

Entry Checklist

STS-131 Flight Supplement

**Mission Operations Directorate
Flight Design and Dynamics Division**

**Final
January 12, 2010**

National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center
Houston, Texas



Incorporates the following:
482#: NONE – Establishes baseline

AREAS OF TECHNICAL RESPONSIBILITY

Book Manager	DM43/G. Jordan-Moore	281-483-1261
Deorbit Burn to Entry Interface	DM43/G. Pogue	281-483-8067
Contingency Procedures and Entry Interface thru Rollout	DM43/G. Pogue	281-483-8067

NOTE

This Flight Supplement must be integrated into the generic Entry Checklist to have a complete document for flight. Insert the Flight Supplement (FS) pages in the proper numerical order in the generic Entry Checklist by using the List of Effective Pages (LOEP) which provides the sequence for merging pages to create a complete Entry Checklist.

ENTRY CHECKLIST
STS-131 FLIGHT SUPPLEMENT

LIST OF EFFECTIVE PAGES

FINAL 01/12/10

Sign Off	* generic	3-9	generic
ii	* generic	3-10	generic
Sign Off	* 131/FIN	3-11	generic
FS iv	* 131/FIN	3-12	generic
v	* generic	3-13	generic
vi	* generic	3-14	generic
vii	* generic	FS 3-15	131/FIN
viii	* generic	FS 3-16	131/FIN
ix	* generic	FS 3-17	131/FIN
x	* generic	FS 3-18	131/FIN
FS xi	* 131/FIN	3-19	generic
FS xii	* 131/FIN	3-20	generic
FS xiii	* 131/FIN	3-21	generic
FS xiv	* 131/FIN	3-22	generic
xv	generic	3-23	generic
xvi	generic	3-24	generic
1-1 (3 pgs)	† generic	3-25	generic
1-2 (3 pgs)	† generic	3-26	generic
2-1	generic	3-27	generic
2-2 (6 pgs)	† generic	3-28	generic
2-3 (6 pgs)	† generic	FS 3-29	131/FIN
2-4	generic	FS 3-30	131/FIN
FS 2-5	131/FIN	3-31	generic
FS 2-6	131/FIN	3-32	generic
FS 3-1	131/FIN	FS 3-33	131/FIN
FS 3-2	131/FIN	FS 3-34	131/FIN
FS 3-3	131/FIN	3-35	generic
FS 3-4	131/FIN	3-36	generic
3-5	generic	3-37	generic
3-6	generic	3-38	generic
FS 3-7	131/FIN	3-39	generic
FS 3-8	131/FIN	3-40	generic

* – Omit from flight book
† – Extra pages in crew copy only

3-41.....	generic	5-23.....	generic
3-42.....	generic	5-24.....	generic
3-43.....	generic	6-1.....	generic
3-44.....	generic	6-2.....	generic
4-1.....	generic	6-3.....	generic
4-2.....	generic	6-4.....	generic
4-3.....	generic	7-1.....*	generic
4-4.....	generic	7-2.....*	generic
FS 4-5.....	131/FIN	FS 8-1.....*	131/FIN
FS 4-6.....	131/FIN	FS CC 8-2.....*	131/FIN
FS 4-7.....	131/FIN	FS CC 8-3.....*	131/FIN
FS 4-8.....	131/FIN	FS CC 8-4.....*	131/FIN
FS 4-9.....	131/FIN	CC 8-5.....*	generic
FS 4-10.....	131/FIN	CC 8-6.....*	generic
4-11.....	generic	CC 8-7.....*	generic
4-12.....	generic	CC 8-8.....*	generic
5-1.....	generic	CC 8-9.....*	generic
5-2.....	generic	CC 8-10.....*	generic
5-3.....	generic	CC 8-11.....*	generic
5-4.....	generic	CC 8-12.....*	generic
5-5.....	generic	CC 8-13.....*	generic
5-6.....	generic	CC 8-14.....*	generic
5-7.....	generic	CC 8-15.....*	generic
5-8.....	generic	CC 8-16.....*	generic
5-9.....	generic	FS CC 8-17.....*	131/FIN
5-10.....	generic	FS CC 8-18.....*	131/FIN
5-11.....	generic	CC 8-19.....*	generic
5-12.....	generic	8-20.....*	generic
5-13.....	generic	CC 8-21.....*	generic
5-14.....	generic	CC 8-22.....*	generic
5-15.....	generic	FS CC 8-23.....*	131/FIN
5-16.....	generic	FS CC 8-24.....*	131/FIN
5-17.....	generic		
5-18.....	generic		
FS 5-19.....	131/FIN		
FS 5-20.....	131/FIN		
5-21.....	generic		
5-22.....	generic		

* – Omit from flight book

ENTRY CUE CARDS

<u>Title</u>	<u>Ref. Page</u>	<u>Card No.</u>
DEORBIT BURN FLIGHT		
RULES (Front).....	FS CC 8-2	ENT-1a/131/D/A
(Back).....	FS CC 8-3	ENT-1b/131/D/A
DEORBIT BURN (RCS)		
(Front)	FS CC 8-4	ENT-3a/D/L
(Back).....	CC 8-6	generic
DEORBIT BURN (2 ENG)		
(Front)	CC 8-8	generic
DEORBIT BURN (1 ENG)		
(Back).....	CC 8-10	generic
UNBALANCED PRPLT		
DEORBIT BURN		
(Front)	CC 8-12	generic
DEORBIT BURN (MIXED		
XFEED) (Back).....	CC 8-14	generic
ENTRY MANEUVERS		
(Front)	CC 8-16	generic
(Back).....	FS CC 8-17	ENT-6b/131/E/A
ENTRY NO-GO CHECKLIST		
(Front)	FS CC 8-18	ENT-7a/E/K
EMERGENCY EGRESS		
(Back).....	CC 8-19	generic
ENTRY CONTROL		
(Front)	CC 8-21	generic
(Back).....	CC 8-22	generic
DEORBIT BURN MONITOR		
(Front)	FS CC 8-23	ENT-2a/131/A,O,D,E/A
OMS FAILURES (Back)	FS CC 8-24	ENT-2b/131/A,O,D,E/A



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OMS/
RCS ΔV

OMS/RCS ΔV

FS 2-5

ENT/131/FIN



OMS He PRESS/ Δ V/BURN TIME

OMS/
RCS Δ V

OMS% GAGE	OMS He Press *	OMS Δ V	RCS Δ V	RCS BURN MIN:SEC
50	3210	255	211	7:20
40	2810	199	165	5:44
38	2730	188	156	5:24
36	2650	177	147	5:05
34	2570	166	138	4:46
32	2490	154	128	4:27
30	2410	143	119	4:08
28	2330	132	110	3:48
26	2250	121	101	3:29
24	2170	109	91	3:10
22	2090	98	82	2:51
20	2010	87	73	2:32
18	1930	76	64	2:12
16	1850	64	54	1:53
14	1770	53	45	1:33
12	1690	42	35	1:13
10	1610	30	25	0:54
8	1530	19	16	0:34
6	1450	8	6	0:14
5	1410	2	2	0:04

