAN PH 21015
Equipment Required: RNDZ Checklists, PGSC
Prerequisite Lesson(s): RNDZ MAN PH BR 21001

Preparation: None

Synopsis: In this lesson, the students will practice the transition between the

rendezvous phase and the prox ops phase of the profile.

The nominal and radar fail rendezvous manual phase timelines from MC3 -5 min will be practiced. The Tools for Rendezvous and Docking (TRAD) system will be used. Five runs are planned.

- Perform the MC3 & MC4 burn and establish the Rbar using the nominal timeline and nominal vectors.
- Perform a twice orbit rate transition to the Vbar and arrive outside the corridor on the Vbar.
- Perform the Radar Fail manual phase from MC3 -5 min to the Rbar with and without radar to panel A2.
- Fly the trajectory within the required Rdot gates and identify how braking controls the trajectory.
- Identify and control out of plane motion.
- Use the TRAD system during the Rndz manual phase.
- Identify the standard TRAD/RPOP configuration for manual phase.
- Discuss the concept and differences of long and short trajectories.
- Discuss and use as required the following piloting cues:
  - CCTV angles
  - Crew Optical Alignment Sight (COAS) angles
  - DAP changes and deadbands
- Identify the callout in the nominal timeline to go to the RR FAIL Block in the checklist for no Rendezvous Radar (RR) to navigation case.
- Discuss parts of the Rules of Thumb document as required.

# 24A **DOCK ATT 21001**

Title: Docking Attitude Alignment Introduction Prebrief

Duration: 0.5 hours Medium: Classroom

**Note:** Schedule in SES Prebrief area.

Student: COMMANDER, MS, PILOT (Schedule CDR and PLT separately

with the MS attending one session.)

Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 09/96

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): APPR & DOCK 21069

Preparation: None

Synopsis: This prebrief reviews the tasks involved in performing an attitude

alignment, including target reading and pointing vector determination.

Objectives: • Define the limits for angular misalignment for docking.

• Place the angular alignment maneuver within the approach and docking timeline.

- Define the markings on the centerline docking target.
- Describe methods for measuring angular misalignment.
- Describe the AUTO ANGULAR FLYOUT cue card.

#### Completion Standards:

The student(s) should be able to:

- Describe the markings on the docking target and how to read them.
- Describe how to use the AUTO ANGULAR FLYOUT cue card to perform an angular alignment maneuver.

#### 24B **DOCK ATT 21069**

Title: Docking Attitude Alignment

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome (SES AFT)

Student: COMMANDER, MS, PILOT (Schedule CDR and PLT separately,

with MS attending one session.)

Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 07/04

Lesson(s) Replaced: DOCK ATT 21015

Equipment Required: None

Prerequisite Lesson(s): DOCK ATT 21001

Preparation: None

# 24B **DOCK ATT 21069 (Concluded)**

Synopsis: In this lesson, the students will perform multiple approaches to docking,

including an attitude alignment maneuver at 30 ft.

Objectives: • Perform (aided) multiple angular alignment maneuvers while stationkeeping at 30 ft.

 Perform (aided) an approach from 30 ft to docking, including an angular alignment maneuver.

 Perform (unaided) a +Vbar approach from 300 ft to docking, or an Rbar approach from 170 ft to docking, including an angular alignment maneuver.

#### Completion Standards:

The student(s) must meet these conditions on all approaches:

- Docking contact conditions:
  - Rdot =  $-0.10\pm0.03$  fps
  - Lateral misalignment < 3 inches</li>
  - Angular misalignment < 2 degrees</li>
- NORM Z braking £ 0.1 fps
- Maintain prescribed approach corridor and Rdot profile ±0.05 fps.
- Maintain range > 10 ft until angular alignment verified.
- Propellant consumption limit is for reference only:
  - < 100 lb for Vbar approach from 300 ft, or Rbar approach from 170 ft.

## 25 **DST MAN PH 61025**

Title: Dynamic Skills Trainer Manual Phase

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 1 (DST 2, DST 6)

Student: COMMANDER, MS, PILOT

Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 07/04

Lesson(s) Replaced: None Equipment Required: PGSC

Prerequisite Lesson(s): RNDZ MAN PH 21069

Preparation: None

Synopsis: In this lesson, the students will learn how to configure the DST desktop

simulator for docking and manual phase. The instructor will assist at the

start of the session.

Objectives: • Log on to the DST and call up the desired initial condition to run.

• Run at least one docking and one manual phase run.

# 25 **DST MAN PH 61025 (Concluded)**

#### Completion Standards:

• The students should be able to start up the trainer and select and run an initial condition unassisted by the instructor.

#### 26 **APPR & GRAP 21069**

Title: Approach and Grapple 1

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome (SES AFT)

Student: COMMANDER, MS, PILOT (Schedule CDR and PLT separately,

with MS attending one session.)

Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 07/04

Lesson(s) Replaced: APP/GRAP 21069

Equipment Required: None

Prerequisite Lesson(s): APPR & F/A 21069

Preparation: None

Synopsis: In this lesson, the students perform two approaches to grapple. During

these runs the students should evaluate the position of the payload grapple fixture, perform a flyaround if required, and perform a payload grapple. The third run should be from 100 feet to evaluate a rotating payload, match rates and grapple. The development of crew coordination and communication between the PLT and RMS operator are stressed.

Objectives:

- Practice coordinating approach and grapple techniques.
- Determine range and range rate using FDF charts.
- Evaluate and perform flyarounds to grapple a payload.

#### Completion Standards:

 The flyaround(s) should be completed with the target not leaving the field of view of the End Effector and A (or B) Cameras. The total approach from 400 feet through the flyaround and grapple should be done within 200 lbs.

# 27A **RNDZ MAN PH 22001**

Title: Rendezvous Manual Phase 2 Prebrief

Duration: 0.5 hours Medium: Classroom

**Note:** Schedule in SES Aft cockpit briefing area.

Student: COMMANDER, MS, PILOT (Schedule CDR and PLT separately with

the MS attending one session. CB Instructor Astronaut (IA) required.)

Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 07/04

Lesson(s) Replaced: None

Equipment Required: RNDZ Checklist

Prerequisite Lesson(s): RNDZ MAN PH 21069

Preparation: Review the RR Fail procedure in the Rendezvous checklist.

#### Synopsis:

During this class the students will do 4 runs from MC2+12 (MC3 -5 min) to stable on the Rbar (600 ft) or Vbar (350 ft). At least one run should go all the way to docking (a grapple run is not required). All runs will be Radar fail without any Trajectory Control Sensor (TCS) data. Hand-Held Lidar (HHL) will not be used any earlier than the first braking gate. This range should be determined by Crew Optical Alignment Sight (COAS) subtended angle. Your goal should be to do these runs by visual references only, therefore minimal HHL data will be used.

To help students evaluate and improve their skills, the instructor will allow the subtended angle data to be compared with the environment (or TCS) data. The instructor will note the fuel usage at the end of each run.

- Review the nominal rendezvous manual phase using the FDF:
  - MC3 and MC4 burns.
  - Manual Phase.
  - Braking gates.
  - Twice Orbit Rate to a Vbar Approach (TORVA) or Rbar approach.
- Review the Rendezvous Radar (RR) Fail block in the Rendezvous checklist.
- Review the HHL options in the RPOP.
- Review the Tools for Rendezvous and Docking (TRAD) configuration for Radar Fail.
- Review the subtended angle charts.

# 27B **RNDZ MAN PH 22069**

Title: Rendezvous Manual Phase 2

Duration: 4.0 hours

Medium: Shuttle Engineering Simulator Dome (SES AFT)

Student: COMMANDER, MS, PILOT (Schedule CDR and PLT separately, with

MS attending one session. CB Instructor Astronaut (IA) required.)

Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 07/04

Lesson(s) Replaced: RNDZ MAN PH 22015

Equipment Required: PGSC

Prerequisite Lesson(s): RNDZ MAN PH 22001

Preparation: None

Synopsis: This lesson, like RNDZ MAN PH 21069, will exercise the Radar fail

manual phase procedure in the FDF, except the radar will not be used at all this time. All the runs will begin at MC2 ET + 12 minutes (MC3 - 5 min)

and conclude when on the Vbar or Rbar. One run will be taken to

docking.

This lesson is a stress case. A major emphasis in this session will be the coordination and communication required to get range and range rate information to the pilot. The amount of failures required to get to this case should not be discussed.

Objectives:

- Use the backup Range and Rdot cues (subtended angles) to perform the rendezvous manual phase without radar.
- Verify the subtended angle data with the radar (or Trajectory Control Sensor (TCS)) while performing the rendezvous manual phase.
- Input Range data (Subtended angle) as Hand-Held Lidar (HHL) Data in RPOP.
- Demonstrate that good Crew Optical Alignment Sight (COAS) logic, range and range rate are all that is required to fly any trajectory.

#### 28A **RNDZ MAL 21001**

Title: Rendezvous Malfunction Prebrief

Duration: 0.5 hours Medium: Classroom

**Note:** Schedule in an SST prebrief room.

Student: COMMANDER, MS, PILOT (Schedule individually.)
Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 05/97

Lesson(s) Replaced: None

Equipment Required: Rendezvous Checklist

## 28A RNDZ MAL 21001 (Concluded)

Prerequisite Lesson(s): RNDZ FAM 21006

Preparation: None

Synopsis: Refer to RNDZ MAL 21006 for synopsis.

Objectives: Refer to RNDZ MAL 21006 for objectives.

#### 28B **RNDZ MAL 21006**

Title: Rendezvous Malfunction

Duration: 2.0 hours

Medium: SST 1, SST 2, or SST 3

Student: COMMANDER, MS, PILOT (Schedule individually.)
Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 09/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): RNDZ MAL 21001

Preparation: Review the "System Concerns" section of the RNDZ MAL 21001

handout.

Synopsis: This lesson covers the same trajectory as RNDZ FAM 21006. The lesson

will start in MM202 post-NC Time of Ignition (TIG) and end after the MC2 burn. In order to bring out a few key points, several malfunctions will be

introduced. The lesson objectives are listed below. A detailed explanation of each is to be found in the Rendezvous Crew Training

Handbook. During this lesson, the student may use either the

Rendezvous FDF or the annotated procedures used in RNDZ FAM 21006.

- Describe the rendezvous profile with respect to burns, sensor passes, and orbiter attitude.
- Identify the major procedural steps in a rendezvous.
- Identify Data Processing System (DPS), Reaction Control System (RCS), hand controller, Inertial Measurement Unit (IMU), etc. failures and their impacts on the rendezvous.
- Exercise the timeline from preliminary NCC targeting through the MC2 burn.
- Discuss and recognize a star lock during a star tracker pass.
- Recognize questionable star tracker residuals.
- Perform a Y star tracker pass.
- Recognize and recover a FF3 failure.

# 28B RNDZ MAL 21006 (Concluded)

- Perform a restring and note effect on the rendezvous software.
- Perform the MC2 burn on a time constraint (vs. elevation angle constraint).

# 29A **APPR & DOCK 22001**

Title: Approach and Docking 2 Prebrief

Duration: 0.5 hours Medium: Classroom

**Note:** Schedule in SES AFT Prebrief area.

Student: COMMANDER, MS, PILOT (Schedule CDR and PLT separately,

with MS attending one session.)

Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 09/96

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): DOCK ATT 21069

Preparation: None

Synopsis:

This lesson introduces malfunctions that affect approach and docking techniques, including loss of Trajectory Control Sensor (TCS), VERNs, Post Contact Thrusting (PCT), and centerline camera. Off-nominal separation techniques, such as failed capture, backouts, breakouts, and expedited separations, are also introduced.

#### Objectives:

- Describe range/rdot determination techniques using Hand-Held Lidar (HHL).
- Describe flight techniques for loss of vernier Reaction Control System (RCS).
- Describe centerline camera failure recovery techniques.
- Describe off-nominal separations:
  - Failed capture
  - Corridor backout
  - Breakouts
  - Expedited separation

#### Completion Standards:

The students(s) should be able to:

- Describe appropriate crew responses and flight techniques for failures of TCS, VERNs, centerline camera, and PCT.
- Distinguish between failed capture, backout, breakout, and expedited separation.

29B **APPR & DOCK 22069** 

Title: Approach and Docking 2

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome (SES AFT)

COMMANDER, MS, PILOT (Schedule CDR and PLT separately, Student:

with MS attending one session.)

Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 07/04

Lesson(s) Replaced: **APPR & DOCK 22015** 

Equipment Required: None

Prerequisite Lesson(s): **APPR & DOCK 22001** 

Preparation: None

In this lesson, the student(s) will perform at least three approaches to Synopsis:

> docking with attitude alignment maneuvers and malfunctions, while demonstrating effective Cockpit Resource Management (CRM) habits and use of the Tools for Rendezvous and Docking (TRAD) system.

- Objectives: Perform (unaided) at least three approaches to docking with attitude alignment maneuvers and the following malfunctions/procedures:\
  - Trajectory Control Sensor (TCS) fail
  - VERN fail
  - Corridor backout
  - Demonstrate effective CRM habits and use of the TRAD system, especially range/rdot determination without TCS.

#### Completion Standards:

The student(s) must meet these conditions on all approaches:

- Docking contact conditions:
  - Rdot =  $-0.10\pm0.03$  fps
  - Lateral misalignment < 3 inches
  - Angular misalignment < 2 degrees
  - Norm Z braking = 0.1 fps
- Maintain prescribed approach corridor and rdot profile ±0.05 fps.
- Propellant consumption standards are for reference only:
  - VERN: < 100 lb for Vbar approach from 300 ft, or Rbar approach from 170 ft.
  - VERN fail: < 200 lb for Vbar approach from 300 ft, or Rbar approach from 170 ft.

## 30 **RNDZ CRM BR 21001**

Title: Rendezvous Cockpit Resource Management Briefing

Duration: 1.5 hours Medium: Classroom

**Note:** Schedule in SMS Prebrief Room.

Student: COMMANDER, MS, PILOT (CB Instructor Astronaut (IA) required.)

Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 07/04

Lesson(s) Replaced: None

Equipment Required: Rendezvous checklist

Prerequisite Lesson(s): DST FAM 21025, RNDZ MAL 21006

Preparation: None

Synopsis:

This briefing is designed to encourage the students to consider and assess the roles of each crewmember in the cockpit during the Rendezvous and Prox Ops timelines. The list of tasks included is not intended to be a complete list; rather, it is intended to be a representative list for discussion in this briefing.

- The instructor will discuss Cockpit Resource Management (CRM) topics with the crew.
- The instructor will review the Tools for Rendezvous and Docking (TRAD) Configuration for the sim.
- Who will be responsible for PGSC inputs during manual phase?
- Who will be responsible for the Hand-Held Lidar (HHL) marks during manual phase?
- Who will do targeting and burns?
- Who will watch REL Navigation (NAV) during sensor passes?
- Who will work (manage) the checklist?
- Who will be the second set of eyes?
- How will malfunctions be managed?
- Who will supply CCTV data?
- Who will supply MCC with regular updates?
- Who will be responsible for photo DTOs, or how will this be worked into the timeline?

- The instructor will discuss some of the terms and concepts of CRM as they apply to rendezvous and prox ops.
- The instructor will review the DT recommended Standard Operating Procedures (crew task assignments) for Rendezvous and Prox Ops.
- The students will discuss, aided by the instructor, the CRM Plan for the upcoming SMS/SES sessions.

# 30 RNDZ CRM BR 21001 (Concluded)

- The instructor should review the starting point (and any initial conditions) for the SMS session (NCC - 45 min. or Phase Elapsed Time (PET) - 1:50).
- The instructor should review the payload for the load being used (picture) (e.g., grapple fixture location).

# 31 **RNDZ OPS 21012**

Title: Rendezvous Operations

Duration: 5.0 hours

**Note:** Thirty minutes of facility time (prior to this session) will be required

for PGSC setup by the crew.

Medium: SMS-FB

Student: COMMANDER, MS, PILOT (CB Instructor Astronaut (IA) required.)

Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 10/05

Lesson(s) Replaced: None

Equipment Required: COAS, Aft Visual, PGSCs

Prerequisite Lesson(s): APPR & DOCK 22069, RNDZ CRM BR 21001,

RNDZ MAN PH 21069

Preparation: None

Synopsis:

This lesson brings together the skills learned in SST and SES training. The material will be similar to that of the two previous SST lessons, but the lesson will start 1 hour prior to the NCC burn (or NC - 30 min for 1 rev to Ti flights) and proceed through grapple (or docking). Some new information will be covered, and there will be malfunctions from which to recover. This is the first coordinated lesson with the dedicated rendezvous crewmembers, performing their assigned tasks, and exercising good crew coordination and communication. The Tools for Rendezvous and Docking (TRAD) system will be used in this session.

- Execute the rendezvous timeline from NCC-1hr to grapple or docking while exercising the CRM plan developed in the CRM briefing.
- Apply previously learned techniques to a crew environment.
- Demonstrate the following rendezvous procedures/signatures:
  - Crew Optical Alignment Sight (COAS) navigation.
  - Incorporation of sensor data in MM 202.
  - Rendezvous Radar autotrack acquisition.
  - Compute a burn with the Time of Ignition (TIG) in the past.
  - Divergence of Lambert guidance at 180° transfer angles.
  - Rendezvous radar mode indications.

# 31 RNDZ OPS 21012 (Concluded)

- Demonstrate effective use of the TRAD system during rendezvous and manual phase.
- Recognize the impacts to Rendezvous for some single system failures.

# 32 **RNDZ QUAL 21006**

Title: Rendezvous Qualification

Duration: 2.0 hours

Medium: SST 1, SST 2, or SST3

Student: COMMANDER, MS, PILOT (Schedule individually.)
Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 02/90

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): RNDZ OPS 21012

Preparation: None

Synopsis: This lesson will verify completion standards of the training course by

executing the rendezvous timeline without the use of procedures. No

malfunctions will be introduced.

Objectives: • Execute the rendezvous timeline from the beginning of the Rendezvous

book through the MC2 burn without procedures.

• Explain the purpose of the remaining two midcourse burns (MC3 and

MC4).

## 33 **R/PO QUAL 21069**

Title: Rendezvous/Prox Ops Qualification

Duration: 4.0 hours

Medium: Shuttle Engineering Simulator Dome (SES AFT)

Student: COMMANDER, MS, PILOT (Schedule CDR and PLT separately, with

MS attending one session. CB Instructor Astronaut (IA) required.)

Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 07/04

Lesson(s) Replaced: R/PO QUAL 21015

Equipment Required: None

Prerequisite Lesson(s): RNDZ OPS 21012

Preparation: None

Synopsis: During this lesson, the student will verify that manual flying completion

standards for the 20000-Level Rendezvous training flow have been met.

#### 33 R/PO QUAL 21069 (Concluded)

- Objectives: Perform a "Radar Fail" approach from MC3 through a Twice Orbit Rate to a Vbar Approach (TORVA) and dock using less than 450 lbs. of fuel following current techniques and rdot profile. (Low Z at 1000 feet).
  - Perform a Nominal approach from MC3 to an Rbar approach and grapple using less than 300 lbs. of fuel (Low Z at 200 feet).
  - Use the PGSC.
  - Do not use FDF Procedures.

#### 34 **RNDZ CRM BR 31001**

Title: Rendezvous Cockpit Resource Management Meeting

**Duration:** 1.0 hour Medium: Classroom

Schedule in SMS Prebrief room. Note:

Student: COMMANDER

Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 07/04

Lesson(s) Replaced: None

Equipment Required: Rendezvous checklist Prerequisite Lesson(s): Flight assignment

Preparation: None

Synopsis:

This is a meeting with the Commander assigned to a rendezvous flight. It should be conducted before the CDR makes his final Crew Task list (shortly after assigned to the flight).

The Rendezvous instructor will discuss some options for a Rendezvous Cockpit Resource Management (CRM) plan with the CDR before any training has started.

- Discuss interface with the payload (i.e., commanding) and the Tools for Rendezvous and Docking (TRAD) system during the PROX OPS timeline.
- The CDR and Rendezvous Instructor will discuss the CDR's "Crew Assignment List" and try to optimize the assignments for Rndz/Prox Ops and other training required (PDRS/EVA).

#### 35 RNDZ FS-TRAD BR 31001

Title: Flight-Similar Rendezvous Briefing

**Duration:** 3.0 hours Medium: Classroom

Student: COMMANDER, MS, PILOT (Other crewmembers may support.)

Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 09/05

Lesson(s) Replaced: None

Equipment Required: 1 PGSC, HHL, Cables, RPOP Playback trainer

Prerequisite Lesson(s): R/PO QUAL 21069, R/PO QUAL 41069,

RNDZ CRM BR 31001, RNDZ QUAL 21006,

RNDZ QUAL 41006

Preparation: None

Synopsis: This briefing is intended to provide a flight-similar introduction to the

planned rendezvous. It is normally given before any mission-specific or load-specific data has been released. This briefing introduces the crew to the type of rendezvous that they will support, and provides for a general review/refresher of the rendezvous profile. Key DM personnel (Guidance Procedures Officer (GPO), Flight Dynamics Officer (FDO)) should support this briefing. Flight Director and CAPCOM can be invited to this briefing. The Tools for Rendezvous and Docking (TRAD) configuration will be reviewed. The Portable Onboard Computer Control Board (POCCB) representative for the flight should attend this briefing.

- Review the latest Flight Operations Panel Profiles (if available) for Rendezvous and Prox Ops.
- Review the components of the TRAD system.
- Review the Trajectory Control Sensor (TCS) Hardware.
- Review the data that WinDecom supplies to RPOP.
- Demonstrate RPOP and RPOP guidance using the RPOP Playback Trainer.
- Connect the Hand-Held Lidar (HHL) to RPOP and demo its use.
- Review the connection of the TRAD System as described in the RNDZ TOOLS section of the Rendezvous checklist and the Flight-specific PGSC configuration (if available).
- Ensure the crew has a copy of the RPOP Playback Trainer and assist the crew in installing it on their Office Personal Computers (PCs) (if required).
- Give the crew a copy of the HHL Training Guide.

# 35 RNDZ FS-TRAD BR 31001 (Concluded)

- Homework:
  - Review the RPOP Playback Trainer.
  - Review the TRAD Malfunction Procedures (Section 7 in Rendezvous Checklist).
  - Review the HHL Training Guide.

## 36 **PO APPR 31069**

Title: Proximity Operations Approaches

Duration: 4.0 hours

Medium: Shuttle Engineering Simulator Dome (SES AFT)

Student: COMMANDER, MS, PILOT

Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 07/04

Lesson(s) Replaced: None Equipment Required: PGSC

Prerequisite Lesson(s): RNDZ FS-TRAD BR 31001

Preparation: None

Synopsis: In this lesson, the student performs flight-similar approaches using

techniques designed for the flight and/or payload(s) in question. The flight similar approach is practiced using CCTVs, radar, and the angle ranging chart while also observing orbital mechanics effects. The CDR and PLT

should alternate runs flying and using the PGSC.

Objectives: • Practice flight-similar approach techniques.

- Work on Cockpit Resource Management (CRM) topics.
- Use the Tools for Rendezvous and Docking (TRAD) system in this lesson.

#### 37 **APPR & F/A 31069**

Title: Approach and Flyaround

Duration: 4.0 hours

Medium: Shuttle Engineering Simulator Dome (SES AFT)

Student: COMMANDER, MS, PILOT

Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 07/04

Lesson(s) Replaced: APPR & F/A 31015

Equipment Required: None

Prerequisite Lesson(s): PO APPR 31069

Preparation: None

## 37 **APPR & F/A 31069 (Concluded)**

Synopsis:

In this lesson, the student will perform a flight-similar approach. The instructor will ensure that the payload/ISS is oriented in an off nominal orientation (with or without rates), such that a flyaround or attitude flyout is required for final grapple or docking. The CDR and PLT may alternate runs flying.

Objectives:

- Practice flight-similar approach with attitude flyout (and/or flyaround) techniques.
- Demonstrate the upper limits for a matched rate flyaround for "small payload" (e.g., SPARTAN, SPAS) grapple flights.
- Work on Cockpit Resource Management (CRM) topics.
- For grapple flights, do not use the PGSC in this lesson. All approaches shall be flown with Hand-Held Lidar (HHL) and visual cues only.
- For Docking flights:
  - Attitude flyouts should be practiced.
  - Approaches from long-range stationkeeping or from 30 ft. stationkeeping should be considered.
  - Tools for Rendezvous and Docking (TRAD) use is optional.

## 38 **SEP/TRANS 31069**

Title: Separation and Transition

Duration: 4.0 hours

Medium: Shuttle Engineering Simulator Dome (SES AFT)

Student: COMMANDER, MS, PILOT

Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 07/04

Lesson(s) Replaced: SEP/TRANS 31015

Equipment Required: PGSC

Prerequisite Lesson(s): RNDZ FS-TRAD BR 31001

Preparation: None

Synopsis:

In this lesson, the student will perform flight-similar techniques to separate from an RMS-deployed payload or to undock from a space station. Flight-similar transitions and approach techniques will be executed, as well as a contingency/emergency separation (i.e., No RMS deploy, Expedited Undocking).

- Practice flight-similar techniques to separate from an RMS deployed payload or a space station.
- Practice flight-similar transition and/or approach techniques (as required).

#### 38 SEP/TRANS 31069 (Concluded)

- Perform a contingency/emergency payload separation.
- Work on Cockpit Resource Management (CRM) topics.
- Use the PGSC.
- For Docking Flights:
  - Perform the Undocking and Separation timeline.
  - Three runs planned.
  - Loss of Verns should be considered.

#### 39A **RNDZ MAL 31001**

Rendezvous Malfunctions 1 Prebrief Title:

Duration: 1.0 hour

Note: This time should not conflict with PGSC set-up time in the simulator.

Classroom (SMS-Prebrief Room) Medium:

COMMANDER, MS, PILOT Student:

DM34/Rendezvous Guidance, Procedures and Training Source:

07/04 Date:

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): SEP/TRANS 31069 and APPR & F/A 31069

Preparation: Review a rendezvous checklist from a previous similar flight.

Synopsis: During this lesson, the crew will determine the Cockpit Resource

> Management (CRM) plan for the SMS lesson giving consideration to the planned malfunction. The instructor will identify the initial conditions of the simulation and assist with the CRM discussions. (Consider including the

DM34/Docking Rationale ("Y-Y-Y") presentation.)

- Define simulation initial conditions and FDF starting point.
- Distribute Preliminary Advisory Data (PAD) and Time of Ignition (TIG)
- Review CRM topics from the RNDZ CRM BR 31001 lesson.
- Review CRM topics observed during the SES training.
- Determine an initial CRM plan for this sim using the "Crew Management Plan" table.

39B **RNDZ MAL 31012** 

Title: Rendezvous Malfunctions 1

Duration: 5.0 hours

**Note:** Thirty minutes of facility time (prior to this session) will be required for

PGSC setup. The selected crewmembers should support this setup.

Medium: SMS-FB

Student: COMMANDER, MS, PILOT

Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 03/05

Lesson(s) Replaced: None

Equipment Required: COAS, wireless headsets, aft visual, PGSC

Prerequisite Lesson(s): RNDZ MAL 31001

Preparation: None

**Note:** This class may be credited based on crew participation in a Generic or

Flight-Specific integrated rendezvous simulation.

Synopsis: This lesson will begin with the orbiter several hours away from the target

(Station). The main goal of this lesson is to slightly complicate the rendezvous timeline with navigation sensor failures and other orbiter malfunctions. During this period, several off-nominal procedures will be

exercised to demonstrate how Rndz Nav and orbit targeting work.

Objectives: • Perform the rendezvous timeline from NC -30 min (NCC - 1 hr) to docking (grapple) or breakout while exercising good Cockpit Resource Management (CRM).

 Complete manual phase through docking/grapple within the budgeted fuel for the flight.

- Maintain profile and attitude awareness.
- Demonstrate effective use of the Tools for Rendezvous and Docking (TRAD) system.
- Discuss various breakouts and when/where each is applicable.
- Recognize the impacts to Rendezvous for some single system failures.
  - Recognize the loss of the -Z Star Tracker (STRK) (panel bus) and the need to use the -Y STRK.
  - Recognize unacceptable radar angle data.
  - Perform a General Purpose Computer (GPC) redundant set reconfiguration during the rendezvous.
  - Coordinate the partial loss of translational capability.
- Examine and manage other orbiter system failures (including APDS) during the rendezvous timeline.

# 40 **APPR & DOCK 31069**

Title: Approach and Docking 1

Duration: 4.0 hours

Medium: Shuttle Engineering Simulator Dome (SES AFT)

Student: COMMANDER, MS, PILOT

Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 07/04

Lesson(s) Replaced: APP DOCK MAL 31069

Equipment Required: PGSC

Prerequisite Lesson(s): PO APPR 31069

Preparation: None

Synopsis: This lesson is for docking flights only. During this lesson, the student will

demonstrate an understanding of the Prox Ops techniques and tools as applied to docking with another spacecraft. Trajectory Control Sensor (TCS) and radar failures will be introduced to stress the visual cues. The

PGSC will be used in this session.

Objectives: • Perform TCS Fail approach and docking techniques.

• Work on Cockpit Resource Management (CRM) topics.

• Use the Tools for Rendezvous and Docking (TRAD) System with Hand-Held Lidar (HHL) data during this session.

• Attempt to minimize Translation Hand Controller (THC) inputs (use the whole corridor).

• Two runs planned:

MC3 through docking (TCS fail and failed capture).

MC3 through docking (Radar fail, TCS fail, and attitude flyout).

#### Completion Standards:

Contact Conditions:

Position: < 2 inches</li>Angle: < 2 degrees</li>Rdot: 0.1±0.03 fps

• Complete within the defined (flight-specific) window.

#### 41 **RNDZ MAL 32012**

Title: Rendezvous Malfunctions 2

Duration: 5.0 hours

**Note:** Thirty minutes of facility time (prior to this session) will be required for

PGSC setup. The selected crewmembers should support this setup.

Medium: SMS-FB

Student: COMMANDER, MS, PILOT

Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 03/05

Lesson(s) Replaced: None

Equipment Required: COAS, wireless headsets, aft visual, PGSC Prerequisite Lesson(s): RNDZ MAL 31012, SEP/TRANS 31069, and

APPR & F/A 31069

Preparation: None

**Note:** This class may be credited based on crew participation in a Generic or

Flight-Specific integrated rendezvous simulation.

Synopsis: This lesson, like RNDZ MAL 31012, will begin several hours away from

the target (Station) (NCC -45 minutes or NC -30 minutes). The main goal of this lesson is to complete the rendezvous with no Rendezvous Radar to Navigation (NAV) (FF3). A trajectory dispersion may be introduced; as before, off-nominal procedures will be exercised to demonstrate how Rndz Nav and orbit targeting work. The crew should exercise their Cockpit Resource Management (CRM) plan as modified after the last SMS lesson.

- Perform a Radar Fail rendezvous timeline from NC -30 min (NCC 1 hr) to docking (grapple) or breakout while exercising good CRM.
  - Complete manual phase through docking/grapple within the budgeted fuel.
  - Maintain profile and attitude awareness.
- Demonstrate effective use of the Tools for Rendezvous and Docking (TRAD) system.
- Discuss various breakouts and when/where each is applicable.
- Recognize the impacts to Rendezvous for some single system failures, such as:
  - Recognizing a bad Inertial Measurement Unit (IMU) and how it may affect NAV.
  - Recognizing loss of General Purpose Computer (GPC) rendezvous radar pointing.
  - Recognizing loss of rendezvous radar data.
  - Discuss Translation Hand Controller (THC) contacts and jet requirements.

# 41 RNDZ MAL 32012 (Concluded)

- Examine and manage other orbiter system failures during the rendezvous timeline.
- Malfunction shopping list:
  - Demonstrate "FLTR PROP > 40K" procedure (IMU).
  - Exercise RR AUTO TRACK ACQ cue card.
  - Use -Y Star Tracker (STRK) post Ti.
  - Practice Radar Fail manual phase techniques.
  - Examine and manage other orbiter system failures during the rendezvous timeline.
  - Use PGSC during rendezvous manual phase.
  - Performing <u>FAILED CAPTURE</u> due to an APDS problem is optional.
  - Exercise procedures from <u>APDS OFF-NOMINAL</u> on approach or after contact.

## 42 **RNDZ MAN PH 31069**

Title: Rendezvous Manual Phase 3

Duration: 4.0 hours

Medium: Shuttle Engineering Simulator Dome (SES AFT)

Student: COMMANDER, MS, PILOT

Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 07/04

Lesson(s) Replaced: None

Equipment Required: PGSC (optional)

Prerequisite Lesson(s): APP DOCK MAL 31069 (docking flights),

APPR & F/A 31069, RNDZ MAL 31012

Preparation: None

Synopsis: In this lesson, the student will perform the initiation of the manual phase of

rendezvous, using the Radar Fail procedure to complete the manual phase and to manage range and range rate. A flight-similar approach is used. Flight-similar information relative to piloting technique (plume impingement, etc.) is discussed. (Trajectory Control Sensor (TCS)/

Hand-Held Lidar (HHL) data will not be used.)

One run post Ti through grapple or Docking may be included to exercise Crew Optical Alignment Sight (COAS) Navigation (NAV) procedures and techniques (as desired).

# 42 RNDZ MAN PH 31069 (Concluded)

Objectives:

- Perform manual phase rendezvous techniques.
- Use the Radar Fail procedure to complete the manual phase.
- Use COAS subtended angle and the PGSC to get range and range rate information.
- Transition to Vbar (Rbar), establish Vbar (Rbar) and perform a Vbar (Rbar) approach to grapple or docking (as required).
- Use PGSC during the manual phase (optional).
- Exercise the COAS NAV Radar Fail procedure (if desired).

# Completion Standards:

- RMS Flights:
  - The flight similar approach from Post MC3 through grapple should be flown within 500 lbs. total Reaction Control System (RCS) fuel (this may include a flyaround).
- Docking Flights:
  - The flight-similar approach from MC2 + 10 minutes through docking should be flown within 500 lbs. total RCS fuel. This includes 5 minutes of stationkeeping at both a long range (170 ft.) and 30 ft. distance, and at least a one-axis attitude flyout.

# 43A **TI DELAY 31001**

Title: Ti Delay Prebrief

Duration: 0.5 hours Medium: Classroom

**Note:** Schedule on prebrief room.

Student: COMMANDER, MS, PILOT (Schedule individually.)
Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 05/97

Lesson(s) Replaced: None

Equipment Required: Rendezvous checklist Prerequisite Lesson(s): RNDZ MAL 32012

Preparation: None

Synopsis: Refer to TI DELAY 31006 for synopsis.

Objectives: Refer to TI DELAY 31006 for objectives.

43B **TI DELAY 31006** 

Title: Ti Delay Duration: 2.0 hours

Medium: SST 1, SST 2, or SST 3

Student: COMMANDER, MS, PILOT (Schedule individually.)
Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 09/05

Lesson(s) Replaced: RNDZ SKILLS 31012

Equipment Required: None

Prerequisite Lesson(s): TI DELAY 31001

Preparation: None

Synopsis: This lesson introduces the concepts, procedures, and issues associated

with delaying the rendezvous with a Ti delay burn, and terminating a rendezvous with a backout or breakout. The lesson will begin with the orbiter about 30 minutes from the NCC burn. The main goal of this lesson is to execute the one-rev delay at the Ti point. Navigation (NAV) sensor anomalies will be demonstrated; the use of Star Tracker (STRK) data will be used post Ti, and the effect of OPS transitions on Rndz Nav will be

demonstrated.

Objectives: • Perform (aided) the Ti delay procedures.

 Perform (unaided) an External Delta-V (EXT DV) burn instead of a Lambert burn.

Perform STRK and radar navigation post Ti or Ti delay.

 Demonstrate an understanding of the RNDZ BREAKOUT PROCEDURES OVERVIEW in the Rendezvous checklist.

Perform RNDZ NAV SAFING and RECOVERY for an OPS transition.

• Manage other orbiter system failures during the rendezvous timeline.

## 44 **R/PO QUAL 31069**

Title: Rendezvous and Proximity Operations Qualification

Duration: 4.0 hours

Medium: Shuttle Engineering Simulator Dome (SES AFT)

Student: COMMANDER, MS, PILOT

Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 07/04

Lesson(s) Replaced: None

Equipment Required: PGSC (Optional)
Prerequisite Lesson(s): RNDZ MAN PH 31069

Preparation: None

# 44 R/PO QUAL 31069 (Concluded)

Synopsis: During this lesson, the crew will demonstrate that manual flying

completion standards for the planned rendezvous training flow have been

met. (Use of FDF will be left up to the instructor.)

Objectives:

 Perform a "Radar Fail" approach from MC3 cutoff to grapple or docking using less than 450 lbs. of fuel. Perform Vbar (Rbar) stationkeeping as required. Perform a "Radar Fail" approach from MC3 cutoff to grapple or docking, using Hand-Held Lidar (HHL) only (no Tools for Rendezvous and Docking (TRAD)) and using less than 550 lbs. Perform Vbar (Rbar) stationkeeping as required and arrive at 250 feet prior to sunset.

Contact conditions for docking flights:

Position: < 2 inches</li>Angle: < 1 degree</li>Rdot: 0.1±0.03 fps

Time: Within the docking window

Minimal Translation Hand Controller (THC) inputs (use the whole corridor)

## 45 **RNDZ QUAL 31006**

Title: Rendezvous Qualification

Duration: 2.0 hours

Medium: SST 1, SST 2, or SST 3

Student: COMMANDER, MS, PILOT (Schedule individually.)
Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 04/88

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): TI DELAY 31006

Preparation: None

Synopsis:

This lesson is completed without the use of FDF in order to ascertain the student's ability to complete a rendezvous without a so-called "cookbook" approach to the procedures. Awareness of the flight profile and the necessary actions are stressed.

- Demonstrate an understanding of the flight-specific rendezvous profile sequence.
- Perform necessary actions and malfunction procedures to complete the rendezvous without FDF from the NC burn through the MC2 burn.

# 46 **PROX OPS TOPICS 31069**

Title: Flight Specific Prox Ops Topics

Duration: 2.0 hours

Medium: Shuttle Engineering Simulator Dome (SES AFT)

Student: COMMANDER, MS, PILOT

Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 03/06

Lesson(s) Replaced: EVA RESCUE 31069

Equipment Required: None

Prerequisite Lesson(s): EVA RESCUE 21069, R/PO QUAL 31069

Preparation: None

**Note:** Since the Joint Operations Panel has not addressed shuttle rescue of

a stranded EVA crewmember while docked to a Station, this class will be used as a placeholder session for docking flights. Its' objectives will

be left up to the instructor.

Synopsis: Review of various topics associated with the flight specific Prox Ops

profile. These include but are not limited to:

EVA Rescue

Tools for Rendezvous and Docking (TRAD) skills

Manual phase and approach skills and techniques

• Undocking and/or separation skills and techniques

Objectives: To be determined by the Instructor and the Flight Commander.

# 47 **APPR & DOCK 91069**

Title: Approach and Docking Timeline Note: Schedule for docking flights only.

Note: Scheduled prior to first docking integrated simulation (sim).

Note: The CDR or Rndz instructor can move this lesson to the SMS as

desired.

Duration: 4.0 hours

Medium: Shuttle Engineering Simulator Dome (SMS-FB)

Student: COMMANDER, MS, PILOT

Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 07/04

Lesson(s) Replaced: APP DOCK 91069

Equipment Required: PGSC

Prerequisite Lesson(s): R/PO QUAL 31069 and RNDZ QUAL 31006

Preparation: None

## 47 APPR & DOCK 91069 (Concluded)

Synopsis:

This lesson is for docking flights only and should be scheduled prior to the first integrated sim. During this lesson the student will demonstrate an understanding of the prox ops techniques and tools as applied to docking with another spacecraft. The PGSC will be used in this session.

Objectives:

- Perform nominal timeline from MC3 Time of Ignition (TIG) (MC2 Cutoff if in SMS) to docking.
- Work on Cockpit Resource Management (CRM) topics.
- Use PGSC (radar, Hand-Held Lidar (HHL), and Trajectory Control Sensor (TCS) data).
- Two runs planned from MC3 TIG through Docking (MC2 Cutoff if in SMS):
  - Failed capture is optional on one run.
  - Loss of verns is optional on one run.
- Undock and separate through the start of flyaround (if time permits).

## 48 **RNDZ T/L 91012**

Title: Rendezvous Timeline

Duration: 5.0 hours

**Note:** Schedule 1 hour prebrief as instructor/crew desire.

Medium: SMS-FB

**Note:** Thirty minutes of facility time (prior to this session) will be required for

PGSC Setup. The selected crewmembers should support this setup.

Student: COMMANDER, MS, PILOT. Include the flight CAPCOM and RGPO.

Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 03/05

Lesson(s) Replaced: None

Equipment Required: COAS, wireless headsets, aft visual, PGSC Prerequisite Lesson(s): R/PO QUAL 31069, RNDZ QUAL 31006

Preparation: None

Synopsis:

This lesson may be the crew's first look at the rendezvous profile in the training load with the FDF. It may also be the crew's first look at the rendezvous profile in the SMS. Most of this lesson will cover basic objectives. This method will allow the crew a chance to review the trajectory, the target sets, and the FDF. A training script with inputs from the crew, DT/Rendezvous training, and DM/Orbit Dynamics may be developed on a case-by-case basis. A prebrief covering the highlights of the flight-specific material may be conducted prior to the SMS session.

# 48 **RNDZ T/L 91012 (Concluded)**

Objectives: • Examine rendezvous profile with load-specific software and FDF.

- Examine load-specific information:

  Output

  Description:

  Out
  - Sun angle/lighting (beta)/DTOs
  - FDF changes
- Review several other training and malfunction objectives from the Rendezvous Training Flow (including APDS).

## 49 **RNDZ/PO T/L 91012**

Title: Rendezvous/Proximity Operations Timeline

Duration: 5.0 hours Medium: 5MS-FB

**Note:** Thirty minutes of facility time (prior to this session) will be required for

PGSC Setup. The selected crewmembers should support this setup.

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT (Include the flight

CAPCOM, RGPO, PDRS, or MACCS (as desired).)

Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 11/01

Lesson(s) Replaced: RETR MAL T/L 91012

Equipment Required: COAS, wireless headsets, aft visual, PGSC

Prerequisite Lesson(s): APP DOCK 91069 (docking flights), R/PO QUAL 31069,

RNDZ QUAL 31006

Preparation: None

Synopsis: This lesson will cover the nominal manual phase, rendezvous, and all of

proximity operations through grapple or docking. Specific objectives will be flight-specific and arranged beforehand with the crew (e.g., undocking and/or separation profiles). Malfunctions may be introduced to promote crew interaction and coordination. Malfunctions for the sake of system training only should be discouraged.

Flight-Specific FDF should be used during this session.

Malfunction shopping list: Instructor should consider these malfunctions but should not try to use all of them in one session. Any malfunction used in this session must be apparent in the cockpit.

## **Grapple Flight:**

Payload Power interface problem

Loss of safety inhibits

Standard Switch Panel (SSP) Malfunctions

Loss of Verns

System Management (SM) General Purpose Computer (GPC) fail

## 49 RNDZ/PO T/L 91012 (Continued)

RMS hand controller problem CCTV problem End Effector (EE) malfunction

#### Docking Flight:

Hooks single motor failure Fixers problem Damping problem Indicator light problem

#### Objectives:

- Exercise load-specific manual phase and proximity operations for both rendezvous and separation timelines.
- For PDRS Deploy (a PDRS instructor should support this session):
  - Exercise PDRS Deploy operations from payload unberth through the separation burns.
  - Exercise the retrieve timeline through payload berthing. This run should include a single axis flyaround for a payload that is not in the correct attitude.
- For docking Flights (an APDS instructor should support this session):
  - Perform one run from MC2 through docking (including attitude flyout).
  - Perform several runs from, and including, 30 feet stationkeeping through docking.
  - Failed capture/backouts for APDS problem and flyouts should be exercised.
  - One run to include undocking and separation profile from Orbit Docking System (ODS) power-up through the separation burns.
- Run 1: MC2 through docking (hard dock) or grapple (payload berth).
   (As time permits, some payload procedures may be considered after payload berth.)
- Run 2 (docking): Undocking 30 minutes through a separation burn (May be a continuation of run 1, no reset required).
   (Early separation or breakout from the flyaround should be considered.)
- Run 2 (grapple): Payload activation/unberth through the Separation (SEP) 2 burn (May be done before Run 1).

#### 49 **RNDZ/PO T/L 91012 (Concluded)**

Run 3 (docking): Start at 30 ft. stationkeeping

Attitude flyout

Failed capture (APDS problem)

Perform the Corridor Backout to 30 ft.

Run 4 (docking): Start at 30 ft. stationkeeping

Attitude flyout

Perform the Corridor Backout to 30 ft. for APDS problem

• Run 5 (docking): Start at 30 ft. stationkeeping

Attitude flyout

Station does not go to free drift (moding lights)

Un-latch and perform the Corridor Backout procedure to 30 ft.

## 50A **UNDOCK MAL T/L 91001**

Title: Undock Malfunction Timeline Prebrief

Duration: 1.0 hour Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT

Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 07/07

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): SEP/TRANS 31069

Preparation: None

Synopsis: This lesson will provide the students with the timeline to be executed

during the following lesson, UNDOCK MAL T/L 91012.

Guidelines for coordination between crewmembers should be discussed. Secondary tasks are prioritized as to not interfere with the primary task. Review the Rendezvous (RNDZ) Digital Autopilot (DAP) constraints for

this timeline.

Objectives: Discuss the following:

Nominal undocking timeline

- Flight Plan and possible contingency situations:
  - Initial Condition: Docked with Orbiter Docking System (ODS) powered down, hatch opened
  - ODS Powerup
  - Vestibule depress
  - Leak Check
  - Undocking

## 50A UNDOCK MAL T/L 91001 (Concluded)

Separation (SEP) 1 and backaway

Fly around

SEP 2 (Breakout can be substituted)

#### 50B **UNDOCK MAL T/L 91012**

Title: Undock Malfunction Timeline

Duration: 4.0 hours

**Note:** As required, the SMS should be scheduled for one hour of PGSC and

photo/TV setup training prior to the start of the lesson.

Medium: SMS-FB (FB, as requested.)

Student: Entire crew (CB Instructor Astronaut (IA) attendance optional.)

Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 07/07

Lesson(s) Replaced: None

Equipment Required: PGSC, COAS

Prerequisite Lesson(s): SEP/TRANS 31069,

UNDOCK MAL T/L 91001

Preparation: None

Synopsis: Special attention should be paid to coordination between crewmembers

and prioritization of tasks. This lesson exercises the Undocking timeline, integrating all Rendezvous (RNDZ), APDS and Payload tasks, as the crew will perform them in flight. The CDR should coordinate the flight deck

activities to establish a proper balance between command and

crewmember participation, and act decisively when the situation requires.

#### Objectives: • I

- Perform undocking timeline with the following malfunctions:
  - Hatch Fail Leak Check
  - APDS manual hook release
  - Breakout from sep/flyaround due to orbiter problem or Any Attitude undock and separation
- Summary
  - Run 1 Initial Condition: Hard Docked, orbiter controlling attitude, hatches open
    - Close hatches
    - Orbiter Docking System (ODS) Power-up
    - Vestibule depress
    - Leak Check
    - Undocking
    - Vbar Sep
    - ODS power down

## 50B UNDOCK MAL T/L 91012 (Concluded)

- Flyaround (if timelined)
- Breakout burn
- Run 2 (If time permits) Initial Condition: Hard Docked, orbiter controlling attitude, hatches closed
  - Any Attitude Separation

#### 51 **PROX OPS T/L 91012**

Title: Proximity Operations Timeline

Duration: 4.0 hours

**Note:** As required, the SMS should be scheduled for one hour of PGSC and

photo/TV setup training prior to the start of the lesson.

Medium: SMS-FB

Student: CDR, PLT, MS 1, MS 2, MS 3

Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 07/07

Lesson(s) Replaced: None

Equipment Required: PGSC, COAS

Prerequisite Lesson(s): RNDZ/PO QUAL 31069 (all flights), RMS/PL CONT 91012

(for grapple flights)

Preparation: None

Synopsis: During this lesson, the crewmembers will perform the flight-specific

separations and/or approaches, with an emphasis on the recent changes to the FDF and Flight Rules. Some malfunctions may be introduced on a review basis. The emphasis should be on Cockpit Resource Management

(CRM).

(Optional Class) The CDR and/or Rendezvous Instructor for the flight can

credit this class if the objectives are met in another class.

For deploy flights, this lesson will be used to cover contingency

procedures from the applicable deploy checklist.

Objectives: Deploy/Retrieve/Docking/Rendezvous flights:

 Perform deploy/undock timeline from the start of the release, deploy or docking system powerup timeline through the final Separation burn with malfunctions.

 Perform retrieve/dock timeline through berthing or docking system power down.

## 52 **RNDZ MAN PH 91069**

Title: Rendezvous Manual Phase 4
Note: Schedule at L-2 weeks or later.

Duration: 4.0 hours

Medium: Shuttle Engineering Simulator Dome (SES AFT)

Student: COMMANDER, MS, PILOT

Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 07/04

Lesson(s) Replaced: RNDZ COMPL 91015

Equipment Required: PGSC

Prerequisite Lesson(s): RNDZ/PO T/L 91012

Preparation: None

Synopsis: In this lesson, the student will perform the initiation of the manual phase of

rendezvous, using the Radar Fail and nominal procedures to complete the manual phase, and to manage range and range rate. A flight-similar approach is used. Flight-similar information relative to piloting technique (plume impingement, etc.) is discussed. Trajectory Control Sensor (TCS)/Hand-Held Lidar (HHL) data will not be used on one run.

Objectives: • Perform the nominal manual phase rendezvous techniques.

• Use the Radar Fail procedure to complete the manual phase.

• Use Crew Optical Alignment Sight (COAS) subtended angle to get range and the PGSC to get range rate information.

• Use PGSC during manual phase.

Completion Standards: Have a good flight!

#### **RNDZ FAM PRF 41001**

Title: Rendezvous Familiarization 1 Briefing

Duration: 0.5 hours Medium: Classroom

Student: COMMANDER, MS, PILOT (Schedule individually.)
Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 07/93

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): EVA RESCUE 21069, RNDZ FAM 21006,

SEP/TRANS 22069

Preparation: None

Synopsis: Refer to RNDZ FAM PRF 41006 for synopsis.

Objectives: Refer to RNDZ FAM PRF 41006 for objectives.

#### **RNDZ FAM PRF 41006**

Title: Rendezvous Familiarization 1

Duration: 2.0 hours

Medium: SST 1, SST 2, or SST 3

Student: COMMANDER, MS, PILOT (Schedule individually.)
Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 05/97

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): RNDZ FAM PRF 21001

Preparation: None

Synopsis: This lesson is designed for students that have completed the "Deploy

Only" part of this training flow. In this lesson, the student will perform the nominal timeline from the start of the Contingency Rendezvous book to the MC2 burn. The use of REL NAV (SPEC 33) ORBIT TGT (SPEC 34), and sensor data will be stressed. During the class, the student will use the annotated procedures found in the Rendezvous Crew Training

Handbook.

Objectives: • Perform the nominal rendezvous timeline.

Evaluate Navigation (NAV) sensor data.

- Configure orbiter crew Station switches for rendezvous operations.
- Evaluate burn solutions, choose the correct engines, and execute rendezvous Reaction Control System (RCS) burns.
- Configure the software for rendezvous operations.
- Explain Inertial Measurement Unit (IMU) attitude selection.

#### **PO PRF ADV 41069**

Title: Proximity Operations Proficiency

Duration: 2.0 hours/as required

Medium: Shuttle Engineering Simulator Dome (SES AFT)

Student: COMMANDER, MS, PILOT (Schedule CDR and PLT separately.

with MS attending one session.)

Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 07/04

Lesson(s) Replaced: None Equipment Required: PGSC

Prerequisite Lesson(s): PROX TECH 21069, SEP/TRANS 22069

Preparation: None

## PO PRF ADV 41069 (Concluded)

Synopsis: This lesson is designed for students that have completed the "Deploy

Only" part of this training flow. This lesson is designed to practice prox

ops techniques.

Objectives: Exercise prox ops approaches and separations.

#### RNDZ PRF ADV 41001

Title: Advanced Rendezvous Proficiency Briefing

Duration: 0.5 hours Medium: Classroom

Student: COMMANDER, MS, PILOT (Schedule individually.)
Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 07/93

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): Completion of 20000-level Rendezvous training

Preparation: None

Synopsis: The prebrief will include content such as: the lesson overview, a systems

review, a review of FDF use and procedures, switch configurations, and

other crew training aids.

Objectives: Refer to RNDZ PRF ADV 41006 for objectives.

#### **RNDZ PRF ADV 41006**

Title: Advanced Rendezvous Proficiency

Duration: 2.0 hours/6 months Medium: SST 1, SST 2, or SST 3

Student: COMMANDER, MS, PILOT (Schedule individually.)
Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 05/97

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): RNDZ PRF ADV 41001

Preparation: None

Synopsis: This lesson is designed to assure that the student has achieved a level of

competence/awareness necessary to support an integrated rendezvous session. Sensor biases, their impact on rendezvous navigation, and subsequent Lambert targeting are stressed. In order to bring out a few

key points, especially as far as the management of Rendezvous

Navigation, several malfunctions will be introduced.

## RNDZ PRF ADV 41006 (Concluded)

- Objectives: Identify star lock-ons during a Star Tracker (STRK) pass.
  - Perform DPS reconfigurations and recognize when RNDZ NAV SAFING and RECOVERY is required.
  - Identify STRK power problems and sensor biases.
  - Identify the radar/Nav data path.
  - Evaluate burn solutions, choose the correct engines, and execute RNDZ OMS BURN procedure.
  - Evaluate the MC2 solution and perform this burn on time rather than on elevation angle.

## **R/PO PRF ADV 41069**

Title: Advanced Rendezvous and Proximity Operations Proficiency

4.0 hours/6 months (Pilot Pool Proficiency) Duration:

4.0 hours/2 weeks (Assigned crew proficiency)

Shuttle Engineering Simulator Dome (SES AFT) Medium:

COMMANDER, MS, PILOT (Schedule CDR and PLT separately, Student:

with MS attending one session.)

Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 07/04

Lesson(s) Replaced: RNDZ PROF 41012, PROX PRF ADV 41012

Equipment Required: **PGSC** 

Prerequisite Lesson(s): Completion of 20000-level Rendezvous training

Preparation: None

Synopsis: This lesson is designed to maintain the proficiency level necessary to

support integrated rendezvous simulations. Generic rendezvous

approaches will be exercised to include nominal, short, and long trajectory

cases. The rendezvous will span the timeframe between MC3 and stationkeeping, grapple, or docking. If this class is being used for proficiency after a launch slip, one class every two weeks is the

requirement. This assures that the last class will be at L-2 weeks or less.

A DST or SMS session can be substituted to meet this requirement.

Objectives: Exercise generic rendezvous approaches from MC3 to grapple or docking.

#### **R/PO PRF ADV 41025**

Title: Advanced Rendezvous and Proximity Operations Proficiency

Duration: 2.0 hours/as desired
Medium: Dynamic Skills Trainer 1

Student: COMMANDER, MS, PILOT (Schedule separately or as desired.)

Source: DM34/Rendezvous Guidance, Procedures and Training

**Note:** Schedule as 71025 if instructor not required

Date: 05/97

Lesson(s) Replaced: None Equipment Required: PGSC

Prerequisite Lesson(s): DST FAM 21025

Preparation: None

Synopsis: This lesson is designed to introduce the student to the capabilities of the

DST. The instructor will demonstrate the logon procedure as well as the PGSC hook-ups. The rendezvous profile will span the timeframe between MC3 and stationkeeping, grapple or docking, as well as undocking and

separations.

Objectives: • Logon to the DST for use as a Rendezvous/Prox Ops and PGSC

software trainer.

• Exercise generic rendezvous approaches from MC3 to grapple or

docking.

• Practice using the PGSC and managing the data inputs.

#### **RNDZ QUAL 41006**

Title: Rendezvous Qualification

Duration: 2.0 hours

Medium: SST 1, SST 2, or SST 3

Student: COMMANDER, MS, PILOT (Schedule individually.)
Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 02/90

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): RNDZ OPS 21012 or RNDZ PRF ADV 41006 if regaining

proficiency

Preparation: None

Synopsis: In this lesson the student will verify completion standards of the training

course by executing the rendezvous timeline without the use of

procedures. No malfunctions will be introduced.

Objectives: Refer to RNDZ QUAL 21006 for objectives.

## **R/PO QUAL 41069**

Title: Rendezvous Qualification

Duration: 4.0 hours

Medium: Shuttle Engineering Simulator Dome (SES AFT)

Student: COMMANDER, MS, PILOT

Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 07/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): RNDZ OPS 21012 or RNDZ PRF ADV 41006 if regaining

proficiency

Preparation: None

Synopsis: Refer to R/PO QUAL 21069 for synopsis.

Objectives: Refer to R/PO QUAL 21069 for objectives.

#### **GEN RNDZ 31042**

Title: Integrated Generic Rendezvous

Duration: 8.0 hours Medium: MCC/FB

Student: COMMANDER, MS, PILOT (Other crewmembers as required by

CDR.)

Source: DM34/Rendezvous Guidance, Procedures and Training

Date: 04/93

Lesson(s) Replaced: None

Equipment Required: Rendezvous Checklist Prerequisite Lesson(s): RNDZ QUAL 21006

Preparation: None

Synopsis: It is highly desirable that the flight crew supports an integrated generic

rendezvous simulation. RNDZ MAL 31012 or RNDZ MAL 32012 can be

credited based on this support.

Objectives: Exercise crew coordination options to complete the rendezvous during a

generic rendezvous simulation.

#### SECTION 11.0 SPACEHAB/MPLM TRAINING COURSE

This section contains two separate training courses: for the Spacehab and for the Multipurpose Logistics Module (MPLM). The applicable training flow will be chosen based on the flight-specific mission configuration (i.e., which payload is manifested).

The Spacehab Training Course specifies the lessons required to prepare a student to understand and develop the skills necessary to operate the Spacehab. The subsystems for the Spacehab Logistics Module (LM) are dependent on the flight-specific configuration.

Upon completing the Spacehab Training Course, the student shall be able to perform all nominal procedures to operate the Spacehab module subsystems. Additionally, the student shall use the malfunction procedures to recognize and recover from module failures and failures of Orbiter interfaces.

The course utilizes various facilities for training including the classroom, the Payload Trainer (PYLD), the Spacehab Volumetric Trainer (SVT), the SMS, the FFT, and the CCT at JSC. The Payload Trainer is a UNIX-based trainer located in JSC's building 4S providing standalone training on the Spacehab subsystems. The PYLD shall be used as the primary systems trainer for Spacehab. The FFT or CCT shall be used to provide Spacehab tunnel operations training. The facility used is dependent on the flight-specific Orbiter airlock configuration. The SMS-FB and SVT shall be used to exercise coordinated crew procedures required for Spacehab subsystem nominal and contingency operations. The SMS GNS and SVT may also be used for training (if required), although this combination is less desirable since the SMS-GNS is in building 35 and the SVT and SMS-FB are in building 5N.

The CDR shall select the MS responsible for Spacehab prime and backup support.

The MPLM Training Course specifies the lessons required to prepare a student to understand and develop the skills necessary to operate the MPLM Orbiter interfaces while in the payload bay. Upon completing the MPLM Training Course, the student shall be able to perform nominal demate/mate of the Remotely Operated Electrical Umbilical (ROEU) and release/latch of the MPLM Payload Retention Latch Assemblies (PRLA) and Active Keel Actuator (AKA).

The course utilizes various facilities for training, including the classroom and PYLD at JSC, as well as an actual MPLM during a supplemental facility visit at KSC.

The CDR shall select the MS responsible for MPLM prime and backup support.

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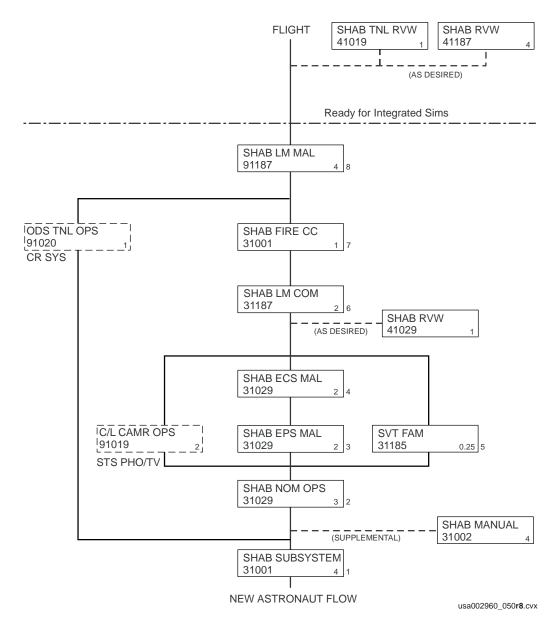


Figure 11-1. Spacehab Lesson Flow Chart

**Table 11-1. Spacehab Crew Training Requirements** 

Date Last Modified: 06/08

								Non-C	rew Rot	ation				Crew F	Rotation			
Stage	Ref Num	Lesson Code	Media	Hrs	Sched Code	С	Р	MS1	MS2	MS3	MS4	PS	O	Р	MS1	MS2	Alt Fac	Comments
0	1	SHAB SUBSYSTEM 31001	CLR	4	8	4	4	4	4	4	4	4	4	4	4	4		
0	2	SHAB NOM OPS 31029	PYLD	3	1			3	3						3	3		As assigned by CDR
0	3	SHAB EPS MAL 31029	PYLD	2	2			2	2						2	2		As assigned by CDR
0	4	SHAB ECS MAL 31029	PYLD	2	2			2	2						2	2		As assigned by CDR
0	5	SVT FAM 31185	SVT	0.25	8	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25		Schedule w/SHAB LM COM 31187
																		Schedule by shift as
0	6	SHAB LM COM 31187	SVTFB	2	4	2	2	2	2				2	2	2	2	SVTGNS	assigned
0	7	SHAB FIRE CC 31001	CLR	1	8	1	1	1	1	1	1	1	1	1	1	1		
0	8	SHAB LM MAL 91187	SVTFB	4	8			4	4						4	4	SVTGNS	Prime and Backup required, rest of crew optional
0		SHAB MANUAL 31002	WBK	4	1			4	4						4	4		As assigned by CDR; Supplemental
0		SHAB TNL RVW 41019	FFT	1	2			1	1						1	1	ССТ	As assigned by CDR; as desired
0		SHAB RVW 41029	PYLD	1	2	1	1	1	1	1	1	1	1	1	1	1		As desired
0		SHAB RVW 41187	SVTFB	4	2			4	4						4	4		As assigned by CDR; as desired
0		Sub T	otal for Stage		Stage Totals F	Per Crewn	nember:											
0				28.25		8.25	8.25	28.25	28.25	6.25	6.25	6.25	8.25	8.25	28.25	28.25		

## 1 SHAB SUBSYSTEM 31001

Title: Spacehab Subsystems Familiarization Briefing

Duration: 4.0 hours Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS 1

Source: Spacehab Inc.

Date: 03/05

Lesson(s) Replaced: SHAB FAM 31001 Equipment Required: Overhead projector Prerequisite Lesson(s): New Astronaut Flow

Preparation: None

Synopsis: This lesson is a briefing given by Spacehab Inc. about the Spacehab

payload. The briefing provides an overview of the Spacehab module and

each subsystem, including interfaces with the orbiter and crew. In addition, this lesson covers the purpose and use of the Spacehab Subsystem (SS) PGSC system as it relates to Spacehab, including a

display overview and command capability.

Objectives: By the end of this lesson, the students will be able to:

Identify components and subsystems of the Spacehab module.

• Name all Orbiter/crew interfaces.

Describe Spacehab operational concepts and procedures.

## 2 **SHAB NOM OPS 31029**

Title: Spacehab Operations Nominal

Duration: 3.0 hours Medium: PYLD Trainer

Student: As assigned by CDR (Schedule individually.)
Source: DO5/Cargo Integration and Operations Branch

Date: 03/05

Lesson(s) Replaced: SHAB RDM NOM 31029

Equipment Required: Spacehab Operations Checklist (SH OPS)

Prerequisite Lesson(s): SHAB SUBSYSTEM 31001

Preparation: None

## 2 SHAB NOM OPS 31029 (Concluded)

Synopsis:

This lesson provides an overview of the Spacehab Logistics Module (LM) EPS and Environmental Control Subsystem (ECS). The lesson builds student proficiency at monitoring and controlling the Spacehab Emergency direct current (EMER DC), DC, and AC power systems as well as the Atmosphere Revitalization Subsystem (ARS), water loop, and Fire Suppression Subsystem (FSS) systems. The lesson also discusses how the Orbiter provides power to Spacehab. It exercises the post insertion, activation, and entry prep procedures for unpowered ascent and powered entry configuration. Current FDF shall be used.

Objectives:

By the end of this lesson, the student shall be able to:

- Identify the following cockpit interfaces:
  - Standard Switch Panel (SSP) switches and talkbacks
  - R1A1 and MA73C power switches
  - C3A5 switches
  - Multifunction Electronic Display Subsystem (MEDS) displays
  - MEDS commanding
- Describe the EPS in terms of:
  - EMER DC bus configuration
  - DC bus configuration
  - AC bus configuration
  - Experiment Connector Panel (EXCP) AC and DC power switching
- Describe the ECS in terms of:
  - ARS and Cabin Fan control and monitoring
  - ECS data displayed on the MEDS displays
  - Water loop control and monitoring
  - Module smoke detection
  - FSS commanding
  - FSS Self Test
  - Atmospheric Pressure Limiting Subsystem (APLS) valves
- Execute the Spacehab Activation procedure for unpowered ascent.
- Execute the Spacehab Entry Prep procedure for powered entry.

## 3 **SHAB EPS MAL 31029**

Title: Spacehab Electrical Power Subsystem Malfunction

Duration: 2.0 hours
Medium: PYLD Trainer

Student: As assigned by CDR (Schedule individually or in pairs.)

Source: DO5/Cargo Integration and Operations Branch

Date: 10/05

Lesson(s) Replaced: None

Equipment Required: Spacehab Operations Checklist (SH OPS), Spacehab

Malfunction Procedures and System Data (SH MAL)

Prerequisite Lesson(s): SHAB NOM OPS 31029

Preparation: None

Synopsis: This lesson exposes the student to a variety of Spacehab EPS

malfunction signatures. Malfunctions shall be exercised for the Spacehab Emergency direct current (EMER DC), DC, and AC power systems. Possible malfunction scenarios may include: relay failures, sensor failures, bus shorts, equipment shorts, fuse failures, switch failures, or Spacehab inverter failures. This lesson contains two objectives that must

be completed before the lesson is considered complete.

Objectives: By the end of this lesson, the student shall be able to:

 Identify the Spacehab EPS anomalies presented and perform the appropriate malfunction procedure and/or recovery procedure from the SH OPS or SH MAL.

• Explain the impacts of each anomaly with respect to Spacehab systems and Orbiter operations.

#### 4 SHAB ECS MAL 31029

Title: Spacehab Environmental Control Subsystem Malfunction

Duration: 2.0 hours Medium: PYLD Trainer

Student: As assigned by CDR (Schedule individually or in pairs.)

Source: DO5/Cargo Integration and Operations Branch

Date: 10/05

Lesson(s) Replaced: None

Equipment Required: Spacehab Operations Checklist (SH OPS), Spacehab

Malfunction Procedures and System Data (SH MAL)

Prerequisite Lesson(s): SHAB EPS MAL 31029

Preparation: None

## 4 SHAB ECS MAL 31029 (Concluded)

#### Synopsis:

This lesson exposes the student to a variety of Environmental Control Subsystem (ECS) component failure signatures. This lesson contains two objectives that must be completed before the lesson is considered complete. Malfunctions shall be exercised in the Atmosphere Revitalization Subsystem (ARS), Atmosphere Thermal Control Subsystem (ATCS), Atmosphere Monitoring Subsystem (AMS), Atmosphere Pressure Limiting Subsystem (APLS), and the Fire Suppression Subsystem (FSS). Possible malfunction scenarios may include:

- Cabin leak
- Cabin/ARS fan delta pressure high/low
- Cabin pressure high/low
- Partial Pressure Carbon Dioxide (PPCO2) high/low
- Partial Pressure Oxygen (PPO2) high/low
- Cabin temperature high/low
- Water pump outlet pressure
- Water pump inlet pressure
- Water pump accumulator quantity
- Inadvertent FSS ARM
- Smoke sensor A/B alarm
- False fire
- Slow propagating fire
- Fast propagating fire
- Single bottle Halon discharge
- Multi-bottle Halon discharge

#### Objectives:

By the end of this lesson, the student shall be able to:

- Identify the Spacehab ECS anomalies presented and perform the appropriate malfunction procedure and/or recovery procedure from the Spacehab Operations Checklist (SH OPS) or Spacehab Malfunction Procedures and System Data (SH MAL).
- Explain the impacts of each anomaly with respect to Spacehab systems and Orbiter operations.

## 5 **SVT FAM 31185**

Title: Spacehab Volumetric Trainer Familiarization

Duration: 0.25 hours

Medium: SVT

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS 1

Source: DO5/Cargo Integration and Operations Branch

Date: 10/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): SHAB NOM OPS 31029

Preparation: None

Note: Schedule with SHAB LM COM 31187

Synopsis: This lesson shall cover a Spacehab Volumetric Trainer (SVT)

familiarization briefing inside the SVT. Included in the briefing shall be safety features, operational constraints, and operational limitations.

Objectives: By the end of this lesson, the student shall be able to:

Describe the SVT operational capabilities and limitations.

• Describe the SVT safety hazards.

• Follow the SVT safety precautions and escape routes in the event of

fire.

#### 6 **SHAB LM COM 31187**

Title: Spacehab Logistics Module Communication and Caution & Warning

Duration: 2.0 hours

Medium: SVTFB (SVTGNS)

Student: COMMANDER, MSs, PILOT (Schedule by shift, MSs as assigned.)

Source: DO5/Cargo Integration and Operations Branch

Date: 03/05

Lesson(s) Replaced: SHAB RDM COM 31187

Equipment Required: Spacehab Operations Checklist (SH OPS), Spacehab

Experiment Handbook (if flown), Subsystem (SS) Payload General Support Computer (PGSC), Photo/Television (TV) Checklist (C/L) (as required), Battery Powered Speaker

Microphone Unit (BPSMU)

Prerequisite Lesson(s): SHAB ECS MAL 31029, SVT FAM 31185,

C/L CAMR OPS 91019

Preparation: None

## 6 SHAB LM COM 31187 (Concluded)

Synopsis:

The student shall receive an overview of the Spacehab Data subsystem, Caution and Warning (C&W), and Orbiter Fault Detection and Annunciation (FDA) provided for the Spacehab subsystems. This lesson contains four objectives that must be completed before the lesson is considered complete. The lesson provides an overview of the following classes of the C&W system:

Class 1: Emergency C&WClass 2: Hardware C&WClass 2: Backup C&W

• Class 3: FDA

Objectives:

By the end of this lesson, the student shall be able to:

- Describe the data flow between the Orbiter and Spacehab.
- Differentiate between the visual and aural cues for Class 1, 2, and 3 Spacehab C&W alarms.
- Perform the instructor-specified steps contained in the Spacehab Activation Section (SYSTEM CONFIG, MODULE CONFIG, SS PGSC ACTIVATION) of the Spacehab Operations Checklist (SH OPS), without instructor assistance.
- Perform the instructor-specified steps contained in the Spacehab Entry Prep section (MODULE CLOSEOUT, SYSTEM CONFIG) of the SH OPS, without instructor assistance.

#### 7 **SHAB FIRE CC 31001**

Title: Spacehab Fire Alarm Cue Card Briefing

Duration: 1.0 hour Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS 1

Source: DO5/Cargo Integration and Operations Branch

Date: 03/05

Lesson(s) Replaced: None

Equipment Required: Overhead projector Prerequisite Lesson(s): SHAB LM COM 31187

Preparation: None

Synopsis: The briefing covers the Ascent/Entry and Orbit Spacehab Fire Alarm Cue

Cards (front and back). The format, expected crew responses to either

smoke or fire indications, and flight rules will be reviewed.

## 7 SHAB FIRE CC 31001 (Concluded)

Objectives: By the end of this lesson, the student shall be able to:

- Describe various paths of Spacehab Fire Alarm Cue Cards.
- Describe crew coordination required for Spacehab fire or smoke.
- Describe emergency deactivation, emergency egress, and 30-minute deactivation.
- Describe Spacehab operational procedures to be implemented during orbit and/or ascent/entry.

#### 8 **SHAB LM MAL 91187**

Title: Spacehab Logistics Module Subsystem Malfunction Operations

Duration: 4.0 hours

Medium: SVTFB (SVTGNS)

Student: As assigned by CDR (Rest of crew optional.)
Source: DO5/Cargo Integration and Operations Branch

Date: 03/05

Lesson(s) Replaced: SHAB RDM MAL 91187

Equipment Required: Spacehab Volumetric Trainer (SVT) Middeck Locker

Equivalent (MLE) mockups, hard lockers, experiment mockups or Class III training hardware, Spacehab Operations Checklist (SH OPS), Spacehab Malfunction Procedures and System Data (SH MAL), Spacehab Experiment Handbook (if flown), Flight-Specific FDF (as required), Subsystem (SS) Payload General Support

Computer (PGSC), Photo/Television (TV) Checklist (C/L) (as

required), Battery Powered Speaker Microphone Unit

(BPSMU)

Prerequisite Lesson(s): SHAB FIRE CC 31001, ODS TNL OPS 91020

Preparation: None

Synopsis: This lesson shall cover the contingency and malfunction procedures

contained in the SH OPS and SH MAL. Malfunctions will be individually

presented by the instructor, and resolved by the student via the

malfunction procedures. Other crew activities during the session may take

place on a non-interference basis.

Objectives: By the end of this lesson, the student shall be able to:

• Utilize the SH OPS, SH MAL, and/or cue cards to identify and/or correct presented malfunctions.

- Update Spacehab subsystems measurements monitored on Systems Management (SM) SPEC 60.
- Change upper and lower alarm limits for Spacehab parameters.

## **SUPPLEMENTARY LESSONS**:

#### **SHAB MANUAL 31002**

Title: Spacehab Subsystem Training Manual

Duration: 4.0 hours Medium: Workbook

Student: As assigned by CDR (Rest of crew optional.) (Schedule individually.)

Source: Spacehab Inc.

Date: 03/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): SHAB SUBSYSTEM 31001

Preparation: None

Synopsis: This manual provides the student with an operational knowledge of the

Spacehab module and its subsystems.

Objectives: Become familiar with the Spacehab subsystem design, operation, and

interfaces with the orbiter.

#### **SHAB RVW 41029**

Title: Spacehab Subsystem Review

Duration: 1.0 hour Medium: PYLD Trainer

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT (Schedule

individually or in pairs.)

