



International Space Station Robotics Group Robotics Book - Flight Specific

ISS-LF1

Mission Operations Directorate
Operations Division

01 JUN 05

**This publication replaces
all previous publications.**
These procedures are available
electronically on the SODF Homepage
at <http://mod.jsc.nasa.gov/do3>

National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center
Houston, Texas

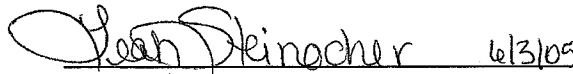


United Space Alliance

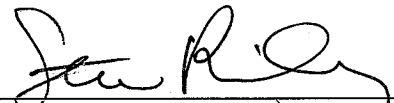
**INTERNATIONAL SPACE STATION
ROBOTICS GROUP
ROBOTICS BOOK - FLIGHT SPECIFIC
ISS-LF1**

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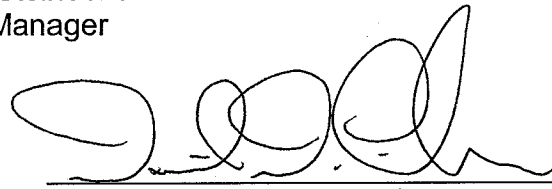
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	Robotics_FSU163	Robotics_FSU167
	Robotics_FSU164	Robotics_FSU168
	Robotics_FSU165	Robotics_FSU169
		Robotics_FSU170
		Robotics_FSU171
		Robotics_FSU172
		Robotics_FSU173

Uplinked Messages (or Approved Flight Notes) replaced by this revision,
remove from Book:

None

**INTERNATIONAL SPACE STATION
ROBOTICS GROUP
ROBOTICS BOOK - FLIGHT SPECIFIC
ISS-LF1**

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RBT FS

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OBSS OPS

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1.110 BERTHED OBSS GRAPPLE

(RBT FS/LF1/FIN 1/SPN) Page 1 of 7 pages

1. HAND CONTROLLER CALIBRATION

1.1 Translational Hand Controller (THC) Calibration

THC

Deflect [X] Axis to positive hard stop where [X] =

Deflect [X] Axis to negative hard stop.

Repeat

1.2 Rotational Hand Controller (RHC) Calibration

RHC

Deflect [X] Axis to positive hard stop where [X] =

Deflect [X] Axis to negative hard stop.

Repeat

2. SETUP

ODS Hatch

√V10 Cables Connected

Verify SRMS is at the PRE-CRADLE Position.

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
92: Camera D (-10, 30)	91: SRMS Elbow (-90, 100)	22: Base Elbow (75, -20)	Camera A (0, 35)
13: LAB Stbd Zenith (10, -35)		24: Tip Elbow (-5, 10)	Camera C (0, 25)

PCS MSS: SSRMS:

Change Loaded Parameters ► OBSS ► OBSS Mid MPM SYH
Verify 'Loaded Parameters' (two) – OBSS Mid MPM, SY Held

Verify Unloaded Parameters – √
Change Unloaded Parameters ► Unloaded ► LEE Tip SYH
Verify 'Unloaded Parameters' (two) – LEE Tip, SY Held

Change Display ► LAB ► Berthed OBSS MidMPM (Verify LAB>Berthed OBSS MidMPM)

Change Command ► SSRMS ► Internal (Verify SSRMS>Internal)

Verify SSRMS at Dock Viewing position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+110.0	+55.0	+5.0	+122.2	-179.6	-190.0	+33.7
X	Y	Z	Pitch	Yaw	Roll	
+125	+467	-847	+58.7	-74.0	+127.9	
FOR	Unloaded – LEE Tip, SY Held					
Disp	LAB>Berthed OBSS MidMPM					

1.110 BERTHED OBSS GRAPPLE
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Figure 1.- Dock Viewing
(92: Camera D: -10, 30).

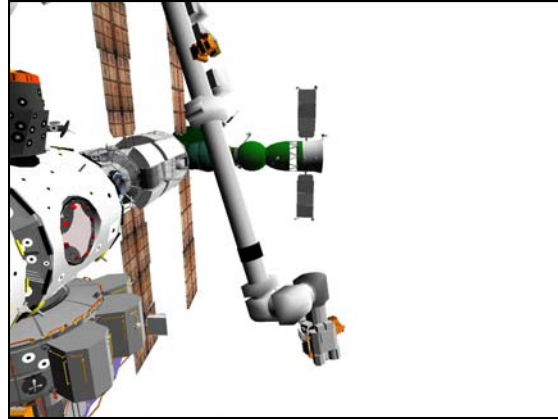


Figure 2.- Dock Viewing
(91: SRMS Elbow: -90, 100).

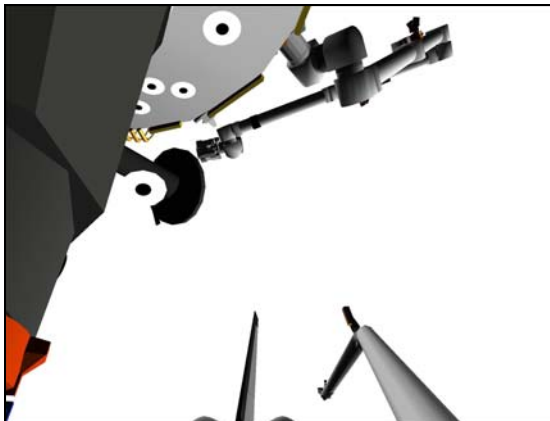


Figure 3.- Dock Viewing
(V10: Camera A: 0, 35).

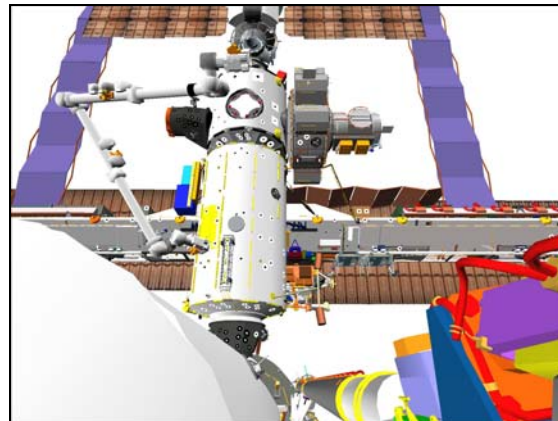


Figure 4.- Dock Viewing
(V10: Camera C: 0, 25).

3. MANEUVER TO PRE-GRAPPLE

PCS MSS: SSRMS: SSRMS Safing:

cmd Remove (Verify Not Safed)

DCP BRAKES SSRMS → OFF (Verify OFF)

RHC RATE → VERNIER (Verify Vernier on PCS)

PCS MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

1.110 BERTHED OBSS GRAPPLE
 (RBT FS/LF1/FIN 1/SPN) Page 3 of 7 pages

SSRMS Joint OCAS

Input 'Joint Angles' 'Destination' for OBSS Pre-Grapple position.

SR	SY	SP	EP	WP	WY	WR
+77.9	+40.4	+31.7	+122.2	-179.6	-141.0	+33.7

NOTE
 The Target and Error fields on the SSRMS Joint OCAS display will not be correct. This data should be verified and monitored on the Joint Angle Position overlay. (SCR 31169)

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON Verify joint angles and errors are correct on Joint Angle Position overlay.

	SR	SY	SP	EP	WP	WY	WR
(current)	+110.0	+55.0	+5.0	+122.2	-179.6	-190.0	+33.7
TGT	+77.9	+40.4	+31.7	+122.2	-179.6	-141.0	+33.7
ERR	+32.1	+14.6	-26.7	0.0	0.0	-49.0	0.0

PCS * If joint angles/errors are incorrect
 * **cmd Cancel** (Verify Sequence Status – Waiting Destination)
 *
 * Input correct Dest joint angles per table above.
 *
 * **cmd Load** (Verify Sequence Status – Confirm or Cancel)
 *
 MON * Verify joint angles and errors are correct on Joint Angle Position
 * overlay.

PCS **cmd Confirm** (Verify Sequence Status – Auto Seq sw - Hot)

DCP AUTO SEQ → PROC



Figure 5.- OBSS Pre-Grapple
 (92: Camera D: -10, 30).

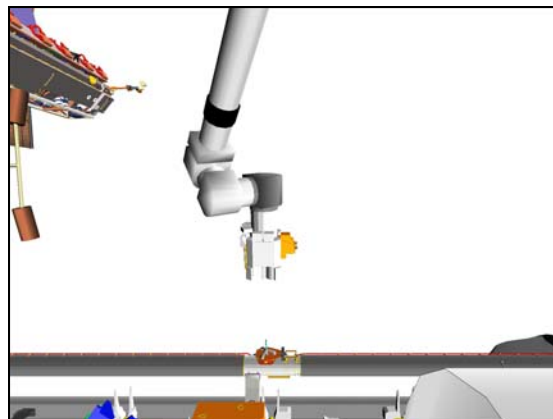


Figure 6.- OBSS Pre-Grapple
 (91: SRMS Elbow: -90, 20).

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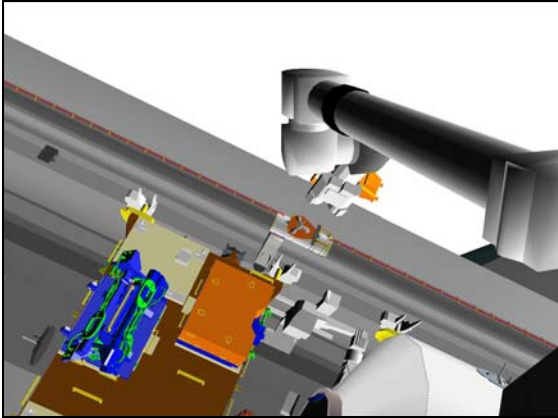


Figure 7.- OBSS Pre-Grapple
 (22: Base Elbow: 75, -20).



Figure 8.- OBSS Pre-Grapple
 (V10: Camera A: 0, 35).

PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at OBSS Pre-Grapple position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+77.9	+40.4	+31.7	+122.2	-179.6	-141.0	+33.7
X	Y	Z	Pitch	Yaw	Roll	
+22	+87	-174	-90.1	-30.0	0.0	
FOR	Unloaded – LEE Tip, SY Held					
Disp	LAB>Berthed OBSS MidMPM					

4. OBSS GRAPPLE SETUP AND CAPTURE

NOTE

MSS Effector Overlay will not appear on the monitor until the “confirm” command is sent to the LEE.

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
92: Camera D (-10, 25) 91: SRMS Elbow (-90, 10)	25: Tip LEE	22: Base Elbow (75, -20)	Camera A (0, 30) Camera C (0, 20)

4.1 Setup

NOTE

Tip LEE Camera must be fully zoomed out to correspond to target overlay.

PCS MSS: SSRMS: Rate:

Set ‘Scale’ ‘Vernier’ Rate Scale: as required

1.110 BERTHED OBSS GRAPPLE

(RBT FS/LF1/FIN 1/SPN) Page 5 of 7 pages

MSS: SSRMS:

√Vernier

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

4.2 Slow Capture Commands

MSS: SSRMS: Tip LEE:

cmd Capture ► Automatic ► Slow, Limp (Verify Speed – Slow)

Verify '**Confirm or Terminate**' prompt.

CAUTION

Due to end-to-end system latency, the RHC Trigger is hot up to 3 seconds prior to receiving a Trigger Hot icon status on the PCS.

NOTE

Once the trigger is hot, only safing or trigger commands should be sent to the Robotics equipment. If a configuration change is required, including routing MSS cameras, safe the system to exit LEE operations (SCR 23262, 14662).

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Auto Capture

4.3 Maneuvering to Within Grapple Envelope

RHC/
THC

Maneuver to within grapple envelope.

4.4 Grapple

RHC

TRIGGER → press (momentarily)

PCS

Verify 'Snare' Close, Capture (two) – blue (12 s max)
Verify Capture to Latch – No (SCR 19282)
Verify 'Carriage' Tension ~5500 N (90 s max)
Verify 'Carriage' Retract – blue

4.5 Grapple Cleanup

Give SRMS Operator GO for Maneuver to OBSS PRE-GRAPPLE position.

Verify Posn Hold – orange

Verify Loaded Parameters – √

1.110 BERTHED OBSS GRAPPLE
 (RBT FS/LF1/FIN 1/SPN) Page 6 of 7 pages

Verify 'Loaded Parameters' (two) – OBSS Mid MPM, SY Held

DCP BRAKES SSRMS → ON (Verify ON)

PCS MSS: SSRMS:

Change Unloaded Parameters ► Unloaded ► LEE Tip SRH
 Verify 'Unloaded Parameters' (two) – LEE Tip, SR Held

Change Command ► LAB ► Berthed OBSS MidMPM (Verify
 LAB>Berthed OBSS MidMPM)

If LOS, record OBSS Grapple joint angles and FOR.

	SR	SY	SP	EP	WP	WY	WR
Expected	+68.4	+40.4	+38.4	+113.4	-188.4	-144.8	+25.9
	X	Y	Z	Pitch	Yaw	Roll	
Expected	0	0	0	0.0	0.0	0.0	
	FOR	Loaded – OBSS Mid MPM, SY Held					
	Disp	LAB>Berthed OBSS MidMPM					

Review {SSRMS LEE CUE CARD}, all (SODF: RBT GEN:
 REFERENCE)

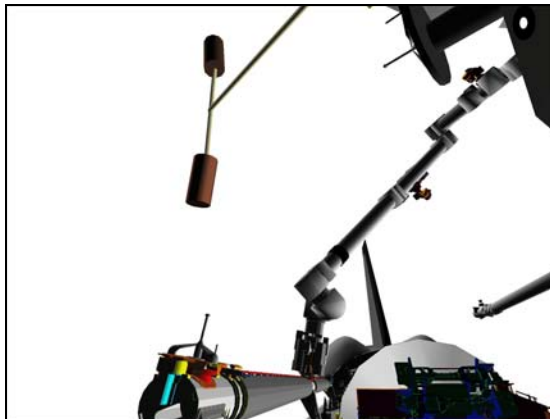


Figure 9.- OBSS Grapple
 (92: Camera D: -10, 25).

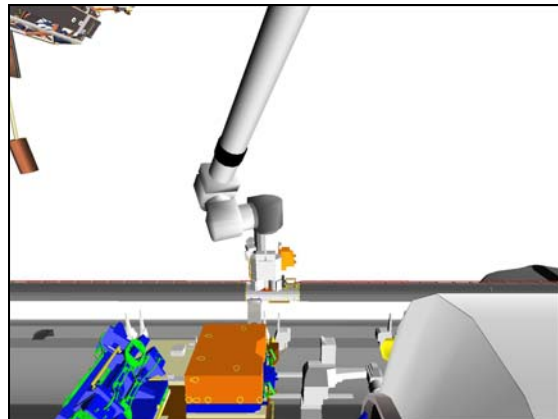


Figure 10.- OBSS Grapple
 (91: SRMS Elbow: -90, 10).

1.110 BERTHED OBSS GRAPPLE
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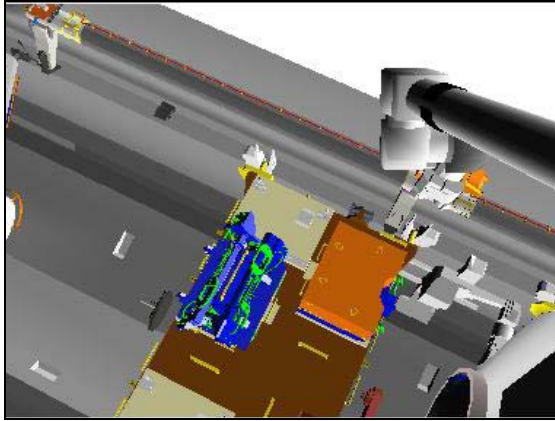


Figure 11.- OBSS Grapple
(22: Base Elbow: 75, -20).

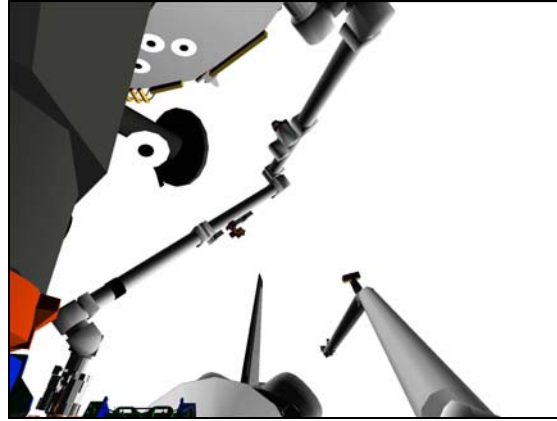


Figure 12.- OBSS Grapple
(V10: Camera A: 0, 30).

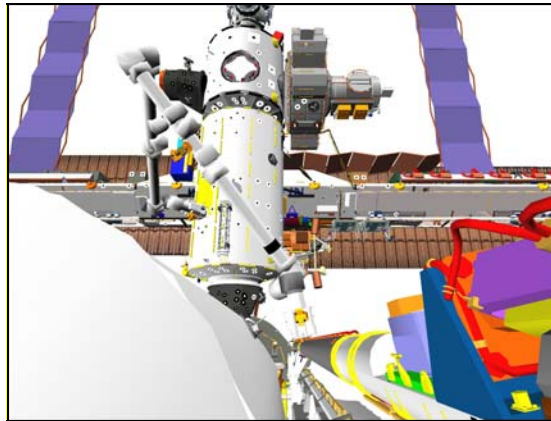


Figure 13.- OBSS Grapple
(V10: Camera C: 0, 20).

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1.111 OBSS UNBERTH

(RBT FS/LF1/FIN 1)

Page 1 of 4 pages

1. SETUP

Verify SRMS is at OBSS PRE-GRAPPLE Posn.

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
92: Camera D (-10, 15) 13: LAB Stbd Zenith (-20, -40)	91: SRMS Elbow (-113, 20)	22: Base Elbow (75, -20)	Camera A (0, 30) Camera C (10, 25)

PCS

MSS: SSRMS:

Verify Loaded Parameters – √

Verify 'Loaded Parameters' (two) – OBSS Mid MPM, SY Held

Verify Display – LAB>Berthed OBSS MidMPM

Verify Command – LAB>Berthed OBSS MidMPM

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: 0.3 (Verify 0.3)

2. ATTITUDE CONTROL CONFIGURATION

MSS: SSRMS: Thrusters:

Verify 'Desat Request:' – Inh

If using shuttle attitude control, coordinate with shuttle crew members:

DAP: FREE

3. MRL RELEASE

Give SRMS Operator GO to Release STBD MRLs.

4. MANEUVERING TO LOW HOVER POSITION

On SRMS Operator GO for OBSS Unberth:

DCP

BRAKES SSRMS → OFF (Verify OFF)

PCS

MSS: SSRMS:

√Vernier

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

1.111 OBSS UNBERTH

(RBT FS/LF1/FIN 1)

NOTE

1. Monitor clearance to UHF Antenna using LAB Stbd Zenith or SRMS Elbow Camera. Clearance at Low Hover is approximately 91 cm.
2. Monitor clearance to MPLM using Camera C.

THC/
RHC

Maneuver OBSS to Low Hover position (within 5 cm/1 deg).

	Locked					
SR	SY	SP	EP	WP	WY	WR
+77.2	+40.4	+38.4	+116.2	-181.2	-141.2	+33.0
X	Y	Z	Pitch	Yaw	Roll	
0	0	-100	0.0	0.0	0.0	
FOR	Loaded – OBSS Mid MPM, SY Held					
Disp	LAB>Berthed OBSS MidMPM					

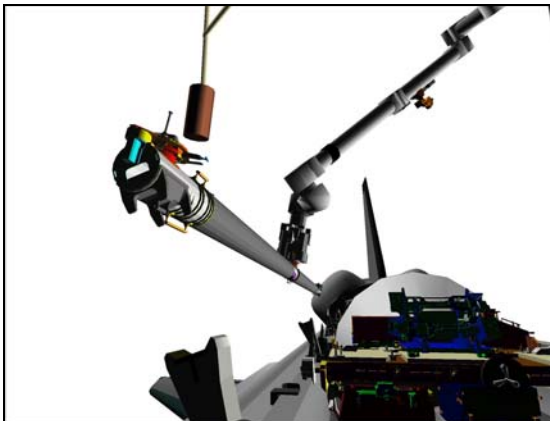


Figure 1.- OBSS Low Hover
(92: Camera D: -10, 15).

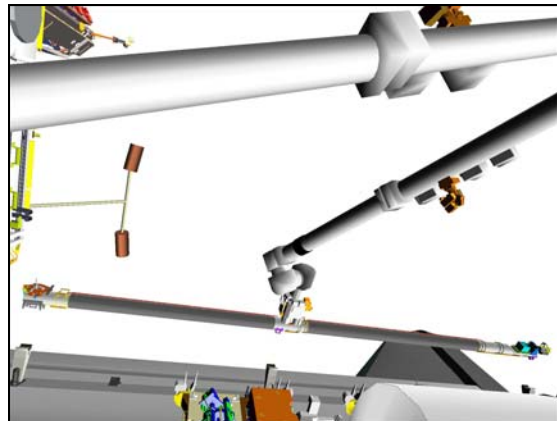


Figure 2.- OBSS Low Hover
(91: SRMS Elbow: -113, 20).

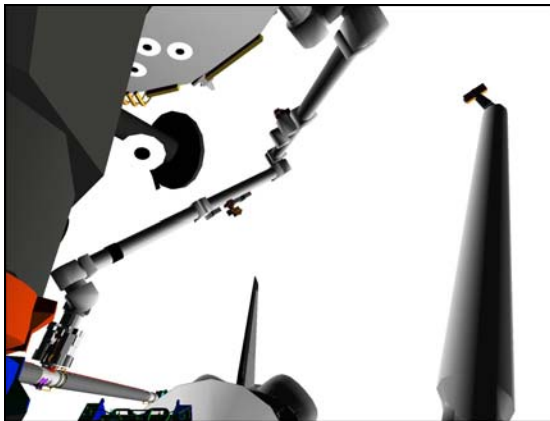


Figure 3.- OBSS Low Hover
(V10: Camera A: 0, 30).

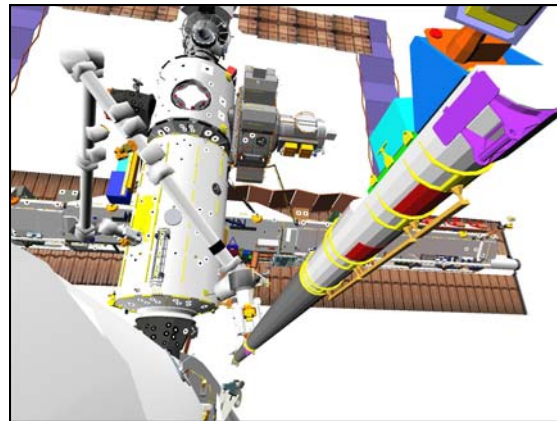


Figure 4.- OBSS Low Hover
(V10: Camera C: 10, 25).

1.111 OBSS UNBERTH

(RBT FS/LF1/FIN 1)

5. ATTITUDE CONTROL CONFIGURATION

If using shuttle attitude control, coordinate with shuttle crew members:

DAP: LVLH

When rates damped:

DAP: FREE > 2 seconds

Then DAP: AUTO

6. MANEUVERING CLEAR OF UHF ANTENNA

PCS

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: 1.0 (Verify 1.0)

MSS: SSRMS:

Enter Mode – FOR OCAS (Verify blue)

MSS: SSRMS: SSRMS FOR OCAS: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

√Vernier

pick File ► LAB ► OBSS Unberth

Verify 'FOR' 'Destination' for Clear UHF Antenna position.

X	Y	Z	Pitch	Yaw	Roll
0	-190	-167	0.0	0.0	0.0

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON

Verify FOR and errors are correct on FOR Position overlay.

	X	Y	Z	Pitch	Yaw	Roll
FOR	0	0	-100	0.0	0.0	0.0
TGT	0	-190	-167	0.0	0.0	0.0
ERR	0	+190	+67	0.0	0.0	0.0

* If FOR/errors are incorrect

PCS

* **cmd** Cancel (Verify Sequence Status – Waiting Destination)

* Input correct Dest FOR per table above.

* **cmd** Load (Verify Sequence Status – Confirm or Cancel)

MON

* Verify FOR and errors are correct on FOR Position overlay.

1.111 OBSS UNBERTH

(RBT FS/LF1/FIN 1)

PCS **cmd** Confirm (Verify Sequence Status – Auto Seq Sw-Hot)

DCP AUTO SEQ → PROC

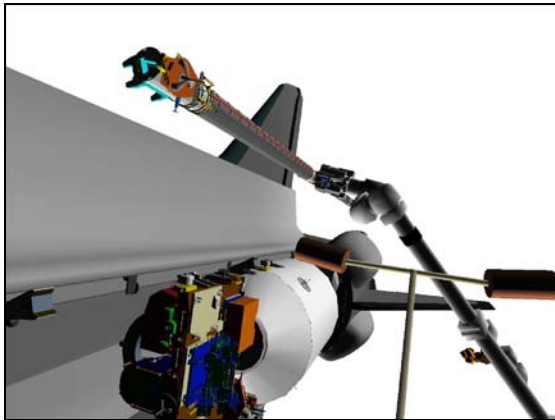


Figure 5.- Clear UHF Antenna
(13: LAB Stbd Zenith: -20, -18).

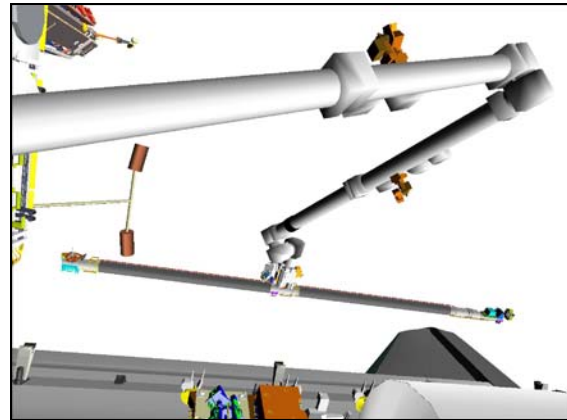


Figure 6.- Clear UHF Antenna
(91: SRMS Elbow: -113, 20).

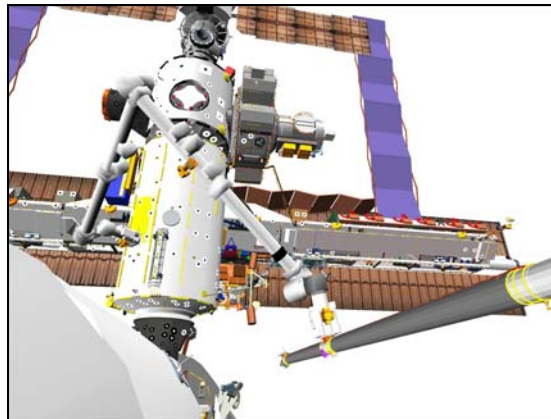


Figure 7.- Clear UHF Antenna
(V10: Camera C: 10, 25).

PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at Clear UHF Antenna position (within 5 cm/1 deg).

	Locked					
SR	SY	SP	EP	WP	WY	WR
+86.2	+40.4	+54.2	+101.7	-171.2	-138.7	+41.4
X	Y	Z	Pitch	Yaw	Roll	
0	-190	-167	0.0	0.0	0.0	
FOR	Loaded – OBSS Mid MPM, SY Held					
Disp	LAB>Berthed OBSS MidMPM					

1.112 OBSS MNVR TO HANDOFF

(RBT FS/LF1/FIN 1)

1. SETUP

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
13: LAB Stbd Zenith (-20, -18)	91: SRMS Elbow (-105, 20)	92: Camera C (10, 25)	Camera A (0, 35)

RHC RATE – as desired

PCS MSS: SSRMS:

Verify Mode – FOR OCAS

Verify SY – Locked

2. MANEUVERING TO AFT POSITION

pick File ► LAB ► OBSS Handoff Mnvr 1

Verify 'FOR' 'Destination' for Aft position.

X	Y	Z	Pitch	Yaw	Roll
+327	-225	-447	0.0	0.0	0.0

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON Verify FOR and errors are correct on FOR Position overlay.

	X	Y	Z	Pitch	Yaw	Roll
FOR	0	-190	-167	0.0	0.0	0.0
TGT	+327	-225	-447	0.0	0.0	0.0
ERR	-327	+35	+280	0.0	0.0	0.0

* If FOR/errors are incorrect

PCS * **cmd** Cancel (Verify Sequence Status – Waiting Destination)

* Input correct Dest FOR per table above.

MON * Verify FOR and errors are correct on FOR Position overlay.

PCS **cmd** Confirm (Verify Sequence Status – Auto Seq Sw - Hot)

DCP AUTO SEQ → PROC

1.112 OBSS MNVR TO HANDOFF

(RBT FS/LF1/FIN 1)

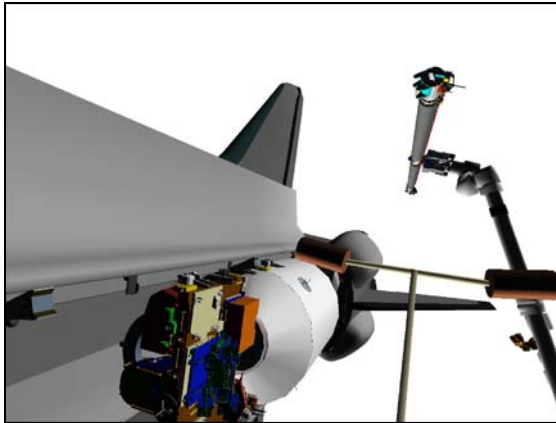


Figure 1.- Aft Position
(13: LAB Stbd Zenith: -20, -18).

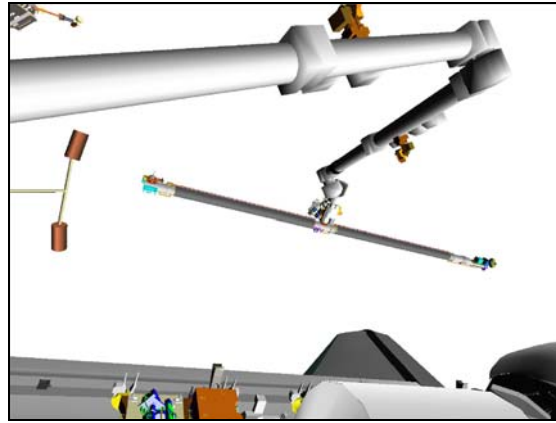


Figure 2.- Aft Position
(91: SRMS Elbow: -105, 20).

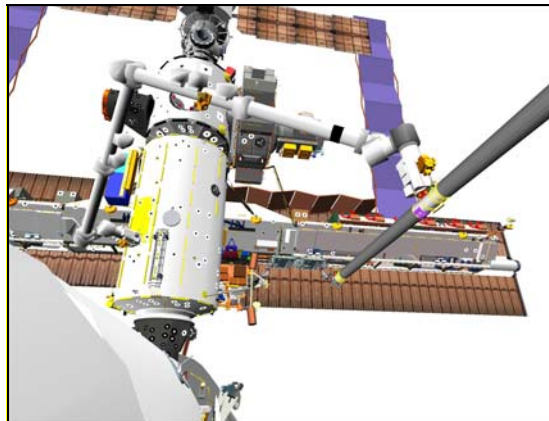


Figure 3.- Aft Position
(92: Camera C: 10, 25).

PCS

MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at Aft position (within 5 cm/1 deg).

	Locked					
SR	SY	SP	EP	WP	WY	WR
+91.6	+40.4	+52.7	+72.6	-133.5	-137.8	+46.7
X	Y	Z	Pitch	Yaw	Roll	
+327	-225	-447	0.0	0.0	0.0	
FOR	Loaded – OBSS Mid MPM, SY Held					
Disp	LAB>Berthed OBSS MidMPM					

1.112 OBSS MNVR TO HANDOFF

(RBT FS/LF1/FIN 1)

3. MANEUVERING TO HANDOFF POSITION

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
13: LAB Stbd Zenith (18, -25) 22: Base Elbow (80, 0) 24: Tip Elbow (-40, 35)	91: SRMS Elbow (-105, 20)	92: Camera C (10, 25) 92: Camera A (0, 35)	Camera B (20, 30)

SSRMS FOR OCAS

pick File ► LAB ► OBSS Handoff Mnvr 2

Verify 'FOR' 'Destination' for OBSS Handoff position.

X	Y	Z	Pitch	Yaw	Roll
+325	+704	-198	+91.1	-70.6	+47.0

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON

Verify FOR and errors are correct on FOR Position overlay.

	X	Y	Z	Pitch	Yaw	Roll
FOR	+327	-225	-447	0.0	0.0	0.0
TGT	+325	+704	-198	+91.1	-70.6	+47.0
ERR	+2	-929	-249	-91.1	+70.6	-47.0

PCS

* If FOR/errors are incorrect
* **cmd** Cancel (Verify Sequence Status – Waiting Destination)

* Input correct Dest FOR per table above.

* **cmd** Load (Verify Sequence Status – Confirm or Cancel)

MON

* Verify FOR and errors are correct on FOR Position overlay.

PCS

cmd Confirm (Verify Sequence Status – Auto Seq Sw-Hot)

DCP

AUTO SEQ → PROC

1.112 OBSS MNVR TO HANDOFF

(RBT FS/LF1/FIN 1)

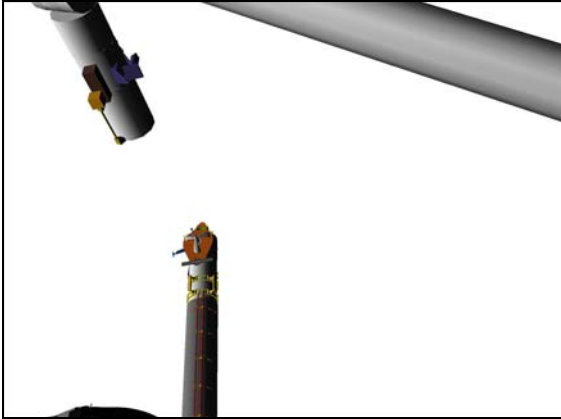


Figure 4.- OBSS Handoff
(24: Tip Elbow: 0, 65).

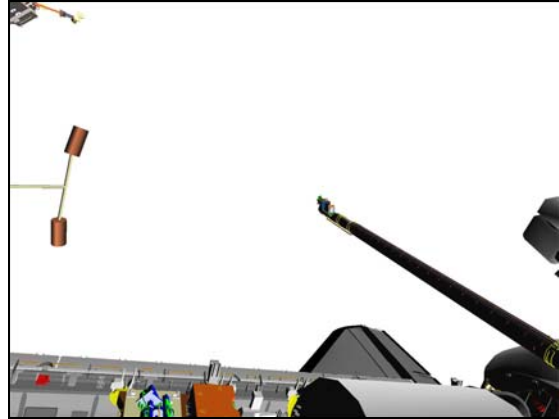


Figure 5.- OBSS Handoff
(91: SRMS Elbow: -105, 20).

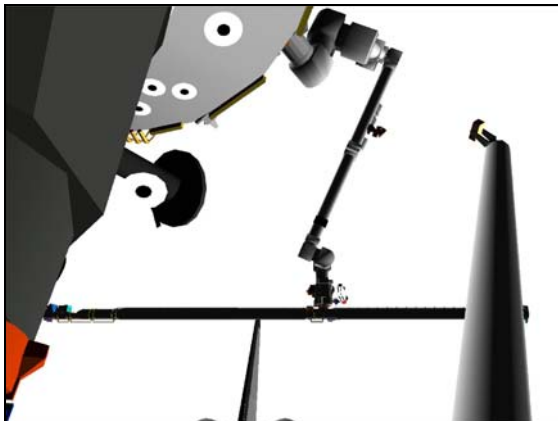


Figure 6.- OBSS Handoff
(92: Camera A: 0, 35).

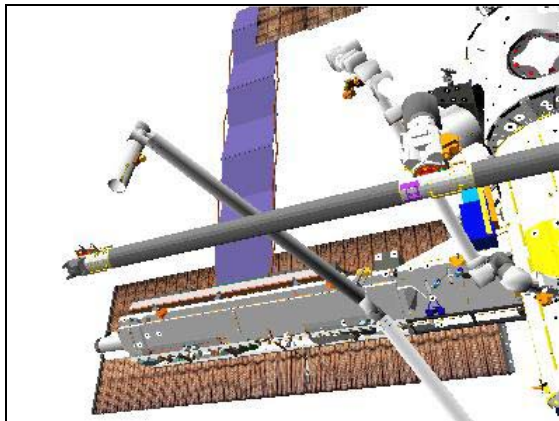


Figure 7.- OBSS Handoff
(V10: Camera B: -25, 30).

PCS

MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at OBSS Handoff position (within 5 cm/1 deg).

	Locked					
SR	SY	SP	EP	WP	WY	WR
+31.7	+40.4	-39.3	+124.5	-167.7	-155.3	-88.7
X	Y	Z	Pitch	Yaw	Roll	
+325	+704	-198	+91.1	-70.6	+47.0	
FOR	Loaded – OBSS Mid MPM, SY Held					
Disp	LAB>Berthed OBSS MidMPM					

DCP

BRAKES SSRMS → ON (Verify ON)

1.112 OBSS MNVR TO HANDOFF

(RBT FS/LF1/FIN 1)

Page 5 of 5 pages

4. ATTITUDE CONTROL CONFIGURATION

PCS

MSS: SSRMS: Thrusters:

Thruster Controls for MSS Ops

Verify 'Desat Request:' – Inh

If using shuttle attitude control, coordinate with shuttle crewmembers:

DAP: FREE

5. SRMS GO FOR GRAPPLE

Give SRMS Operator GO for SRMS OBSS Grapple.

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1.113 OBSS UNGRAPPLE AT HANDOFF
(RBT FS/LF1/FIN 1/SPN) Page 1 of 3 pages

1. SETUP

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
91: SRMS Elbow (-140, 100)	25: Tip LEE	92: Camera A (0, 30)	Camera B (-25, 30)

PCS

MSS: SSRMS:

Verify 'Unloaded Parameters' (two) – LEE Tip, SR Held

Verify Display – LAB>Berthed OBSS MidMPM

Change Command ► SSRMS ► Internal (Verify SSRMS>Internal)

√Vernier

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: as required

2. OBSS UNGRAPPLE

On SRMS Operator GO for OBSS Ungrapple:

DCP

BRAKES SSRMS → OFF (Verify OFF)

PCS

2.1 SSRMS LIMP

MSS: SSRMS: Limp:

cmd All Limp (Verify Limp – blue)

MSS: SSRMS:

Verify all joints – Limped

2.2 AUTO RELEASE

MSS: SSRMS: Tip LEE:

cmd Release ► Automatic ► Slow (Verify Speed – Slow)

Verify '**Confirm or Terminate**' prompt.

CAUTION

Due to end-to-end system latency, the RHC Trigger is hot up to 3 seconds prior to receiving a Trigger Hot icon status on the PCS.

1.113 OBSS UNGRAPPLE AT HANDOFF

(RBT FS/LF1/FIN 1/SPN) Page 2 of 3 pages

NOTE

Once the trigger is hot, only safing or trigger commands should be sent to the Robotics equipment. If a configuration change is required, including routing MSS Cameras, safe the system to exit LEE operations. (SCR 23262, 14662)

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Auto Release

RHC TRIGGER → press (momentarily)

PCS
 Verify 'Carriage' Derigidize – blue (90 s max)
 Verify 'Snare' Open – blue (12 s max)
 Verify 'Carriage' Extend – blue (90 s max)

2.3 SSRMS BACKOFF

MSS: SSRMS: Limp: SSRMS Limp

cmd None Limp (Verify Standby – blue)

MSS: SSRMS: SSRMS

Verify Unloaded Parameters – √

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock: Joint Lock

cmd Shoulder Roll (Verify SR – Locked)

THC/
RHC
 Maneuver to Grapple Fixture Backoff position (-X THC Command)
 (within 5 cm/1 deg).

Locked						
SR	SY	SP	EP	WP	WY	WR
+31.7	+46.6	-55.3	+127.9	-152.4	-156.2	-82.0
X	Y	Z	Pitch	Yaw	Roll	
+259	+754	-407	-75.1	-18.8	-85.4	
FOR	Unloaded – LEE Tip, SR Held					
Disp	LAB>Berthed OBSS MidMPM					

DCP BRAKES SSRMS → ON (Verify ON)

1.113 OBSS UNGRAPPLE AT HANDOFF
(RBT FS/LF1/FIN 1/SPN) Page 3 of 3 pages

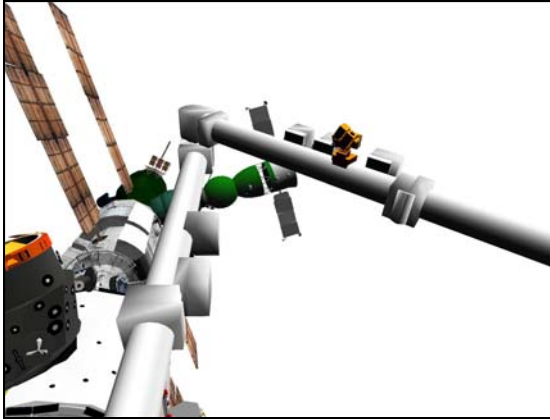


Figure 1.- OBSS Ungrapple
(91: SRMS Elbow: -140, 100).

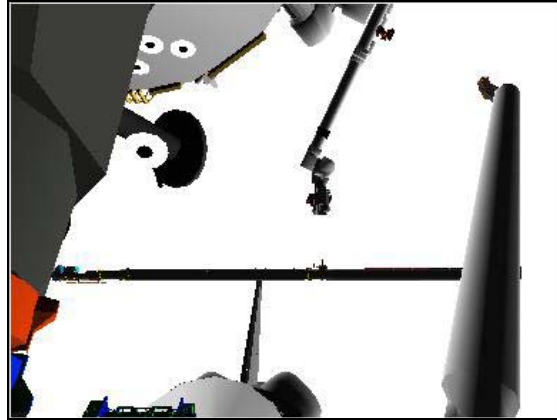


Figure 2.- OBSS Ungrapple
(92: Camera A: 0, 30).

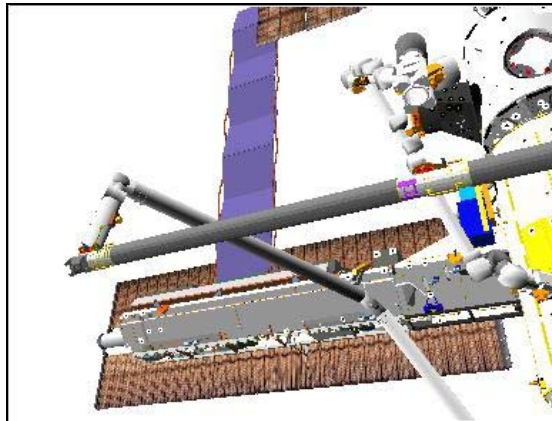


Figure 3.- OBSS Ungrapple
(V10: Camera B: -25, 30).

3. GIVING SRMS OPERATOR GO FOR MNVR
Give SRMS Operator GO for maneuver to OBSS CMG R&R VIEWING Posn.

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1.114 MNVR TO ACBM INSPECTION POSN

(RBT FS/LF1/FIN 1/SPN) Page 1 of 6 pages

1. ATTITUDE CONTROL CONFIGURATION

On SRMS Operator GO for MnvR to ACBM Inspection Posn:

If using shuttle attitude control, coordinate with shuttle crewmembers:

```

|   DAP: LVLH
|   When rates damped:
|   |   DAP: FREE > 2 seconds
|   |   Then DAP: AUTO
    
```

2. SETUP

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
91: SRMS Elbow (170, 40)	24: Tip Elbow (-20, 10) 22: Base Elbow (-20, 0)	92: Camera A (0, 40) 13: LAB Stbd Zenith (20, -32)	Camera C (-10, 50) OBSS ITVC (105, -50)

PCS

MSS: SSRMS:

Verify SSRMS at OBSS Ungrapple position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+31.7	+46.6	-55.3	+127.9	-152.4	-156.2	-82.0
X	Y	Z	Pitch	Yaw	Roll	
+259	+754	-407	-75.1	-18.8	-85.4	
FOR	Unloaded – LEE Tip, SR Held					
Disp	LAB>Berthed OBSS MidMPM					

PCS

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: 1.0

3. SJ MNVR TO INTERMEDIATE POSITION

DCP

BRAKES SSRMS → OFF (Verify OFF)

RHC

RATE – as desired

PCS

MSS: SSRMS:

Enter Mode – Single (Verify blue)

WARNING

The active joint must be checked on the PCS before initiating motion. Failure to do so may result in movement of the wrong joint.

1.114 MNVR TO ACBM INSPECTION POSN

(RBT FS/LF1/FIN 1/SPN) Page 2 of 6 pages

THC Perform Single Joint maneuver to Intermediate position (within 1 deg).

	SR	SY	SP	EP	WP	WY	WR
OBSS	+31.7	+46.6	-55.3	+127.9	-152.4	-156.2	-82.0
Ungrapple				+85.0			
1: EP -							
2: SR -	-40.0						
3: SP -			-80.0				
Intermediate	-40.0	+46.6	-80.0	+85.0	-152.4	-156.2	-82.0
	X	Y	Z	Pitch	Yaw	Roll	
	+737	+542	-635	-49.8	+21.3	-99.6	
FOR	Unloaded – LEE Tip, SR Held						
Disp	LAB>Berthed OBSS MidMPM						

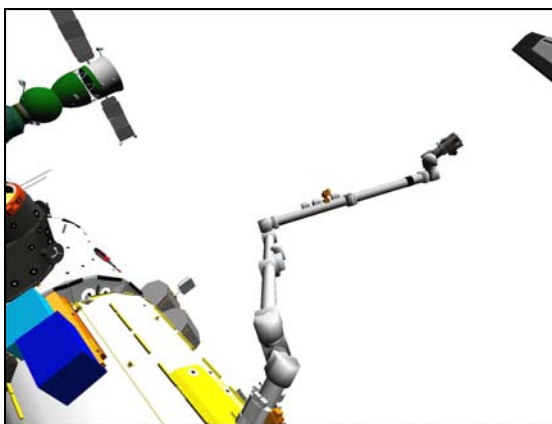


Figure 1.- Intermediate Posn
(91: SRMS Elbow: 170, 40).

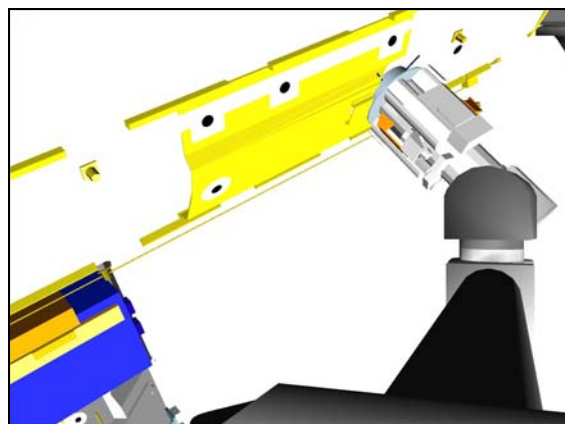


Figure 2.- Intermediate Posn
(22: Base Elbow: -20, 0).



Figure 3.- Intermediate Posn
(13: LAB Stbd Zenith: 20, -32).

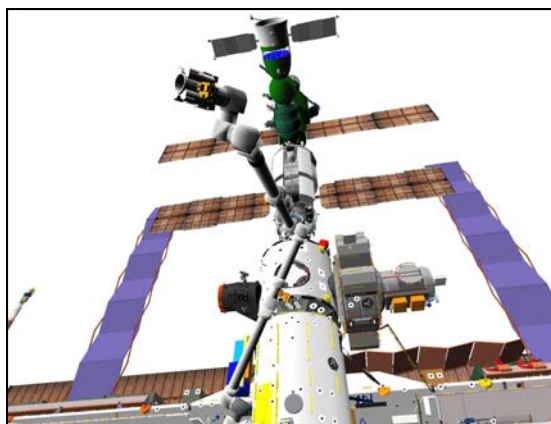


Figure 4.- Intermediate Posn
(V10: Camera C: -10, 50).

1.114 MNVR TO ACBM INSPECTION POSN

(RBT FS/LF1/FIN 1/SPN) Page 3 of 6 pages



Figure 5.- Intermediate Posn (V10: OBSS ITVC: 105, -50).

4. JOINT OCAS TO ACBM INSPECTION POSN

RHC RATE → VERNIER (Verify Vernier on PCS)

PCS MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

Input 'Joint Angles' 'Destination' for ACBM Inspection position.

SR	SY	SP	EP	WP	WY	WR
-60.0	-15.0	-80.0	+85.0	-91.0	-122.0	+50.4

NOTE

The Target and Error fields on the SSRMS Joint OCAS display will not be correct. This data should be verified and monitored on the Joint Angle Position overlay. (SCR 31169)

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON Verify joint angles and errors are correct on Joint Angle Position overlay.

	SR	SY	SP	EP	WP	WY	WR
(current)	-40.0	+46.6	-80.0	+85.0	-152.4	-156.2	-82.0
TGT	-60.0	-15.0	-80.0	+85.0	-91.0	-122.0	+50.4
ERR	+20.0	+61.6	0.0	0.0	-61.4	-34.2	-132.4

1.114 MNVR TO ACBM INSPECTION POSN

(RBT FS/LF1/FIN 1/SPN) Page 4 of 6 pages

```
*****
* If joint angles/errors are incorrect
PCS * cmd Cancel (Verify Sequence Status – Waiting Destination)
*
* Input correct Dest joint angles per table above.
*
* cmd Load (Verify Sequence Status – Confirm or Cancel)
*
MON * Verify joint angles and errors are correct on Joint Angle Position
* overlay.
*****
```

PCS **cmd** Confirm (Verify Sequence Status – Auto Seq sw - Hot)

DCP AUTO SEQ → PROC

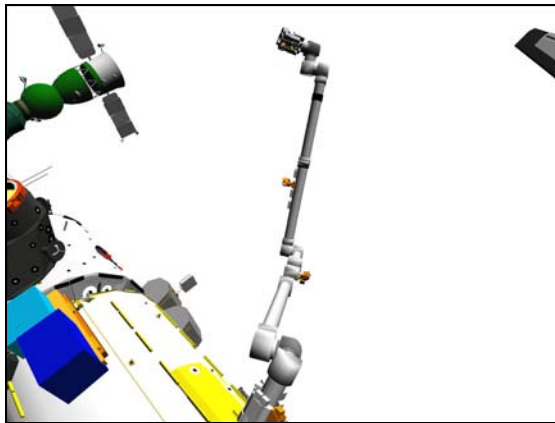


Figure 6.- ACBM Inspection
(91: SRMS Elbow: 170, 40).

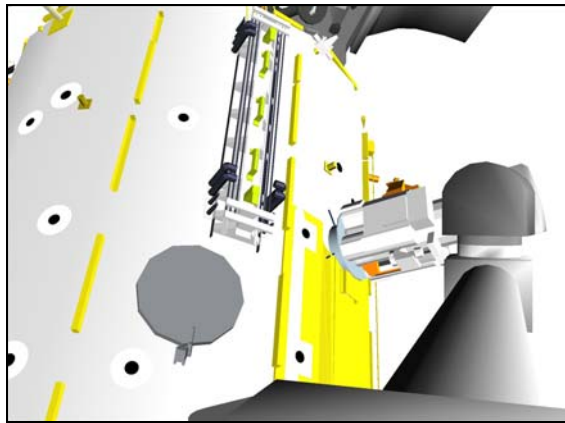


Figure 7.- ACBM Inspection
(22: Base Elbow: -20, 0).

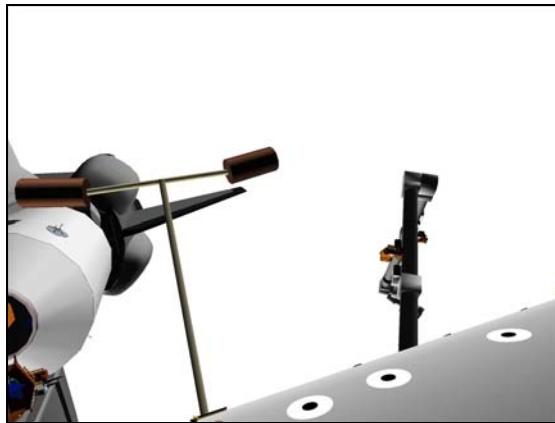


Figure 8.- ACBM Inspection
(13: LAB Stbd Zenith: 20, -32).

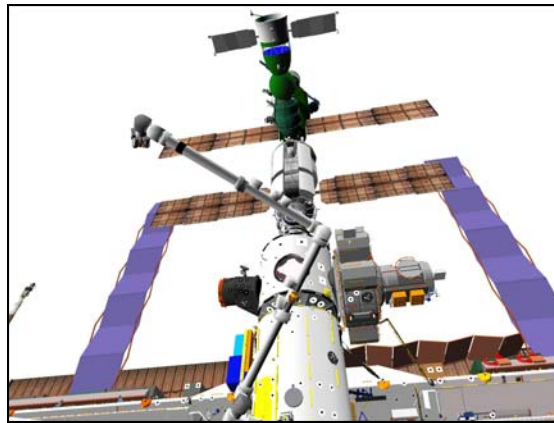


Figure 9.- ACBM Inspection
(V10: Camera C: -10, 50).

1.114 MNVR TO ACBM INSPECTION POSN

(RBT FS/LF1/FIN 1/SPN) Page 5 of 6 pages

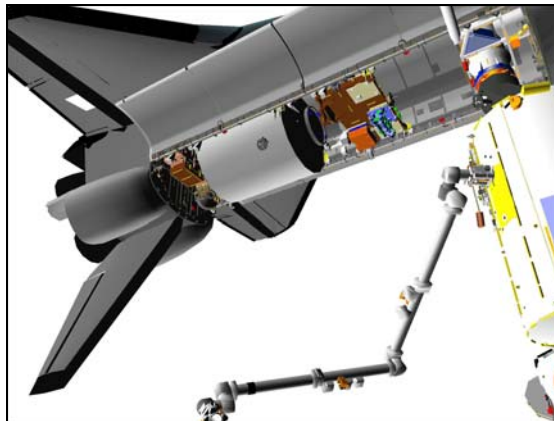


Figure 10.- ACBM Inspection
(V10: OBSS ITVC: 105, -50).

PCS

MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at ACBM Inspection position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-60.0	-15.0	-80.0	+85.0	-91.0	-122.0	+50.4
X	Y	Z	Pitch	Yaw	Roll	
+349	+1147	-1020	+163.1	+39.9	+148.0	
FOR	Unloaded – LEE Tip, SR Held					
Disp	LAB>Berthed OBSS MidMPM					

5. CLEANUP

Pan and tilt SSRMS Tip Elbow Camera per picture below to set up for overnight ground ACBM inspection.

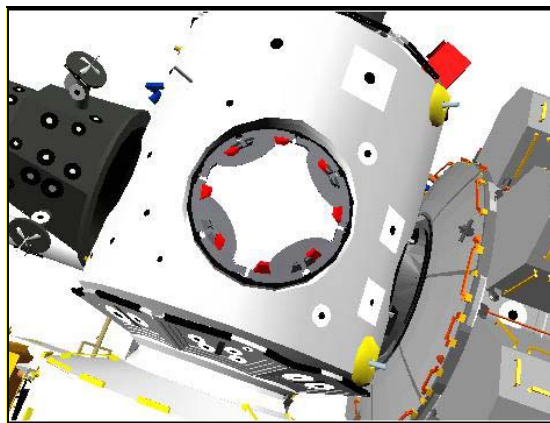


Figure 11.- ACBM Inspection
(24: Tip Elbow: 145, 45).

1.114 MNVR TO ACBM INSPECTION POSN

(RBT FS/LF1/FIN 1/SPN) Page 6 of 6 pages

NOTE

Expect the following message when safing is commanded:

'R3Z - MSS OCS SSRMS Prime(Redun) ACU SRT Cat-1 Brk Stat Fail' (SCR 17495)

This message should return to Norm.

DCP SAFING → SAFE (Verify ON)

ODS Hatch Disconnect V10 Cables

NOTE

Steps in gray are performed by shuttle crew to ensure ISS Video is available through shuttle KU for overnight ACBM inspection by the ground.

R12 √Green Jumper – ISS
(VPU) √VPU PWR – ON (LED on)

1.120 MNVR TO OBSS GRAPPLE AT HANDOFF

(RBT FS/LF1/FIN 1/SPN) Page 1 of 6 pages

1. SETUP

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
92: Camera C (-10, 30) 92: Camera A (0, 35)	13: LAB Stbd Zenith (10, -30) 24: Tip Elbow (0, 0)	91: SRMS Elbow (-135, 45) 09: P1 Lower Outboard (-10, 30)	OBSS ITVC (90, -58)

PCS

MSS: SSRMS:

Verify Unloaded Parameters – √

Verify 'Unloaded Parameters' (two) – LEE Tip, SY Held

Verify Display – LAB>MPLM Berth

Verify SSRMS at Berthed MPLM Pre-Grapple position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-136.0	-42.0	-9.9	-96.1	-65.4	+75.2	+25.9
X	Y	Z	Pitch	Yaw	Roll	
+120	+288	-207	-90.2	-49.9	+149.8	
FOR	Unloaded – LEE Tip, SY Held					
Disp	LAB>MPLM Berth					

2. SINGLE JOINT MANEUVER CLEAR OF MPLM

DCP

BRAKES SSRMS → OFF (Verify OFF)

RHC

RATE – as required (VERNIER within 1.5 m of structure)

PCS

MSS: SSRMS:

Enter Mode – Single (Verify blue)

WARNING

The active joint must be checked on the PCS before initiating motion. Failure to do so may result in movement of the wrong joint.

DCP

JOINT SELECT → SHOULDER ROLL (Verify SR – Selected on PCS)

THC

Perform “+” Single Joint maneuver to SR: -90.0 (THC up)

1.120 MNVR TO OBSS GRAPPLE AT HANDOFF

(RBT FS/LF1/FIN 1/SPN) Page 2 of 6 pages

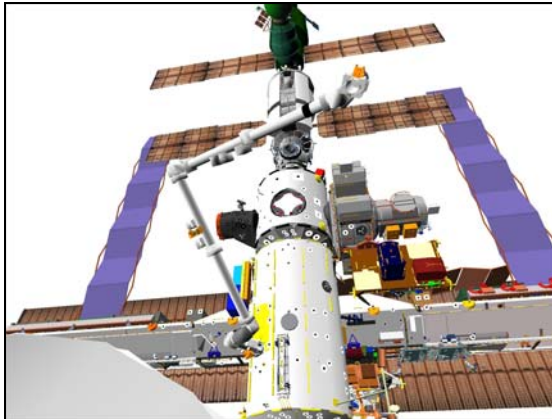


Figure 1.- Clear MPLM
(92: Camera C: -10, 40).



Figure 2.- Clear MPLM
(13: LAB Stbd Zenith: 10, -30).



Figure 3.- Clear MPLM
(91: SRMS Elbow: -140, 66).

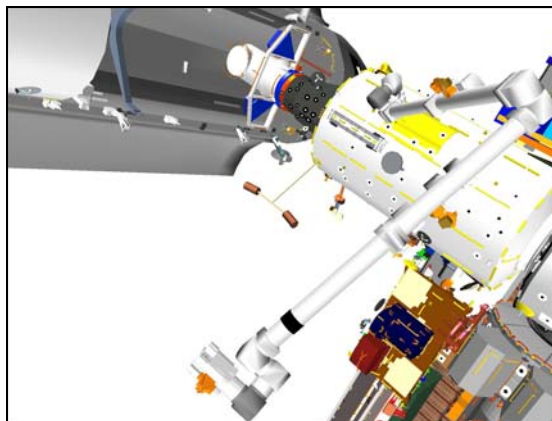


Figure 4.- Clear MPLM
(V10: OBSS ITVC: 90, -58).

3. JOCAS TO INTERMEDIATE POSITION

RHC RATE → VERNIER (Verify Vernier on PCS)

PCS MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

NOTE
Expect singularity warning for EP between -15 and +15 deg.

Input 'Joint Angles' 'Destination' for Intermediate position.

SR	SY	SP	EP	WP	WY	WR
-90.0	0.0	-55.3	+20.0	-65.4	+75.2	+25.9

1.120 MNVR TO OBSS GRAPPLE AT HANDOFF

(RBT FS/LF1/FIN 1/SPN) Page 3 of 6 pages

NOTE

The Target and Error fields on the SSRMS Joint OCAS display will not be correct. This data should be verified and monitored on the Joint Angle Position overlay. (SCR 31169)

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON

Verify joint angles and errors are correct on Joint Angle Position overlay.

	SR	SY	SP	EP	WP	WY	WR
(current)	-90.0	-42.0	-9.9	-96.1	-65.4	+75.2	+25.9
TGT	-90.0	0.0	-55.3	+20.0	-65.4	+75.2	+25.9
ERR	0.0	-42.0	+45.4	-116.1	0.0	0.0	0.0

PCS

* If joint angles/errors are incorrect
 * **cmd** Cancel (Verify Sequence Status – Waiting Destination)
 *
 * Input correct Dest joint angles per table above.
 *
 * **cmd** Load (Verify Sequence Status – Confirm or Cancel)
 *

MON

* Verify joint angles and errors are correct on Joint Angle Position overlay.
 *

PCS

cmd Confirm (Verify Sequence Status – Auto Seq sw - Hot)

DCP

AUTO SEQ → PROC

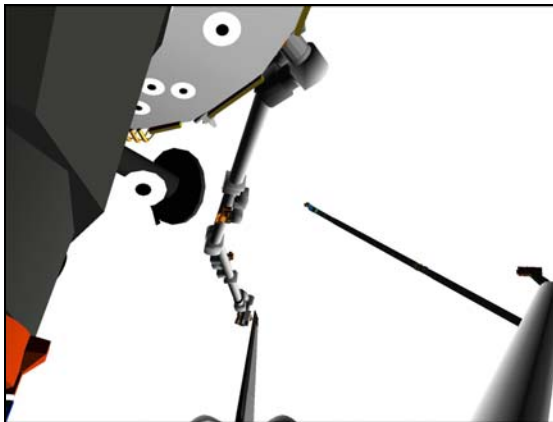


Figure 5.- Intermediate (92: Camera A: 0, 35).

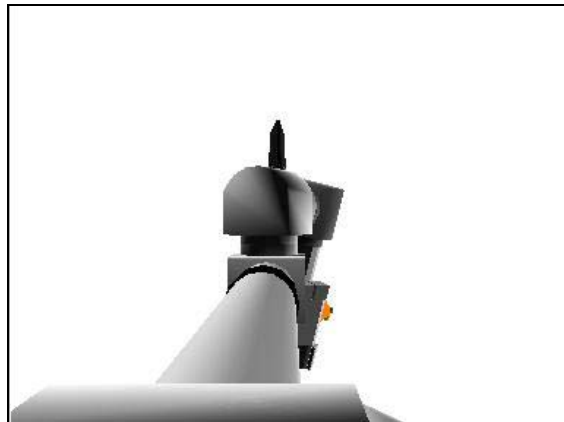


Figure 6.- Intermediate (24: Tip Elbow: 0, 0).

1.120 MNVR TO OBSS GRAPPLE AT HANDOFF

(RBT FS/LF1/FIN 1/SPN) Page 4 of 6 pages

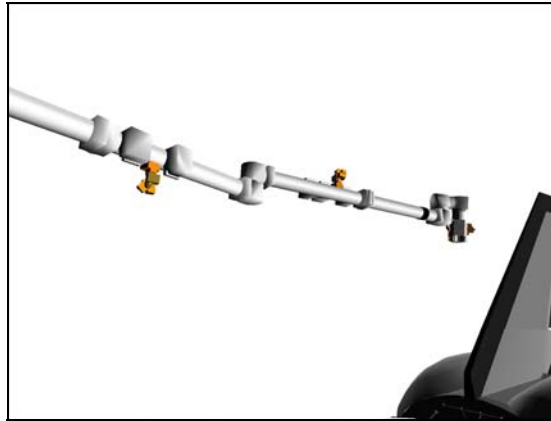


Figure 7.- Intermediate
(91: SRMS Elbow: -95, 45).

PCS

MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at Intermediate position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-90.0	0.0	-55.3	+20.0	-65.4	+75.2	+25.9
X	Y	Z	Pitch	Yaw	Roll	
-561	+19	-693	-97.7	+13.2	-126.5	
FOR	Unloaded – LEE Tip, SY Held					
Disp	LAB>MPLM Berth					

4. JOCAS TO OBSS PRE-GRAPPLE POSITION

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
92: Camera A (0, 35)	22: Base Elbow (155, 0)	91: SRMS Elbow (-95, 45)	OBSS ITVC (70, -45)
92: Camera C (-30, 40)	24: Tip Elbow (0, 0)	09: P1 Lower Outboard (-10, 30)	

pick File ► LAB ► OBSS Pre-Grapple

Verify 'Joint Angles' 'Destination' for OBSS Pre-Grapple position.

SR	SY	SP	EP	WP	WY	WR
+31.7	+46.6	-55.3	+127.9	-152.4	-156.2	-82.0

cmd Load (Verify Sequence Status – Confirm or Cancel)

1.120 MNVR TO OBSS GRAPPLE AT HANDOFF

(RBT FS/LF1/FIN 1/SPN) Page 5 of 6 pages

MON Verify joint angles and errors are correct on Joint Angle Position overlay.

	SR	SY	SP	EP	WP	WY	WR
(current)	-90.0	0.0	-55.3	+20.0	-65.4	+75.2	+25.9
TGT	+31.7	+46.6	-55.3	+127.9	-152.4	-156.2	-82.0
ERR	-121.7	-46.6	0.0	-107.9	+87.0	+231.4	+107.9

PCS * If joint angles/errors are incorrect
 * **cmd** Cancel (Verify Sequence Status – Waiting Destination)
 *
 * Input correct Dest joint angles per table above.
 *
 * **cmd** Load (Verify Sequence Status – Confirm or Cancel)
 *
 MON * Verify joint angles and errors are correct on Joint Angle Position
 * overlay.

PCS **cmd** Confirm (Verify Sequence Status – Auto Seq sw - Hot)

DCP AUTO SEQ → PROC

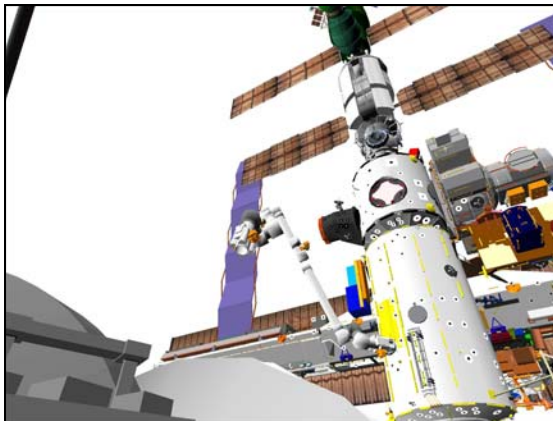


Figure 8.- OBSS Pre-Grapple
 (92: Camera C: -30, 40).

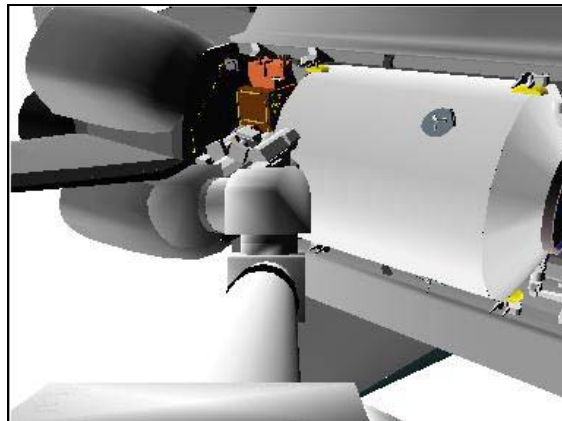


Figure 9.- OBSS Pre-Grapple
 (24: Tip Elbow: 0, 0).

1.120 MNVR TO OBSS GRAPPLE AT HANDOFF

(RBT FS/LF1/FIN 1/SPN) Page 6 of 6 pages



Figure 10.- OBSS Pre-Grapple
(91: SRMS Elbow: 170, 75).

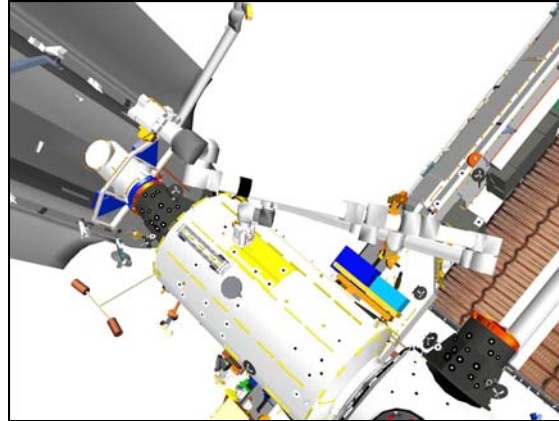


Figure 11.- OBSS Pre-Grapple
(V10: OBSS ITVC: 70, -45).

PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at OBSS Pre-Grapple position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+31.7	+46.6	-55.3	+127.9	-152.4	-156.2	-82.0
X	Y	Z	Pitch	Yaw	Roll	
+237	-309	-690	-104.1	-0.1	+89.7	
FOR	Unloaded – LEE Tip, SY Held					
Disp	LAB>MPLM Berth					

DCP BRAKES SSRMS → ON (Verify ON)

5. GIVING SRMS OPERATOR GO

Give SRMS Operator GO for maneuver to OBSS HANDOFF position.

1.121 OBSS GRAPPLE AT HANDOFF
 (RBT FS/LF1/FIN 1/SPN) Page 1 of 4 pages

1. SETUP

PCS MSS: SSRMS:

Change Loaded Parameters ► OBSS ► OBSS Mid MPM SYH
 Verify 'Loaded Parameters' (two) – OBSS Mid MPM, SY Held

Change Unloaded Parameters ► Unloaded ► LEE Tip SRH
 Verify 'Unloaded Parameters' (two) – LEE Tip, SR Held

Change Display ► LAB ► Berthed OBSS MidMPM (Verify LAB>Berthed OBSS MidMPM)

Verify Command – SSRMS>Internal

√Vernier

Verify SSRMS at OBSS Pre-Grapple position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+31.7	+46.6	-55.3	+127.9	-152.4	-156.2	-82.0
X	Y	Z	Pitch	Yaw	Roll	
+259	+754	-407	-75.1	-18.8	-85.4	
FOR	Unloaded – LEE Tip, SR Held					
Disp	LAB>Berthed OBSS MidMPM					



Figure 1.- OBSS Pre-Grapple
 (92: Camera A: 0, 28).

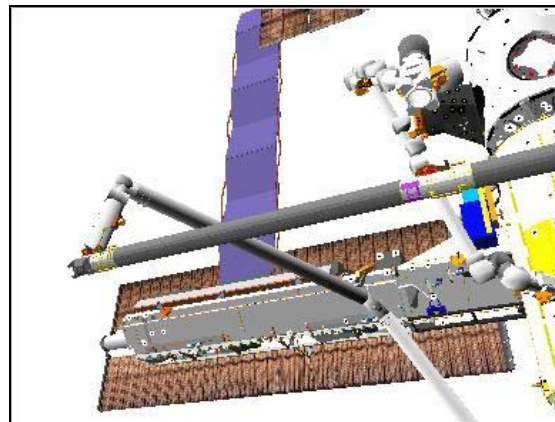


Figure 2.- OBSS Pre-Grapple
 (V10: Camera B: -25, 30).

On SRMS Operator GO for OBSS Grapple:
 Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
92: Camera A (0, 28)	25: Tip LEE	91: SRMS Elbow (-140, 100) 09: P1 Lower Outboard (-10, 30)	Camera B (-25, 30)

2. ATTITUDE CONTROL CONFIGURATION

PCS MSS: SSRMS: Thrusters:

Verify 'Desat Request:' – Inh

If using shuttle attitude control, coordinate with shuttle crewmembers:
DAP: FREE

3. OBSS GRAPPLE SETUP AND CAPTURE

3.1 Setup

NOTE
Tip LEE Camera must be fully zoomed out to correspond to target overlay.

PCS MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: as required

DCP BRAKES SSRMS → OFF (Verify OFF)

PCS MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

3.2 Slow Capture Commands

MSS: SSRMS: Tip LEE:

cmd Capture ► Automatic ► Slow, Limp (Verify Speed – Slow)

Verify '**Confirm or Terminate**' prompt.

CAUTION
Due to end-to-end system latency, the RHC Trigger is hot up to 3 seconds prior to receiving a Trigger Hot icon status on the PCS.

NOTE
Once the trigger is hot, only safing or trigger commands should be sent to the Robotics equipment. If a configuration change is required, including routing MSS Cameras, safe the system to exit LEE operations (SCR 23262, 14662).

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Auto Capture

1.121 OBSS GRAPPLE AT HANDOFF
 (RBT FS/LF1/FIN 1/SPN) Page 3 of 4 pages

RHC/
THC 3.3 Maneuvering to Within Grapple Envelope
 Maneuver to within grapple envelope.

RHC 3.4 Grapple
 TRIGGER → press (momentarily)

PCS Verify 'Snare' Close, Capture (two) – blue (12 s max)
 Verify Capture to Latch – No (SCR 19282)
 Verify 'Carriage' Tension ~5500 N (90 s max)
 Verify 'Carriage' Retract – blue

3.5 Cleanup
 Verify Posn Hold – orange

 Verify Loaded Parameters – √
 Verify 'Loaded Parameters' (two) – OBSS Mid MPM, SY Held

DCP BRAKES SSRMS → ON (Verify ON)

PCS MSS: SSRMS: SSRMS

Change Command ► LAB ► Berthed OBSS MidMPM (Verify
 LAB>Berthed OBSS MidMPM)

Expected OBSS Grapple position (√ MCC if SY not within 0.2 deg).

SR	SY	SP	EP	WP	WY	WR
+31.7	+40.4	-39.3	+124.5	-167.7	-155.3	-88.7
X	Y	Z	Pitch	Yaw	Roll	
+326	+704	-198	+91.0	-70.6	+46.9	
FOR	Loaded – OBSS Mid MPM, SY Held					
Disp	LAB>Berthed OBSS MidMPM					

Review {SSRMS LEE CUE CARD}, all (SODF: RBT GEN:
 REFERENCE).

1.121 OBSS GRAPPLE AT HANDOFF
(RBT FS/LF1/FIN 1/SPN) Page 4 of 4 pages

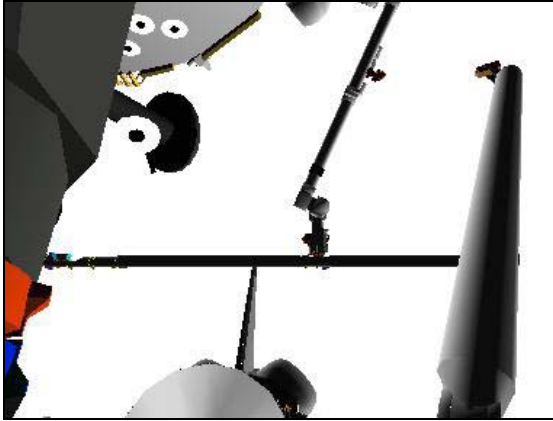


Figure 3.- OBSS Grapple
(92: Camera A: 0, 28).

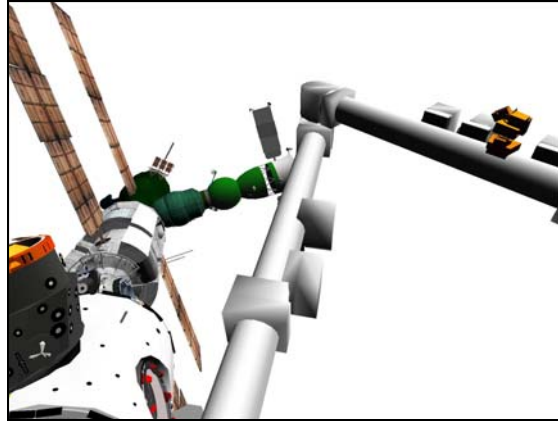


Figure 4.- OBSS Grapple
(91: SRMS Elbow: -140, 100).

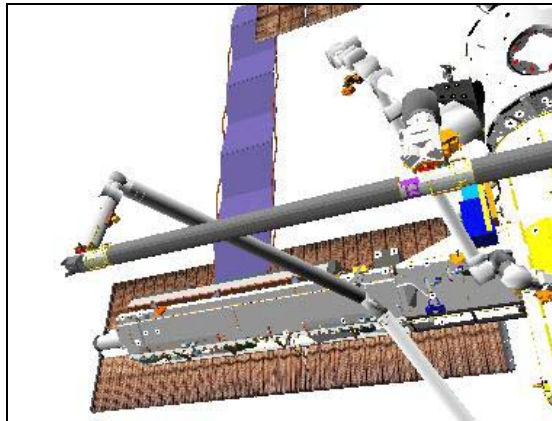


Figure 5.- OBSS Grapple
(V10: Camera B: -25, 30).

4. SRMS GO FOR UNGRAPPLE
Give SRMS Operator Go for OBSS UNGRAPPLE.

1.122 OBSS MNVR TO CLEAR UHF

(RBT FS/LF1/FIN 1)

Page 1 of 5 pages

1. SETUP

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
92: Camera A (0, 28)	24: Tip Elbow (0, 65)	91: SRMS Elbow (-105, 20)	Camera B (-25, 30)
92: Camera C (-20, 25)	22: Base Elbow (70, 0)	09: P1 Lower Outboard (-10, 30)	
	13: LAB Stbd Zenith (20, -30)		

PCS

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: 1.0 (Verify 1.0)

MSS: SSRMS:

Verify Loaded Parameters – √

Verify 'Loaded Parameters' (two) – OBSS Mid MPM, SY Held

Verify Display – LAB>Berthed OBSS MidMPM

2. ATTITUDE CONTROL CONFIGURATION

If using shuttle attitude control, coordinate with shuttle crewmembers:

DAP: LVLH

When rates damped:

DAP: FREE > 2 seconds

Then DAP: AUTO

3. MANEUVERING TO AFT POSITION

On SRMS Operator GO for maneuver to Aft Position:

DCP

BRAKES SSRMS → OFF (Verify OFF)

RHC

RATE – as desired

PCS

MSS: SSRMS:

Enter Mode – FOR OCAS (Verify blue)

MSS: SSRMS: SSRMS FOR OCAS: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

1.122 OBSS MNVR TO CLEAR UHF

(RBT FS/LF1/FIN 1)

NOTE

Due to the way the FOR OCAS file was built, the following are expected on the SSRMS FOR OCAS page on the PCS when the FOR OCAS file is selected:

- 'Display Frame' field has a red background and indicates LAB>Berthed OBSS FwdMPM display frame.
- 'FOR' field indicates OBSS Fwd MPM
- Error symbol present on the Confirm button.

SSRMS FOR OCAS

pick File ► LAB ► OBSS Clr UHF 1

Verify 'FOR' 'Destination' for Aft position.

X	Y	Z	Pitch	Yaw	Roll
+327	-225	-447	0.0	0.0	0.0

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON

Verify FOR and errors are correct on FOR Position overlay.

	X	Y	Z	Pitch	Yaw	Roll
FOR	+326	+704	-198	+91.0	-70.6	+46.9
TGT	+327	-225	-447	0.0	0.0	0.0
ERR	-1	+929	+249	+91.0	-70.6	+46.9

PCS

* If FOR/errors are incorrect
 * **cmd** Cancel (Verify Sequence Status – Waiting Destination)
 *
 * Input correct Dest FOR per table above.
 *
 * **cmd** Load (Verify Sequence Status – Confirm or Cancel)
 *

MON

* Verify FOR and errors are correct on FOR Position overlay.

PCS

cmd Confirm (Verify Sequence Status – Auto Seq Sw-Hot)

DCP

AUTO SEQ → PROC

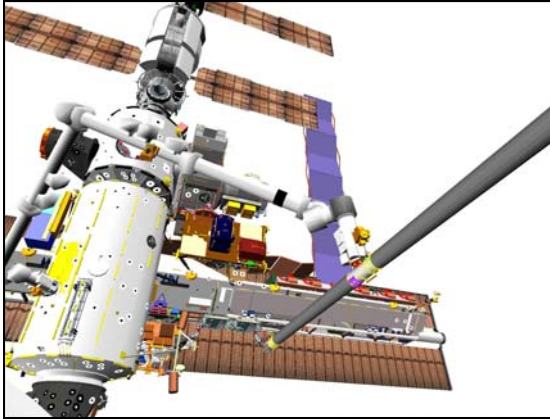


Figure 1.- Aft Position
 (92: Camera C: 20, 35).



Figure 2.- Aft Position
 (13: LAB Stbd Zenith: 20, -20).

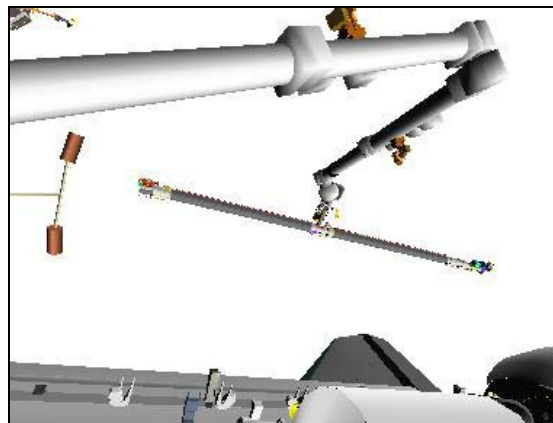


Figure 3.- Aft Position
 (91: SRMS Elbow: -105, 20).

PCS

MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at Aft position (within 5 cm/1 deg).

	Locked					
SR	SY	SP	EP	WP	WY	WR
+91.6	+40.4	+52.7	+72.5	-133.5	-137.8	+46.7
X	Y	Z	Pitch	Yaw	Roll	
+327	-225	-447	0.0	0.0	0.0	
FOR	Loaded – OBSS Mid MPM, SY Held					
Disp	LAB>Berthed OBSS MidMPM					

1.122 OBSS MNVR TO CLEAR UHF

(RBT FS/LF1/FIN 1)

4. MANEUVER TO CLEAR UHF POSITION

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
92: Camera C (20, 25)	13: LAB Stbd Zenith (0, -20)	91: SRMS Elbow (-105, 20)	Camera D (-10, 15)

SSRMS FOR OCAS

Verify Joint Lock – SY Lock

pick File ► LAB ► OBSS Clr UHF 2

<u>NOTE</u>
Due to the way the FOR OCAS file was built, the following are expected on the SSRMS FOR OCAS page on the PCS:
<ul style="list-style-type: none"> • 'Display Frame' field has a red background and indicates LAB>Berthed OBSS FwdMPM display frame. • 'FOR' field indicates OBSS Fwd MPM • Error symbol present on the Confirm button.

Verify 'FOR' 'Destination' for Clear UHF Antenna position.

X	Y	Z	Pitch	Yaw	Roll
-1	-190	-167	0.0	0.0	0.0

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON

Verify FOR and errors are correct on FOR Position overlay.

	X	Y	Z	Pitch	Yaw	Roll
FOR	+327	-225	-447	0.0	0.0	0.0
TGT	-1	-190	-167	0.0	0.0	0.0
ERR	+328	-35	-280	0.0	0.0	0.0

PCS

* If FOR/errors are incorrect
* **cmd** Cancel (Verify Sequence Status – Waiting Destination)

* Input correct Dest FOR per table above.

* **cmd** Load (Verify Sequence Status – Confirm or Cancel)

MON

* Verify FOR and errors are correct on FOR Position overlay.

PCS

cmd Confirm (Verify Sequence Status – Auto Seq Sw-Hot)

DCP

AUTO SEQ → PROC

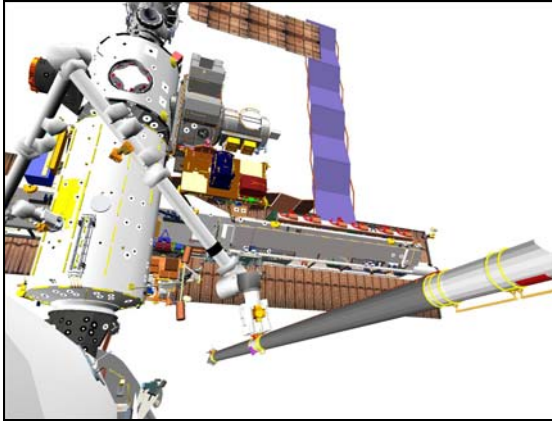


Figure 4.- Clear UHF Antenna
 (92: Camera C: 20, 25).



Figure 5.- Clear UHF Antenna
 (13: LAB Stbd Zenith: -20, -20).

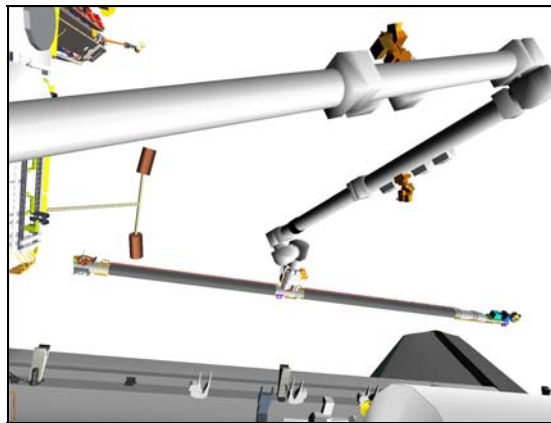


Figure 6.- Clear UHF Antenna
 (91: SRMS Elbow: -115, 20).

PCS

MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at Clear UHF Antenna position (within 5 cm/1 deg).

	Locked					
SR	SY	SP	EP	WP	WY	WR
+86.3	+40.4	+54.2	+101.7	-171.2	-138.6	+41.4
X	Y	Z	Pitch	Yaw	Roll	
-1	-190	-167	0.0	0.0	0.0	
FOR	Loaded – OBSS Mid MPM, SY Held					
Disp	LAB>Berthed OBSS MidMPM					

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1.123 OBSS BERTH

(RBT FS/LF1/FIN 1)

1. SETUP

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
92: Camera C (10, 15)	13: LAB Stbd Zenith (-20, -20)	91: SRMS Elbow (-115, 20)	Camera D (-10, 15)

PCS

MSS: SSRMS:

Verify Loaded Parameters – √

Verify 'Loaded Parameters' (two) – OBSS Mid MPM, SY Held

Verify Display – LAB>Berthed OBSS MidMPM

Verify Command – LAB>Berthed OBSS MidMPM

√Vernier

Verify Mode – FOR OCAS

Verify SY – Locked

2. MANEUVER TO LOW HOVER POSITION

NOTE

1. Due to the way the FOR OCAS file was built, the following are expected on the SSRMS FOR OCAS page on the PCS when the FOR OCAS file is selected:
 - a) 'Display Frame' field has a red background and indicates LAB>Berthed OBSS FwdMPM display frame.
 - b) 'FOR' field indicates OBSS Fwd MPM
 - c) Error symbol present on the Confirm button.
2. Monitor clearance to UHF Antenna using Lab Stbd Zenith, Camera C, or SRMS Elbow camera. Clearance at Low Hover is approximately 91 cm.
3. Monitor clearance to MPLM with Camera C.

pick File ► LAB ► OBSS Berth

Verify 'FOR' 'Destination' for OBSS Low Hover position.

X	Y	Z	Pitch	Yaw	Roll
0	0	-100	0.0	0.0	0.0

cmd Load (Verify Sequence Status – Confirm or Cancel)

1.123 OBSS BERTH

(RBT FS/LF1/FIN 1)

MON Verify FOR and errors are correct on FOR Position overlay.

	X	Y	Z	Pitch	Yaw	Roll
FOR	-1	-190	-167	0.0	0.0	0.0
TGT	0	0	-100	0.0	0.0	0.0
ERR	-1	-190	-67	0.0	0.0	0.0

PCS * If FOR/errors are incorrect
 * **cmd** Cancel (Verify Sequence Status – Waiting Destination)
 *
 * Input correct Dest FOR per table above.
 *
 * **cmd** Load (Verify Sequence Status – Confirm or Cancel)
 *

MON * Verify FOR and errors are correct on FOR Position overlay.

PCS **cmd** Confirm (Verify Sequence Status – Auto Seq Sw-Hot)

DCP AUTO SEQ → PROC

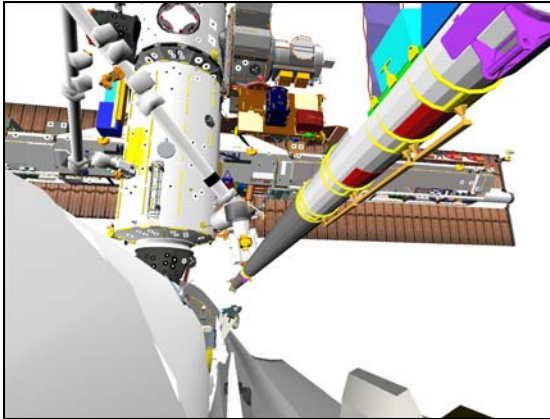


Figure 1.- OBSS Low Hover
(92: Camera C: 10, 15).

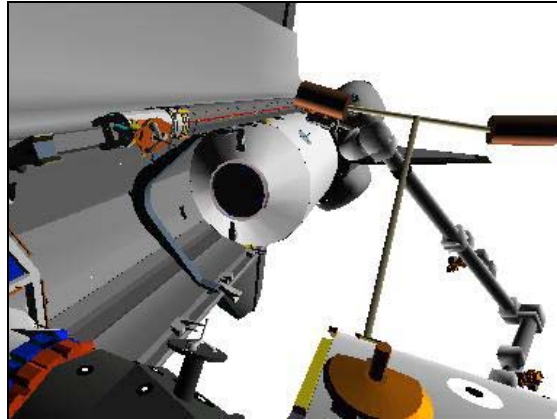


Figure 2.- OBSS Low Hover
(13: LAB Stbd Zenith: -20, -40).

1.123 OBSS BERTH

(RBT FS/LF1/FIN 1)

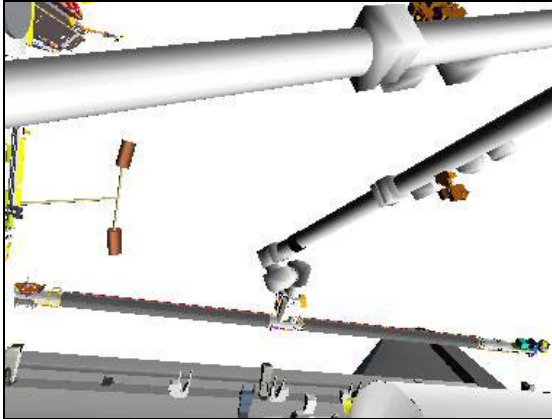


Figure 3.- OBSS Low Hover
(91: SRMS Elbow: -113, 20).



Figure 4.- OBSS Low Hover
(V10: Camera D: -10, 15).

PCS

MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at OBSS Low Hover position (within 5 cm/1 deg).

	Locked					
SR	SY	SP	EP	WP	WY	WR
+77.2	+40.4	+38.3	+116.2	-181.2	-141.1	+32.9
X	Y	Z	Pitch	Yaw	Roll	
0	0	-100	0.0	0.0	0.0	
FOR	Loaded – OBSS Mid MPM, SY Held					
Disp	LAB>Berthed OBSS MidMPM					

3. ATTITUDE CONTROL CONFIGURATION

MSS: SSRMS: Thrusters:

Verify 'Desat Request:' – Inh

If using shuttle attitude control, coordinate with shuttle crewmembers
DAP: FREE

4. BERTHING OBSS

Notify shuttle crew to watch for STBD RMS R-F-Ls.

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: 0.3 (Verify 0.3)

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

1.123 OBSS BERTH

(RBT FS/LF1/FIN 1)

MSS: SSRMS: SSRMS Manual: Joint Lock: Joint Lock

cmd Shoulder Yaw (Verify SY – Locked)

THC/RHC Maneuver OBSS to Berthed position (until shuttle crew callout that 3 of 3 STBD RMS R-F-L tb - gray, expected at Z: 0)

Expected OBSS Berthed position.

		Locked					
SR	SY	SP	EP	WP	WY	WR	
+68.4	+40.4	+38.4	+113.4	-188.4	-144.8	+25.9	
X	Y	Z	Pitch	Yaw	Roll		
0	0	0	0.0	0.0	0.0		
FOR	Loaded – OBSS Mid MPM, SY Held						
Disp	LAB>Berthed OBSS MidMPM						

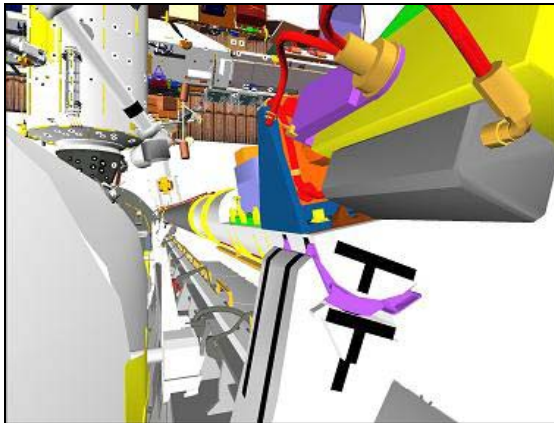


Figure 5.- OBSS Berth
(92: Camera C: 20, 0).

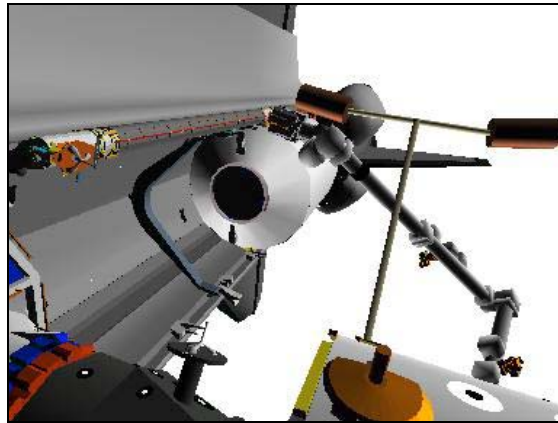


Figure 6.- OBSS Berth
(13: LAB Stbd Zenith: -20, -40).



Figure 7.- OBSS Berth
(V10: Camera D: -10, 15).

1.123 OBSS BERTH

(RBT FS/LF1/FIN 1)

Page 5 of 5 pages

PCS

MSS: SSRMS:

Verify Posn Hold – orange

Enter Mode – Standby (Verify blue)

5. LIMPING WRIST JOINTS

NOTE

Protocol for latching the OBSS is as follows once the SSRMS wrist joints are limped (repeat until MRLs fully latched):

R1: Drives the latches for 3 seconds.
Verifies SSRMS ready to continue.

M1: Verifies the following:
Safing indicator on Status Overlay - '**Limped**'
RWS STATUS - '**Active**'
Monitor numbers on the monitors of the Active RWS are still flashing, overlays still present, and no blue screen displayed.

M1: Gives GO to continue driving the latches.

MSS: SSRMS: Limp:

sel WP, WY, WR

cmd Execute

MSS: SSRMS:

Verify Limp – blue

Verify WP, WY, WR – Limped

6. LATCHING MRLs

Give SRMS Operator GO to Latch STBD MRLs.

7. CLEANUP AND ATTITUDE CONTROL CONFIGURATION

On SRMS Operator GO for OBSS Ungrapple

DCP

BRAKES SSRMS → ON (Verify ON)

If using Shuttle attitude control, coordinate with shuttle crewmembers

DAP: LVLH

When rates damped

DAP: FREE > 2 seconds

Then DAP: AUTO

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1.124 BERTHED OBSS UNGRAPPLE

(RBT FS/LF1/FIN 1/SPN)

Page 1 of 6 pages

1. SETUP

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
92: Camera C (0, 20)	25: Tip LEE	22: Base Elbow (75, -10)	Camera D (-10, 10)

PCS

MSS: SSRMS:

Change Unloaded Parameters ► Unloaded ► LEE Tip SYH
Verify 'Unloaded Parameters' (two) – LEE Tip, SY Held

Verify Display – LAB>Berthed OBSS MidMPM

Change Command ► SSRMS ► Internal (Verify SSRMS>Internal)

√Vernier

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: as required

2. UNGRAPPLING OBSS (PUSHOFF)

DCP

BRAKES SSRMS → OFF (Verify OFF)

PCS

2.1 SSRMS Limp

MSS: SSRMS: Limp:

cmd All Limp (Verify Limp – blue)

MSS: SSRMS:

Verify all joints – Limped

2.2 Auto Release

MSS: SSRMS: Tip LEE:

cmd Release ► Automatic ► Slow (Verify Speed – Slow)

Verify 'Confirm or Terminate' prompt.

CAUTION

Due to end-to-end system latency, the RHC Trigger is hot up to 3 seconds prior to receiving a Trigger Hot icon status on the PCS.

NOTE

Once the trigger is hot, only safing or trigger commands should be sent to the Robotics equipment. If a configuration change is required, including routing MSS Cameras, safe the system to exit LEE operations (SCR 23262, 14662).

1.124 BERTHED OBSS UNGRAPPLE

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Auto Release

RHC TRIGGER → press (momentarily)

PCS
 Verify 'Carriage' Derigidize – blue (90 s max)
 Verify 'Snare' Open – blue (12 s max)
 Verify 'Carriage' Extend – blue (90 s max)

2.3 SSRMS Backoff

MSS: SSRMS: Limp:

cmd None Limp (Verify Standby – blue)

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

THC/
 RHC Maneuver SSRMS to Grapple Fixture Backoff position (within 5 cm/
 1 deg).

	<input type="text" value="Locked"/>					
SR	SY	SP	EP	WP	WY	WR
+77.9	+40.4	+31.7	+122.2	-179.6	-141.0	+33.7
X	Y	Z	Pitch	Yaw	Roll	
+22	+87	-174	-90.1	-30.0	0.0	
FOR	Unloaded – LEE Tip, SY Held					
Disp	LAB>Berthed OBSS MidMPM					

1.124 BERTHED OBSS UNGRAPPLE

(RBT FS/LF1/FIN 1/SPN)

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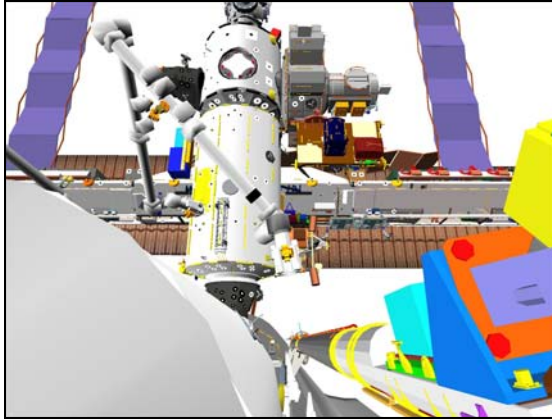


Figure 1.- Cradled OBSS Ungrapple
(92: Camera C: 0, 20).