* He pressure not valid until 1 hr after last burn

ΔV CAPABILITY	
ARCS Δ V fps =	$\boxed{0.8} \times [L\% + R\% - \text{AFT QTY } 1]$
FRCS Δ V fps =	$\boxed{0.9} \times \text{FRCS } \%$
OMS Δ V fps =	$\boxed{5.6} \times \text{OMS } \%$

NOTE: Uses assumed vehicle weight of 236,616 lb



DEORBIT BURN

DEORBIT
BURN



FS 3-1

ENT/131/FIN

**STS-131 LANDING SITE TABLE
(50° to 63.5° INCLINATION)**

**DEORBIT
BURN**

S I T E	LOCATION	RWY	TACANS		MLS CH	LG	+ OVR RUN
				ITEM 5			
1	KSC	KSC 15 KSC 33	TTS 59Y	COF 97	8 6	15000 15000	1000 1000
2	BEN GUERIR	BEN 36 BEN 18	MAK 80 ■	CBA 116 ■	- -	13720 13220	0 1000
3	MORON AB	MRN 20 MRN 02	MRN 100	AOG 23	◆6 -	11730 11730	1000 1000
4	ZARAGOZA	ZZA 30L ZZA 12R	ZZA 64	ZAR 77 ■	◆6 -	12200 12200	1000 1010
5	MYRTLE BEACH	MYR 36 MYR 18	ILM 117	FLO 99	- -	9500 9500	1000 1000
6	WILMINGTON	ILM 06 ILM 24	ILM 117	DIW 107 ■	- -	7500 7500	0 0
7	CHERRY POINT	NKT 32L NKT 23R	EWN 83 ■	NCA 101	- -	7110 7100	800 880
8	OCEANA NAS	NTU 32R NTU 23L	NGU 86Y	ORF 116	- -	7500 11500	0 0
9	WALLOPS	WAL 28 WAL 04	SBY 49	SWL 71	- -	7510 8750	0 0
10	DOVER AFB	DOV 32 DOV 19	SIE 95	CYN 81	- -	12400 9100	0 0
11	ATLANTIC CITY	ACY 31 ACY 13	CYN 81	SIE 95	- -	9500 9500	0 0
12	BEN GUERIR	BEN 36 BEN 18	MAK 80 ■	CBA 116 ■	- -	13720 13220	0 1000
13	*MORON AB	MRN 20 MRN 02	MRN 100	AOG 23	◆6 -	11730 11730	1000 1000
14	*ZARAGOZA	ZZA 30L ZZA 12R	ZZA 64	ZAR 77 ■	◆6 -	12200 12200	1000 1010
15	GABRESKI	FOK 06 FOK 24	HTO 83	GON 45Y■	- -	8500 8500	1000 1000

◆ Available for TAL Only

* LO XRNG TAL Site

■ DME

Length after displaced threshold

**STS-131 LANDING SITE TABLE
(50° to 63.5° INCLINATION)**

S I T E	LOCATION	RWY	TACANS		MLS CH	LG	+ OVR RUN
				ITEM 5			
16	CAPE COD CGAS	FMH 32 FMH 23	PVD 103	ACK 109 ■	- -	9000 7500	0 0
17	PEASE INT'L	PSM 34 PSM 16	ENE 118	BOS 74 ■	- -	10020 10020	0 0
18	HALIFAX INT'L	YHZ 23 YHZ 32	UAW 38	YHZ 98 ■	- -	8800 7700	0 0
19	STEPHENVILLE	YJT 09 YJT 27	YJT 78	YDF 80 ■	- -	9500 9500	0 0
20	ST JOHNS INT'L	YYT 29 YYT 11	UYT 23	YYT 82 ■	- -	8500 8500	0 0
21	GANDER INT'L	YQX 21 YQX 31	YQX 74	IQX 32 ■	- -	9700 8900	0 0
22	GOOSE BAY	YYR 26 YYR 34	UYR 40	YYR 120 ■	- -	10550 9080	0 0
23	LAJES AB	LAJ 15 LAJ 33	TRM 109	LAJ 45	- -	10870 10870	970 990
24	BEJA AB	BEJ 01L BEJ 19R	MOJ 37	BEJ 105	- -	10820 10820	0 900
25	KEFLAVIK INT'L	IKF 20 IKF 29	KEF 57	HL 44 ■	- -	9520 9560	0 0
26	SHANNON	INN 06 INN 24	SHA 80 ■	CRK 93 ■	- -	9540 9540	0 0
27	FAIRFORD	FFA 27 FFA 09	FFA 81	BZN 56	- -	9490 9490	990 970
28	KOLN-BONN	KBO 14L KBO 32R	GIX 18	DOR 23Y ■	- -	12020 12020	0 0
29	ISTRES AB	FMI 33 FMI 15	◆FMI 16	NIM 53	◆6 -	11300 12300	3960 0
30	ESENBOGA	ESN 03R ESN 21L	BAG 78 ■	BUK 90 ■	- -	11800 11800	0 0

◆ Available for TAL Only

■ DME

Length after displaced threshold

**STS-131 LANDING SITE TABLE
(50° to 63.5° INCLINATION)**

S I T E	LOCATION	RWY	TACANS		MLS CH	LG	+ OVR RUN
				ITEM 5			
31	KING KHALED	KKI 15R KKI 33L	RIY 92	KIA 80	- -	13300 13300	0 0
32	DIEGO GARCIA	JDG 31 JDG 13	NKW 57	NKW 57	- -	12000 12000	950 950
33	AMBERLEY TINDAL RAAF	AMB 15 PTN 14	AMB 94 -	- TDL 70	- -	9500 8500	0 0
34	YOKOTA AB	JTY 36 JTY 18	SHT 19	NJA 98	- -	11000 11000	1000 1000
35	ANDERSEN AFB	GUA 06L GUA 24R	UAM 54	UNZ 105	- -	10560 10560	1050 1000
36	WAKE ISLAND	WAK 28 WAK 10	AWK 82	AWK 82	- -	9340 9340	0 0
37	HONOLULU	HNL 08R HNL 26L	HNL 95	NGF 93	- -	11500 11500	0 0
38	ELMENDORF	EDF 24 EDF 06	EDF 81	BGQ 72	- -	9500 9500	0 0
39	HAO ATOLL	HAO 12 HAO 30	HAO 85 ■	HAO 85 ■	- -	10690 10690	0 0
40	EDW TEMP	EDT 22R EDT 04L	EDW 111	LHS 21	8 6	12000 12000	1000 1000
41	ASCENSION	HAW 13 HAW 31	ASI 59	ASI 59	- -	9520 9520	0 0
42	NORTHROP	NOR 17 NOR 23	SNG 121Y	HMN 92	6 6	15000 15000	Lkbd Lkbd
43	NORTHROP	NOR 05 NOR 35	SNG 121Y	HMN 92	- -	15000 15000	Lkbd Lkbd
44	EDWARDS AFB	EDW 15 EDW 18L	EDW 111	LHS 21	- -	16300 15000	Lkbd Lkbd
45	EDWARDS AFB	EDW 22 EDW 04	EDW 111	LHS 21	8/† 6	15020 14020	0 1800

† MSBLS Jr. Ch 8 - Requires Uplink

■ DME
Length after displaced threshold

1: GNC DEORB MNVR COAST	2: GNC 50 HORIZ SIT
3: BFS, GNC 50 HORIZ SIT	

HORIZ SIT CONFIG

ALTM – ITEM 9 + .