Source: DO5/Cargo Integration and Operations Branch

Date: 03/05

Lesson(s) Replaced: None

Equipment Required: Spacehab Operations Checklist (SH OPS), Spacehab

Malfunction Procedures and System Data (SH MAL),

Spacehab Experiment Handbook (if flown)

Prerequisite Lesson(s): SHAB ECS MAL 31029

Preparation: None

Synopsis: This lesson is available for a repeat of any of the previous lessons

conducted in the Payload Trainer. This lesson shall concentrate on procedures or malfunctions specifically requested by the student or by

agreement between student and instructor.

Objectives: The objectives for this lesson shall be determined by the student and

instructor on a case-by-case basis.

#### **SHAB TNL RVW 41019**

Title: Spacehab Tunnel Review

Duration: 1.0 hour Medium: FFT (CCT)

Student: As assigned by CDR (Schedule in pairs.)

Source: DX45/Crew Systems Group

Date: 03/05

Lesson(s) Replaced: None

Equipment Required: Tunnel Adapter mockup with either Spacehab mockup or

Spacelab tunnel, Spacehab Operations Checklist (SH OPS)

Prerequisite Lesson(s): SHAB LM MAL 91187, ODS TNL OPS 91020

Preparation: None

**Note:** This lesson is conducted by request only.

Synopsis: This lesson is available for a review of information that was covered in the

ODS TNL OPS 91020 lesson.

Objectives: The objectives for this lesson shall be determined by the student and

instructor on a case-by-case basis.

#### **SHAB RVW 41187**

Title: Spacehab Subsystem Operations and Malfunctions Review

Duration: 4.0 hours

Medium: SVTFB (SVTGNS)
Student: As assigned by CDR.

Source: DO5/Cargo Integration and Operations Branch

Date: 03/05

Lesson(s) Replaced: None

Equipment Required: Spacehab Volumetric Trainer (SVT) Middeck Locker

Equivalent (MLE) mockups, hard lockers, experiment mockups or Class III training hardware, Spacehab Operations Checklist (SH OPS), Spacehab Malfunction Procedures and System Data (SH MAL), Spacehab Experiment Handbook, Flight-Specific FDF (as required), Subsystem (SS) Payload General Support Computer (PGSC), Photo/Television (TV) C/L (as required), Battery

Powered Speaker Microphone Unit (BPSMU)

Prerequisite Lesson(s): SHAB LM MAL 91187

Preparation: None

**Note:** This lesson is conducted by request only.

## SHAB RVW 41187 (Concluded)

Synopsis: This lesson is available for a repeat of any of the previous SHAB LM

MAL 91187 lessons. This lesson shall concentrate on procedures or malfunctions specifically requested by the student or by agreement

between student and instructor.

Objectives: The objectives for this lesson shall be determined by the student and

instructor on a case-by-case basis.

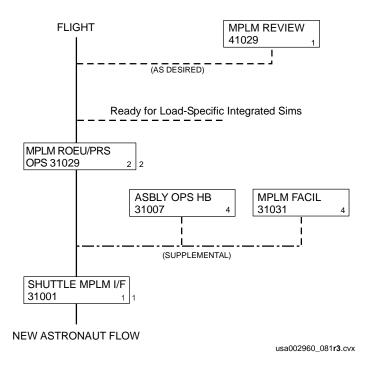


Figure 11-2. MPLM Lesson Flow Chart

As assigned by CDR; supplemental

As assigned by CDR; as desired

# **Table 11-2. MPLM Crew Training Requirements**

MS1

2

12

2

12

Sched

Code

2

С

Stage Totals Per Crewmember:

Media

CLR

PYLD

TEXT

KSC

PYLD Sub Total for Stage: Hrs

2

4

12

Ref

Num

Lesson Code

SHUTTLE MPLM I/F 31001

ASBLY OPS HB 31007

MPLM REVIEW 41029

MPLM FACIL 31031

MPLM ROEU/PRS OPS 31029

Stage

0

0

0

0

0

Non-Crew Rotation

MS2

MS3

MS4

PS

12

12

			Date Last Modified: 06/08								
Crew R	Rotation										
Р	MS1	MS2	Alt Fac	Comments							
1	1	1									
2	2										
4	4			As assigned by CDR;							

## 1 **SHUTTLE MPLM I/F 31001**

Title: Shuttle Multipurpose Logistics Module Interfaces Overview

Duration: 1.0 hour Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT

Source: DS45/Shuttle Systems Training Group

Date: 03/05

Lesson(s) Replaced: None

Equipment Required: PC projector with PowerPoint or overhead projector (backup)

Prerequisite Lesson(s): None

Preparation: None

Synopsis: This briefing is given by the Spaceflight Training Division subject matter

expert on the Shuttle interfaces with the MPLM. The briefing reviews:

• The basic purpose of the MPLM

 An overview of the organizational structure, MPLM system, interfaces with the orbiter, crew, and MCC interfaces

 An overview of nominal and contingency operations, mission objectives, and flight rules with respect to MPLM in the Shuttle cargo bay

Objectives: Upon completion of this lesson, the student will be able to:

• State the primary mission objectives of the MPLM.

- Name and describe all MPLM-to-Orbiter interfaces including mechanical, electrical, command and data, and crew interfaces.
- Demonstrate a basic knowledge of operational concepts and procedures with respect to MPLM in the Shuttle cargo bay.
- Describe applicable MPLM subsystems and functions.
- Compare/contrast the passive and active configurations of MPLM with respect to MPLM in the Shuttle cargo bay.

#### 2 MPLM ROEU/PRS OPS 31029

Title: Multipurpose Logistics Module Remotely Operated Electrical

Umbilical/Payload Retention System Operations

Duration: 2.0 hours Medium: PYLD Trainer

Student: As assigned by CDR.

Source: DS45/Shuttle Systems Training Group

Date: 03/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): SHUTTLE MPLM I/F 31001

Preparation: None

## 2 MPLM ROEU/PRS OPS 31029 (Concluded)

Synopsis:

This lesson provides an overview of how the Payload Retention System (PRS) and Remotely Operated Electrical Umbilical (ROEU) support MPLM and other applicable cargo elements. It also allows the student the opportunity to practice the PRS and ROEU operations incurred during unberthing/berthing of the MPLM. The student will also practice resolving anomalies affecting the PRS and ROEU systems.

Objectives:

Upon completion of this lesson, the student should be able to:

- State the purpose of the PRS major components and ROEU.
- Describe the payload select rotary switch, payload retention latch switches and talkbacks, payload retention logic power, Motor Controller Assembly power logic circuit breakers, and payload bay mechanical power.
- Explain the latch, release, and ready-to-latch indications displayed on SPEC 97.
- Identify the types of PRS components that support MPLM.
- Given the appropriate FDF or Station Operations Data File (SODF), demate/mate ROEU and release/latch MPLM Payload Retention Latch Assemblies (PRLAs) and Active Keel Actuator (AKA).
- Recognize and resolve PRS and ROEU anomalies using the appropriate ROEU Malfunction and EVA contingency procedures or knowledge of the system to resolve a problem.

## ASBLY OPS HB 31007

Title: Assembly Operations Handbook (Supplemental)

Duration: 4.0 hours Medium: Text

Student: As assigned by CDR.

Source: DO5/Cargo Integration and Operations Branch

Date: 03/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): SHUTTLE MPLM I/F 31001

Preparation: None

## ASBLY OPS HB 31007 (Concluded)

Synopsis:

An Assembly Operations Handbook (AOH) is developed for each ISS assembly mission by DO5/Cargo Integrations and Operations personnel. An AOH includes information covering the entire launch package, including MPLM-specific data for missions where an MPLM is manifested. The AOH provides systems descriptions of the MPLM command, telemetry, power, and data interfaces. This manual includes schematics

and serves as an excellent data source. If the current mission AOH is not yet published, an AOH from the prior MPLM mission may be used as

study material.

Objectives:

Upon completion of this lesson, the student should be able to:

Demonstrate knowledge of the systems drawings.

 Point out orbiter power, structural, and data interfaces applicable to MPLM.

#### **MPLM FACIL 31031**

Title: Multipurpose Logistics Module Hardware Facility Visit (Supplemental)

Duration: 4.0 hours (or as available)

Medium: KSC

Student: As assigned by CDR.

Source: DS45/Shuttle Systems Training Group

Date: 03/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): SHUTTLE MPLM I/F 31001

Preparation: None

Synopsis:

This lesson provides an opportunity for the student(s) to see actual MPLM flight hardware and get a hands-on look at the MPLM.

Note:

- Recommend scheduling this visit alongside other activities at KSC.
- Coordinate with Vehicle Integration and Test Team at KSC for this visit.
- Consider crew travel time between JSC and KSC.

Objectives:

Upon completion of this lesson, the student should have developed familiarity with the locations of internal and external MPLM subsystem components that have potential for hands-on crew interface.

## **MPLM REVIEW 41029**

Title: Multipurpose Logistics Module Review

Duration: 1.0 hour Medium: PLYD Trainer

Student: As assigned by CDR.

Source: DS45/Shuttle Systems Training Group

Date: 03/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): MPLM ROEU/PRS OPS 31029

Preparation: None

Synopsis: This lesson is a review of particular aspects of the MPLM operations.

Emphasis is placed on in-depth discussion or review of payload systems, nominal/malfunction procedures, or other payload operations. The review may include portions of previous lessons. This lesson provides a review of the payload retention and umbilical system used for MPLM. It will review the payload retention and Remotely Operated Electrical Umbilical (ROEU) system equipment, the crew interfaces, the operating procedures, and the generic flight rules. The student should coordinate with the assigned instructor about the subject areas to be covered. This lesson is scheduled on request by the student or instructor, but frequency should be

limited to once every four weeks.

Objectives: Lesson objectives vary with the subject matter covered and should be

agreed to in advance by the student and instructor.

#### SECTION 12.0 CORE STATION SYSTEMS FOR STS CREW TRAINING

The Core Station Systems training flow for STS crewmembers is the subset of Station systems training relevant to the assigned Shuttle crews. It provides the flight crew with a reference to all Space Station-related training. Many classes in the flow are taken from the ISS training catalog, thus being a subset of those classes that Expedition crewmembers take. Certain core classes in this flow are actually Shuttle crewmember-unique versions of one or multiple related Station classes.

The core classes will cover an Operations Baseline review (flight-specific), ISS Operations Local Area Network (LAN) (Onboard Short Term Plan Viewer (OSTPV), International Procedure Viewer (IPV) and the Execute Package), Portable Computer System (PCS) operations, crew responsibility for Caution and Warning (C&W) events, EPS familiarization, Motion Control (including functions, attitude control operations concept, Guidance, Navigation, and Control (GNC) modes, docking timeline tasks), Structures and Mechanisms (S&M), Environmental Control and Life Support Systems (ECLSS), and use of audio and video equipment. The actual classes required will be very dependent upon mission activities.

Towards the end of the flow, an opportunity will be available to review past material and/or have the crew receive additional training due to updates to the mission profile. Integrated simulations between the Shuttle and ISS flight control teams will follow this review. In some cases, the actual Expedition crew, which will be on orbit with the Shuttle crew, will participate. These integrated simulations will occur in parallel with some planned system specific training. Lastly, an opportunity will be available to review Station Program Notes (SPNs) that were not able to be covered in training or are not already documented in procedures. Any changes in maintenance activities will also be covered close to launch.

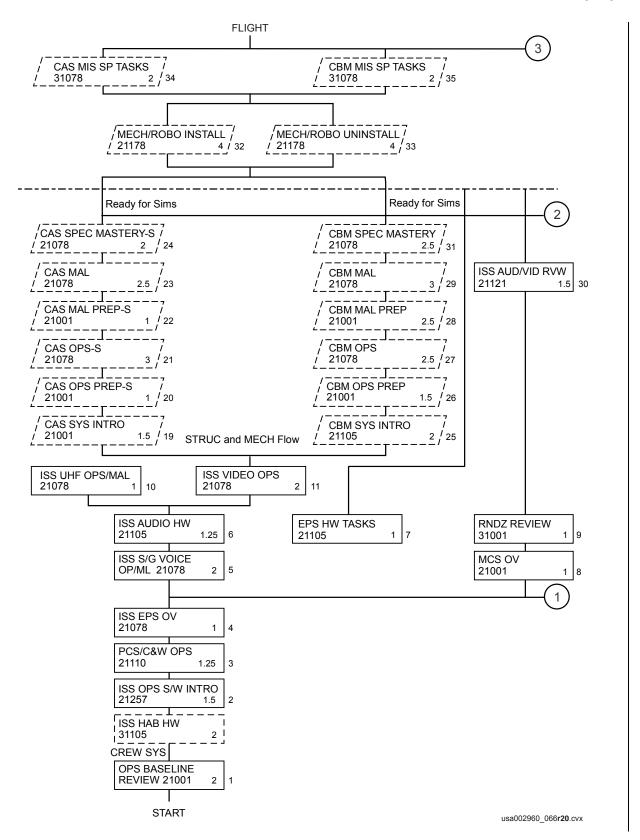


Figure 12-1. Core Station Systems for STS Crew Training Flow Chart (Sheet 1 of 2)

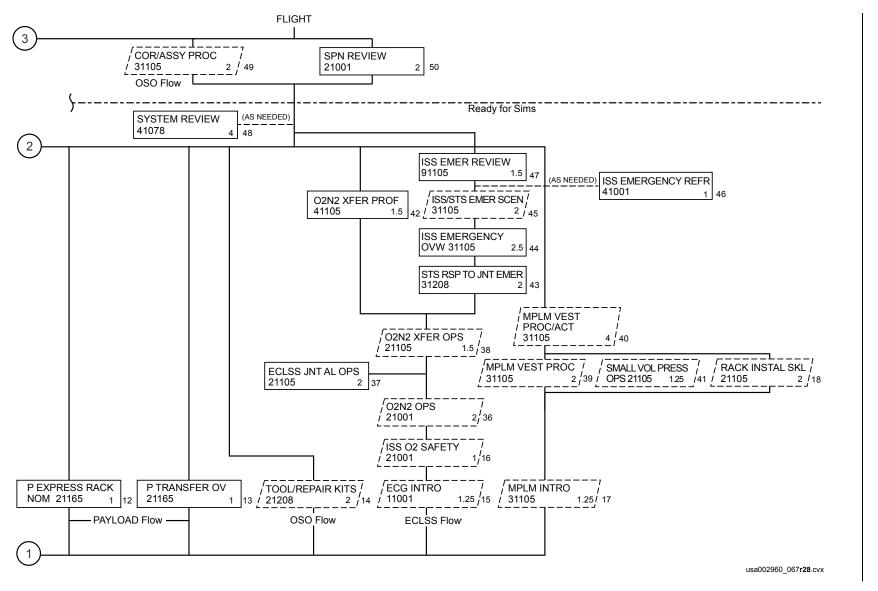


Figure 12-1. Core Station Systems for STS Crew Training Flow Chart (Sheet 2 of 2)

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Table 12-1. Core Station Systems for STS Crew Training Requirements

Date Last Modified: 06/08

				Non-Crew Rotation Crew Rotation														
	Ref	I		Sched			14011-0	Tow Rote	1011				CIEWIN	lotation				
Stage	Num	Lesson Code	Media	Hrs	Code	С	P	MS1	MS2	MS3	MS4	PS	С	P	MS1	MS2	Alt Fac	Comments
4	1	OPS BASELINE REVIEW 21001	CLR	2	8	2	2	2	2	2	2		2	2	2	2	1	Commonto
		OF O BY COLUMN THE VIEW EVOL	OPS LAN															
4	2	ISS OPS S/W INTRO 21257	PTT	1.5	3	1.5	1.5	1.5	1.5	1.5	1.5		1.5	1.5	1.5	1.5		
4	3	PCS/C&W OPS 21 <b>110</b>	SSTF	1.25	2	1.25	1.25	1.25	1.25	1.25	1.25		1.25	1.25	1.25	1.25		
4	4	ISS EPS OV 21078	PTT	1	2	1	1	1	1	1	1		1	1	1	1		
4	5	ISS S/G VOICE OP/ML 21078	PTT	2	2		2							2				IV for an ISS-based EVA
4	6	ISS AUDIO HW 21105	SSMTF	1.25	8			1.25	1.25						1.25	1.25		As assigned by CDR
4	7	EPS HW TASKS 21105	SSMTF	1	4			1	1						1	1		As assigned by CDR
4	8	MCS OV 21001	CLR	1	8			1	1						1	1		As assigned by CDR
4	9	RNDZ REVIEW 31001	CLR	1	8	1	1	1	1	1	1		1	1	1	1		Schedule with Expedition Crew
4	10	ISS UHF OPS/MAL 21078	PTT	1	3		1	1	1					1	1	1		As assigned by CDR
4	11	ISS VIDEO OPS 21078	PTT	2	2			2	2						2	2		As assigned by CDR
4	12	P EXPRESS RACK NOM 21165	SSTF RBUA	1	1			1							1			As assigned by CDR
4	13	P TRANSFER OV 21165	SSTF RBUA	1	8			1							1			As assigned by CDR
4	14	TOOL/REPAIR KITS 21 <b>208</b>	B9 SUIT ROOM	2	4	2	2	2	2	2	2		2	2	2	2		
4	15	ECG INTRO 11001	CLR	1.25	8	1.25	1.25	1.25	1.25	1.25	1.25		1.25	1.25	1.25	1.25		
4	16	ISS 02 SAFETY 21001	CLR	1	8	1	1	1	1	1	1		1	1	1	1		
4	17	MPLM INTRO 31105	SSMTF	1.25	8	1.25	1.25	1.25	1.25	1.25			1.25	1.25	1.25	1.25		Schedule with Expedition Crew
4	18	RACK INSTAL SKL 21105	SSMTF	2	3			2	2						2	2		As assigned by CDR
4	25	CBM SYS INTRO 21105	SSMTF	2	4			2	2						2	2		As assigned by CDR
4	26	CBM OPS PREP 21001	CLR	1.5	2			1.5	1.5						1.5	1.5		As assigned by CDR
4		Sub Total for Stage			Stage Totals	otals Per Crewmember:												
4				28.0		12.25	15.25	26.0	24.0	12.25	11.0	0	12.25	15.25	26.0	24.0		

Table 12-1. Core Station Systems for STS Crew Training Requirements (continued)

Date Last Modified: 06/08

								Non-C	rew Rota	ation				Crew F	Rotation			
	Ref				Sched													
Stage	Num	Lesson Code	Media	Hrs	Code	С	Р	MS1	MS2	MS3	MS4	PS	С	Р	MS1	MS2	Alt Fac	Comments
3	27	CBM OPS 21078	PTT	2.5	2			2.5	2.5						2.5	2.5		As assigned by CDR
3	28	CBM MAL PREP 21001	CLR	2.5	1-4			2.5	2.5						2.5	2.5		As assigned by CDR
3	29	CBM MAL 21078	PTT	3	2			3	3						3	3		As assigned by CDR
3	30	ISS AUD/VID RVW 21121	SSTF	1.5	7	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5		Invite Mission CAPCOMs
3	31	CBM SPEC MASTERY 21078	PTT	2.5	1			2.5	2.5						2.5	2.5		As assigned by CDR
3	33	MECH/ROBO UNINSTALL 21178	SSTF	4	8			4	4						4	4		As assigned by CDR
3	36	O2N2 OPS 21001	CLR	2	8	2	2	2	2	2	2		2	2	2	2		IV, EV, and O2N2 transfer assigned crewmembers only
3	37	ECLSS JNT AL OPS 21105	SSMTF	2	4		2	2	2					2	2	2		EVA assigned crewmembers only
3	38		SSMTF	1.5	8			1.5	1.5						1.5	1.5		Crewmembers as assigned
3	39	MPLM VEST PROC 31105	SSMTF	2	3			2	2						2	2		As assigned by CDR
3	40	MPLM VEST PROC/ACT 31105	SSMTF	4	4			4	4						4	4		Schedule with Expedition Crew
3	41	SMALL VOL PRESS OPS 21105	SSMTF	1.25	3			1.25	1.25						1.25	1.25		As assigned by CDR
3	43		B9 SUIT RM	2	7	2	2	2	2	2	2		2	2	2	2		
3	44	ISS EMERGENCY OVW 31105	SSMTF	2.5	8	2.5	2.5	2.5	2.5	2.5	2.5		2.5	2.5	2.5	2.5		
3	48	SYSTEM REVIEW 41078	PTT	4	2	4	4	4	4	4	4		4	4	4	4		As needed
3	49		SSMTF	2	3			2	2						2	2		As assigned by CDR
3		Sub Tot	tal for Stage		Stage Totals													
3				39.25		12.0	14.0	39.25	39.25	12.0	12.0	1.5	12.0	14.0	39.25	39.25		

Table 12-1. Core Station Systems for STS Crew Training Requirements (concluded)

Date Last Modified: 06/08

															Medined: Corce			
							Non-Crew Rotation							Crew Rotation				
	Ref				Sched													
Stage	Num	Lesson Code	Media	Hrs	Code	С	Р	MS1	MS2	MS3	MS4	PS	С	Р	MS1	MS2	Alt Fac	Comments
2	32	MECH/ROBO INSTALL 21178	SSTF	4	8			4	4						4	4		As assigned by CDR
2	35	CBM MIS SP TASKS 31078	PTT	2	2			2	2						2	2		As assigned by CDR
																		Crewmembers as
2	42	O2N2 XFER PROF 41105	SSMTF	1.5	8			1.5	1.5						1.5	1.5		assigned
2	45	ISS/STS EMER SCEN 31105	SSMTF	2	8	2	2	2	2	2	2		2	2	2	2		Expedition Crew
2	47	ISS EMER REVIEW 91105	SSMTF	1.5	7	1.5	1.5	1.5	1.5	1.5	1.5		1.5	1.5	1.5	1.5		
2	50	SPN REVIEW 21001	CLR	2	8	2	2	2	2	2	2		2	2	2	2		As assigned by CDR
2		Sub Total for Stage Stage Totals					ewmemb	er:										
2				13		5.5	5.5	13	13	5.5	5.5	0	5.5	5.5	13	13		
0	19	CAS SYS INTRO 21001	CLR	1.5	4			1.5	1.5						1.5	1.5		As required by CDR
0	20	CAS OPS PREP-S 21001	CLR	1	2			1	1						1	1		As assigned by CDR
0	21	CAS OPS-S 21078	PTT	3	2			3	3						3	3		As assigned by CDR
0	22	CAS MAL PREP-S 21001	CLR	1	2			1	1						1	1		As assigned by CDR
0	23	CAS MAL 21078	PTT	2.5	1			2.5	2.5						2.5	2.5		As assigned by CDR
0	24	CAS SPEC MASTERY-S 21078	PTT	2	1			2	2						2	2		As assigned by CDR
0	34	CAS MIS SP TASKS 31078	PTT	2	2			2	2						2	2		As assigned by CDR
																		Stage 3 (L-19) if more
																		than 12 weeks
																		between ISS/STS
																		Emergency Scenarios
																		and first emergency case in a flight-specfic
0	46	ISS EMERGENCY REFR 41001	CLR	4	7	4	1	4	1	4	1		1	4	1	4		sim
0	40						Per Crewmember:											SIIII
		Sub 10	lai ioi Stage		Stage Totals	rei Cie	winemb	1	4.4		-	0		4	4.4	4.4		
0				14		1	1	14	14	1	1	0	1	1	14	14		

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# 1 OPS BASELINE REVIEW 21001

Title: Operations Baseline Review

Duration: 2.0 hours Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT

Source: DA72/Station Training Leads and DO5/Cargo Integration & Operations

Branch

Date: 09/04

Lesson(s) Replaced: None

Equipment Required: Computer/projector

Prerequisite Lesson(s): None

Preparation: None

Synopsis: This class includes an assembly overview, assumptions, issues being

worked, contingency scenarios, etc. Also presented is the training/simulation plan, showing how this fits in with the flight priorities. The Assembly and Checkout Officer (ACO) for the flight will lead this class.

Objectives: Describe the major Station-related activities for the mission.

# 2 <u>ISS OPS S/W INTRO 21257</u>

Title: ISS Operations Software Introduction

Duration: 1.5 hours
Medium: OPS LAN PTT

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT (Schedule in groups

of 3.)

**Note:** For crewmembers with previous ISS CAPCOM experience, this lesson

may be more of a refresher and take less time.

Source: DO55/Daily Operations Group

Date: 06/08

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): OPS BASELINE REVIEW 21001

Preparation: None

Synopsis: This lesson will introduce Shuttle crewmembers to *the Operations Local* 

Area Network (Ops LAN) onboard the ISS, its primary components, and

the daily operations tools that reside on the Station Support

Computers (SSCs). The students will perform practical exercises with the Onboard Short Term Plan Viewer (OSTPV), International Procedure Viewer (IPV), and the Execute Package that ISS crewmembers utilize onboard the ISS to execute daily tasks. Communication tools available on the SSCs are also demonstrated. Operational concepts are addressed regarding how the software tools are used individually and collectively.

# 2 ISS OPS S/W INTRO 21257 (Concluded)

Objectives:

- Access, configure, and use the OSTPV application for routine station operations.
- Access, annotate, and use the IPV application to find and read electronic-form procedures.
- Access and use Internet Explorer to read items from a typical Execute Package.
- Access, configure, and use the communication tools available on the Ops LAN.
- Describe the current Ops LAN configuration and identify where the equipment you need to access is located onboard the ISS.
- Describe how the OSTPV, IPV, and the Execute package interact with one another in the course of routine operations.

# 3 **PCS/C&W OPS 21110**

Title: Portable Computer System/Caution and Warning Operations

Duration: 1.25 hours

Medium: Space Station Training Facility (SSTF)

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT (Schedule in pairs.)

Source: D/25/Station Command & Data Handling Group

Date: 06/08

Lesson(s) Replaced: PCS/C&W OPS 21078

Equipment Required: None

Prerequisite Lesson(s): ISS OPS S/W INTRO 21257

Preparation: None

Synopsis:

- A Command and Data Handling (CDH) introduction to include the tiered structure and a general understanding of how the system recovers itself when there are malfunctions.
- Caution & Warning (C&W) information, including C&W classifications, ideology, C&W toolbar and summary pages, and the C&W panel.
- Overview of major telemetry indications and commanding from the Portable Computer System (PCS).

- Describe the purpose of the ISS C&W system, and differentiate among the *four* classes of alarms.
- For all C&W Hardware, describe the location, the signatures available and the functionality that each offers for the crew to respond to annunciations.
- Describe each of the three emergency events, identify the signatures associated with them, and manually initiate the annunciation of them.
- Demonstrate basic operation of the PCS including navigation, commanding and an understanding of how to utilize display standards.

# 4 <u>ISS EPS OV 21078</u>

Title: ISS Electrical Power System Overview

Duration: 1.0 hour

Medium: Generic Part Task Trainer

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT (Schedule

individually or in pairs.)

Source: DI43/Station Electrical Power System and Thermal Control

System Group

Date: 09/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): PCS/C&W OPS 21110

Preparation: None

Synopsis: There are two goals for this lesson.

- The first is to give the students a very basic understanding of the EPS system architecture and redundancy. The student should have a basic understanding of how EPS failures can impact the station, and what would constitute a major failure.
- The second goal is to provide the student with some basic commanding skills, so that they can use the EPS system in support of other systems' tasks. These skills will include EPS display navigation, Remote Power Control Module (RPCM) commanding, and the knowledge required to know when it is safe/allowable to command RPCMs.

Objectives:

- Understand the basic architecture and redundancy of the EPS system.
- Safely route power to other systems' Orbital Replacement Units (ORUs).

# 5 **ISS S/G VOICE OP/ML 21078**

Title: ISS Space-to-Ground Voice Operations and Malfunctions

Duration: 2.0 hours

Medium: Generic Part Task Trainer

Student: IV (ISS-based EVA) (Schedule in pairs.)

Source: D/23/ISS Communications and Tracking Group

Date: 09/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ISS EPS OV 21078

Preparation: None

# 5 ISS S/G VOICE OP/ML 21078 (Concluded)

Synopsis:

After a prebrief, which covers the Audio and S-band subsystems, the student will demonstrate how to execute some of the procedures associated with Audio and S-band (configure public calls, recover from loss of 1 Internal Audio Controller (IAC), Audio Terminal Unit (ATU) darkened front panel, S-Band String swap). The student steps through these procedures, elaborating on the steps and the rationale. The instructor will act as ground when directing the crew to perform S-band procedures. The lesson will end with a discussion about what the crewmember will be required to do to keep Audio operating and when to troubleshoot S-band. Emphasis is placed on awareness and understanding of how and when to run these procedures.

Objectives:

- State the function of Audio and S-Band display elements essential to crew tasking.
- Perform the following communications activities:
  - Using the Portable Computer System (PCS) and ATU, configure and execute Public Calls.
  - Troubleshoot ATU failures.
  - Recover from an IAC failure.
  - Discuss impacts of S-Band String handover.
- While executing these activities:
  - State the assumptions and rationale for the key operational and procedural steps.

# 6 **ISS AUDIO HW 21105**

Title: ISS Audio Hardware

Duration: 1.25 hours

Medium: Space Station Mock-up and Training Facility

Student: As assigned by CDR.

Source: DI23/ISS Communications and Tracking Group

Date: 06/08

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ISS S/G VOICE OP/ML 21078 (IV only)

Preparation: None

# 6 ISS AUDIO HW 21105 (Concluded)

Synopsis:

The lesson covers the layout and capabilities of the Audio Terminal Unit (ATU) and public call configurations. The students configure the ATU for public calls and communicate with each other using both the flight-like ATUs, portable microphones (P-mics), and the headsets. The class also covers Caution and Warning (C&W) interaction with the ATU. This lesson covers only nominal audio operations from the ATU. The lesson also covers audio connectivity to both the Russian Audio system and docked Orbiter.

Objectives:

- Demonstrate the public call configuration using the ATU.
- Demonstrate the use of the ATU front panel and headset controls.

# 7 **EPS HW TASKS 21105**

Title: ISS Electrical Power Systems Hardware Tasks

Duration: 1.0 hour

Medium: Space Station Mock-up and Training Facility

Student: As assigned by CDR.

Source: DI43/Station Electrical Power System and Thermal Control

System Group

Date: 06/08

Lesson(s) Replaced: ISS EPS HW TASKS 21105

Equipment Required: See Building 9 FUR for lesson requirements.

Prerequisite Lesson(s): ISS EPS OV 21078

Preparation: None

Synopsis:

This lesson is designed to cover EPS safety issues captured in the Operational Control Agreement Database (OCAD). All visitors to the ISS United States On-orbit Segment (USOS) are required to take this lesson to protect against shock hazard, cable entanglement, and to ensure successful egress on the USOS. The mockup is used to get hands-on interaction with EPS hardware. The mockup has very good fidelity and is used to give realistic Utility Outlet Panel (UOP) operations (button signatures), Emergency Egress Light (EEL) signatures, and the mechanical manipulation of a Rack Power Switch (RPS).

- Operate the ISS General Luminaire Assemblies (GLAs) in the USOS.
- Respond to illuminated ISS EELs.
- State the safety hazards associated with UOPs and portable equipment.
- Remove power from a rack using the RPS.

# 8 MCS OV 21001

Title: Motion Control System Overview

Duration: 1.0 hour Medium: Classroom

Student: As assigned by CDR.

Source: D/33/ISS Motion Control Group

Date: 09/04

Lesson(s) Replaced: None

Equipment Required: Computer, projector Prerequisite Lesson(s): ISS EPS OV 21078

Preparation: None

#### Synopsis:

This class is designed to introduce students to the Motion Control Group (MCG) at a high level. The students become familiar with the functions of MCG. The primary crew displays and schematics are utilized to place this information in an operational perspective. A high-level overview of each function is performed, including the minimum Orbital Replacement Units (ORUs) required during mated operations. Then, the attitude control operations concept (priorities, permissible attitude, attitude deviation constraints, how the ISS maintains attitude control, when/who will be in attitude control) during mated operation is reviewed, followed by the translation control operations concept. Next, ISS reference frames and Euler angles are defined. Time is then spent reviewing the Guidance, Navigation, and Control (GNC) modes, describing compatible US and Russian Segment (RS) GNC modes and operational scenarios when they are utilized. Finally, the docking timeline is described. This portion focuses on the actual docking, moding lights, docking sensors and hardware, and the requirements for docking.

- Describe how each of the following ISS Motion Control System (MCS) functions are fulfilled by both the US and RS segments for your flight:
  - State Vector Determination
  - Attitude Determination
  - Attitude Control
  - Translational Control
  - Pointing & Support
- Describe the following reference frames and their uses:
  - ISS Body
  - LVLH
  - J2000
  - XPOP
- Recognize the RS СУДН and US GNC software modes used for attitude control.

#### 8 MCS OV 21001 (Concluded)

- Understand the ISS perspective of Orbiter docking and undocking.
- Be familiar with the MCS Malfunctions that can involve the Orbiter.
- Understand the attitude control handover process.

#### 9 **RNDZ REVIEW 31001**

Title: Rendezvous Review

Duration: 1.0 hour Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT

Note: Schedule with the Expedition Crew. DI33/ISS Motion Control Group Source:

Date: 09/04

Lesson(s) Replaced: None

**Equipment Required:** Computer, projector Prerequisite Lesson(s): MCS OV 21001

Preparation: None

Synopsis: Rendezvous Review is a guided discussion between the Shuttle and

> Station crews to review the docking tasks and milestones. The crews step through a high-level docking timeline, emphasizing crew tasks with lineby-line reviews of procedures. The main purpose is to have the crews talk about what they are expecting of each other, particularly crew calls at docking (preferred wording, who's making the calls, etc). Usually a Shuttle Rendezvous instructor, the Shuttle flight Motion Control Group (MCG) instructor, the Expedition crew MCG instructor, and an Attitude Determination and Control Officer (ADCO) are in attendance. This time also is a last chance for the Shuttle crew to ask any questions they have on the Motion Control System (MCS).

Objectives: Summarize the Shuttle role during a docking to the ISS.

• Discuss with Station crew the docking activities and crew calls.

#### 10 **ISS UHF OPS/MAL 21078**

Title: ISS Ultra High Frequency Operations and Malfunctions

1.0 hour Duration:

Generic Part Task Trainer Medium: EV1, EV2, IV (ISS-based EVA.) Student:

DI23/ISS Communications and Tracking Group Source:

Date: 09/04

Lesson(s) Replaced: None Equipment Required: None

# 10 ISS UHF OPS/MAL 21078 (Concluded)

Prerequisite Lesson(s): ISS AUDIO HW 21105

Preparation: None

Synopsis: This lesson consists of the use of the UHF Subsystem through the

Portable Computer System (PCS). Emphasis will be placed on UHF subsystem power up, configuration, and how to recognize and workaround system failures. The lesson begins with a subsystem familiarization that describes and demonstrates the controls of the system. Features and controls are pointed out. Activities are set to integrate student interaction, which will reinforce student abilities. Once student skill base has been

established, there is a discussion of the related procedures.

Objectives: The student will be able to accomplish the following:

• Use the PCS to activate and configure the UHF Subsystem for nominal EVA operations.

- Perform nominal UHF Subsystem activation, configuration, and subsystem monitoring.
- Identify and recover from a malfunction of a single UHF Subsystem radio.

# 11 **ISS VIDEO OPS 21078**

Title: ISS Video Operations

Duration: 2.0 hours

Medium: Generic Part Task Trainer

Student: As assigned by CDR. (Schedule in pairs.)
Source: DI23/ISS Communications and Tracking Group

Date: 09/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ISS AUDIO HW 21105

Preparation: None

Synopsis: This lesson prepares students to use the Video Distribution Subsystem

(VDS) in support of crew activities. Emphasis is placed on how the crew will use the VDS onboard ISS. The lesson provides a brief introduction to the VDS and its components. The students then role-play in crew activity scenarios (EVA, Robotics) in which they must route/deroute video from a Portable Computer System (PCS). The crew's actions in the scenarios are discussed and related to the grounds' actions. Also, the PCS video routes are compared and contrasted to video routes from the Robotics Workstation Display & Control Panel. The lesson also provides a high level explanation of the VDS hardware and software actions during an

# 11 <u>ISS VIDEO OPS 21078 (Concluded)</u>

autoroute. The VDS interfaces to other subsystems, systems, and modules are discussed. The student also learns how to distribute video to/from these interfaces. Finally, a review is conducted to re-emphasize the lesson objectives.

# Objectives:

- Describe the function of the VDS and each VDS Orbital Replacement Unit (ORU).
- Describe the capabilities and limitations of how crewmembers route video.
- Autoroute video signals from a given source to a given destination via PCS.
- Describe the differences between flight crew and flight controller responsibilities for the VDS.
- Describe the software and hardware process for routing video signals.
- Describe connectivity between VDS and other systems and subsystems.

## 12 P EXPRESS RACK NOM 21165

Title: ISS EXPRESS Rack Nominal Operations

Duration: 1.0 hour

Medium: SSTF Rack Build-Up Area

Student: As assigned by CDR. (Schedule individually.)

Source: EO20A/ISS Payload Training

Date: 09/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ISS OPS S/W INTRO 21257

Preparation: None

### Synopsis:

This lesson introduces the crewmembers to the EXpedite the PRocessing of Experiments to Space Station (EXPRESS) Rack nominal operations procedures. It begins with a review of the rack layout and panel nomenclature. Differences between the training and flight hardware are pointed out. The procedures to be performed are previewed by the instructor. Crewmembers then execute the procedures using the EXPRESS Rack Trainer and EXPRESS Rack Laptop Computer. As crewmembers step through the procedures, they will receive feedback on the fine points of the procedures and rationale for specific steps.

#### 12 P EXPRESS RACK NOM 21165 (Concluded)

- Objectives: State the purpose of the EXPRESS Rack.
  - List the major components of the EXPRESS Rack.
  - Define the primary functions of the EXPRESS Rack major components.
  - Perform specified EXPRESS Rack nominal operations procedures using the EXPRESS Rack Trainer.

#### 13 P TRANSFER OV 21165

Title: Payload Transfer Overview (Shared – Shuttle)

Duration: 1.0 hour

Medium: SSTF Rack Build-Up Area Student: As assigned by CDR.

Source: EO-10/Shuttle Operations Coordinator

Date: 09/04

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

Synopsis:

The first part of this lesson is a classroom presentation consisting of the following: Flight-specific Shuttle and ISS mission topology, timeline, issues, and payload transport/transfer overview. The second part of the lesson will be hands-on instruction of the payload-unique aspects of transport and transfer operations. The hands-on instruction will conclude with instruction on the Daily Status Check Cue Card operations. Differences the crewmember will encounter between the training and the actual flight hardware they will be using on board the ISS are pointed out as the lesson progresses. The session shall end with a discussion of the lesson events, including a review of any action items that were assigned.

- Identify ISS payloads that have unique transport/transfer requirements.
- Describe the payload transfer activities.
- Describe the unique transfer activities associated with payloads.
- Perform Daily Status Check Cue Card steps.

# 14 <u>TOOL/REPAIR KITS 21208</u>

Title: ISS Repair Kits Familiarization (Shared – ISS)

Duration: 2.0 hours
Medium: B9 Suit Room

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT Source: DX42/Mechanisms & Maintenance Systems Group

Date: 06/08

Lesson(s) Replaced: TOOL/REPAIR KITS 21105

Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

Synopsis: During this lesson students learn the content and specific usage of all

tools contained in the U.S. Intravehicular Activity (IVA) Toolbox, the power tools (including the cordless Driver Drill, Impact Driver, Scopemeter Power Adapter (SMPA)/Battery Charger Kit) and Repair kits onboard ISS. This lesson emphasizes hands-on practical applications and involves actual

tool usage as might be encountered on-orbit. Tool stowage and

organization is taught with the tools stowed in their correct on-orbit kits.

Objectives: • Identify the contents and organization of the ISS IVA Toolbox.

• Demonstrate the use of select tools from the ISS IVA Toolbox (i.e., Torque Wrench).

- Describe/demonstrate use of the Power Tools (Driver Drill, Impact Driver & SMPA/Battery Charger Kits, etc.).
- Describe/demonstrate use of the Repair Kits (Clamp & Bracket, Sewing, Ethernet, Fiber Optic, etc.).
- State any crew safety issues related to the on-orbit equipment and procedures.

# 15 **ECG INTRO 11001**

Title: Environmental Control Group Introduction (Shared – ISS)

Duration: 1.25 hours Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT

Source: DI54/Environmental Control and Life Support System (ECLSS)

**Training** Group

Date: 06/08

Lesson(s) Replaced: ISS ECG OV 11001

Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

# 15 **ECG INTRO 11001 (Concluded)**

Synopsis:

The Environmental Control Group (ECG) Introduction lesson discusses the general atmospheric characteristics on the ISS, including total and partial pressures, and temperature and humidity. The bulk of the lesson focuses on key pieces of ECG equipment, including equipment for total and partial pressure control, temperature and humidity control, water resources, food and sanitary hygiene, and equipment used to detect and respond to ISS emergencies. Operator interfaces and responsibilities for equipment are discussed, as well as operational hierarchy.

Objectives:

- Discuss the general atmospheric characteristics on the ISS.
- Discuss the major functions of the ECG.
- List the major pieces of equipment that support the functions of ECG.

# 16 **ISS O2 SAFETY 21001**

Title: ISS Oxygen Systems Safety (Shared – ISS)

Duration: 1.0 hour Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT Source: DX42/Mechanisms & Maintenance Systems Group

Date: 08/03

Lesson(s) Replaced: ISS O2 SAFETY C 21001

Equipment Required: None

Prerequisite Lesson(s): ISS DIAG EQUIP 21001 (ISS), ECG INTRO 11001 (STS)

Preparation: None

Synopsis:

This lesson covers the often over-looked topic of Oxygen System Safety, specifically concentrating on the correct and safe handling of oxygen equipment onboard the ISS. Safety protocols are needed to prevent possible ignition and subsequent explosion of oxygen systems onboard the ISS. These protocols include risk management through prevention and avoidance of contaminants, and the mechanics of oxygen ignition sources.

- Summarize the elements of the ISS Oxygen System.
- Explain ignition mechanisms to be aware of when handling oxygen equipment.
- Explain methods to minimize oxygen-related hazards.

# 17 MPLM INTRO 31105

Title: Multi-Purpose Logistics Module Introduction (Shared – ISS)

Duration: 1.25 hours

Medium: Space Station Mock-up and Training Facility Student: COMMANDER, MS 1, MS 2, MS 3, PILOT

**Note:** Schedule with the Expedition Crew.

Source: DI54/Environmental Control and Life Support System (ECLSS)

**Training** Group

Date: 09/04

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

Synopsis: This lesson gives an overview of the purpose and capabilities of the Multi

Purpose Logistics Module (MPLM), with special emphasis on the MPLM-unique crew interfaces. The instructor will define the purpose of the MPLM, show hardware and locations, demonstrate manipulation of manual interfaces and then observe student's performance, and finally will

briefly discuss crew activities as a lead into the MPLM Procedures lesson,

taken by the crew later in the flow.

Objectives: • State the purpose of the MPLM.

Describe Environmental Control and Life Support System (ECLSS),

Thermal Control System (TCS), EPS, and Communication and

Tracking (C&T) components of the MPLM.

• Know which components are MPLM-unique.

# 18 RACK INSTAL SKL 21105

Title: ISS Rack Removal and Installation Skills (Shared – ISS)

Duration: 2.0 hours

Medium: Space Station Mock-up and Training Facility
Student: As assigned by CDR. (Schedule in groups of 3.)
Source: DX42/Mechanisms & Maintenance Systems Group

Date: 09/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): TOOL/REPAIR KITS 21208, MPLM INTRO 31105

Preparation: None

# 18 RACK INSTAL SKL 21105 (Concluded)

Synopsis:

During this lesson students learn how to safely remove and install ISS System Racks, International Standard Payload Racks (ISPRs), Resupply Stowage Platforms (RSPs), ISS Lockers, and International Subrack Interface Standard (ISIS) Drawers. This class teaches the operation of all rack-to-module structural interfaces, including: launch restraints, pivot mechanisms, pivot pins, knee braces, grounding straps, and tethers. Mating of electrical, data, and fluid utility connectors is also covered. A generic MPLM-to-ISS rack transfer procedure is taught using medium and high fidelity mockups of each of the rack-to-module interfaces. The International Partners and Payload Principle Investigators will train the crew on any unique interfaces that are specific to their respective module or rack.

Objectives:

- Identify all rack-to-module structural interfaces.
- Explain the rationale for the sequence of steps used to install all rack-to-module structural interfaces.
- Perform a generic rack transfer procedure using all rack-to-module structural interfaces.
- State any crew safety issues related to the on-orbit equipment and procedures.

# 19 **CAS SYS INTRO 21001**

Title: Common Attach System Introduction (Shared – ISS)

Duration: 1.5 hours Medium: Classroom

Student: As required by CDR.

Source: DX23/Station Mechanical & Robotics

Date: 09/04

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

Synopsis: This lesson describes the two types of Common Attach System (CAS):

Payload Attach System (PAS) and the Unpressurized Cargo Carrier Attach System (UCCAS). Specifics of these mechanisms are discussed,

including components, physical operation, system interfaces, and

redundancy. Students are also shown photos of real flight hardware and videos of latch and Umbilical Mechanism Assembly (UMA) operations.

# 19 CAS SYS INTRO 21001 (Concluded)

Objectives: • Describe the components of the CAS.

- Explain the utilization of the CAS.
- Explain the operation of the CAS.
- Explain the redundancy of the CAS.
- Describe CAS Electrical Power System (EPS) and Command and Data Handling (CDH) connectivity.

# 20 **CAS OPS PREP-S 21001**

Title: Common Attach System Operations Preparation

Duration: 1.0 hour Medium: Classroom

Student: As assigned by CDR. (Schedule in pairs.)
Source: DX23/Station Mechanical & Robotics

Date: 07/07

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): CAS SYS INTRO 21001

Preparation: None

Synopsis:

This lesson begins with a detailed discussion of Common Attach System (CAS) software configuration in the Multiplexer/Demultiplexers (MDMs). Next, a discussion of CAS operations, incorporating procedures and flight rules, introduces the student to CAS commands and constraints that are outlined in the flight rules. Overall focus on the lesson is on the system operational constraints, procedures execution, safety considerations, time constraints, and anticipated interfaces with Mission Control Center-Houston (MCC-H). CAS Portable Computer System (PCS) displays will be briefly introduced in this lesson.

- Explain key Integrated Motor Controller Assembly (IMCA) software concepts: Commands, Telemetry, and Modes.
- Compare Manual versus Normal CAS Application Software States.
- State the types of commands available to the operator.
- Describe CAS flight rule philosophy.

# 21 **CAS OPS-S 21078**

Title: Common Attach System Operations

Duration: 3.0 hours

Medium: Generic Part Task Trainer

Student: As assigned by CDR. (Schedule in pairs.)
Source: DX23/Station Mechanical & Robotics

Date: 09/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): CAS OPS PREP-S 21001

Preparation: None

Synopsis: After a review of topics from the mechanism System Intro lesson, and an

overview of displays and the procedures, the student will execute a nominal mate and demate. Throughout the lesson, rationale for procedure

steps, expected command responses, and applicable telemetry items are discussed. Emphasis in the lesson is placed on learning both the operational aspects of the Common Attach System (CAS) and the

procedures associated with mating and demating.

Objectives: • Demonstrate proper display monitoring, navigation, and commanding skills.

• Provide rationale for procedure steps.

• Using CAS displays, verify proper command response and summarize the state of the system.

• Characterize the crew versus ground roles in operations.

# 22 **CAS MAL PREP-S 21001**

Title: Common Attach System Malfunctions Preparation

Duration: 1.0 hour Medium: Classroom

Student: As assigned by CDR. (Schedule in pairs.)
Source: DX23/Station Mechanical & Robotics

Date: 07/07

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): CAS OPS-S 21078

Preparation: None

# 22 CAS MAL PREP-S 21001 (Concluded)

Synopsis:

This lesson revolves around introducing the student to the key malfunction scenarios of the Common Attach System (CAS), including typical causes and effects. The lesson covers CAS malfunction troubleshooting philosophy with emphasis placed on system knowledge. Overall focus of the lesson is on key aspects of malfunction recognition and resolution, impacts to other systems, operational constraints, safety considerations, time constraints, and anticipated interfaces with Mission Control Center-Houston (MCC-H) and on-orbit crewmembers.

Objectives:

- Given specific CAS failures, explain display indicators, possible causes, and impacts to operations.
- Describe CAS hardware and software responses, including Integrated Motor Controller Assembly (IMCA) responses to CAS malfunctions and interface failures.
- Anticipate the user response to CAS malfunctions and interface failures.

# 23 **CAS MAL 21078**

Title: Common Attach System Malfunctions (Shared – ISS)

Duration: 2.5 hours

Medium: Generic Part Task Trainer

Student: As assigned by CDR. (Schedule individually.)

Source: DX23/Station Mechanical & Robotics

Date: 09/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): CAS MAL PREP-S 21001

Preparation: None

Synopsis:

This lesson introduces the student to recognizing malfunctions in the Common Attach System (CAS) and the process for troubleshooting and recovering from those failures. The biggest part of the lesson is working with the malfunction procedures and their many intricacies.

- Identify failures and describe their impacts to CAS.
- Develop and execute a recovery plan.
- Summarize the state of the system throughout operations.

# 24 <u>CAS SPEC MASTERY-S 21078</u>

Title: Common Attach System Specialist Mastery

Duration: 2.0 hours

Medium: Generic Part Task Trainer

Student: As assigned by CDR. (Schedule individually.)

Source: DX23/Station Mechanical & Robotics

Date: 09/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): CAS MAL 21078

Preparation: None

Synopsis: This lesson is used to pull all material from the course together and

maintain proficiency on system knowledge. Material from previous

lessons will be reviewed and the student will get an opportunity to perform

both nominal and malfunction procedures, including malfunction recognition and resolution. Feedback on performance and possible further study in preparation for increment-specific training will be provided

at the end of the lesson.

Objectives: Given several Common Attach System (CAS)-related failure scenarios, using CAS procedures, without instructor assistance and within a timely

manner, the student will perform the following:

• Using CAS displays, identify off-nominal signatures.

- Describe the immediate failure impacts, including impacts to the current hardware configuration.
- Determine appropriate malfunction procedure block(s) and execute them correctly.
- Confirm command actions through telemetry signatures.
- Summarize the degraded state of the CAS, including capabilities, limitations, and redundancies.
- Describe any impacts to the system, procedures, and/or operations.

# 25 **CBM SYS INTRO 21105**

Title: Common Berthing Mechanism System Introduction (Shared – ISS)

Duration: 2.0 hours

Medium: Space Station Mock-up and Training Facility

Student: As assigned by CDR.

Source: DX23/Station Mechanical & Robotics

Date: 09/04

Lesson(s) Replaced: None Equipment Required: None

# 25 CBM SYS INTRO 21105 (Concluded)

Prerequisite Lesson(s): None

Preparation: None

Synopsis: This lesson provides an introduction to the Common Berthing Mechanism

(CBM) using a hands-on approach. Videos, schematics, and hardware mock-ups are used to explain the architecture, operation, redundancy, and

interfaces of the mechanism.

Objectives: • Describe the components of the CBM.

• Explain the utilization plan for the CBM.

• Summarize flight rules for selected CBM operations.

• Explain the operational sequence of the CBM.

• Explain the redundancy of a CBM.

• Describe the Electrical Power System (EPS) and Command and Data Handling (CDH) connectivity using CBM schematics and displays.

# 26 **CBM OPS PREP 21001**

Title: Common Berthing Mechanism Operations Preparation (Shared – ISS)

Duration: 1.5 hours Medium: Classroom

Student: As assigned by CDR.

Source: DX23/Station Mechanical & Robotics

Date: 07/07

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): CBM SYS INTRO 21105

Preparation: None

Synopsis: This lesson is geared towards giving the assigned crew member(s) the

fundamental skills and knowledge items needed in order to nominally operate the Common Berthing Mechanism (CBM). The lesson covers Electrical Power System (EPS) and Command and Data Handling (CDH) interfaces (including command and telemetry paths), discusses the CBM display in detail, and also introduces students to the procedures they will

be executing in their next lesson.

Objectives: • Review EPS and CDH connectivity and redundancy for CBM.

• Trace CBM command and telemetry paths from Portable Computer System (PCS) to Controllers.

Identify display fields and information.

State the purpose of nominal CBM commands.

#### 26 CBM OPS PREP 21001 (Concluded)

- Using your nominal procedures, predict display changes.
- Understand the CBM hardware and software configuration at different milestones throughout the procedures.
- Explain the redundancy of CBM hardware.

#### 27 **CBM OPS 21078**

Title: Common Berthing Mechanism Operations (Shared – ISS)

Duration: 2.5 hours

Medium: Generic Part Task Trainer

As assigned by CDR. (Schedule in pairs.) Student: DX23/Station Mechanical & Robotics

Source:

Date: 09/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): CBM OPS PREP 21001

Preparation: None

Synopsis:

After a review of topics from Common Berthing Mechanism (CBM) Operations Preparation, and an overview of displays and procedures, the student will execute a nominal Prep for Mate. Mate. Prep for Demate and Demate. Throughout the lesson, rationale for procedure steps, expected command and hardware responses, and applicable telemetry items are discussed. Emphasis in the lesson is placed on learning both the operational aspects of the CBM system and procedures associated with mating and demating.

#### Objectives:

Given CBM procedures, with instructor assistance, the student will execute a nominal mate and demate while doing the following:

- Describe CBM display layout and content.
- Demonstrate proper display monitoring and navigation.
- Summarize CBM Nominal Procedures and Generic Flight Rules that govern those procedures.
- Provide rationale for procedures and significant steps.
- Execute nominal commands correctly.
- Using CBM displays and procedures, verify proper command response.
- Using CBM displays, summarize the state of the system (hardware and software).

#### 28 CBM MAL PREP 21001

Title: Common Berthing Mechanism Malfunctions Preparation

(Shared - ISS)

2.5 hours Duration: Medium: Classroom

As assigned by CDR. Student:

DX23/Station Mechanical & Robotics Source:

Date: 04/06

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): **CBM OPS 21078** 

Preparation: None

Synopsis: The lesson starts with a short review of nominal Common Berthing

Mechanism (CBM) software processes as this information is needed to understand off-nominal software responses. After the review, students learn about auto-safing responses, followed by a discussion of the various types of CBM malfunctions, including expected signatures and impacts. Once the students are familiar with CBM failure details, they learn about typical command responses to these different failures. Additionally, the malfunction recovery philosophy used in the malfunction procedures is covered. The CBM history can be discussed during the lesson (if time), or can be given as homework for students to review.

- Given a CBM-related failure, determine if any auto-safing responses would be performed by the Multiplexer/Demultiplexer (MDM), Master, and/or slave(s).
- Given a CBM-related failure, predict expected display signatures and potential failure causes.
- Given a CBM-related failure, summarize potential impacts to the system, procedures, operations, and the mission.
- Given a CBM-related failure, identify the appropriate malfunction procedures and flight rules needed to develop a recovery plan.
- Given a CBM malfunction procedure, describe the rationale for its particular organization and depth.
- Given any CBM configuration, determine how to safely attain structural integrity in the shortest possible time.

# 29 **CBM MAL 21078**

Title: Common Berthing Mechanism Malfunctions (Shared – ISS)

Duration: 3.0 hours

Medium: Generic Part Task Trainer

Student: As assigned by CDR. (Schedule individually.)

Source: DX23/Station Mechanical & Robotics

Date: 09/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): CBM MAL PREP 21001

Preparation: None

#### Synopsis:

This lesson introduces students to a variety of failures that impact Common Berthing Mechanism (CBM) operations, while they execute procedures. After identifying any off-nominal signatures, the student will demonstrate how to read through malfunction procedures and execute a recovery plan. Each failure is presented separately to give the student an opportunity to fully resolve the problem. After recovery attempts are complete, the instructor should guide the students through assessing impacts to their system and the timeline. Students are also expected to provide rationale to any commands executed, as well as anticipate system response and display signatures. Overall focus of the lesson is on malfunction recognition and resolution, determining impacts to the timeline, and identifying existence of any safety issues or time constraints. The procedures executed in this lesson will be adjusted as appropriate based on the crew member's task assignment. (Install-only tasks will cover the CBM Mating procedures and MPLM flights or Relocate tasks will cover both Mating and Demating procedures.)

#### Objectives:

Given several CBM-related failure scenarios, using CBM procedures, with instructor assistance and within a timely manner, the student will perform the following for each failure case:

- Using CBM displays, identify off-nominal signatures.
- Describe the immediate failure impacts, including impacts to current hardware configuration.
- Determine appropriate malfunction procedure block(s) and execute them correctly.
- Confirm command actions through telemetry signatures.
- Summarize degraded state of the CBM, including capabilities, limitations and redundancies.
- Describe any impacts to the system, procedures, and/or operations.

# 30 **ISS AUD/VID RVW 21121**

Title: ISS Audio/Video Review

Duration: 1.5 hours

Medium: Space Station Training Facility (SSTF)

Student: COMMANDER, PILOT, MS 1, MS 2, MS 3, MS 4, PS1 (Invite Mission

CAPCOMs.)

Source: DI23/ISS Communications and Tracking Group

Date: 06/08

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ISS VIDEO OPS 21078

Preparation: None

Synopsis: The

The lesson starts with a review by the instructor of audio and video changes in system performance since their previous communication lessons. The crewmembers then will use the audio equipment, Audio Terminal Units (ATUs), Battery Powered Speaker Microphone Units (BPSMU(s)), etc., for crew calls using proper call protocol. The crew will be encouraged to work out their unique communications approach for the tasks they will perform. The video equipment (Robotics Workstation (RWS) and Portable Computer System (PCS)) will be available to practice video routing with audio coordination for their unique flight-specific tasks. Lastly, the crew will be given an opportunity to walk through airlock and EVA audio, procedures, and operations. The differences between SSTF airlock audio and the real audio will be explained and emphasized in order to facilitate successful simulations and real-time EVAs.

- Using ISS and STS communication procedures and Audio Hardware (HW), perform communication configurations.
- Explain voice paths relevant for flight configurations and crewmembers.
- Perform appropriate audio calls using proper call protocol and crew requirements.
- Perform Video Routing from ISS and STS locations per crew requirements.

# 31 CBM SPEC MASTERY 21078

Title: Common Berthing Mechanism Specialist Mastery (Shared – ISS)

Duration: 2.5 hours

Medium: Generic Part Task Trainer

Student: As assigned by CDR. (Schedule individually.)

Source: DX23/Station Mechanical & Robotics

Date: 09/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): CBM MAL 21078

Preparation: None

#### Synopsis:

This lesson will confirm that the student can accurately work through nominal and malfunction procedures, responding appropriately to failures. without instructor assistance and under a time limit. The student will have one hour to work through scenario(s) given to them during this lesson. During nominal procedure execution, the student will encounter various failures that may not have a defined recovery plan specified in the malfunction procedures. The goal is for the student to either successfully recover from the failure and complete the task, or resolve the situation so that the system is left in a safe state. Successful completion of this lesson implies that the student has demonstrated an acceptable level of Common Berthing Mechanism (CBM) system knowledge needed to move forward to mission specific training. The scenarios presented in this lesson will be adjusted based on the crew member's task assignment. (Crew members assigned to an Install-only task will only be required to demonstrate their skills for a Mate scenario. However, for crew members assigned to MPLM flights or Relocate tasks, they will be presented with Mate or Demate scenario, for which they will be required to demonstrate their skills).

#### Objectives:

Given several CBM-related failure scenarios, using CBM procedures, without instructor assistance and within a timely manner, the student will perform the following:

- Using CBM displays, identify off-nominal signatures.
- Describe the immediate failure impacts, including impacts to the current hardware configuration.
- Determine appropriate malfunction procedure block(s) and execute them correctly.
- Confirm command actions through telemetry signatures.
- Summarize degraded state of the CBM, including capabilities, limitations and redundancies.
- Describe any impacts to the system, procedures and/or operations.

# 32 MECH/ROBO INSTALL 21178

Title: Mechanisms/Robotics Installation (Shared – ISS)

Duration: 4.0 hours

Medium: Space Station Training Facility

Student: As assigned by CDR.

Source: DX23/Station Mechanical & Robotics and DX42/Mechanisms and

Maintenance Training Group

Date: 04/06

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): CAS SPEC MASTERY-S 21078 or

**CBM SPEC MASTERY 21078** 

Preparation: None

**Note:** Every effort should be made to teach this lesson within 3 to 4 weeks

prior to the associated integrated sim.

Synopsis: This lesson is to exercise the Space Flight Resource Management

(SFRM) aspects of the Robotics and Mechanism mating tasks. These aspects are Communication, Decision Making, Situational Awareness, Leadership, Command, and Workload Management. The crewmembers are put in a flight-like environment and exercise flight-like procedures to install a payload on ISS. Throughout the task, they are managing systems and failures, maintaining situational awareness, communicating completion of steps, and communicating for good camera views. Malfunctions are added to emphasize the need for leadership and communication between students and vehicles (when Shuttle simulator also involved). This lesson is a bridge between the system-specific flows

and the flight-specific simulations.

- Perform flight-like procedures to grapple and install an ISS payload utilizing a Common Attach System (CAS) or Common Berthing Mechanism (CBM).
- Demonstrate SFRM Command techniques by providing direction and information as needed by other crewmembers and ground.
- Demonstrate SFRM Leadership techniques by encouraging crewmember interaction.
- Demonstrate SFRM Workload Management techniques by planning and prioritizing activities and crewmember use.
- Demonstrate SFRM Communication techniques by communicating information between crewmembers and ground.

# 32 MECH/ROBO INSTALL 21178 (Concluded)

- Demonstrate SFRM Situational Awareness techniques by scanning all camera views and displays, observing any warnings, and structural proximity concerns.
- Demonstrate SFRM decision-making techniques by recognizing and assessing problems and correctly responding to the failures.

Given the Mechanism procedures, perform them with minimal instructor assistance and demonstrate the following:

- Apply proper display navigation and scan pattern techniques during operation.
- Demonstrate proper command protocol.
- Anticipate and confirm telemetry changes due to command actions.
- Continually report system status to the ground.

Given the malfunction procedures, diagnose and maintain functionality of the system during a failure by demonstrating the following:

- Recognize and report failures to the ground.
- Describe failure impacts.
- Develop and exercise a failure resolution plan (with assistance, if requested).

#### 33 MECH/ROBO UNINSTALL 21178

Title: Mechanism/Robotics Uninstallation (Shared – ISS)

Duration: 4.0 hours

Medium: Space Station Training Facility

Student: As assigned by CDR.

Source: DX23/Station Mechanical & Robotics and DX42/Mechanisms and

Maintenance Training Group

Date: 04/06

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): CAS SPEC MASTERY-S 21078 or

**CBM SPEC MASTERY 21078** 

Preparation: None

**Note:** Every effort should be made to teach this lesson within 3 to 4 weeks

prior to the associated integrated sim.

# 33 MECH/ROBO UNINSTALL 21178 (Continued)

#### Synopsis:

This lesson is to exercise the Space Flight Resource Management (SFRM) aspects of the Robotics and Mechanism demating tasks. These aspects are Communication, Decision Making, Situational Awareness, Leadership, Command, and Workload Management. The crewmembers are put in a flight-like environment and exercise flight-like procedures to uninstall a payload on ISS. Throughout the task, they are managing systems and failures, maintaining situational awareness, communicating completion of steps, and communicating for good camera views. Malfunctions are added to emphasize the need for leadership and communication between students and vehicles (when Shuttle simulator also involved). This lesson is a bridge between the system-specific flows and the flight-specific simulations.

#### Objectives:

- Perform flight-like procedures to grapple and uninstall a payload utilizing a Common Attach System (CAS) or Common Berthing Mechanism (CBM).
- Demonstrate SFRM Command techniques by providing direction and information as needed by other crewmembers and ground.
- Demonstrate SFRM Leadership techniques by encouraging crewmember interaction.
- Demonstrate SFRM Workload Management techniques by planning and prioritizing activities and crewmember use.
- Demonstrate SFRM Communication techniques by communicating information between crewmembers and ground.
- Demonstrate SFRM Situational Awareness techniques by scanning all camera views and displays, observing any warnings, and structural proximity concerns.
- Demonstrate SFRM decision-making techniques by recognizing and assessing problems and correctly responding to the failures.

Given the Mechanism procedures, perform them with minimal instructor assistance and demonstrate the following:

- Apply proper display navigation and scan pattern techniques during operation.
- Demonstrate proper command protocol.
- Anticipate and confirm telemetry changes due to command actions.
- Continually report system status to the ground.

## 33 MECH/ROBO UNINSTALL 21178 (Concluded)

Given the malfunction procedures, diagnose and maintain functionality of the system during a failure by demonstrating the following:

- Recognize and report failures to the ground.
- Describe failure impacts.
- Develop and exercise a failure resolution plan (with assistance, if requested).

# **34** CAS MIS SP TASKS 31078

Title: Common Attach System Mission Specific Tasks (Shared – ISS)

Duration: 2.0 hours

Medium: Generic Part Task Trainer

Student: As assigned by CDR. (Schedule in pairs.)
Source: DX23/Station Mechanical & Robotics

Date: 09/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): CAS SPEC MASTERY-S 21078

Preparation: None

**Note:** Every effort should be made to teach this lesson after the last

mechanism-related integrated sim.

Synopsis: This lesson will focus on Common Attach System (CAS) content specific

to the crewmember's flight or increment. The class may include flight rule discussions, addressing flight-specific issues or concerns, and working through flight- or increment-specific nominal and malfunction CAS

procedures.

Objectives: The instructor will customize lesson objectives to fit the individual student

and review them at the beginning of the lesson.

Possible objectives include:

- Perform CAS increment-/flight-specific activities and procedures.
- Diagnose and maintain functionality of the system during a failure external or internal to the CAS.
- Identify and resolve any CAS flight-specific issues.

# 35 CBM MIS SP TASKS 31078

Title: Common Berthing Mechanism Mission Specific Tasks (Shared – ISS)

Duration: 2.0 hours

Medium: Generic Part Task Trainer

Student: As assigned by CDR. (Schedule in pairs.)
Source: DX23/Station Mechanical & Robotics

Date: 09/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): CBM SPEC MASTERY 21078

Preparation: None

**Note:** Every effort should be made to teach this lesson after the last

mechanism-related integrated sim.

Synopsis: This lesson will be used to cover any mission specific information not

discussed or which has changed since the student's previous Common Berthing Mechanism (CBM) training. Topics may include the following:

software issues/updates, procedure issues/updates, display

issues/updates, areas of concern during a specific CBM operation, etc.

Objectives: The instructor will customize lesson objectives to fit the individual student

and review them at the beginning of the lesson. Possible objectives

include:

• Discuss CBM increment-/flight-specific issues or updates to any of the following: displays, procedures, flight rules, software, hardware, etc.

• Perform CBM increment-/flight-specific activities and procedures.

• Given CBM displays, identify failure signatures affecting CBM operations for the student's particular mission.

Perform safing or maintain functionality of the system.

# 36 O2N2 OPS 21001

Title: Oxygen and Nitrogen System Operations (Shared – ISS)

Duration: 2.0 hours Medium: Classroom

Student: Crewmembers as assigned.

Source: DI54/Environmental Control and Life Support System (ECLSS)

**Training** Group

Date: 03/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ISS O2 SAFETY 21001 (STS & ISS)

Preparation: None

# 36 O2N2 OPS 21001 (Concluded)

Synopsis:

This lesson provides an overview of the U.S. oxygen and nitrogen supply and distribution system. The lesson introduces the three functional divisions of the system: High-pressure oxygen, low-pressure oxygen, and nitrogen. Each functional division is then discussed in detail, following the flow of gas from the storage tanks to the end users on-board ISS. Crew actions required for system reconfiguration due to flight software response are discussed. The second half of the lesson provides an overview of the recharge systems, following the flow of gas from the Shuttle storage tanks to the ISS  $O_2/N_2$  systems. The lesson concludes with a discussion of the ISS/Shuttle oxygen system configuration to support prebreathe.

Objectives:

- Trace the flow path of the O<sub>2</sub>/N<sub>2</sub> System and the key crew interfaces.
- Compare the high-pressure oxygen, low-pressure oxygen, and nitrogen supply and distribution systems, and the users of each system.
- Describe the nominal configuration of the oxygen and nitrogen supply and distribution systems during current ISS stage operations.
- Describe the oxygen and nitrogen recharge systems and their key crew interfaces.
- Compare and contrast the oxygen and nitrogen recharge systems.

# **ECLSS JNT AL OPS 21105**

Title: Environmental Control and Life Support System Joint Airlock

Operations (Shared – Shuttle)

Duration: 2.0 hours

Medium: Space Station Mock-Up and Training Facility

Student: EV1, EV2, IV

Source: DI54/Environmental Control and Life Support System (ECLSS)

**Training** Group

Date: 05/02

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ECG INTRO 11001, ISS O2 SAFETY 21001,

02N2 OPS 21001

Preparation: None

**Note:** This lesson is a prerequisite to ISS EVA Prep and Post.

Synopsis: This lesson covers the nominal operation of Environmental Control and

Life Support System (ECLSS) equipment required for an EVA from the Joint Airlock. The function, location, operational crew interfaces, and interfaces with other ISS systems are discussed for each piece of ECLSS hardware required for an EVA from the Joint Airlock. Emphasis is placed

on the configuration of the Airlock for 10.2 psi operations.

#### 37 **ECLSS JNT AL OPS 21105 (Concluded)**

- Objectives: Identify which ECLSS components are required for EVA from the Joint Airlock.
  - Describe the function, location, operational crew interfaces, and nominal operational modes of each ECLSS component required for EVA from the Joint Airlock.
  - Explain how each ECLSS component required for EVA from the Joint Airlock interfaces with other ECLSS subsystems or ISS systems.
  - Describe the overall navigation scheme, general display contents (prominent Graphical User Interface (GUI) features and key telemetry fields) and crew controls available for ECLSS from the Joint Airlock Display.
  - Describe the configuration of the Joint Airlock during the following activities: housekeeping mode, 10.2 psi operations, EMU purge, EMU prebreathe, and crew lock egress/ingress.

#### 38 **O2N2 XFER OPS 21105**

Title: Oxygen and Nitrogen Transfer Operations (Shared – ISS)

Duration: 1.5 hours

Space Station Mock-Up and Training Facility Medium:

Crewmembers as assigned. (Schedule in groups of 2.) Student:

DI54/Environmental Control and Life Support System (ECLSS) Source:

**Training** Group

Date: 03/05

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): O2N2 OPS 21001 (STS & ISS)

Preparation: None

Synopsis:

This lesson provides an opportunity for students to apply their knowledge of oxygen and nitrogen systems by performing oxygen and nitrogen transfer procedures. Students will perform the appropriate oxygen transfer initiation, and transfer procedures with a discussion of the termination process. Students will also practice any rapid safing responses. This lesson emphasizes both knowledge of system architecture, as well as proper safety techniques.

- Configure the Joint Airlock and Orbiter Docking System (ODS) Vestibule for oxygen and nitrogen tank transfer or EVA prebreathe correctly and in a safe manner.
- Describe what disconnections need to be made to safe the system and close the hatches between Shuttle and Station for emergency or nominal undocking.

# 39 MPLM VEST PROC 31105

Title: ISS Multi Purpose Logistics Module Vestibule Procedures

(Shared – ISS)

Duration: 2.0 hours

Medium: Space Station Mock-up and Training Facility

Student: As assigned by CDR.

Source: DX42/Mechanisms & Maintenance Systems Group

Date: 09/04

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

Synopsis:

During this lesson students learn how to outfit the Inter-Module Vestibule before and after the mating or demating of the MPLM. This task includes removing the Center Disk Cover, Controller Panel Assemblies (CPAs), MPLM Thermal Blanket, and then installing the Element-to-Element Ground Straps, Vestibule Jumpers, and Vestibule Closeout Panel. Vestibule and MPLM ingress is also covered during this lesson. Vestibule ingress, which occurs prior to vestibule outfitting, includes vestibule pressurization and a gross leak check using the MPEV, Internal Sampling Adapter (ISA), Vacuum Access Jumper (VAJ), and ScopeMeter. MPLM ingress, which occurs after vestibule outfitting, includes air sampling of the MPLM using the External Sampling Adapter (ESA), L-shaped adapter, and Grab Sample Containers (GSCs). This class must be taught prior to all flights/increments where the MPLM is mated or demated.

- Identify vestibule cabling, plumbing, closeouts, thermal/debris blankets, and Common Berthing Mechanism (CBM) components.
- Explain the procedures for removing and replacing vestibule cabling, plumbing, closeouts, thermal/debris blankets, and CBM components.
- Remove and replace vestibule cabling, plumbing, closeouts, thermal/debris blankets, and CBM components.
- Perform MPLM ingress/egress procedure.
- State any crew safety issues related to the on-orbit equipment and procedures.

# 40 MPLM VEST PROC/ACT 31105

Title: Multi-Purpose Logistics Module Vestibule Procedures and Activation

(Shared – ISS)

Duration: 4.0 hours

Medium: Space Station Mock-up and Training Facility

Student: As assigned by CDR.

**Note:** Schedule with Expedition crew.

Source: DI54/Environmental Control and Life Support System (ECLSS)

Training Group; DX42/Mechanisms & Maintenance Systems Group

Date: 03/05

Lesson(s) Replaced: MPLM VEST PROC/ACT 31179

Equipment Required: None

Prerequisite Lesson(s): MPLM VEST PROC 31105,

SMALL VOL PRESS OPS 21105

Preparation: None

Synopsis: This lesson covers the nominal outfitting, activation, and ingress of the

MPLM, and is conducted in a timeline format. The student(s) will perform all of the procedure activities associated with the same timelined activities that will be performed during flight. The function, location, operational crew interfaces, and interfaces with related ISS systems is also discussed.

This lesson is conducted by instructors from both DX42/OSO and

DI54/ECLSS sections.

Objectives: Perform the timelined activities that begin after MPLM berthing to ISS,

continuing through the MPLM ingress.

#### 41 SMALL VOL PRESS OPS 21105

Title: Small Volume Pressurization and Depressurization Operations

(Shared – ISS)

Duration: 1.25 hours

Medium: Space Station Mock-up and Training Facility

Student: As assigned by CDR.

Source: DI54/Environmental Control and Life Support System (ECLSS)

**Training** Group

Date: 03/05

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

# 41 SMALL VOL PRESS OPS 21105 (Concluded)

Synopsis:

After a short prebrief, which will present the tasks that need to be performed on orbit, the Internal Sampling Adapter (ISA)/Flukemeter, Vacuum Access Jumper (VAJ), Manual Pressure Equalization Valve (MPEV) will be passed around for student familiarization and inspection. The location, use, and function of each piece of equipment will be presented. After component familiarization, the students will be shown how to assemble the equipment for the Volume Repressurization and Depressurization tasks. The expected readings on the Flukemeter will be reviewed for each of the tasks. The instructor will discuss what specific Portable Computer System (PCS) steps need to be performed for the Volume Depress task. The student will perform Volume Repress, Depress, and Leak Check procedures using the PCS, Flukemeter, and support equipment.

Objectives:

Conduct vestibule/volume depress, repress, and leak check, and contingency airlock depress operations per procedure.