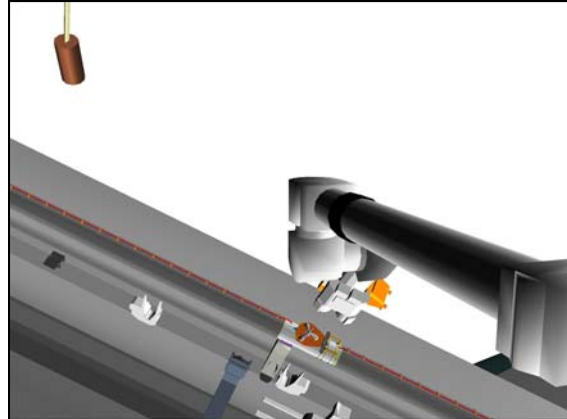


Figure 2.- Cradled OBSS Ungrapple
(22: Base Elbow: 75, -10).

3. MANEUVERING TO UNDOCK VIEWING POSITION

PCS

MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
92: Camera C (0, 20)	13: LAB Stbd Zenith (10, -35)	91: SRMS Elbow (-95, 30)	Camera A (0, 35)

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: 1.0 (Verify 1.0)

Input 'Joint Angles' 'Destination' for Undock Viewing position.

SR	SY	SP	EP	WP	WY	WR
+110.0	+55.0	+5.0	+122.2	-179.6	-190.0	+33.7

NOTE

The Target and Error fields on the SSRMS Joint OCAS display will not be correct. This data should be verified and monitored on the Joint Angle Position overlay. (SCR 31169)

cmd Load (Verify Sequence Status – Confirm or Cancel)

1.124 BERTHED OBSS UNGRAPPLE

(RBT FS/LF1/FIN 1/SPN)

MON Verify joint angles and errors are correct on Joint Angle Position overlay.

	SR	SY	SP	EP	WP	WY	WR
(current)	+77.9	+40.4	+31.7	+122.2	-179.6	-141.0	+33.7
TGT	+110.0	+55.0	+5.0	+122.2	-179.6	-190.0	+33.7
ERR	-32.1	-14.6	+26.7	0.0	0.0	+49.0	0.0

PCS * If joint angles/errors are incorrect
 * **cmd** Cancel (Verify Sequence Status – Waiting Destination)
 *
 * Input correct Dest joint angles per table above.
 *
 * **cmd** Load (Verify Sequence Status – Confirm or Cancel)
 *
 MON * Verify joint angles and errors are correct on Joint Angle Position
 * overlay.

PCS **cmd** Confirm (Verify Sequence Status – Auto Seq sw - Hot)

DCP AUTO SEQ → PROC

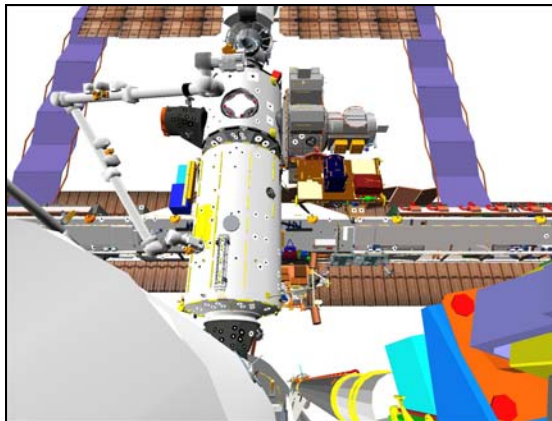


Figure 3.- Undock Viewing
(92: Camera C: 0, 25).

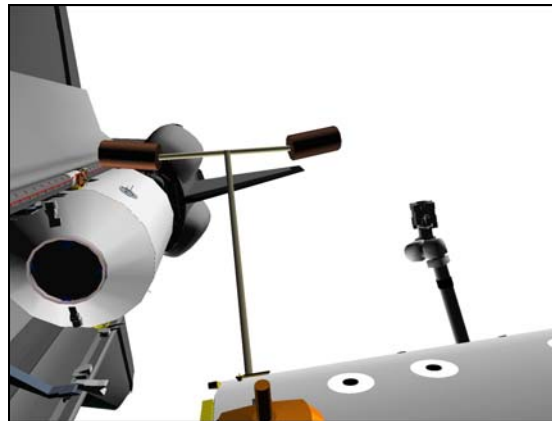


Figure 4.- Undock Viewing
(13: LAB Stbd Zenith: 10, -35).

1.124 BERTHED OBSS UNGRAPPLE

(RBT FS/LF1/FIN 1/SPN)

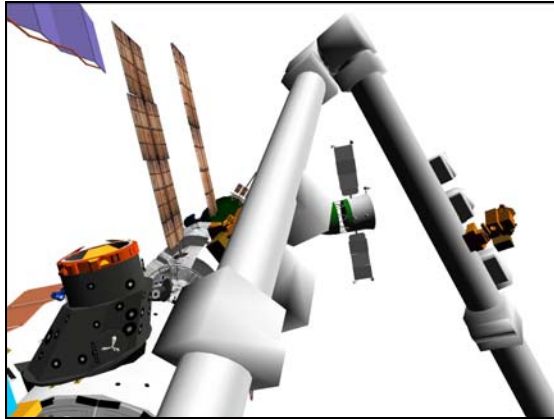


Figure 5.- Undock Viewing
(91: SRMS Elbow: -140, 115).

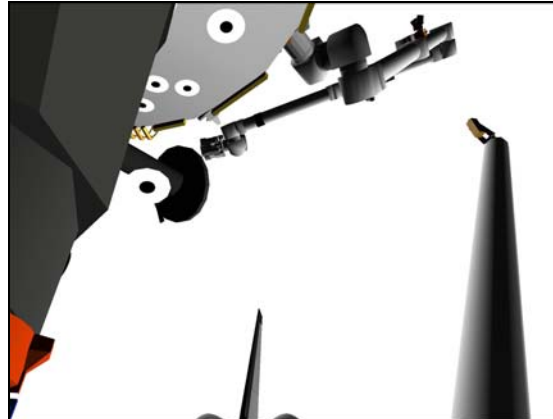


Figure 6.- Undock Viewing
(V10: Camera A: 0, 35).

PCS

MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at Undock Viewing position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+110.0	+55.0	+5.0	+122.2	-179.6	-190.0	+33.7
X	Y	Z	Pitch	Yaw	Roll	
+125	+467	-847	+58.7	-74.0	+127.9	
FOR	Unloaded – LEE Tip, SY Held					
Disp	LAB>Berthed OBSS MidMPM					

4. SRMS OPERATOR GO

Give SRMS Operator GO for RMS Powerdown.

5. CLEANUP

Pan and Tilt SSRMS Elbow Cameras per pictures below to view shuttle undocking.

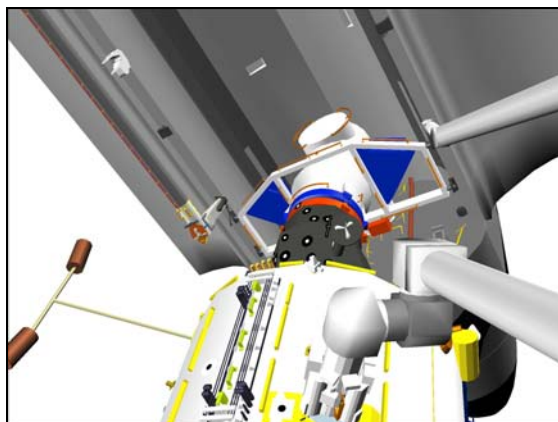


Figure 7.- Undock Viewing
(24: Tip Elbow: 65, -5).

1.124 BERTHED OBSS UNGRAPPLE

(RBT FS/LF1/FIN 1/SPN)

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NOTE

Expect the following message when safing is commanded:

**'R3Z - MSS OCS SSRMS Prime(Redun) ACU SRT Cat-1 Brk Stat
Fail'** (SCR 17495)

This message should return to Norm.

DCP SAFING → SAFE (Verify ON)

ODS Hatch Disconnect V10 Cables.

MPLM OPS

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1. HAND CONTROLLER CALIBRATION

1.1 Translational Hand Controller (THC) Calibration

THC

Deflect [X] Axis to positive hard stop where [X] =

Deflect [X] Axis to negative hard stop.

Repeat

1.2 Rotational Hand Controller (RHC) Calibration

RHC

Deflect [X] Axis to positive hard stop where [X] =

Deflect [X] Axis to negative hard stop.

Repeat

2. SETUP

ODS
Hatch

√V10 Cables Connected

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
91: SRMS Elbow (-170, 40)	13: LAB Stbd Zenith (15, -30)	92: Camera C (-10, 40) 92: Camera B (20, 40)	OBSS ITVC (105, -52)

PCS

MSS: SSRMS:

Change Loaded Parameters ► MPLM ► MPLM Berth SYH
 Verify 'Loaded Parameters' (two) – MPLM Berth, SY Held

Verify Unloaded Parameters – √

Change Unloaded Parameters ► Unloaded ► LEE Tip SYH
 Verify 'Unloaded Parameters' (two) – LEE Tip, SY Held

Change Display ► LAB ► MPLM Berth (Verify LAB>MPLM Berth)

Verify Command – SSRMS>Internal

1.210 BERTHED MPLM GRAPPLE
 (RBT FS/LF1/FIN 1/SPN) Page 2 of 7 pages

Verify SSRMS at ACBM Inspection position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-60.0	-15.0	-80.0	+85.0	-91.0	-122.0	+50.4
X	Y	Z	PITCH	YAW	ROLL	
+148	-475	-1399	+30.0	-32.0	-9.9	
FOR	Unloaded – LEE Tip, SY Held					
Disp	LAB>MPLM Berth					

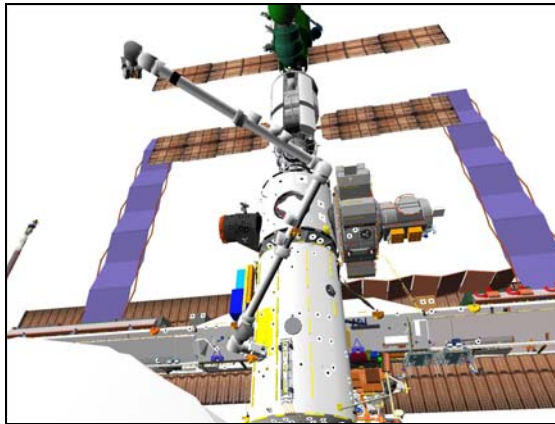


Figure 1.- ACBM Inspection
 (92: Camera C: -10, 40).

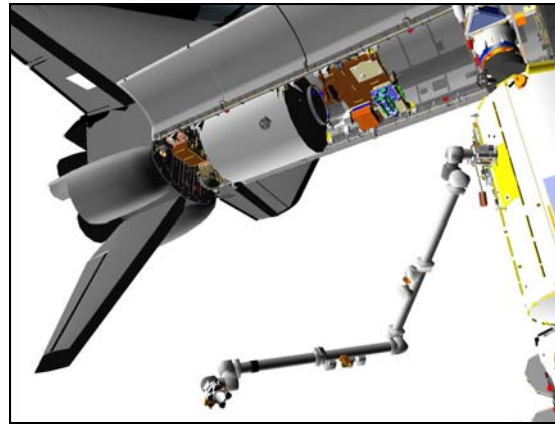


Figure 2.- ACBM Inspection
 (V10: OBSS ITVC: 105, -52).

3. JOCAS TO BERTHED MPLM PRE-GRAPPLE

PCS MSS: SSRMS: SSRMS Safing:

cmd Remove (Verify Not Safed)

DCP BRAKES SSRMS → OFF (Verify – OFF)

Notify shuttle crew SSRMS maneuver to MPLM Pre-Grapple is about to begin.

PCS MSS: SSRMS:

√Vernier

Enter Mode – Joint OCAS (Verify blue)

NOTE
 Expect brief singularity warning as SR axis points to the Wrist cluster during the Joint OCAS maneuver.

SSRMS Joint OCAS

pick File ► LAB ► Berthed MPLM PreGrap

1.210 BERTHED MPLM GRAPPLE
 (RBT FS/LF1/FIN 1/SPN) Page 3 of 7 pages

Verify 'Joint Angles' 'Destination' for MPLM Pre-Grapple position.

SR	SY	SP	EP	WP	WY	WR
-116.8	+123.0	-155.3	+95.2	-91.0	-122.0	+50.4

NOTE

The Target and Error fields on the SSRMS Joint OCAS display will not be correct. This data should be verified and monitored on the Joint Angle Position overlay. (SCR 31169)

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON Verify joint angles and errors are correct on Joint Angle Position overlay.

	SR	SY	SP	EP	WP	WY	WR
(current)	-60.0	-15.0	-80.0	+85.0	-91.0	-122.0	+50.4
TGT	-116.8	+123.0	-155.3	+95.2	-91.0	-122.0	+50.4
ERR	+56.8	-138.0	+75.3	-10.2	0.0	0.0	0.0

PCS * If joint angles/errors are incorrect
 * **cmd** Cancel (Verify Sequence Status – Waiting Destination)
 *
 * Input correct Dest joint angles per table above.
 *
 * **cmd** Load (Verify Sequence Status – Confirm or Cancel)
 *
 MON * Verify joint angles and errors are correct on Joint Angle Position overlay.
 *

PCS **cmd** Confirm (Verify Sequence Status – Auto Seq sw - Hot)

DCP AUTO SEQ → PROC

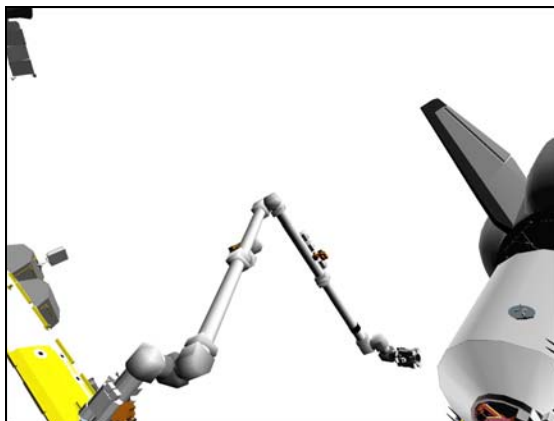


Figure 3. - Berthed MPLM Pre-Grapple (91: SRMS Elbow: -170, 40).

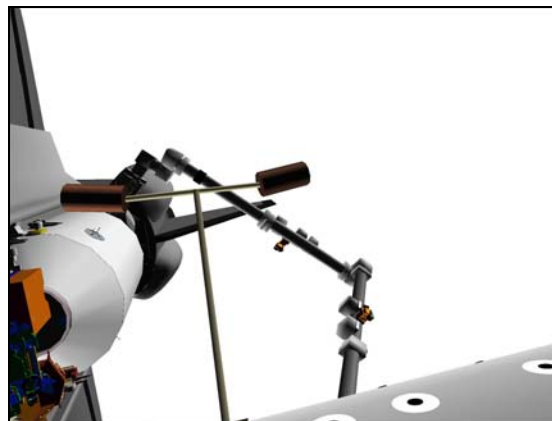


Figure 4. - Berthed MPLM Pre-Grapple (13: LAB Stbd Zenith: 15, -30.)

1.210 BERTHED MPLM GRAPPLE
 (RBT FS/LF1/FIN 1/SPN) Page 4 of 7 pages

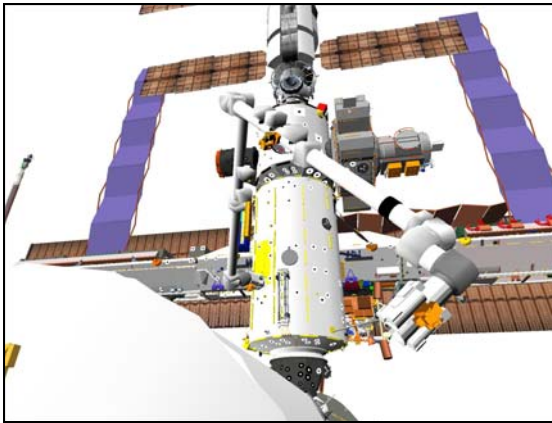


Figure 5.- Berthed MPLM Pre-Grapple
 (92: Camera C: -10, 30).

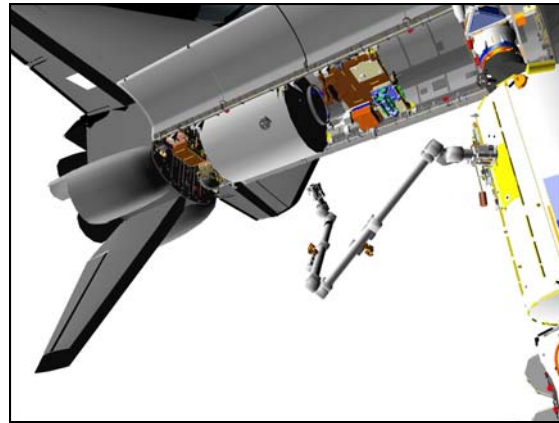


Figure 6.- Berthed MPLM Pre-Grapple
 (V10: OBSS ITVC: 105, -52)

PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at Berthed MPLM Pre-Grapple position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-116.8	+123.0	-155.3	+95.2	-91.0	-122.0	+50.4
X	Y	Z	Pitch	Yaw	Roll	
+120	+288	-207	-90.2	-49.9	+149.9	
FOR	Unloaded – LEE Tip, SY Held					
Disp	LAB>MPLM Berth					

4. MPLM GRAPPLE SETUP

NOTE

MSS Effector Overlay will not appear on the monitor until the “confirm” confirm command is sent to the LEE.

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
13: LAB Stbd Zenith (15, -30)	25: Tip LEE	92: Camera C (-5, 20) 91: Camera D (0, 20)	OBSS ITVC (105, -52)

4.1 Setup

NOTE

Tip LEE Camera must be fully zoomed out to correspond to target overlay.

1.210 BERTHED MPLM GRAPPLE

(RBT FS/LF1/FIN 1/SPN) Page 5 of 7 pages

PCS

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: as required

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

4.2 Slow Capture Commands

MSS: SSRMS: Tip LEE:

cmd Capture ► Automatic ► Slow, Limp (Verify Speed – Slow)

Verify '**Confirm or Terminate**' prompt.

CAUTION

Due to end-to-end system latency, the RHC Trigger is hot up to 3 seconds prior to receiving a Trigger Hot icon status on the PCS.

NOTE

Once the trigger is hot, only safing or trigger commands should be sent to the Robotics equipment. If a configuration change is required, including routing MSS Cameras, safe the system to exit LEE operations. (SCR 23262, 14662)

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Auto Capture

RHC/
THC

4.3 Maneuvering To Within Grapple Envelope

Maneuver to within grapple envelope.

RHC

4.4 Grapple

TRIGGER → press (momentarily)

PCS

Verify 'Snare' Close, Capture (two) – blue (12 s max)

Verify Capture to Latch – No (SCR 19282)

Verify 'Carriage' Tension ~5500 N (90 s max)

Verify 'Carriage' Retract – blue

1.210 BERTHED MPLM GRAPPLE
 (RBT FS/LF1/FIN 1/SPN) Page 6 of 7 pages

4.5 Grapple Cleanup
 MSS: SSRMS: SSRMS

Verify Posn Hold – orange

Verify Loaded Parameters – √
 Verify 'Loaded Parameters' (two) – MPLM Berth, SY Held

DCP BRAKES SSRMS → ON (Verify ON)

PCS Expected Berthed MPLM Grapple joint angles and FOR.

SR	SY	SP	EP	WP	WY	WR
-130.2	+123.0	-164.3	+98.8	-108.4	-119.8	+36.8
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded – MPLM Berth, SY Held					
Disp	LAB>MPLM Berth					

Review {SSRMS LEE CUE CARD}, all (SODF: RBT GEN: REFERENCE)



Figure 7. - Berthed MPLM Grapple
 (13: LAB Stbd Zenith: 15, -30).

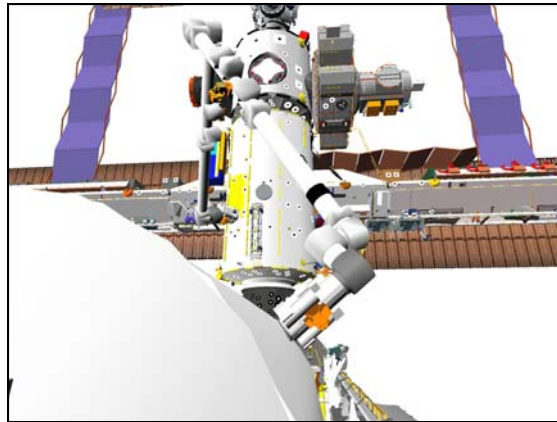


Figure 8. - Berthed MPLM Grapple
 (92: Camera C: -5, 20).

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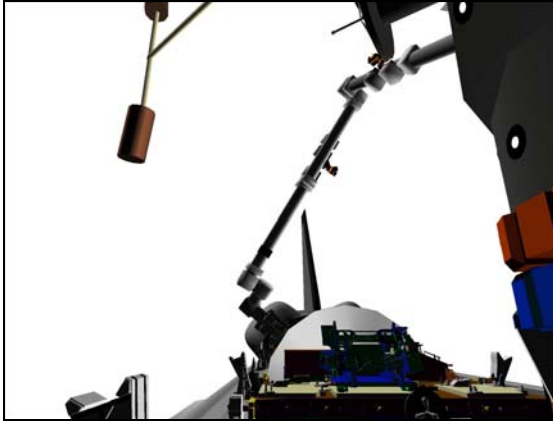


Figure 9.- Berthed MPLM Grapple
(91: Camera D: 0, 20).

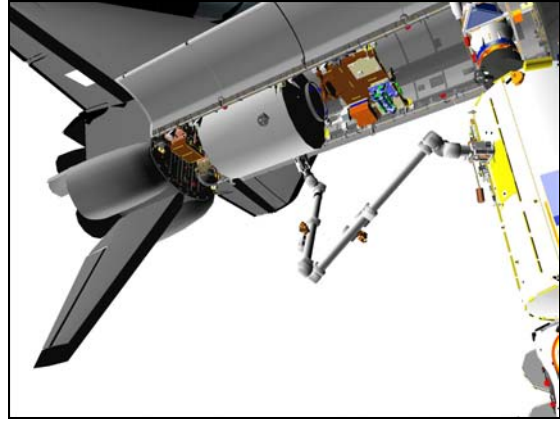


Figure 10.- Berthed MPLM Grapple
(V10: OBSS ITVC: 105, -52)

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(RBT FS/LF1/FIN 1)

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1. ACTIVATE KEEL CAMERA

Give shuttle crew GO to activate Keel CCTV.

NOTE

Steps in grey are performed by shuttle crew to activate the Keel Camera.

SSP2 √cb SW PWR 3 (CB2) – cl

MPLM KEEL CAM PWR – ON

MPLM KEEL CAM HTR/ILLUM PWR – OFF, then ON for HI,
(repeat for MED, LO, OFF)

2. SETUP FOR UNBERTH

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
22: Base Elbow (65, -27)	91: Mux Camera B (0, -10)/ C (0, -10)	92: OBSS ITVC (105, -52) 92: Keel Camera	Mux Camera A (0, 0)/ D (0, 0)

Take digital picture of the monitor configured with the Keel Camera prior to AKA and PRLA release.

PCS

MSS: SSRMS:

Verify Loaded Parameters – √

Verify 'Loaded Parameters' (two) – MPLM Berth, SY Held

Verify Display – LAB>MPLM Berth

Change Command ► ISS ► OBAS (Verify ISS>OBAS)

√Vernier

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: 0.5 (Verify 0.5)

NOTE

The following will send the SSRMS Base Elbow Camera to the orbiter to view ROEU Demate.

MSS: Video: VTR2:

cmd BELB

1.211 MPLM UNBERTH

(RBT FS/LF1/FIN 1)

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3. ATTITUDE CONTROL CONFIGURATION

MSS: SSRMS: Thrusters:

Thruster Controls for MSS Ops

Verify 'Desat Request:' – Inh

If using Shuttle attitude control, coordinate with Shuttle crew members:
DAP: FREE

4. ROEU DEMATE

Give shuttle crew GO for ROEU and PRLA Ops.

NOTE

Steps 4.1 to 8 are performed by shuttle crew to demate the ROEU and to open MPLM PRLAs.

4.1 Setup

CCTV – Config for ROEU demate

MON 1	PL2: SSRMS Base Elbow
MON 2	D

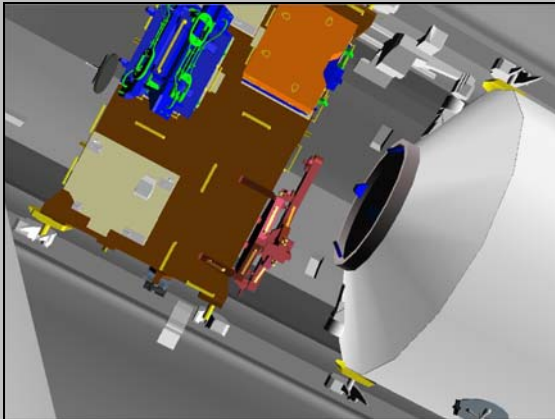


Figure 1. - ROEU Demate
(22: Base Elbow: 65, -27).

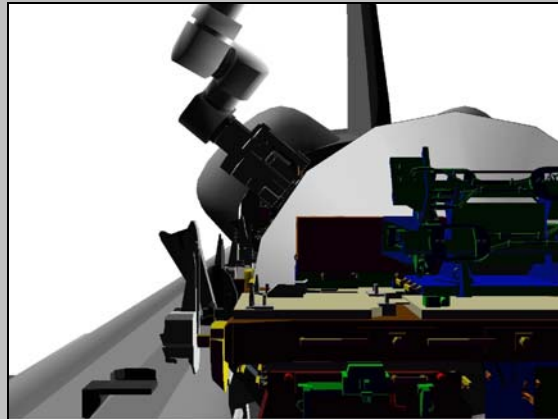


Figure 2. - ROEU Demate
(91: Camera D: 0, 0, focus 15).

4.2 Deadface ROEU

SSP 1 √MPLM CHAN 1,2 HTR PWR – OFF (tb–bp)
 √APCU 1 OUTPUT RLY – OP (tb–bp)

A6U Install ROEU A6U PANEL OVERLAY.

 √PL RETEN LAT (five) - OFF
 PL RETEN PL SEL – 2

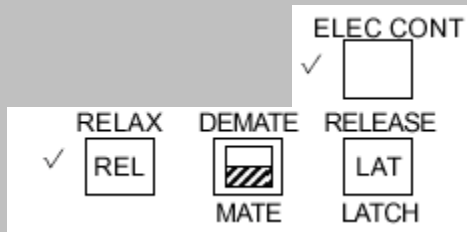
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SM 97 PL RETENTION

√REL 2,3 (four) – 0

 * If LATCH 2,3 REL msw shows 1, drive latch
 * for single motor time.



4.3 Activate ROEU

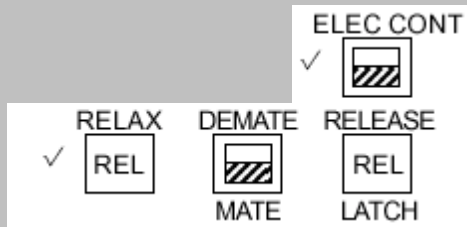
PL RETEN LOGIC PWR SYS 1,2 (two) – ON
 BAY MECH PWR SYS 1,2 (two) – ON

R13L

4.4 Release Latches

Note single motor time (> 20 seconds).

RELEASE/LATCH – REL (tb-REL), 40 s max
 – OFF

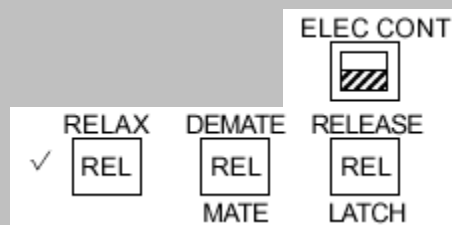


4.5 Demate ROEU

Note single motor time (> 18 seconds).

DEMATE/MATE – DEMATE (tb-REL), 36 s max
 – OFF

A6U



4.6 Deactivate ROEU

PL RETEN LOGIC PWR SYS 1,2 (two) – OFF
 BAY MECH PWR SYS 1,2 (two) – OFF

A6U
 R13L

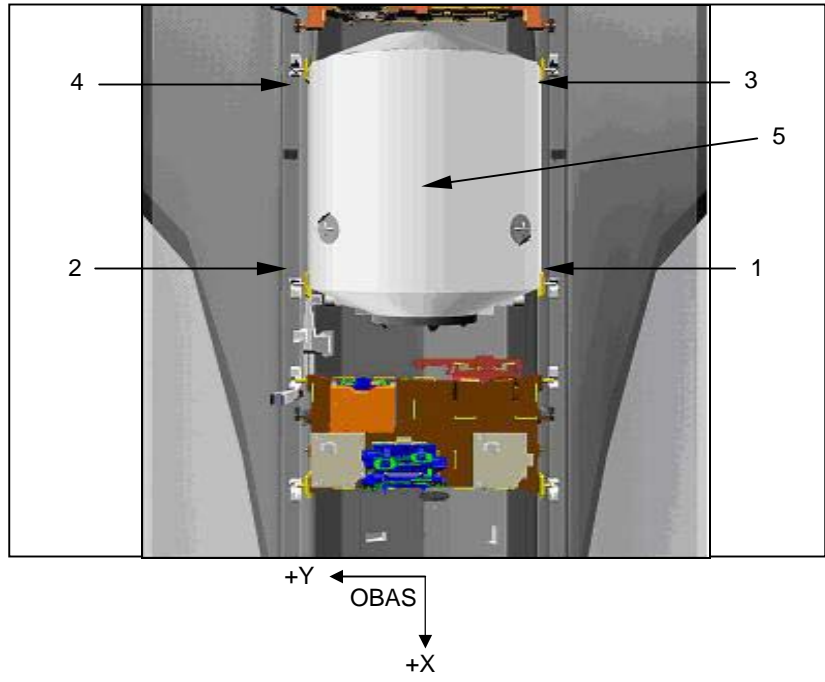


Figure 3.- MPLM PRLA Configuration

5. ACTIVATE LATCHES

√MPLM ROEU DEMATE complete

A6U √PL RETEN LAT (five) – OFF
 PL SEL – 1
 LOGIC PWR 1,2 (two) – ON

R13L PL BAY MECH PWR SYS 1,2 (two) – ON

SM 97 PL RETENTION

√RDY-FOR-LAT 1,2,3,4,5 (ten): 1

√LAT 1,2,3,4,5 (ten): 1

 * If any REL msw shows 1, expect single
 * motor time (60 seconds).

6. AKA RELEASE

A6U √PL RETEN LAT 5 tb – LAT
 √RDY 5 tb – gray

Note single motor drive times (> 30 seconds).

PL RETEN LAT 5 – REL (tb-REL), 60 s max
 – OFF

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(RBT FS/LF1/FIN 1)

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MSS: SSRMS: SSRMS Manual: Joint Lock: Joint Lock

cmd Shoulder Yaw (Verify SY – Locked)

THC/
RHC

Maneuver to MPLM Low Hover position (within 5 cm/1 deg)

	Locked					
SR	SY	SP	EP	WP	WY	WR
-103.9	+123.0	-172.6	+104.0	-63.6	-126.4	+60.1
X	Y	Z	PITCH	YAW	ROLL	
0	0	-480	0.0	0.0	0.0	
FOR	Loaded – MPLM Berth, SY Held					
Disp	LAB>MPLM Berth					

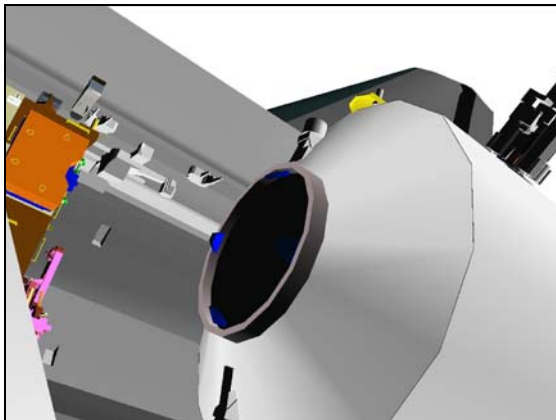


Figure 4.- MPLM Low Hover
(22: Base Elbow: 65, -27).

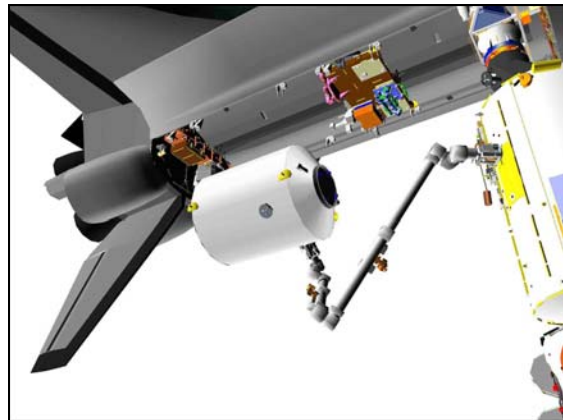


Figure 5.- MPLM Low Hover
(V10: OBSS ITVC: 105, -52).

DCP BRAKES SSRMS → ON (Verify – ON)

Give shuttle crew GO for MPLM PCBM inspection.

NOTE

Step 10 is performed by shuttle crew to deactivate the MPLM Keel Camera.

10. DEACTIVATING KEEL CAMERA

SSP2

MPLM KEEL CAM HTR/ILLUM PWR – Toggle until illuminator OFF
(leave sw in ON position)

MPLM KEEL CAM PWR – OFF

1.211 MPLM UNBERTH

(RBT FS/LF1/FIN 1)

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11. ATTITUDE CONTROL CONFIGURATION

If using shuttle attitude control, coordinate with shuttle crewmembers:

Temp edit ALT RATE DB

GNC 20 DAP CONFIG

ALT RATE DB - ITEM 38 + 0.1 EXEC

If attitude maintenance reqd:

DAP: LVLH

When rates damped:

DAP: FREE > 2 seconds

Then DAP: AUTO

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1.212 MPLM INSTALL

(RBT FS/LF1/FIN 1)

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1. SETUP

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
22: Base Elbow (90, -20) 13: LAB Stbd Zenith (25, -30)	91: Mux Camera B (0, 40)/ C (0, 40)	92: OBSS ITVC (85, -55) 24: Tip Elbow (-10, 0)	SRMS Elbow (170, 40)

PCS

MSS: SSRMS:

Verify Loaded Parameters – √

Change Loaded Parameters ► MPLM ► MPLM CBCS SYH
Verify 'Loaded Parameters' (two) – MPLM CBCS, SY Held

Change Display ► LAB ► MPLM CBCS (Verify LAB>MPLM CBCS)

Change Command ► SSRMS ► Internal (Verify SSRMS>Internal)

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: 1.0 (Verify 1.0)

2. ATTITUDE CONTROL CONFIGURATION

If using shuttle attitude control, coordinate with shuttle crewmembers:

| If DAP: AUTO, when in attitude
| DAP: FREE

3. FOR OCAS 1 TO MPLM PRE-INSTALL PAUSE POINT

Verify shuttle crew has completed MPLM PCBM inspection.

DCP

BRAKES SSRMS → OFF (Verify – OFF)

RHC

RATE → COARSE (Verify Coarse on PCS)

PCS

MSS: SSRMS:

Enter Mode – FOR OCAS (Verify blue)

MSS: SSRMS: SSRMS FOR OCAS: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

pick File ► LAB ► MPLM Pause Point

1.212 MPLM INSTALL

(RBT FS/LF1/FIN 1)

Verify 'FOR' 'Destination' for MPLM Pre-Install Pause Point position.

X	Y	Z	Pitch	Yaw	Roll
+250	0	+300	0.0	0.0	0.0

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON

Verify FOR and errors are correct on FOR Position overlay.

	X	Y	Z	Pitch	Yaw	Roll
FOR	+707	+1	+1002	-0.9	+0.2	-89.9
TGT	+250	0	+300	0.0	0.0	0.0
ERR	+457	+1	+702	-0.9	+0.2	-89.9

PCS

* If FOR/errors are incorrect
 * **cmd** Cancel (Verify Sequence Status – Waiting Destination)
 *
 * Input correct Dest FOR per table above.
 *
 * **cmd** Load (Verify Sequence Status – Confirm or Cancel)
 *

MON

* Verify FOR and errors are correct on FOR Position overlay.

PCS

cmd Confirm (Verify Sequence Status – Auto Seq Sw - Hot)

DCP

AUTO SEQ → PROC

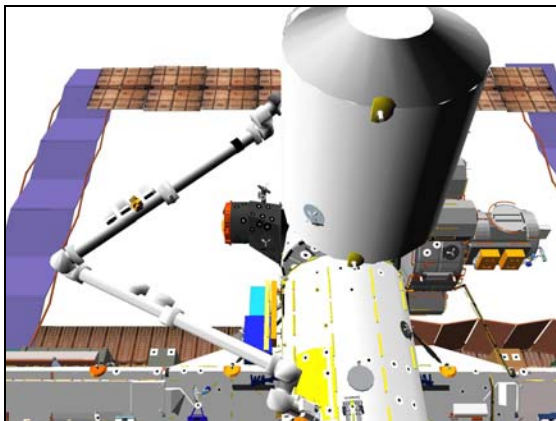


Figure 1.- MPLM Pre-Install Pause Point
(91: Camera B: 0, 40)

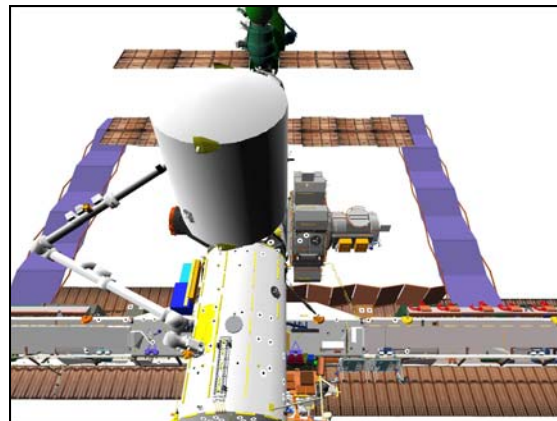


Figure 2.- MPLM Pre-Install Pause Point
(91: Camera C: 0, 40).

1.212 MPLM INSTALL

(RBT FS/LF1/FIN 1)

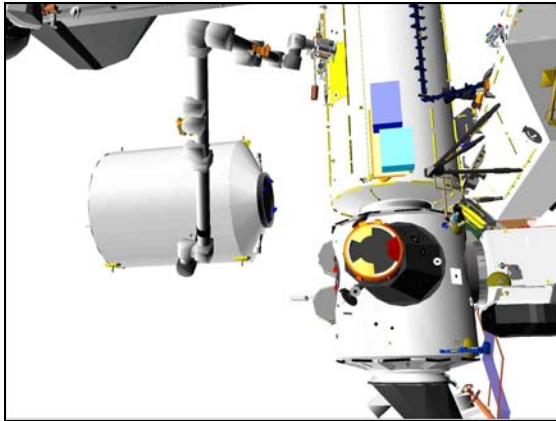


Figure 3.- MPLM Pre-Install Pause Point
(92: OBSS ITVC: 85, -65)

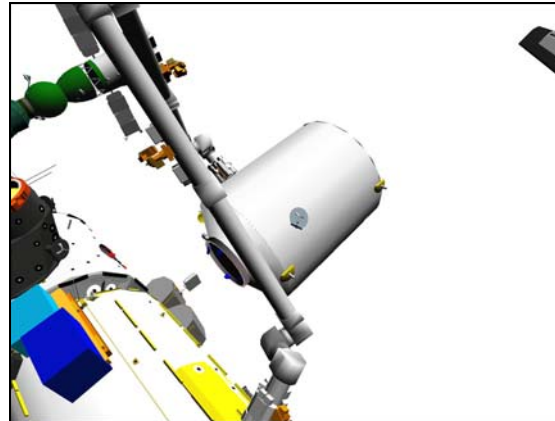


Figure 4.- MPLM Pre-Install Pause Point
(V10: SRMS Elbow: 170, 40).

PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at MPLM Pre-Install Pause Point position (within 5 cm/1 deg).

	Locked					
SR	SY	SP	EP	WP	WY	WR
-27.2	+123.0	-175.3	+117.9	-95.8	-173.8	+44.9
X	Y	Z	Pitch	Yaw	Roll	
+250	0	+300	0.0	0.0	0.0	
FOR	Loaded – MPLM CBCS, SY Held					
Disp	LAB>MPLM CBCS					

4. ATTITUDE CONTROL CONFIGURATION

If using shuttle attitude control, coordinate with shuttle crewmembers:

 If attitude maintenance reqd:

 DAP: LVLH

 When rates damped:

 DAP: FREE > 2 seconds

 Then DAP: AUTO

 When in attitude:

 DAP: FREE

5. FOR OCAS 2 TO MPLM PRE-INSTALL

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
22: Base Elbow (90, 3) 24: Tip Elbow (20, -15)	91: Mux Camera B (0, 40)/ C (0, 40)	92: OBSS ITVC (85, -65) 13: LAB Stbd Zenith (40, -30)	SRMS Elbow (160, 40)

1.212 MPLM INSTALL

(RBT FS/LF1/FIN 1)

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RHC RATE → VERNIER (Verify Vernier on PCS)

PCS SSRMS FOR OCAS

Verify Joint Lock – SY Lock

pick File ► LAB ► MPLM Pre-Install

Verify 'FOR' 'Destination' for MPLM Pre-Install position.

X	Y	Z	Pitch	Yaw	Roll
+130	0	0	0.0	0.0	0.0

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON Verify FOR and errors are correct on FOR Position overlay.

	X	Y	Z	Pitch	Yaw	Roll
FOR	+250	0	+300	0.0	0.0	0.0
TGT	+130	0	0	0.0	0.0	0.0
ERR	+120	0	+300	0.0	0.0	0.0

PCS * If FOR/errors are incorrect
 * **cmd** Cancel (Verify Sequence Status – Waiting Destination)
 *
 * Input correct Dest FOR per table above.
 *
 * **cmd** Load (Verify Sequence Status – Confirm or Cancel)
 *
 MON * Verify FOR and errors are correct on FOR Position overlay.

NOTE

1. Monitor clearance between the MPLM and ONTO/MISSE with Camera C.
2. The following are approximate minimum clearances seen during the maneuver to Pre-Install Position:
 - MPLM to ONTO: 89 cm
 - MPLM to MISSE: 70 cm

PCS **cmd** Confirm (Verify Sequence Status – Auto Seq Sw - Hot)

DCP AUTO SEQ → PROC

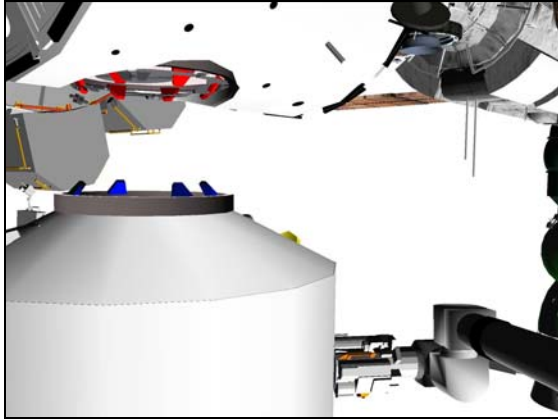


Figure 5.- MPLM Pre-Install
(22: Base Elbow:90, 3).

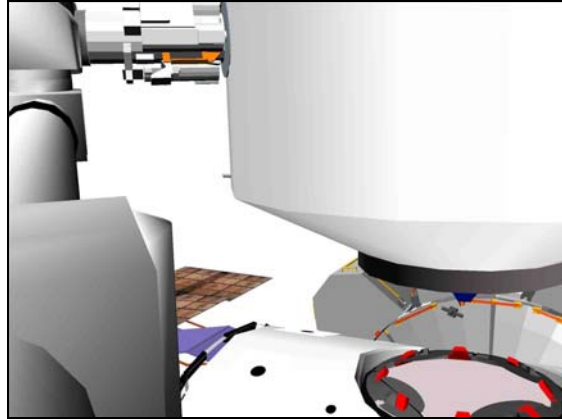


Figure 6.- MPLM Pre-Install
(24: Tip Elbow: 20, -15)

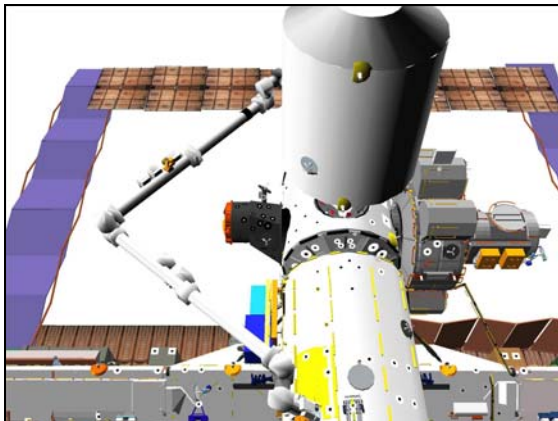


Figure 7.- MPLM Pre-Install
(91: Camera B: 0, 40)

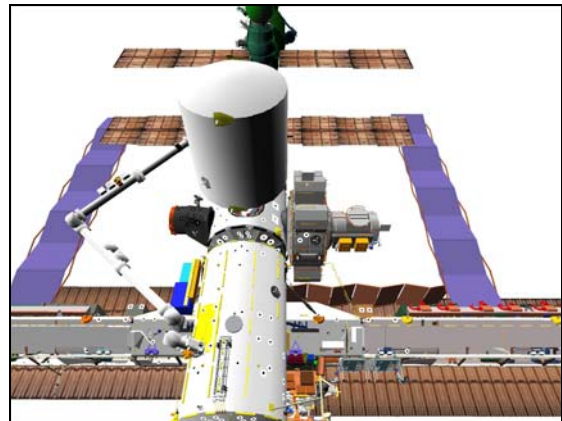


Figure 8.- MPLM Pre-Install
(91: Camera C: 0, 40)

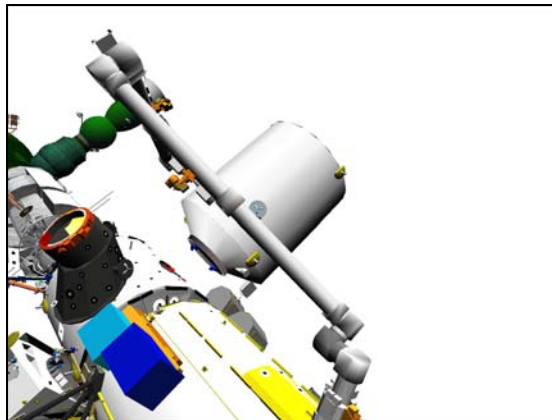


Figure 9.- MPLM Pre-Install
(V10: SRMS Elbow: 160, 40).

1.212 MPLM INSTALL

(RBT FS/LF1/FIN 1)

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PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at MPLM Pre-Install position (within 5 cm/1 deg).

	Locked					
SR	SY	SP	EP	WP	WY	WR
-8.5	+123.0	-146.4	+93.1	-83.7	-179.6	+53.3
X	Y	Z	Pitch	Yaw	Roll	
+130	0	0	0.0	0.0	0.0	
FOR	Loaded – MPLM CBCS, SY Held					
Disp	LAB>MPLM CBCS					

6. MPLM INSTALL SETUP

Verify {1.505 NODE 1 CBM VERIFY PRE-MATE STATUS}, all (SODF: S&M: NOMINAL: CBM) complete.

√CBCS setup complete.

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
22: Base Elbow (90, 0) 24: Tip Elbow (35, -20)	17: N1 Cam (CBCS)	91: Camera C (0, 40) 13: LAB Stbd Zenith (65, -30)	SRMS Elbow (160, 40) OBSS ITVC (85, -65)

7. ATTITUDE CONTROL CONFIGURATION

PCS MSS: SSRMS: Thrusters:

Verify 'Desat Request:' – Inh

If using shuttle attitude control, coordinate with shuttle crewmembers:

If attitude maintenance reqd:
 DAP: LVLH
 When rates damped:
 DAP: FREE > 2 seconds
 Then DAP: AUTO
 When in attitude:
 DAP: FREE

8. MANEUVERING MPLM TO READY-TO-LATCH POSITION

Monitor CBM RTLs using USOS Eff overlay.

CAUTION
Minimum distance between MPLM and Airlock ONTO during mnvr to RTL posn is 42 cm. Monitor clearance with Camera C or Lab Stbd Zenith Camera.

1.212 MPLM INSTALL

(RBT FS/LF1/FIN 1)

NOTE
 Monitor clearance between MPLM and MISSE.
 Minimum clearance during mnvr to RTL is 70 cm.

PCS

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: 0.5 (Verify 0.5)

MSS: SSRMS:

Verify 'Loaded Parameters' (two) – MPLM CBCS, SY Held

Verify Display – LAB>MPLM CBCS

Verify Command – SSRMS>Internal

√Vernier

Enter Mode – Manual (Verify – blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

THC/
RHC

Maneuver MPLM to Install position until RTL (four) – green

PCS

Expected Ready-To-Latch position:

	Locked					
SR	SY	SP	EP	WP	WY	WR
+3.1	+123.0	-137.9	+95.4	-85.0	-184.3	+57.5
X	Y	Z	Pitch	Yaw	Roll	
+11	0	0	0.0	0.0	0.0	
FOR	Loaded – MPLM CBCS, SY Held					
Disp	LAB>MPLM CBCS					

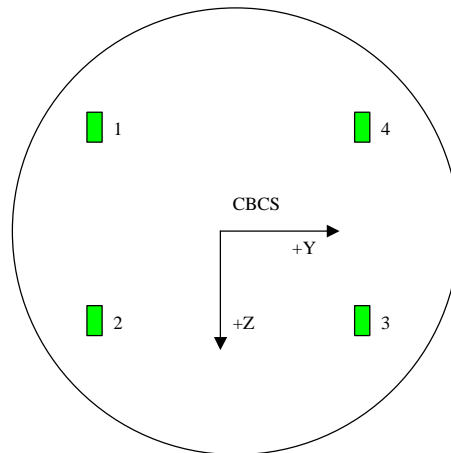


Figure 10.- RTL Diagram.

PCS

MSS: SSRMS:

Verify Posn Hold – orange

Notify CBM operator, “Maneuver to RTL complete, GO for First Stage Capture.”

9. FIRST STAGE CAPTURE

Verify {1.506 NODE 1 CBM CAPTURE/ABOLT }, steps 1 to 3 (SODF: S&M: NOMINAL: CBM) complete.

On CBM Operator “GO for SSRMS Limp Mode”:

PCS

Enter Mode – Standby (Verify blue)

MSS: SSRMS: Limp:

cmd All Limp (Verify Limp – blue)

MSS: SSRMS:

Verify all joints – Limped

NOTE

Following SSRMS Mode to Limp, closed RTLs may open due to RTL spring forces. RTL closed indication is not required prior to execution of second stage capture (for latches used during first stage capture).

Notify CBM operator, “SSRMS mode to Limp complete, GO for Second Stage Capture.”

1.212 MPLM INSTALL

(RBT FS/LF1/FIN 1)

10. SECOND STAGE CAPTURE

WARNING
Continuation of Second Stage Capture if SSRMS fails to brakes-on from limp mode may cause structural failure of SSRMS or primary structure. If CBM stops unexpectedly (and Cmd Code changes to 'Stop'), \surd MCC-H before proceeding.

NOTE
If the SSRMS safes during Second Stage Capture, \surd MCC-H before proceeding.

Verify {1.506 NODE 1 CBM CAPTURE/ABOLT}, steps 4 to 6 (SODF: S&M: NOMINAL: CBM) complete.

On CBM operator "GO for SSRMS brakes on, can ungrapple element per timeline":

DCP BRAKES SSRMS → ON (Verify – ON)

PCS Expected MPLM Install Position joint angles and FOR.

SR	SY	SP	EP	WP	WY	WR
+4.2	+123.0	-137.0	+95.6	-85.1	-184.7	+57.9
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded – MPLM CBCS, SY Held					
Disp	LAB>MPLM CBCS					

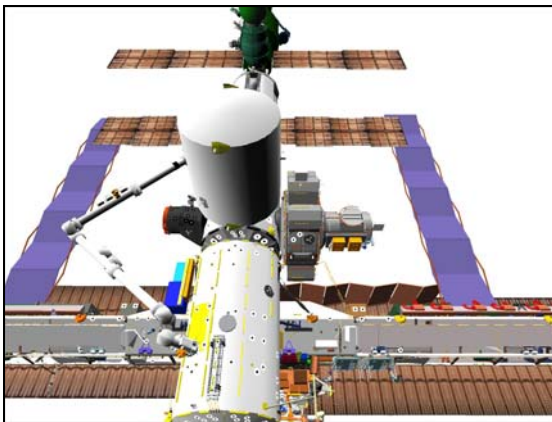


Figure 11.- MPLM Install Position (91: Camera C: 0, 40).

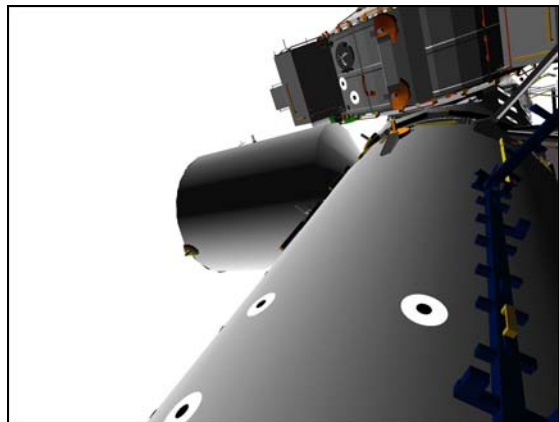


Figure 12.- MPLM Install Position (13: LAB Stbd Zenith: 65, -30).

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(RBT FS/LF1/FIN 1)

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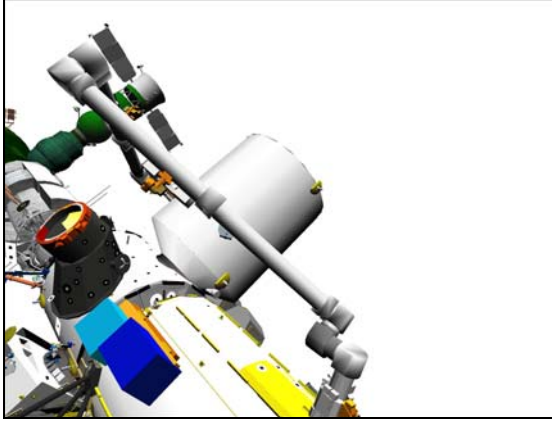


Figure 13.- MPLM Install Position
(V10: SRMS Elbow: 160, 40).

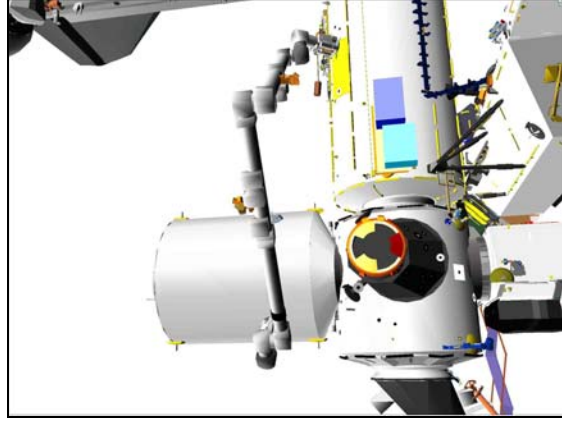


Figure 14.- MPLM Install Position
(92: OBSS ITVC: 85, -65).

11. CLEANUP AND ATTITUDE CONTROL CONFIGURATION

Bring up CBCS image and CBCS overlay on any RWS monitor and take photograph of RWS monitor for ground analysis.

If using shuttle attitude control, coordinate with shuttle crewmembers:

Config DAP B to B12

DAP: LVLH

When rates damped:

DAP: FREE > 2 seconds

Then DAP: AUTO

1.213 MATED MPLM UNGRAPPLE

(RBT FS/LF1/FIN 1/SPN)

Page 1 of 3 pages

1. SETUP

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
22: Base Elbow (110, -5) 24: Tip Elbow (0,0)	25: Tip LEE	91: Camera B (0, 40)	OBSS ITVC (85, -65) SRMS Elbow (160, 40)

PCS

MSS: SSRMS:

Verify Loaded Parameters – √

Verify 'Unloaded Parameters' (two) – LEE Tip, SY Held

Change Display ► ISS ► ISSACS (Verify ISS>ISSACS)

Verify Command – SSRMS>Internal

√Vernier

PCS

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: as required

DCP

BRAKES SSRMS → OFF (Verify – OFF)

2. MPLM UNGRAPPLE

2.1 SSRMS Limp

PCS

MSS: SSRMS: Limp:

cmd All Limp (Verify Limp – blue)

MSS: SSRMS:

Verify all joints – Limped

2.2 Auto Release

MSS: SSRMS: Tip LEE:

cmd Release ► Automatic ► Slow (Verify Speed – Slow)

Verify 'Confirm or Terminate' prompt.

CAUTION

Due to end-to-end system latency, the RHC Trigger is hot up to 3 seconds prior to receiving a Trigger Hot icon status on the PCS.

1.213 MATED MPLM UNGRAPPLE

(RBT FS/LF1/FIN 1/SPN)

Page 2 of 3 pages

NOTE

Once the trigger is hot, only safing or trigger commands should be sent to the Robotics equipment. If a configuration change is required, including routing MSS Cameras, safe the system to exit LEE operations. (SCR 23262, 14662)

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Auto Release

RHC TRIGGER → press (momentarily)

PCS
 Verify 'Carriage' Derigidize – blue (90 s max)
 Verify 'Snare' Open – blue (12 s max)
 Verify 'Carriage' Extend – blue (90 s max)

2.3 SSRMS Backoff

MSS: SSRMS: Limp: SSRMS Limp

cmd None Limp (Verify Standby – blue)

MSS: SSRMS: SSRMS

Verify Unloaded Parameters – √

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock: Joint Lock

cmd Shoulder Yaw (Verify SY – Locked)

THC/
RHC
 Maneuver to Mated MPLM Pre-Grapple position (within 5 cm/1 deg).

		Locked				
SR	SY	SP	EP	WP	WY	WR
+3.1	+123.0	-135.6	+81.2	-73.0	-184.2	+57.5
X	Y	Z	Pitch	Yaw	Roll	
-734	-243	+899	-0.1	+40.1	+150.1	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>ISSACS					

DCP BRAKES SSRMS → ON (Verify – ON)

1.213 MATED MPLM UNGRAPPLE

(RBT FS/LF1/FIN 1/SPN)

Page 3 of 3 pages

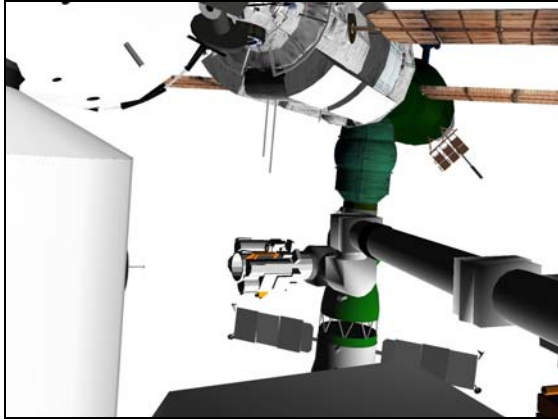


Figure 1.- Mated MPLM Pre-Grapple
(22: Base Elbow: 110, -5).



Figure 2.- Mated MPLM Pre-Grapple
(24: Tip Elbow: 0, 0).

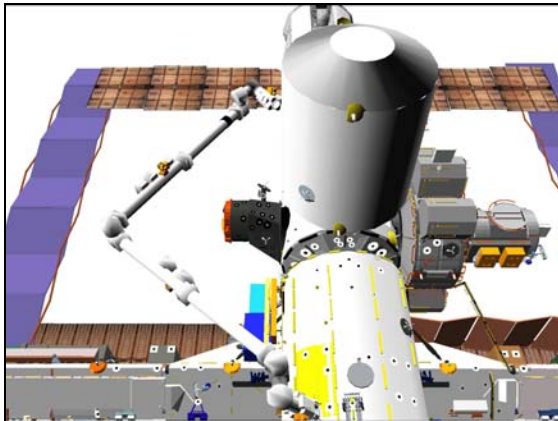


Figure 3.- Mated MPLM Pre-Grapple
(91: Camera B: 0, 40).

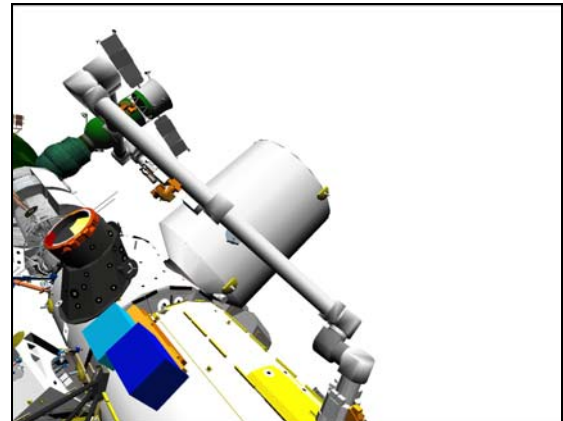


Figure 4.- Mated MPLM Pre-Grapple
(V10: SRMS Elbow: 160, 40).

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1.220 MNVR TO MATED MPLM PRE-GRAPPLE SETUP

(RBT FS/LF1/FIN 1/SPN) Page 1 of 6 pages

1. SETUP

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
91: Camera C (10, 35)	13: LAB Stbd Zenith (50, 0) 92: Camera D (-60, 60)	22: Base Elbow (-90, -25) 24: Tip Elbow (-10, 25)	OBSS ITVC (100, -65) SRMS Elbow (170, 35)

PCS

MSS: SSRMS:

Verify Unloaded Parameters – √

Verify 'Unloaded Parameters' (two) – LEE Tip, SY Held

Verify Display – ISS>ISSACS

Verify SSRMS at Grapple Fixture Backoff position (within 5 cm/2 deg).

SR	SY	SP	EP	WP	WY	WR
-82.3	-23.2	-87.4	-115.6	-176.0	-65.7	-70.1
X	Y	Z	Pitch	Yaw	Roll	
+244	+500	+565	+179.9	0.0	+179.7	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>ISSACS					

2. MANEUVERING TO JOCAS START POSITION

DCP

BRAKES SSRMS → OFF (Verify OFF)

RHC

RATE – as required (VERNIER within 1.5 m of structure)

PCS

MSS: SSRMS:

Enter Mode – Single (Verify blue)

WARNING

The active joint must be checked on the PCS before initiating motion. Failure to do so may result in movement of the wrong joint.

NOTE

Coarse rates may be used starting at EP: -90.0.

1.220 MNVR TO MATED MPLM PRE-GRAPPLE SETUP

(RBT FS/LF1/FIN 1/SPN) Page 2 of 6 pages

THC Perform Single Joint maneuver to JOCAS Start position (within 1 deg).

	SR	SY	SP	EP	WP	WY	WR
Backoff	-82.3	-23.2	-87.4	-115.6	-176.0	-65.7	-70.1
1: EP +				-50.0			
2: SP +			-20.0				
JOCAS Start	-82.3	-23.2	-20.0	-50.0	-176.0	-65.7	-70.1
	X	Y	Z	Pitch	Yaw	Roll	
	-359	+68	+1824	+135.7	-3.7	+49.2	
FOR	Unloaded – LEE Tip, SY Held						
Disp	ISS>ISSACS						

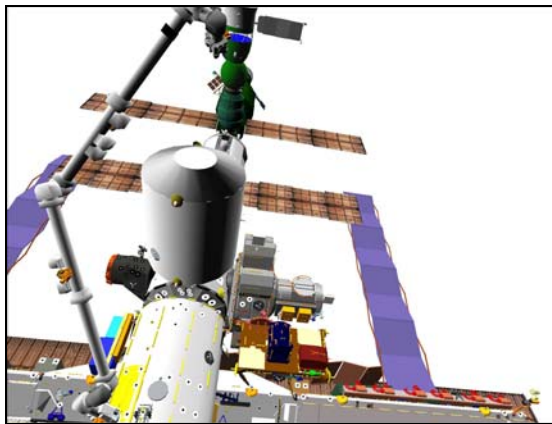


Figure 1.- JOCAS Start
(91: Camera C: 10, 50).

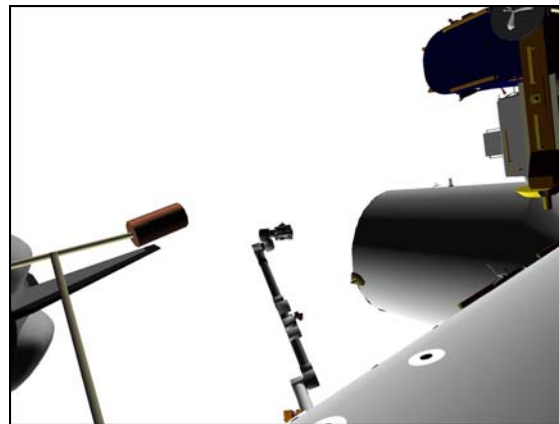


Figure 2.- JOCAS Start
(13: LAB Stbd Zenith: 35, -25).

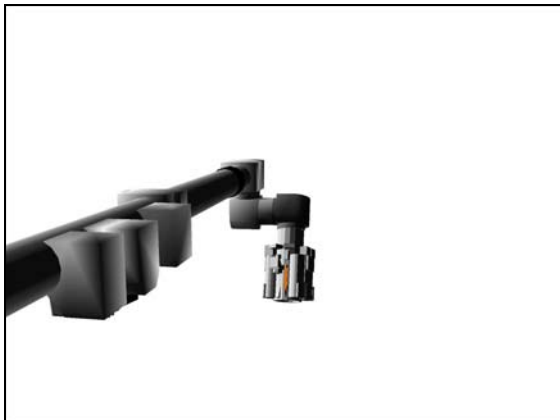


Figure 3.- JOCAS Start
(22: Base Elbow: -140, -10).



Figure 4.- JOCAS Start
(V10: OBSS ITVC: 100, -65).

1.220 MNVR TO MATED MPLM PRE-GRAPPLE SETUP

(RBT FS/LF1/FIN 1/SPN) Page 3 of 6 pages

3. JOCAS TO PRE-GRAPPLE SETUP POSN

RHC RATE → VERNIER (Verify Vernier on PCS)

PCS MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
91: Camera C (0, 50)	92: Camera A (30, 60)	22: Base Elbow (-130, -20)	OBSS ITVC (100, -65)

Input 'Joint Angles' 'Destination' for Mated MPLM Pre-Grapple Setup position.

SR	SY	SP	EP	WP	WY	WR
-7.2	+1.4	-20.0	-50.0	-123.3	+37.7	+102.3

NOTE
The Target and Error fields on the SSRMS Joint OCAS display will not be correct. This data should be verified and monitored on the Joint Angle Position overlay. (SCR 31169)

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON Verify joint angles and errors are correct on Joint Angle Position overlay.

	SR	SY	SP	EP	WP	WY	WR
(current)	-82.3	-23.2	-20.0	-50.0	-176.0	-65.7	-70.1
TGT	-7.2	+1.4	-20.0	-50.0	-123.3	+37.7	+102.3
ERR	-75.1	-24.6	0.0	0.0	-52.7	-103.4	-172.4

PCS * If joint angles/errors are incorrect
* **cmd** Cancel (Verify Sequence Status – Waiting Destination)

* Input correct Dest joint angles per table above.

* **cmd** Load (Verify Sequence Status – Confirm or Cancel)

MON * Verify joint angles and errors are correct on Joint Angle Position overlay.

PCS **cmd** Confirm (Verify Sequence Status – Auto Seq sw - Hot)

DCP AUTO SEQ → PROC

1.220 MNVR TO MATED MPLM PRE-GRAPPLE SETUP

(RBT FS/LF1/FIN 1/SPN) Page 4 of 6 pages

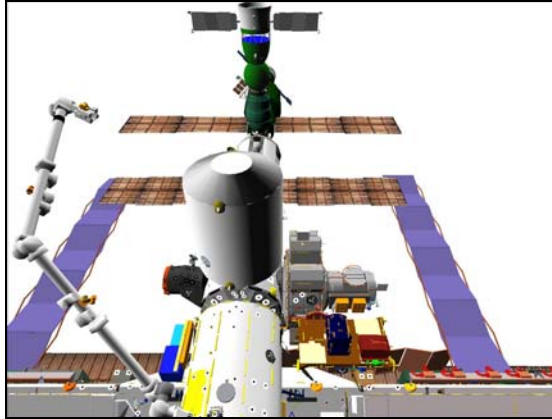


Figure 5.- Mated MPLM Pre-Grapple Setup
(91: Camera C: 0, 50).

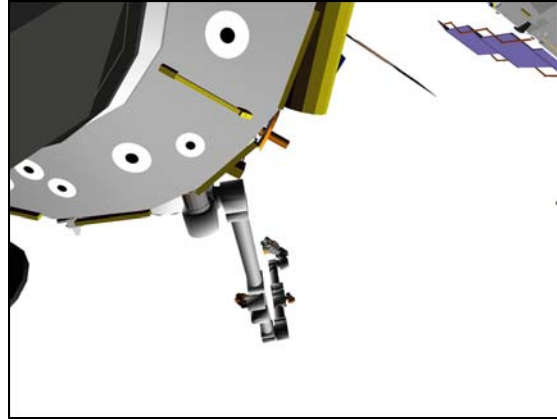


Figure 6.- Mated MPLM Pre-Grapple Setup
(92: Camera A: 30, 60).

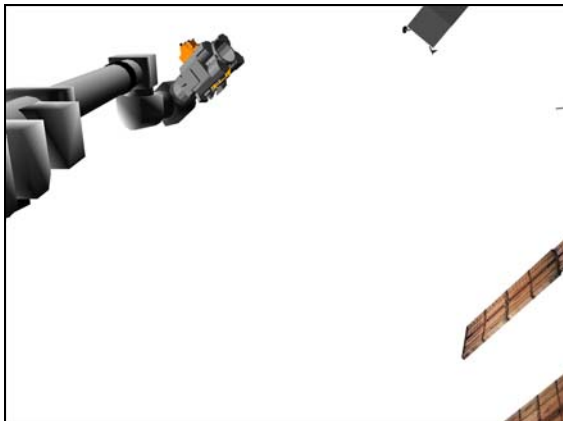


Figure 7.- Mated MPLM Pre-Grapple Setup
(22: Base Elbow: -130, -20).



Figure 8.- Mated MPLM Pre-Grapple Setup
(V10: OBSS ITVC: 100, -65)

PCS

MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at Mated MPLM Pre-Grapple Setup position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-7.2	+1.4	-20.0	-50.0	-123.3	+37.7	+102.3
X	Y	Z	Pitch	Yaw	Roll	
-672	-657	+1450	+47.4	+68.0	+140.4	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>ISSACS					

1.220 MNVR TO MATED MPLM PRE-GRAPPLE SETUP

(RBT FS/LF1/FIN 1/SPN) Page 5 of 6 pages

4. JOCAS TO MATED MPLM PRE-GRAPPLE POSN

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
91: Camera B (0, 45)	92: SRMS Elbow (150, 45)	22: Base Elbow (-120, 0)	OBSS ITVC (100, -65)

SSRMS Joint OCAS

Input 'Joint Angles' 'Destination' for Mated MPLM Pre-Grapple position.

SR	SY	SP	EP	WP	WY	WR
-7.2	+1.4	-39.2	-79.0	-123.3	+37.7	+102.3

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON

Verify joint angles and errors are correct on Joint Angle Position overlay.

	SR	SY	SP	EP	WP	WY	WR
(current)	-7.2	+1.4	-20.0	-50.0	-123.3	+37.7	+102.3
TGT	-7.2	+1.4	-39.2	-79.0	-123.3	+37.7	+102.3
ERR	0.0	0.0	+19.2	+29.0	0.0	0.0	0.0

PCS

* If joint angles/errors are incorrect

* **cmd** Cancel (Verify Sequence Status – Waiting Destination)

* Input correct Dest joint angles per table above.

* **cmd** Load (Verify Sequence Status – Confirm or Cancel)

MON

* Verify joint angles and errors are correct on Joint Angle Position overlay.

PCS

cmd Confirm (Verify Sequence Status – Auto Seq sw - Hot)

DCP

AUTO SEQ → PROC

1.220 MNVR TO MATED MPLM PRE-GRAPPLE SETUP

(RBT FS/LF1/FIN 1/SPN) Page 6 of 6 pages

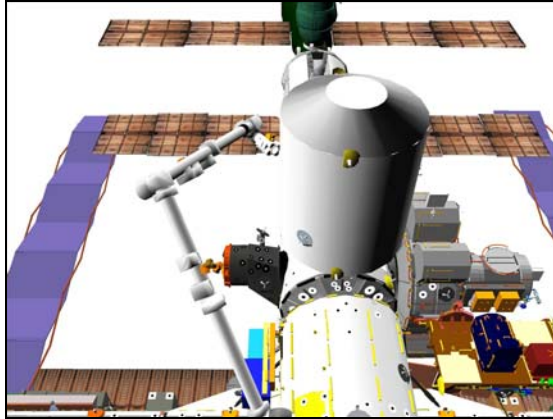


Figure 9.- MPLM Pre-Grapple
(91: Camera B: 0, 45).

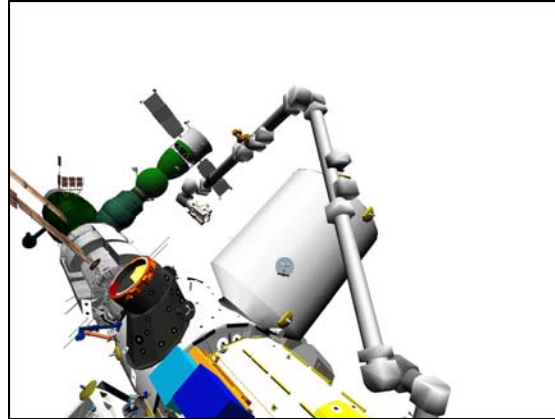


Figure 10.- MPLM Pre-Grapple
(92: SRMS Elbow: 150, 45).

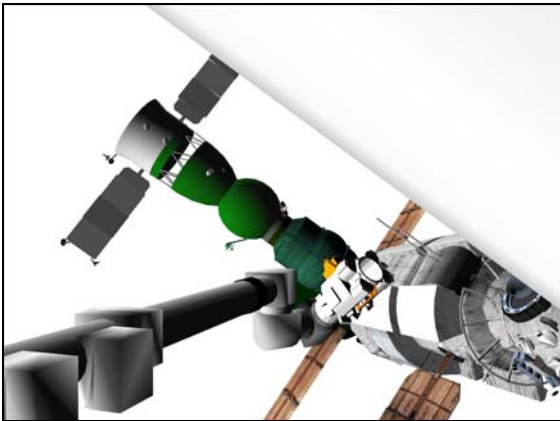


Figure 11.- MPLM Pre-Grapple
(22: Base Elbow: -120, 0).



Figure 12.- MPLM Pre-Grapple
(V10: OBSS ITVC: 100, -65).

PCS

MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at Mated MPLM Pre-Grapple position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-7.2	+1.4	-39.2	-79.0	-123.3	+37.7	+102.3
X	Y	Z	Pitch	Yaw	Roll	
-734	-244	+900	-0.1	+40.1	+150.1	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>ISSACS					

DCP

BRAKES SSRMS → ON (Verify ON)

1.221 MATED MPLM GRAPPLE

(RBT FS/LF1/FIN 1/SPN) Page 1 of 4 pages

1. SETUP

NOTE

Although the FRGF is blocked by the Tip Boom in the Tip Elbow Camera view, it will come into view as you maneuver in to grapple. The Tip Elbow will provide the necessary orthogonal view.

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
91: Camera B (0, 45)	25: Tip LEE	24: Tip Elbow (-23, -4)	SRMS Elbow (150, 45) OBSS ITVC (100, -65)

PCS

MSS: SSRMS:

Change Loaded Parameters ► MPLM ► MPLM Berth SYH
Verify 'Loaded Parameters' (two) – MPLM Berth, SY Held

Verify Unloaded Parameters – ✓

Verify 'Unloaded Parameters' (two) – LEE Tip, SY Held

Change Display ► LAB ► MPLM Berth (Verify LAB>MPLM Berth)

Verify Command – SSRMS>Internal

Verify SSRMS at Mated MPLM Pre-Grapple position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-7.2	+1.4	-39.2	-79.0	-123.3	+37.7	+102.3
X	Y	Z	Pitch	Yaw	Roll	
+845	-243	-1726	-90.9	+40.1	+149.9	
FOR	Unloaded – LEE Tip, SY Held					
Disp	LAB>MPLM Berth					

MSS: SSRMS: Rate:

As required, Set 'Scale' 'Vernier' Rate Scale:

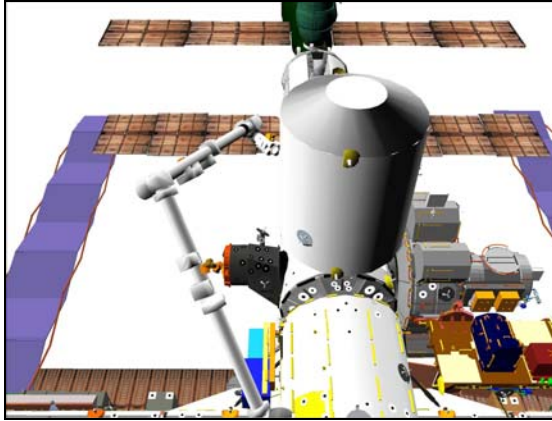


Figure 1.- Mated MPLM Pre-Grapple
 (91: Camera B: 0, 45).

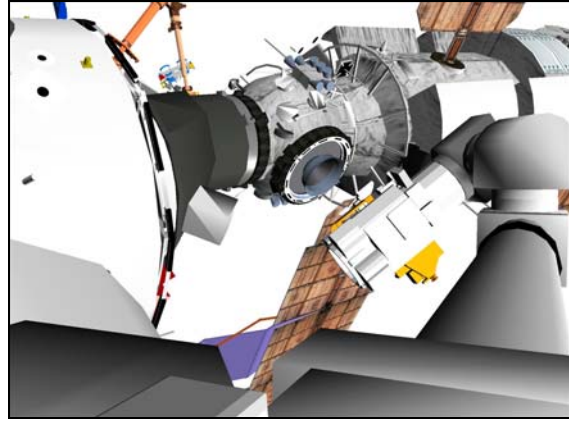


Figure 2.- Mated MPLM Pre-Grapple
 (24: Tip Elbow: -23, -4).

2. MATED MPLM GRAPPLE SETUP AND CAPTURE

2.1 Setup

NOTE

The LEE Camera must be fully zoomed out to correspond to the target overlay.

DCP BRAKES SSRMS → OFF (Verify OFF)

PCS MSS: SSRMS:

Enter Mode – Manual (Verify – blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

2.2 Slow Capture Commands

MSS: SSRMS: Tip LEE:

cmd Capture ► Automatic ► Slow, Limp (Verify Speed – Slow)

Verify '**Confirm or Terminate**' prompt.

CAUTION

Due to end-to-end system latency, the RHC Trigger is hot up to 3 seconds prior to receiving a Trigger Hot icon status on the PCS.

NOTE

Once the trigger is hot, only safing or trigger commands should be sent to the Robotics equipment. If a configuration change is required, including routing MSS Cameras, safe the system to exit LEE operations. (SCR 23262, 14662)

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Auto Capture

RHC/
THC 2.3 MANEUVERING TO WITHIN GRAPPLE ENVELOPE
 Maneuver to within grapple envelope.

RHC 2.4 GRAPPLE TRIGGER → press (momentarily)

PCS Verify 'Snare' Close, Capture (two) – blue (12 s max)
 Verify Capture to Latch – No (SCR 19282)
 Verify 'Carriage' Tension ~5500 N (90 s max)
 Verify 'Carriage' Retract – blue

2.5 GRAPPLE CLEANUP

MSS: SSRMS:

Verify Posn Hold - orange

Verify Loaded Parameters – √
 Verify 'Loaded Parameters' (two) – MPLM Berth, SY Held

Expected Mated MPLM Grapple joint angles and FOR.

SR	SY	SP	EP	WP	WY	WR
-12.1	+1.4	-34.0	-93.7	-111.9	+41.9	+99.1
X	Y	Z	Pitch	Yaw	Roll	
+722	-35	-1439	-0.9	-0.2	-89.9	
FOR	Loaded – MPLM Berth, SY Held					
Disp	LAB>MPLM Berth					

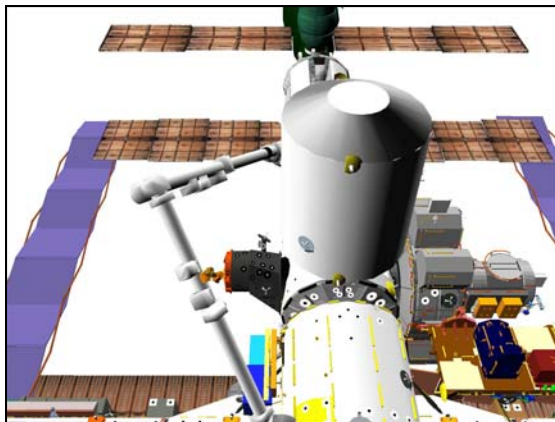


Figure 3.- Mated MPLM Grapple
 (91: Camera B: 0, 45).

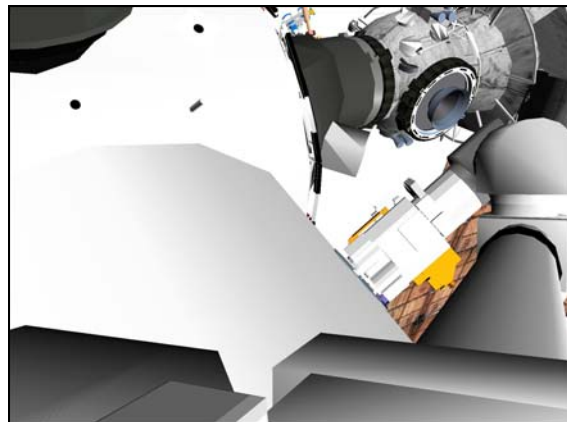


Figure 4.- Mated MPLM Grapple
 (24: Tip Elbow: -23, -4).

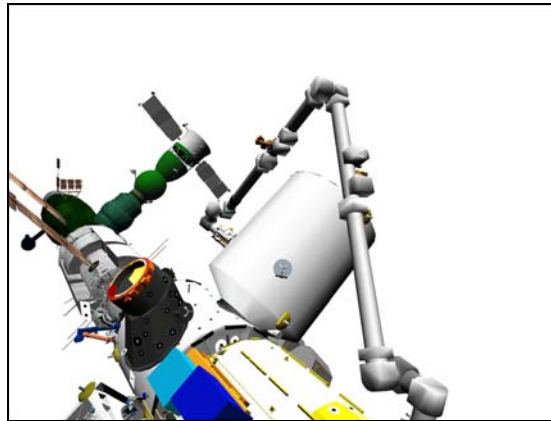


Figure 5.- Mated MPLM Grapple
(V10: SRMS Elbow: 150, 45).

3. CLEANUP

NOTE

Expect the following message when safing is commanded:
**'R3Z - MSS OCS SSRMS Prime(Redun) ACU SRT Cat-1 Brk Stat
Fail'** (SCR 17495)
This message should return to Norm.

DCP SAFING → SAFE (Verify ON)

ODS
Hatch Disconnect V10 Cables.

1.222 MPLM UNINSTALL

(RBT FS/LF1/FIN 1/SPN) Page 1 of 6 pages

1. HAND CONTROLLER CALIBRATION

1.1 Translational Hand Controller (THC) Calibration

THC

- Deflect [X] Axis to positive hard stop where [X] =
- Deflect [X] Axis to negative hard stop.
- Repeat

1.2 Rotational Hand Controller (RHC) Calibration

RHC

- Deflect [X] Axis to positive hard stop where [X] =
- Deflect [X] Axis to negative hard stop.
- Repeat

2. SETUP FOR UNINSTALL

Verify SRMS is in the MPLM VIEWING position.

ODS
Hatch

√V10 Cables Connected

Review {[SSRMS LEE CUE CARD](#)}, all (SODF: RBT GEN: REFERENCE).

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
22: Base Elbow (-80, 0)	91: Camera C (0, 50)	92: SRMS Elbow (150, 55)	OBSS ITVC (60, -55)
13: LAB Stbd Zenith (45, -30)	91: Camera A (0, 60)	09: P1 Lower Outboard (-20, 10)	

PCS

MSS: SSRMS:

Verify Display – LAB>MPLM Berth

Change Command ► ISS ► ISSACS (Verify ISS>ISSACS)

√Vernier

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: 0.5 (Verify 0.5)

Verify {[1.509 NODE 1 CBM DEMATE](#)}, steps 1 to 9 (SODF: S&M: NOMINAL: CBM) complete

1.222 MPLM UNINSTALL

(RBT FS/LF1/FIN 1/SPN) Page 2 of 6 pages

3. MANEUVERING TO MPLM UNINSTALL

On CBM operator, "Steps 1 to 9 complete. GO for RMS translation per timeline."

Monitor CBM RTLs using USOS Eff overlay.

PCS MSS: SSRMS: SSRMS Safing:

cmd Remove (Verify Not Safed)

DCP BRAKES SSRMS → OFF (Verify OFF)

PCS MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

CAUTION

Minimum distance between MPLM and Airlock ONTO during mnvr to MPLM Uninstall posn is 42 cm. Monitor clearance with Camera C.

NOTE

If the MISSE was not removed from the ONTO during EVA, Monitor clearance between the MPLM and MISSE with Camera C. Minimum clearance is approximately 70 cm.

THC/
RHC Maneuver MPLM to X: +435 (+Z THC command) (MPLM Uninstall)
(within 5 cm/1 deg).

		Locked					
SR	SY	SP	EP	WP	WY	WR	
-20.8	+1.4	-26.6	-84.6	-123.9	+49.2	+92.5	
X	Y	Z	Pitch	Yaw	Roll		
+435	-34	-1444	-0.9	-0.2	-89.9		
FOR	Loaded – MPLM Berth, SY Held						
Disp	LAB>MPLM Berth						

1.222 MPLM UNINSTALL

(RBT FS/LF1/FIN 1/SPN) Page 3 of 6 pages

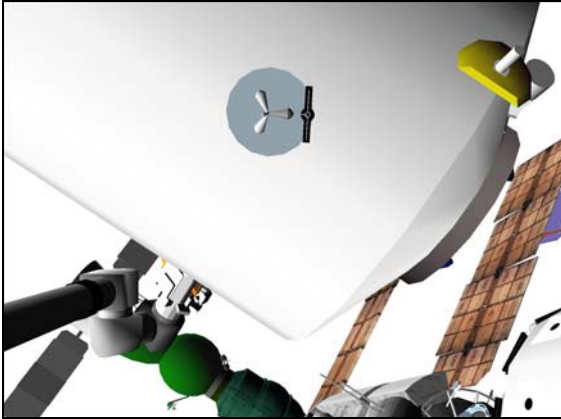


Figure 1.- MPLM Uninstall
(22: Base Elbow: -100, 0)

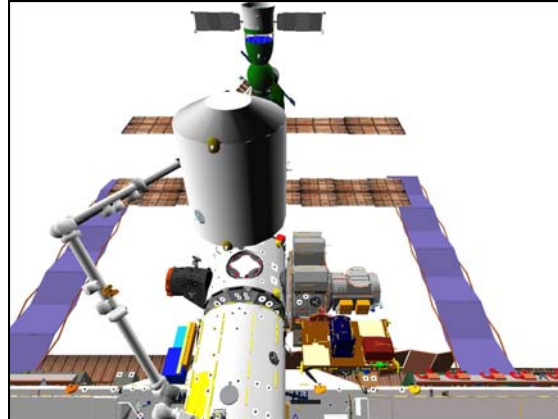


Figure 2.- MPLM Uninstall
(91: Camera C: 0, 50)

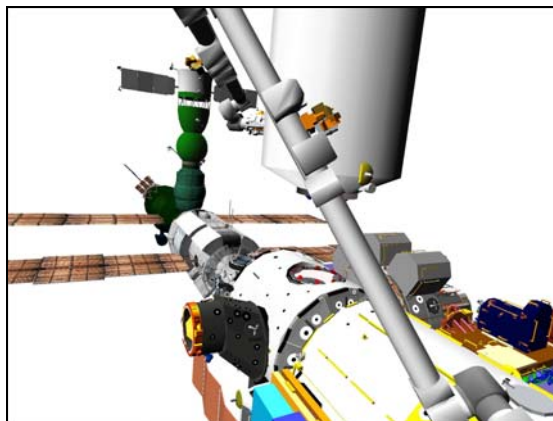


Figure 3.- MPLM Uninstall
(92: SRMS Elbow: 150, 65)

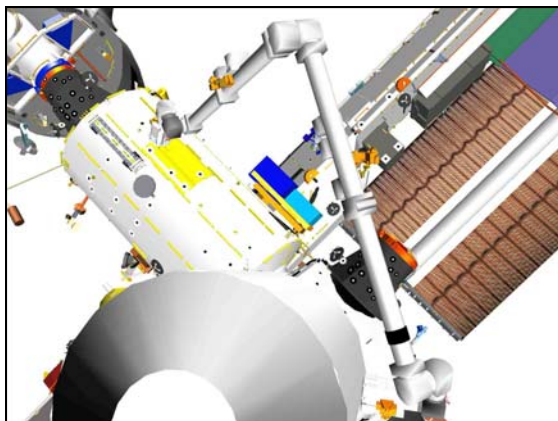


Figure 4.- MPLM Uninstall
(V10: OBSS ITVC: 60, -55)

Notify CBM operator, "SSRMS/MPLM is clear of structure, go to close CBM petals."

PCS MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: 1.0 (Verify 1.0)

4. ATTITUDE CONTROL CONFIGURATION

If using shuttle attitude control:

PCS MSS: SSRMS:

Enter Mode – Standby (Verify blue)

Coordinate with shuttle crewmembers

Temp edit ALT RATE DB

ALT RATE DB - ITEM 38 + 0.1 EXEC

1.222 MPLM UNINSTALL

(RBT FS/LF1/FIN 1/SPN) Page 4 of 6 pages

If attitude maintenance required:

DAP: LVLH

When rates damped:

DAP: FREE > 2 seconds

Then DAP: Auto

When in attitude:

DAP: FREE

5. ACTIVATING KEEL CAMERA

Give shuttle crew GO to activate KEEL CCTV.

NOTE

Steps in gray are performed by the shuttle crew to activate the MPLM keel Camera.

SSP2

cb SW PWR 3 (CB2) – cl

MPLM KEEL CAM PWR – ON

MPLM KEEL CAM HTR/ILLUM PWR – OFF, then ON for HI
(repeat for MED, LO, OFF)

6. JOCAS TO LOW HOVER POSITION

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
13: LAB Stbd Zenith (30, -30)	91: Camera C (0, 20)	92: SRMS Elbow (-140, 80) 09: P1 Lower Outboard (-20, 10)	OBSS ITVC (60, -55)

NOTE

JOCAS maneuver will take approximately 6 minutes.

RHC

RATE → COARSE (Verify Coarse on PCS)

PCS

MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

Input 'Joint Angles' 'Destination' for Low Hover position.

SR	SY	SP	EP	WP	WY	WR
-124.4	-42.0	+8.8	-103.0	-115.7	+73.5	+57.7

1.222 MPLM UNINSTALL

NOTE

The Target and Error fields on the SSRMS Joint OCAS display will not be correct. This data should be verified and monitored on the Joint Angle Position overlay. (SCR 31169)

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON Verify joint angles and errors are correct on Joint Angle Position overlay.

	SR	SY	SP	EP	WP	WY	WR
(current)	-20.8	+1.4	-26.6	-84.6	-123.9	+49.2	+92.5
TGT	-124.4	-42.0	+8.8	-103.0	-115.7	+73.5	+57.7
ERR	+103.6	+43.4	-35.4	+18.4	-8.2	-24.3	+34.8

PCS * If joint angles/errors are incorrect
 * **cmd** Cancel (Verify Sequence Status – Waiting Destination)
 *
 * Input correct Dest joint angles per table above.
 *
 * **cmd** Load (Verify Sequence Status – Confirm or Cancel)
 *
 MON * Verify joint angles and errors are correct on Joint Angle Position overlay.
 *

PCS **cmd** Confirm (Verify Sequence Status – Auto Seq sw - Hot)

DCP AUTO SEQ → PROC

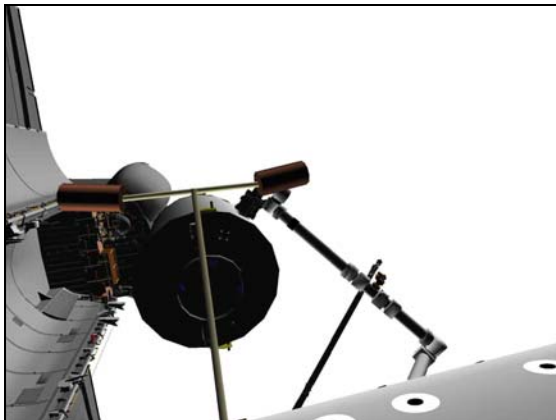


Figure 5.- MPLM Low Hover
(13: LAB Stbd Zenith: 15, -30).

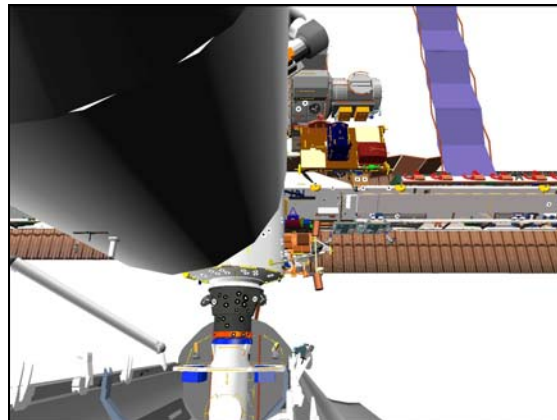


Figure 6.- MPLM Low Hover
(91: Camera C: 0, 20).

1.222 MPLM UNINSTALL

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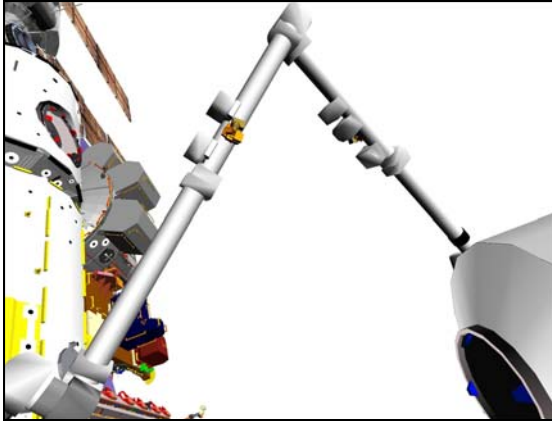


Figure 7.- MPLM Low Hover
(92: SRMS Elbow: -140, 60).

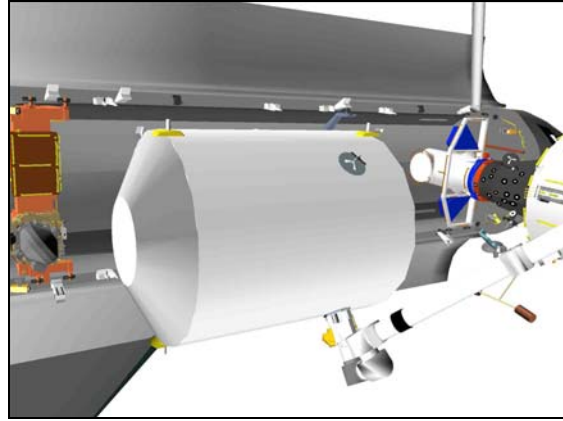


Figure 8.- MPLM Low Hover
(V10: OBSS ITVC: 115, -45).

PCS

MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at Low Hover position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-124.4	-42.0	+8.8	-103.0	-115.7	+73.5	+57.7
X	Y	Z	Pitch	Yaw	Roll	
0	0	-480	0.0	0.0	0.0	
FOR	Loaded – MPLM Berth, SY Held					
Disp	LAB>MPLM Berth					

DCP

BRAKES SSRMS → ON (Verify ON)

7. ATTITUDE CONTROL CONFIGURATION

If using shuttle attitude control, coordinate with shuttle crewmembers:

 | If attitude maintenance reqd:

 | DAP: LVLH

 | When rates damped:

 | DAP: FREE > 2 seconds

 | Then DAP: AUTO

1.223 MPLM BERTH

(RBT FS/LF1/FIN 1)

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1. SETUP FOR BERTH

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
13: LAB Stbd Zenith (-5, -35) 09: P1 Lower Outboard (20, 40)	91: Mux A (0, 0) /D (0, 0) 91: Keel Camera	92: Mux B (0, 0) /C (0, 0) 22: Base Elbow (-90, 0)	OBSS ITVC (115, -45)

PCS

MSS: SSRMS:

Verify Display – LAB>MPLM Berth

Change Command ► ISS ► OBAS (Verify ISS>OBAS)

√Vernier

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: 0.5 (Verify 0.5)

2. VERIFICATION OF DESAT

PCS

MSS: SSRMS: Thrusters:

Verify 'Desat Request:' – Inh

If using shuttle attitude control, coordinate with shuttle crewmembers:

| If DAP: AUTO, when in attitude:

| DAP: FREE

3. BERTHING MPLM

Verify shuttle crew standing by for MPLM PRLA tb – gray callouts during berth

Review digital pictures taken of the Keel Camera view after AKA and PRLAs were released during MPLM Unberth.

NOTE

Prior to latching the PRLAs, the following conditions must be met:

A6U PL RETEN RDY 1,2,3,4 tb (four) – gray

PCS Y = 0 (within 2.5cm)

DCP

BRAKES SSRMS → OFF (Verify – OFF)

PCS

MSS: SSRMS:

Enter Mode – Manual (Verify – blue)

1.223 MPLM BERTH

(RBT FS/LF1/FIN 1)

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MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

NOTE

1. Clearance between MPLM and CMG FSE at the fully berthed position is 36 cm.
2. Clearances between the MPLM and LMC/CMG/CMG FSE can be monitored using the OBSS ITVC. Clearance can be preserved by monitoring and maintaining alignment between trunnion pins and V-guides as well as Keel target during MPLM reberth.

THC/
RHC

Maneuver to MPLM Berthed position (Until shuttle callout of PL RETEN RDY 1,2,3,4 tb – gray).

PCS

MSS: SSRMS:

Verify MPLM Berth Posn (Y within 2.5cm)

	Locked					
SR	SY	SP	EP	WP	WY	WR
-148.3	-42.0	-3.4	-98.8	-33.6	+71.0	-2.5
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded – MPLM Berth, SY Held					
Disp	LAB>MPLM Berth					

Verify Posn Hold – orange



Figure 1.- MPLM Berthed
(13: Lab Stbd Zenith: -5, -35).

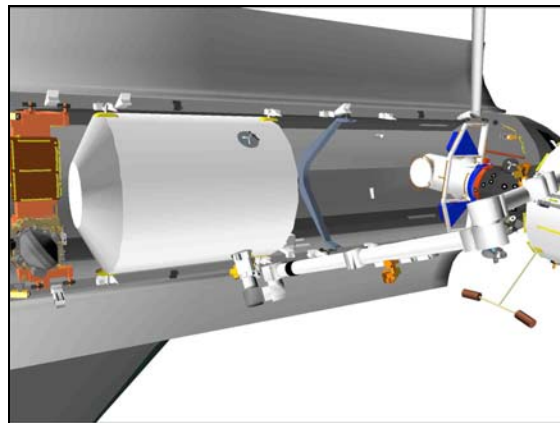


Figure 2.- MPLM Berthed
(V10: OBSS ITVC: 115, -45).