	<u>PASS ITEM</u>		<u>BFS ITEM</u>	
PTI	INH	√1		
LAND SITE (DEL PAD)		√41		√41
RWY (DEL PAD)		√3		√3
		√4		√4
TACAN (DEL PAD)		√5		√5
RA	blank	√46		
TAEM TGT				
G&N	OVHD	√6	blank	
HSI	blank		blank	
XEP	NEP	√7	NEP	√7
AIM (DEL PAD)	NOM	√8	NOM	√8
	(or CLSE)		or (CLSE)	
SPDBK	NOM	√39		
TAC	INH	√20	INH	√20
GPS	INH	√43	INH	√43
DRAG H	AUT	√22	AUT	√22
ADTA H	INH	√26	INH	√26
ADTA TO G&C	INH	√29	AUT	√28
DES any failed TACANs		√		√
TAC	DELTA	√35		
AIF_G	INH	√48		

* If BFS engaged: *

* Set BFS HSD ITEMS to PASS config *

G51 SEL ATMOSPHERE:
 incl ≤ 50° ITEM 22 EXEC
 incl > 50° SEL ITEM NR (table)

Hemi	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
N Desc	23	23	23	23	22	24	24	24	22	23	23	23
S Asc	24	24	22	23	23	23	23	23	23	23	22	24
N Asc	22											
S Desc	22											

1: GNC DEORB MNVR COAST | 2: GNC 50 HORIZ SIT

3: GNC 51 OVERRIDE

- √ELEVON AUTO – ITEM 17 (*)
- √SSME REPOS – ITEM 19 (ENA)
- √WRAP MODE – ITEM 45 (ENA)
- If PLB holding > 10K lb:
 - FILTER ALT – ITEM 21 EXEC (*)

3: BFS, GNC 51 OVERRIDE

- √ELEVON AUTO – ITEM 17 (*)
- √SSME REPOS – ITEM 19 (ENA)
- √WRAP MODE – ITEM 45 (ENA)
- If PLB holding > 10K lb:
 - √FILTER ALT – ITEM 21 (*)

- * DES any failed/comm faulted *
- * IMU, RGA, AA, or SURF feedback *

2: GNC DEORB MNVR COAST

3: BFS, GNC DEORB MNVR COAST

- √BFS GMBL sel config same as PASS GMBL sel config



DEORBIT BURN CARDS

**BURN
CARDS**

MS ONLY

FS 3-15

ENT/131/FIN



DEORBIT BURN FLIGHT RULES
ONE-ORBIT LATE AVAILABLE ENT-1a/131/D/A

BURN CARDS

FAILURE	PRE TIG		POST TIG
	Delay (max)		Stop Burn, > Safe HP
	One Orbit	One Day	
APU/HYD			
1 No APU operating .....	... X ...	.....
DPS			
2 RDNT fail, Split.....	.....	...X...	.....X
3 1 GPC.....	... X ...	.....
4 BFS .....	.....	...X...	
5 GPC BITE (Multiple GPCs) .....	.....	...X...	
ECLS			
6 2 Av Bay Fans in Bay 3.....	... X ...	.....
7 2 Av Bay Fans in Bay 1 or 2.....	.....	...X...	
ELEC			
8 H2 Manf or TK leak (not in depleted tk(s) _____).....	... X ...	.....
9 2 MN Buses.....	.....	...X...	.....X
10 CNTL CA1 (No BFS Engage in GPC 3/5).....	.....	...X...	
11 Multi Φ AC BUS (unshorted) .....	... X ...	.....
GNC			
12 1 MLS (if reqd), IMU, or TACAN (C-band not avail).....	... X ...	.....
13 IMU Dilemma.....	.....	...X...	.....X
14 RHC Dilemma .....	... X ...	.....
15 2 IMUs (Not targeting EDW/NOR) .....	.....	...X...	
16 2 ADTAs (Winds>80kts or Dynamic Wx) .....	... X ...	.....
HOOK VELCRO			HOOK VELCRO
17 2 FCS Channels (same surface) (Not targeting NOR/EDW) .....	... X ...	.....
18 2 AAs, RGAs (Not targeting EDW/NOR) .....	... X ...	.....
OMS			
19 Prplt Tank.....	... X ...	.....	.....X ①
20 Ignition (neither eng ignites).....	... X ...	.....	.....X ②
21 Both OMS Eng fail.....	.....	.....	.....X ②
22 Prplt Lk after LAST LOS.....	perigee adjust		
AFT RCS			
23 2 jets, same direction, same pod .....	... X ...	.....
24 Prplt Lk after LAST LOS.....	... X ...	.....
25 1 AFT RCS PROP TK fail .....	... X ...	.....
COMM			
26 MCC GO for DEORBIT not rcvd .....	.....	...X...	

① Stop Burn > OMS PRPLT FAIL HP (Ref: DEL PAD/BURN Card)
 ② Stop Burn > OMS ENG FAIL HP (Ref: DEL PAD/BURN Card)

DEORBIT BURN FLIGHT RULES
ONE-ORBIT LATE NOT AVAILABLE ENT-1b/131/D/A

FAILURE	PRE TIG	POST TIG
	Delay (max)	Stop Burn, > Safe HP
	One Day	
APU/HYD		
1 No APU operating .....	..... X	
DPS		
2 RDNT fail, Split.....	..... X .....	.....X
3 1 GPC.....	..... X	
4 BFS .....	..... X	
5 GPC BITE (Multiple GPCs) .....	..... X	
ECLS		
6 2 Av Bay Fans in Bay 3.....	..... X	
7 2 Av Bay Fans in Bay 1 or 2.....	..... X	
ELEC		
8 H2 Manf or TK leak (not in depleted tk(s) .....	..... X	
9 2 MN Buses.....	..... X .....	.....X
10 CNTL CA1 (No BFS Engage in GPC 3/5).....	..... X	
11 Multi Φ AC BUS (unshorted) .....	..... X	
GNC		
12 1 MLS (if reqd), IMU, or TACAN (C-band not avail) .....	..... X	
13 IMU Dilemma.....	..... X .....	.....X
14 RHC Dilemma .....	..... X	
15 2 IMUs (Not targeting EDW/NOR) .....	..... X	
16 2 ADTAs (Winds>80kts or Dynamic Wx) .....	..... X	
HOOK VELCRO		HOOK VELCRO
17 2 FCS Channels (same surface) (Not targeting NOR/EDW) .....	..... X	
18 2 AAs, RGAs (Not targeting EDW/NOR) .....	..... X	
OMS		
19 Prplt Tank.....	..... X .....	.....X ①
20 Ignition (neither eng ignites).....	..... X	
21 Both OMS Eng fail.....	..... X .....	.....X ②
22 Prplt Lk after LAST LOS.....	perigee adjust	
AFT RCS		
23 2 jets, same direction, same pod .....	..... X	
24 Prplt Lk after LAST LOS.....	..... X	
25 1 AFT RCS PROP TK fail .....	..... X	
COMM		
26 MCC GO for DEORBIT not rcvd .....	..... X	