# **42** O2N2 XFER PROF 41105

Title: Oxygen and Nitrogen Transfer Proficiency (Shared – Shuttle)

Duration: 1.5 hours

Medium: Space Station Mock-Up and Training Facility

Student: Crewmembers as assigned. (Schedule in groups of 2.)

Source: DI54/Environmental Control and Life Support System (ECLSS)

**Training** Group

Date: 01/03

Lesson(s) Replaced: None

Equipment Required: Appropriate clothing for SSMTF

Prerequisite Lesson(s): O2N2 XFER OPS 21105 (STS & ISS)

Preparation: None

Synopsis:

This lesson provides a final pre-flight opportunity for students to apply their oxygen and nitrogen systems knowledge and skills. Students will receive a pre-flight update on the scheduled transfer activities and the students will then perform the appropriate oxygen and/or nitrogen transfer procedures. Students will also review the system safing responses. This lesson emphasizes both knowledge of system architecture, as well as proper safety techniques.

Objectives:

Given Joint Airlock and Orbiter Docking System (ODS)/Pressurized Mating Adapter (PMA) mockups with all of the necessary Environmental Control and Life Support System (ECLSS) hardware and a procedure, configure the Joint Airlock and ODS Vestibule for oxygen and nitrogen tank recharge correctly and in a safe manner.

### 43 STS RSP TO JNT EMER 31208

Title: Shuttle Response to Joint Emergency

Duration: 2.0 hours

Medium: SSMTF (Suit room)

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT

Source: DI54/Environmental Control and Life Support System (ECLSS)

**Training** Group

Date: 04/06

Lesson(s) Replaced: ISS EMERGENCY H/W 11105

Equipment Required: Training Notes

Prerequisite Lesson(s): O2/N2 XFER OPS 21105

Preparation: None

Synopsis: This lesson is the first lesson the STS crew receives on handling an

emergency (Fire, Rapid Depress, or Toxic Atmosphere) while docked to the ISS. It begins with a general introduction to the Joint Emergency philosophy, and then looks at each of the types of emergencies individually. The lesson moves from the philosophy discussion, to looking at the procedures and hardware (gas masks, fire extinguishers, etc.) the crew will interact with in the response. The initial response procedure will be covered in detail, and the crew will be able to interact with high fidelity

mockups of the emergency equipment.

Objectives:

- Recall the responsibilities of an STS crew in an emergency situation while the Shuttle is docked to ISS.
- Identify the procedures to be run in responding to an emergency during the docked timeframe.
- Identify the actions the STS crew is required to perform in the emergency egress procedures.
- Identify the quantities of ISS emergency equipment in each module.
- Demonstrate the proper use of ISS emergency equipment.

### 44 ISS EMERGENCY OVW 31105

Title: ISS Emergency Overview

Duration: 2.5 hours

Medium: Space Station Mock-Up and Training Facility Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT

Source: DI54/Environmental Control and Life Support System (ECLSS)

**Training** Group

Date: 04/06

Lesson(s) Replaced: None Equipment Required: None

### 44 ISS EMERGENCY OVW 31105 (Concluded)

Prerequisite Lesson(s): STS RSP TO JNT EMER 31208

Preparation: None

Synopsis:

This is the second lesson in the STS crew's ISS emergency training flow. It begins by showing the crew the location of emergency equipment on the ISS by using the mockups. Next, a review of the STS crew's responsibilities during a joint emergency is covered. Finally, the crew will walk through multiple emergency scenarios in the mockups. Each scenario will be a different type of emergency and allows the crew to walk through their response in the mockups using necessary equipment. The lesson will also give the STS crew a chance to practice their actions in the Joint Emergency Egress procedure. This includes closing ISS hatches, including the Russian built Androgynous Peripheral Assembly System (APAS) hatch, as well as disconnecting the high pressure oxygen and nitrogen lines which run through the hatches. The lesson will focus on worst case situations where the emergency is between the STS crew and the Shuttle, and cases where some of the STS crew is isolated in the ISS Airlock (A/L).

Objectives:

- Identify the location of ISS emergency equipment in the ISS mockups.
- Demonstrate the proper response to emergencies during the docked timeframe.
- Demonstrate proper use of emergency equipment when responding to an emergency.
- Perform steps to safely isolate the ISS from the Shuttle as part of the Joint Emergency Egress procedure.

### **45 ISS/STS EMER SCEN 31105**

Title: ISS Emergency Scenarios (Shared – ISS)

Duration: 2.0 hours Medium: SSMTF

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT

Source: DI54/Environmental Control and Life Support System (ECLSS)

**Training** Group

Date: 04/06

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ISS EMERGENCY OVW 31105

Preparation: None

### 45 ISS/STS EMER SCEN 31105 (Concluded)

Synopsis:

ISS/STS Emergency Scenarios lesson is a "hands-on" lesson for Expedition and STS crewmembers. It will also be given to all STS crewmembers with instructors role playing ISS crewmembers, if necessary. This lesson will consist of a 0.5 hour prebrief to review the information provided in ISS EMERGENCY OVW 31105, a 1.0 hour scenarios lesson, and a 0.5 hour debrief. The lesson will utilize the Space Station Mockup Training Facility (SSMTF) and the Part Task Trainer (PTT). The lesson utilizes the spatial accuracy of the SSMTF module-layout combined with the Portable Computer System (PCS) Emergency telemetry and the Caution & Warning (C&W) tones provided by the PTT to train Expedition Crews and STS Crews to Identify, Respond, and Recover from Emergency Scenarios in a safe and time efficient manner.

Objectives:

- Demonstrate the proper response to emergencies during the docked timeframe.
- Coordinate STS crew actions with ISS commander to properly respond to an emergency in the docked timeframe.
- Perform emergency egress of ISS and coordinate with ISS crew about completion of STS crew steps and information critical to crew response.
- Demonstrate the ability to isolate an emergency event and recover from it safely.

### 46 ISS EMERGENCY REFR 41001

Title: ISS Emergency Refresher

Duration: 1.0 hour Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT

Source: DI54/Environmental Control and Life Support System (ECLSS)

**Training** Group

Date: 04/06

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ISS/STS EMER SCEN 31105

Preparation: None

Synopsis: This lesson is to provide proficiency on emergency response for the STS

crew. The proficiency is needed if there is a greater than 12 week gap

between the ISS/STS Emergency Scenarios lesson and the first

emergency case in a flight-specific sim. This is to insure the STS crew will respond properly during an emergency in a sim. The lesson will be a

#### 46 **ISS EMERGENCY REFR 41001 (Concluded)**

tabletop review of the material previously covered, including crew responsibilities, procedure actions, and previous agreements with the ISS crew.

Note:

This lesson is optional if the ISS/STS Scenarios lesson happens within 12 weeks of the crew's first emergency case in a joint integrated flightspecific sim.

- Objectives: Review the STS crew responsibilities during a joint emergency scenario.
  - Review the procedures the STS crew needs to run in a joint emergency, and the steps to be performed.
  - Review agreements made with the ISS crew during the ISS/STS Emergency Scenarios class.

#### 47 **ISS EMER REVIEW 91105**

Title: ISS Emergency Review

Duration: 1.5 hours

Medium: SSMTF (Suit room and Mockups)

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT

Source: DI54/Environmental Control and Life Support System (ECLSS)

**Training** Group

04/06 Date:

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): **ISS/STS EMER SCEN 31105** 

Preparation: None

Synopsis:

This lesson provides a review of joint emergency response closer to the STS crew launch date. The previous lesson on emergency response occurred sometime in the L-30 to L-14 week timeframe, so a review is needed before launch. It will start with a 30 minute prebrief, and then spend 60 minutes walking through some emergency cases in the mockups.

- Review the STS crew responsibilities during a joint emergency scenario.
- Review the procedures the STS crew needs to run in a joint emergency, and the steps to be performed.
- Review agreements made with the ISS crew during the ISS/STS Emergency Scenarios class.

### 48 SYSTEM REVIEW 41078

Title: System Review

Duration: 4.0 hours

Medium: Generic Part Task Trainer

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT (Schedule in pairs.)

Source: DA72/Station Training Leads

Date: 09/04

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

Synopsis: The Systems Review class will be an opportunity to do refresher training

for the crew upon their request, or add additional training due to changes

in the mission profile.

Objectives: Provide refresher training and/or additional training prior to integrated

simulations.

### **49 COR/ASSY PROC 31105**

Title: ISS Corrective & Assembly Procedures (Shared – ISS)

Duration: 2.0 hours

Medium: Space Station Mock-up and Training Facility

Student: As assigned by CDR.

Source: DX42/Mechanisms & Maintenance Systems Group

Date: 09/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): Preparation: None

Synopsis: This lesson covers the particular Intravehicular Activity corrective

maintenance and hardware installation activities planned for a specific increment or crew. This lesson is usually taught 1 to 2 months prior to crew launch to allow the addition of any last minute failures that may have occurred onboard the ISS. Some assembly tasks performed in this class may include the configuration of EPS connector patch panels, removal of Positive Pressure Relief Valves (PPRVs)/Negative Pressure Relief Valves (NPRVs), and the installation of Intermodule Ventilation valves. The majority of ISS assembly tasks are trained due to their inherent timeline and assembly risks. The International Partners will train students on how to perform corrective maintenance on their respective hardware

components.

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#### 49 COR/ASSY PROC 31105 (Concluded)

- Objectives: Identify the tools and hardware associated with example corrective and assembly procedures.
  - Explain the rationale for the sequence of steps in example corrective and assembly procedures.
  - Perform example corrective and assembly tasks using on-orbit maintenance tools and procedures.
  - State any crew safety issues related to the on-orbit equipment and procedures.

#### *50* **SPN REVIEW 21001**

Title: Station Program Note Review

Duration: 2.0 hours Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT

**DA72**/Station Training Leads Source:

Date: 09/04

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

Synopsis: This class will cover important Station Program Notes (SPNs) that should

> be reviewed with the crew just before flight. The SPNs will typically be limited to ones the crew may be likely to see, not already covered in

training or documented in procedures.

Objectives: Review pertinent SPNs prior to flight.

# SECTION 13.0 MOBILE SERVICING SYSTEM FOR STS CREW TRAINING

The Mobile Servicing System (MSS) crew training flow has several major components. The first step is generic robotic skills. This is achieved by either completing the PDRS flow or Generic Robotics Training. This activity should occur before assignment as an MSS Specialist, as the flows assume that basic skills have been grasped.

Once a crewmember is assigned to operate the MSS, they enter the MSS *Robotics* Fundamentals Flow. This flow includes classes that help apply generic concepts to the ISS and MSS and includes two 1-week trips to the Canadian Space Agency (CSA) to complete the MSS Robotics Operator (MRO) course.

Upon completion of the MRO course, crewmembers continue to build their MSS operating skills in the MSS *Qualification* flow. The evaluation included in this flow should be completed before the L-6 month mark.

The remaining flows shown in this catalog depend on the specific task assignments of crewmembers. There are mission-specific task flows for EVA support, Main Element Installation, *SPDM Qualification Flow, SPDM Maintenance, SSRMS Proficiency Flow, and* Thermal Protection System (TPS) *Inspection and* Repair Support. Several lessons in these flows are shared with EVA and/or PDRS. The training manager and lead MSS instructor will develop a detailed training plan based on these flows, taking into consideration task assignments.

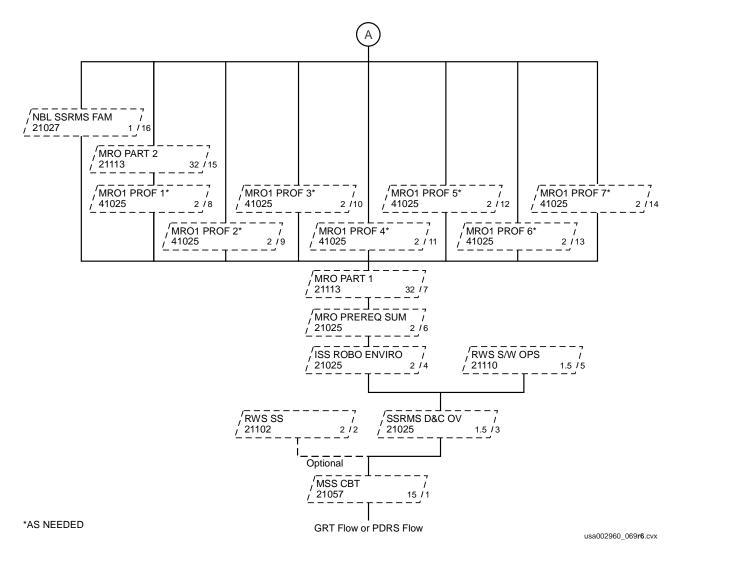


Figure 13-1. Mobile Servicing System for STS Crew Training
Lesson Flow Chart
(Sheet 1 of 9)
MSS Robotics Fundamentals

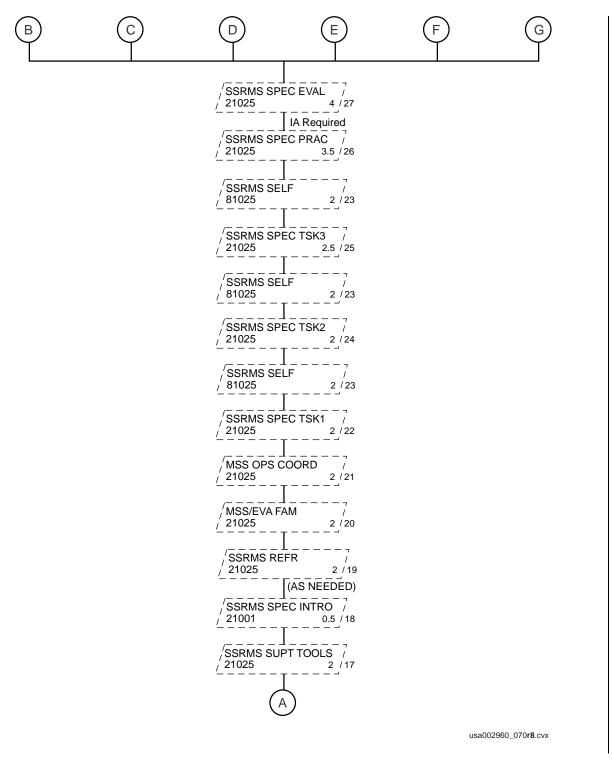


Figure 13-1. Mobile Servicing System for STS Crew Training
Lesson Flow Chart
(Sheet 2 of 9)
SSRMS Qual Flow

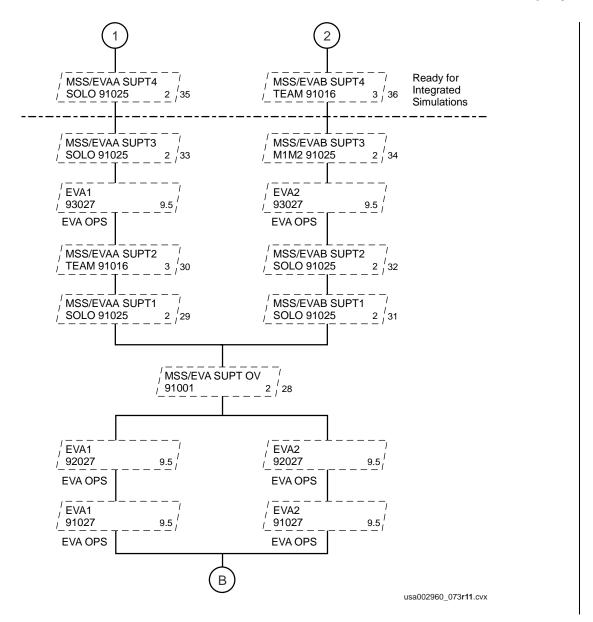


Figure 13-1. Mobile Servicing System for STS Crew Training
Lesson Flow Chart
(Sheet 3 of 9)

MSS Complex EVA Flow (Page 1 of 2)

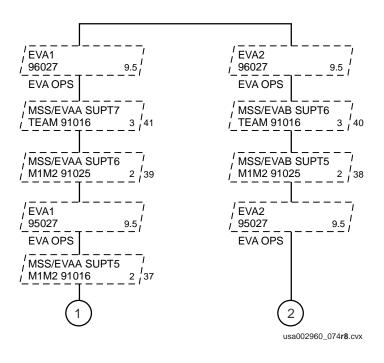


Figure 13-1. Mobile Servicing System for STS Crew Training
Lesson Flow Chart
(Sheet 4 of 9)
MSS Complex EVA Support (Page 2 of 2)

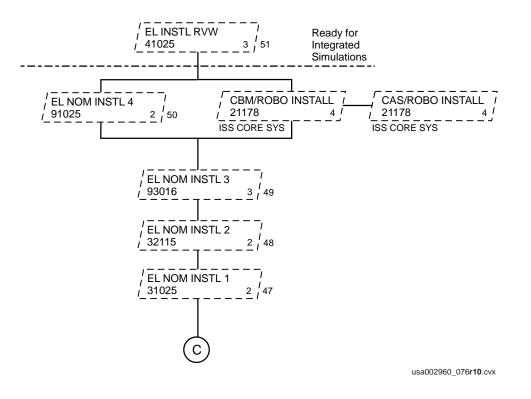


Figure 13-1. Mobile Servicing System for STS Crew Training
Lesson Flow Chart
(Sheet 5 of 9)
MSS Main Element

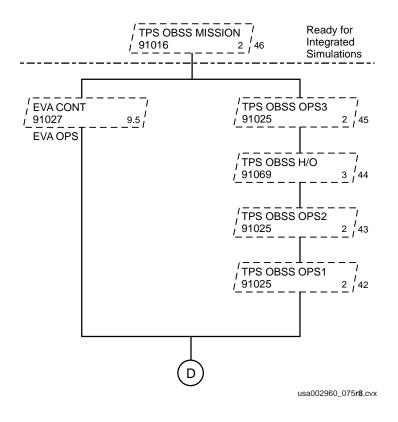


Figure 13-1. Mobile Servicing System for STS Crew Training
Lesson Flow Chart
(Sheet 6 of 9)
MSS TPS Inspection and Repair

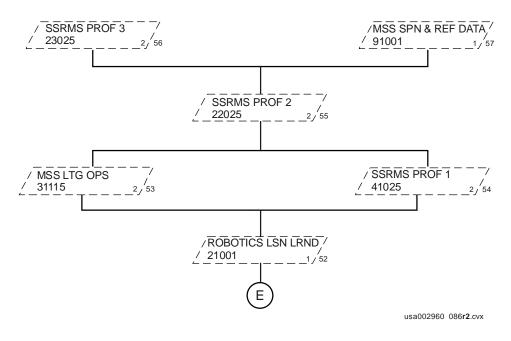


Figure 13-1. Mobile Servicing System for STS Crew Training
Lesson Flow Chart
(Sheet 7 of 9)

SSRMS Proficiency

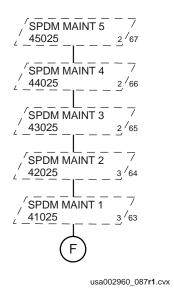


Figure 13-1. Mobile Servicing System for STS Crew Training
Lesson Flow Chart
(Sheet 8 of 9)

SPDM Maintenance

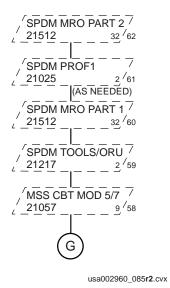


Figure 13-1. Mobile Servicing System for STS Crew Training
Lesson Flow Chart
(Sheet 9 of 9)
SPDM Qualification

Table 13-1. Mobile Servicing System for STS Crew Training Requirements

Date Last Modified: 06/08

A									Non-C	rew Rot	ation			С	rew R	otation	)		
A		Ref				Sched				M2									
4	Stage	Num	Lesson Code	Media	Hrs	Code	С	M1 P	MS1	MS2	MS3	MS4	PS	M1 C	Р	MS1	MS2	Alt Fac	Comments
4         18         SSRMS SPEC INTRO 21001         CLR         0.5         1         0.5         0.5         0.5         DST           4         20         MSS/EVA FAM 21025         DST 1         2         1         2         2         2         2,3,4,5,10           4         21         MSS OPS COORD 21025         DST 10         2         1         2         2         DST 1,2,3,4,5           4         22         SSRMS SPEC TSK1 21025         DST 1         2         1         2         2         2,3,4,5,10           4         23         SSRMS SELF 81025         DST 1         2         1         2         2         2,3,4,5,10           4         24         SSRMS SPEC TSK2 21025         DST 1         2         1         2         2         2,3,4,5,10           4         23         SSRMS SELF 81025         DST 1         2         1         2         2         2,3,4,5,10           4         23         SSRMS SPEC TSK3 21025         DST 1         2         1         2         2         2,3,4,5,10           4         25         SSRMS SPEC TSK3 21025         DST 1         2.5         1         2.5         2.5         2.5         2																		DST	
4 20 MSS/EVA FAM 21025 DST 1 2 1 2 2 DST 1,2,3,4,5 10  4 21 MSS OPS COORD 21025 DST 10 2 1 2 DST 1,2,3,4,5 10  4 22 SSRMS SPEC TSK1 21025 DST 1 2 1 2 2 2 2 2,3,4,5,10  4 23 SSRMS SELF 81025 DST 1 2 1 2 2 2 2 2,3,4,5,10  4 24 SSRMS SPEC TSK2 21025 DST 1 2 1 2 2 2 2 2,3,4,5,10  5 3 SSRMS SELF 81025 DST 1 2 1 2 2 2 2 2,3,4,5,10  4 23 SSRMS SELF 81025 DST 1 2 1 2 2 2 2 2,3,4,5,10  5 4 23 SSRMS SELF 81025 DST 1 2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	4	17	SSRMS SUPT TOOLS 21025	DST 1	2	1		2						2				2,3,4,5 <b>,10</b>	
4 20 MSS/EVA FAM 21025 DST 1 2 1 2 2 DST 1,2,3,4,5 10  4 21 MSS OPS COORD 21025 DST 10 2 1 2 DST 1,2,3,4,5 10  4 22 SSRMS SPEC TSK1 21025 DST 1 2 1 2 2 2 2 2,3,4,5,10  4 23 SSRMS SELF 81025 DST 1 2 1 2 2 2 2 2,3,4,5,10  4 24 SSRMS SPEC TSK2 21025 DST 1 2 1 2 2 2 2 2,3,4,5,10  5 3 SSRMS SELF 81025 DST 1 2 1 2 2 2 2 2,3,4,5,10  4 23 SSRMS SELF 81025 DST 1 2 1 2 2 2 2 2,3,4,5,10  5 4 23 SSRMS SELF 81025 DST 1 2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2																			
4   20   MSS/EVA FAM 21025   DST 1   2   1   2   2   2   2   2   2   2	4	18	SSRMS SPEC INTRO 21001	CLR	0.5	1		0.5						0.5				DOT	
4 21 MS OPS COORD 21025 DST 10 2 1 2 2 DST 1,2,3,4,5 10  2 SSRMS SPEC TSK1 21025 DST 1 2 1 2 2 2 2,3,4,5,10  4 22 SSRMS SELF 81025 DST 1 2 1 2 2 2 2,3,4,5,10  4 23 SSRMS SPEC TSK2 21025 DST 1 2 1 2 2 2 2,3,4,5,10  5 SSRMS SPEC TSK2 21025 DST 1 2 1 2 2 2 2,3,4,5,10  4 24 SSRMS SPEC TSK2 21025 DST 1 2 1 2 2 2 2,3,4,5,10  5 SSRMS SELF 81025 DST 1 2 1 2 2 2 2,3,4,5,10  4 25 SSRMS SPEC TSK3 21025 DST 1 2 1 2 2 2 2,3,4,5,10  5 SSRMS SPEC TSK3 21025 DST 1 2 1 2 2 2 2,3,4,5,10  4 26 SSRMS SPEC PRAC 21025 DST 1 3.5 1 3.5 1 3.5 DST  4 27 SSRMS SPEC EVAL 21025 DST 1 4 1 4 4 4 4 4 2 2,3,4,5,10  5 SSRMS SPEC EVAL 21025 DST 1 4 1 4 4 4 4 4 4 2 2,3,4,5,10  5 SSRMS SPEC EVAL 21025 DST 1 4 1 4 4 4 4 4 4 2 2,3,4,5,10  6 SSRMS SPEC EVAL 21025 DST 1 4 1 4 4 4 4 4 4 2 2,3,4,5,10  6 SSRMS SPEC EVAL 21025 DST 1 4 1 4 4 4 4 4 4 2 2,3,4,5,10  6 SSRMS SPEC EVAL 21025 DST 1 4 1 4 4 4 4 4 4 2 2,3,4,5,10  6 SSRMS SPEC EVAL 21025 DST 1 4 1 4 4 4 4 4 4 2 2,3,4,5,10  6 SSRMS SPEC EVAL 21025 DST 1 4 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	4	20	MCC/EVA FAM 24025	DOT 4	2	4												_	
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4 22 SSRMS SPEC TSK1 21025 DST 1 2 1 2 2 2 2 2,3,4,5,10 DST 2 1 2 1 2 2 2 2,3,4,5,10 DST 2,3,4,5	4	21	MSS OPS COORD 21025	DST 10	2	1		2						2				DST 1 2 3 4 5	
4 22 SSRMS SPEC TSK1 21025 DST 1 2 1 2 DST 1 2 1 DST 1 2 1 DST 1 2 1 DST 1 2 1 DST 1 2 DST 1		<del></del> -	Mee of a court E 1929	201 10		<del></del>		_						-					
4 23 SSRMS SELF 81025 DST 1 2 1 2 2 2 2,3,4,5,10 DST 4 24 SSRMS SPEC TSK2 21025 DST 1 2 1 2 2 2 2,3,4,5,10 DST 5 2,3,4,5,10 DST 6 2,3,4,5,10 DST 6 2,3,4,5,10 DST 7 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	4	22	SSRMS SPEC TSK1 21025	DST 1	2	1		2						2					
4 24 SSRMS SPEC TSK2 21025 DST 1 2 1 2 2 2 2 2,3,4,5,10 DST 4 23 SSRMS SELF 81025 DST 1 2 1 2 2 2 2,3,4,5,10 DST 4 25 SSRMS SPEC TSK3 21025 DST 1 2 1 2 2 2 2,3,4,5,10 DST 4 23 SSRMS SELF 81025 DST 1 2 1 2 2 2 2,3,4,5,10 DST 4 26 SSRMS SPEC PRAC 21025 DST 1 3.5 1 3.5 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2																		DST	
4       24       SSRMS SPEC TSK2 21025       DST 1       2       1       2       2       2,3,4,5,10       DST         4       23       SSRMS SELF 81025       DST 1       2.5       1       2.5       2.5       2.3,4,5,10       DST         4       25       SSRMS SPEC TSK3 21025       DST 1       2.5       1       2.5       2.5       2.3,4,5,10       DST         4       23       SSRMS SELF 81025       DST 1       2       1       2       2       2       2,3,4,5,10       DST         4       26       SSRMS SPEC PRAC 21025       DST 1       3.5       1       3.5       3.5       3.5       2,3,4,5,10       DST         4       27       SSRMS SPEC PRAC 21025       DST 1       4       1       4       4       4       4       2,3,4,5,10       DST         4       27       SSRMS SPEC EVAL 21025       DST 1       4       1       4       4       4       4       4       2,3,4,5,10       DST       IA Requir         4       28       MSS/EVA SUPT OV 91001       CLR       2       5       2       2       2       2       2       2       2       2       2       2	4	23	SSRMS SELF 81025	DST 1	2	1		2						2					
4 23 SSRMS SELF 81025 DST 1 2 1 2 2 2 2 2 3,4,5,10  4 25 SSRMS SPEC TSK3 21025 DST 1 2 1 2 2 2 2 3,4,5,10  4 23 SSRMS SELF 81025 DST 1 2 1 2 2 2 2 3,4,5,10  4 26 SSRMS SPEC PRAC 21025 DST 1 3.5 1 3.5 2 3.5 2,3,4,5,10  4 27 SSRMS SPEC EVAL 21025 DST 1 4 1 4 4 4 4 2 2 3 2 2 2 2 2 2 2 2 2 2 2 2 2																			
4 23 SSRMS SPEC TSK3 21025 DST 1 2 1 2 2 2 2 3,4,5,10 DST 4 2 5 SSRMS SPEC TSK3 21025 DST 1 2 1 2 2 2 3,4,5,10 DST 4 23 SSRMS SPEC TSK3 21025 DST 1 2 1 2 2 2 2 3,4,5,10 DST 4 26 SSRMS SPEC PRAC 21025 DST 1 3.5 1 3.5 1 3.5 2 3,4,5,10 DST 4 2 8 MSS/EVA SUPT OV 91001 CLR 2 5 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	4	24	SSRMS SPEC TSK2 21025	DST 1	2	1		2						2					
4 25 SSRMS SPEC TSK3 21025 DST 1 2.5 1 2.5 2.5 2.3,4,5,10 DST 2,3,4,5,10 DST 2,3,																			
4 25 SSRMS SPEC TSK3 21025 DST 1 2.5 1 2.5	4	23	SSRMS SELF 81025	DST 1	2	1		2						2		-			
4 23 SSRMS SELF 81025 DST 1 2 1 2 2 2 2,3,4,5,10  4 26 SSRMS SPEC PRAC 21025 DST 1 3.5 1 3.5 2,3,4,5,10  4 27 SSRMS SPEC EVAL 21025 DST 1 4 1 4 4 4 4 4 28 MSS/EVA SUPT OV 91001 CLR 2 5 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	4	25	SSPMS SPEC TSK2 21025	DST 1	2.5	1		2.5						2.5					
4 23 SSRMS SPEC PRAC 21025 DST 1 3.5 1 3.5 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	- 4	23	33KW3 3FLC 13K3 21023	D31 1	2.3	-		2.3				+		2.3		+			
4 26 SSRMS SPEC PRAC 21025 DST 1 3.5 1 3.5 2,3,4,5,10 DST 2,3,4,5,10 DST 4 27 SSRMS SPEC EVAL 21025 DST 1 4 1 4 4 4 4 4 4 4 28 MSS/EVA SUPT OV 91001 CLR 2 5 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	4	23	SSRMS SELF 81025	DST 1	2	1		2						2				_	
4 27 SSRMS SPEC EVAL 21025 DST 1 4 1 4 4 4 4 4 4 4 4 2 2 2 2 2 2 2 2 2			0.11	2011															
4 27 SSRMS SPEC EVAL 21025 DST 1 4 1 4 4 4 4 4 4 4 4 2 2 2 3 4 2 2 2 2 2 2 2	4	26	SSRMS SPEC PRAC 21025	DST 1	3.5	1		3.5						3.5				2,3,4,5,10	
4 28 MSS/EVA SUPT OV 91001 CLR 2 5 2 2 2 2 2 2 2 2 2 2 2 2 2 4 52 4 5																		DST	
4       52       ROBOTICS LSN LRND 21001       CLR       1       3       1       1       1       1       Night Operation of the property of the prope																		2,3,4,5 <b>,10</b>	IA Required
4         53         MSS LTG OPS 31115         MRMDF         2         1         2         2         Sight Op Bldg 9 rd           4         54         SSRMS PROF 1 41025         DST 1         2         1         2         2         2         DST 2,3,4,5,10         2         2         2,3,4,5,10         2         2         2,3,4,5,10         2         2         2         2         2,3,4,5,10         2 <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th>2</th> <th></th> <th>2</th> <th>2</th> <th>2</th> <th></th> <th></th> <th></th> <th>2</th> <th>2</th> <th>2</th> <th></th> <th></th>							2		2	2	2				2	2	2		
4     53     MSS LTG OPS 31115     MRMDF     2     1     2     2     2     Bidg 9 responsible of the state of the s	4	52	ROBOTICS LSN LRND 21001	CLR	1	3		1						1					
4     53     MSS LTG OPS 31115     MRMDF     2     1     2     2     2     Bidg 9 responsible of the state of the s																			
4         54         SSRMS PROF 1 41025         DST 1         2         1         2         2         2         2,3,4,5,10           4         Sub Total for Stage         Stage Totals Per Crewmember:         Stage Totals Per Crewmember:         Stage Totals Per Crewmember:																			Night Ops in
4         54         SSRMS PROF 1 41025         DST 1         2         1         2         2         2         2         2,3,4,5,10           4         Sub Total for Stage         Stage Totals Per Crewmember:         Stage	4	53	MSS LTG OPS 31115	MRMDF	2	1		2						2				DOT	Bldg 9 required
4 Sub Total for Stage Stage Totals Per Crewmember:			00DM0 DD0E 4 4400E	DOT 4															
	-	54			2		Dor C	_	hor					2				2,3,4,5,10	
4			Sub II	otal for Stage	33.5	Stage Totals	2	33.5	ber: 2	6	2	0	0	33.5	2	2	2		

Table 13-1. Mobile Servicing System for STS Crew Training Requirements (continued)

Date Last Modified: 06/08

						Non-Crew Rotation							С	rew R	otation			
	Ref				Sched				M2									
Stage	Num	Lesson Code	Media	Hrs	Code	С	M1 P	MS1	MS2	MS3	MS4	PS	M1 C	Р	MS1	MS2	Alt Fac	Comments
																	DST	
3	29	MSS/EVAA SUPT1 SOLO 91025	DST 1	2	1		2						2				2,3,4,5 <b>,10</b>	
3	30	MSS/EVAA SUPT2 TEAM 91016	VR LAB	3	5	3	3	3	3				3	3	3	3	DST 2,3,4,5 <b>,10</b>	
3	30	WISS/EVAA SOF 12 TEAWI 91010	VK LAD	3	5	3	3	3	3				3	3	3	3	DST	
3	31	MSS/EVAB SUPT1 SOLO 91025	DST 1	2	1		2						2				2,3,4,5,10	
																	DST	
3	32	MSS/EVAB SUPT2 SOLO 91025	DST 1	2	1		2						2				2,3,4,5 <b>,10</b>	
0	33	MCC/EVAA CUIDTO COLO 0400E	DOT 4	0	1												DST 2,3,4,5 <b>,10</b>	
3	33	MSS/EVAA SUPT3 SOLO 91025	DST 1	2	1		2						2				2,3,4,5,10 DST	
3	34	MSS/EVAB SUPT3 M1M2 91025	DST 1	2	2		2						2				2,3,4,5, <b>10</b>	
																	DST	
3	35	MSS/EVAA SUPT4 SOLO 91025	DST 1	2	1		2						2				2,3,4,5 <b>,10</b>	
_					_				_									
3	36	MSS/EVAB SUPT4 TEAM 91016	VR LAB	3	5	3	3	3	3				3	3	3	3	DST	
3	37	MSS/EVAA SUPT5 M1M2 91016	VR LAB	2	2		2						2				2,3,4,5,10	
	37	INISS/EVAA SOI 13 WITWE 91010	VICEAD														DST	
3	38	MSS/EVAB SUPT5 M1M2 91025	DST 1	2	2		2						2				2,3,4,5 <b>,10</b>	
	"		55														DST	
3	42	TPS OBSS OPS1 91025	DST 1	2	1		2						2				2,3,4,5 <b>,10</b>	
																	DST	
3	43	TPS OBSS OPS2 91025	VR LAB	2	2		2						2				2,3,4,5,10	
																	DST	
0		TD2 0D00 11/0 04000	0500														2,3,4,5 <b>,10</b>	Crosslisted with
3	44	TPS OBSS H/O 91069	SESD	3	4	3	3	3	3				3	3	3	3	VR Lab DST	PDRS
3	47	EL NOM INSTL 1 31025	DST 1	2	1		2						2				2,3,4,5,10	
																	DST	
3	48	EL NOM INSTL 2 32115	MRMDF	2	2		2						2				2,3,4,5,10	
2	40	EL NOM INICTL 2 02046	VR LAB		1								_				DST	
3	49	EL NOM INSTL 3 93016	VK LAB	3	1		3						3				2,3,4,5,10 DST	
3	55	SSRMS PROF 2 22065	DST 1	2	1		2						2				2,3,4,5,10	
3			tal for Stage		Stage Totals													
3				38		9	38	9	9	0	0	0	38	9	9	9		

Table 13-1. Mobile Servicing System for STS Crew Training Requirements (continued)

Date Last Modified: 06/08

								Non-C	rew Rot	ation			Cr	ew Ro	tation	)		
	Ref				Sched				M2									
Stage	Num	Lesson Code	Media	Hrs	Code	С	M1 P	MS1	MS2	MS3	MS4	PS	M1 C	Р	MS1	MS2	Alt Fac	Comments
																	DST	
2	39	MSS/EVAA SUPT6 M1M2 91025	DST 1	2	2		2						2				2,3,4,5 <b>,10</b>	
		MOO/EVAD CUIDTO TEAM OAGAC	\ \( \tag{\chi} \)		_				0									
2	40	MSS/EVAB SUPT6 TEAM 91016	VR LAB	3	5	3	3	3	3				3	3	3	3		
2	41	MSS/EVAA SUPT7 TEAM 91016	VR LAB	3	5	3	3	3	3				3	3	3	3		45-Day Currency
	45	TRO ORGO ORGO 0400F	DOT 4														DST	
2	45	TPS OBSS OPS3 91025	DST 1	2	1		2						2				2,3,4,5,10	
2	46	TPS <b>OBSS</b> MISSION 91016	VR LAB	2	2		2						2					
_				_	_												DST	
2	50	EL NOM INSTL 4 91025	DST 1	2	1		2						2				2,3,4,5,10	
																	DST	
2	56	SSRMS PROF 3 23025	DST 1	2	1		2						2				2,3,4,5,10	
2	57	MSS SPN & REF DATA 91001	CLR	1	1		1						1					
2		Sub To	tal for Stage		Stage Totals	Per C												
2				17		6	17	6	6	0	0	0	17	6	6	6		
																	DST	
1	51	EL INSTL RVW 41025	DST 1	3	1		3						3				2,3,4,5,10	45-Day Currency
1	Sub Total for Stage Stage Totals				Per C	rewmemb	per:											
				3		0	3	0	0	0	0	0	3	0	0	0		

Table 13-1. Mobile Servicing System for STS Crew Training Requirements (concluded)

	Date													ate	Last Modified: 06/			
						Non-Crew Rotation Crew Rota									otation			
	Ref				Sched				M2									
Stage	Num	Lesson Code	Media	Hrs	Code	С	M1 P	MS1	MS2	MS3	MS4	PS	M1 C	Р	MS1	MS2	Alt Fac	Comments
0	1	MSS CBT 21057	CBT	15	1		15						15					
0	2	RWS SS 21102	SELF	2	1		2						2					Optional
	_		L														DST	
0	3	<b>SSRMS</b> D&C OV 21025	DST 1	1.5	1		1.5						1.5				2,3,4,5,10	
0	4	ISS BORO ENVIRO 24025	DOT 4	_			2						2				DST	
0	5	ISS ROBO ENVIRO 21025 RWS S/W OPS 21110	DST 1 SSTF	2 1.5	3		1.5										2,3,4,5, <b>10</b>	
- 0	3	1000 0/00 01 0 21110	0011	1.5	3		1.5										DST	
0	6	MRO PREREQ SUM 21025	DST 1	2	1		2						2				2,3,4,5,10	
																	_,0,1,0,	Training in
0	7	MRO PART 1 21113	CSA	32	2		32						32					Canada
																	DST	
0	8	MRO1 PROF 1 41025	DST 1	2	1		2						2				2,3,4,5 <b>,10</b>	As needed
																	DST	
0	9	MRO1 PROF 2 41025	DST 1	2	1		2						2				2,3,4,5,10	As needed
0	10	MDO4 DDOE 0 44005	DOT 4	0	1												DST	A - v d - d
0	10	MRO1 PROF 3 41025	DST 1	2	1		2						2				2,3,4,5 <b>,10</b> DST	As needed
0	11	MRO1 PROF 4 41025	DST 1	2	1		2						2				2,3,4,5 <b>,10</b>	As needed
0	- 11	WINOT FROT 441025	D31 1														DST	As Heeded
0	12	MRO1 PROF 5 41025	DST 1	2	1		2						2				2,3,4,5,10	As needed
																	DST	
0	13	MRO1 PROF 6 41025	DST 1	2	1		2						2				2,3,4,5 <b>,10</b>	As needed
																	DST	
0	14	MRO1 PROF 7 41025	DST 1	2	1		2						2				2,3,4,5 <b>,10</b>	As needed
																		Training in
0	15	MRO PART 2 21113	CSA	32	2		32						32					Canada
0	16	NBL SSRMS FAM 21027	NBL	1	1		1						1				DST	
0	19	SSRMS REFR 21025	DST 1	2	1		2						2				2,3,4,5,10	As needed
0	58	MSS CBT MOD 5/7 21057	CBT	9	1		9						9				2,3,4,3,10	A3 liceueu
	- 00	mice of mer on the	02.														Bldg 9 High	
0	59	SPDM TOOLS/ORU 21217	DMT	2	1		2						2				Bay	
																		Training in
0	60	SPDM MRO PART 1 21512	CSA	32	2		32						32					Canada
																	DST	
0	61	SPDM PROF1 21025	DST 1	0	1		0						0				2,3,4,5,10	As needed
																		Training in
0	62	SPDM MRO PART 2 21512	CSA	32	2		32						32					Canada
																	DST	
0	63	SPDM MAINT 1 41025	DST1	3	1		3						3				2,3,4,5,10 DST	As required
0	64	SPDM MAINT 2 42025	DST1	3	1		3						3					As required
	04	OI DIN MAINT 2 42023	5011	,			-										DST	A3 required
0	65	SPDM MAINT 3 43025	DST1	2	1		2						2					As required
0	66	SPDM MAINT 4 44025	DST1	2	1		2						2				2,3,4,5,10	As required
																		As required
																	DST	inside 45-Day
0	67	SPDM MAINT 5 45025	DST1	2	1		2						2				2,3,4,5,10	Currency
0		Sub To	tal for Stage	400.0	Stage Totals				0.0				400.5	0				
0				192.0		0	192.0	0	0.0	0	0	0	190.5	0	0	0		

### 1 MSS CBT 21057

Title: Mobile Servicing System Computer Based Training (Shared – ISS)

Duration: 15.0 hours

Medium: Computer Based Trainer

Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): Generic Robotics Training Flow or PDRS flow

Preparation: None

Synopsis:

This Computer Based Training (CBT) introduces crewmembers to the Mobile Servicing System (MSS) and the Mobile Remote Servicer Base System (MBS). The CBT is arranged such that each module builds on the previous module. Module 1 describes the MSS system components, focusing on the structure, functionality, and characteristics of each component. It also introduces MSS operations and operational considerations. Module 2 describes the components, tools, and features used to command and control the MSS. Module 3 introduces the MSS System Architectures and focuses on how they are distributed throughout the MSS during the different operational states. An understanding of the system's redundancy is also emphasized. Module 4 introduces the tools and processes used for MSS system health monitoring and failure detection, annunciation, and recovery.

- Identify MSS components and component parts.
- Define MSS capabilities.
- Identify MSS Graphical User Interface (GUI) functionality.
- Identify the coordinate frames used during MSS Operations.
- Distinguish between SSRMS Modes.
- Define MSS operational considerations.
- Describe MBS and SSRMS architectures.
- Explain the redundancy of the MSS.
- Describe health monitoring in terms of system detection versus operator detection.
- Recognize the different categories of failure annunciation.
- Describe the recovery process.

# 2 **RWS SS 21102**

Title: ISS Robotic Workstation Overview (Shared – ISS)

Duration: 2.0 hours Medium: Self Study

Note: This self study is optional.
Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): MSS CBT 21057

Preparation: None

Synopsis: This study guide will provide feedback to ensure student understanding of

the Robotic Workstation (RWS) section of the MSS SPECIFIC CBT lesson. The format is a series of questions and references to guide the student through the Computer Based Training (CBT). After working the study guide, the student will have a foundation on which the Robotic

Workstation Software (RWS SW) lesson can be built.

Objectives: • Identify the internal and external RWS components and their function(s).

• Define RWS power data, video, and thermal architectures.

Define the general role(s) of Workstation Host Software (WHS),
 Operations and Control Software (OCS), and Video Graphic Software (VGS).

Recognize the RWS power up/power down sequence.

• Identify the function of RWS in failure management.

# 3 **SSRMS D&C OV 21025**

Title: SSRMS Displays and Controls Overview (Shared – ISS)

Duration: 1.5 hours

Medium: Dynamic Skills Trainer 1 or DST 2, 3, 4, 5, 10

Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: MSS D&C OV 21025

Equipment Required: None

Prerequisite Lesson(s): MSS CBT 21057

Preparation: None

### 3 SSRMS D&C OV 21025 (Concluded)

Synopsis:

The Mobile Servicing System (MSS) Displays and Controls class introduces the student to the crew interface for the MSS. The student will become familiar with all MSS displays and controls while practicing proper scan patterns and navigation in preparation for the Canadian Space Agency (CSA) MSS Robotics Operator (MRO) course. Some commands will be sent to the MSS, but the lesson emphasis will be on the display and telemetry changes due to student input. The Graphical User Interface (GUI) images incorporated into the lesson plan are from the 15A load and will need to be revised as the loads are updated.

Objectives:

- Describe the overall MSS navigation and commanding capabilities of the MSS Operator.
- Given a specific MSS telemetry item, navigate to the proper display.

### 4 **ISS ROBO ENVIRO 21025**

Title: ISS Robotics Environment (Shared – ISS)

Duration: 2.0 hours

Medium: Dynamics Skills Trainer 1 or DST 2, 3, 4, 5, 10

Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): SSRMS D&C OV 21025

Preparation: None

Synopsis:

This lesson provides the student with an opportunity to learn the ISS environment from the perspective of the cameras available on station. Interpretation of camera cues is the most significant skill required for a robotic operator. The student will be shown the locations of the various ISS, Mobile Servicing System (MSS), and Orbiter camera ports and each of their respective views. Student handouts illustrate the location of each camera and their DCP numbers. While viewing each camera, identification of structure and orientation of both ISS Analysis Coordinate System (ISSACS) and Orbiter Body Axis System (OBAS) coordinate systems will occur. After viewing each camera, the student will be given several viewing task scenarios and will be asked to predict which cameras provide adequate or optimal views. The student will select the cameras and predict the proper pan and tilt commands needed to find the worksite or survey object. The final task is a robotic scenario for which the student must set-up the appropriate set of camera views on their workstation.

### 4 <u>ISS ROBO ENVIRO 21025 (Concluded)</u>

A 3-dimensional ISS model is used to facilitate the teaching of all training points and the tasks.

Objectives:

- Given an ISS, MSS, or Orbiter camera view, identify ISS structure in site and pan/tilt the camera to view other specific ISS landmarks.
- Describe camera selection strategy for each camera.
- Given a viewing task, identify and pan/tilt the ISS, MSS, and Orbiter cameras in the correct direction to provide the appropriate view.
- Given a robotic task, configure the ISS, MSS, and Orbiter cameras to provide the appropriate views: big picture, task, and clearance.
- Given an ISS, MSS, or Orbiter camera view, identify the correct orientation of ISSACS and OBAS command frames.

### 5 **RWS S/W OPS 21110**

Title: Robotic Workstation Software Operations (Shared – ISS)

Duration: 1.5 hours

Medium: Space Station Training Facility Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): SSRMS D&C OV 21025

Preparation: None

Synopsis:

This lesson begins with a brief overview of the external and internal components of the Robotics Workstation (RWS). Data connectivity between those components is covered. This is followed by a discussion of data connectivity between the RWS and the rest of the Mobile Servicing System (MSS). Finally, the data connectivity between the MSS and the Command and Control (C&C) Multiplexer/Demultiplexer (MDM) is discussed. The functionality of the three major software packages contained in the RWS is covered during this discussion. Those packages are Workstation Host Software (WHS), Operations and Control Software (OCS), and Video Graphic Software (VGS). A nominal workstation activation and checkout procedures are used as a template to demonstrate the correlation of software packages to hardware activation. A brief discussion of the Artificial Vision Unit (AVU), Common Video Interface Units (CVIUs), and video architecture is included for completeness. The lesson concludes with several student activities.

### 5 RWS S/W OPS 21110 (Concluded)

He/she is asked to trace the flow of data through the hardware/software for some nominal activities (applying brakes, etc.).

#### Objectives:

- Explain the functionality of the hardware components of the RWS.
- Describe the Control Electronics Unit (CEU) connectivity with other MSS components and the C&C MDM.
- Explain the high level functions of the WHS, OCS, and the VGS.
- Execute the RWS Power Up procedure.
- Execute the RWS Display and Control Panel checkout procedure.
- Execute the RWS Hand Controller checkout procedure.
- Describe the flow of data originating from the Display and Control Panel, SSRMS, and Portable Computer System (PCS) passing through various busses and software packages in the RWS.

## 6 MRO PREREQ SUM 21025

Title: MSS Robotics Operator Prerequisite Summary (Shared – ISS)

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 1 or DST 2, 3, 4, 5, 10

Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): ISS ROBO ENVIRO 21025

Preparation: None

#### Synopsis:

This lesson helps the student transition from a Generic Robotics Training (GRT) environment into the SSRMS environment. This lesson complements the prerequisite MSS CBT for the Canadian Space Agency (CSA) Mobile Servicing System (MSS) Robotics Operator (MRO) course and provides an opportunity for the student to ask questions and review the important material from the MSS CBT. The lesson discusses GRT concepts and relates them to SSRMS. The lesson will review the manual mode control algorithms, single joint motions, and frames. The student will also look at the singularities and self-collisions associated with the SSRMS. Finally, the student will perform grapple and release operations using different Latching End Effector (LEE) operation modes. At the conclusion of the lesson, the student should have a good comprehension of all prerequisite material for the MRO course.

### 6 MRO PREREQ SUM 21025 (Concluded)

Objectives:

- Describe in your own words the different coordinate frames, Frame of Resolution (FOR), Display Frame, Command Frame, and state specific SSRMS examples.
- Describe the 3 SSRMS control algorithms and their differences.
- Given an arm model, properly demonstrate SSRMS singularities and predict the Degree of Freedom (DOF) lost.
- Given an arm model and scenario, predict the correct single joint direction using the single joint mnemonics.
- Given the grapple mode, verbalize the operator actions and cues during grapple and release.

### 7 MRO PART 1 21113

Title: MSS Robotics Operator Course Part 1 (Shared – ISS)

Duration: 32.0 hours

Medium: Canadian Space Agency
Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): MRO PREREQ SUM 21025

Preparation: None

Synopsis:

This course, conducted at the Canadian Space Agency (CSA) in Saint Hubert, Quebec, is designed to provide the skills, knowledge, and attitudes associated with Mobile Servicing System (MSS) unloaded operations under nominal conditions. Lessons include: MSS Overview, System Feedback, Coordinate Frames, Camera Selection & Control, Modes & Features Selection, Arm Configuration During Motion, MSS Unloaded Operations, Singularities & Self-Collisions, and a Nominal Unloaded Exercise. At the end of this one-week course, you will be asked to complete a performance check, which is a simulation exercise designed to assess your ability to safely and efficiently operate an unloaded SSRMS, situated on the Mobile Remote Servicer Base System (MBS), under nominal conditions.

- Demonstrate situational awareness of the MSS.
- Manage nominal MSS feedback data displayed at the Robotic Workstation (RWS) to ensure the safe operation of the MSS.
- Fly SSRMS to target destinations using different command and display frames.
- Select and control cameras while flying SSRMS to a target destination.

### 7 MRO PART 1 21113 (Concluded)

- Select and implement proper modes and features for different operational tasks.
- Predict and control arm configuration during motion.
- Recognize and correctly respond to singularities, self-collision, and collision with structure.
- Maneuver SSRMS to perform nominal unloaded operations.

### 8 MRO1 PROF 1 41025

Title: MSS Robotics Operator Part 1 Proficiency 1 Mode Selection

(Shared – ISS)

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 1 or DST 2, 3, 4, 5, 10

Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): MRO PART 1 21113

Preparation: None

#### Synopsis:

This lesson is taught, as necessary, to maintain the student's proficiency between the Canadian Space Agency's (CSA) Mobile Servicing System (MSS) Robotics Operator (MRO) Part 1 and Part 2 courses. During this exercise, the learner will perform a fly-to task, where s/he must determine/strategize which modes and features would be best to use. The most important part of this lesson, apart from getting the arm to its final destination, is the discussion of the various modes and features: their advantages and limitations, applicability to different situations, and efficiency.

- Select and control cameras to always monitor and maintain clearance between the SSRMS and ISS structure.
- Correctly operate Hand Controller (HC) inputs to move the arm in the intended direction as verbalized by the operator.
- Use appropriate scan patterns.
- Given a fly-to task, select an appropriate mode and discuss alternatives.
- Determine proper mode termination procedure by applying Safing, Brakes, or selecting another mode in accordance with operational tasks.
- Select proper operational features in accordance with operational tasks.

### 9 MRO1 PROF 2 41025

Title: MSS Robotics Operator Part 1 Proficiency 2 Mode Selection

(Shared – ISS)

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 1 or DST 2, 3, 4, 5, 10

Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): MRO PART 1 21113

Preparation: None

### Synopsis:

This lesson is taught, as necessary, to maintain the student's proficiency between the Canadian Space Agency's (CSA) Mobile Servicing System (MSS) Robotics Operator (MRO) Part 1 and Part 2 courses. During this lesson, the learner will perform a fly-to task, where s/he must determine/ strategize which modes and features would be best to use to complete the task. The most important part of this lesson, apart from getting the arm to its final destination, is the discussion of the various modes and features, their advantages and limitations, applicability to different situations, and efficiency. The learner will have an opportunity to compare efficiency by performing the fly-to task twice, using different combinations of modes.

- Select and control cameras to always monitor and maintain clearance between the SSRMS and ISS structure.
- Correctly operate Hand Controller (HC) inputs to move the arm in the intended direction as verbalized by the operator.
- Use appropriate scan patterns.
- Given a fly-to task, select an appropriate mode and discuss alternatives.
- Determine proper mode termination procedure by applying Safing, Brakes, or selecting another mode in accordance with operational tasks.
- Select proper operational features in accordance with operational tasks.

### 10 **MRO1 PROF 3 41025**

Title: MSS Robotics Operator Part 1 Proficiency 3 Mode Selection

(Shared – ISS)

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 1 or DST 2, 3, 4, 5, 10

Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): MRO PART 1 21113

Preparation: None

### Synopsis:

This lesson is taught, as necessary, to maintain the student's proficiency between the Canadian Space Agency's Mobile Servicing System (MSS) Robotics Operator (MRO) Part 1 and Part 2 courses. During this exercise, the learner will perform an inspection task during which s/he must recognize and correctly respond to singularities, self-collision, and joint angle limits. It highlights Pitch Plane as an effective method to manage singularities and self-collisions, as well as locking the alternate joint when 6 Degree of Freedom (DOF) singularities are encountered. This exercise provides an opportunity for the learner to observe arm behavior and operator feedback. The learner should also make use of assessment tools, such as Self-Collision Charts and XYZ Position Grids.

- Select and control cameras to always monitor and maintain clearance between SSRMS and ISS structure.
- Select appropriate coordinate frames in accordance with dominant camera view.
- Predict arm destination based on Frame of Resolution (FOR) values and/or joint angles using model and/or XYZ Position Grids.
- Determine proper mode selection in accordance with operational tasks.
- Determine proper mode termination procedure by applying Safing, Brakes, or selecting another mode in accordance with operational tasks.
- Select appropriate operational features in accordance with operational task.
- Correctly operate Hand Controller (HC) inputs to move the arm in the intended direction as verbalized by the operator.
- Use smooth and multi-DOF HC motions.
- Demonstrate situational awareness by using available tools to avoid collision with structure.

### 10 MRO1 PROF 3 41025 (Concluded)

- Using appropriate scan patterns, observe and correctly respond to Self Collision, Singularities, and Joint Angle Limits.
- Recognize the operational conditions and warnings for imminent singularities, self-collisions, and collisions with ISS structure.
- Correctly select the appropriate SSRMS modes to recover from singularities, self-collisions, and collisions with ISS structure.

### 11 **MRO1 PROF 4 41025**

Title: MSS Robotics Operator Part 1 Proficiency 4 Mode Selection

(Shared – ISS)

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 1 or DST 2, 3, 4, 5, 10

Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): MRO PART 1 21113

Preparation: None

#### Synopsis:

This lesson is taught, as necessary, to maintain the student's proficiency between the Canadian Space Agency's (CSA) Mobile Servicing System (MSS) Robotics Operator (MRO) Part 1 and Part 2 courses. During this exercise, the learner will perform an inspection task during which s/he must recognize and correctly respond to singularities, self-collision, and joint angle limits. It emphasizes the need to predispose a joint during Frame of Resolution (FOR) Operator Controlled Auto Sequence (OCAS); working around an Elbow Pitch (EP) singularity during inspection; the use of mixed command frames during inspection; and the difference between singularity management when a joint is held versus locked. The learner should also make use of assessment tools, such as Self-Collision Charts and XYZ Position Grids.

- Select and control cameras to always monitor and maintain clearance between SSRMS and ISS structure.
- Select appropriate coordinate frames in accordance with dominant camera view.
- Predict arm destination based on FOR values and/or joint angles using model and/or XYZ Position Grids.
- Determine proper mode selection in accordance with operational tasks.

### 11 <u>MRO1 PROF 4 41025 (Concluded)</u>

- Determine proper mode termination procedure by applying Safing, Brakes, or selecting another mode in accordance with operational tasks.
- Select appropriate operational features in accordance with operational task.
- Correctly operate Hand Controller (HC) inputs to move the arm in the intended direction as verbalized by the operator.
- Use smooth and multi-Degree of Freedom (DOF) HC motions.
- Maintain situational awareness by using available tools to avoid collision with structure.
- Using appropriate scan patterns, observe and correctly respond to Self-Collision, Singularities, and Joint Angle Limits.
- Recognize the operational conditions and warnings for imminent singularities, self-collisions, and collisions with ISS structure.
- Correctly select the appropriate SSRMS modes to recover from singularities, self-collisions, and collisions with ISS structure.

### 12 **MRO1 PROF 5 41025**

Title: MSS Robotics Operator Part 1 Proficiency 5 Mode Selection

(Shared – ISS)

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 1 or DST 2, 3, 4, 5, 10

Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): MRO PART 1 21113

Preparation: None

Synopsis:

This lesson is taught, as necessary, to maintain the student's proficiency between the Canadian Space Agency's (CSA) Mobile Servicing System (MSS) Robotics Operator (MRO) Part 1 and Part 2 courses. During this exercise, the learner will perform an inspection task during which s/he must recognize and correctly respond to singularities, self-collision, and joint angle limits. It also reviews the use of mixed command frames during inspection and Pitch Plane as a method for avoiding self-collision. The learner should also make use of assessment tools, such as Self-Collision Charts and XYZ Position Grids.

### 12 MRO1 PROF 5 41025 (Concluded)

Objectives:

- Select and control cameras to always monitor and maintain clearance between the SSRMS and ISS structure.
- Select appropriate coordinate frames in accordance with dominant camera view.
- Predict arm destination based on Frame of Resolution (FOR) values and/or joint angles using model and/or XYZ Position Grids.
- Determine proper mode selection in accordance with operational tasks.
- Determine proper mode termination procedure by applying Safing, Brakes, or selecting another mode in accordance with operational tasks.
- Select appropriate operational features in accordance with operational task.
- Correctly operate Hand Controller (HC) inputs to move the arm in the intended direction as verbalized by the operator.
- Use smooth and multi-Degree of Freedom (DOF) HC motions.
- Maintain situational awareness by using available tools to avoid collision with structure.
- Using appropriate scan patterns, observe and correctly respond to Self Collision, Singularities, and Joint Angle Limits.
- Recognize the operational conditions and warnings for imminent singularities, self-collisions, and collisions with ISS structure.
- Correctly select the appropriate SSRMS modes to recover from singularities, self-collisions, and collisions with ISS structure.

### 13 **MRO1 PROF 6 41025**

Title: MSS Robotics Operator Part 1 Proficiency 6 Mode Selection

(Shared – ISS)

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 1 or DST 2, 3, 4, 5, 10

Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): MRO PART 1 21113

Preparation: None

Synopsis: This lesson is taught, as necessary, to maintain the student's proficiency

between the Canadian Space Agency's Mobile Servicing System (MSS) Robotics Operator (MRO) Part 1 and Part 2 courses. During this exercise, the learner will perform a series of fly-to tasks, each of which requires the

### 13 MRO1 PROF 6 41025 (Concluded)

learner to analyze the initial configuration of the SSRMS and strategize a trajectory, utilizing/rationalizing appropriate modes, coordinate frames and features to reach the given destination. The learner is constrained to flying all Frame of Resolution (FOR) Modes with a Locked Joint.

#### Objectives:

- Determine proper mode selection in accordance with operational tasks.
- Determine proper mode termination procedure by applying Safing, Brakes, or selecting another mode in accordance with operational tasks.
- Select appropriate coordinate frames in accordance with dominant camera view.
- Select appropriate operational features in accordance with operational tasks.
- Select and control cameras to always monitor and maintain clearance between the SSRMS and ISS structure.
- Predict arm destination based on FOR values and/or joint angles using model and/or XYZ Position Grids.
- Correctly operate Hand Controller (HC) inputs to move the arm in the intended direction as verbalized by the operator.
- Use smooth and multi-Degree of Freedom (DOF) HC motions.
- Maintain situational awareness by using available tools to avoid collision with structure.
- Using appropriate scan patterns, observe and correctly respond to Self-Collision, Singularities, and Joint Angle Limits.

### 14 **MRO1 PROF 7 41025**

Title: MSS Robotics Operator Part 1 Proficiency 7 Mode Selection

(Shared – ISS)

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 1 or DST 2, 3, 4, 5, 10

Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): MRO PART 1 21113

Preparation: None

# 14 MRO1 PROF 7 41025 (Concluded)

Synopsis:

This lesson is taught, as necessary, to maintain the student's proficiency between the Canadian Space Agency's (CSA) Mobile Servicing System (MSS) Robotics Operator (MRO) Part 1 and Part 2 courses. During this lesson, the learner will perform an inspection task, which requires the learner to analyze the initial configuration of the SSRMS and strategize a trajectory, utilizing/rationalizing appropriate modes, coordinate frames and features to reach the given destination. The learner is constrained to flying all Frames of Resolution Modes with a Locked Joint. In addition, the learner must recognize and correctly respond to Singularities, Self-Collision, and Joint Angle Limits.

#### Objectives:

- Determine proper mode selection in accordance with operational tasks.
- Determine proper mode termination procedure by applying Safing, Brakes, or selecting another mode in accordance with operational tasks.
- Select appropriate coordinate frames in accordance with dominant camera view.
- Select appropriate operational features in accordance with operational tasks.
- Select and control cameras to always monitor and maintain clearance between the SSRMS and ISS structure.
- Predict arm destination based on Frame of Resolution (FOR) values and/or joint angles using model and/or XYZ Position Grids.
- Correctly operate Hand Controller (HC) inputs to move the arm in the intended direction as verbalized by the operator.
- Use smooth and multi-Degree of Freedom (DOF) HC motions not to induce oscillations and control target positions.
- Maintain situational awareness by using available tools to avoid collision with structure or the MSS.
- Using appropriate scan patterns, observe and correctly respond to Self-Collision, Singularities, and Joint Angle Limits.

### 15 **MRO PART 2 21113**

Title: MSS Robotics Operator Course Part 2 (Shared – ISS)

Duration: 32.0 hours

Medium: Canadian Space Agency
Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: None Equipment Required: None

### 15 MRO PART 2 21113 (Concluded)

Prerequisite Lesson(s): MRO PART 1 21113

Preparation: None

Synopsis: This course is a follow-on to the Part 1 course and is designed to provide

the knowledge, skills, and attitudes associated with MSS loaded

operations under off-nominal conditions. Lessons include Part 1 Review, Effector Operations, Payload Operations, System Architecture, Failure and Recovery, and an Off-Nominal Loaded Exercise. The duration of this course is also one week, and will culminate in the performance of a final check designed to assess your ability to safely and efficiently operate the SSRMS, situated on the Mobile Remote Servicer Base System (MBS),

with an attached payload, under off-nominal conditions.

Objectives: • Perform Latching End Effector (LEE)/Payload ORU Accommodation (POA) capture and release operations.

Maneuver the payload in free space.

 Explain how the MSS System Architectures (power, thermal, data, and video) and their redundancies contribute to the operational capabilities of the MBS and SSRMS.

· Recover from MSS failure conditions.

Perform MSS loaded operations.

## 16 NBL SSRMS FAM 21027

Title: Neutral Buoyancy Lab Space Station Remote Manipulator System

Familiarization (Shared – ISS)

Duration: 1.0 hour

Medium: Neutral Buoyancy Lab

Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): MSS/EVAA SUPT2 TEAM 91016,

MSS/EVAB SUPT2 SOLO 91025

Preparation: None

Synopsis: The NBL SSRMS Familiarization lesson introduces robotic operators to

the NBL simulator. The lesson stresses the facility safety and the

differences between the hardware simulator arm and the flight equipment. An NBL technician will teach this class and cover all the pertinent safety

issues associated with this facility.

### 16 NBL SSRMS FAM 21027 (Concluded)

Objectives: • Identify the difference between the NBL SSRMS and the flight

equipment.
Explain safety issues associated with the operation of the NBL SSRMS.

### 17 <u>SSRMS SUPT TOOLS 21025</u>

Title: SSRMS Support Tools (Shared – ISS)

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 1 or DST 2, 3, 4, 5, 10

Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: MSS SUPT TOOLS 21025

Equipment Required: MSS Quick Reference Guide and SSRMS scale model;

A31p SSC with DOUG v1.6

Prerequisite Lesson(s): Robotics Fundamentals Flow

Preparation: None

Synopsis:

This lesson will introduce the student to the basic features of three situational awareness tools used to support robotic operations. This lesson is the student's first opportunity to have "hands on" use of Dynamic On-orbit Ubiquitous Graphics (DOUG) as a robotic tools, and the student will also practice using two targeting systems, the Centerline Berthing Camera System (CBCS) for mating operations to the ISS, and the Keel target for berthing operations in the Orbiter Payload Bay (PLB). Multiple exercises will be performed using each tool. This class will prepare the student for the use of these tools in the remaining classes of generic MSS training and in support of flight and increment specific training.

- Describe the DOUG functions that may be used for training or real time operations.
- Configure the DOUG tool for use in support of robotic operations.
- Interpret the misalignments seen with the CBCS as a primary targeting
- Interpret the misalignments seen with the Keel target as a secondary targeting cue.

# 18 **SSRMS SPEC INTRO 21001**

Title: SSRMS Specialist Skills Flow Introduction (Shared – ISS)

Duration: 0.5 hours
Medium: Classroom

Student: M1 (M2 support as needed.) (CB Robotics Branch Chief should be

scheduled to attend this lesson.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): SSRMS SUPT TOOLS 21025

Preparation: None

Synopsis: This lesson is used to introduce the student to the Specialist Skills Flow.

The content of each lesson and evaluation criteria is discussed. The student is provided with information of extra resources that can be utilized

during the flow to achieve maximum benefit and score in the eval.

Objectives: • Know the expectation of the flow with respect to evaluation criteria and

content of the course.

Know the resources available to students during the Spec Skills flow.

#### 19 **SSRMS REFR 21025**

Title: SSRMS Refresher
Duration: 2.0 hours (As needed.)

Medium: Dynamic Skills Trainer 1 or DST 2, 3, 4, 5, 10

Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): SSRMS SPEC INTRO 21001

Preparation: None

Synopsis: This lesson is meant to serve as a refresher of Space Station Remote

Manipulator System (SSRMS) knowledge and skills using the Dynamic Skills Trainer (DST) environment. Specific content of this lesson will be

determined by the lead instructor for the flight.

Objectives: Understand and perform the content of the lesson.

# **MSS/EVA FAM 21025**

Title: MSS/EVA Familiarization (Shared – ISS)

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 1 or DST 2, 3, 4, 5, 10

Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: None

Equipment Required: MSS Quick Reference Guide and SSRMS scale model

Prerequisite Lesson(s): SSRMS SUPT TOOLS 21025

Preparation: None

Synopsis: The lesson covers the voice protocol that is used by the crew on orbit

while supporting EVA. After a discussion of safety issues and voice protocols, the student will have practice moving the SSRMS using EVA protocol as the role played by the instructor. Typical EVA sites will be used for several exercises. *The EVA rescue task is introduced and* 

exercised at the end of the lesson.

Objectives: • *Understand* and use correct EVA Communication protocol.

 Visualize Frame of Resolution (FOR), Command Frame (CDF), and Display Frame (DYF) axes.

- Determine best combination of FOR, CDF, and DYF to achieve desired motion as simply as possible.
- Execute correct maneuvers based on EVA voice commands.
- Maintain awareness of arm configuration to ensure crew and hardware safety.

#### **MSS OPS COORD 21025**

Title: MSS Operations Coordination (Shared – ISS)

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 10 or DST 2, 3, 4, 5

Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: None

Equipment Required: MSS Quick Reference Guide and SSRMS scale model

Prerequisite Lesson(s): MSS/EVA FAM 21025

Preparation: None

# 21 MSS OPS COORD 21025 (Concluded)

Synopsis:

The lesson presents SSRMS operations in a flight-like scenario by using procedures, robotics tools, and M1 and M2 coordination. The lesson will formally introduce the roles and responsibilities of the M1 and the M2, and emphasize the importance of communication and coordination required between the M1 and the M2 during robotics operations. Several mission typical procedures will be executed with the student in either the M1 or the M2 role. Situational awareness is an important aspect of all robotics and will be enhanced in this lesson with the use of the Dynamic Onboard Ubiquitous Graphics (DOUG).

Objectives:

- Execute roles and responsibilities of the M1 and M2.
- Communicate effectively with M1 or M2, EVA, MCC, and Shuttle using voice protocols.
- Make ALL STOP calls as appropriate.
- Predict arm motion, clearances, and any other general Situational Awareness (SA) concerns for each maneuver.
- Configure camera views and robotics tools to correctly monitor clearances and maintain situational awareness, with instructor assistance.
- Execute robotics operations per procedure.
- Use DOUG as a secondary SA tool.
- Demonstrate proper hand controller technique.
- Verify system configuration using consistent technique Desat, Overlays, Cue Card, Controls, Cameras, Rates, and Mode (i.e., DOCCCRM).

#### 22 **SSRMS SPEC TSK1 21025**

Title: SSRMS Specialist Task 1 (Shared – ISS)

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 1 or DST 2, 3, 4, 5, 10

Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: MSS SPEC TASK 1 21025

Equipment Required: MSS Quick Reference Guide and SSRMS scale model

Prerequisite Lesson(s): MSS OPS COORD 21025

Preparation: None

Synopsis: This lesson exercises student skills associated with unloaded operations

using the SSRMS. Tasks include three unloaded tasks that incorporate different clearance concerns, convoluting joint clusters, and the need to Pitch Plane. Single joint, manual, and automatic arm modes can be used.

#### 22 SSRMS SPEC TSK1 21025 (Concluded)

Objectives:

- Demonstrate strong situational awareness by executing a periodic scan, maintaining more that 2 good camera views, and avoiding joint limits, singularities, and collisions.
- Identify clearance concerns by verbalizing clearance ranges and monitoring the entire arm including elbow.
- Perform tasks accurately and efficiently by strategizing using 5S technique and completing tasks within tolerance and time constraints.
- Demonstrate proper hand controller techniques by good grip, smooth ramping, and multi-axis commands.
- Manage resources efficiently and effectively by utilizing Dynamic Onboard Ubiquitous Graphics (DOUG) and communicating and coordinating with M2.
- Correctly configure the system.
- Perform operations in accordance with procedures and flight rules.

# 23 **SSRMS SELF 81025**

Title: SSRMS Self Study

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 1 or DST 2, 3, 4, 5, 10

Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): SSRMS SPEC TSK1 21025

Preparation: None

Synopsis: This self-paced lesson is used for self-study in the DSTs preparing for a

lesson or maintaining proficiency without an instructor. A variety of self-

paced exercises are available in the DSTs.

Objectives: None

# **24 SSRMS SPEC TSK2 21025**

Title: SSRMS Specialist Task 2 (Shared – ISS)

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 1 or DST 2, 3, 4, 5, 10

Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: MSS SPEC TASK 2 21025

Equipment Required: MSS Quick Reference Guide and SSRMS scale model

Prerequisite Lesson(s): SSRMS SPEC TSK1 21025

Preparation: None

Synopsis: This lesson exercises student skills associated with unloaded operations

using the SSRMS. Tasks include three unloaded tasks that incorporate different clearance concerns, convoluting joint clusters, and the need to Pitch Plane. Single-joint, manual, and automatic arm modes can be used.

Objectives:

- Demonstrate proper situational awareness by performing a constant scan pattern, maintaining 2 or more good camera views, and avoiding unexpected reach limits/singularities/self-collisions.
- Apply the 5S concept to develop a well planned strategy to arrive at the provided position and orientation within the allotted time.
- Demonstrate proper hand controller techniques through proper grip, smooth ramping of commands, and multi-axis flying.
- Demonstrate proper resource management techniques by utilizing the Dynamic Onboard Ubiquitous Graphics (DOUG) tool, communicating and coordinating with M2 and EVA for each task.
- Apply proper system management techniques to correctly configure the system for each task.
- Perform proper operations techniques by following procedures and adhering to flight rules.

# 25 **SSRMS SPEC TSK3 21025**

Title: SSRMS Specialist Task 3 (Shared – ISS)

Duration: 2.5 hours

Medium: Dynamic Skills Trainer 1 or DST 2, 3, 4, 5, 10

Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: MSS SPEC TASK 3 21025

Equipment Required: MSS Quick Reference Guide and SSRMS scale model

Prerequisite Lesson(s): SSRMS SPEC TSK2 21025

Preparation: None

## 25 SSRMS SPEC TSK3 21025 (Concluded)

Synopsis:

This lesson exercises student skills associated with loaded operations using the SSRMS. Tasks include a pre-grapple fly-to, grapple with no Latching End Effector (LEE) camera, unberth from the Orbiter Payload Bay (OPB), a loaded fly-to and ungrapple. Single-joint, manual, and automatic arm modes are used.

Objectives:

- Demonstrate proper situational awareness by performing a constant scan pattern, maintaining 2 or more good camera views, and avoiding unexpected reach limits/singularities/self-collisions.
- Identify and verbalize clearance issues for each task by consistently monitoring Elbow and the entire arm.
- Apply the 5S concept to develop a well planned strategy to arrive at the provided position and orientation within the allotted time.
- Demonstrate proper hand controller techniques through proper grip, smooth ramping of commands, and multi-axis flying.
- Demonstrate proper resource management techniques by utilizing the Dynamic Onboard Ubiquitous Graphics (DOUG) tool, communicating and coordinating with M2 for each task.
- Apply proper system management techniques to correctly configure the system for each task.
- Perform proper operational techniques by following procedures and adhering to flight rules.