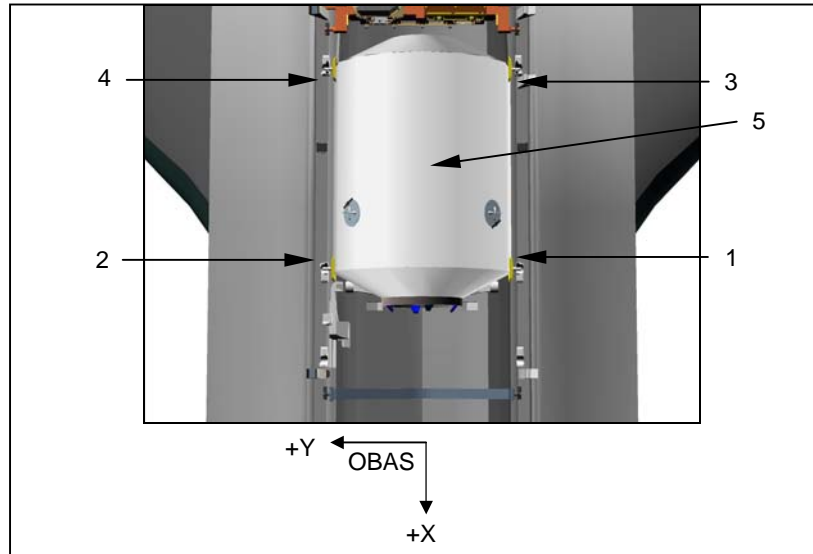


Figure 3.- MPLM PRLA Configuration

NOTE

Steps highlighted in gray are performed by the shuttle crew to latch MPLM PRLAs and AKA and mate ROEU.

4. PRLA SETUP

Give shuttle crew GO for PRLA Steps.

WARNING

An incorrect PRLA selection could cause structural damage/failure to the MPLM, SSRMS or Orbiter. PRLA selection should be verified by a minimum of two crewmembers.

A6U PL RETEN PL SEL – 1
 √RDY 1,2,3,4 tb (four) – gray
 √LAT 1,2,3,4 tb (four) – REL

SM 97 PL RETENTION

√RDY-FOR-LAT 1,2,3,4 (eight): 1
 √LAT 1,2,3,4,5 (ten): 0

 * If any LAT msw shows 1, expect single
 * motor time (60 seconds).

5. ACTIVATE LATCHES

R13L PL RETEN LOGIC PWR SYS 1,2 (two) – ON
 BAY MECH PWR SYS 1,2 (two) – ON

1.223 MPLM BERTH

(RBT FS/LF1/FIN 1)

6. AKA LATCH

A6U

√PL RETEN LAT 5 tb – REL

Note single motor drive times (> 30 seconds).

PL RETEN LAT 5 – LAT (tb-LAT), 60 s max
– OFF

√PL RETEN RDY 5 tb – gray

√PL RETEN RDY 1,2,3,4 tb (four) – gray

PCS

MSS: SSRMS:

Verify Posn Hold – orange

If any PL RETEN RDY tb – bp, √MCC for go to perform starred block

* A6U √PL RETEN LAT 5 tb – LAT

* Note single motor drive times (> 30 seconds)

*

* PL RETEN LAT 5 – REL (tb-REL), 60 s max
* – OFF

*

* PL RETEN LOGIC PWR SYS 1,2 (two) – OFF
*R13L BAY MECH PWR SYS 1,2 (two) – OFF

*

* Notify SSRMS Operator, AKA Released.

*

*THC/

Maneuver to MPLM Berthed position (Until shuttle callout of PL RETEN RDY 1,2,3,4 tb – gray).

*RHC

*

*PCS

MSS: SSRMS:

*

*

Verify MPLM Berth Posn (Y within 2.5cm)

*

*

*

*

*

*

*

*

*

*

*

*

	Locked					
SR	SY	SP	EP	WP	WY	WR
-148.3	-42.0	-3.4	-98.8	-33.6	+71.0	-2.5
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded – MPLM Berth, SY Held					
Disp	LAB>MPLM Berth					

Verify Posn Hold – orange

Go to step 5

1.223 MPLM BERTH

(RBT FS/LF1/FIN 1)

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7. PRLA LATCH

√PL RETEN RDY 1,2,3,4 tb (four) – gray

√LAT 1,2,3,4 tb (four) – REL

Note single motor drive times (> 30 seconds).

PL RETEN LAT 3,4 (two) – LAT (tb-LAT), 60 s max
– OFF

Verify PL RETEN RDY 1,2,3,4 tb (four) – gray

Give SSRMS operator GO for limping.

PCS

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

MSS: SSRMS: Limp:

cmd All Limp (Verify Limp – blue)

MSS: SSRMS:

Verify all joints – Limped

Give PRLA operator GO for forward latches.

PL RETEN LAT 1,2 (two) – LAT (tb-LAT), 60 s max
– OFF

8. DEACTIVATE LATCHES

R13L

PL RETEN LOGIC PWR SYS 1,2 (two) – OFF
BAY MECH PWR SYS 1,2 (two) – OFF

SSP2

9. DEACTIVATE MPLM KEEL CCTV

MPLM KEEL CAM HTR/ILLUM PWR – Toggle until illuminator OFF
(leave switch in ON position)

PWR – OFF

10. ROEU MATE

NOTE

The following will send the SSRMS Base Elbow Camera to the orbiter for ROEU mate viewing.

PCS

MSS: Video: VTR2

cmd BELB

1.223 MPLM BERTH

(RBT FS/LF1/FIN 1)

10.1 Setup CCTV – config for ROEU mate

A6U

Install ROEU A6U PANEL OVERLAY.

MON 1	PL2: SSRMS Base Elbow
MON 2	A

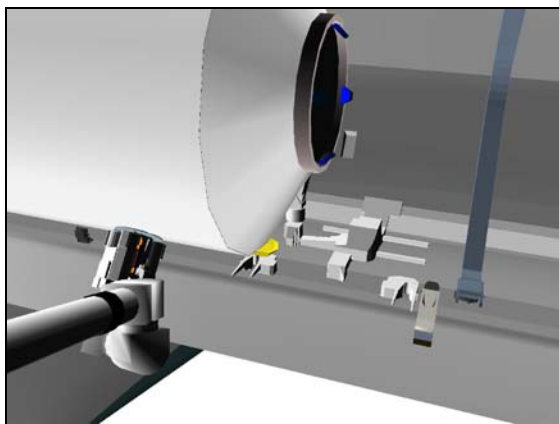


Figure 4.- ROEU Mate
(22: Base Elbow: -90, 0).

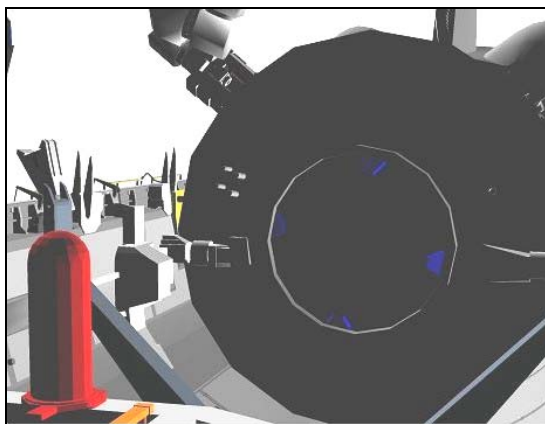


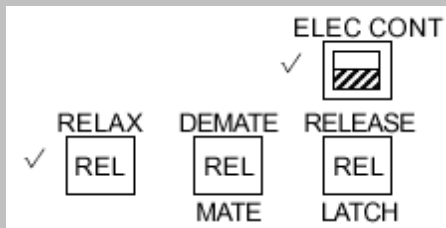
Figure 5.- ROEU Mate
(91: Camera A: -15, -5, f15).

PL RETEN PL SEL – 2

SM 97 PL RETENTION

√LAT 1,2,3 (six): 0

* If LATCH 2,3 LAT msw shows 1, drive latch
* for single motor time.



10.2 Verify ROEU Inhibits

SSP1

√MPLM CH 1,2 HTR PWR - OFF (tb-bp)

√APCU 1 OUTPUT RLY - OP (tb-bp)

10.3 Activate ROEU

A6U

PL RETEN LOGIC PWR SYS 1,2 (two) – ON

R13L

BAY MECH PWR SYS 1,2 (two) – ON

1.223 MPLM BERTH

(RBT FS/LF1/FIN 1)

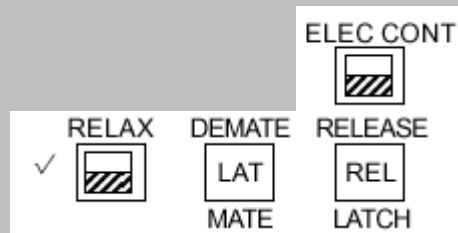
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10.4 Mate ROEU

Note single motor time (> 30 seconds).

A6U

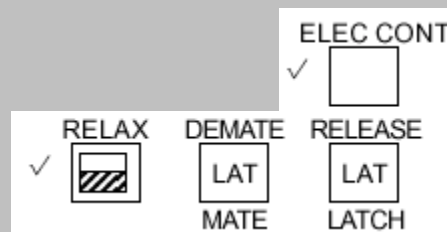
DEMATE/MATE – MATE (tb-LAT), 60 s max
– OFF



10.5 Latch Latches

Note single motor time (> 20 seconds).

RELEASE/LATCH – LATCH (tb-LAT), 40 s max
– OFF



10.6 Relax ROEU

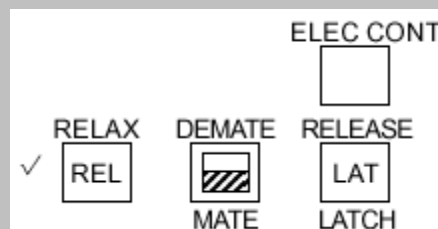
NOTE

Monitor PL SEL 2 LATCH 1 REL SYS msws on SPEC 97.

Note single motor time (> 12 seconds).

RELAX – RELAX (tb-REL), 24 s max

When LATCH 1 REL A(B) msw changes to 1
RELAX – OFF



10.7 Deactivate ROEU

A6U

PL RETEN LOGIC PWR SYS 1,2 (two) – OFF
PL SEL – MON

R13L

PL BAY MECH PWR SYS 1,2 (two) – OFF

1.223 MPLM BERTH

(RBT FS/LF1/FIN 1)

Page 8 of 8 pages

- DCP 11. CLEANUP AND ATTITUDE CONTROL CONFIGURATION
BRAKES SSRMS → ON (Verify – ON)

If using shuttle attitude control, coordinate with shuttle crewmembers:

Config DAP B to B12

DAP: LVLH

When rates damped:

 DAP: FREE > 2 seconds

 Then DAP: AUTO

1.224 BERTHED MPLM UNGRAPPLE
(RBT FS/LF1/FIN 1/SPN) Page 1 of 3 pages

1. SETUP

NOTE
MSS Effector Overlay will not appear on the monitor until the “confirm” command is sent to the LEE.

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
92: Camera C (0, 20) 91: Camera D (0, 5)	25: Tip LEE	22: Base Elbow (-90, 0)	OBSS ITVC (115, -45) SRMS Elbow (-130, 35)

PCS

MSS: SSRMS:

Verify Loaded Parameters – ✓

Verify ‘Unloaded Parameters’ (two) – LEE Tip, SY Held

Verify Display – LAB>MPLM Berth

Change Command ► SSRMS ► Internal (Verify SSRMS>Internal)

MSS: SSRMS: Rate:

Set ‘Scale’ ‘Vernier’ Rate Scale: as required

DCP

BRAKES SSRMS → OFF (Verify – OFF)

2. FRGF RELEASE

2.1 SSRMS Limp

PCS

MSS: SSRMS: Limp:

cmd All Limp (Verify Limp – blue)

MSS: SSRMS:

Verify all joints – Limped

2.2 AUTO Release

MSS: SSRMS: Tip LEE:

cmd Release ► Automatic ► Slow (Verify Speed – Slow)

Verify ‘**Confirm or Terminate**’ prompt.

CAUTION
Due to end-to-end system latency, the RHC Trigger is hot up to 3 seconds prior to receiving a Trigger Hot icon status on the PCS.

1.224 BERTHED MPLM UNGRAPPLE
 (RBT FS/LF1/FIN 1/SPN) Page 2 of 3 pages

NOTE

Once the trigger is hot, only safing or trigger commands should be sent to the Robotics equipment. If a configuration change is required, including routing MSS Cameras, safe the system to exit LEE operations. (SCR 23262, 14662)

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Auto Release

RHC TRIGGER → press (momentarily)

PCS Verify 'Carriage' Derigidize – blue (90 s max)
 Verify 'Snare' Open – blue (12 s max)
 Verify 'Carriage' Extend – blue (90 s max)

2.3 SSRMS Backoff

MSS: SSRMS: Limp:

cmd None Limp (Verify Standby – blue)

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

√Vernier

THC/
RHC Maneuver SSRMS to Berthed MPLM Pre-Grapple position
 (-X THC command) (within 5 cm/1 deg).

Locked						
SR	SY	SP	EP	WP	WY	WR
-136.0	-42.0	-9.9	-96.1	-65.4	+75.2	+25.9
X	Y	Z	Pitch	Yaw	Roll	
+120	+288	-207	-90.2	-49.9	+149.8	
FOR	Unloaded – LEE Tip, SY Held					
Disp	LAB>MPLM Berth					

DCP BRAKES SSRMS → ON (Verify ON)

1.224 BERTHED MPLM UNGRAPPLE
(RBT FS/LF1/FIN 1/SPN) Page 3 of 3 pages



Figure 1.- Berthed MPLM Pre-Grapple
(92: Camera C: 0, 20).

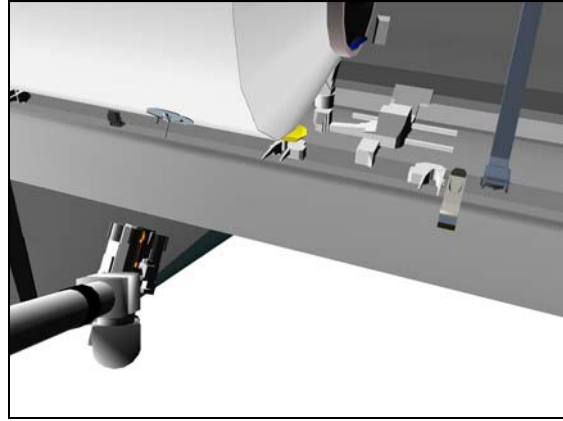


Figure 2.- Berthed MPLM Pre-Grapple
(22: Base Elbow: -90, 0).

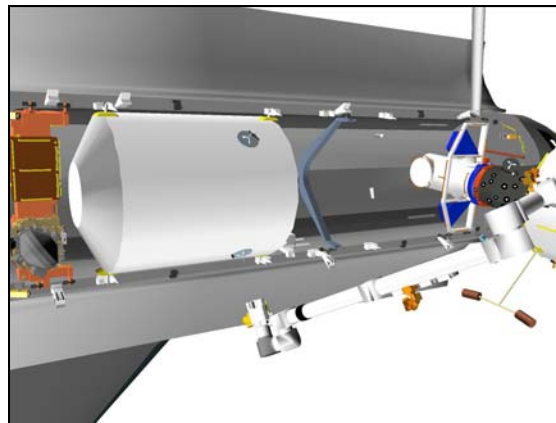


Figure 3- Berthed MPLM Pre-Grapple
(V10: OBSS ITVC: 115, -45).

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SRMS SURVEY SUPPORT

SRMS SURVEY
SUPPORT

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1.410 WS4 MBS PDGF 1 GRAPPLE
 (RBT FS/LF1/FIN 1/SPN) Page 1 of 13 pages

1. SETUP

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
24: Tip Elbow (0, 0)	92: Camera A (40, 50)	91: Camera B (-20, 40)	SRMS Elbow (115, 50)
22: Base Elbow (100, -10)			OBSS ITVC (100, -65)

PCS

MSS: SSRMS:

Change Loaded Parameters ► Walk Off ► MBS PDGF 1
 Verify 'Loaded Parameters' (two) – MBS PDGF 1, SR Held

Verify Unloaded Parameters – √

Change Unloaded Parameters ► Unloaded ► LEE Tip SRH
 Verify 'Unloaded Parameters' (two) – LEE Tip, SR Held

Change Display ► ISS ► W4MBS PDGF 1 (Verify ISS>W4MBS PDGF 1)

Verify Command – SSRMS>Internal

√Vernier

Verify SSRMS at Mated MPLM Pre-Grapple position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+3.1	+123.0	-135.6	+81.2	-73.0	-184.2	+57.5
X	Y	Z	Pitch	Yaw	Roll	
+1022	+861	+711	+175.4	-15.4	+24.7	
FOR	Unloaded – LEE Tip, SR Held					
Disp	ISS>W4MBS PDGF 1					

2. MANEUVERING TO MPLM CLEARANCE POSITION

DCP

BRAKES SSRMS → OFF (Verify OFF)

PCS

MSS: SSRMS:

Enter Mode – Single (Verify blue)

WARNING
The active joint must be checked on the PCS before initiating motion. Failure to do so may result in movement of the wrong joint.

1.410 WS4 MBS PDGF 1 GRAPPLE
 (RBT FS/LF1/FIN 1/SPN) Page 2 of 13 pages

THC Perform Single Joint maneuver to MPLM Clearance position (within 1 deg).

	SR	SY	SP	EP	WP	WY	WR
Pre-Grapple	+3.1	+123.0	-135.6	+81.2	-73.0	-184.2	+57.5
1: SP -			-160.0				
2: EP -				+40.0			
3: SY +		+150.0					
MPLM Clearance	+3.1	+150.0	-160.0	+40.0	-73.0	-184.2	+57.5
	X	Y	Z	Pitch	Yaw	Roll	
	+1320	+1621	+380	-111.9	-64.6	+63.3	
FOR	Unloaded – LEE Tip, SR Held						
Disp	ISS>W4MBS PDGF 1						

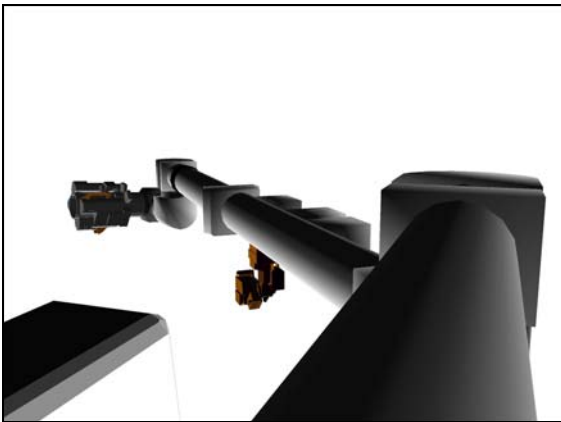


Figure 1.- MPLM Clearance
 (22: Base Elbow: 160, -10).

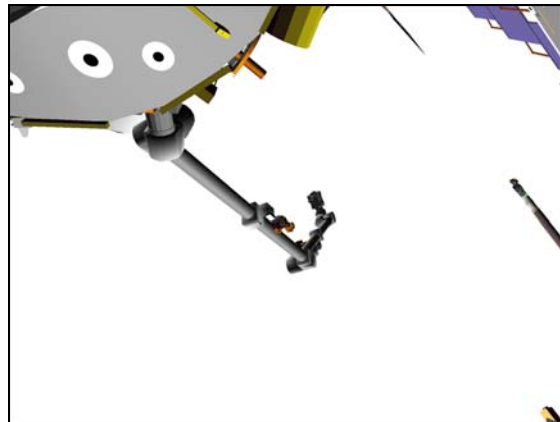


Figure 2.- MPLM Clearance
 (92: Camera A: 40, 50).

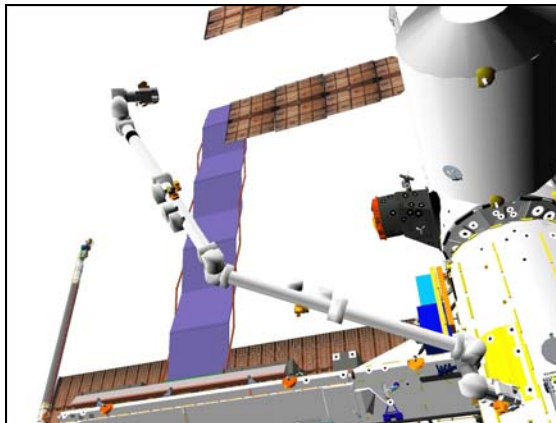


Figure 3.- MPLM Clearance
 (91: Camera B: -20, 40).

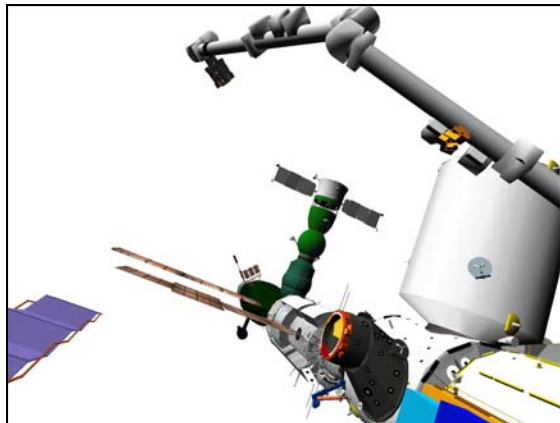


Figure 4.- MPLM Clearance
 (V10: SRMS Elbow: 115, 50).

3. MBS GRAPPLE JOCAS 1

PCS MSS: SSRMS: SSRMS

Enter Mode – Joint OCAS (Verify blue)

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
22: Base Elbow (160, -10) 13: LAB Stbd Zenith (40, -30)	92: Camera C (-20, 60)	91: SRMS Elbow (140, 50)	OBSS ITVC (100, -65) Camera A (40, 50)

NOTE
 Expect singularity warning for EP between -15 and +15 deg.

SSRMS Joint OCAS

pick File ► LAB ► MBS Grapple JOCAS 1

Verify 'Joint Angles' 'Destination' for MBS Grapple JOCAS 1 position.

SR	SY	SP	EP	WP	WY	WR
-50.0	+215.0	-125.0	-40.0	-73.0	-184.2	+57.5

NOTE
 The Target and Error fields on the SSRMS Joint OCAS display will not be correct. This data should be verified and monitored on the Joint Angle Position overlay. (SCR 31169)

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON Verify joint angles and errors are correct on Joint Angle Position overlay.

	SR	SY	SP	EP	WP	WY	WR
(current)	+3.1	+150.0	-160.0	+40.0	-73.0	-184.2	+57.5
TGT	-50.0	+215.0	-125.0	-40.0	-73.0	-184.2	+57.5
ERR	+53.1	-65.0	-35.0	+80.0	0.0	0.0	0.0

PCS * If joint angles/errors are incorrect
 * **cmd** Cancel (Verify Sequence Status – Waiting Destination)
 *
 * Input correct Dest joint angles per table above.
 *
 * **cmd** Load (Verify Sequence Status – Confirm or Cancel)
 *

MON * Verify joint angles and errors are correct on Joint Angle Position overlay.
 *

PCS **cmd** Confirm (Verify Sequence Status – Auto Seq sw - Hot)

1.410 WS4 MBS PDGF 1 GRAPPLE
 (RBT FS/LF1/FIN 1/SPN) Page 4 of 13 pages

DCP AUTO SEQ → PROC

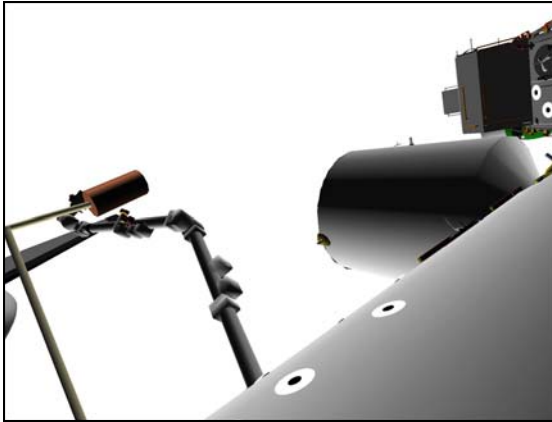


Figure 5.- MBS Grapple JOCAS 1
 (13: LAB Stbd Zenith: 40, -30).

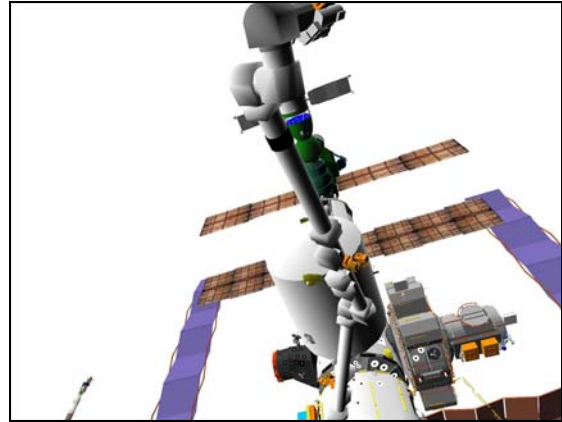


Figure 6.- MBS Grapple JOCAS 1
 (92: Camera C: -20, 60).

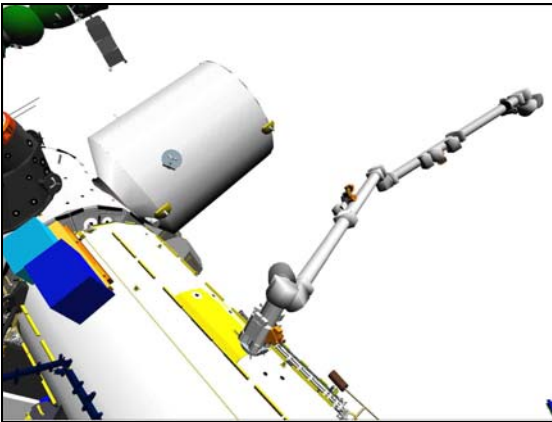


Figure 7.- MBS Grapple JOCAS 1
 (91: SRMS Elbow: 170, 30).



Figure 8.- MBS Grapple JOCAS 1
 (V10: OBSS ITVC: 100, -65).

PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at MBS Grapple JOCAS 1 position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-50.0	+215.0	-125.0	-40.0	-73.0	-184.2	+57.5
X	Y	Z	Pitch	Yaw	Roll	
-400	+1713	+1111	-65.7	-30.7	-176.5	
FOR	Unloaded – LEE Tip, SR Held					
Disp	ISS>W4MBS PDGF 1					

4. MBS GRAPPLE JOCAS 2

SSRMS Joint OCAS

pick File ► LAB ► MBS Grapple JOCAS 2

Verify 'Joint Angles' 'Destination' for MBS Grapple JOCAS 2 position.

SR	SY	SP	EP	WP	WY	WR
-80.0	+90.0	-70.0	-50.0	-73.0	-184.2	+57.5

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON

Verify joint angles and errors are correct on Joint Angle Position overlay.

	SR	SY	SP	EP	WP	WY	WR
(current)	-50.0	+215.0	-125.0	-40.0	-73.0	-184.2	+57.5
TGT	-80.0	+90.0	-70.0	-50.0	-73.0	-184.2	+57.5
ERR	+30.0	+125.0	-55.0	+10.0	0.0	0.0	0.0

PCS

* If joint angles/errors are incorrect
 * **cmd** Cancel (Verify Sequence Status – Waiting Destination)

* Input correct Dest joint angles per table above.

* **cmd** Load (Verify Sequence Status – Confirm or Cancel)

MON

* Verify joint angles and errors are correct on Joint Angle Position overlay.

PCS

cmd Confirm (Verify Sequence Status – Auto Seq sw - Hot)

DCP

AUTO SEQ → PROC

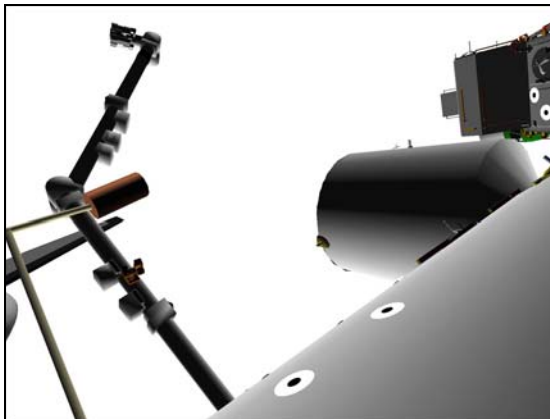


Figure 9.- MBS Grapple JOCAS 2
 (13: LAB Stbd Zenith: 40, -30).

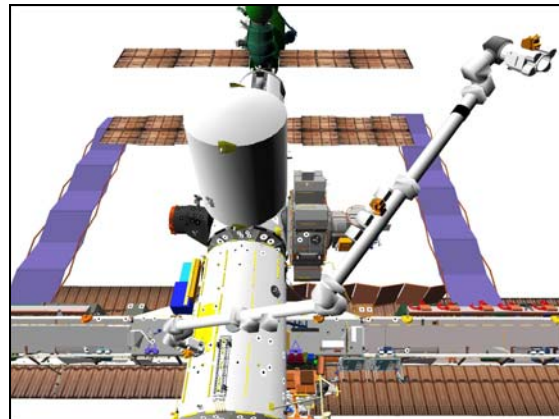


Figure 10.- MBS Grapple JOCAS 2
 (92: Camera C: 0, 40).

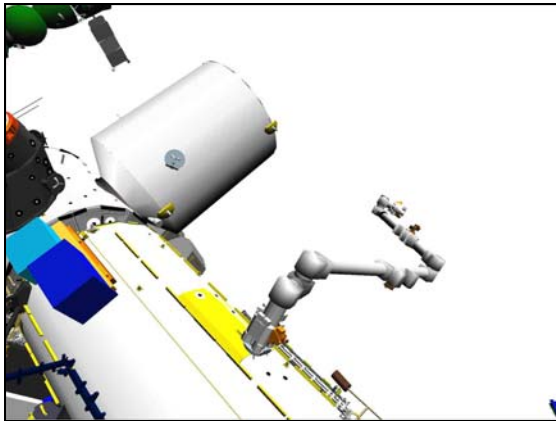


Figure 11.- MBS Grapple JOCAS 2
 (91: SRMS Elbow: 170, 30).



Figure 12.- MBS Grapple JOCAS 2
 (V10: OBSS ITVC: 100, -65).

PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at MBS Grapple JOCAS 2 position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-80.0	+90.0	-70.0	-50.0	-73.0	-184.2	+57.5
X	Y	Z	Pitch	Yaw	Roll	
-454	+1046	+1319	+166.3	+4.1	+54.3	
FOR	Unloaded – LEE Tip, SR Held					
Disp	ISS>W4MBS PDGF 1					

5. [MBS GRAPPLE JOCAS 3](#)

pick File ► LAB ► MBS Grapple JOCAS 3

Verify 'Joint Angles' 'Destination' for MBS Grapple JOCAS 3 position.

SR	SY	SP	EP	WP	WY	WR
-68.1	-27.2	-100.0	-50.0	-118.1	-52.5	+17.4

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON

Verify joint angles and errors are correct on Joint Angle Position overlay.

	SR	SY	SP	EP	WP	WY	WR
(current)	-80.0	+90.0	-70.0	-50.0	-73.0	-184.2	+57.5
TGT	-68.1	-27.2	-100.0	-50.0	-118.1	-52.5	+17.4
ERR	-11.9	+117.2	+30.0	0.0	+45.1	-131.7	+40.1

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 (RBT FS/LF1/FIN 1/SPN) Page 7 of 13 pages

```

*****
* If joint angles/errors are incorrect
PCS  * cmd Cancel (Verify Sequence Status – Waiting Destination)
*
* Input correct Dest joint angles per table above.
*
* cmd Load (Verify Sequence Status – Confirm or Cancel)
*
MON  * Verify joint angles and errors are correct on Joint Angle Position
* overlay.
*****

PCS  cmd Confirm (Verify Sequence Status – Auto Seq sw - Hot)

DCP  AUTO SEQ → PROC
  
```

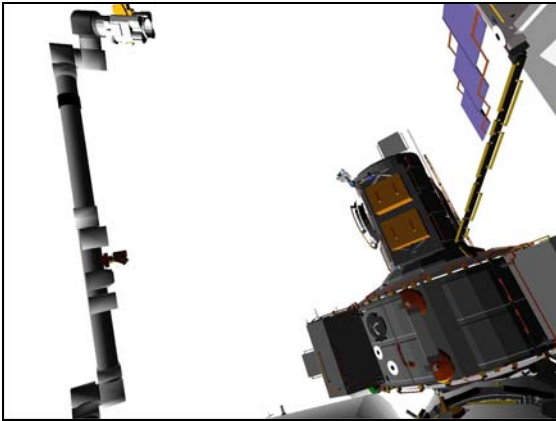


Figure 13.- MBS Grapple JOCAS 3
 (13: LAB Stbd Zenith: 60, 10).

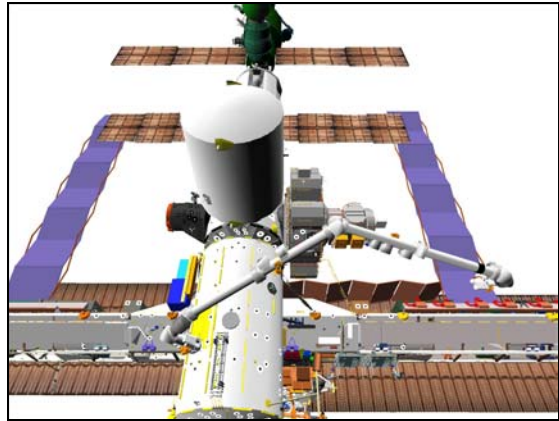


Figure 14.- MBS Grapple JOCAS 3
 (92: Camera C: 0, 40).

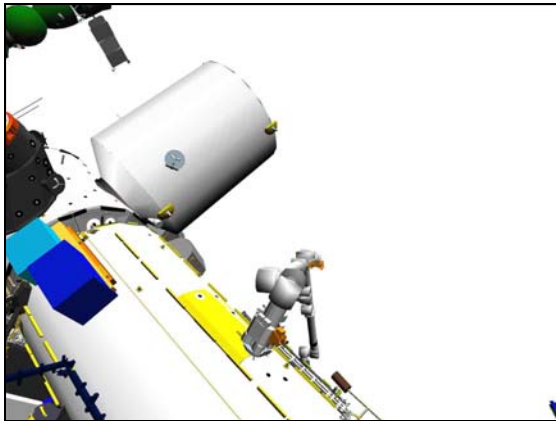


Figure 15.- MBS Grapple JOCAS 3
 (91: SRMS Elbow: 170, 30).

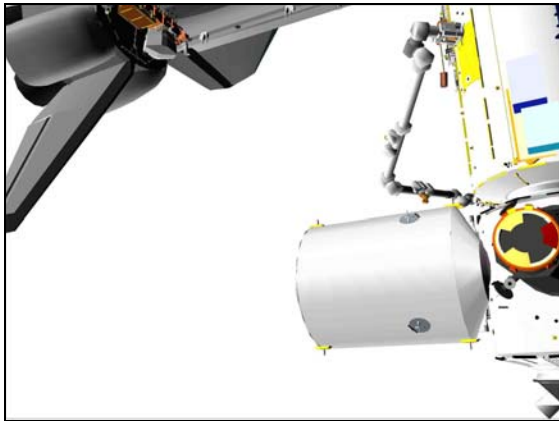


Figure 16.- MBS Grapple JOCAS 3
 (V10: OBSS ITVC: 100, -65).

1.410 WS4 MBS PDGF 1 GRAPPLE
 (RBT FS/LF1/FIN 1/SPN) Page 8 of 13 pages

PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at MBS Grapple JOCAS 3 position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-68.1	-27.2	-100.0	-50.0	-118.1	-52.5	+17.4
X	Y	Z	Pitch	Yaw	Roll	
-318	+55	+913	+29.9	-26.4	-48.0	
FOR	Unloaded – LEE Tip, SR Held					
Disp	ISS>W4MBS PDGF 1					

6. MANEUVERING TO MBS PDGF 1 PRE-GRAPPLE

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
22: Base Elbow (-130, -15) 24: Tip Elbow (-20, 5)	92: Camera C (0, 20)	91: OBSS ITVC (100, -65)	Camera D (-85, 50)

NOTE

1. In steps 6 and 7, monitor clearance between the SSRMS Wrist cluster and LAB Stbd Zenith Camera with the Base Elbow camera or the Tip Elbow Camera. Minimum clearance varies based on Pan and Tilt of the LAB Stbd Zenith Camera, but may be as little as 75 cm.
2. Monitor clearance between the Base Elbow Camera and the UHF antenna with Camera C. Minimum clearance is 136 cm.
3. Monitor clearance between the Base boom and the LAB with the OBSS ITVC Camera.

PCS MSS: SSRMS:

Enter Mode – Single (Verify blue)

WARNING
The active joint must be checked on the PCS before initiating motion. Failure to do so may result in movement of the wrong joint.

1.410 WS4 MBS PDGF 1 GRAPPLE
 (RBT FS/LF1/FIN 1/SPN) Page 9 of 13 pages

THC Perform Single Joint maneuver to Pre-grapple position (within 1 deg).

	SR	SY	SP	EP	WP	WY	WR
JOCAS 3	-68.1	-27.2	-100.0	-50.0	-118.1	-52.5	+17.4
1: SP -			-125.6				
2: EP -				-91.0			
Pre-grapple	-68.1	-27.2	-125.6	-91.0	-118.1	-52.5	+17.4
	X	Y	Z	Pitch	Yaw	Roll	
	-150	0	0	0.0	0.0	0.0	
FOR	Unloaded – LEE Tip, SR Held						
Disp	ISS>W4MBS PDGF 1						

PCS MSS: SSRMS:

Enter Mode – Standby (Verify blue)

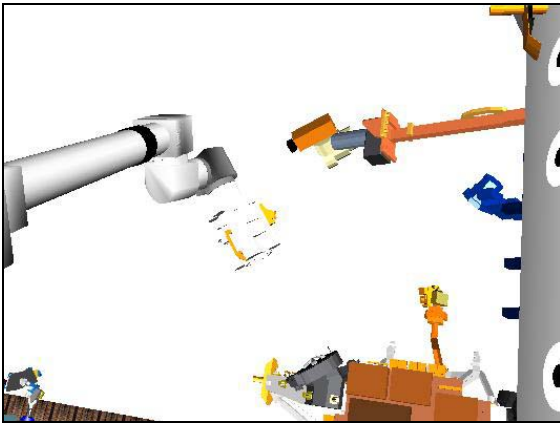


Figure 17.- MBS PDGF 1 Pre-Grapple
 (22: Base Elbow: -100, -15).

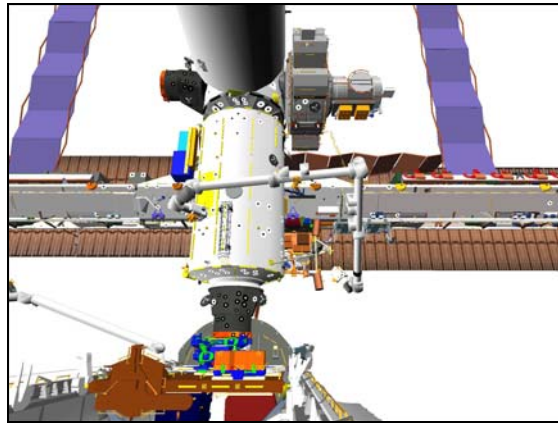


Figure 18.- MBS PDGF 1 Pre-Grapple
 (92: Camera C: 0, 20).

7. MBS PDGF 1 GRAPPLE SETUP AND CAPTURE

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
22: Base Elbow (-100, -15)	25: Tip LEE	92: Camera C (0, 20)	Camera D (-95, 60)

PCS MSS: SSRMS:

Verify Command – SSRMS>Internal

√Vernier

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: as required

7.1 Setting Up for Grapple

NOTE
The LEE Camera must be fully zoomed out to correspond to the target overlay.

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

7.2 Slow Capture Commands

MSS: SSRMS: Tip LEE:

cmd Capture ► Automatic ► Slow, Limp (Verify Speed – Slow)

Verify '**Confirm or Terminate**' prompt.

CAUTION

Due to end-to-end system latency, the RHC Trigger is hot up to 3 seconds prior to receiving a Trigger Hot icon status on the PCS.

NOTE
Once the trigger is hot, only safing or trigger commands should be sent to the Robotics equipment. If a configuration change is required, including routing MSS Cameras, safe the system to exit LEE operations (SCR 23262, 14662).

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Auto Capture

7.3 Maneuvering to Grapple

RHC/
THC

Maneuver to within grapple envelope.

7.4 Grapple

RHC

TRIGGER → press (momentarily)

PCS

Verify 'Snare' Close, Capture (two) – blue (12 s max)
Verify Capture to Latch – Yes (SCR 19282)
Verify 'Carriage' Tension ~5500 N (90 s max)
Verify 'Carriage' Retract – blue
Verify 'Latch' Latch – blue (65 s max)

7.5 Umbilical Mate

cmd 'Umbilical' Mate (Verify '**Confirm or Terminate**' prompt)
cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Mate

RHC TRIGGER → press (momentarily)

PCS Verify 'Umbilical' Mate – blue (10 s max)
 Verify 'Connector Continuity' Prime, Redundant (two) – Yes

7.6 Grapple Cleanup

MSS: SSRMS:

Verify Posn Hold – orange

Verify Loaded Parameters – √
 Verify 'Loaded Parameters' (two) – MBS PDGF 1, SR Held

Expected MBS Grapple joint angles and FOR.

SR	SY	SP	EP	WP	WY	WR
-68.1	-20.0	-124.0	-98.2	-107.7	-58.9	+23.3
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded – MBS PDGF 1, SR Held					
Disp	ISS>W4MBS PDGF 1					

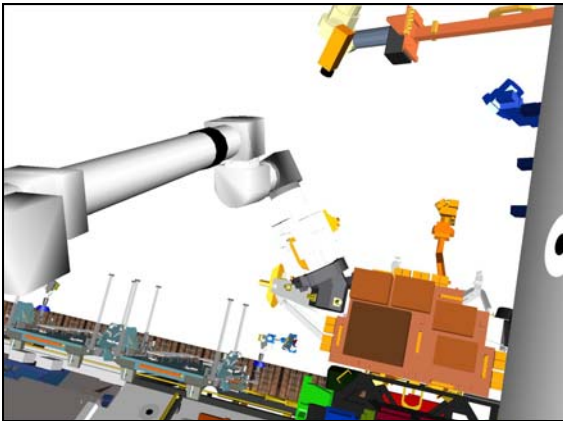


Figure 19.- MBS Grapple
 (22: Base Elbow: -100, -15).

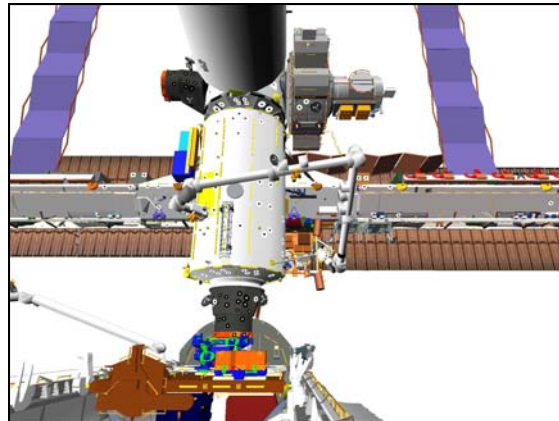


Figure 20.- MBS Grapple
 (92: Camera C: 0, 20).

8. SETUP FOR SSRMS BASE CHANGE

NOTE

Expect the following message when safing is commanded:
'R3Z - MSS OCS SSRMS Prime(Redun) ACU SRT Cat-1 Brk Stat Fail' (SCR 17495)
This message should return to Norm.

DCP SAFING → SAFE (Verify ON)

NOTE

Steps 9 thru 13 may be performed by the Ground.

9. POWERDOWN TO OFF

NOTE

1. Expect the following message when Off is commanded:
'R1E - MSS OCS SSRMS Prime(Redun) ACU SRT Comm Fail' (SCR 17730)
This message should return to Norm.

2. It might take up to 30 seconds for the Off status indication to appear on PCS.

PCS MSS: SSRMS: Power:

cmd 'SSRMS' Prime(Redundant) – Off (Verify Off)

10. OPERATING BASE CHANGE

PCS MSS: SSRMS:

MSS: SSRMS: Base LEE:

cmd B

MSS: SSRMS:

Verify Base LEE – B

Verify PDGF – MBS1

11. POWERUP PRIME(REDUNDANT) STRING TO KEEP-ALIVE

PCS MSS: SSRMS: Power:

cmd 'SSRMS' Prime(Redundant) – Keep-Alive (Verify Keep-Alive)

12. POWERUP PRIME(REDUNDANT) STRING TO OPERATIONAL

NOTE
SSRMS transition from Keep-Alive to Operational will require at least 6 minutes to complete. The time is contingent on file transfer activity from the C&C MDM.

cmd 'SSRMS' Prime(Redundant) – Operational

Verify 'Systems State' – Operational

13. VIDEO COMPONENTS POWERUP

PCS

MSS: SSRMS: Base LEE VDU icon: MSS VDUs

cmd 'SSRMS' 'Base LEE' On (Verify On)

cmd 'SSRMS' 'Base Elbow' On (Verify On)

cmd 'SSRMS' 'Tip Elbow' On (Verify On)

cmd 'SSRMS' 'Tip LEE' On (Verify On)

NOTE
The color balance and gamma setting feedback will not be available until the Camera is routed through a Camera Status Reader. The ground will route the SSRMS Cameras through the CSRs after the Camera setup in this step.

MSS: SSRMS: Base Elbow Camera icon: SSRMS Base Elbow Camera

sel [X] where [X] = B-Elb 22 T-Elb 24 LEE 25

cmd 'Power' On (Verify On)

cmd 'Color Bal' Metal

cmd 'Gamma' 0.45

Repeat

Power up the SSRMS lights as required.

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1. SETUP FOR LAB PDGF UNGRAPPLE

NOTE

Monitor clearance between the SSRMS Base cluster and LAB Stbd Zenith Camera with Camera C. Minimum clearance varies based on Pan and Tilt of the LAB Stbd Zenith Camera, but may be as little as 75 cm.

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
Mux 24: Tip Elbow (-12, 0) / 22: Base Elbow (-8, 0)	25: Tip LEE	92: Camera C (0,20)	OBSS ITVC (100, -65) SRMS Elbow (170, 30)

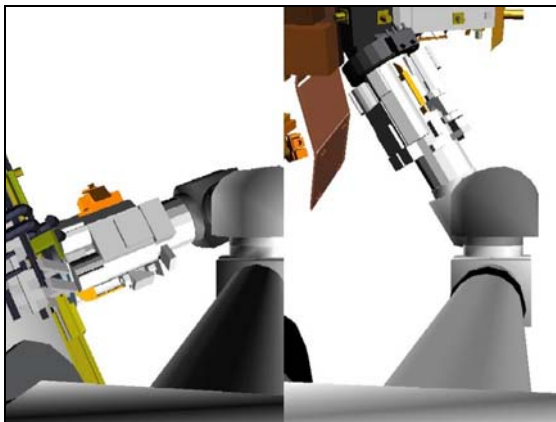


Figure 1.- LAB PDGF Grapple
 [MUX 24: Tip Elbow (-12, 0)/22: Base Elbow (-8, 0)]

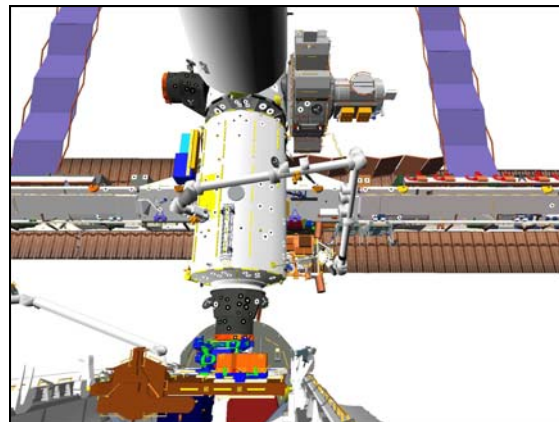


Figure 2.- LAB PDGF Grapple
 (92: Camera C: 0, 20).

PCS

MSS: SSRMS: SSRMS

Verify Loaded Parameters – √

Verify 'Loaded Parameters' (two) – LAB PDGF, SR Held

Change Unloaded Parameters ► Unloaded ► LEE Tip SYH

Verify 'Unloaded Parameters' (two) – LEE Tip, SY Held

Change Display ► W4 ► LAB PDGF (Verify W4>LAB PDGF)

Verify Command – SSRMS>Internal

1.411 LAB PDGF UNGRAPPLE

(RBT FS/LF1/FIN 1/SPN) Page 2 of 4 pages

Verify SSRMS at LAB PDGF Grapple position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+23.3	+58.9	-107.7	-98.2	-124.0	+20.0	-68.1
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded – LAB PDGF, SR Held					
Disp	W4>LAB PDGF					

MSS: SSRMS: SSRMS Safing:

cmd Remove (Verify Not Safed)

DCP BRAKES SSRMS → OFF (Verify OFF)

2. LAB PDGF SEMI-MANUAL RELEASE

2.1 SSRMS Limp

PCS MSS: SSRMS: Limp:

cmd All Limp (Verify Limp – blue)

MSS: SSRMS:

Verify all joints – Limped

Wait 30 seconds.

MSS: SSRMS: Limp:

cmd None Limp (Verify Standby – blue)

2.2 Enter Manual Mode

PCS MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: as required

MSS: SSRMS:

√Vernier

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

2.3 Carriage Rigidization

MSS: SSRMS: Tip LEE:

cmd 'Carriage' Rigidize ► Slow (Verify Speed – Slow)

1.411 LAB PDGF UNGRAPPLE

(RBT FS/LF1/FIN 1/SPN) Page 3 of 4 pages

Verify '**Confirm or Terminate**' prompt.

CAUTION

Due to end-to-end system latency, the RHC Trigger is hot up to 3 seconds prior to receiving a Trigger Hot icon status on the PCS.

NOTE

Once the trigger is hot, only safing or trigger commands should be sent to the Robotics equipment. If a configuration change is required, including routing MSS Cameras, safe the system to exit LEE operations (SCR 23262, 14662)

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Rigidize

RHC TRIGGER → press (momentarily) (SCR 19064)

PCS Verify 'Carriage' Tension ~5500 N (90 s max)
Verify 'Carriage' Retract – blue

2.4 LAB PDGF Release

PCS MSS: SSRMS: Tip LEE: SSRMS Tip LEE

cmd Release ► Semi-manual ► Slow (Verify Speed – Slow)

Verify '**Confirm or Terminate**' prompt.

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Semi-manual Release

RHC TRIGGER → press (hold until 'Umbilical' Demate – blue) (10 s max)

TRIGGER → press (hold until 'Latch' Unlatch – blue) (65 s max)

TRIGGER → press (hold until 'Carriage' Derigidize – blue) (90 s max)

TRIGGER → press (hold until 'Snare' Open – blue) (12 s max)

2.5 Maneuver Away From LAB PDGF

THC Back off from grapple fixture until clear of pin.

2.6 LAB PDGF Ungrapple Cleanup

RHC TRIGGER → press (hold until Motors – Inh) (90 s max)

PCS Verify 'Carriage' Extend – blue

1.411 LAB PDGF UNGRAPPLE

(RBT FS/LF1/FIN 1/SPN) Page 4 of 4 pages

THC Maneuver SSRMS to LAB PDGF Backoff position (within 5 cm/1 deg).

		Locked					
SR	SY	SP	EP	WP	WY	WR	
+34.0	+58.9	-104.3	-82.6	-132.3	+16.8	-72.8	
X	Y	Z	Pitch	Yaw	Roll		
-150	0	0	0.0	0.0	0.0		
FOR	Unloaded – LEE Tip, SY Held						
Disp	W4>LAB PDGF						

DCP BRAKES SSRMS → ON (Verify ON)

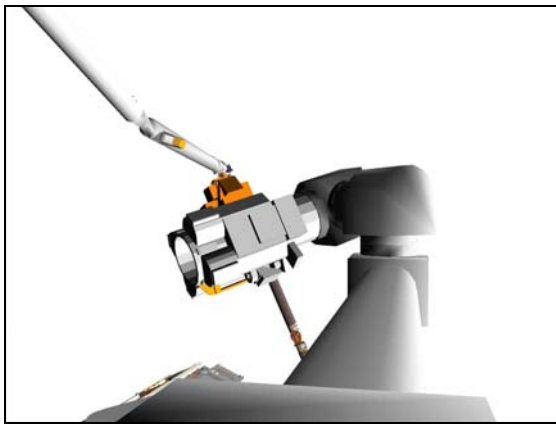


Figure 3.- LAB PDGF Backoff
(24: Tip Elbow: -20, 0).

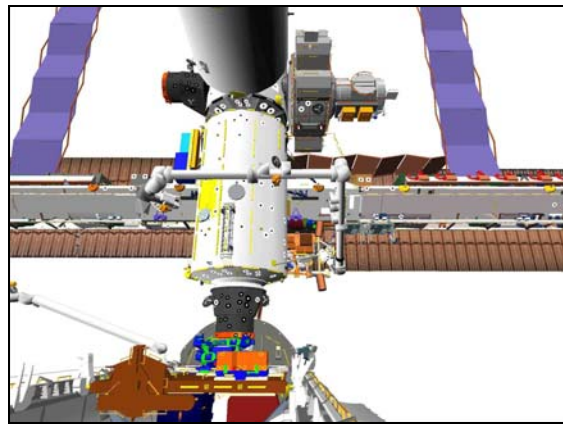


Figure 4.- LAB PDGF Backoff
(92: Camera C: 0, 20).

1.412 MANEUVER TO SURVEY SUPPORT VIEWING POSITION

(RBT FS/LF1/FIN 1/SPN) Page 1 of 8 pages

1. SETUP

NOTE

Throughout the procedure, monitor clearance between the SSRMS Base cluster and LAB Stbd Zenith Camera with Tip Elbow Camera or Camera C. Minimum clearance varies based on Pan and Tilt of the Lab Stbd Zenith Camera, but may be as little as 75 cm.

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
24: Tip Elbow (-95, 0)	91: Camera D (-53, 62)	92: Camera C (7, 20)	OBSS ITVC (100, -60)
22: Base Elbow (-120, -15)	13: LAB Stbd Zenith (40, -25)		SRMS Elbow (170, 15)

PCS

MSS: SSRMS:

Verify Unloaded Parameters – √

Verify 'Unloaded Parameters' (two) – LEE Tip, SY Held

Verify Display – W4>LAB PDGF

√Vernier

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: 1.0 (Verify 1.0)

DCP

BRAKES SSRMS → OFF (Verify OFF)

2. JOINT OCAS 1

PCS

MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

SSRMS Joint OCAS

pick File ► W4MBS1 ► Srvy Viewing JOCAS 1

Verify 'Joint Angles' 'Destination' for Joint OCAS 1 End position.

SR	SY	SP	EP	WP	WY	WR
+34.0	+18.0	-17.0	-97.0	-41.5	+34.0	+51.5

1.412 MANEUVER TO SURVEY SUPPORT VIEWING POSITION

(RBT FS/LF1/FIN 1/SPN) Page 2 of 8 pages

NOTE

The Target and Error fields on the SSRMS Joint OCAS display will not be correct. This data should be verified and monitored on the Joint Angle Position overlay. (SCR 31169)

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON Verify joint angles and errors are correct on Joint Angle Position overlay.

	SR	SY	SP	EP	WP	WY	WR
(current)	+34.0	+58.9	-104.3	-82.6	-132.3	+16.8	-72.8
TGT	+34.0	+18.0	-17.0	-97.0	-41.5	+34.0	+51.5
ERR	0.0	+40.9	-87.3	+14.4	-90.8	-17.2	-124.3

PCS * If joint angles/errors are incorrect
 * **cmd** Cancel (Verify Sequence Status – Waiting Destination)
 *
 * Input correct Dest joint angles per table above.
 *
 * **cmd** Load (Verify Sequence Status – Confirm or Cancel)
 *
 MON * Verify joint angles and errors are correct on Joint Angle Position overlay.
 *

PCS **cmd** Confirm (Verify Sequence Status – Auto Seq sw - Hot)

DCP AUTO SEQ → PROC

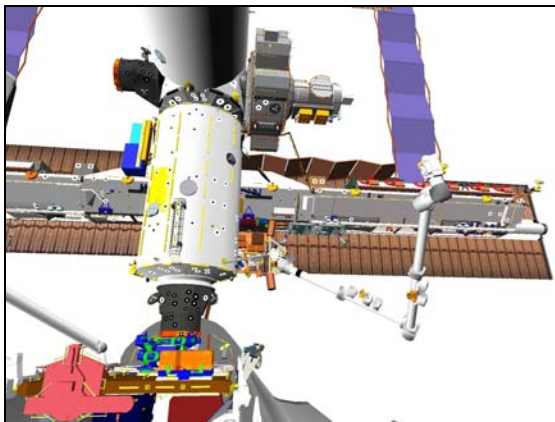


Figure 1.- Joint OCAS 1 End
(92: Camera C: 7, 20).

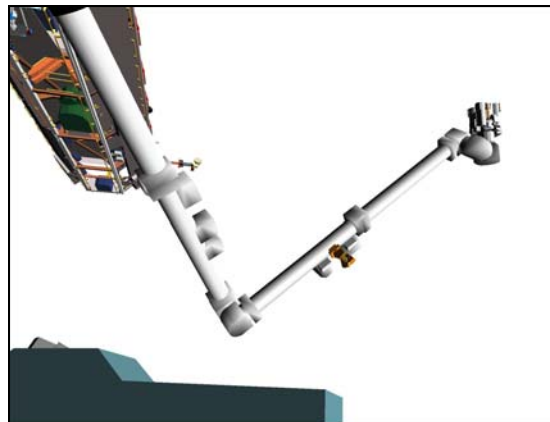


Figure 2.- Joint OCAS 1 End
(91: Camera D: -75, 20).

PCS MSS: SSRMS: SSRMS

Verify Posn Hold – orange

1.412 MANEUVER TO SURVEY SUPPORT VIEWING POSITION

(RBT FS/LF1/FIN 1/SPN) Page 3 of 8 pages

Verify SSRMS at Joint OCAS 1 End position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+34.0	+18.0	-17.0	-97.0	-41.5	+34.0	+51.5
X	Y	Z	Pitch	Yaw	Roll	
+227	-1075	+49	-95.7	+9.8	-62.5	
FOR	Unloaded – LEE Tip, SY Held					
Disp	W4>LAB PDGF					

3. JOINT OCAS TO SURVEY SUPPORT VIEWING POSITION

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
24: Tip Elbow (-100, -10) 22: Base Elbow (0, 0)	13: LAB Stbd Zenith (-15, 30)	92: Camera C (7, 20)	Camera D (-65, 20)

SSRMS Joint OCAS

pick File ► W4MBS1 ► Srvy Viewing JOCAS 2

Verify 'Joint Angles' 'Destination' for Survey Support Viewing position.

SR	SY	SP	EP	WP	WY	WR
+80.0	+10.0	+40.0	-50.0	-110.0	-25.0	+115.0

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON

Verify joint angles and errors are correct on Joint Angle Position overlay.

	SR	SY	SP	EP	WP	WY	WR
(current)	+34.0	+18.0	-17.0	-97.0	-41.5	+34.0	+51.5
TGT	+80.0	+10.0	+40.0	-50.0	-110.0	-25.0	+115.0
ERR	-46.0	+8.0	-57.0	-47.0	+68.5	+59.0	-63.5

PCS

* If joint angles/errors are incorrect
* **cmd** Cancel (Verify Sequence Status – Waiting Destination)

* Input correct Dest joint angles per table above.

* **cmd** Load (Verify Sequence Status – Confirm or Cancel)

MON

* Verify joint angles and errors are correct on Joint Angle Position overlay.

PCS

cmd Confirm (Verify Sequence Status – Auto Seq sw - Hot)

DCP

AUTO SEQ → PROC

1.412 MANEUVER TO SURVEY SUPPORT VIEWING POSITION

(RBT FS/LF1/FIN 1/SPN) Page 4 of 8 pages

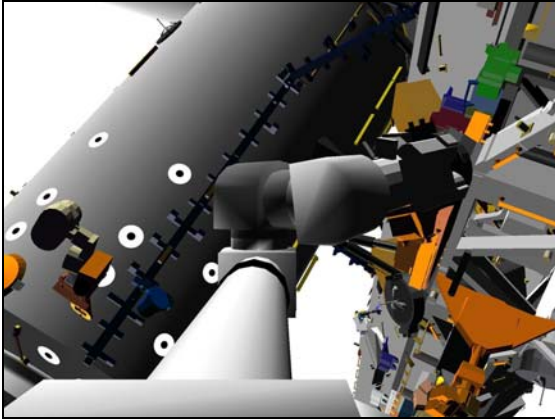


Figure 3.- Survey Support Viewing Position (22: Base Elbow: 0, 0).

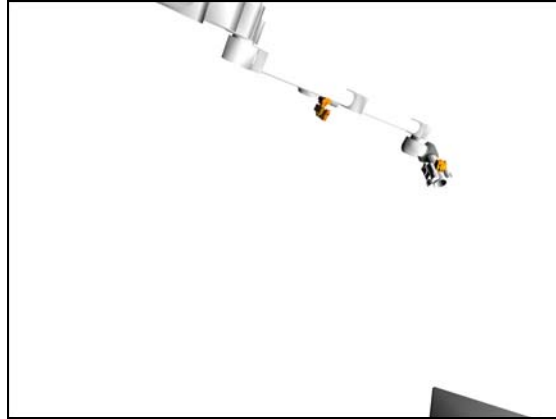


Figure 4.- Survey Support Viewing Position (13: LAB Stbd Zenith: -100, 40).

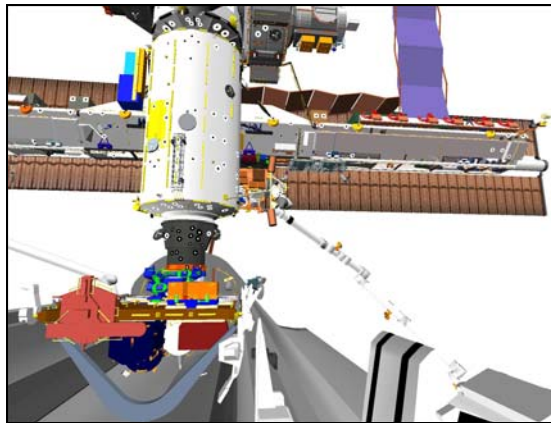


Figure 5.- Survey Support Viewing Position (92: Camera C: 7, 10).

PCS

MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at Survey Support Viewing position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+80.0	+10.0	+40.0	-50.0	-110.0	-25.0	+115.0
X	Y	Z	Pitch	Yaw	Roll	
+1101	-916	-1113	+177.1	+30.0	-11.0	
FOR	Unloaded – LEE Tip, SY Held					
Disp	W4> LAB PDGF					

DCP

BRAKES SSRMS → ON (Verify ON)

1.412 MANEUVER TO SURVEY SUPPORT VIEWING POSITION

(RBT FS/LF1/FIN 1/SPN) Page 5 of 8 pages

4. SURVEY VIEWING SUPPORT

Bring SSRMS Tip Elbow Camera up on a monitor and pan and tilt Camera per picture below to set up for survey viewing support.

Once Tip Elbow Camera has been setup as desired for viewing support, give SRMS operator GO to begin survey.

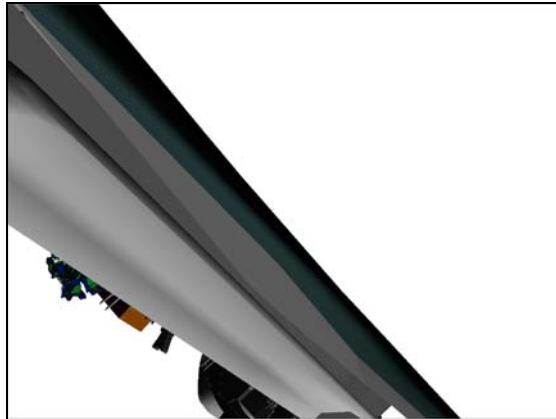


Figure 6.- Survey Support Viewing Position
(24: Tip Elbow: -80, 10).

NOTE

To view other areas below the orbiter, the Tip Elbow Camera may be configured as follows:

Nose area of Orbiter: P: -105, T: 40

Mid area of Orbiter: P: -75, T: 20

Aft area of Orbiter: P: -55, T: 5

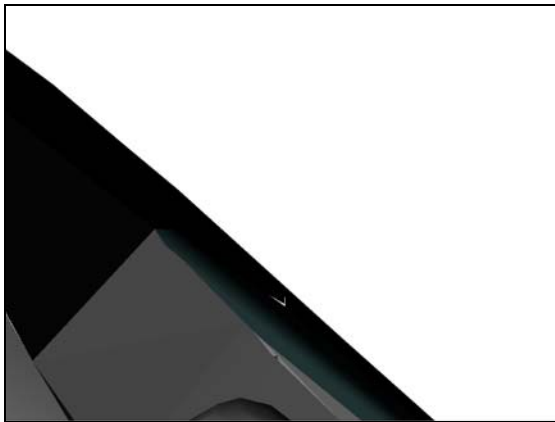


Figure 7.- Nose Area of Orbiter
(24: Tip Elbow: -105, 40).

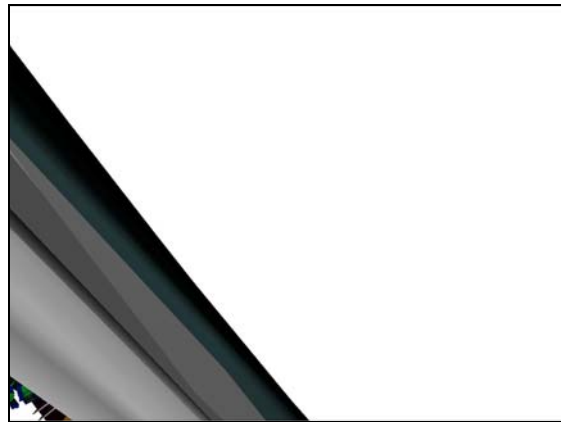


Figure 8.- Mid Area of Orbiter
(24: Tip Elbow: -75, 20).

1.412 MANEUVER TO SURVEY SUPPORT VIEWING POSITION

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Figure 9.- Aft Area of Orbiter
(24: Tip Elbow: -55, 5).

5. VIEWING AREAS OF ORBITER WITH TIP LEE CAMERA (OPTIONAL)

Bring Tip LEE Camera up on a monitor.

Once Camera has been setup as desired for viewing support, give SRMS operator GO to begin survey.

5.1 Single Joint Wrist reconfiguration

To view areas of the orbiter using the Tip LEE Camera, the Wrist Cluster can be reconfigured in Single Joint mode, as follows:

DCP BRAKES SSRMS → OFF (Verify OFF)

PCS MSS: SSRMS:

Enter Mode – Single (Verify blue)

WARNING
The active joint must be checked on the PCS before initiating motion. Failure to do so may result in movement of the wrong joint.

THC Perform Single Joint maneuver to Mid Orbiter viewing position (within 1 deg).

	SR	SY	SP	EP	WP	WY	WR
Initial Viewing Posn	+80.0	+10.0	+40.0	-50.0	-110.0	-25.0	+115.0
1: WP +					-95.0		
2: WY +						-20.0	
Mid Orbiter	+80.0	+10.0	+40.0	-50.0	-95.0	-20.0	+115.0
	X	Y	Z	Pitch	Yaw	Roll	
	+1107	-949	-1129	+172.1	+16.0	-14.8	
FOR	Unloaded – LEE Tip, SY Held						
Disp	W4>LAB PDGF						

1.412 MANEUVER TO SURVEY SUPPORT VIEWING POSITION

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NOTE

To view other areas of the orbiter, the WP and WY joints can be reconfigured in single joint mode.

- Fwd area of orbiter: negative maneuver
- Aft area of orbiter: positive maneuver.

DCP

BRAKES SSRMS → ON (Verify ON)

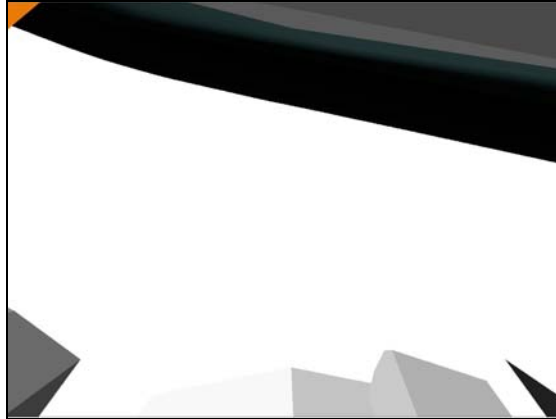


Figure 10.- Survey Support - Mid Orbiter
(25: Tip LEE).

5.2 Return To Survey Support Viewing Position

If required, once viewing support complete, return to the initial Survey Support Viewing Position using Single Joint Mode:

DCP

BRAKES SSRMS → OFF (Verify OFF)

PCS

MSS: SSRMS:

Enter Mode – Single (Verify blue)

WARNING

The active joint must be checked on the PCS before initiating motion. Failure to do so may result in movement of the wrong joint.

If WP not -110.0

DCP

JOINT SELECT → WP (Verify WP – Selected on PCS)

THC

Perform Single Joint maneuver to WP: -110.0

1.412 MANEUVER TO SURVEY SUPPORT VIEWING POSITION

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If WY not -25.0
DCP | JOINT SELECT → WY (Verify WY – Selected on PCS)
THC | Perform Single Joint maneuver to WY: -25.0
PCS | MSS: SSRMS:

Verify SSRMS at Survey Support Viewing position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+80.0	+10.0	+40.0	-50.0	-110.0	-25.0	+115.0
X	Y	Z	Pitch	Yaw	Roll	
+1101	-916	-1113	+177.1	+30.0	-11.0	
FOR	Unloaded – LEE Tip, SY Held					
Disp	W4>LAB PDGF					

6. CLEANUP

NOTE

Expect the following message when safing is commanded:

'R3Z - MSS OCS SSRMS Prime(Redun) ACU SRT Cat-1 Brk Stat Fail' (SCR 17495)

This message should return to Norm.

DCP | SAFING → SAFE (Verify ON)
ODS Hatch | Disconnect V10 Cables.

1.413 LAB PDGF GRAPPLE

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1. HAND CONTROLLER CALIBRATION

- 1.1 Translational Hand Controller (THC) Calibration
- THC Deflect [X] Axis to positive hard stop where [X] =
- Deflect [X] Axis to negative hard stop.
- Repeat
- 1.2 Rotational Hand Controller (RHC) Calibration
- RHC Deflect [X] Axis to positive hard stop where [X] =
- Deflect [X] Axis to negative hard stop.
- Repeat

2. SETUP

NOTE

Throughout the procedure, monitor clearance between the SSRMS Base cluster and LAB Stbd Zenith Camera with Tip Elbow Camera or Camera C. Minimum clearance varies based on Pan and Tilt of the Lab Stbd Zenith Camera, but may be as little as 75 cm.

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3
92: Camera C (7, 20)	13: LAB Stbd Zenith (-50, 40)	24: Tip Elbow (-135, 0)

PCS MSS: SSRMS:

Verify 'Loaded Parameters' (two) – LAB PDGF, SR Held

Verify Unloaded Parameters – √

Verify 'Unloaded Parameters' (two) – LEE Tip, SY Held

Verify Display – W4>LAB PDGF

Verify Command – SSRMS>Internal

√Vernier

Verify SSRMS at Survey Support Viewing position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+80.0	+10.0	+40.0	-50.0	-110.0	-25.0	+115.0
X	Y	Z	Pitch	Yaw	Roll	
+1101	-916	-1113	+177.1	+30.0	-11.0	
FOR	Unloaded – LEE Tip, SY Held					
Disp	W4>LAB PDGF					

1.413 LAB PDGF GRAPPLE

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3. JOINT OCAS 1

PCS MSS: SSRMS: SSRMS Safing:

cmd Remove (Verify Not Safed)

DCP BRAKES SSRMS → OFF (Verify OFF)

PCS MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

Input 'Joint Angles' 'Destination' for Joint OCAS 1 End position.

SR	SY	SP	EP	WP	WY	WR
+34.0	+18.0	-17.0	-97.0	-41.5	+34.0	+51.5

NOTE

The Target and Error fields on the SSRMS Joint OCAS display will not be correct. This data should be verified and monitored on the Joint Angle Position overlay. (SCR 31169)

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON Verify joint angles and errors are correct on Joint Angle Position overlay.

	SR	SY	SP	EP	WP	WY	WR
(current)	+80.0	+10.0	+40.0	-50.0	-110.0	-25.0	+115.0
TGT	+34.0	+18.0	-17.0	-97.0	-41.5	+34.0	+51.5
ERR	+46.0	-8.0	+57.0	+47.0	-68.5	-59.0	+63.5

* If joint angles/errors are incorrect

PCS * **cmd** Cancel (Verify Sequence Status – Waiting Destination)

*

* Input correct Dest joint angles per table above.

*

* **cmd** Load (Verify Sequence Status – Confirm or Cancel)

*

MON * Verify joint angles and errors are correct on Joint Angle Position overlay.

*

PCS **cmd** Confirm (Verify Sequence Status – Auto Seq sw - Hot)

DCP AUTO SEQ → PROC

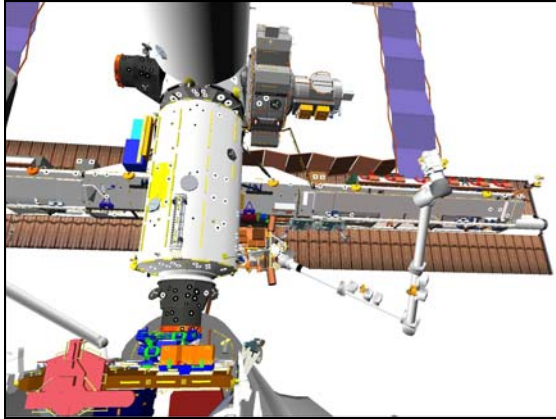


Figure 1.- Joint OCAS 1 End
 (92: Camera C: 7, 20).



Figure 2.- Joint OCAS 1 End
 (13: LAB Stbd Zenith: -5, 35).

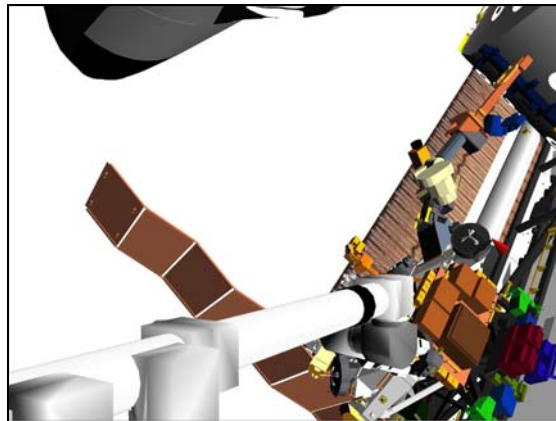


Figure 3.- Joint OCAS 1 End
 (24: Tip Elbow: -115, 0).

PCS

MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at Joint OCAS 1 End position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+34.0	+18.0	-17.0	-97.0	-41.5	+34.0	+51.5
X	Y	Z	Pitch	Yaw	Roll	
+227	-1075	+49	-95.7	+9.8	-62.5	
FOR	Unloaded – LEE Tip, SY Held					
Disp	W4> LAB PDGF					

1.413 LAB PDGF GRAPPLE

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4. JOINT OCAS TO LAB PDGF PRE-GRAPPLE POSITION

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3
92: Camera C (0, 20)	13: LAB Stbd Zenith (-5, 35) 22: Base Elbow (-120, -15)	24: Tip Elbow (-115, 0)

SSRMS Joint OCAS

pick File ► W4MBS1 ► LAB PDGF Pre-Grapple

Verify 'Joint Angles' 'Destination' for LAB PDGF Pre-Grapple position.

SR	SY	SP	EP	WP	WY	WR
+34.0	+58.9	-104.3	-82.6	-132.3	+16.8	-72.8

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON Verify joint angles and errors are correct on Joint Angle Position overlay.

	SR	SY	SP	EP	WP	WY	WR
(current)	+34.0	+18.0	-17.0	-97.0	-41.5	+34.0	+51.5
TGT	+34.0	+58.9	-104.3	-82.6	-132.3	+16.8	-72.8
ERR	0.0	-40.9	+87.3	-14.4	+90.8	+17.2	+124.3

PCS * If joint angles/errors are incorrect
 * **cmd** Cancel (Verify Sequence Status – Waiting Destination)
 *
 * Input correct Dest joint angles per table above.
 *
 * **cmd** Load (Verify Sequence Status – Confirm or Cancel)
 *
 MON * Verify joint angles and errors are correct on Joint Angle Position
 * overlay.

PCS **cmd** Confirm (Verify Sequence Status – Auto Seq sw - Hot)

DCP AUTO SEQ → PROC

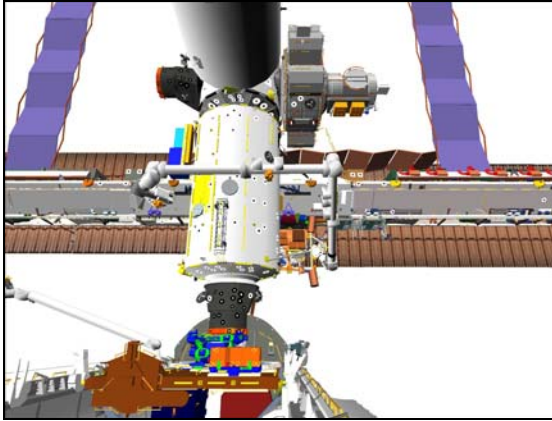


Figure 4.- LAB PDGF Pre-Grapple
 (92: Camera C: 0, 20).

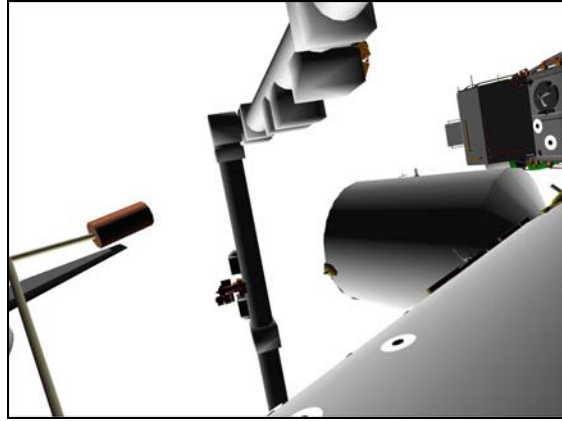


Figure 5.- LAB PDGF Pre-Grapple
 (13: LAB Stbd Zenith: 40, -25).

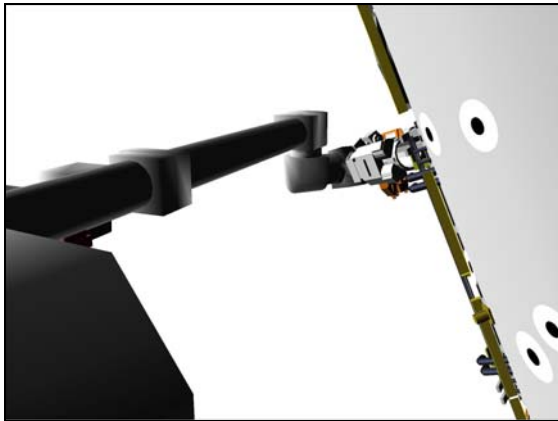


Figure 6.- LAB PDGF Pre-Grapple
 (22: Base Elbow: -120, -15).

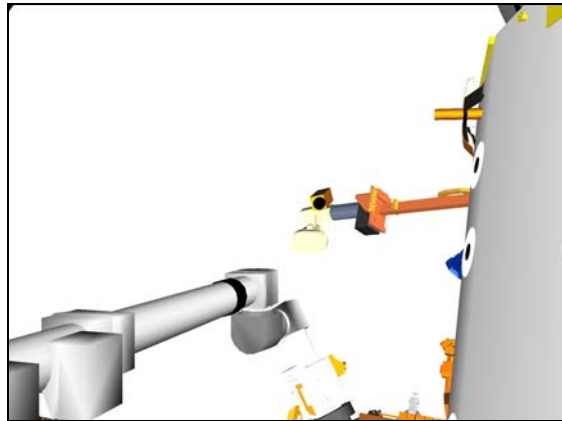


Figure 7.- LAB PDGF Pre-Grapple
 (24: Tip Elbow: -115, 0).

PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at Lab PDGF Pre-Grapple position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+34.0	+58.9	-104.3	-82.6	-132.3	+16.8	-72.8
X	Y	Z	Pitch	Yaw	Roll	
-150	0	0	0.0	0.0	0.0	
FOR	Unloaded – LEE Tip, SY Held					
Disp	W4>LAB PDGF					

1.413 LAB PDGF GRAPPLE

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5. LAB PDGF GRAPPLE SETUP AND CAPTURE

NOTE

MSS Effector Overlay will not appear on the monitor until the “confirm” command is sent to the LEE.

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3
92: Camera C (0,20)	25: Tip LEE	24: Tip Elbow (-30, 0)

PCS

MSS: SSRMS:

Verify Command – SSRMS>Internal

√Vernier

MSS: SSRMS: Rate:

Set ‘Scale’ ‘Vernier’ Rate Scale: as required.

5.1 Setting Up for Grapple

NOTE

Tip Lee Camera must be fully zoomed out to correspond to target overlay.

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

5.2 Slow Capture Commands

MSS: SSRMS: Tip LEE:

cmd Capture ► Automatic ► Slow, Limp (Verify Speed – Slow)

Verify ‘**Confirm or Terminate**’ prompt.

CAUTION

Due to end-to-end system latency, the RHC Trigger is hot up to 3 seconds prior to receiving a Trigger Hot icon status on the PCS.

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NOTE

Once the trigger is hot, only safing or trigger commands should be sent to the Robotics equipment. If a configuration change is required, including routing MSS Cameras, safe the system to exit LEE operations (SCR 23262, 14662).

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Auto Capture

- RHC/
THC
- 5.3 Maneuvering to Grapple
Maneuver to within grapple envelope.
- RHC
- 5.4 Grapple
TRIGGER → press (momentarily)
- PCS
- Verify 'Snare' Close, Capture (two) – blue (12 s max)
Verify Capture to Latch – Yes (SCR 19282)
Verify 'Carriage' Tension ~5500 N (90 s max)
Verify 'Carriage' Retract – blue
Verify 'Latch' Latch – blue (65 s max)
- 5.5 Umbilical Mate
cmd 'Umbilical' Mate (Verify '**Confirm or Terminate**' prompt)
cmd Confirm (Verify RHC Trigger Hot icon)
- Verify LEE Mode – Mate
- RHC
- TRIGGER → press (momentarily)
- PCS
- Verify 'Umbilical' Mate – blue (10 s max)
Verify 'Connector Continuity' Prime, Redundant (two) – Yes
- 5.6 Carriage Derigidize
cmd 'Carriage' Derigidize ► Slow (Verify Speed – Slow)
- Verify '**Confirm or Terminate**' prompt.
- cmd** Confirm (Verify RHC Trigger Hot icon)
- Verify LEE Mode – Derigidize
- RHC
- TRIGGER → press (momentarily) (SCR 19064)
- PCS
- Verify 'Carriage' Derigidize – blue (90 s max)

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5.7 Grapple Cleanup

MSS: SSRMS: SSRMS

Verify Posn Hold – Orange

Verify Loaded Parameters – √

Verify 'Loaded Parameters' (two) – LAB PDGF, SR Held

Expected LAB PDGF Grapple joint angles and FOR.

SR	SY	SP	EP	WP	WY	WR
+23.3	+58.9	-107.7	-98.2	-124.0	+20.0	-68.1
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded – LAB PDGF, SR Held					
Disp	W4>LAB PDGF					

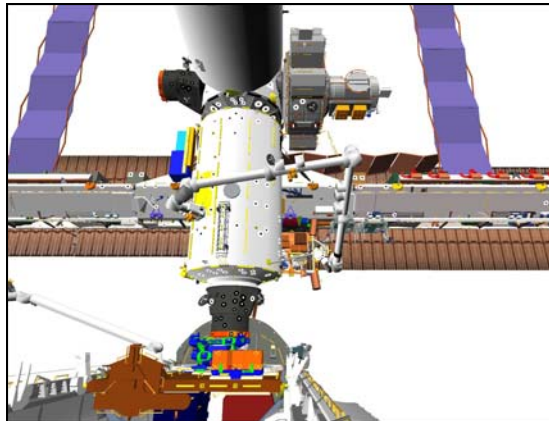


Figure 8.- LAB PDGF Grapple
(92: Camera C: 0, 20).

6. SETTING UP FOR SSRMS BASE CHANGE

NOTE

Expect the following message when safing is commanded:

**'R3Z - MSS OCS SSRMS Prime(Redun) ACU SRT
Cat-1 Brk Stat Fail'** (SCR 17495)

This message should return to Norm.

DCP

SAFING → SAFE (Verify ON)

NOTE

Steps 7 thru 11 may be preformed by the Ground.

1.413 LAB PDGF GRAPPLE

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7. POWERDOWN TO OFF

NOTE

Expect the following message when Off is commanded:
**'R1E - MSS OCS SSRMS Prime(Redun) ACU SRT
Comm Fail'** (SCR 17730)
This message should return to Norm.

PCS MSS: SSRMS: Power:

cmd 'SSRMS' Prime(Redundant) – Off (Verify Off)

8. OPERATING BASE CHANGE

PCS MSS: SSRMS:

MSS: SSRMS: Base LEE:

cmd A

MSS: SSRMS:

Verify Base LEE – A

Verify PDGF – LAB

9. POWERUP PRIME(REDUNDANT) STRING TO KEEP-ALIVE

NOTE

It might take up to 30 seconds for the Keep-Alive status indication to appear on PCS.

PCS MSS: SSRMS: Power:

cmd 'SSRMS' Prime(Redundant) – Keep-Alive (Verify Keep-Alive)

10. POWERUP PRIME(REDUNDANT) STRING TO OPERATIONAL

NOTE

SSRMS transition from Keep-Alive to Operational will require at least 6 minutes to complete. The time is contingent on file transfer activity from the C&C MDM.

cmd 'SSRMS' Prime(Redundant) – Operational

Verify 'Systems State' – Operational

11. VIDEO COMPONENTS POWERUP

PCS MSS: SSRMS: Base LEE VDU icon:

cmd 'SSRMS' 'Base LEE' On (Verify On)

cmd 'SSRMS' 'Base Elbow' On (Verify On)

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cmd 'SSRMS' 'Tip Elbow' On (Verify On)

cmd 'SSRMS' 'Tip LEE' On (Verify On)

NOTE

The color balance and gamma setting feedback will not be available until the Camera is routed through a Camera Status Reader. The ground will route the SSRMS Cameras through the CSRs after the Camera setup in this step.

MSS: SSRMS: Base Elbow Camera icon: **SSRMS Base Elbow Camera**

sel [X] where [X] = **B-Elb 22** **T-Elb 24** **LEE 25**

cmd 'Power' On (Verify On)

cmd 'Color Bal' Metal

cmd 'Gamma' 0.45

Repeat

Power up the SSRMS lights as required.

1.414 WS4 MBS PDGF 1 UNGRAPPLE
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1. SETUP

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3
92: Camera C (0, 20)	25: Tip LEE	22: Base Elbow (-93, -11)

PCS

MSS: SSRMS:

Verify Loaded Parameters – ✓

Verify 'Loaded Parameters' (two) – MBS PDGF 1, SR Held

Change Unloaded Parameters ► Unloaded ► LEE Tip SRH

Verify 'Unloaded Parameters' (two) – LEE Tip, SR Held

Change Display ► ISS ► W4MBS PDGF 1 (Verify ISS>W4MBS PDGF 1)

Verify Command – SSRMS>Internal

✓Vernier

Verify SSRMS at MBS PDGF1 Grapple position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-68.1	-20.0	-124.0	-98.2	-107.7	-58.9	+23.3
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded – MBS PDGF 1, SR Held					
Disp	ISS>W4MBS PDGF 1					

PCS

MSS: SSRMS: SSRMS Safing:

cmd Remove (Verify Not Safed)

DCP

BRAKES SSRMS → OFF (Verify OFF)

2. WS4 MBS PDGF 1 SEMI-MANUAL RELEASE

NOTE

1. Monitor clearance between the SSRMS Wrist cluster and LAB Stbd Zenith Camera with the Base Elbow Camera. Minimum clearance depends on Pan and Tilt of Lab Stbd Zenith Camera, but may be as little as 103 cm.
2. Monitor clearance between the Base Boom and the UHF antenna with Camera C. Minimum clearance is 146 cm.

1.414 WS4 MBS PDGF 1 UNGRAPPLE

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PCS 2.1 SSRMS Limp
MSS: SSRMS: Limp:

cmd All Limp (Verify Limp – blue)

MSS: SSRMS:

Verify all joints – Limped

Wait 30 seconds.

MSS: SSRMS: Limp:

cmd None Limp (Verify Standby – blue)

2.2 Enter Manual Mode

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: as required.

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

2.3 WS4 MBS PDGF 1 Release

MSS: SSRMS: Tip LEE:

cmd Release ► Semi-manual ► Slow (Verify Speed – Slow)

Verify '**Confirm or Terminate**' prompt.

CAUTION

Due to end-to-end system latency, the RHC Trigger is hot up to 3 seconds prior to receiving a Trigger Hot icon status on the PCS.

NOTE

Once the trigger is hot, only safing or trigger commands should be sent to the Robotics equipment. If a configuration change is required, including routing MSS Cameras, safe the system to exit LEE operations (SCR 23262, 14662).

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Semi-manual Release

1.414 WS4 MBS PDGF 1 UNGRAPPLE

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RHC TRIGGER → press (hold until 'Umbilical' Demate – blue) (10 s max)

TRIGGER → press (hold until 'Latch' Unlatch – blue) (65 s max)

TRIGGER → press (hold until 'Carriage' Derigidize – blue)
(90 s max)

TRIGGER → press (hold until 'Snare' Open – blue) (12 s max)

2.4 Maneuver Away From MBS PDGF 1

THC Back off from grapple fixture until clear of pin.

2.5 WS4 MBS PDGF 1 Ungrapple Cleanup

RHC TRIGGER → press (hold until Motors – Inh) (90 s max)

PCS Verify 'Carriage' Extend – blue

THC Maneuver SSRMS to Grapple Fixture Backoff position (within 5 cm/1 deg).

Locked						
SR	SY	SP	EP	WP	WY	WR
-68.1	-27.2	-125.6	-91.1	-118.1	-52.5	+17.4
X	Y	Z	Pitch	Yaw	Roll	
-150	0	0	0.0	0.0	0.0	
FOR	Unloaded – LEE Tip, SR Held					
Disp	ISS>W4MBS PDGF 1					

DCP BRAKES SSRMS → ON (Verify ON)

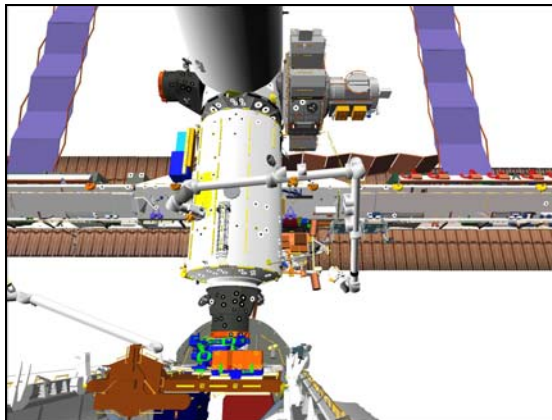


Figure 1.- Grapple Fixture Backoff
(92: Camera C: 0, 20).

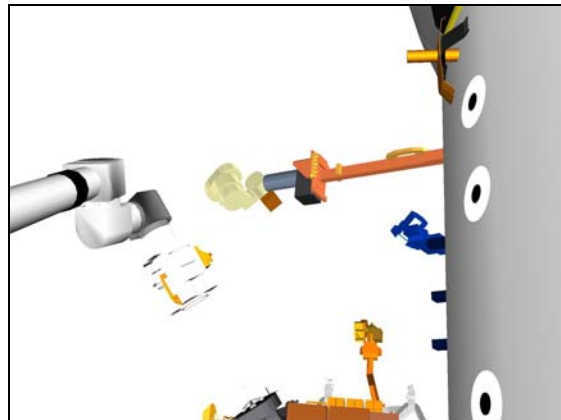


Figure 2.- Grapple Fixture Backoff
(22: Base Elbow: -93, -11).

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CMG R&R EVA SUPPORT

**CMG R&R EVA
SUPPORT**

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1.511 CMG R&R EVA SETUP

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1. SETUP

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
13: LAB Stbd Zenith (25, -5)	92: Camera B (20, 35)	91: SRMS Elbow (170, 35)	OBSS ITVC (105, -55)

PCS

MSS: SSRMS:

Verify Unloaded Parameters – √

Verify 'Unloaded Parameters' (two) – LEE Tip, SY Held

Verify Display – ISS>ISSACS

√Vernier

Verify SSRMS at Clear Structure position (SR, SP, EP within 2 deg).

SR	SY	SP	EP	WP	WY	WR
-81.9	-4.0	-75.3	-110.9	-30.8	-3.4	+110.2
X	Y	Z	Pitch	Yaw	Roll	
+138	+693	+623	+85.4	+1.0	-163.8	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>ISSACS					



Figure 1.- Clear Structure
(13: LAB Stbd Zenith: 25, -5).

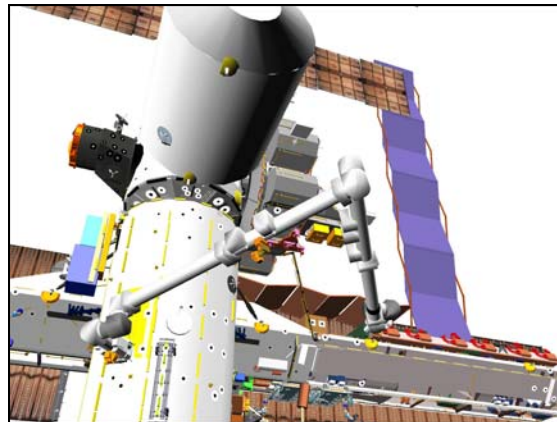


Figure 2.- Clear Structure
(92: Camera B: 20, 35).

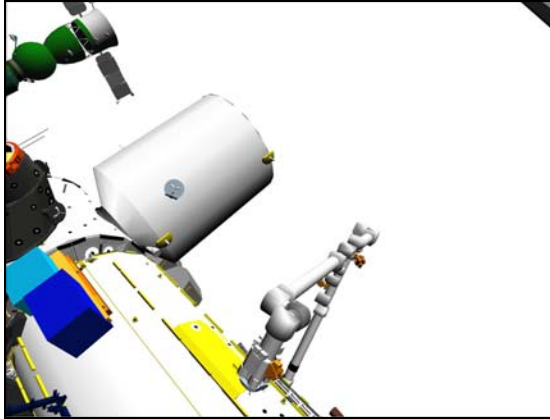


Figure 3.- Clear Structure
 (91: SRMS Elbow: 170, 35).

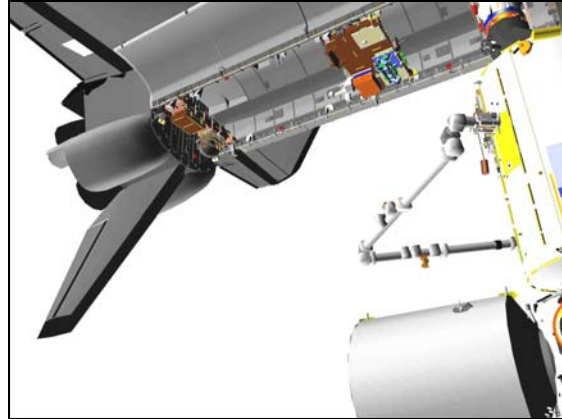


Figure 4.- Clear Structure
 (V10: OBSS ITVC: 105, -55).

DCP BRAKES SSRMS → OFF (Verify OFF)

2. JOCAS 1

PCS MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

Input 'Joint Angles' 'Destination' for JOCAS 1 position.

SR	SY	SP	EP	WP	WY	WR
-81.9	-4.0	0.0	-59.0	-66.0	+7.0	-9.0

NOTE

The Target and Error fields on the SSRMS Joint OCAS display will not be correct. This data should be verified and monitored on the Joint Angle Position overlay. (SCR 31169)

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON Verify joint angles and errors are correct on Joint Angle Position overlay.