① Stop Burn > OMS PRPLT FAIL HP (Ref: DEL PAD/BURN Card)
 ② Stop Burn > OMS ENG FAIL HP (Ref: DEL PAD/BURN Card)

DEORBIT BURN MONITOR

OMS TEMP* FU IN P \geq <table border="1" style="display: inline-table; vertical-align: middle;"> <tr><td style="width: 20px;">L</td><td style="width: 20px;">R</td></tr> <tr><td style="text-align: center;">225</td><td style="text-align: center;">220</td></tr> <tr><td style="text-align: center;">205</td><td style="text-align: center;">204</td></tr> </table> or No FU IN P	L	R	225	220	205	204	OMS ENG FAIL OMS PRPLT FAIL
L	R						
225	220						
205	204						
OMS PC* & OMS ↓ (BFS: $\sqrt{\text{accel}}$) ENG VLV 1 or 2 < 70 or OX IN P > 227 OX IN P \leq 227 or No OX IN P	OMS ENG FAIL OMS PRPLT FAIL						
OMS OX/FU TK P ($\sqrt{\text{ENG IN P}}$) OX/FU LOW OX & FU HIGH	He PRESS/VAP ISOL (two) – OP If aff TK P not incr: He PRESS/VAP ISOL (two) – CL At PC < 72 or OMS TEMP: OMS PRPLT FAIL He PRESS/VAP ISOL (two) – CL Cycle He A(B) to maintain TK P 234-284						
OMS GMBL PRI fail SEC fail	L(R) OMS GMBL – SEC If high RCS usage: OMS ENG FAIL						
GPC 1(4) & Burning OMS aff SEC GMBL lost 2 FAs lost	aff GPC PWR – OFF If SEC GMBL avail: aff MDM FF 1(4) – OFF,ON L(R) OMS GMBL – SEC If high RCS usage: OMS ENG FAIL $\sqrt{\text{MAN SHUTDN}}$						
I/O ERROR FA 1(4) 2 FAs lost	L(R) OMS GMBL – SEC ♦ I/O RESET (if recov: BFS I/O RESET) If high RCS usage: OMS ENG FAIL $\sqrt{\text{MAN SHUTDN}}$						
BCE STRG D 1(4)	I/O RESET (if recov: >>) If high RCS usage: L(R) OMS GMBL – SEC						
RM DLMA IMU or ABOVE SAFE HP \Rightarrow <table border="1" style="display: inline-table; vertical-align: middle;"> <tr><td style="width: 20px; height: 15px;"></td><td style="width: 20px; height: 15px;"></td></tr> </table> GPC SET SPLIT or 2 MN BUSES BELOW SAFE HP \Rightarrow			STOP BURN: OMS ENG(s) – OFF >> IMU DLMA: After C/O: $\sqrt{\text{timer}}$ G21 If any IMU ACC > 0.03: aff IMU – desel I'cnct OMS to RCS ($\sqrt{\text{RCS Burn Time}}$) THC +X to TGT HP (EOM) or 3.5 x timer at C/O (AOA) SET SPLIT: Go to "GPC" above				
I/O ERROR PCM	OI PCMMU PWR – 2(1)						

*If XFD, BLDN, or sensor fail, monitor ENG IN P for off-nominal performance

ENT-2a/131/A,O,D,E/A

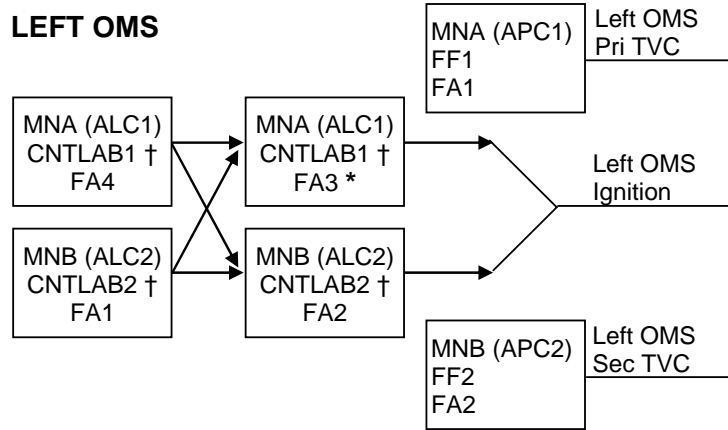
MS ONLY

FS 3-29

ENT/131/FIN

OMS FAILURES

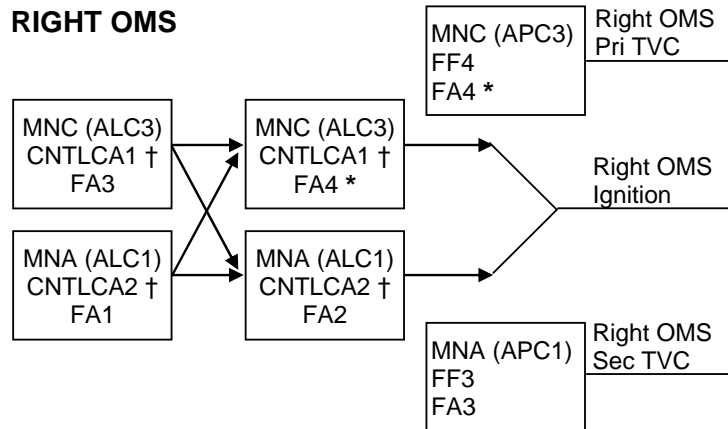
LEFT OMS



† If CNTL AB1 or AB2 (CA1 or CA2) failed and ign path still exists at OMS fail, assume L(R) OMS ↓ is PRPLT FAIL

* If L(R) P_C failed high during burn, or FA3(4) failed, at L(R) OMS fail, no guidance downmode after L(R) OMS ENG switch OFF (TGO slow, ADI needles in error, 6 ft/s underburn)