#### 26 **SSRMS SPEC PRAC 21025**

Title: SSRMS Specialist *Practice* (Shared – ISS)

Duration: 3.5 hours

Medium: Dynamic Skills Trainer 1 or DST 2, 3, 4, 5, 10

Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: MSS SPEC TASK 7 21025

Equipment Required: MSS Quick Reference Guide and SSRMS scale model

Prerequisite Lesson(s): SSRMS SPEC TSK3 21025

Preparation: None

Synopsis:

This lesson is designed to exercise all previously gained knowledge and skills for operating the SSRMS in preparation for the Mobile Servicing System (MSS) Specialist Evaluation (MSS SPEC EVAL). Tasks include unloaded and loaded maneuvering of the arm, EVA support, and a timed activity. The instructor provides an assessment of skills in several skill areas, including situational awareness, hand controller techniques, system and resource management, camera usage, and task completion.

# 26 SSRMS SPEC PRAC 21025 (Concluded)

Objectives:

- Maneuver an unloaded SSRMS in various modes (manual, Single Joint (SJ), Operator Command Auto Sequence (OCAS), Pitch Plane) by determining proper direction of motion, using proper mnemonics and applying good hand controller skills so not to induce oscillations on the arm.
- Maneuver SSRMS with a large payload attached in different modes, including Manual, Joint OCAS, Frame of Resolution (FOR) OCAS safely, within flight rule constraints and without inducing oscillations.
- Apply the Latch End Effector (LEE) Cue Card appropriately during loaded operations.
- Configure camera views and robotics tools to correctly monitor clearances and maintain situational awareness, with instructor assistance.
- Execute automatic and manual LEE Operations without instructor assistance.
- Maneuver the SSRMS with EVA crewmember attached using the Robotics/EVA voice protocol and EVA commands.
- Communicate sufficiently with EVA crew and M2.
- Configure the SSRMS system properly, including loading correct files and configuring the LEE for grapple without instructor assistance.

## 27 **SSRMS SPEC EVAL 21025**

Title: SSRMS Specialist Evaluation (Shared – ISS)

Duration: 4.0 hours

Medium: Dynamic Skills Trainer 1 or 2

Student: M1 (M2 supports as needed.) (IA Required)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: MSS SPEC EVAL 21025

Equipment Required: MSS Quick Reference Guide and SSRMS scale model

Prerequisite Lesson(s): SSRMS SPEC PRAC 21025

Preparation: None

Synopsis:

The Mobile Servicing System (MSS) Evaluation is designed to exercise all previously gained knowledge and skills for operating the SSRMS. The evaluation includes unloaded and loaded maneuvering of the arm, EVA support and a timed activity. An instructor and an Instructor Astronaut (IA) perform the evaluation. Several skill areas are evaluated, including situational awareness, hand controller techniques, system and resource management, camera usage, and task completion.

# 27 SSRMS SPEC EVAL 21025 (Concluded)

Objectives:

- Maneuver an unloaded SSRMS in various modes (manual, Single Joint (SJ), Operator Command Auto Sequence (OCAS), Pitch Plane) by determining proper direction of motion, using proper mnemonics and applying good hand controller skills so not to induce oscillations on the arm.
- Maneuver SSRMS with a large payload attached in different modes, including Manual, Joint OCAS, Frame of Resolution (FOR) Operator Command Auto Sequence (OCAS) safely, within flight rule constraints and without inducing oscillations.
- Apply Latch End Effector (LEE) Cue Card appropriately during loaded operations.
- Maintain situational awareness and clearance monitoring by selecting and adjusting appropriate camera views during tasks.
- Perform automatic and manual LEE Operations without instructor assistance.
- Maneuver the SSRMS with EVA crewmember attached using the Robotics/EVA voice protocol and EVA commands.
- Communicate sufficiently with the EVA crew and M2.
- Configure the SSRMS system properly, including loading correct files and configuring the LEE for grapple without instructor assistance.

## **MSS/EVA SUPT OV 91001**

Title: MSS EVA Support Overview (Shared – ISS)

Duration: 2.0 hours Medium: Classroom

Student: EV1, EV2, IV, M1, M2

Source: DX23/Station Mechanical & Robotics

Date: 09/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): EVA1 92027 (EVA OPS), EVA2 92027 (EVA OPS)

Preparation: None

Synopsis:

The Mobile Servicing System (MSS) EVA Support Overview lesson provides an overview of all SSRMS-supported EVAs for the flight/increment. Photos, Dynamic Onboard Ubiquitous Graphics (DOUG) and other media are used to familiarize students with each of the EVAs. The focal point of the lesson hinges on a discussion of SSRMS support of the EVAs, highlighting the importance of team resource coordination. In addition, the lesson presents an overview of SSRMS configurations, a discussion of clearance and camera viewing issues and, finally, Ground

## 28 MSS/EVA SUPT OV 91001 (Concluded)

Control Assist (GCA) protocol is addressed. This lesson is led by the Robotics Instructor and supported by Robotics and EVA Flight Control Leads. It is desired to have both Crews (ISS and Shuttle) present. At a minimum, the designated M1, M2, IV, EV1, and EV2 must be present.

#### Objectives:

- Identify the MSS configurations and maneuvers during all EVA timelines, including any associated clearance issues.
- Explain standard communication protocol with IV, EVA crew, and M2 specific to all EVA timelines.
- Describe EVA Ground Control Approach (GCA) command preferences based on EV1/EV2/IV's experiences from the initial NBL runs for each timeline.

## MSS/EVAA SUPT1 SOLO 91025

Title: MSS EVAA Support 1 with Solo M1 (Shared – ISS)

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 1 or DST 2, 3, 4, 5, 10

Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): MSS/EVA SUPT OV 91001

Preparation: None

#### Synopsis:

The Mobile Servicing System (MSS) EVAA Support 1 with Solo M1 lesson provides the Crew with an initial opportunity to gain situational awareness by exploring the trajectories, arm configurations, telemetry monitoring, clearances, and camera views associated with EVAA. The lesson emphasizes familiarity with the task and its nuances. The lesson concludes with a summary of the lesson activities and an informal skill review. M1 and M2 each take this lesson individually (solo) and operate from the M1 position. Flight procedures are used and the instructor role-plays M2, IV, EV1 and/or EV2.

- Configure camera views to correctly monitor clearances and maintain situational awareness.
- Identify clearance issues for the MSS configurations and maneuvers during this EVA timeline.
- Identify limiting SSRMS configurations, such as reach limits, singularities, and self-collisions, encountered throughout this EVA timeline.

# 29 MSS/EVAA SUPT1 SOLO 91025 (Concluded)

- Accurately maneuver the SSRMS with an EVA crewmember attached, using the Robotics/EVA voice protocol and EVA commands while maintaining situational awareness.
- List effective Ground Control Approach (GCA) communication among the crew, M1, M2, EV1, EV2, and IV, including but not limited to: direction, magnitude, verification, motion initiation, and all-stop for each task in the EVA timeline.
- Explain SSRMS limitations and capabilities for joint locked and joint held algorithms.
- Correctly configure the SSRMS system, including loading correct files without instructor assistance.
- Maneuver the SSRMS for each task in accordance with flight rules.
- Configure the Robotics Workstation (RWS) to ensure safe and efficient operations, including overlays, caution and warning summary page, MSS discrete log, and Dynamic Onboard Ubiquitous Graphics (DOUG).

#### 30 MSS/EVAA SUPT2 TEAM 91016

Title: MSS EVAA Support 2 for Team (Shared – ISS)

Duration: 3.0 hours

Medium: Virtual Reality Trainer Student: EV1, EV2, IV, M1, M2

Source: DX23/Station Mechanical & Robotics

Date: 09/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): MSS/EVAA SUPT1 SOLO 91025

Preparation: None

Synopsis:

The Mobile Servicing System (MSS) EVAA Support 2 for Team is the first simulator lesson with M1, M2, IV, EV1, and EV2 working together in their designated positions for EVAA. The focus of this lesson is group coordination and communication (i.e., Space Flight Resource Management (SFRM)). By the end of this lesson, a Ground Control Assist (GCA) protocol is established. M1 and M2 operate from their designated positions, EV crew are in Virtual Reality (VR) helmets, and IV performs his/her designated tasks. All participants communicate via head-sets. The instructor role-plays any other crew as needed, to include controlling shuttle cameras. This lesson prepares M1/M2/IV/EV for the next NBL run. The lesson concludes with a review of the session's events, and addresses participants' strengths and weaknesses during the execution of those tasks.

#### 30 MSS/EVAA SUPT2 TEAM 91016 (Concluded)

Objectives:

- Configure camera views to correctly monitor clearances and maintain situational awareness.
- Explain clearance issues for the MSS configurations and maneuvers during this EVA timeline.
- Explain limiting SSRMS configurations, such as reach limits, singularities, and self-collisions, encountered throughout this EVA timeline.
- Accurately maneuver the SSRMS with an EVA crewmember attached, using the Robotics/EVA voice protocol and EVA commands while maintaining situational awareness.
- Explain and use effective Ground Control Approach (GCA) communication among the crew, M1, M2, EV1, EV2, and IV, including but not limited to: direction, magnitude, verification, motion initiation, and all-stop for each task in the EVA timeline.
- Explain SSRMS limitations and capabilities for joint locked and joint held algorithms.
- Correctly configure the SSRMS system, including loading correct files without instructor assistance.
- Maneuver the SSRMS for each task in accordance with flight rules.
- Configure the Robotics Workstation (RWS) to ensure safe and efficient operations including overlays, caution and warning summary page, MSS discrete log, and Dynamic Onboard Ubiquitous Graphics (DOUG).

# 31 MSS/EVAB SUPT1 SOLO 91025

Title: MSS EVAB Support 1 with Solo M1 (Shared – ISS)

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 1 or DST 2, 3, 4, 5, 10

Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): MSS/EVA SUPT OV 91001

Preparation: None

# 31 MSS/EVAB SUPT1 SOLO 91025 (Concluded)

## Synopsis:

The Mobile Servicing System (MSS) EVAB Support 1 with Solo M1 lesson provides the Crew with an initial opportunity to gain situational awareness by exploring the trajectories, arm configurations, telemetry monitoring, clearances, and camera views associated with EVAB. The focus for the lesson is trajectory exploration and nuances. The lesson concludes with a summary of the lesson activities and an informal skill review. M1 and M2 each take this lesson individually (Solo) and operate from the M1 position. Flight procedures are used and the instructor role-plays M2, IV, EV1 and/or EV2.

- Configure camera views to correctly monitor clearances and maintain situational awareness.
- Identify clearance issues for the MSS configurations and maneuvers during this EVA timeline.
- Identify limiting SSRMS configurations, such as reach limits, singularities, and self-collisions, encountered throughout this EVA timeline.
- Accurately maneuver the SSRMS with an EVA crewmember attached, using the Robotics/EVA voice protocol and EVA commands while maintaining situational awareness.
- List effective Ground Control Approach (GCA) communication among the crew, M1, M2, EV1, EV2, and IV, including but not limited to: direction, magnitude, verification, motion initiation, and all-stop for each task in the EVA timeline.
- Explain SSRMS limitations and capabilities for joint locked and joint held algorithms.
- Correctly configure the SSRMS system, including loading correct files without instructor assistance.
- Maneuver the SSRMS for each task in accordance with flight rules.
- Configure the Robotics Workstation (RWS) to ensure safe and efficient operations, including overlays, caution and warning summary page, MSS discrete log, and Dynamic Onboard Ubiquitous Graphics (DOUG).

# 32 MSS/EVAB SUPT2 SOLO 91025

Title: MSS EVAB Support 2 with Solo M1 (Shared – ISS)

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 1 or DST 2, 3, 4, 5, 10

Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): MSS/EVAB SUPT1 SOLO 91025

Preparation: None

Synopsis:

The Mobile Servicing System (MSS) EVAB Support 2 with Solo M1 lesson provides the crewmember with another opportunity to explore the trajectories, clearances, and camera views associated with EVAB. This lesson prepares MSS crewmembers for the next NBL run. The lesson concludes with a summary of the lesson activities and an informal skill review. M1 and M2 each take this lesson individually (Solo) and operate from the M1 position. Flight procedures are used and the instructor role-plays M2, IV, EV1 and/or EV2.

- Configure camera views to correctly monitor clearances and maintain situational awareness.
- Explain clearance issues for the MSS configurations and maneuvers during this EVA timeline.
- Explain limiting SSRMS configurations, such as reach limits, singularities, and self-collisions, encountered throughout this EVA timeline.
- Accurately maneuver the SSRMS with an EVA crewmember attached, using the Robotics/EVA voice protocol and EVA commands while maintaining situational awareness.
- Explain and use effective Ground Control Approach (GCA)
  communication among the crew, M1, M2, EV1, EV2, and IV, including
  but not limited to: direction, magnitude, verification, motion initiation,
  and all-stop for each task in the EVA timeline.
- Explain SSRMS limitations and capabilities for joint locked and joint held algorithms.
- Correctly configure the SSRMS system, including loading correct files without instructor assistance.
- Maneuver the SSRMS for each task in accordance with flight rules.
- Configure the Robotics Workstation (RWS) to ensure safe and efficient operations, including overlays, caution and warning summary page, MSS discrete log, and Dynamic Onboard Ubiquitous Graphics (DOUG).

# 33 MSS/EVAA SUPT3 SOLO 91025

Title: MSS EVAA Support 3 with Solo M1 (Shared – ISS)

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 1 or DST 2, 3, 4, 5, 10

Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): NBL SSRMS FAM 21027, EVA1 93027 (EVA OPS)

Preparation: None

Synopsis:

The Mobile Servicing System (MSS) EVAA Support 3 with Solo M1 lesson provides the crew with another opportunity to explore the trajectories, clearances, and camera views associated with EVAA. M1 and M2 each take this lesson individually (Solo) and operate from the M1 position. Flight procedures are used and the instructor role-plays M2, IV, EV1 and/or EV2. This lesson prepares the MSS crew for the next NBL run. The lesson concludes with a summary of the lesson activities and an informal skill review.

- Configure camera views to correctly monitor clearances and maintain situational awareness.
- Accurately maneuver the SSRMS with an EVA crewmember attached, using the Robotics/EVA voice protocol and EVA commands while maintaining clearance and managing reach limits, singularities, and self-collisions.
- Use effective Ground Control Approach (GCA) communication among the crew, M1, M2, EV1, EV2, and IV, including but not limited to: direction, magnitude, verification, motion initiation, and all-stop for each task in the EVA timeline.
- Correctly configure the SSRMS system, including loading correct files without instructor assistance.
- Maneuver the SSRMS for each task in accordance with flight rules.
- Configure the Robotics Workstation (RWS) to ensure safe and efficient operations, including overlays, caution and warning summary page, MSS discrete log, and Dynamic Onboard Ubiquitous Graphics (DOUG).

# 34 MSS/EVAB SUPT3 M1M2 91025

Title: MSS EVAB Support 3 for M1M2 (Shared – ISS)

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 1 or DST 2, 3, 4, 5, 10

Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): NBL SSRMS FAM 21027, EVA2 93027 (EVA OPS)

Preparation: None

Synopsis: The focus of the Mobile Servicing System (MSS) EVAB Support 3 for

M1M2 lesson is M1/M2 coordination (i.e., Space Flight Resource

Management (SFRM)). This is the first simulator lesson with the M1 and M2 working together in their designated positions for EVAB. Flight procedures are used and the tasks are flown as flight-like as possible, with the instructor role-playing EV and IV. This lesson prepares M1 and M2 for

the next NBL run. The lesson concludes with a summary of the lesson

activities and an informal skill review.

- Configure camera views to correctly monitor clearances and maintain situational awareness.
- Accurately maneuver the SSRMS with an EVA crewmember attached, using the Robotics/EVA voice protocol and EVA commands while maintaining clearance and managing reach limits, singularities, and self-collisions.
- Use effective Ground Control Approach (GCA) communication among the crew, M1, M2, EV1, EV2, and IV, including but not limited to: direction, magnitude, verification, motion initiation, and all-stop for each task in the EVA timeline.
- Correctly configure the SSRMS system, including loading correct files without instructor assistance.
- Maneuver the SSRMS for each task in accordance with flight rules.
- Configure the Robotics Workstation (RWS) to ensure safe and efficient operations, including overlays, caution and warning summary page, MSS discrete log, and Dynamic Onboard Ubiquitous Graphics (DOUG).

# 35 MSS/EVAA SUPT4 SOLO 91025

Title: MSS EVAA Support 4 with Solo M1 (Shared – ISS)

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 1 or DST 2, 3, 4, 5, 10

Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): MSS/EVAA SUPT3 SOLO 91025

Preparation: None

Synopsis:

The Mobile Servicing System (MSS) EVAA Support 4 with Solo M1 lesson provides the crew with yet another opportunity to explore the trajectories, clearances, and camera views associated with EVAA. Since this is the fourth time to see EVAA MSS activities, off-nominal scenarios are explored during this lesson. The off-nominal scenarios are at the discretion of the instructor and may include: camera failure(s), different joint lock/held algorithm, vastly different EV body positions, etc. M1 and M2 each take this lesson individually (Solo) and operate from the M1 position. The instructor role-plays M2, EV, and IV. Flight procedures are used.

- Configure camera views to correctly monitor clearances and maintain situational awareness.
- Accurately maneuver the SSRMS with an EVA crewmember attached, using the Robotics/EVA voice protocol and EVA commands while maintaining clearance and managing reach limits, singularities, and self-collisions.
- Use effective Ground Control Approach (GCA) communication among the crew, M1, M2, EV1, EV2, and IV, including but not limited to: direction, magnitude, verification, motion initiation, and all-stop for each task in the EVA timeline.
- Correctly configure the SSRMS system, including loading correct files without instructor assistance.
- Maneuver the SSRMS for each task in accordance with flight rules.
- Configure the Robotics Workstation (RWS) to ensure safe and efficient operations, including overlays, caution and warning summary page, MSS discrete log, and Dynamic Onboard Ubiquitous Graphics (DOUG).

## 36 MSS/EVAB SUPT4 TEAM 91016

Title: MSS EVAB Support 4 for Team (Shared – ISS)

Duration: 3.0 hours

Medium: Virtual Reality Trainer Student: EV1, EV2, IV, M1, M2

Source: DX23/Station Mechanical & Robotics

Date: 09/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): MSS/EVAB SUPT3 M1M2 91025

Preparation: None

Synopsis: The Mobile Servicing System (MSS) EVAB Support 4 for Team lesson is

the first simulator lesson with M1, M2, IV, EV1, and EV2 working together in their designated positions for EVAB. The focus for this lesson is group coordination Space Flight Resource Management (SFRM). By the end of the lesson, a Ground Command Assist (GCA) protocol is established. M1 and M2 operate from their designated positions; EV crewmembers are in Virtual Reality (VR) helmets. The lesson concludes with a summary of the lesson activities and an informal skill review. All participants communicate via head-sets. The instructor adjusts Shuttle cameras if needed. This

lesson prepares M1/M2/IV/EV1/EV2 for the next NBL run.

**Note:** For Stage EVAs, M2 and IV are the responsibility of the ground MCC team

and are role-played during this session.

- Configure camera views to correctly monitor clearances and maintain situational awareness.
- Accurately maneuver the SSRMS with an EVA crewmember attached, using the Robotics/EVA voice protocol and EVA commands while maintaining clearance and managing reach limits, singularities, and self-collisions.
- Use effective Ground Control Approach (GCA) communication among the crew, M1, M2, EV1, EV2, and IV, including but not limited to: direction, magnitude, verification, motion initiation, and all-stop for each task in the EVA timeline.
- Correctly configure the SSRMS system, including loading correct files without instructor assistance.
- Maneuver the SSRMS for each task in accordance with flight rules.
- Configure the Robotics Workstation (RWS) to ensure safe and efficient operations, including overlays, caution and warning summary page, MSS discrete log, and Dynamic Onboard Ubiquitous Graphics (DOUG).

# 37 MSS/EVAA SUPT5 M1M2 91016

Title: MSS EVAA Support 5 for M1M2 (Shared – ISS)

Duration: 2.0 hours

Medium: Virtual Reality Trainer

Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): MSS/EVAA SUPT4 SOLO 91025

Preparation: None

Synopsis:

The Mobile Servicing System (MSS) EVAA Support 5 for M1M2 lesson is the second simulator lesson with the M1 and M2 working together in their designated positions for EVAA. The focus for this lesson is M1/M2 coordination (Space Flight Resource Management (SFRM)). The lesson also provides crewmembers an opportunity to become proficient with camera commanding and camera configuration. The lesson uses current Flight procedures, and the tasks are flown as flight-like as possible, with the instructor role-playing EV and IV. This lesson prepares M1 and M2 for the next NBL run. At the end of this lesson, crew are comfortable and efficient with this timeline.

- Configure camera views to correctly monitor clearances and maintain situational awareness.
- Accurately maneuver the SSRMS with an EVA crewmember attached, using the Robotics/EVA voice protocol and EVA commands while maintaining clearance and managing reach limits, singularities, and self-collisions.
- Use effective Ground Control Approach (GCA) communication among the crew, M1, M2, EV1, EV2, and IV, including but not limited to: direction, magnitude, verification, motion initiation, and all-stop for each task in the EVA timeline.
- Correctly configure the SSRMS system, including loading correct files without instructor assistance.
- Maneuver the SSRMS for each task in accordance with flight rules.
- Configure the Robotics Workstation (RWS) to ensure safe and efficient operations, including overlays, caution and warning summary page, MSS discrete log, and Dynamic Onboard Ubiquitous Graphics (DOUG).

# 38 MSS/EVAB SUPT5 M1M2 91025

Title: MSS EVAB Support 5 for M1M2 (Shared – ISS)

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 1 or DST 2, 3, 4, 5, 10

Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): MSS/EVAB SUPT4 TEAM 91016, EVA2 95027 (EVA OPS)

Preparation: None

Synopsis:

The Mobile Servicing System (MSS) EVAB Support 5 for M1M2 lesson has M1 and M2 working together in their designated positions for part of the tasks, and then switching positions. This gives the "real" M1 his/her only opportunity to work as the M2 for EVAB. The lesson concludes with a summary of the lesson activities and an informal skill review. Flight procedures are used and the tasks are flown as flight-like as possible, with the instructor role-playing EV and IV.

- Configure camera views to correctly monitor clearances and maintain situational awareness.
- Accurately maneuver the SSRMS with an EVA crewmember attached, using the Robotics/EVA voice protocol and EVA commands while maintaining clearance and managing reach limits, singularities, and self-collisions.
- Use effective Ground Control Approach (GCA) communication among the crew, M1, M2, EV1, EV2, and IV, including but not limited to: direction, magnitude, verification, motion initiation, and all-stop for each task in the EVA timeline.
- Correctly configure the SSRMS system, including loading correct files without instructor assistance.
- Maneuver the SSRMS for each task in accordance with flight rules.
- Configure the Robotics Workstation (RWS) to ensure safe and efficient operations, including overlays, caution and warning summary page, MSS discrete log, and Dynamic Onboard Ubiquitous Graphics (DOUG).

# 39 MSS/EVAA SUPT6 M1M2 91025

Title: MSS EVAA Support 6 for M1M2 (Shared – ISS)

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 1 or DST 2, 3, 4, 5, 10

Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): MSS/EVAA SUPT5 M1M2 91016, EVA1 95027 (EVA OPS)

Preparation: None

Synopsis:

The Mobile Servicing System (MSS) EVAA Support 6 for M1M2 lesson has M1 and M2 working together in their designated positions for part of the tasks, and will swap positions for the remainder of the session. This gives the "real" M1 his/her only opportunity to work as the M2 for EVAA. Flight procedures are used and the tasks are flown as flight-like as possible, with the instructor role-playing EV and IV. The lesson concludes with a summary of the lesson activities and an informal skill review.

- Configure camera views to correctly monitor clearances and maintain situational awareness.
- Accurately maneuver the SSRMS with an EVA crewmember attached, using the Robotics/EVA voice protocol and EVA commands while maintaining clearance and managing reach limits, singularities, and self-collisions.
- Use effective Ground Control Approach (GCA) communication among the crew, M1, M2, EV1, EV2, and IV, including but not limited to: direction, magnitude, verification, motion initiation, and all-stop for each task in the EVA timeline.
- Correctly configure the SSRMS system, including loading correct files without instructor assistance.
- Maneuver the SSRMS for each task in accordance with flight rules.
- Configure the Robotics Workstation (RWS) to ensure safe and efficient operations, including overlays, caution and warning summary page, MSS discrete log, and Dynamic Onboard Ubiquitous Graphics (DOUG).

## 40 MSS/EVAB SUPT6 TEAM 91016

Title: MSS EVAB Support 6 for Team (Shared – ISS)

Duration: 3.0 hours

Medium: Virtual Reality Trainer Student: EV1, EV2, IV, M1, M2

Source: DX23/Station Mechanical & Robotics

Date: 09/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): MSS/EVAB SUPT5 M1M2 91025

Preparation: None

Synopsis:

This is the final Mobile Servicing System (MSS) lesson for EVAB. It is desired to have the entire team (ISS and Shuttle) present. At a minimum, the designated M1, M2, IV, EV1, and EV2 must be present. M1 and M2 operate from their designated positions; EV crewmembers are in Virtual Reality (VR) helmets. All participants communicate via head-sets. It is desired to have the actual Shuttle camera operator present. Flight procedures are used and the tasks are flown as flight-like as possible. The lesson concludes with a summary of the lesson activities and an informal skill review.

- Configure camera views to correctly monitor clearances and maintain situational awareness.
- Accurately maneuver the SSRMS with an EVA crewmember attached, using the Robotics/EVA voice protocol and EVA commands while maintaining clearance and managing reach limits, singularities, and self-collisions.
- Use effective Ground Control Approach (GCA) communication among the crew, M1, M2, EV1, EV2, and IV, including but not limited to: direction, magnitude, verification, motion initiation, and all-stop for each task in the EVA timeline.
- Correctly configure the SSRMS system, including loading correct files without instructor assistance.
- Maneuver the SSRMS for each task in accordance with flight rules.
- Configure the Robotics Workstation (RWS) to ensure safe and efficient operations, including overlays, caution and warning summary page, MSS discrete log, and Dynamic Onboard Ubiquitous Graphics (DOUG).

## 41 MSS/EVAA SUPT7 TEAM 91016

Title: MSS EVAA Support 7 for Team (Shared – ISS)

Duration: 3.0 hours

Medium: Virtual Reality Trainer Student: EV1, EV2, IV, M1, M2

Source: DX23/Station Mechanical & Robotics

Date: 09/04

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): MSS/EVAA SUPT6 M1M2 91025

Preparation: None

Synopsis: The Mobile Servicing System (MSS) EVAA Support 7 for Team session

prepares the crew for the final NBL run of this EVAA timeline. It is desired to have entire the Crew (ISS and Shuttle) present. At a minimum, the designated M1, M2, IV, EV1, and EV2 must be present. M1 and M2 will operate from their designated positions; EV crew are in Virtual Reality (VR) helmets. All participants communicate via head-sets. It is desired to have the actual Shuttle camera operator present. Flight procedures are used and the tasks are flown as flight-like as possible. The lesson concludes with a summary of the lesson activities and an informal skill

review.

**Note:** The next NBL run is assumed to be the final EVA1 NBL run in the ISS

EVA flow.

- Configure camera views to correctly monitor clearances and maintain situational awareness.
- Accurately maneuver the SSRMS with an EVA crewmember attached, using the Robotics/EVA voice protocol and EVA commands while maintaining clearance and managing reach limits, singularities, and self-collisions.
- Use effective Ground Control Approach (GCA) communication among the crew, M1, M2, EV1, EV2, and IV, including but not limited to: direction, magnitude, verification, motion initiation, and all-stop for each task in the EVA timeline.
- Correctly configure the SSRMS system, including loading correct files without instructor assistance.
- Maneuver the SSRMS for each task in accordance with flight rules.
- Configure the Robotics Workstation (RWS) to ensure safe and efficient operations, including overlays, caution and warning summary page, MSS discrete log, and Dynamic Onboard Ubiquitous Graphics (DOUG).

# **TPS OBSS OPS1 91025**

Title: Tile Protection System Orbiter Boom Sensor System Operations 1

Solo (Shared – ISS)

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 1 or DST 2, 3, 4, 5, 10

Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: MSS TPS OBSS OPS1 91025
Equipment Required: Flight-specific procedures

Prerequisite Lesson(s): None

Preparation: None

Synopsis: The Mobile Servicing System (MSS) Tile Protection System (TPS) Orbiter

Boom Sensor System (OBSS) Operations 1 lesson focuses on the SSRMS procedures used for OBSS grapple, unberth, and handoff to

SRMS, as well as the reberth into the Manipulator Positioning Mechanisms (MPMs). The crewmember will execute the flight procedures. The M1 and M2 for this task will complete this class

individually.

Objectives: • Perform OBSS grapple, unberth, and maneuver to handoff position.

Perform the OBSS handoff to the SRMS.

Interpret the visual cues used to berth the OBSS into the MPMs.

Perform the OBSS berthing.

# 43 TPS OBSS OPS2 91025

Title: TPS OBSS Operations 2 (Shared – ISS)

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 1 or DST 2, 3, 4, 5, 10

Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: MSS TPS OBSS OPS2 91016

Equipment Required: Flight-specific procedures, MSS Quick Reference Guide,

SSRMS Model (1/50th scale)

Prerequisite Lesson(s): TPS OBSS OPS1 91025

Preparation: None

# 43 TPS OBSS OPS2 91025 (Concluded)

Synopsis: The Mobile Servicing System (MSS) Tile Protection System (TPS) Orbiter

Boom Sensor System (OBSS) Operations 2 lesson allows the MSS specialists (M1 and M2) to work on coordination for SSRMS tasks related to the OBSS boom. The M1/M2 team will complete OBSS unberth,

handoff, and berth operations using procedures.

Objectives: • Perform OBSS grapple, unberth, handoff to the SRMS and reberth.

Perform Space Flight Resource Management (SFRM) for OBSS

operations.

#### 44 TPS OBSS H/O 91069

Title: Tile Protection System Orbiter Boom Sensor System Handoff

(Shared – ISS)

Duration: 3.0 hours

Medium: Virtual Reality Trainer or SESD

**Note:** Schedule in SESD only.

Student: M1, M2, R1, R2

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: MSS TPS OBSS H/O 91069

Equipment Required: SSRMS model (1/50th scale), MSS Quick Reference Guide,

flight-specific procedures

Prerequisite Lesson(s): TPS OBSS OPS2 91025

Preparation: None

**Note:** This lesson is cross listed with PDRS.

Synopsis: The Mobile Servicing System (MSS) Tile Protection System (TPS) Orbiter

Boom Sensor System (OBSS) Handoff lesson focuses on coordination between the Station and Shuttle crew for the OBSS handoff and survey operations. The crew will execute the joint procedures for this timeline, including OBSS handoff to the SRMS, survey operations with SSRMS viewing operations, and handoff to the SSRMS. The lesson will be conducted with M1, M2, R1, and R2 in the Systems Engineering Simulator

conducted with M1, M2, R1, and R2 in the Systems Engineering Simulator

(SES).

Objectives: • Perform OBSS handoff from SSRMS to SRMS.

 Perform viewing operations and camera support during a portion of the OBSS surveys by SRMS.

- Perform OBSS handoff from SRMS to SSRMS.
- Perform dual arm operations Space Flight Resource Management (SFRM) skills for OBSS tasks.

# 45 **TPS OBSS OPS3 91025**

Title: TPS OBSS Operations 3 (Shared – ISS)

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 1 or DST 2, 3, 4, 5, 10

Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: None

Equipment Required: SSRMS model (1/50th scale), MSS Quick Reference Guide,

flight-specific procedures

Prerequisite Lesson(s): TPS OBSS H/O 91069

Preparation: None

Synopsis: The Mobile Servicing System (MSS) Tile Protection System (TPS) Orbiter

Boom Sensor System (OBSS) Operations 3 lesson allows the MSS specialists (M1 and M2) to work on coordination for Space Station Robotics Manipulator System (SSRMS) tasks related to the OBSS boom. The M1/M2 team will complete the OBSS unberth, handoff, and berth

operations using procedures.

Objectives: • Perform OBSS grapple, unberth, handoff to the Shuttle Remote

Manipulator System (SRMS), and reberth.

• Perform Space Flight Resource Management (SFRM) for OBSS

operations.

#### **46** TPS **OBSS** MISSION 91016

Title: Tile Protection System OBSS Mission (Shared – ISS)

Duration: 2.0 hours

Medium: Virtual Reality Trainer

Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: MSS TPS MISSION 91016

Equipment Required: SSRMS model (1/50th scale), MSS Quick Reference Guide,

flight-specific procedures

Prerequisite Lesson(s): TPS OBSS H/O 91069, EVA CONT 91027 (EVA OPS)

Preparation: None

Synopsis: This Mobile Servicing System (MSS) Tile Protection System (TPS)

Mission lesson provides the final training session for the M1 and M2 crewmembers to review all the SSRMS procedures associated with tile  $\frac{1}{2}$ 

inspection and repair while finalizing their Space Flight Resource

Management (SFRM) teamwork skills. It will also be the final opportunity

## 46 TPS MISSION 91016 (Concluded)

for the M1 and M2 operators to review any potential Thermal Protection System (TPS) scenarios, including Orbiter Boom Sensor System (OBSS) handoff operations, Orbiter Repair Maneuver (ORM) monitoring, or EVA repair scenarios.

Objectives:

- Execute procedures related to OBSS operations, ORM monitoring, and EVA tile repair.
- Demonstrate SFRM skills associated with tile inspection and repair tasks.

#### 47 <u>EL NOM INSTL 1 31025</u>

Title: Element Nominal Installation #1 (Shared – ISS)

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 1 or DST 2, 3, 4, 5, 10

Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): MSS SPEC EVAL 21025

Preparation: None

Synopsis:

The Mobile Servicing System (MSS) Element Nominal Installation #1 lesson provides an initial exposure to the installation task and procedures for a specific element planned for an increment or flight. During this lesson, the student will unberth the element from the payload bay or accept a handoff from SRMS, translate the element to various points (low hover, premate, capture envelope, etc.), and then mate the element to the ISS. The unberth and mate will be nominal and allow the use of tools, such as Dynamic Onboard Ubiquitous Graphics (DOUG) and Robotics Situational Awareness Display (RSAD).

- Execute a nominal unberth/handoff, translate, and mate for the main element.
- Use the task-specific command frames, display frames, and Frames of Resolution (FOR) for the main element.
- Identify generic and element-specific flight rules associated with nominal operations.
- Describe unberthing/mating interfaces and associated system feedback for the main element.
- Describe the end-to-end process associated with unberthing and mating the main element.

## 47 EL NOM INSTL 1 31025 (Concluded)

- Describe the operational constraints and limitations to the specific planned task, including the unberthing and mating corridors, visual cues, available robotics tools, etc.
- Communicate effectively with Shuttle and M2 using voice protocols.
- Configure camera views and robotics tools to correctly monitor clearances and maintain situational awareness, with instructor assistance.
- Apply correct hand controller techniques as required for the specific task.

# **EL NOM INSTL 2 32115**

Title: Element Nominal Installation #2 (Shared – ISS)

Duration: 2.0 hours

Medium: Multiuse Remote Manipulator Development Facility

Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): *EL NOM INSTL 1 31025* 

Preparation: None

#### Synopsis:

The Mobile Servicing System (MSS) Element Nominal Installation #2 lesson provides the M1 and M2 an opportunity to practice the installation of a specific element. During this lesson, the student will start grappled to an element and translate the element to various points (low hover, premate, capture envelope, etc.), and then mate the element to the ISS. The unberth and mate will be nominal and allow the use of tools, such as Dynamic Onboard Ubiquitous Graphics (DOUG) and Robotics Situational Awareness Display (RSAD). This lesson utilizes the hardware facility to emphasize the need to avoid structural contact and real camera use (focus iris zoom).

- Execute a nominal unberth/handoff, translate, and mate for the main element.
- Use the task-specific command frames, display frames, and Frames of Resolution (FOR) for the main element.
- Identify generic and element-specific flight rules associated with nominal operations.
- Describe unberthing/mating interfaces and associated system feedback for the main element.

## 48 EL NOM INSTL 2 32115 (Concluded)

- Describe the end-to-end process associated with unberthing and mating the main element.
- Describe the operational constraints and limitations to the specific planned task, including the unberthing and mating corridors, visual cues, available robotics tools, etc.
- Communicate effectively with Shuttle and M2 using voice protocols.
- Configure camera views and robotics tools to correctly monitor clearances and maintain situational awareness, with instructor assistance.
- Apply correct hand controller techniques as required for the specific task.
- Demonstrate proper facility-specific camera management during the operation.

#### **49** EL NOM INSTL 3 93016

Title: Element Nominal Installation #3 (Shared – ISS)

Duration: 3.0 hours

Medium: Virtual Reality Trainer

Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): EL NOM INSTL 2 32115

Preparation: None

Synopsis:

The Mobile Servicing System (MSS) Element Nominal Installation #3 lesson provides another opportunity for the M1 and M2 to practice the procedures for a main element installation task planned for an increment or flight. During this lesson, the M1 will grapple an element and translate the element to various points (low hover, premate, capture envelope, etc.), and then mate the element to the ISS. The M2 will provide support during the task. The unberth and mate will be nominal and allow the use of tools, such as Dynamic Onboard Ubiquitous Graphics (DOUG) and Robotics Situational Awareness Display (RSAD). Using the Virtual Reality Lab allows the session to integrate Shuttle Robotics and EVA crew if appropriate.

- Execute a nominal unberth/handoff, translate, and mate for the main element.
- Use the task-specific command frames, display frames, and Frames of Resolution (FOR) for the main element.

## 49 EL NOM INSTL 3 93016 (Concluded)

- Identify generic and element-specific flight rules associated with nominal operations.
- Describe unberthing/mating interfaces and associated system feedback for the main element.
- Describe the end-to-end process associated with unberthing and mating the main element.
- Describe the operational constraints and limitations to the specific planned task, including the unberthing and mating corridors, visual cues, available robotics tools, etc.
- Communicate effectively with Shuttle and M2 using voice protocols.
- Configure camera views and robotics tools to correctly monitor clearances and maintain situational awareness, with instructor assistance.
- Apply correct hand controller techniques as required for the specific task.
- Demonstrate proper facility-specific camera management during the operation.

# 50 **EL NOM INSTL 4 91025**

Title: Element Installation 4 (Shared – ISS)

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 1 or 2, 3, 4, 5, 10

Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: EL TRAJ MOD 1 91025

Equipment Required: None

Prerequisite Lesson(s): EL NOM INSTL 3 93016

Preparation: None

#### Synopsis:

The Mobile Servicing System (MSS) Element Installation #4 lesson provides a review of the specific task procedures and operations and includes changes/revisions/modifications that have been incorporated since the student last received the nominal lessons associated with the operation. The instructor will guide the student through the procedures, highlighting any changes with discussions regarding the reasoning behind the modifications. The lesson may be repeated as required.

- Execute a nominal unberth/handoff, translate, and mate for the main element.
- Use the task-specific command frames, display frames, and Frames of Resolution (FOR) for the main element.

## 50 EL NOM INSTL 4 91025 (Concluded)

- Identify generic- and element-specific flight rules associated with nominal operations.
- Describe unberthing/mating interfaces and associated system feedback for the main element.
- Describe the end-to-end process associated with unberthing and mating the main element.
- Describe the operational constraints and limitations to the specific planned task, including the unberthing and mating corridors, visual cues, available robotics tools, etc.
- Communicate effectively with Shuttle and M2 using voice protocols.
- Configure camera views and robotics tools to correctly monitor clearances and maintain situational awareness, with instructor assistance.
- Apply correct hand controller techniques as required for the specific task.
- Demonstrate proper facility-specific camera management during the operation.

#### 51 EL INST*L* RVW 41025

Title: Element Installation Review (Shared – ISS)

Duration: 3.0 hours

Medium: Dynamic Skills Trainer 1 or DST 2, 3, 4, 5, 10

Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: *EL INST RVW 41025* 

Equipment Required: None

Prerequisite Lesson(s): *EL NOM INSTL 4 91025* 

Preparation: None

Synopsis:

The Mobile Servicing System (MSS) Element Installation Review lesson provides additional practice for a specific element installation task planned for an increment or flight as necessary. During this lesson, the student will unberth the element from the payload bay or accept a handoff from SRMS, translate the element to various points (low hover, premate, capture envelope, etc.), and then mate the element to the ISS. The unberth and mate can be nominal or with malfunctions and allows the use of tools, such as Dynamic Onboard Ubiquitous Graphics (DOUG) and Robotics Situational Awareness Display (RSAD).

#### 51 EL INSTL RVW 41025 (Concluded)

Objectives:

- Execute a nominal unberth/handoff, translate, and mate for the main element.
- Use the task-specific command frames, display frames, and Frames of Resolution (FOR) for the main element.
- Identify generic and element-specific flight rules associated with nominal operations.
- Describe unberthing/mating interfaces and associated system feedback for the main element.
- Describe the end-to-end process associated with unberthing and mating the main element.
- Describe the operational constraints and limitations to the specific planned task, including the unberthing and mating corridors, visual cues, available robotics tools, etc.
- Communicate effectively with Shuttle and M2 using voice protocols.
- Configure camera views and robotics tools to correctly monitor clearances and maintain situational awareness, with instructor assistance.
- Apply correct hand controller techniques as required for the specific task.

#### *5*2 **ROBOTICS LSN LRND 21001**

Title: Robotics Lessons Learned (Shared – ISS)

**Duration:** 1.0 hour Medium: Classroom

Student: M1 (M2 supports as needed.)

DX23/Station Mechanical & Robotics Source:

06/08 Date:

Lesson(s) Replaced: None **Equipment Required:** None Prerequisite Lesson(s): None

Preparation: None

This lesson covers the Robotics lessons learned. These include on-orbit Synopsis:

close calls, software features, and significant robotics anomalies. The lesson also includes the All Stop Voice Protocol for unexpected arm

motion.

- Describe the factors leading up to the robotics close calls on-orbit.
- Explain the All Stop Voice Protocol for unexpected arm motion.
- Describe the software feature updates that affect robotics operations.
- Summarize the significant robotics anomalies seen on-orbit.

# 53 **MSS LTG OPS 31115**

Title: MSS Lighting Operations

Duration: 2.0 hours

Medium: Multiuse Remote Manipulator Development Facility

**Note:** This lesson requires night operations in Building 9 High Bay.

Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

Synopsis: This lesson trains students to manage and control cameras that are

affected from non-ideal lighting conditions while using the SSRMS. Tasks

emphasize manipulating the camera viewing angles and control

parameters to maintain an effective camera view when non-ideal lighting

situations affect the view. Joint and manual modes are used.

Objectives: Recognize and properly react to camera effects due to adverse lighting

conditions.

#### 54 **SSRMS PROF 1 41025**

Title: SSRMS Proficiency 1

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 1
Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: None

Equipment Required: MSS Quick Reference Guide, SSRMS Model, and Personal

Operations Checklist

Prerequisite Lesson(s): ROBOTICS LSN LRND 21001

Preparation: None

Synopsis: This is a proficiency lesson in the skills for flying the SSRMS robotics

system. This lesson fits the format of the Spec Skills classes. The student will be asked to plan trajectories and perform tasks that test the

generic skills of robotics operations.

#### 54 SSRMS PROF 1 41025 (Concluded)

Objectives:

- Maneuver an unloaded SSRMS in various modes (Manual, Single Joint (SJ), Operator Command Auto Sequence (OCAS), Pitch Plane) by determining proper direction of motion, using proper mnemonics and applying good hand controller skills so not to induce oscillations on the arm.
- Maneuver SSRMS with a large payload attached in different modes, including Manual, Joint OCAS, Frame of Resolution (FOR), and OCAS safely, within flight rule constraints and without inducing oscillations.
- Apply Latch End Effector (LEE) Cue Card appropriately during loaded operations.
- Maintain situational awareness and clearance monitoring by selecting and adjusting appropriate camera views during tasks.
- Perform automatic and manual LEE Operations without instructor assistance.
- Maneuver the SSRMS with EVA crewmember attached using the Robotics/EVA voice protocol and EVA commands.
- Communicate sufficiently with EVA crew and M2.
- Configure the SSRMS system properly including loading correct files and configuring the LEE for grapple without instructor assistance.

#### 55 **SSRMS PROF 2 22025**

Title: SSRMS Proficiency 2

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 1
Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: None

Equipment Required: MSS Quick Reference Guide, SSRMS Model, and Personal

**Operations Checklist** 

Prerequisite Lesson(s): SSRMS PROF 1 41025

Preparation: None

Synopsis: This is a proficiency lesson in the skills for flying the SSRMS robotics

system. This lesson fits the format of the Spec Skills classes. The student will be asked to plan trajectories and perform tasks that test the

generic skills of robotics operations.

# 55 SSRMS PROF 2 22025 (Concluded)

Objectives:

- Maneuver an unloaded SSRMS in various modes (Manual, Single Joint (SJ), Operator Command Auto Sequence (OCAS), Pitch Plane) by determining proper direction of motion, using proper mnemonics and applying good hand controller skills so not to induce oscillations on the arm.
- Maneuver SSRMS with a large payload attached in different modes, including Manual, Joint OCAS, Frame of Resolution (FOR), and OCAS safely, within flight rule constraints and without inducing oscillations.
- Apply Latch End Effector (LEE) Cue Card appropriately during loaded operations.
- Maintain situational awareness and clearance monitoring by selecting and adjusting appropriate camera views during tasks.
- Perform automatic and manual LEE Operations without instructor assistance.
- Maneuver the SSRMS with EVA crewmember attached using the Robotics/EVA voice protocol and EVA commands.
- Communicate sufficiently with EVA crew and M2.
- Configure the SSRMS system properly including loading correct files and configuring the LEE for grapple without instructor assistance.

#### 56 **SSRMS PROF 3 23025**

Title: SSRMS Proficiency 3

Duration: 2.0 hours

Medium: Dynamic Skills Training 1
Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: None

Equipment Required: MSS Quick Reference Guide, SSRMS Model, and Personal

**Operations Checklist** 

Prerequisite Lesson(s): SSRMS PROF 2 22025

Preparation: None

Synopsis: This is a proficiency lesson in the skills for flying the SSRMS robotics

system. This lesson fits the format of the Spec Skills classes. The student will be asked to plan trajectories and perform tasks that test the

generic skills of robotics operations.

# 56 SSRMS PROF 3 23025 (Concluded)

#### Objectives:

- Maneuver an unloaded SSRMS in various modes (Manual, Single Joint (SJ), Operator Command Auto Sequence (OCAS), Pitch Plane) by determining proper direction of motion, using proper mnemonics and applying good hand controller skills so not to induce oscillations on the arm.
- Maneuver SSRMS with a large payload attached in different modes, including Manual, Joint OCAS, Frame of Resolution (FOR), and OCAS safely, within flight rule constraints and without inducing oscillations.
- Apply Latch End Effector (LEE) Cue Card appropriately during loaded operations.
- Maintain situational awareness and clearance monitoring by selecting and adjusting appropriate camera views during tasks.
- Perform automatic and manual LEE Operations without instructor assistance.
- Maneuver the SSRMS with EVA crewmember attached using the Robotics/EVA voice protocol and EVA commands.
- Communicate sufficiently with EVA crew and M2.
- Configure the SSRMS system properly including loading correct files and configuring the LEE for grapple without instructor assistance.

## 57 MSS SPN & REF DATA 91001

Title: MSS Station Program Note and Reference Data (Shared – ISS)

Duration: 1.0 hour Medium: Classroom

Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

Synopsis: The Mobile Servicing System (MSS) Station Program Note (SPN) and

Reference Data lesson reviews pertinent SPNs that affect crew operations

and provides the crew with any updates to operating software.

Objectives: • Recognize relevant SPN cases.

Explain major software updates relevant to the mission.

#### 58 **MSS CBT MOD 5/7 21057**

Title: MSS CBT Modules 5, 6, and 7

Duration: 9.0 hours

Medium: Computer Based Training
Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

Synopsis: The Computer Based Training (CBT) is a Canadian Space Agency (CSA)

product.

Objectives: None

## 59 **SPDM TOOLS/ORU 21217**

Title: SPDM Tools and ORU Lesson (Shared – ISS)

Duration: 2.0 hours

Medium: Dexterous Manipulator Trainer (Building 9 High Bay)

Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): MSS CBT MOD 5/7 21057

Preparation: None

Synopsis: The purpose of this lesson is to prepare the student for the Canadian

Space Agency (CSA) Special Purpose Dexterous Manipulator (SPDM) Mobile Servicing System (MSS) Robotics Operator (MRO) course by

introducing them to the SPDM tools and Orbital Replacement

Units (ORUs). Main point one covers the components of the ORU Tool Changeout Mechanism (OTCM) and how the grippers and socket drive interfaces with the SPDM tools. Main point two goes through the three SPDM tools: Set, Robotic Offset Tool (ROST), and Robot Micro Conical Tool (RMCT) and how these tools operate with the OTCM. Main point three addresses the different type of grasp fixtures that the OTCM and SPDM tools interface with and their differences. The order of this lesson follows the mechanical means necessary to interact with an ORU grasp fixture, i.e.: OTCM > Tool > Grasp Fixture. This part of the lesson plan is meant to provide a working knowledge of the SPDM tools and how they

## 59 SPDM TOOLS/ORU 21217 (Concluded)

interface with the OTCM and associated grasp fixtures. This lesson also explores characteristics of SPDM compatible ORUs. More specifically; what makes an ORU SPDM compatible, where these ORUs and spares are physically located, how they are attached, what the attach status indicators are, what alignment guides and markings (if available) they have, what tool(s) are required for removal and insertion, what types of targets exist on the ORUs, SPDM compatible Flight Support Equipment (FSE)s (Flight Releasable Attachment Mechanism (FRAM) (External Stowage Platform (ESP)-2, Integrated Cargo Carrier (ICC), and Square grid) & Cargo Transport Container (CTC)).

## Objectives:

- Identify components of OTCM.
- Describe how the OTCM interfaces with tools and fixtures.
- Describe the operation of each of the 3 SPDM tools while interfacing with an ORU.
- Describe how each tool interfaces with the tool holster.
- Identify the fixtures each tool interfaces with.
- Identify/locate ORU and Spare locations (handout).
- Identify ORU Targets & Grapple fixture types (handout and Dexterous Manipulator Trainer (DMT) ORU models).
- Describe the various ORU alignment markings (DMT ORU models).
- Describe the various ORU hold-down mechanisms (handout and DMT models).
- Describe ORU status indicators and how they operate (handout and DMT ORU models).
- Identify ORU Carriers (FRAM, CTC, Columbus External Payload Adapter (CEPA), etc.).

## 60 **SPDM MRO PART 1 21512**

Title: CSA SPDM MRO Part 1

Duration: 32.0 hours

Medium: Canadian Training Facility
Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): SPDM TOOLS/ORU 21217

Preparation: None

Synopsis: This training is conducted at the Canadian Space Agency (CSA).

Objectives: None

## 61 **SPDM PROF1 21025**

Title: SPDM Proficiency 1

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 1
Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): SPDM MRO PART 1 21512

Preparation: None

Synopsis: This is a proficiency lesson in the skills for flying the Special Purpose

Dexterous Manipulator (SPDM) robotics system. This lesson is optional and intended to refresh SPDM operational concepts and techniques. It is intended for students with long breaks between SPDM MRO Part 1 and 2.

- Maneuver an unloaded SPDM in various modes (Manual, Single Joint (SJ), Operator Command Auto Sequence (OCAS), Pitch Plane) by determining proper direction of motion, using proper mnemonics and applying good hand controller skills so not to induce oscillations on the arm.
- Maneuver SPDM with a payload attached in different modes including Manual, Joint OCAS, Frame of Resolution (FOR), and OCAS safely, within flight rule constraints and without inducing oscillations.
- Maintain situational awareness and clearance monitoring by selecting and adjusting appropriate camera views during tasks.
- Perform ORU and Tool Changeout Mechanism (OTCM) Operations without instructor assistance.
- Maneuver the SPDM with EVA crewmember Ground Control Assistance (GCA) using the proper voice protocol.
- Communicate sufficiently with EVA crew and M2.
- Configure and manage the SPDM system properly without instructor assistance.

#### 62 SPDM MRO PART 2 21512

Title: CSA SPDM MRO Part 2

**Duration:** 32.0 hours

Canadian Training Facility Medium: Student: M1 (M2 supports as needed.)

DX23/Station Mechanical & Robotics Source:

Date:

Lesson(s) Replaced: None Equipment Required: None

*Prerequisite Lesson(s):* SPDM MRO PART 1 21512

Preparation: None

This course is taught at the Canadian Space Agency (CSA). Synopsis:

Objectives: None

#### 63 **SPDM MAINT1 41025**

Title: Special Purpose Dexterous Manipulator Maintenance Lesson 1

**Duration:** 3.0 hours

Dynamic Skills Trainer 1 or DST 2, 3, 4, 5, 10 Medium:

Student: M1 (M2 supports as needed.)

DX23/Station Mechanical & Robotics Source:

06/08 Date:

Lesson(s) Replaced: None Equipment Required: None *Prerequisite Lesson(s):* None

Preparation: None

This is the first in a series of maintenance lessons designed to keep a Synopsis:

> Station crewmember proficient in complex operations using the Special Purpose Dexterous Manipulator (SPDM). The class will cover EVA or payload operations concentrating on the end-to-end process. Student will interact with EVA while maneuvering payloads, such as batteries and other Orbital Replacement Units (ORUs). Determination of task will be

made by the Lead robotics instructor for the Increment.

- Demonstrate proper situational awareness by performing a constant scan pattern, maintaining 2 or more good camera views, and avoiding unexpected reach limits/singularities/self collisions.
- Identify and verbalize clearance issues for each task by consistently monitoring arm operations.
- Demonstrate proper hand controller techniques through proper grip, smooth ramping of commands, and multi-axis flying.

## 63 SPDM MAINT1 41025 (Concluded)

- Demonstrate proper resource management techniques by utilizing the Dynamic Onboard Ubiquitous graphics (DOUG) tool, communicating and coordinating with M2 and EVA for each task.
- Apply proper system management techniques to correctly configure the system for each task.
- Perform proper operations techniques by following procedures and adhering to flight rules.

## 64 **SPDM MAINT2 42025**

Title: Special Purpose Dexterous Manipulator Maintenance Lesson 2

Duration: 3.0 hours

Medium: Dynamic Skills Trainer 1 or DST 2, 3, 4, 5, 10

Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

Synopsis:

This is the second in a series of maintenance lessons designed to keep a Station crewmember proficient in complex operations using the Special Purpose Dexterous Manipulator (SPDM). The class will cover EVA or payload operations and focus on the end-to-end process. Student will interact with EVA while maneuvering payloads, such as batteries and other On-Orbit Replaceable Units (ORUs). Determination of task will be made by the Lead robotics instructor for the Increment.

- Demonstrate proper situational awareness by performing a constant scan pattern, maintaining 2 or more good camera views, and avoiding unexpected reach limits/singularities/self collisions.
- Identify and verbalize clearance issues for each task by consistently monitoring arm operations.
- Demonstrate proper hand controller techniques through proper grip, smooth ramping of commands, and multi-axis flying.
- Demonstrate proper resource management techniques by utilizing the Dynamic Onboard Ubiquitous graphics (DOUG) tool, communicating and coordinating with M2 and EVA for each task.
- Apply proper system management techniques to correctly configure the system for each task.
- Perform proper operations techniques by following procedures and adhering to flight rules.

## 65 **SPDM MAINT3 43025**

Title: Special Purpose Dexterous Manipulator Maintenance Lesson 3

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 1 or DST 2, 3, 4, 5, 10

Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

Synopsis: This is the third in a series of maintenance lessons designed to keep a

Station crewmember proficient in complex operations using the Special Purpose Dexterous Manipulator (SPDM). The class will cover EVA or payload operations. Student will refamiliarize with tools while performing tasks with the SPDM. Determination of task will be made by the Lead

robotics instructor for the Increment.

Objectives:

- Demonstrate proper situational awareness by performing a constant scan pattern, maintaining 2 or more good camera views, and avoiding unexpected reach limits/singularities/self collisions.
- Identify and verbalize clearance issues for each task by consistently monitoring arm operations.
- Demonstrate proper hand controller techniques through proper grip, smooth ramping of commands, and multi-axis flying.
- Demonstrate proper resource management techniques by utilizing the Dynamic Onboard Ubiquitous Graphics (DOUG) tool, communicating and coordinating with M2 and EVA for each task.
- Apply proper system management techniques to correctly configure the system for each task.
- Perform proper operations techniques by following procedures and adhering to flight rules.

#### 66 **SPDM MAINT4 44025**

Title: Special Purpose Dexterous Manipulator Maintenance Lesson 4

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 1 or DST 2, 3, 4, 5, 10

Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: None Equipment Required: None

## 66 SPDM MAINT4 44025 (Concluded)

Prerequisite Lesson(s): None

Preparation: None

Synopsis: This is the fourth in a series of maintenance lessons designed to keep a

Station crewmember proficient in complex operations using the Special Purpose Dexterous Manipulator (SPDM). The class will cover EVA or payload operations. Student will interact with EVA while maneuvering

payloads, such as batteries and other On-Orbit Replaceable

Units (ORUs). Determination of task will be made by the Lead robotics

instructor for the Increment.

Objectives:

- Demonstrate proper situational awareness by performing a constant scan pattern, maintaining 2 or more good camera views, and avoiding unexpected reach limits/singularities/self collisions.
- Identify and verbalize clearance issues for each task by consistently monitoring arm operations.
- Demonstrate proper hand controller techniques through proper grip, smooth ramping of commands, and multi-axis flying.
- Demonstrate proper resource management techniques by utilizing the Dynamic Onboard Ubiquitous Graphics (DOUG) tool, communicating and coordinating with M2 and EVA for each task.
- Apply proper system management techniques to correctly configure the system for each task.
- Perform proper operations techniques by following procedures and adhering to flight rules.

## 67 **SPDM MAINT5 45025**

Title: Special Purpose Dexterous Manipulator Maintenance Lesson 5

Duration: 2.0 hours

Medium: Dynamic Skills Trainer 1 or DST 2, 3, 4, 5, 10

Student: M1 (M2 supports as needed.)

Source: DX23/Station Mechanical & Robotics

Date: 06/08

Lesson(s) Replaced: None Equipment Required: None Prerequisite Lesson(s): None

Preparation: None

## 67 **SPDM MAINT5 45025 (Concluded)**

## Synopsis:

This is the fifth in a series of maintenance lessons designed to keep a Station crewmember proficient in complex operations using the Special Purpose Dexterous Manipulator (SPDM). The class will cover EVA or payload operations. Student will interact with EVA while maneuvering payloads, such as batteries and other On-Orbit Replaceable Units (ORUs). Determination of task will be made by the Lead robotics instructor for the Increment.

- Demonstrate proper situational awareness by performing a constant scan pattern, maintaining 2 or more good camera views, and avoiding unexpected reach limits/singularities/self collisions.
- Identify and verbalize clearance issues for each task by consistently monitoring arm operations.
- Demonstrate proper hand controller techniques through proper grip, smooth ramping of commands, and multi-axis flying.
- Demonstrate proper resource management techniques by utilizing the Dynamic Onboard Ubiquitous Graphics (DOUG) tool, communicating and coordinating with M2 and EVA for each task.
- Apply proper system management techniques to correctly configure the system for each task.
- Perform proper operations techniques by following procedures and adhering to flight rules.

## SECTION 14.0 TRANSFER OPERATIONS FOR SHUTTLE CREWS TRAINING COURSE

The Transfer Operations for Shuttle Crews Training Course provides the flight crew and selected flight operations support personnel with the knowledge and skills necessary to perform the transfer of logistics from Shuttle, SPACEHAB, MPLM, or Automatic Transfer Vehicle (ATV) to ISS and back using the Transfer List Procedures.

Upon completion of the Transfer Operations for Shuttle Crews Training Course, the student will be able to:

- Perform simple and complex logistics transfers using the Transfer List procedure and associated referenced procedures.
- Transfer powered payloads.
- Understand the priorities of logistics transfer and how transfer tasks fit into the objectives and timeline for the flight.

Training facilities used include classroom instruction and the Building 9A ISS mockups for hands-on performance of logistics transfer. The Loadmaster will attend the ISS Hardware Bench Review that is held in Houston to review the hardware involved in complex transfers or hardware used in docked Shuttle operations.

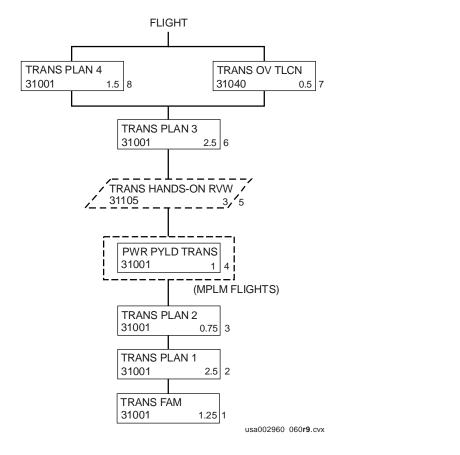


Figure 14-1. Transfer Operations for Shuttle Crews Lesson Flow Chart

**Table 14-1. Transfer Operations for Shuttle Crews Training Requirements** 

Date Last Modified: 06/08

Date Last Mealines. 30/00																		
							Non-Crew Rotation Crew Rotation					n						
	Ref				Sched													
Stage	Num	Lesson Code	Media	Hrs	Code	С	Р	MS1	MS2	MS3	MS4	PS	С	Р	MS1	MS2	Alt Fac	Comments
2	1	TRANS FAM 31001	CLR	1.25	8	1.25	1.25	1.25	1.25	1.25	1.25		1.25	1.25	1.25	1.25		
2	2	TRANS PLAN 1 31001	CLR	2.5	2			2.5		2.5						2.5		Loadmaster & Backup - As assigned by CDR
2	3	TRANS PLAN 2 31001	CLR	0.75	2			0.75		0.75						0.75		Loadmaster & Backup - As assigned by CDR
2	4	PWR PYLD TRANS 31001	CLR	1	2			1		1						1		If manifested; As assigned by CDR
2	5	TRANS HANDS-ON RVW 31105		3	7	3	3	3	3	3	3		3	3	3	3		
2		Sub Tot	al for Stage		Stage Totals													
2				8.5		4.25	4.25	8.5	4.25	8.5	4.25	0	4.25	4.25	4.25	8.5		
1	6	TRANS PLAN 3 31001	CLR	2.5	2			2.5		2.5						2.5		Loadmaster & Backup - As assigned by CDR
1	7	TRANS OV TLCN 31040	MCC	0.5	2	0.5		0.5					0.5			0.5		Commander & Loadmaster as assigned by CDR
1	8	TRANS PLAN 4 31001	CLR	1.5	2			1.5		1.5						1.5		Loadmaster & Backup - As assigned by CDR. Schedule during Quarantine
1		Sub Tot	al for Stage		Stage Totals	Per Cre	wmembe	r:										
1				4.5	Ü	0.5	0	4.5	0	4	0	0	0.5	0	0	4.5		

## 1 **TRANS FAM 31001**

Title: Transfer Familiarization

Duration: 1.25 hours Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT

**Note:** Schedule with Expedition crew if crew exchange mission.

Source: DO55/Daily Operations Group

Date: 07/04

Lesson(s) Replaced: None

Equipment Required: Viewgraph machine or computer and corresponding

electronic view projector

Prerequisite Lesson(s): None

Preparation: None

Synopsis:

This class will focus on reviewing the protocol for transferring supplies to and from the Station and Shuttle. First, students will be introduced to transfer lists, which detail everything that needs to be transferred both from the Station to the Shuttle, and from the Shuttle to the Station. Then, students will become familiar with the procedures that must be followed when making these transfers. Students will also be introduced to the Shuttle Loadmaster and the FDF that he or she maintains. Finally, students will become familiar with the tabs and tab content of the FDF. This lesson will show students examples of returning Cargo Transfer Bags (CTB) content and re-supplying CTB content, as well as photos of ISS stowage and past staging areas (used for temporary stowage), FDF examples from previous flights, and a preliminary Transfer List from their upcoming flight for them to practice reading. By the end of this class, students will have been introduced to all aspects of a transfer. They will be self-directed in performing these tasks, as the Shuttle Loadmasters are frequently too busy to supervise.

- Identify the Shuttle Loadmaster and state his/her job.
- Identify the Transfer List and state its purpose.
- Describe the transfer operations concept for their specific flight.
- Execute self-directed transfers from the Transfer List as timelined.
- Describe the layout of the flight-specific Transfer FDF and its tabs.

## 2 **TRANS PLAN 1 31001**

Title: Transfer List Format & Transfer Plan Review 1

Duration: 2.5 hours
Medium: Classroom

Student: Loadmaster and backup as assigned by CDR.

Source: DO55/Daily Operations Group

Date: 06/08

Lesson(s) Replaced: None

Equipment Required: Viewgraph projector or computer and electronic projector

Prerequisite Lesson(s): TRANS FAM 31001

Preparation: None

Synopsis: This is the first in a series of four sessions dedicated to the review and

understanding of the flight-specific Transfer List tasks – line-by-line review. A second objective will be to familiarize the crew with an example of their Flight Data File - the tabs and the contents. The crew will learn how to use the Flight Data File: where to find the stowage layouts, the Master Transfer List, where to find various alphabetic or numeric sorts of the Transfer List, and how to find other procedures associated with

Transfer.

Objectives:

- Explain how to read a Transfer List.
- Execute the transfer item as instructed.
- Perform the additional tasks and procedures as noted on the Transfer List and check the transfer item off as complete.
- Explain how to use the Flight Data File.
- Describe how to read logistics stowage drawings and ISS location coding and relate that back to the Transfer List.
- Recall the content of the Transfer List and the ODF Transfer book.

## 3 TRANS PLAN 2 31001

Title: Transfer List Format & Transfer Plan Review 2

Duration: 0.75 hours

**Note:** This session may be lengthened if an MPLM flight.

**Note:** This lesson is to be scheduled No Later Than (NLT) L-5 weeks.

Medium: Classroom

Student: Loadmaster and backup as assigned by CDR.

Source: DO55/Daily Operations Group

Date: 06/08

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): TRANS PLAN 1 31001

Preparation: Review the Transfer List

## 3 TRANS PLAN 2 31001 (Concluded)

Synopsis:

This is the second in a series of four Transfer Plan sessions. The lesson will discuss the choreography of unloading and reloading the logistics vehicle in relationship to the Flight Timeline and number of crew assigned to the transfer task. The transfer roles and responsibilities of the crew during a Launch On Need (LON) shuttle mission will also be discussed.

Objectives:

- Relate items seen at the bench reviews to the Transfer List instructions.
- Identify how the Loadmaster will manage the crew within the constraints of the flight to accomplish the transfer tasks.
- Describe the roles and responsibilities associated with transfer for a Launch On Need (LON) shuttle mission.

## 4 PWR PLYD TRANS 31001

Title: Powered Payload Transfer

Duration: 1.0 hour Medium: Classroom

Student: As assigned by CDR.

Source: DO55/Daily Operations Group

Date: 11/03

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): TRANS PLAN 2 31001

Preparation: Review the Power Payloads Transfer Procedure

Synopsis:

This lesson is required only when crew will be transferring powered payloads. Either Assembly and Checkout Officer (ACO) Systems or ACO Data will brief the crew on the powered transfer procedures. A review of the Power Payloads Transfer Procedure will take place, with a focus on execution and coordination of transfers in parallel. The lesson will focus much attention to procedure updates that have been made (often

significant) since MSFC trained the crew.

- Explain how to transfer the powered payload.
- Describe the preparation for the transfer.
- List the constraints in handling the payload.
- Identify how to power up the payload.

## 5 **TRANS HANDS-ON RVW 31105**

Title: Transfer Hands-On Review (Shared – ISS)

Duration: 3.0 hours

Medium: Space Station Mock-Up And Training Facility Student: COMMANDER, MS 1, MS 2, MS 3, PILOT

**Note:** Schedule with the Expedition crew if crew exchange mission.

Source: DO55/Daily Operations Group

Date: 06/08

Lesson(s) Replaced: None

Equipment Required: See Facility Utilization Request

Prerequisite Lesson(s): TRANS PLAN 2 31001

Preparation: Review the Transfer List

Synopsis:

This class is a practical follow up to the Transfer Operations class. The first hour is a lecture that focuses on reviewing the flight-specific transfer list and other documents and concepts that were introduced in the Transfer Operations class. This first hour is also used to set up the following hands-on activities by showing the students actual documents that they will use in the mockups. The last two hours of the class are used for practical hands-on exercises of the material. The instructor will first walk the students through the mockups, pointing out and explaining various stowage locations and other areas the instructor deems important. After the walk through, the students will perform a mock transfer under the supervision of the instructor. By the end of the class, the students will be able to perform an unsupervised transfer of materials between the Station and Shuttle.

- Read and follow a transfer list and track transfers.
- Find specific item to transfer and locate it on the Transfer List.
- Find specific ISS stowage locations (as detailed on the Transfer List).
- Execute Transfer List as a team (Station and Shuttle crew).
- Describe what to do with a particular transfer item.
- Provide calldowns to the ground regarding transfer status.

## 6 TRANS PLAN 3 31001

Title: Transfer List Format & Transfer Plan Review 3

Duration: 2.5 hours Medium: Classroom

Student: Loadmaster and backup as assigned by CDR.

Source: DO55/Daily Operations Group

Date: 06/08

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): TRANS HANDS-ON RVW 31105

Preparation: Review of Transfer List

## Synopsis:

This session is the third in the four-part series of Transfer Plan sessions. This lesson will build on the previous lessons and review the entire Transfer List in a line-by-line fashion. The crew will learn to determine the purpose of each item – if it is simply logistics resupply for Expedition Crew, an item needed to execute a Shuttle docked procedure, or part of a complex procedure for items being swapped. This session also briefly highlights changes in the stowage layouts and transfer lists from the previous sessions. The focus is on several major things: loading the logistics vehicle for return, real time operations, and how to use the electronic version of the Transfer List. The Real Time operations review gives both the ground controllers and loadmaster an opportunity to discuss each other's roles and responsibilities during the flight regarding transfer call downs, execute package messages, and change coordination. The Electronic Transfer File training is also given at this session, or this can be done in the crew office around their personal computer. The crew will learn about electronic sorts and how to perform sorts in Microsoft Excel.

- Explain the purpose of each item in the Transfer List.
- Explain which items have transfer constraints and why.
- Explain the changes/updates in the Transfer List.
- Describe how to consolidate foam, return trash, and manage other
  packing materials in order to satisfy the returning logistics module loads
  and Center of Gravity (c.g.) requirements.
- Describe the role of the Shuttle Loadmaster in relation to the ground Assembly and Checkout Officer (ACO) Transfer Flight Controller position and how they will communicate during the mission with execute package messages, real time call downs, and Transfer List changes.
- Show how to perform various "sorts" using the Microsoft Excel version of the Transfer List.
- Identify the operations to accomplish the transfer mission.

## **TRANS OV TLCN 31040**

Title: Transfer Teleconference

Duration: 0.5 hours Medium: MCC

Student: Commander and Loadmaster as assigned by CDR.

Source: DO55/Daily Operations Group

Date: 06/08

Lesson(s) Replaced: None

Equipment Required: This telecon will be arranged by DO5 in the Blue Flight

Control Room (FCR) - usually held in the BME room

Prerequisite Lesson(s): TRANS PLAN 3 31001

Preparation: None

Synopsis: This is the teleconference between the onboard Expedition Crew and at

least the Shuttle Loadmaster. If possible, have the Shuttle CDR there, too. This serves as the Final Transfer Station/Shuttle Tag up before flight to answer questions, review late changes, and coordinate between them. This will be facilitated by Assembly and Checkout Officer (ACO) Prepack and ACO Transfer. The discussion is expected to clarify any remaining logistics operational issues and allow the on-orbit crew to tell the Shuttle

Loadmaster about the transfer "staging areas" for returning items.

Objectives: Describe the details of how resupply and returning logistics will be handled

between both Shuttle and Expedition Crews.

## 8 **TRANS PLAN 4 31001**

Title: Transfer List Format & Transfer Plan Review 4

Duration: 1.5 hours

Note: This session may be lengthened if an MPLM flight.
Note: This lesson is to be scheduled during Quarantine.

Medium: Classroom

Student: Loadmaster and backup as assigned by CDR.

Source: DO55/Daily Operations Group

Date: 06/08

Lesson(s) Replaced: None Equipment Required: None

Prerequisite Lesson(s): TRANS PLAN 3 31001

Preparation: Review the Transfer List

## 8 TRANS PLAN 4 31001 (Concluded)

Synopsis:

This session is the fourth in the four-part series of Transfer Plan sessions. This session should briefly highlight changes in the stowage layouts and transfer lists from the previous session and review the return logistics transfer plan in detail. The crew will be given information on Transfer priorities for the case of a shortened undock mission. There will also be a final question and answer session, and a review of transfer operations.

- Explain the changes/updates in the Transfer List.
- Describe the transfer priorities for a shortened undock mission.

#### SECTION 15.0 INTEGRATED SIMULATIONS TRAINING COURSE

Eventually, all training courses lead to integrated simulations (sims). These simulations build the team coordination that is necessary between the crew, the Flight Control Teams, MCC-M, and the customer Payload Operations Control Centers (POCCs) to ensure a successful mission.

Table 15-1 is a summary of standard integrated simulation requirements. This table is used in the initial development of each mission's integrated simulation requirements, which are approved at the Mission Operations Directorate (MOD) Cargo Integration Review Dry Run (CIRD).

Typically, there are four 4-hour ascent simulations and one 4-hour Flight Dynamics Officer (FDO)/Booster System Engineer (BSE) ascent simulation required per flight. The prime crew is required for all five sims, for a total of 20 hours.

There are two 4-hour entry simulations and one 5-hour entry simulation. The prime crew is required for all three, for a total of 13 hours.

A 4-hour post-insertion simulation is required unless a day 1 simulation starting from lift-off is already scheduled.

A 7-hour deorbit preparation simulation is required unless a requirement exists for a simulation such as a SPACEHAB deactivation, which runs for 8 hours, ending with landing.

The prime crew is required for post-insertion, deorbit preparation, and all orbit simulations which are Joint Integrated Simulations (JIS) involving the customers/remote POCCs. PSs are required for the post-insertion simulation. PS participation in other orbit simulations will be determined on a sim-by-sim basis.

One planning team simulation concentrating on orbiter systems is required unless the planning team is involved in one or more long simulation shifts.

Many lessons in this section are used for both load specific and generic training. These will be indicated by the advanced 20000 level code in parenthesis next to the load specific 90000 level code. Integrated generic lessons are specifically designed to meet Flight Controller training objectives and do not impose additional training requirements on Flight Crews.