	SR	SY	SP	EP	WP	WY	WR
(current)	-81.9	-4.0	-75.3	-110.9	-30.8	-3.4	+110.2
TGT	-81.9	-4.0	0.0	-59.0	-66.0	+7.0	-9.0
ERR	0.0	0.0	-75.3	-51.9	+35.2	-10.4	+119.2

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```

*****
* If joint angles/errors are incorrect
PCS  * cmd Cancel (Verify Sequence Status – Waiting Destination)
*
* Input correct Dest joint angles per table above.
*
* cmd Load (Verify Sequence Status – Confirm or Cancel)
*
MON  * Verify joint angles and errors are correct on Joint Angle Position
* overlay.
*****
  
```

PCS **cmd** Confirm (Verify Sequence Status – Auto Seq sw - Hot)

DCP AUTO SEQ → PROC

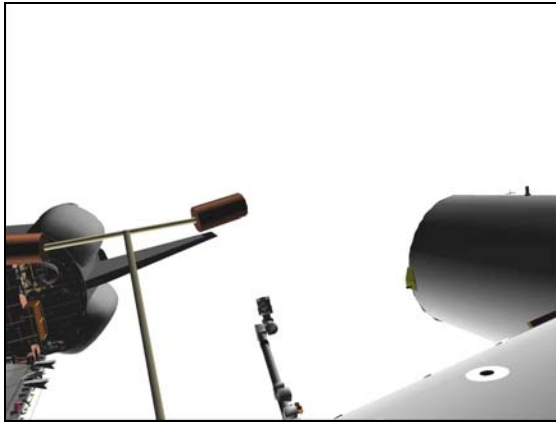


Figure 5.- JOCAS 1
(13: LAB Stbd Zenith: 25, -25).

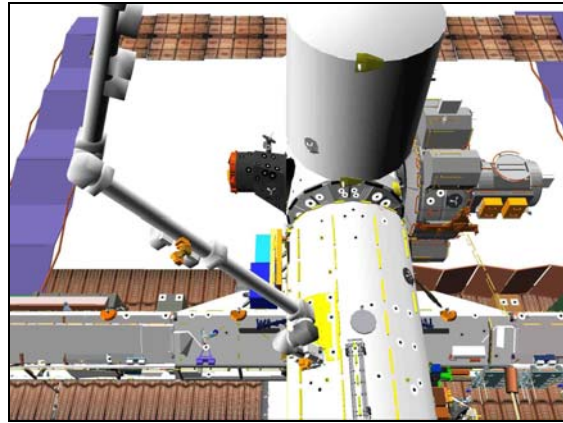


Figure 6.- JOCAS 1
(92: Camera B: 0, 35).

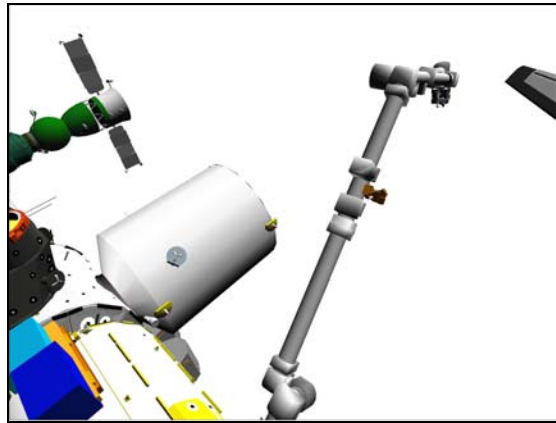


Figure 7.- JOCAS 1
(91: SRMS Elbow: 170, 45).

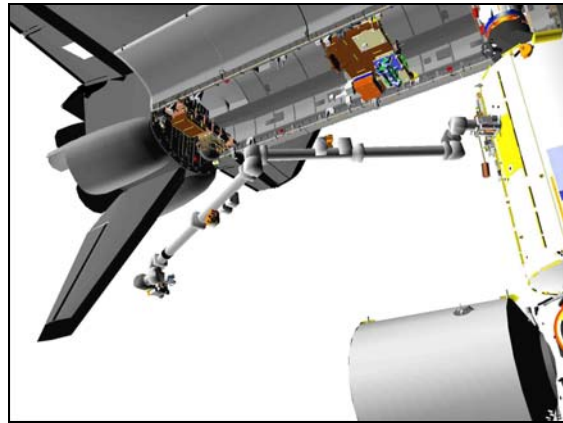


Figure 8.- JOCAS 1
(V10: OBSS ITVC: 105, -55).

PCS MSS: SSRMS:

Verify Posn Hold – orange

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Verify SSRMS at JOCAS 1 position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-81.9	-4.0	0.0	-59.0	-66.0	+7.0	-9.0
X	Y	Z	Pitch	Yaw	Roll	
+19	-239	+2091	-55.0	+85.6	-141.8	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>ISSACS					

3. JOCAS 2

Configure cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
22: Base Elbow (-130, -15)	92: Camera B (-20, 40)	91: Camera A (40, 50)	OBSS ITVC (95, -65)

SSRMS Joint OCAS

Input 'Joint Angles' 'Destination' for JOCAS 2 position.

SR	SY	SP	EP	WP	WY	WR
+32.0	-38.0	-25.0	-59.0	-66.0	+7.0	-9.0

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON

Verify joint angles and errors are correct on Joint Angle Position overlay.

	SR	SY	SP	EP	WP	WY	WR
(current)	-81.9	-4.0	0.0	-59.0	-66.0	+7.0	-9.0
TGT	+32.0	-38.0	-25.0	-59.0	-66.0	+7.0	-9.0
ERR	-113.9	+34.0	+25.0	0.0	0.0	0.0	0.0

PCS

* If joint angles/errors are incorrect
* **cmd** Cancel (Verify Sequence Status – Waiting Destination)

* Input correct Dest joint angles per table above.

* **cmd** Load (Verify Sequence Status – Confirm or Cancel)

MON

* Verify joint angles and errors are correct on Joint Angle Position overlay.

PCS

cmd Confirm (Verify Sequence Status – Auto Seq sw - Hot)

DCP

AUTO SEQ → PROC

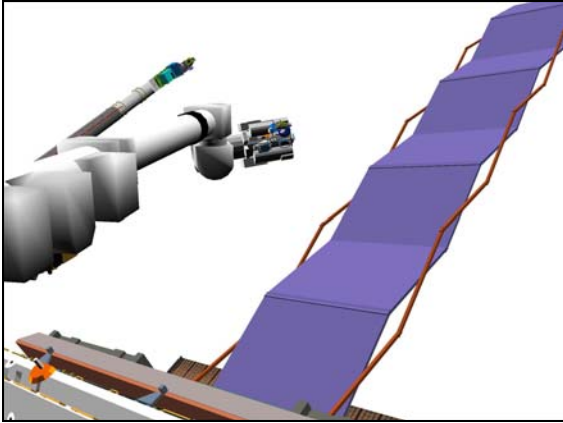


Figure 9.- JOCAS 2
 (22: Base Elbow: -130, -15).

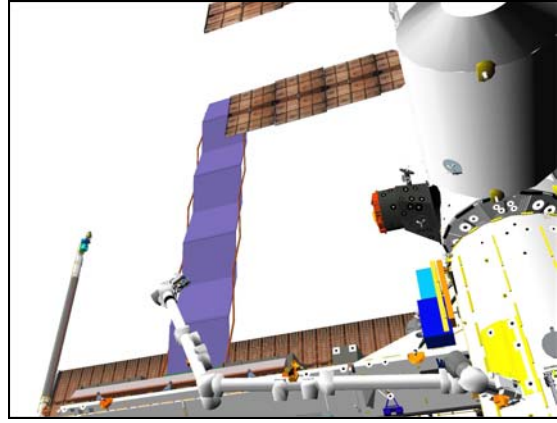


Figure 10.- JOCAS 2
 (92: Camera B: -20, 40).

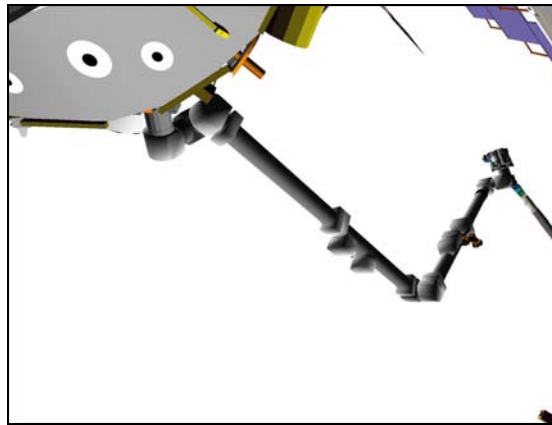


Figure 11.- JOCAS 2
 (91: Camera A : 40, 50).

PCS

MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at JOCAS 2 position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+32.0	-38.0	-25.0	-59.0	-66.0	+7.0	-9.0
X	Y	Z	Pitch	Yaw	Roll	
-402	-1326	+454	+157.4	+35.4	-93.2	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>ISSACS					

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4. MANEUVERING TO Z1 ACCESS POSITION

NOTE

Monitor clearances to PMA3, S0, and PFCS with Camera A and OBSS ITVC. Approximate clearances at EVA - CMG R&R Setup position are as follows:
 SSRMS Upper Boom to PFCS on ESP1: 92 cm
 SSRMS Lower Boom to PMA3: 126 cm

Verify that EV crew is complete with Node Light removal and clear of the Z1 area.

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
22: Base Elbow (-110, -10)	24: Tip Elbow (-20, 0)	91: Mux OBSS ITVC (75, -50) /Camera A (45, 70)	SRMS Elbow (130, 25)

PCS

MSS: SSRMS:

Enter Mode – Single (Verify blue)

WARNING

The active joint must be checked on the PCS before initiating motion. Failure to do so may result in movement of the wrong joint.

DCP

JOINT SELECT → SHOULDER PITCH (Verify SP – Selected on PCS)

THC

Perform “-” Single Joint maneuver to SP: -82.0 (THC down)

Verify SSRMS at Z1 Access position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+32.0	-38.0	-82.0	-59.0	-66.0	+7.0	-9.0
X	Y	Z	Pitch	Yaw	Roll	
-823	-222	+70	+19.1	+87.5	+36.7	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>ISSACS					

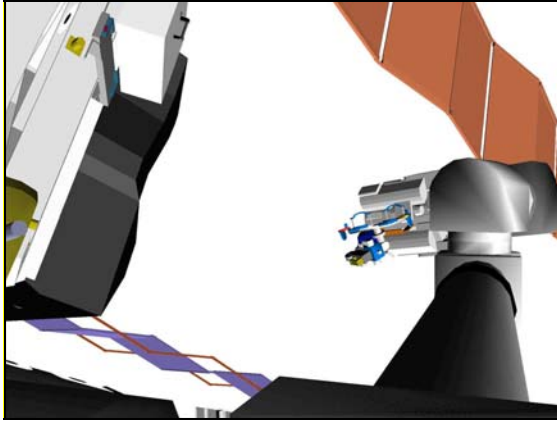


Figure 12.- Z1 Access
(24: Tip Elbow: -20, 0).

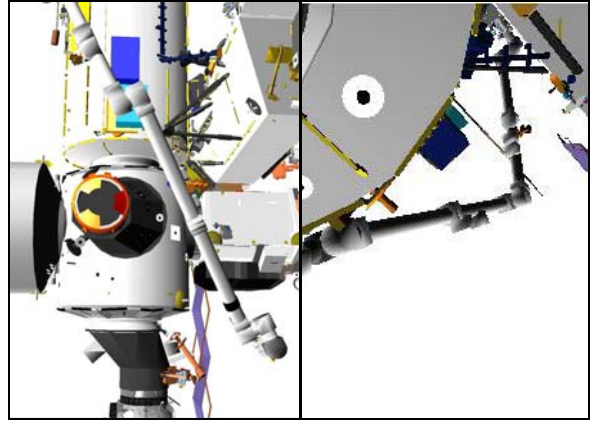


Figure 13.- Z1 Access
(91: OBSS ITVC: 70, -70/
Camera A: 45, 70).

5. MANEUVER TO EVA - CMG R&R SETUP POSN

NOTE

1. Clearances at the CMG R&R Setup Posn are as follows:
Tip Boom to PMA 3: 141 cm
Base Boom to PFCS on ESP1: 128 cm
Tip LEE to Z1: 83 cm
2. If the Node Light was not successfully folded down, clearance from the Tip Boom to the Node light is approximately 99 cm.

PCS

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

Verify Unloaded Parameters – ✓
Change Unloaded Parameters ► Unloaded ► LEE Tip SRH
Verify 'Unloaded Parameters' (two) – LEE Tip, SR Held

Verify Display – ISS>ISSACS

Enter Mode – FOR OCAS (Verify blue)

MSS: SSRMS: SSRMS FOR OCAS: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

SSRMS FOR OCAS

Input 'FOR' 'Destination' for EVA - CMG R&R Setup position.

X	Y	Z	Pitch	Yaw	Roll
-700	-222	+70	+19.1	+87.5	+36.7

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON

Verify FOR and errors are correct on FOR Position overlay.

	X	Y	Z	Pitch	Yaw	Roll
FOR	-823	-222	+70	+19.1	+87.5	+36.7
TGT	-700	-222	+70	+19.1	+87.5	+36.7
ERR	-123	0	0	0.0	0.0	0.0

PCS

* If FOR/errors are incorrect
 * **cmd** Cancel (Verify Sequence Status – Waiting Destination)
 *
 * Input correct Dest FOR per table above.
 *
 * **cmd** Load (Verify Sequence Status – Confirm or Cancel)
 *

MON

* Verify FOR and errors are correct on FOR Position overlay.

PCS

cmd Confirm (Verify Sequence Status – Auto Seq Sw-Hot)

DCP

AUTO SEQ → PROC

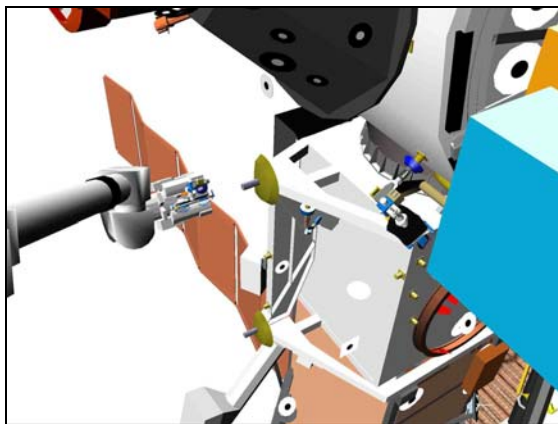


Figure 14.- EVA - CMG R&R Setup
 (22: Base Elbow: -110, -10).

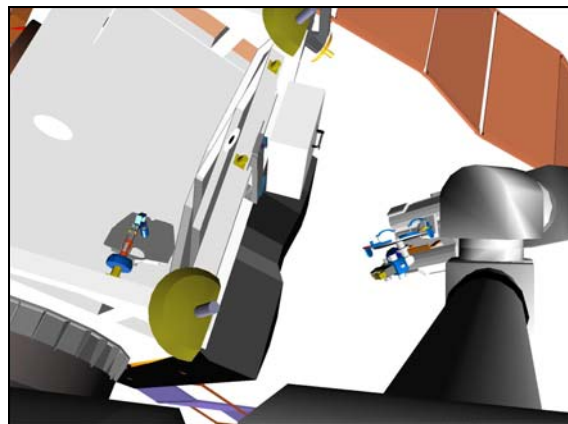


Figure 15.- EVA - CMG R&R Setup
 (24: Tip Elbow: -20, 0).

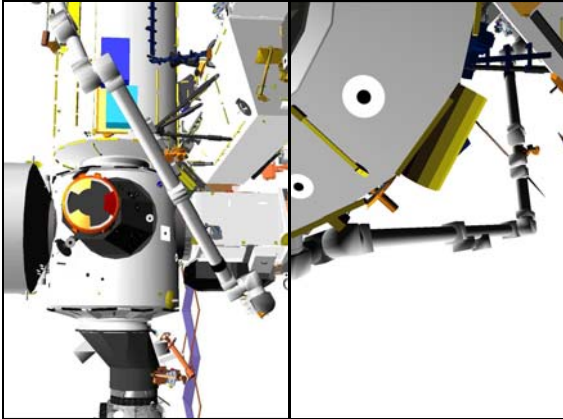


Figure 16.- EVA - CMG R&R Setup
 (91: Mux OBSS ITVC: 70, -70/
 Camera A: 45, 70).

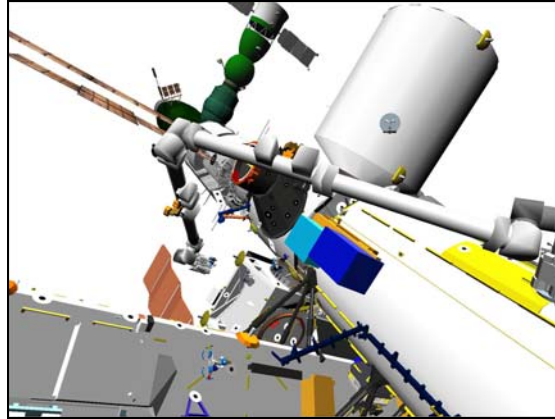


Figure 17.- EVA - CMG R&R Setup
 (V10: SRMS Elbow: 130, 25).

PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at EVA - CMG R&R Setup position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+32.0	-31.5	-75.4	-74.2	-57.9	+12.8	-6.0
X	Y	Z	Pitch	Yaw	Roll	
-700	-222	+70	+19.1	+87.5	+36.7	
FOR	Unloaded – LEE Tip, SR Held					
Disp	ISS>ISSACS					

6. CLEANUP

NOTE

Expect the following message when safing is commanded:
'R3Z - MSS OCS SSRMS Prime(Redun) ACU SRT Cat-1 Brk Stat Fail' (SCR 17495)
 This message should return to Norm.

DCP SAFING → SAFE (Verify ON)

ODS Hatch Disconnect V10 Cables.

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1.512 EVA - CMG R&R

1. HAND CONTROLLER CALIBRATION

1.1 Translational Hand Controller (THC) Calibration

THC

Deflect [X] Axis to positive hard stop where [X] =

Deflect [X] Axis to negative hard stop.

Repeat

1.2 Rotational Hand Controller (RHC) Calibration

RHC

Deflect [X] Axis to positive hard stop where [X] =

Deflect [X] Axis to negative hard stop.

Repeat

2. SETUP

ODS Hatch

√V10 Cables Connected

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3
92: Mux OBSS ITVC (70, -70)/ Camera A (45, 70) 92: SRMS Elbow (130, 10)	22: Base Elbow (-110, -10)	24: Tip Elbow (-20, 0) 91: Camera B (-5, 30)

PCS MSS: SSRMS:

Verify Unloaded Parameters – √
Verify 'Unloaded Parameters' (two) – LEE Tip, SR Held

Verify Display – ISS>ISSACS
Verify Command – ISS>ISSACS

√Vernier

Verify SSRMS at EVA - CMG R&R Setup position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+32.0	-31.5	-75.4	-74.2	-57.9	+12.8	-6.0
X	Y	Z	Pitch	Yaw	Roll	
-700	-222	+70	+19.1	+87.5	+36.7	
FOR	Unloaded – LEE Tip, SR Held					
Disp	ISS>ISSACS					

1.512 EVA - CMG R&R

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3. APFR INGRESS

NOTE

1. Monitor clearances to OTD and Node 1 via calls from EV2 and OBSS ITVC.
2. Monitor clearances to PMA3, S0, and PFCS with Camera A and OBSS ITVC. Approximate clearances at EVA - CMG R&R Setup position are as follows:
 - SSRMS Base Boom to PFCS on ESP1: 128 cm
 - SSRMS Tip Boom to PMA3: 141 cm
3. APFR settings are (12, PP, F, 4).

On EVA GO (when ready for APFR Reconfig/Ingress):
PCS MSS: SSRMS: SSRMS Safing:

cmd Remove (Verify Not Safed)

DCP BRAKES SSRMS → OFF (Verify OFF)

PCS MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

RHC/THC GCA per EVA call for APFR reconfiguration and ingress.

4. CMG01 REMOVAL

When APFR ingress complete
PCS MSS: SSRMS:

Enter Mode – Standby (Verify blue)

Change Unloaded Parameters ► EVA ► Chest 12/PP/F/4 SRH
Verify 'Unloaded Parameters' (two) – Chest 12/PP/F/4, SR Held

NOTE

Before maneuvering with EV crew on the arm, verify that the Ingress Aid is tucked away.

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

1.512 EVA - CMG R&R

THC/
RHC

GCA per EVA call to remove shroud, disconnect J1, 2, 3, and 6 connectors, and remove bolts from CMG01.

NOTE

The following table contains suggested positions for bolt access, designed to maximize clearances. All FORs assume FOR: Unloaded – Ch12PPF4, SR Held and Disp: ISS>ISSACS. SR is locked for all maneuvers.

Bolts 1, 6	+32.0	-39.2	-80.6	-65.2	-65.9	+14.5	-7.8
	FOR	-726	-31	+203	+9.5	-1.5	+99.3
Bolt 2	+32.0	-42.4	-75.9	-67.2	-63.1	+0.1	-10.8
	FOR	-727	-85	+176	+8.9	-3.5	+86.7
Bolts 3, 4	+32.0	-40.9	-77.3	-66.5	-58.1	-8.6	-10.4
	FOR	-726	-70	+106	+8.1	-5.2	+75.9
Bolt 5	+32.0	-37.1	-81.4	-65.3	-60.9	+7.7	-8.1
	FOR	-716	-12	+138	+9.1	-3.0	+89.8

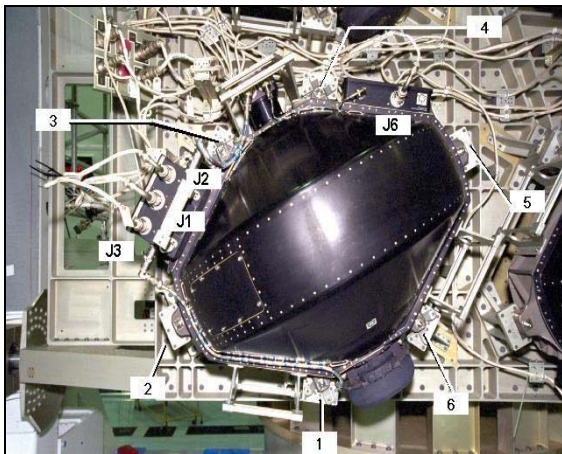


Figure 1.- CMG Bolt Config
(View from ISS Aft).

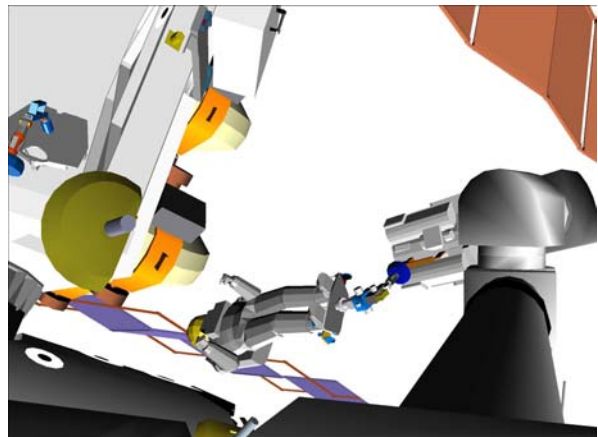


Figure 2.- Access To Bolts 1 and 6
(24: Tip Elbow: -20, 0).

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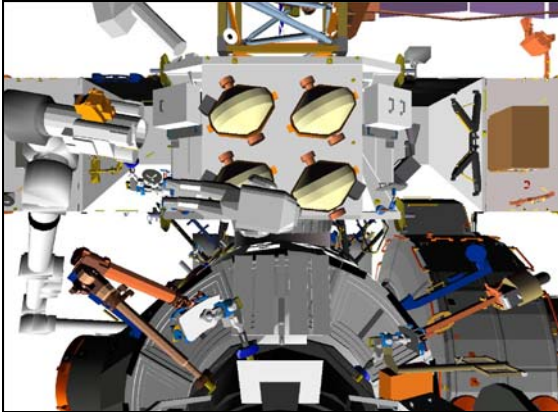


Figure 3.- Access To Bolts 1 and 6
(View from ISS Aft).

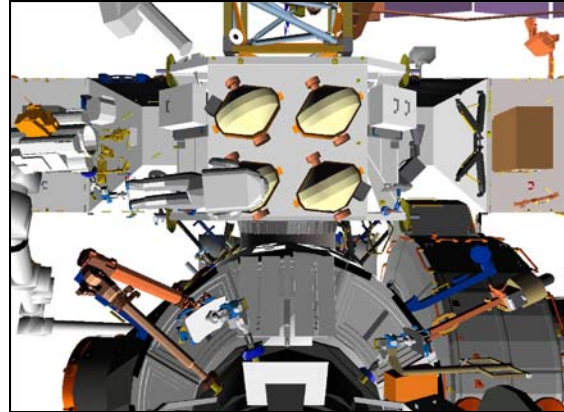


Figure 4.- Access To Bolt 2
(View from ISS Aft).

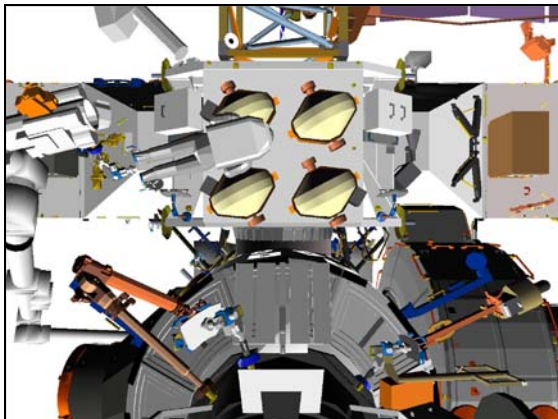


Figure 5.- Access To Bolts 3 and 4
(View from ISS Aft).

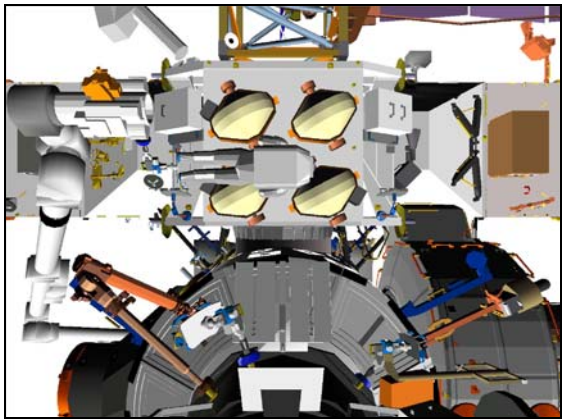


Figure 6.- Access To Bolt 5
(View from ISS Aft).

THC/
RHC

GCA per EVA call to remove CMG01 from Z1.

Record CMG01 Removal joint angles and FOR to insert into step 8.

Locked							
SR	SY	SP	EP	WP	WY	WR	
X	Y	Z	Pitch	Yaw	Roll		
FOR	Unloaded – Ch12PPF4, SR Held						
Disp	ISS>ISSACS						

1.512 EVA - CMG R&R

5. MANEUVERING TO PAYLOAD BAY

NOTE

Monitor clearances to PMA3, S0, and PFCS with Camera A and OBSS ITVC. Approximate clearances at EVA - CMG R&R Setup position are as follows:
 SSRMS Upper Boom to PFCS on ESP1: 92 cm
 SSRMS Lower Boom to PMA3: 126 cm

On EVA GO:
 Maneuver to Z1 Access position (SY, SP, EP within 2 deg).

THC/
 RHC

Locked						
SR	SY	SP	EP	WP	WY	WR
+32.0	-38.0	-82.0	-59.0	-66.0	+7.0	-9.0
X	Y	Z	Pitch	Yaw	Roll	
-761	-64	+136	+8.7	-2.5	+89.5	
FOR	Unloaded – Chest 12/PP/F/4, SR Held					
Disp	ISS>ISSACS					

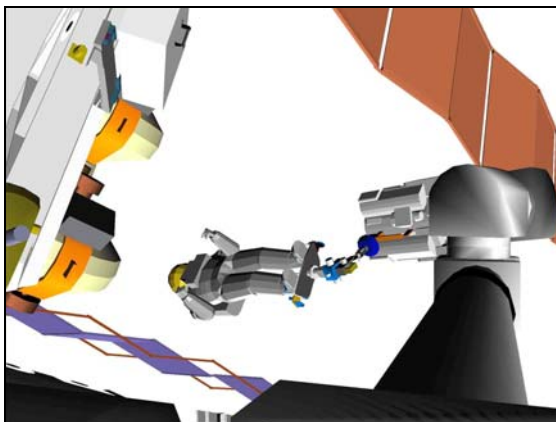


Figure 7.- Z1 Access
 (24: Tip Elbow: -20, 0).

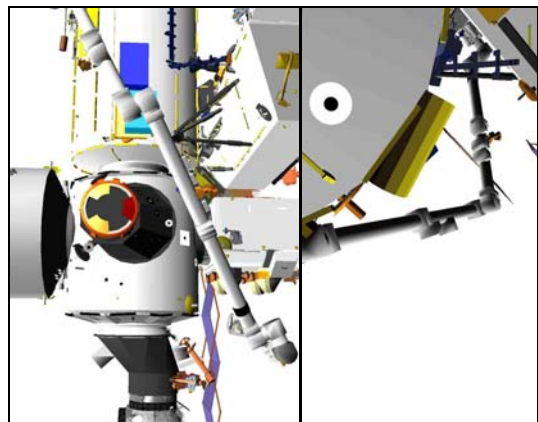


Figure 8.- Z1 Access
 (92: Mux OBSS ITVC: 70, -70/
 Camera A: 45, 70).

PCS MSS: SSRMS:

Enter Mode – Single (Verify blue)

WARNING

The active joint must be checked on the PCS before initiating motion. Failure to do so may result in movement of the wrong joint.

DCP JOINT SELECT → SHOULDER PITCH (Verify SP – Selected on PCS)

THC Perform “+” Single Joint maneuver to SP: -30.0 (THC up)

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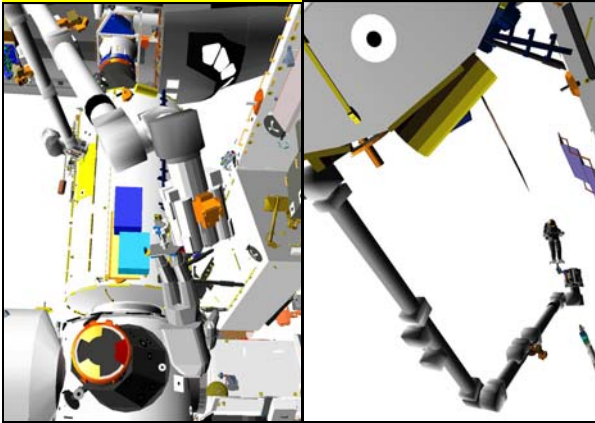


Figure 9.- Z1 Backoff
(92: Mux OBSS ITVC: 70, -55/
Camera A: 60, 65).

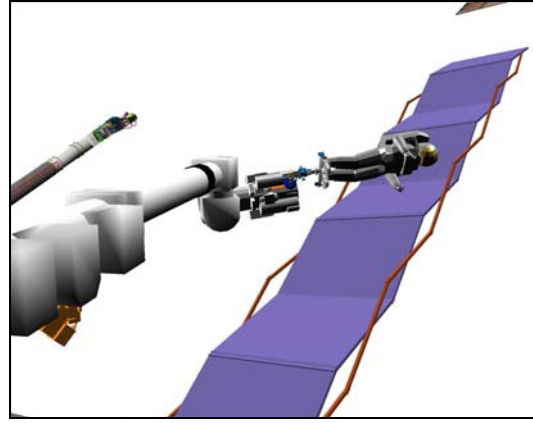


Figure 10.- Z1 Backoff
(22: Base Elbow: -130, -10).

PCS

MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3
92: Camera A (45, 65)	22: Base Elbow (-110, -10)	91: Camera B (-5, 30) 91: SRMS Elbow (-170, 40)

pick File ► LAB ► CMG LMC Access

Verify 'Joint Angles' 'Destination' for LMC Access OCAS position.

SR	SY	SP	EP	WP	WY	WR
-126.0	-7.0	+13.0	-65.0	-121.0	-167.0	+90.0

NOTE

The Target and Error fields on the SSRMS Joint OCAS display will not be correct. This data should be verified and monitored on the Joint Angle Position overlay. (SCR 31169)

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON

Verify joint angles and errors are correct on Joint Angle Position overlay.

	SR	SY	SP	EP	WP	WY	WR
(current)	+32.0	-38.0	-30.0	-59.0	-66.0	+7.0	-9.0
TGT	-126.0	-7.0	+13.0	-65.0	-121.0	-167.0	+90.0
ERR	+158.0	-31.0	-43.0	+6.0	+55.0	+174.0	-99.0

1.512 EVA - CMG R&R

```

*****
* If joint angles/errors are incorrect
PCS * cmd Cancel (Verify Sequence Status – Waiting Destination)
*
* Input correct Dest joint angles per table above.
*
* cmd Load (Verify Sequence Status – Confirm or Cancel)
*
MON * Verify joint angles and errors are correct on Joint Angle Position
* overlay.
*****
    
```

PCS **cmd** Confirm (Verify Sequence Status – Auto Seq sw - Hot)

DCP AUTO SEQ → PROC

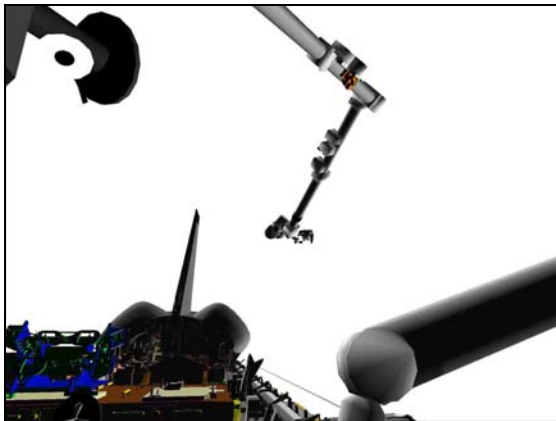


Figure 11.- LMC Access OCAS
(92: Camera A: 10, 20).

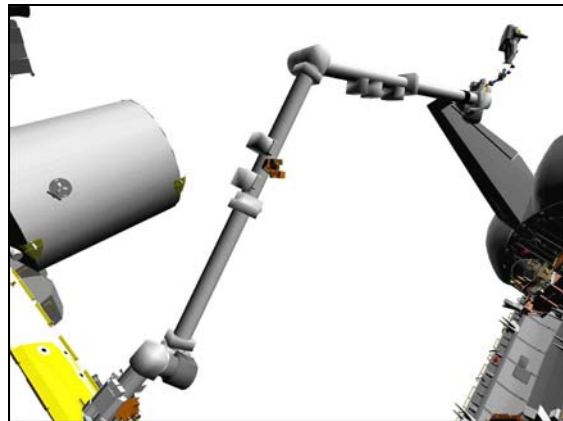


Figure 12.- LMC Access OCAS
(91: SRMS Elbow: -170, 40).

PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at LMC Access OCAS position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-126.0	-7.0	+13.0	-65.0	-121.0	-167.0	+90.0
X	Y	Z	Pitch	Yaw	Roll	
+373	-635	+2250	-20.2	-5.5	-150.7	
FOR	Unloaded – Chest 12/PP/F/4, SR Held					
Disp	ISS>ISSACS					

1.512 EVA - CMG R&R

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Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3
92: Camera B (90, 120)	22: Base Elbow (-130, -10)	91: SRMS Elbow (-160, 40)
92: Camera C (-90, 50)	24: Tip Elbow (20, 0)	

Enter Mode – Single (Verify blue)

WARNING

The active joint must be checked on the PCS before initiating motion. Failure to do so may result in movement of the wrong joint.

DCP JOINT SELECT → ELBOW PITCH (Verify EP – Selected on PCS)

THC Perform “-” Single Joint maneuver to EP: -102.0 (THC down)

PCS Verify SSRMS at LMC Access position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-126.0	-7.0	+13.0	-102.0	-121.0	-167.0	+90.0
X	Y	Z	Pitch	Yaw	Roll	
+618	-149	+2007	+1.0	+9.1	-178.2	
FOR	Unloaded – Ch12PPF4, SR Held					
Disp	ISS>ISSACS					

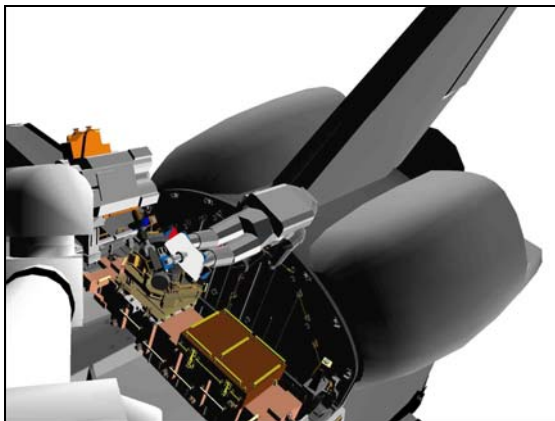


Figure 13.- LMC Access
(24: Tip Elbow: 20, 0).

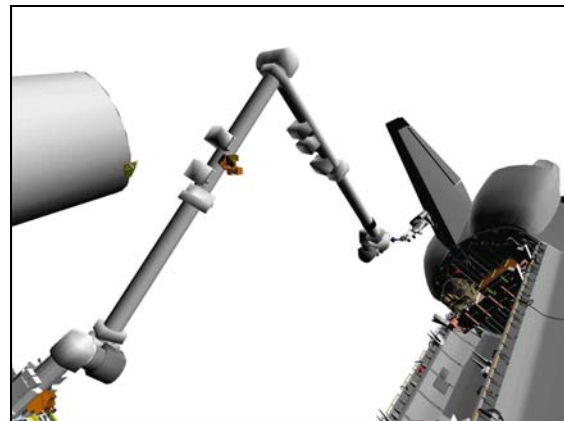


Figure 14.- LMC Access
(91: SRMS Elbow: -160, 40).

6. STOWING CMG01 AND RETRIEVING CMG05

PCS MSS: SSRMS:

Verify Command – ISS>ISSACS

1.512 EVA - CMG R&R

- NOTE
1. Use Camera B/C to monitor clearance between EV1 Helmet/CMG and Aft Bulkhead
 2. To ensure adequate Helmet to aft bulkhead clearance at positions 2 and 5, remind EV1 to “stand up” while maneuvering aft in the payload bay for access to bolts 3 and 4.

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock: Joint Lock

cmd Shoulder Roll (Verify SR – Locked)

THC/
RHC

GCA per EVA call to stow CMG01 and retrieve CMG05.

- NOTE
- The following table contains expected GCA start positions for ops required to stow CMG01 and retrieve CMG05. All positions assume FOR: Unloaded – Ch12PPF4, SR Held and Disp: ISS>ISSACS. SR is locked for all maneuvers.

Posn 1, 4	-126.0	+1.8	-3.3	-91.9	-116.1	-159.4	+85.3
	FOR	+815	-50	+2044	+0.9	+9.1	-178.2
Posn 2, 5	-126	-10.4	-17.3	-76.4	-116.0	-170.0	+91.7
	FOR	+816	+152	+2131	+1.1	+9.1	-178.2
Posn 3, 6	-126.0	+4.0	+0.3	-85.6	-126.5	-157.5	+84.1
	FOR	+815	-171	+2112	+1.0	+9.2	-178.2

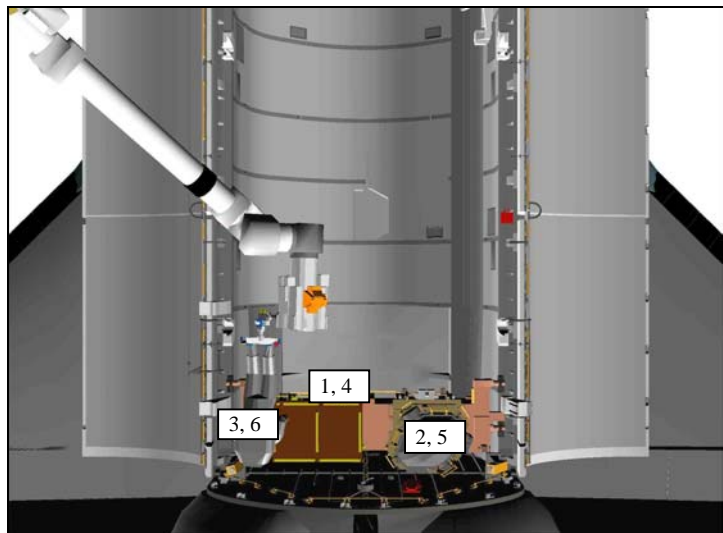


Figure 15.- CMG Swap Task Locations.

1.512 EVA - CMG R&R

7. MANEUVERING TO Z1

On EVA GO:

Maneuver back to LMC Access position (SY, SP, EP within 2 deg).

THC/
RHC

Locked						
SR	SY	SP	EP	WP	WY	WR
-126.0	-7.0	+13.0	-102.0	-121.0	-167.0	+90.0
X	Y	Z	Pitch	Yaw	Roll	
+618	-149	+2007	+1.0	+9.1	-178.2	
FOR	Unloaded – Chest 12/PP/F/4, SR Held					
Disp	ISS>ISSACS					

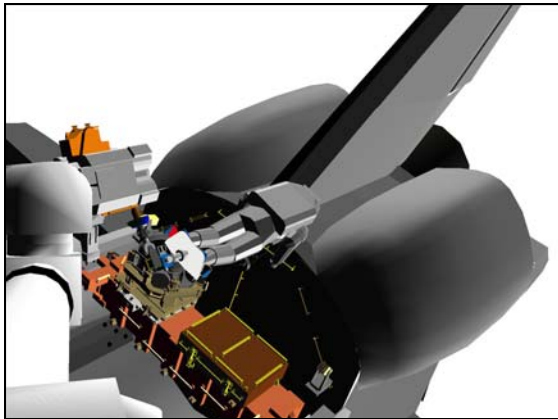


Figure 16.- LMC Access
(24: Tip Elbow: 20, 0).

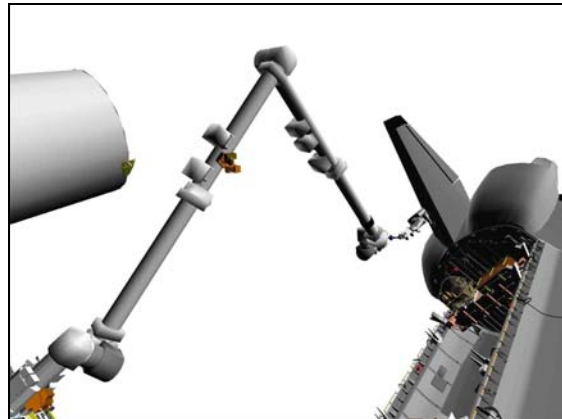


Figure 17.- LMC Access
(91: SRMS Elbow: -160, 40).

PCS

MSS: SSRMS:

Enter Mode – Single (Verify blue)

WARNING
The active joint must be checked on the PCS before initiating motion. Failure to do so may result in movement of the wrong joint.

DCP

JOINT SELECT → ELBOW PITCH (Verify EP – Selected on PCS)

THC

Perform “+” Single Joint maneuver to EP: -65.0 (THC up)

PCS

MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

1.512 EVA - CMG R&R

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3
92: Camera A (10, 20)	22: Base Elbow (-120, -20)	91: SRMS Elbow (-160, 40) 91: Camera B (0, 50)

SSRMS Joint OCAS

pick File ► LAB ► CMG 5 Install Z1

Verify 'Joint Angles' 'Destination' for CMG05 Install OCAS position.

SR	SY	SP	EP	WP	WY	WR
+32.0	-38.0	-30.0	-59.0	-66.0	+7.0	-9.0

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON Verify joint angles and errors are correct on Joint Angle Position overlay.

	SR	SY	SP	EP	WP	WY	WR
(current)	-126.0	-7.0	+13.0	-65.0	-121.0	-167.0	+90.0
TGT	+32.0	-38.0	-30.0	-59.0	-66.0	+7.0	-9.0
ERR	-158.0	+31.0	+43.0	-6.0	-55.0	-174.0	+99.0

PCS * If joint angles/errors are incorrect
 * **cmd** Cancel (Verify Sequence Status – Waiting Destination)
 *
 * Input correct Dest joint angles per table above.
 *
 * **cmd** Load (Verify Sequence Status – Confirm or Cancel)
 *
 MON * Verify joint angles and errors are correct on Joint Angle Position
 * overlay.

PCS **cmd** Confirm (Verify Sequence Status – Auto Seq sw - Hot)

DCP AUTO SEQ → PROC

1.512 EVA - CMG R&R

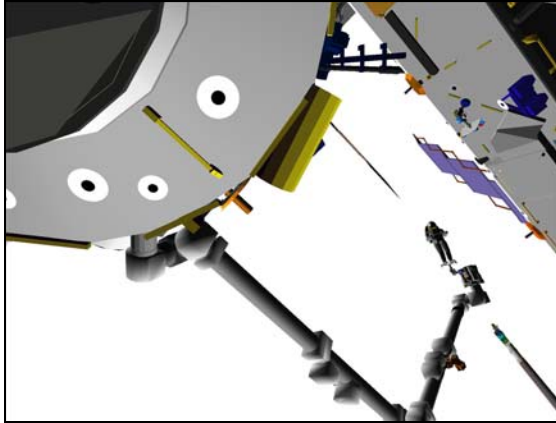


Figure 18.- CMG05 Install OCAS
(92: Camera A: 45, 70).

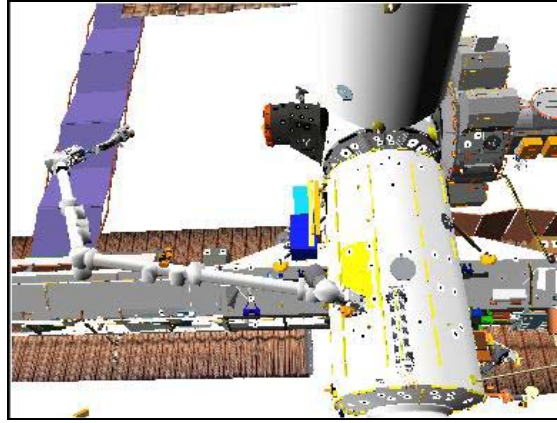


Figure 19.- CMG05 Install OCAS
(91: Camera B: -5, 30).

PCS

MSS: SSRMS: SSRMS

Verify Posn Hold – orange

Verify SSRMS at CMG05 Install OCAS position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+32.0	-38.0	-30.0	-59.0	-66.0	+7.0	-9.0
X	Y	Z	Pitch	Yaw	Roll	
-553	-1091	+408	+28.7	+36.0	+53.1	
FOR	Unloaded – Chest 12/PP/F/4, SR Held					
Disp	ISS>ISSACS					

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3
92: Mux OBSS ITVC (70, -55)/Camera A (45, 70) 91: SRMS Elbow (130, 30)	22: Base Elbow (-120, 0)	24: Tip Elbow (-20, 0)

NOTE

1. Monitor clearances to OTD and Node 1 via calls from EV2 and OBSS ITVC.
2. Monitor clearances to PMA3, S0, and PFCS with Camera A and OBSS ITVC. Approximate clearances at Z1 Access position are as follows:
 - SSRMS Upper Boom to PFCS on ESP1: 92 cm
 - SSRMS Lower Boom to PMA3: 126 cm

1.512 EVA - CMG R&R

PCS MSS: SSRMS:

Enter Mode – Single (Verify blue)

WARNING
The active joint must be checked on the PCS before initiating motion. Failure to do so may result in movement of the wrong joint.

DCP JOINT SELECT → SHOULDER PITCH (Verify SP – Selected on PCS)

THC Perform “-” Single Joint maneuver to SP: -82.0 (THC down)

Verify SSRMS at Z1 Access position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+32.0	-38.0	-82.0	-59.0	-66.0	+7.0	-9.0
X	Y	Z	Pitch	Yaw	Roll	
-761	-64	+136	+8.7	-2.5	+89.5	
FOR	Unloaded – Chest 12/PP/F/4, SR Held					
Disp	ISS>ISSACS					

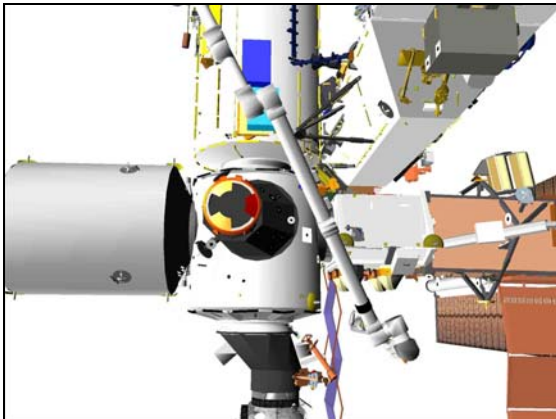


Figure 20.- Z1 Access (92: OBSS ITVC: 70, -70).

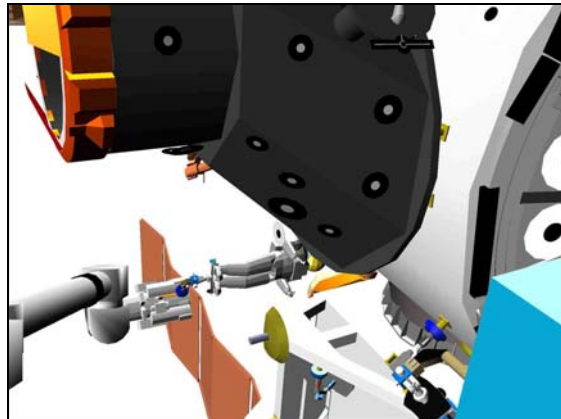


Figure 21.- Z1 Access (22: Base Elbow: -120, 0).

1.512 EVA - CMG R&R

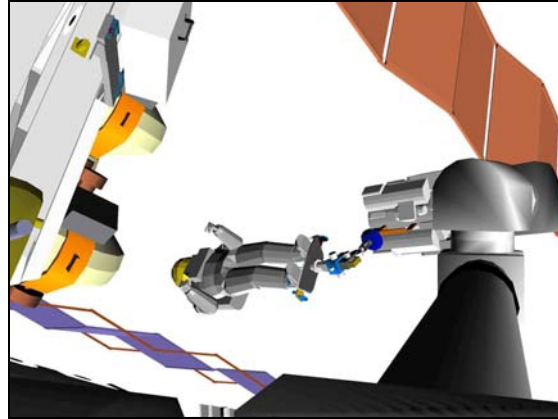


Figure 22.- Z1 Access
(24: Tip Elbow: -20, 0).

8. INSTALLING CMG05

PCS

MSS: SSRMS:

Verify Command – ISS>ISSACS

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

THC/
RHC

Maneuver to CMG05 Install position (Insert numbers from step 4, CMG01 Removal actual angles) (within 5 cm/1 deg).

Locked							
SR	SY	SP	EP	WP	WY	WR	
X	Y	Z	Pitch	Yaw	Roll		
FOR	Unloaded – Chest 12/PP/F/4, SR Held						
Disp	ISS>ISSACS						

GCA per EVA call to install CMG05 and shroud.

<u>NOTE</u>
The following table contains suggested positions for bolt access, designed to maximize clearances. All FORs assume FOR: Unloaded – Ch12PPF4, SR Held and Disp: ISS>ISSACS. SR is locked for all maneuvers.

Bolts 1, 6	+32.0	-39.2	-80.6	-65.2	-65.9	+14.5	-7.8
	FOR	-726	-31	+203	+9.5	-1.5	+99.3

1.512 EVA - CMG R&R

Bolt 2	+32.0	-42.4	-75.9	-67.2	-63.1	+0.1	-10.8
	FOR	-727	-85	+176	+8.9	-3.5	+86.7

Bolts 3, 4	+32.0	-40.9	-77.3	-66.5	-58.1	-8.6	-10.4
	FOR	-726	-70	+106	+8.1	-5.2	+75.9

Bolt 5	+32.0	-37.1	-81.4	-65.3	-60.9	+7.7	-8.1
	FOR	-716	-12	+138	+9.1	-3.0	+89.8

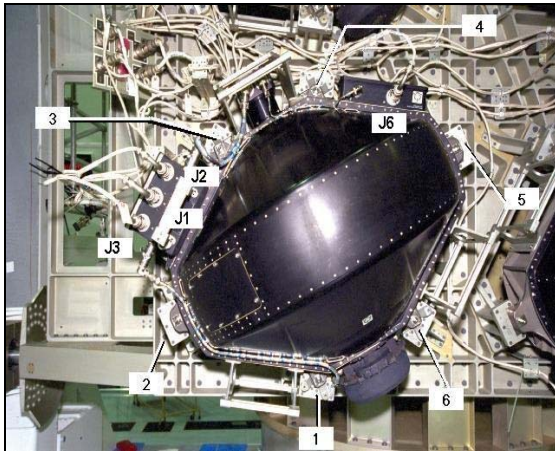


Figure 23.- CMG Bolt Config (View from ISS Aft).

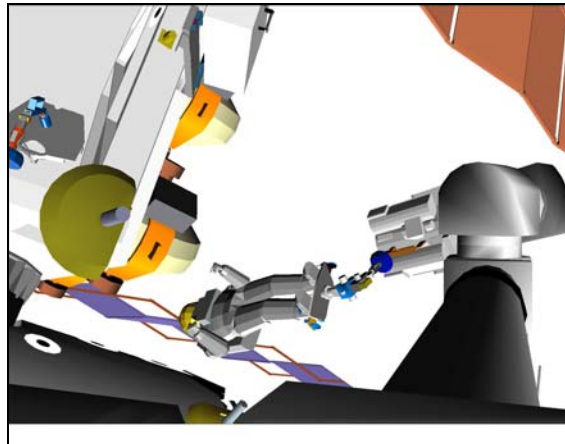


Figure 24.- Access To Bolts 1 and 6 (24: Tip Elbow: -20, 0).

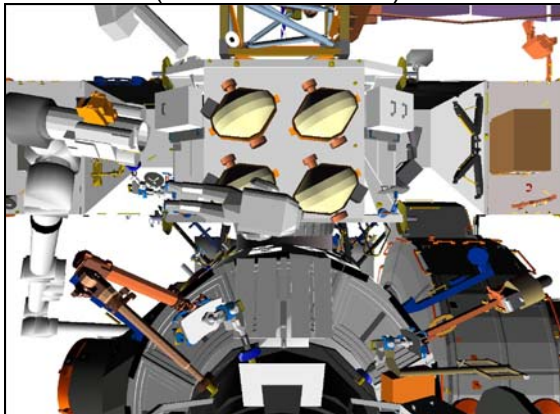


Figure 25.- Access To Bolts 1 and 6 (View from ISS Aft).

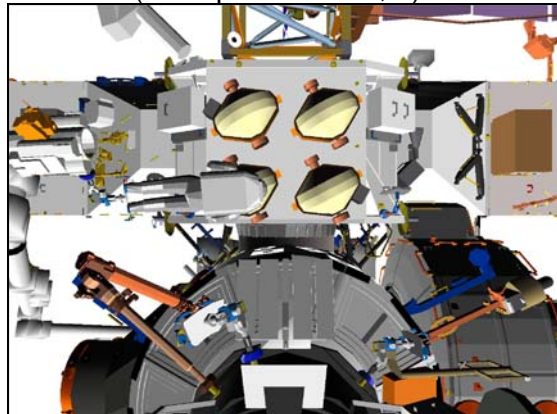


Figure 26.- Access To Bolt 2 (View from ISS Aft).

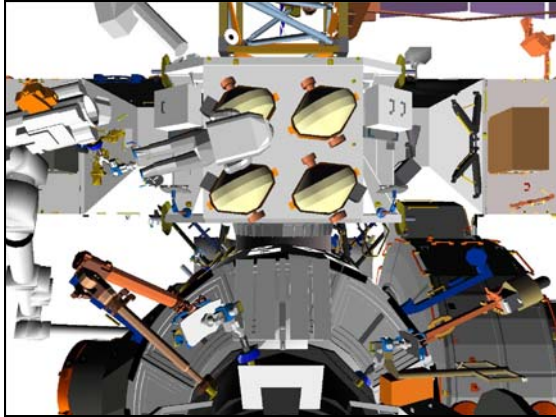


Figure 27.- Access to Bolts 3 and 4 (View from ISS Aft).

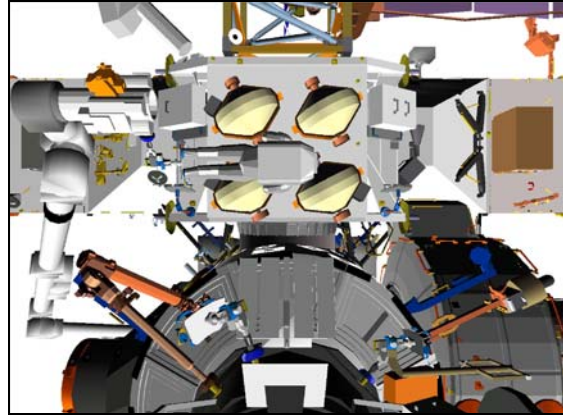


Figure 28.- Access to Bolt 5 (View from ISS Aft).

9. APFR EGRESS

On EVA GO:

GCA per EVA Call for APFR Egress and Reconfiguration and for crew untether.

10. MANEUVERING TO Z1 BACKOFF POSITION

On EVA GO:

Verify EVA is untethered from the arm, and APFR is at the Low Profile config (6/XX/L/2).

PCS

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

Change Unloaded Parameters ► Unloaded ► LEE Tip SRH

Verify 'Unloaded Parameters' (two) – LEE Tip, SR Held

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

THC/
RHC

Maneuver to Z1 Backoff position (SY, SP, EP within 2 deg).

Locked						
SR	SY	SP	EP	WP	WY	WR
+32.0	-31.5	-75.4	-74.2	-57.9	+12.8	-6.0
X	Y	Z	Pitch	Yaw	Roll	
-700	-222	+70	+19.2	+87.5	+36.5	
FOR	Unloaded – LEE Tip, SR Held					
Disp	ISS>ISSACS					

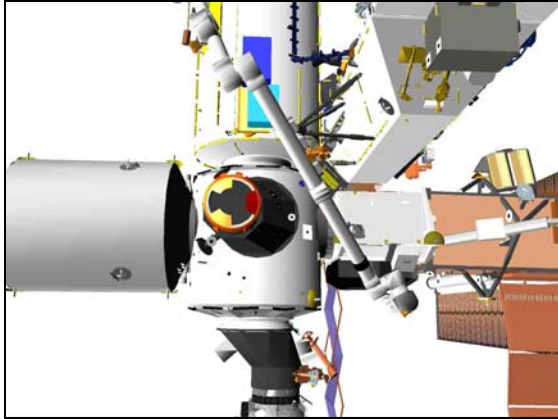


Figure 29.- Z1 Backoff
(92: OBSS ITVC: 70, -70).

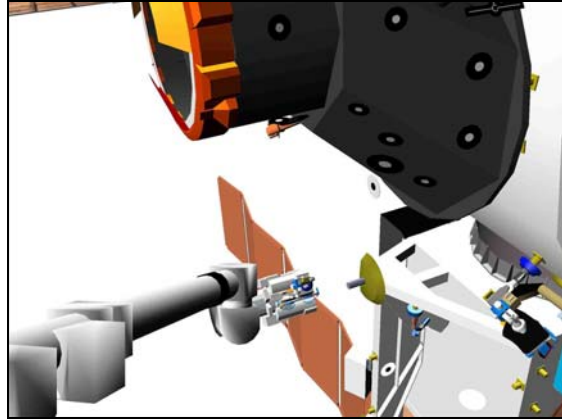


Figure 30.- Z1 Backoff
(22: Base Elbow: -120, 0).

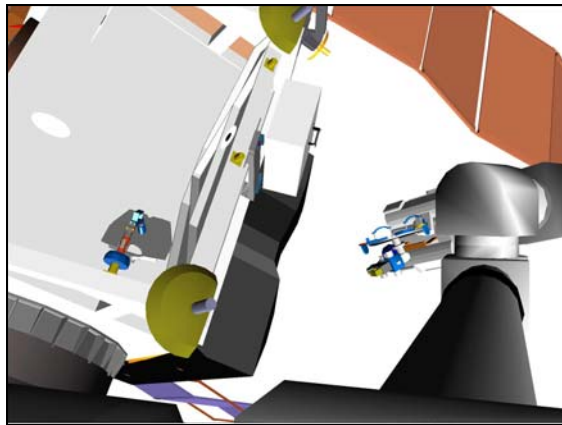


Figure 31.- Z1 Backoff
(24: Tip Elbow: -20, 0).

11. CLEANUP

NOTE

Expect the following message when safing is commanded:
**'R3Z - MSS OCS SSRMS Prime(Redun) ACU SRT Cat-1 Brk Stat
Fail'** (SCR 17495)
This message should return to Norm.

DCP SAFING → SAFE (Verify ON)

ODS Hatch Disconnect V10 cables.

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ESP2 INSTALL EVA SUPPORT

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1.610 ESP2 EVA SETUP

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1. HAND CONTROLLER CALIBRATION

1.1 Translational Hand Controller (THC) Calibration

THC Deflect [X] Axis to positive hard stop where [X] =

Deflect [X] Axis to negative hard stop.

Repeat

1.2 Rotational Hand Controller (RHC) Calibration

RHC Deflect [X] Axis to positive hard stop where [X] =

Deflect [X] Axis to negative hard stop.

Repeat

2. SETUP

ODS Hatch V10 Cables Connected.

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3
92: OBSS ITVC (70, -65)	24: Tip Elbow (-5, 0) 22: Base Elbow (-130, -10)	91: Camera B (-20, 40) 91: Camera A (55, 70)

PCS MSS: SSRMS:

Change Loaded Parameters ► ESP2 ► ESP2 Unberth SYH
Verify 'Loaded Parameters' (two) – ESP2Unbrth, SY Held

Verify Unloaded Parameters –
Change Unloaded Parameters ► Unloaded ► LEE Tip SYH
Verify 'Unloaded Parameters' (two) – LEE Tip, SY Held

Verify Display – ISS>ISSACS
Verify Command – ISS>ISSACS

Verify SSRMS at Z1 Backoff position (SY, SP, EP within 2 deg).

SR	SY	SP	EP	WP	WY	WR
+32.0	-31.5	-75.4	-74.2	-57.9	+12.8	-6.0
X	Y	Z	Pitch	Yaw	Roll	
-700	-222	+70	+19.2	+87.5	+36.5	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>ISSACS					

1.610 ESP2 EVA SETUP

(RBT FS/LF1/FIN 1/SPN) Page 2 of 6 pages

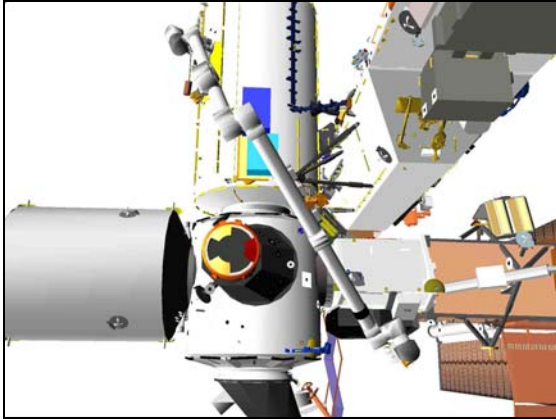


Figure 1.- Z1 Backoff
(92: OBSS ITVC: 70, -65).

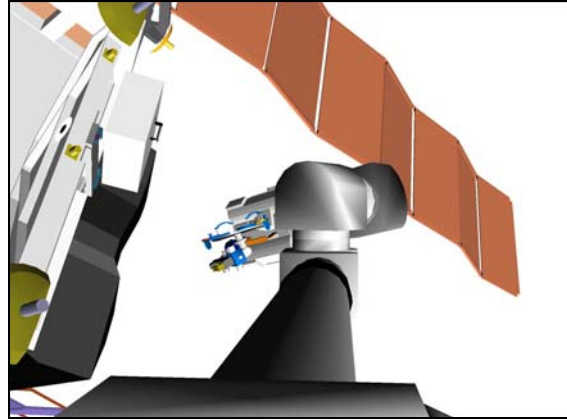


Figure 2.- Z1 Backoff
(24: Tip Elbow: -5, 0).

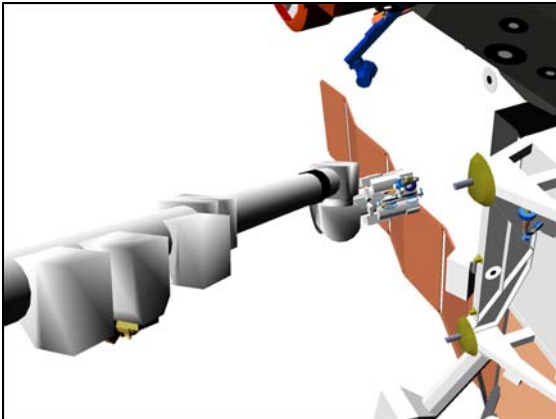


Figure 3.- Z1 Backoff
(22: Base Elbow: -130, -10).

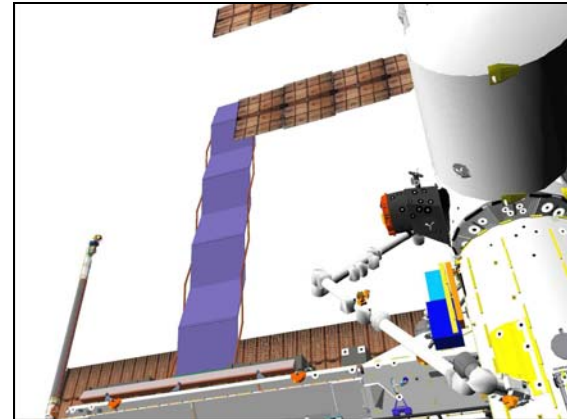


Figure 4.- Z1 Backoff
(91: Camera B: -20, 40).

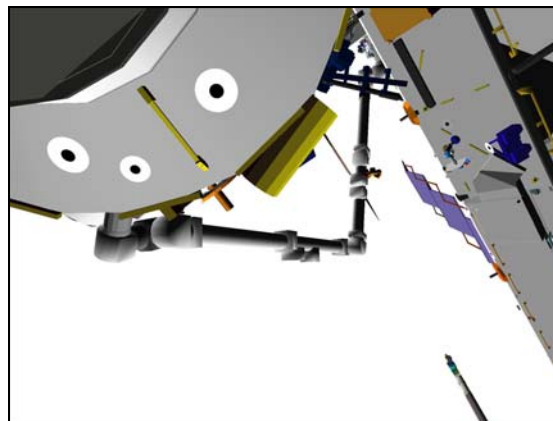


Figure 5.- Z1 Backoff
(91: Camera A: 55, 70).

1.610 ESP2 EVA SETUP

(RBT FS/LF1/FIN 1/SPN) Page 3 of 6 pages

3. SINGLE JOINT MNVR TO INTERMEDIATE POSN

Notify EV crew that SSRMS motion is about to begin.

PCS MSS: SSRMS: SSRMS Safing:

cmd Remove (Verify Not Safed)

DCP BRAKES SSRMS → OFF (Verify OFF)

RHC RATE – as required (VERNIER within 1.5 m of structure)

PCS MSS: SSRMS:

Enter Mode – Single (Verify blue)

WARNING	
The active joint must be checked on the PCS before initiating motion. Failure to do so may result in movement of the wrong joint.	

THC Perform Single Joint maneuver to Intermediate position (within 1 deg).

	SR	SY	SP	EP	WP	WY	WR
Z1 Backoff	+32.0	-31.5	-75.4	-74.2	-57.9	+12.8	-6.0
1: SP +			-11.8				
2: SY +		+18.7					
3: SR +	+49.7						
Intermediate	+49.7	+18.7	-11.8	-74.2	-57.9	+12.8	-6.0
	X	Y	Z	Pitch	Yaw	Roll	
	-404	-1239	+867	+110.0	+7.5	-53.7	
FOR	Unloaded – LEE Tip, SY Held						
Disp	ISS>ISSACS						

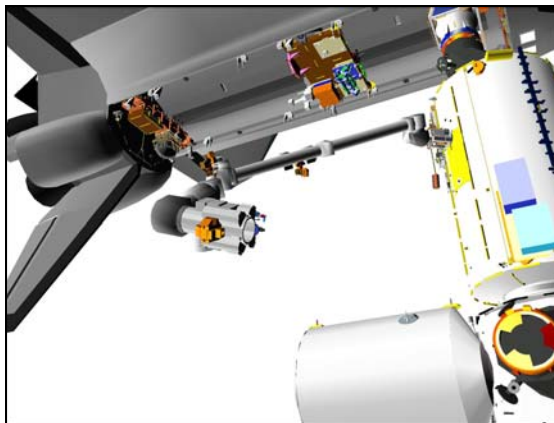


Figure 6.- Intermediate Posn (92: OBSS ITVC: 100, -55).

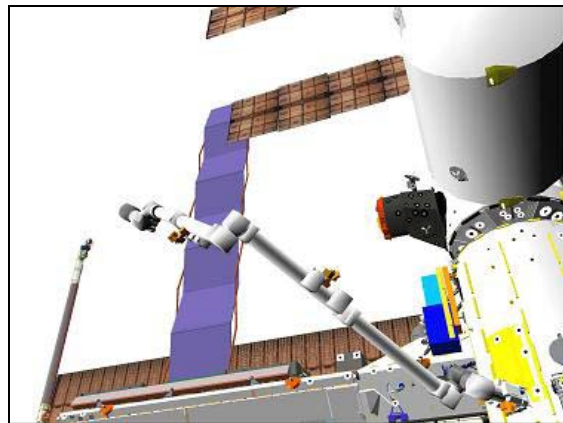


Figure 7.- Intermediate Posn (91: Camera B: -20, 40).

1.610 ESP2 EVA SETUP

(RBT FS/LF1/FIN 1/SPN) Page 4 of 6 pages

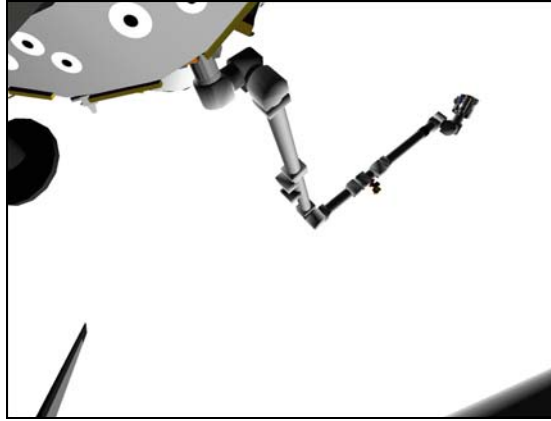


Figure 8.- Intermediate Posn
(91: Camera A: 25, 40).

4. MANEUVERING TO ESP2 EVA SETUP POSITION

PCS

MSS: SSRMS:

√Vernier

Enter Mode – Joint OCAS (Verify blue)

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3
92: OBSS ITVC (120, -55)	24: Tip Elbow (-5, 0) 22: Base Elbow (175, -10)	91: Camera A (25, 40) 91: Camera B (-20, 30)

Input 'Joint Angles' 'Destination' for ESP2 EVA Setup position.

SR	SY	SP	EP	WP	WY	WR
+49.7	+18.7	-11.8	+150.0	-109.6	+6.1	+133.3

NOTE

1. The Target and Error fields on the SSRMS Joint OCAS display will not be correct. This data should be verified and monitored on the Joint Angle Position overlay. (SCR 31169)
2. Expect singularity warning for EP between -15 and +15 deg.

cmd Load (Verify Sequence Status – Confirm or Cancel)

1.610 ESP2 EVA SETUP

MON Verify joint angles and errors are correct on Joint Angle Position overlay.

	SR	SY	SP	EP	WP	WY	WR
(current)	+49.7	+18.7	-11.8	-74.2	-57.9	+12.8	-6.0
TGT	+49.7	+18.7	-11.8	+150.0	-109.6	+6.1	+133.3
ERR	0.0	0.0	0.0	-224.2	+51.7	+6.7	-139.3

PCS * If joint angles/errors are incorrect
 * **cmd** Cancel (Verify Sequence Status – Waiting Destination)
 *
 * Input correct Dest joint angles per table above.
 *
 * **cmd** Load (Verify Sequence Status – Confirm or Cancel)
 *
 MON * Verify joint angles and errors are correct on Joint Angle Position
 * overlay.

PCS **cmd** Confirm (Verify Sequence Status – Auto Seq sw - Hot)

DCP AUTO SEQ → PROC



Figure 9.- ESP2 EVA Setup Position (92: OBSS ITVC: 120, -55).

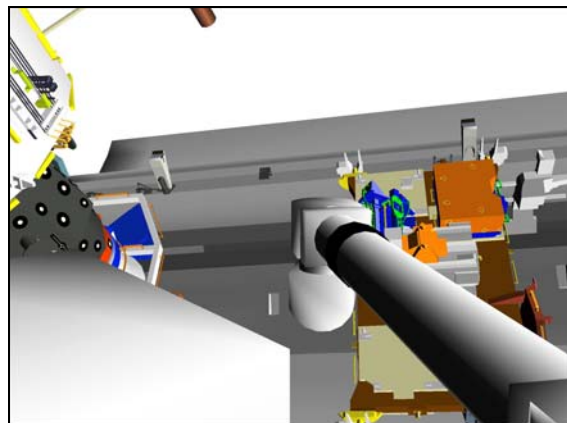


Figure 10.- ESP2 EVA Setup Position (22: Base Elbow: 40, -10).

1.610 ESP2 EVA SETUP

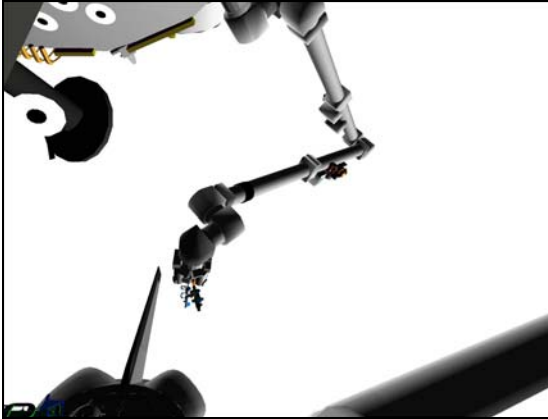


Figure 11.- ESP2 EVA Setup Position
(91: Camera A: 15, 30).

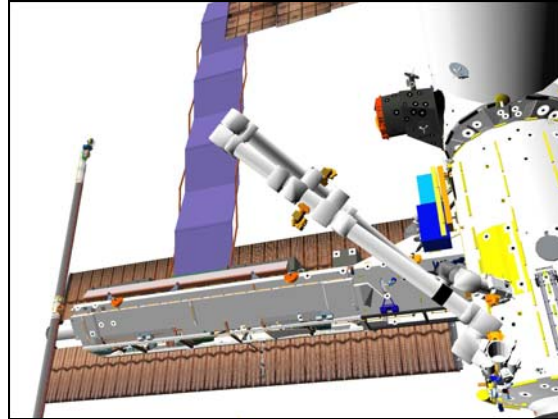


Figure 12.- ESP2 EVA Setup Position
(91: Camera B: -20, 30).

PCS

MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at ESP2 EVA Setup position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+49.7	+18.7	-11.8	+150.0	-109.6	+6.1	+133.3
X	Y	Z	Pitch	Yaw	Roll	
+645	-199	+1162	-89.0	-0.1	-179.9	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>ISSACS					

DCP

BRAKES SSRMS → ON (Verify ON)

1.612 ESP2 GRAPPLE

(RBT FS/LF1/FIN 1/SPN) Page 1 of 5 pages

1. SETUP

NOTE

MSS Effector Overlay will not appear on the monitor until the "confirm" command is sent to the LEE.

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
92: OBSS ITVC (90, -45)	91: Camera A (0, 10) 25: Tip LEE	24: Tip Elbow (-25, 0) 22: Base Elbow (45, -15)	SRMS Elbow (-170, 10)

PCS

MSS: SSRMS:

Verify 'Loaded Parameters' (two) – ESP2Unbrth, SY Held

Verify Unloaded Parameters – √

Verify 'Unloaded Parameters' (two) – LEE Tip, SY Held

Verify Display – ISS>ISSACS

Verify Command – ISS>ISSACS

√Vernier

2. MANEUVERING TO ESP2 PRE-GRAPPLE POSITION

NOTE

Use OBSS ITVC (zoom as required) or SRMS Elbow Camera to monitor clearances. The following are approximate minimum clearances seen during the maneuver to the ESP2 Pre-Grapple position:

- Tip LEE to Camera Stanchions on ESP2: 106 cm
- Tip LEE to ESP2 FRGF: 65 cm
- WP to US LAB: 62 cm
- WP to PMA2 (port grapple fixture): 71 cm
- WY to ODS: 77 cm

Verify EV crew is clear of ESP2 and go for maneuver to ESP2 Pre-Grapple position.

DCP

BRAKES SSRMS → OFF (Verify OFF)

PCS

MSS: SSRMS:

Enter Mode – Manual (Verify – blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

1.612 ESP2 GRAPPLE

THC Maneuver SSRMS to ESP2 Pre-Grapple position (within 5 cm/1 deg).

		Locked						
		SR	SY	SP	EP	WP	WY	WR
		+49.7	+18.7	-11.8	+150.0	-109.6	+6.1	+133.3
		X	Y	Z	Pitch	Yaw	Roll	
ESP2 EVA Setup		+645	-199	+1162	-89.0	-0.1	-179.9	
1: Y	+		-19					
2: Z	-			+960				
3: X	+	+810						
4: Z	-			+897				
5: X	+	+992						
ESP2 PreGrapple		+992	-19	+897	-89.0	-0.1	-179.9	
		SR	SY	SP	EP	WP	WY	WR
		+32.9	+18.7	+43.3	+125.7	-148.2	+12.8	+147.9
FOR		Unloaded – LEE Tip, SY Held						
Disp		ISS>ISSACS						

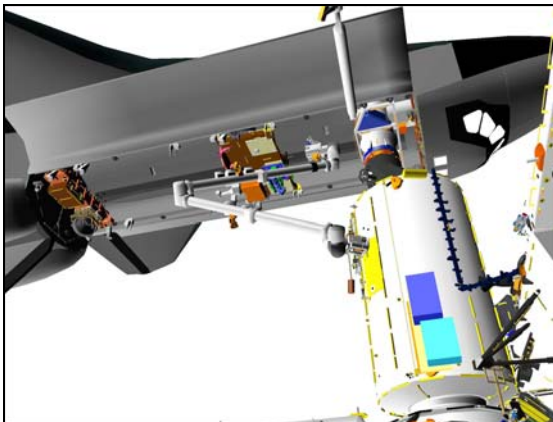


Figure 1.- ESP2 Pre-Grapple (92: OBSS ITVC: 90, -45).

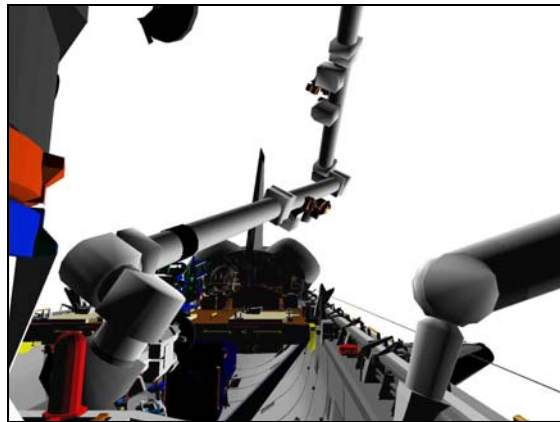


Figure 2.- ESP2 Pre-Grapple (91: Camera A: 0, 10).

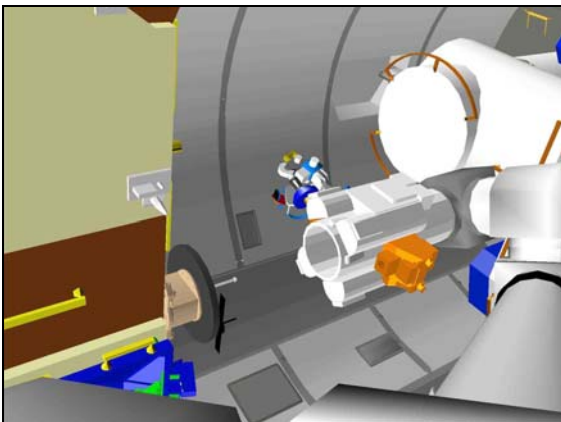


Figure 3.- ESP2 Pre-Grapple (24: Tip Elbow: -25, 0).

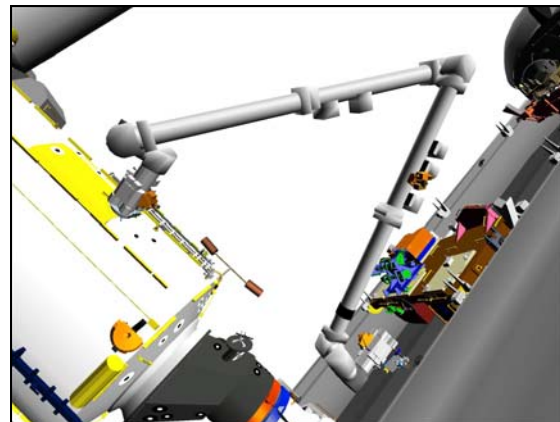


Figure 4.- ESP2 Pre-Grapple (V10: SRMS Elbow: -170, 10).

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3. ESP2 GRAPPLE SETUP AND CAPTURE

NOTE

Tip LEE Camera must be fully zoomed out to correspond to target overlay.

PCS

3.1 Setting Up For Grapple

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: as required

MSS: SSRMS:

Change Command ► SSRMS ► Internal (Verify SSRMS>Internal)

3.2 Slow Capture Commands

MSS: SSRMS: Tip LEE:

cmd Capture ► Automatic ► Slow, Limp (Verify Speed – Slow)

Verify '**Confirm or Terminate**' prompt.

CAUTION

Due to end-to-end system latency, the RHC Trigger is hot up to 3 seconds prior to receiving a Trigger Hot icon status on the PCS.

NOTE

Once the trigger is hot, only safing or trigger commands should be sent to the Robotics equipment. If a configuration change is required, including routing MSS Cameras, safe the system to exit LEE operations (SCR 23262, 14662)

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Auto Capture

RHC/
THC

3.3 Maneuvering To Grapple

Maneuver to within grapple envelope.

RHC

3.4 Grapple

TRIGGER → press (momentarily)

PCS

Verify 'Snare' Close, Capture (two) – blue (12 s max)

Verify Capture to Latch – No (SCR 19282)

Verify 'Carriage' Tension ~5500 N (90 s max)

Verify 'Carriage' Retract – blue

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3.5 Grapple Cleanup

MSS: SSRMS:

Verify Posn Hold – orange

Verify Loaded Parameters – √

Verify 'Loaded Parameters' (two) – ESP2Unbrth, SY Held

DCP

BRAKES SSRMS → ON (Verify – ON)

PCS

Change Display ► LAB ► ESP2 Unberth (Verify LAB>ESP2 Unberth)

Change Command ► ISS ► OBAS (Verify ISS>OBAS)

Expected ESP2 Grapple joint angles and FOR.

SR	SY	SP	EP	WP	WY	WR
+34.8	+18.7	+36.5	+125.0	-139.7	+12.2	+146.2
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	-0.2	
FOR	Loaded – ESP2Unbrth, SY Held					
Disp	LAB>ESP2 Unberth					

Review {[SSRMS LEE CUE CARD](#)}, all (SODF: RBT GEN: REFERENCE)

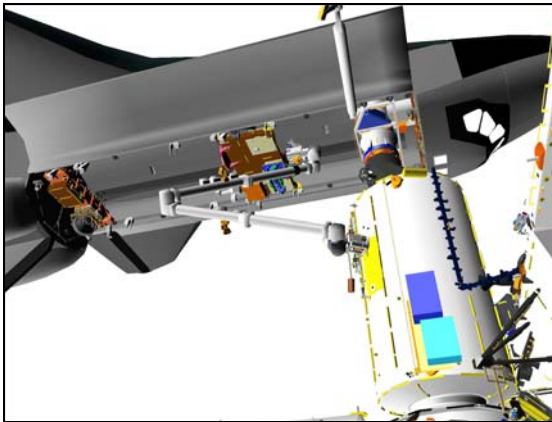


Figure 5.- ESP2 Grapple
(92: OBSS ITVC: 90, -45).

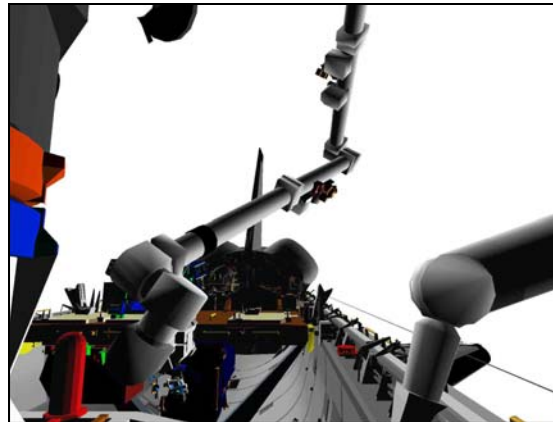


Figure 6.- ESP2 Grapple
(91: Camera A: 0, 10).

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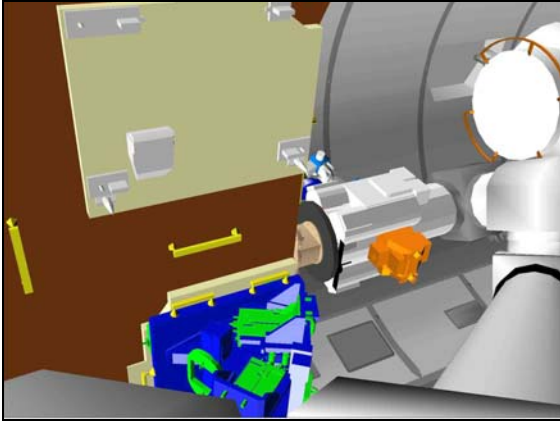


Figure 7.- ESP2 Grapple
(24: Tip Elbow: -25, 0).

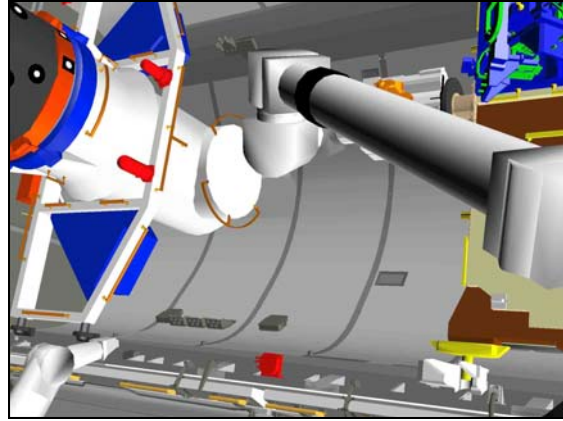


Figure 8.- ESP2 Grapple
(22: Base Elbow: 75, -20).

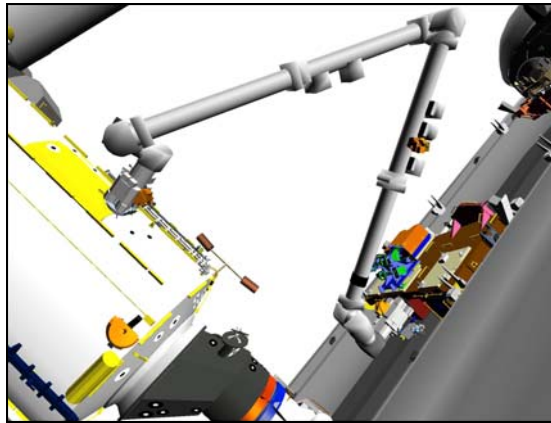


Figure 9.- ESP2 Grapple
(V10: SRMS Elbow: -170, 10).

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1. SETUP

Notify shuttle crew to prepare for PRLA Ops.

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
92: SRMS Elbow (-160, 20) 92: OBSS ITVC (90, -45)	91: Mux Camera B (0, 0)/ C (0, 0)	22: Base Elbow (45, -15)	Camera A (0, 25)

PCS

MSS: SSRMS:

Verify Display – LAB>ESP2 Unberth

Verify Command – ISS>OBAS

√Vernier

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: 0.4 (Verify 0.4)

Verify EVA crew clear of ESP2 structure and go for ESP2 Unberth.

2. ATTITUDE CONTROL CONFIGURATION

MSS: SSRMS: Thrusters:

Verify 'Desat Request:' – Inh

If using shuttle attitude control, coordinate with shuttle crewmembers:
DAP: FREE

3. ACTIVATE LATCHES

Give Shuttle Crew GO for PRLA Release.

NOTE

Steps in gray are performed by shuttle crew to open ESP2 PRLAs.

A6U √PL RETEN LAT (four) – OFF
 PL SEL – 3
 LOGIC PWR 1,2 (two) – ON

R13L PL BAY MECH PWR SYS 1,2 (two) – ON

√RDY-FOR-LAT 1,2,3,4 (eight): 1

√LAT 1,2,3,4 (eight): 1

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* If any REL msw shows '1', expect
* single motor time (60 seconds).

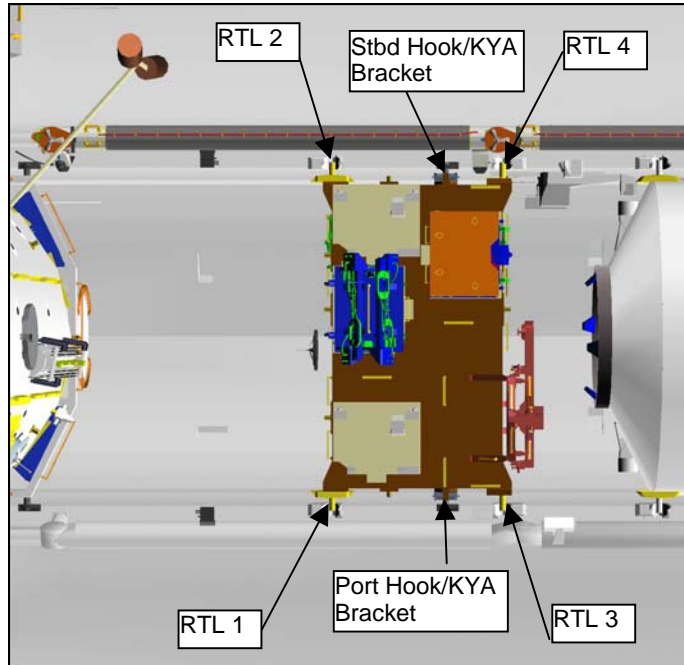


Figure 1.- ESP2 Latch Config.

4. PRLA RELEASE

Note single motor drive time (> 30 seconds).

PL RETEN LAT 1,2 (two) – REL (tb-REL) (60 s max)
– OFF
3,4 (two) – REL (tb-REL) (60 s max)
– OFF

5. DEACTIVATE LATCHES

PL RETEN LOGIC PWR 1,2 (two) – OFF
BAY MECH PWR SYS 1,2 (two) – OFF

R13L

6. ESP2 UNBERTH MANEUVER

√PRLA Ops have been completed

Verify shuttle crew standing by to give callouts for PL RETEN RDY – bp

DCP BRAKES SSRMS → OFF (Verify – OFF)

PCS MSS: SSRMS:

Enter Mode – Manual (Verify – blue)

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MSS: SSRMS: SSRMS Manual: Joint Lock: Joint Lock

cmd Shoulder Yaw (Verify SY – Locked)

NOTE

1. Monitor clearance between SSRMS and US LAB with OBSS ITVC or SRMS Elbow Camera. Minimum clearance is approximately 107 cm.
2. A brief cross-cluster collision may be annunciated during the maneuver to the Low Hover position.

THC/
RHC

Maneuver to ESP2 Low Hover position (within 5 cm/1 deg).

	Locked					
SR	SY	SP	EP	WP	WY	WR
+60.6	+18.7	+28.6	+149.7	-145.6	+0.9	+124.4
X	Y	Z	Pitch	Yaw	Roll	
0	0	-300	0.0	0.0	-0.2	
FOR	Loaded – ESP2Unbrth, SY Held					
Disp	LAB>ESP2 Unberth					

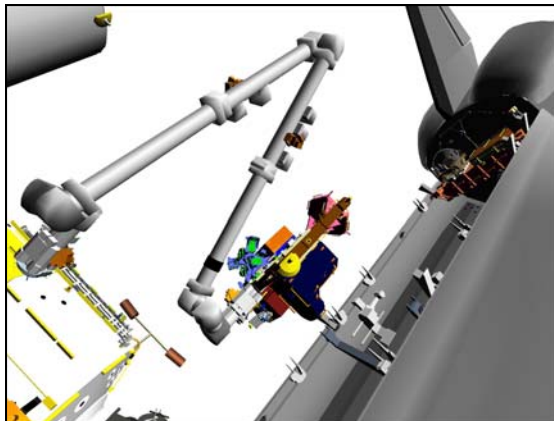


Figure 2.- ESP2 Low Hover
(92: SRMS Elbow: -160, 20).

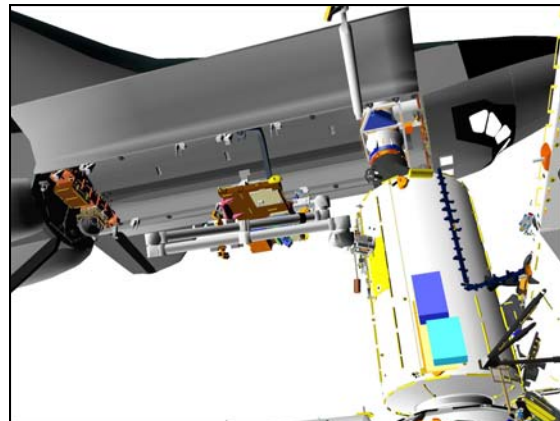


Figure 3.- ESP2 Low Hover
(92: OBSS ITVC: 90, -45).

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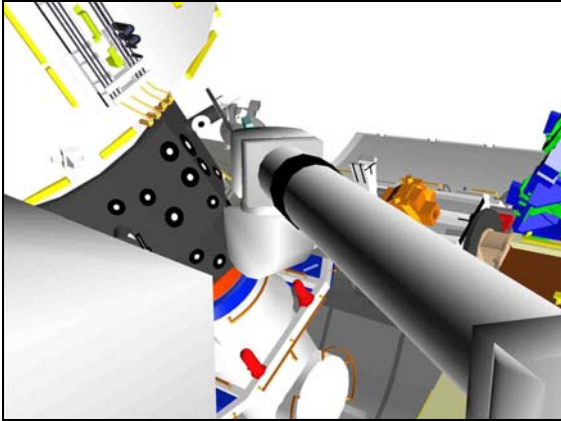


Figure 4.- ESP2 Low Hover
(22: Base Elbow: 45, -15).

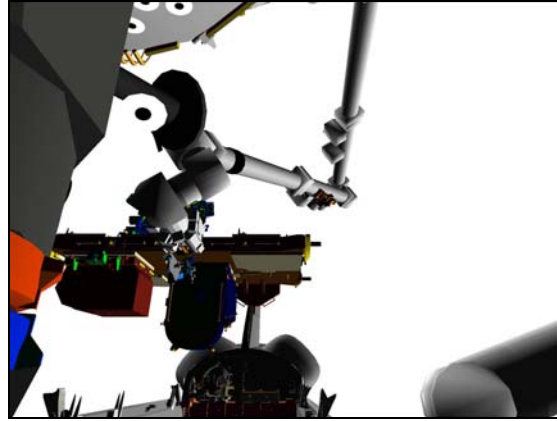


Figure 5.- ESP2 Low Hover
(V10: Camera A: 0, 25).

7. ATTITUDE CONTROL CONFIGURATION

If using shuttle attitude control, coordinate with shuttle crewmembers

DAP: LVLH

When rates damped

DAP: FREE > 2 seconds

Then DAP: AUTO

8. MANEUVERING TO JOCAS 1 START POSITION

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
92: SRMS Elbow (-140, 20)	91: Camera B (0, 10)	22: Base Elbow (65, -10)	Camera A (0, 25)
92: OBSS ITVC (105, -55)		24: Tip Elbow (-10, 0)	

PCS

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: 1.0 (Verify 1.0)

MSS: SSRMS:

Enter Mode – Single (Verify – blue)

WARNING

The active joint must be checked on the PCS before initiating motion. Failure to do so may result in movement of the wrong joint.

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THC Perform Single Joint maneuver to JOCAS1 Start position (within 1 deg).

	SR	SY	SP	EP	WP	WY	WR
ESP2 Low Hover	+60.6	+18.7	+28.6	+149.7	-145.6	+0.9	+124.4
1: SP -			-40.0				
2: WY -						-90.0	
JOCAS1 Start	+60.6	+18.7	-40.0	+149.7	-145.6	-90.0	+124.4
	X	Y	Z	Pitch	Yaw	Roll	
	-48	-499	-281	+91.1	+34.3	-103.7	
FOR	Loaded - ESP2Unbrth, SY Held						
Disp	LAB>ESP2 Unberth						

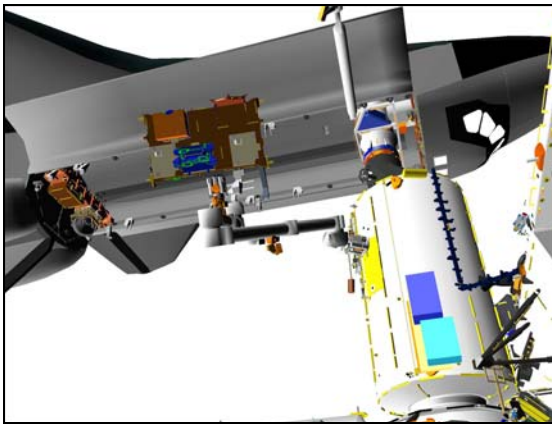


Figure 6.- JOCAS1 Start
(92: OBSS ITVC: 90, -45).

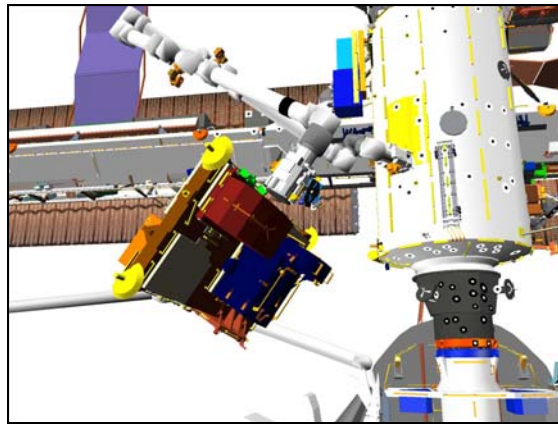


Figure 7.- JOCAS1 Start
(91: Camera B: -10, 15).

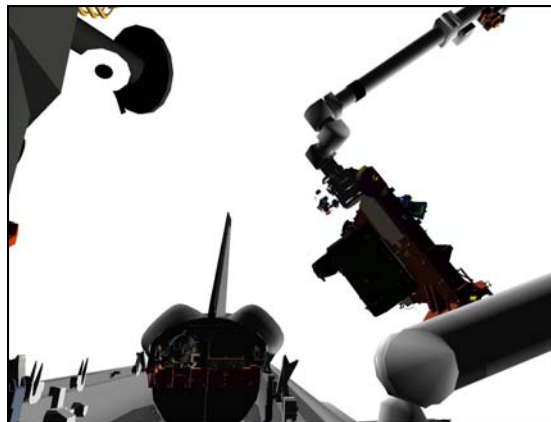


Figure 8.- JOCAS1 Start
(V10: Camera A: 5, 20).

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9. ESP2 UNBERTH JOCAS 1

RHC RATE → COARSE (Verify Coarse on PCS)

PCS MSS: SSRMS:

Enter Mode – Joint OCAS (Verify – blue)

NOTE

Expect singularity warning at SR: +28.2 (WY pointing at shoulder) and for EP between -15 and +15 deg.

SSRMS Joint OCAS

pick File ► LAB ► ESP2 Unberth Jnt OCAS 1

Verify 'Joint Angles' 'Destination' for ESP2 Unberth JOCAS 1 position.

SR	SY	SP	EP	WP	WY	WR
-65.0	+18.7	-40.0	-30.0	-145.6	-90.0	-74.5

NOTE

The Target and Error fields on the SSRMS Joint OCAS display will not be correct. This data should be verified and monitored on the Joint Angle Position overlay. (SCR 31169)

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON Verify joint angles and errors are correct on Joint Angle Position overlay.

	SR	SY	SP	EP	WP	WY	WR
(current)	+60.6	+18.7	-40.0	+149.7	-145.6	-90.0	+124.4
TGT	-65.0	+18.7	-40.0	-30.0	-145.6	-90.0	-74.5
ERR	+125.6	0.0	0.0	+179.7	0.0	0.0	+198.9

PCS * If joint angles/errors are incorrect
 * **cmd** Cancel (Verify Sequence Status – Waiting Destination)

* Input correct Dest joint angles per table above.

* **cmd** Load (Verify Sequence Status – Confirm or Cancel)

MON * Verify joint angles and errors are correct on Joint Angle Position overlay.

PCS **cmd** Confirm (Verify Sequence Status – Auto Seq sw - Hot)

DCP AUTO SEQ → PROC

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Figure 9.- ESP2 Unberth JOCAS 1
(92: OBSS ITVC: 110, -60).

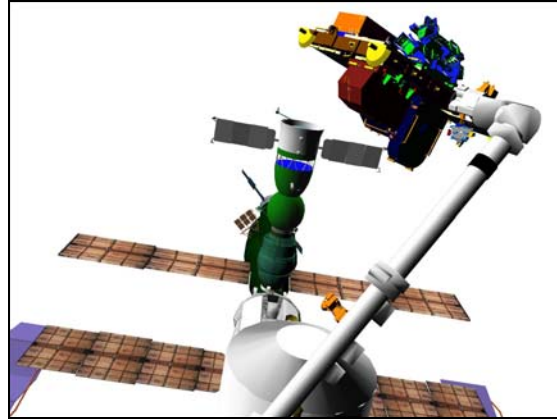


Figure 10.- ESP2 Unberth JOCAS 1
(91: Camera B: 10, 70).

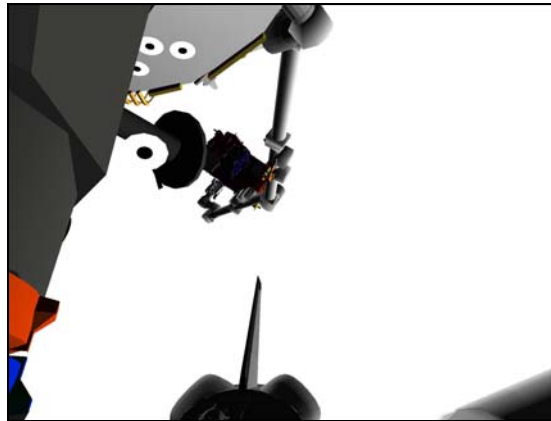


Figure 11.- ESP2 Unberth JOCAS 1
(V10: Camera A: 0, 30).

PCS

MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at ESP2 Unberth JOCAS 1 position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-65.0	+18.7	-40.0	-30.0	-145.6	-90.0	-74.5
X	Y	Z	Pitch	Yaw	Roll	
-951	+81	-1342	-90.2	+30.8	+161.9	
FOR	Loaded – ESP2Unbrth, SY Held					
Disp	LAB>ESP2 Unberth					

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10. ESP2 UNBERTH JOCAS 2

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
92: OBSS ITVC (110, -60)	91: Camera C (0, 40)	13: LAB Stbd Zenith (50, -30) 24: Tip Elbow (-20, 55)	SRMS Elbow (-170, 30)

RHC RATE → VERNIER (Verify Vernier on PCS)

PCS SSRMS Joint OCAS

pick File ► LAB ► ESP2 Unberth Jnt OCAS 2

Verify 'Joint Angles' 'Destination' for ESP2 Unberth JOCAS 2 position.

SR	SY	SP	EP	WP	WY	WR
-81.0	-23.2	-87.8	-90.0	-178.9	-65.3	-72.8

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON Verify joint angles and errors are correct on Joint Angle Position overlay.

	SR	SY	SP	EP	WP	WY	WR
(current)	-65.0	+18.7	-40.0	-30.0	-145.6	-90.0	-74.5
TGT	-81.0	-23.2	-87.8	-90.0	-178.9	-65.3	-72.8
ERR	+16.0	+41.9	+47.8	+60.0	+33.3	-24.7	-1.7

PCS * If joint angles/errors are incorrect
 * **cmd** Cancel (Verify Sequence Status – Waiting Destination)
 *
 * Input correct Dest joint angles per table above.
 *
 * **cmd** Load (Verify Sequence Status – Confirm or Cancel)
 *

MON * Verify joint angles and errors are correct on Joint Angle Position overlay.
 *

PCS **cmd** Confirm (Verify Sequence Status – Auto Seq sw - Hot)

DCP AUTO SEQ → PROC

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Figure 12.- ESP2 Unberth JOCAS 2
(92: OBSS ITVC: 110, -60).

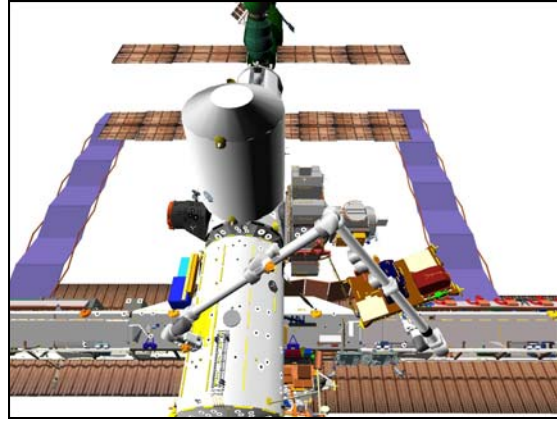


Figure 13.- ESP2 Unberth JOCAS 2
(91: Camera C: 0, 40).

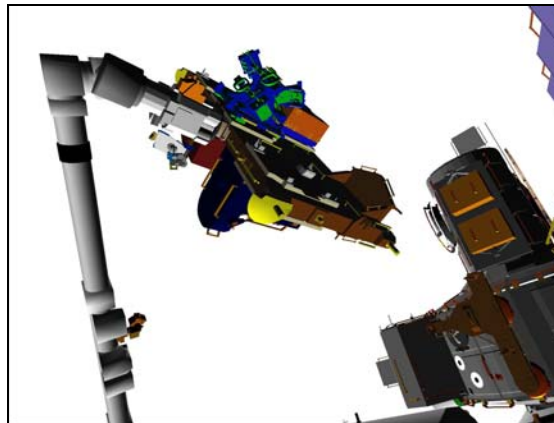


Figure 14.- ESP2 Unberth JOCAS 2
(13: LAB Stbd Zenith: 50, 10).

PCS

MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at ESP2 Unberth JOCAS 2 position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-81.0	-23.2	-87.8	-90.0	-178.9	-65.3	-72.8
X	Y	Z	Pitch	Yaw	Roll	
+482	+762	-911	-96.1	+9.2	+23.5	
FOR	Loaded – ESP2Unbrth, SY Held					
Disp	LAB>ESP2 Unberth					

11. MANEUVERING TO PRE-INSTALL

Notify EVA – 10 minutes to ESP2 Pre-Install

PCS

MSS: SSRMS:

Enter Mode – Standby (Verify – blue)

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Verify Loaded Parameters – √

Change Loaded Parameters ► ESP2 ► ESP2 Install SYH

Verify 'Loaded Parameters' (two) – ESP2Instal, SY Held

Change Display ► LAB ► ESP2 Install (Verify LAB>ESP2 Install)

Change Command ► SSRMS ► Internal (Verify SSRMS>Internal)

Enter Mode – Single (Verify – blue)

NOTE

Monitor clearance between ESP2 trunnion pin and US LAB with Camera C or Lab Stbd Zenith Camera. Clearance at ESP2 Pre-Install is approximately 66 cm.

WARNING

The active joint must be checked on the PCS before initiating motion. Failure to do so may result in movement of the wrong joint.

DCP JOINT SELECT → ELBOW PITCH (Verify EP – Selected on PCS)

THC Perform “–” Single Joint Maneuver to EP: -115.4 (THC down)

PCS Verify SSRMS at ESP2 Pre-Install position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-81.0	-23.2	-87.8	-115.4	-178.9	-65.3	-72.8
X	Y	Z	PITCH	YAW	ROLL	
+140	0	0	0.0	0.0	0.0	
FOR	Loaded – ESP2Instal, SY Held					
Disp	LAB>ESP2 Install					

DCP BRAKES SSRMS → ON (Verify – ON)

1.613 ESP2 UNBERTH



Figure 15.- ESP2 Pre-Install
(92: OBSS ITVC: 110, -60).

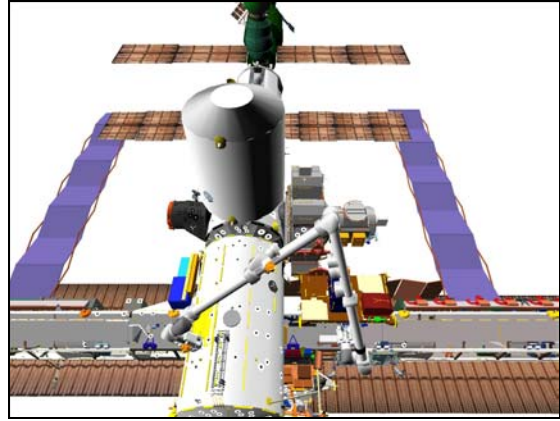


Figure 16.- ESP2 Pre-Install
(91: Camera C: 0, 40).

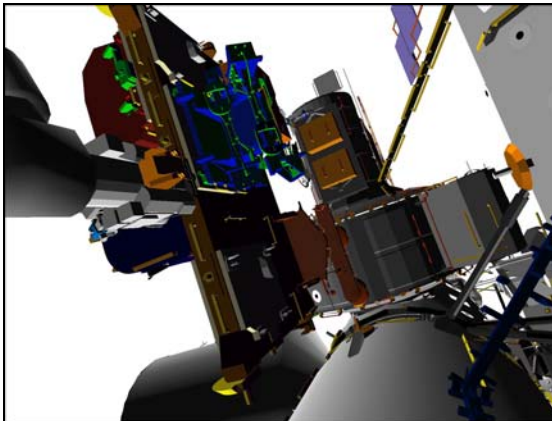


Figure 17.- ESP2 Pre-Install
(13: Lab Stbd Zenith : 70, 0).

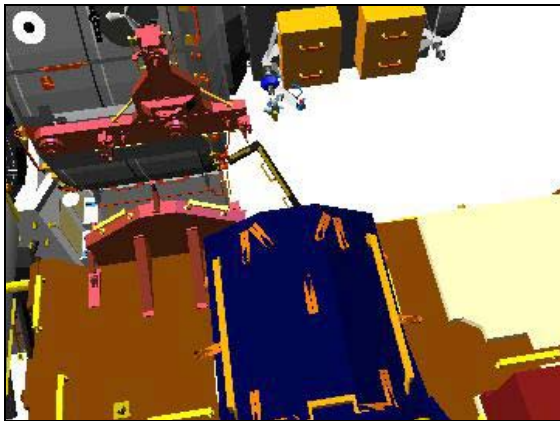


Figure 18.- ESP2 Pre-Install
(24: Tip Elbow: -20, 55).

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1.614 ESP2 INSTALL

(RBT FS/LF1/FIN 1)

1. SETUP

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
24: Tip Elbow (-20, 55)	91: Camera C (0, 40)	13: Lab Stbd Zenith (72, -4)	OBSS ITVC (100, -60)
22: Base Elbow (-75, -55)		92: Camera D (-71, 76)	SRMS Elbow (-170, 30)

PCS

MSS: SSRMS:

Verify Loaded Parameters – ✓

Verify 'Loaded Parameters' (two) – ESP2Instal, SY Held

Verify Display – LAB>ESP2 Install

Verify Command – SSRMS>Internal

Verify SSRMS at ESP2 Pre-Install position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-81.0	-23.2	-87.8	-115.4	-178.9	-65.3	-72.8
X	Y	Z	PITCH	YAW	ROLL	
+140	0	0	0.0	0.0	0.0	
FOR	Loaded – ESP2Instal, SY Held					
Disp	LAB>ESP2 Install					

PCS

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: 0.4 (Verify 0.4)

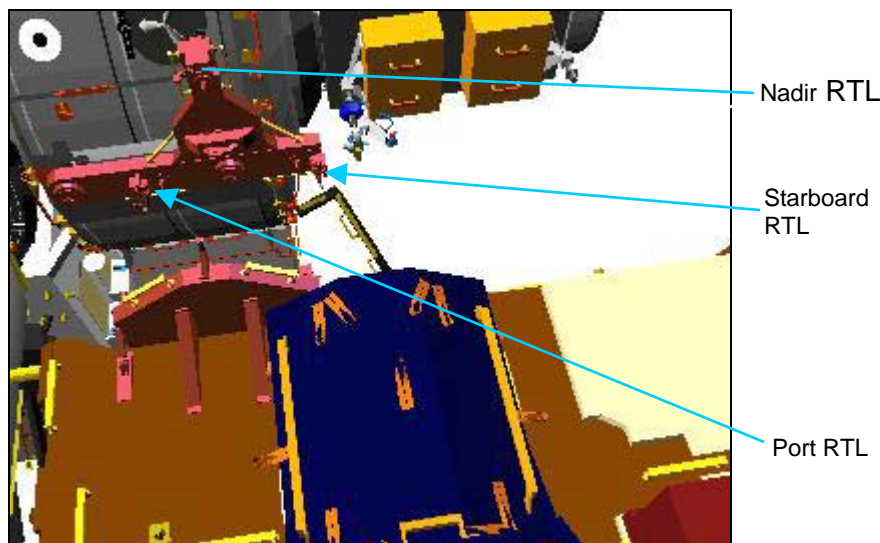


Figure 1.- View of RTLs (24: Tip Elbow: -20, 55).

1.614 ESP2 INSTALL

(RBT FS/LF1/FIN 1)

2. VERIFICATION OF DESAT REQUEST

PCS MSS: SSRMS: Thrusters:

Verify 'Desat Request:' – Inh

If using shuttle attitude control, coordinate with shuttle crewmembers
DAP: FREE

3. MANEUVERING TO ESP2 INSTALL POSITION

DCP BRAKES SSRMS → OFF (Verify – OFF)

PCS MSS: SSRMS:

√Vernier

Enter Mode – Manual (Verify – blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

NOTE

Monitor clearance between ESP2 Trunnion Pin and US LAB Aft Trunnion Pin with Camera C, Lab Stbd Zenith Camera, or SSRMS Base Elbow Camera. Minimum clearance during maneuver to ESP2 Install position is approximately 44 cm (at X = +11).

THC/
RHC

Maneuver to X: +50 position (within 5 cm/1 deg)

		Locked				
SR	SY	SP	EP	WP	WY	WR
-69.6	-23.2	-89.9	-114.1	-199.5	-59.5	-91.9
X	Y	Z	Pitch	Yaw	Roll	
+50	0	0	0.0	0.0	0.0	
FOR	Loaded – ESP2Instal, SY Held					
Disp	LAB>ESP2 Install					

Verify EVA crew in position for GCA.

NOTE

All GCA calls for ESP2 Install will be from EV1.

Maneuver per EVA GCA to ESP2 RTL position.

1.614 ESP2 INSTALL

(RBT FS/LF1/FIN 1)

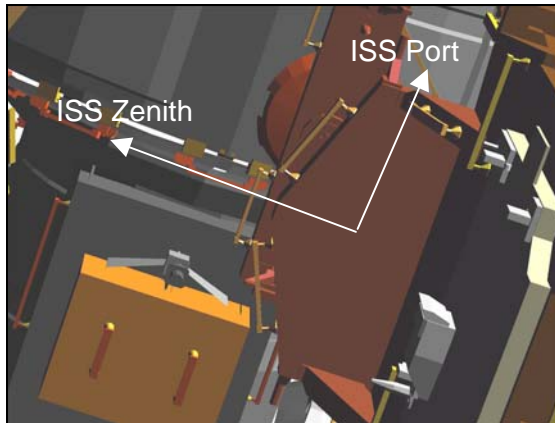


Figure 2.- Orientation View
(92: Camera D: -71, 76).
Focal Length: 40mm

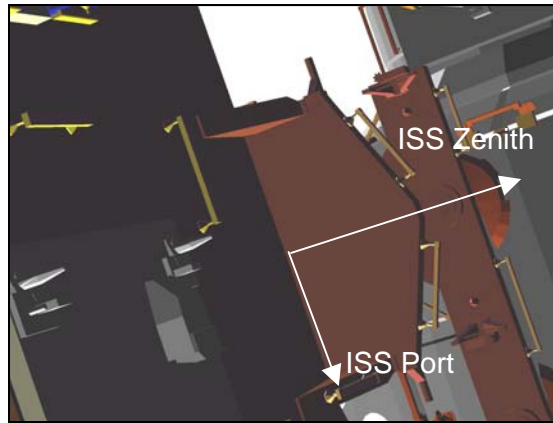


Figure 3.- Orientation View
(13: LAB Stbd Zenith: 72, -4).
Focal Length: 23mm

Expected RTL position:

	Locked					
SR	SY	SP	EP	WP	WY	WR
-64.6	-23.2	-90.3	-113.5	-206.6	-56.1	-97.7
X	Y	Z	Pitch	Yaw	Roll	
+8	0	0	0.0	0.0	0.0	
FOR	Loaded – ESP2Instal, SY Held					
Disp	LAB>ESP2 Install					

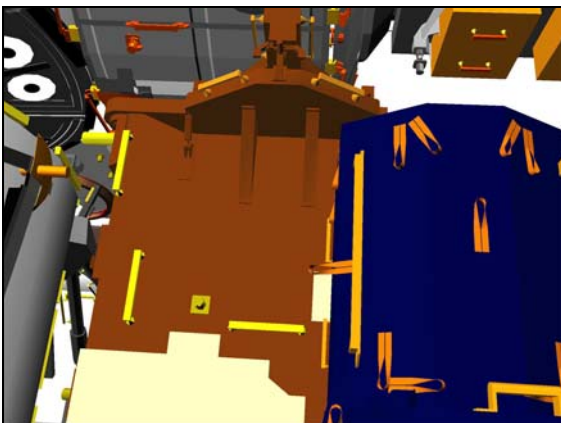


Figure 4.- ESP2 RTL
(24: Tip Elbow: -20, 55).

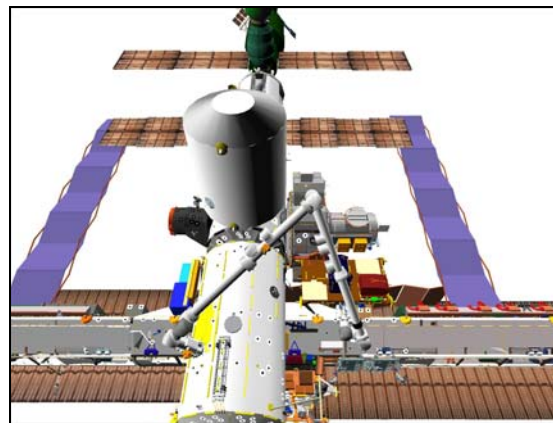


Figure 5.- ESP2 RTL
(91: Camera C: 0, 40).

1.614 ESP2 INSTALL

(RBT FS/LF1/FIN 1)

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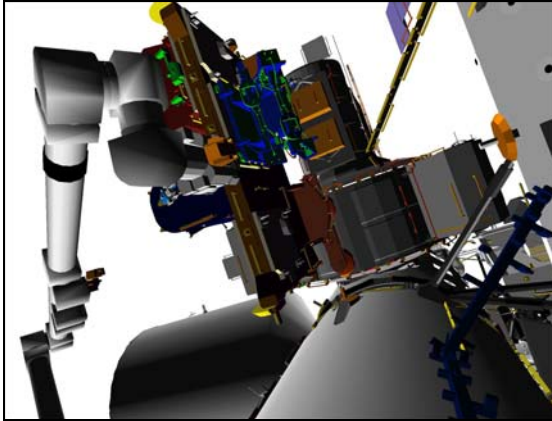


Figure 6.- ESP2 RTL
(13: LAB Stbd Zenith: 72, -4).

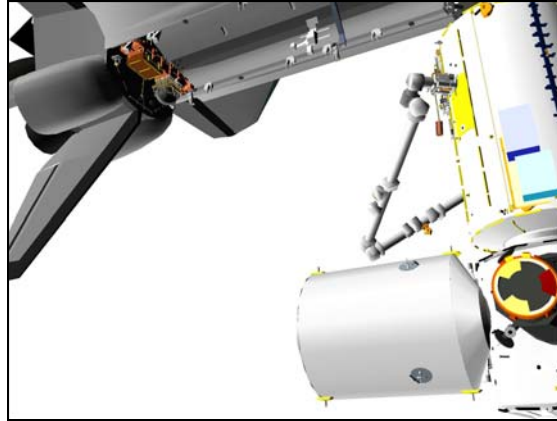


Figure 7.- ESP2 RTL
(V10: OBSS ITVC: 100, -60).

4. INSTALLING ESP2

PCS

MSS: SSRMS:

Verify Posn Hold – orange

Give EVA GO for EVA to drive ESPAD Capture Claw to Capture Bar contact.

On IV GO for SSRMS Limp Mode (when claw contacts capture bar)
Enter Mode – Standby (Verify blue)

MSS: SSRMS: Limp:

cmd All Limp (Verify Limp – blue)

MSS: SSRMS:

Verify joints – Limped

1.614 ESP2 INSTALL

(RBT FS/LF1/FIN 1)

Page 5 of 5 pages

NOTE

Protocol for driving Capture Claw to hard stop is as follows (repeat until ESP2 is fully installed):

EV1: Will drive PGT 1.5 turns
Will give "EV1 Ready" call

M1: Will verify the following:
Safing indicator on Status Overlay - 'Limped'
RWS STATUS - 'Active'
Monitor numbers on the monitors of the Active RWS are still flashing, overlays still present, and no blue screen displayed.

M1: Will give GO to continue driving Capture Claw.

IV: Will give GO to EV1 to continue driving Capture Claw.

Give IV GO for final Capture Claw close using defined protocol.

On IV GO for Brakes (when ESP2 fully torqued)
BRAKES SSRMS → ON (Verify – ON)

DCP

5. GUIDE VANE SWING LATCHES

Give IV GO for Guide Vanes.

Expected ESP2 Installed joint angles and FOR.

SR	SY	SP	EP	WP	WY	WR
-63.7	-23.2	-90.3	-113.4	-207.9	-55.5	-98.7
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded – ESP2Instal, SY Held					
Disp	LAB>ESP2 Install					

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1.615 ESP2 UNGRAPPLE

(RBT FS/LF1/FIN 1/SPN) Page 1 of 3 pages

1. SETUP

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
91: Camera C (0, 40)	25: Tip LEE	24: Tip Elbow (-20, 30)	OBSS ITVC (100, -60) SRMS Elbow (-170, 30)

PCS

MSS: SSRMS:

Verify Loaded Parameters – √

Verify 'Unloaded Parameters' (two) – LEE Tip, SY Held

Change Display ► ISS ► ISSACS (Verify ISS>ISSACS)

Verify Command – SSRMS>Internal

√Vernier

2. ATTITUDE CONTROL CONFIGURATION

On IV GO for ESP2 Ungrapple:

If using shuttle attitude control, coordinate with shuttle crewmembers

DAP: LVLH

When rates damped

DAP: FREE > 2 seconds

Then DAP: AUTO

3. FRGF RELEASE

Verify APFR and WIF Adapter are removed from the Tip LEE and that EV crew and tethers are clear of the SSRMS.

DCP

BRAKES SSRMS → OFF (Verify – OFF)

PCS

3.1 SSRMS Limp

MSS: SSRMS: Limp:

cmd All Limp (Verify Limp – blue)

MSS: SSRMS:

Verify all joints – Limped

3.2 Auto Release

MSS: SSRMS: Tip LEE:

cmd Release ► Automatic ► Slow (Verify Speed – Slow)

Verify 'Confirm or Terminate' prompt.

1.615 ESP2 UNGRAPPLE

(RBT FS/LF1/FIN 1/SPN) Page 2 of 3 pages

CAUTION

Due to end-to-end system latency, the RHC Trigger is hot up to 3 seconds prior to receiving a Trigger Hot icon status on the PCS.

NOTE

Once the trigger is hot, only safing or trigger commands should be sent to the Robotics equipment. If a configuration change is required, including routing MSS Cameras, safe the system to exit LEE operations (SCR 23262, 14662).

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Auto Release

RHC TRIGGER → press (momentarily)

PCS Verify 'Carriage' Derigidize – blue (90 s max)
 Verify 'Snare' Open – blue (12 s max)
 Verify 'Carriage' Extend – blue (90 s max)

3.3 SSRMS Backoff

NOTE

Clearance between Base Boom and UHF Antenna is 144 cm at Grapple Fixture Backoff Position. Monitor with Camera C.

MSS: SSRMS: Limp:

cmd None Limp (Verify Standby – blue)

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

THC/ RHC Maneuver to Grapple Fixture Backoff position (-X THC Command) (within 5 cm/2 deg).

	<input type="text" value="Locked"/>					
SR	SY	SP	EP	WP	WY	WR
-82.3	-23.2	-87.4	-115.6	-176.0	-65.7	-70.1
X	Y	Z	Pitch	Yaw	Roll	
+244	+500	+565	+179.9	0.0	+179.7	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>ISSACS					

1.615 ESP2 UNGRAPPLE

(RBT FS/LF1/FIN 1/SPN) Page 3 of 3 pages

DCP

BRAKES SSRMS → ON (Verify – ON)

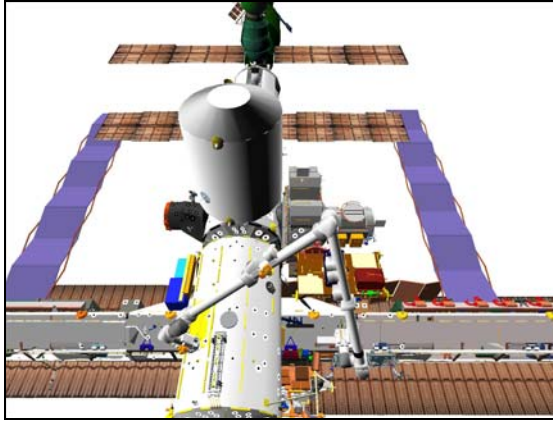


Figure 1.- Grapple Fixture Backoff
(91: Camera C: 0, 40).

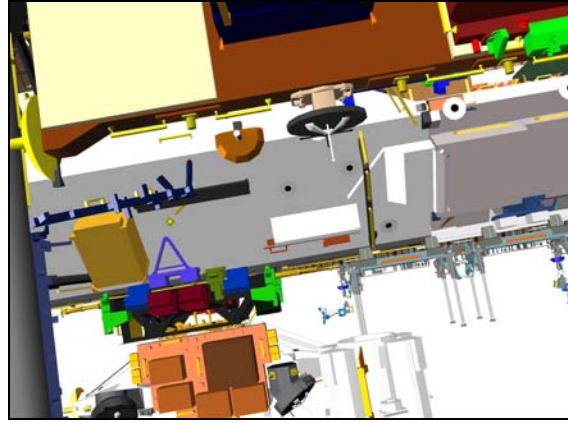


Figure 2.- Grapple Fixture Backoff
(24: Tip Elbow: -20, 30).

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EVA - ESPAD INSTALL

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1.710 ESPAD INSTALL EVA SETUP

(RBT FS/LF1/FIN/SPN)

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1. SETUP

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3
91: Camera B (10, 25)	13: LAB Stbd Zenith (20, -28)	22: Base Elbow (-93, -11)

PCS

MSS: SSRMS:

Change Unloaded Parameters ► Unloaded ► LEE Tip SYH
Verify 'Unloaded Parameters' (two) – LEE Tip, SY Held

Change Display ► ISS ► ISSACS (Verify ISS>ISSACS)

√Vernier

Verify SSRMS at Grapple Fixture Backoff position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-68.1	-27.2	-125.6	-91.1	-118.1	-52.5	+17.4
X	Y	Z	Pitch	Yaw	Roll	
+481	+506	+136	+161.5	-33.5	-135.9	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>ISSACS					

PCS

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: 1.0 (Verify 1.0)

DCP

BRAKES SSRMS → OFF (Verify OFF)

2. SINGLE JOINT TO JOCAS SETUP

PCS

MSS: SSRMS:

Enter Mode – Single (Verify blue)

WARNING

The active joint must be checked on the PCS before initiating motion. Failure to do so may result in movement of the wrong joint.

1.710 ESPAD INSTALL EVA SETUP

(RBT FS/LF1/FIN/SPN)

THC Perform Single Joint maneuver to JOCAS Setup position (within 1 deg).

	SR	SY	SP	EP	WP	WY	WR
Grapple Fixture Backoff	-68.1	-27.2	-125.6	-91.1	-118.1	-52.5	+17.4
1: EP +				-70.0			
2: SP +			-115.0				
JOCAS Setup	-68.1	-27.2	-115.0	-70.0	-118.1	-52.5	+17.4
	X	Y	Z	Pitch	Yaw	Roll	
	+359	+871	+324	+138.4	-36.0	-174.6	
FOR	Unloaded – LEE Tip, SY Held						
Disp	ISS>ISSACS						

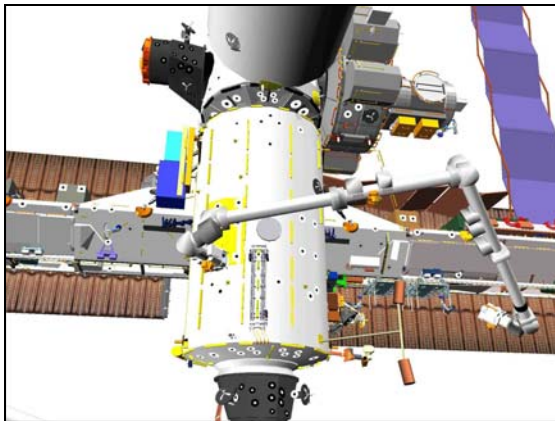


Figure 1.- JOCAS Setup (91: Camera B: 10, 25).

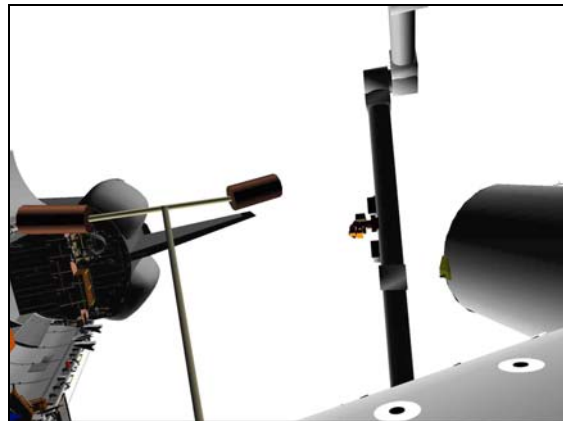


Figure 2.- JOCAS Setup (13: LAB Stbd Zenith: 20, -28).

3. JOCAS TO INTERMEDIATE POSITION

PCS

MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

NOTE

Expect a cross-cluster annunciation when SY between -10.3 and -7.8 degrees.

SSRMS Joint OCAS

Input 'Joint Angles' 'Destination' for Intermediate position.

SR	SY	SP	EP	WP	WY	WR
-120.0	-7.0	+30.0	-156.8	+59.8	-20.7	-25.7

NOTE

The Target and Error fields on the SSRMS Joint OCAS display will not be correct. This data should be verified and monitored on the Joint Angle position overlay. (SCR 31169)

1.710 ESPAD INSTALL EVA SETUP

(RBT FS/LF1/FIN/SPN)

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON Verify joint angles and errors are correct on Joint Angle Position overlay.

	SR	SY	SP	EP	WP	WY	WR
(current)	-68.1	-27.2	-115.0	-70.0	-118.1	-52.5	+17.4
TGT	-120.0	-7.0	+30.0	-156.8	+59.8	-20.7	-25.7
ERR	+51.9	-20.2	-145.0	+86.8	-177.9	-31.8	+43.1

PCS * If joint angles/errors are incorrect
 * **cmd** Cancel (Verify Sequence Status – Waiting Destination)
 *
 * Input correct Dest joint angles per table above.
 *
 * **cmd** Load (Verify Sequence Status – Confirm or Cancel)
 *
 MON * Verify joint angles and errors are correct on Joint Angle Position
 * overlay.

PCS **cmd** Confirm (Verify Sequence Status – Auto Seq sw - Hot)

DCP AUTO SEQ → PROC

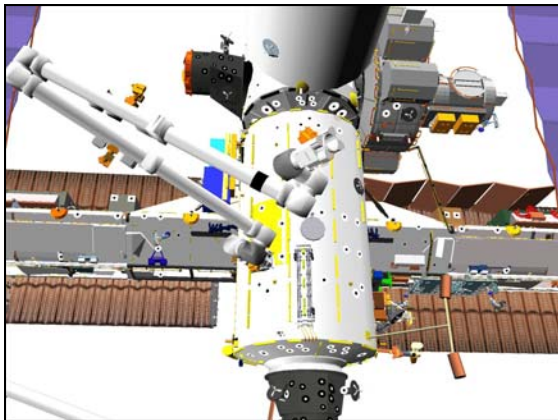


Figure 3.- Intermediate Position
(91: Camera B: 5, 25).

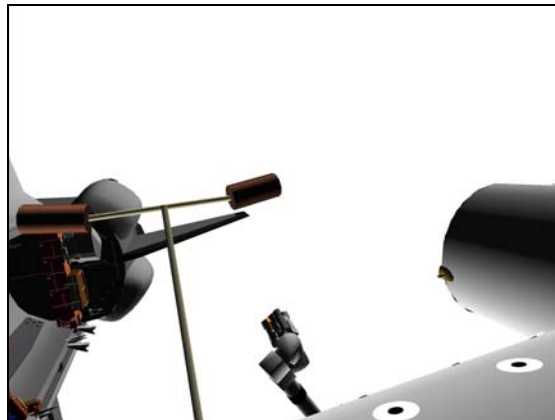


Figure 4.- Intermediate Position
(13: LAB Stbd Zenith: 20, -28).

PCS MSS: SSRMS:

Verify Posn Hold – orange

1.710 ESPAD INSTALL EVA SETUP

(RBT FS/LF1/FIN/SPN)

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Verify SSRMS at Intermediate position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-120.0	-7.0	+30.0	-156.8	+59.8	-20.7	-25.7
X	Y	Z	Pitch	Yaw	Roll	
+326	-43	+1272	-84.0	+33.5	-136.1	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>ISSACS					

4. SINGLE JOINT TO EV CREW TETHER POSITION

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3
91: Camera B (-5, 25)	92: Camera A (0, 21)	24: Tip Elbow (5, 10)

PCS

MSS: SSRMS:

Enter Mode – Single (Verify blue)

WARNING

The active joint must be checked on the PCS before initiating motion. Failure to do so may result in movement of the wrong joint.

NOTE

1. Monitor clearances between the Tip LEE and structure with Camera A or the Tip Elbow Camera. Minimum clearances are:
 - a) Tip LEE to ESP FWD V-Guide: 77 cm
 - b) Tip LEE to Port Sill: 111 cm
2. Prior to starting the Shoulder Pitch maneuver, discuss the following items with **MCC-H**
 - a) Camera A is routed to an RWS monitor and configured to view the clearance between the SSRMS wrist and payload bay port sill, as well as, ESP FWD V-Guide.
 - b) SSRMS Tip Elbow camera is routed to an RWS monitor and configured to view the clearance between the SSRMS wrist and payload bay port sill, as well as, ESP FWD V-Guide.
 - c) SSRMS vernier rates selected.
 - d) SSRMS joint angle configuration

1.710 ESPAD INSTALL EVA SETUP

(RBT FS/LF1/FIN/SPN)

THC Perform Single Joint maneuver to EV Crew Tether position (within 1 deg).

	SR	SY	SP	EP	WP	WY	WR
Intermediate	-120.0	-7.0	+30.0	-156.8	+59.8	-20.7	-25.7
1: SR -	-197.1						
2: SP -			+8.8				
EV Crew Tether	-197.1	-7.0	+8.8	-156.8	+59.8	-20.7	-25.7
	X	Y	Z	Pitch	Yaw	Roll	
	+862	-251	+948	-1.6	+3.4	-175.2	
FOR	Unloaded – LEE Tip, SY Held						
Disp	ISS>ISSACS						

DCP BRAKES SSRMS → ON (Verify ON)

Notify EV crew SSRMS is at tether attach position.

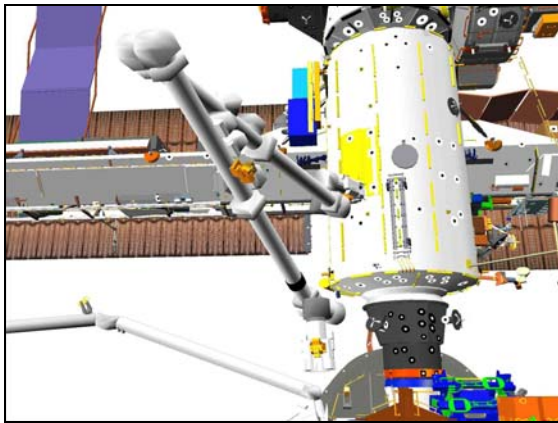


Figure 5.- EV Crew Tether Position (91: Camera B: -5, 18).

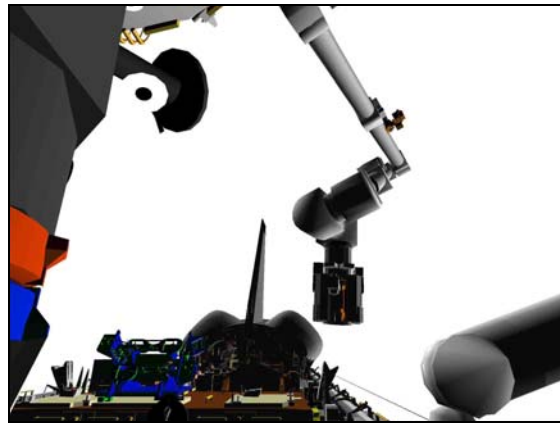


Figure 6.- EV Crew Tether Position (92: Camera A: 0, 21).

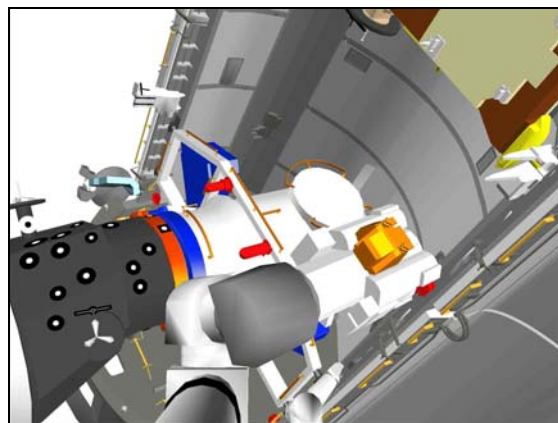


Figure 7.- EV Crew Tether Position (24: Tip Elbow: 5, 10).

1.710 ESPAD INSTALL EVA SETUP

(RBT FS/LF1/FIN/SPN)

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5. FOR OCAS TO ESPAD REMOVAL SETUP POSITION

NOTE

Stop SSRMS motion if EV tether appears to tangle or snag or if EV calls an all stop, then \surd MCC

Verify EV tether attachment complete.

On EV2 GO for SSRMS maneuver

Verify with EV2 that safety tether fairleads are removed and EV2 is in position to watch SSRMS motion.

DCP BRAKES SSRMS → OFF (Verify OFF)

PCS MSS: SSRMS:

\surd Vernier

Enter Mode – FOR OCAS (Verify blue)

MSS: SSRMS: SSRMS FOR OCAS: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

NOTE

1. Expect a cross-cluster annunciation when WY between +8.8 and +21.6 degrees.
2. Monitor tight clearance between Tip LEE and structure with Camera A or Tip Elbow. Minimum clearances during maneuver to ESPAD Removal Setup position are as follows:
 Tip LEE to ESP FWD V-Guide: 76 cm
 Tip LEE to Active ESPAD: 127 cm

Input 'FOR' 'Destination' for ESPAD Removal Setup position.

X	Y	Z	Pitch	Yaw	Roll
+700	-121	+1500	-1.6	+3.4	-175.2

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON Verify FOR and errors are correct on FOR Position overlay.

	X	Y	Z	Pitch	Yaw	Roll
FOR	+862	-251	+948	-1.6	+3.4	-175.2
TGT	+700	-121	+1500	-1.6	+3.4	-175.2
ERR	+162	-130	-552	0.0	0.0	0.0

1.710 ESPAD INSTALL EVA SETUP

(RBT FS/LF1/FIN/SPN)

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```
*****
* If FOR/errors are incorrect
PCS * | cmd Cancel (Verify Sequence Status – Waiting Destination)
* |
* | Input correct Dest FOR per table above.
* |
* | cmd Load (Verify Sequence Status – Confirm or Cancel)
* |
MON * | Verify FOR and errors are correct on FOR Position overlay.
*****
```