RIGHT OMS



If two FA MDMs lost		
MDMs	Preburn: ENG – OFF	During burn: MAN SHUTDN
1,2	LEFT (TVC)	BOTH
1,3	RIGHT (IGN)	LEFT
1,4	LEFT (IGN)	RIGHT
2,3	LEFT (IGN)	RIGHT
2,4	RIGHT (IGN)	LEFT
3,4	RIGHT (TVC)	BOTH

ENT-2b/131/A,O,D,E/A

MS ONLY

FS 3-30

ENT/131/FIN

1: GNC DEORB MNVR EXEC	2: GNC DEORB MNVR EXEC
3: BFS, GNC SYS SUMM 2	

- * **UNDERBURN** *
- * Determine Δ HP (CUR HP – TGT HP) *
- * Record prebank on ENTRY MANEUVERS Cue Card *

* **PREBANK TABLE EDW (HA = 190 NM)** *

EDW									
Δ HP	0	4	8	11	REDES.	12	13	(14)	REDES.
PREBANK	0	80	105	120	NOR ELS	130	140	155	YR
NOR					IF NOR NOGO				
G50 ITEM 41 +4 2, \sqrt RWY 17 SET TACAN tw (three) 121Y									
Δ HP		9	10	12	14	16	18	(19)	REDES.
PREBANK		95	100	105	120	135	165	180	YR
YR									
G50 ITEM 41 +2 2, \sqrt RWY 26 SET TACAN tw (three) 040X									
Δ HP					15	17	20	24	(26) 28
PREBANK					65	80	95	125	145 180

131 oct

* **PREBANK TABLE KSC (HA = 190 NM)** *

KSC									
Δ HP	0	2	4	6	8	10	12	(15)	REDES.
PREBANK	0	50	80	95	105	110	125	170	YQX
YQX									
G50 ITEM 41 +2 1, \sqrt RWY 21 SET TACAN tw (three) 074X									
Δ HP							16	22	(25) RED.
PREBANK							95	135	170 INN
INN									
G50 ITEM 41 +2 6, \sqrt RWY 06 SET TACAN tw (three) 080X									
Δ HP									26 28
PREBANK									135 180

1: GNC DEORB MNVR EXEC	2: GNC DEORB MNVR EXEC
3: BFS, GNC SYS SUMM 2	

C CRT1 **GNC, OPS 303 PRO**

1: GNC DEORB MNVR COAST	2: GNC DEORB MNVR COAST
-------------------------	-------------------------

C CRT1 √Uplinked INRTL EI-5 MM303 ATT with DEL PAD

- * If no deorbit TGT uplink, enter INRTL EI-5 *
- * MM303 ATT from DEL PAD *
- * R – ITEM 24 + _____ *
- * P – ITEM 25 + _____ *
- * Y – ITEM 26 + _____ *

Mnvr to EI-5 ATT – ITEM 27 EXEC (*)	TIME to EI (min)	LVLH PITCH (deg)
	20	339
		343
		347
* If UNDERBURN or no *		351
* DEL PAD, manually *		355
* mnvr to LVLH R 001, *	15	359
* Y 358, P per table *		3
		7
		11
		15
	10	19
		23
		27
		31
		35
	5	39

C **OMS GMBL PWRDN (PASS ONLY)**

CRT1 Verify GMBL positions:

	<u>L</u>	<u>R</u>
P	+5.9	+5.9
Y	+6.4	-6.4

GMBL OFF – ITEM 32 EXEC
– ITEM 33 EXEC

FLIGHT CONDITIONS	MANEUVER			
V = 7K	G50 √TACAN and GPS, INCORPORATE * If ELS: UHF MODE – G T/R *			
V = 5K	ADTA PROBES – DEPLOY (√HEAT) Begin AIL and RUD trim monitoring			
M = 3.5	If previous OMS OX TK, He TK, or RCS OX TK leak: G51 VENT DOOR CNTL OPEN – ITEM 43 EXEC			
M = 2.7	√APUs HUD PWR (two) – ON			
* If M < 2.5; P CSS for ADTA to G&C incorp *				
M = 2.0	Ensure ADTA to G&C else √Theta limits			
M < 1.0	√R FLT CNTLR – ON P,R/Y – CSS as reqd √SPDBK CMD vs POS MAX N _z <table border="1" style="display: inline-table; vertical-align: middle;"><tr><td> </td><td>.</td><td> </td></tr></table> √NWS – 1 Lock Inertia Reels		.	
	.			
M = 0.7	√LG EXTD ISO VLV – OP			
h = 15K	√MLS			
h = 10K	√A/L (KSC – Tabs, Visors, Suit O2)			
h = 2K	LDG GEAR ARM pb – push (ARM It on)			
h = 300	LDG GEAR DN pb – push (DN It on)			
MAIN GEAR TD	√SPDBK – 100%			
V = 195 KEAS	DRAG CHUTE ARM, DPY pb (two) – push (simo) (All Its on)			
V = 185 KEAS	DEROTATE			
NOSE GEAR TD	SRB SEP – MAN/AUTO and depress pb √Auto Load Relief √HYD BK ISOL VLV (three) – OP			
V < 120 KGS or 5K' remaining	BRAKE as required (8-10 fps ² , -0.25 to -0.3G)			
* If 5K' remaining and V > 140 KGS – MAX BRAKING *				
V = 60 KGS	DRAG CHUTE JETT pb – push (JETT1,JETT2 It on)			
V = 40 KGS	BRAKE < 6 fps ² (-0.2G) (Antiskid cutout)			
WHEEL STOP	Go to ENT C/L, <u>POST LANDING PROCEDURES</u>			

ENT-6b/131/E/A
(Partial)

MS ONLY

FS 4-5

ENT/131/FIN



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MS ONLY

FS 4-6

ENT/131/FIN



DRAG CHUTE DEPLOY

MCC Call	Flight Condition
Early	Main Gear TD
NOMINAL	195 KEAS
Late	Post-Nose Gear TD Xwind DTO
Emergency Only	No Deploy Except CDR call
NO DEPLOY prior to MGTD > 230 KEAS < 80 KGS Xwind > 15 kts	

FAILED TIRE TECHNIQUE

Post-MGTD	P – AUTO
185 KEAS	Deploy drag chute
180 KEAS	√Auto derotation
NGTD	Max RHC roll away from failed tire

50K	/
38K	/
28K	/
20K	/
12K	/
7K	/
3K	/
1K	/
SURF	/

ENT-6b/131/E/A
(Partial)

ENTRY
MISC

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MS ONLY

FS 4-8

ENT/131/FIN

ENTRY ALPHA

VR	α ref	R	H	Href	Rref
25	HI 40	LO 4445	400		
24	HI 40	LO 2632	247	-46	L78
23	43 40	37 2162	239	-63	68
22	43 40	37 1803	233	-82	62
21	43 40	37 1522	226	-104	59
20	43 40	37 1301	220	-121	R58
19	43 40	37 1121	214	-144	58
18	43 40	37 978	206	-166	61
17	43 40	37 864	199	-185	62
16	43 40	37 766	193	-196	64