**Table 15-1. Integrated Simulations Crew Training Requirements** 

Date Last Modified: 04/06

						Non-Crew Rotation								Crew R	Rotation			
Stage	Ref Num	Lesson Code	Media	Hrs	Sched Code	С	Р	MS1	MS2	MS3	MS4	PS	С	Р	MS1	MS2	Alt Fac	Comments
3		Pre Sim FDF	IFB	1	8	1	1	1	1	1	1	1	1	1	1	1		
3		Int Sim Mtg	IFB	1	8	1	1	1	1	1	1	1	1	1	1	1		
3		Sub To	tal for Stage		Stage Totals	s Per Crev	vmembe	er:										
3				2		2	2	2	2	2	2	2	2	2	2	2		
2		ASC #1 w/prep and dbrf	MB	4.6	4	4.6	4.6	4.6	4.6				4.6	4.6	4.6	4.6		
2		ASC #2 w/prep and dbrf	MB	4.6	4	4.6	4.6	4.6	4.6				4.6	4.6	4.6	4.6		
2		ENTRY #1 w/prep and dbrf	MB	4.6	4	4.6	4.6		4.6	4.6			4.6	4.6	4.6	4.6		
2		ENTRY #2 w/prep and dbrf	MB	5.6	4	5.6	5.6		5.6	5.6			5.6	5.6	5.6	5.6		
2		INT #1 w/prep and dbrf	IFB	12.1	8	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1		
2		RNDZ DOCK/UNDK w/prep and dbrf	IFB	9.1	8	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1		
2		INT #2 w/prep and dbrf	IFB	10.1	8	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1		
2		INT #3 w/prep and dbrf	IFB	9.1	8	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1		
2		INT #4 w/prep and dbrf	IFB	11.1	8	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1		
2		INT #5 w/prep and dbrf	IFB	9.1	8	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1		
2		INT #6 w/prep and dbrf	IFB	9.1	8	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1		
2		INT #7 w/prep and dbrf	IFB	18.3	8	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3		
2		INT #8 w/prep and dbrf	IFB	9.1	8	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1		
2		RNDZ DOCK/UNDK w/prep and dbrf	IFB	9.1	8	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1		
2		FDO/BSE w/prep and dbrf	IFB	4.6	4	4.6	4.6	4.6	4.6				4.6	4.6	4.6	4.6		
2		Sub To	tal for Stage		Stage Totals	Per Crev	vmembe	er:										
2				130.20		130.20	130.20	120.00	130.20	116.40	106.20	106.20	130.20	130.20	130.20	130.20		
1		ASC #3 w/prep and dbrf	MB	4.6	4	4.6	4.6	4.6	4.6				4.6	4.6	4.6	4.6		
1		ASC #4 w/prep and dbrf	MB	4.6	4	4.6	4.6	4.6	4.6				4.6	4.6	4.6	4.6		
1		D/O PREP w/prep and dbrf	IFB	7.6	8	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6		
1		ENTRY #3 w/prep and dbrf	MB	4.6	4	4.6	4.6		4.6	4.6			4.6	4.6	4.6	4.6		
1		PO INS w/prep and dbrf	IFB	5.8	8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8		
		Sub To	tal for Stage		Stage Totals	s Per Crev	vmembe	er:										
				27.20		27.20	27.20	22.60	27.20	18.00	13.40	13.40	27.20	27.20	27.20	27.20		

The medium and associated facility codes for integrated simulations may be any of the following:

MCC	XX040
MCC/FB	XX042
MCC/GNS	XX022
MCC/FB/NBL	XX080
MCC/GNS/NBL	XX039
MCC/MB	XX043
STRING1/FB	XY121
STRING2/FB	XY122
STRING1/GNS	XY123
STRING2/GNS	XY124
MCC/STRING1	XY125
MCC/STRING2	XY126
MCC/STRING 1/FB	XY127
MCC/STRING 2/FB	XY128
MCC/STRING 1/GNS	XY129
MCC/STRING 2/GNS	XY130
STRING 1/MB	XY132
STRING 2/MB	XY133
STRING 1/NBL	XY134
STRING 2/NBL	XY135
STRING 1/FB/NBL	XY136
STRING 2/FB/NBL	XY137
STRING 1/GNS/NBL	XY138
STRING 2/GNS/NBL	XY139
MCC/STRING 1/NBL	XY140
MCC/STRING 2/NBL	XY141
MCC/STRING 1/FB/NBL	XY142
MCC/STRING 2/FB/NBL	XY143
MCC/STRING 1/GNS/NBL	XY144
MCC/STRING 2/GNS/NBL	XY145

The "XX" or "XY" may be a "91" for flight-specific integrated simulations or a "21" for generic integrated simulations.

Table 15-2. Integrated Sim Requirements

TYPE	RUNS	HRS/FLT
ASCENT *		
SHORT RUNS (ABORTS)	4	16
FDO/BSE	1	4
POST-INSERTION – (if not included in Day 1 Sim)	1	4
ENTRY *		
SHORT RUNS (200K)	2	8
DEORBIT MINUS 30-MINUTES and SHORT RUNS (200K)	1	5
DEORBIT PREP	1	7
<u>ORBIT</u>		
A. SPACEHAB		
REFLIGHT		
LONG SIM	1	36
• (ACT-16, SYS-8)	2	24
NEW INTERFACES		
LONG SIM (ACT-24, TIMELINE 36)	2	60
B. ISS		
RNDZ/DOCKING	2	18
UNDOCKING	2	12
(1) SEE BELOW		
C. PALLET (COMPLEX)		
ORBIT OPS	1	8
LONG SIM	1	36
D. PLANNED EVA (PER EVA)	1	10
E. FREE-FLYERS (IF MCC SUPPORT REQUIRED)	2	12
F. RENDEZVOUS/PROX OPS/RETRIEVAL OPS	2	20
G. PLANNING TEAM TRAINING – (if not included in a long sim)	1	8
(1) FOR ISS FLIGHTS THE FLIGHT PLAN WILL BE REVIEWED AND THE C WILL BE DETERMINED AND COVERED DURING SIMULATIONS.	RITICAL AC	TIVITIES
* IF SCHEDULE CONSTRAINTS REQUIRE – ONE ASCENT AND ONE ENTI COMBINED INTO A SINGLE 6-HR SIM (3 hours ascents/3 hours entries)	RY CAN BE	
	FOIG App	proved 2/88

#### INTEGRATED SIMULATIONS LESSON LIST

The following list includes all the lessons in the Integrated Simulations Training Course. The lessons in this course are unnumbered and are arranged in this catalog in the order shown below.

ABT AOA 910XX (210XX)
ABT-ATO 910XX (210XX)
ABT-CONT 910XX (210XX)
ABT-NOM 910XX (210XX)

ABT-NOM 910XX (210XX) ABT-PAD 910XX (210XX)

ABT-REV3 910XX (210XX) ABT-RTLS 910XX (210XX)

ABT-TAL 910XX (210XX)

FDO/BSE-AOA 910XX (210XX)

FDO/BSE-ATO 910XX (210XX)

FDO/BSE-CONT 910XX (210XX)

FDO/BSE-NOM 910XX (210XX)

FDO/BSE-PAD 910XX (210XX)

FDO/BSE-RSO 910XX (210XX)

FDO/BSE-RTLS 910XX (210XX)

FDO/BSE-TAL 910XX (210XX)

**ENTRY 910XX (210XX)** 

D/O PREP 910XX (210XX)

PO INS 9XYYY (2XYYY)

SYSTEMS 9XYYY (2XYYY)

ACT/DEACT 9XYYY(2XYYY)

DAY X 9XYYY (2XYYY)

MOD 9XYYY (2XYYY)

EVA 9XYYY (2XYYY)

RNDZ/DOCK 9XYYY (2XYYY)

RNDZ/PROX 9XYYY (2XYYY)

MAJOR CASE 9XYYY(2XYYY)

PLANNING 9XYYY (2XYYY)

LONG SIM 9XYYY(2XYYY)

ORB OPS/EVA 9XYYY (2XYYY)

ORBIT OPS 9XYYY (2XYYY)

PYLD DPLY 9XYYY (2XYYY)

PYLD L DPLY 9XYYY(2XYYY)

**DEBRIEF 9XYYY (2XYYY)** 

ROBOTICS DPLY 9XYYY (2XYYY)

ROBOTICS L DPLY 99XYYY (2XYY)

ROBOTICS OPS 9XYYY (2XYYY)

PLD-PRELAUNCH 910XX (210XX)

PROX/PDRS 910XX (210XX)

INT SIM MEET 91001

DEPART 9XYYY (2YXXX)

## **Objectives**

I. Generic Integrated Simulation Training Goals and Objectives

Prior to flight-specific simulations, it is assumed that each operator is qualified to operate his/her systems and maintain the associated operational capability according to the roles and characteristics as defined by the Flight Controller Integrated Simulation Objectives (ISOs). See the Flight Controller ISO list below. These ISOs define the qualities that are desirable in a Flight Controller. The goal of generic integrated simulations is to develop these qualities in all flight control operators.

The objective of generic simulations is to present scenarios to the individual operators in order to develop the qualities listed in the ISOs. The ISOs are the criteria used to gauge the successful resolution by any Flight Control Operator of any scenario presented to them in an integrated simulation.

## Flight Controller Integrated Simulation Objectives

- 1. The Flight Controllers must demonstrate an awareness of mission status under all situations, including payload operations. The Flight Controllers must present and discuss any deviations from normal systems operations and must realize how any failures that occur in any discipline affect the activity that is taking place, as well as the impact to their own disciplines' systems.
- The Flight Controllers must accurately and concisely convey system limitations in their disciplines, caused by failures within their disciplines, to all other affected Flight Controllers. They must also inform the other Flight Controllers of the impact of any subsequent failures to the systems.
- The Flight Controllers must convey accurately and concisely to the Flight
  Director what has occurred and recommend the appropriate corrective action.
  They must also provide the rationale for the action that must be taken. They are
  to clearly communicate any mission duration/success impacts to the Flight
  Director.
- 4. The Flight Controllers must define plans for resolving and managing problems that develop in a mission by considering mission status and failure impacts. They must make trade-offs involving flight activities, wave-offs, extension days, or other management techniques required to prevent or minimize violations of flight rules/redlines.
- 5. The Flight Controllers must demonstrate the ability to work with all console tools and must coordinate and submit all the forms/paperwork associated with the operation of their consoles.

## **Objectives (Continued)**

- 6. The Flight Controllers must guide the crew and the rest of the Flight Control Team through the successful completion of all actions and procedures that are required in order to maintain systems integrity and capabilities, mission success, vehicle integrity, and crew safety.
- 7. The Flight Controllers must demonstrate a knowledge of the interactions of other systems in all disciplines with their own systems. The Flight Controllers must be able to identify the effect of other disciplines' system failures on their own systems.
- 8. The Flight Controllers must demonstrate confidence, ownership, competence, and a commanding knowledge of their own disciplines' systems. The Flight Controllers must stand by all calls made to the Flight Director. The Flight Controllers should be open minded but they must also exhibit the confidence to not let the Flight Director change their minds if they feel they are correct. It is the Flight Director's prerogative to simply override them, but this should not change the Flight Controllers' minds or alter their confidence in their own decisions.
- 9. The Flight Controllers must exhibit and demonstrate a positive attitude towards console operations. They must exhibit a courteous and cooperative relationship with all other Flight Controllers. When developing solutions and workarounds, they must demonstrate that every effort has been made to obtain a solution. No possibility for a solution is to be left unexplored.
- The Flight Controllers must demonstrate accurate, cordial, coordinated, and professional intra- and inter-discipline team communication/management. They must demonstrate assertive, but not aggressive, communication.
- 11. The Flight Control Room (FCR) Flight Controllers must demonstrate the ability to manage and adjust to the capabilities and deficiencies of their Multipurpose Support Room (MPSR) Flight Controllers. The FCR Flight Controllers are to ensure that two-way communication occurs. The FCR Flight Controllers must keep the MPSR team informed of the overall mission status. The FCR Flight Controllers are to routinely poll the MPSR on their workload and systems' status. They must properly and evenly allocate the workload to the MPSR team.
- 12. The FCR Flight Controllers must demonstrate that they accept responsibility for all of the disciplines of the FCR position. They must demonstrate that they accept responsibility for all of the team's decisions and recommendations.

## **Objectives (Continued)**

- 13. The Flight Controllers must willingly admit when they have erred or are incorrect as well as when they do not have an immediate solution or matter of recourse in a given situation. They must not demonstrate a tendency to assign blame to others or to variables that may have contributed to their poor performance. If they do not have the answer to the situation or scenario, they are to demonstrate an attitude that they will do their best to obtain the solution to the situation/scenario.
- II. Flight-Specific Integrated Simulation Training Goals and Objectives

## 1.0 Ultimate Goal

The ultimate goal of flight-specific integrated simulations is to mold a Flight Team that is capable of safely managing orbiter/payload operations in any possible situation. The Flight Team is defined as the Houston-MCC Flight Controllers, the mission's POCC Flight Controllers, the Flight Crew, and any other entity that is involved in flight operations.

## 2.0 Flight-Specific Integrated Simulation Training Goal

The flight-specific integrated simulation training goal is to exercise and develop the Flight Team's ability, system knowledge, and confidence to <u>safely</u> operate all orbiter/payload/ground capabilities and to successfully accomplish the mission in a manner consistent with the flight rules. The objective of scenarios used in the flight-specific simulations should be a stimulus to aid in the molding of the individuals composing the Flight Team into a team that operates as a whole. An assumption is that each individual is qualified (certified) to operate his/her system in order to fulfill his/her responsibility. Characteristics that each individual must possess prior to Flight Team training are developed during generic simulations. In summary, the tasks of the simulation team for flight-specific integrated simulations are:

- To present a "Flight" environment that is as realistic as possible. This should include minimum interaction between the Flight Team and the sim team during the run (zero is ideal).
- To present scenarios/cases that promote interaction and communication between the Flight Crew, the Flight Control Team, and the payload operations team.

## **Objectives (Continued)**

- To mold the individual Flight Controllers, the Flight Crew, the Payload Team, and the Science Team into one team (Flight Team) that has confidence and trust in themselves and each other.
- To present simulations that test the Flight Team's ability to recognize and solve problems in a timely and comprehensive manner while ensuring that safety and mission objectives are met.

## 3.0 Flight Team Objectives

There are two major types of training objectives that are to be accomplished for the Flight Team during flight-specific integrated simulations. The first type is training objectives that prepare the Flight Team for the specific mission, and the second is training objectives that stress the Flight Team's ability to maintain the operational capability of the orbiter and all associated systems and operations.

## 3.1 Mission Training Objectives

The mission and the mission objectives are the primary purpose of any flight. Flight-specific integrated simulation mission training objectives are those objectives that develop the Flight Team's overall ability to execute the mission. These mission training objectives stress the Flight Team's capability to accomplish primary mission objectives and exercise the Flight Team's prioritization and capability to replan the mission.

The exercising of different timelines and scenarios are used to accomplish flight-specific integrated simulation mission training objectives. The flight-specific integrated simulation mission training objectives are:

- For the Flight Team to exercise the prime mission objectives and timelines for the mission.
- For the Flight Team to work alternative timelines for the mission, including minimum duration flight, launch slips, off-nominal orbits, and next Primary Landing Site (PLS).
- For the Flight Team to work timelines and scenarios that test their ability to cope with the realtime reprioritization and replanning of mission objectives.
- For the Flight Team to work scenarios that stress mission constraints such as water dumps, thermal attitudes, DAP constraints, etc.
- For the Flight Team to work tradeoffs between various mission objectives or between various operational capabilities.

## **Objectives (Concluded)**

## 3.2 Operational Capability Objectives

An operational capability is a primary orbiter, payload, or ground system characteristic or capability that must be maintained to satisfy mission requirements or vehicle and Flight Crew safety. Examples of operational capabilities include: Navigation and Energy Management, Vehicle Control, Power Generation, and Communication. It is the job of the Flight Team to preserve operational capabilities in order to <u>safely</u> accomplish the mission. The emphasis should always be on safety.

The flight-specific integrated simulation operational capability training objectives are objectives that cause the Flight Team to make tradeoffs between maintaining the operational capability of the orbiter and ground systems and satisfying the mission's objectives. Each operational capability objective will impact an individual operator's system that provides a certain capability. Each system's operator (Flight Controller) is responsible for the health and maintenance of that system and the operational capability that it supports. The flight-specific integrated simulation operational capability training objectives are:

- For the Flight Team to work tradeoffs between regaining the loss of capability of any individual member of the Flight Team's system, caused by a failed or degraded system, and the mission objectives.
- For the Flight Team to cope with a lost or degraded system capability
  of any individual member of the Flight Team in order to have the Flight
  Team engage in communication, cooperation, and team building
  between the individual with the lost or degraded system and
  another/other members of the Flight Team.
- For the Flight Team to cope with and work with the loss or degradation of a system that is extremely important to the mission's objectives.
- To have all Flight Team members impacted by the loss or degradation of a system utilize all data, support tools, operators, and documentation in an effort to maintain the system and the operational capability it supports.

ABT-AOA 910XX (210XX)
ABT-ATO 910XX (210XX)
ABT-CONT 910XX (210XX)
ABT-NOM 910XX (210XX)
ABT-PAD 910XX (210XX)
ABT-REV3 910XX (210XX)
ABT-RTLS 910XX (210XX)
ABT-TAL 910XX (210XX)

Title: Integrated Ascent Simulation

Duration: 4.0 hours/4 sessions for flight-specific Student: COMMANDER, MS 1, MS 2, PILOT Source: DA724/Simulation Supervisor Group

Date: 04/99

Lesson(s) Replaced: None

Equipment Required: MS seats installed, ascent FDF set up, ACESs required for

prime crew during 2 ascent simulations

Preparation: Flight-specific ascent integrated simulations require that the crew(s)

scheduled to support have completed the first 3 standalone ascent skills lessons (ASC SKL 31011, ASC SKL 32011, ASC SKL 33011), with at least 1 of those on a simulator training load similar to the one

scheduled for the integrated simulation.

Synopsis: Flight-specific crew coordination/interaction with MCC will be exercised in

at least one of each type of the basic abort profiles associated with that flight's ascent trajectory. The crew should complete at least 4 hours of standalone load-specific ascent skills before their first load-specific integrated ascent simulation. The approximate timeframe for these simulations should be between the weeks of Launch-12 (L-12) and L-1.

The final ascent is scheduled during the L-1 week.

FDO/BSE-AOA 910XX (210XX)

FDO/BSE-ATO 910XX (210XX)

FDO/BSE-CONT 910XX (210XX)

FDO/BSE-NOM 910XX (210XX)

FDO/BSE-PAD 910XX (210XX)

**FDO/BSE-RSO 910XX (210XX)** 

FDO/BSE-RTLS 910XX (210XX)

FDO/BSE-TAL 910XX (210XX)

Title: Integrated Flight Dynamics Officer/Booster Systems Engineer Ascent

Simulation

Duration: 4.0 hours

Student: COMMANDER, MS 1, MS 2, PILOT Source: DA724/Simulation Supervisor Group

Date: 04/99

Lesson(s) Replaced: None

Equipment Required: MS seats installed, ascent FDF set up

Preparation: None

Synopsis:

Flight-specific coordination/interaction between the crew and MCC is exercised concerning critical ascent calls made by the Flight Dynamics Officer (FDO) and Booster Systems Engineer (BSE) MCC operators. The script will emphasize any flight-specific changes in the calls related to trajectory and performance (such as abort boundaries and main engine limits management). Only those malfunctions required to exercise the required type of FDO/BSE cases will be included. Full MCC team manning is not required. The Flight Director, Booster Systems Engineer, Flight Dynamics Officer, Trajectory Console Operator, and Guidance/ Procedures Officer are required to support. The flight-specific FDO/BSE must include a Range Safety case to demonstrate the Range Safety decision making process, communications flow, and to exercise limit line avoidance procedures.

Generic FDO/BSE simulations are used to more efficiently train the uncertified Flight Directors, Booster Systems Engineers, Flight Dynamics Officers, Trajectory Console Operators, and Guidance and Procedures Officers. The Guidance, Navigation and Control (GNC) and Propulsion (PROP) console operators also benefit from participation in these simulations. The sim is more efficient for these personnel because orbiter systems failures are kept to a minimum. Flight Crews and Flight Directors for upcoming flights may also benefit by scheduling themselves for these simulations since the flight loads for the next flight are usually scheduled for use. Thus, these sims become, in effect, an "extra" simulation for the Flight Crew and Flight Director.

## **ENTRY 910XX (210XX)**

Title: Integrated Entry Simulation

Duration: 4.0 hours/2 sessions; 5.0 hours/1 session flight-specific

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT

Source: DA724/Simulation Supervisor Group

Date: 04/99

Lesson(s) Replaced: None

Equipment Required: MS seats installed, standard entry FDF set up, deorbit FDF

available

Preparation: Flight-specific entry integrated simulations require that the crew

scheduled to support has completed the first 2 standalone entry skills lessons (ENT SKL 31011, ENT SKL 32011), with at least one of those on a simulator load similar to the one scheduled for the integrated

entry simulation.

Synopsis: Flight-specific crew coordination/interaction with the MCC will be

exercised on numerous 200K feet runs through landing. At least one run per flight will continue through postlanding procedures. Some runs may start prior to the Deorbit (D/O) burn or prior to Entry Interface (EI). The crew should complete at least 4 hours of load-specific standalone entry skills before their first load specific integrated entry simulation. The approximate timeframe for these simulations should be during Launch (L)-12 and L-1 weeks. The final entry is scheduled between the L-1 week.

Flight-specific ENTRY #2 is 5 hours with all runs going to the backup landing site. The first run will start at D/O - 30 minutes, with the rest

starting at 200K.

## **D/O PREP 910XX (210XX)**

Title: Integrated Deorbit Preparation Simulation

Duration: 7.0 hours

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS 1

Source: DA724/Simulation Supervisor Group

Date: 04/99

Lesson(s) Replaced: None

Equipment Required: Full stowage, MS seats stowed, PGSC, standard Deorbit

(D/O) and entry FDF stowed, orbit FDF set up, ACES required for D/O PREP 91042 (all crewmembers), flight-specific locker stowage configuration (for sims occurring

within L-8 weeks)

Preparation: Flight-specific deorbit preparation simulations require that the crew

scheduled to support has completed the first 2 standalone Entry Skills

lessons (ENT SKL 31011, ENT SKL 32011).

Synopsis: Flight-specific crew coordination/interaction with MCC will be exercised

from just prior to entering in the D/O PREP Checklist (C/L) (D/O-5 hours through post-landing activities). The load-specific simulator software

training load for that flight will be used.

## PO INS 9XYYY (2XYYY)

Title: Integrated Post Insertion Simulation

Duration: 4.0 hours

**Note:** Duration varies with flight.

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS (CB IA

attendance mandatory.)

Source: DA724/Simulation Supervisor Group

Date: 04/99

Lesson(s) Replaced: None

Equipment Required: Full stowage, Crew Optical Alignment Sight (COAS), PGSC,

ascent FDF set up, ACES required for PO INS 91042 (all crewmembers), flight-specific locker stowage configuration

(for sims occurring within L-8 weeks)

Preparation: None

Synopsis: Flight-specific crew coordination/interaction with MCC will be exercised

from Lift-Off (L/O)-9 minutes through an approximate MET of 4 hours. This lesson may be credited if a flight's orbit simulation requirements include the post insertion timeline as part of a longer simulation.

## **SYSTEMS 9XYYY (2XYYY)**

Title: Flight-Specific Integrated Systems Simulation

Duration: 6.0 hours

**Note:** Duration varies with flight.

Student: COMMANDER, MS 1, MS 2, PILOT (Prime crew not required.)

Source: DA724/Simulation Supervisor Group

Date: 04/99

Lesson(s) Replaced: None

Equipment Required: Stowage, COAS, PGSC, FDF, flight-specific locker stowage

configuration (for sims occurring within L-8 weeks)

Preparation: None

Synopsis: The first systems simulation is typically the first integrated simulation done

for each flight. Flight- specific crew coordination/interaction with the MCC will be exercised on numerous orbiter systems problems. The timeline used is typically that which the planning team would be involved in

planning for during the mission.

# ACT/DEACT 9XYYY (2XYYY) DAY X 9XYYY (XYYY) MOD 9XYYY (2XYYY)

Title: Integrated Orbit Simulation

Duration: 8.0, 12.0, or 16.0 hours (Per session.) Student: COMMANDER, MS 1, MS 2, MS 3, PILOT

Source: DA724/Simulation Supervisor Group

Date: 07/00

Lesson(s) Replaced: None

Equipment Required: Stowage, COAS, PGSC, FDF, flight-specific locker stowage

configuration (for sims occurring within L-8 weeks)

Preparation: None

Synopsis: Activation and deactivation simulations are used to exercise the Flight

Controllers and Flight Crews in the Orbiter and Module/Element systems and interfaces. The simulations are also to be used for Flight Controller and Flight Crew team building as well as for development of proper coordination between MCC-H, the Crew, and other control centers.

The Spacehab Activation simulation may also be used to satisfy the requirement for the flight-specific post-insertion integrated simulation if it begins in the prelaunch count (usually Lift-Off minus 9 minutes MET). When this option is exercised, the entire Flight Crew must participate.

The Spacehab Deactivation simulation may preclude the need for the flight-specific Deorbit Prep integrated simulation if it is conducted through landing with the entire Flight Crew participating.

## **EVA 9XYYY (2XYYY)**

Title: Integrated Extravehicular Activity Simulation

Duration: 8.0-10.0 hours (Per session. Duration varies with Flight)
Student: COMMANDER, MS 1, MS 2, MS 3, PILOT (CB IA attendance

optional.)

Source: DA724/Simulation Supervisor Group

Date: 04/99

Lesson(s) Replaced: None

Equipment Required: Stowage, COAS, PGSC, FDF, flight-specific locker stowage

configuration (for sims occurring within L-8 weeks)

Preparation: None

Synopsis: One integrated flight-specific EVA simulation is usually required per

planned EVA. This simulation will begin prior to airlock egress and end

post airlock ingress.

## RNDZ/DOCK 9XYYY (2XYYY) RNDZ/PROX 9XYYY (2XYYY)

Title: Integrated Rendezvous/Docking/Proximity Operations/Retrieval

Simulation

Duration: 8.0-10.0 hours (Per session.) **Note:** Duration varies with flight.

Student: COMMANDER, MS 1, MS 2, PILOT Source: DA724/Simulation Supervisor Group

Date: 04/99

Lesson(s) Replaced: None

Equipment Required: Stowage, COAS, PGSC, flight specific locker stowage

configuration (for sims occurring within L-8 weeks)

Preparation: Generic rendezvous simulations require that the crew scheduled to

support meets the requirements for generic rendezvous integrated simulations, as defined in the Rendezvous/Proximity Operations Training Course. Rendezvous simulations including RMS operations require that the RMS crewmember complete the core training within

the PDRS Training Course.

Synopsis: Two runs are required for missions with planned rendezvous/prox

ops/retrieval operations. These runs begin prior to Terminal Phase

Initiation (TI) and continue until retrieval operations completion or docking.

## **MAJOR CASE 9XYYY (2XYYY)**

Title: Integrated Major Case Simulation

Duration: 10.0 hours

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT

Source: DA724/Simulation Supervisor Group

Date: 04/99

Lesson(s) Replaced: None

Equipment Required: Stowage, COAS, PGSC, FDF

Preparation: None

Synopsis: Crew coordination/interaction with MCC will be exercised in the handling

of major malfunction scenarios. Crews scheduled for this type of simulation should contain a high level of experience. The following are

examples of major case simulation scenarios:

- Post-insertion:
  - Rev 3 deorbit
  - Operational Sequence (OPS) 3 overlay uplink
  - Primary Avionics System Software (PASS) recovery after Backup Flight Software (BFS) engage
- Orbit:
  - Emergency deorbit
  - Contingency deorbit/major power downs
  - Loss of Flash Evaporator System (FES)
  - Loss of two fuel cells
  - Loss of two H<sub>2</sub>O loops
  - Loss of two freon loops
  - Major ISS assembly problem
  - Major ISS system failure
- Deorbit Preparation:
  - Deorbit backout

## **PLANNING 9XYYY (2XYYY)**

Title: Integrated Planning Team Simulation

Duration: 8.0 hours

Medium: MCC (MCC/SMTF or MCC/SSTF)

Student: No Crew Required

Source: DA724/Simulation Supervisor Group

Date: 04/99

Lesson(s) Replaced: None Equipment Required: None

Preparation: None

Synopsis: This simulation is an integrated simulation for the purpose of conducting a

planning team shift for a Flight Control Team. If the SMS is not utilized, any vehicle response requirements are provided by the Training Team. This simulation may also be part of a multiple part simulation. The Execute Package generated during these sims can be used to start a full

integrated simulation on the following day.

This simulation can be utilized for either flight-specific or generic

simulations.

## **LONG SIM 9XYYY (2XYYY)**

Title: Integrated Long Duration Simulation

Duration: Up to 56.0 hours

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT

Source: DA724/Simulation Supervisor Group

Date: 04/99

Lesson(s) Replaced: None

Equipment Required: Stowage, COAS, PGSC, FDF, flight-specific locker stowage

configuration (for sims occurring within L-8 weeks)

Preparation: None

Synopsis: This simulation involves continuous support from the SMS/SSTF and

MCC. Flight Crew support is required during crew awake periods only.

Generic long duration simulations require that the crew scheduled to support has completed the training course requirements associated with the timeline to be exercised during the simulation. This will be coordinated

between the Simulation Supervisor, Station Training Lead,

Payload/Communications Department, and the Crew Scheduling Office.

# ORB OPS/EVA 9XYYY (2XYYY)

Title: Integrated Generic Orbit Operations/Extravehicular Activity Simulation

Duration: 8.0 hours

Student: COMMANDER, MS 1, MS 2, PILOT Source: DA724/Simulation Supervisor Group

Date: 04/99

Lesson(s) Replaced: None

Equipment Required: Stowage, COAS, PGSC, FDF

Preparation: None

Synopsis: These simulations involve a known pre-run scenario requiring an

unscheduled EVA. This may include orbiter or payload-related EVAs.

#### **ORBIT OPS 9XYYY (2XYYY)**

Title: Integrated Generic Orbit Operations Simulation

Duration: 8.0 hours

Student: COMMANDER, MS 1, MS 2, MS 3, PILOT

Source: DA724/Simulation Supervisor Group

Date: 07/00

Lesson(s) Replaced: ORBIT OPS 21042

Equipment Required: Stowage, COAS, PGSC, FDF

Preparation: None

Synopsis: These simulations are flight-specific or generic integrated simulations that

involve timeline or payload operations so unique that they are not accurately described by the other flight-specific integrated simulation

lesson descriptions.

MCC only, voice only, or "paper" simulations that do not involve the use of

a Front End Processor (FEP) may also use this lesson code. These

simulations, however, still do "execute" and follow a timeline.

# PYLD DPLY 9XYYY(2XYYY) PYLD L DPLY 9XYYY (2XYYY)

Title: Payload Deploy Simulations

Duration: 8.0 hours (Duration varies with flight.)
Student: COMMANDER, MS 1, MS 2, PILOT
Source: DA724/Simulation Supervisor Group

Date: 04/99

Lesson(s) Replaced: None

Equipment Required: Stowage, COAS, PGSC, FDF, flight-specific locker stowage

configuration (for sims occurring within L-8 weeks)

Preparation: All payload-specific Systems Training Courses through the MAL

3X0XX level must have been completed by the Flight Crew before they

may be scheduled to support.

Synopsis: Integrated deploy simulations will consist of any simulation in which a

payload is deployed by any means other than with the PDRS. This is to

include all currently known carriers, as well as any future carriers.

The PYLD L DPLY code will be used only when the simulation begins at a prelaunch point, usually Lift-Off (L/0)-9 minutes, and proceeds through deploy. This does not include long simulations, which have their own

lesson description and code.

#### **DEBRIEF 9XYYY (2XYYY)**

Title: Integrated Simulation Debrief

Duration: Variable

Student: Flight Control Team and Flight-Crew

**Note:** This debrief lesson code is to be used only when the debrief is

conducted on another day than that of the simulation.

Source: DA724/Simulation Supervisor Group

Date: 04/99

Lesson(s) Replaced: None

Equipment Required: Headsets or conference room

Preparation: None

Synopsis: Integrated simulation debriefs are for discussing and reviewing the

simulation. All issues and concerns are to be brought up as well as scenarios that were not fully understood by either the Flight Control Team

or the Flight Crew.

# ROBOTICS DPLY 9XYYY (2XYYY) ROBOTICS L DPLY 9XYYY (2XYYY)

Title: Payload Deploy and Retrieval System Payload Deploy Simulations

Duration: 8.0 hours

**Note:** Duration varies with flight.

Student: COMMANDER, MS 1, MS 2, PILOT Source: DA724/Simulation Supervisor Group

Date: 04/99

Lesson(s) Replaced: None

Equipment Required: Stowage, COAS, PGSC, FDF, flight-specific locker stowage

configuration (for sims occurring within L-8 weeks)

Preparation: Completion of the PDRS Training Course flow by the RMS

crewmember is required for these simulations.

Synopsis: Integrated deploy simulations will consist of any simulation in which a

payload is deployed with the use of the PDRS. This is to include all currently known payloads such as Hubble Space Telescope (HST), Shuttle-Pointed Autonomous Research Tool for Astronomy (SPARTAN),

etc., as well as any future PDRS deployable payloads.

The PDRS L DPLY code will be used only when the simulation begins at a prelaunch point, usually Lift-Off (L/O)-9 minutes, and proceeds through a deploy. This does not include long simulations which have their own

lesson description and code.

#### **ROBOTICS OPS 9XYYY (2XYYY)**

Title: Payload Deploy and Retrieval System Attached Operations

**Simulations** 

Duration: 8.0 hours (Duration varies with flight.)
Student: COMMANDER, MS 1, MS 2, PILOT
Source: DA724/Simulation Supervisor Group

Date: 03/94

Lesson(s) Replaced: None

Equipment Required: Stowage, COAS, PGSC, FDF, flight-specific locker stowage

configuration (for sims occurring within L-8 weeks)

Preparation: Completion of the PDRS Training Course flow by the RMS

crewmember is required for these simulations.

Synopsis: Integrated Robotics Operations (OPS) simulations will consist of any

simulation in which a payload is already unberthed but is still grappled to the RMS and involves RMS operations (Attached OPS). This is to include all currently known payloads such as Hubble Space Telescope (HST),

SPARTAN, as well as any future payloads.

### PLD-PRELAUNCH 910XX (210XX)

Title: Payload Prelaunch Simulation

Duration: 3.5 hours

Student: Flight-specific payload Flight Controllers Source: DA724/Simulation Supervisor Group

04/99 Date:

Lesson(s) Replaced: None Equipment Required: Headsets

Preparation: None

Synopsis: Payload Prelaunch Simulations are conducted for selected STS missions

> in parallel with the TCDT for the same STS mission. The simulation "piggy-backs" with the TCDT countdown and begins at L-3 hour 30 minutes. It is a voice only simulation and all the scenarios are "greencarded". The intent is to exercise the payload management

personnel for that flight with respect to Launch GO/NO-GO criteria as well

as the entire decision making process.

# **PROX/PDRS 910XX (210XX)**

Title: Proximity/Payload Deploy and Retrieval System Operations

Simulations

8.0 hours (Duration varies with flight.) Duration: COMMANDER, MS 1, MS 2, PILOT Student: Source: DA724/Simulation Supervisor Group

04/99 Date:

Lesson(s) Replaced: None

Equipment Required: Stowage, COAS, PGSC, FDF, flight-specific locker stowage

configuration (for sims occurring within L-8 weeks)

The crew scheduled to support must meet the requirements defined in Preparation:

the Rendezvous/Proximity Operations Training Course. Completion of

the PDRS Training Course flow by the RMS crewmember is also

required for these simulations.

Synopsis: Integrated Proximity/PDRS Operations (OPS) Simulations will consist of

> any simulation which begins with a Payload that is within approximately 400 feet of the orbiter and with the intent of proceeding through with an RMS capture and berthing of the payload. This is to include all currently known payloads such as SPARTAN, etc., as well as any future payload.

#### **INT SIM MEET 91001**

Title: Integrated Simulation Meeting

Duration: 1.0 hour Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS 1

Source: DA724/Simulation Supervisor Group

Date: 07/00

Lesson(s) Replaced: None Equipment Required: None

Preparation: None

Synopsis: The primary purpose of this meeting is for the Flight Crew and Simulation

Supervisors to establish a working relationship to use during the course of

the flight-specific integrated simulation training. The Simulation

Supervisors and Flight Crew will discuss the overall plan and objectives for the flight-specific integrated simulations at this time. The crew may also take this opportunity to inform the Simulation Supervisors of any concerns and issues they would like to see addressed during the course

of the flight-specific integrated simulations.

#### **DEPART 9XYYY(2XYYY)**

Title: Integrated Undocking/Departure Simulation

Duration: 8.0-10.0 hours
Medium: SMTF/MCC/SSTF

Student: COMMANDER, MS 1, MS 2, MS 3, ISS-1, ISS-2, ISS-3, PILOT

Source: DA72/Training Execution Branch

Date: 06/98

Lesson(s) Replaced: None

Equipment Required: Stowage, COAS, PGSC, flight-specific locker stowage

configuration (for sims occurring within L-8 weeks)

Prerequisite Lesson(s): None

Preparation: None

Synopsis: This simulation exercises Shuttle crew/Flight Control Team (FCT) to ISS

crew/FCT communication and coordination during undocking operations. It is preferred that MCC-M participate to provide the most realistic practice

for multi-segment interactions. The simulation spans the activities beginning with powerdown of ISS systems, continues through Shuttle undocking and finishes with ISS system power up or Shuttle Sep 2 burn,

whichever occurs later.

# **CREW TRAINING CATALOG ADDENDUM**

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#### A.1 INTRODUCTION

## **Purpose**

This addendum documents and describes assigned crew activities and training other than those listed in the main section of the Crew Training Catalog. Specifically, it is designed to give readers a general overview of those assigned crew activities routinely conducted prior to flight that are in addition to the formal lessons outlined in the Crew Training Catalog.

#### Scope

This addendum lists the most common preflight crew activities and training requirements for Space Shuttle flight operations, which are assigned in addition to those courses specified in the formal Crew Training Catalog lesson flows. Activities in this addendum have been identified as:

- (a) Flight Support Requirements, such as Annual Physical and Flight Operations Review
- (b) Aircraft Operations Requirements for Assigned Crews, such as T-38 flight time
- (c) Informal Requirements for Assigned Crews, such as admin time

Other additional training requirements for payloads or technical activities associated with a particular flight may not be included in this addendum, but will be included in the crew training plan for that particular shuttle flight as they become identified. This addendum does not cover the astronaut candidate training program, unassigned astronaut training requirements, or post-flight activities.

#### **Addendum Revisions**

Addendum revisions are accomplished by Lesson Change Requests (LCRs). These revisions require the approval of the Crew Training Catalog Addendum supervisor and concurrence by the designated CB training representative. The addendum will be revised along with the Crew Training Catalog on an as-needed basis.

#### A.2 FLIGHT SUPPORT REQUIREMENTS

The following table outlines the content of this section. The activities contained in this section are scheduled items that must be accomplished by flight crewmembers during the time frame indicated. Refer to Flight Support Descriptions on the following pages for details about each activity.

# **Table ADD-1. Flight Support Requirements**

Date Last Modified: 06/08

	1	<del> </del>	1	Sched	1	<b>-</b>		<b>†</b>	<del>                                     </del>	1		Approx	1
Stage	Ref Num	Lesson Code	Hours	Code	С	P	MS1	MS2	MS3	MS4	PS	Timeframe	Comments
o.u.go		2000011 0000	Hours	0000	Ľ	-	IVIOI	WIGZ	WIGG	WIOT	13	rimonamo	@ FCE. Schedule 2
													at a time; try to
													schedule a flown
													crewmember with a
													non-flown
4	FS-1	ACES Fitcheck	2	1	2	2	2	2	2	2	2		crewmember
				_		_		_	_		_	Start of	
4	FS-2	TRAINING KICKOFF MTG	2	8	2	2	2	2	2	2	2	Training Start of	
4	FS-3	OnOrbit Crew Email	1	8	1	1	1	1	1	1	1	Training	
- 4	1 3-3	Cholbit Crew Linaii	'	0	-	-	-	-	-	-	-	Training	Yearly on birth
4	FS-4	Annual Physical	3.5	1	3.5	3.5	3.5	3.5	3.5	3.5		Yearly	month
4	FS-5	Crew Equipment Review	1	8	1	1	1	1	1	1	1		
												Prior to SMS	As required
4	FS-6	Crew Study Guide	2	1	2	2	2	2	2	2	2	start	
4	FS-7	Crew Task Panel	2	8	2								
4	FS-8	Dental	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	Annually	
4 to 3	FS-9	Flight IPT	2	8	2							Every 2 to 8 weeks	As needed
4 10 3	F3-9	riigiit ir i										Every 4 to 8	As needed
4 to 3	FS-10	Flight JOP	2	8	2							weeks	A3 riccaca
4	FS-11	Shuttle Food Sys Briefing	1	8	1	1	1	1	1	1	1		Food Tasting
		, ,											2 hours 3x/week for
												1.5 hours	EVA CMs within 6
4-1	FS-12	Physical Training (Gym)	1.5	8	1.5	1.5	1.5	1.5	1.5	1.5	1.5	3x/week	months of launch
												Prior to 3000	CDR, CB IA, SMS
4	FS-13	SFRM Training Strategy Meeting	1	1	1							SMS Lessons	Team Lead
4	FS-14	Med DSO Brf	2	8	2	2	2	2	2	2	2	SIVIS LESSONS	Informed consent
· ·						_	_			_			Schedule near
4	FS-15	Vision	1	1	1	1	1	1	1	1	1	Annually	Annual Physical
												7 to 8 months	
4	FS-16	FPSR	3	8	3	3	3	3	3	3	3	prior to launch	
3	FS-17	Flight Clothing Fitcheck	2	1	2	2	2	2	2	2	2	L-6 months	@ FCE
3	F3-17	Postflight Appearances Planning		1								L-0 IIIOIIIIIS	⊌ FUE
3	FS-18	Meeting	0.5	1	0.5							L-3 months	
3	FS-19	Crew Photo	4	8	4	4	4	4	4	4	4		
												3 to 4 months	As requested
3	FS-20	Flight Ops Review	8	8	8							prior to flight	
												NLT 2 weeks	
3	FS-21	FDF/ODF Pre Simulation Briefing	1.5	8	1.5	1.5	1.5	1.5	1.5	1.5	1.5	before start of int sims	
3	F5-21	PDF/ODF Pre Simulation Briefing	1.5	ď	1.5	1.5	1.5	1.5	1.5	1.5	1.5	L-5 to L-4	
3	FS-22	PAO Big Picture Mtg	1	8	1	1	1	1	1	1	1	months	
J	F3-22	FAO DIG FICIUIE WILG		0							- 1	HIUHHI	

**Table ADD-1. Flight Support Requirements (Concluded)** 

Date Last Modified: 06/08

2 F.	FS-24 FS-25 FS-26 FS-27 FS-28 FS-29 FS-30 FS-31 FS-32 FS-33 FS-34	Lesson Code VITT Brief Guest List L-16 DA7/CB T/U Menu Review  FCOD MRR Individual PAO Interview Contingency Landing Training CEIT KSC Videotapes	Hours  2 2 0.5 1  1.5 1.5 1.5	Sched Code 8 8 1 2	2 2 0.5 1	P 2 2 0.5 1	2 2 0.5 1	2 2 0.5	2 2 0.5	2 2 0.5	2 2 0.5	Approx Timeframe	Comments
2 F.	FS-24 FS-25 FS-26 FS-27 FS-28 FS-29 FS-30 FS-31 FS-32 FS-33 FS-34	Guest List L-16 DAT/CB T/U  Menu Review  FCOD MRR Individual PAO Interview Contingency Landing Training CEIT	2 0.5 1 1.5 1.5	8 1 2	2 0.5	2 0.5	2 0.5	2 0.5	2 0.5	2	2	L-16 weeks	
2 F.	FS-25 FS-26 FS-27 FS-28 FS-29 FS-30 FS-31 FS-32 FS-33 FS-33	L-16 DA7/CB T/U Menu Review  FCOD MRR Individual PAO Interview Contingency Landing Training CEIT	0.5 1 1.5 1.5	1 2 8	0.5	0.5	0.5	0.5	0.5			L-16 weeks	
2 F.	FS-26 FS-27 FS-28 FS-29 FS-30 FS-31 FS-32 FS-33 FS-34	Menu Review  FCOD MRR Individual PAO Interview Contingency Landing Training CEIT	1.5 1.5	8					_	0.5	0.5	L-16 weeks	
2 F.	FS-27 FS-28 FS-29 FS-30 FS-31 FS-32 FS-33 FS-34	FCOD MRR Individual PAO Interview Contingency Landing Training CEIT	1.5 1.5	8					1	1	1		
2 F.	FS-28 FS-29 FS-30 FS-31 FS-32 FS-33 FS-34	Individual PAO Interview Contingency Landing Training CEIT	1.5				-	1		-	- 1		Other crewmembers
2 F.	FS-28 FS-29 FS-30 FS-31 FS-32 FS-33 FS-34	Individual PAO Interview Contingency Landing Training CEIT	1.5										as assigned by CDR
2 F.	FS-29 FS-30 FS-31 FS-32 FS-33 FS-34	Contingency Landing Training CEIT		0	1.5							L-3 months	as assigned by SETT
2 F.	FS-30 FS-31 FS-32 FS-33 FS-34	CEIT	1.5	8	1.5	1.5	1.5	1.5	1.5	1.5	1.5	L-3 months	
2 F.	FS-31 FS-32 FS-33 FS-34			2	1.5	1.5						L-6 weeks	
2 F.	FS-31 FS-32 FS-33 FS-34												Additional travel time
2 F:	FS-32 FS-33 FS-34	NSC videotapes	12	8	12	12	12	12	12	12	12	L-8 weeks	required
2 Fi 2 Fi 2 Fi 2 Fi 2 Fi	FS-33 FS-34	Annual Ethics Briefing	1	<u>8</u> 8	1	1	1	1	1	1		Yearly Yearly	
2 F:	FS-34	Annual Security Briefing	1	8	1	1	1	1	1	1		Yearly	
2 F		Annual IT Security Briefing	1 1	8	1	1	1	1	1	1		Yearly	
2 F		ELSA Training	0.25	1	0.25	0.25	0.25	0.25	0.25	0.25		Yearly	
	FS-25	L-6 DA7/CB T/U	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	L-6 weeks	
2 F	FS-36	TV STRATEGY	1	8	1	1	1	1	1	1	1	L-5 weeks	
2   F													@ FCE; sometimes
	FS-37	BENCH REVIEW	8	8	8	8	8	8	8	8	8	L-5 weeks	split over two days
													With PGSC
													Engineer; best to
2 F	FS-38	POC REVIEW	1.5	1	1.5	1.5	1.5	1.5	1.5	1.5	1.5	L-5 weeks	schedule around Bench Review
	10-50	1 OO KEVIEW	1.0	-	1.5	1.5	1.5	1.5	1.5	1.5	1.0	L-5 WCCR3	L-5 weeks for
													approximate
2 F	FS-39	Crew Press Conf	4	8	4	4	4	4	4	4	4	L-5 weeks	timeframe
1 F	FS-40	FCOD FRR	2	1	2							L-1 month	
													Should be scheduled directly before the
													first Integrated
													Ascent or Entry
													simulation after
													TCDT
1 F	FS-41	Range Safety Brief at JSC	0.25	2	0.25	0.25							
		and the second s											Additional travel time
1 F		TCDT	22	8	22	22	22	22	22	22	22	L-3 weeks	required
		L-10 PHYSICAL	3	8	3	3	3	3	3	3	3	L-10 days	
		L-10 Bench Review	3	1				<b>.</b>	3			L-10 Days	Loadmaster only
		FNL FDF RVW FLT DIR MTG	2	<u>8</u> 8	4	2	2	2	4	2	2	L-4 weeks L-1 week	
1 1 5	FS-46	FLI DIR MTG		0						2	2	L-1 week	
								Г					Loadmaster +1; this
													bench review is only
													required for Shuttle
													Missions launching
													logistics modules
													(i.e., MPLM, Spacehab, JEM,
0 F	FS-47	MPLM KSC Bench Review	8	2					8				Columbus)
		Initial FDF T/U	1	8	1	1	1	1	1	1	1	L-11 months	Optional
		MSN Study Time	1	1	1	1	1	1	1	1	1		As needed
													@ KSC during TCDT
0 F	FS-50	RANGE SAFETY	1	2	1	1		<u> </u>				L-3 weeks	
	E0 E /	DDEELT MENUL								0 -		2 weeks prior	As needed
0 F	FS-51	PREFLT MENU	0.5	2	0.5	0.5	0.5	0.5	0.5	0.5	0.5	to TCDT	An needed
0 F	FS-52	Earth Observations Briefing	1	8	1	1	1	1	1	1	1	L-9 to L-1 month	As needed
J   F	. 0-32	Latti Observations Difeting		J	<del></del>			<del>-</del>	_		1	monu	SHAB/PYLD flights
1 1	FS-53	Payload MST	2 days	4			16	16	16	16	16	L-2 months	only
0 F			, 5		i						-		SHAB/PYLD flights
0 F	FS-54	Payload IVT	2 days	4			16	16	16	16	16	L-6 weeks	only
		-											SHAB/PYLD flights
0 F		Payload FDF Review	4	8		L	4	4	4	4	4	L-4 weeks	only
0 F	FS-55	,										L-4 WEEKS	
0 F	FS-55	,										L-4 Weeks	First time
0 F	FS-55	,							·		-	L-4 WEEKS	

#### FLIGHT SUPPORT ACTIVITY DESCRIPTION

FS-1 <u>ACES Fitcheck</u>

Duration: 2.0 hours

Medium: Flight Crew Equipment (FCE) Facility

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS

(Schedule individually.)

Timeframe: L-6 months Source: USA/FCE

Synopsis: This is a fit check of the ACES and parachute harness, which are worn

during launch and entry in case of an emergency bailout by the crew

during controlled flight.

FS-2 TRAINING KICKOFF MTG

Duration: 2.0 hours Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS

Timeframe: Start of Training

Source: DA72/Training Execution Branch

Synopsis: This is a meeting led by the Training Manager, in which all Training

Leads and Subject Matter Experts (SMEs) are introduced to the crew and flight directors. A high level training plan for each discipline is

discussed.

FS-3 OnOrbit Crew Email

Duration: 1.0 hour Medium: Classroom

Student: CDR, PLT, MS 1, MS 2, MS 3, MS 4, MS 5

Timeframe: Stage 4

Source: CB/Astronaut Office

Synopsis: This is a briefing conducted by the technical assistant to the Chief of

the Astronaut Office. The On-Orbit Email event informs the shuttle crewmembers of the current policies and procedures regarding the use

of the on-orbit e-mail. The crewmembers are also briefed on the

policies for the Internet Protocol (IP) phone and Orbiter

Communications Adapter (OCA) video-teleconference, and Handheld

Amateur Radio Operator (HAM) radio messages.

FS-4 Annual Physical

Duration: 3.5 hours\*

Medium: Flight Medicine Clinic/Bldg. 8 – JSC

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT (Schedule

individually.)

Frequency: Annually on birth month

Source: SD2/Medical Operations Branch

Synopsis: Crewmembers are required to fast for 12 hours before their physical.

The physical consists of blood draws, electrocardiogram, pulmonary functions, an ophthalmology exam, and a dental visit, if requested.

\*Note: If a treadmill or proctology exam is required, add one hour per

procedure to the baseline 3 1/2-hour exam.

FS-5 <u>Crew Equipment Review</u>

Duration: 1.0 hour Medium: Crew Office

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS

Timeframe: Stage 4 Source: USA/FCE

Synopsis: Astronaut Office crew equipment personnel provide a briefing to inform

crewmembers of the known scheduled activities for their flight and discuss crew equipment needed. Crewmembers select two training

shirts shortly following this meeting.

FS-6 Crew Study Guide

Duration: 2.0 hours Medium: Self Study

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS

(Schedule individually.)

Timeframe: Upon crew assignment through start of SMS training

Source: DA7/Space Flight Training Management Office

Synopsis: The crew will be responsible for reviewing the crew study guide prior to

SMS training start time. This is done to prepare crew for their simulations beforehand in an effort to better utilize SMS facilities.

FS-7 <u>Crew Task Panel</u>

Duration: 2.0 hours
Medium: Meeting Room
Student: COMMANDER
Timeframe: Start of Training

Source: DA8/Flight Director's Office

Synopsis: This is a meeting chaired by the Flight Director's office to discuss crew

tasks. It is supported by the Training Manager to discuss the tasking effects on crew loading. The goal of the meeting is to assign the crew tasks in a way that is most effective and efficient for training and on

orbit tasks.

FS-8 Dental

Duration: 0.5 hours

Medium: Clinic (B8/278)

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS

Timeframe: Annually

Source: Dental Services

Synopsis: This is the annual dentist appointment.

FS-9 Flight IPT

Duration: 2.0 hours
Medium: Meeting Room
Student: COMMANDER
Timeframe: Every 2-8 wks

Source: Flight Integration Manager (FIM)

Synopsis: This is the Integrated Product Team (IPT) meeting, in which all flight

products are discussed and issues are resolved.

FS-10 Flight JOP

Duration: 2.0 hours Medium: Meeting Room

Student: Representative from assigned crew

Frequency: Every 4-8 wks

Source: DA8

Synopsis: This is the Joint Operations Plan meeting chaired by the Flight

Director's office to work out operations issues specific to a particular

flight.

#### FS-11 Shuttle Food Sys Briefing

Duration: 1.0 hour

Medium: Food System Engineering Facility

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS

Timeframe: L-9 months

Source: SA/Space and Life Sciences Directorate

Synopsis: Each of the categories of foods--fresh food, intermediate moisture,

natural form, rehydratable, and thermostabilized--are discussed, and opening techniques for each type of packaging--beverage pouch, can, retort pouch, and square rehydratable container--are demonstrated. Crewmembers are given an opportunity to evaluate the different foods and beverages and are responsible for selecting their own personal

flight menus. Food preferences for the Terminal Countdown

Demonstration Test (TCDT), preflight food service, and launch day carry-on are also discussed. A second session may be arranged at a

later date upon request by one or more of the crewmembers.

#### FS-12 Physical Training (Gym)

Duration: 1.5 hours

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS

(Schedule individually.)

Frequency: 3 times per week

Synopsis: This time allows for crewmembers to keep up their physical training

while preparing for flight. It should not be scheduled in place of lunch. The time of 1.5 hours enables transit time and time to shower after

working out.

Beginning at six months prior to launch. Shuttle EVA crewmembers should be scheduled for a minimum of 3 two-hour sessions per week.

#### FS-13 SFRM Training Strategy Meeting

Duration: 1.0 hour
Medium: Classroom
Student: COMMANDER

Timeframe: Prior to any 30000 Level SMS lessons

Source: DA7/Space Flight Training Management Office

Synopsis: This meeting will be held with:

• CDR

- CB Instructor Astronaut (IA)
- SMS Team Lead
- Topics to be addressed will include:
  - SMS lessons the CB IA will attend (additional to those already marked as mandatory in the Crew Training Catalog)
  - CDR's expectations
  - CB IA expectations
  - CDR's, CB IA's and SMS Team Lead's roles for debriefing CRM topics during SMS debriefs

After this meeting, the SMS Team Lead will supply the name of the primary assigned CB IA and which SMS lessons he/she will attend to the Training Manager.

CB IA attendance is mandatory for the following classes:

- ASC SKL 33011
- E SKL 32011
- PO INS OPS 91012

CB IA attendance is possible for the following classes:

- DPLY MAL T/L 91012
- RETR MAL T/L 91012
- EVA 910XX

#### FS-14 Med DSO Brf

Duration: 2.0 hours Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS

Timeframe: L-9 months

Source: SA/Space and Life Sciences Directorate

Synopsis: Specific medical experiments are proposed for each flight. Crew

participation in DSO's is optional and voluntary. Training for a medical DSO is highly variable and may consist of one or more sessions to familiarize the crew with equipment needed to perform the experiment,

as well as baseline data takes, sometimes through launch week.

FS-15 Vision

Duration: 1.0 hour Medium: Clinic (B8)

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS

Timeframe: Annually (Near annual physical)

Source: Flight Medicine

Synopsis: A complete visual system evaluation is performed, to include dilation of

the pupils. A detailed stowage plan for eyeglasses and contact lenses

is delineated within 6 months of launch.

FS-16 FPSR

Duration: 3.0 hours Medium: Meeting Room

Student: Representative from assigned crew

Timeframe: 7-8 months prior to launch

Source: Flight Integration Manager (FIM)

Synopsis: This meeting is the last opportunity to manifest simple middeck

payload items. 3-4 weeks prior to the Flight Planning Stowage Review (FPSR), a FPSR Assessment List is distributed to the IPT identifying a list of candidate DTOs/DSOs, and secondary payloads that should be

assessed for compatibility with mission capabilities (crew time, stowage volume, weight, etc.). The FPSR occurs as a special IPT,

chaired by the Flight Manager.

FS-17 Flight Clothing Fitcheck

Duration: 2.0 hours

Medium: Flight Crew Equipment (FCE) Facility

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS

(Schedule individually.)

Timeframe: L-6 months Source: USA/FCE

Synopsis: Measurements are taken for flight clothing to be worn while in orbit.

Selection of personal crew equipment to be flown for each individual is

also made.

#### FS-18 Postflight Appearances Planning Meeting

Duration: 0.5 hours
Medium: Crew Office
Student: COMMANDER
Timeframe: L-3 months

Source: CB/Astronaut Appearances Office

Synopsis: This meeting will explain role differences between the Publicist and

Appearance Administrator, define NASA's expectations for the postflight program, inquire about preferences for postflight

visits/publicity, determine tentative postflight period, inquire about pre-arranged appearance requests that need to be logged into the appearance database, and determine the Commander's preference for communication flow with other crew members. The meeting also

communication flow with other crew members. The meeting also serves to determine if any short-fused, high profile appearances held *immediately* after landing are in accordance with the Commander's

planning schedule.

#### FS-19 Crew Photo

Duration: 4.0 hours
Medium: Bldg. 8 Studio

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS

Timeframe: L-8 months

Source: IS/Information and Imaging Sciences Division

Synopsis: Each assigned crew is required to take a crew photo. Timeframe for

this picture is dependent on when the crew has finished designing their crew patch. This photo may require more than one visit to the photo studio, however, the standard should be to placehold one 4-hour

session.

## FS-20 Flight Ops Review

Duration: 8.0 hours (over the course of 3-4 days)

Medium: Meeting Room

Student: Representative from assigned crew

Timeframe: 3-4 months prior to flight Source: Flight Director's Office

Synopsis: This is a meeting held with all Mission Operations Directorate

disciplines, Shuttle Program Office, and any Shuttle Program customers to ensure all products are available to properly train the

crew.

#### FS-21 FDF/ODF Pre Simulation Briefing

Duration: 1.5 hours

Medium: B4S, Crew Conference Room

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS (Including ODF

and Expedition (EXP) crews, if available.)

Timeframe: At least 2 weeks before start of integrated training.

Source: DO3/Flight Procedures Management

Synopsis: Prior to the start of integrated crew training, the FDF (and ODF)

Coordinator(s) conduct a Pre Simulation Briefing with the shuttle crew. At the meeting, the Coordinator(s) review the Content List(s) with the

crew to determine the quantity of the flight books, cue cards,

miscellaneous documents, removable software, hardware, and office

supplies required for sims and for flight.

# FS-22 PAO Big Picture Meeting

Duration: 1.0 hour Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS

Timeframe: L-5 months to L-4 months

Source: AP/Office of *Communications and* Public Affairs

Synopsis: The crew is required to meet with the Office of Public Affairs to discuss

strategy of public relations-type activities to be performed during

preparation for flight.

#### FS-23 VITT Brief

Duration: 2.0 hours Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS

Timeframe: L-3 months

Source: CA4/Vehicle Integration Test Office

Synopsis: This briefing, conducted by the lead Vehicle Integration Test Team

(VITT) engineer for that particular flight, will outline the schedule of activities to be conducted at KSC during the launch processing flow. The crew will decide which of the activities will be supported and which

crewmembers will support them.

The primary tests requiring crew support are the following:

- Crew Equipment Interface Test
- Payload Interface Verification Test
- Payload Mission Sequence Test
- Terminal Countdown Demonstration Test

FS-24 Guest List

Duration: 2.0 hours Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS

Timeframe: Stage 2 Source: CB

Synopsis: This is scheduled by the crew secretary for each crewmember to go

through their guest list for launch.

FS-25 L-16 DA7/CB T/U and L-6 DA7/CB T/U

Duration: 0.5 hours
Medium: Meeting room

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS

Timeframe: L-4 months and L-2 months

Source: DA7/Space Flight Training (SFT) Director

Synopsis: This meeting is held with the CDR and Training organization to review

flight training status and address any training concerns that the CDR

may have.

FS-26 Menu Review

Duration: 1.0 hour Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS

Timeframe: Stage 2

Source: USA Space Food Systems Laboratory

Synopsis: This is a review with the food lab to go over menu item preferences

with each crewmember.

FS-27 FCOD MRR

Duration: 1.5 hours
Medium: Classroom
Student: COMMANDER
Timeframe: L-3 months

Source: CB/Astronaut Office

Synopsis: Mission status to FCOD and CB management. CDR (and other

crewmembers designated by CDR) will status FCOD director, FCOD deputy director, Chief and Deputy Chief of the Astronaut Office on any

outstanding issues relating to their mission.

FS-28 Individual PAO Interview

Duration: 1.5 hours

Medium: Bldg. 2 Studio (Room 135)

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS

(Schedule individually.)

Timeframe: L-3 months

Source: AP/Office of Communications and Public Affairs

Synopsis: Each crewmember is required to hold an individual interview with the

Office of Public Affairs.

FS-29 Contingency Landing Training

Duration: 1.5 hours Medium: Classroom

Student: COMMANDER, PILOT

Timeframe: L-6 weeks

Source: DM3/Landing Support Office

**Note:** Equipment required (PC with projector)

Synopsis: Crew will be provided the capabilities and procedures for contingency

landings at Transatlantic Abort Landing (TAL), East Coast Abort Landing (ECAL), Department of Defense Emergency Landing Site (DOD ELS), and Non-DOD ELS sites. Items covered will include:

communications pre-landing, convoy support, post-landing

communications, and post-landing procedures.

FS-30 CEIT

Duration: 1 and 1/2 days

**Note:** Schedule additional time for travel.

Medium: KSC

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS

Timeframe: L-8 to L-6 weeks

Source: CA4/Vehicle Integration Test Office

Synopsis: This test consists of In-Flight Maintenance (IFM) checklist procedures

walk-through, fit check of crew equipment in crew compartment, accessibility checks, payload fit checks and procedures, payload bay

walkdown and sharp edge inspection. An additional Crew Equipment

Interface Test (CEIT) is performed for Spacehab flights.

FS-31 KSC Videotapes

Duration: 1.0 hour Medium: Videotape

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT (Schedule

individually.)

Frequency: Annually Source: KSC

Synopsis: Videotaped safety briefings required by Kennedy Space Center (KSC)

prior to flight, which cover KSC facilities; not all videos require annual

review.

FS-32 Annual Ethics Briefing

Duration: 1.0 hour Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT (Schedule

individually.)

Frequency: As required

Synopsis: All NASA Civil Servants are required to attend the annual ethics

briefing as prescribed by JSC Human Resources Office.

FS-33 Annual Security Briefing

Duration: 1.0 hour Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT (Schedule

individually.)

Frequency: As required

Synopsis: All NASA civil servants are required to attend the annual security

briefing as prescribed by JSC Human Resources Office.

FS-34 Annual IT Security Briefing

Duration: 1.0 hour Medium: CBT

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT

Timeframe: Annually

Source: Information Systems Directorate

Synopsis: Annual requirement for all JSC employees to review IT security

policies.

FS-35 ELSA Training

Duration: 0.25 hours Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT

Timeframe: Annually

Source: NS226/Safety Learning Center

Synopsis: Required for unescorted badges at KSC and Edwards AFB. Training

is provided on Emergency Life Support Apparatus (ELSA).

FS-36 TV STRATEGY

Duration: 1.0 hour Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS

Timeframe: L-5 weeks

Source: AP/Office of Communications and Public Affairs

Synopsis: Review the TV programming plan for the mission and discusses any

in-flight special events. CAPCOMs should also be scheduled for this meeting. This briefing will be supplemented with a written package of material to be delivered to the crew during quarantine. This package

will include: approved client list, TV schedule, and hot topics.

FS-37 <u>BENCH REVIEW</u>

Duration: 8.0 hours

Medium: Flight Crew Equipment (FCE) Facility

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS

Timeframe: L-5 weeks Source: USA/FCE

Synopsis: The crewmembers conduct a physical inventory of clothing, personal

items, and equipment they will take onboard the orbiter. Any lastminute changes or modifications to the clothing or equipment inventory are made at this time. Upon completion of the bench review, the equipment, along with food to be flown on the flight, is shipped to the launch site for stowage on the orbiter. This requires that the bench

review occur on or about the L-28 day timeframe.

#### FS-38 POC Review

Duration: 1.5 hours Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS

Timeframe: L-5 weeks

Source: MS4/Flight Software Office

Synopsis: This meeting is designed to review PGSC-related items (applications,

procedures, ops notes, etc.) that the Crew, CAPCOM, and Flight

Activities Officers (FAOs) should be aware of going into their upcoming flight. The meeting will also provide the Crew, CAPCOM, and FAOs an opportunity to understand schedules and strategies for PGSC-related activities once on orbit, such as OCA updates and family mail. Additionally, the PGSC Usage Chart, PGSC ops notes, and PGSC

backup plan are discussed.

#### FS-39 <u>Crew Press Conf</u>

Duration: 4.0 hours

Medium: Bldg. 2 Studio (Room 135)

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS

Timeframe: L-5 weeks

Source: AP/Office of Communications and Public Affairs

Synopsis: The conference is generally divided into a group press conference

followed by round robin crew interviews.

#### FS-40 FCOD FRR

Duration: 2.0 hours
Medium: Meeting Room
Student: COMMANDER
Timeframe: L-1 month

Source: Flight Crew Operations Directorate

Synopsis: This is a meeting between the CDR and management in the Flight

Crew Operations Directorate to review any concerns of the flight.

FS-41 Range Safety Brief at JSC

Duration: 0.25 hours Medium: Classroom

Student: COMMANDER, PILOT

Timeframe: Stage 1

Source: DA8/Flight Director Office

**Note:** Should be scheduled directly before the first Integrated Ascent or Entry

simulation after Terminal Countdown Demonstration Test (TCDT).

Synopsis: Quick brief with Flight Director Office to obtain required signatures and

assure that the crew knows their responsibility with regard to Range

Safety at KSC.

FS-42 TCDT

Duration: 22.0 hours

**Note:** Schedule additional time for travel.

Medium: KSC

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS

Timeframe: L-4 weeks to L-2 weeks

Source: CA4/Vehicle Integration Test Office

Synopsis: This is a dress rehearsal for the crew and their launch team in

preparation for launch. It includes orbiter, payload, safety, crew

escape briefings, and hands-on emergency training prior to the launch

countdown test itself.

FS-43 L-10 PHYSICAL

Duration: 3.0 hours

Medium: Flight Medicine Clinic/Bldg. 8

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS

Timeframe: L-10 days

Source: SD2/Medical Operations Branch

Synopsis: Crewmembers are required to fast for 12 hours before the L-10

physical. The physical consists of:

• Blood draws from each crewmember

Collection of baseline data for medical Detailed Secondary

Objectives (DSOs)

Physical examinations

• MED REFR 91001 is scheduled with the L-10 physicals.

FS-44 <u>L-10 Bench Review</u>

Duration: 3.0 hours

Medium: Flight Crew Equipment (FCE) Facility

Student: Loadmaster only

Timeframe: L-10 days Source: USA/FCE

Synopsis: The crewmembers conduct a physical inventory of clothing, personal

items, and equipment they will take onboard the orbiter. Any last minute changes or modifications to the clothing or equipment inventory

are made at this time.

FS-45 FNL FDF RVW

Duration: 4.0 hours Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS

Timeframe: L-4 weeks

Source: DO3/Mission Operations Procedures Branch

Synopsis: This is a final review of the checklists, cue cards, and manuals that will

be flown onboard the orbiter. This session allows the crew to highlight

material and add non-technical reminders at the review. Upon completion of the review and any changes, the FDF is packed and

shipped to the launch-site for stowage onboard the orbiter.

FS-46 FLT DIR MTG

Duration: 2.0 hours

Medium: JSC Crew Quarters

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS

Timeframe: L-1 week

Source: DA8/Flight Director Office

Synopsis: This meeting takes place the week before launch. At this time, the

Flight Directors, CAPCOMs, FCOD Management, and other appropriate individuals meet with the flight crew to discuss flight operations and any safety issue before the flight. Crewmembers are given an opportunity to voice any concerns they may have prior to

flight.

FS-47 MPLM KSC Bench Review

Duration: 8.0 hours

Note: This bench review is only required for Shuttle Missions launching

logistics modules (i.e., MPLM, Spacehab, JEM, Columbus).

Medium: Flight Crew Equipment (FCE) Facility

Student: Loadmaster (+1)

Timeframe: Stage 0 Source: USA/FCE

Synopsis: The crewmembers conduct a physical inventory of clothing, personal

items, and equipment they will take onboard the orbiter. Any last minute changes or modifications to the clothing or equipment inventory

are made at this time.

FS-48 <u>Initial FDF T/U</u>

Duration: 1.0 hour

Medium: Conference Room

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS (Including ODF

and Expedition (EXP) crews, if available.)

Timeframe: L-12 months

Source: DO3/Flight Procedures Management

Synopsis: This is an optional class that introduces key FDF and ODF personnel

and processes to the crew early in the flow. At the meeting, the Coordinator(s) will review key FDF/ODF events, and discuss the FDF

Workflow system as well as the Coordinator's roles and

responsibilities.

FS-49 MSN Study Time

Duration: 1.0 hour Medium: Self-Study

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS

(Schedule individually.)

Frequency: 3 times per week at SMS training start through L-1 week

Synopsis: This time allows crewmembers to review lesson material and prepare

for upcoming simulator sessions as needed.

#### FS-50 RANGE SAFETY

Duration: 1.0 hour Medium: Classroom

Student: COMMANDER, PILOT

Timeframe: Usually occurs during TCDT Source: Cape Canaveral Air Station

Synopsis: Cape Canaveral Air Station provides a brief to the crew of actions that

will be taken if there is a shuttle loss of control over a populated area.

#### FS-51 PREFLT Menu

Duration: 0.5 hours Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT

Timeframe: 2 weeks prior to TCDT

Source: Food Lab

Synopsis: Review menu items for TCDT and quarantine.

#### FS-52 <u>Earth Observations Briefing</u>

Duration: 1.0 hour Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS

Timeframe: L-9 months to L-1 month

Source: SX/Human Exploration Science Office

Synopsis: Once the trajectory and ground track for a flight are calculated, the

Earth Science Branch will determine specific sites of interest for photography and viewing by the crew. Typical topics for discussion and observation are geological, meteorological, oceanographic,

environmental, and geomorphological sites. Discussion also includes the types of film to be used and specific changes in the earth at given locations. Total time for training is dependent upon the crew, and the level of detail they request in these briefings. An initial briefing is held

with the crew to establish specific briefing requirements.

FS-53 Payload MST

Duration: 2 days

**Note:** Duration is variable. Schedule additional time for travel.

Medium: KSC

Student: MS 1, MS 2, MS 3, MS 4, PS (Schedule Payload Crew, as required.)

Timeframe: L-2 months

Source: CA4/Vehicle Integration Test Office

Synopsis: A Mission Sequence Test (MST) is performed for certain Spacehab

missions and other missions with complex payloads to verify that their

payload and orbiter systems operate per mission planning. It is

supported by the applicable payload crewmembers.

FS-54 Payload IVT

Duration: 2 days

**Note:** Duration is variable. Schedule additional time for travel.

Medium: KSC

Student: MS 1, MS 2, MS 3, MS 4, PS (Schedule Payload Crew, as required.)

Timeframe: L-6 weeks

Source: CA4/Vehicle Integration Test Office

Synopsis: This is scheduled for Spacehab or complex payload flights only. Verify

electrical and functional interfaces between payload and orbiter. It is

supported by the applicable payload crewmembers.

FS-55 Payload FDF Review

Duration: 4.0 hours Medium: Classroom

Student: MS 1, MS 2, MS 3, MS 4, PS (Schedule Payload Crew, as required.)

Timeframe: L-4 weeks

Source: DO3/Mission Operations Procedures Branch

Synopsis: This is scheduled for Spacehab or complex payload flights only.

Crewmembers associated with payload activity may be required to participate in an additional FDF review for their payload procedures.

FS-56 Brooks AFB Centrifuge

Duration: 4.0 hours

**Note:** Travel time required.

Medium: Centrifuge

Student: MS 1, MS 2, MS 3, PILOT, PS (Schedule first-time crewmembers, as

required.)

Timeframe: L-9 months to L-6 months

Source: Brooks AFB, San Antonio, TX and CB/Astronaut Office

Synopsis: This is an optional requirement to verify proper ACES suit fit under

G loading.

#### A.3 AIRCRAFT OPERATIONS REQUIREMENTS FOR ASSIGNED CREWS

The following table summarizes the content in this section. The activities contained in this section are schedule items that should be accomplished by assigned crewmembers as indicated below. Refer to the Aircraft Operations Activity Descriptions on the following pages for details about each activity.

Table ADD-2. Aircraft Operations Requirements for Assigned Crews

Date Last Modified: 07/07

				Sched								Арргох	
Stage	Ref Num	Lesson Code	Hours	Code	С	Р	MS1	MS2	MS3	MS4	PS	Timeframe	Comments
												Bi-wkly until L-	4-6 hours travel time
												12 wks; Wkly	
4 to 1	A/C-1	STA	2	1	2	2						L-12 to launch	
4 to 1	A/C-2	T38 Flight for STAs	6	2	6	6							
Variable	A/C-3	T38 Q Check	3	1	3	3	3	3	3	3		Annually	
												Annually	Front seat T-38
													crewmember. Travel
													time required. EP
Variable	A/C-4	T38 EP Sim	3	1	3	3							Sim
												Annually	Prior to T-38 check
Variable	A/C-5	T38 Groundschool	4	1	4	4	4	4	4	4			rides
4 to 1	A/C-6	T38 Flight For Pilots	15	1	15	15						Monthly	
4 to 1	A/C-6	T38 Flight For MSs	5	1			5	5	5	5	5	Monthly	
Variable	A/C-7	AMES	12*	1	12	12						Bi-annually	Travel time required
													Front seat T-38
		T38 Instrument Ck (3 hours x 2											crewmember. Bag
Variable	A/C-8	people)	3		3	3							Ride
												1 time within	1 sortie with L-6
												L-6 months	months
2		HAT Flight	4	1	4	4							
0	A/C-10	Physiological Refresher Training	3.5	1	3.5	3.5	3.5	3.5	3.5	3.5	3.5	Every 3 years	Altitude Chamber

**Note:** This AMES exercise includes travel time of approximately 1.5 days to and from Ames.

#### AIRCRAFT OPERATIONS ACTIVITY DESCRIPTIONS

A/C-1 STA

Duration: 2.0 hours

**Note:** Schedule an additional 4-6 hours travel time.

Medium: STA

Student: COMMANDER, PILOT (Schedule together.)