NOTE

Prior to issuing the confirm command, discuss the following items with **MCC-H**

- a) Camera A is routed to an RWS monitor and configured to view the clearance between the SSRMS wrist and payload bay port sill, as well as, ESP FWD V-Guide.
- b) SSRMS Tip Elbow Camera is routed to an RWS monitor and configured to view the clearance between the SSRMS wrist and payload bay port sill, as well as, ESP FWD V-Guide.
- c) SSRMS vernier rates selected.
- d) Current FOR values.
- e) Destination FOR values.
- f) EV2 tethered to SSRMS, safety tether fairleads are removed, and EV2 in position to monitor SSRMS motion.

PCS **cmd** Confirm (Verify Sequence Status – Auto Seq Sw - Hot)

Notify EV2 that SSRMS motion is about to begin.

DCP AUTO SEQ → PROC

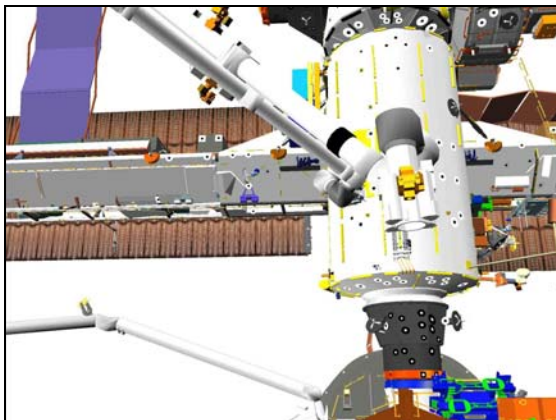


Figure 8.- ESPAD Removal Setup
(91: Camera B: -5, 18).

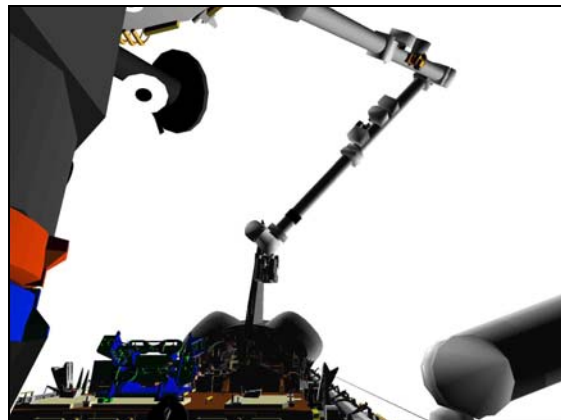


Figure 9.- ESPAD Removal Setup
(92: Camera A: 0, 21).

1.710 ESPAD INSTALL EVA SETUP

(RBT FS/LF1/FIN/SPN)

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PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at ESPAD Removal Setup position (within 5 cm/1 deg).

	Locked					
SR	SY	SP	EP	WP	WY	WR
-136.3	-7.0	+20.6	-127.3	+9.9	+39.6	-23.1
X	Y	Z	Pitch	Yaw	Roll	
+700	-121	+1500	-1.6	+3.4	-175.2	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>ISSACS					

DCP BRAKES SSRMS → ON (Verify ON)

Give EV2 GO to translate on port sill to DTO Box.

6. SETUP FOR SHUTTLE CREW

PCS MSS: SSRMS:

Change Command ► ISS ► ISSACS (Verify ISS>ISSACS)

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3
91: SRMS Elbow (-160, 37)	22: Base Elbow (-75, 0)	92: Camera B (5, 15)

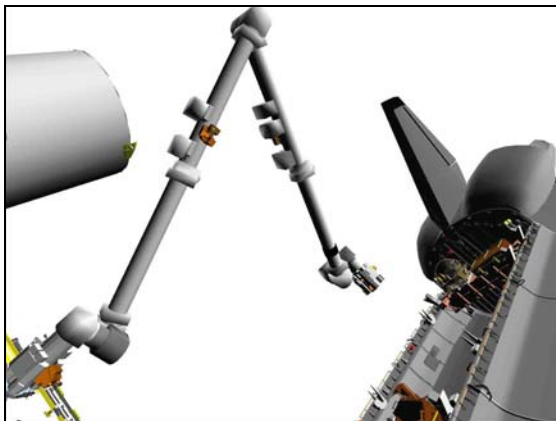


Figure 10.- ESPAD Removal Setup
(91: SRMS Elbow: -160, 37).

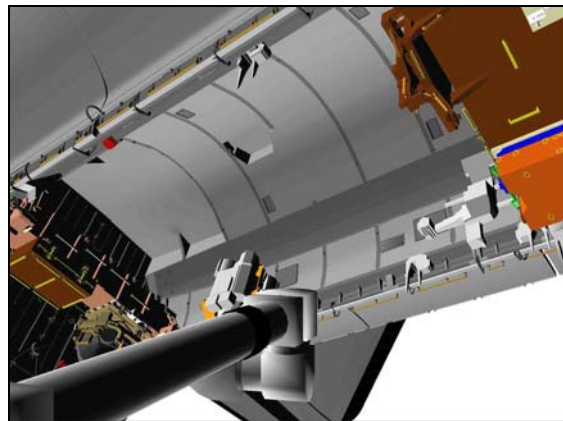


Figure 11.- ESPAD Removal Setup
(22: Base Elbow: -75, 0).

1.710 ESPAD INSTALL EVA SETUP

(RBT FS/LF1/FIN/SPN)

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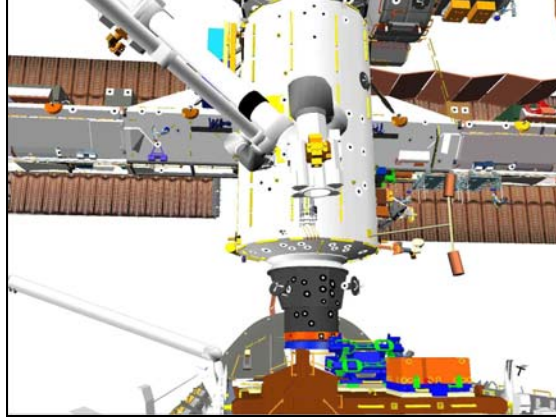


Figure 12.- ESPAD Removal Setup
(92: Camera B: 5, 15).

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1.711 EVA - ESPAD INSTALL

(RBT FS/LF1/FIN/SPN) Page 1 of 9 pages

NOTE GCA calls will be from EV2 unless otherwise noted.

1. SETUP

ODS Hatch
√V10 Cables Connected

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
91: SRMS Elbow (-160, 37)	22: Base Elbow (-75, 0)	92: Camera B (5, 15)	Camera A (0, 25) OBSS ITVC (95, -50)

PCS MSS: SSRMS:

Verify Unloaded Parameters – √
Verify 'Unloaded Parameters' (two) – LEE Tip, SY Held

Verify Display – ISS>ISSACS
Verify Command – ISS>ISSACS

√Vernier

Verify SSRMS at ESPAD Removal Setup position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-136.3	-7.0	+20.6	-127.3	+9.9	+39.6	-23.1
X	Y	Z	PITCH	YAW	ROLL	
+700	-121	+1500	-1.6	+3.4	-175.2	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>ISSACS					

2. APFR INSTALL AND INGRESS

DCP BRAKES SSRMS → OFF (Verify OFF)

PCS MSS: SSRMS:

Enter Mode – Manual (Verify – blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

1.711 EVA - ESPAD INSTALL

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THC/
RHC

Maneuver to APFR Install position (within 5 cm/1 deg).

	Locked					
SR	SY	SP	EP	WP	WY	WR
-150.0	-7.0	+11.3	-123.9	+18.2	+26.1	-24.7
X	Y	Z	Pitch	Yaw	Roll	
+890	-121	+1455	-1.6	+3.4	-175.2	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>ISSACS					

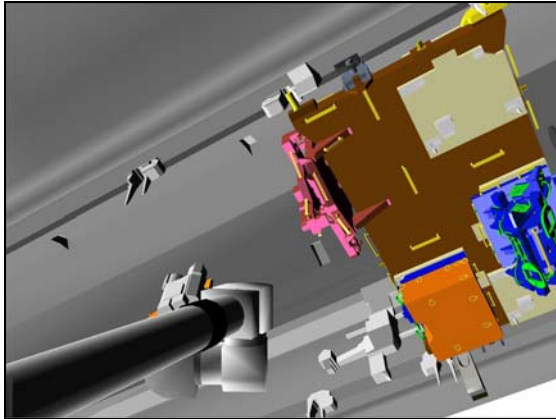


Figure 1.- APFR Install
(22: Base Elbow: -75, 0).

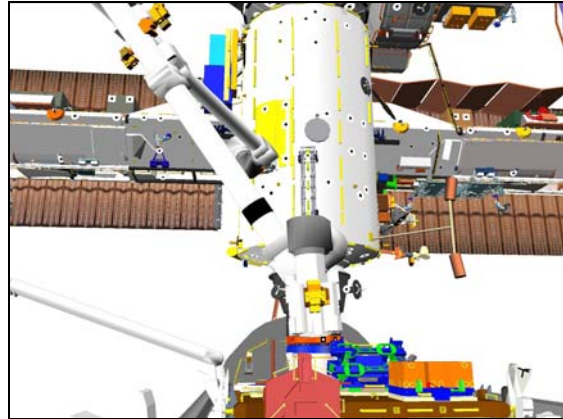


Figure 2.- APFR Install
(92: Camera B: 5, 15).

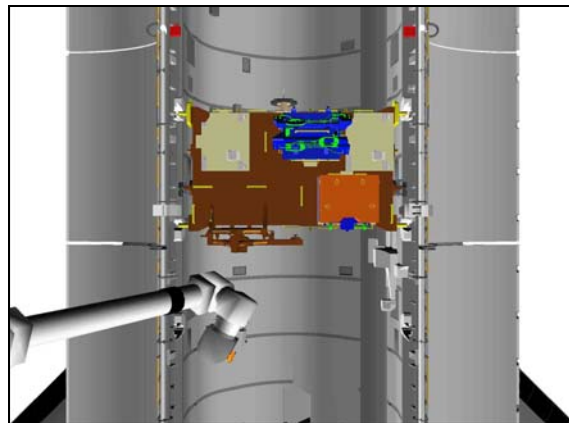


Figure 3.- ESPAD Removal
(View from ISS Aft, looking Fwd).

NOTE
APFR Setting is (12, PP, F, 6).

THC/
RHC

GCA per EV2 call for APFR install and ingress.

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3. ESPAD REMOVAL

PCS

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

Verify Unloaded Parameters – ✓

Change Unloaded Parameters ► EVA ► Chest 12/PP/F/6 SYH
Verify 'Unloaded Parameters' (two) – Chest 12/PP/F/6, SY Held

Verify Display – ISS>ISSACS

Verify Command – ISS>ISSACS

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

THC/
RHC

GCA per EV2 call for Active ESPAD Removal from ESP2.

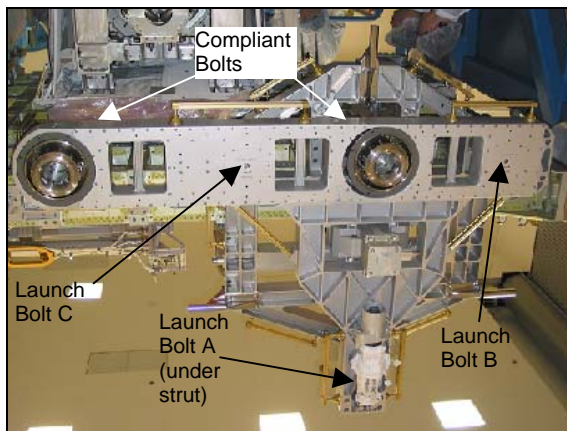


Figure 4.- ESPAD Bolt Config
(View from EV crewmember).

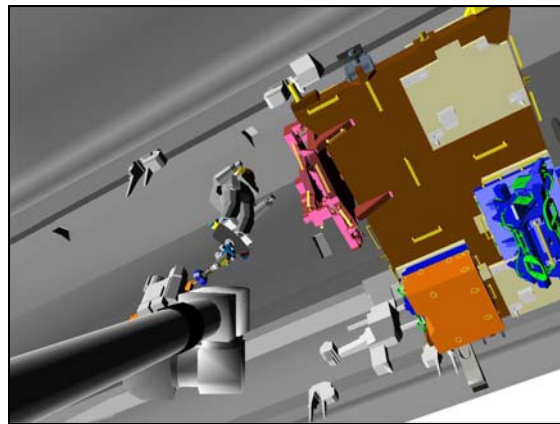


Figure 5.- ESPAD Removal
(22: Base Elbow: -75, 0).

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4. SETUP FOR MANEUVER TO AIRLOCK TRUNNIONS

On EV2 GO:

THC/
RHC

Maneuver to JOCAS Setup position (SR, SP, EP within 2 deg).

	Locked					
SR	SY	SP	EP	WP	WY	WR
-130.9	-7.0	+21.0	-124.8	+5.7	+44.9	-22.2
X	Y	Z	Pitch	Yaw	Roll	
+815	-130	+1460	+87.7	-12.2	+176.5	
FOR	Unloaded – Chest 12/PP/F/6, SY Held					
Disp	ISS>ISSACS					

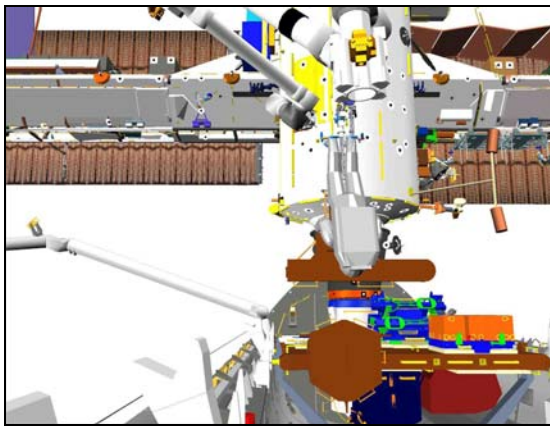


Figure 6.- JOCAS Setup
(92: Camera B: 0, 10).

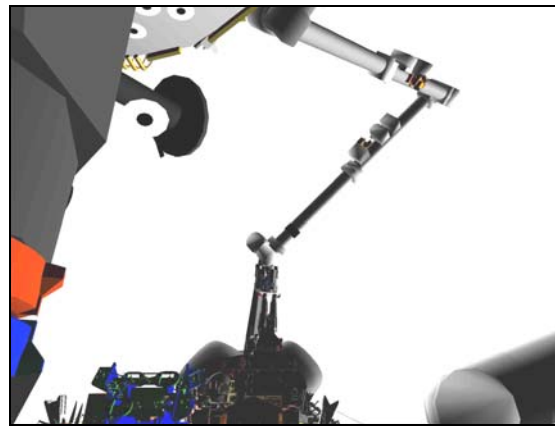


Figure 7.- JOCAS Setup
(V10: Camera A: 0, 25).

5. JOINT OCAS TO ESPAD INSTALL OCAS POSITION

PCS

MSS: SSRMS:

Enter Mode – Joint OCAS (Verify – blue)

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
91: SRMS Elbow (-160, 35) 13: LAB Stbd Zenith (70, 5)	22: Base Elbow (-75, 0)	92: Camera C (-10, 20)	Camera B (5, 15) OBSS ITVC (95, -50)

pick File ► LAB ► ESPAD Install Jnt OCAS

1.711 EVA - ESPAD INSTALL

Verify 'Joint Angles' 'Destination' for ESPAD Install OCAS position.

SR	SY	SP	EP	WP	WY	WR
-76.0	-4.0	-52.0	-130.0	-25.0	-7.0	+115.0

NOTE

The Target and Error fields on the SSRMS Joint OCAS display will not be correct. This data should be verified and monitored on the Joint Angle Position overlay. (SCR 31169)

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON

Verify joint angles and errors are correct on Joint Angle Position overlay.

	SR	SY	SP	EP	WP	WY	WR
(current)	-130.9	-7.0	+21.0	-124.8	+5.7	+44.9	-22.2
TGT	-76.0	-4.0	-52.0	-130.0	-25.0	-7.0	+115.0
ERR	-54.9	-3.0	+73.0	+5.2	+30.7	+51.9	-137.2

PCS

* If joint angles/errors are incorrect
 * **cmd** Cancel (Verify Sequence Status – Waiting Destination)

* Input correct Dest joint angles per table above.

* **cmd** Load (Verify Sequence Status – Confirm or Cancel)

MON

* Verify joint angles and errors are correct on Joint Angle position overlay.

PCS

cmd Confirm (Verify Sequence Status – Auto Seq sw - Hot)

DCP

AUTO SEQ → PROC

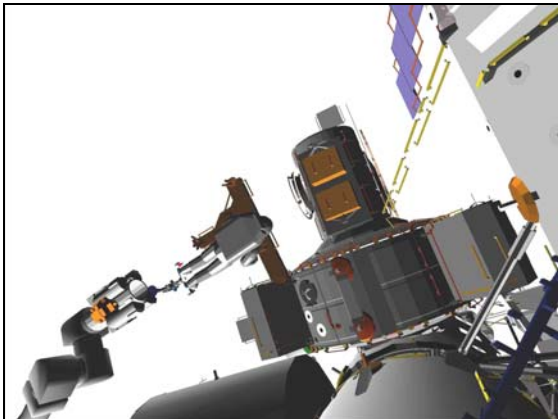


Figure 8.- ESPAD Install OCAS
 (13: Lab Stbd Zenith : 70, 5)

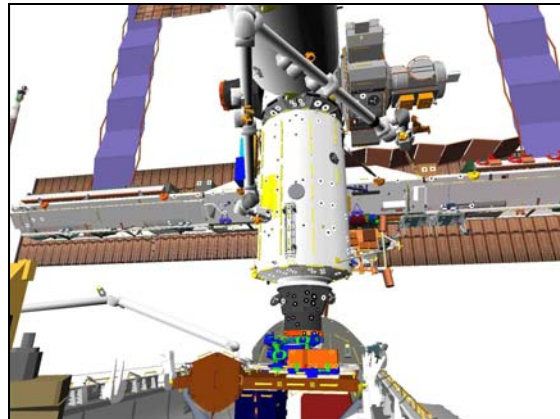


Figure 9.- ESPAD Install OCAS
 (92: Camera C: -10, 20).

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PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at ESPAD Install OCAS position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-76.0	-4.0	-52.0	-130.0	-25.0	-7.0	+115.0
X	Y	Z	Pitch	Yaw	Roll	
-18	+504	+612	+176.7	-2.1	+169.2	
FOR	Unloaded – Chest 12/PP/F/6, SY Held					
Disp	ISS>ISSACS					

6. SINGLE JOINT TO ESPAD INSTALL POSITION

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
13: LAB Stbd Zenith (70, 5)	24: Tip Elbow (-5, 20) 22: Base Elbow (-75, -20)	92: Camera C (0, 40) 91: SRMS Elbow (-165, 30)	OBSS ITVC (85, -55)

PCS MSS: SSRMS:

Enter Mode – Single (Verify – blue)

WARNING

The active joint must be checked on the PCS before initiating motion. Failure to do so may result in movement of the wrong joint.

NOTE

Monitor clearance between EV crew and US LAB with Tip Elbow/Lab Stbd Zenith Camera. Distance is approximately 96 cm at ESPAD Install posn.

DCP JOINT SELECT → ELBOW PITCH (Verify EP – Selected on PCS)

THC Perform “–” Single Joint Maneuver to EP: -140.0 (THC down)

PCS Verify SSRMS at ESPAD Install position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-76.0	-4.0	-52.0	-140.0	-25.0	-7.0	+115.0
X	Y	Z	PITCH	YAW	ROLL	
+21	+353	+532	+175.4	-0.8	+179.0	
FOR	Unloaded – Chest 12/PP/F/6, SY Held					
Disp	ISS>ISSACS					

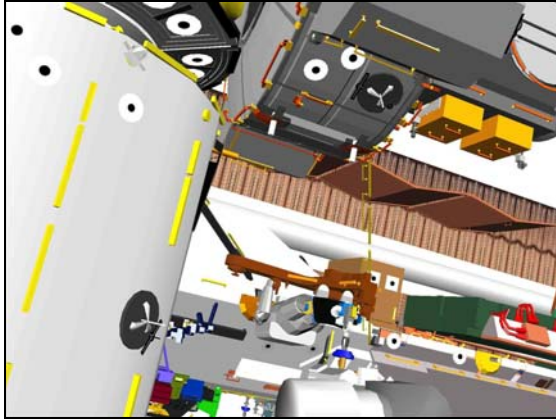


Figure 10.- ESPAD Install
 (24: Tip Elbow: -5, 20).

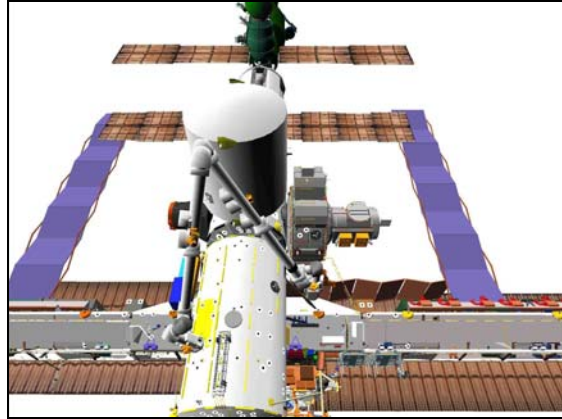


Figure 11.- ESPAD Install
 (92: Camera C: 0, 40).

7. ESPAD INSTALL

NOTE

Before GCA begins, EV2 should be notified of the following constraint:
 To prevent safing, the SSRMS must be in POSN HOLD before Active
 ESPAD is installed by EV crew.

PCS

MSS: SSRMS:

Verify Command – ISS>ISSACS

Enter Mode – Manual (Verify – blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

THC/
RHC

GCA per EV2 call for Active ESPAD Installation on Airlock Trunnions.

 * If POSN HOLD not reached within 10 seconds
 * | after releasing HC
 * | Cycle BRAKES ON then OFF to stop motion
 * | and obtain POSN HOLD.

PCS

Verify POSN HOLD.

Give IV GO for ESPAD Install.

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If required, when ESPAD Softdock complete

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

THC/
RHC

GCA per EV2 call to tighten EUTAS bolts.

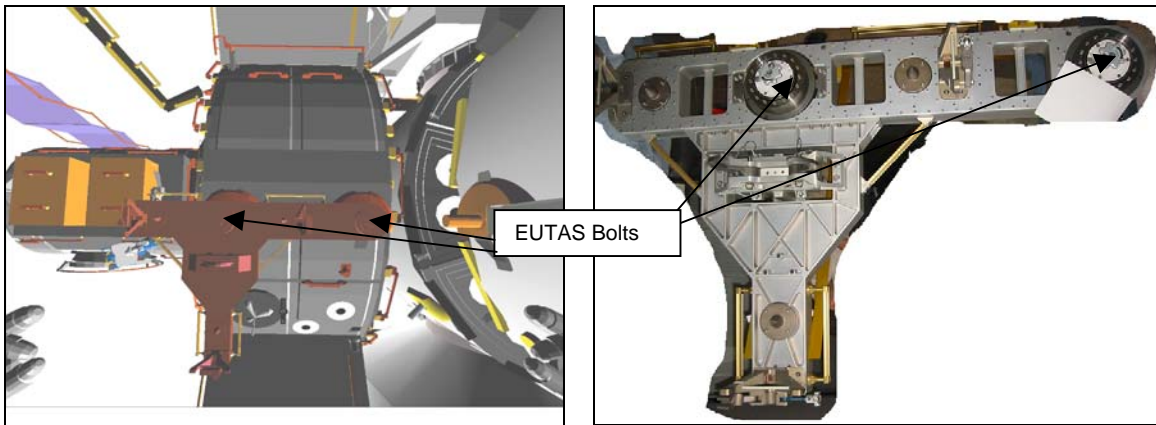


Figure 12.- EUTAS Bolt Config
(View from EV2).

Figure 13.- EUTAS Bolt Config
(View from EV2).

THC/
RHC

GCA for APFR Egress and reconfiguration to low profile, as well as, EV crew untether.

8. MANEUVERING CLEAR OF STRUCTURE

PCS

MSS: SSRMS:

Enter Mode – Standby (Verify – blue)

On EV2 GO to maneuver SSRMS clear:

Verify EV Tether has been removed and is clear of SSRMS translation path.

Verify APFR in low profile configuration (6,XX,L,2).

Verify Unloaded Parameters – √

Change Unloaded Parameters ► Unloaded ► LEE Tip SYH

Verify 'Unloaded Parameters' (two) – LEE Tip, SY Held

Enter Mode – Manual (Verify blue)

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MSS: SSRMS: SSRMS Manual: Joint Lock: Joint Lock

cmd Shoulder Yaw (Verify SY – Locked)

THC/
RHC

Maneuver clear of structure (SR, SP, EP within 2 deg).

	Locked					
SR	SY	SP	EP	WP	WY	WR
-81.9	-4.0	-75.3	-110.9	-30.8	-3.4	+110.2
X	Y	Z	PITCH	YAW	ROLL	
+138	+693	+623	+85.4	+1.0	-163.8	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>ISSACS					

DCP BRAKES SSRMS → ON (Verify ON)

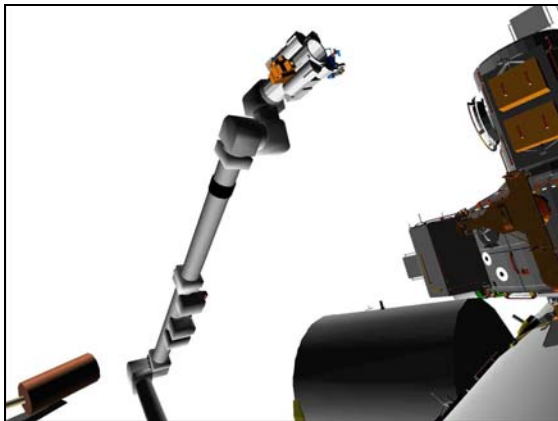


Figure 14.- Clear Structure
(13: LAB Stbd Zenith: 45, -5).

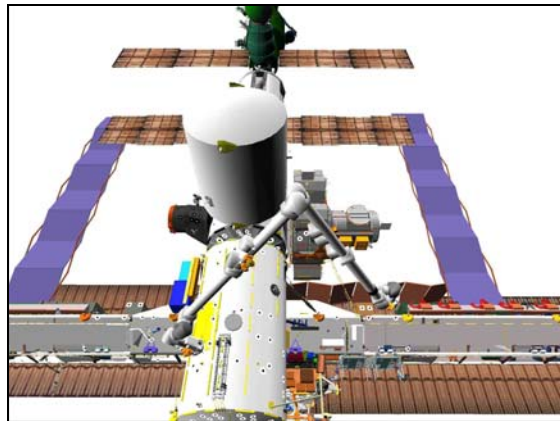


Figure 15.- Clear Structure
(92: Camera C: 0, 40).

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CONTINGENCY OPS

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2.110 CONTINGENCY ESP2 BERTH

(RBT FS/LF1/FIN/SPN) Page 1 of 12 pages

1. SETUP

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
22: Base Elbow (-75, -55) 24: Tip Elbow (-20, 55)	91: Camera C (0, 40)	13: LAB Stbd Zenith (72, -4) 92: Camera D (-71, 76)	SRMS Elbow (-170, 30) OBSS ITVC (105, -55)

PCS

MSS: SSRMS:

Verify Loaded Parameters – √

Verify 'Loaded Parameters' (two) – ESP2Instal, SY Held

Verify Display – LAB>ESP2 Install
Verify Command – SSRMS>Internal

√Vernier

2. MANEUVERING TO ESP2 PRE-INSTALL POSITION

Verify EV crew and Tethers clear of ESP2.

DCP

BRAKES SSRMS → OFF (Verify – OFF)

PCS

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

THC/
RHC

Maneuver to ESP2 Pre-Install position (within 5 cm/1 deg).

	Locked					
SR	SY	SP	EP	WP	WY	WR
-81.0	-23.2	-87.8	-115.4	-178.9	-65.3	-72.8
X	Y	Z	Pitch	Yaw	Roll	
+140	0	0	0.0	0.0	0.0	
FOR	Loaded – ESP2Instal, SY Held					
Disp	LAB>ESP2 Install					

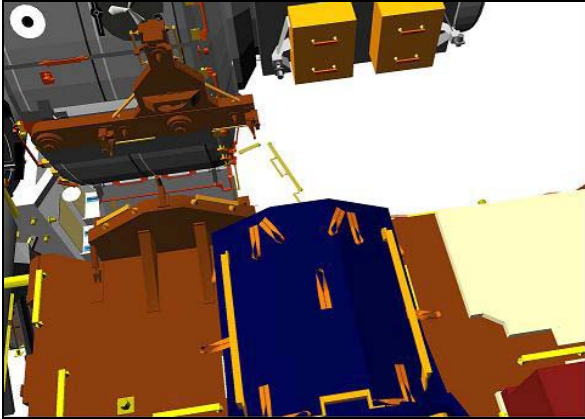


Figure 1.- ESP2 Pre-Install
(24: Tip Elbow: -20, 55).

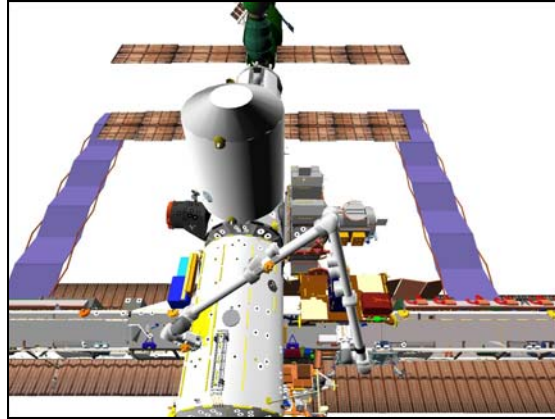


Figure 2.- ESP2 Pre-Install
(91: Camera C: 0, 40).

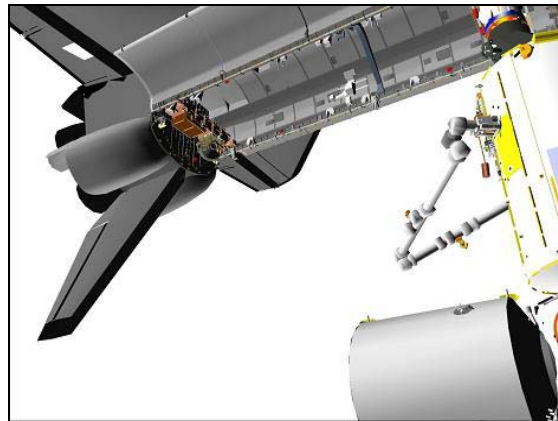


Figure 3.- ESP2 Pre-Install
(V10: OBSS ITVC: 105, -55).

3. ATTITUDE CONTROL CONFIGURATION

If using shuttle attitude control, coordinate with shuttle crewmembers

DAP: LVLH

When rates damped

DAP: FREE > 2 seconds

Then DAP: AUTO

4. SINGLE JOINT MANEUVER TO CLEAR STRUCTURE

PCS

MSS: SSRMS:

Enter Mode – Single (Verify – blue)

WARNING

The active joint must be checked on the PCS before initiating motion. Failure to do so may result in movement of the wrong joint.

2.110 CONTINGENCY ESP2 BERTH

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DCP JOINT SELECT → ELBOW PITCH (Verify EP – Selected on PCS)

THC Perform “+” Single Joint maneuver to EP: -90.0 (THC up).

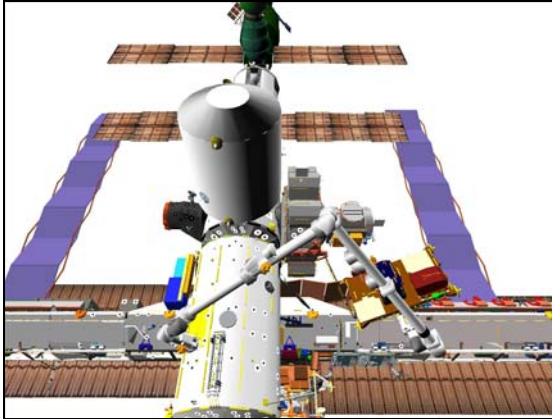


Figure 4.- Single Joint Mnvr End
(91: Camera C: 0, 40).

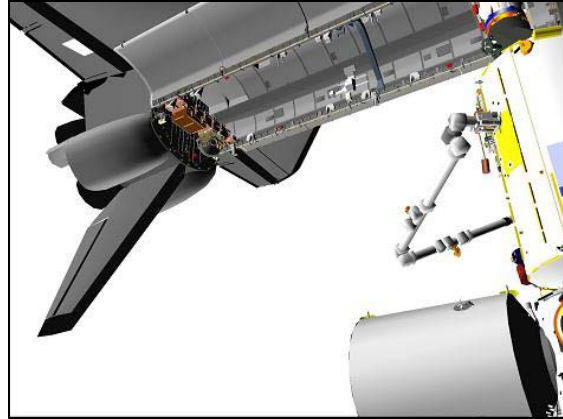


Figure 5.- Single Joint Mnvr End
(V10: OBSS ITVC: 105, -55).

5. JOINT OCAS1

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
91: Camera C (0, 40)	92: OBSS ITVC (105, -55)	13: LAB Stbd Zenith (50, -30)	SRMS Elbow (-170, 30) Camera A (0, 30)

PCS MSS: SSRMS:

Enter Mode – Joint OCAS (Verify – blue)

pick File ► LAB ► ESP2 Unberth Jnt OCAS 1

Verify ‘Joint Angles’ ‘Destination’ for Joint OCAS 1 position.

SR	SY	SP	EP	WP	WY	WR
-65.0	+18.7	-40.0	-30.0	-145.6	-90.0	-74.5

NOTE

The Target and Error fields on the SSRMS Joint OCAS display will not be correct. This data should be verified and monitored on the Joint Angle Position overlay. (SCR 31169)

cmd Load (Verify Sequence Status – Confirm or Cancel)

2.110 CONTINGENCY ESP2 BERTH
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MON Verify joint angles and errors are correct on Joint Angle Position overlay.

	SR	SY	SP	EP	WP	WY	WR
(current)	-81.0	-23.2	-87.8	-90.0	-178.9	-65.3	-72.8
TGT	-65.0	+18.7	-40.0	-30.0	-145.6	-90.0	-74.5
ERR	-16.0	-41.9	-47.8	-60.0	-33.3	+24.7	+1.7

* If joint angles/errors are incorrect
* **cmd** Cancel (Verify Sequence Status – Waiting Destination)
*
* Input correct Dest joint angles per table above.
*
* **cmd** Load (Verify Sequence Status – Confirm or Cancel)
*
MON * Verify joint angles and errors are correct on Joint Angle Position
* overlay.

PCS **cmd** Confirm (Verify Sequence Status – Auto Seq sw - Hot)

DCP AUTO SEQ → PROC

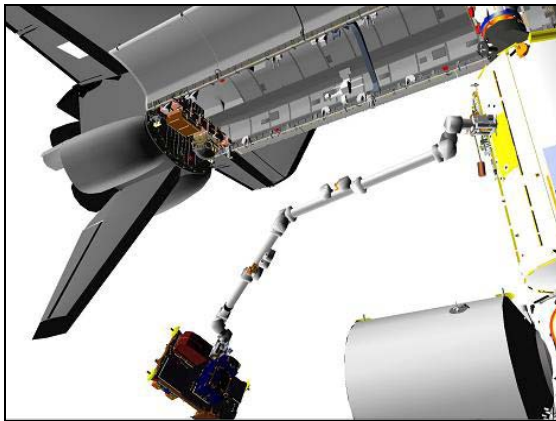


Figure 6.- Joint OCAS 1 End
(92: OBSS ITVC: 105, -55).

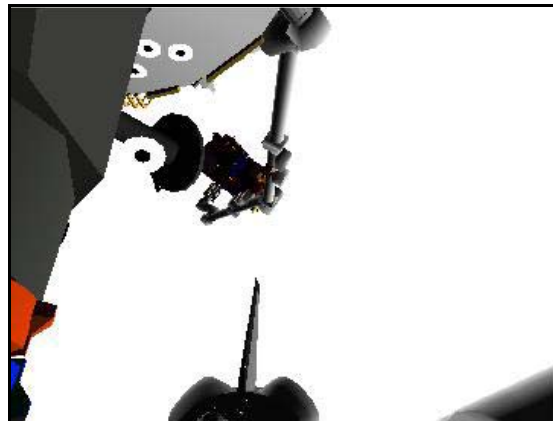


Figure 7.- Joint OCAS 1 End
(V10: Camera A: 0, 30).

PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at Joint OCAS 1 position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-65.0	+18.7	-40.0	-30.0	-145.6	-90.0	-74.5
X	Y	Z	Pitch	Yaw	Roll	
-314	-298	+1527	+1.0	+30.9	+161.9	
FOR	Loaded – ESP2Instal, SY Held					
Disp	LAB>ESP2 Install					

6. JOINT OCAS 2

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
92: SRMS Elbow (-140, 20) 92: OBSS ITVC (105, -45)	91: Camera B (0, 10)	22: Base Elbow (65, -10) 24: Tip Elbow (-10, 0)	Camera A (0, 30)

RHC RATE → COARSE (Verify Coarse on PCS)

NOTE
Expect singularity warning for EP between -15 and +15 deg and at SR approx 26 deg (WY pointing at shoulder).

PCS SSRMS Joint OCAS

Input 'Joint Angles' 'Destination' for Joint OCAS 2 position.

SR	SY	SP	EP	WP	WY	WR
+60.6	+18.7	-40.0	+149.7	-145.6	-90.0	+124.5

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON Verify joint angles and errors are correct on Joint Angle Position overlay.

	SR	SY	SP	EP	WP	WY	WR
(current)	-65.0	+18.7	-40.0	-30.0	-145.6	-90.0	-74.5
TGT	+60.6	+18.7	-40.0	+149.7	-145.6	-90.0	+124.5
ERR	-125.6	0.0	0.0	-179.7	0.0	0.0	-199.0

```

*****
* If joint angles/errors are incorrect
* | cmd Cancel (Verify Sequence Status – Waiting Destination)
* |
* | Input correct Dest joint angles per table above.
* |
* | cmd Load (Verify Sequence Status – Confirm or Cancel)
* |
MON * | Verify joint angles and errors are correct on Joint Angle Position
* | overlay.
*****

```

PCS **cmd** Confirm (Verify Sequence Status – Auto Seq sw - Hot)

DCP AUTO SEQ → PROC

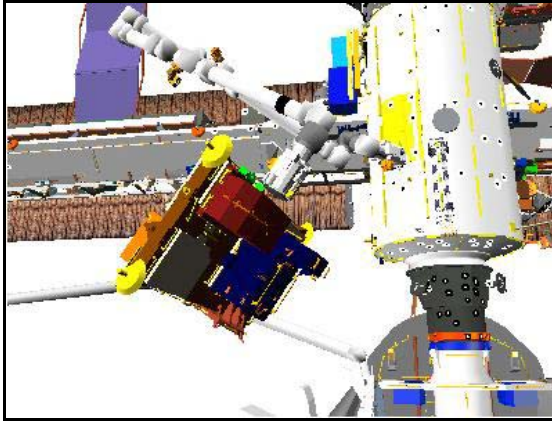


Figure 8.- Joint OCAS 2 End
 (91: Camera B: -10, 15).

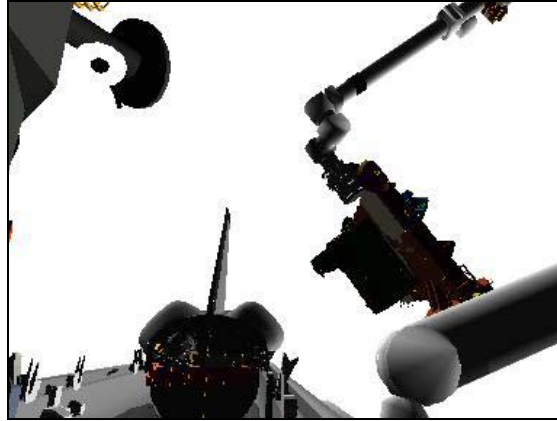


Figure 9.- Joint OCAS 2 End
 (V10: Camera A: 5, 20).

PCS MSS: SSRMS: SSRMS

Verify Posn Hold – orange

Verify SSRMS at Joint OCAS 2 position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+60.6	+18.7	-40.0	+149.7	-145.6	-90.0	+124.5
X	Y	Z	Pitch	Yaw	Roll	
+1035	-966	+513	-177.9	+34.4	-103.4	
FOR	Loaded – ESP2Instal, SY Held					
Disp	LAB>ESP2 Install					

7. MANEUVERING TO ESP2 LOW HOVER

Enter Mode – Standby (Verify – blue)

Verify Loaded Parameters – √

Change Loaded Parameters ► ESP2 ► ESP2 Unberth SYH

Verify 'Loaded Parameters' (two) – ESP2Unbrth, SY Held

Change Display ► LAB ► ESP2 Unberth (Verify LAB>ESP2 Unberth)

Change Command ► ISS ► OBAS (Verify ISS>OBAS)

NOTE

Monitor clearance between SSRMS wrist cluster and US LAB with SRMS Elbow Camera or OBSS ITVC. Minimum clearance is approximately 127 cm.

Enter Mode – Single (Verify – blue)

RHC RATE – as required (VERNIER within 1.5 m of structure)

2.110 CONTINGENCY ESP2 BERTH
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WARNING

The active joint must be checked on the PCS before initiating motion. Failure to do so may result in movement of the wrong joint.

THC Perform Single Joint maneuver to ESP2 Low Hover position (within 1 deg).

	SR	SY	SP	EP	WP	WY	WR
JOCAS 2	+60.6	+18.7	-40.0	+149.7	-145.6	-90.0	+124.5
1: WY +						+0.9	
2: SP +			+28.6				
Low Hover	+60.6	+18.7	+28.6	+149.7	-145.6	+0.9	+124.5
	X	Y	Z	Pitch	Yaw	Roll	
	0	0	-300	0.0	0.0	-0.2	
FOR	Loaded – ESP2Unbrth, SY Held						
Disp	LAB>ESP2 Unberth						



Figure 10.- ESP2 Low Hover
(92: OBSS ITVC: 105, -45).

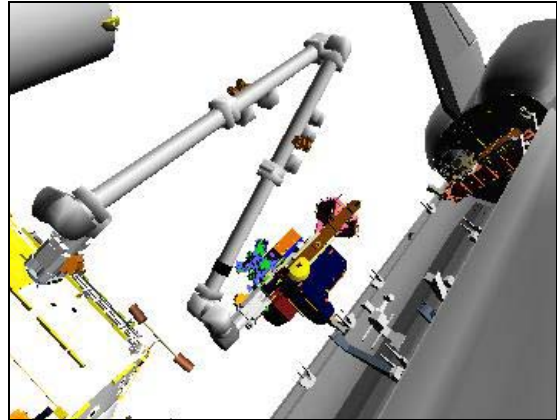


Figure 11.- ESP2 Low Hover
(92: SRMS Elbow: -160, 20).

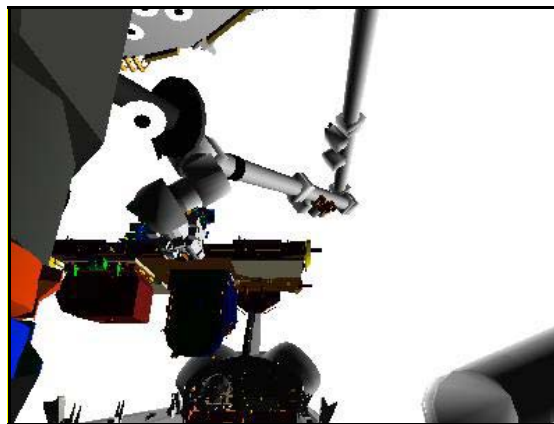


Figure 12.- ESP2 Low Hover
(V10: Camera A: 0, 25).

8. VERIFICATION OF DESAT REQUEST

PCS MSS: SSRMS: Thrusters:

Verify 'Desat Request:' – Inh

If using shuttle attitude control, coordinate with shuttle crewmembers
 DAP: FREE

9. MANEUVERING ESP2 TO RTL

MSS: SSRMS:

Enter Mode – Standby (Verify – blue)

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
92: SRMS Elbow (-160, 20) 92: OBSS ITVC (105, -45)	91: Mux Camera B/C	24: Tip Elbow (-25, 30)	Camera A (0, 25)

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: 0.4 (Verify 0.4)

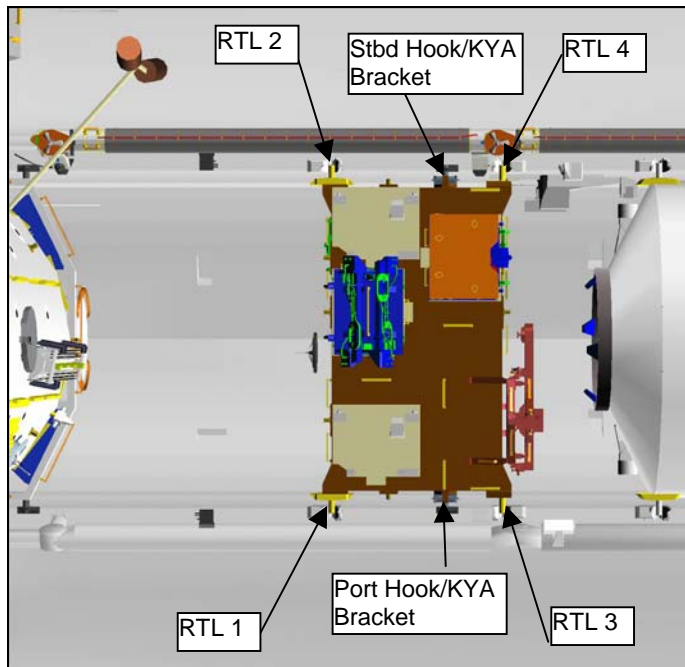


Figure 13.- ESP2 Latch Config.

2.110 CONTINGENCY ESP2 BERTH
(RBT FS/LF1/FIN/SPN) Page 9 of 12 pages

PCS MSS: SSRMS: SSRMS

√Vernier

Enter Mode – Manual (Verify – blue)

MSS: SSRMS: SSRMS Manual: Joint Lock: Joint Lock

cmd Shoulder Yaw (Verify SY – Locked)

Verify shuttle crew standing by for ESP2 PRLA tb – gray callouts

NOTE
Steps in gray are performed by the shuttle crew to verify RDYs and latch PRLAs.

A6U Shuttle crew verify:
√PL RETEN PL SEL – 3

THC/
RHC Maneuver to ESP2 Berthed position (Until shuttle callout of PL RETEN RDY 1,2,3,4 tb – gray).

NOTE
For purposes of ESP2 Berth, Visual RTL may be confirmed when both port and starboard hook/KYA brackets and the four PRLAs are visually at RTL (expected at Z: -3). The hook/KYA bracket may prevent the trunnions from being driven down far enough to receive RTL talkbacks from the PRLAs.

THC/
RHC

* If four of four RTLs cannot be achieved or sustained
* Maneuver to Visual RTL.
*
* Pitch approximately 1 deg to obtain FWD RTL Talkbacks while
* maintaining ESP2 Visual RTL on AFT PRLAs.
*
* (-Pitch on RHC, +Z on THC)
*
* Listen for shuttle crew callout of PL RETEN RDY 1,2 tb – gray

NOTE
Steps in gray are performed by the shuttle crew to close ESP2 PRLAs for berth in payload bay.

10. PRLA SETUP

Give shuttle crew GO for PRLA Latch.

A6U √PL RETEN PL SEL – 3
 √RDY 1,2 tb (two) – gray
 √LAT 1,2,3,4 tb (four) – REL
 Visually verify aft trunnions are within PRLA capture envelopes.

 * If any RDY not gray, then visually verify trunnion
 * within PRLA capture envelope.

SM 97 PL RETENTION

√RDY-FOR-LAT 1,2 (four): 1
 √LAT 1,2,3,4 (eight): 0

 * If any rel msw shows 1, expect single motor time
 * (60 seconds).

11. ACTIVATE LATCHES

R13L PL RETEN LOGIC PWR SYS 1,2 (two) – ON
 BAY MECH PWR SYS 1,2 (two) – ON

12. LATCH PRLAS

Note single motor drive times (> 30 seconds).

A6U PL RETEN LAT 1,2 (two) – LAT (tb-LAT), 60 s max
 – OFF

PCS MSS: SSRMS: **SSRMS**

Verify Posn Hold – orange

A6U PL RETEN LAT 3,4 (two) – LAT (tb-LAT), 60 s max
 – OFF

To confirm good capture
 √PL RETEN RDY 1,2,3,4 tb (four) – gray

13. DEACTIVATE LATCHES

R13L PL RETEN LOGIC PWR SYS 1,2 (two) – OFF
 BAY MECH PWR SYS 1,2 (two) – OFF

2.110 CONTINGENCY ESP2 BERTH
 (RBT FS/LF1/FIN/SPN) Page 11 of 12 pages

14. CLEANUP

PCS MSS: SSRMS:

Enter Mode – Standby (Verify blue)

MSS: SSRMS: Limp:

cmd All Limp (Verify Limp – blue)

MSS: SSRMS:

Verify joints – Limped

DCP BRAKES SSRMS → ON (Verify – ON)

PCS Expected ESP2 Berth Posn (within 5cm/ 1deg).

SR	SY	SP	EP	WP	WY	WR
+34.8	+18.7	+36.5	+125.0	-139.7	+12.2	+146.3
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	-0.2	
FOR	Loaded – ESP2Unbrth, SY Held					
Disp	LAB>ESP2 Unberth					



Figure 14.- ESP2 Berth
 (92: OBSS ITVC: 105, -45).

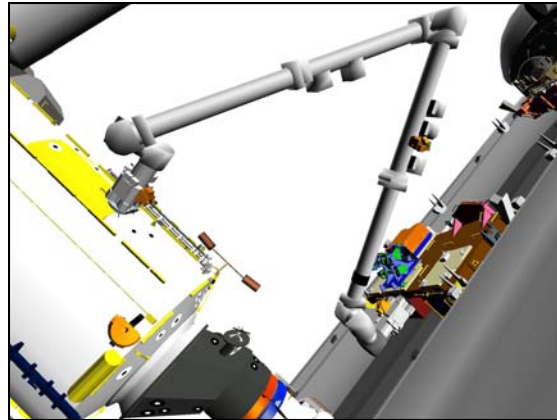


Figure 15.- ESP2 Berth
 (92: SRMS Elbow: -170, 10).

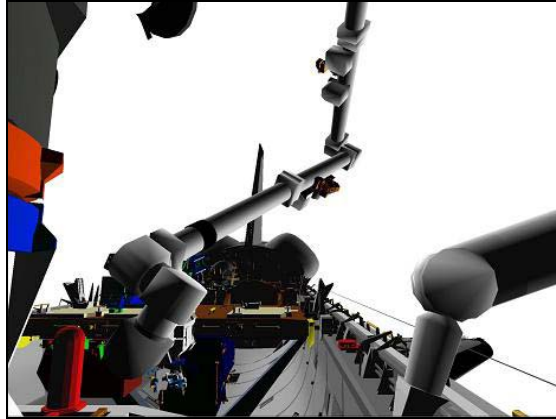


Figure 16.- ESP2 Berth
(V10: Camera A: 0, 10).

15. ATTITUDE CONTROL CONFIGURATION

If using shuttle attitude control, coordinate with shuttle crewmembers

 | DAP: LVLH

 | When rates damped:

 | DAP: FREE > 2 seconds

 | Then DAP: AUTO

2.120 CONTINGENCY BERTHED ESP2 UNGRAPPLE

(RBT FS/LF1/FIN/SPN) Page 1 of 5 pages

1. SETUP

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
92: OBSS ITVC (90, -45)	25: Tip LEE 91: Camera A (0, 10)	24: Tip Elbow (-25, 0) 22: Base Elbow (45, -15)	SRMS Elbow (-170, 10)

PCS

MSS: SSRMS:

Verify 'Unloaded Parameters' (two) – LEE Tip, SY Held

Change Display ► ISS ► ISSACS (Verify ISS>ISSACS)

Change Command ► SSRMS ► Internal (Verify SSRMS>Internal)

√Vernier

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: as required

2. ESP2 UNGRAPPLE

DCP

BRAKES SSRMS → OFF (Verify – OFF)

PCS

2.1 SSRMS Limp

MSS: SSRMS: Limp:

cmd All Limp (Verify Limp – blue)

MSS: SSRMS:

Verify all joints – Limped

2.2 Auto Release

MSS: SSRMS: Tip LEE:

cmd Release ► Automatic ► Slow (Verify Speed – Slow)

Verify '**Confirm or Terminate**' prompt.

CAUTION

Due to end-to-end system latency, the RHC Trigger is hot up to 3 seconds prior to receiving a Trigger Hot icon status on the PCS.

2.120 CONTINGENCY BERTHED ESP2 UNGRAPPLE

(RBT FS/LF1/FIN/SPN) Page 2 of 5 pages

NOTE

Once the trigger is hot, only safing or trigger commands should be sent to the Robotics equipment. If a configuration change is required, including routing MSS Cameras, safe the system to exit LEE operations. (SCR 23262, 14662)

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Auto Release

RHC TRIGGER → press (momentarily)

PCS
 Verify 'Carriage' Derigidize – blue (90 s max)
 Verify 'Snare' Open – blue (12 s max)
 Verify 'Carriage' Extend – blue (90 s max)

2.3 SSRMS Backoff

NOTE

Monitor distance between ODS and SSRMS wrist cluster using OBSS ITVC or SRMS Elbow Camera. Distance is approximately 75 cm at Grapple Fixture Backoff position.

MSS: SSRMS: Limp:

cmd None Limp (Verify Standby – blue)

MSS: SSRMS:

Verify Unloaded Parameters – √
 Verify 'Unloaded Parameters' (two) – LEE Tip, SY Held

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

THC/
 RHC
 Maneuver to ESP2 Ungrapple position (-X THC command)
 (within 5 cm/2 deg).

		Locked				
SR	SY	SP	EP	WP	WY	WR
+32.9	+18.7	+43.3	+125.7	-148.2	+12.8	+147.9
X	Y	Z	Pitch	Yaw	Roll	
+992	-19	+897	-89.0	-0.1	-179.9	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>ISSACS					

2.120 CONTINGENCY BERTHED ESP2 UNGRAPPLE

(RBT FS/LF1/FIN/SPN) Page 3 of 5 pages

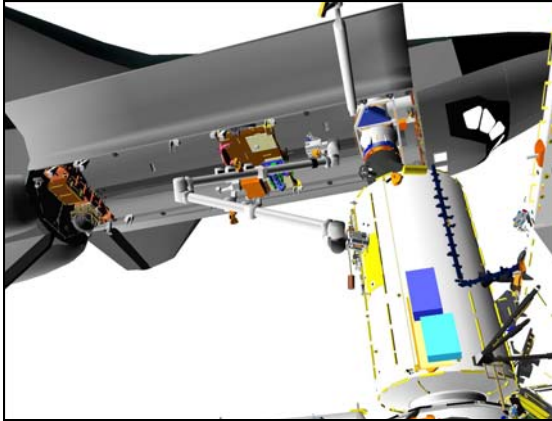


Figure 1.- ESP2 Ungrapple
(92: OBSS ITVC: 90, -45).

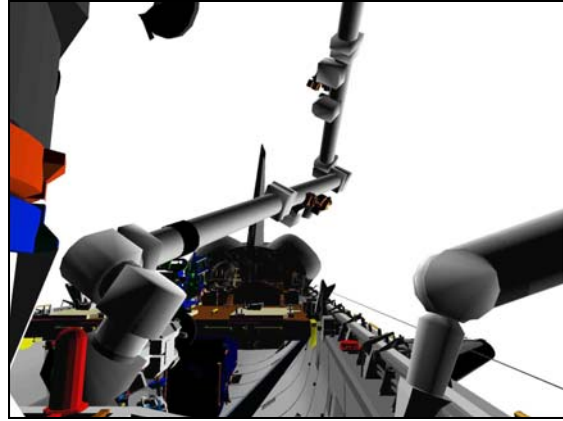


Figure 2.- ESP2 Ungrapple
(91: Camera A: 0, 10).

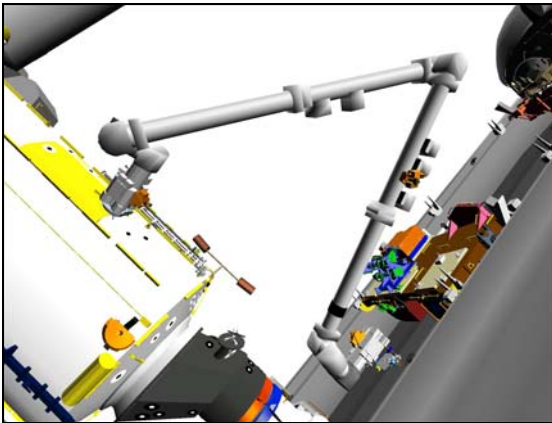


Figure 3.- ESP2 Ungrapple
(92: SRMS Elbow: -170, 10).

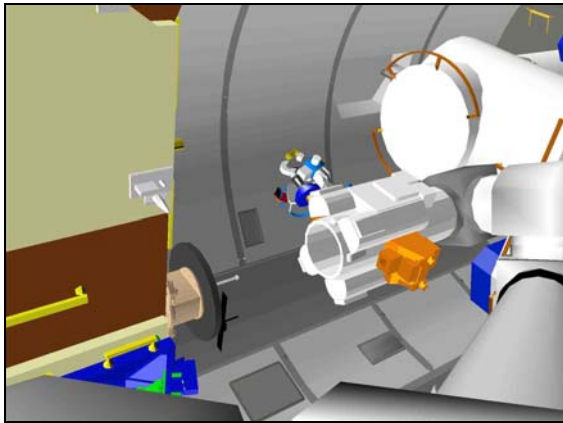


Figure 4.- ESP2 Ungrapple
(24: Tip Elbow: -25, 0).

3. MANEUVERING CLEAR OF STRUCTURE

PCS

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: 1.0 (Verify 1.0)

MSS: SSRMS:

Change Command ► ISS ► ISSACS (Verify ISS>ISSACS)

2.120 CONTINGENCY BERTHED ESP2 UNGRAPPLE

(RBT FS/LF1/FIN/SPN) Page 4 of 5 pages

<u>NOTE</u>						
Use OBSS ITVC (zoom as required) or SRMS Elbow Camera to monitor clearances. The following are approximate minimum clearances seen during the maneuver to the Clear Structure Posn:						
Tip LEE to ESP2 Camera Stanchions: 106 cm						
Tip LEE to ESP2 FRGF: 65 cm						
WP to US LAB: 62 cm						
WP to PMA2 (port grapple fixture): 71 cm						
WY to ODS: 77 cm						

THC Maneuver SSRMS to Clear Structure position (within 5 cm/1 deg).

		Locked						
		SR	SY	SP	EP	WP	WY	WR
		+32.9	+18.7	+43.3	+125.7	-148.2	+12.8	+147.9
		X	Y	Z	Pitch	Yaw	Roll	
ESP2		+992	-19	+897	-89.0	-0.1	-179.9	
Ungrapple								
1: X	-	+810						
2: Z	+			+960				
3: X	-	+645						
4: Z	+			+1163				
5: Y	-		-199					
Clear Structure		+645	-199	+1163	-89.0	-0.1	-179.9	
		SR	SY	SP	EP	WP	WY	WR
		+49.7	+18.7	-11.8	+150.0	-109.6	+6.1	+133.3
		FOR	Unloaded – LEE Tip, SY Held					
		Disp	ISS>ISSACS					

DCP BRAKES SSRMS → ON (Verify – ON)



Figure 5.- Single Joint Maneuver End (92: OBSS ITVC: 120, -55).