KSC 15

MAX L/D	
M	α
3	17
2	15
1	12

(131 OCF CY)

HOOK
VELCRO

ASC-14b/131/A,E/A

HOOK
VELCRO

HOOK
VELCRO

15	43 40	37 688	186	-118	64
14	43 40	37 615	182	-126	62
13	43 40	37 547	178	-136	60
12	43 40	37 485	173	-151	58
11	42 39	36 426	167	-194	L55
10	41 38	35 376	164	-173	46
9	39 36	33 328	158	-205	42
8	37 34	31 279	150	-237	38
7	33 30	27 230	140	-266	36
6	30 27	24 184	129	-271	38
5	26 23	20 142	116	-274	39
4	22 19	18 105	103	-263	R40
3	19 16	15 74	89	-248	36
2.5	15	60	81	-258	
2	13	50	75	-278	
1.5	9	38	65	-330	
1	7	26	48	-268	

HOOK VELCRO

MS ONLY

FS 4-9

ENT/131/FIN



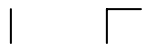
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MS ONLY

FS 4-10

ENT/131/FIN



1:	2:
3:	

POST LANDING PAYLOAD ACTIVITIES

N/A



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CUE CARD
CONFIG

ENTRY CUE CARD CONFIG

FAB USE ONLY

FS 8-1

ENT/131/FIN

DEORBIT BURN FLIGHT RULES
ONE-ORBIT LATE AVAILABLE ENT-1a/131/D/A

FAILURE	PRE TIG		POST TIG
	Delay (max)		Stop Burn, > Safe HP
	One Orbit	One Day	
APU/HYD			
1 No APU operating .....	... X ...	.....
DPS			
2 RDNT fail, Split.....	.....	...X...	.....X
3 1 GPC.....	... X ...	.....
4 BFS .....	.....	...X...	
5 GPC BITE (Multiple GPCs).....	.....	...X...	
ECLS			
6 2 Av Bay Fans in Bay 3.....	... X ...	.....
7 2 Av Bay Fans in Bay 1 or 2.....	.....	...X...	
ELEC			
8 H2 Manf or TK leak (not in depleted tk(s) .....	... X ...	.....
9 2 MN Buses.....	.....	...X...	.....X
10 CNTL CA1 (No BFS Engage in GPC 3/5).....	.....	...X...	
11 Multi Φ AC BUS (unshorted).....	... X ...	.....
GNC			
12 1 MLS (if reqd), IMU, or TACAN (C-band not avail).....	... X ...	.....
13 IMU Dilemma.....	.....	...X...	.....X
14 RHC Dilemma .....	... X ...	.....
15 2 IMUs (Not targeting EDW/NOR) .....	.....	...X...	
16 2 ADTAs (Winds>80kts or Dynamic Wx).....	... X ...	.....
HOOK VELCRO			HOOK VELCRO
17 2 FCS Channels (same surface) (Not targeting NOR/EDW) .....	... X ...	.....
18 2 AAs, RGAs (Not targeting EDW/NOR) .....	... X ...	.....
OMS			
19 Prplt Tank.....	... X ...	.....	.....X ①
20 Ignition (neither eng ignites).....	... X ...	.....
21 Both OMS Eng fail.....	.....	.....	.....X ②
22 Prplt Lk after LAST LOS.....	perigee adjust		
AFT RCS			
23 2 jets, same direction, same pod .....	... X ...	.....
24 Prplt Lk after LAST LOS.....	... X ...	.....
25 1 AFT RCS PROP TK fail .....	... X ...	.....
COMM			
26 MCC GO for DEORBIT not rcvd .....	.....	...X...	

① Stop Burn > OMS PRPLT FAIL HP (Ref: DEL PAD/BURN Card)

② Stop Burn > OMS ENG FAIL HP (Ref: DEL PAD/BURN Card)

(reduced copy)

TOP
BACK OF 'DEORBIT BURN FLIGHT RULES'

DEORBIT BURN FLIGHT RULES
ONE-ORBIT LATE NOT AVAILABLE ENT-1b/131/D/A

FAILURE	PRE TIG	POST TIG
	Delay (max)	Stop Burn, > Safe HP
	One Day	
APU/HYD		
1 No APU operating .....	..... X	
DPS		
2 RDNT fail, Split.....	..... X .....	.....X
3 1 GPC.....	..... X	
4 BFS .....	..... X	
5 GPC BITE (Multiple GPCs).....	..... X	
ECLS		
6 2 Av Bay Fans in Bay 3.....	..... X	
7 2 Av Bay Fans in Bay 1 or 2.....	..... X	
ELEC		
8 H2 Manf or TK leak (not in depleted tk(s) .....).....	..... X	
9 2 MN Buses.....	..... X .....	.....X
10 CNTL CA1 (No BFS Engage in GPC 3/5).....	..... X	
11 Multi Φ AC BUS (unshorted).....	..... X	
GNC		
12 1 MLS (if reqd), IMU, or TACAN (C-band not avail) .....	..... X	
13 IMU Dilemma.....	..... X .....	.....X
14 RHC Dilemma .....	..... X	
15 2 IMUs (Not targeting EDW/NOR) .....	..... X	
16 2 ADTAs (Winds>80kts or Dynamic Wx) .....	..... X	
HOOK VELCRO		HOOK VELCRO
17 2 FCS Channels (same surface) (Not targeting NOR/EDW) .....	..... X	
18 2 AAs, RGAs (Not targeting EDW/NOR) .....	..... X	
OMS		
19 Prplt Tank.....	..... X .....	.....X ①
20 Ignition (neither eng ignites).....	..... X	
21 Both OMS Eng fail.....	..... X .....	.....X ②
22 Prplt Lk after LAST LOS.....	perigee adjust	
AFT RCS		
23 2 jets, same direction, same pod .....	..... X	
24 Prplt Lk after LAST LOS.....	..... X	
25 1 AFT RCS PROP TK fail .....	..... X	
COMM		
26 MCC GO for DEORBIT not rcvd .....	..... X	

① Stop Burn > OMS PRPLT FAIL HP (Ref: DEL PAD/BURN Card)

② Stop Burn > OMS ENG FAIL HP (Ref: DEL PAD/BURN Card)

(reduced copy)

FAB USE ONLY

FS CC 8-3

ENT/131/FIN

TOP

HOOK
VELCRO

DEORBIT
BURN
(RCS)

HOOK
VELCRO

√MM302 √RCS SEL
√RCS BURN CONFIG (L OMS I'CNCT)
L,R OMS He PRESS/VAP ISOL A (two) – OP
..... Wait 2 sec B (two) – OP
√DAP – INRTL/DISC
ADI – LVLH(REF)/MED/MED
FLT CNTLR PWR (two) – ON

TIG THC +X (No Deorbit > TIG + :)
Maintain PITCH ATT ERR ± 3°
Monitor ΔVTOT:
RCS I'CNCT TK SW at ΔVTOT =
R OMS XFEED (two) – OP
L OMS XFEED (two) – CL