**Note:** Although the requirement for this activity is for CDR and PLT, other

crewmembers are invited to participate when feasible.

Timeframe: (see below)

Source: CC/Aircraft Operations Division

Synopsis: The Shuttle Training Aircraft (STA) is flown by the CDR and PLT to

familiarize themselves with an aircraft that approximates the handling characteristics of the orbiter during approach and landing. STAs are flown at the White Sands Missile Range (WSMR), Edwards Air Force

Base (EDW), or the Kennedy Space Center (KSC).

• From the time the crew assignment is announced to the L-9 month timeframe, the CDR and PLT will each fly the STA once per month.

- From L-9 to L-6 months a crewmember flying in an assigned position for the first time will fly the STA on a bi-weekly basis.
   However, a crewmember flying in the same position in which they have flown previously will continue to fly at a once per month rate.
- From L-6 to L-3 months, the CDR and PLT will fly on a bi-weekly basis regardless of past flight history.
- From L-3 months to launch, the CDR and PLT will fly the STA on a weekly basis.

#### Additional considerations:

- Although not required, the CDR and PLT should fly four nighttime periods during the L-6 month to launch period.
- From L-2 months to launch, the crew usually flies two EDW flights.
- From L-1 month to launch, the crew usually flies two KSC flights.
- Highly desired for the crew to fly at least two periods wearing the Launch and Entry Suit.
- For flights having a nighttime launch and/or landing planned, the CDR and PLT will increase the number of nighttime periods.

**Note:** Approximate travel times to/from the required sites is as follows:

6 hours for EDW, 4-6 hours for KSC and 4 hours for WSMR.

A/C-2 T-38 Flight for STAs

Duration: 6.0 hours Medium: T-38 Aircraft

Student: All T-38 flight crewmembers

Frequency: Bi-weekly until L-12 weeks; Weekly L-12 to launch

Source: CC/Aircraft Operations Division

Synopsis: Flight time to and from STA.

A/C-3 T-38 Q Check

Duration: 3.0 hours Medium: T-38 Aircraft

Student: All T-38 flight crewmembers

Frequency: Annually

Source: CC/Aircraft Operations Division

Synopsis: Proficiency check flight includes a written examination and ejection

seat/ground egress training. Mission Specialists (MSs) will complete a written exam and demonstrate proficiency in instrument procedures in

conjunction with their annual proficiency check.

A/C-4 <u>T-38 EP Sim</u>

Duration: 3.0 hours

**Note:** Schedule additional time for travel.\*

Medium: T-38 Aircraft

Student: Front seat T-38 pilots

Frequency: Annually

Source: CC/Aircraft Operations Division

Synopsis: Front seat T-38 crewmembers travel to one of the following Air Force

Training Bases (Randolph, Vance, Reese, Laughlin, or Columbus) for a 1.3 hour simulation with an Air Force or Contract instructor. Training includes a review of the T-38 checklist emergency procedures as well as practicing aborts, loss of engine on takeoff, ejection, tire failure, and

various systems malfunctions and emergencies.

\*Note: Due to travel time required for this activity the entire process from

takeoff to landing will range from 4-5 hours. Although the requirement for this activity is for front seat T-38 crewmembers, backseaters are welcome to go along on these trips, and usually are offered a chance

to fly a T-38 sim with an Air Force instructor as well.

## A/C-5 T-38 Groundschool

Duration: 4.0 hours

**Note:** Ground School is offered the first Tuesday of the month.

Medium: Ellington Field

Student: All T-38 flight crewmembers

Frequency: Annually

Source: CC/Aircraft Operations Division

Synopsis: This briefing is required prior to the front seat T-38 crewmember's

Instrument Check and the T-38 back seat crewmember's Proficiency

Check.

#### A/C-6 T-38 Flight For Pilots/For MS's

Duration: Variable\*
Medium: T-38 Aircraft

Student: All T-38 flight crewmembers

Frequency: 15 hrs. per month (T-38 front seat)/5 hrs. per month (T-38 back seat)\*\*

Source: CC/Aircraft Operations Division

Synopsis: Front seat T-38 Pilot time is logged when flying solo, when flying dual

as the pilot at the controls, or when accompanied by a designated instructor pilot performing instructional duties. Back seat T-38 Pilot time is logged when flying dual and not in any of the capacities

previously listed.

\*Note: Out and back flight of roughly 3.0 logged hours requires 5 hours to

include transit time to/from Ellington Field. Local flight of roughly 1.5 hours requires 4 hours to include transit time to/from Ellington

Field.

\*\*Note: All other T-38 activities such as Emergency Procedures (EP) sim

technical travel are applicable to a crewmember's flight time.

A/C-7 AMES

Duration: 4.0 hours

**Note:** Schedule additional time for travel.\*

Medium: VMS

Student: COMMANDER, PILOT

Frequency: Every 6 months Source: CB/Astronaut Office

Synopsis: Assigned CDRs and PLTs undergo high-stress landing and rollout

training on a high-fidelity simulator.

\*Note: This exercise, including travel time to and from Ames, requires

approximately 1.5 days.

A/C-8 T-38 Instrument CK

Duration: 3.0 hours Medium: T-38 Aircraft

Student: Front seat T-38 pilots

Frequency: Annually

Source: CC/Aircraft Operations Division

Synopsis: Instrument check ride includes written instrument exam. Instrument

pre-check and instrument check flight shall be flown with different

instructor pilots.

A/C-9 HAT Flight

Duration: 4.0 hours

Medium: C9

Student: COMMANDER, PILOT Timeframe: 1 sortie within L-6 months

Source: CC/Aircraft Operations Division

Synopsis: The CDR and PLT will fly one Heavy Aircraft Training (HAT) flight

within 6 months of launch in preparation for their shuttle flight. This flight will familiarize the crew with the handling characteristics of a large aircraft as opposed to the smaller T-38 and STA with which the

crew is more familiar.

# A/C-10 Physiological Refresher Training

Duration: 3.5 hours

Medium: Altitude Chamber

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS (Schedule

individually.)

Frequency: Every 3 years

Source: SD/Medical Sciences Division

Synopsis: Lecture and brief exposure to hypobaric conditions in the altitude

chamber for familiarization with one's hypoxic symptoms.

#### A.4 INFORMAL ACTIVITIES

The activities listed below are viewed by the Crew Office as having slightly lower priority than the Flight Support and Aircraft Operations activities for Assigned Crews. These activities may be amended or deleted by the assigned crewmembers.

## **Table ADD-3. Informal Requirements**

Date Last Modified: 04/06

				Sched								Арргох	
Stage	Ref Num	Lesson Code	Hrs	Code	С	P	MS1	MS2	MS3	MS4	PS	Timeframe	Comments
4 to 1	INF-1	ADMIN	5	1	5	5	5	5	5	5	5	Weekly	
4 to 2	INF-2	CREW T/U	1	8	1	1	1	1	1	1	1	Monthly	
4 to 2	INF-3	CB MTG	1	8	1	1	1	1	1	1	1	Weekly	
0	INF-4	Aviation Safety Meeting	1	8	1	1	1	1	1	1		Bi-monthly	As needed
n	INF-5	Crew Debriefs	3	1	3	3	3	3	3	3		After another crew's mission	As requested
												Prior to L-6	
0	INF-6	Public Relations Speaking	Variable	1								months	
												Schedule	As requested by
0	INF-7	Russian Language Training	2	1	2	2	2	2	2	2	2	permitting	crewmember

## INF-1 ADMIN

Duration: 1.0 hour

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS (Schedule

individually.)

Frequency: 5 times per week

Synopsis: This time allows crewmembers to perform administrative tasks.

## INF-2 CREW T/U

Duration: 1.0 hour Medium: Crew Office

Student: COMMANDER, MS 1, MS 2, MS 3, MS4, PILOT, PS

Timeframe: Monthly Source: CB

Synopsis: The crew meets in this forum to status each other on where they are in

respect to mission readiness, discuss issues and concerns, and plan

forward work.

INF-3 CB MTG

Duration: 1.0 hour Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS

Frequency: Every Monday morning

Synopsis: Each crewmember is requested to attend Monday morning status

meeting with the Crew Office.

INF-4 Aviation Safety Meeting

Duration: 1.0 hour Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT

Frequency: Bi-monthly (as required)

Synopsis: Each crewmember is requested to attend informational briefings

presented by the Aircraft Operations Division as they are scheduled.

Generally, these briefings will occur once every other month.

INF-5 <u>Crew Debriefs</u>

Duration: 3.0 hours Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT

Frequency: Following each Space Shuttle mission

Synopsis: Debriefs from previous crews are scheduled for lessons learned.

INF-6 Public Relations Appearances

Duration: Variable

Medium: Public appearance

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS (Schedule

individually.)

Timeframe: Prior to L-6 months

Source: CB/Appearances Coordination/Scheduling

Synopsis: All public appearances are voluntary and subject to approval by crew

commander. As a standard, there should be no scheduled public appearances after L-6 months. Appearances should be limited to one a month, not to exceed 48 hours away from the office during a work

week (including travel time).

INF-7 Russian Language Training

Duration: 2.0 hours

**Note:** As requested by crewmember.

Medium: Classroom

Student: COMMANDER, MS 1, MS 2, MS 3, MS 4, PILOT, PS (Schedule

individually.)

Timeframe: Schedule permitting

Source: JSC Language Education Center (JLEC)

Synopsis: Optional training for crewmembers assigned to ISS flights requiring

some level of Russian language capability.

# APPENDIX A SHUTTLE BUDGET TEAM INFORMATION

#### A.1 PURPOSE

The Shuttle Budget will manage loading and stage distribution of the generic Shuttle crew training curriculum. This appendix documents the summary loading totals, the data used to model flight-specific applications of the generic curriculum, as well as charts depicting the current status of the generic curriculum.

## A.2 SCOPE

The Shuttle Budget will assess those mission preparation activities that have loading impacts for Shuttle mission crewmembers. This includes both training and non-training activities. Guidelines for inclusion of activities in the budget are set forth in the Shuttle Budget Team (SBT) Model.

## A.3 REVISIONS

Revisions to the Shuttle Budget, its tables, model, and appendix are accomplished by Lesson Change Requests (LCRs). These revisions require approval of the SBT Chair, the Astronaut Office Training Representative, the Training Integration Manager, and the *Spaceflight Training Management Office* Director. The appendix will be revised with the Crew Training Catalog on an as needed basis.

The model will continually be evaluated to ensure that it appropriately reflects training requirements for the majority of upcoming missions. Additionally, the model must be re-evaluated if major changes are proposed for any lessons that fall outside its range.

#### A.4 MODEL ASSESSMENT

The mission profile and crew task assignments defined in the SBT Model were established based on actual data from recently flown missions and on input from Subject Matter Experts (SMEs) projecting parameters for upcoming missions.

The budget contains all known mission prep activities, including generic flight requirements and anticipated meetings (IPTs, JOPs) as well as all training requirements associated with each mission task.

Each activity documented in the Crew Training Catalog will be assigned to a particular training stage. This will facilitate better distribution of the course load across the training template.

#### A.5 LOADING LIMITS

Shuttle Budget loading limits are different from but do not replace the limits defined for managing flight-specific crew loading. The budget loading limits are lower to account for total elapsed hours rather than event hours only. Elapsed hours represent a more comprehensive view of crew loading.

Event hours include only the length of the scheduled activities for each work week.

Elapsed hours include event hours and all overhead associated with the scheduled activities. The overhead includes travel time, meal breaks, and any other time between activities.

The stage loading limits were calculated by defining a practical duty week as an average of 48 elapsed hours. The daily overhead was estimated to be 1.5 hours. This daily estimate multiplied by 5 days equals 7.5 hours of overhead per week. Therefore, event hours are 40.5 hrs/wk. This was rounded to 41 hours.

$$48 \sim 41 + (1.5 * 5)$$

Historical mission training records have shown a consistent need for an increased training load during the Stage 2 timeframe. This historical pattern is the basis for the increased acceptable load in Stage 2.

#### A.6 GROWTH

There is a need to account for flight-specific training plan growth within the generic curriculum. Training plans for previous flights were found to average a 15% growth rate in hours prior to integrated simulation start (Stages 4 & 3) and a 3% growth rate post integrated simulation start (Stages 2 & 1). These growth hours will be reflected in the CTC summary tables as a line item in each stage.

#### A.7 SHUTTLE BUDGET MODEL

#### A.7.1 Mission Profile Information

#### Three EVAs

1 with a 7:1 training ratio 2 with a 5:1 training ratio

## Robotics (Mobile Servicing System – MSS)

1 Main Element Install Flow TPS OBSS Flow 1 Complex EVA Flow SSRMS Proficiency Flow

## **PDRS**

Orbiter Boom Sensor System (OBSS) Station Build Flow Unloaded Flow

# Payload/MPLM/SHAB/DTO&DSO

80 hrs total:

Stage 4 – 30 hrs Stage 3 – 25 hrs

Stage 2 – 20 hrs Stage 1 – 5 hrs

Table A-1. Crew Task Allocations (Non-Crew Rotation and Crew Rotation)

	N	Ion-Crew	Rotation			
	CDR	PLT	MS1	MS2	(MS3)	(MS4)
A/E	Х	Х		Х		
RNDZ	Х	Х	Х	Х		
EVA			IV	EV1	EV2	
PDRS		Х				Х
ROBO (MSS)		Х				
MED OPS	Х					Х
XFER			Х		Х	
CR SYS	Х	Х	Х	Х	Х	Х
PHO/TV	Х	Х	Х	Х	Х	Х
ORB	Х	Х	Х	Х	Х	Х
ISS SYS	Х	Х	Х	Х	Х	Х

		Cre	w Rotation	on			
	CDR	PLT	MS1	MS2	(ISS1)	(ISS2)	(ISS3)
A/E	Х	Х	ASC	Х			
RNDZ	Х	Х	Х	Х			
EVA		IV	EV1	EV2			
PDRS	Х						
ROBO (MSS)		Х					
MED OPS			Х				
XFER				Х			
CR SYS	Х	Х	Х	Х			
PHO/TV	Х	Х	Х	Х			
ORB	Х	Х	Х	Х			
ISS SYS	Х	Х	Х	Х			

**Table A-2. Training Milestones** 

Training Start	March
Integrated Sim Start	L-18 weeks
Holidays and Leave	
Memorial Day	L-42
Summer Leave (1 wk)	L-38
Independence Day	L-37
Summer Leave (1 wk)	L-30
Labor Day	L-28
Columbus Day	L-23
Veterans' Day	L-19
Thanksgiving (3 days)	L-16
Winter Break (2 days)	L-13
Winter Break (1 wk)	L-12
Winter Break (2 days)	L-11
Martin Luther King Day	L-9
Presidents' Day	L-4
Crew Birthdays (for currencies)	
CDR	L-24
PLT	L-28
MS1	L-15
MS2	L-10
MS3	L-37
MS4	L-6
Launch	March

#### A.7.2 Assessment Information

#### Stage Breakdown:

Stage 4 – Training start through L-35

Stage 3 – L-34 through L-19

Stage 2 – L-18 through L-5

Stage 1 – L-4 through "T-38 to KSC" (not launch)

## **Stage Loading Limits:**

These are average limits per week.

Stage 4 - 41 hrs

Stage 3 – 41 hrs

Stage 2 – 44 hrs

Stage 1 – 41 hrs

#### Growth:

Standard growth rates will be added to the total hours as follows:

12% of total hours added to Stages 3 & 4

3% of total hours added to Stage 2

1% of total hours added to Stage 1

## A.7.3 Assumptions and Background Information

- Launch not "clustered" with others
- All milestones met, all flight products available on-time
- Start @ 52-weeks FULL TIME
- Task panel occurs 5 weeks prior to training start requirement
- Crewmembers all 20000-level qual'd in EVA, PDRS, RNDZ, and ROBO
- All standard Aircraft Operations Directorate (AOD) requirements, Physical Training, and Admin requirements are included in the assessment
- No AOD or other non-flight specific currency requirements will be satisfied within four weeks of launch
- JOP, IPT, Monthly crew tags through L-10
- No refresher, proficiency, or "as required" training in the budget
- Schedule constraints are not considered (e.g., Expedition crew availability, personal constraints, facility constraints)
- Only one Crew Medical Officer (CMO) for crew rotation flights

- PDRS crewmembers back each other up
- ROBO (MSS) operators back each other up
- CBM training is assumed for budget which should umbrella any necessary CAS or Segment-to-Segment Attachment System (SSAS) training
- No travel PAO/Public Relations (PR) events inside of Stage 3. No local PAO/PR events inside of Stage 2
- When CTC presents lesson options dependent upon experience or currency, budget will assume crew is inexperienced and/or out of currency. For example, budget will assess full chamber run and photo EQ lessons as opposed to overviews

Table A-3. Budget Summary

Date Last Modified: 06/08

			N.	C	Datation			Da		vioairiea	. 00,00
					Rotation				Crew R		
Flow Name		С	Р	MS1	MS2	MS3	MS4	С	Р	MS1	MS2
Stage 4	Stage Totals										
CORE SYS Flow		15	19	2	19	2	0	15	19	2	19
CREW SYS Flow		5	5	11	11	5	5	5	5	11	11
MED OPS Flow	<u> </u>	0.4	0.4	0.4	1.4	1.4	0.4	0.4	0.4	1.4	1.4
STS PHO/TV Flow	<u> </u>	22	22	22	22	22	22	22	22	22	22
ASC ENT Flow	<u> </u>	83.5	83.5	22	83.5	5	3	83.5	83.5	22	83.5
ORB FO Flow		40	40	38.5	35.5	32.5	0	40	40	38.5	35.5
EVA SYS Ops Flow		19	0	10	19	19	0	0	17	19	19
EVA TASK Ops Flow		15.5	8	75	75	75	0	55.5	75	75	75
PDRS Flow		7	14	4	7	4	14	14	7	4	7
RNDZ Flow	<u> </u>	7	6	6	6	0	0	7	6	6	6
SHAB Flow		0	0	0	0	0	0	0	0	0	0
MPLM Flow		0	0	0	0	0	0	0	0	0	0
ISS CORE Sys Flow		12.25	15.25	26	24	12.25	11	12.25	15.25	26	24
MSS Flow		2	33.5	2	6	2	0	33.5	2	2	2
TRANSFER OPS Flow		0	0	0	0	0	0	0	0	0	0
INT SIM Flow		0	0	0	0	0	0	0	0	0	0
Flight Support		113	92	92	92	95.5	92	113	92	92	92
Informal		107	107	107	107	107	107	107	107	107	107
A/C Ops		110	110	16	16	23	16	110	110	16	16
Holiday/Leave		56	56	56	56	56	56	56	56	56	56
GROWTH		74	73	59	70	55	39	81	79	60	69
Stage Sub-Total		688.41	685.05	548.69	650.05	517.05	365.57	755.05	736.01	559.89	645.57
Stage 3	Stage Totals										
CORE SYS Flow	<u> </u>	0	0	0	0	0	0	0	0	0	0
CREW SYS Flow		24.75	24.75	24.75	24.75	24.75	23.5	24.75	24.75	24.75	24.75
MED OPS Flow	<u>/                                    </u>										
STS PHO/TV Flow		11.5	7.5	11.25	11.25	11.25	8	7.5	10.5	11.75	10.5
		14.5	14.5	25	25	11.25 14.5	14.5	12.5	10.5 9.5	11.75 20	20
ASC ENT Flow		<b>14.5</b> 17	<b>14.5</b> 17	<b>25</b> 7	<b>25</b> 17	11.25 14.5 7	<b>14.5</b> 0	<b>12.5</b> 17	10.5 9.5 17	11.75 20 7	<b>20</b> 17
ASC ENT Flow ORB FO Flow		14.5 17 30.5	14.5 17 30.5	<b>25</b> 7 29	25 17 30.5	11.25 14.5 7 29	<b>14.5</b> 0 0	12.5 17 30.5	10.5 9.5 17 30.5	11.75 20 7 29	20 17 30.5
ASC ENT Flow		<b>14.5</b> 17	14.5 17 30.5 0	<b>25</b> 7	<b>25</b> 17	11.25 14.5 7 29 25.25	0 0 0	<b>12.5</b> 17	10.5 9.5 17	11.75 20 7	<b>20</b> 17
ASC ENT Flow ORB FO Flow EVA SYS Ops Flow EVA TASK Ops Flow		14.5 17 30.5 21.25 12	14.5 17 30.5 0 47.5	25 7 29 9 120	25 17 30.5 25.25 120	11.25 14.5 7 29 25.25 120	0 0 0 0	12.5 17 30.5 0 85.5	10.5 9.5 17 30.5 25.25 120	11.75 20 7 29 25.25 120	20 17 30.5 25.25 120
ASC ENT Flow ORB FO Flow EVA SYS Ops Flow EVA TASK Ops Flow PDRS Flow		14.5 17 30.5 21.25 12 23	14.5 17 30.5 0 47.5 50	25 7 29 9 120 0	25 17 30.5 25.25 120 23	11.25 14.5 7 29 25.25 120	14.5 0 0 0 0 0 50	12.5 17 30.5 0 85.5 50	10.5 9.5 17 30.5 25.25 120 23	11.75 20 7 29 25.25 120	20 17 30.5 25.25 120 23
ASC ENT Flow ORB FO Flow EVA SYS Ops Flow EVA TASK Ops Flow PDRS Flow RNDZ Flow		14.5 17 30.5 21.25 12 23 36.5	14.5 17 30.5 0 47.5 50 36.5	25 7 29 9 120 0 36.5	25 17 30.5 25.25 120 23 36.5	11.25 14.5 7 29 25.25 120 0	14.5 0 0 0 0 0 50	12.5 17 30.5 0 85.5 50 36.5	10.5 9.5 17 30.5 25.25 120 23 36.5	11.75 20 7 29 25.25 120 0 36.5	20 17 30.5 25.25 120 23 36.5
ASC ENT Flow ORB FO Flow EVA SYS Ops Flow EVA TASK Ops Flow PDRS Flow RNDZ Flow SHAB Flow		14.5 17 30.5 21.25 12 23 36.5 0	14.5 17 30.5 0 47.5 50 36.5	25 7 29 9 120 0 36.5 0	25 17 30.5 25.25 120 23 36.5 0	11.25 14.5 7 29 25.25 120 0	14.5 0 0 0 0 0 50 0	12.5 17 30.5 0 85.5 50 36.5	10.5 9.5 17 30.5 25.25 120 23 36.5 0	11.75 20 7 29 25.25 120 0 36.5	20 17 30.5 25.25 120 23 36.5 0
ASC ENT Flow ORB FO Flow EVA SYS Ops Flow EVA TASK Ops Flow PDRS Flow RNDZ Flow SHAB Flow MPLM Flow		14.5 17 30.5 21.25 12 23 36.5 0	14.5 17 30.5 0 47.5 50 36.5 0	25 7 29 9 120 0 36.5 0	25 17 30.5 25.25 120 23 36.5 0	11.25 14.5 7 29 25.25 120 0 0	14.5 0 0 0 0 0 50 0	12.5 17 30.5 0 85.5 50 36.5 0	10.5 9.5 17 30.5 25.25 120 23 36.5 0	11.75 20 7 29 25.25 120 0 36.5 0	20 17 30.5 25.25 120 23 36.5 0
ASC ENT Flow ORB FO Flow EVA SYS Ops Flow EVA TASK Ops Flow PDRS Flow RNDZ Flow SHAB Flow MPLM Flow ISS CORE Sys Flow		14.5 17 30.5 21.25 12 23 36.5 0	14.5 17 30.5 0 47.5 50 36.5 0	25 7 29 9 120 0 36.5 0 0 39.25	25 17 30.5 25.25 120 23 36.5 0 0 39.25	11.25 14.5 7 29 25.25 120 0 0 0	14.5 0 0 0 0 50 0 0 0 12	12.5 17 30.5 0 85.5 50 36.5 0	10.5 9.5 17 30.5 25.25 120 23 36.5 0 0	11.75 20 7 29 25.25 120 0 36.5 0 0 39.25	20 17 30.5 25.25 120 23 36.5 0 0 39.25
ASC ENT Flow ORB FO Flow EVA SYS Ops Flow EVA TASK Ops Flow PDRS Flow RNDZ Flow SHAB Flow MPLM Flow ISS CORE Sys Flow MSS Flow		14.5 17 30.5 21.25 12 23 36.5 0 0	14.5 17 30.5 0 47.5 50 36.5 0 0 14	25 7 29 9 120 0 36.5 0 0 39.25 9	25 17 30.5 25.25 120 23 36.5 0 0 39.25	11.25 14.5 7 29 25.25 120 0 0 0 0	14.5 0 0 0 0 50 0 0 0 12	12.5 17 30.5 0 85.5 50 36.5 0 0	10.5 9.5 17 30.5 25.25 120 23 36.5 0 0 14	11.75 20 7 29 25.25 120 0 36.5 0 0 39.25 9	20 17 30.5 25.25 120 23 36.5 0 0 39.25
ASC ENT Flow ORB FO Flow EVA SYS Ops Flow EVA TASK Ops Flow PDRS Flow RNDZ Flow SHAB Flow MPLM Flow ISS CORE Sys Flow MSS Flow TRANSFER OPS Flow		14.5 17 30.5 21.25 12 23 36.5 0 0 12 9	14.5 17 30.5 0 47.5 50 36.5 0 0 14 38	25 7 29 9 120 0 36.5 0 39.25 9	25 17 30.5 25.25 120 23 36.5 0 0 39.25 9	11.25 14.5 7 29 25.25 120 0 0 0 0 12 0	14.5 0 0 0 0 50 0 0 0 12 0	12.5 17 30.5 0 85.5 50 36.5 0 0 12 38	10.5 9.5 17 30.5 25.25 120 23 36.5 0 0 14 9	11.75 20 7 29 25.25 120 0 36.5 0 39.25 9	20 17 30.5 25.25 120 23 36.5 0 39.25 9
ASC ENT Flow ORB FO Flow EVA SYS Ops Flow EVA TASK Ops Flow PDRS Flow RNDZ Flow SHAB Flow MPLM Flow ISS CORE Sys Flow MSS Flow TRANSFER OPS Flow INT SIM Flow		14.5 17 30.5 21.25 12 23 36.5 0 0 12 9	14.5 17 30.5 0 47.5 50 36.5 0 0 14 38 0	25 7 29 9 120 0 36.5 0 39.25 9 0	25 17 30.5 25.25 120 23 36.5 0 39.25 9	11.25 14.5 7 29 25.25 120 0 0 0 12 0	14.5 0 0 0 0 50 0 0 12 0 0 2	12.5 17 30.5 0 85.5 50 36.5 0 12 38 0	10.5 9.5 17 30.5 25.25 120 23 36.5 0 14 9 0 2	11.75 20 7 29 25.25 120 0 36.5 0 0 39.25 9 0	20 17 30.5 25.25 120 23 36.5 0 0 39.25 9
ASC ENT Flow ORB FO Flow EVA SYS Ops Flow EVA TASK Ops Flow PDRS Flow RNDZ Flow SHAB Flow MPLM Flow ISS CORE Sys Flow MSS Flow TRANSFER OPS Flow INT SIM Flow Flight Support		14.5 17 30.5 21.25 12 23 36.5 0 0 12 9 0 2	14.5 17 30.5 0 47.5 50 36.5 0 0 14 38 0 2	25 7 29 9 120 0 36.5 0 39.25 9 0 2 76	25 17 30.5 25.25 120 23 36.5 0 0 39.25 9 0 2	11.25 14.5 7 29 25.25 120 0 0 0 12 0 0	14.5 0 0 0 0 50 0 0 0 12 0 0 2	12.5 17 30.5 0 85.5 50 36.5 0 0 12 38 0 2	10.5 9.5 17 30.5 25.25 120 23 36.5 0 0 14 9 0 2 79.5	11.75 20 7 29 25.25 120 0 36.5 0 0 39.25 9 0 2 76	20 17 30.5 25.25 120 23 36.5 0 0 39.25 9 0
ASC ENT Flow ORB FO Flow EVA SYS Ops Flow EVA TASK Ops Flow PDRS Flow RNDZ Flow SHAB Flow MPLM Flow ISS CORE Sys Flow MSS Flow TRANSFER OPS Flow INT SIM Flow Flight Support		14.5 17 30.5 21.25 12 23 36.5 0 0 12 9 0 2 104	14.5 17 30.5 0 47.5 50 36.5 0 0 14 38 0 2 79.5	25 7 29 9 120 0 36.5 0 39.25 9 0 2 76 94	25 17 30.5 25.25 120 23 36.5 0 0 39.25 9 0 2	11.25 14.5 7 29 25.25 120 0 0 0 12 0 2 76	14.5 0 0 0 0 50 0 0 0 12 0 0 2 76 94	12.5 17 30.5 0 85.5 50 36.5 0 0 12 38 0 2 104	10.5 9.5 17 30.5 25.25 120 23 36.5 0 0 14 9 0 2 79.5 94	11.75 20 7 29 25.25 120 0 36.5 0 0 39.25 9 0 2 76 94	20 17 30.5 25.25 120 23 36.5 0 0 39.25 9 0 2 76
ASC ENT Flow ORB FO Flow EVA SYS Ops Flow EVA TASK Ops Flow PDRS Flow RNDZ Flow SHAB Flow MPLM Flow ISS CORE Sys Flow MSS Flow TRANSFER OPS Flow INT SIM Flow Flight Support Informal A/C Ops		14.5 17 30.5 21.25 12 23 36.5 0 0 12 9 0 2 104 94 103	14.5 17 30.5 0 47.5 50 36.5 0 0 14 38 0 2 79.5 94	25 7 29 9 120 0 36.5 0 39.25 9 0 2 76 94 16	25 17 30.5 25.25 120 23 36.5 0 0 39.25 9 0 2 76 94	11.25 14.5 7 29 25.25 120 0 0 0 12 0 0 2 76 94	14.5 0 0 0 0 50 0 0 0 12 0 0 2 76 94 16	12.5 17 30.5 0 85.5 50 36.5 0 0 12 38 0 2 104 94	10.5 9.5 17 30.5 25.25 120 23 36.5 0 0 14 9 0 2 79.5 94 103	11.75 20 7 29 25.25 120 0 36.5 0 0 39.25 9 0 2 76 94 16	20 17 30.5 25.25 120 23 36.5 0 0 39.25 9 0 2 76 94
ASC ENT Flow ORB FO Flow EVA SYS Ops Flow EVA TASK Ops Flow PDRS Flow RNDZ Flow SHAB Flow MPLM Flow ISS CORE Sys Flow MSS Flow TRANSFER OPS Flow INT SIM Flow Flight Support		14.5 17 30.5 21.25 12 23 36.5 0 0 12 9 0 2 104 94 103 64	14.5 17 30.5 0 47.5 50 36.5 0 0 14 38 0 2 79.5 94 103 64	25 7 29 9 120 0 36.5 0 39.25 9 0 2 76 94 16 64	25 17 30.5 25.25 120 23 36.5 0 0 39.25 9 0 2 76 94 16 64	11.25 14.5 7 29 25.25 120 0 0 0 0 12 0 0 2 76 94 16	14.5 0 0 0 0 50 0 0 0 12 0 0 2 76 94 16 64	12.5 17 30.5 0 85.5 50 36.5 0 0 12 38 0 2 104 94 103 64	10.5 9.5 17 30.5 25.25 120 23 36.5 0 0 14 9 0 2 79.5 94 103 64	11.75 20 7 29 25.25 120 0 36.5 0 0 39.25 9 0 2 76 94	20 17 30.5 25.25 120 23 36.5 0 0 39.25 9 0 2 76 94 16 64
ASC ENT Flow ORB FO Flow EVA SYS Ops Flow EVA TASK Ops Flow PDRS Flow RNDZ Flow SHAB Flow MPLM Flow ISS CORE Sys Flow MSS Flow TRANSFER OPS Flow INT SIM Flow Flight Support Informal A/C Ops		14.5 17 30.5 21.25 12 23 36.5 0 0 12 9 0 2 104 94 103	14.5 17 30.5 0 47.5 50 36.5 0 0 14 38 0 2 79.5 94	25 7 29 9 120 0 36.5 0 39.25 9 0 2 76 94 16	25 17 30.5 25.25 120 23 36.5 0 0 39.25 9 0 2 76 94	11.25 14.5 7 29 25.25 120 0 0 0 12 0 0 2 76 94	14.5 0 0 0 0 50 0 0 0 12 0 0 2 76 94 16	12.5 17 30.5 0 85.5 50 36.5 0 0 12 38 0 2 104 94	10.5 9.5 17 30.5 25.25 120 23 36.5 0 0 14 9 0 2 79.5 94 103	11.75 20 7 29 25.25 120 0 36.5 0 0 39.25 9 0 2 76 94 16	20 17 30.5 25.25 120 23 36.5 0 0 39.25 9 0 2 76 94

Table A-3. Budget Summary (Concluded)

Date Last Modified: 06/08

								Dai	e Last I		: 06/08
					Rotation				Crew R		
Flow Name		С	Р	MS1	MS2	MS3	MS4	С	Р	MS1	MS2
Stage 2	Stage Totals	Per Crewm	ember:								
CORE SYS Flow		0	0	0	0	0	0	0	0	0	0
CREW SYS Flow		16.5	16.5	20	20	16.5	16.5	16.5	16.5	20	20
MED OPS Flow		7.5	0	1	2	2	7.5	1	1	8.5	2
STS PHO/TV Flow		5	5	5	5	5	5	5	5	5	5
ASC ENT Flow		18	18	0	18	0	0	18	18	0	18
ORB FO Flow		4	4	5.75	4	5.75	0	4	4	5.75	4
EVA SYS Ops Flow		20.5	0	3	33.25	33.25	0	0	19	33.25	33.25
EVA TASK Ops Flow		4.5	0	68	68	68	0	38	68	68	68
PDRS Flow		10	13	0	10	0	13	13	10	0	10
RNDZ Flow		31	31	31	29	14	0	31	31	31	29
SHAB Flow		0	0	0	0	0	0	0	0	0	0
MPLM Flow		0	0	0	0	0	0	0	0	0	0
ISS CORE Sys Flow		5.5	5.5	13	13	5.5	5.5	5.5	5.5	13	13
MSS Flow		6	17	6	6	0	0	17	6	6	6
TRANSFER OPS Flow		4.25	4.25	8.5	4.25	8.5	4.25	4.25	4.25	4.25	8.5
INT SIM Flow		130.2	130.2	120	130.2	116.4	106.2	130.2	130.2	130.2	130.2
Flight Support		111.75	98.25	100.25	100.25	96.75	100.25	113.75	98.25	100.25	100.25
Informal		77	77	77	77	77	77	77	77	77	77
A/C Ops		107	107	19	9	2	19	107	107	19	19
Holiday/Leave		104	104	104	104	104	104	104	104	104	104
GROWTH		20	19	17	19	17	14	21	21	19	19
Stage Sub-Total		682.58	649.62	598.95	651.94	571.29	471.95	705.76	725.84	643.96	666.62
						· · · · ·					
Stage 1	Stage Totals				301101	0				0.0.00	
	Stage Totals			0	0	0	0	0	0	0	0
Stage 1	Stage Totals	Per Crewm	ember:								
Stage 1 CORE SYS Flow	Stage Totals	Per Crewm 0	ember: 0	0	0	0 4 1	0	0 4 1	0	0 4 1	0
Stage 1 CORE SYS Flow CREW SYS Flow	Stage Totals	Per Crewm 0 4	ember: 0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4
Stage 1 CORE SYS Flow CREW SYS Flow MED OPS Flow	Stage Totals	9 Per Crewm 0 4 1 2 4	0 4 1	0 4 1 2 4	0 4 1	0 4 1 2 0	0 4 1	0 4 1 2 4	0 4 1	0 4 1	0 4 1
Stage 1 CORE SYS Flow CREW SYS Flow MED OPS Flow STS PHO/TV Flow	Stage Totals	Per Crewm 0 4 1	ember: 0 4 1 2	0 4 1 2	0 4 1 2	0 4 1 2	0 4 1 2	0 4 1 2	0 4 1 2	0 4 1 2	0 4 1 2
Stage 1 CORE SYS Flow CREW SYS Flow MED OPS Flow STS PHO/TV Flow ASC ENT Flow	Stage Totals	9 Per Crewm 0 4 1 2 4	ember: 0 4 1 2 4	0 4 1 2 4 0	0 4 1 2 4 0	0 4 1 2 0	0 4 1 2 0	0 4 1 2 4 0	0 4 1 2 4 0	0 4 1 2 4 0	0 4 1 2 4 0
Stage 1 CORE SYS Flow CREW SYS Flow MED OPS Flow STS PHO/TV Flow ASC ENT Flow ORB FO Flow	Stage Totals	8 Per Crewm 0 4 1 2 4 0	ember: 0 4 1 2 4 0	0 4 1 2 4 0	0 4 1 2 4 0	0 4 1 2 0	0 4 1 2 0	0 4 1 2 4	0 4 1 2 4 0	0 4 1 2 4 0	0 4 1 2 4 0
Stage 1 CORE SYS Flow CREW SYS Flow MED OPS Flow STS PHO/TV Flow ASC ENT Flow ORB FO Flow EVA SYS Ops Flow EVA TASK Ops Flow PDRS Flow	Stage Totals	8 Per Crewm 0 4 1 2 4 0 0 4.5	ember:  0 4 1 2 4 0 0 18	0 4 1 2 4 0 2 32 0	0 4 1 2 4 0 2 32 0	0 4 1 2 0 0 2 32 0	0 4 1 2 0 0	0 4 1 2 4 0 0 28.5	0 4 1 2 4 0 2 21.5	0 4 1 2 4 0 2 32 0	0 4 1 2 4 0 2 32
Stage 1 CORE SYS Flow CREW SYS Flow MED OPS Flow STS PHO/TV Flow ASC ENT Flow ORB FO Flow EVA SYS Ops Flow EVA TASK Ops Flow PDRS Flow RNDZ Flow	Stage Totals	8 Per Crewm 0 4 1 2 4 0 0 4.5	ember:  0  4  1  2  4  0  0  18	0 4 1 2 4 0 2 32 0 4	0 4 1 2 4 0 2 32 0 4	0 4 1 2 0 0 2 32	0 4 1 2 0 0 0	0 4 1 2 4 0 0 28.5 0	0 4 1 2 4 0 2 21.5	0 4 1 2 4 0 2 32	0 4 1 2 4 0 2 32
Stage 1 CORE SYS Flow CREW SYS Flow MED OPS Flow STS PHO/TV Flow ASC ENT Flow ORB FO Flow EVA SYS Ops Flow EVA TASK Ops Flow PDRS Flow RNDZ Flow SHAB Flow	Stage Totals	9 Per Crewm 0 4 1 2 4 0 0 4.5 0 4 0	ember: 0 4 1 2 4 0 0 18 0 4	0 4 1 2 4 0 2 32 0 4 0	0 4 1 2 4 0 2 32 0 4 0	0 4 1 2 0 0 0 2 32 0 0	0 4 1 2 0 0 0 0 0 0	0 4 1 2 4 0 0 28.5 0 4	0 4 1 2 4 0 2 21.5 0 4	0 4 1 2 4 0 2 32 0 4 0	0 4 1 2 4 0 2 32 0 4 0
Stage 1 CORE SYS Flow CREW SYS Flow MED OPS Flow STS PHO/TV Flow ASC ENT Flow ORB FO Flow EVA SYS OPS Flow EVA TASK OPS Flow PDRS Flow RNDZ Flow SHAB Flow MPLM Flow	Stage Totals	9 Per Crewm 0 4 1 2 4 0 0 4.5 0 4 0 0	ember: 0 4 1 2 4 0 0 18 0 4 0 0	0 4 1 2 4 0 2 32 0 4 0 0	0 4 1 2 4 0 2 32 0 4 0 0	0 4 1 2 0 0 0 2 32 0 0 0	0 4 1 2 0 0 0 0 0 0 0	0 4 1 2 4 0 0 28.5 0 4 0	0 4 1 2 4 0 2 21.5 0 4 0	0 4 1 2 4 0 2 32 0 4 0 0	0 4 1 2 4 0 2 32 0 4 0 0
Stage 1 CORE SYS Flow CREW SYS Flow MED OPS Flow STS PHO/TV Flow ASC ENT Flow ORB FO Flow EVA SYS Ops Flow PDRS Flow RNDZ Flow SHAB Flow MPLM Flow ISS CORE Sys Flow	Stage Totals	9 Per Crewm 0 4 1 2 4 0 0 4.5 0 4 0 0 0 0 0 0 0 0 0 0 0 0 0 0	ember: 0 4 1 2 4 0 0 18 0 4 0 0 0 0	0 4 1 2 4 0 2 32 0 4 0 0	0 4 1 2 4 0 2 32 0 4 0 0 0	0 4 1 2 0 0 0 2 32 0 0 0 0 0	0 4 1 2 0 0 0 0 0 0 0 0	0 4 1 2 4 0 0 28.5 0 4 0	0 4 1 2 4 0 2 21.5 0 4 0 0	0 4 1 2 4 0 2 32 0 4 0 0	0 4 1 2 4 0 2 32 0 4 0 0
Stage 1 CORE SYS Flow CREW SYS Flow MED OPS Flow STS PHO/TV Flow ASC ENT Flow ORB FO Flow EVA SYS OPS Flow EVA TASK OPS Flow PDRS Flow RNDZ Flow SHAB Flow MPLM Flow ISS CORE Sys Flow MSS Flow	Stage Totals	8 Per Crewm 0 4 1 2 4 0 0 4.5 0 0 0 0 0 0 0 0 0 0	ember: 0 4 1 2 4 0 0 18 0 4 0 3	0 4 1 2 4 0 2 32 0 4 0 0 0	0 4 1 2 4 0 2 32 0 4 0 0 0 0	0 4 1 2 0 0 0 2 32 0 0 0 0 0 0	0 4 1 2 0 0 0 0 0 0 0 0 0 0 0	0 4 1 2 4 0 0 0 28.5 0 4 0 0	0 4 1 2 4 0 2 21.5 0 4 0 0	0 4 1 2 4 0 2 32 0 4 0 0 0	0 4 1 2 4 0 2 32 0 4 0 0
Stage 1 CORE SYS Flow CREW SYS Flow MED OPS Flow STS PHO/TV Flow ASC ENT Flow ORB FO Flow EVA SYS OPS Flow EVA TASK OPS Flow PDRS Flow RNDZ Flow SHAB Flow MPLM Flow ISS CORE Sys Flow MSS Flow TRANSFER OPS Flow	Stage Totals	8 Per Crewm 0 4 1 2 4 0 0 4.5 0 4 0 0 0 0 0 0 0 0 0 0 0 0	ember: 0 4 1 2 4 0 0 18 0 4 0 0 3 0	0 4 1 2 4 0 2 32 0 4 0 0 0 0 4 0 0	0 4 1 2 4 0 2 32 0 4 0 0 0 0 0	0 4 1 2 0 0 0 2 32 0 0 0 0 0 0 0 0 0 0 0 0 0	0 4 1 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 4 1 2 4 0 0 0 28.5 0 4 0 0 0 3	0 4 1 2 4 0 2 21.5 0 4 0 0 0 0	0 4 1 2 4 0 2 32 0 4 0 0 0 0 0	0 4 1 2 4 0 2 32 0 4 0 0 0 4
Stage 1 CORE SYS Flow CREW SYS Flow MED OPS Flow STS PHO/TV Flow ASC ENT Flow ORB FO Flow EVA SYS OPS Flow EVA TASK OPS Flow PDRS Flow RNDZ Flow SHAB Flow MPLM Flow ISS CORE SyS Flow MSS Flow TRANSFER OPS Flow INT SIM Flow	Stage Totals	9 Per Crewm 0 4 1 2 4 0 0 4.5 0 4 0 0 0 0 0 0 0 0 0 0 5 27.2	ember: 0 4 1 2 4 0 0 18 0 4 0 0 3 0 27.2	0 4 1 2 4 0 2 32 0 4 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 4 1 2 4 0 2 32 0 4 0 0 0 0 0 0	0 4 1 2 0 0 0 2 32 0 0 0 0 0 0 0 0 4 1 1 8	0 4 1 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 4 1 2 4 0 0 0 28.5 0 4 0 0 0 3 0 0 0	0 4 1 2 4 0 2 21.5 0 4 0 0 0 0 0	0 4 1 2 4 0 2 32 0 4 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 4 1 2 4 0 2 32 0 4 0 0 0 0 4 0 0 0 4
Stage 1 CORE SYS Flow CREW SYS Flow MED OPS Flow STS PHO/TV Flow ASC ENT Flow ORB FO Flow EVA SYS Ops Flow EVA TASK Ops Flow PDRS Flow RNDZ Flow SHAB Flow MPLM Flow ISS CORE Sys Flow MSS Flow TRANSFER OPS Flow INT SIM Flow Flight Support	Stage Totals	9 Per Crewm 0 4 1 2 4 0 0 4.5 0 4 0 0 0 0 5 27.2 51.25	ember: 0 4 1 2 4 0 0 18 0 4 0 0 3 0 27.2 49.25	0 4 1 2 4 0 2 32 0 4 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 4 1 2 4 0 2 32 0 4 0 0 0 0 0 0 0 0 2 2 32 4 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 4 1 2 0 0 2 32 0 0 0 0 0 0 0 4 18	0 4 1 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 4 1 2 4 0 0 0 28.5 0 4 0 0 0 3 0 0 5 2 7.2 5 5 1.25	0 4 1 2 4 0 2 21.5 0 4 0 0 0 0 0 0 2 2 24.5 0 4 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 4 1 2 4 0 2 32 0 4 0 0 0 0 0 0 0 0 2 2 32 0 0 0 0 0 0 0 0	0 4 1 2 4 0 2 32 0 4 0 0 0 0 4 0 0 0 4 0 0 0 0 0 0 0 0
Stage 1 CORE SYS Flow CREW SYS Flow MED OPS Flow STS PHO/TV Flow ASC ENT Flow ORB FO Flow EVA SYS Ops Flow EVA TASK Ops Flow PDRS Flow RNDZ Flow SHAB Flow MPLM Flow ISS CORE Sys Flow MSS Flow INT SIM Flow Flight Support	Stage Totals	9 Per Crewm 0 4 1 2 4 0 0 4.5 0 4 0 0 0 0 2.7.2 51.25	ember: 0 4 1 2 4 0 0 18 0 4 0 0 3 0 27.2 49.25	0 4 1 2 4 0 2 32 0 4 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 4 1 2 4 0 2 32 0 4 0 0 0 0 0 0 0 0 2 32 4 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 4 1 2 0 0 2 32 0 0 0 0 0 0 0 0 4 18 52 16	0 4 1 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 4 1 2 4 0 0 0 28.5 0 4 0 0 0 3 0.5 27.2 51.25	0 4 1 2 4 0 2 21.5 0 4 0 0 0 0 0 0 0 2 2 21.5 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 4 1 2 4 0 2 32 0 4 0 0 0 0 0 0 0 2 32 0 4 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 4 1 2 4 0 2 32 0 4 0 0 0 0 0 4 0 0 0 0 4 0 0 0 0 0 0
Stage 1 CORE SYS Flow CREW SYS Flow MED OPS Flow STS PHO/TV Flow ASC ENT Flow ORB FO Flow EVA SYS Ops Flow EVA TASK Ops Flow PDRS Flow RNDZ Flow SHAB Flow MPLM Flow ISS CORE Sys Flow MSS Flow INT SIM Flow Flight Support Informal A/C Ops	Stage Totals	9 Per Crewm 0 4 1 2 4 0 0 4.5 0 4 0 0 0 0 5 27.2 51.25 16 30	ember: 0 4 1 2 4 0 0 18 0 4 0 0 27.2 49.25 16 30	0 4 1 2 4 0 2 32 0 4 0 0 0 0 0 0 0 4 0 0 0 0 0 0 0 0 0	0 4 1 2 4 0 2 32 0 4 0 0 0 0 0 0 0 0 2 32 0 4 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 4 1 2 0 0 2 32 0 0 0 0 0 0 0 0 4 18 52 16 6	0 4 1 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 4 1 2 4 0 0 0 28.5 0 4 0 0 0 0 3 0.5 27.2 51.25 16	0 4 1 2 4 0 2 21.5 0 4 0 0 0 0 0 0 2 2 4 0 0 2 4 0 0 0 0 0	0 4 1 2 4 0 2 32 0 4 0 0 0 0 0 0 0 2 32 0 4 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 4 1 2 4 0 2 32 0 4 0 0 0 0 0 0 4 0 0 0 0 0 0 0 0 0 0
Stage 1 CORE SYS Flow CREW SYS Flow MED OPS Flow STS PHO/TV Flow ASC ENT Flow ORB FO Flow EVA SYS Ops Flow EVA TASK Ops Flow PDRS Flow RNDZ Flow SHAB Flow MPLM Flow ISS CORE Sys Flow MSS Flow TRANSFER OPS Flow INT SIM Flow Flight Support Informal A/C Ops Holiday/Leave	Stage Totals	9 Per Crewm 0 4 1 2 4 0 0 4.5 0 4 0 0 0 0 5 27.2 51.25 16 30 8	ember: 0 4 1 2 4 0 0 18 0 4 0 0 3 0 27.2 49.25 16 30 8	0 4 1 2 4 0 2 32 0 4 0 0 0 0 0 0 0 0 4 0 0 0 0 0 0 0 0	0 4 1 2 4 0 2 32 0 4 0 0 0 0 0 0 0 2 32 0 4 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 4 1 2 0 0 2 32 0 0 0 0 0 0 0 0 4 18 52 16 6	0 4 1 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 4 1 2 4 0 0 0 28.5 0 4 0 0 0 0 3 0.5 27.2 51.25 16 30 8	0 4 1 2 4 0 2 21.5 0 4 0 0 0 0 0 0 2 7.2 4 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	0 4 1 2 4 0 2 32 0 4 0 0 0 0 0 0 0 2 2 32 0 0 2 4 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 4 1 2 4 0 2 32 0 4 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Stage 1 CORE SYS Flow CREW SYS Flow MED OPS Flow STS PHO/TV Flow ASC ENT Flow ORB FO Flow EVA SYS OPS Flow EVA TASK OPS Flow PDRS Flow RNDZ Flow SHAB Flow MPLM Flow ISS CORE SyS Flow MSS Flow TRANSFER OPS Flow INT SIM Flow Flight Support Informal A/C OPS Holiday/Leave GROWTH	Stage Totals	9 Per Crewm 0 4 1 2 4 0 0 4.5 0 4 0 0 0 0 5 27.2 51.25 16 8 8 2	ember: 0 4 1 2 4 0 0 18 0 4 0 0 27.2 49.25 130 8 2	0 4 1 2 4 0 2 32 0 4 0 0 0 0 0 0 0 4.5 22.6 49 16 6 8	0 4 1 2 4 0 2 32 0 4 0 0 0 0 0 0 0 2 7.2 4 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	0 4 1 2 0 0 0 2 32 0 0 0 0 0 0 0 0 0 0 0 0 0	0 4 1 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 4 1 2 4 0 0 0 28.5 0 4 0 0 0 0 3 0.5 27.2 51.25 16 30 8	0 4 1 2 4 0 2 21.5 0 4 0 0 0 0 0 0 27.2 49.25 16 16 16 16 16 16 16 16 16 16 16 16 16	0 4 1 2 4 0 2 32 0 4 0 0 0 0 0 0 0 2 7.2 49 16 6 8 8	0 4 1 2 4 0 2 32 0 4 0 0 0 0 0 0 0 4.5 27.2 49 16 6 8
Stage 1 CORE SYS Flow CREW SYS Flow MED OPS Flow STS PHO/TV Flow ASC ENT Flow ORB FO Flow EVA SYS Ops Flow EVA TASK Ops Flow PDRS Flow RNDZ Flow SHAB Flow MPLM Flow ISS CORE Sys Flow MSS Flow TRANSFER OPS Flow INT SIM Flow Flight Support Informal A/C Ops Holiday/Leave	Stage Totals	9 Per Crewm 0 4 1 2 4 0 0 4.5 0 4 0 0 0 0 5 27.2 51.25 16 30 8	ember: 0 4 1 2 4 0 0 18 0 4 0 0 3 0 27.2 49.25 16 30 8	0 4 1 2 4 0 2 32 0 4 0 0 0 0 0 0 0 0 4 0 0 0 0 0 0 0 0	0 4 1 2 4 0 2 32 0 4 0 0 0 0 0 0 0 2 32 0 4 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 4 1 2 0 0 2 32 0 0 0 0 0 0 0 0 4 18 52 16 6	0 4 1 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 4 1 2 4 0 0 0 28.5 0 4 0 0 0 0 3 0.5 27.2 51.25 16 30 8	0 4 1 2 4 0 2 21.5 0 4 0 0 0 0 0 0 2 7.2 4 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	0 4 1 2 4 0 2 32 0 4 0 0 0 0 0 0 0 2 2 32 0 0 2 4 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 4 1 2 4 0 2 32 0 4 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Stage 1 CORE SYS Flow CREW SYS Flow MED OPS Flow STS PHO/TV Flow ASC ENT Flow ORB FO Flow EVA SYS OPS Flow EVA TASK OPS Flow PDRS Flow RNDZ Flow SHAB Flow MPLM Flow ISS CORE SyS Flow MSS Flow TRANSFER OPS Flow INT SIM Flow Flight Support Informal A/C OPS Holiday/Leave GROWTH	Stage Totals	9 Per Crewm 0 4 1 2 4 0 0 4.5 0 4 0 0 0 0 5 27.2 51.25 16 8 8 2	ember: 0 4 1 2 4 0 0 18 0 4 0 0 27.2 49.25 130 8 2	0 4 1 2 4 0 2 32 0 4 0 0 0 0 0 0 0 4.5 22.6 49 16 6 8	0 4 1 2 4 0 2 32 0 4 0 0 0 0 0 0 0 2 7.2 4 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	0 4 1 2 0 0 0 2 32 0 0 0 0 0 0 0 0 0 0 0 0 0	0 4 1 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 4 1 2 4 0 0 0 28.5 0 4 0 0 0 0 3 0.5 27.2 51.25 16 30 8	0 4 1 2 4 0 2 21.5 0 4 0 0 0 0 0 0 27.2 49.25 16 16 16 16 16 16 16 16 16 16 16 16 16	0 4 1 2 4 0 2 32 0 4 0 0 0 0 0 0 0 2 7.2 49 16 6 8 8	0 4 1 2 4 0 2 32 0 4 0 0 0 0 0 0 0 4.5 27.2 49 16 6 8

Table A-4. Flight Support – Information

Date Last Modified: 07/07

																Dali	Last Mice	illea. 07/07
								Non-	Crew Rotati	ion				Crew I	Rotation			
Stage	Seq Num	Lesson Code	Media	Hours	Sched Code	С	Р	MS1	MS2	MS3	MS4	PS	С	Р	MS1	MS2	Approx Timeframe	Comments
																		@ FCE. Schedule 2 at a time; try to schedule a flown crewmember with a non-flown
4		ACES Fitcheck		2	1	2	2	2	2	2	2	2	2	2	2	2		crewmember
4			CLR	2	8	2	2	2	2	2	2	2	2	2	2	2	Start of Training	
4	FS-3	OnOrbit Crew Email	CLR	1	8	1	1	1	1	1	1	1	1	1	1	1	Start of Training	
4	FS-4	Annual Physical	JSC/Bldg 8	3.5	1					3.5							Yearly	Yearly on birth month
4	FS-5	Crew Equipment Review	Crew Office	1	8	1	1	1	1	1	1	1	1	1	1	1		
																	Prior to SMS	
4	FS-6	Crew Study Guide	SELF	2	1	2	2	2	2	2	2	2	2	2	2	2	start	As required
4	FS-7	Crew Task Panel	Mtg Rm	2	8	2							2					
4	FS-8	Dental	Clinic	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	Annually	
4	FS-9	Flight IPT (2 hours x 5 months)	Mtg Rm	10	8	10							10				Every 2 to 8 weeks	As needed
4	FS-10	Flight JOP (2 hours x 4)	Mtg Rm	8	8	8							8				Every 4 to 8 weeks	As needed
4	FS-11	Shuttle Food Sys Briefing	Food Sys Eng Facility	1	8	1	1	1	1	1	1	1	1	1	1	1		Food tasting
4	FS-12	Physical Training (Gym)[4.5 hours x 17 weeks]		76.5	8	76.5	76.5	76.5	76.5	76.5	76.5	76.5	76.5	76.5	76.5	76.5	1.5 hours 3x/week	2hours 3x/week for EVA CMs within 6 mos of launch
				7 0.0	- ŭ	7 0.0	7 0.0	7 0.0	7 0.0	7 0.0	7 0.0	7 0.0	7 0.0	7 0.0	7 0.0	7 0.0	Prior to 3000	CDR, CB IA, SMS
4	FS-13	SFRM Training Strategy Meeting	CLR	1	1	1							1				SMS Lessons	Team Lead
4		Med DSO Brf	CLR	2	8	2	2	2	2	2	2	2	2	2	2	2		Informed consent
4	FS-15	Vision	Clinic	1	1	1	1	1	1	1	1	1	1	1	1	1	Annually	Schedule near Annual Physical
4	FS-16	FPSR	Mta Rm	3	8	3	3	3	3	3	3	3	3	3	3	3	7 to 8 months	
4	. 5 10		otal for Stage			Per Crewmer				,			0	3	3	-	p.i.s. 13 iddition	
4		Cus II	Olago	116.5	Jango Fotono	113	92	92	92	95.5	92	92	113	92	92	92		

Table A-4. Flight Support – Information (Continued)

																ate La	ast Modif	ied: 06/08
	Seq		1	ı	Sched		1	Non-	Crew Rotati	ion		1		Crew F	Rotation		Approx	
Stage	Num	Lesson Code	Media	Hours	Code	С	Р	MS1	MS2	MS3	MS4	PS	С	Р	MS1	MS2	Timeframe	Comments
3	FS-4	Annual Physical	JSC/Bldg 8	3.5	1	3.5	3.5						3.5	3.5			Yearly	Yearly on birth month
3		Flight Clothing Fitcheck	o con a nage	2	1	2	2	2	2	2	2	2	2	2	2	2	L-6 months	@ FCE
		Postflight Appearances Planning																
3	FS-18	Meeting	Crew Office Bldg 8	0.5	1	0.5							0.5				L-3 Months	
3	FS-19	Crew Photo	Studio	4	8	4	4	4	4	4	4	4	4	4	4	4		
																	Every 2 to 8	
3	FS-8	Flight IPT (2 hours x 4 months)	Mtg Rm	8	8	8							8				weeks	As needed
3	FS-20	Flight Ops Review	Mtg Rm	8	8	8							8				3 to 4 months prior to flight	As requested
	1 0 20	i iigiit opertorion	Imag rum	- ŭ									Ü				Every 4 to 8	7 to requested
3	FS-10	Fllight JOP (2 hours x 4)	Mtg Rm	8	8	8							8				weeks	As needed
3	EQ.12	Physical Training (Gym)[4.5 hours x 15 weeks]		67.5	1	67.5	67.5	67.5	67.5	67.5	67.5	67.5	67.5	67.5	67.5	67.5	1.5 hours 3x/week	2 hours 3x/week for EVA CMs within 6 months of launch
	1 3-12	x 15 weeksj		07.5		07.5	07.5	07.5	07.5	07.5	07.5	07.5	07.5	07.5	07.5	07.5	NLT 2 weeks	months of laurich
3	FS-21	FDF/ODF Pre Simulation Briefing	Crew CR	1.5	8	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	before start of int sims	
	F0 00	D10 D: D:	OL D														L-5 to L-4	
3	FS-22	PAO Big Picture Mtg	otal for Stage	1	8 Stage Totals	Per Crewme	mher:	1	1	1	1	1	1	1	1	1	months	
3		Cub i	otal for otage	104.0	Otage Totale	104.0	79.5	76	76	76	76	76	104.0	79.5	76	76		
		Physical Training (Gym) [4.5															1.5 hours	2 hours 3x/week for EVA CMs within 6
2	FS-12	hours x 13 weeks]		58.5	1	58.5	58.5	58.5	58.5	58.5	58.5	58.5	58.5	58.5	58.5	58.5	3x/week	mos of launch
2		VITT Brief	CLR	2	8	2	2	2	2	2	2	2	2	2	2	2		
2		Guest List	CLR	2	8	2	2	2	2	2	2	2	2	2	2	2		
2	FS-25	L-16 DA7/CB T/U	Mtg Rm	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	L-16 weeks	
2	FS-9	Flight IPT (2 hours x 3)	Mtg Rm	6	8	6							6				Every 2 to 8 weeks	As needed
2		Menu Review	CLR	1	2	1	1	1	1	1	1	1	1	1	1	1	Woold	7 to Hoodod
																	Every 4 to 8	
2	FS-10	Flight JOP (2 hours x 3)	Mtg Rm	6	8	6							8				weeks	As needed
																		Other crewmembers
2	FS-27	FCOD MRR	CLR	1.5	8	1.5							1.5				L-3 months	as assigned by CDR
																		Yearly on birth
2	FS-4	Annual Physical	JSC/Bldg 8 Bldg 2	3.5	1			3.5	3.5		3.5				3.5	3.5	Yearly	month
2	FS-28	Individual PAO Interview	Studio	1.5	8	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	L-3 months	
2	FS-29	Contingency Landing Training	CLR	1.5	2	1.5	1.5						1.5	1.5			L-6 weeks	
2	FS-30		KSC	12	8	12	12	12	12	12	12	12	12	12	12	12	L-8 weeks	
2	FS-31	KSC Videotapes Annual Ethics Briefing	Video CLR	1	8	1	1	1	1	1	1		1	1	1	1	Yearly Yearly	
2		Annual Security Briefing	CLR	1	8	1	1	1	1	1	1		1	1	1	1	Yearly Yearly	
2	FS-34	Annual IT Security Briefing	CBT	1	8	1	1	1	1	1	1		1	1	1	1	Yearly	
2	FS-35	ELSA Training	CLR	0.25	1	0.25	0.25	0.25	0.25	0.25	0.25		0.25	0.25	0.25	0.25	Yearly	
2		L-6 DA7/CB T/U TV STRATEGY	Mtg Rm CLR	0.5	1 8	0.5	0.5	0.5	0.5	0.5 1	0.5	0.5	0.5	0.5 1	0.5	0.5	L-6 weeks	
2	FS-36	IVSTRATEGY	CLR	1	8	1	1	1	1	1	1	1	1	1	1	1	L-5 weeks	
																		@ FCE; sometimes
2	FS-37	BENCH REVIEW		8	8	8	8	8	8	8	8	8	8	8	8	8	L-5 weeks	split over two days
																		With PGSC Engineer; best to
																		schedule around
2	FS-38	POC REVIEW	CLR	1.5	1	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	L-5 weeks	Bench Review
																		I. Sweeter (
			Bldg 2															L-5 weeks for approximate
2	FS-39	Crew Press Conf	Studio	4	8	4	4	4	4	4	4	4	4	4	4	4	L-5 weeks	timeframe
2			otal for Stage			Per Crewme	mber:											
2				115.25		111.75	98.25	100.25	100.25	96.75	100.25	92.50	113.75	98.25	100.25	100.25		

Table A-4. Flight Support – Information (Concluded)

Date Last Modified: 06/08

								Non-	Crew Rotati	ion				Crowl	Rotation	Date	Last Will	Jilleu. 00/08
	Seq				Sched			INOII	Ciew itolal					Ciewi	Votation		Approx	
Stage	Num	Lesson Code	Media	Hours	Code	С	P	MS1	MS2	MS3	MS4	PS	С	Р	MS1	MS2	Timeframe	Comments
Olage	Italii	Ecoson code	modia	Hours	Gode		•	INIO	WIGZ	IVIOS	1004	- 10	U	•	WO	IVIOZ	Timenane	
																		2 hours 3x/week for
	FC 40	Physical Training (Gym) [4.5		40		40	40	40	40	40	40	40	40	40	40	40	1.5 hours	EVA CMs within 6
1		hours x 4 weeks) FCOD FRR	Mtg Rm	18	1	18 2	18	18	18	18	18	18	18	18	18	18	3x/week L-1 month	mos of launch
- 1	F3-40	FCOD FRR	IVILG KIII														L-1 month	
1	FS-41	Range Safety Brief at JSC	CLR	0.25	1	0.25	0.25						0.25	0.25				Should be scheduled in directly before the first Integrated Ascent or Entry simulation after TCDT
																		Additional travel time
1		TCDT	KSC	22	8	22	22	22	22	22	22	22	22	22	22	22	L-3 weeks	required
1	FS-43	L-10 PHYSICAL	Bldg 8	3	8	3	3	3	3	3	3	3	3	3	3	3	L-10 days	
1	EC 44	L-10 Bench Review	FCE Facility	3	1					3							L-10 Days	Loadmaster only.
1	FS-45	FNL FDF RVW	CLR	4	8	4	4	4	4	4	4	4	4	4	4	4	L-4 weeks	Loadinaster only.
	10 40	THE FOR IKW	JSC Crew		Ů	-					-			-	-	-	L 4 WCCRS	
1	FS-46	FLT DIR MTG	Quarters	2	8	2	2	2	2	2	2	2	2	2	2	2	L-1 week	
1		Sub T	otal for Stage		Stage Totals	Per Crewmer												
1				54.25		51.25	49.25	49	49	52	49	49	51.25	49.25	49	49		Note: Loadmaster
0	FS-47	MPLM KSC Bench Review	FCE Facility	8	2					8								(+1); this bench review is only required for Shuttle Missions launching logistics modules (i.e., MPLM, Spacehab, JEM, Columbus)
0			Conf Rm	1	8	1	1	1	1	1	1	1	1	1	1	1	L-11 months	Optional
0	FS-49	MSN Study Time	SELF	1	1	1	1	1	1	1	1	1	1	1	1	1		As needed
0	FS-50	RANGE SAFETY	CLR	1	2	1	1						1	1			L-3 weeks	@ KSC during TCDT
0	FS-51	PREFLT MENU	CLR	0.5	2	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2 weeks prior to TCDT	As needed
-	1001	THE ET MENO	OLIC	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1001	715 Heeded
0	FS-52	Earth Observations Briefing	CLR	1	8	1	1	1	1	1	1	1	1	1	1	1	L-9 to L-1 month	As needed
																		SHAB/PYLD flights
0	FS-53	Payload MST	KSC	16	4			16	16	16	16	16			16	16	L-2 months	only
	F0 54	B 1 107	1400	40				40	40	40	40	40			40	40		SHAB/PYLD flights
0	FS-54	Payload IVT	KSC	16	4			16	16	16	16	16			16	16	L-6 weeks	only SHAB/PYLD flights
0	FS-55	Payload FDF Review	CLR	4	8			4	4	4	4	4			4	4	L-4 weeks	only
0		Brooks AFB Centrifuge	Centrifuge	4	2													First time crewmembers; additional travel time required
0		Sub T	otal for Stage		Stage Totals	Per Crewmer		00.5	00.5	47.5	00.5	00.5	4.5	4.5	00.5	00.5		
0				52.5		4.5	4.5	39.5	39.5	47.5	39.5	39.5	4.5	4.5	39.5	39.5		

**Table A-5. Aircraft Operations – Information** 

Date Last Modified: 07/07

								,	lon-C	raw D	otatio	n			raw E	Rotatio		LUST IVI	odilied: 07/07
		Ref				Sched			1011-0	-wr	otatio			C	iewr	l	/11		
C+			1 O-d-	Media	١	Code	_	_						_				Ala E	
Stag	je r	Num	Lesson Code	Media	Hrs	Code	С	Р	MS1	MS2	MS3	MS4	PS	С	Р	MS1	MS2	Alt Fac	Comments
																			Bi-weekly until L-
																			12 weeks;
																			Weekly L-12 to
4	- 1	A/C-1	STA (2 hours x 9 weeks)	STA	18	1	18	18						18	18				launch
																			Bi-weekly until L-
			TOO Eligible for OTA - 40 hours of O	T 00															12 weeks;
4	0		T38 Flight for STAs (6 hours x 9 weeks)	T-38 Aircraft	54	2	54	54						54	54				Weekly L-12 to launch
- 4		AVC-Z	weeks)	T-38	54		54	54						54	54				launen
4	,	A/C 2	T38 Q Check (3 hours x 3 people)	Aircraft	9	1	3	3			3			3	3				Annually
		WC-3	130 Q Check (3 hodis x 3 people)	T-38	9	<u>'</u>	J	J			J			J					Annually
4	1	∆/C-4	T38 EP Sim (3 hours x 2 people)	Aircraft	6	1	3	3						3	3				Annually
		70-7	130 E1 GIII (3 110013 X 2 pcopie)	Ellington	L .	<u> </u>													Aimdany
4	1	A/C-5	T38 Groundschool	Field	4	1					4								Annually
			T38 Flight For Pilots (5 hours x 4	T-38	<u> </u>	<u> </u>													rimanij
4	I A	A/C-6	months)	Aircraft	20	1	20	20						20	20				Monthly
			T38 Flight For MS's (4 hours x 4	T-38															
4	A	A/C-6	months)	Aircraft	16	1			16	16	16	16	16			16	16		Monthly
4			AMES	VMS	12	1	12	12						12	12				Bi-annually
4			Sub Tot	al for Stage	tage To	tals Per Crev	wmemb	er:											
4					139		110	110	16	16	23	16	16	110	110	16	16		
																			Bi-weekly until L-
																			12 weeks;
	١,																		Weekly L-12 to
3	<i>F</i>	A/C-1	STA (2 hours x 8 weeks)	STA	16	1	16	16						16	16				launch
																			Bi-weekly until L-
			T20 Flight for CT ( - 40 house of 0	T-38															12 weeks;
3	,		T38 Flight for STAs (6 hours x 8 weeks)	Aircraft	48	2	48	48						48	48				Weekly L-12 to launch
		AV C-2	T38 Instrument Ck (3 hours x 2	T-38	40		40	40						40	40				launch
3		A/C-8	people)	Aircraft	6		3	3						3	3				Annually
	——	~~~	T38 Groundschool (4 hours x 2	Ellington	-										,				Aillidally
3		A/C-5	people)	Field	8		Δ.	4						4	4				Annually
			T38 Flight for Pilots (5 hours x 4	T-38															raindany
3	A	A/C-6	months)	Aircraft	20	1	20	20						20	20				Monthly
			T38 Flight For MS's (4 hours x 4	T-38															,
3	A	A/C-6	months)	Aircraft	16				16	16	16	16	16			16	16		Monthly
3			AMES	VMS	12	1	12	12						12	12				Bi-annually
3			Sub Tot	al for Stage	Stage T	otals Per Cr													
3					126		103	103	16	16	16	16	16	103	103	16	16		

**Table A-5. Aircraft Operations – Information (Concluded)** 

Date Last Modified: 07/07

							1	lon-C	rew R	otatio	n		С	rew F	Rotatio			loanica. 01701
	Ref				Sched													
Stage	Num	Lesson Code	Media	Hrs	Code	С	Р	MS1	MS2	MS3	MS4	PS	С	Р	MS1	MS2	Alt Fac	Comments
																		Bi-weekly until L-
																		12 weeks;
																		Weekly L-12 to
2	A/C-1	STA (2 hours x 11 weeks)	STA	22	1	22	22						22	22				launch
																		Bi-weekly until L-
			T 00															12 weeks;
2		T38 Flight for STAs (6 hours x 11	T-38 Aircraft		_ ا		66							66				Weekly L-12 to
2	A/C-2	weeks)	T-38	66	2	66	66						66	96				launch
2	A/C-3	T38 Q Check (3 hours x 3 people)	Aircraft	9				3	3		3				3	3		Annually
	700	T38 Groundschool (4 hours x 3	Ellington	l –					<u> </u>		,				-	<u> </u>		Annually
2	A/C-5	people)	Field	12	1			4	4		4				4	4		Annually
		T38 Flight For Pilots (5 hours x 3	T-38															,
2	A/C-6	months)	Aircraft	15		15	15						15	15				Monthly
		T38 Flight for MS's (4 hours x 3	T-38															
2	A/C-6	months)	Aircraft	12				12	2	2	12	12			12	12		Monthly
						١.	١.											1x within L-6
2	A/C-9	HAT Flight	C9	Stone T	i Totals Per Cr	4	4						4	4				Months
2		300 100	arior Stage	140	otais Per Cr	107	107	19	9	2	19	12	107	107	19	19		
				140		107	107	13	3		13	12	107	107	13	13		
																		Bi-weekly until L-
																		12 weeks;
																		Weekly L-12 to
1	A/C-1	STA	STA	6	1	6	6						6	6				launch
																		Bi-weekly until L-
			T 00															12 weeks;
1	4/0.2	TOO Elimba for STA	T-38 Aircraft	18	2	18	18						18	18				Weekly L-12 to launch
- 1	A/C-2	T38 Flight for STAs	T-38	10		10	10						10	10				laurich
1	A/C-6	тзв (тсрт)	Aircraft	6	1	l 6	6	6	6	6	6	6	6	6	6	6		Monthly
1	~~~	Sub Tot			otals Per Cr				0	0	0		0	0	-	0		inoning
1		000 100		30	113.0 . 0. 01	30	30	6	6	6	6	6	30	30	6	6		
			Altitude															
0	A/C-10	Physiological Refresher Training	Chamber	3.5	1	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5		Every 3 years
0			al for Stage		otals Per Cr		nber:											
0				3.5		3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5		