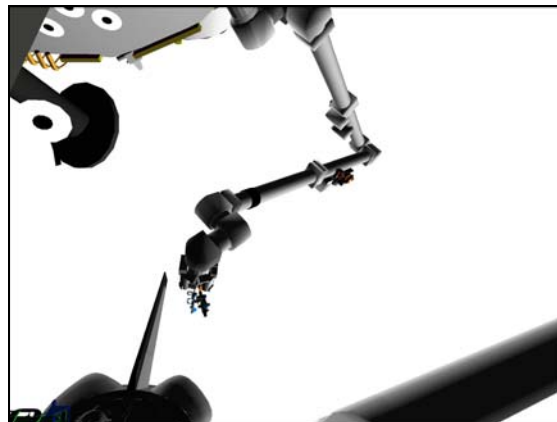


Figure 6.- Single Joint Maneuver End (91: Camera A: 15, 30).

2.120 CONTINGENCY BERTHED ESP2 UNGRAPPLE
(RBT FS/LF1/FIN/SPN) Page 5 of 5 pages

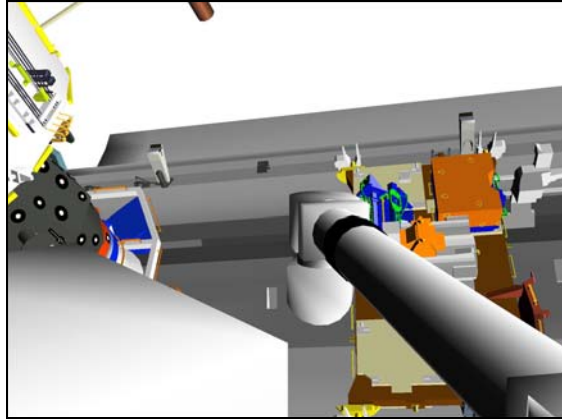


Figure 7.- Single Joint Maneuver End
(22: Base Elbow: 40, -10).

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2.210 CONTINGENCY CMG AND FSE TEMP STOW ON CETA

(RBT FS/LF1/FIN/SPN) Page 1 of 9 pages

NOTE

This procedure assumes a start point backed off from a GCA position at the LMC during step 6 of 1.512 EVA - CMG R&R, with brakes on.

1. SETUP

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3
92: Camera B (80, 10)	22: Base Elbow (-110, -10)	91: SRMS Elbow (-160, 40)
92: Camera C (-90, 50)	24: Tip Elbow (20, 0)	

PCS

MSS: SSRMS:

Verify Unloaded Parameters – √

Verify 'Unloaded Parameters' (two) – Chest 12/PP/F/4, SR Held

Verify Display – ISS>ISSACS

Verify Command – ISS>ISSACS

√Vernier

2. CMG AND FSE REMOVAL FROM LMC

DCP

BRAKES SSRMS → OFF (Verify OFF)

PCS

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

NOTE

To ensure adequate clearance between EVA Helmet and Aft Bulkhead, notify EV crewmember to “stand up” prior to any mnvrs to the Aft portion of the LMC.

THC/
RHC

GCA per EVA call to remove CMG and FSE from LMC.

2.210 CONTINGENCY CMG AND FSE TEMP STOW ON CETA

(RBT FS/LF1/FIN/SPN) Page 2 of 9 pages

When CMG FSE successfully removed from LMC and EVA is ready to maneuver away from structure:

THC/
RHC

Maneuver to LMC Access position (SY, SP, EP within 2 deg).

Locked						
SR	SY	SP	EP	WP	WY	WR
-126.0	-7.0	+13.0	-102.0	-121.0	-167.0	+90.0
X	Y	Z	Pitch	Yaw	Roll	
+618	-149	+2007	+1.0	+9.1	-178.2	
FOR	Unloaded – Chest 12/PP/F/4, SR Held					
Disp	ISS>ISSACS					

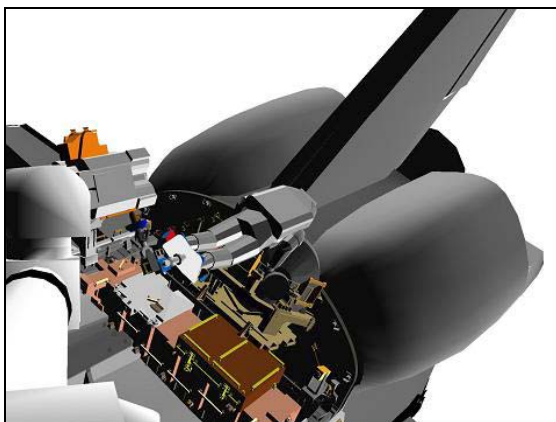


Figure 1.- LMC Access
(24: Tip Elbow: 20, 0).

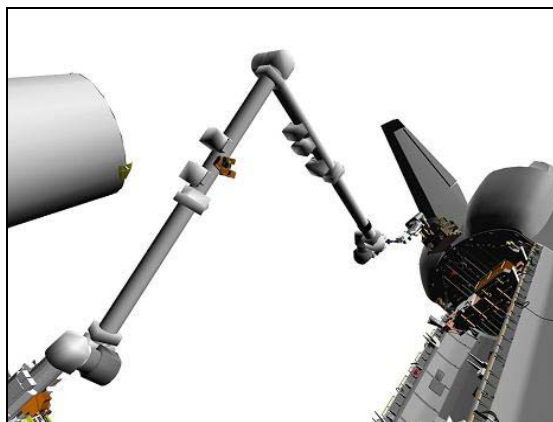


Figure 2.- LMC Access
(91: SRMS Elbow: -160, 40).

3. MANEUVERING TO CETA ACCESS JOCAS POSN

PCS

MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3
91: SRMS Elbow (-160, 40)	24: Tip Elbow (20, 0)	92: Camera C (-40, 30)
13: LAB Stbd Zenith (20, -30)	22: Base Elbow (-110, -10)	

2.210 CONTINGENCY CMG AND FSE TEMP STOW ON CETA

(RBT FS/LF1/FIN/SPN) Page 3 of 9 pages

SSRMS Joint OCAS

Input 'Joint Angles' 'Destination' for CETA Access JOCAS position.

SR	SY	SP	EP	WP	WY	WR
-68.0	-42.0	-117.0	-83.0	-44.0	-67.0	+22.6

NOTE

The Target and Error fields on the SSRMS Joint OCAS display will not be correct. This data should be verified and monitored on the Joint Angle Position overlay. (SCR 31169)

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON

Verify joint angles and errors are correct on Joint Angle Position overlay.

	SR	SY	SP	EP	WP	WY	WR
(current)	-126.0	-7.0	+13.0	-102.0	-121.0	-167.0	+90.0
TGT	-68.0	-42.0	-117.0	-83.0	-44.0	-67.0	+22.6
ERR	-58.0	+35.0	+130.0	-19.0	-77.0	-100.0	+67.4

PCS

* If joint angles/errors are incorrect

* **cmd** Cancel (Verify Sequence Status – Waiting Destination)

*

* Input correct Dest joint angles per table above.

*

* **cmd** Load (Verify Sequence Status – Confirm or Cancel)

*

MON

* Verify joint angles and errors are correct on Joint Angle Position overlay.

PCS

cmd Confirm (Verify Sequence Status – Auto Seq sw - Hot)

DCP

AUTO SEQ → PROC

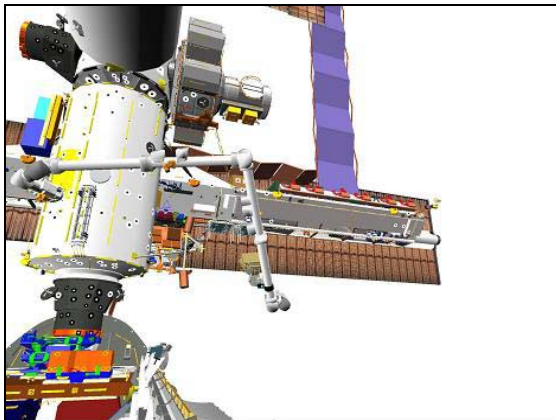


Figure 3.- CETA Access JOCAS
(92: Camera C: 20, 20).

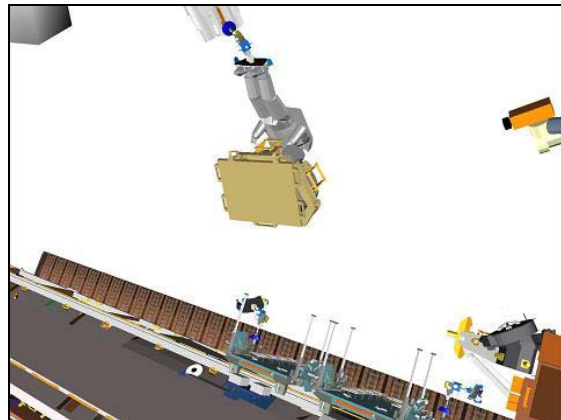


Figure 4.- CETA Access JOCAS
(22: Base Elbow: -110, -35).

2.210 CONTINGENCY CMG AND FSE TEMP STOW ON CETA

(RBT FS/LF1/FIN/SPN) Page 4 of 9 pages

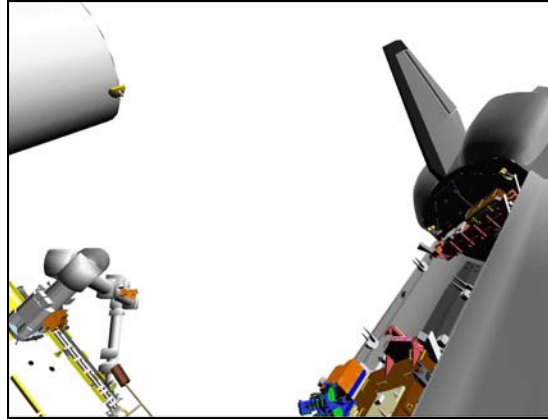


Figure 5.- CETA Access JOCAS
(91: SRMS Elbow: -160, 30).

PCS

MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at CETA Access JOCAS position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-68.0	-42.0	-117.0	-83.0	-44.0	-67.0	+22.6
X	Y	Z	Pitch	Yaw	Roll	
+551	+785	+232	-156.6	+0.2	+178.4	
FOR	Unloaded – Chest 12/PP/F/4, SR Held					
Disp	ISS>ISSACS					

4. ATTACHING CMG FSE TO CETA CART

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3
92: Camera C (20, 20)	24: Tip Elbow (-130, 0)	13: LAB Stbd Zenith (130, 90)
91: OBSS ITVC (70, -45)		22: Base Elbow (-110, -35)

NOTE

1. At the CETA Access posn, the distance between the SSRMS Base Boom and the UHF Antenna is approximately 91 cm. Monitor using Camera C.
2. Monitor clearance between the SSRMS base boom and the LAB using the Tip Elbow camera or OBSS ITVC. Minimum clearance at CETA Access position is approximately 66 cm.

2.210 CONTINGENCY CMG AND FSE TEMP STOW ON CETA

(RBT FS/LF1/FIN/SPN) Page 5 of 9 pages

PCS MSS: SSRMS:

Verify Command – ISS>ISSACS

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

THC/
RHC Maneuver to CETA Access position (-Z THC command)
(within 5 cm/1 deg).

Locked	SR	SY	SP	EP	WP	WY	WR
	-68.0	-34.4	-131.9	-71.2	-27.1	-62.9	+37.8
	X	Y	Z	Pitch	Yaw	Roll	
	+551	+785	+10	-156.6	+0.2	+178.4	
FOR	Unloaded – Chest 12/PP/F/4, SR Held						
Disp	ISS>ISSACS						

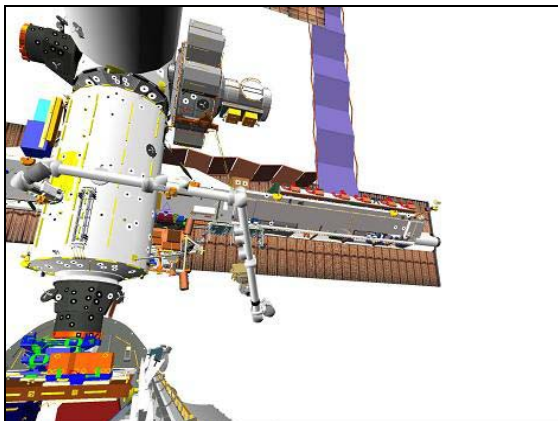


Figure 6.- CETA Access
(92: Camera C: 20, 20).

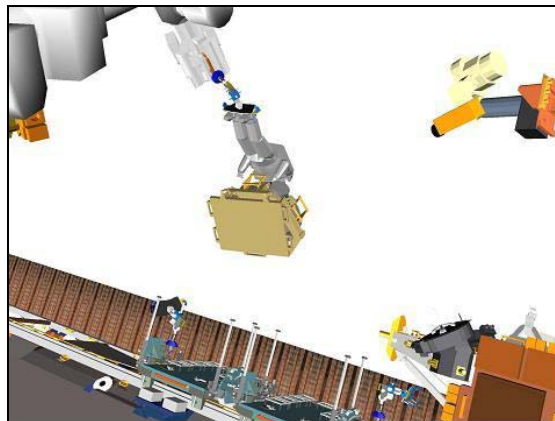


Figure 7.- CETA Access
(22: Base Elbow: -120, -30).

2.210 CONTINGENCY CMG AND FSE TEMP STOW ON CETA

(RBT FS/LF1/FIN/SPN) Page 6 of 9 pages

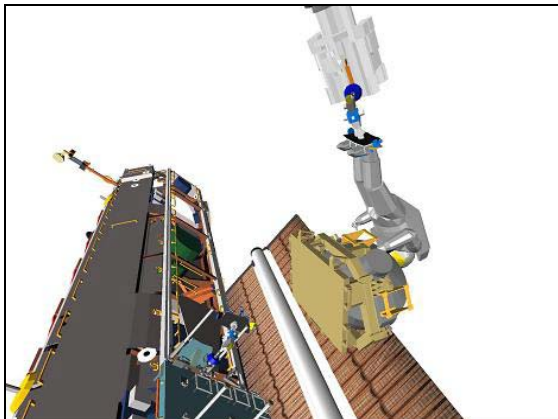


Figure 8.- CETA Access
(13: LAB Stbd Zenith: 130, 80).

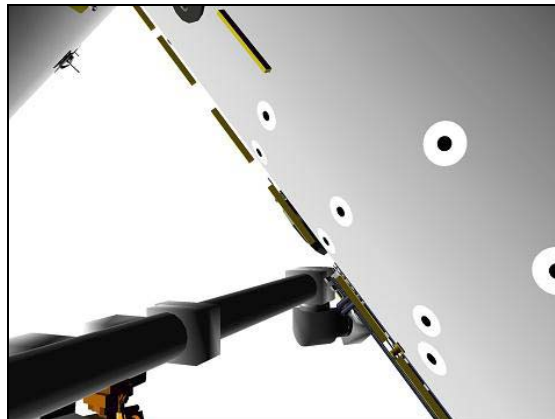


Figure 9.- CETA Access
(24: Tip Elbow: -130, 0).

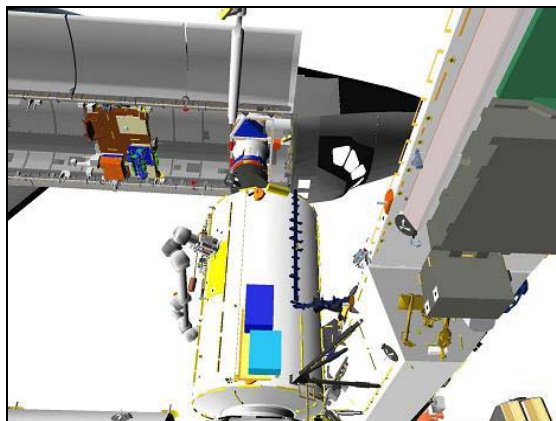


Figure 10.- CETA Access
(91: OBSS ITVC: 70, -45).

THC/
RHC

GCA per EVA call to attach CMG FSE to CETA Cart.

When EVA has successfully attached CMG FSE to CETA Cart and is ready to maneuver away from structure:

THC
/RHC

Maneuver back to CETA Access JOCAS position (SY, SP, EP within 2 deg).

Locked						
SR	SY	SP	EP	WP	WY	WR
-68.0	-42.0	-117.0	-83.0	-44.0	-67.0	+22.6
X	Y	Z	Pitch	Yaw	Roll	
+551	+785	+232	-156.6	+0.2	+178.4	
FOR	Unloaded – Chest 12/PP/F/4, SR Held					
Disp	ISS>ISSACS					

2.210 CONTINGENCY CMG AND FSE TEMP STOW ON CETA

(RBT FS/LF1/FIN/SPN) Page 7 of 9 pages

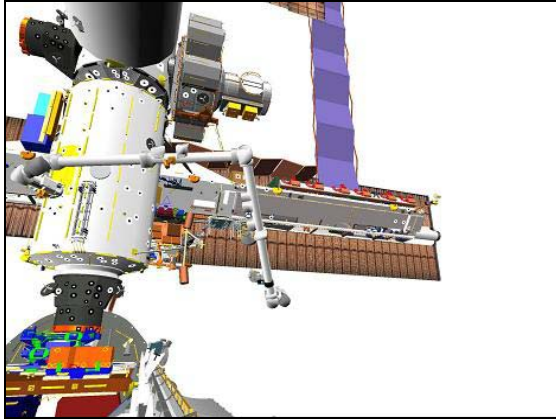


Figure 11.- CETA Access JOCAS
(92: Camera C: 20, 20).

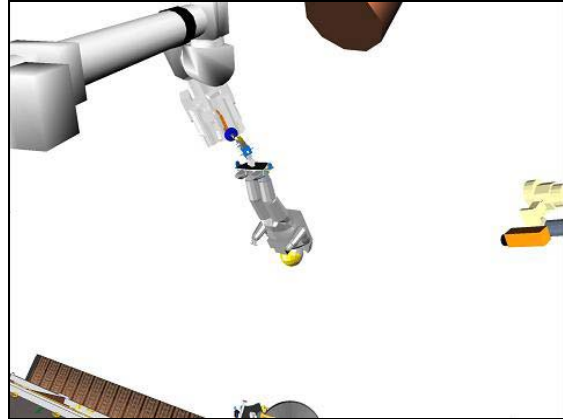


Figure 12.- CETA Access JOCAS
(22: Base Elbow: -110, -25).

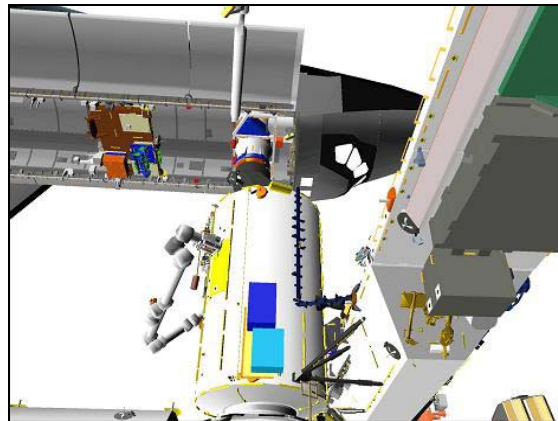


Figure 13.- CETA Access JOCAS
(91: OBSS ITVC: 70, -45).

5. MANEUVERING TO LMC

PCS

MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

√Vernier

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3
92: Camera C (20, 20)	24: Tip Elbow (0, -10) 22: Base Elbow (-110, -25)	13: LAB Stbd Zenith (130, 90) 91: SRMS Elbow (-160, 30)

2.210 CONTINGENCY CMG AND FSE TEMP STOW ON CETA

(RBT FS/LF1/FIN/SPN) Page 8 of 9 pages

SSRMS Joint OCAS

Input 'Joint Angles' 'Destination' for LMC Access position.

SR	SY	SP	EP	WP	WY	WR
-126.0	-7.0	+13.0	-102.0	-121.0	-167.0	+90.0

NOTE

The Target and Error fields on the SSRMS Joint OCAS display will not be correct. This data should be verified and monitored on the Joint Angle Position overlay. (SCR 31169)

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON

Verify joint angles and errors are correct on Joint Angle Position overlay.

	SR	SY	SP	EP	WP	WY	WR
(current)	-68.0	-42.0	-117.0	-83.0	-44.0	-67.0	+22.6
TGT	-126.0	-7.0	+13.0	-102.0	-121.0	-167.0	+90.0
ERR	+58.0	-35.0	-130.0	+19.0	+77.0	+100.0	-67.4

PCS

* If joint angles/errors are incorrect

* **cmd** Cancel (Verify Sequence Status – Waiting Destination)

*

* Input correct Dest joint angles per table above.

*

* **cmd** Load (Verify Sequence Status – Confirm or Cancel)

*

MON

* Verify joint angles and errors are correct on Joint Angle Position overlay.

PCS

cmd Confirm (Verify Sequence Status – Auto Seq sw - Hot)

DCP

AUTO SEQ → PROC

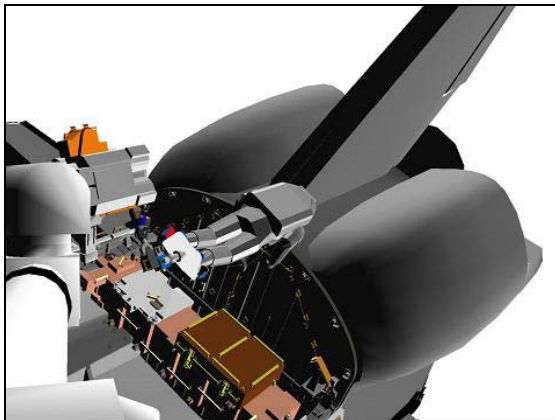


Figure 14.- LMC Access
(24: Tip Elbow: 20, 0).

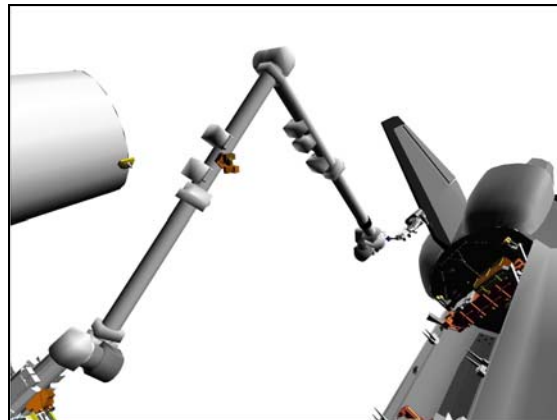


Figure 15.- LMC Access
(91: SRMS Elbow: -160, 40).

2.210 CONTINGENCY CMG AND FSE TEMP STOW ON CETA

(RBT FS/LF1/FIN/SPN) Page 9 of 9 pages

PCS MSS: SSRMS: SSRMS

Verify Posn Hold – orange

Verify SSRMS at LMC Access position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-126.0	-7.0	+13.0	-102.0	-121.0	-167.0	+90.0
X	Y	Z	Pitch	Yaw	Roll	
+618	-149	+2007	+1.0	+9.1	-178.2	
FOR	Unloaded – Chest 12/PP/F/4, SR Held					
Disp	ISS>ISSACS					

DCP BRAKES SSRMS → ON (Verify ON)

√MCC

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2.220 CONTINGENCY CMG TEMP STOW ON SSRMS

(RBT FS/LF1/FIN/SPN) Page 1 of 6 pages

1. SETUP

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3
92: Camera A (0, 0)	22: Base Elbow (-130, -10)	91: SRMS Elbow (-160, 40)
92: Camera B (90, 120)	24: Tip Elbow (0, -10)	

If APFR Egress required

PCS MSS: SSRMS:

Verify Display – ISS>ISSACS
Verify Command – ISS>ISSACS

√Vernier

DCP BRAKES SSRMS → OFF (Verify OFF)

PCS Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

THC/
RHC GCA per EVA call for APFR Egress.

DCP When APFR Egress complete:
BRAKES SSRMS → ON (Verify ON)

2. CMG ATTACH TO SSRMS

PCS MSS: SSRMS:

Change Unloaded Parameters ► Unloaded ► LEE Tip SRH
Verify 'Unloaded Parameters' (two) – LEE Tip, SR Held

DCP BRAKES SSRMS → OFF (Verify OFF)

PCS Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

2.220 CONTINGENCY CMG TEMP STOW ON SSRMS

(RBT FS/LF1/FIN/SPN) Page 2 of 6 pages

THC/
RHC

Maneuver to CMG Attach position (SY, SP, EP within 2 deg).

Locked						
SR	SY	SP	EP	WP	WY	WR
-126.0	+5.8	+10.1	-85.0	-126.3	-186.9	+224.9
X	Y	Z	Pitch	Yaw	Roll	
+754	-336	+1954	-65.0	-25.1	-68.0	
FOR	Unloaded – LEE Tip, SR Held					
Disp	ISS>ISSACS					

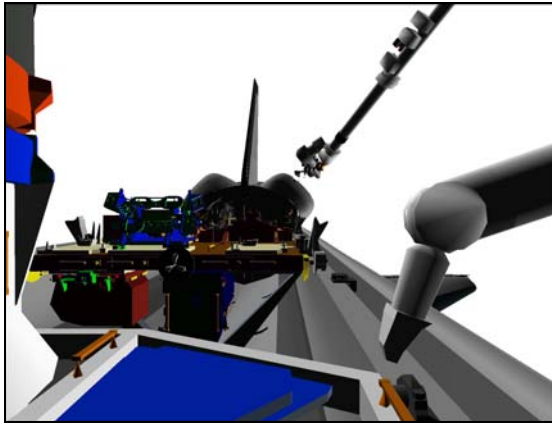


Figure 1.- CMG Attach
(92: Camera A: 0, 0).

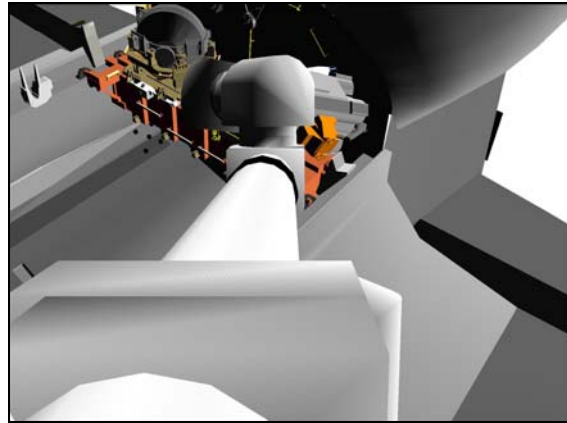


Figure 2.- CMG Attach
(24: Tip Elbow: 0, -10).

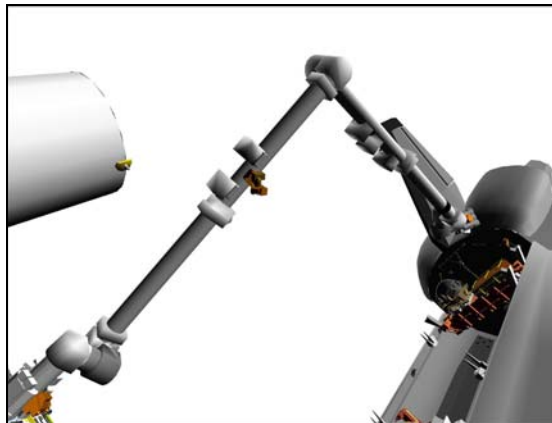


Figure 3.- CMG Attach
(91: SRMS Elbow: -160, 40).

<p>NOTE APFR Settings are 12/FF/F/12.</p>
--

GCA per EVA call for APFR reconfig and CMG attachment.

2.220 CONTINGENCY CMG TEMP STOW ON SSRMS

(RBT FS/LF1/FIN/SPN) Page 3 of 6 pages

3. MANEUVERING TO CMG TEMP STOW POSN

When EVA has successfully attached the CMG to the SSRMS

PCS

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

Verify Unloaded Parameters – √

Change Unloaded Parameters ► EVA ► Chest 12/FF/F/12 SRH

Verify 'Unloaded Parameters' (two) – Chest 12/FF/F/12, SR Held

√Vernier

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

THC/
RHC

Maneuver to JOCAS Setup position (SY, SP, EP within 2 deg).

Locked						
SR	SY	SP	EP	WP	WY	WR
-126.0	-2.0	+16.3	-88.2	-129.9	-194.2	+227.8
X	Y	Z	Pitch	Yaw	Roll	
+620	-98	+2030	-64.9	-25.0	+95.0	
FOR	Unloaded – Chest 12/FF/F/12, SR Held					
Disp	ISS>ISSACS					

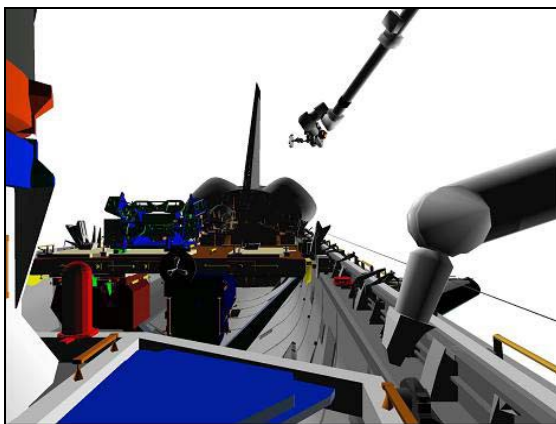


Figure 4.- CMG Attach
(92: Camera A: 0, 0)

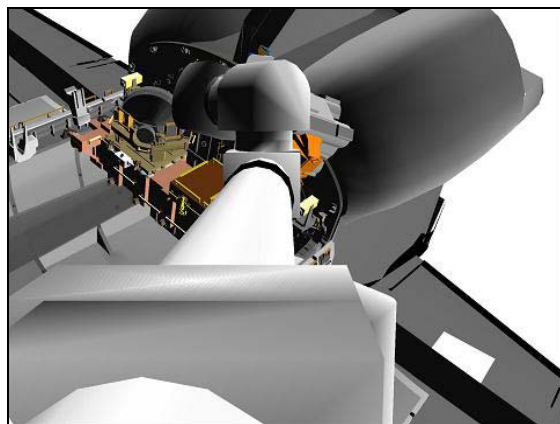


Figure 5 CMG Attach
(24: Tip Elbow: 0, -10).

2.220 CONTINGENCY CMG TEMP STOW ON SSRMS

(RBT FS/LF1/FIN/SPN) Page 4 of 6 pages

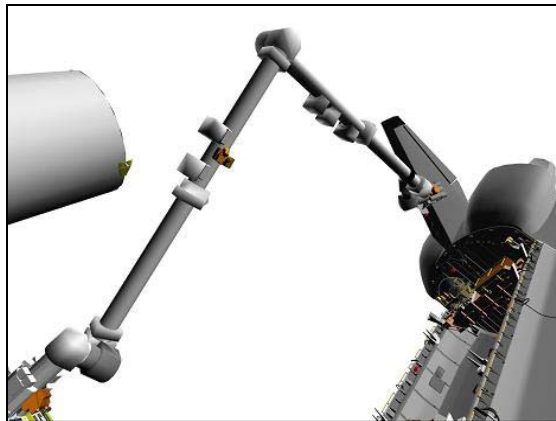


Figure 6.- CMG Attach
(91: SRMS Elbow: -160, 40).

4. MANEUVERING TO CMG TEMP STOW POSN

PCS

MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

Input 'Joint Angles' 'Destination' for CMG Temp Stow position.

SR	SY	SP	EP	WP	WY	WR
-126.0	-13.0	+27.1	-87.6	-149.7	-170.1	-36.2

NOTE

The Target and Error fields on the SSRMS Joint OCAS display will not be correct. This data should be verified and monitored on the Joint Angle Position overlay. (SCR 31169)

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON

Verify joint angles and errors are correct on Joint Angle Position overlay.

	SR	SY	SP	EP	WP	WY	WR
(current)	-126.0	-2.0	+16.3	-88.2	-129.9	-194.2	+227.8
TGT	-126.0	-13.0	+27.1	-87.6	-149.7	-170.1	-36.2
ERR	0.0	+11.0	-10.8	-0.6	+19.8	-24.1	+264.0

2.220 CONTINGENCY CMG TEMP STOW ON SSRMS

(RBT FS/LF1/FIN/SPN) Page 5 of 6 pages

```
*****
* If joint angles/errors are incorrect
PCS * | cmd Cancel (Verify Sequence Status – Waiting Destination)
* |
* | Input correct Dest joint angles per table above.
* |
* | cmd Load (Verify Sequence Status – Confirm or Cancel)
MON * |
* | Verify joint angles and errors are correct on Joint Angle Position
* | overlay.
*****

PCS cmd Confirm (Verify Sequence Status – Auto Seq sw - Hot)

DCP AUTO SEQ → PROC
```

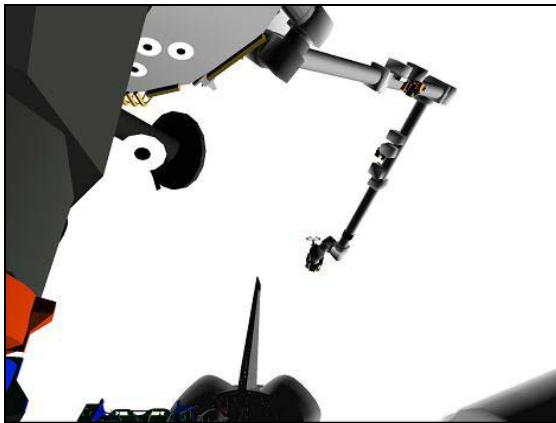


Figure 7.- CMG Temp Stow
(92: Camera A: 0, 30).

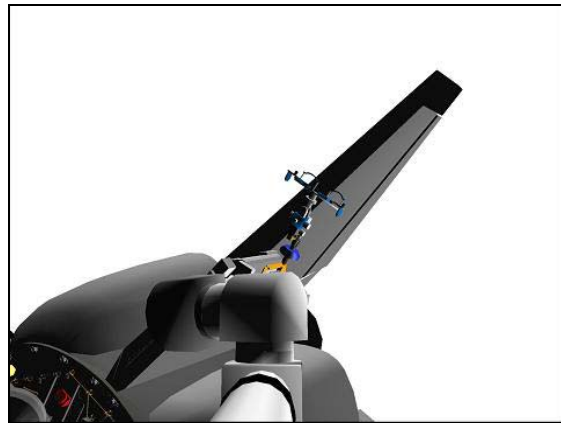


Figure 8.- CMG Temp Stow
(24: Tip Elbow: 0, 10).

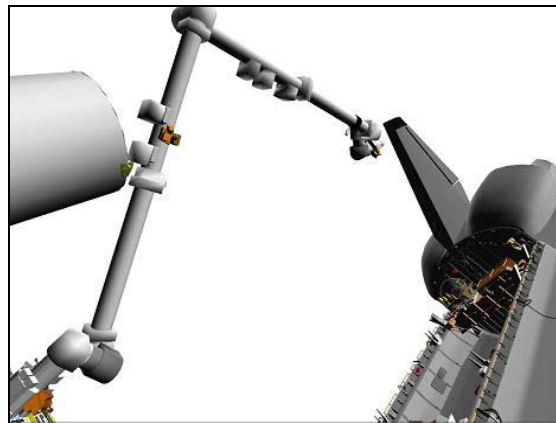


Figure 9.- CMG Temp Stow
(91: SRMS Elbow: -160, 40).

```
PCS MSS: SSRMS: 

Verify Posn Hold – orange
```

2.220 CONTINGENCY CMG TEMP STOW ON SSRMS

(RBT FS/LF1/FIN/SPN) Page 6 of 6 pages

Verify SSRMS at CMG Temp Stow position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-126.0	-13.0	+27.1	-87.6	-149.7	-170.1	-36.2
X	Y	Z	Pitch	Yaw	Roll	
+55	-324	+1929	-90.0	0.0	-180.0	
FOR	Unloaded – Chest 12/FF/F/12, SR Held					
Disp	ISS>ISSACS					

4. CLEANUP

NOTE

Expect the following message when safing is commanded:

**'R3Z - MSS OCS SSRMS Prime(Redun) ACU SRT Cat-1 Brk Stat
Fail'** (SCR 17495)

This message should return to Norm.

DCP SAFING → SAFE (Verify ON)

ODS Hatch Disconnect V10 Cables.

2.410 CONTINGENCY PORT CREW CABIN INSPECTION

(RBT FS/LF1/FIN)

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NOTE

The SSRMS is assumed to be based on the LAB PDGF.

1. SETUP

Verify SRMS is at the MPLM VIEWING position.

NOTE

Throughout the procedure, monitor the following clearances:

- a) Tip LEE to Port Payload Bay Door with Base Elbow Camera. Minimum clearance is 67 cm in step 8.
- b) Tip LEE to orbiter crew cabin with Base Elbow Camera. Minimum clearance is 90 cm in step 5.
- c) Base Boom to US LAB with Cameras A and B. Minimum clearance is 73 cm in steps 4 and 5.

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
91: SRMS Elbow (150, -20)	25: Tip LEE (FL: 24 mm)	22: Base Elbow (-100, 0)	Cam B (0, 10)
92: OBSS ITVC (80, -45)			Cam A (75, 55)

PCS

MSS: SSRMS:

Change Unloaded Parameters ► Unloaded ► LEE Tip SRH
Verify 'Unloaded Parameters' (two) – LEE Tip, SR Held

Change Display ► ISS ► OBAS (Verify ISS>OBAS)

√Vernier

Verify SSRMS at Port Crew Cabin Inspection Start position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+61.1	+71.3	-117.8	-94.5	-73.6	+39.7	+159.9
X	Y	Z	Pitch	Yaw	Roll	
-1300	-581	-950	-179.0	+85.0	+179.6	
FOR	Unloaded – LEE Tip, SR Held					
Disp	ISS>OBAS					

PCS

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: 0.7 (Verify 0.7)

2.410 CONTINGENCY PORT CREW CABIN INSPECTION

(RBT FS/LF1/FIN)

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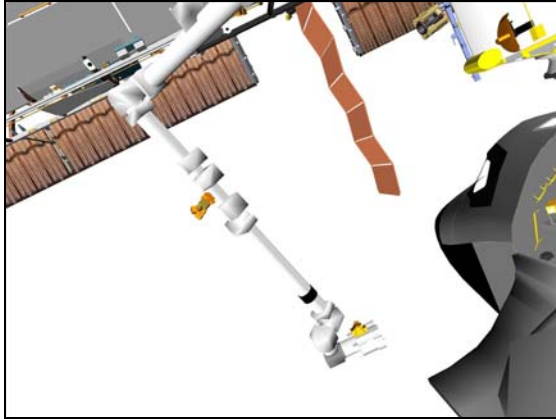


Figure 1.- Port Crew Cabin Inspection Start
(91: SRMS Elbow: 150, -20).

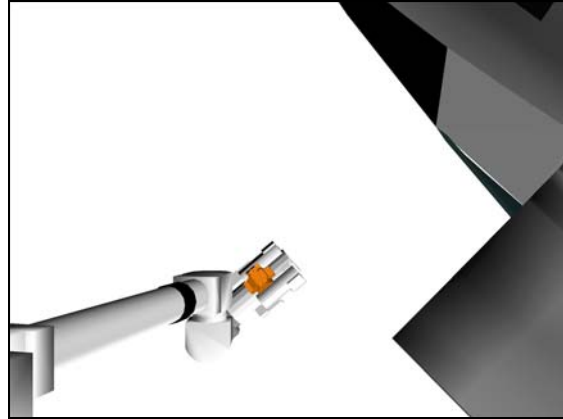


Figure 2.- Port Crew Cabin Inspection Start
(22: Base Elbow: -100, 0).

2. [TRAJECTORY #1](#)

Notify **MCC-H** to begin recording the Tip LEE view.

PCS

MSS: SSRMS:

Enter Mode – FOR OCAS (Verify blue)

MSS: SSRMS: SSRMS FOR OCAS: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

Input 'FOR' 'Destination' for Trajectory #1 End position.

X	Y	Z	Pitch	Yaw	Roll
-760	-425	-900	+179.8	+70.0	-179.7

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON

Verify FOR and errors are correct on FOR position overlay.

	X	Y	Z	Pitch	Yaw	Roll
FOR	-1300	-581	-950	-179.0	+85.0	+179.6
TGT	-760	-425	-900	+179.8	+70.0	-179.7
ERR	-540	-156	-50	-358.8	+15.0	+359.3

2.410 CONTINGENCY PORT CREW CABIN INSPECTION

(RBT FS/LF1/FIN)

Page 3 of 11 pages

- PCS * If FOR/errors are incorrect
 * **cmd** Cancel (Verify Sequence Status – Waiting Destination)
 *
 * Input correct Dest FOR per table above.
 *
 * **cmd** Load (Verify Sequence Status – Confirm or Cancel)
 *
 MON * Verify FOR and errors are correct on FOR position overlay.

PCS **cmd** Confirm (Verify Sequence Status – Auto Seq Sw - Hot)

DCP AUTO SEQ → PROC

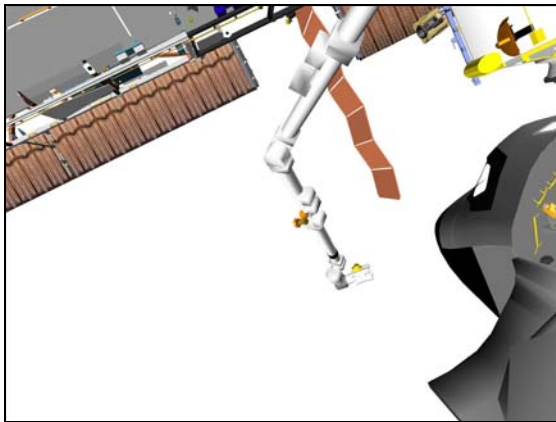


Figure 3.- Trajectory #1 End
 (91: SRMS Elbow: 150, -20).

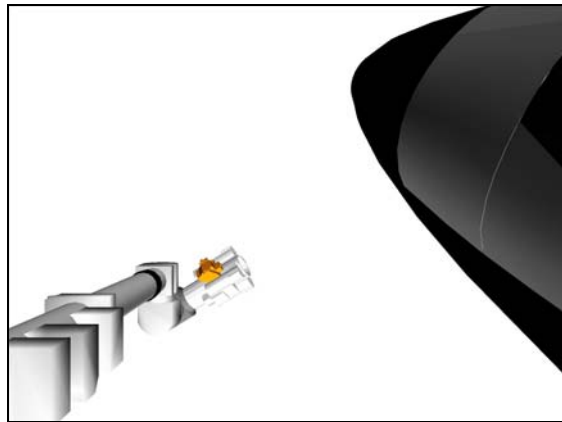


Figure 4.- Trajectory #1 End
 (22: Base Elbow: -140, 0).

PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at Trajectory #1 End position (within 5 cm/1 deg).

Locked	SR	SY	SP	EP	WP	WY	WR
	+61.1	+50.8	-142.3	-39.2	-99.6	+31.4	+140.3
	X	Y	Z	Pitch	Yaw	Roll	
	-760	-425	-900	+179.8	+70.0	-179.7	
FOR	Unloaded – LEE Tip, SR Held						
Disp	ISS>OBAS						

2.410 CONTINGENCY PORT CREW CABIN INSPECTION

(RBT FS/LF1/FIN)

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3. TRAJECTORY #2

SSRMS FOR OCAS

Verify SR – Locked

Input 'FOR' 'Destination' for Trajectory #2 End position.

X	Y	Z	Pitch	Yaw	Roll
-650	-200	-900	+179.8	+85.0	-179.7

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON

Verify FOR and errors are correct on FOR position overlay.

	X	Y	Z	Pitch	Yaw	Roll
FOR	-760	-425	-900	+179.8	+70.0	-179.7
TGT	-650	-200	-900	+179.8	+85.0	-179.7
ERR	-110	-225	0	0.0	-15.0	0.0

PCS

* If FOR/errors are incorrect

* **cmd** Cancel (Verify Sequence Status – Waiting Destination)

*

* Input correct Dest FOR per table above.

*

* **cmd** Load (Verify Sequence Status – Confirm or Cancel)

*

MON

* Verify FOR and errors are correct on FOR Position overlay.

PCS

cmd Confirm (Verify Sequence Status – Auto Seq Sw - Hot)

DCP

AUTO SEQ → PROC

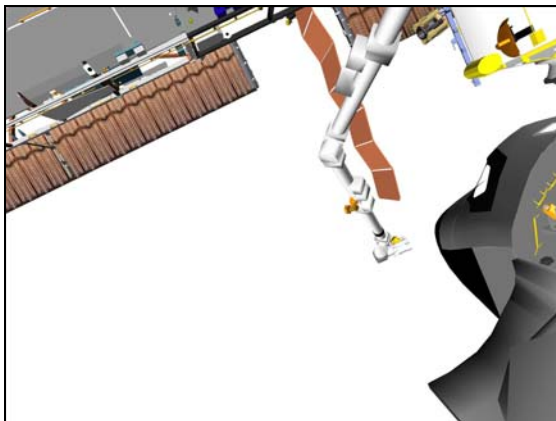


Figure 5.- Trajectory #2 End
(91: SRMS Elbow: 150, -20).

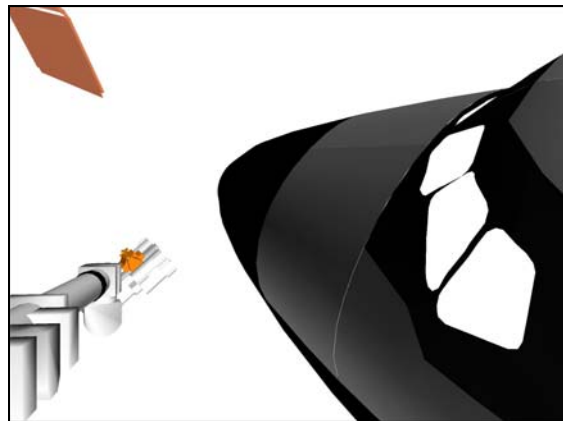


Figure 6.- Trajectory #2 End
(22: Base Elbow: -140, 0).

2.410 CONTINGENCY PORT CREW CABIN INSPECTION

(RBT FS/LF1/FIN)

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PCS MSS: SSRMS: SSRMS

Verify Posn Hold – orange

Verify SSRMS at Trajectory #2 End position (within 5 cm/1 deg).

Locked						
SR	SY	SP	EP	WP	WY	WR
+61.1	+43.2	-152.1	-32.1	-77.1	+41.6	+122.2
X	Y	Z	Pitch	Yaw	Roll	
-650	-200	-900	+179.8	+85.0	-179.7	
FOR	Unloaded – LEE Tip, SR Held					
Disp	ISS>OBAS					

4. TRAJECTORY #3

SSRMS FOR OCAS

Verify SR – Locked

Input 'FOR' 'Destination' for Trajectory #3 End position.

X	Y	Z	Pitch	Yaw	Roll
-1300	-580	-865	+179.8	+85.0	-179.7

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON

Verify FOR and errors are correct on FOR position overlay.

	X	Y	Z	Pitch	Yaw	Roll
FOR	-650	-200	-900	+179.8	+85.0	-179.7
TGT	-1300	-580	-865	+179.8	+85.0	-179.7
ERR	+650	+380	-35	0.0	0.0	0.0

* If FOR/errors are incorrect

PCS

* **cmd** Cancel (Verify Sequence Status – Waiting Destination)

*

* Input correct Dest FOR per table above.

*

* **cmd** Load (Verify Sequence Status – Confirm or Cancel)

*

MON

* Verify FOR and errors are correct on FOR position overlay.

PCS

cmd Confirm (Verify Sequence Status – Auto Seq Sw - Hot)

DCP

AUTO SEQ → PROC

2.410 CONTINGENCY PORT CREW CABIN INSPECTION

(RBT FS/LF1/FIN)

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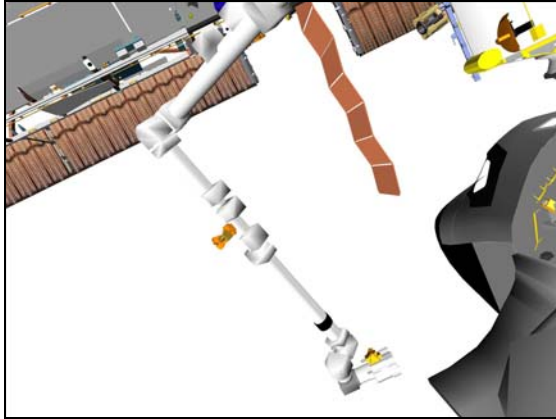


Figure 7.- Trajectory #3 End
(91: SRMS Elbow: 150, -20).

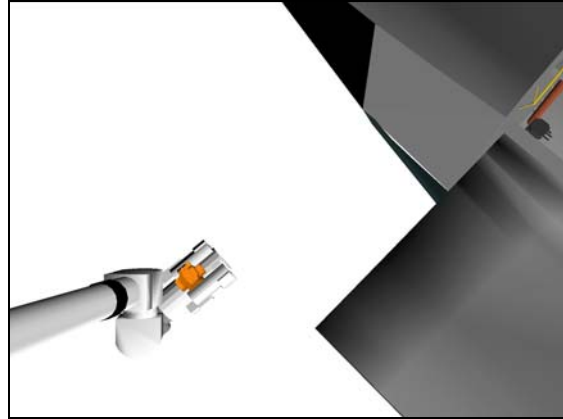


Figure 8.- Trajectory #3 End
(22: Base Elbow: -100, 0).

PCS

MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at Trajectory #3 End position (within 5 cm/1 deg).

Locked	SR	SY	SP	EP	WP	WY	WR
	+61.1	+72.5	-124.7	-87.2	-75.1	+39.4	+161.0
	X	Y	Z	Pitch	Yaw	Roll	
	-1300	-580	-865	+179.8	+85.0	-179.7	
FOR	Unloaded – LEE Tip, SR Held						
Disp	ISS>OBAS						

5. TRAJECTORY #4

Verify SR – Locked

Input 'FOR' 'Destination' for Trajectory #4 End position.

X	Y	Z	Pitch	Yaw	Roll
-675	-200	-800	+179.8	+85.0	-179.7

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON

Verify FOR and errors are correct on FOR position overlay.

	X	Y	Z	Pitch	Yaw	Roll
FOR	-1300	-580	-865	+179.8	+85.0	-179.7
TGT	-675	-200	-800	+179.8	+85.0	-179.7
ERR	-625	-380	-65	0.0	0.0	0.0

2.410 CONTINGENCY PORT CREW CABIN INSPECTION

(RBT FS/LF1/FIN)

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- PCS * If FOR/errors are incorrect
 * **cmd** Cancel (Verify Sequence Status – Waiting Destination)
 *
 * Input correct Dest FOR per table above.
 *
 * **cmd** Load (Verify Sequence Status – Confirm or Cancel)
 *
 MON * Verify FOR and errors are correct on FOR Position overlay.

PCS **cmd** Confirm (Verify Sequence Status – Auto Seq Sw - Hot)

DCP AUTO SEQ → PROC

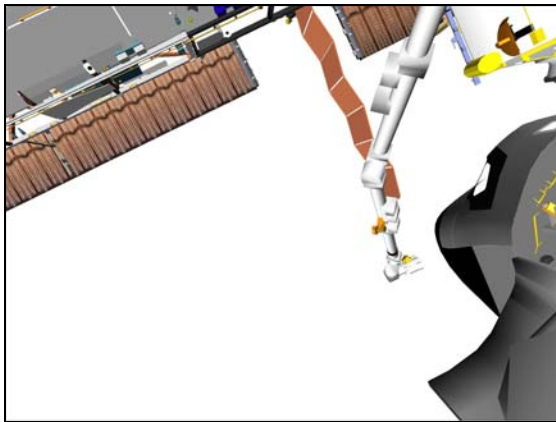


Figure 9.- Trajectory #4 End
(91: SRMS Elbow: 150, -20).

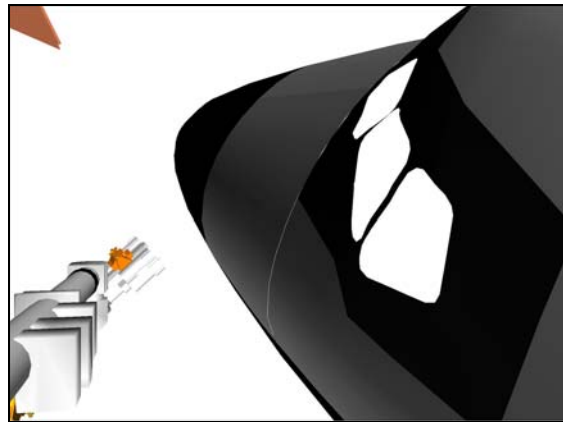


Figure 10.- Trajectory #4 End
(22: Base Elbow: -150, 0).

PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at Trajectory #4 End position (within 5 cm/1 deg).

Locked	SR	SY	SP	EP	WP	WY	WR
	+61.1	+46.0	-162.3	-17.0	-84.4	+41.9	+126.0
	X	Y	Z	Pitch	Yaw	Roll	
	-675	-200	-800	+179.8	+85.0	-179.7	
FOR	Unloaded – LEE Tip, SR Held						
Disp	ISS>OBAS						

2.410 CONTINGENCY PORT CREW CABIN INSPECTION

(RBT FS/LF1/FIN)

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6. TRAJECTORY #5

SSRMS FOR OCAS

Verify SR – Locked

Input 'FOR' 'Destination' for Trajectory #5 End position.

X	Y	Z	Pitch	Yaw	Roll
-760	-425	-800	+179.8	+70.0	-179.7

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON

Verify FOR and errors are correct on FOR position overlay.

	X	Y	Z	Pitch	Yaw	Roll
FOR	-675	-200	-800	+179.8	+85.0	-179.7
TGT	-760	-425	-800	+179.8	+70.0	-179.7
ERR	+85	+225	0	0.0	+15.0	0.0

PCS

* If FOR/errors are incorrect

* **cmd** Cancel (Verify Sequence Status – Waiting Destination)

*

* Input correct Dest FOR per table above.

*

* **cmd** Load (Verify Sequence Status – Confirm or Cancel)

*

MON

* Verify FOR and errors are correct on FOR position overlay.

PCS

cmd Confirm (Verify Sequence Status – Auto Seq Sw - Hot)

DCP

AUTO SEQ → PROC

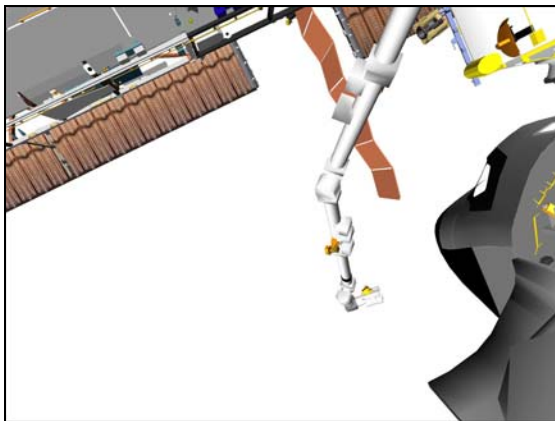


Figure 11.- Trajectory #5 End
(91: SRMS Elbow: 150, -20).

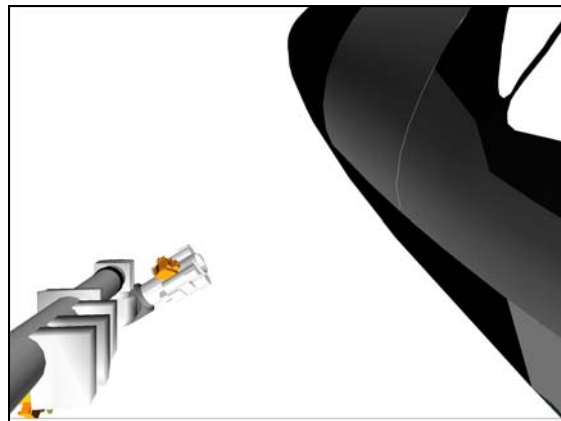


Figure 12.- Trajectory #5 End
(22: Base Elbow: -150, 0).

2.410 CONTINGENCY PORT CREW CABIN INSPECTION

(RBT FS/LF1/FIN)

PCS MSS: SSRMS: SSRMS

Verify Posn Hold – orange

Verify SSRMS at Trajectory #5 End position (within 5 cm/1 deg).

Locked						
SR	SY	SP	EP	WP	WY	WR
+61.1	+53.0	-154.6	-20.2	-107.6	+31.0	+142.8
X	Y	Z	Pitch	Yaw	Roll	
-760	-425	-800	+179.8	+70.0	-179.7	
FOR	Unloaded – LEE Tip, SR Held					
Disp	ISS>OBAS					

7. TRAJECTORY #6

SSRMS FOR OCAS

Verify SR – Locked

Input 'FOR' 'Destination' for Trajectory #6 End position.

X	Y	Z	Pitch	Yaw	Roll
-1300	-580	-850	-115.0	+85.0	+115.0

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON

Verify FOR and errors are correct on FOR position overlay.

	X	Y	Z	Pitch	Yaw	Roll
FOR	-760	-425	-800	+179.8	+70.0	-179.7
TGT	-1300	-580	-850	-115.0	+85.0	+115.0
ERR	+540	+155	+50	+294.8	-15.0	-294.7

PCS

* If FOR/errors are incorrect
* **cmd** Cancel (Verify Sequence Status – Waiting Destination)

* Input correct Dest FOR per table above.

* **cmd** Load (Verify Sequence Status – Confirm or Cancel)

MON

* Verify FOR and errors are correct on FOR position overlay.

PCS

cmd Confirm (Verify Sequence Status – Auto Seq Sw - Hot)

DCP

AUTO SEQ → PROC

2.410 CONTINGENCY PORT CREW CABIN INSPECTION

(RBT FS/LF1/FIN)

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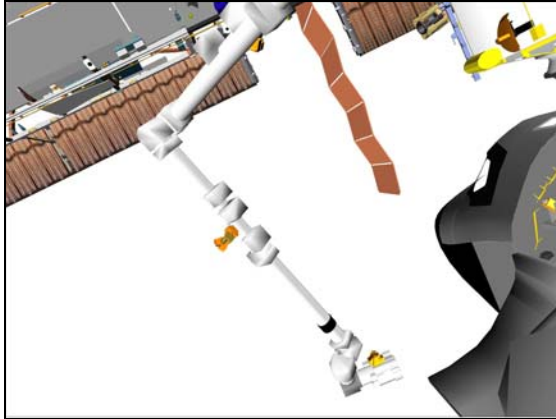


Figure 13.- Trajectory #6 End
(91: SRMS Elbow: 150, -20).

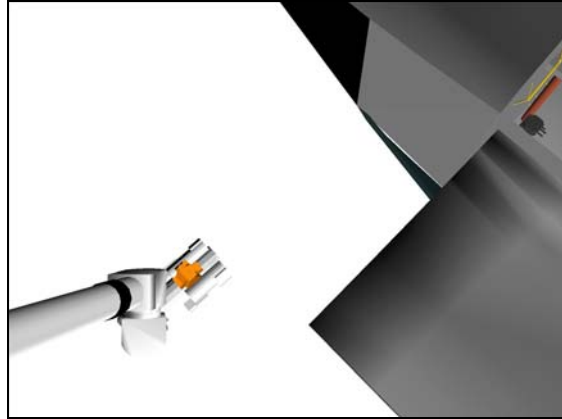


Figure 14.- Trajectory #6 End
(22: Base Elbow: -100, 0).

Verify Posn Hold – orange

Verify SSRMS at Trajectory #6 End position (within 5 cm/1 deg).

Locked						
SR	SY	SP	EP	WP	WY	WR
+61.1	+72.8	-125.2	-87.6	-67.5	+40.3	+156.7
X	Y	Z	Pitch	Yaw	Roll	
-1300	-580	-850	-115.0	+85.0	+115.0	
FOR	Unloaded – LEE Tip, SR Held					
Disp	ISS>OBAS					

8. TRAJECTORY #7

SSRMS FOR OCAS

Verify SR – Locked

Input 'FOR' 'Destination' for Trajectory #7 End position.

X	Y	Z	Pitch	Yaw	Roll
-2250	-875	-850	-135.0	+75.0	+135.0

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON

Verify FOR and errors are correct on FOR position overlay.

	X	Y	Z	Pitch	Yaw	Roll
FOR	-1300	-580	-850	-115.0	+85.0	+115.0
TGT	-2250	-875	-850	-135.0	+75.0	+135.0
ERR	+950	+295	0	+20.0	+10.0	-20.0

2.410 CONTINGENCY PORT CREW CABIN INSPECTION

(RBT FS/LF1/FIN)

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- PCS * If FOR/errors are incorrect
 * **cmd** Cancel (Verify Sequence Status – Waiting Destination)
 *
 * Input correct Dest FOR per table above.
 *
 * **cmd** Load (Verify Sequence Status – Confirm or Cancel)
 *
 MON * Verify FOR and errors are correct on FOR position overlay.

PCS **cmd** Confirm (Verify Sequence Status – Auto Seq Sw - Hot)

DCP AUTO SEQ → PROC



Figure 15.- Trajectory #7 End
 (22: Base Elbow: -110, -10).



Figure 16.- Trajectory #7 End
 (V10: Camera A: 50, 0).

PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at Trajectory #7 End position (within 5 cm/1 deg).

Locked						
SR	SY	SP	EP	WP	WY	WR
+61.1	+121.6	-145.5	-77.0	-75.4	+14.1	+205.6
X	Y	Z	Pitch	Yaw	Roll	
-2250	-875	-850	-135.0	+75.0	+135.0	
FOR	Unloaded – LEE Tip, SR Held					
Disp	ISS>OBAS					

DCP BRAKES SSRMS → ON (Verify ON)

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2.420 CONTINGENCY STARBOARD CREW CABIN INSPECTION

(RBT FS/LF1/FIN)

Page 1 of 10 pages

NOTE

1. The SRMS is assumed to be at the CMG R&R viewing position.
2. The SSRMS is assumed to be based on MBS PDGF 1 at WS 4.

1. SETUP

NOTE

Throughout the procedure, monitor the following clearances:

- SSRMS Shoulder Cluster to Lab Stbd Zenith Camera with Tip Elbow Camera. Minimum clearance varies with pan and tilt of Lab Stbd Zenith Camera, but may be as little as 107 cm.
- Tip LEE to Starboard Payload Bay Door with Lab Stbd Zenith Camera. Minimum clearance is 130 cm in step 4.

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
13: LAB Stbd Zenith (-110, 26)	25: Tip LEE (FL: 24 mm)	22: Base Elbow (160, -10) 24: Tip Elbow (-50, -20)	Cam C (0, 10)

PCS

MSS: SSRMS:

Change Unloaded Parameters ► Unloaded ► LEE Tip SYH
Verify 'Unloaded Parameters' (two) – LEE Tip, SY Held

Change Display ► W4 ► OBAS (Verify W4>OBAS)

√Vernier

Verify SSRMS at Stbd Crew Cabin Inspection Start position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+127.0	0.0	+64.5	-133.8	-50.4	+3.1	+156.7
X	Y	Z	Pitch	Yaw	Roll	
-1300	+581	-950	-179.8	-80.0	-179.8	
FOR	Unloaded – LEE Tip, SY Held					
Disp	W4>OBAS					

PCS

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: 0.7 (Verify 0.7)

2.420 CONTINGENCY STARBOARD CREW CABIN INSPECTION

(RBT FS/LF1/FIN)

Page 2 of 10 pages

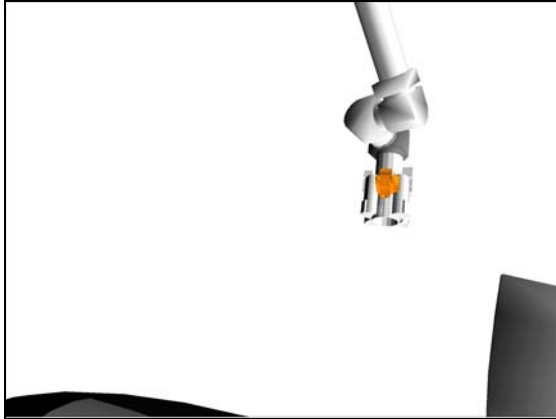


Figure 1.- Stbd Crew Cabin Inspection Start
(13: LAB Stbd Zenith: -110, 26).

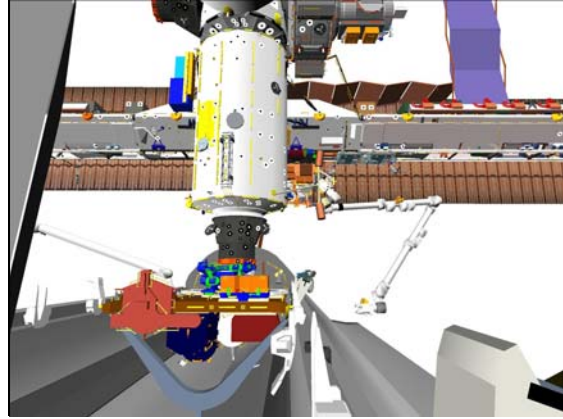


Figure 2.- Stbd Crew Cabin Inspection Start
(V10: Camera C: 0, 10).

2. [TRAJECTORY #1](#)

Notify **MCC-H** to begin recording the Tip LEE view.

PCS

MSS: SSRMS:

Enter Mode – FOR OCAS (Verify blue)

MSS: SSRMS: SSRMS FOR OCAS: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

Input 'FOR' 'Destination' for Trajectory #1 End position.

X	Y	Z	Pitch	Yaw	Roll
-760	+425	-900	+179.8	-70.0	+179.7

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON

Verify FOR and errors are correct on FOR position overlay.

	X	Y	Z	Pitch	Yaw	Roll
FOR	-1300	+581	-950	-179.8	-80.0	-179.8
TGT	-760	+425	-900	+179.8	-70.0	+179.7
ERR	-540	+156	-50	-359.6	-10.0	-359.5

2.420 CONTINGENCY STARBOARD CREW CABIN INSPECTION

(RBT FS/LF1/FIN)

Page 3 of 10 pages

- PCS * If FOR/errors are incorrect
 * **cmd** Cancel (Verify Sequence Status – Waiting Destination)
 *
 * Input correct Dest FOR per table above.
 *
 * **cmd** Load (Verify Sequence Status – Confirm or Cancel)
 *
 MON * Verify FOR and errors are correct on FOR position overlay.

PCS **cmd** Confirm (Verify Sequence Status – Auto Seq sw - Hot)

DCP AUTO SEQ → PROC

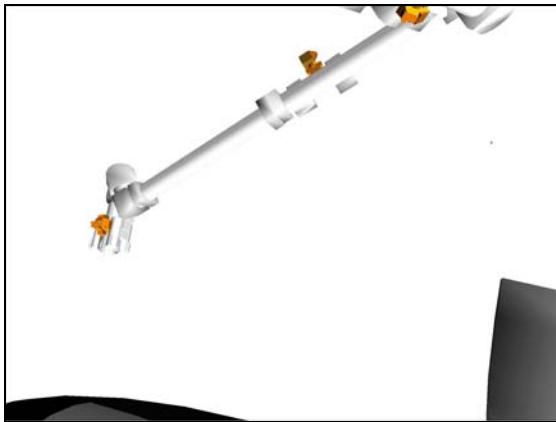


Figure 2.- Trajectory #1 End
 (13: LAB Stbd Zenith: -110, 26).

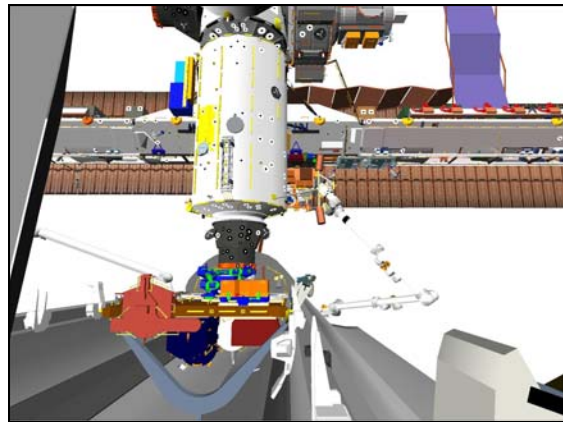


Figure 3.- Trajectory #1 End
 (V10: Camera C: 0, 10).

PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at Trajectory #1 End position (within 5 cm/1 deg).

	Locked					
SR	SY	SP	EP	WP	WY	WR
+194.8	0.0	+5.8	-122.1	-46.0	+63.5	+220.6
X	Y	Z	Pitch	Yaw	Roll	
-760	+425	-900	+179.8	-70.0	+179.7	
FOR	Unloaded – LEE Tip, SY Held					
Disp	W4>OBAS					

2.420 CONTINGENCY STARBOARD CREW CABIN INSPECTION

(RBT FS/LF1/FIN)

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3. TRAJECTORY #2

SSRMS FOR OCAS

Verify SY – Locked

Input 'FOR' 'Destination' for Trajectory #2 End position.

X	Y	Z	Pitch	Yaw	Roll
-500	+250	-900	+179.8	-55.0	+179.7

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON

Verify FOR and errors are correct on FOR position overlay.

	X	Y	Z	Pitch	Yaw	Roll
FOR	-760	+425	-900	+179.8	-70.0	+179.7
TGT	-500	+250	-900	+179.8	-55.0	+179.7
ERR	-260	+175	0	0.0	-15.0	0.0

PCS

* If FOR/errors are incorrect

* **cmd** Cancel (Verify Sequence Status – Waiting Destination)

*

* Input correct Dest FOR per table above.

*

* **cmd** Load (Verify Sequence Status – Confirm or Cancel)

*

MON

* Verify FOR and errors are correct on FOR Position overlay.

PCS

cmd Confirm (Verify Sequence Status – Auto Seq sw - Hot)

DCP

AUTO SEQ → PROC

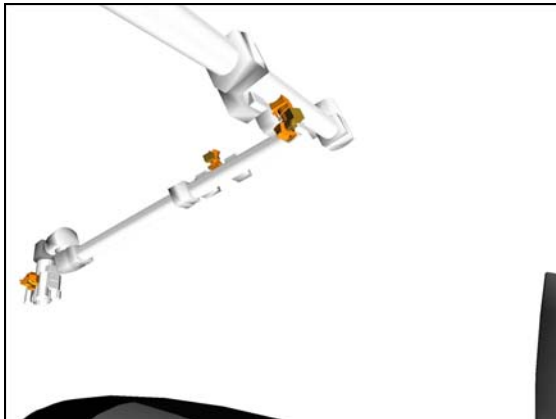


Figure 4.- Trajectory #2 End
(13: LAB Stbd Zenith: -115, 26).

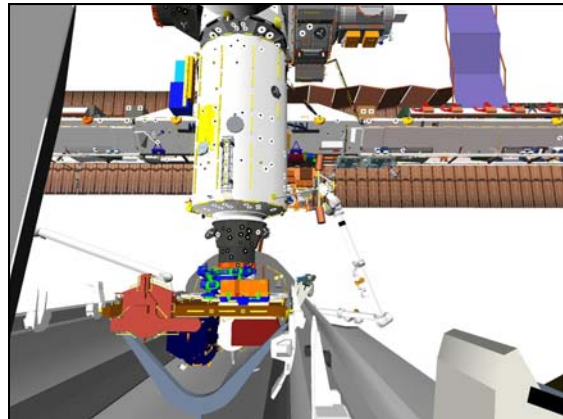


Figure 5.- Trajectory #2 End
(V10: Camera C: 0, 10).

2.420 CONTINGENCY STARBOARD CREW CABIN INSPECTION

(RBT FS/LF1/FIN)

Page 5 of 10 pages

PCS MSS: SSRMS: SSRMS

Verify Posn Hold – orange

Verify SSRMS at Trajectory #2 End position (within 5 cm/1 deg).

	Locked					
SR	SY	SP	EP	WP	WY	WR
+197.2	0.0	-23.1	-101.0	-78.7	+71.3	+259.3
X	Y	Z	Pitch	Yaw	Roll	
-500	+250	-900	+179.8	-55.0	+179.7	
FOR	Unloaded – LEE Tip, SY Held					
Disp	W4>OBAS					

4. TRAJECTORY #3

SSRMS FOR OCAS

Verify SY – Locked

Input 'FOR' 'Destination' for Trajectory #3 End position.

X	Y	Z	Pitch	Yaw	Roll
-1300	+580	-865	+179.8	-85.0	+179.7

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON

Verify FOR and errors are correct on FOR position overlay.

	X	Y	Z	Pitch	Yaw	Roll
FOR	-500	+250	-900	+179.8	-55.0	+179.7
TGT	-1300	+580	-865	+179.8	-85.0	+179.7
ERR	+800	-330	-35	0.0	+30.0	0.0

PCS

* If FOR/errors are incorrect

* **cmd** Cancel (Verify Sequence Status – Waiting Destination)

*

* Input correct Dest FOR per table above.

*

* **cmd** Load (Verify Sequence Status – Confirm or Cancel)

*

MON

* Verify FOR and errors are correct on FOR position overlay.

PCS

cmd Confirm (Verify Sequence Status – Auto Seq sw-Hot)

DCP

AUTO SEQ → PROC

2.420 CONTINGENCY STARBOARD CREW CABIN INSPECTION

(RBT FS/LF1/FIN)

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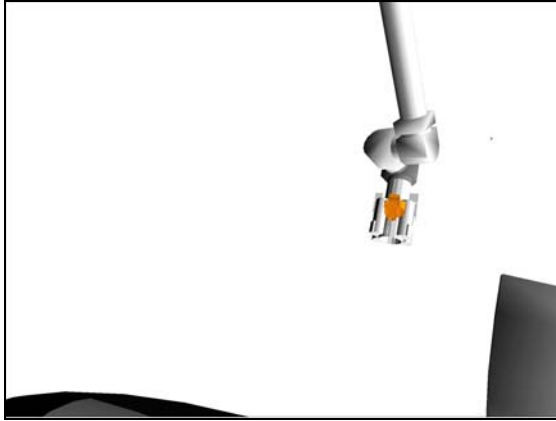


Figure 6.- Trajectory #3 End
(13: LAB Stbd Zenith: -110, 26).

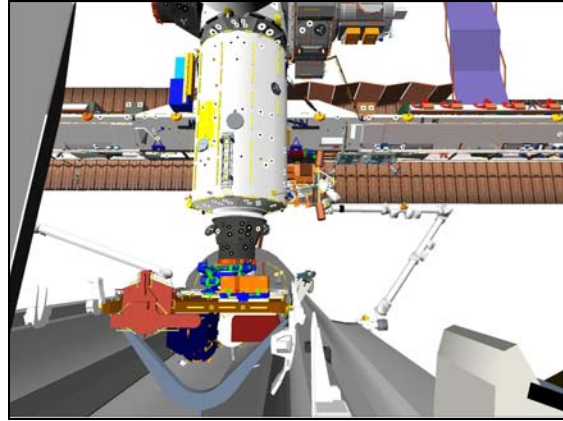


Figure 7.- Trajectory #3 End
(V10: Camera C: 0, 10).

PCS

MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at Trajectory #3 End position (within 5 cm/1 deg).

	Locked					
SR	SY	SP	EP	WP	WY	WR
+134.0	0.0	+55.8	-126.9	-50.6	+4.5	+160.4
X	Y	Z	Pitch	Yaw	Roll	
-1300	+580	-865	+179.8	-85.0	+179.7	
FOR	Unloaded – LEE Tip, SY Held					
Disp	W4>OBAS					

5. TRAJECTORY #4

Verify SY – Locked

Input 'FOR' 'Destination' for Trajectory #4 End position.

X	Y	Z	Pitch	Yaw	Roll
-500	+250	-800	-179.8	-55.0	-179.7

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON

Verify FOR and errors are correct on FOR position overlay.

	X	Y	Z	Pitch	Yaw	Roll
FOR	-1300	+580	-865	+179.8	-85.0	+179.7
TGT	-500	+250	-800	-179.8	-55.0	-179.7
ERR	-800	+330	-65	+359.6	-30.0	+359.4

2.420 CONTINGENCY STARBOARD CREW CABIN INSPECTION

(RBT FS/LF1/FIN)

Page 7 of 10 pages

- PCS * If FOR/errors are incorrect
 * **cmd** Cancel (Verify Sequence Status – Waiting Destination)
 *
 * Input correct Dest FOR per table above.
 *
 * **cmd** Load (Verify Sequence Status – Confirm or Cancel)
 *
 MON * Verify FOR and errors are correct on FOR Position overlay.

PCS **cmd** Confirm (Verify Sequence Status – Auto Seq sw - Hot)

DCP AUTO SEQ → PROC

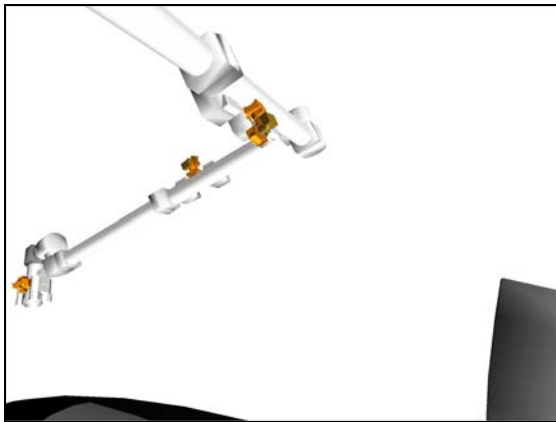


Figure 8.- Trajectory #4 End
(13: LAB Stbd Zenith: -110, 26).

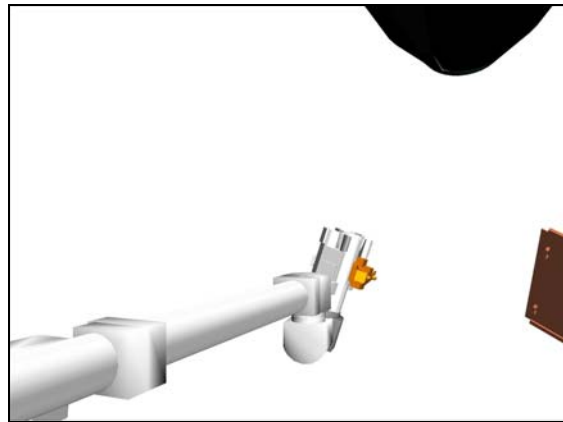


Figure 9.- Trajectory #4 End
(22: Base Elbow: -110, 0).

PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at Trajectory #4 End position (within 5 cm/1 deg).

	Locked					
SR	SY	SP	EP	WP	WY	WR
+195.6	0.0	-23.4	-93.9	-80.6	+72.1	+254.3
X	Y	Z	Pitch	Yaw	Roll	
-500	+250	-800	-179.8	-55.0	-179.7	
FOR	Unloaded – LEE Tip, SY Held					
Disp	W4>OBAS					

2.420 CONTINGENCY STARBOARD CREW CABIN INSPECTION

(RBT FS/LF1/FIN)

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6. TRAJECTORY #5

SSRMS FOR OCAS

Verify SY – Locked

Input 'FOR' 'Destination' for Trajectory #5 End position.

X	Y	Z	Pitch	Yaw	Roll
-760	+425	-800	+179.8	-70.0	+179.7

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON

Verify FOR and errors are correct on FOR Position overlay.

	X	Y	Z	Pitch	Yaw	Roll
FOR	-500	+250	-800	-179.8	-55.0	-179.7
TGT	-760	+425	-800	+179.8	-70.0	+179.7
ERR	+260	-175	0	-359.6	+15.0	-359.4

PCS

* If FOR/errors are incorrect

* **cmd** Cancel (Verify Sequence Status – Waiting Destination)

* Input correct Dest FOR per table above.

* **cmd** Load (Verify Sequence Status – Confirm or Cancel)

MON

* Verify FOR and errors are correct on FOR position overlay.

PCS

cmd Confirm (Verify Sequence Status – Auto Seq sw - Hot)

DCP

AUTO SEQ → PROC



Figure 10.- Trajectory #5 End
(13: LAB Stbd Zenith: -110, 26).

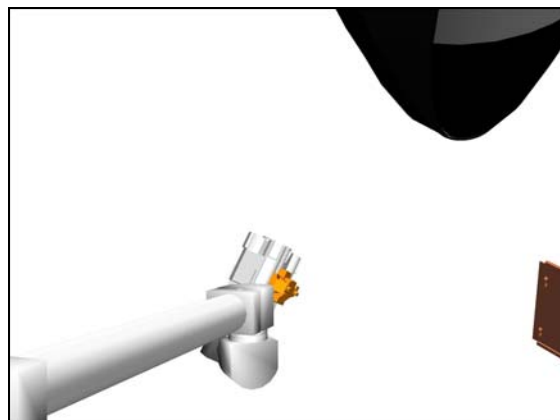


Figure 11.- Trajectory #5 End
(22: Base Elbow: -85, 0).

2.420 CONTINGENCY STARBOARD CREW CABIN INSPECTION

(RBT FS/LF1/FIN)

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PCS MSS: SSRMS: SSRMS

Verify Posn Hold – orange

Verify SSRMS at Trajectory #5 End position (within 5 cm/1 deg).

	Locked					
SR	SY	SP	EP	WP	WY	WR
+192.6	0.0	+4.2	-114.2	-48.2	+62.8	+216.0
X	Y	Z	Pitch	Yaw	Roll	
-760	+425	-800	+179.8	-70.0	+179.7	
FOR	Unloaded – LEE Tip, SY Held					
Disp	W4>OBAS					

7. TRAJECTORY #6

SSRMS FOR OCAS

Verify SY – Locked

Input 'FOR' 'Destination' for Trajectory #6 End position.

X	Y	Z	Pitch	Yaw	Roll
-1300	+580	-850	+179.8	-80.0	+179.7

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON

Verify FOR and errors are correct on FOR position overlay.

	X	Y	Z	Pitch	Yaw	Roll
FOR	-760	+425	-800	+179.8	-70.0	+179.7
TGT	-1300	+580	-850	+179.8	-80.0	+179.7
ERR	+540	-155	+50	0.0	+10.0	0.0

PCS

* If FOR/errors are incorrect

* **cmd** Cancel (Verify Sequence Status – Waiting Destination)

*

* Input correct Dest FOR per table above.

*

* **cmd** Load (Verify Sequence Status – Confirm or Cancel)

*

MON

* Verify FOR and errors are correct on FOR Position overlay.

PCS

cmd Confirm (Verify Sequence Status – Auto Seq sw - Hot)

DCP

AUTO SEQ → PROC

2.420 CONTINGENCY STARBOARD CREW CABIN INSPECTION

(RBT FS/LF1/FIN)

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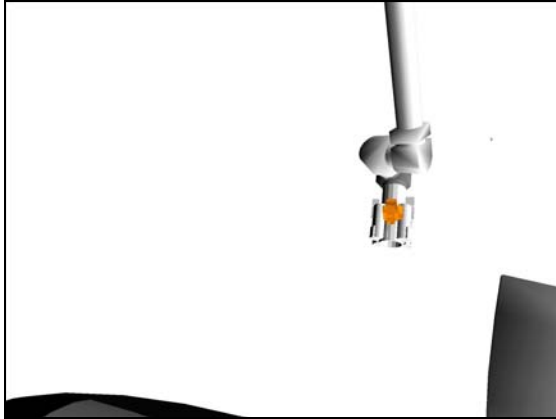


Figure 12.- Trajectory #6 End
(13: LAB Stbd Zenith: -110, 26).

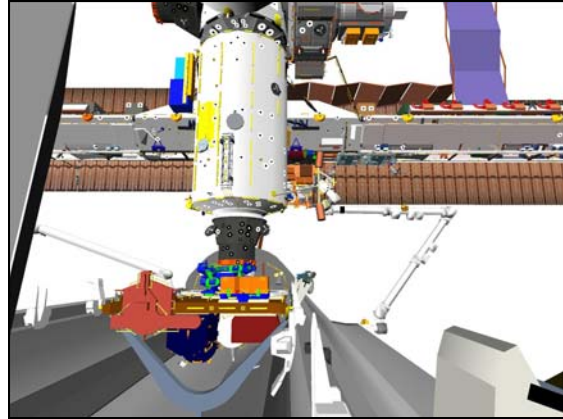


Figure 13.- Trajectory #6 End
(V10: Camera C: 0, 10).

PCS

MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at Trajectory #6 position (within 5 cm/1 deg).

	Locked					
SR	SY	SP	EP	WP	WY	WR
+138.5	0.0	+53.5	-126.0	-48.1	+13.1	+162.5
X	Y	Z	Pitch	Yaw	Roll	
-1300	+580	-850	+179.8	-80.0	+179.7	
FOR	Unloaded – LEE Tip, SY Held					
Disp	W4>OBAS					

DCP

BRAKES SSRMS → ON (Verify ON)

2.430 CONTINGENCY WS4 MBS PDGF 1 GRAPPLE

(RBT FS/LF1/FIN/SPN) Page 1 of 13 pages

1. SETUP

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
24: Tip Elbow (0, 0)	92: Camera A (40, 50)	91: Camera B (-20, 40)	SRMS Elbow (105, 50)
22: Base Elbow (100, -10)			OBSS ITVC (45, -55)

PCS

MSS: SSRMS:

Change Loaded Parameters ► Walk Off ► MBS PDGF 1
Verify 'Loaded Parameters' (two) – MBS PDGF 1, SR Held

Verify Unloaded Parameters – √

Change Unloaded Parameters ► Unloaded ► LEE Tip SRH
Verify 'Unloaded Parameters' (two) – LEE Tip, SR Held

Change Display ► ISS ► W4MBS PDGF 1 (Verify ISS>W4MBS PDGF 1)

Verify Command – SSRMS>Internal

√Vernier

Verify SSRMS at Mated MPLM Pre-Grapple position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+3.1	+123.0	-135.6	+81.2	-73.0	-184.2	+57.5
X	Y	Z	Pitch	Yaw	Roll	
+1022	+861	+711	+175.4	-15.4	+24.7	
FOR	Unloaded – LEE Tip, SR Held					
Disp	ISS>W4MBS PDGF 1					

2. MANEUVERING TO MPLM CLEARANCE POSITION

DCP

BRAKES SSRMS → OFF (Verify OFF)

PCS

MSS: SSRMS:

Enter Mode – Single (Verify blue)

WARNING

The active joint must be checked on the PCS before initiating motion. Failure to do so may result in movement of the wrong joint.

2.430 CONTINGENCY WS4 MBS PDGF 1 GRAPPLE

(RBT FS/LF1/FIN/SPN)

Page 2 of 13 pages

THC

Perform Single Joint maneuver to MPLM Clearance position (within 1 deg).

	SR	SY	SP	EP	WP	WY	WR
Pre-Grapple	+3.1	+123.0	-135.6	+81.2	-73.0	-184.2	+57.5
1: SP -			-160.0				
2: EP -				+40.0			
3: SY +		+150.0					
MPLM Clearance	+3.1	+150.0	-160.0	+40.0	-73.0	-184.2	+57.5
	X	Y	Z	Pitch	Yaw	Roll	
	+1320	+1621	+380	-111.9	-64.6	+63.3	
FOR	Unloaded – LEE Tip, SR Held						
Disp	ISS>W4MBS PDGF 1						

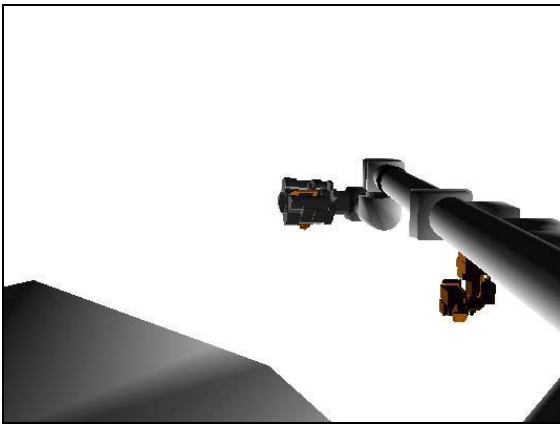


Figure 1.- MPLM Clearance
(22: Base Elbow: 140, -10).

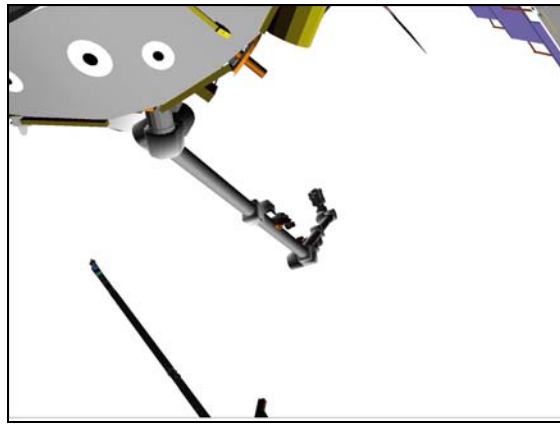


Figure 2.- MPLM Clearance
(92: Camera A: 40, 50).

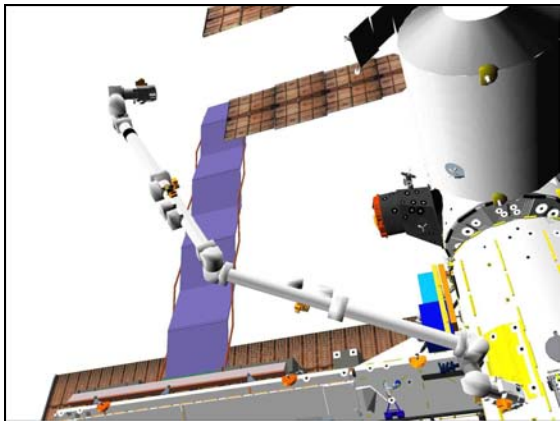


Figure 3.- MPLM Clearance
(91: Camera B: -20, 40).

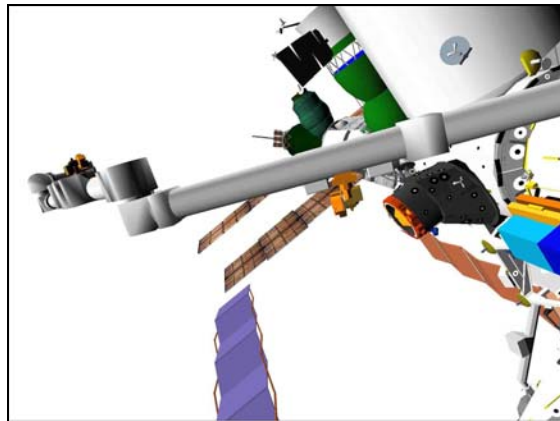


Figure 4.- MPLM Clearance
(V10: SRMS Elbow: 105, 50).

2.430 CONTINGENCY WS4 MBS PDGF 1 GRAPPLE

(RBT FS/LF1/FIN/SPN) Page 3 of 13 pages

3. MBS GRAPPLE JOCAS 1

PCS

MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
22: Base Elbow (140, -10) 13: LAB Stbd Zenith (40, -30)	92: Camera C (-20, 60)	91: SRMS Elbow (-170, 55)	OBSS ITVC (110, -60) Camera A (40, 50)

NOTE
Expect singularity warning for EP between -15 and +15 deg.

pick File ► LAB ► MBS Grapple JOCAS 1

Verify 'Joint Angles' 'Destination' for MBS Grapple JOCAS 1 position.

SR	SY	SP	EP	WP	WY	WR
-50.0	+215.0	-125.0	-40.0	-73.0	-184.2	+57.5

NOTE
The Target and Error fields on the SSRMS Joint OCAS display will not be correct. This data should be verified and monitored on the Joint Angle Position overlay. (SCR 31169)

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON

Verify joint angles and errors are correct on Joint Angle Position overlay.

	SR	SY	SP	EP	WP	WY	WR
(current)	+3.1	+150.0	-160.0	+40.0	-73.0	-184.2	+57.5
TGT	-50.0	+215.0	-125.0	-40.0	-73.0	-184.2	+57.5
ERR	+53.1	-65.0	-35.0	+80.0	0.0	0.0	0.0

PCS

- * If joint angles/errors are incorrect
- * **cmd** Cancel (Verify Sequence Status – Waiting Destination)
- *
- * Input correct Dest joint angles per table above.
- *
- * **cmd** Load (Verify Sequence Status – Confirm or Cancel)
- *

MON

- * Verify joint angles and errors are correct on Joint Angle position overlay.

2.430 CONTINGENCY WS4 MBS PDGF 1 GRAPPLE

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PCS **cmd** Confirm (Verify Sequence Status – Auto Seq sw - Hot)

DCP AUTO SEQ → PROC

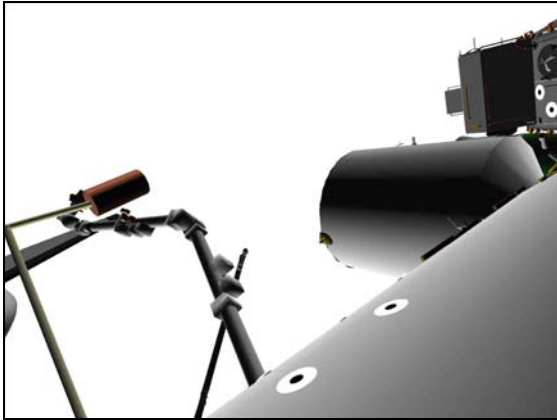


Figure 5.- MBS Grapple JOCAS 1
(13: LAB Stbd Zenith: 40, -30).

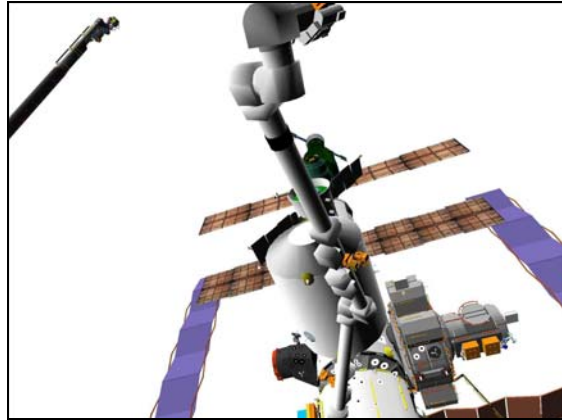


Figure 6.- MBS Grapple JOCAS 1
(92: Camera C: -20, 60).

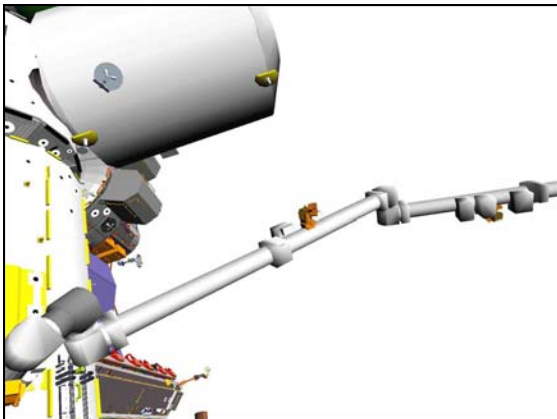


Figure 7.- MBS Grapple JOCAS 1
(91: SRMS Elbow: -140, 55).

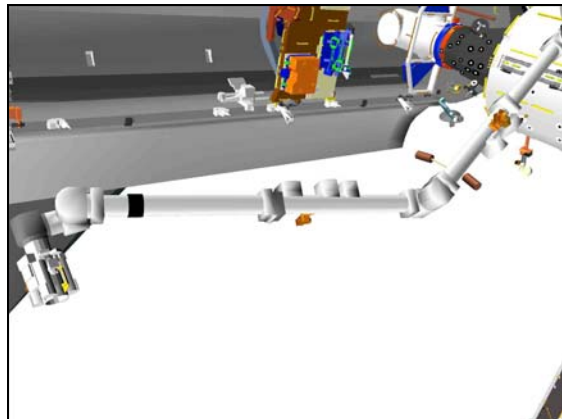


Figure 8.- MBS Grapple JOCAS 1
(V10: OBSS ITVC: 110, -60).

PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at MBS Grapple JOCAS 1 position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-50.0	+215.0	-125.0	-40.0	-73.0	-184.2	+57.5
X	Y	Z	Pitch	Yaw	Roll	
-400	+1713	+1111	-65.7	-30.7	-176.5	
FOR	Unloaded – LEE Tip, SR Held					
Disp	ISS>W4MBS PDGF 1					

2.430 CONTINGENCY WS4 MBS PDGF 1 GRAPPLE

(RBT FS/LF1/FIN/SPN) Page 5 of 13 pages

4. MBS GRAPPLE JOCAS 2

SSRMS Joint OCAS

pick File ► LAB ► MBS Grapple JOCAS 2

Verify 'Joint Angles' 'Destination' for MBS Grapple JOCAS 2 position.

SR	SY	SP	EP	WP	WY	WR
-80.0	+90.0	-70.0	-50.0	-73.0	-184.2	+57.5

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON

Verify joint angles and errors are correct on Joint Angle Position overlay.

	SR	SY	SP	EP	WP	WY	WR
(current)	-50.0	+215.0	-125.0	-40.0	-73.0	-184.2	+57.5
TGT	-80.0	+90.0	-70.0	-50.0	-73.0	-184.2	+57.5
ERR	+30.0	+125.0	-55.0	+10.0	0.0	0.0	0.0

PCS

* If joint angles/errors are incorrect

* **cmd** Cancel (Verify Sequence Status – Waiting Destination)

*

* Input correct Dest joint angles per table above.

*

* **cmd** Load (Verify Sequence Status – Confirm or Cancel)

*

MON

* Verify joint angles and errors are correct on Joint Angle position overlay.

PCS

cmd Confirm (Verify Sequence Status – Auto Seq sw - Hot)

DCP

AUTO SEQ → PROC

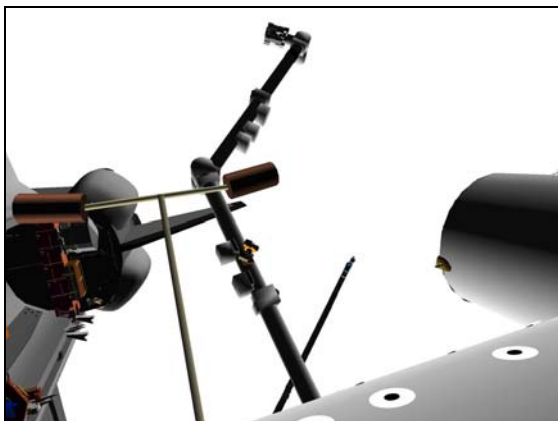


Figure 9.- MBS Grapple JOCAS 2
(13: LAB Stbd Zenith: 20, -30).

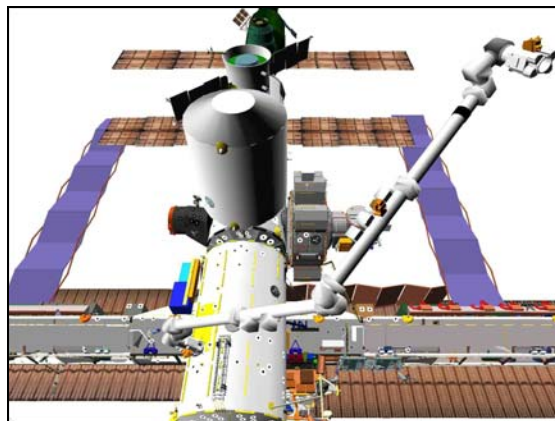


Figure 10.- MBS Grapple JOCAS 2
(92: Camera C: 0, 40).

2.430 CONTINGENCY WS4 MBS PDGF 1 GRAPPLE

(RBT FS/LF1/FIN/SPN)

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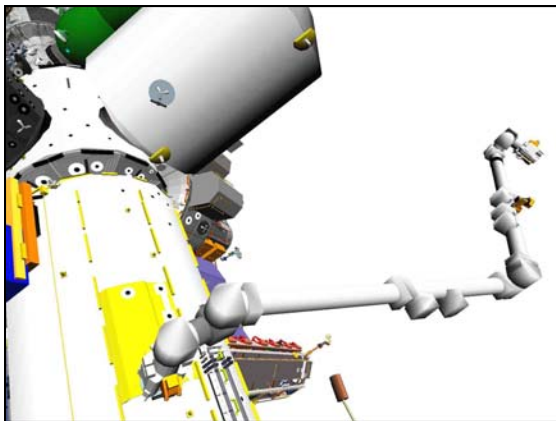


Figure 11.- MBS Grapple JOCAS 2
(91: SRMS Elbow: -160, 50).