OMS PRPLT LOW
AFT RCS RECONFIG AT ΔVTOT =
RCS COMPLETION

*** OMS PRPLT FAIL (MULTIPLE JETS FAIL OFF):**

*	Secure aff OMS	*
*		*
*	STOP BURN:	*
*	SAFE <input type="text"/> <input type="text"/> APU _s – SHUT DN	*
*	HP -----	*
*	CONTINUE BURN:	*
*	ITEM 18 +0 EXEC	*
*	<input type="text"/> Resel jets	*
*	Interconnect good OMS to RCS	*
*	THC +X (√OMS% vs RCS Burn Time)	*
*	AFT RCS RECONFIG	*
*	RCS COMPLETION	*
*	RCS +X JET FAIL OFF:	*
*	STOP BURN:	*
*	SAFE <input type="text"/> <input type="text"/> APU _s – SHUT DN	*
*	HP -----	*
*	CONTINUE BURN:	*
*	ITEM 18 +0 EXEC	*
*	<input type="text"/> Resel jets	*
*		*

ENT-3a/D/L

HINGE

(reduced copy)

FAB USE ONLY

FS CC 8-4

ENT/131/FIN

TOP
BACK OF 'ENTRY MANEUVERS'

	FLIGHT CONDITIONS	MANEUVER	
HOOK VELCRO	V = 7K	[G50] √TACAN and GPS, INCORPORATE * If ELS: UHF MODE – G T/R *	HOOK VELCRO
	V = 5K	ADTA PROBES – DEPLOY (√HEAT) Begin ALL and RUD trim monitoring	
	M = 3.5	If previous OMS OX TK, He TK, or RCS OX TK leak: [G51] VENT DOOR CNTL OPEN – ITEM 43 EXEC	
	M = 2.7	√APUs HUD PWR (two) – ON * If M < 2.5: P CSS for ADTA to G&C incorp *	
	M = 2.0	Ensure ADTA to G&C else √Theta limits	
	M < 1.0	√R FLT CNTLR – ON P,R/Y – CSS as reqd √SPDBK CMD vs POS MAX Nz <input type="text"/> . <input type="text"/> √NWS – 1 Lock Inertia Reels	
	M = 0.7	√LG EXT ISO VLV – OP	
	h = 15K	√MLS	
	h = 10K	√AL (KSC – Tabs, Visors, Suit O2)	
	h = 2K	LDG GEAR ARM pb – push (ARM It on)	
	h = 300	LDG GEAR DN pb – push (DN It on)	
	MAIN GEAR TD	√SPDBK – 100%	
	V = 195 KEAS	DRAG CHUTE ARM, DPY pb (two) – push (simo) (All Its on)	
	V = 185 KEAS	DEROTATE	
	NOSE GEAR TD	SRB SEP – MAN/AUTO and depress pb √Auto Load Relief √HYD BK ISOL VLV (three) – OP	
V < 120 KGS or 5K' remaining	BRAKE as required (8-10 fps ² , -0.25 to -0.3G) * If 5K' remaining and V > 140 KGS – MAX BRAKING *		
V = 60 KGS	DRAG CHUTE JETT pb – push (JETT1, JETT2 It on)		
V = 40 KGS	BRAKE < 6 fps ² (-0.2G) (Antiskid cutout)		
WHEEL STOP	Go to ENT C/L, <u>POST LANDING PROCEDURES</u>		

DRAG CHUTE DEPLOY	
MCC Call	Flight Condition
Early	Main Gear TD
NOMINAL	195 KEAS
Late	Post-Nose Gear TD Xwind DTO
Emergency Only	No Deploy Except CDR call
NO DEPLOY prior to MGTD > 230 KEAS < 80 KGS Xwind > 15 kts	

FAILED TIRE TECHNIQUE	
Post-MGTD	P – AUTO
185 KEAS	Deploy drag chute
180 KEAS	√Auto derotation
NGTD	Max RHC roll away from failed tire

50K	/
38K	/
28K	/
20K	/
12K	/
7K	/
3K	/
1K	/
SURF	/

ENT-6b/131/E/A

(reduced copy)

FAB USE ONLY

FS CC 8-17

ENT/131/FIN

TOP

HOOK
VELCRO

HOOK
VELCRO

ENTRY NO-GO CHECKLIST

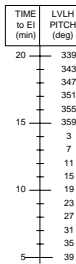
FAILURE OF:	AERO PTI DTO	AUTO FCS MODE	XWIND DTC ①
APU/HYD: 1 APU.....			X
2 APUs.....			X
DISPLAYS: 2 ADIs.....	X		
CDR HUD.....			X ②
CONTROLLERS:			
RHC: 1L.....			X
2L & 2R.....	X		X
RPTA: 2L or 2R.....	X		X
GNC: 2 AAs (LAT).....	X	X ③	X
2 RAs.....	X		X
2 AAs (NORM).....	X (M < 2.5)	X ④	X
2 RAs.....	X		X
2 R DDU PWIR SPLY.....			X
2 IMU (or 1 IMU + BITE).....	X		X
2 ADTAs.....			X
ADTA NOT INCORP OR DLMA.....	X (M < 2)		X
MLS NOT INCORP.....	X (< 6K ft)		X
DPS: 2 FCS CH (same surface).....	X		X ⑤
1 GPC (not restrung).....			X ⑥
2 GPC (restrung).....	X	X ⑦	X ⑧
2 GPC (not restrung).....	X	X ⑨	X ⑩
1 FF.....	X		X
2 FF.....	X	X ⑪	X
RCS: 2 FA.....	X		X
LEAK (AFT - during ENT).....	X		X
2 YAW JETs (same side).....	X		X
MIN RCS QTY.....	X		X
TRIM: All > ± 2.0 deg.....	X		X
DOWNMODE:			
FCS problem.....	X	X	X
ADA.....	X		X
PLB: PLBD Latch Gang.....	X		X
LDC/DECEL:			
Tire Leak.....			X
HYD BRAKE ISOL VLV.....			X
< 100% Brake.....			X
NWS.....			X
ENERGY - OFF NOMINAL:			
Roll Ref Alert.....	X		X
Above Upper Traj Line.....	X		X
MCC GCA, or VEL & PSN update.....	X	X	X
No ALL by 6K ft.....	X		X
DATA: SOLID STATE RECORDERS... X (LOS)			X
XWIND:			
< 10 Knots Peak.....			X
> 15 Knots Peak.....			X
> 10 Knots Gust.....			X
GROUND SYSTEMS:			
No Runway Aim Point.....			X

HOOK
VELCRO

HOOK
VELCRO

HOOK
VELCRO

HOOK
VELCRO



- NOTES**
- ① Consider runway redesignation (M > 6) to avoid Xwind landing
 - ② GO if PAPI and BALL BAR available
 - ③ Pitch AUTO mode NO-GO for M < 2.5
 - ④ GO if only string 4 affected