Table A-6. Informal – Information

Date Last Modified: 04/06

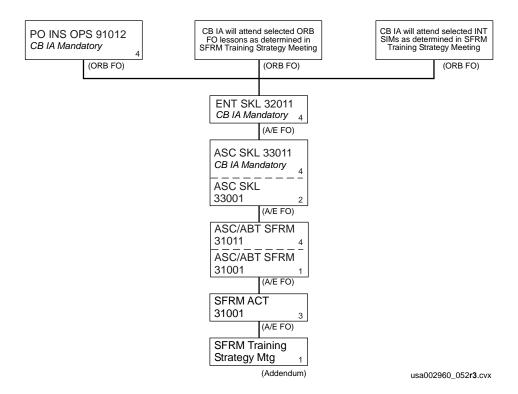
								Non	-Crew F	Rotation	1			Crew	Rotatio	n		
Stage	Ref Num	Lesson Code	Media	Hrs	Sched Code	С	Р	MS1	MS2	MS3	MS4	PS	С	Р	MS1	MS2	Approx Timeframe	Comments
4	INF-1	ADMIN (5 hours/wk x 17 weeks)		85	1	85	85	85	85	85	85	85	85	85	85	85	Weekly	
		CREW T/U (1 hour/mo x 5				•••••												
4	INF-2	months) CB MTG (1 hour/wk x 17	Crew Office	5	8	5	5	5	5	5	5	5	5	5	5	5	Monthly	
4	INF-3	weeks)	CLR	17	8	17	17	17	17	17	17	17	17	17	17	17	Weekly	
4			Sub Total for Stage		otals Per Cr				<u> </u>									
4				107		107	107	107	107	107	107	107	107	107	107	107		
3	INF-1	ADMIN (5 hours/wk x 15 weeks) CREW T/U (1 hour/mo x 4		75	1	75	75	75	75	75	75	75	75	75	75	75	Weekly	
3	INF-2	months)	Crew Office	4	8	4	4	4	4	4	4	4	4	4	4	4	Monthly	
3	INF-3	CB MTG (1 hour/wk x 15 weeks)	CLR	15	8	15	15	15	15	15	15	15	15	15	15	15	Weekly	
3			Sub Total for Stage	Stage T	otals Per Cr	ewmen	nber:											
3				94		94	94	94	94	94	94	94	94	94	94	94		
2	INF-1	ADMIN (5 hours/wk x 13 weeks)		65	1	65	65	65	65	65	65	65	65	65	65	65	Weekly	
2	INF-2	CREW T/U (1 hour/mo x 3 months)	Crew Office	3	8	3	3	3	3	3	3	3	3	3	3	3	Monthly	
2	INF-3	CB MTG (1 hour/wk x 9 weeks)	CLR	9	8	9	9	9	9	9	9	9	9	9	9	9	Weekly	
2			Sub Total for Stage	Stage T	otals Per Cr	ewmen	nber:											
2				77		77	77	77	77	77	77	77	77	77	77	77		
1	INF-1	ADMIN		16	1	16	16	16	16	16	16	16	16	16	16	16	Weekly	
1			Sub Total for Stage	Stage T	otals Per Cr	ewmen	nber:											
1				16		16	16	16	16	16	16	16	16	16	16	16		
0	INF-4	Aviation Safety Meeting	CLR	1	8	1	1	1	1	1	1		1	1	1	1	Bi-monthly	As needed
0 -		Crew Debriefs	CLR	3	1	3	3	3	3	3	3		3	3	3	3	After another crew's mission Prior to L-6	As requested
0		Public Relations Appearances Russian Language Training	Variable CLR	2	1	2	2	2	2	2		2						As requested by crewmember
0	1141 7	resonan Language Training	Sub Total for Stage	Stage T	otals Per Cr	ewmen	nber:										permitting	CI CHINICII DEI
0				6		6	6	6	6	6	4	2	4	4	4	4		

Table A-7. Holiday – Information

Date Last Modified: 10/05

						Non-Crew Rotation					Crew Rotation							
	Ref				Sched													
Stage	Num	Lesson Code	Media	Hrs	Code	С	Р	MS1	MS2	MS3	MS4	PS	С	Р	MS1	MS2	Alt Fac	Comments
4		Holiday (8 hours x 2)		16	8	16	16	16	16	16	16	16	16	16	16	16		
4		Leave		40	8	40	40	40	40	40	40	40	40	40	40	40		
4		Sub Tot	al for Stage	Stage T	otals Per Cr	ewmen	nber:											
4				56		56	56	56	56	56	56	56	56	56	56	56		
3		Holiday (8 hours x 3)		24	8	24	24	24	24	24	24	24	24	24	24	24		
3		Leave		40	8	40	40	40	40	40	40	40	40	40	40	40		
3		Sub Tot	al for Stage	Stage T	otals Per Cr	ewmen	nber:											
3				64		64	64	64	64	64	64	64	64	64	64	64		
2		Holiday (8 hours x 4)		32	8	32	32	32	32	32	32	32	32	32	32	32		
2		Leave (Thanksgiving)		16	8	16	16	16	16	16	16	16	16	16	16	16		
2		Leave (Christmas/New Year)		56	8	56	56	56	56	56	56	56	56	56	56	56		
2		Sub Tot	al for Stage	Stage T	otals Per Cr	ewmen	nber:											
2				104		104	104	104	104	104	104	104	104	104	104	104		
1		Holiday		8	8	8	8	8	8	8	8	8	8	8	8	8		
1		Sub Tot	al for Stage	Stage T	otals Per Cr	ewmen	nber:											
1				8		8	8	8	8	8	8	8	8	8	8	8		

## APPENDIX B SPACEFLIGHT RESOURCE MANAGEMENT



APPENDIX C PAYLOAD SPECIALIST TRAINING INFORMATION

## PAYLOAD SPECIALIST SELF STUDY MATERIAL LIST

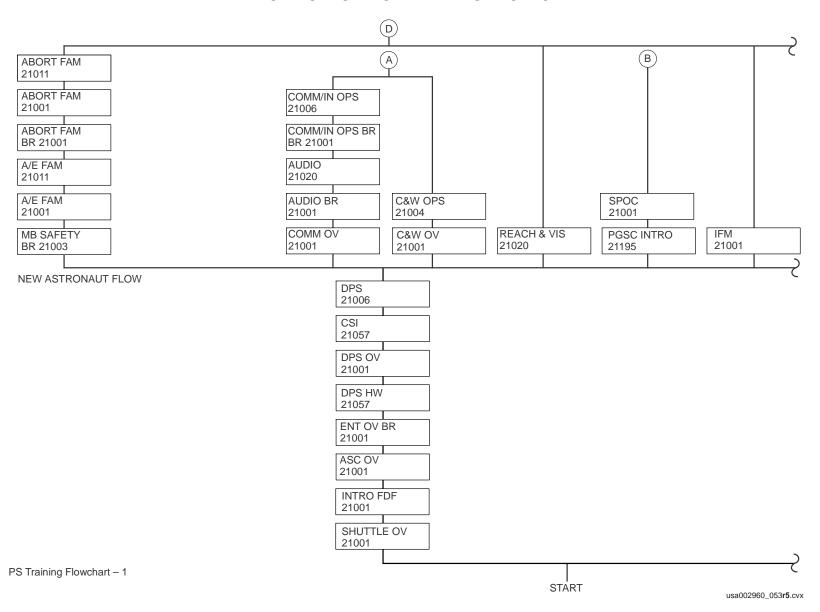
Title	Code	Lesson Association	Source	Hours
Shuttle FDF CBT	FDF 21057	INTRO FDF 21001	DO354	2.0
Location Coding Workbook	LOC CODE 21002	CREW CAB FAM 21020	DX45	2.0
Audio/UHF Training Manual	AUD/UHF 21002	AUDIO BR 21001	DS25	2.0
Caution & Warning Workbook	C&W 21002	C&W OPS 21004	DS45	2.0
Communication Overview CBT	COMM OV 21057	COMM/IN OPS BR 21001	DS25	2.0
Communication SPEC/Display (COMM/SPEC) CBT	COMM SPEC 21057	COMM/IN OPS 21006	DS25	2.0
Crew Software Interface Workbook	CSI 21002	CSI 21057	DS12	2.0
DPS Overview Workbook	DPS OV 21002	DPS 21006	DS24	1.5
S-Band Comm/Inst Workbook	S-BND COM/IN 21002	COMM/IN OPS BR 21001	DS25	4.0
Food System and Dining Workbook	FOOD SYS 21002	GALLEY 21020	DX45	2.0
Guidance-Navigation-and-Control (GNC) Dedicated Displays – 2157 CBT	GNC DED DISP 21057	A/E FAM 21001	DS66	2.0
Intact Ascent Aborts Workbook	Intact Ascent Aborts 21002	ABORT FAM BR 21001	DS66	3.0
Instrumentation CBT	INST 21057	COMM/IN OPS BR 21001	DS25	2.0

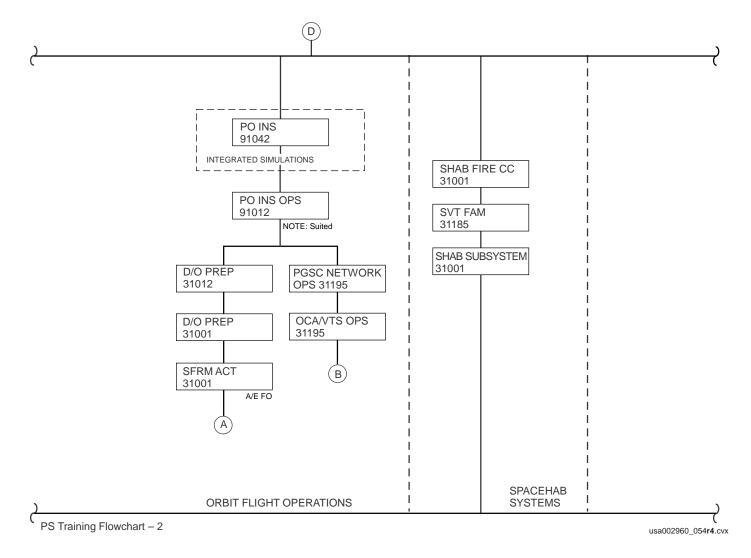
## **Recommended Reference Material**

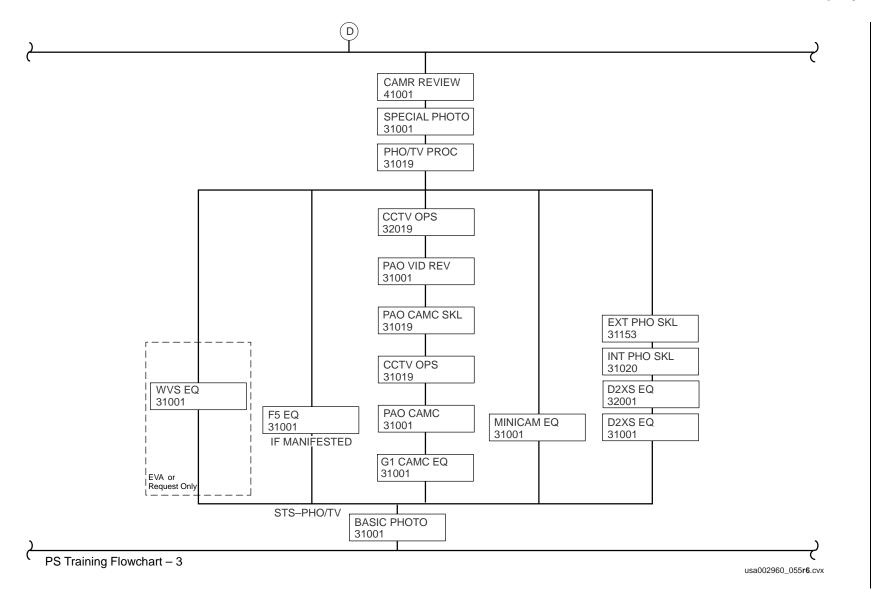
Shuttle Crew Operations Manual

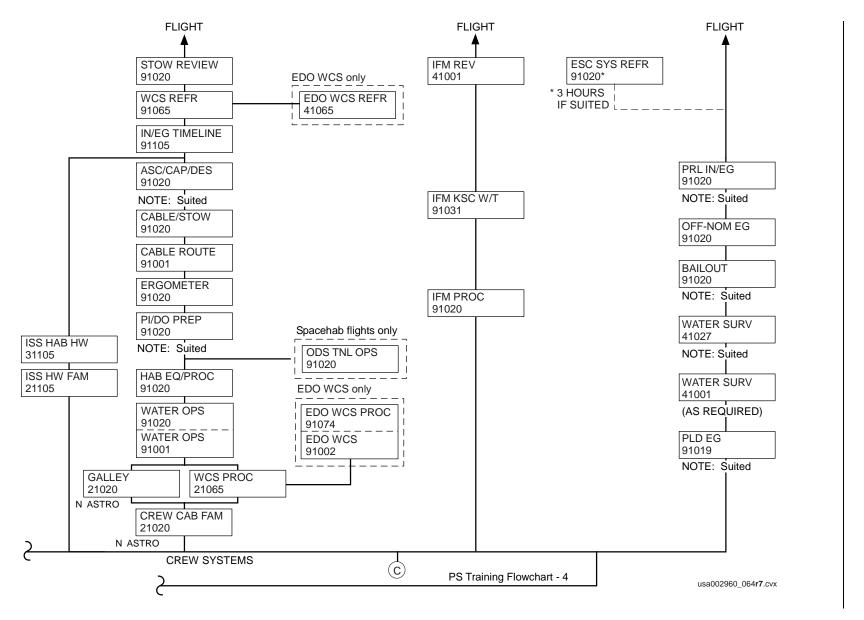
Shuttle Crew Training Catalog

## PAYLOAD SPECIALIST TRAINING FLOW CHART









#### APPENDIX D ACRONYMS AND ABBREVIATIONS

#### D.1 COMMON WORDS AND ACRONYMS

The below listed acronyms do not have to be spelled out every time they appear.

AC Alternating Current

ACES Advanced Crew Escape Suit

APDS Androgynous Peripheral Docking System

ASCAN Astronaut Candidate

CAPCOM Capsule Communicator
CBT Computer Based Trainer
CCT Crew Compartment Trainer
CCTV Closed Circuit Television

CD Compact Disk
CDR Commander
COMM Communications

CPR Cardiopulmonary Resuscitation

CRT Cathode-Ray Tube
CST Crew Software Trainer

DAP Digital Autopilot DC Direct Current

DPS Data Processing System

DSO Detailed Secondary Objectives

DST Dynamic Skills Trainer
DTO Detailed Test Objective

EMU Extravehicular Mobility Unit EPS Electrical Power System

EV Extravehicular

EVA Extravehicular Activity

FAM Familiarization
FB Fixed Base
FDF Flight Data File

FFT Full Fuselage Trainer

GMT Greenwich Mean Time

GNS Guidance Navigation Simulator

H<sub>2</sub>O Water H/W Hardware

INRTL Inertial

ISS International Space Station

IV Intravehicular

JSC Johnson Space Center

KSC Kennedy Space Center

L- Launch minus

LVLH Local Vertical/Local Horizontal

MAL Malfunction
MALS Malfunctions
MB Motion Base

MCC Mission Control Center

MCC-H Mission Control Center-Houston MCC-M Mission Control Center-Moscow

MET Mission Elapsed Time

MPLM Multipurpose Logistics Module

MS Mission Specialist

MSFC Marshall Space Flight Center

NASA National Aeronautical and Space Administration

NBL Neutral Buoyancy Laboratory

NOM Nominal

O<sub>2</sub> Oxygen

OMS Orbital Maneuvering System

PABF Precision Air Bearing Floor

PDRS Payload Deployment and Retrieval System

PGSC Payload General Support Computer

PLT Pilot

PRF Proficiency PROC Procedure

PS Payload Specialist PTT Part Task Trainer

QUAL Qualification

RMS Remote Manipulator System

RPOP Rendezvous and Proximity Operations Program

S/W Software

SAFER Simplified Aid for Extravehicular Activity

SMS Shuttle Mission Simulator

SMTF Shuttle Mission/Mock-up Training Facility

SPEC Specialist Function

SRMS Shuttle Remote Manipulator System

SSMTF Space Station Mock-up and Training Facility SSRMS Space Station Remote Manipulator System

SST Single System Trainer

Space Station Training Facility Space Transportation System Systems SSTF STS

SYS

TCDT **Terminal Countdown Demonstration Test** 

UHF **Ultrahigh Frequency** 

**VERN** Vernier Jet

## D.2 DOCUMENT ACRONYMS

A/A Air-to-Air
A/E Ascent/Entry

A/L Airlock

Approach and Landing

A/G Air-to-Ground

AA Accelerometer Assembly
ABE Arm-Based Electronics

ACAS Automatically Commanded Auto Sequence

ACCU Audio Central Control Unit
ACO Assembly and Checkout Officer
ACS Audio Control Subsystem
ADC Analog to Digital Converter

ADCO Attitude Determination and Control Officer

ADI Attitude Direction Indicator

ADS Air Data System

Audio Distribution System

ADTA Air Data Transducer Assembly
AESP Ascent/Entry Systems Procedure

AKA Active Keel Actuator
ALC AFT Load Controller
AMI Alpha Mach Indicator

AMS Atmosphere Monitoring Subsystem

ANT Antenna

AOA Abort Once Around

AOD Aircraft Operations Directorate

AOS Acquisition of Signal APCL Ascent Pocket Checklist

APFR Articulating Portable Foot Restraint

APLS Atmosphere Pressure Limiting Subsystem

APU Auxiliary Power Unit

ARCS AFT Reaction Control System

ARS Atmosphere Revitalization (Sub)system

ASA Aerosurface Servo Amplifier

ASC Ascent

ASM Aviation Safety Meeting
ASP Astronaut Support Personnel
ATCS Active Thermal Control System

Atmosphere Thermal Control Subsystem

ATO Abort To Orbit

ATT Attitude

ATU Audio Terminal Unit

ATV Automatic Transfer Vehicle
ATVC Ascent Thrust Vector Control

AUT Automatic

Av Avionics

AVVI Altitude Vertical Velocity Indicator

AVU Artificial Vision Unit

AZ Azimuth

BCA Battery Charger Assembly

BDA Bermuda

BFC Backup Flight Controller
BFS Backup Flight Software
Backup Flight System

BIT Built-In Test

BITE Built-In Test Equipment BNC British Naval Connector

BOB Breakout Box

BPSMU Battery Powered Speaker Microphone Unit

BSA Battery Stowage Assembly
BSE Booster Systems Engineer
BTA Bends Treatment Adapter

BTU Bus Terminal Unit

C&C Command and Control

C&DH Command and Data Handling C&T Communication and Tracking

C&W Caution and Warning

C/L Checklist C/O Checkout

c.g. Center of Gravity

CAD Command and Display

CAL Calibration

CAM Computer Annunciation Matrix

CAP Crew Activity Plan
CAS Common Attach System

cb circuit breaker

CBCS Centerline Berthing Camera System

CBT Computer Based Training

CCA Communications Carrier Assembly CCC Contaminant Control Cartridge

CCCR Crew Compartment Configuration Review

CCK Contaminant Cleanup Kit CCU Crew Communicator Umbilical

CDF Command Frame

CDH Command and Data Handling

CDM Carbon Dioxide Monitor

CEIT Crew Equipment Interface Test

CEPA Columbus External Payload Adaptor

CETA Crew and Equipment Translation Aid

Crew Equipment Translation Aid

CEU Control Electronics Unit

CEVIS Cycle Ergometer with Vibration Isolation System

CF Compact Flash
CIL Critical Items List

CIRD Cargo Integration Review Dry Run

CMD Command

CMO Crew Medical Officer

CMOS Complementary Metal Oxide Semi-Conductor

CO2 Carbon Dioxide

COAS Crew Optical Alignment Sight
COMSEC Communications Security
CPA Controller Panel Assembly
CPD Crew Personal Dosimeter
CPN Change Package Notice

CRM Cockpit Resource Management

CRYO Cryogenic CS Common Set

CSA Canadian Space Agency

CSA-CP Compound Specific Analyzer-Combustion Product

CSA-O2 Compound Specific Analyzer-Oxygen

CSS Control Stick Steering
CTB Cargo Transfer Bag

CTC Cargo Transport Container
CTVC Color Television Camera
CVIU Common Video Interface Unit
CWC Contingency Waste Container
CWS Caution and Warning System

D&C Display and Control

D/O Deorbit

DBN Data Bus Network

DCM Display and Control Module DCS Decompression Sickness

DEL Delta

DEU

DFL

Deorbit, Entry, and Landing
Display Electronics Unit
Decommutator Format Load

DDCU Direct Current to Direct Current Converter Unit

DISP Display

DK Display/Keyboard

DLMA Dilemma

DMM Digital Multimeter
DOF Degree of Freedom

DOUG Dynamic On-orbit Ubiquitous Graphics

Dynamic Onboard Ubiquitous Graphics

DPLY Deploy

DRAG Drag Altitude (DRAG H)
DSC Dedicated Signal Conditioner
DTM Dexterous Manipulator Trainer

DTV Digital Television

DV Delta-V

DYF Display Frame

E/O Engine Out

ECAL East Coast Abort Landing
ECG Environmental Control Group

ECLSS Environmental Control and Life Support System

ECS Environmental Control Subsystem

ECWS Extravehicular Mobility Unit Caution and Warning System

EDO Extended Duration Orbiter EDW Edwards Air Force Base

EE End Effector

EEL Emergency Egress Light
EENT Eye, Ear, Nose, and Throat
EES Emergency Egress Slide

EI Entry Interface
EKG Electrocardiogram

ELS Emergency Landing Site

ELSA Emergency Life Support Apparatus

EMER Emergency

EMS Emergency Medical Services

ENG Engine ENT Entry

EOM End Of Mission Elbow Pitch

**Emergency Procedures** 

EPDC Electrical Power Distribution and Control

EPS Electrical Power Subsystem
ESA External Sampling Adaptor
ESP External Stowage Platform

ESS Essential
ET External Tank
Endotracheal

ETA Environmental Test Article EVAAT EVA Assessment Team

EVAL Evaluation

EXCP Experiment Connector Panel

EXEC Execute

EXL Exercise Physiology Lab

EXPRESS EXpedite the PRocessing of Experiments to Space Station

FA Flight Aft

FAO Flight Activities Officer

FC Flight Critical

Fuel Cell

FCE Flight Crew Equipment

FCOD Flight Crew Operations Directorate

FCMS Fuel Cell Monitoring System

FCP Fuel Cell Powerplant
FCR Flight Control Room
FCS Flight Control System
FCT Flight Control Team

Flight Controller Trainer

FD Flight Director

Freeze Dried

FDA Fault Detection and Annunciation

FDIR Fault Detection, Identification, and Reconfiguration

Fault Detection, Isolation, and Recovery

FDO Flight Dynamics Officer
FEP Front End Processor
FES Flash Evaporator System
FIM Flight Integration Manager

FLT Flight

FM Frequency Modulation

FMEA Failure Mode and Effect Analysis
FMK Formaldehyde Monitoring Kit

FO Flight Operations FOR Flight Ops Review

Force

Frame of Resolution

FPC Forward Power Controller

FPSR Flight Planning Stowage Review

FRAM Flight Releasable Attachment Mechanism

FRCS Forward Reaction Control System

FRP Fuselage Reference Plane FRR Flight Readiness Review

FS Flight Supplement

Flight-Similar

FSE Flight Support Equipment
FSS Fire Suppression Subsystem

FTH Fail to Halt FTS Fail to Sync

Flight Termination System

FUR Facility Utilization Request

G&C Guidance and Control
GCA Ground Control Assist*ance* 

**Ground Controlled Approach** 

Ground rules, Constraints, and Assumptions

GCIL Ground Command/Control Interface Logic

GG Gas Generator

GIRA Galley Iodine Removal Assembly
GLA General Luminaire Assembly
GMM Geometrical Math Model

GNC Guidance, Navigation, and Control

GPC General Purpose Computer
GPO Guidance Procedures Officer
GPS Global Positioning System
GRT Generics Robotics Training
GSC Grab Sample Container
GUI Graphical User Interface

H Altitude H/O Hand-Off

HAC Heading Alignment Cone

HAM Handheld Amateur Radio Operator

HAT Heavy Aircraft Training
HAZMAT Hazardous Material
HC Hand Controller
Hdot Altitude Rate

He Helium

HFA Hab Fan Assembly HHL Hand-Held Lidar

HLCM Highest Loaded Crew Member

HP Height of perigee HRM Heart Rate Monitor

HIS Horizontal Situation Indicator
HSP Health Stabilization Program
HST Hubble Space Telescope

HUD Heads-Up Display HUT Hard Upper Torso

HYD Hydraulic

I/O Input/Output I/F Interface

IA Instructor Astronaut
IAC Internal Audio Controller

IC Initial Condition

ICC Integrated Cargo Carrier
ICOM Intercommunication

ID Identification

IDP Integrated Display Processor

IFM In-Flight Maintenance

ILMA Intubating Laryngeal Mask Airway
IMCA Integrated Motor Controller Assembly

IMU Inertial Measurement Unit

INH Inhibit

INCNCT Interconnect
INST Instrument(ation)
IP Instructor Pilot
Internet Protocol

IPL Initial Product Load

IPT Integrated Product Team

IPV International Procedure Viewer

IRU In-flight Refill Unit

IS&AG Imaging Science and Analysis Group

ISA Internal Sampling Adapter

ISIS International Subrack Interface Standard

ISO Integrated Simulation Objective
ISPR International Standard Payload Rack
ISSACS ISS Analysis Coordinate System
ITVC Intensified Television Camera

IVA Intravehicular Activity
IVT Interface Verification Test

JEUS Joint Expedited Undocking and Separation

JOP Joint Operations Plan

KEAS Knots Equivalent Airspeed KFX Ku-Band File Transfer

L/D Lift-to-Drag Ratio

L/O Liftoff

LAN Local Area Network
LCC Launch Commit Criteria
LCR Lesson Change Request

LCVG Liquid Cooling Ventilation Garment

LEE Latching End Effector
LM Logistics Module
LOC Loss of Control
LON Launch On Need
LOS Loss of Signal
LPU Life Preserver Unit
LRU Line Replaceable Unit

Line Replacement Unit

LS Load-Specific

LSS Life Support System

MBM Manual Berthing Mechanism

MBS Mobile Remote Servicer Base System

MCA Motor Controller Assembly MCG Motion Control Group

MCIU Manipulator Controller Interface Unit

MDF Minimum Duration Flight
MDM Multiplexer/Demultiplexer
MDU Multifunction Display Unit

MECH Mechanical Mechanics

MECO Main Engine Cutoff

MEDS Multifunction Electronic Display System

MFX Modem File Transfer

MLE Middeck Locker Equivalent
MLS Microwave Landing System
MMI Manual Minimum Impulse
MMU Modular Memory Unit

MNC Main Bus C MNVR Maneuver

MOD Mission Operations Directorate
MPLM Multi-Purpose Logistics Module
MPM Manipulator Positioning Mechanism

MPS Main Propulsion System
MPSR Multipurpose Support Room
MRL Manipulator Retention Latch

MRMDF Multiuse Remote Manipulator Development Facility

MRO MSS Robotics Operator

MSBLS Microwave Scanning Beam Landing System

MSN Mission

MSS Mobile Servicing System
MST Mission Sequence Test
MTU Master Timing Unit

MUX Multiplexer

MWS Mini Work Station

N<sub>2</sub> NitrogenNAV NavigationNAVAID Navigation Aid

NBAT Nominal Bus Assignment Table NOPA Nitrogen/Oxygen Purge Adaptor NPRV Negative Pressure Relief Valve

NSP Network Signal Processor NSS Network Systems Simulator

NTD NASA Test Director NWS Nose Wheel Steering

NYJ No Yaw Jet

NZ Normal Acceleration

OBAS Orbiter Body Axis System

OBS Operational Bioinstrumentation System

OBSS Orbiter Boom Sensor System
OCA Orbiter Communications Adapter

OCAD Operational Control Agreement Database

OCAS Operator Command Auto Sequence

Operator Controlled Auto Sequence

OCS Operations and Control Software

ODS Orbiter Docking System
OF Operational Forward

OI Operational Instrumentation

OIU Orbiter Interface Unit
OPCL Orbit Pocket Checklist
OPF Orbiter Processing Facility

OPS Operational

**Operational Sequence** 

Operations

ORB Orbital

ORCS OMS and RCS Configuration Screen

ORM Orbiter Repair Maneuver ORU Orbital Replacement Unit

OSTPV Onboard Short Term Plan Viewer

OTC Orbiter Test Conductor

OTCM ORU Tool Changeout Mechanism

OTD ORU Transfer Device

P-mic Portable Microphone

P/L Payload

PAD Preliminary Advisory Data

PAO Public Affairs Office
PAS Payload Attach System

PASS Primary Avionics Software System

PC Personal Computer

Portable Computer

PCM Pulse Code Modulator

PCMMU Pulse Code Modulation Master Unit

PCS Portable Computer System

Pressure Control System

PCT Post Contact Thrusting PDU Power Distribution Unit

PEEK Portable Electronic Equipment Kit

PEG Powered Explicit Guidance
PEP Portable Emergency Provision

PET Phase Elapsed Time Pr Payload Forward

PFR Portable Foot Restraint

PGT Pistol Grip Tool
Pl Post Insertion

Principle Investigator

PILOT Portable Inflight Landing Operations Trainer

PKT Pocket
PL Payload
PLB Payload Bay
PLBD Payload Bay Door

PLS Primary Landing Site

PLSS Primary Life Support System

PM Phase Modulation

PMA Pressurized Mating Adapter PMC Private Medical Conference

PNL Panel

POA Payload ORU Accommodation

POCC Payload Operations (and) Control Center
POCCB Portable Onboard Computer Control Board

POHS Position Orientation Hold Submode

POR Point of Reference

Point of Resolution

PPA Power Pitch Around

PPCO<sub>2</sub> Partial Pressure Carbon Dioxide PPO<sub>2</sub> Partial Pressure of Oxygen PPRV Positive Pressure Relief Valve

PR Public Relations

PRI Primary

PRL Priority Rate Limiting

PRLA Payload Retention Latch Actuator

Payload Retention Latch Assembly

PROP Propulsion PRPLT Propellant

PRS Payload Retention System

PRSD Power Reactants Storage and Distribution

PSA Power Supply Assembly

**Provisions Stowage Assembly** 

PSI Pound per Square Inch PSP Payload Signal Processor

PTG Pointing

PTI Programmed Test Input
PWR Payload Water Reservoir

PYLD Payload

QD Quick Disconnect QDM Quick Don Mask

R&MA Restraints & Mobility Aids

RA Radar Altimeter

RACU Russian to American Converter Unit

RAM Radiation Area Monitor
RCC Reinforced Carbon Carbon
RCS Reaction Control System

RCU Remote Control Unit
RDM Research Double Module

REBA Rechargeable EVA Battery Assembly

REF Reference

REFSMMAT Reference Stable Member Matrix

REL Relative Display Mode

RESID Residual

RF Radio Frequency RGA Rate Gyro Assembly

RHC Rotational Hand Control(ler)

RJD Reaction Jet Driver

RM Redundancy Management

RMCT Robot Micro Conical Tool

ROEU Remotely Operated Electrical Umbilical

ROS Russian On-orbit Segment

ROST Robotic Offset Tool

RPCM Remote Power Control Module

RPOPSIM Rendezvous/Prox Ops Program Simulation

RPS Rack Power Switch

RPTA Rudder Pedal Transducer Assembly

RR Rendezvous Radar RS Redundant Set Russian Segment

RSAD Remote Manipulator System (RMS) Situational Awareness Display

RSO Range Safety Officer

RSP Resupply Stowage Platform

RTL Ready-To-Latch

RTLS Return-To-Launch Site RWS Robotic Workstation

SA Situational Awareness

SAIL Shuttle Avionics Integration Laboratory

SAR Search and Rescue

SARSAT Search and Rescue Satellite Aided Tracking SAW Soyuz, Acknowledge alarm, Warn others

SBT Shuttle Budget Team

SBTC Speed Brake Thrust Controller
SCOM Shuttle Crew Operations Manual
SCU Service and Cooling Umbilical
SEE Shuttle Emergency Eyewash

SEP Separation

SERC Single Engine Roll Control
SES Shuttle Engineering Simulator

Systems Engineering Simulator

SFRM Space Flight Resource Management

SGLS Space-Ground Link System

SHAB Spacehab SJ Single Joint

SOP

SM Systems Management
SME Subject Matter Expert
SMPA Scopemeter Power Adapter
SMRD Spin Motor Rotation Detector
SODF System Operations Data File
SOMS Shuttle Orbiter Medical System

SPARTAN Shuttle-Pointed Autonomous Research Tool for Astronomy

SPCE Service Performance and Checkout Equipment

Secondary Oxygen Package

SPN Station Program Note

SpOC Space Operations Computing

SPOC Space Program Operations Contract

SRB Solid Rocket Booster SS Spacehab Subsystem SSA Space Suit Assembly

SSAS Segment-to-Segment Attachment System

SSATA Space Station Airlock Test Article

SSC Station Support Computer

SSCS Space-to-Space Communication System

SSDS Single-Surface Diving System

Surface Supplied Diving System

SSER Space-to-Space EMU Radio
SSME Space Shuttle Main Engine
SSOR Space-to-Space Orbiter Radio

SSP Space Shuttle Program

Standard Switch Panel

SSR Single System Recovery

SSSH Space Shuttle Systems Handbook SSSR Space-to-Space Station Radio

SSV Sequential Still Video STA Shuttle Training Aircraft

STBY Standby

STDN Spaceflight Tracking and Data Network

STRK Star Tracker

SVT Spacehab Volumetric Trainer

SW Software

TAC Tactical Air Navigation Unit TACAN Tactical Air Navigation

**Tactical Air Navigation Units** 

TAEM Terminal Area Energy Management

TAL Transatlantic Abort Landing
TCS Thermal Control System
Training Course Supervisor

Tailing Oddisc Odpervisor

Trajectory Control Sensor

TDRS Tracking and Data Relay Satellite

TEC techniques

TEPC Tissue Equivalent Proportional Counter

TERM Terminate

TFL Telemetry Format Load

TGT Target

THC Translation(al) Hand Controller

TI Terminal Phase Initiation

TIG Time of Ignition TM Torque Multiplier

TMG Thermal Model Generator

TNL Tunnel

TORVA Twice Orbit Rate to a Vbar Approach

TPS Thermal Protection System

Tile Protection System

TRAD Tile Repair Ablator Dispenser

Tools for Rendezvous and Docking

TRAJ Trajectory
TRK Track

TSA Tool Stowage Assembly

TV Television Time-Vector

UCCAS Unpressurized Cargo Carrier Attach System

UIA Umbilical Interface Assembly UMA Umbilical Mechanism Assembly

UNIV Universal

UOP Utility Outlet Panel
USA United Space Alliance

USOS United States On-orbit Segment

V-BAR Velocity Vector Axis
VAJ Vacuum Access Jumper

VCU Video Control Unit

VDS Video Distribution Subsystem

VGO Velocity to Go

VGS Video Graphic Software

VI Inertial Velocity

VITT Vehicle Integration Test Team
VLHS Very Lightweight Headset
VMS Vertical Motion Simulator

VR Virtual Reality
Vrel Relative Velocity
VSU Video Switching Unit
VTR Video Tape Recorder

VTS Video Teleconference System

WCS Waste Collection System
WHS Workstation Host Software
WIF Worksite Interface Fixture
WinDecom Windows DeCommutator
WONG Wait On Nose Gear
WSB Water Spray Boiler

WSMR White Sands Missile Range WVS Wireless Video System

XFEED Crossfeed

Y Yaw

## **INDEX**

The following list includes all the lessons in the Crew Training Catalog arranged in alphabetical order. Each lesson is identified by the training flow name and reference number for ease of reference.

## **Notes**

A/E FO Ascent/Entry Flight Operations Training Course

CR SYS Crew Systems Training Course

EVA GEN Extravehicular Activity Generic Training Course

EVA SYS Extravehicular Activity Systems Training Course

EVA TASK Extravehicular Activity Task Training Course

INT SIM Integrated Simulations Training Course

ISS CORE Core Stations Systems for STS Crew Training

MED OPS Medical Operations

STS MSS Mobile Servicing System for STS Crews

NEW ASTRO New Astronaut Training

ORB FO Orbit Flight Operations Training Course

PDRS Payload Deployment and Retrieval System Training Course

REFR Core Systems Refresher Training Course

RNDZ/PO Rendezvous/Proximity Operations Training Course

SHAB Spacehab Training Course

MPLM Multipurpose Logistics Module Training Course

PHO/TV Space Transportation System Photo TV Training Course

TRANSFER Transfer Operations for Shuttle Crews Training Course

## Note On Stage Assignments:

The N ASTRO Flow is completed before the crewmember is assigned to a mission; the stages only apply to time periods within training for a specific flight. The INT SIM section is not designed to be a flow. It is extremely flight-specific and is not consistent across missions. For more information on INT SIM stage assignments, refer to the INT SIM table.

<sup>\*1</sup> Lesson without a specific reference number. Refer to Table 1 or lesson description within course.

Lesson Code	Course	Stage – <u>Ref. No.</u>	<u>Lesson Code</u>	Course	Stage – <u>Ref. No.</u>	
A/E BFS 21001	N ASTRO	176A	APDS REVIEW 41029	ORB FO	0-*1	I
A/E BFS 21011	N ASTRO	176B	APPR & DOCK BR 21001	RNDZ/PO	0-20	ļ
A/E CL USE 21001	N ASTRO	13	APPR & DOCK 21069	RNDZ/PO	0-21	
A/E DPS MAL 21001	N ASTRO	84	APPR & DOCK 22001	RNDZ/PO	0-29A	
A/E FAM 21001	N ASTRO	97A	APPR & DOCK 22069	RNDZ/PO	0-29B	
A/E FAM 21011	N ASTRO	97B	APPR & DOCK 31069	RNDZ/PO	3-40	
A/E FCS 21001	N ASTRO	92A	APPR & DOCK 91069	RNDZ/PO	2-47	
A/E FCS 21006	N ASTRO	92B	APPR & F/A 21001	RNDZ/PO	0-16A	
A/E FCS 31001	A/E FO	4-2A	APPR & F/A 21069	RNDZ/PO	0-16B	
A/E FCS 31006	A/E FO	4-2B	APPR & F/A 31069	RNDZ/PO	3-37	
A/E FCS BR 21001	N ASTRO	88	APPR & GRAP 21069	RNDZ/PO	0-26	
A/E SYS 21001	N ASTRO	188A	APPR/LNDG 21001	N ASTRO	49A	
A/E SYS 21011	N ASTRO	188B	APPR/LNDG 21011	N ASTRO	49B	
ABORT FAM 21001	N ASTRO	143A	APPR/LNDG 31001	A/E FO	4-3A	
ABORT FAM 21011	N ASTRO	143B	APPR/LNDG 31011	A/E FO	4-3B	
ABORT FAM 22001	N ASTRO	149A	APPR/LNDG BR 21001	N ASTRO	19	
ABORT FAM 22011	N ASTRO	149B	APU REFR 41001	REFR	0- <i>7A</i>	
ABORT FAM BR 21001	N ASTRO	102	APU REFR 41004	REFR	0- <i>7B</i>	
ABORT FDF 21001	N ASTRO	120	APU REVIEW 41004	REFR	0- <mark>8</mark>	
ABT-AOA, 910XX			APU/HYD MAL 21004	N ASTRO	119	
(210XX)	INT SIM	*1	APU/HYD MAL BR 21001	N ASTRO	101	
ABT-ATO 910XX	INT SIM	*1	APU/HYD OPS 21001	N ASTRO	55A	
(210XX)	IINT SIIVI	ı	APU/HYD OPS 21004	N ASTRO	55B	
ABT-CONT, 910XX (210XX)	INT SIM	*1	APU/HYD OPS BR 21001	N ASTRO	47	
ABT-NOM, 910XX			APU/HYD OV 21001	N ASTRO	24	
(210XX)	INT SIM	*1	APU/HYD QUAL 21004	N ASTRO	182	
ABT-PAD, 910XX			APU/HYD QUAL 31004	REFR	4-4	
(210XX)	INT SIM	*1	ASBLY OPS HB 31007	MPLM	0-*1	
ABT-REV 3, 910XX	INT SIM	*1	ASC C/L RVW 21001	N ASTRO	86	
(210XX) ABT-RTLS 910XX	IINT SIIVI	1	ASC DPS MAL 21001	N ASTRO	161A	
(210XX)	INT SIM	*1	ASC DPS MAL 21006	N ASTRO	161B	
ABT-TAL, 910XX			ASC GUID BR 21001	N ASTRO	96	
(210XX)	INT SIM	*1	ASC OV 21001	N ASTRO	10	
ACT/DEACT 9XYYY			ASC PRF FS 41011	A/E FO	0-31	
(2XYYY)	INT SIM	*1	ASC PRF LS 41011	A/E FO	0-41	ı
APDS 21057	RNDZ/PO	0-17	ASC SKL 21001	N ASTRO	206A	
APDS FAM 21205	RNDZ/PO	0-18	ASC SKL 21011	N ASTRO	206B	
APDS MAL 21029	ORB FO	4-11	ASC SKL 31001	A/E FO	4-5A	
APDS MAL 22029	ORB FO	4-12	ASC SKL 31011	A/E FO	4-5B	
APDS MAL 23029	ORB FO	4-13	ASC SKL 32001	A/E FO	4-6A	
APDS OPS 21029	RNDZ/PO	0-19	ASC SKL 32011	A/E FO	4-6B	

Lesson Code	Course	Stage – Ref. No.	Lesson Code	Course	Stage – <u>Ref. No.</u>
ASC SKL 33001	A/E FO	4-16A	CBM OPS PREP 21001	ISS CORE	4-26
ASC SKL 33011	A/E FO	4-16B	CBM SYS INTRO		
ASC SKL 34001	A/E FO	3-21A	21105	ISS CORE	4-25
ASC SKL 34012	A/E FO	3-21B	CCTV LIGHTING 91019	PHO/TV	3-28
ASC SKL 35011	A/E FO	3-27	CCTV MAL 21001	N ASTRO	107A
ASC SKL 91011	A/E FO	2-36	CCTV MAL 21008	N ASTRO	107B
ASC SKL 92011	A/E FO	2-37	CCTV OPS 21001	N ASTRO	63B
ASC/ABT SFRM 31001	A/E FO	4-1B	CCTV OPS 21008	N ASTRO	63C
ASC/ABT SFRM 31011	A/E FO	4-1C	CCTV OPS BR 21001	N ASTRO	63A
ASC/CAP/DES 91020	CR SYS	2-12	CCTV OPS 31019	PHO/TV	4-14
AUDIO 21001	N ASTRO	33A	CCTV OPS 32019	PHO/TV	3-17
AUDIO 21006	N ASTRO	33C	CCTV REFR 41001	REFR	0- <i>10</i> A
AUDIO 21020	N ASTRO	33B	CCTV REFR 41008	REFR	0- <i>10B</i>
AUDIO BR 21001	N ASTRO	32	CCTV REVIEW 41008	REFR	0-11
BAILOUT 91020	CR SYS	3-20	CEVIS & HRM OPS	MED ODG	0.4
BASIC PHOTO 31001	PHO/TV	4-2	31001	MED OPS	3-4
BFS FAM BR 21001	N ASTRO	162	CLS I BOOT EVAL 61001	EVA SYS	0-14
BTA OPS 31001	EVA SYS	3-11	CLS I BOOT FIT PRF 61001	EVA SYS	0-*1
C/L CAMR OPS 91019	PHO/TV	3-27	CLS I BT/GLV FITCK	LVAGIO	0 1
C&W MAL 21004	N ASTRO	164	61001	EVA SYS	2-15
C&W OPS 21004	N ASTRO	39	CLS I GLOVE FITCK		
C&W OV 21001	N ASTRO	30	61001	EVA SYS	0-13
C&W REFR 41004	REFR	0-9	CLS I GLV FIT PRF	<b>5</b> 1/4 61/6	0.44
CABLE ROUTE 91001	CR SYS	2-10	61001	EVA SYS	0-*1
CABLE/STOW 91020	CR SYS	2-11	CLS III FIT PRF 61001	EVA GEN	0-*1
CAMR REVIEW 41001	PHO/TV	1-37	CLS III FITCK 61001	EVA GEN	0-12
CAS MAL 21078	ISS CORE	0-23	CLS III GLOVE FITCK 61001	EVA GEN	0-11
CAS MAL PREP-S 21001	ISS CORE	0-22	CLS III GLV FIT PRF	LV/(OLIV	0 77
CAS MIS SP TASKS			61001	EVA GEN	0-*1
31078	ISS CORE	0-3 <i>4</i>	CLS III MEAS 61001	EVA GEN	0-10
CAS OPS PREP-S 21001	ISS CORE	0-20	CLS III MEAS PRF 61001	EVA GEN	0-*1
CAS OPS-S 21078	ISS CORE	0-21	CO2 31074	MED OPS	4-2
CAS SPEC MASTERY-S	ISS CORE	0.24	COM/IN MAL 21006	N ASTRO	173
21078	ISS CORE	0-24	COM/IN MAL BR 21001	N ASTRO	172
CAS SYS INTRO 21001	ISS CORE	0-19	COM/IN RVW 41008	REFR	0-13
CBM MAL 21078	ISS CORE	3-29	COMM OV 21001	N ASTRO	25
CBM MAL PREP 21001	ISS CORE	3-28	COMM/IN OPS 21001	N ASTRO	40A
CBM MIS SP TASKS 31078	ISS CORE	2-3 <mark>5</mark>	COMM/IN OPS 21006	N ASTRO	40B
CBM SPEC MASTERY			COMM/IN OPS BR 21001	N ASTRO	31
21078	ISS CORE	3-31	COMM/IN QUAL 21008	N ASTRO	191
CBM OPS 21078	ISS CORE	3-27	COMM/IN QUAL 31008	REFR	4-12
					I

Lesson Code	Course	Stage – <u>Ref. No.</u>	Lesson Code	Course	Stage – <u>Ref. No.</u>
CONT ABORT 21011	N ASTRO	169B	D/O BURN 31001	A/E FO	4-23
CONT ABT 21001	N ASTRO	169A	D/O BURN 31011	A/E FO	4-24
CONT ABT 31011	A/E FO	4-15	D/O BURN 91011	A/E FO	2-38
CONT ABT 32011	A/E FO	4-18	D/O BURN BR 21001	N ASTRO	193
CONT ABT 91011	A/E FO	1-39	D/O BURN BR 22001	N ASTRO	196
CONT ABT BR 21001	N ASTRO	160	D/O BURN QUAL 21011	N ASTRO	199
CONT ABT BR 31001	A/E FO	4-14	D/O FLT TECH 21001	N ASTRO	194A
CONT ABT BR 32001	A/E FO	4-17	D/O FLT TECH 21012	N ASTRO	194B
CONT ABT PRF 41056	A/E FO	0-32	D/O PREP 21001	N ASTRO	125A
CONT ABT RVW 21001	REFR	0- <i>35A</i>	D/O PREP 21012	N ASTRO	125B
CONT ABT RVW 21011	REFR	0- <i>35B</i>	D/O PREP 31001	ORB FO	4-10A
CONT ABT RVW 41001	A/E FO	0-1*	D/O PREP 31012	ORB FO	4-10B
CONT ABT RVW 41011	A/E FO	0-1*	D/O PREP 910XX		
CONT D/O 31001	ORB FO	3-21A	(210XX)	INT SIM	*1
CONT D/O 31012	ORB FO	3-21B	DAY X 9XYYY (2XYYY)	INT SIM	*1
CONT D/O 32001	ORB FO	3-22A	DEBRIEF 9XYYY	INIT OIM	<b>*</b> 4
CONT D/O 32012	ORB FO	3-22B	(2XYYY)	INT SIM	*1
CONT OPS 21002	EVA GEN	0-2	DENTAL 31001	MED OPS	2-16
CONT OPS 41001	EVA TASK	0-*1	DEPART 9XYYY (2XYYY)	INT SIM	*1
CONUL PRF 41069	PDRS	0-*1	DOCK ATT 21001	RNDZ/PO	0-24A
CONUL RVW 41012	PDRS	0-*1	DOCK ATT 21069	RNDZ/PO	0-24B
CONUL RVW 41025	PDRS	0-*1	DO PREP 21020	N ASTRO	137
COR/ASSY PROC			DO PREP BKOT 21001	N ASTRO	203A
31105	ISS CORE	3-49	DO PREP BKOT 21012	N ASTRO	203B
CREW CAB FAM 21020	N ASTRO	9	DPLY MAL T/L 91012	ORB FO	0-32
CREW DUTY 21001	N ASTRO	112	DPLY NOM T/L 91001	ORB FO	0-29A
CREW HAB 21001	N ASTRO	5	DPLY NOM T/L 91012	ORB FO	0-29B
CSI 21057	N ASTRO	22	DPLY PRF 41069	PDRS	0-*1 <sub>I</sub>
D2XS EQ 31001	PHO/TV	4-3	DPLY RVW 41012	PDRS	0-*1
D2XS EQ 32001	PHO/TV	4-4	DPLY RVW 41025	PDRS	0-*1
D2XS EVA EQ 31001	PHO/TV	4-9	DPLY SJ T/L 91012	ORB FO	0-35
D2XS EVA PHO SKL 31031	PHO/TV	0-10	DPS 21006	N ASTRO	27
D2XS OV 31001	PHO/TV	0-5	DPS FAM 21001	N ASTRO	42A
D&R PRF 41069	PDRS	0-*1	DPS FAM 21006	N ASTRO	42B
D&R RVW 41012	PDRS	0-*1	DPS FAM 22001	N ASTRO	48A
D&R RVW 41012	PDRS	0-*1	DPS FAM 22006	N ASTRO	48B
D/O BURN 21001	N ASTRO	195A	DPS FAM 23006	N ASTRO	65
D/O BURN 21011	N ASTRO	195A 195B	DPS HW 21057	N ASTRO	14
D/O BURN 22001	N ASTRO	193B 197A	DPS MAL 21006	N ASTRO	116
D/O BURN 22011	N ASTRO	197A 197B	DPS MAL 21057	N ASTRO	128
D, O DOMN 22011	NAOINO	1070			

<u>Lesson Code</u>	Course	Stage – <u>Ref. No.</u>	<u>Lesson Code</u>	Course	Stage – <u>Ref. No.</u>
DPS OV 21001	N ASTRO	20	ECLSS OPS 21004	N ASTRO	57B
DPS Q 31001	REFR	4- <i>15</i>	ECLSS OPS 22004	N ASTRO	59
DPS QUAL 21001	N ASTRO	192	ECLSS OPS BR 21001	N ASTRO	52
DPS REVIEW 41006	REFR	0-14	ECLSS OPS BR 22001	N ASTRO	58
DST FAM 21025	RNDZ/PO	0-14	ECLSS REFR 41001	REFR	0- <i>16A</i>
DST MAN PH 61025	RNDZ/PO	0-25	ECLSS REFR 41004	REFR	0- <i>16B</i>
E DAP 21001	N ASTRO	80A	ECLSS REVIEW 41004	REFR	0-17
E DAP 21011	N ASTRO	80B	ECLSS/C&W/MECH		'
E DAP BR 21001	N ASTRO	76	QUAL 21008	N ASTRO	183
E DAP SKL BR 21001	N ASTRO	79	ECLSS/C&W/MECH	DEED	4.0
E DTO 91056	A/E FO	0-29	QUAL 31008	REFR	4-6
E DTO BR 91001	A/E FO	0-28	ECWS ETA/REV 31014	EVA SYS	0-25
E GUID 21011	N ASTRO	91	ECWS INTRO 21014	EVA GEN	0-36
E GUID 21057	N ASTRO	87	ECWS MALS 21014	EVA GEN EVA SYS	0-37
E GUID 31011	A/E FO	4-9	ECWS PRF 41014	EVASIS	3-7 0-7
E GUID 31057	A/E FO	4-8			0-*1
E GUID BR 21001	N ASTRO	81	ECWS V1103 21014	EVA GEN	0-39
E GUID BR 31001	A/E FO	4-7	EDO WCS 91002	CR SYS	0-2A
E NAV 21001	N ASTRO	75A	EDO WCS PROC 91074	CR SYS	0-2B
E NAV 21006	N ASTRO	75B	EDO WCS REFR 41065	CR SYS	0-15
E NAV 22001	N ASTRO	153A	EL INSTL RVW 41025	STS MSS	1-51
E NAV 22006	N ASTRO	153B	EL NOM INSTL 1 31025	STS MSS	3-47
E NAV BR 21001	N ASTRO	68	EL NOM INSTL 2 32115	STS MSS	3- <b>48</b>
E SKL 21001	N ASTRO	207A	EL NOM INSTL 3 93016	STS MSS	3- <b>49</b>
E SKL 21011	N ASTRO	207B	EL NOM INSTL 4 91025	STS MSS	2-50
E SKL 31001	A/E FO	4-22A	ELE/TSK RVW 41012	PDRS	0-*1
E SKL 31011	A/E FO	4-22B	EMU SYS 21057	EVA GEN	0-1
E SKL 32011	A/E FO	3-26	EMU/AL 21020	EVA GEN	0-35
E SKL 91011	A/E FO	2-34	EMU/AL 31054	EVA SYS	0-27
E SKL 92011	A/E FO	2-35	EMU/AL WT 31054	EVA SYS	0-26
ECG INTRO 11001	ISS CORE	4-15	EMU/AL 1DAY 31154	EVA SYS	0-28
ECL 10.2 ATM 41004	REFR	0-32	EMU RESIZE 31209	EVA SYS	3-12
ECLSS 21057	N ASTRO	44	ENG REF OV 21001	N ASTRO	36
ECLSS JNT AL OPS	ISS CORE	3-37	ENT AERO BR 21001	N ASTRO	69
21105 ECLSS MAL A/E 21004	N ASTRO	3-37 127	ENT C/L RVW 21001	N ASTRO	83
ECLSS MAL A/E BR	NASTRO	127	ENT DAP SK 31001	A/E FO	4-25A
21001	N ASTRO	115	ENT DAP SK 31011	A/E FO	4-25B
ECLSS MAL O 21004	N ASTRO	138	ENT DPS MAL 21001	N ASTRO	170A
ECLSS MAL O BR 21001		131	ENT DPS MAL 21006	N ASTRO	170B
ECLSS OPS 21001	N ASTRO	57A	ENT OV BR 21001	N ASTRO	11
			ENT PRF FS 41011	A/E FO	0-30

		Stage -			Stage -
Lesson Code	<u>Course</u>	Ref. No.	Lesson Code	<u>Course</u>	Ref. No.
ENT PRF LS 41011	A/E FO	0-40	EVA CETA OPS 31028	EVA TASK	4-3
ENTRY 910XX (210XX)	INT SIM	*1	EVA CONT 1G 31001	EVA TASK	3-21
EPS HW TASKS 21105	ISS CORE	4-7	EVA CONT 1G 32001	EVA TASK	2-28
EPS MAL A/E 21004	N ASTRO	150	EVA CONT 91027	EVA TASK	3-22
EPS MAL A/E BR 21001	N ASTRO	144	<b>EVA CONT 92027</b>	EVA TASK	2-29
EPS MAL O 21004	N ASTRO	151	<b>EVA CONT 93027</b>	EVA TASK	0-34
EPS MAL O BR 21001	N ASTRO	145	EVA CONT 94027	EVA TASK	0-36
EPS OPS 21001	N ASTRO	54A	EVA DECON 31001	<b>EVA SYS</b>	0-*1
EPS OPS 21004	N ASTRO	54B	EVA FLOW 61001	EVA TASK	4-1
EPS OPS BR 21001	N ASTRO	46	EVA FLUID QD OPS		
EPS OV 21001	N ASTRO	23	21197	EVA GEN	0-8
EPS QUAL 21004	N ASTRO	181	EVA FLUID QD OPS		2.0
EPS QUAL 31004	REFR	4-3	31197	EVA TASK	3-9
EPS REFR 41001	REFR	0- <i>18A</i>	EVA FLUID QD OPS 32197	EVA TASK	2-16
EPS REFR 41004	REFR	0- <i>18B</i>	EVA FLUID QD OPS	LV/(I/(OIC	2 10
EPS REVIEW 41004	REFR	0-19	33197	EVA TASK	0-32
ERGOMETER 91020	CR SYS	4-9	EVA FLUID QD OPS		ı.
ESC EQ/SYS 21001	N ASTRO	99	41197	EVA TASK	0-*1
ESC PROC 21001	N ASTRO	118	EVA HDW/PRF 41027	EVA TASK	0-*1
ESC PROC 21020	N ASTRO	132	EVA INTRO 21001	N ASTRO	110
ESC SYS REFR 91020	CR SYS	1-23	EVA MASS OPS 31028	EVA TASK	0-10
ET EQ 31001	PHO/TV	3-18	EVA MASS OPS 32028	EVA TASK	0-18
ET PHO SKL 31001	PHO/TV	3-19	EVA MASS OPS 33028	EVA TASK	0-27
EVA 9XYYY (2XYYY)	INT SIM	*1	EVA MASS OPS 34028	EVA TASK	0-35
EVA 1 91027	EVA TASK	4-7	EVA MASS OPS 41016	EVA TASK	0-*1
EVA 1 92027	EVA TASK	4-12	EVA OPS 21027	EVA GEN	0-28
EVA 1 93027	EVA TASK	3-14	EVA OPS 22027	EVA GEN	0-31
EVA 1 94027	<b>EVA TASK</b>	3-19	EVA OPS 1G 21001	EVA GEN	0-27
EVA 1 95027	EVA TASK	3-23	EVA OPS 1G 22001	EVA GEN	0-30
EVA 1 96027	EVA TASK	2-30	EVA OPS 1G 31001	EVA TASK	4-5
EVA 1 97027	EVA TASK	1-37	EVA OPS 1G 41001	EVA TASK	0-*1
EVA 2 91027	EVA TASK	4-7	EVA OV 21001	EVA GEN	0-5
EVA 2 92027	EVA TASK	3-12	EVA OV 22001	EVA GEN	0-6
EVA 2 93027	EVA TASK	3-14	EVA P/P 21020	EVA GEN	0-38
EVA 2 94027	EVA TASK	2-19	EVA P/P 31020	EVA SYS	3-8
EVA 2 95027	EVA TASK	1-23	EVA P/P 32020	EVA SYS	0-24
EVA 3 91027	EVA TASK	4-7	EVA P/P 33020	EVA SYS	0-29
EVA 3 92027	EVA TASK	3-12	EVA P/P 41020	EVA SYS	0-*1
EVA 3 93027	EVA TASK	3-14	EVA PGT POGO 31028	EVA TASK	4-31
EVA 3 94027	EVA TASK	2-19	EVA PGT/TM 21001	EVA GEN	0-18
EVA 3 95027	EVA TASK	1-23	EVA PGT/TM 31001	EVA TASK	4-2

Lesson Code	Course	Stage – <u>Ref. No.</u>	Lesson Code	Course	Stage – Ref. No.	
EVA PGT/TM 32001	EVA TASK	2-17	EVAX 95027	EVA TASK		
EVA PGT/TM 33001	EVA TASK	1-33	EVAX 96027	EVA TASK		
EVA PGT/TM 41001	EVA TASK	0-*1	EVAX 90027 EVAX 97027	EVA TASK		
EVA RCC REPAIR 31703	_	2-56	EXT PHO SKL 31153	PHO/TV	4-8	
EVA RCC REPAIR 31703	EVATASK	2-50	F5 EQ 31001	PHO/TV PHO/TV	4-6 4-6	
61001	EVA TASK	0-48	FCS C/O 21006	N ASTRO		
EVA RESCUE 21001	RNDZ/PO	0-8A			123	
EVA RESCUE 21069	RNDZ/PO	0-8B	FCS C/O 31006	A/E FO	4-20	
EVA REVIEW 1G 41001	EVA TASK	0-*1	FDF 21020	N ASTRO	38	
EVA REVIEW 41027	EVA TASK	0-*1	FDO/BSE-AOA 910XX (210XX)	INT SIM	*1	
EVA SCUBA 21027	EVA GEN	0-19	FDO/BSE-ATO 910XX			
EVA SCUBA 41027	EVA TASK	0-*1	(210XX)	INT SIM	*1	
EVA SCUBA 91027	EVA TASK	4-6	FDO/BSE-CONT 910XX			
EVA SKILLS 21003	EVA GEN	0-3	(210XX)	INT SIM	*1	
EVA SOP 21007	EVA GEN	0-3 0-14	FDO/BSE-NOM 910XX			
EVA SSCS 21002	EVA GEN	0- <i>14</i> 0- <i>15</i>	(210XX)	INT SIM	*1	
EVA T/U 61001	EVA TASK	4-11	FDO/BSE-PAD 910XX	INIT OIM	*1	
LVA 1/0 01001	LVATASK	3-11	(210XX) FDO/BSE-RSO 910XX	INT SIM	I	
		2-11	(210XX)	INT SIM	*1	
		1-11	FDO/BSE-RTLS 910XX		•	
EVA TU E DEDAID 04700	EV/A TAOK	0-11	(210XX)	INT SIM	*1	
EVA TILE REPAIR 31703		3-51	FDO/BSE-TAL 910XX			
EVA TILE REPAIR 32703	EVA TASK	3-55	(210XX)	INT SIM	*1	
EVA TOOL CONFIG 31020	EVA TASK	0-45	FFV 61001	EVA SYS	0-17	
EVA TOOL CONFIG	LVATAGIK	0-43	FIRST AID 31001	MED OPS	3- <mark>5</mark>	
32020	EVA TASK	0-46	FLIGHT PLAN 21001	N ASTRO	122	
EVA TOOL CONFIG			FLIGHT RULES 21001	N ASTRO	37	
33020	EVA TASK	0-47	FLT COMM PLN 31020	ORB FO	4-5	
EVA TPS LOADS 31016	EVA TASK	3-52	FLT COMM PLN BRF			
EVA TPS OPS 91027	EVA TASK	3-54	31001	ORB FO	4-4	
EVA TPS OPS 1G 31001	EVA TASK	3-53	FLT CONT QUAL 21006	N ASTRO	135	
EVA TPS OV 31706	EVA TASK	4-50	G1 CAMC EQ 31001	PHO/TV	4-11	
EVA TPS REPAIR 21002	EVA TASK	4-49	G1 CAMC OV 31001	PHO/TV	0-12	
EVA TPS REPAIR SKLS			G&C SENS BR 21001	N ASTRO	94	
31073	EVA TASK	2-57	GALLEY 21020	N ASTRO	61	
EVA TPS SAFER 91016	EVA SYS	3-10	GEN RNDZ 31042	RNDZ/PO	0-*1	
EVA TPS SAFER RES			HAB EQ/PROC 21020	N ASTRO	113	
91705	EVA SYS	2-22	HAB/EQ PROC 91020	CR SYS	3-4	
EVAX 91027	EVA TASK	0-7	HDW V1103 21001	EVA GEN	0- <i>40</i>	
EVAX 92027	EVA TASK	0-12	IFM 21001	N ASTRO	103	
EVAX 93027	EVA TASK	0-14	IFM KSC W/T 91031	CR SYS	0-18	
EVAX 94027	EVA TASK	0-19	IFM PIN KIT 21001	N ASTRO	121	

Lesson Code	Course	Stage – <u>Ref. No.</u>	<u>Lesson Code</u>	Course	Stage – <u>Ref. No.</u>
IFM PROC 91020	CR SYS	4-17	ISS EVA SCUBA 21027	EVA GEN	0-33
IFM REV 41001	CR SYS	0-*1	ISS EVA LARGE TOOLS		ı
IMU BR 21001	N ASTRO	78	21028	EVA GEN	0-26
IMU FAM 21006	N ASTRO	82	ISS EVA SMALL	E\/A OE\	o 47
IMU 21006	N ASTRO	129	TOOLS 21001	EVA GEN	0-17
IN/EG TIMELINE 91105	CR SYS	2-13	ISS EVA SMALL TOOLS 31001	EVA TASK	4-4
INT PHO SKL 31020	PHO/TV	4-7	ISS EVA SMALL	277171011	
INT SIM MEET 91001	INT SIM	*1	TOOLS 41001	EVA TASK	0-*1
INTRO FDF 21001	N ASTRO	6	ISS EVA TOOL CONFIG		
IR CAMR EQ 31001	PHO/TV	4-29	31105	EVA TASK	3-13
IR CAMR SKL 31001	PHO/TV	4-30	ISS EVA TOOL CONFIG 32105	EVA TASK	2-20
ISS/STS EMER SCEN 31105	ISS CORE	2-45	ISS EVA TOOL CONFIG		I
ISS AUD/VID RVW 21121		3-30	41105	EVA TASK	0-*1
ISS AUDIO HW 21105	ISS CORE	4-6	ISS EXT SRVY 91001	PHO/TV	3-33
ISS ECWS INTRO			ISS HAB HW 31105	CR SYS	4-6
21014	EVA GEN	0-23	ISS HW FAM 21105	CR SYS	4-5
ISS ECWS MALS			ISS JNT AL INTRO	E) / A O E N I	2 22 1
21014	EVA GEN	0- <b>24</b>	21105	EVA GEN	0-22
ISS ECWS PRF 41014	EVA SYS	4-4 3-4	ISS JNT AL HDW 31105	EVA SYS	4-2
		3-4 2-4	ISS O2 SAFETY 21001	ISS CORE	4-16
		1-4 0-4	ISS OPS S/W INTRO 21257	ISS CORE	4-2
ISS EMER REVIEW		<b>.</b>	ISS ROBO ENVIRO	070 1400	0.4
91105	ISS CORE	2-47	21025	STS MSS	0-4
ISS EMERGENCY	100 0005	0.44	ISS S/G VOICE OP/ML 21078	ISS CORE	4-5
OVW 31105	ISS CORE	3-4 <i>4</i>	ISS SSATA 1DAY 31154	EVA SYS	0-19
ISS EMERENCY REFR 41001	ISS CORE	0-46	ISS SSATA 31154	EVA SYS	2-20
ISS EMU 21105	EVA GEN	0-16	ISS SSATA WT 31154	EVA SYS	2-18
ISS EPS OV 21078	ISS CORE	4-4	ISS SUIT QUAL		
ISS EVA MAINT 1G			1G 21001	EVA GEN	0- <b>20</b>
21001	EVA GEN	0-32	ISS SUIT QUAL 21027	EVA GEN	0-21
ISS EVA MAINT 21027	EVA GEN	0- <b>34</b>	ISS UHF OPS/MAL 21078	ISS CORE	4.10
ISS EVA MASS OPS	E) / A T A C / /	4.0	ISS VIDEO OPS 21078	ISS CORE	4-10 ' 4-11
91016	EVA TASK	4-8	JNT AL MANUAL 21002	EVA GEN	0-13
ISS EVA MASS OPS 92016	EVA TASK	2-15	JNT EVA SSCS 31170	EVA SYS	4-3
ISS EVA P/P 21105	EVA GEN	0-29	KU BAND 31001	EVA TASK	1
ISS EVA P/P 31105	EVA SYS	4-5	KU OPS 21001	N ASTRO	73A
ISS EVA P/P 32105	EVA SYS	3-9	KU OPS 21006	N ASTRO	73B
ISS EVA P/P 33105	EVA SYS	2-21	KU OPS BR 21001	N ASTRO	70
ISS EVA P/P 41105	EVA SYS	0-*1	LCS EQ 31001	PHO/TV	3-25

		Stage -			Stage -
<u>Lesson Code</u>	<u>Course</u>	Ref. No.	<u>Lesson Code</u>	<u>Course</u>	Ref. No.
LDRI EQ 21001	PHO/TV	0-1	MED DIAG 31001	MED OPS	2-11
LDRI EQ 31001	PHO/TV	3-24	MED EVAL DCS 31001	MED OPS	2-12
LDRI OPS 31012	PHO/TV	3-26	MED EVAL DCS EXP		
LOAD MAL T/L 91012	ORB FO	0-31	31001	MED OPS	0-13
LOAD NOM T/L 91001	ORB FO	0-28A	MED PROC 31001	MED OPS	3-10
LOAD NOM T/L 91012	ORB FO	0-28B	MED PROF 41001	MED OPS	0-21
LOAD PRF 41069	PDRS	0-*1	MED REFR 91001	MED OPS	1-19
LOAD RVW 41012	PDRS	0-*1	MED THER 31001	MED OPS	2-14
LOAD RVW 41025	PDRS	0-*1	MED THER 32001	MED OPS	2-15
LOAD SJ T/L 91012	ORB FO	0-34	MINICAM EQ 31001	PHO/TV	3-20
MAJOR CASE 9XYYY			MINICAM PHO SKL	DUO/TV	2.24
(2XYYY)	INT SIM	*1	31019	PHO/TV	3-21
MAL FDF USE 21001	N ASTRO	64	MOD 9XYYY (2XYYY)	INT SIM	*1
MAN ABORT 31011	A/E FO	4-13	MPLM FACIL 31031	MPLM	0-*1
MAN ABT 21001	REFR	0- <i>34A</i>	MPLM INTRO 31105	ISS CORE	4-17
MAN ABT 21011	REFR	0- <i>34B</i>	MPLM REVIEW 41029	MPLM	0-*1
MAN ABT 41001	A/E FO	0-1*	MPLM ROEU/PRS OPS	MDLM	0.0
MAN ABT 41011	A/E FO	0-1*	31029	MPLM	<del>0</del> -2
MAN ABT BR 31001	A/E FO	4-12	MPLM VEST PROC 31105	ISS CORE	3-39
MAN ASC 21001	REFR	0-33A	MPLM VEST PROC/ACT	100 00112	
MAN ASC 21011	REFR	0- <i>33B</i>	31105	ISS CORE	3- <b>40</b>
MAN ASC 31011	A/E FO	4-11	MPS BSE FLT BRF		•
MAN ASC 41001	A/E FO	0-1*	31001	A/E FO	3-33
MAN ASC 41011	A/E FO	0-1*	MPS MAL 21001	N ASTRO	142A
MAN ASC BR 31001	A/E FO	4-10	MPS MAL 21006	N ASTRO	142B
MAN MNVR 21025	N ASTRO	158	MPS MAL 22006	N ASTRO	168
MB SAFETY BR 21003	N ASTRO	18	MPS MAL BR 21001	N ASTRO	133
MCS OV 21001	ISS CORE	4-8	MPS MAL BR 22001	N ASTRO	159
MECH MAL 21008	N ASTRO	126	MPS OPS 21001	N ASTRO	56A
MECH MAL BR 21001	N ASTRO	114	MPS OPS 21006	N ASTRO	56B
MECH OPS 21001	N ASTRO	53A	MPS OPS BR 21001	N ASTRO	50
MECH OPS 21008	N ASTRO	53B	MPS OV 21001	N ASTRO	43
MECH OV 21001	N ASTRO	45	MPS QUAL 21006	N ASTRO	175
MECH REFR 41001	REFR	0-2 <i>0A</i>	MPS QUAL 31006	REFR	4-1
MECH REFR 41004	REFR	0-2 <i>0B</i>	MPS REFR 41006	REFR	0-22
MECH REVIEW 41004	REFR	0-21	MPS REVIEW 41006	REFR	0-23
MECH/ROBO INSTALL		0 2 1	MRO 1 PROF 1 41025	STS MSS	0-8
21178	ISS CORE	2-3 <mark>2</mark>	MRO1 PROF 2 41025	STS MSS	0-9
MECH/ROBO			MRO1 PROF 3 41025	STS MSS	0-10
UNINSTALL 21178	ISS CORE	3-3 <mark>3</mark>	MRO1 PROF 4 41025	STS MSS	0-11
MED CPR 31001	MED OPS	3- <mark>6</mark>	MRO1 PROF 5 41025	STS MSS	0-12

		Stage –			Stage -
Lesson Code	Course	Ref. No.	Lesson Code	<u>Course</u>	Ref. No.
MRO1 PROF 6 41025	STS MSS	0-13	NAV QUAL 21001	N ASTRO	154
MRO1 PROF 7 41025	STS MSS	0-14	NAV REVIEW 41006	REFR	0- <b>24</b>
MRO PART 1 21113	STS MSS	0-7	NBL SSRMS FAM		,
MRO PART 2 21113	STS MSS	0-15	21027	STS MSS	0- <i>16</i>
MRO PREREQ SUM			NITROX TRNG 61001	EVA GEN	0-7
21025	STS MSS	0-6	O2N2 OPS 21001	ISS CORE	3-3 <mark>6</mark>
MSS/EVA FAM 21025	STS MSS	4- <u>20</u>	O2N2 XFER OPS 21105	ISS CORE	3-38
MSS/EVA SUPT OV 91001	STS MSS	4-28	O2N2 XFER PROF 41105	ISS CORE	2-42
MSS/EVAA SUPT1 SOLO			O/D/R CONT 31027	EVA TASK	2-26
91025	STS MSS	3-29	O/D/R CONT 1G 31001	EVA TASK	2-25
MSS/EVAA SUPT2 TEAM			OCA/VTS OPS 31195	ORB FO	4-14
91016	STS MSS	3-30	ODS TNL OPS 91020	CR SYS	0-7
MSS/EVAA SUPT3 SOLO 91025	STS MSS	3-33	OFF-NOM EG 21116	N ASTRO	139 <sub>I</sub>
MSS/EVAA SUPT4 SOLO	313 W33	3-33	OFF-NOM EG 91020	CR SYS	3-21
91025	STS MSS	3- <mark>35</mark>	OGNC QUAL 21006	N ASTRO	184
MSS/EVAA SUPT5 M1M2			OGNC QUAL 31006	REFR	4- <mark>26</mark>
91016	STS MSS	3- <mark>37</mark>	OM/RC A/E Q 31006	REFR	4-27
MSS/EVAA SUPT6 M1M2			OM/RC BURNS 21001	N ASTRO	171A
91025	STS MSS	2-39	OM/RC BURNS 21006	N ASTRO	171B
MSS/EVAA SUPT7 TEAM 91016	STS MSS	2-41	OM/RC BURNS BR	NAOTRO	400
MSS/EVAB SUPT1 SOLO			21001	N ASTRO	163
91025	STS MSS	3-31	OM/RC DP/EPS 21006	N ASTRO	185
MSS/EVAB SUPT 2 SOLO			OM/RC DP/EPS BR 21001	N ASTRO	179 ı
91025	STS MSS	3-32	OM/RC Q O 31006	REFR	4-31
MSS/EVAB SUPT3 M1M2 91025		3- <b>34</b>	OM/RC QUAL A/E 21006	N ASTRO	189
MSS/EVAB SUPT4 TEAM	STS MSS	3-34	OM/RC QUAL O 21006	N ASTRO	186
91016	STS MSS	3- <u>36</u>	OM/RC REVIEW 41008	REFR	0-28
MSS/EVAB SUPT5 M1M2			OMRC REFR 41008	REFR	0-29
91025	STS MSS	3- <mark>38</mark>	OMRC REFR 42008	REFR	0-30
MSS/EVAB SUPT6 TEAM			OMS MAL 21001	N ASTRO	148A
91016	STS MSS	2- <del>40</del>	OMS MAL 21006	N ASTRO	148B
MSS CBT 21057	STS MSS	0-1	OMS MAL BR 21001	N ASTRO	147
MSS CBT MOD 5/7	070 4400	0.50	OMS OPS 21001	N ASTRO	34A
21057	STS MSS	0-58	OMS OPS 21006	N ASTRO	34B
MSS LTG OPS 31115	STS MSS	<i>4</i> -53	OMS OPS BR 21001	N ASTRO	28
MSS OPS COORD 21025	STS MSS	4-21	OMS OV 21001	N ASTRO	17
MSS SPN & REF DATA	2.200	/	OMS TGTING 21001	N ASTRO	21
91001	STS MSS	2-57	OMS TGTING 22001	N ASTRO	134
NAV OV BR 21001	N ASTRO	16	OPS BASELINE REVIEW		
NAV Q 31001	REFR	4-25	21001	ISS CORE	4-1