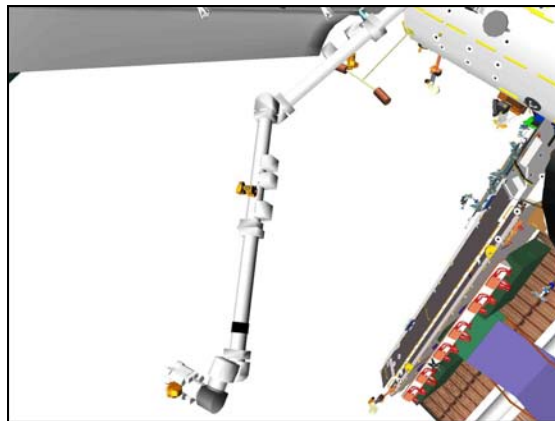


Figure 12.- MBS Grapple JOCAS 2
(V10: OBSS ITVC: 100, -70).

PCS

MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at MBS Grapple JOCAS 2 position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-80.0	+90.0	-70.0	-50.0	-73.0	-184.2	+57.5
X	Y	Z	Pitch	Yaw	Roll	
-454	+1046	+1319	+166.3	+4.1	+54.3	
FOR	Unloaded – LEE Tip, SR Held					
Disp	ISS>W4MBS PDGF 1					

5. [MBS GRAPPLE JOCAS 3](#)

pick File ► LAB ► MBS Grapple JOCAS 3

Verify 'Joint Angles' 'Destination' for MBS Grapple JOCAS 3 position.

SR	SY	SP	EP	WP	WY	WR
-68.1	-27.2	-100.0	-50.0	-118.1	-52.5	+17.4

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON

Verify joint angles and errors are correct on Joint Angle position overlay.

	SR	SY	SP	EP	WP	WY	WR
(current)	-80.0	+90.0	-70.0	-50.0	-73.0	-184.2	+57.5
TGT	-68.1	-27.2	-100.0	-50.0	-118.1	-52.5	+17.4
ERR	-11.9	+117.2	+30.0	0.0	+45.1	-131.7	+40.1

2.430 CONTINGENCY WS4 MBS PDGF 1 GRAPPLE

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```

*****
* If joint angles/errors are incorrect
PCS  * | cmd Cancel (Verify Sequence Status – Waiting Destination)
*   |
*   | Input correct Dest joint angles per table above.
*   |
*   | cmd Load (Verify Sequence Status – Confirm or Cancel)
*   |
MON  * | Verify joint angles and errors are correct on Joint Angle position
*   | overlay.
*****
PCS  cmd Confirm (Verify Sequence Status – Auto Seq sw - Hot)
DCP  AUTO SEQ → PROC
    
```

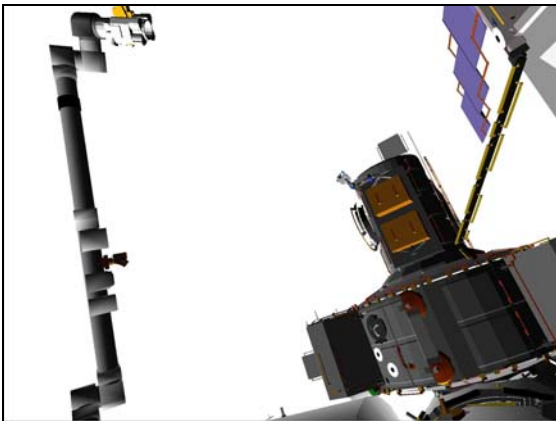


Figure 13.- MBS Grapple JOCAS 3
(13: LAB Stbd Zenith: 60, 10).

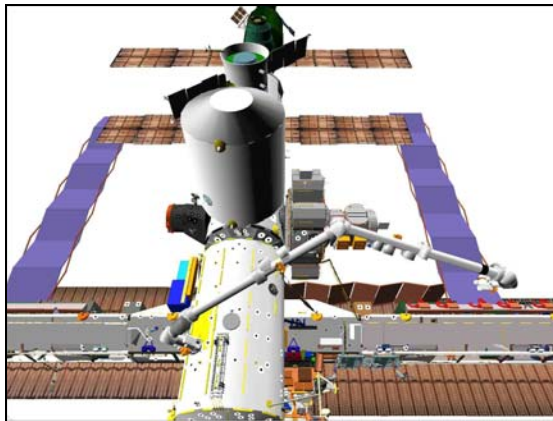


Figure 14.- MBS Grapple JOCAS 3
(92: Camera C: 0, 40).

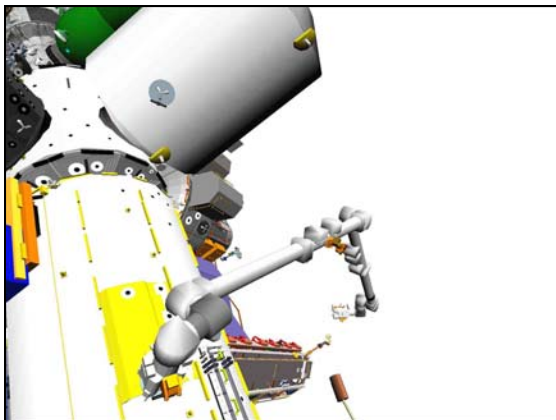


Figure 15.- MBS Grapple JOCAS 3
(91: SRMS Elbow: -160, 50).

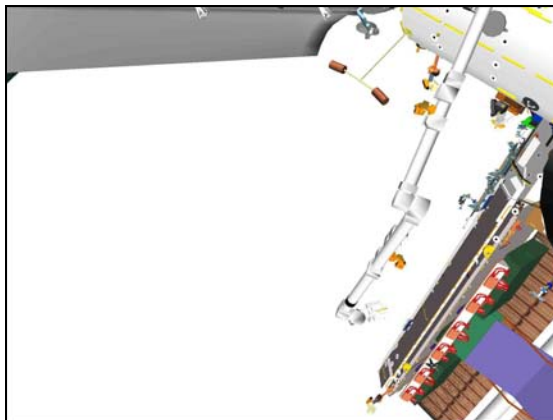


Figure 16.- MBS Grapple JOCAS 3
(V10: OBSS ITVC: 100, -70).

2.430 CONTINGENCY WS4 MBS PDGF 1 GRAPPLE

(RBT FS/LF1/FIN/SPN) Page 8 of 13 pages

PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at MBS Grapple JOCAS 3 position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-68.1	-27.2	-100.0	-50.0	-118.1	-52.5	+17.4
X	Y	Z	Pitch	Yaw	Roll	
-318	+55	+913	+29.9	-26.4	-48.0	
FOR	Unloaded – LEE Tip, SR Held					
Disp	ISS>W4MBS PDGF 1					

6. MANEUVERING TO MBS PDGF 1 PRE-GRAPPLE

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
22: Base Elbow (-130, -15) 24: Tip Elbow (-20, 5)	92: Camera C (0, 20)	91: SRMS Elbow (-160, 50)	OBSS ITVC (100, -60)

NOTE

1. In steps 6 and 7, monitor clearance between the SSRMS Wrist cluster and LAB Stbd Zenith Camera with the Base Elbow Camera or the Tip Elbow Camera. Minimum clearance varies based on Pan and Tilt of the LAB Stbd Zenith Camera, but may be as little as 75 cm.
2. Monitor clearance between the Base Elbow Camera and the UHF antenna with Camera C. Minimum clearance is 136 cm.
3. Monitor clearance between the Base boom and the LAB with the OBSS ITVC Camera.

PCS MSS: SSRMS:

Enter Mode – Single (Verify blue)

WARNING

The active joint must be checked on the PCS before initiating motion. Failure to do so may result in movement of the wrong joint.

2.430 CONTINGENCY WS4 MBS PDGF 1 GRAPPLE

(RBT FS/LF1/FIN/SPN) Page 9 of 13 pages

THC Perform Single Joint maneuver to Pre-grapple position (within 1 deg).

	SR	SY	SP	EP	WP	WY	WR
JOCAS 3	-68.1	-27.2	-100.0	-50.0	-118.1	-52.5	+17.4
1: SP -			-125.6				
2: EP -				-91.0			
Pre-grapple	-68.1	-27.2	-125.6	-91.0	-118.1	-52.5	+17.4
	X	Y	Z	Pitch	Yaw	Roll	
	-150	0	0	0.0	0.0	0.0	
FOR	Unloaded – LEE Tip, SR Held						
Disp	ISS>W4MBS PDGF 1						

PCS MSS: SSRMS:

Enter Mode – Standby (Verify blue)

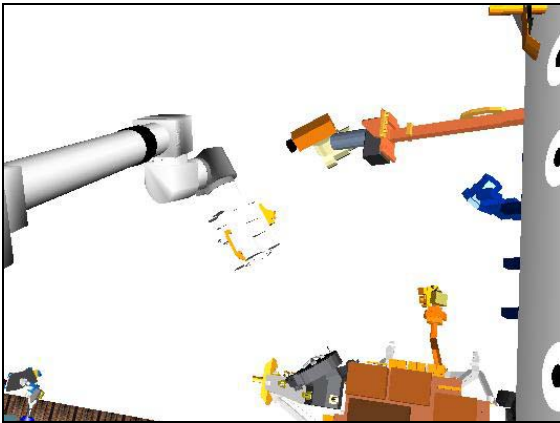


Figure 17.- MBS PDGF 1 Pre-Grapple
(22: Base Elbow: -100, -15).

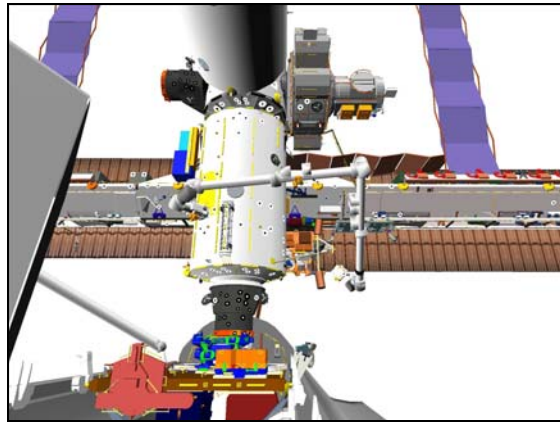


Figure 18.- MBS PDGF 1 Pre-Grapple
(92: Camera C: 0, 20).

7. MBS PDGF 1 GRAPPLE SETUP AND CAPTURE

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
22: Base Elbow (-100, -15)	25: Tip LEE	92: Camera C (0, 20)	Camera D (-95, 60)

PCS MSS: SSRMS:

Verify Command – SSRMS>Internal

√Vernier

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: as required

2.430 CONTINGENCY WS4 MBS PDGF 1 GRAPPLE

(RBT FS/LF1/FIN/SPN) Page 10 of 13 pages

7.1 Setting Up for Grapple

NOTE

The LEE Camera must be fully zoomed out to correspond to the target overlay.

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

7.2 Slow Capture Commands

MSS: SSRMS: Tip LEE:

cmd Capture ► Automatic ► Slow, Limp (Verify Speed – Slow)

Verify '**Confirm or Terminate**' prompt.

CAUTION

Due to end-to-end system latency, the RHC Trigger is hot up to 3 seconds prior to receiving a Trigger Hot icon status on the PCS.

NOTE

Once the trigger is hot, only safing or trigger commands should be sent to the Robotics equipment. If a configuration change is required, including routing MSS cameras, safe the system to exit LEE operations (SCR 23262, 14662).

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Auto Capture

7.3 Maneuvering to Grapple

RHC/
THC

Maneuver to within grapple envelope.

7.4 Grapple

RHC

TRIGGER → press (momentarily)

PCS

Verify 'Snare' Close, Capture (two) – blue (12 s max)

Verify Capture to Latch – Yes (SCR 19282)

Verify 'Carriage' Tension ~5500 N (90 s max)

Verify 'Carriage' Retract – blue

Verify 'Latch' Latch – blue (65 s max)

2.430 CONTINGENCY WS4 MBS PDGF 1 GRAPPLE

(RBT FS/LF1/FIN/SPN) Page 11 of 13 pages

7.5 Umbilical Mate

cmd 'Umbilical' Mate (Verify '**Confirm or Terminate**' prompt)

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Mate

RHC TRIGGER → press (momentarily)

PCS Verify 'Umbilical' Mate – blue (10 s max)
Verify 'Connector Continuity' Prime, Redundant (two) – Yes

7.6 Grapple Cleanup

MSS: SSRMS:

Verify Posn Hold – orange

Verify Loaded Parameters – √

Verify 'Loaded Parameters' (two) – MBS PDGF 1, SR Held

Expected MBS Grapple joint angles and FOR.

SR	SY	SP	EP	WP	WY	WR
-68.1	-20.0	-124.0	-98.2	-107.7	-58.9	+23.3
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded – MBS PDGF 1, SR Held					
Disp	ISS>W4MBS PDGF 1					

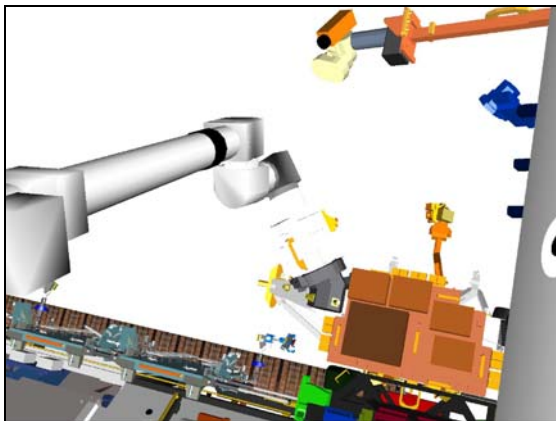


Figure 19.- MBS Grapple
(22: Base Elbow: -100, -15).

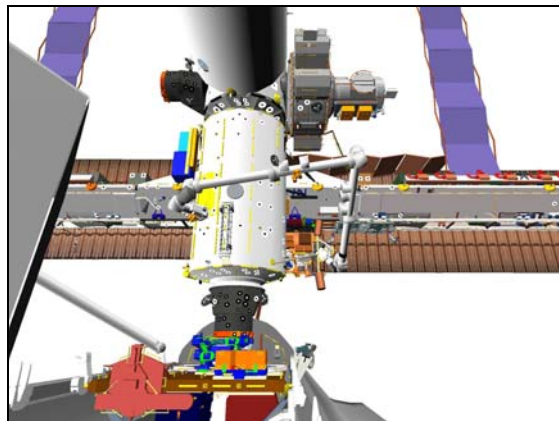


Figure 20.- MBS Grapple
(92: Camera C: 0, 20).

2.430 CONTINGENCY WS4 MBS PDGF 1 GRAPPLE

(RBT FS/LF1/FIN/SPN) Page 12 of 13 pages

8. SETUP FOR SSRMS BASE CHANGE

NOTE

Expect the following message when safing is commanded:

'R3Z - MSS OCS SSRMS Prime(Redun) ACU SRT Cat-1 Brk Stat Fail' (SCR 17495)

This message should return to Norm.

DCP SAFING → SAFE (Verify ON)

NOTE

Steps 9 thru 13 may be performed by the Ground.

9. POWERDOWN TO OFF

NOTE

1. Expect the following message when Off is commanded:

'R1E - MSS OCS SSRMS Prime(Redun) ACU SRT Comm Fail' (SCR 17730)

This message should return to Norm.

2. It might take up to 30 seconds for the Off status indication to appear on PCS.

PCS MSS: SSRMS: Power:

cmd 'SSRMS' Prime(Redundant) – Off (Verify Off)

10. OPERATING BASE CHANGE

PCS MSS: SSRMS:

MSS: SSRMS: Base LEE:

cmd B

MSS: SSRMS:

Verify Base LEE – B

Verify PDGF – MBS1

11. POWERUP PRIME(REDUNDANT) STRING TO KEEP-ALIVE

PCS MSS: SSRMS: Power:

cmd 'SSRMS' Prime(Redundant) – Keep-Alive (Verify Keep-Alive)

2.430 CONTINGENCY WS4 MBS PDGF 1 GRAPPLE

(RBT FS/LF1/FIN/SPN)

Page 13 of 13 pages

12. POWERUP PRIME(REDUNDANT) STRING TO OPERATIONAL

NOTE

SSRMS transition from Keep-Alive to Operational will require at least 6 minutes to complete. The time is contingent on file transfer activity from the C&C MDM.

cmd 'SSRMS' Prime(Redundant) – Operational

Verify 'Systems State' – Operational

13. VIDEO COMPONENTS POWERUP

PCS

MSS: SSRMS: Base LEE VDU icon: MSS VDUs

cmd 'SSRMS' 'Base LEE' On (Verify On)

cmd 'SSRMS' 'Base Elbow' On (Verify On)

cmd 'SSRMS' 'Tip Elbow' On (Verify On)

cmd 'SSRMS' 'Tip LEE' On (Verify On)

NOTE

The color balance and gamma setting feedback will not be available until the camera is routed through a Camera Status Reader. The ground will route the SSRMS cameras through the CSRs after the camera setup in this step.

MSS: SSRMS: Base Elbow Camera icon: SSRMS Base Elbow Camera

sel [X] where [X] = B-Elb 22 T-Elb 24 LEE 25

cmd 'Power' On (Verify On)

cmd 'Color Bal' Metal

cmd 'Gamma' 0.45

Repeat

Power up the SSRMS lights as required.

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2.431 CONTINGENCY LAB PDGF UNGRAPPLE

(RBT FS/LF1/FIN/SPN) Page 1 of 4 pages

1. SETUP FOR LAB PDGF UNGRAPPLE

NOTE

Monitor clearance between the SSRMS Base cluster and LAB Stbd Zenith Camera with Camera C. Minimum clearance varies based on Pan and Tilt of the Lab Stbd Zenith Camera, but may be as little as 75 cm.

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
Mux 24: Tip Elbow (-12, 0) / 22: Base Elbow (-8, 0)	25: Tip LEE	92: Camera C (0,20)	SRMS Elbow (-160, 50)

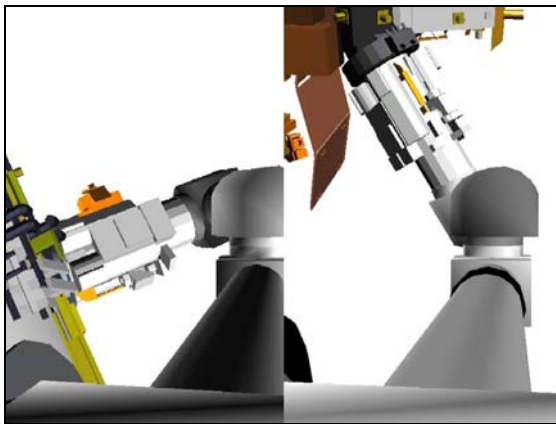


Figure 1.- LAB PDGF Grapple
(MUX 24: Tip Elbow (-12, 0)/22: Base Elbow (-8, 0))

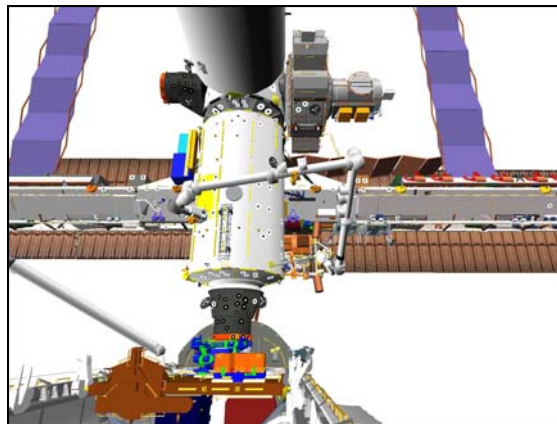


Figure 2.- LAB PDGF Grapple
(92: Camera C: 0, 20).

PCS

MSS: SSRMS:

Verify Loaded Parameters – √

Verify 'Loaded Parameters' (two) – LAB PDGF, SR Held

Change Unloaded Parameters ► Unloaded ► LEE Tip SYH

Verify 'Unloaded Parameters' (two) – LEE Tip, SY Held

Change Display ► W4 ► LAB PDGF (Verify W4>LAB PDGF)

Verify Command – SSRMS>Internal

2.431 CONTINGENCY LAB PDGF UNGRAPPLE

(RBT FS/LF1/FIN/SPN) Page 2 of 4 pages

Verify SSRMS at LAB PDGF Grapple position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+23.3	+58.9	-107.7	-98.2	-124.0	+20.0	-68.1
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded – LAB PDGF, SR Held					
Disp	W4>LAB PDGF					

MSS: SSRMS: SSRMS Safing:

cmd Remove (Verify Not Safed)

DCP BRAKES SSRMS → OFF (Verify OFF)

2. LAB PDGF SEMI-MANUAL RELEASE

2.1 SSRMS Limp

PCS MSS: SSRMS: Limp:

cmd All Limp (Verify Limp – blue)

MSS: SSRMS:

Verify all joints – Limped

Wait 30 seconds.

MSS: SSRMS: Limp:

cmd None Limp (Verify Standby – blue)

2.2 Enter Manual Mode

PCS MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: as required

MSS: SSRMS:

√Vernier

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

2.3 Carriage Rigidization

MSS: SSRMS: Tip LEE:

cmd 'Carriage' Rigidize ► Slow (Verify Speed – Slow)

2.431 CONTINGENCY LAB PDGF UNGRAPPLE

(RBT FS/LF1/FIN/SPN) Page 3 of 4 pages

Verify '**Confirm or Terminate**' prompt.

CAUTION

Due to end-to-end system latency, the RHC Trigger is hot up to 3 seconds prior to receiving a Trigger Hot icon status on the PCS.

NOTE

Once the trigger is hot, only safing or trigger commands should be sent to the Robotics equipment. If a configuration change is required, including routing MSS Cameras, safe the system to exit LEE operations (SCR 23262, 14662)

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Rigidize

RHC TRIGGER → press (momentarily) (SCR 19064)

PCS Verify 'Carriage' Tension ~5500 N (90 s max)
Verify 'Carriage' Retract – blue

2.4 LAB PDGF Release

PCS MSS: SSRMS: Tip LEE: SSRMS Tip LEE

cmd Release ► Semi-manual ► Slow (Verify Speed – Slow)

Verify '**Confirm or Terminate**' prompt.

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Semi-manual Release

RHC TRIGGER → press (hold until 'Umbilical' Demate – blue) (10 s max)

TRIGGER → press (hold until 'Latch' Unlatch – blue) (65 s max)

TRIGGER → press (hold until 'Carriage' Derigidize – blue) (90 s max)

TRIGGER → press (hold until 'Snare' Open – blue) (12 s max)

2.5 Maneuver Away From LAB PDGF

THC Back off from grapple fixture until clear of pin.

2.6 LAB PDGF Ungrapple Cleanup

RHC TRIGGER → press (hold until Motors – Inh) (90 s max)

PCS Verify 'Carriage' Extend – blue

2.431 CONTINGENCY LAB PDGF UNGRAPPLE

(RBT FS/LF1/FIN/SPN) Page 4 of 4 pages

THC Maneuver SSRMS to LAB PDGF Backoff position (within 5 cm/1 deg).

	Locked					
SR	SY	SP	EP	WP	WY	WR
+34.0	+58.9	-104.3	-82.6	-132.3	+16.8	-72.8
X	Y	Z	Pitch	Yaw	Roll	
-150	0	0	0.0	0.0	0.0	
FOR	Unloaded – LEE Tip, SY Held					
Disp	W4>LAB PDGF					

DCP BRAKES SSRMS → ON (Verify ON)

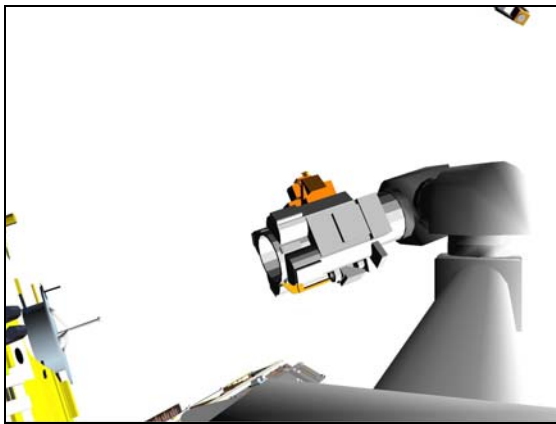


Figure 3.- LAB PDGF Backoff
(24: Tip Elbow: -20, 0).

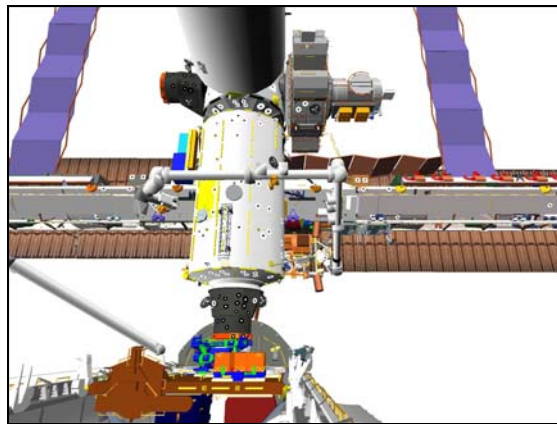


Figure 4.- LAB PDGF Backoff
(92: Camera C: 0, 20).

1. SETUP

NOTE

Throughout the procedure, monitor clearance between the SSRMS Base cluster and LAB Stbd Zenith Camera with Tip Elbow Camera or Camera C. Minimum clearance varies based on Pan and Tilt of the LAB Stbd Zenith Camera, but may be as little as 75 cm.

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
22: Base Elbow (-120, -15) 24: Tip Elbow (-95, 0)	91: Camera D (-53, 62) 13: LAB Stbd Zenith (40, -25)	92: Camera C (7, 20)	OBSS ITVC (100, -60) SRMS Elbow (-150, 40)

PCS

MSS: SSRMS:

Verify Unloaded Parameters – √

Verify 'Unloaded Parameters' (two) – LEE Tip, SY Held

Verify Display – W4>LAB PDGF

√Vernier

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: 1.0 (Verify 1.0)

DCP

BRAKES SSRMS → OFF (Verify OFF)

2. JOINT OCAS 1

PCS

MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

SSRMS Joint OCAS

pick File ► W4MBS1 ► Srvy Viewing JOCAS 1

Verify 'Joint Angles' 'Destination' for Joint OCAS 1 End position.

SR	SY	SP	EP	WP	WY	WR
+34.0	+18.0	-17.0	-97.0	-41.5	+34.0	+51.5

NOTE

The Target and Error fields on the SSRMS Joint OCAS display will not be correct. This data should be verified and monitored on the Joint Angle Position overlay. (SCR 31169)

cmd Load (Verify Sequence Status – Confirm or Cancel)

2.432 CONTINGENCY MANEUVER TO SURVEY SUPPORT VIEWING POSN
 (RBT FS/LF1/FIN/SPN) Page 2 of 8 pages

MON Verify joint angles and errors are correct on Joint Angle Position overlay.

	SR	SY	SP	EP	WP	WY	WR
(current)	+34.0	+58.9	-104.3	-82.6	-132.3	+16.8	-72.8
TGT	+34.0	+18.0	-17.0	-97.0	-41.5	+34.0	+51.5
ERR	0.0	+40.9	-87.3	+14.4	-90.8	-17.2	-124.3

PCS * If joint angles/errors are incorrect
 * **cmd** Cancel (Verify Sequence Status – Waiting Destination)
 *
 * Input correct Dest joint angles per table above.
 *
 * **cmd** Load (Verify Sequence Status – Confirm or Cancel)
 *
 MON * Verify joint angles and errors are correct on Joint Angle Position
 * overlay.

PCS **cmd** Confirm (Verify Sequence Status – Auto Seq sw - Hot)

DCP AUTO SEQ → PROC

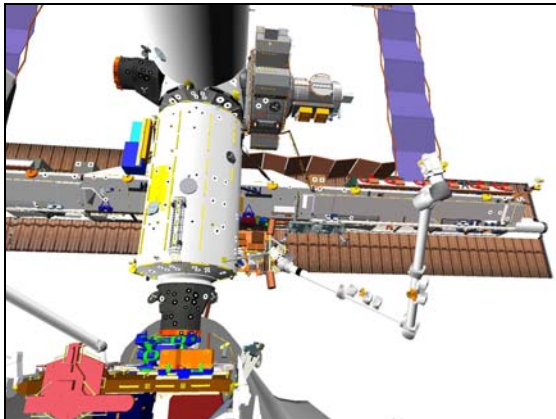


Figure 1.- Joint OCAS 1 End
 (92: Camera C: 7, 20).

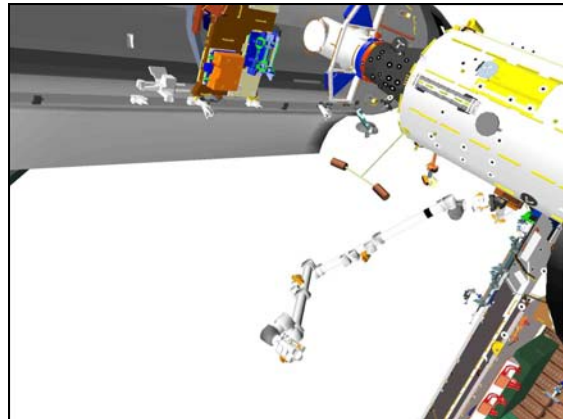


Figure 2.- Joint OCAS 1 End
 (V10: OBSS ITVC: 100, -60).

PCS MSS: SSRMS:

Verify Posn Hold – orange

2.432 CONTINGENCY MANEUVER TO SURVEY SUPPORT VIEWING POSN
 (RBT FS/LF1/FIN/SPN) Page 3 of 8 pages

Verify SSRMS at Joint OCAS 1 End position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+34.0	+18.0	-17.0	-97.0	-41.5	+34.0	+51.5
X	Y	Z	Pitch	Yaw	Roll	
+227	-1075	+49	-95.7	+9.8	-62.5	
FOR	Unloaded – LEE Tip, SY Held					
Disp	W4>LAB PDGF					

3. JOINT OCAS TO SURVEY SUPPORT VIEWING POSITION

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
22: Base Elbow (0, 0)	13: LAB Stbd Zenith (-100, 40)	92: Camera C (7, 20)	OBSS ITVC (100, -60)

SSRMS Joint OCAS

pick File ► W4MBS1 ► Srvy Viewing JOCAS 2

Verify 'Joint Angles' 'Destination' for Survey Support Viewing position.

SR	SY	SP	EP	WP	WY	WR
+80.0	+10.0	+40.0	-50.0	-110.0	-25.0	+115.0

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON Verify joint angles and errors are correct on Joint Angle Position overlay.

	SR	SY	SP	EP	WP	WY	WR
(current)	+34.0	+18.0	-17.0	-97.0	-41.5	+34.0	+51.5
TGT	+80.0	+10.0	+40.0	-50.0	-110.0	-25.0	+115.0
ERR	-46.0	+8.0	-57.0	-47.0	+68.5	+59.0	-63.5

PCS * If joint angles/errors are incorrect
 * **cmd** Cancel (Verify Sequence Status – Waiting Destination)
 *
 * Input correct Dest joint angles per table above.
 *
 * **cmd** Load (Verify Sequence Status – Confirm or Cancel)
 *
 MON * Verify joint angles and errors are correct on Joint Angle Position
 * overlay.

2.432 CONTINGENCY MANEUVER TO SURVEY SUPPORT VIEWING POSN
(RBT FS/LF1/FIN/SPN) Page 4 of 8 pages

PCS cmd Confirm (Verify Sequence Status – Auto Seq sw - Hot)

DCP AUTO SEQ → PROC

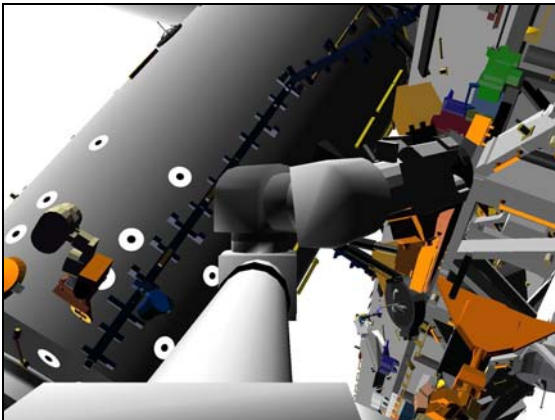


Figure 3.- Survey Support Viewing Position (22: Base Elbow: 0, 0).

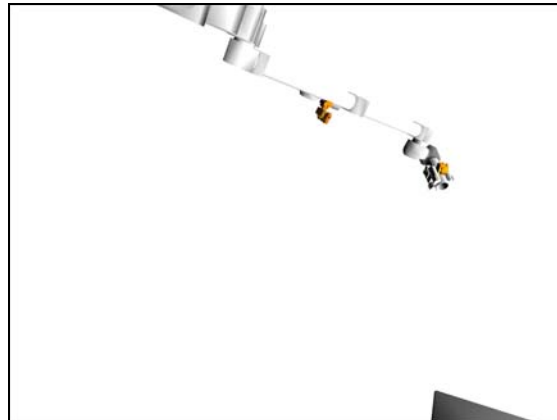


Figure 4.- Survey Support Viewing Position (13: LAB Stbd Zenith: -100, 40).

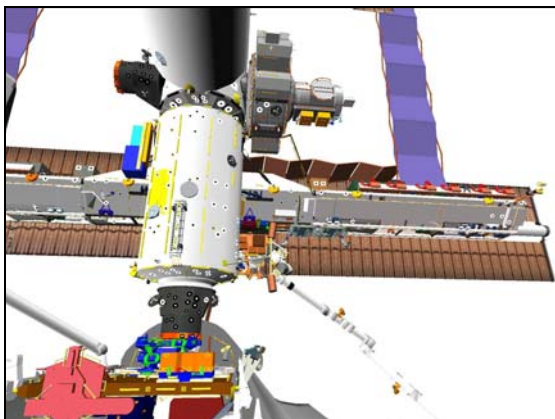


Figure 5.- Survey Support Viewing Position (92: Camera C: 7, 10).

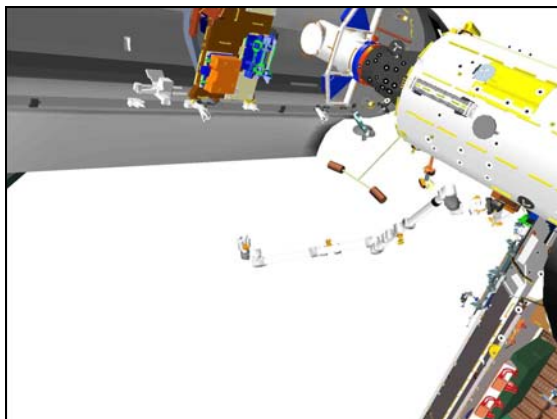


Figure 6.- Survey Support Viewing Position (V10: OBSS ITVC: 100, -60).

PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at Survey Support Viewing position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+80.0	+10.0	+40.0	-50.0	-110.0	-25.0	+115.0
X	Y	Z	Pitch	Yaw	Roll	
+1101	-916	-1113	+177.1	+30.0	-11.0	
FOR	Unloaded – LEE Tip, SY Held					
Disp	W4> LAB PDGF					

DCP BRAKES SSRMS → ON (Verify ON)

4. SURVEY VIEWING SUPPORT

Bring SSRMS Tip Elbow Camera up on a monitor and pan and tilt
Camera per picture below to set up for survey viewing support.

Once Tip Elbow Camera has been setup as desired for viewing support,
give SRMS operator GO to begin survey.

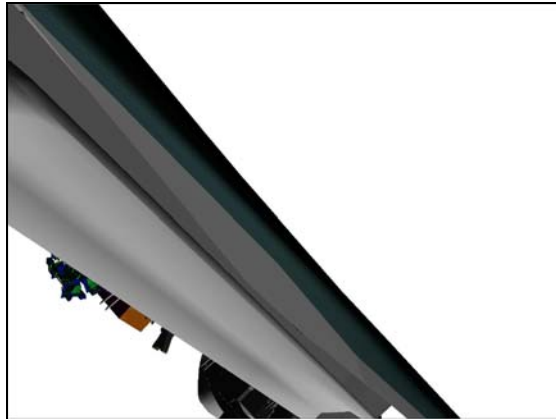


Figure 7.- Survey Support Viewing Position
(24: Tip Elbow: -80, 10).

NOTE

To view other areas below the orbiter, the Tip Elbow Camera may
be configured as follows:

Nose area of Orbiter: P: -105, T: 40

Mid area of Orbiter: P: -75, T: 20

Aft area of Orbiter: P: -55, T: 5



Figure 8.- Nose Area of Orbiter
(24: Tip Elbow: -105, 40).

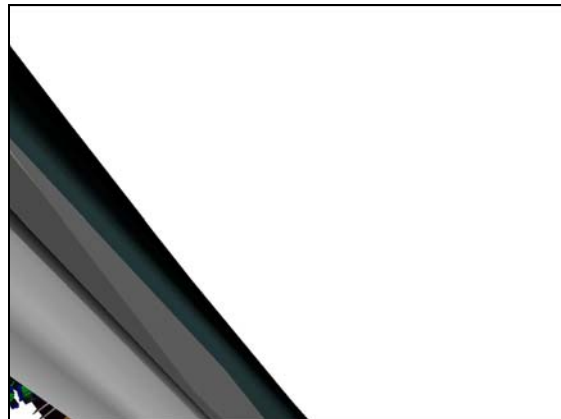


Figure 9.- Mid Area of Orbiter
(24: Tip Elbow: -75, 20).



Figure 10.- Aft Area of Orbiter
 (24: Tip Elbow: -55, 5).

5. VIEWING AREAS OF ORBITER WITH TIP LEE CAMERA (OPTIONAL)

Bring Tip LEE camera up on a monitor. Once Camera has been setup as desired for viewing support, give SRMS operator GO to begin survey.

5.1 Single Joint Wrist reconfiguration

To view areas of the orbiter using the Tip LEE Camera, the Wrist Cluster can be reconfigured in Single Joint mode, as follows:

DCP BRAKES SSRMS → OFF (Verify OFF)

PCS MSS: SSRMS:

Enter Mode – Single (Verify blue)

WARNING
The active joint must be checked on the PCS before initiating motion. Failure to do so may result in movement of the wrong joint.

THC Perform Single Joint maneuver to Mid Orbiter viewing position (within 1 deg).

	SR	SY	SP	EP	WP	WY	WR
Initial Viewing Posn	+80.0	+10.0	+40.0	-50.0	-110.0	-25.0	+115.0
1: WP +					-95.0		
2: WY +						-20.0	
Mid Orbiter	+80.0	+10.0	+40.0	-50.0	-95.0	-20.0	+115.0
	X	Y	Z	Pitch	Yaw	Roll	
	+1107	-949	-1129	+172.1	+16.0	-14.8	
FOR	Unloaded – LEE Tip, SY Held						
Disp	W4>LAB PDGF						

NOTE

To view other areas of the orbiter, the WP and WY joints can be reconfigured in single joint mode.
Fwd area of orbiter: negative maneuver
Aft area of orbiter: positive maneuver.

DCP

BRAKES SSRMS → ON (Verify ON)

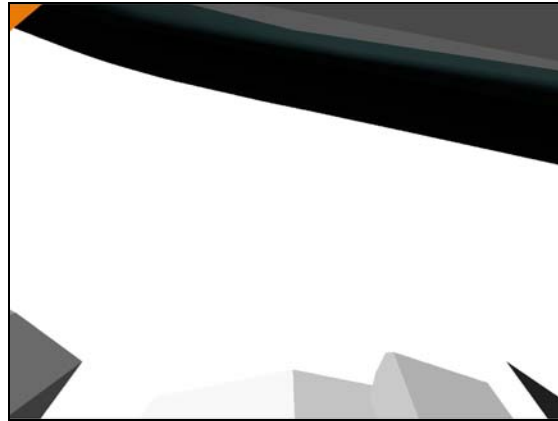


Figure 11.- Survey Support - Mid Orbiter
(25: Tip LEE).

5.2 Return To Survey Support Viewing Position

If required, once viewing support complete, return to the initial Survey Support Viewing Position using Single Joint Mode:

DCP

BRAKES SSRMS → OFF (Verify OFF)

PCS

MSS: SSRMS:

Enter Mode – Single (Verify blue)

WARNING

The active joint must be checked on the PCS before initiating motion. Failure to do so may result in movement of the wrong joint.

If WP not -110.0

DCP

JOINT SELECT → WP (Verify WP – Selected on PCS)

THC

Perform Single Joint maneuver to WP: -110.0

2.432 CONTINGENCY MANEUVER TO SURVEY SUPPORT VIEWING POSN
 (RBT FS/LF1/FIN/SPN) Page 8 of 8 pages

- If WY not -25.0
- DCP | JOINT SELECT → WY (Verify WY – Selected on PCS)
- THC | Perform Single Joint maneuver to WY: -25.0
- PCS | MSS: SSRMS: SSRMS

Verify SSRMS at Survey Support Viewing position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+80.0	+10.0	+40.0	-50.0	-110.0	-25.0	+115.0
X	Y	Z	Pitch	Yaw	Roll	
+1101	-916	-1113	+177.1	+30.0	-11.0	
FOR	Unloaded – LEE Tip, SY Held					
Disp	W4>LAB PDGF					

6. CLEANUP

NOTE

Expect the following message when safing is commanded:
'R3Z - MSS OCS SSRMS Prime(Redun) ACU SRT Cat-1 Brk Stat Fail' (SCR 17495)
 This message should return to Norm.

- DCP | SAFING → SAFE (Verify ON)
- ODS Hatch | Disconnect V10 Cables.

2.510 CONTINGENCY MNVR TO ACBM INSPECTION POSN

(RBT FS/LF1/FIN/SPN)

Page 1 of 6 pages

1. ATTITUDE CONTROL CONFIGURATION

On SRMS Operator GO for Mnvr to ACBM Inspection Posn

If using shuttle attitude control, coordinate with shuttle crewmembers

DAP: LVLH

When rates damped

DAP: FREE > 2 seconds

Then DAP: Auto

2. SETUP

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
91: SRMS Elbow (-170, 70)	24: Tip Elbow (-20, 10) 22: Base Elbow (-20, 0)	92: Camera A (0, 40) 13: LAB Stbd Zenith (20, -32)	Camera C (-10, 50) OBSS ITVC (65, -40)

PCS

MSS: SSRMS:

Verify SSRMS at OBSS Ungrapple position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+31.7	+46.6	-55.3	+127.9	-152.4	-156.2	-82.0
X	Y	Z	Pitch	Yaw	Roll	
+259	+754	-407	-75.1	-18.8	-85.4	
FOR	Unloaded – LEE Tip, SR Held					
Disp	LAB>Berthed OBSS MidMPM					

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: 1.0

3. SJ MNVR TO INTERMEDIATE POSITION

DCP

BRAKES SSRMS → OFF (Verify OFF)

RHC

RATE – as desired

PCS

MSS: SSRMS:

Enter Mode – Single (Verify blue)

WARNING

The active joint must be checked on the PCS before initiating motion. Failure to do so may result in movement of the wrong joint.

2.510 CONTINGENCY MNVR TO ACBM INSPECTION POSN

(RBT FS/LF1/FIN/SPN)

Page 2 of 6 pages

THC Perform Single Joint maneuver to Intermediate position (within 1 deg).

	SR	SY	SP	EP	WP	WY	WR
OBSS	+31.7	+46.6	-55.3	+127.9	-152.4	-156.2	-82.0
Ungrapple				+85.0			
1: EP -							
2: SR -	-40.0						
3: SP -			-80.0				
Intermediate	-40.0	+46.6	-80.0	+85.0	-152.4	-156.2	-82.0
	X	Y	Z	Pitch	Yaw	Roll	
	+737	+542	-635	-49.8	+21.3	-99.6	
FOR	Unloaded – LEE Tip, SR Held						
Disp	LAB>Berthed OBSS MidMPM						

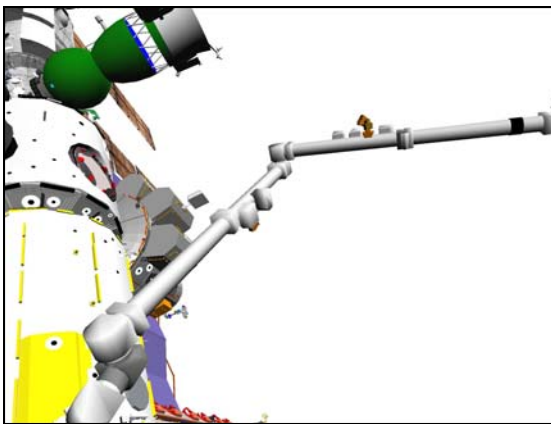


Figure 1.- Intermediate Posn
(91: SRMS Elbow: -150, 60).

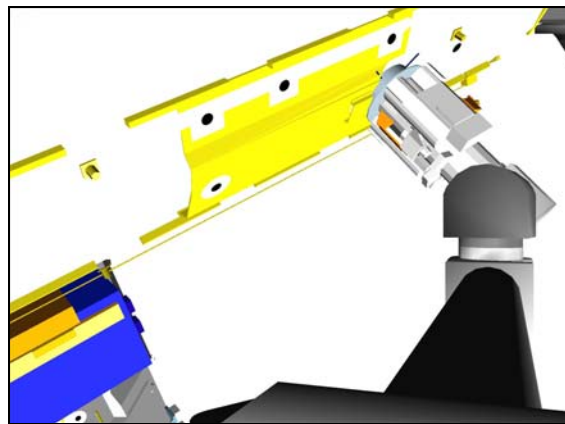


Figure 2.- Intermediate Posn
(22: Base Elbow: -20, 0).

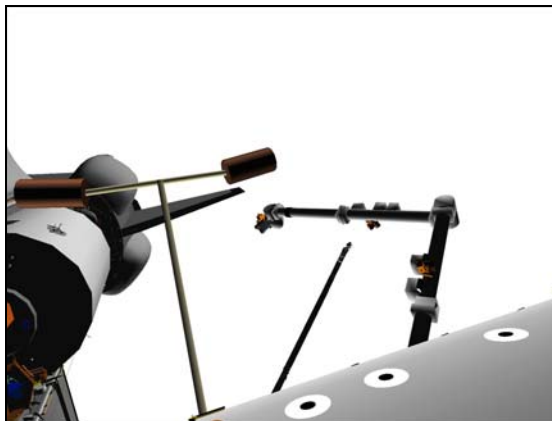


Figure 3.- Intermediate Posn
(13: LAB Stbd Zenith: 20, -32).

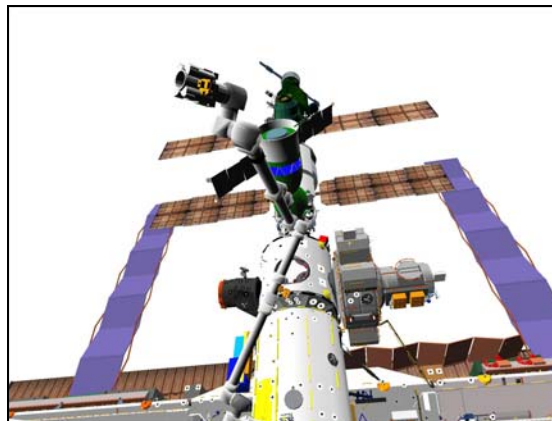


Figure 4.- Intermediate Posn
(V10: Camera C: -10, 50).

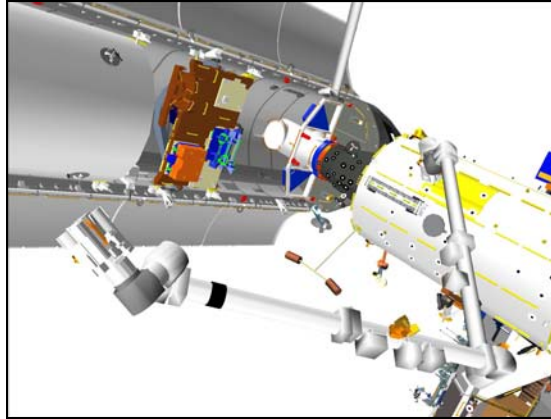


Figure 5.- Intermediate Posn
 (V10: OBSS ITVC: 95, -50).

4. JOINT OCAS TO ACBM INSPECTION POSN

RHC RATE → VERNIER (Verify Vernier on PCS)

PCS MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

Input 'Joint Angles' 'Destination' for ACBM Inspection position.

SR	SY	SP	EP	WP	WY	WR
-60.0	-15.0	-80.0	+85.0	-91.0	-122.0	+50.4

NOTE

The Target and Error fields on the SSRMS Joint OCAS display will not be correct. This data should be verified and monitored on the Joint Angle Position overlay. (SCR 31169)

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON Verify joint angles and errors are correct on Joint Angle position overlay.

	SR	SY	SP	EP	WP	WY	WR
(current)	-40.0	+46.6	-80.0	+85.0	-152.4	-156.2	-82.0
TGT	-60.0	-15.0	-80.0	+85.0	-91.0	-122.0	+50.4
ERR	+20.0	+61.6	0.0	0.0	-61.4	-34.2	-132.4

2.510 CONTINGENCY MNVR TO ACBM INSPECTION POSN

(RBT FS/LF1/FIN/SPN)

Page 4 of 6 pages

```
*****
* If joint angles/errors are incorrect
PCS * cmd Cancel (Verify Sequence Status – Waiting Destination)
*
* Input correct Dest joint angles per table above.
*
* cmd Load (Verify Sequence Status – Confirm or Cancel)
*
MON * Verify joint angles and errors are correct on Joint Angle Position
* overlay.
*****

PCS cmd Confirm (Verify Sequence Status – Auto Seq sw - Hot)