ENT-7a/E/K

(reduced copy)

FAB USE ONLY

FS CC 8-18

ENT/131/FIN

TOP

HOOK
VELCRO

HOOK
VELCRO

**DEORBIT
BURN
MONITOR**

OMS TEMP*	<table border="1"> <tr> <td></td> <td>L</td> <td>R</td> </tr> <tr> <td>FU IN P ≥</td> <td>225</td> <td>220</td> </tr> <tr> <td>≤</td> <td>205</td> <td>204</td> </tr> </table>		L	R	FU IN P ≥	225	220	≤	205	204	<p>OMS ENG FAIL</p> <p>-----</p> <p>OMS PRPLT FAIL</p>
	L	R									
FU IN P ≥	225	220									
≤	205	204									
or No FU IN P											
OMS PC* & OMS ↓ (BFS: √accel)	<p>ENG VLV 1 or 2 < 70</p> <p>or OX IN P > 227</p> <p>-----</p> <p>OX IN P ≤ 227</p> <p>or No OX IN P</p>	<p>OMS ENG FAIL</p> <p>-----</p> <p>OMS PRPLT FAIL</p>									
OMS OX/FU TK P (√ENG IN P)	OX/FU LOW	<p>He PRESS/VAP ISOL (two) – OP</p> <p>If aff TK P not incr:</p> <p>He PRESS/VAP ISOL (two) – CL</p> <p>At PC < 72 or OMS TEMP:</p> <p>OMS PRPLT FAIL</p> <p>-----</p> <p>OX & FU HIGH</p> <p>He PRESS/VAP ISOL (two) – CL</p> <p>Cycle He A(B) to maintain TK P 234-284</p>									
OMS GMBL	<p>PRI fail</p> <p>SEC fail</p>	<p>L(R) OMS GMBL – SEC</p> <p>-----</p> <p>If high RCS usage: OMS ENG FAIL</p>									
GPC	<p>1(4) &</p> <p>Burning OMS aff</p> <p>-----</p> <p>SEC GMBL lost</p> <p>2 FAs lost</p>	<p>aff GPC PWR – OFF</p> <p>If SEC GMBL avail:</p> <p>aff MDM FF 1(4) – OFF,ON</p> <p>L(R) OMS GMBL – SEC</p> <p>-----</p> <p>If high RCS usage: OMS ENG FAIL</p> <p>√MAN SHUTDN</p>									
I/O ERROR FA	1(4)	<p>L(R) OMS GMBL – SEC</p> <p>-----</p> <p>♦I/O RESET (if recov: BFS I/O RESET)</p> <p>If high RCS usage: OMS ENG FAIL</p> <p>-----</p> <p>2 FAs lost</p> <p>√MAN SHUTDN</p>									
BCE STRG D	1(4)	<p>I/O RESET (if recov: >>)</p> <p>-----</p> <p>If high RCS usage:</p> <p>L(R) OMS GMBL – SEC</p>									
RM DLMA IMU	ABOVE SAFE	<p>STOP BURN: OMS ENG(s) – OFF >></p> <p>-----</p> <p>IMU DLMA:</p> <p>After C/O: √timer G21</p> <p>If any IMU ACC > 0.03: aff IMU – desel</p> <p>I'cnct OMS to RCS (√RCS Burn Time)</p> <p>THC +X to TGT HP (EOM) or</p> <p>3.5 x timer at C/O (AOA)</p> <p>SET SPLIT: Go to "GPC" above</p>									
or	HP ⇒ <input type="checkbox"/> <input type="checkbox"/>										
GPC SET SPLIT											
or	BELOW SAFE										
2 MN BUSES	HP ⇒										
I/O ERROR PCM		OI PCMMU PWR – 2(1)									

*If XFD, BLDN, or sensor fail, monitor ENG IN P for off-nominal performance

ENT-2a/131/A,O,D,E/A

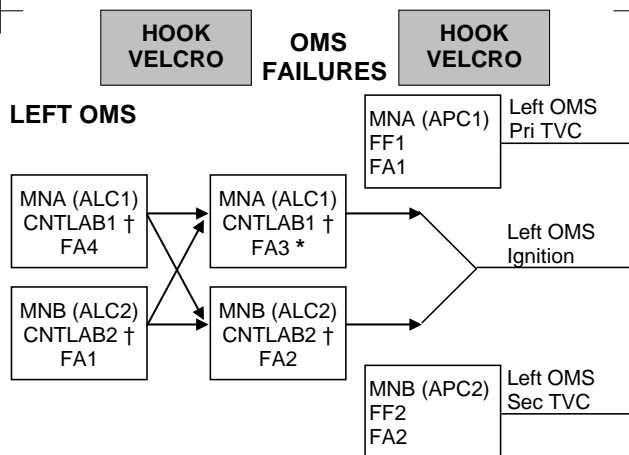
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FAB USE ONLY

FS CC 8-23

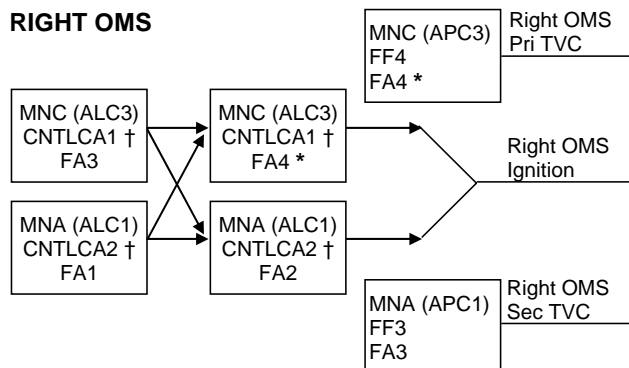
ENT/131/FIN

TOP
BACK OF 'DEORBIT BURN MONITOR'



† If CNTL AB1 or AB2 (CA1 or CA2) failed and ign path still exists at OMS fail, assume L(R) OMS ↓ is PRPLT FAIL

* If L(R) P_c failed high during burn, or FA3(4) failed, at L(R) OMS fail, no guidance downmode after L(R) OMS ENG switch OFF (TGO slow, ADI needles in error, 6 ft/s underburn)



If two FA MDMs lost		
MDMs	Preburn: ENG – OFF	During burn: MAN SHUTDN
1,2	LEFT (TVC)	BOTH
1,3	RIGHT (IGN)	LEFT
1,4	LEFT (IGN)	RIGHT
2,3	LEFT (IGN)	RIGHT
2,4	RIGHT (IGN)	LEFT
3,4	RIGHT (TVC)	BOTH

ENT-2b/131/A,O,D,E/A

(reduced copy)

FAB USE ONLY

FS CC 8-24

ENT/131/FIN

Space Shuttle Program
FLIGHT DATA FILE

JSC-48020-131
FINAL



ENTRY CHECKLIST

STS
131

Flight Cover (trim bottom to expose tabs)