Lesson Code         Course         Ref. No.         Lesson Code         Course         Ref. No.           ORB CONT 31027         EVA TASK         0-39         P/L COM/OIU OPS 21001         N ASTRO         71A           ORB CONT 32027         EVA TASK         0-41         P/L COM/OIU OPS 21006         N ASTRO         71B           ORB DONT 32027         EVA TASK         0-41         P/L COM/OIU OPS         21001         N ASTRO         64           ORB DAD 21057         N ASTRO         85         BR 21001         N ASTRO         64           ORB DPS MAL 21006         N ASTRO         166A         P/L EVA 1G 31001         EVA TASK         0-40           ORB DPS MAL 21006         N ASTRO         166B         P/L EVA 91027         EVA TASK         0-42           ORB DRS DRAW 21001         N ASTRO         165         P/L EVA 92027         EVA TASK         0-42           ORB DRS DES 21001         N ASTRO         26         P/L EVA 92027         EVA TASK         0-42           ORB DRS DR SOR 21001         N ASTRO         26         P/L EVA 92027         EVA TASK         0-42           ORB DRS DR SOR 21001         N ASTRO         26         P/L EVA 93027         EVA TASK         0-42           ORB DR SOR 21001			Stage –			Stage –
ORB CONT 31027         EVA TASK         0-39         P/L COM/OIU OPS 21001         N ASTRO         71A           ORB CONT 32027         EVA TASK         0-41         P/L COM/OIU OPS 21006         N ASTRO         71B           ORB CONT 33027         EVA TASK         0-43         P/L COM/OIU OPS 21006         N ASTRO         71B           ORB DAP 21057         N ASTRO         85         BR 21001         N ASTRO         64           ORB DPS MAL 21006         N ASTRO         166A         P/L EVA 91027         EVA TASK         0-38           ORB DPS MAL 21006         N ASTRO         166B         P/L EVA 92027         EVA TASK         0-40           ORB EPS 21004         N ASTRO         166         P/L EVA 92027         EVA TASK         0-42           ORB EPS USE 21001         N ASTRO         165         P/L EVA 93027         EVA TASK         0-42           ORB FO USE 21001         N ASTRO         166         P/L EVA 93027         EVA TASK         0-42           ORB FO USE 21001         N ASTRO         26         P/L EVA 93027         EVA TASK         0-42           ORB MAI TI 21012         N ASTRO         174B         P/L COMOUNT         1902         P/L EVA 93027         EVA TASK         0-42           ORB MA	Lesson Code	Course		Lesson Code	Course	-
ORB CONT 32027         EVA TASK         0-41         P/L COM/OIU OPS 21006         N ASTRO         71B           ORB CONT 33027         EVA TASK         0-43         P/L COM/OIU OPS         N ASTRO         64           ORB DAP 21057         N ASTRO         85         BR 21001         N ASTRO         64           ORB DPS MAL 21001         N ASTRO         166A         P/L EVA 1G 31001         EVA TASK         0-40           ORB EPS 21004         N ASTRO         166B         P/L EVA 93027         EVA TASK         0-40           ORB FDF USE 21001         N ASTRO         26         P/L EVA 93027         EVA TASK         0-40           ORB MAN ATT 21001         N ASTRO         26         P/L EVA 93027         EVA TASK         0-40           ORB MAN ATT 21010         N ASTRO         174B         P/L EVA 93027         EVA TASK         0-41           ORB MECH OV 21001         N ASTRO         174B         P/L EVA 93027         EVA TASK         0-41           ORB MECH OV 21001         N ASTRO         2         P/L EVA 93027         EVA TASK         0-41           ORB MECH OV 21001         N ASTRO         2         P/L EVA 93027         EVA TASK         0-41           ORB MECH OV 21001         N ASTRO         19		<u> </u>			N ASTRO	
ORB CONT 33027         EVA TASK         0-43         P/L COM/OIU OPS         N ASTRO         64           ORB DAP 21057         N ASTRO         85         BR 21001         N ASTRO         64           ORB DPS MAL 21001         N ASTRO         166A         P/L EVA 1G 31001         EVA TASK         0-38           ORB DPS MAL 21006         N ASTRO         166B         P/L EVA 91027         EVA TASK         0-40           ORB FDF USE 21001         N ASTRO         165         P/L EVA 93027         EVA TASK         0-42           ORB MAN ATT 21001         N ASTRO         26         P/L EVA 93027         EVA TASK         0-42           ORB MAN ATT 21001         N ASTRO         174B         P/L PRF ADV 41027         EVA TASK         0-41           ORB MAN ATT 21012         N ASTRO         174B         P/L PRF ADV 41027         EVA TASK         0-41           ORB MECH OV 21001         N ASTRO         174B         P/L EVA 93027         EVA TASK         0-41           ORB DM GPS 31012         ORB FO         4-19A         P/L EVA 93027         EVA TASK         0-41           ORB DM GPS 31012         ORB FO         4-19B         P/L EVA 93027         EVA TASK         0-42           ORB DM GPS 31012         ORB FO						
ORB DAP 21057         N ASTRO         85         BR 21001         N ASTRO         64           ORB DPS MAL 21001         N ASTRO         166A         P/L EVA 1G 31001         EVA TASK         0-38           ORB DPS MAL 21006         N ASTRO         166B         P/L EVA 91027         EVA TASK         0-40           ORB FPS 21004         N ASTRO         166         P/L EVA 92027         EVA TASK         0-42           ORB FPS 21004         N ASTRO         166         P/L EVA 92027         EVA TASK         0-42           ORB FPS 21001         N ASTRO         166         P/L EVA 93027         EVA TASK         0-44           ORB MAN ATT 21001         N ASTRO         174B         P/L EVA 93027         EVA TASK         0-44           ORB MECH OV 21001         N ASTRO         174B         P/L PFR ADV 41027         EVA TASK         0-44           ORB MECH OV 21001         N ASTRO         174B         PAO CAMC 31001         PHO/TV         4-15           ORB MOM OPS 31001         ORB FO         4-19A         PAO CAMC 31001         PHO/TV         3-16           ORB OPS/COMM 21001         ORB FO         4-19B         PAPER SIM 22001         N ASTRO         201           ORB OPS/COMM 21001         N ASTRO         187A<						
ORB DPS MAL 21001         N ASTRO         166A         P/L EVA 1G 31001         EVA TASK         0-38           ORB DPS MAL 21006         N ASTRO         166B         P/L EVA 91027         EVA TASK         0-40           ORB EPS 21004         N ASTRO         166B         P/L EVA 91027         EVA TASK         0-40           ORB FDF USE 21001         N ASTRO         166         P/L EVA 93027         EVA TASK         0-44           ORB MAN ATT 21010         N ASTRO         174A         P/L PRF ADV 41027         EVA TASK         0-44           ORB MAN ATT 21012         N ASTRO         174B         PAO CAMC 31001         PHO/TV         4-13           ORB MOM OPS 31001         ORB FO         4-19A         PAO CAMC SKL 31019         PHO/TV         3-15           ORB NOM OPS 31012         ORB FO         4-19A         PAPER SIM 21001         N ASTRO         95           ORB OPS/COMM 21010         N ASTRO         187A         PAPER SIM 22001         N ASTRO         201           ORB OPS/COMM 21012         N ASTRO         187A         PAPER SIM 23001         N ASTRO         202           ORB OPS/EVA 9XYYY         INT SIM         *1         PASS RECOV 31001         ORB FO         3-24A           ORB OPS/FCS 210101         N					N ASTRO	64
ORB DPS MAL 21006         N ASTRO         166B         P/L EVA 91027         EVA TASK         0-40           ORB EPS 21004         N ASTRO         1665         P/L EVA 92027         EVA TASK         0-42           ORB FDF USE 21001         N ASTRO         26         P/L EVA 92027         EVA TASK         0-42           ORB MAN ATT 21012         N ASTRO         174A         P/L PAR ADV 41027         EVA TASK         0-41           ORB MAN ATT 21012         N ASTRO         174B         PAO CAMC SICU101         PHO/TV         4-13           ORB MECH OV 21001         N ASTRO         2         PAO CAMC SICU101         PHO/TV         3-15           ORB NOM OPS 31001         ORB FO         4-19B         PAPER SIM 21001         N ASTRO         95           ORB OPS/COMM 21001         N ASTRO         8         PAPER SIM 22001         N ASTRO         95           ORB OPS/COMM 21001         N ASTRO         187A         PAPER SIM 23001         N ASTRO         201           ORB OPS/FCS 21001         N ASTRO         187B         PAPER SIM 23001         N ASTRO         202           ORB OPS/FCS 21001         N ASTRO         190B         PASS RECOV 31001         ORB FO         3-24A           ORB OPS/FCS 21001         N ASTRO				P/L EVA 1G 31001	EVA TASK	0-38
ORB EPS 21004         N ASTRO         165         P/L EVA 92027         EVA TASK         0-42           ORB FDF USE 21001         N ASTRO         26         P/L EVA 93027         EVA TASK         0-44           ORB MAN ATT 21001         N ASTRO         174A         P/L PFR ADV 41027         EVA TASK         0-41           ORB MAN ATT 21012         N ASTRO         174B         PAO CAMC 31001         PHO/TV         4-13           ORB MECH OV 21001         N ASTRO         2         PAO CAMC SKL 31019         PHO/TV         3-15           ORB NOM OPS 31001         ORB FO         4-19A         PAO VID REV 31001         PHO/TV         3-16           ORB ORS OV 21001         N ASTRO         8         PAPER SIM 21001         N ASTRO         95           ORB OPS/COMM 21001         N ASTRO         8         PAPER SIM 22001         N ASTRO         201           ORB OPS/COMM 21012         N ASTRO         187B         PAPER SIM 22001         N ASTRO         202           ORB OPS/EVA 9XYYY         (2/YYY)         INT SIM         *1         PASS RECOV 31001         ORB 50         3-24A           ORB OPS/FCS 21012         N ASTRO         190B         PGS/C&W OPS 21110         INS CORE         4-3           ORB SKL 31001				P/L EVA 91027	EVA TASK	0-40
ORB FDF USE 21001         N ASTRO         26         P/L EVA 93027         EVA TASK         0-44           ORB MAN ATT 21001         N ASTRO         174A         P/L PRF ADV 41027         EVA TASK         0-*1           ORB MAN ATT 21012         N ASTRO         174B         PAO CAMC SIL 31019         PHO/TV         4-13           ORB MECH OV 21001         N ASTRO         2         PAO CAMC SKL 31019         PHO/TV         3-16           ORB NOM OPS 31001         ORB FO         4-19A         PAO VID REV 31001         PHO/TV         3-16           ORB NOM OPS 31012         ORB FO         4-19B         PAPER SIM 21001         N ASTRO         95           ORB OPS OV 21001         N ASTRO         8         PAPER SIM 22001         N ASTRO         201           ORB OPS/COMM 21012         N ASTRO         187A         PAPER SIM 22001         N ASTRO         202           ORB OPS/COMM 21012         N ASTRO         187A         PAPER SIM 22001         N ASTRO         204           ORB OPS/EVA 9XYYY         INT SIM         *1         PASS RECOV 31001         N ASTRO         204           ORB OPS/ECS 21001         N ASTRO         190A         PASS RECOV 31006         ORB FO         3-24A           ORB OPS/FCS 210101         N				P/L EVA 92027	EVA TASK	0-42
ORB MAN ATT 21001         N ASTRO         174A         P/L PRF ADV 41027         EVA TASK         0-*1           ORB MAN ATT 21012         N ASTRO         174B         PAO CAMC 31001         PHO/TV         4-13           ORB MECH OV 21001         N ASTRO         2         PAO CAMC SKL 31019         PHO/TV         3-15           ORB NOM OPS 31001         ORB FO         4-19B         PAPER SIM 21001         N ASTRO         95           ORB OND OPS 31001         ORB FO         4-19B         PAPER SIM 22001         N ASTRO         95           ORB OPS OV 21001         N ASTRO         8         PAPER SIM 22001         N ASTRO         201           ORB OPS/COMM 21001         N ASTRO         187B         PAPER SIM 23001         N ASTRO         202           ORB OPS/COMM 21012         N ASTRO         187B         PAPER SIM 25001         N ASTRO         202           ORB OPS/EVA 9XYYY         INT SIM         *1         PASS RECOV 31001         ORB FO         3-24A           ORB OPS/FCS 21001         N ASTRO         190A         PASS RECOV 31006         ORB FO         3-24B           ORB PRF LS 41012         ORB FO         0-*1         PDRS/EVA DAY X 91016         PDRS         0-92           ORB SKL 31001         ORB FO <td>ORB FDF USE 21001</td> <td>N ASTRO</td> <td>26</td> <td>P/L EVA 93027</td> <td>EVA TASK</td> <td>0-44</td>	ORB FDF USE 21001	N ASTRO	26	P/L EVA 93027	EVA TASK	0-44
ORB MECH OV 21001         N ASTRO         2         PAO CAMC SKL 31019         PHO/TV         3-15           ORB NOM OPS 31001         ORB FO         4-19A         PAO VID REV 31001         PHO/TV         3-16           ORB NOM OPS 31012         ORB FO         4-19B         PAPER SIM 21001         N ASTRO         95           ORB OPS OV 21001         N ASTRO         8         PAPER SIM 22001         N ASTRO         201           ORB OPS/COMM 21001         N ASTRO         187A         PAPER SIM 23001         N ASTRO         202           ORB OPS/COMM 21012         N ASTRO         187B         PAPER SIM 24001         N ASTRO         204           ORB OPS/COMM 21012         N ASTRO         187B         PAPER SIM 24001         N ASTRO         204           ORB OPS/FCS 21001         N ASTRO         190A         PASS RECOV 31001         ORB FO         3-24A           ORB OPS/FCS 21012         N ASTRO         190A         PASS RECOV 31001         ORB FO         3-24A           ORB PF FS 41012         ORB FO         0-*1         PDRS/EVA DAY X 91016         PDRS         0-92           ORB PR FS 41012         ORB FO         0-*1         PDRS/EVA OPS X 91016         PDRS         0-88           ORB SKL 31001         ORB FO </td <td></td> <td></td> <td></td> <td>P/L PRF ADV 41027</td> <td>EVA TASK</td> <td>0-*1</td>				P/L PRF ADV 41027	EVA TASK	0-*1
ORB MECH OV 21001         N ASTRO         2         PAO CAMC SKL 31019         PHO/TV         3-15           ORB NOM OPS 31001         ORB FO         4-19A         PAO VID REV 31001         PHO/TV         3-16           ORB NOM OPS 31012         ORB FO         4-19B         PAPER SIM 21001         N ASTRO         95           ORB OPS OV 21001         N ASTRO         8         PAPER SIM 22001         N ASTRO         201           ORB OPS/COMM 21001         N ASTRO         187A         PAPER SIM 23001         N ASTRO         202           ORB OPS/COMM 21012         N ASTRO         187B         PAPER SIM 24001         N ASTRO         204           ORB OPS/EVA 9XYYY         INT SIM         *1         PASS RECOV 31001         OR STRO         205           ORB OPS/FCS 21001         N ASTRO         190A         PASS RECOV 31006         ORB FO         3-24B           ORB OPS/FCS 21012         N ASTRO         190B         PCS/C&W OPS 21110         ISS CORE         4-3           ORB PF FS 41012         ORB FO         0-*1         PDRS/EVA DAY X 91016         PDRS         0-92           ORB SKL 31001         ORB FO         3-20A         PDRS/EVA PAM X 91001         PDRS         0-88           ORB SKL 32012         ORB FO <td></td> <td></td> <td></td> <td>PAO CAMC 31001</td> <td>PHO/TV</td> <td>4-13</td>				PAO CAMC 31001	PHO/TV	4-13
ORB NOM OPS 31012 ORB FO 4-19B ORB OPS OV 21001 ORB OPS OV 21001 ORB OPS OV 21001 ORB OPS OV 21001 ORB OPS/COMM 21012 ORB FO 0-*1 PDRS/COM OPS 21110 ORB FO 3-24B ORB OPS/FCS 21001 ORB FO 0-*1 PDRS/CVA DAY X 91016 PDRS 0-92 ORB PRF LS 41012 ORB FO 0-*1 PDRS/CVA DAY X 91016 PDRS 0-88 ORB SKL 31001 ORB FO 3-20A PDRS/CVA OPS X 91069 PDRS 0-91 ORB SKL 32012 ORB FO 3-26B PDRS/CVA OPS X 91069 PDRS 0-*1 ORB SKL 32012 ORB FO 3-26B PDRS/CVA PRF 41069 PDRS 0-*1 ORB SKL COMM 21008 N ASTRO 167 PDRS/CVA RVW 41016 PDRS 0-*1 ORB SKL COMM 31008 ORB FO 4-6 PDRS/CVA RVW 41025 PDRS 0-*1 ORB SKL SYS 31004 ORB FO 4-2 PDRS/CVA RVW 41025 PDRS 0-*1 ORB SKL SYS 31004 ORB FO 4-3 PDRS/CBS RVW 41025 PDRS 0-*1 ORB SKS 21001 N ASTRO 180B PDRS/CBS RVW 41025 PDRS 0-*1 ORB SYS 21001 N ASTRO 180B PDRS/CBS RVW 41025 PDRS 0-*1 ORB SYS 21001 N ASTRO 180B PDRS/CBS RVW 41025 PDRS 0-*1 ORB SYS 21001 N ASTRO 180B PDRS ADV SRG 21002 PDRS 0-*3 ORB SYS TRNG 21001 N ASTRO 180B PDRS D&R CON 91069 PDRS 0-78 PDRS D&R CON 91069 PDRS 0-78 PDRS D&R CON 91069 PDRS 0-79 PDRS D&R CON 91069 PDRS 0-79 PDRS D&R CON 91069 PDRS 0-79 PDRS D&R OPS 90069 PDRS 0-79 PDRS D&R OPS 90069 PDRS 0-70 PDRS D&R OPS 900	ORB MECH OV 21001	N ASTRO	2	PAO CAMC SKL 31019	PHO/TV	3-15
ORB OPS OV 21001 N ASTRO 8 PAPER SIM 22001 N ASTRO 201 ORB OPS OV 21001 N ASTRO 187A PAPER SIM 23001 N ASTRO 202 ORB OPS/COMM 21012 N ASTRO 187B PAPER SIM 24001 N ASTRO 204 ORB OPS/EVA 9XYYY (2XYYY) INT SIM 1 PASS RECOV 31001 ORB FO 3-24A ORB OPS/FCS 21001 N ASTRO 190B PCS/C&W OPS 21110 ISS CORE 4-3 ORB PRF FS 41012 ORB FO 0-*1 PDRS/EVA DAY X 91016 PDRS 0-92 ORB PRF LS 41012 ORB FO 0-*1 PDRS/EVA DAY X 91016 PDRS 0-88 ORB SKL 31001 ORB FO 3-26B PDRS/EVA OPS X 91069 PDRS 0-*1 ORB SKL 22001 ORB FO 3-26B PDRS/EVA PRF 41069 PDRS 0-*1 ORB SKL COMM 21008 N ASTRO 167 PDRS/EVA RVW 41016 PDRS 0-*1 ORB SKL COMM 21008 ORB FO 4-6 PDRS/EVA RVW 41025 PDRS 0-*1 ORB SKL SYS 31004 ORB FO 4-2 PDRS/EVA TSK X 91025 PDRS 0-*1 ORB SYS 21012 N ASTRO 180A PDRS/OBSS RVW 41025 PDRS 0-*1 ORB SYS 21012 N ASTRO 180A PDRS/OBSS RVW 41025 PDRS 0-*1 ORB SYS 21012 N ASTRO 180A PDRS/OBSS RVW 41025 PDRS 0-*1 ORB SYS 21001 N ASTRO 180A PDRS/OBSS RVW 41025 PDRS 0-*1 ORB SYS 21001 N ASTRO 180A PDRS/OBSS RVW 41025 PDRS 0-*1 ORB SYS 21012 N ASTRO 180A PDRS/OBSS RVW 41025 PDRS 0-*1 ORB SYS 21012 N ASTRO 180A PDRS/OBSS RVW 41025 PDRS 0-*1 ORB SYS 21012 N ASTRO 180A PDRS/OBSS RVW 41025 PDRS 0-*1 ORB SYS 21012 N ASTRO 180B PDRS ADV SRG 21002 PDRS 0-3A ORB/RMS I/F 31012 PDRS 4-42 PDRS BASICS 21001 PDRS 0-3B ORBIT OPS 9XYYY (2XYYY) INT SIM *1 PDRS D&R CON 91069 PDRS 0-79 PDRS D&R OPS 92069 PDRS 0-79 PDRS	ORB NOM OPS 31001	ORB FO	4-19A	PAO VID REV 31001	PHO/TV	3-16
ORB OPS/COMM 21001 N ASTRO 187A PAPER SIM 23001 N ASTRO 202 ORB OPS/COMM 21012 N ASTRO 187B PAPER SIM 24001 N ASTRO 204 ORB OPS/COMM 21012 N ASTRO 187B PAPER SIM 24001 N ASTRO 204 ORB OPS/EVA 9XYYY PAPER SIM 25001 N ASTRO 205 ORB OPS/FCS 21001 N ASTRO 190A PASS RECOV 31001 ORB FO 3-24A ORB OPS/FCS 21012 N ASTRO 190B PCS/C&W OPS 21110 ISS CORE 4-3 ORB PRF FS 41012 ORB FO 0-*1 PDRS/EVA DAY X 91016 PDRS 0-92 ORB PRF LS 41012 ORB FO 0-*1 PDRS/EVA FAM X 91001 PDRS 0-88 ORB SKL 31001 ORB FO 3-20A PDRS/EVA OPS X 91016 PDRS 0-89 ORB SKL 31012 ORB FO 3-20B PDRS/EVA OPS X 91069 PDRS 0-91 ORB SKL 32001 ORB FO 3-26B PDRS/EVA OPS X 91069 PDRS 0-*1 ORB SKL 32012 ORB FO 3-26B PDRS/EVA RVW 41016 PDRS 0-*1 ORB SKL COMM 21008 N ASTRO 167 PDRS/EVA RVW 41016 PDRS 0-*1 ORB SKL COMM 31008 ORB FO 4-6 PDRS/EVA RVW 41025 PDRS 0-*1 ORB SKL DPS 31006 ORB FO 4-2 PDRS/OBSS RVW 41025 PDRS 0-*1 ORB SKL SYS 31004 ORB FO 4-3 PDRS/OBSS RVW 41025 PDRS 0-*1 ORB SKS 21012 N ASTRO 180A PDRS/OBSS RVW 41121 PDRS 0-*1 ORB SYS 21012 N ASTRO 180A PDRS/OBSS RVW 41121 PDRS 0-*1 ORB SYS 21012 N ASTRO 180B PDRS ADV SRG 21002 PDRS 0-3A ORB/RMS I/F 31012 PDRS 4-42 PDRS BASICS 21001 PDRS 0-3A ORB/RMS I/F 31012 PDRS 4-42 PDRS BASICS 21001 PDRS 0-3A ORB/RMS I/F 31012 PDRS 4-42 PDRS D&R CON 92069 PDRS 0-78 (2XYYY) INT SIM *1 PDRS D&R CON 92069 PDRS 0-79 PEXPRESS RACK NOM 21165 ISS CORE 4-12 PDRS D&R OPS 92069 PDRS 0-79 PEXPRESS RACK NOM 21165 ISS CORE 4-13 PDRS D&R OPS 92069 PDRS 0-79 PL& APDS OV 21001 N ASTRO 104 PDRS D&R OPS 92069 PDRS 0-70 PDRS D&R OPS 92069 PDRS 0-70 PDRS D&R OPS 93069 PDRS 0-71	ORB NOM OPS 31012	ORB FO	4-19B	PAPER SIM 21001	N ASTRO	95
ORB OPS/COMM 21012 N ASTRO 187B ORB OPS/COMM 21012 N ASTRO 187B ORB OPS/EVA 9XYYY (2XYYY) INT SIM *1 PASS RECOV 31001 ORB FO 3-24A ORB OPS/FCS 21001 N ASTRO 190A PASS RECOV 31006 ORB FO 3-24B ORB OPS/FCS 21012 N ASTRO 190B PCS/C&W OPS 21110 ISS CORE 4-3 ORB PRF FS 41012 ORB FO 0-*1 PDRS/EVA DAY X 91016 PDRS 0-92 ORB PRF LS 41012 ORB FO 3-20A PDRS/EVA DAY X 91016 PDRS 0-88 ORB SKL 31001 ORB FO 3-20A PDRS/EVA OPS X 91069 PDRS 0-91 ORB SKL 32001 ORB FO 3-26B PDRS/EVA PRF 41069 PDRS 0-*1 ORB SKL 32012 ORB FO 3-26B PDRS/EVA RVW 41016 PDRS 0-*1 ORB SKL COMM 21008 N ASTRO 167 PDRS/EVA RVW 41025 PDRS 0-*1 ORB SKL OMM 31008 ORB FO 4-6 PDRS/EVA TSK X 91025 PDRS 0-*1 ORB SKL SYS 31004 ORB FO 4-2 PDRS/OBSS RVW 41025 PDRS 0-*1 ORB SKL SYS 31001 N ASTRO 180A PDRS/OBSS RVW 41026 PDRS 0-*1 ORB SYS 21012 N ASTRO 180A PDRS/OBSS RVW 41121 PDRS 0-*1 ORB SYS 21012 N ASTRO 1 80B PDRS ADV SRG 21002 PDRS 0-3A ORB/RMS I/F 31012 PDRS 4-42 PDRS BASICS 21172 PDRS 0-3A ORB/RMS I/F 31012 PDRS 4-42 PDRS D&R CON 91069 PDRS 0-78 (2XYYY) INT SIM *1 PDRS BASICS 21172 PDRS 0-38 ORB TS D&R OPS 92069 PDRS 0-79 P EXPRESS RACK NOM 21165 ISS CORE 4-12 PDRS D&R OPS 92069 PDRS 0-70 PL& APDS OV 21001 N ASTRO 104 PDRS D&R OPS 93069 PDRS 0-70	ORB OPS OV 21001	N ASTRO	8	PAPER SIM 22001	N ASTRO	201
ORB OPS/COMM 21012         N ASTRO         187B         PAPER SIM 24001         N ASTRO         204           ORB OPS/EVA 9XYYY         (2XYYY)         INT SIM         *1         PASS RECOV 31001         ORB FO         3-24A           ORB OPS/FCS 21001         N ASTRO         190A         PASS RECOV 31006         ORB FO         3-24B           ORB OPS/FCS 21012         N ASTRO         190B         PCS/C&W OPS 21110         ISS CORE         4-3           ORB PRF FS 41012         ORB FO         0*1         PDRS/EVA DAY X 91016         PDRS         0*92           ORB PRF LS 41012         ORB FO         0*1         PDRS/EVA DAY X 91016         PDRS         0*88           ORB PRF LS 41012         ORB FO         3*20A         PDRS/EVA OPS X 91016         PDRS         0*88           ORB SKL 31001         ORB FO         3*20B         PDRS/EVA OPS X 91069         PDRS         0*91           ORB SKL 32001         ORB FO         3*26A         PDRS/EVA PRF 41069         PDRS         0*91           ORB SKL COMM 21008         N ASTRO         167         PDRS/EVA RVW 41025         PDRS         0*1           ORB SKL COMM 31008         ORB FO         4*6         PDRS/EVA TSK X 91025         PDRS         0*1           ORB SKL SYS 3	ORB OPS/COMM 21001	N ASTRO	187A	PAPER SIM 23001	N ASTRO	202
ORB OPS/EVA 9XYYY (2XYYY) INT SIM *1 PASS RECOV 31001 ORB FO 3-24A ORB OPS/FCS 21001 N ASTRO 190A PASS RECOV 31006 ORB FO 3-24B ORB OPS/FCS 21012 N ASTRO 190B PCS/C&W OPS 21110 ISS CORE 4-3 ORB PRF FS 41012 ORB FO 0-*1 PDRS/EVA DAY X 91016 PDRS 0-92 ORB PRF LS 41012 ORB FO 0-*1 PDRS/EVA DAY X 91016 PDRS 0-88 ORB SKL 31001 ORB FO 3-20A PDRS/EVA OPS X 91016 PDRS 0-89 ORB SKL 31001 ORB FO 3-20B PDRS/EVA OPS X 91069 PDRS 0-91 ORB SKL 32001 ORB FO 3-26A PDRS/EVA PRF 41069 PDRS 0-*1 ORB SKL 32012 ORB FO 3-26B PDRS/EVA RVW 41016 PDRS 0-*1 ORB SKL COMM 21008 N ASTRO 167 PDRS/EVA RVW 41025 PDRS 0-*1 ORB SKL DPS 31006 ORB FO 4-6 PDRS/EVA TSK X 91025 PDRS 0-*1 ORB SKL SYS 31004 ORB FO 4-2 PDRS/OBSS RVW 41025 PDRS 0-*1 ORB SYS 21011 N ASTRO 180A PDRS/OBSS RVW 41025 PDRS 0-*1 ORB SYS 21012 N ASTRO 180A PDRS/OBSS RVW 41012 PDRS 0-*1 ORB SYS 21012 N ASTRO 180B PDRS ADV SRG 21002 PDRS 0-3A ORB/RMS I/F 31012 PDRS 4-42 PDRS BASICS 21101 PDRS 0-3A ORB/RMS I/F 31012 PDRS 4-42 PDRS BASICS 21101 PDRS 0-3A ORB/RMS I/F 31012 PDRS 4-42 PDRS BASICS 21101 PDRS 0-3A ORB/RMS I/F 31012 PDRS 4-42 PDRS BASICS 21101 PDRS 0-3A ORB/RMS I/F 31012 PDRS 4-42 PDRS BASICS 21101 PDRS 0-3B ORBIT OPS 9XYYY (2XYYY) INT SIM *1 PDRS BASICS 21102 PDRS 0-79 PEXPRESS RACK NOM 21165 ISS CORE 4-12 PDRS D&R ON 91069 PDRS 0-79 PLX APDS OV 21001 N ASTRO 104 PDRS D&R OPS 93069 PDRS 0-70 PDRS D&R OPS 93069 PDRS 0-71		N ASTRO		PAPER SIM 24001	N ASTRO	204
ORB OPS/FCS 21001         N ASTRO         190A         PASS RECOV 31006         ORB FO         3-24B           ORB OPS/FCS 21012         N ASTRO         190B         PCS/C&W OPS 21110         ISS CORE         4-3           ORB PRF FS 41012         ORB FO         0-*1         PDRS/EVA DAY X 91016         PDRS         0-92           ORB PRF LS 41012         ORB FO         0-*1         PDRS/EVA DAY X 91016         PDRS         0-92           ORB PRF LS 41012         ORB FO         0-*1         PDRS/EVA DAY X 91016         PDRS         0-92           ORB SKL 31001         ORB FO         3-20A         PDRS/EVA FAM X 91001         PDRS         0-88           ORB SKL 31012         ORB FO         3-20B         PDRS/EVA OPS X 91069         PDRS         0-91           ORB SKL 32001         ORB FO         3-26A         PDRS/EVA PRF 41069         PDRS         0-*1           ORB SKL 2001         ORB FO         3-26B         PDRS/EVA RVW 41016         PDRS         0-*1           ORB SKL COMM 21008         N ASTRO         167         PDRS/EVA RVW 41025         PDRS         0-*1           ORB SKL COMM 31008         ORB FO         4-6         PDRS/EVA RVW 41025         PDRS         0-*0           ORB SKL SYS 31004         ORB FO </td <td>ORB OPS/EVA 9XYYY</td> <td></td> <td></td> <td>PAPER SIM 25001</td> <td>N ASTRO</td> <td>205</td>	ORB OPS/EVA 9XYYY			PAPER SIM 25001	N ASTRO	205
ORB OPS/FCS 21012         N ASTRO         190B         PCS/C&W OPS 21110         ISS CORE         4-3           ORB PRF FS 41012         ORB FO         0-*1         PDRS/EVA DAY X 91016         PDRS         0-92           ORB PRF LS 41012         ORB FO         0-*1         PDRS/EVA FAM X 91001         PDRS         0-88           ORB SKL 31001         ORB FO         3-20A         PDRS/EVA OPS X 91016         PDRS         0-89           ORB SKL 31012         ORB FO         3-20B         PDRS/EVA OPS X 91069         PDRS         0-91           ORB SKL 32001         ORB FO         3-26A         PDRS/EVA PRF 41069         PDRS         0-91           ORB SKL 20012         ORB FO         3-26B         PDRS/EVA RVW 41016         PDRS         0-*1           ORB SKL COMM 21008         N ASTRO         167         PDRS/EVA RVW 41025         PDRS         0-*1           ORB SKL COMM 31008         ORB FO         4-6         PDRS/EVA TSK X 91025         PDRS         0-90           ORB SKL DPS 31006         ORB FO         4-2         PDRS/OBSS RVW 41025         PDRS         0-*1           ORB SYS 21001         N ASTRO         180A         PDRS/OBSS RVW 411021         PDRS         0-*1           ORB SYS TRNG 21001         N ASTRO<	(2XYYY)	INT SIM	*1	PASS RECOV 31001	ORB FO	3-24A
ORB PRF FS 41012         ORB FO         0-*1         PDRS/EVA DAY X 91016         PDRS         0-92           ORB PRF LS 41012         ORB FO         0-*1         PDRS/EVA FAM X 91001         PDRS         0-88           ORB SKL 31001         ORB FO         3-20A         PDRS/EVA OPS X 91016         PDRS         0-89           ORB SKL 31012         ORB FO         3-20B         PDRS/EVA OPS X 91069         PDRS         0-91           ORB SKL 32001         ORB FO         3-26A         PDRS/EVA PRF 41069         PDRS         0-*1           ORB SKL 32012         ORB FO         3-26B         PDRS/EVA RVW 41016         PDRS         0-*1           ORB SKL COMM 21008         N ASTRO         167         PDRS/EVA RVW 41025         PDRS         0-*1           ORB SKL COMM 31008         ORB FO         4-6         PDRS/EVA TSK X 91025         PDRS         0-*1           ORB SKL DPS 31006         ORB FO         4-2         PDRS/OBSS RVW 41025         PDRS         0-*1           ORB SYS 21001         N ASTRO         180A         PDRS/OBSS RVW 41069         PDRS         0-*1           ORB SYS 21012         N ASTRO         180B         PDRS ADV SRG 21002         PDRS         0-*3           ORB SYS TRNG 21001         N ASTRO	ORB OPS/FCS 21001	N ASTRO	190A	PASS RECOV 31006	ORB FO	3-24B
ORB PRF LS 41012         ORB FO         0-*1         PDRS/EVA FAM X 91001         PDRS         0-88           ORB SKL 31001         ORB FO         3-20A         PDRS/EVA OPS X 91016         PDRS         0-89           ORB SKL 31012         ORB FO         3-20B         PDRS/EVA OPS X 91069         PDRS         0-91           ORB SKL 32001         ORB FO         3-26A         PDRS/EVA PRF 41069         PDRS         0-*1           ORB SKL 32012         ORB FO         3-26B         PDRS/EVA PRF 41069         PDRS         0-*1           ORB SKL COMM 21008         N ASTRO         167         PDRS/EVA RVW 41016         PDRS         0-*1           ORB SKL COMM 31008         ORB FO         4-6         PDRS/EVA RVW 41025         PDRS         0-*1           ORB SKL COMM 31008         ORB FO         4-6         PDRS/EVA RVW 41025         PDRS         0-*1           ORB SKL COMM 31008         ORB FO         4-6         PDRS/EVA RVW 41025         PDRS         0-*1           ORB SKL COMM 31008         ORB FO         4-6         PDRS/OBSS RVW 41025         PDRS         0-*1           ORB SKL SYS 31004         ORB FO         4-3         PDRS/OBSS RVW 41069         PDRS         0-*1           ORB SYS 21001         N ASTRO	ORB OPS/FCS 21012	N ASTRO	190B	PCS/C&W OPS 21110	ISS CORE	4-3
ORB SKL 31001         ORB FO         3-20A         PDRS/EVA OPS X 91016         PDRS         0-89           ORB SKL 31012         ORB FO         3-20B         PDRS/EVA OPS X 91069         PDRS         0-91           ORB SKL 32001         ORB FO         3-26A         PDRS/EVA PRF 41069         PDRS         0-*1           ORB SKL 32012         ORB FO         3-26B         PDRS/EVA RVW 41016         PDRS         0-*1           ORB SKL COMM 21008         N ASTRO         167         PDRS/EVA RVW 41025         PDRS         0-*1           ORB SKL COMM 31008         ORB FO         4-6         PDRS/EVA TSK X 91025         PDRS         0-*1           ORB SKL DPS 31006         ORB FO         4-6         PDRS/OBSS RVW 41025         PDRS         0-*1           ORB SKL SYS 31004         ORB FO         4-3         PDRS/OBSS RVW 41069         PDRS         0-*1           ORB SYS 21001         N ASTRO         180A         PDRS/OBSS RVW 41121         PDRS         0-*1           ORB SYS 21012         N ASTRO         180B         PDRS ADV SRG 21002         PDRS         0-23           ORB SYS TRNG 21001         N ASTRO         1         PDRS BASICS 21001         PDRS         0-3A           ORB/RMS I/F 31012         PDRS <t< td=""><td>ORB PRF FS 41012</td><td>ORB FO</td><td>0-*1</td><td>PDRS/EVA DAY X 91016</td><td>PDRS</td><td>0-92</td></t<>	ORB PRF FS 41012	ORB FO	0-*1	PDRS/EVA DAY X 91016	PDRS	0-92
ORB SKL 31012         ORB FO         3-20B         PDRS/EVA OPS X 91069         PDRS         0-91           ORB SKL 32001         ORB FO         3-26A         PDRS/EVA PRF 41069         PDRS         0-*1           ORB SKL 32012         ORB FO         3-26B         PDRS/EVA RVW 41016         PDRS         0-*1           ORB SKL COMM 21008         N ASTRO         167         PDRS/EVA RVW 41025         PDRS         0-*1           ORB SKL COMM 31008         ORB FO         4-6         PDRS/EVA TSK X 91025         PDRS         0-90           ORB SKL DPS 31006         ORB FO         4-2         PDRS/OBSS RVW 41025         PDRS         0-*1           ORB SKL SYS 31004         ORB FO         4-3         PDRS/OBSS RVW 41069         PDRS         0-*1           ORB SYS 21001         N ASTRO         180A         PDRS/OBSS RVW 41121         PDRS         0-*1           ORB SYS 21012         N ASTRO         180B         PDRS ADV SRG 21002         PDRS         0-23           ORB SYS TRNG 21001         N ASTRO         1         PDRS BASICS 21101         PDRS         0-3A           ORB/RMS I/F 31012         PDRS         4-42         PDRS BASICS 21172         PDRS         0-78           (2XYYY)         INT SIM         *1	ORB PRF LS 41012	ORB FO	0-*1	PDRS/EVA FAM X 91001	PDRS	0-88
ORB SKL 32001 ORB FO 3-26A PDRS/EVA PRF 41069 PDRS 0-*1 ORB SKL 32012 ORB FO 3-26B PDRS/EVA RVW 41016 PDRS 0-*1 ORB SKL COMM 21008 N ASTRO 167 PDRS/EVA RVW 41025 PDRS 0-*1 ORB SKL COMM 31008 ORB FO 4-6 PDRS/EVA TSK X 91025 PDRS 0-90 ORB SKL DPS 31006 ORB FO 4-2 PDRS/OBSS RVW 41025 PDRS 0-*1 ORB SKL SYS 31004 ORB FO 4-3 PDRS/OBSS RVW 41069 PDRS 0-*1 ORB SYS 21001 N ASTRO 180A PDRS/OBSS RVW 41121 PDRS 0-*1 ORB SYS 21012 N ASTRO 180B PDRS ADV SRG 21002 PDRS 0-23 ORB SYS TRNG 21001 N ASTRO 1 PDRS BASICS 21001 PDRS 0-3A ORB/RMS I/F 31012 PDRS 4-42 PDRS BASICS 21001 PDRS 0-3B ORBIT OPS 9XYYY PDRS D&R CON 91069 PDRS 0-78 (2XYYY) INT SIM *1 PDRS D&R CON 92069 PDRS 0-79 P EXPRESS RACK NOM 21165 ISS CORE 4-12 PDRS D&R OPS 91069 PDRS 0-69 PTRANSFER OV 21101 N ASTRO 104 P/L COM/OILL MAI 21006 N ASTRO 109	ORB SKL 31001	ORB FO	3-20A	PDRS/EVA OPS X 91016	PDRS	0-89
ORB SKL 32012 ORB FO 3-26B PDRS/EVA RVW 41016 PDRS 0-*1 ORB SKL COMM 21008 N ASTRO 167 PDRS/EVA RVW 41025 PDRS 0-*1 ORB SKL COMM 31008 ORB FO 4-6 PDRS/EVA TSK X 91025 PDRS 0-90 ORB SKL DPS 31006 ORB FO 4-2 PDRS/OBSS RVW 41025 PDRS 0-*1 ORB SKL SYS 31004 ORB FO 4-3 PDRS/OBSS RVW 41069 PDRS 0-*1 ORB SYS 21001 N ASTRO 180A PDRS/OBSS RVW 41121 PDRS 0-*1 ORB SYS 21012 N ASTRO 180B PDRS ADV SRG 21002 PDRS 0-23 ORB SYS TRNG 21001 N ASTRO 1 PDRS BASICS 21001 PDRS 0-3A ORB/RMS I/F 31012 PDRS 4-42 PDRS BASICS 21172 PDRS 0-3B ORBIT OPS 9XYYY PDRS D&R CON 91069 PDRS 0-78 (2XYYY) INT SIM *1 PDRS D&R CON 92069 PDRS 0-79 P EXPRESS RACK NOM 21165 ISS CORE 4-12 PDRS D&R OPS 91069 PDRS 0-69 P TRANSFER OV 21101 N ASTRO 104 PDRS D&R OPS 92069 PDRS 0-70 P/L & APDS OV 21001 N ASTRO 104 P/L COM/OILL MAL 21006 N ASTRO 109	ORB SKL 31012	ORB FO	3-20B	PDRS/EVA OPS X 91069	PDRS	0-91
ORB SKL COMM 21008 N ASTRO 167 PDRS/EVA RVW 41025 PDRS 0-*1 ORB SKL COMM 31008 ORB FO 4-6 PDRS/EVA TSK X 91025 PDRS 0-90 ORB SKL DPS 31006 ORB FO 4-2 PDRS/OBSS RVW 41025 PDRS 0-*1 ORB SKL SYS 31004 ORB FO 4-3 PDRS/OBSS RVW 41069 PDRS 0-*1 ORB SYS 21001 N ASTRO 180A PDRS/OBSS RVW 41121 PDRS 0-*1 ORB SYS 21012 N ASTRO 180B PDRS ADV SRG 21002 PDRS 0-23 ORB SYS TRNG 21001 N ASTRO 1 PDRS BASICS 21001 PDRS 0-3A ORB/RMS I/F 31012 PDRS 4-42 PDRS BASICS 21172 PDRS 0-3B ORBIT OPS 9XYYY PDRS D&R CON 91069 PDRS 0-78 (2XYYY) INT SIM *1 PDRS D&R CON 92069 PDRS 0-79 P EXPRESS RACK NOM 21165 ISS CORE 4-12 PDRS D&R OPS 91069 PDRS 0-69 P TRANSFER OV 21165 ISS CORE 4-13 PDRS D&R OPS 92069 PDRS 0-70 P/L & APDS OV 21001 N ASTRO 104 PDRS D&R OPS 93069 PDRS 0-70 PDRS D&R OPS 93069 PDRS 0-71	ORB SKL 32001	ORB FO	3-26A	PDRS/EVA PRF 41069	PDRS	0-*1
ORB SKL COMM 31008 ORB FO 4-6 PDRS/EVA TSK X 91025 PDRS 0-90 ORB SKL DPS 31006 ORB FO 4-2 PDRS/OBSS RVW 41025 PDRS 0-*1 ORB SKL SYS 31004 ORB FO 4-3 PDRS/OBSS RVW 41069 PDRS 0-*1 ORB SYS 21001 N ASTRO 180A PDRS/OBSS RVW 41121 PDRS 0-*1 ORB SYS 21012 N ASTRO 180B PDRS ADV SRG 21002 PDRS 0-23 ORB SYS TRNG 21001 N ASTRO 1 PDRS BASICS 21001 PDRS 0-3A ORB/RMS I/F 31012 PDRS 4-42 PDRS BASICS 21172 PDRS 0-3B ORBIT OPS 9XYYY PDRS D&R CON 91069 PDRS 0-78 (2XYYY) INT SIM *1 PDRS D&R CON 92069 PDRS 0-79 P EXPRESS RACK NOM 21165 ISS CORE 4-12 PDRS D&R OPS 91069 PDRS 0-69 PTRANSFER OV 21101 N ASTRO 104 P/L & APDS OV 21001 N ASTRO 104 P/L COM/OILL MAL 21006 N ASTRO 109	ORB SKL 32012	ORB FO	3-26B	PDRS/EVA RVW 41016	PDRS	0-*1
ORB SKL DPS 31006 ORB FO 4-2 PDRS/OBSS RVW 41025 PDRS 0-*1 ORB SKL SYS 31004 ORB FO 4-3 PDRS/OBSS RVW 41069 PDRS 0-*1 ORB SYS 21001 N ASTRO 180A PDRS/OBSS RVW 41121 PDRS 0-*1 ORB SYS 21012 N ASTRO 180B PDRS ADV SRG 21002 PDRS 0-23 ORB SYS TRNG 21001 N ASTRO 1 PDRS BASICS 21001 PDRS 0-3A ORB/RMS I/F 31012 PDRS 4-42 PDRS BASICS 21172 PDRS 0-3B ORBIT OPS 9XYYY PDRS D&R CON 91069 PDRS 0-78 (2XYYY) INT SIM *1 PDRS D&R CON 92069 PDRS 0-79 PEXPRESS RACK NOM 21165 ISS CORE 4-12 P TRANSFER OV 21165 ISS CORE 4-13 P/L & APDS OV 21001 N ASTRO 104 P/L COM/OILL MAL 21006 N ASTRO 109	ORB SKL COMM 21008	N ASTRO	167	PDRS/EVA RVW 41025	PDRS	0-*1
ORB SKL SYS 31004 ORB FO 4-3 PDRS/OBSS RVW 41069 PDRS 0-*1 ORB SYS 21001 N ASTRO 180A PDRS/OBSS RVW 41121 PDRS 0-*1 ORB SYS 21012 N ASTRO 180B PDRS ADV SRG 21002 PDRS 0-23 ORB SYS TRNG 21001 N ASTRO 1 PDRS BASICS 21001 PDRS 0-3A ORB/RMS I/F 31012 PDRS 4-42 PDRS BASICS 21172 PDRS 0-3B ORBIT OPS 9XYYY PDRS D&R CON 91069 PDRS 0-78 (2XYYY) INT SIM *1 PDRS D&R CON 92069 PDRS 0-79 P EXPRESS RACK NOM 21165 ISS CORE 4-12 P TRANSFER OV 21165 ISS CORE 4-13 P/L & APDS OV 21001 N ASTRO 104 P/L COM/OILL MAL 21006 N ASTRO 109	ORB SKL COMM 31008	ORB FO	4-6	PDRS/EVA TSK X 91025	PDRS	0-90
ORB SYS 21001         N ASTRO         180A         PDRS/OBSS RVW 41121         PDRS         0-*1           ORB SYS 21012         N ASTRO         180B         PDRS ADV SRG 21002         PDRS         0-23           ORB SYS TRNG 21001         N ASTRO         1         PDRS BASICS 21001         PDRS         0-3A           ORB/RMS I/F 31012         PDRS         4-42         PDRS BASICS 21172         PDRS         0-3B           ORBIT OPS 9XYYY         PDRS D&R CON 91069         PDRS         0-78           (2XYYY)         INT SIM         *1         PDRS D&R CON 92069         PDRS         0-79           P EXPRESS RACK NOM 21165         ISS CORE         4-12         PDRS D&R OPS 91069         PDRS         0-69           P TRANSFER OV 21165         ISS CORE         4-13         PDRS D&R OPS 92069         PDRS         0-70           P/L & APDS OV 21001         N ASTRO         104         PDRS D&R OPS 93069         PDRS         0-71           P/L COM/OILL MAL 21006         N ASTRO         109         109         PDRS D&R OPS 93069         PDRS         0-71	ORB SKL DPS 31006	ORB FO	4-2	PDRS/OBSS RVW 41025	PDRS	0-*1
ORB SYS 21012         N ASTRO         180B         PDRS ADV SRG 21002         PDRS         0-23           ORB SYS TRNG 21001         N ASTRO         1         PDRS BASICS 21001         PDRS         0-3A           ORB/RMS I/F 31012         PDRS         4-42         PDRS BASICS 21172         PDRS         0-3B           ORBIT OPS 9XYYY         PDRS D&R CON 91069         PDRS         0-78           (2XYYY)         INT SIM         *1         PDRS D&R CON 92069         PDRS         0-79           P EXPRESS RACK NOM 21165         ISS CORE 4-12         PDRS D&R INT 91012         PDRS         0-73           PTRANSFER OV 21165         ISS CORE 4-13         PDRS D&R OPS 91069         PDRS         0-69           PL & APDS OV 21001         N ASTRO         104         PDRS D&R OPS 93069         PDRS         0-71           P/L COM/OILL MAL 21006         N ASTRO         109         109         PDRS D&R OPS 93069         PDRS         0-71	ORB SKL SYS 31004	ORB FO	4-3	PDRS/OBSS RVW 41069	PDRS	0-*1
ORB SYS TRNG 21001 N ASTRO 1 PDRS BASICS 21001 PDRS 0-3A ORB/RMS I/F 31012 PDRS 4-42 PDRS BASICS 21172 PDRS 0-3B ORBIT OPS 9XYYY PDRS D&R CON 91069 PDRS 0-78 (2XYYY) INT SIM *1 PDRS D&R CON 92069 PDRS 0-79 P EXPRESS RACK NOM 21165 ISS CORE 4-12 PDRS D&R INT 91012 PDRS 0-73 P TRANSFER OV 21165 ISS CORE 4-13 PDRS D&R OPS 91069 PDRS 0-69 P/L & APDS OV 21001 N ASTRO 104 P/L COM/OILL MAI 21006 N ASTRO 109	ORB SYS 21001	N ASTRO	180A	PDRS/OBSS RVW 41121	PDRS	0-*1
ORB/RMS I/F 31012         PDRS         4-42         PDRS BASICS 21172         PDRS         0-3B           ORBIT OPS 9XYYY         PDRS D&R CON 91069         PDRS         0-78           (2XYYY)         INT SIM         *1         PDRS D&R CON 92069         PDRS         0-79           P EXPRESS RACK NOM 21165         ISS CORE 4-12         PDRS D&R INT 91012         PDRS         0-73           P TRANSFER OV 21165         ISS CORE 4-13         PDRS D&R OPS 91069         PDRS         0-69           P/L & APDS OV 21001         N ASTRO         104         PDRS D&R OPS 93069         PDRS         0-71           P/L COM/OUL MAL 21006         N ASTRO         109         PDRS D&R OPS 93069         PDRS         0-71	ORB SYS 21012	N ASTRO	180B	PDRS ADV SRG 21002	PDRS	0-23
ORBIT OPS 9XYYY (2XYYY) INT SIM *1 PDRS D&R CON 91069 PDRS 0-78 P EXPRESS RACK NOM 21165 ISS CORE 4-12 P TRANSFER OV 21165 ISS CORE 4-13 P/L & APDS OV 21001 N ASTRO 104 P/L COM/OILL MAI 21006 N ASTRO 109 PDRS D&R CON 92069 PDRS 0-79 PDRS D&R OPS 91069 PDRS 0-69 PDRS D&R OPS 92069 PDRS 0-70 PDRS D&R OPS 93069 PDRS 0-71	ORB SYS TRNG 21001	N ASTRO	1	PDRS BASICS 21001	PDRS	0-3A
(2XYYY)       INT SIM       *1       PDRS D&R CON 92069       PDRS       0-79         P EXPRESS RACK NOM 21165       ISS CORE 4-12       PDRS D&R INT 91012       PDRS       0-73         P TRANSFER OV 21165       ISS CORE 4-13       PDRS D&R OPS 91069       PDRS       0-69         P/L & APDS OV 21001       N ASTRO       104       PDRS D&R OPS 93069       PDRS       0-70         P/L COM/OUL MAL 21006       N ASTRO       109       PDRS D&R OPS 93069       PDRS       0-71	ORB/RMS I/F 31012	PDRS	4- <i>4</i> 2	PDRS BASICS 21172	PDRS	0-3B
P EXPRESS RACK NOM 21165 ISS CORE 4-12 PDRS D&R OPS 91069 PDRS 0-69 PL & APDS OV 21001 N ASTRO 104 PDRS D&R OPS 93069 PDRS 0-70 P/L COM/OILL MAL 21006 N ASTRO 109				PDRS D&R CON 91069	PDRS	0-78
21165 ISS CORE 4-12 P TRANSFER OV 21165 ISS CORE 4-13 P/L & APDS OV 21001 N ASTRO 104 P/L COM/OILL MAI 21006 N ASTRO 109 P TRANSFER OV 21001 N ASTRO 109 P DRS D&R OPS 92069 PDRS 0-70 PDRS D&R OPS 93069 PDRS 0-71	,	INT SIM	*1	PDRS D&R CON 92069	PDRS	0-79
P TRANSFER OV 21165 ISS CORE 4-13 P/L & APDS OV 21001 N ASTRO 104 P/L COM/OILL MAI 21006 N ASTRO 109 PDRS D&R OPS 91069 PDRS 0-70 PDRS D&R OPS 93069 PDRS 0-71		ISS CODE	4.40	PDRS D&R INT 91012	PDRS	0-73
P/L & APDS OV 21001 N ASTRO 104 P/L COM/OILL MAL 21006 N ASTRO 109 PDRS D&R OPS 92069 PDRS 0-70 PDRS D&R OPS 93069 PDRS 0-71				PDRS D&R OPS 91069	PDRS	0-69
P/I COM/OILI MAI 21006 N ASTRO 109				PDRS D&R OPS 92069	PDRS	0-70
PDRS D&R OPS 94069 PDRS 0-72				PDRS D&R OPS 93069	PDRS	0-71
	1 /L GOIVI/OIO IVIAL 2 1000	NASINO	103	PDRS D&R OPS 94069	PDRS	0-72

		Stage -			Stage –
Lesson Code	<u>Course</u>	Ref. No.	Lesson Code	<u>Course</u>	Ref. No.
PDRS D&R SJ 91069	PDRS	0-74	PDRS N-TSK X 92069	PDRS	3-83
PDRS D&R SJ 92069	PDRS	0-75	PDRS NBL FAM 31027	PDRS	4- <i>4</i> 1
PDRS D&R SJ 93069	PDRS	0-76	PDRS NOM RVW 21069	PDRS	0-12
PDRS D&R SJ 94069	PDRS	0-77	PDRS NOM SRG 21002	PDRS	0-1A
PDRS DPLY CON 91069	PDRS	0- <i>60</i>	PDRS NOM TSK 21069	PDRS	0-13
PDRS DPLY CON 92069	PDRS	0-61	PDRS NOM TSK X 91012	PDRS	2- <mark>85</mark>
PDRS DPLY INT 91012	PDRS	0-57	PDRS OBSS INTRO		
PDRS DPLY OPS 91069	PDRS	0- <u>55</u>	21025	PDRS	0-36
PDRS DPLY OPS 92069	PDRS	0- <u>56</u>	PDRS OBSS FOC INSP	PDRS	2.06
PDRS DPLY SJ 91069	PDRS	0- <u>58</u>	91069	PDRS	3-96
PDRS DPLY SJ 92069	PDRS	0-59	PDRS OBSS BERTH 91069	PDRS	3-98
PDRS ELE MAL X 91012	PDRS	2-87	PDRS OBSS SURVEY	7 2710	0 00
PDRS EVA OPS 21001	PDRS	0-11A	21069	PDRS	0-37
PDRS EVA OPS 21016	PDRS	0-11B	PDRS OBSS SURVEY		
PDRS EVA OPS 22016	PDRS	0-29	22069	PDRS	0-38
PDRS EVAL 21069	PDRS	0-33	PDRS OBSS SURVEY	DDD0	2 22 1
PDRS FLT QL 1 31069	PDRS	0-34	23069	PDRS	0-39
PDRS FLT QL 2 31069	PDRS	<i>0-35</i>	PDRS OPS 91001	PDRS	4-43
PDRS GRP SKL 21001	PDRS	0-4A	PDRS ORM OPS 91121	PDRS	3-102
PDRS GRP SKL 21172	PDRS	0-4B	PDRS ORM TSK 91069	PDRS	3-101
PDRS H/W SYS 21001	PDRS	0-24	PDRS OV 21001	N ASTRO	106
PDRS INTRO 21001	PDRS	0-2	PDRS PRF ADV 41001	PDRS	0-*1
PDRS LD CON 91069	PDRS	0-53	PDRS PRF ADV 41012	PDRS	0-*1
PDRS LD CON 92069	PDRS	0- <i>54</i>	PDRS PRF ADV 41025	PDRS	0-*1
PDRS LD INT 91012	PDRS	0- <i>50</i>	PDRS PRF ADV 41069	PDRS	0-*1
PDRS LD OPS 21001	PDRS	0-8A	PDRS QUAL1 21069	PDRS	0-31
PDRS LD OPS 91069	PDRS	0- <i>4</i> 8	PDRS QUAL2 21069	PDRS	0-32
PDRS LD OPS 92069	PDRS	0- <i>4</i> 9	PDRS RETR CON 91069	PDRS	0-67
PDRS LD OPS1 21172	PDRS	0-8B	PDRS RETR CON 92069	PDRS	0-68
PDRS LD OPS2 21069	PDRS	0-9	PDRS RETR INT 91012	PDRS	0-64
PDRS LD SJ 91069	PDRS	0- <i>51</i>	PDRS RETR OPS 91069	PDRS	0-62
PDRS LD SJ 92069	PDRS	0-52	PDRS RETR OPS 92069	PDRS	0-63
PDRS LSN LRN 91001	PDRS	2-93	PDRS RETR SJ 91069	PDRS	0-65
PDRS MAL OPS 21001	PDRS	0-26	PDRS RETR SJ 92069	PDRS	0-66
PDRS MAL1 21012	PDRS	0-27	PDRS RVW 21069	PDRS	0-30
PDRS MAL2 21012	PDRS	0-28	PDRS S/W SYS 21001	PDRS	0-25
PDRS MODES 21001	PDRS	0-10A	PDRS SJ LD 21001	PDRS	0-18A
PDRS MODES 21069	PDRS	0-10B	PDRS SJ LD1 21173	PDRS	0-18B
PDRS N-TSK X 91025	PDRS	4- <i>80</i>	PDRS SJ LD2 21173	PDRS	0-19
PDRS N-TSK X 91069	PDRS	3-82	PDRS SJ LD3 21069	PDRS	0-20
PDRS N-TSK X 92025	PDRS	3-81	PDRS SJ RVW 21069	PDRS	0-21

Lesson Code	Course	Stage – <u>Ref. No.</u>	Lesson Code	Course	Stage – Ref. No.
PDRS SJ SRG 21002	PDRS	0-14	PI/DO PREP 91020	CR SYS	3-8
PDRS SJ TSK 21069	PDRS	0-22	PLANNING 9XYYY	ORCOTO	0.0
PDRS SJ TSK X 91069	PDRS	2- <u>86</u>	(2XYYY)	INT SIM	*1
PDRS SJ TSK X 91173	PDRS	3- <i>84</i>	PLD-PRELAUNCH 910XX		
PDRS SJ UL 21001	PDRS	0-15A	(210XX)	INT SIM	*1
PDRS SJ UL1 21173	PDRS	0-15B	PLD EG 91019	CR SYS	3-19
PDRS SJ UL2 21173	PDRS	0-16	PO APPR 21069	RNDZ/PO	0-15
PDRS SJ UL3 21069	PDRS	0-17	PO APPR 31069	RNDZ/PO	3-36
PDRS SRVY DAY RVW 91121	PDRS	3-100	PO INS 9XYYY (2XYYY)	INT SIM	*1
PDRS SURVEY DAY			PO INS MAL 31001	ORB FO	4-9A
91012	PDRS	3- <mark>99</mark>	PO INS MAL 31012	ORB FO	4-9B
PDRS TOOLS 21025	PDRS	0-6	PO INS MAL 32012	ORB FO	3-25
PDRS TPS OBSS H/O			PO INS OPS 21001	N ASTRO	124A
91069	PDRS	3- <i>94</i>	PO INS OPS 21012	N ASTRO	124B
PDRS TPS OBSS H/O 91121	PDRS	3- <u>95</u>	PO INS OPS 91012	ORB FO	2-39
PDRS TPS REPAIR	PDRS	3-90	PO INS PRF 41012	ORB FO	0-*1
91069	PDRS	3-97	PO PRF ADV 41069	RNDZ/PO	0-*1
PDRS TSK PRF 41069	PDRS	0-*1	PREBREATHE 31001	MED OPS	3- <mark>3</mark>
PDRS TSK RVW 41025	PDRS	0-*1	PRL 21057	REFR	0-5
PDRS UL OPS 21001	PDRS	0-5A	PRL IN/EG 91020	CR SYS	2-22
PDRS UL OPS1 21172	PDRS	0-5B	PRL PROC 91020	CR SYS	0-*1
PDRS UL OPS2 21069	PDRS	0-7	PROP DUMPS 21001	N ASTRO	178A
PDRS UL OPS 91025	PDRS	4-44	PROP DUMPS 21006	N ASTRO	178B
PDRS UL OPS 91069	PDRS	4- <i>4</i> 5	PROP DUMPS BR 21001	N ASTRO	177
PDRS UL SJ 91025	PDRS	3- <i>4</i> 6	PROX INTRO BR 21001	RNDZ/PO	0-3
PDRS UL SJ 91069	PDRS	3-47	PROX INTRO 21069	RNDZ/PO	0-4
PDRS UNDK SJ OBSS			PROX OPS T/L 91012	RNDZ/PO	2-51
<b>2</b> 1069	PDRS	0- <i>40</i>	PROX OPS TOPICS 31069	RNDZ/PO	2-46
PEAK CYCLE TEST 31001	MED OPS	4-1	PROX TECH BR 21001	RNDZ/PO	0-5
PGSC INTRO 21195	N ASTRO	117	PROX TECH 21069	RNDZ/PO	0-7
PGSC NETWORK	NAOIRO	117	PROX/PDRS 910XX		
OPS 31195	ORB FO	4-15	(210XX)	INT SIM	*1
PGSC MAL 31195	ORB FO	4-17	PRS OPS 31029	ORB FO	4-18
PGSC OPS 21195	N ASTRO	130	PTG 21006	N ASTRO	89
PGSC REVIEW 41195	ORB FO	0-*1	PWDN BR 31001	A/E FO	3-19
PHO/TV PROC 31019	PHO/TV	3-32	PWR PYLD TRANS		
PHO/TV PROC 91019	PHO/TV	2- <b>34</b>	31001	TRANSFER	R 2-4
PHO/TV PROC 92019	PHO/TV	2-35	PYLD DPLY 9XYYY (2XYYY)	INT SIM	*1
PHO/TV PROC 93019	PHO/TV	2-36	PYLD L DPLY 9XYYY	5	•
PI 21020	N ASTRO	136	(2XYYY)	INT SIM	*1

<u>Lesson Code</u>	Course	Stage – <u>Ref. No.</u>	<u>Lesson Code</u>	Course	Stage – <u>Ref. No.</u>
R/PO PRF ADV 41025	RNDZ/PO	0-*1	RNDZ MAL 32012	RNDZ/PO	3-41
R/PO PRF ADV 41069	RNDZ/PO	0-*1	RNDZ MAN PH BR		
R/PO QUAL 21069	RNDZ/PO	0-33	21001	RNDZ/PO	0-22
R/PO QUAL 31069	RNDZ/PO	2-44	RNDZ MAN PH 21069	RNDZ/PO	0-23
R/PO QUAL 41069	RNDZ/PO	4-*1	RNDZ MAN PH 22001	RNDZ/PO	0-27A
RACK INSTAL SKL 21105	ISS CORE	4.40	RNDZ MAN PH 22069 RNDZ MAN PH 31069	RNDZ/PO RNDZ/PO	0-27B 3-42
RANGE SAFETY 21001	N ASTRO	4-18 111	RNDZ MAN PH 91069	RNDZ/PO	3-42 1-52
RCS MAL 21001	N ASTRO	156A	RNDZ OPS 21012	RNDZ/PO	0-31
RCS MAL 21001	N ASTRO	156A 156B	RNDZ OV 21001	N ASTRO	108
RCS MAL BR 21001	N ASTRO	1555	RNDZ PRF ADV 41001	RNDZ/PO	0-*1
			RNDZ PRF ADV 41001		_
RCS OPS 21001	N ASTRO	41A		RNDZ/PO	0-*1
RCS OPS 21006	N ASTRO	41B	RNDZ REVIEW 31001	ISS CORE	4-9
RCS OPS BR 21001	N ASTRO	35	RNDZ QUAL 21006	RNDZ/PO	0-32
RCS OV 21001	N ASTRO	29	RNDZ QUAL 31006	RNDZ/PO	2-45
REACH & VIS 21020	N ASTRO	141	RNDZ QUAL 41006	RNDZ/PO	4-*1
REF DATA USE 21001	N ASTRO	74	RNDZ T/L 91012	RNDZ/PO	2-48
RETR MAL T/L 91012	ORB FO	0-33	RNDZ TRNG OV BR 21001	RNDZ/PO	0-1
RETR NOM T/L 91001	ORB FO	0-30A	RNDZ/DOCK 9XYYY	KNDZ/FO	0-1
RETR NOM T/L 91012	ORB FO	0-30B	(2XYYY)	INT SIM	*1
RETR PRF 41069	PDRS	0-*1	RNDZ/PO T/L 91012	RNDZ/PO	2-49
RETR RVW 41012	PDRS	0-*1	RNDZ/PROX 9XYYY		
RETR RVW 41025	PDRS	0-*1	(2XYYY)	INT SIM	*1
RETR SJ T/L 91012	ORB FO	0-36	<b>ROBOTICS APT 21025</b>	PDRS	0-1
RMS/PL CONT 91012	ORB FO	0-37	ROBOTICS DPLY 9XYYY	,	
RNDZ BRIEF 21001	RNDZ/PO	0-12	(2XYYY)	INT SIM	*1
RNDZ CONCEPTS 21057	RNDZ/PO	0-11	ROBOTICS DPLY L 9XYY (2XYYY)	/Y INT SIM	*1
RNDZ CRM BR 21001	RNDZ/PO	0-30	ROBOTICS LSN LRND		
RNDZ CRM BR 31001	RNDZ/PO	4-34	21001	STS MSS	<i>4</i> -52
RNDZ CT HB 21007	RNDZ/PO	0-2	ROBOTICS OPS 9XYYY		
RNDZ FAM 21001	RNDZ/PO	0-13A	(2XYYY)	INT SIM	*1
RNDZ FAM 21006	RNDZ/PO	0-13B	RWS S/W OPS 21110	STS MSS	0-5
RNDZ FAM PRF 41001	RNDZ/PO	0-*1	RWS SS 21102	STS MSS	0-2
RNDZ FAM PRF 41006	RNDZ/PO	0-*1	S&C QUAL 31006	REFR	4-2
RNDZ FS-TRAD BR			SAFER INTRO 21016	EVA GEN	0-25
31001	RNDZ/PO	3-35	SAFER OPS 21002	EVA GEN	0-4
RNDZ MAL 21001	RNDZ/PO	0-28A	SAFER PRF 41016	EVA SYS	0-*1
RNDZ MAL 21006	RNDZ/PO	0-28B	SAFER RES OPS 91016	EVA SYS	4-1
RNDZ MAL 31001	RNDZ/PO	3-39A	SAFER RES OPS 92016	EVA SYS	3-6
RNDZ MAL 31012	RNDZ/PO	3-39B	SCOM OV 21001	N ASTRO	3
			SCUBA QUAL 21027	EVA GEN	0-9

<u>Lesson Code</u>	Course	Stage – <u>Ref. No.</u>	<u>Lesson Code</u>	Course	Stage – Ref. No.
SEE OPS 31020	MED OPS	2-17	SPECIAL PHOTO 31001	PHO/TV	3-31
SENS/CNTL 21006	N ASTRO	105	SPN REVIEW 21001	ISS CORE	2- <u>50</u>
SEP/TRANS 21001	RNDZ/PO	0-9A	SPOC 21001	N ASTRO	152
SEP/TRANS 21069	RNDZ/PO	0-9B	SPOC 31001	ORB FO	4-1
SEP/TRANS 22069	RNDZ/PO	0-10	SRB OV 21001	N ASTRO	51
SEP/TRANS 31069	RNDZ/PO	3-38	SSATA PREP 31014	EVA SYS	2-16
SFRM ACT 31001	A/E FO	4-1A	SSRMS D&C OV 21025	STS MSS	<u>0-</u> 3
SFRM APPL METH			SSRMS PROF 1 41025	STS MSS	4-54
21001	N ASTRO	93	SSRMS PROF 2 22025	STS MSS	3-55
SFRM OV 21001	N ASTRO	90	SSRMS PROF 3 23025	STS MSS	2-56
SHAB ECS MAL 31029	SHAB	<i>0</i> -4	SSRMS REFR 21025	STS MSS	0-19
SHAB EPS MAL 31029	SHAB	<i>0</i> -3	SSRMS SELF 81025	STS MSS	4-23
SHAB FIRE CC 31001	SHAB	<u>0</u> -7	SSRMS SPEC EVAL		
SHAB LM COM 31187	SHAB	<i>0</i> -6	21025	STS MSS	4-27
SHAB LM MAL 91187	SHAB	<i>0</i> -8	SSRMS SPEC INTRO		
SHAB MANUAL 31002	SHAB	<i>0</i> -*1	21001	STS MSS	4-18
SHAB NOM OPS 31029	SHAB	<u>0</u> -2	SSRMS SPEC PRAC 21065	STS MSS	<i>4</i> -26
SHAB RVW 41029	SHAB	0-*1	SSRMS SPEC TSK1	31310133	4-20
SHAB RVW 41187	SHAB	0-*1	21025	STS MSS	4-22
SHAB SUBSYSTEM			SSRMS SPEC TSK2		
31001	SHAB	<i>0</i> -1	21025	STS MSS	4-24
SHAB TNL RVW 41019	SHAB	0-*1	SSRMS SPEC TSK3		
SHUTTLE MPLM I/F	MOLM	0.4	21025	STS MSS	4-25
31001	MPLM	<i>0</i> -1	SSRMS SUPT TOOLS	OTO MOO	4.47
SHUTTLE OV 21001 SHUTTLE REVIEW	N ASTRO	4	21025	STS MSS	4-17
41006	REFR	0-36	SSSH 21001	N ASTRO	15
SMALL VOL PRESS OPS			STOW REVIEW 91020	CR SYS	1-16
21105	ISS CORE	3-4 <i>1</i>	STS PROG OV 21001	N ASTRO	7
SOMS CMO REFR			STS RSP TO JNT EMER 31208	ISS CORE	3-43
41001	MED OPS	0-20	STS SSCS 31170	EVA SYS	0-23
SPDM MAINT1 41025	STS MSS	<i>0-63</i>	STS TOX OPS	2171010	0 20
SPDM MAINT2 42025	STS MSS	0-64	31001	MED OPS	3- <mark>8</mark>
SPDM MAINT3 43025	STS MSS	<i>0-65</i>	SUBMAX CYCLE		
SPDM MAINT4 44025	STS MSS	0-66	TEST 31001	MED OPS	2-18
SPDM MAINT5 45025	STS MSS	0-67	SVT FAM 31185	SHAB	<u>0</u> -5
SPDM MRO PART 1	CTC MCC	0.00	SWITCH RM BR 21001	N ASTRO	100
21512 CDDM MBO BART 2	STS MSS	0-60	SYS ABT 21001	N ASTRO	200A
SPDM MRO PART 2 21512	STS MSS	0-62	SYS ABT 21011	N ASTRO	200B
SPDM PROF1 21025	STS MSS	0-61	SYS PGSC 31195	ORB FO	4-16
SPDM TOOLS/ORU	3.0.00	001	SYSTEM REVIEW	100.005	0.40
21217	STS MSS	0-59	41078	ISS CORE	3-48
					'

Lesson Code	Course	Stage – Ref. No.	Lesson Code	Course	Stage – Ref. No.
SYSTEMS 9XYYY	<u> </u>	110111101		<u> </u>	110111101
(2XYYY)	INT SIM	*1	TRANS OV TLCN 31040	TRANSFER	1-7
TAEM GUID 21001	N ASTRO	77A	TRANS PLAN 1 31001	TRANSFER	Į.
TAEM GUID 21011	N ASTRO	77B	TRANS PLAN 2 31001	TRANSFER	
TAEM GUID 31001	A/E FO	4-4A	TRANS PLAN 3 31001	TRANSFER	
TAEM GUID 31011	A/E FO	4-4B	TRANS PLAN 4 31001	TRANSFER	I
TAEM GUID BR 21001	N ASTRO	72	UNDOCK MAL T/L 91001	RNDZ/PO	2-50A
TEPC 31001	MED OPS	3- <mark>9</mark>	UNDOCK MAL T/L 91012		2-50B
TI DELAY 31001	RNDZ/PO	3-43A	UNIV PTG 21001	N ASTRO	66
TI DELAY 31006	RNDZ/PO	3-43B	UNLD MAL T/L 91001	ORB FO	0-27A
TIER TEST 21001	N ASTRO	12	UNLD MAL T/L 91012	ORB FO	0-27B
TIER TEST 22001	N ASTRO	60	UL PRF 41069	PDRS	0-*1
TIER TEST 23001	N ASTRO	98	UL RVW 41012	PDRS	0-*1
TIER TEST 24001	N ASTRO	157	UL RVW 41025	PDRS	0-*1
TIER TEST 25001	N ASTRO	198	WATER SURV 21001	N ASTRO	140
TOOL/REPAIR KITS			WATER SURV 21027	N ASTRO	146
21208	ISS CORE	4-14	WATER SURV 41001	CR SYS	<b>3</b> -*1
TOXICOLOGY 91001	MED OPS	3- <mark>7</mark>	WATER SURV 41027	CR SYS	<b>3</b> -*1
TPS OBSS MISSION 91016	STS MSS	2-46	WATER OPS 91001	CR SYS	4-3A
TPS OBSS H/O 91069	STS MSS	2- <del>4</del> 0 3-44	WATER OPS 91020	CR SYS	4-3B
TPS OBSS 0PS1 91025	STS MSS	3-44 3-42	WCS PROC 21065	N ASTRO	62
TPS OBSS OPS1 91025	STS MSS	3-42 3-43	WCS PROC 31065	CR SYS	4-1
TPS OBSS OPS2 91025	STS MSS	3-43 2-45	WCS REFR 91065	CR SYS	2-14
TRAD OV 21195	RNDZ/PO	0-6	WLES FAM BRF 31001	ORB FO	3-7
TRAD 6V 21193 TRANS FAM 31001	TRANSFER	0-0 2-1	WLES OPS I 91001	ORB FO	3-8
TRANS HANDS-ON	TRANSFER	2-1	WLES OPS II 91020	ORB FO	2-23
RVW 31105	TRANSFER	2-5	WLES RVW 91001	ORB FO	2-38
		-	WVS EQ 31001	PHO/TV	3-22
			WVS OPS 31019	PHO/TV	3-23

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