DCP AUTO SEQ → PROC
```

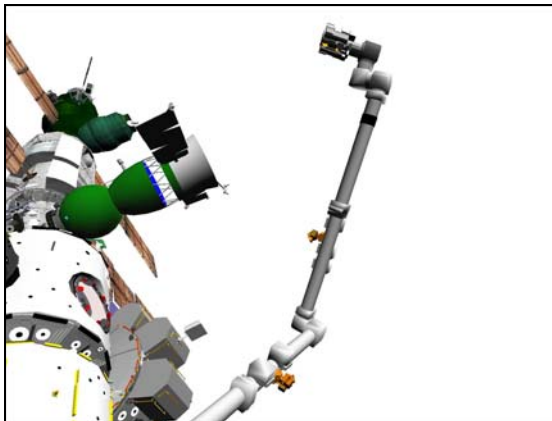


Figure 6.- ACBM Inspection
(91: SRMS Elbow: -150, 80).

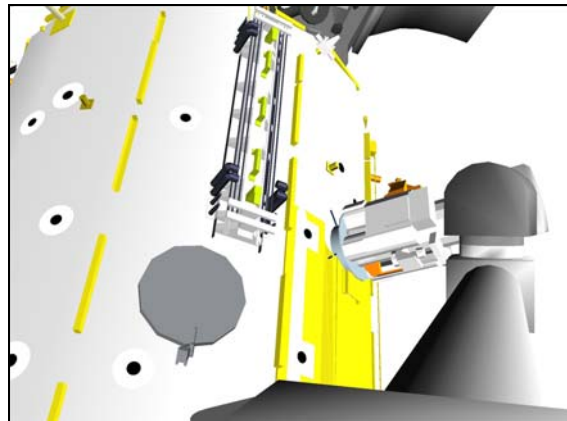


Figure 7.- ACBM Inspection
(22: Base Elbow: -20, 0).

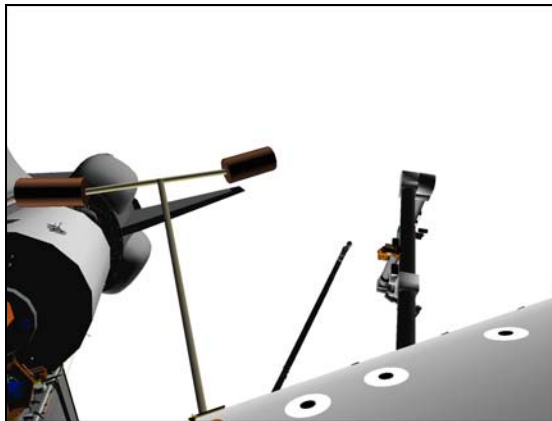


Figure 8.- ACBM Inspection
(13: LAB Stbd Zenith: 20, -32).

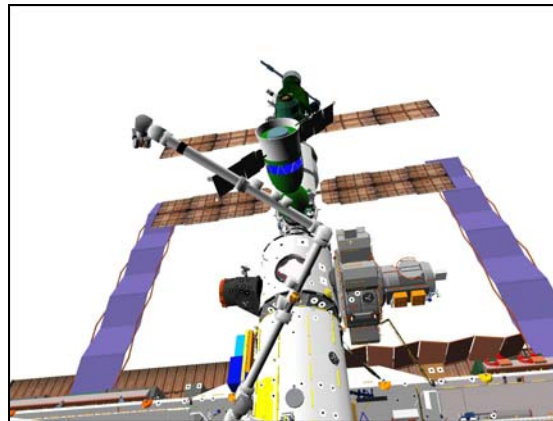


Figure 9.- ACBM Inspection
(V10: Camera C: -10, 50).

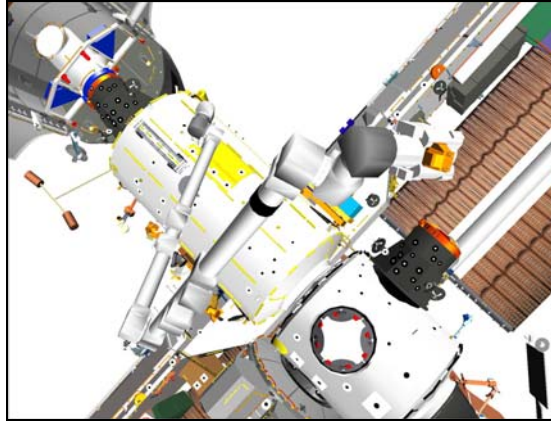


Figure 10.- ACBM Inspection
 (V10: OBSS ITVC: 65, -55).

PCS

MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at ACBM Inspection position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-60.0	-15.0	-80.0	+85.0	-91.0	-122.0	+50.4
X	Y	Z	Pitch	Yaw	Roll	
+349	+1147	-1020	+163.1	+39.9	+148.0	
FOR	Unloaded – LEE Tip, SR Held					
Disp	LAB>Berthed OBSS MidMPM					

5. CLEANUP

Pan and tilt SSRMS Tip Elbow Camera per picture below to set up for overnight ground ACBM inspection.

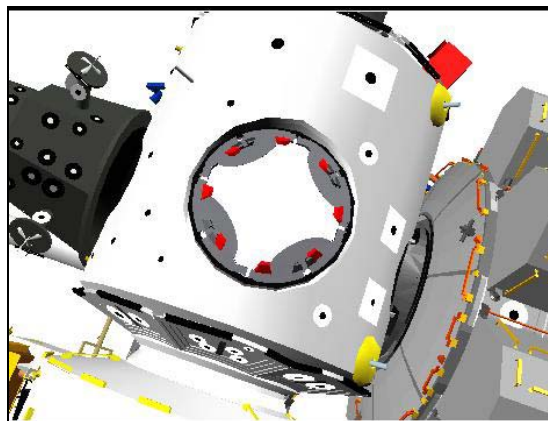


Figure 11.- ACBM Inspection
 (24: Tip Elbow: 145, 45).

2.510 CONTINGENCY MNVR TO ACBM INSPECTION POSN

(RBT FS/LF1/FIN/SPN)

Page 6 of 6 pages

NOTE

Expect the following message when safing is commanded:

'R3Z - MSS OCS SSRMS Prime(Redun) ACU SRT Cat-1 Brk Stat Fail' (SCR 17495)

This message should return to Norm.

DCP SAFING → SAFE (Verify ON)

ODS Hatch Disconnect V10 Cables

NOTE

Steps in gray are performed by shuttle crew to ensure ISS Video is available through shuttle KU for overnight ACBM inspection by the ground.

R12 √Green Jumper – ISS
(VPU) √VPU PWR – ON (LED on)

2.610 CONTINGENCY BERTHED MPLM GRAPPLE

(RBT FS/LF1/FIN/SPN) Page 1 of 7 pages

1. HAND CONTROLLER CALIBRATION

1.1 Translational Hand Controller (THC) Calibration

THC

- Deflect [X] Axis to positive hard stop where [X] =
- Deflect [X] Axis to negative hard stop.
- Repeat

1.2 Rotational Hand Controller (RHC) Calibration

RHC

- Deflect [X] Axis to positive hard stop where [X] =
- Deflect [X] Axis to negative hard stop.
- Repeat

2. SETUP

ODS

Hatch

√V10 Cables Connected

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
91: SRMS Elbow (-130, 40)	13: LAB Stbd Zenith (15, -30)	92: Camera C (-10, 40) 92: Camera B (20, 40)	OBSS ITVC (90, -50)

PCS

MSS: SSRMS:

Change Loaded Parameters ► MPLM ► MPLM Berth SYH
Verify 'Loaded Parameters' (two) – MPLM Berth, SY Held

Verify Unloaded Parameters – √

Change Unloaded Parameters ► Unloaded ► LEE Tip SYH
Verify 'Unloaded Parameters' (two) – LEE Tip, SY Held

Change Display ► LAB ► MPLM Berth (Verify LAB>MPLM Berth)

Verify Command – SSRMS>Internal

2.610 CONTINGENCY BERTHED MPLM GRAPPLE

(RBT FS/LF1/FIN/SPN) Page 2 of 7 pages

Verify SSRMS at ACBM Inspection position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-60.0	-15.0	-80.0	+85.0	-91.0	-122.0	+50.4
X	Y	Z	PITCH	YAW	ROLL	
+148	-475	-1399	+30.0	-32.0	-9.9	
FOR	Unloaded – LEE Tip, SY Held					
Disp	LAB>MPLM Berth					

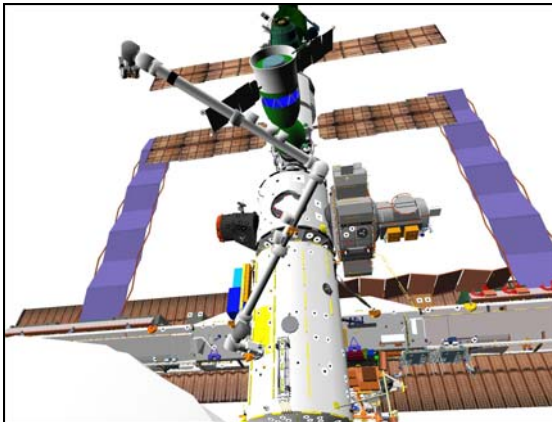


Figure 1.- ACBM Inspection
(92: Camera C: -10, 40).

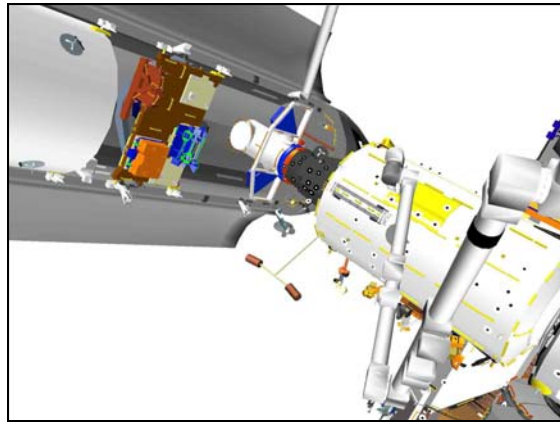


Figure 2.- ACBM Inspection
(V10: OBSS ITVC: 90, -50).

3. JOCAS TO BERTHED MPLM PRE-GRAPPLE

PCS MSS: SSRMS: SSRMS Safing:

cmd Remove (Verify Not Safed)

DCP BRAKES SSRMS → OFF (Verify – OFF)

Notify shuttle crew SSRMS maneuver to MPLM Pre-Grapple is about to begin.

PCS MSS: SSRMS:

√Vernier

Enter Mode – Joint OCAS (Verify blue)

NOTE

Expect brief singularity warning as SR axis points to the Wrist cluster during the Joint OCAS maneuver.

SSRMS Joint OCAS

pick File ► LAB ► Berthed MPLM PreGrap

2.610 CONTINGENCY BERTHED MPLM GRAPPLE

(RBT FS/LF1/FIN/SPN) Page 3 of 7 pages

Verify 'Joint Angles' 'Destination' for MPLM Pre-Grapple position.

SR	SY	SP	EP	WP	WY	WR
-116.8	+123.0	-155.3	+95.2	-91.0	-122.0	+50.4

NOTE

The Target and Error fields on the SSRMS Joint OCAS display will not be correct. This data should be verified and monitored on the Joint Angle Position overlay. (SCR 31169)

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON

Verify joint angles and errors are correct on Joint Angle Position overlay.

	SR	SY	SP	EP	WP	WY	WR
(current)	-60.0	-15.0	-80.0	+85.0	-91.0	-122.0	+50.4
TGT	-116.8	+123.0	-155.3	+95.2	-91.0	-122.0	+50.4
ERR	+56.8	-138.0	+75.3	-10.2	0.0	0.0	0.0

PCS

* If joint angles/errors are incorrect

* **cmd** Cancel (Verify Sequence Status – Waiting Destination)

*

* Input correct Dest joint angles per table above.

*

* **cmd** Load (Verify Sequence Status – Confirm or Cancel)

*

MON

* Verify joint angles and errors are correct on Joint Angle Position overlay.

PCS

cmd Confirm (Verify Sequence Status – Auto Seq sw - Hot)

DCP

AUTO SEQ → PROC

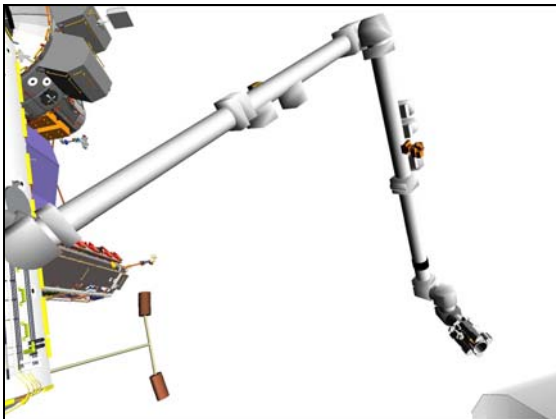


Figure 3. - Berthed MPLM Pre-Grapple (91: SRMS Elbow: -130, 40).

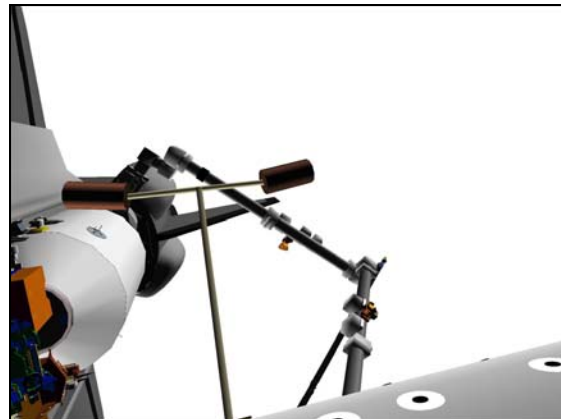


Figure 4. - Berthed MPLM Pre-Grapple (13: LAB Stbd Zenith: 15, -30.)

2.610 CONTINGENCY BERTHED MPLM GRAPPLE

(RBT FS/LF1/FIN/SPN) Page 4 of 7 pages

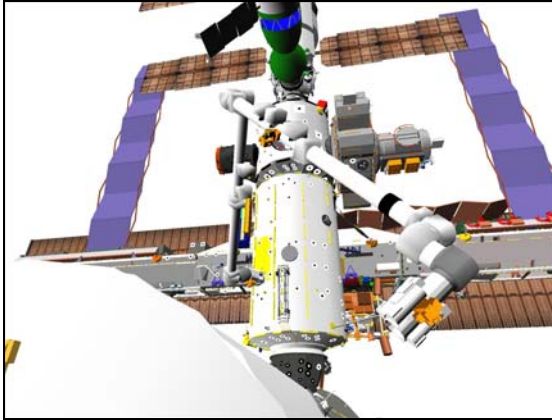


Figure 5.- Berthed MPLM Pre-Grapple
(92: Camera C: -10, 30).

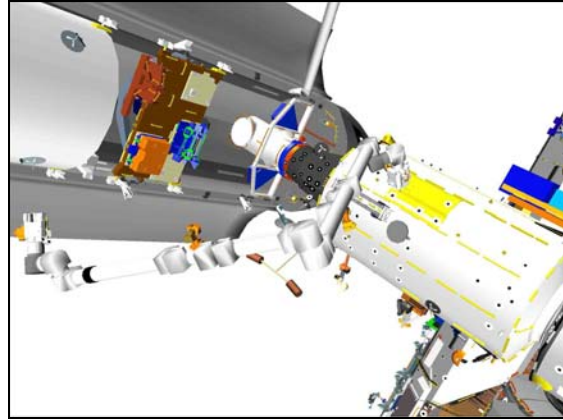


Figure 6.- Berthed MPLM Pre-Grapple
(V10: OBSS ITVC: 90, -50)

PCS

MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at Berthed MPLM Pre-Grapple position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-116.8	+123.0	-155.3	+95.2	-91.0	-122.0	+50.4
X	Y	Z	Pitch	Yaw	Roll	
+120	+288	-207	-90.2	-49.9	+149.9	
FOR	Unloaded – LEE Tip, SY Held					
Disp	LAB>MPLM Berth					

4. MPLM GRAPPLE SETUP

NOTE

MSS Effector Overlay will not appear on the monitor until the “confirm” command is sent to the LEE.

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
13: LAB Stbd Zenith (15, -30)	25: Tip LEE	92: Camera C (-5, 20) 91: Camera D (0, 20)	OBSS ITVC (111, -50)

4.1 Setup

NOTE

Tip LEE Camera must be fully zoomed out to correspond to target overlay.

2.610 CONTINGENCY BERTHED MPLM GRAPPLE

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PCS

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: as required

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

4.2 Slow Capture Commands

MSS: SSRMS: Tip LEE:

cmd Capture ► Automatic ► Slow, Limp (Verify Speed – Slow)

Verify '**Confirm or Terminate**' prompt.

CAUTION

Due to end-to-end system latency, the RHC Trigger is hot up to 3 seconds prior to receiving a Trigger Hot icon status on the PCS.

NOTE

Once the trigger is hot, only safing or trigger commands should be sent to the Robotics equipment. If a configuration change is required, including routing MSS Cameras, safe the system to exit LEE operations. (SCR 23262, 14662)

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Auto Capture

RHC/
THC

4.3 Maneuvering To Within Grapple Envelope

Maneuver to within grapple envelope.

RHC

4.4 Grapple

TRIGGER → press (momentarily)

PCS

Verify 'Snare' Close, Capture (two) – blue (12 s max)

Verify Capture to Latch – No (SCR 19282)

Verify 'Carriage' Tension ~5500 N (90 s max)

Verify 'Carriage' Retract – blue

2.610 CONTINGENCY BERTHED MPLM GRAPPLE

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4.5 Grapple Cleanup

MSS: SSRMS:

Verify Posn Hold – orange

Verify Loaded Parameters – √

Verify 'Loaded Parameters' (two) – MPLM Berth, SY Held

DCP

BRAKES SSRMS → ON (Verify ON)

PCS

Expected Berthed MPLM Grapple joint angles and FOR.

SR	SY	SP	EP	WP	WY	WR
-130.2	+123.0	-164.3	+98.8	-108.4	-119.8	+36.8
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded – MPLM Berth, SY Held					
Disp	LAB>MPLM Berth					

Review {SSRMS LEE CUE CARD}, all (SODF: RBT GEN: REFERENCE)

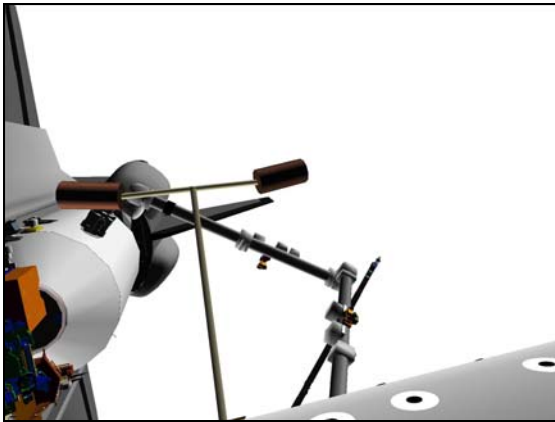


Figure 7. - Berthed MPLM Grapple
(13: LAB Stbd Zenith: 15, -30).

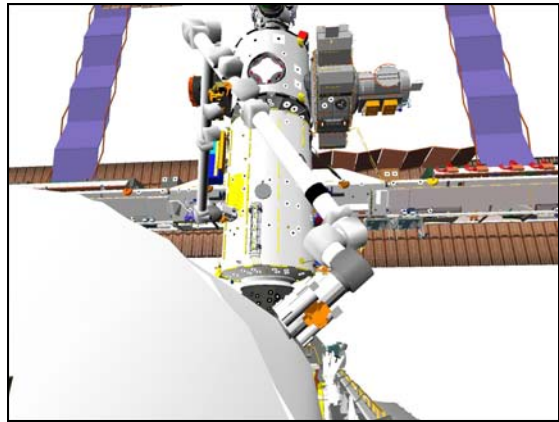


Figure 8. - Berthed MPLM Grapple
(92: Camera C: -5, 20).

2.610 CONTINGENCY BERTHED MPLM GRAPPLE

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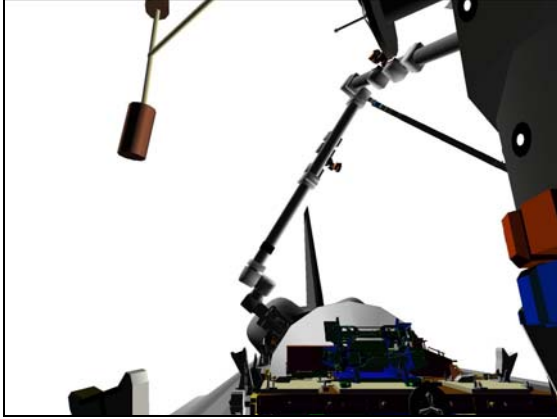


Figure 9.- Berthed MPLM Grapple
(91: Camera D: 0, 20).

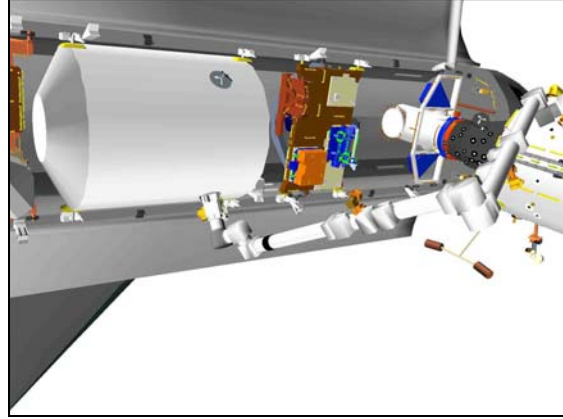


Figure 10.- Berthed MPLM Grapple
(V10: OBSS ITVC: 111, -50)

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2.611 CONTINGENCY MPLM UNBERTH

(RBT FS/LF1/FIN)

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1. ACTIVATE KEEL CAMERA

Give shuttle crew GO to activate Keel CCTV.

NOTE

Steps in gray are performed by shuttle crew to activate the Keel Camera.

SSP2 √cb SW PWR 3 (CB2) – cl

MPLM KEEL CAM PWR – ON

MPLM KEEL CAM HTR/ILLUM PWR – OFF, then ON for HI,
(repeat for MED, LO, OFF)

2. SETUP FOR UNBERTH

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
22: Base Elbow (65, -27)	91: Mux Camera B (0, -10)/ C (0, -10)	92: OBSS ITVC (111, -50) 92: Keel Camera	Mux Camera A (0, 0)/ D (0, 0)

Take digital picture of the monitor configured with the Keel Camera prior to AKA and PRLA release.

PCS

MSS: SSRMS:

Verify Loaded Parameters – √

Verify 'Loaded Parameters' (two) – MPLM Berth, SY Held

Verify Display – LAB>MPLM Berth

Change Command ► ISS ► OBAS (Verify ISS>OBAS)

√Vernier

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: 0.5 (Verify 0.5)

NOTE

The following will send the SSRMS Base Elbow Camera to the orbiter to view ROEU Demate.

MSS: Video: VTR2:

cmd BELB

2.611 CONTINGENCY MPLM UNBERTH

(RBT FS/LF1/FIN)

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3. ATTITUDE CONTROL CONFIGURATION

MSS: SSRMS: Thrusters:

Thruster Controls for MSS Ops

Verify 'Desat Request:' – Inh

If using shuttle attitude control, coordinate with shuttle crewmembers

DAP: FREE

4. ROEU DEMATE

Give shuttle crew GO for ROEU and PRLA Ops.

NOTE

Steps 4.1 to 8 are performed by shuttle crew to demate the ROEU and to open MPLM PRLAs.

4.1 Setup

CCTV – Config for ROEU demate

MON 1	PL2: SSRMS Base Elbow
MON 2	D

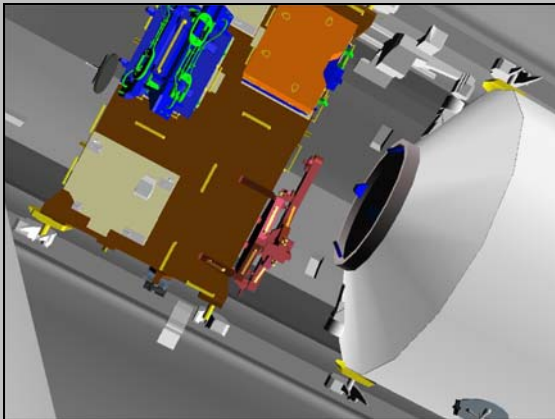


Figure 1.- ROEU Demate
(22: Base Elbow: 65, -27).

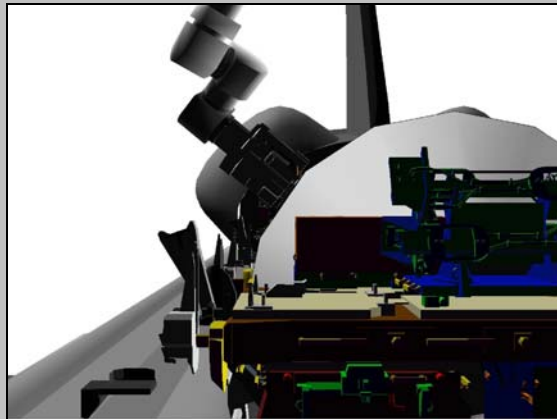


Figure 2.- ROEU Demate
(91: Camera D: 0, 0, focus 15).

4.2 Deadface ROEU

SSP 1 √MPLM CHAN 1,2 HTR PWR – OFF (tb – bp)
 √APCU 1 OUTPUT RLY – OP (tb – bp)

A6U Install ROEU A6U PANEL OVERLAY.

 √PL RETEN LAT (five) – OFF
 PL RETEN PL SEL – 2

2.611 CONTINGENCY MPLM UNBERTH

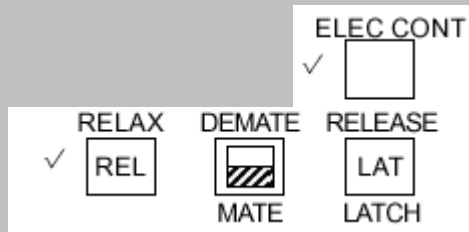
(RBT FS/LF1/FIN)

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SM 97 PL RETENTION

√REL 2,3 (four): 0

 * If LATCH 2,3 REL msw shows "1", drive latch
 * for single motor time.



4.3 Activate ROEU

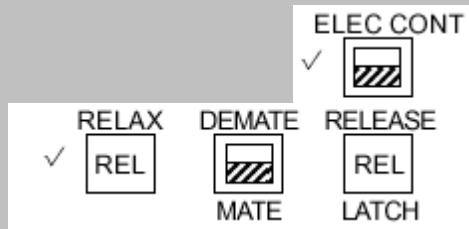
R13L

PL RETEN LOGIC PWR SYS 1,2 (two) – ON
 BAY MECH PWR SYS 1,2 (two) – ON

4.4 Release Latches

Note single motor time (> 20 seconds).

RELEASE/LATCH – REL (tb – REL), 40 s max
 – OFF

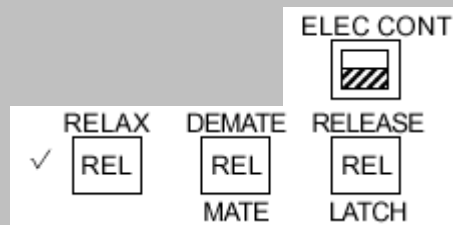


4.5 Demate ROEU

Note single motor time (> 18 seconds).

A6U

DEMATE/MATE – DEMATE (tb – REL), 36 s max
 – OFF



4.6 Deactivate ROEU

A6U
 R13L

PL RETEN LOGIC PWR SYS 1,2 (two) – OFF
 BAY MECH PWR SYS 1,2 (two) – OFF

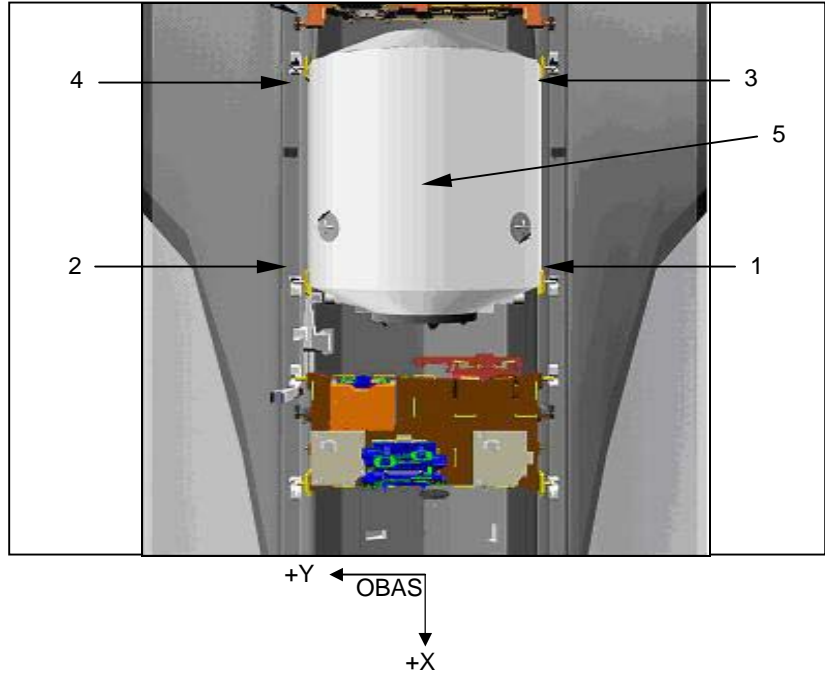


Figure 3.- MPLM PRLA Configuration

5. ACTIVATE LATCHES

√MPLM ROEU DEMATE complete

A6U √PL RETEN LAT (five) – OFF
√PL SEL – 1
√LOGIC PWR 1,2 (two) – ON

R13L PL BAY MECH PWR SYS 1,2 (two) – ON

SM 97 PL RETENTION

√RDY-FOR-LAT 1,2,3,4,5 (ten): 1

√LAT 1,2,3,4,5 (ten): 1

* If any REL msw shows "1", expect single
* motor time (60 seconds).

6. AKA RELEASE

A6U √PL RETEN LAT 5 tb – LAT
√RDY 5 tb – gray

Note single motor drive times (> 30 seconds).

2.611 CONTINGENCY MPLM UNBERTH

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PL RETEN LAT 5 – REL (tb – REL), 60 s max
– OFF

7. PRLA RELEASE

A6U √PL RETEN LAT 1,2,3,4 tb (four) – LAT
 √RDY 1,2,3,4 tb (four) – gray

Note single motor drive times (> 30 seconds).

PL RETEN LAT 1,2 (two) – REL (tb – REL), 60 s max
– OFF
3,4 (two) – REL (tb – REL), 60 s max
– OFF

8. DEACTIVATE LATCHES

R13L PL RETEN LOGIC PWR SYS 1,2 (two) – OFF
 BAY MECH PWR SYS 1,2 (two) – OFF

Give SSRMS Operator GO for step 9.

9. MANEUVERING MPLM TO LOW HOVER

On shuttle crew GO

√MPLM AKA and PRLA release has been completed

Take digital picture of the monitor configured with the Keel Camera after
AKA and PRLA release.

DCP BRAKES SSRMS → OFF (Verify – OFF)

NOTE

1. Clearances between the MPLM and LMC/CMG/CMG FSE can be monitored using the OBSS ITVC or preserved by monitoring and maintaining alignment between trunnion pins and V-guides as well as Keel target during MPLM unberth. Clearance is 36 cm between MPLM and CMG FSE at the fully berthed position and during beginning of unberth.
2. Clearance between MPLM and Active ESPAD on ESP2 can be monitored using the Base Elbow Camera. Clearance is 73 cm between MPLM and Active ESPAD on ESP2 at the fully berthed position.

PCS MSS: SSRMS:

Enter Mode – Manual (Verify – blue)

2.611 CONTINGENCY MPLM UNBERTH

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MSS: SSRMS: SSRMS Manual: Joint Lock: Joint Lock

cmd Shoulder Yaw (Verify SY – Locked)

THC/
RHC

Maneuver to MPLM Low Hover position (within 5 cm/1 deg)

	Locked					
SR	SY	SP	EP	WP	WY	WR
-103.9	+123.0	-172.6	+104.0	-63.6	-126.4	+60.1
X	Y	Z	PITCH	YAW	ROLL	
0	0	-480	0.0	0.0	0.0	
FOR	Loaded – MPLM Berth, SY Held					
Disp	LAB>MPLM Berth					

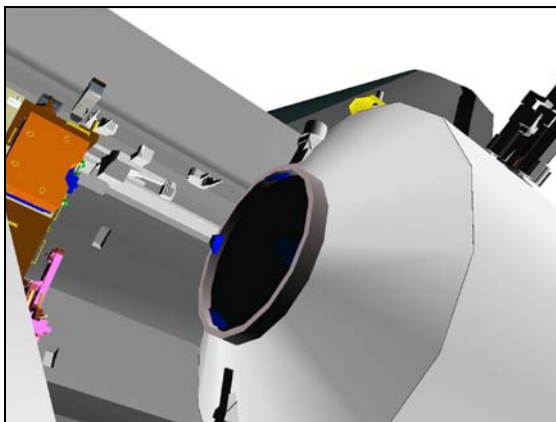


Figure 4.- MPLM Low Hover
(22: Base Elbow: 65, -27).

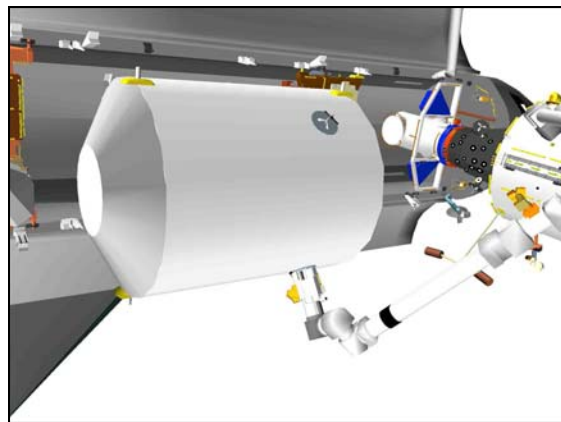


Figure 5.- MPLM Low Hover
(V10: OBSS ITVC: 111, -50).

DCP BRAKES SSRMS → ON (Verify – ON)

Give shuttle crew GO for MPLM PCBM inspection.

NOTE

Step 10 is performed by shuttle crew to deactivate the MPLM Keel Camera.

SSP2 **10. DEACTIVATING KEEL CAMERA**
MPLM KEEL CAM HTR/ILLUM PWR – Toggle until illuminator OFF
(leave sw in ON position)
MPLM KEEL CAM PWR – OFF

11. ATTITUDE CONTROL CONFIGURATION
If using shuttle attitude control, coordinate with shuttle crewmembers
Temp edit ALT RATE DB
GNC 20 DAP CONFIG
ALT RATE DB - ITEM 38 + 0.1 EXEC

2.611 CONTINGENCY MPLM UNBERTH
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If attitude maintenance reqd
| DAP: LVLH
| When rates damped
| | DAP: FREE > 2 seconds
| | Then DAP: AUTO

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2.612 CONTINGENCY MPLM INSTALL

(RBT FS/LF1/FIN/SPN) Page 1 of 10 pages

1. SETUP

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
22: Base Elbow (90, -20) 13: LAB Stbd Zenith (25, -30)	91: Mux Camera B (0, 40)/ C (0, 40)	92: OBSS ITVC (111, -50) 24: Tip Elbow (-10, 0)	SRMS Elbow (140, 65)

PCS

MSS: SSRMS:

Verify Loaded Parameters – √

Change Loaded Parameters ► MPLM ► MPLM CBCS SYH
Verify 'Loaded Parameters' (two) – MPLM CBCS, SY Held

Change Display ► LAB ► MPLM CBCS (Verify LAB>MPLM CBCS)

Change Command ► SSRMS ► Internal (Verify SSRMS>Internal)

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: 1.0 (Verify 1.0)

2. ATTITUDE CONTROL CONFIGURATION

If using shuttle attitude control, coordinate with shuttle crewmembers

| If DAP: AUTO, when in attitude
| DAP: FREE

3. FOR OCAS 1 TO MPLM PRE-INSTALL PAUSE POINT

Verify shuttle crew has completed MPLM PCBM inspection.

DCP

BRAKES SSRMS → OFF (Verify – OFF)

RHC

RATE → COARSE (Verify Coarse on PCS)

PCS

MSS: SSRMS:

Enter Mode – FOR OCAS (Verify blue)

MSS: SSRMS: SSRMS FOR OCAS: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

pick File ► LAB ► MPLM Pause Point

2.612 CONTINGENCY MPLM INSTALL

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Verify 'FOR' 'Destination' for MPLM Pre-Install Pause Point position.

X	Y	Z	Pitch	Yaw	Roll
+250	0	+300	0.0	0.0	0.0

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON

Verify FOR and errors are correct on FOR position overlay.

	X	Y	Z	Pitch	Yaw	Roll
FOR	+707	+1	+1002	-0.9	+0.2	-89.9
TGT	+250	0	+300	0.0	0.0	0.0
ERR	+457	+1	+702	-0.9	+0.2	-89.9

PCS

* If FOR/errors are incorrect
 * **cmd** Cancel (Verify Sequence Status – Waiting Destination)
 *
 * Input correct Dest FOR per table above.
 *
 * **cmd** Load (Verify Sequence Status – Confirm or Cancel)
 *

MON

* Verify FOR and errors are correct on FOR Position overlay.

PCS

cmd Confirm (Verify Sequence Status – Auto Seq Sw - Hot)

DCP

AUTO SEQ → PROC

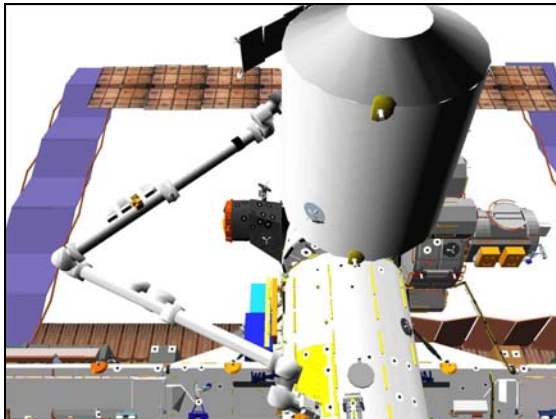


Figure 1.- MPLM Pre-Install Pause Point (91: Camera B: 0, 40).

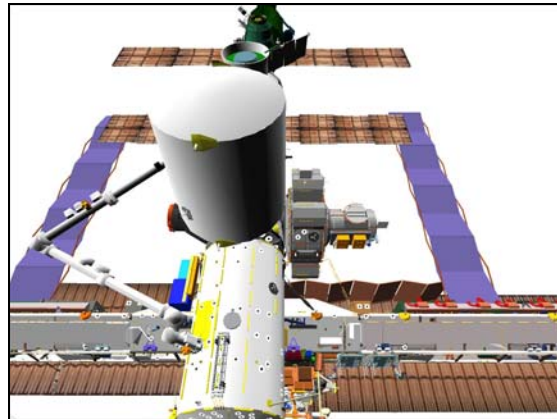


Figure 2.- MPLM Pre-Install Pause Point (91: Camera C: 0, 40).

2.612 CONTINGENCY MPLM INSTALL

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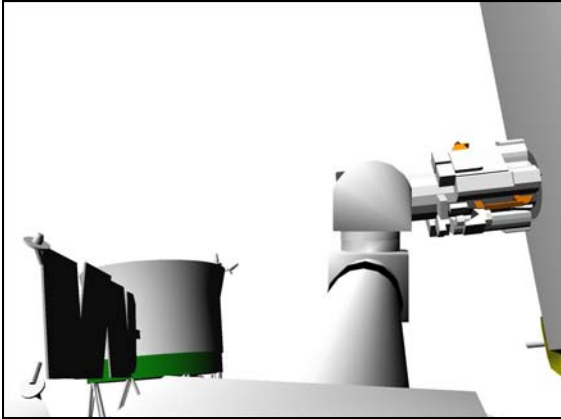


Figure 3.- MPLM Pre-Install Pause Point
(24: Tip Elbow: -10, 0).

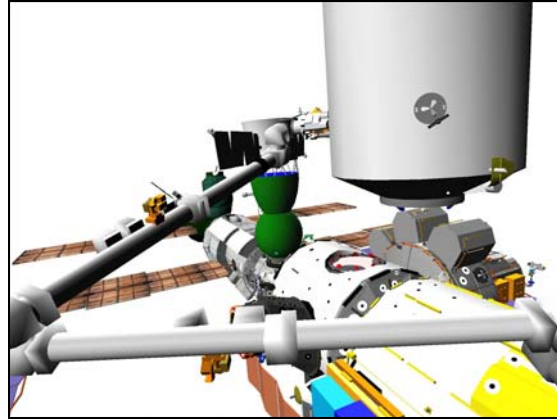


Figure 4.- MPLM Pre-Install Pause Point
(V10: SRMS Elbow: 140, 65).

PCS

MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at MPLM Pre-Install Pause Point position (within 5 cm/1 deg).

	Locked					
SR	SY	SP	EP	WP	WY	WR
-27.2	+123.0	-175.3	+117.9	-95.8	-173.8	+44.9
X	Y	Z	Pitch	Yaw	Roll	
+250	0	+300	0.0	0.0	0.0	
FOR	Loaded – MPLM CBCS, SY Held					
Disp	LAB>MPLM CBCS					

4. ATTITUDE CONTROL CONFIGURATION

If using shuttle attitude control, coordinate with shuttle crewmembers

If attitude maintenance reqd

DAP: LVLH

When rates damped

DAP: FREE > 2 seconds

Then DAP: AUTO

When in attitude

DAP: FREE

5. FOR OCAS 2 TO MPLM PRE-INSTALL

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
22: Base Elbow (90, 3) 24: Tip Elbow (-5, 0)	91: Mux Camera B (0, 40)/ C (0, 40)	92: OBSS ITVC (65, -70)	SRMS Elbow (140, 65)

2.612 CONTINGENCY MPLM INSTALL

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RHC RATE → VERNIER (Verify Vernier on PCS)

PCS SSRMS FOR OCAS

Verify Joint Lock – SY Lock

pick File ► LAB ► MPLM Pre-Install

Verify 'FOR' 'Destination' for MPLM Pre-Install position.

X	Y	Z	Pitch	Yaw	Roll
+130	0	0	0.0	0.0	0.0

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON Verify FOR and errors are correct on FOR position overlay.

	X	Y	Z	Pitch	Yaw	Roll
FOR	+250	0	+300	0.0	0.0	0.0
TGT	+130	0	0	0.0	0.0	0.0
ERR	+120	0	+300	0.0	0.0	0.0

PCS * If FOR/errors are incorrect
 * **cmd** Cancel (Verify Sequence Status – Waiting Destination)
 *
 * Input correct Dest FOR per table above.
 *
 * **cmd** Load (Verify Sequence Status – Confirm or Cancel)
 *
 MON * Verify FOR and errors are correct on FOR Position overlay.

NOTE

1. Monitor clearance between the MPLM and ONTO/MISSE with Camera C.
2. Monitor clearance between the MPLM and Soyuz with OBSS ITVC and Tip Elbow Camera.
3. Monitor clearance between the SSRMS and Soyuz with Tip Elbow Camera and Camera B or OBSS ITVC
4. The following are approximate minimum clearances seen during the maneuver to Pre-Install position:
 MPLM to ONTO: 89 cm
 MPLM to MISSE: 70 cm
 SSRMS to Soyuz (array): 68 cm

PCS **cmd** Confirm (Verify Sequence Status – Auto Seq sw - Hot)

2.612 CONTINGENCY MPLM INSTALL
(RBT FS/LF1/FIN/SPN) Page 5 of 10 pages

DCP AUTO SEQ → PROC

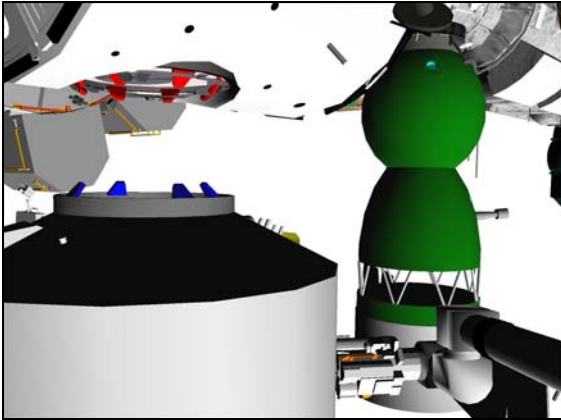


Figure 5.- MPLM Pre-Install
(22: Base Elbow: 90, 3).

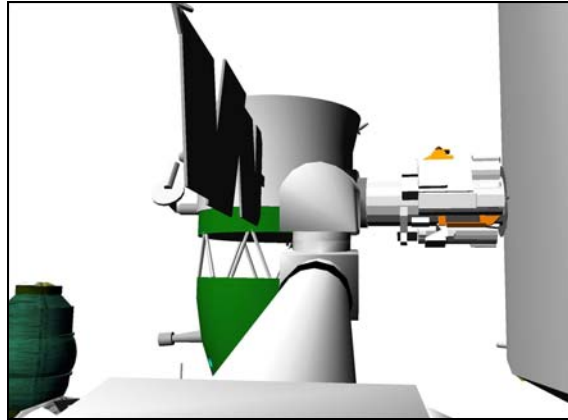


Figure 6.- MPLM Pre-Install
(24: Tip Elbow: -5, 0).

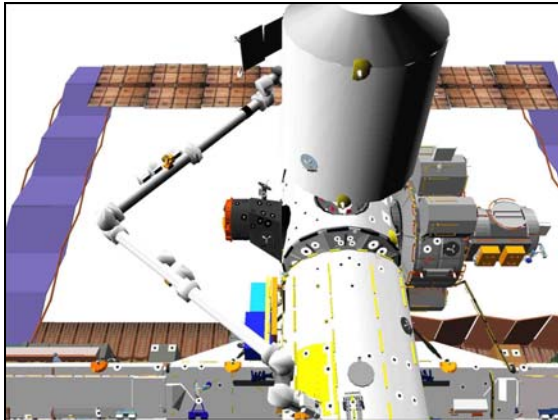


Figure 7.- MPLM Pre-Install
(91: Camera B: 0, 40).

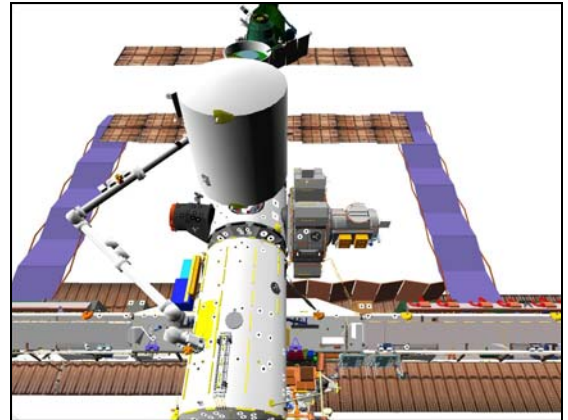


Figure 8.- MPLM Pre-Install
(91: Camera C: 0, 40).

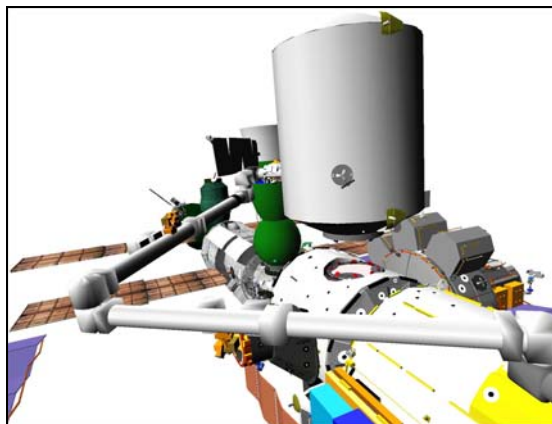


Figure 9.- MPLM Pre-Install
(V10: SRMS Elbow: 140, 65).

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PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at MPLM Pre-Install position (within 5 cm/1 deg).

	Locked					
SR	SY	SP	EP	WP	WY	WR
-8.5	+123.0	-146.4	+93.1	-83.7	-179.6	+53.3
X	Y	Z	Pitch	Yaw	Roll	
+130	0	0	0.0	0.0	0.0	
FOR	Loaded – MPLM CBCS, SY Held					
Disp	LAB>MPLM CBCS					

6. MPLM INSTALL SETUP

Verify {1.505 NODE 1 CBM VERIFY PRE-MATE STATUS}, all (SODF: S&M: NOMINAL: CBM) complete.

√CBCS setup complete

Configure cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
22: Base Elbow (90, 0) 24: Tip Elbow (10, -10)	17: N1 Cam (CBCS)	91: Camera C (0, 40) 13: LAB Stbd Zenith (65, -30)	SRMS Elbow (140, 65) OBSS ITVC (60, -70)

7. ATTITUDE CONTROL CONFIGURATION

PCS MSS: SSRMS: Thrusters:

Verify 'Desat Request:' – Inh

If using shuttle attitude control, coordinate with shuttle crewmembers

If attitude maintenance reqd

DAP: LVLH	
When rates damped	
DAP: FREE > 2 seconds	
Then DAP: AUTO	
When in attitude	
DAP: FREE	

2.612 CONTINGENCY MPLM INSTALL

(RBT FS/LF1/FIN/SPN) Page 7 of 10 pages

8. MANEUVERING MPLM TO READY-TO-LATCH POSITION

Monitor CBM RTLs using USOS Eff overlay.

CAUTION

Minimum distance between MPLM and Airlock ONTO during mnvr to RTL posn is 42 cm. Monitor clearance with Camera C or Lab Stbd Zenith Camera.

NOTE

1. Monitor clearance between the MPLM and MISSE with Camera C.
2. Monitor clearance between the MPLM and Soyuz with OBSS ITVC or Tip Elbow or Base Elbow Camera.
3. Monitor clearance between the SSRMS and Soyuz with Tip Elbow Camera or OBSS ITVC
4. The following are approximate clearances seen at MPLM Install position:
MPLM to MISSE: 70 cm
SSRMS to Soyuz (array): 128 cm

PCS

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: 0.5 (Verify 0.5)

MSS: SSRMS:

Verify 'Loaded Parameters' (two) – MPLM CBCS, SY Held

Verify Display – LAB>MPLM CBCS

Verify Command – SSRMS>Internal

√Vernier

Enter Mode – Manual (Verify – blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

THC/
RHC

Maneuver MPLM to Install position until RTL (four) – green

2.612 CONTINGENCY MPLM INSTALL

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PCS Expected Ready-To-Latch position

Locked						
SR	SY	SP	EP	WP	WY	WR
+3.1	+123.0	-137.9	+95.4	-85.0	-184.3	+57.5
X	Y	Z	Pitch	Yaw	Roll	
+11	0	0	0.0	0.0	0.0	
FOR	Loaded – MPLM CBCS, SY Held					
Disp	LAB>MPLM CBCS					

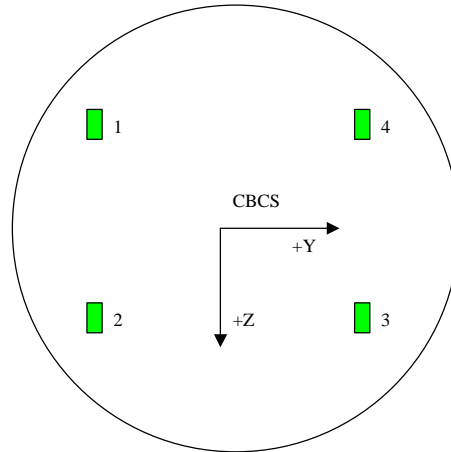


Figure 10.- RTL Diagram.

PCS MSS: SSRMS:

Verify Posn Hold – orange

Notify CBM operator, “Maneuver to RTL complete. GO for First Stage Capture.”

9. FIRST STAGE CAPTURE

Verify {1.506 NODE 1 CBM CAPTURE/ABOLT}, steps 1 to 3 (SODF: S&M: NOMINAL: CBM) complete.

On CBM Operator, “GO for SSRMS Limp Mode”

PCS Enter Mode – Standby (Verify blue)

MSS: SSRMS: Limp:

cmd All Limp (Verify Limp – blue)

MSS: SSRMS:

Verify all joints – Limped

2.612 CONTINGENCY MPLM INSTALL

(RBT FS/LF1/FIN/SPN) Page 9 of 10 pages

NOTE

Following SSRMS Mode to Limp, closed RTLs may open due to RTL spring forces. RTL closed indication is not required prior to execution of second stage capture (for latches used during first stage capture).

Notify CBM operator, "SSRMS mode to Limp complete. GO for Second Stage Capture."

10. SECOND STAGE CAPTURE

WARNING

Continuation of Second Stage Capture if SSRMS fails to brakes-on from limp mode may cause structural failure of SSRMS or primary structure. If CBM stops unexpectedly (and Cmd Code changes to 'Stop'), √**MCC-H** before proceeding.

NOTE

If the SSRMS safes during Second Stage Capture, √**MCC-H** before proceeding.

Verify {1.506 NODE 1 CBM CAPTURE/ABOLT}, steps 4 to 6 (SODF: S&M: NOMINAL: CBM) complete.

On CBM operator, "GO for SSRMS Brakes ON, can ungrapple element per timeline."

DCP BRAKES SSRMS → ON (Verify-ON)

PCS Expected MPLM Install Position joint angles and FOR.

SR	SY	SP	EP	WP	WY	WR
+4.2	+123.0	-137.0	+95.6	-85.1	-184.7	+57.9
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded – MPLM CBCS, SY Held					
Disp	LAB>MPLM CBCS					

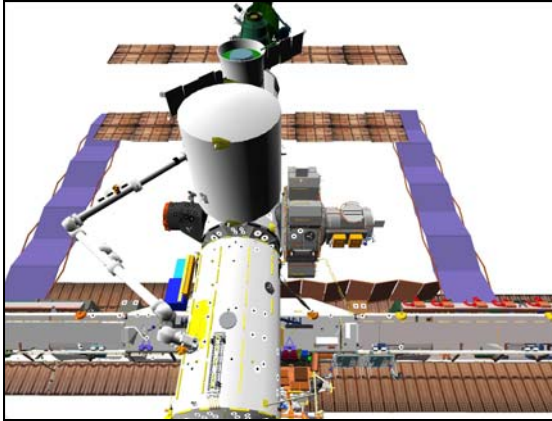


Figure 11.- MPLM Install Position
(91: Camera C: 0, 40).

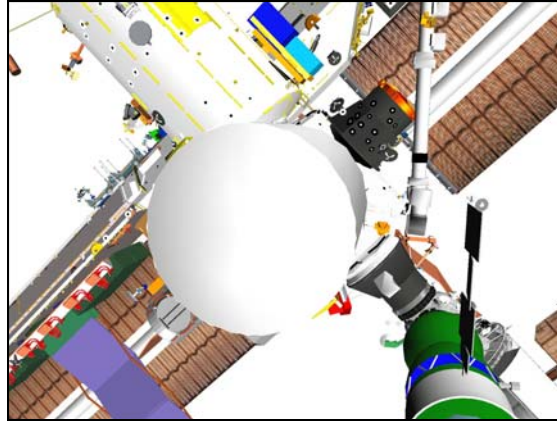


Figure 12.- MPLM Install Position
(92: OBSS ITVC: 60, -70).



Figure 13.- MPLM Install Position
(V10: SRMS Elbow: 140, 65).

11. CLEANUP AND ATTITUDE CONTROL CONFIGURATION

Bring up CBCS image and CBCS overlay on any RWS monitor and take photograph of RWS monitor for ground analysis.

If using shuttle attitude control, coordinate with shuttle crewmembers

Config DAP B to B12

DAP: LVLH

When rates damped

| DAP: FREE > 2 seconds

| Then DAP: AUTO

2.613 CONTINGENCY MATED MPLM UNGRAPPLE

(RBT FS/LF1/FIN/SPN)

Page 1 of 3 pages

1. SETUP

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
24: Tip Elbow (0,0) 22: Base Elbow (110, -5)	25: Tip LEE	91: Camera B (0, 40)	OBSS ITVC (60, -70) SRMS Elbow (140, 65)

PCS

MSS: SSRMS:

Verify Loaded Parameters – √

Verify 'Unloaded Parameters' (two) – LEE Tip, SY Held

Change Display ► ISS ► ISSACS (Verify ISS>ISSACS)

Verify Command – SSRMS>Internal

√Vernier

PCS

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: as required

DCP

BRAKES SSRMS → OFF (Verify – OFF)

2. MPLM UNGRAPPLE

NOTE

Monitor clearance between SSRMS Tip LEE and Soyuz (array) using Tip Elbow Camera. Minimum clearance during maneuver to Pre-Grapple is 87 cm.

PCS

2.1 SSRMS Limp

MSS: SSRMS: Limp:

cmd All Limp (Verify Limp – blue)

MSS: SSRMS:

Verify all joints – Limped

2.2 Auto Release

MSS: SSRMS: Tip LEE:

cmd Release ► Automatic ► Slow (Verify Speed – Slow)

Verify '**Confirm or Terminate**' prompt.

2.613 CONTINGENCY MATED MPLM UNGRAPPLE

(RBT FS/LF1/FIN/SPN)

Page 2 of 3 pages

CAUTION

Due to end-to-end system latency, the RHC Trigger is hot up to 3 seconds prior to receiving a Trigger Hot icon status on the PCS.

NOTE

Once the trigger is hot, only safing or trigger commands should be sent to the Robotics equipment. If a configuration change is required, including routing MSS Cameras, safe the system to exit LEE operations. (SCR 23262, 14662)

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Auto Release

RHC TRIGGER → press (momentarily)

PCS
 Verify 'Carriage' Derigidize – blue (90 s max)
 Verify 'Snare' Open – blue (12 s max)
 Verify 'Carriage' Extend – blue (90 s max)

2.3 SSRMS Backoff

MSS: SSRMS: Limp:

cmd None Limp (Verify Standby – blue)

MSS: SSRMS:

Verify Unloaded Parameters – √

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

THC/
 RHC
 Maneuver to Mated MPLM Pre-Grapple position (within 5 cm/
 1 deg).

	Locked					
SR	SY	SP	EP	WP	WY	WR
+3.1	+123.0	-135.6	+81.2	-73.0	-184.2	+57.5
X	Y	Z	Pitch	Yaw	Roll	
-734	-243	+899	-0.1	+40.1	+150.1	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>ISSACS					

DCP BRAKES SSRMS → ON (Verify – ON)

2.613 CONTINGENCY MATED MPLM UNGRAPPLE
(RBT FS/LF1/FIN/SPN)

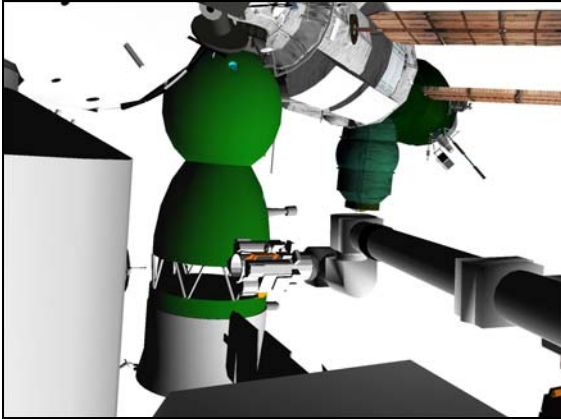


Figure 1.- Mated MPLM Pre-Grapple
(22: Base Elbow: 110, -5).

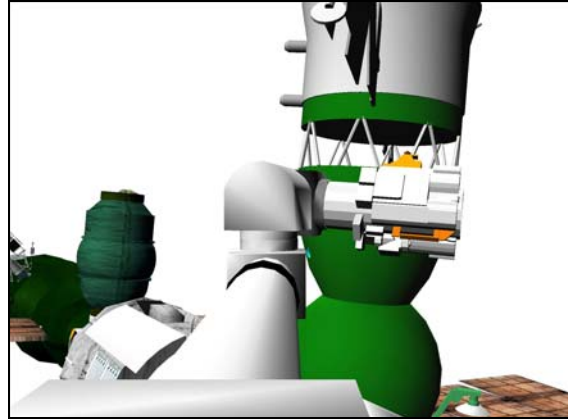


Figure 2.- Mated MPLM Pre-Grapple
(24: Tip Elbow: 0, 0).

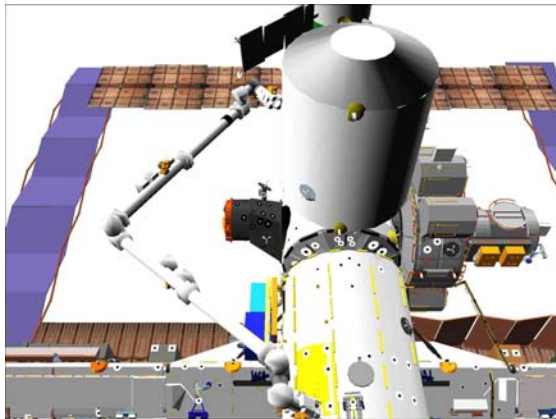


Figure 3.- Mated MPLM Pre-Grapple
(91: Camera B: 0, 40).

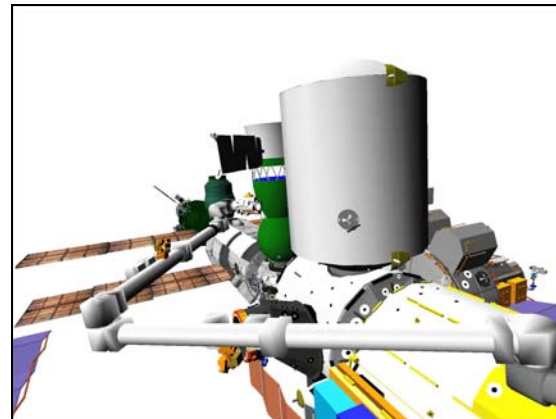


Figure 4.- Mated MPLM Pre-Grapple
(V10: SRMS Elbow: 140, 65).

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2.620 CONTINGENCY MNVR TO MATED MPLM PRE-GRAPPLE SETUP

(RBT FS/LF1/FIN/SPN) Page 1 of 7 pages

1. SETUP

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
91: Camera C (10, 35)	13: LAB Stbd Zenith (50, 0) 92: Camera D (-60, 60)	22: Base Elbow (-90, -25)	OBSS ITVC (100, -60)

PCS

MSS: SSRMS:

Verify Unloaded Parameters – √

Verify 'Unloaded Parameters' (two) – LEE Tip, SY Held

Verify Display – ISS>ISSACS

√Vernier

Verify SSRMS at Grapple Fixture Backoff position (within 5 cm/2 deg).

SR	SY	SP	EP	WP	WY	WR
-82.3	-23.2	-87.4	-115.6	-176.0	-65.7	-70.1
X	Y	Z	Pitch	Yaw	Roll	
+244	+500	+565	+179.9	0.0	+179.7	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>ISSACS					

2. MANEUVERING TO JOCAS 1 START POSITION

DCP

BRAKES SSRMS → OFF (Verify OFF)

PCS

MSS: SSRMS:

Enter Mode – Single (Verify blue)

WARNING
The active joint must be checked on the PCS before initiating motion. Failure to do so may result in movement of the wrong joint.

DCP

JOINT SELECT → ELBOW PITCH (Verify EP – Selected on PCS)

THC

Perform “+” Single Joint maneuver to EP: -40.0 (THC up)

2.620 CONTINGENCY MNVR TO MATED MPLM PRE-GRAPPLE SETUP

(RBT FS/LF1/FIN/SPN) Page 2 of 7 pages

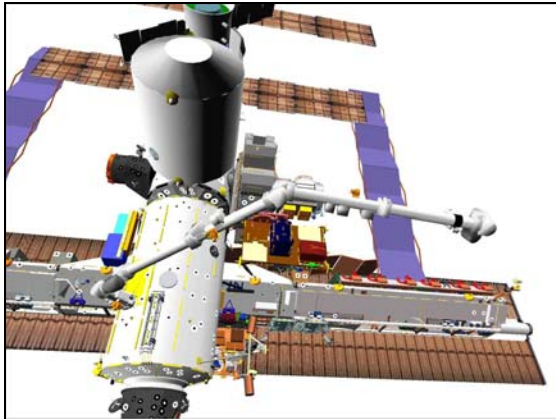


Figure 1.- JOCAS 1 Start
(91: Camera C: 10, 35).

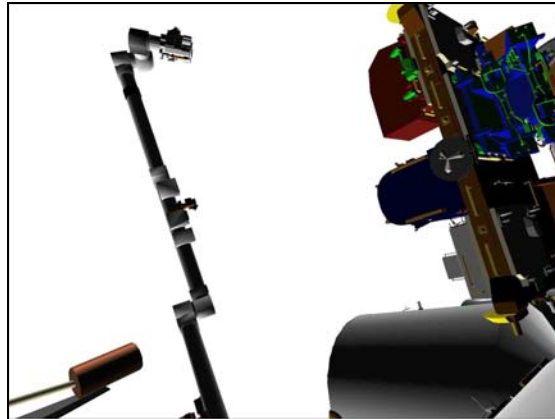


Figure 2.- JOCAS 1 Start
(13: LAB Stbd Zenith: 40, -5).

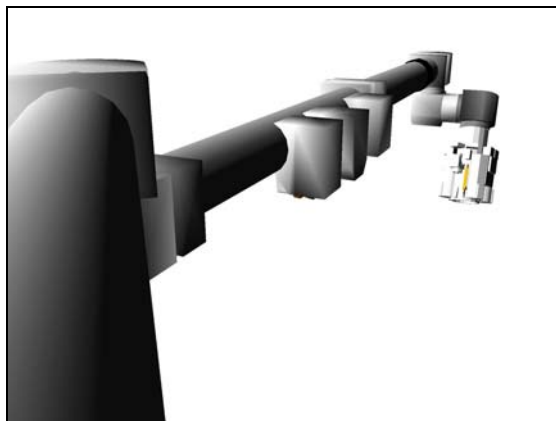


Figure 3.- JOCAS 1 Start
(22: Base Elbow: -165, -20).

3. JOCAS 1

PCS

MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
91: Camera C (10, 35)	13: LAB Stbd Zenith (20, -10) 22: Base Elbow (-130, -25)	92: SRMS Elbow (160, 40)	OBSS ITVC (100, -60)

2.620 CONTINGENCY MNVR TO MATED MPLM PRE-GRAPPLE SETUP

(RBT FS/LF1/FIN/SPN) Page 3 of 7 pages

SSRMS Joint OCAS

Input 'Joint Angles' 'Destination' for JOCAS 1 End position.

SR	SY	SP	EP	WP	WY	WR
-82.3	+160.0	-120.0	-40.0	-73.0	-184.2	+57.5

NOTE

The Target and Error fields on the SSRMS Joint OCAS display will not be correct. This data should be verified and monitored on the Joint Angle Position overlay. (SCR 31169)

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON

Verify joint angles and errors are correct on Joint Angle position overlay.

	SR	SY	SP	EP	WP	WY	WR
(current)	-82.3	-23.2	-87.4	-40.0	-176.0	-65.7	-70.1
TGT	-82.3	+160.0	-120.0	-40.0	-73.0	-184.2	+57.5
ERR	0.0	-183.2	+32.6	0.0	-103.0	+118.5	-127.6

PCS

* If joint angles/errors are incorrect

* **cmd** Cancel (Verify Sequence Status – Waiting Destination)

*

* Input correct Dest joint angles per table above.

*

* **cmd** Load (Verify Sequence Status – Confirm or Cancel)

*

MON

* Verify joint angles and errors are correct on Joint Angle Position overlay.

PCS

cmd Confirm (Verify Sequence Status – Auto Seq sw - Hot)

DCP

AUTO SEQ → PROC



Figure 4.- JOCAS 1 End
(92: Camera C: 10, 45).

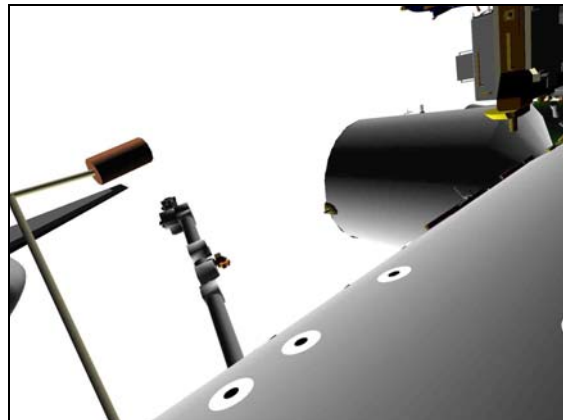


Figure 5.- JOCAS 1 End
(13: LAB Stbd Zenith: 40, -35).

2.620 CONTINGENCY MNVR TO MATED MPLM PRE-GRAPPLE SETUP
 (RBT FS/LF1/FIN/SPN) Page 4 of 7 pages

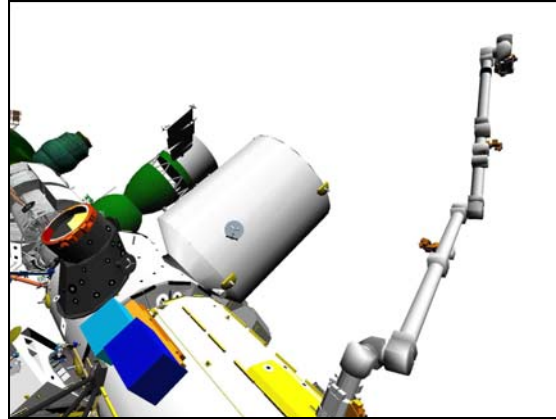


Figure 6.- JOCAS 1 End
 (91: SRMS Elbow: 160, 40).

PCS

MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at JOCAS 1 End position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-82.3	+160.0	-120.0	-40.0	-73.0	-184.2	+57.5
X	Y	Z	Pitch	Yaw	Roll	
+9	-6	+2202	-44.8	+87.8	-98.3	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>ISSACS					

4. JOCAS 2

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
92: Camera C (-10, 45)	13: LAB Stbd Zenith (40, -35)	91: SRMS Elbow (160, 46)	OBSS ITVC (100, -65)
92: Camera B (0, 45)	22: Base Elbow (170, -10)		

NOTE

Expect singularity warning for EP between -15 and +15 deg.

Input 'Joint Angles' 'Destination' for JOCAS 2 End position.

SR	SY	SP	EP	WP	WY	WR
+3.1	+160.0	-170.0	+81.2	-73.0	-184.2	+57.5

cmd Load (Verify Sequence Status – Confirm or Cancel)

2.620 CONTINGENCY MNVR TO MATED MPLM PRE-GRAPPLE SETUP

(RBT FS/LF1/FIN/SPN) Page 5 of 7 pages

MON Verify joint angles and errors are correct on Joint Angle position overlay.

	SR	SY	SP	EP	WP	WY	WR
(current)	-82.3	+160.0	-120.0	-40.0	-73.0	-184.2	+57.5
TGT	+3.1	+160.0	-170.0	+81.2	-73.0	-184.2	+57.5
ERR	-85.4	0.0	+50.0	-121.2	0.0	0.0	0.0

PCS * If joint angles/errors are incorrect
 * **cmd** Cancel (Verify Sequence Status – Waiting Destination)
 *
 * Input correct Dest joint angles per table above.

PCS * **cmd** Load (Verify Sequence Status – Confirm or Cancel)

MON * Verify joint angles and errors are correct on Joint Angle Position overlay.
 *

PCS **cmd** Confirm (Verify Sequence Status – Auto Seq sw - Hot)

DCP AUTO SEQ → PROC

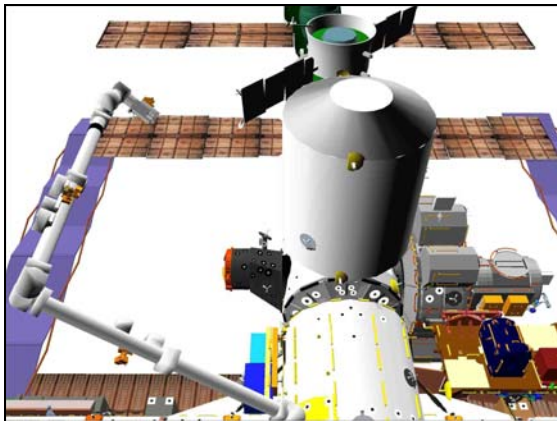


Figure 7.- JOCAS 2 End
(92: Camera B: 0, 45).



Figure 8.- JOCAS 2 End
(V10: OBSS ITVC: 100, -65).

PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at JOCAS 2 End position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+3.1	+160.0	-170.0	+81.2	-73.0	-184.2	+57.5
X	Y	Z	Pitch	Yaw	Roll	
-573	-639	+1164	+62.0	+50.8	+78.1	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>ISSACS					

5. MANEUVERING TO MATED MPLM PRE-GRAPPLE SETUP POSITION

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
92: Camera B (-10, 40)	22: Base Elbow (100, -10) 24: Tip Elbow (20, 0)	91: OBSS ITVC (100, -65)	Camera A (50, 60) SRMS Elbow (145, 46)

PCS

MSS: SSRMS:

Enter Mode – Single (Verify blue)

WARNING
The active joint must be checked on the PCS before initiating motion. Failure to do so may result in movement of the wrong joint.

DCP

JOINT SELECT → SHOULDER YAW (Verify SY – Selected on PCS)

THC

Perform “-” Single Joint maneuver to SY: +123.0 (THC down)

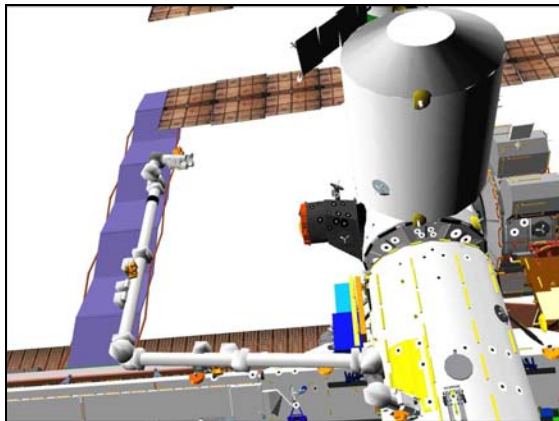


Figure 9.- Mated MPLM Pre-Grapple Setup (92: Camera B: -10, 40).

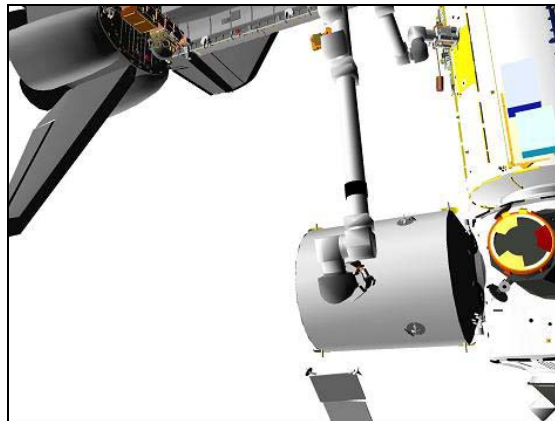


Figure 10.- Mated MPLM Pre-Grapple Setup (91: OBSS ITVC: 100, -65).

2.620 CONTINGENCY MNVR TO MATED MPLM PRE-GRAPPLE SETUP
 (RBT FS/LF1/FIN/SPN) Page 7 of 7 pages

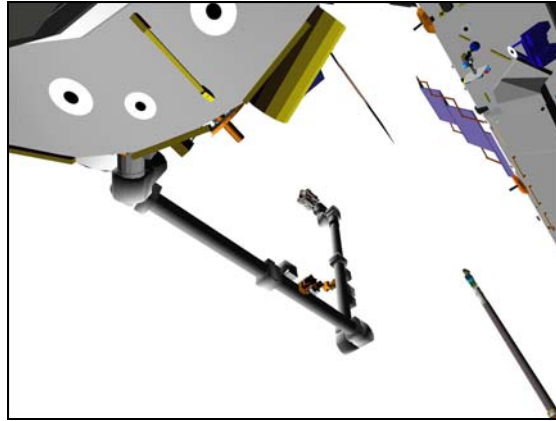


Figure 11.- Mated MPLM Pre-Grapple Setup
 (V10: Camera A: 50, 60).

PCS

Verify SSRMS at Mated MPLM Pre-Grapple Setup position
 (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+3.1	+123.0	-170.0	+81.2	-73.0	-184.2	+57.5
X	Y	Z	Pitch	Yaw	Roll	
-555	-813	+858	-2.9	+74.4	+149.9	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>ISSACS					

DCP

BRAKES SSRMS → ON (Verify ON)

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2.621 CONTINGENCY MATED MPLM GRAPPLE

(RBT FS/LF1/FIN/SPN)

Page 1 of 5 pages

1. SETUP

Verify SRMS is at the MPLM VIEWING position.

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
91: OBSS ITVC (50, -60)	92: Camera B (-10, 40)	22: Base Elbow (110, -5) 24: Tip Elbow (0, 0)	SRMS Elbow (145, 46)

PCS

MSS: SSRMS:

Change Loaded Parameters ► MPLM ► MPLM Berth SYH
Verify 'Loaded Parameters' (two) – MPLM Berth, SY Held

Verify Unloaded Parameters – √
Verify 'Unloaded Parameters' (two) – LEE Tip, SY Held

Change Display ► LAB ► MPLM Berth (Verify LAB>MPLM Berth)

Verify Command – SSRMS>Internal

√Vernier

Verify SSRMS at MPLM Pre-Grapple Setup position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+3.1	+123.0	-170.0	+81.2	-73.0	-184.2	+57.5
X	Y	Z	Pitch	Yaw	Roll	
+883	-812	-1547	-93.2	+74.3	+149.3	
FOR	Unloaded – LEE Tip, SY Held					
Disp	LAB>MPLM Berth					

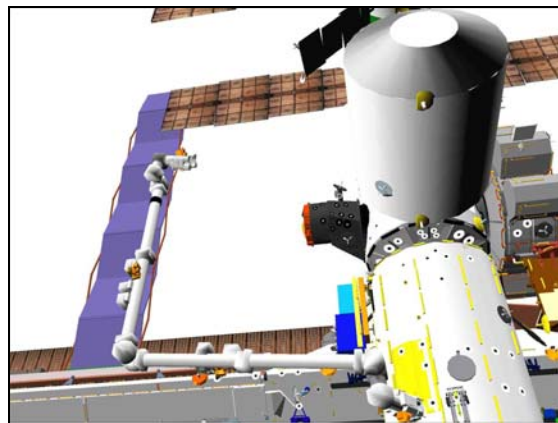


Figure 1.- Mated MPLM Pre-Grapple Setup
(92: Camera B: -10, 40).

2.621 CONTINGENCY MATED MPLM GRAPPLE

(RBT FS/LF1/FIN/SPN)

Page 2 of 5 pages

2. MANEUVERING TO MATED MPLM PRE-GRAPPLE

DCP BRAKES SSRMS → OFF (Verify OFF)

NOTE

Monitor clearance between the SSRMS and Soyuz array with the Tip Elbow Camera. Minimum clearance is approximately 74 cm.

PCS MSS: SSRMS:

Enter Mode – Single (Verify blue)

WARNING

The active joint must be checked on the PCS before initiating motion. Failure to do so may result in movement of the wrong joint.

DCP JOINT SELECT → SHOULDER PITCH (Verify SP – Selected on PCS)

THC Perform “+” Single Joint maneuver to SP: -135.6 (THC up).

Verify SSRMS at Mated MPLM Pre-Grapple position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+3.1	+123.0	-135.6	+81.2	-73.0	-184.2	+57.5
X	Y	Z	PITCH	YAW	ROLL	
+846	-242	-1726	-90.9	+40.1	+149.9	
FOR	Unloaded – LEE Tip, SY Held					
Disp	LAB>MPLM Berth					

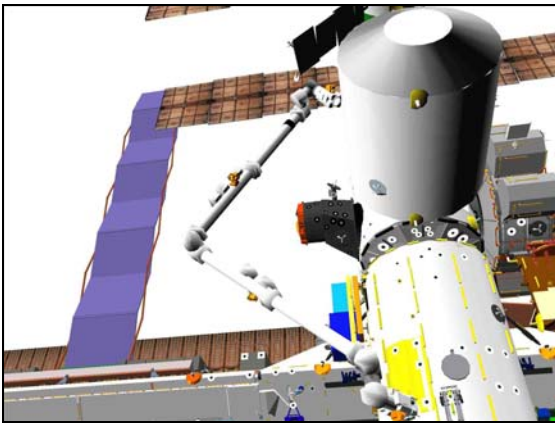


Figure 2.- Mated MPLM Pre-Grapple
(92: Camera B: -10, 40).

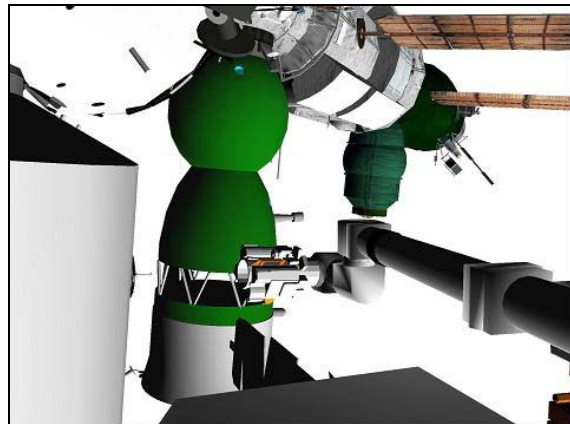


Figure 3.- Mated MPLM Pre-Grapple
(22: Base Elbow: 110, -5).

2.621 CONTINGENCY MATED MPLM GRAPPLE

(RBT FS/LF1/FIN/SPN)

Page 3 of 5 pages

3. MATED MPLM GRAPPLE SETUP AND CAPTURE

Configure Cameras and overlays for grapple.

Monitor 1	Monitor 2	Monitor 3	V10
91: OBSS ITVC (50, -60)	25: Tip LEE	24: Tip Elbow (0, 0) 22: Base Elbow (110, -5)	Camera B (-10, 40)

3.1 Setup

NOTE

1. The LEE Camera must be fully zoomed out to correspond to the target overlay
2. Monitor clearance between Tip LEE and Soyuz array with Tip/Base Elbow Camera. Minimum clearance during maneuver to Pre-Grapple is 88 cm.

PCS

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: as required

MSS: SSRMS:

Enter Mode – Manual (Verify – blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

3.2 Slow Capture Commands

MSS: SSRMS: Tip LEE:

cmd Capture ► Automatic ► Slow, Limp (Verify Speed – Slow)

Verify '**Confirm or Terminate**' prompt.

CAUTION

Due to end-to-end system latency, the RHC Trigger is hot up to 3 seconds prior to receiving a Trigger Hot icon status on the PCS.

NOTE

Once the trigger is hot, only safing or trigger commands should be sent to the Robotics equipment. If a configuration change is required, including routing MSS Cameras, safe the system to exit LEE operations. (SCR 23262, 14662)

cmd Confirm (Verify RHC Trigger Hot icon)

2.621 CONTINGENCY MATED MPLM GRAPPLE

(RBT FS/LF1/FIN/SPN)

Page 4 of 5 pages

Verify LEE Mode – Auto Capture

RHC/
THC 3.3 Maneuvering to within Grapple Envelope
Maneuver to within grapple envelope.

RHC 3.4 Grapple
TRIGGER → press (momentarily)

PCS
Verify 'Snare' Close, Capture (two) – blue (12 s max)
Verify Capture to Latch – No (SCR 19282)
Verify 'Carriage' Tension ~5500 N (90 s max)
Verify 'Carriage' Retract – blue

3.5 Grapple Cleanup
MSS: SSRMS:

Verify Posn Hold - orange

Verify Loaded Parameters – √
Verify 'Loaded Parameters' (two) – MPLM Berth, SY Held

Expected Mated MPLM Grapple joint angles and FOR.

SR	SY	SP	EP	WP	WY	WR
+4.2	+123.0	-137.0	+95.6	-85.1	-184.7	+57.9
X	Y	Z	Pitch	Yaw	Roll	
+722	-35	-1439	-0.9	-0.1	-89.9	
FOR	Loaded – MPLM Berth, SY Held					
Disp	LAB>MPLM Berth					

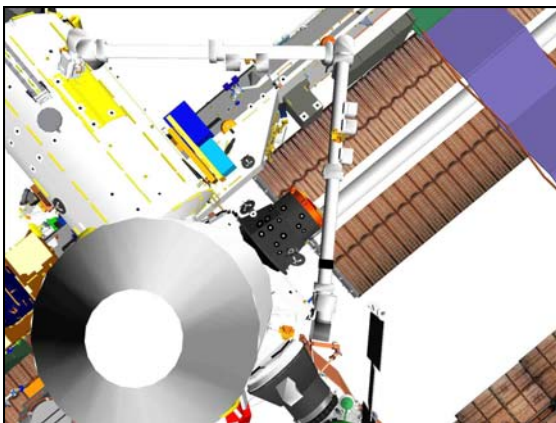


Figure 4.- Mated MPLM Grapple
(91: OBSS ITVC: 50, -60).

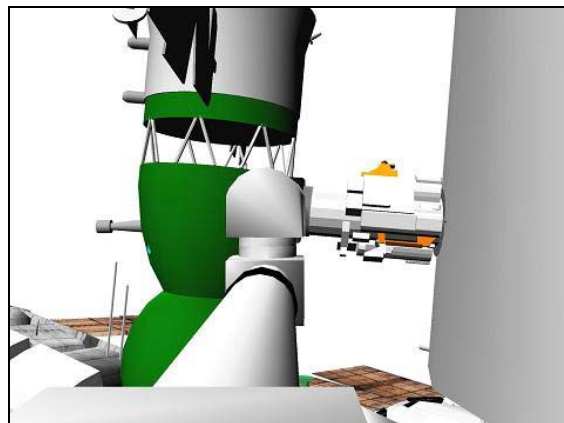


Figure 5.- Mated MPLM Grapple
(24: Tip Elbow: 0, 0).

2.621 CONTINGENCY MATED MPLM GRAPPLE

(RBT FS/LF1/FIN/SPN)

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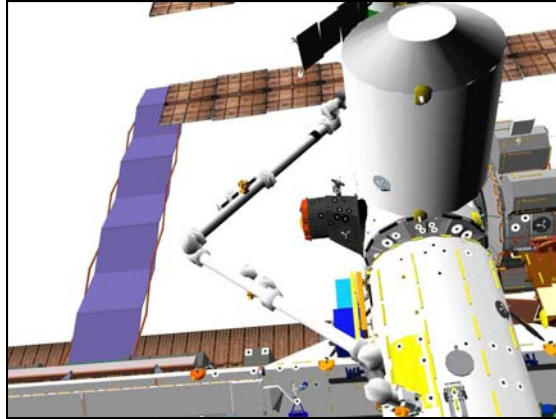


Figure 6.- Mated MPLM Grapple
(V10: Camera B: -10, 40).

4. CLEANUP

NOTE

Expect the following message when safing is commanded:

**'R3Z - MSS OCS SSRMS Prime(Redun) ACU SRT Cat-1 Brk Stat
Fail'** (SCR 17495)

This message should return to Norm.

DCP SAFING → SAFE (Verify ON)

ODS
Hatch Disconnect V10 Cables.

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2.622 CONTINGENCY MPLM UNINSTALL

(RBT FS/LF1/FIN/SPN)

Page 1 of 10 pages

1. HAND CONTROLLER CALIBRATION

1.1 Translational Hand Controller (THC) Calibration

THC

- Deflect [X] Axis to positive hard stop where [X] =
- Deflect [X] Axis to negative hard stop.
- Repeat

1.2 Rotational Hand Controller (RHC) Calibration

RHC

- Deflect [X] Axis to positive hard stop where [X] =
- Deflect [X] Axis to negative hard stop.
- Repeat

2. SETUP FOR UNINSTALL

ODS
Hatch

√V10 Cables connected

Review {[SSRMS LEE CUE CARD](#)}, all (SODF: RBT GEN: REFERENCE).

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
92: OBSS ITVC (60, -70)	91: Camera C (0, 50)	22: Base Elbow (90, 0)	SRMS Elbow (150, 50)
13: LAB Stbd Zenith (45, -30)		24: Tip Elbow (0, 0)	Camera B (0, 40)

PCS

MSS: SSRMS:

Verify Display – LAB>MPLM Berth

Change Command ► ISS ► ISSACS (Verify ISS>ISSACS)

√Vernier

PCS

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: 0.5 (Verify 0.5)

Verify {[1.509 NODE 1 CBM DEMATE](#)}, steps 1 to 9 (SODF: S&M: NOMINAL: CBM) complete.

2.622 CONTINGENCY MPLM UNINSTALL

(RBT FS/LF1/FIN/SPN)

Page 2 of 10 pages

3. MANEUVERING TO MPLM UNINSTALL

On CBM operator, "Steps 1 to 9 complete. GO for RMS translation per timeline"

Monitor CBM RTLs using USOS Eff overlay.

PCS MSS: SSRMS: SSRMS Safing:

cmd Remove (Verify Not Safed)

DCP BRAKES SSRMS → OFF (Verify OFF)

PCS MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

CAUTION

Minimum distance between MPLM and Airlock ONTO during mnvr to MPLM Uninstall posn is 42 cm. Monitor clearance with Camera C.

NOTE

1. If MISSE was not removed from the ONTO during EVA, monitor clearance between MPLM and MISSE with Camera C. Minimum clearance is approximately 70 cm.
2. Monitor clearance between the MPLM and Soyuz with the OBSS ITVC or Tip Elbow Camera.
3. Monitor clearance between the SSRMS and the Soyuz (array) with Base Elbow or Tip Elbow Camera and SRMS Elbow or OBSS ITVC. Minimum clearance is approximately 64 cm.

THC/
RHC

Maneuver MPLM to X: +572 (+Z THC command) (Pre-Install)
(within 5 cm/1 deg).

		Locked				
SR	SY	SP	EP	WP	WY	WR
-10.4	+123.0	-147.7	+92.6	-83.4	-178.9	+52.5
X	Y	Z	Pitch	Yaw	Roll	
+572	-34	-1441	-0.9	-0.1	-89.9	
FOR	Loaded – MPLM Berth, SY Held					
Disp	LAB>MPLM Berth					

2.622 CONTINGENCY MPLM UNINSTALL

(RBT FS/LF1/FIN/SPN)

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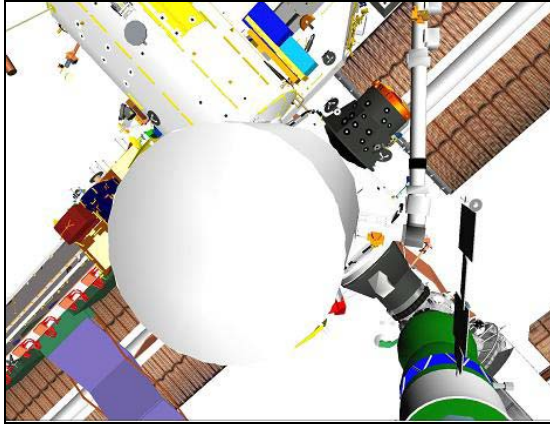


Figure 1.- MPLM Uninstall
(92: OBSS ITVC: 60, -70)

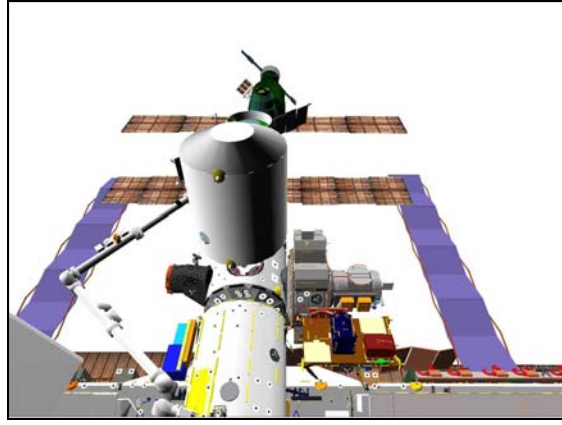


Figure 2.- MPLM Uninstall
(91: Camera C: 0, 50)

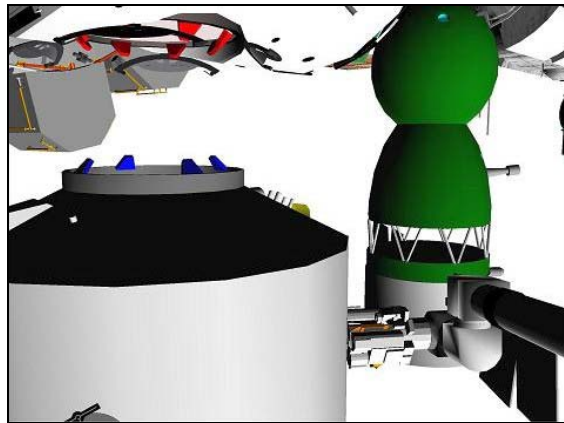


Figure 3.- MPLM Uninstall
(22: Base Elbow: 90, 0)

4. ATTITUDE CONTROL CONFIGURATION

If using shuttle attitude control

PCS

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

Coordinate with shuttle crewmembers

Temp edit ALT RATE DB

ALT RATE DB – ITEM 38 + 0.1 EXEC

If attitude maintenance reqd

DAP: LVLH

When rates damped

DAP: FREE > 2 seconds

Then DAP: Auto

When in attitude

DAP: FREE

2.622 CONTINGENCY MPLM UNINSTALL

(RBT FS/LF1/FIN/SPN)

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5. SINGLE JOINT TO UNINSTALL CLEAR POSITION

PCS

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: 1.0 (Verify 1.0)

MSS: SSRMS:

Enter Mode – Single (Verify blue)

WARNING	
The active joint must be checked on the PCS before initiating motion. Failure to do so may result in movement of the wrong joint.	

THC

Perform Single Joint maneuver to Uninstall Clear position (within 1 deg).

	SR	SY	SP	EP	WP	WY	WR
Uninstall Posn	-10.4	+123.0	-147.7	+92.6	-83.4	-178.9	+52.5
1: WY +						-160.0	
2: SR -	-20.0						
Uninstall Clear Posn	-20.0	+123.0	-147.7	+92.6	-83.4	-160.0	+52.5
	X	Y	Z	Pitch	Yaw	Roll	
	+388	+24	-1399	-11.2	+9.7	-78.3	
	FOR	Loaded – MPLM Berth, SY Held					
	Disp	LAB>MPLM Berth					

PCS

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

Notify CBM operator, "SSRMS/MPLM is Clear of Structure. GO to close CBM petals."

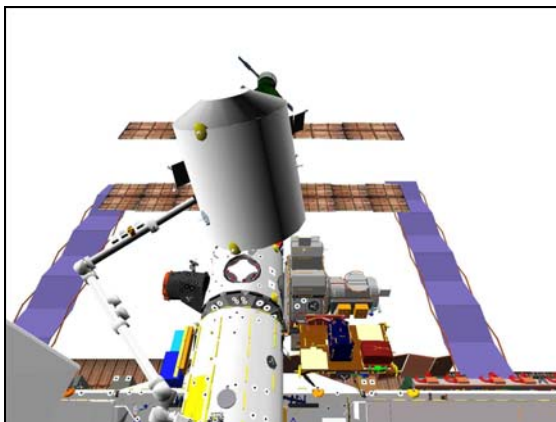


Figure 4.- Uninstall Clear Position
(92: Camera C: 0, 50).

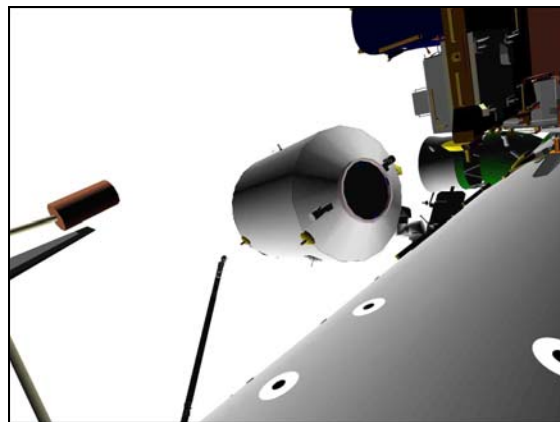


Figure 5.- Uninstall Clear Position
(13: LAB Stbd Zenith: 45, -30).

2.622 CONTINGENCY MPLM UNINSTALL

(RBT FS/LF1/FIN/SPN)

Page 5 of 10 pages

6. ACTIVATING KEEL CAMERA

Give shuttle crew GO to activate KEEL CCTV.

NOTE

Steps in gray are performed by the shuttle crew to activate the MPLM Keel Camera.

SSP2

cb SW PWR 3 (CB2) – cl

MPLM KEEL CAM PWR – ON

MPLM KEEL CAM HTR/ILLUM PWR – OFF, then ON for HI
(repeat for MED, LO, OFF)

7. MPLM UNINSTALL JOCAS 1

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
13: LAB Stbd Zenith (45, -30)	91: Camera C (0, 50)	92: SRMS Elbow (-150, 65)	Camera B (0, 40) OBSS ITVC (60, -70)

RHC

RATE → COARSE (Verify Coarse on PCS)

PCS

MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

NOTE

1. Expect singularity warning for SY between +96 and +93 deg and for EP between -15 and +15 deg.
2. JOCAS maneuver will take approximately 6 minutes.

pick File ► LAB ► MPLM Berth JOCAS 1

Verify 'Joint Angles' 'Destination' for MPLM Uninstall JOCAS 1 position.

SR	SY	SP	EP	WP	WY	WR
-70.0	+70.0	-60.0	-40.0	-120.0	-110.0	+57.7

NOTE

The Target and Error fields on the SSRMS Joint OCAS display will not be correct. This data should be verified and monitored on the Joint Angle position overlay. (SCR 31169)

cmd Load (Verify Sequence Status – Confirm or Cancel)

2.622 CONTINGENCY MPLM UNINSTALL

(RBT FS/LF1/FIN/SPN)

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MON Verify joint angles and errors are correct on Joint Angle position overlay.

(current)	SR	SY	SP	EP	WP	WY	WR
TGT	-20.0	+123.0	-147.7	+92.6	-83.4	-160.0	+52.5
ERR	-70.0	+70.0	-60.0	-40.0	-120.0	-110.0	+57.7
	+50.0	+53.0	-87.7	+132.6	+36.6	-50.0	-5.2

PCS * If joint angles/errors are incorrect
 * **cmd** Cancel (Verify Sequence Status – Waiting Destination)
 *
 * Input correct Dest joint angles per table above.
 *
 * **cmd** Load (Verify Sequence Status – Confirm or Cancel)
 *
 MON * Verify joint angles and errors are correct on Joint Angle Position overlay.
 *

PCS **cmd** Confirm (Verify Sequence Status – Auto Seq sw - Hot)

DCP AUTO SEQ → PROC

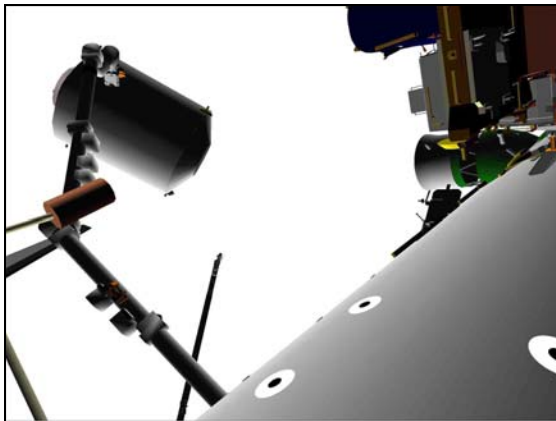


Figure 6.- MPLM Uninstall JOCAS 1
 (13: LAB Stbd Zenith: 45, -30)

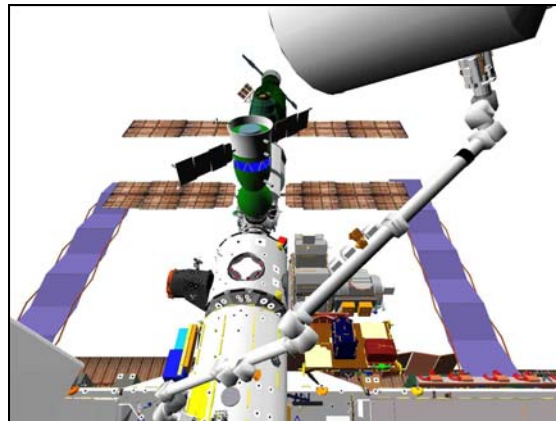


Figure 7.- MPLM Uninstall JOCAS 1
 (91: Camera C: 0, 50)

PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at MPLM Uninstall JOCAS 1 position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-70.0	+70.0	-60.0	-40.0	-120.0	-110.0	+57.7
X	Y	Z	Pitch	Yaw	Roll	
-307	+498	-1134	-128.7	+43.7	-11.7	
FOR	Loaded – MPLM Berth, SY Held					
Disp	LAB>MPLM Berth					

2.622 CONTINGENCY MPLM UNINSTALL

(RBT FS/LF1/FIN/SPN)

8. ATTITUDE CONTROL CONFIGURATION

If using shuttle attitude control, coordinate with shuttle crewmembers

```

    | If attitude maintenance reqd
    |   | DAP: LVLH
    |   | When rates damped
    |   |   | DAP: FREE > 2 seconds
    |   |   | Then DAP: Auto
    |   |   | When in attitude
    |   |   |   | DAP: FREE
    
```

9. MPLM UNINSTALL JOCAS 2

NOTE
JOCAS maneuver will take approximately 15 minutes.

SSRMS Joint OCAS

pick File ► LAB ► MPLM Berth JOCAS 2

Verify 'Joint Angles' 'Destination' for MPLM Uninstall JOCAS 2 position.

SR	SY	SP	EP	WP	WY	WR
-70.0	-42.0	+8.8	-103.0	-115.7	+73.5	+57.7

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON

Verify joint angles and errors are correct on Joint Angle position overlay.

	SR	SY	SP	EP	WP	WY	WR
(current)	-70.0	+70.0	-60.0	-40.0	-120.0	-110.0	+57.7
TGT	-70.0	-42.0	+8.8	-103.0	-115.7	+73.5	+57.7
ERR	0.0	+112.0	-68.8	+63.0	-4.3	-183.5	0.0

PCS

* If joint angles/errors are incorrect
* **cmd** Cancel (Verify Sequence Status – Waiting Destination)

* Input correct Dest joint angles per table above.

* **cmd** Load (Verify Sequence Status – Confirm or Cancel)

MON

* Verify joint angles and errors are correct on Joint Angle Position overlay.

PCS

cmd Confirm (Verify Sequence Status – Auto Seq sw - Hot)

DCP

AUTO SEQ → PROC

2.622 CONTINGENCY MPLM UNINSTALL

(RBT FS/LF1/FIN/SPN)

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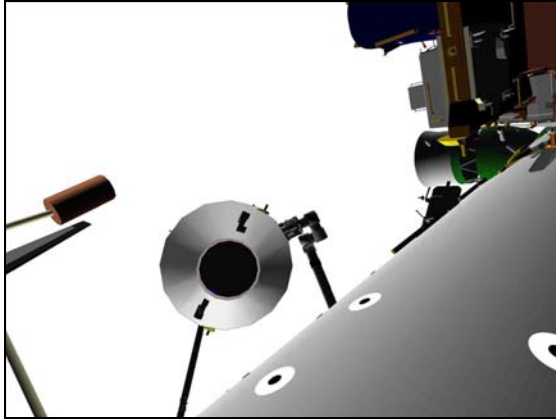


Figure 8.- MPLM Uninstall JOCAS 2
(13: LAB Stbd Zenith: 45, -30).

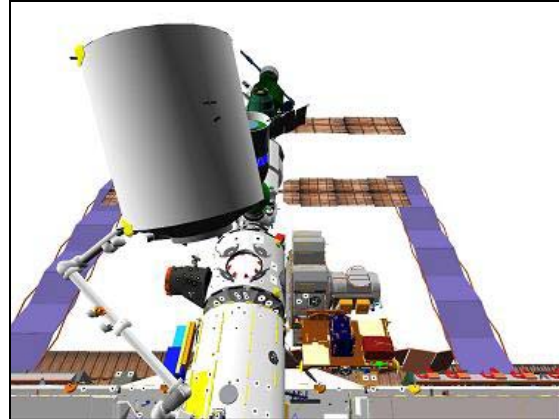


Figure 9.- MPLM Uninstall JOCAS 2
(91: Camera C: 0, 50).

PCS

MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at MPLM Uninstall JOCAS 2 position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-70.0	-42.0	+8.8	-103.0	-115.7	+73.5	+57.7
X	Y	Z	Pitch	Yaw	Roll	
+117	-138	-1164	-30.5	+11.0	-41.3	
FOR	Loaded – MPLM Berth, SY Held					
Disp	LAB>MPLM Berth					

10. ATTITUDE CONTROL CONFIGURATION

If using shuttle attitude control, coordinate with shuttle crewmembers

If attitude maintenance reqd

DAP: LVLH

When rates damped

DAP: FREE > 2 seconds

Then DAP: Auto

When in attitude

DAP: FREE

11. SINGLE JOINT TO LOW HOVER

PCS

MSS: SSRMS:

Enter Mode – Single (Verify blue)

WARNING

The active joint must be checked on the PCS before initiating motion. Failure to do so may result in movement of the wrong joint.

2.622 CONTINGENCY MPLM UNINSTALL

(RBT FS/LF1/FIN/SPN)

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- RHC RATE – as required (VERNIER within 1.5 m of structure)
- DCP JOINT SELECT → SHOULDER ROLL (Verify SR – Selected on PCS)
- THC Perform “–“ Single Joint maneuver to SR: -124.4 (THC down)
- PCS MSS: SSRMS:

Verify SSRMS at Low Hover position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-124.4	-42.0	+8.8	-103.0	-115.7	+73.5	+57.7
X	Y	Z	Pitch	Yaw	Roll	
0	0	-480	0.0	0.0	0.0	
FOR	Loaded – MPLM Berth, SY Held					
Disp	LAB>MPLM Berth					

- DCP BRAKES SSRMS → ON (Verify ON)



Figure 10.- MPLM Low Hover
(13: LAB Stbd Zenith: 15, -30).

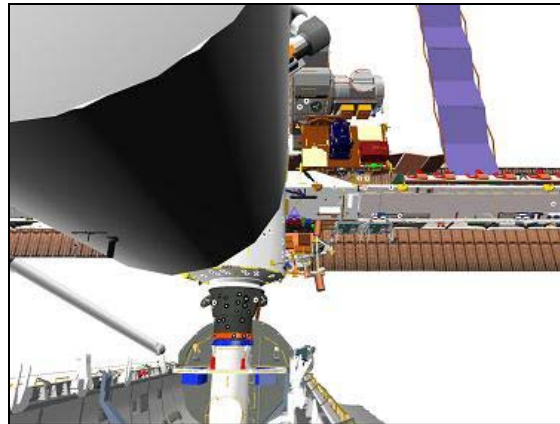


Figure 11.- MPLM Low Hover
(91: Camera C: 0, 20).

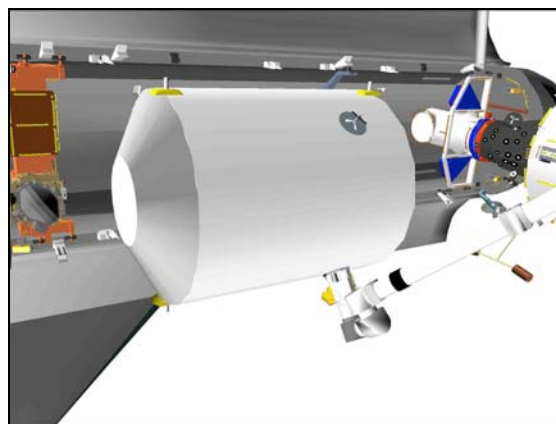


Figure 12.- MPLM Low Hover
(92: OBSS ITVC: 115, -50).

2.622 CONTINGENCY MPLM UNINSTALL

(RBT FS/LF1/FIN/SPN)

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12. ATTITUDE CONTROL CONFIGURATION

If using shuttle attitude control, coordinate with shuttle crewmembers

| If attitude maintenance reqd

| | DAP: LVLH

| | When rates damped

| | | DAP: FREE > 2 seconds

| | | Then DAP: Auto

2.666 CBM LATCH STALL RECOVERY

(RBT FS/LF1/FIN 1)

Page 1 of 2 pages

1. SSRMS SAFING AND BRAKES STATUS

On CBM Operator, "Go for CBM Latch Stall Recovery."

PCS MSS: SSRMS:

√SSRMS Safing – Not Safed

DCP √BRAKES SSRMS - OFF

2. SSRMS MODE ENTRY

PCS If Limp - blue

MSS: SSRMS: Limp:

cmd None Limp (Verify Standby – blue)

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

3. SSRMS SETUP

MSS: SSRMS:

√Command – SSRMS>Internal

√Vernier

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: 0.5 (Verify 0.5)

4. CBM MATING

THC Apply Full -X deflection (THC out) for 5 sec

PCS MSS: SSRMS:

Verify Posn Hold - orange

Enter Mode – Standby (Verify blue)

2.666 CBM LATCH STALL RECOVERY

(RBT FS/LF1/FIN 1)

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MSS: SSRMS: Limp:

cmd All Limp (Verify Limp – blue)

MSS: SSRMS:

Verify all joints – Limped

Give CBM Operator Go to reattempt CBM 2nd Stage Capture.

2.710 MSS CHANNEL 2B LOAD SHED PRE-EMPTION - GROUND ONLY

(RBT FS/LF1/FIN)

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NOTE

1. This procedure was written for EPS Load Shed Table R4v15.
2. This procedure assumes assembly criticality 1 MSS operations are in progress.

1. APPLYING RPC OPEN INHIBITS

Equipment	RPCM	PUI	Command
VSU 2	LAD52B A C RPC 5	LAPR96IM1425K:050	RPC Open Cmd – Inhibit
SCU 2	LAD52B A C RPC 6	LAPR96IM1425K:051	RPC Open Cmd – Inhibit
VSU 3	LA2B G RPC 8	LAPR96IM1414K:051	RPC Open Cmd – Inhibit
CVIU 4	LAS5 2A3B A RPC 4	LAPR96IM0236K:050	RPC Open Cmd – Inhibit
CVIU 5	LAS5 2A3B A RPC 5	LAPR96IM0236K:051	RPC Open Cmd – Inhibit
CVIU 6	LAS5 2A3B A RPC 6	LAPR96IM0236K:052	RPC Open Cmd – Inhibit
TUS 2 VSC	S03A E RPC 2	S0PR96IM0750K:050	RPC Open Cmd – Inhibit
TUS 1 VSC	S03A F RPC 2	S0PR96IM0751K:050	RPC Open Cmd – Inhibit
CUP RWS CEU	LAS5 2A3B A RPC 2	LAPR96IM0236K:053	RPC Open Cmd – Inhibit
SSRMS @ LAB PDGF	S03A D RPC 2	S0PR96IM0749K:050	RPC Open Cmd – Inhibit
MSS @ WS 4	S03A A RPC 1	S0PR96IM0746K:050	RPC Open Cmd – Inhibit
MSS @ WS 5	S03A B RPC 1	S0PR96IM0747K:050	RPC Open Cmd – Inhibit
MSS @ WS 2	S13A E RPC 1	S0PR96IM1049K:050	RPC Open Cmd – Inhibit
MSS @ WS 3	S13A F RPC 1	S0PR96IM1050K:050	RPC Open Cmd – Inhibit
MSS @ WS 7	P13A E RPC 1	S0PR96IM0903K:050	RPC Open Cmd – Inhibit
MSS @ WS 6	P13A F RPC 1	S0PR96IM0904K:050	RPC Open Cmd – Inhibit

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2.720 MSS CHANNEL 4B LOAD SHED PRE-EMPTION - GROUND ONLY

(RBT FS/LF1/FIN)

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NOTE

1. This procedure was written for EPS Load Shed Table R4v15.
2. This procedure assumes assembly criticality 1 MSS operations are in progress.

1. APPLYING RPC OPEN INHIBITS

Equipment	RPCM	PUI	Command
Lab ETVCG Light	S01A C RPC 12	LAPR96IM1792K:050	RPC Open Cmd – Inhibit
Lab ETVCG	S01A C RPC 13	LAPR96IM1792K:051	RPC Open Cmd – Inhibit
S1 LOOB ETVCG Light	S11A A RPC 1	S0PR96IM1040K:050	RPC Open Cmd – Inhibit
S1 LOOB ETVCG	S11A A RPC 15	S0PR96IM1040K:051	RPC Open Cmd – Inhibit
P1 LOOB ETVCG Light	P11A A RPC 1	S0PR96IM0894K:050	RPC Open Cmd – Inhibit
P1 LOOB ETVCG	P11A A RPC 15	S0PR96IM0894K:051	RPC Open Cmd – Inhibit
SCU 1	LAD11B A RPC 3	LAPR96IM1419K:050	RPC Open Cmd – Inhibit
VSU 1	LAD11B A RPC 4	LAPR96IM1419K:051	RPC Open Cmd – Inhibit
CVIU 12	LAP5 1A4A A RPC 4	LAPR96IM0235K:050	RPC Open Cmd – Inhibit
CVIU 2	LAP5 1A4A A RPC 5	LAPR96IM0235K:051	RPC Open Cmd – Inhibit
CVIU 3	LAP5 1A4A A RPC 6	LAPR96IM0235K:052	RPC Open Cmd – Inhibit
TUS 2 VSC	S04B E RPC 2	S0PR96IM0756K:050	RPC Open Cmd – Inhibit
TUS 1 VSC	S04B F RPC 2	S0PR96IM0757K:050	RPC Open Cmd – Inhibit
Lab RWS CEU	LAP5 1A4A A RPC 2	LAPR96IM0235K:053	RPC Open Cmd – Inhibit
SSRMS @ Lab PDGF	S04B D RPC 2	S0PR96IM0755K:050	RPC Open Cmd – Inhibit
MSS @ WS 4	S04B A RPC 1	S0PR96IM0752K:050	RPC Open Cmd – Inhibit
MSS @ WS 5	S04B B RPC 1	S0PR96IM0753K:050	RPC Open Cmd – Inhibit
MSS @ WS 2	S14B E RPC 1	S0PR96IM1044K:050	RPC Open Cmd – Inhibit
MSS @ WS 3	S14B F RPC 1	S0PR96IM1045K:050	RPC Open Cmd – Inhibit
MSS @ WS 7	P14B E RPC 1	S0PR96IM0896K:050	RPC Open Cmd – Inhibit
MSS @ WS 6	P14B F RPC 1	S0PR96IM0897K:050	RPC Open Cmd – Inhibit

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2.730 MSS CHANNEL 2B CONTINUATION OF LOAD SHED - GROUND ONLY

(RBT FS/LF1/FIN)

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NOTE

This procedure was written for EPS Load Shed Table R4v15.

POWERING DOWN EQUIPMENT

Equipment	RPCM	PUI	Command
VSU 2	LAD52B A RPC 5	LAPR96IM1425K:055	RPC Open Cmd – Enable
		LAPR96IM1270K	RPC Position - Open
SCU 2	LAD52B A RPC 6	LAPR96IM1425K:056	RPC Open Cmd – Enable
		LAPR96IM1271K	RPC Position - Open
VSU 3	LA2B G RPC 8	LAPR96IM1425K:056	RPC Open Cmd – Enable
		LAPR96IM1127K	RPC Position - Open
CVIU 4	LAS5 2A3B A RPC 4	LAPR96IM0236K:055	RPC Open Cmd – Enable
		LAPR96IM0404K	RPC Position - Open
CVIU 5	LAS5 2A3B A RPC 5	LAPR96IM0236K:056	RPC Open Cmd – Enable
		LAPR96IM0405K	RPC Position - Open
CVIU 6	LAS5 2A3B A RPC 6	LAPR96IM0236K:057	RPC Open Cmd – Enable
		LAPR96IM0406K	RPC Position - Open
TUS 2 VSC	S03A E RPC 2	S0PR96IM0750K:055	RPC Open Cmd – Enable
		S0PR96IM0621K	RPC Position - Open
TUS 1 VSC	S03A F RPC 2	S0PR96IM0751K:055	RPC Open Cmd – Enable
		S0PR96IM0639K	RPC Position - Open
SSRMS @ LAB PDGF	S03A D RPC 2	S0PR96IM0749K:055	RPC Open Cmd – Enable
MSS @ WS 4	S03A A RPC 1	S0PR96IM0746K:055	RPC Open Cmd – Enable
MSS @ WS 5	S03A B RPC 1	S0PR96IM0747K:055	RPC Open Cmd – Enable
MSS @ WS 2	S13A E RPC 1	S0PR96IM1049K:055	RPC Open Cmd – Enable
MSS @ WS 3	S13A F RPC 1	S0PR96IM1050K:055	RPC Open Cmd – Enable
MSS @ WS 7	P13A E RPC 1	S0PR96IM0903K:055	RPC Open Cmd – Enable
MSS @ WS 6	P13A F RPC 1	S0PR96IM0904K:055	RPC Open Cmd – Enable
SSRMS		CMRM96IM0454K	SSRMS Safing - Apply
SSRMS		CMRM96IM0117K	SSRMS Pwr Red - Off
MBS		CMRM96IM0455K	MBS Safing - Apply
MBS		CMRM96IM0207K	MBS Pwr Red - Off
CUP RWS CEU	LAS5 2A3B A RPC 2	LAPR96IM0236K:058	RPC Open Cmd – Enable
	LAS5 2A3B A RPC 2	LAPR96IM0402K	RPC Position - Open

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2.740 MSS CHANNEL 4B CONTINUATION OF LOAD SHED - GROUND ONLY

(RBT FS/LF1/FIN)

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NOTE

This procedure was written for EPS Load Shed Table R4v15.

POWERING DOWN EQUIPMENT

Equipment	RPCM	PUI	Command
Lab ETVCG Light	S01A C RPC 12	LAPR96IM1792K:055	RPC Open Cmd – Enable
	S01A C RPC 12	LAPR96IM1823K	RPC Position - Open
Lab ETVCG	S01A C RPC 13	LAPR96IM1792K:056	RPC Open Cmd – Enable
	S01A C RPC 13	LAPR96IM1824K	RPC Position - Open
S1 LOOB ETVCG Light	S11A A RPC 1	S0PR96IM1040K:055	RPC Open Cmd – Enable
	S11A A RPC 1	S0PR96IM0906K	RPC Position - Open
S1 LOOB ETVCG	S11A A RPC 15	S0PR96IM1040K:056	RPC Open Cmd – Enable
	S11A A RPC 15	S0PR96IM0920K	RPC Position - Open
P1 LOOB ETVCG Light	P11A A RPC 1	S0PR96IM0894K:055	RPC Open Cmd – Enable
	P11A A RPC 1	S0PR96IM0760K	RPC Position - Open
P1 LOOB ETVCG	P11A A RPC 15	S0PR96IM0894K:056	RPC Open Cmd – Enable
	P11A A RPC 15	S0PR96IM0774K	RPC Position - Open
SCU 1	LAD11B A RPC 3	LAPR96IM1419K:055	RPC Open Cmd – Enable
	LAD11B A RPC 3	LAPR96IM1174K	RPC Position - Open
VSU 1	LAD11B A RPC 4	LAPR96IM1419K:056	RPC Open Cmd – Enable
	LAD11B A RPC 4	LAPR96IM1175K	RPC Position - Open
CVIU 12	LAP5 1A4A A RPC 4	LAPR96IM0235K:055	RPC Open Cmd – Enable
	LAP5 1A4A A RPC 4	LAPR96IM0386K	RPC Position - Open
CVIU 2	LAP5 1A4A A RPC 5	LAPR96IM0235K:056	RPC Open Cmd – Enable
	LAP5 1A4A A RPC 5	LAPR96IM0387K	RPC Position - Open
CVIU 3	LAP5 1A4A A RPC 6	LAPR96IM0235K:057	RPC Open Cmd – Enable
	LAP5 1A4A A RPC 6	LAPR96IM0388K	RPC Position - Open
TUS 2 VSC	S04B E RPC 2	S0PR96IM0756K:055	RPC Open Cmd – Enable
	S04B E RPC 2	S0PR96IM0667K	RPC Position - Open
TUS 1 VSC	S04B F RPC 2	S0PR96IM0757K:055	RPC Open Cmd – Enable
	S04B F RPC 2	S0PR96IM0685K	RPC Position - Open
SSRMS @ Lab PDGF	S04B D RPC 2	S0PR96IM0755K:055	RPC Open Cmd – Enable
MSS @ WS 4	S04B A RPC 1	S0PR96IM0752K:055	RPC Open Cmd – Enable
MSS @ WS 5	S04B B RPC 1	S0PR96IM0753K:055	RPC Open Cmd – Enable
MSS @ WS 2	S14B E RPC 1	S0PR96IM1044K:055	RPC Open Cmd – Enable
MSS @ WS 3	S14B F RPC 1	S0PR96IM1045K:055	RPC Open Cmd – Enable
MSS @ WS 7	P14B E RPC 1	S0PR96IM0896K:055	RPC Open Cmd – Enable
MSS @ WS 6	P14B F RPC 1	S0PR96IM0897K:055	RPC Open Cmd – Enable
SSRMS		CMRM96IM0454K	SSRMS Safing - Apply
SSRMS		CMRM96IM0116K	SSRMS Pwr Prime - Off
MBS		CMRM96IM0455K	MBS Safing - Apply
MBS		CMRM96IM0205K	MBS Pwr Prime - Off
LAB RWS CEU	LAP5 1A4A A RPC 2	LAPR96IM0235K:058	RPC Open Cmd - Enable
	LAP5 1A4A A RPC 2	LAPR96IM0384K	RPC Position - Open

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2.750 MSS CHANNEL 2B LOAD SHED PRE-EMPT BACKOUT - GROUND ONLY

(RBT FS/LF1/FIN)

Page 1 of 1 page

NOTE

This procedure was written for EPS Load Shed Table R4v15.

APPLYING RPC OPEN COMMAND ENABLES

Equipment	RPCM	PUI	Command
VSU 2	LAD52B A RPC 5	LAPR96IM1425K:055	RPC Open Cmd – Enable
SCU 2	LAD52B A RPC 6	LAPR96IM1425K:056	RPC Open Cmd – Enable
VSU 3	LA2B G RPC 8	LAPR96IM1425K:056	RPC Open Cmd – Enable
CVIU 4	LAS5 2A3B A RPC 4	LAPR96IM0236K:055	RPC Open Cmd – Enable
CVIU 5	LAS5 2A3B A RPC 5	LAPR96IM0236K:056	RPC Open Cmd – Enable
CVIU 6	LAS5 2A3B A RPC 6	LAPR96IM0236K:057	RPC Open Cmd – Enable
TUS 2 VSC	S03A E RPC 2	S0PR96IM0750K:055	RPC Open Cmd – Enable
TUS 1 VSC	S03A F RPC 2	S0PR96IM0751K:055	RPC Open Cmd – Enable
SSRMS @ LAB PDGF	S03A D RPC 2	S0PR96IM0749K:055	RPC Open Cmd – Enable
MSS @ WS 4	S03A A RPC 1	S0PR96IM0746K:055	RPC Open Cmd – Enable
MSS @ WS 5	S03A B RPC 1	S0PR96IM0747K:055	RPC Open Cmd – Enable
MSS @ WS 2	S13A E RPC 1	S0PR96IM1049K:055	RPC Open Cmd – Enable
MSS @ WS 3	S13A F RPC 1	S0PR96IM1050K:055	RPC Open Cmd – Enable
MSS @ WS 7	P13A E RPC 1	S0PR96IM0903K:055	RPC Open Cmd – Enable
MSS @ WS 6	P13A F RPC 1	S0PR96IM0904K:055	RPC Open Cmd – Enable
CUP RWS CEU	LAS5 2A3B A RPC 2	LAPR96IM0236K:058	RPC Open Cmd – Enable

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2.760 MSS CHANNEL 4B LOAD SHED PRE-EMPT BACKOUT- GROUND ONLY

(RBT FS/LF1/FIN)

Page 1 of 1 page

NOTE

This procedure was written for EPS Load Shed Table R4v15.

APPLYING RPC OPEN COMMAND ENABLES

Equipment	RPCM	PUI	Command
Lab ETVCG Light	S01A C RPC 12	LAPR96IM1792K:055	RPC Open Cmd – Enable
Lab ETVCG	S01A C RPC 13	LAPR96IM1792K:056	RPC Open Cmd – Enable
S1 LOOB ETVCG Light	S11A A RPC 1	S0PR96IM1040K:055	RPC Open Cmd – Enable
S1 LOOB ETVCG	S11A A RPC 15	S0PR96IM1040K:056	RPC Open Cmd – Enable
P1 LOOB ETVCG Light	P11A A RPC 1	S0PR96IM0894K:055	RPC Open Cmd – Enable
P1 LOOB ETVCG	P11A A RPC 15	S0PR96IM0894K:056	RPC Open Cmd – Enable
SCU 1	LAD11B A RPC 3	LAPR96IM1419K:055	RPC Open Cmd – Enable
VSU 1	LAD11B A RPC 4	LAPR96IM1419K:056	RPC Open Cmd – Enable
CVIU 12	LAP5 1A4A A RPC 4	LAPR96IM0235K:055	RPC Open Cmd – Enable
CVIU 2	LAP5 1A4A A RPC 5	LAPR96IM0235K:056	RPC Open Cmd – Enable
CVIU 3	LAP5 1A4A A RPC 6	LAPR96IM0235K:057	RPC Open Cmd – Enable
TUS 2 VSC	S04B E RPC 2	S0PR96IM0756K:055	RPC Open Cmd – Enable
TUS 1 VSC	S04B F RPC 2	S0PR96IM0757K:055	RPC Open Cmd – Enable
SSRMS @ Lab PDGF	S04B D RPC 2	S0PR96IM0755K:055	RPC Open Cmd – Enable
MSS @ WS 4	S04B A RPC 1	S0PR96IM0752K:055	RPC Open Cmd – Enable
MSS @ WS 5	S04B B RPC 1	S0PR96IM0753K:055	RPC Open Cmd – Enable
MSS @ WS 2	S14B E RPC 1	S0PR96IM1044K:055	RPC Open Cmd – Enable
MSS @ WS 3	S14B F RPC 1	S0PR96IM1045K:055	RPC Open Cmd – Enable
MSS @ WS 7	P14B E RPC 1	S0PR96IM0896K:055	RPC Open Cmd – Enable
MSS @ WS 6	P14B F RPC 1	S0PR96IM0897K:055	RPC Open Cmd – Enable
LAB RWS CEU	LAP5 1A4A A RPC 2	LAPR96IM0235K:058	RPC Open Cmd – Enable

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REFERENCE DATA

REFERENCE DATA

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3.110 CBCS RTL CONFIGURATION

(RBT FS/LF1/FIN)

Page 1 of 1 page

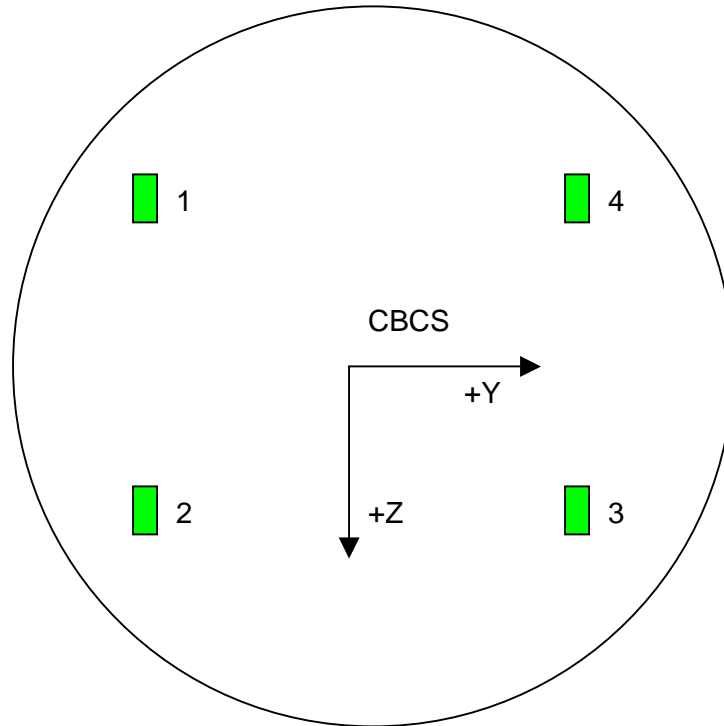


Figure 1.- CBCS RTL Configuration.

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3.120 ESP2/ESPAD RTL CHEAT SHEET

(RBT FS/LF1/FIN)

Page 1 of 2 pages

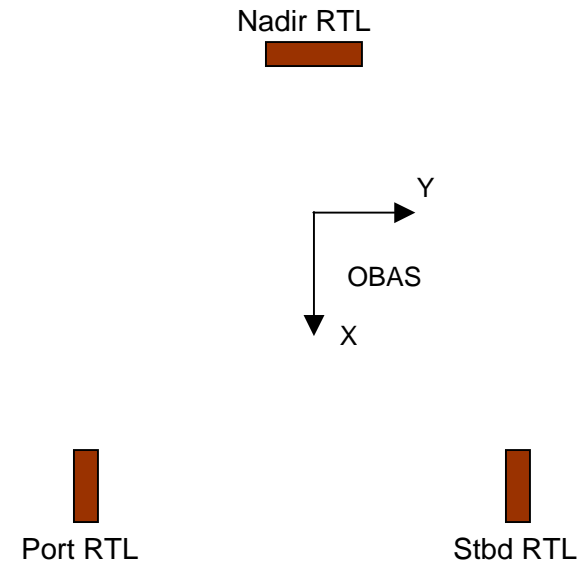
411

RTL			RHC Input *
Port	Starboard	Nadir	
-	-	√	+ Pitch**
√	-	-	- Roll**
-	√	-	+ Roll**
√	√	-	- Pitch
√	-	√	- Roll, + Pitch
-	√	√	+ Roll, + Pitch

* All inputs with respect to OBAS.

** With only one RTL depressed, monitor Yaw misalignment during correction.

Figure 1.- Used When ESP2 Install OBAS FOR loaded.



3.120 ESP2/ESPAD RTL CHEAT SHEET

(RBT FS/LF1/FIN)

Page 2 of 2 pages

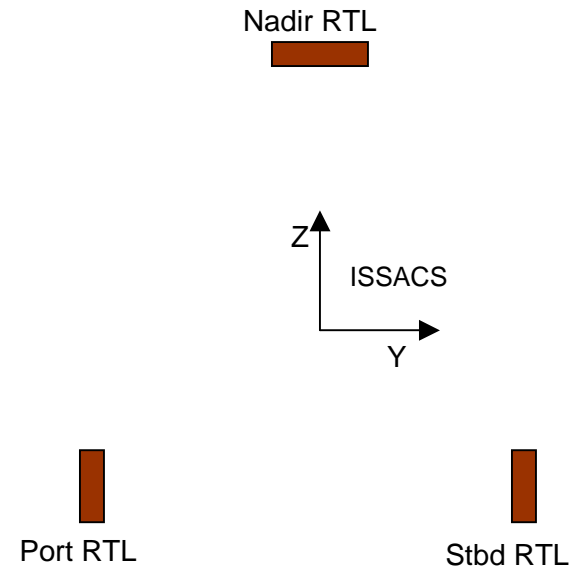
412

RTL			RHC Input *
Port	Starboard	Nadir	
-	-	√	+ Pitch **
√	-	-	+ Yaw **
-	√	-	- Yaw **
√	√	-	- Pitch
√	-	√	+ Yaw, + Pitch
-	√	√	- Yaw, + Pitch

* All inputs with respect to ISSACS.

** With only one RTL depressed, monitor Roll misalignment during correction.

Figure 2.- Used When ESP2 Install FOR loaded.



3.130 PAYLOAD BAY PRLA CONFIGURATION
(RBT FS/LF1/FIN)

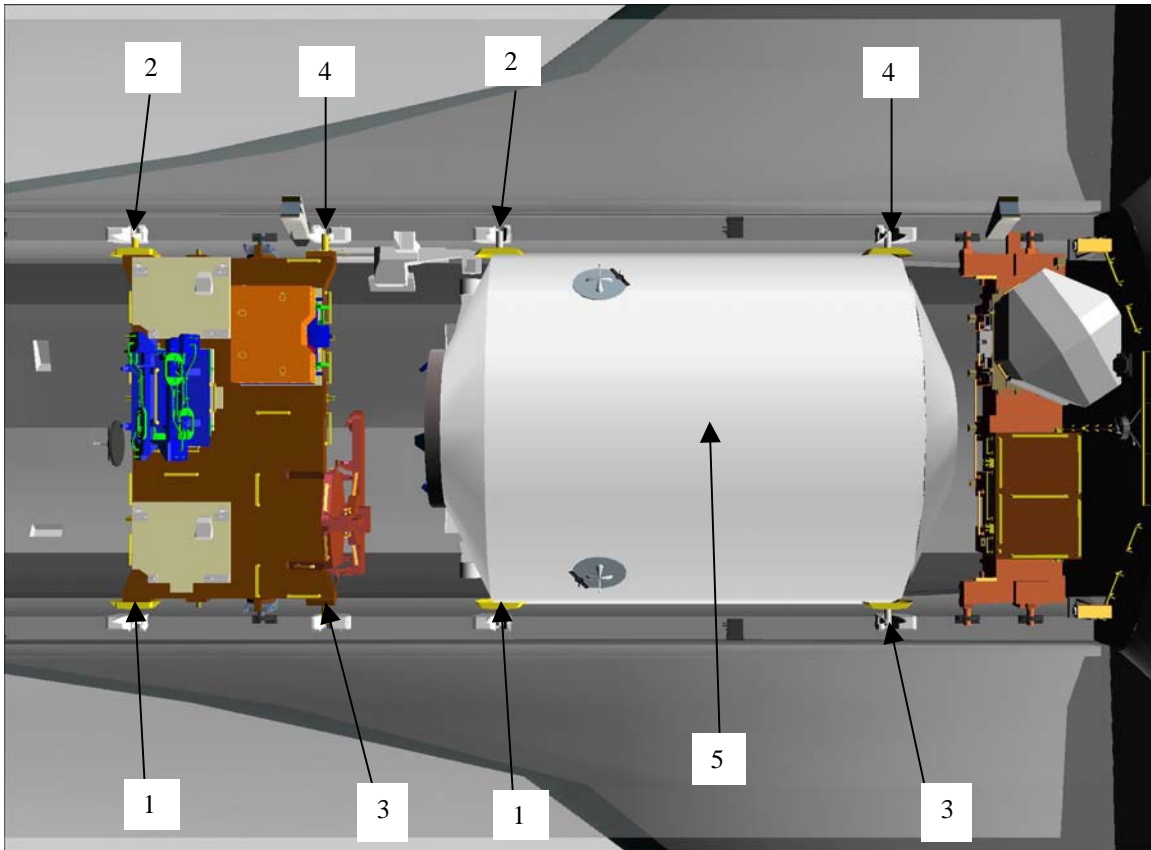


Figure 1.- ESP2 and MPLM PRLA Configuration.

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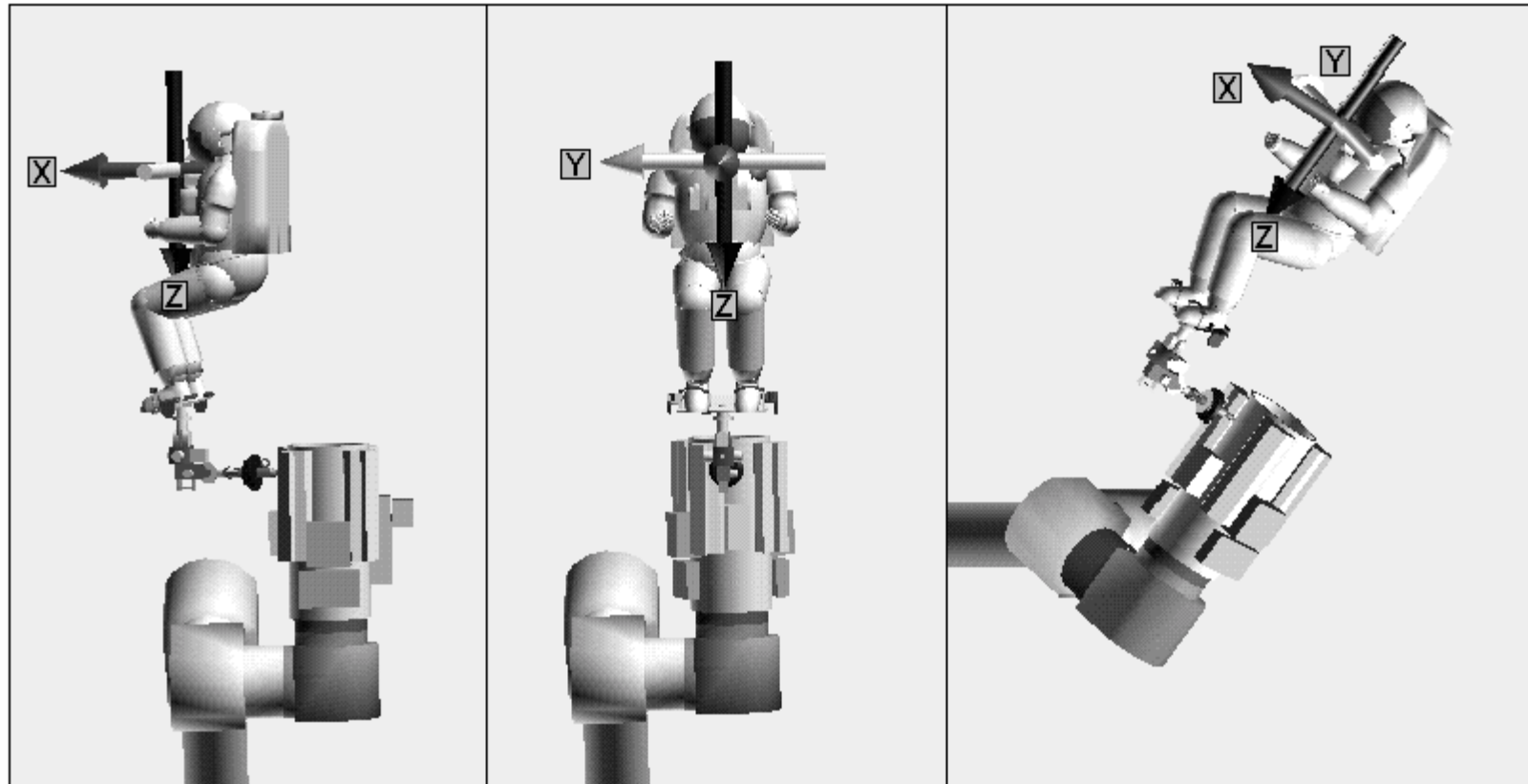
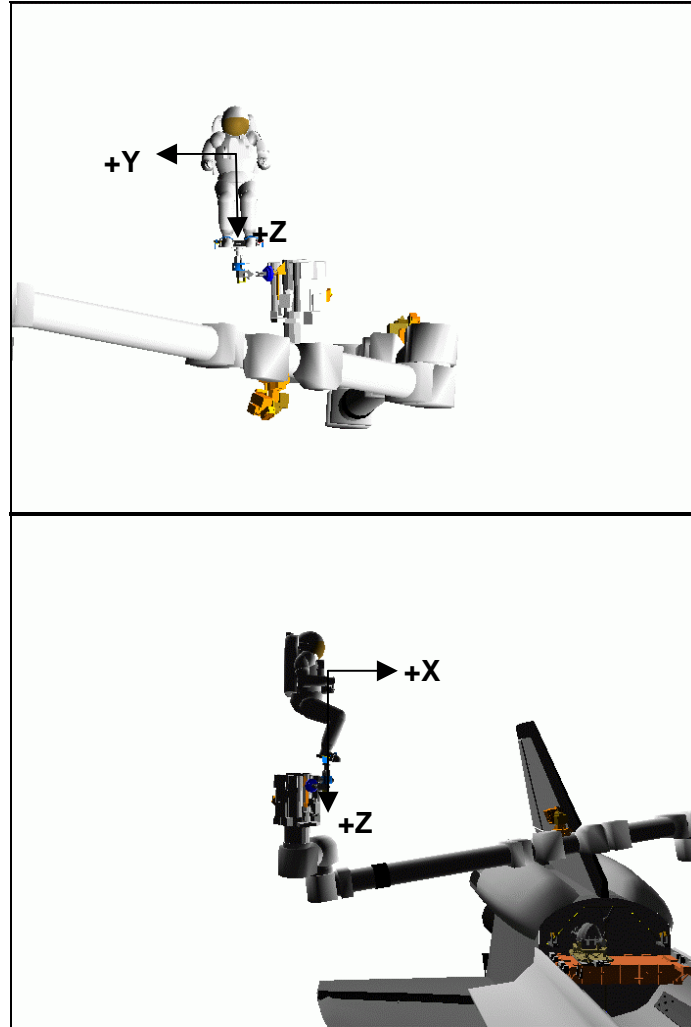


Figure 1.- EVA Chest 12/PP/F/6 Frame of Reference.

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3.220 FRAME OF REFERENCE (FOR): EVA, CHEST 12/PP/F/4
(RBT FS/LF1/FIN) Page 1 of 1 page



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3.310 FRAME OF REFERENCE (FOR): MPLM>MPLM BERTH
 (RBT FS/LF1/FIN) Page 1 of 1 page

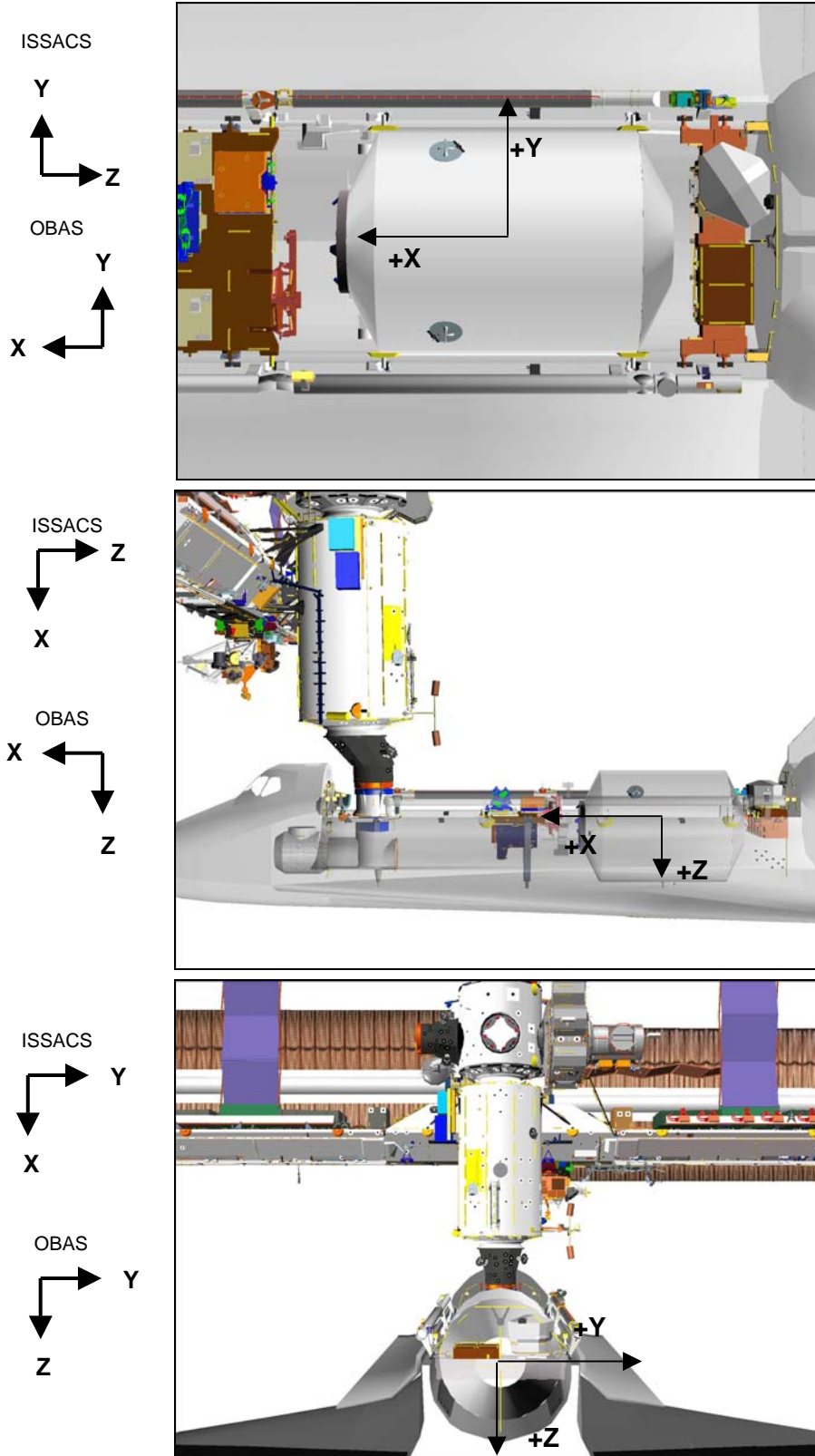


Figure 1.- MPLM Berth Frame of Reference and Display Frame.

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3.320 DISPLAY FRAME: LAB>MPLM CBCS
 (RBT FS/LF1/FIN) Page 1 of 1 page

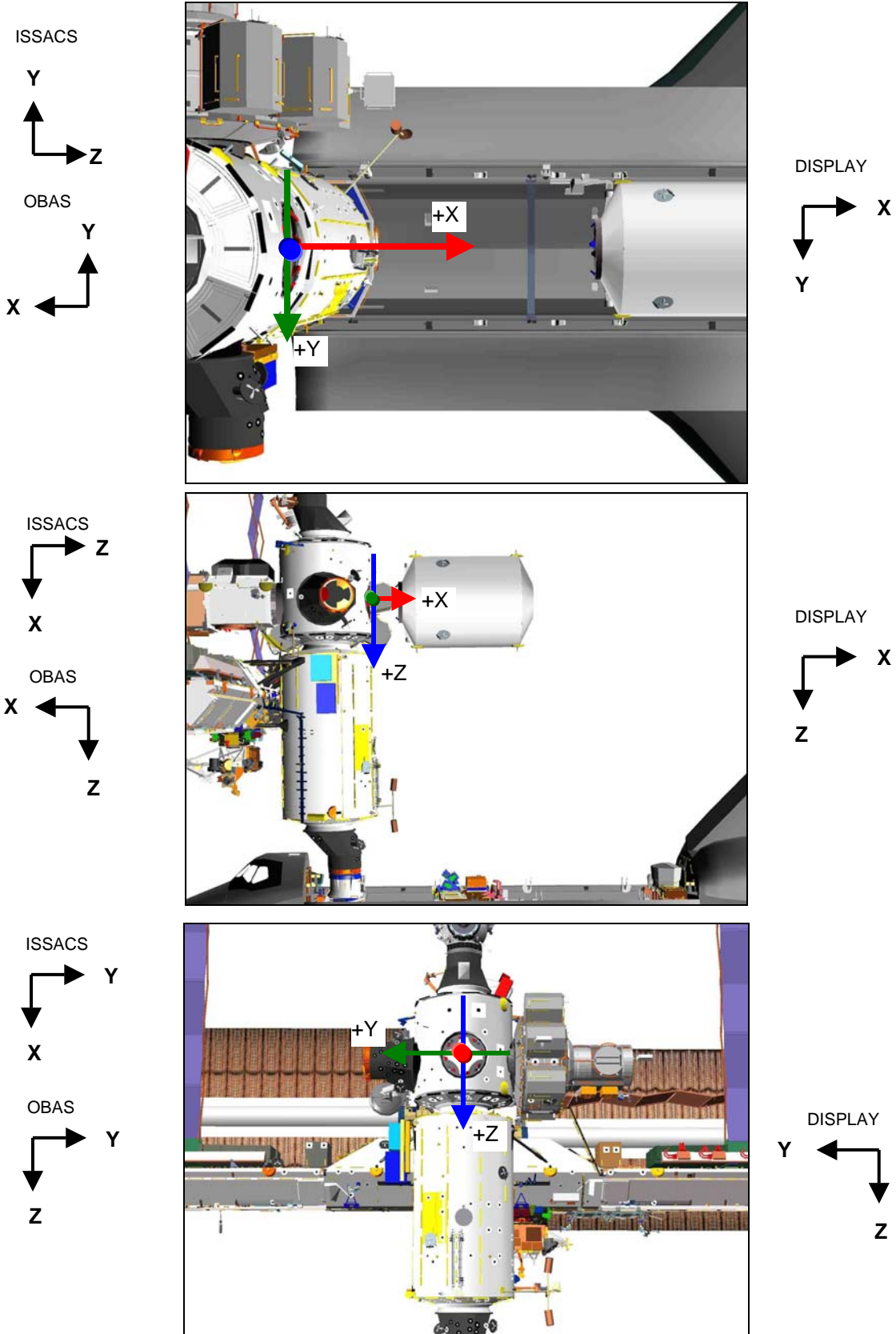


Figure 1.- MPLM CBCS Display Frame.

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3.330 FRAME OF REFERENCE (FOR): MPLM>MPLM CBCS
 (RBT FS/LF1/FIN) Page 1 of 1 page

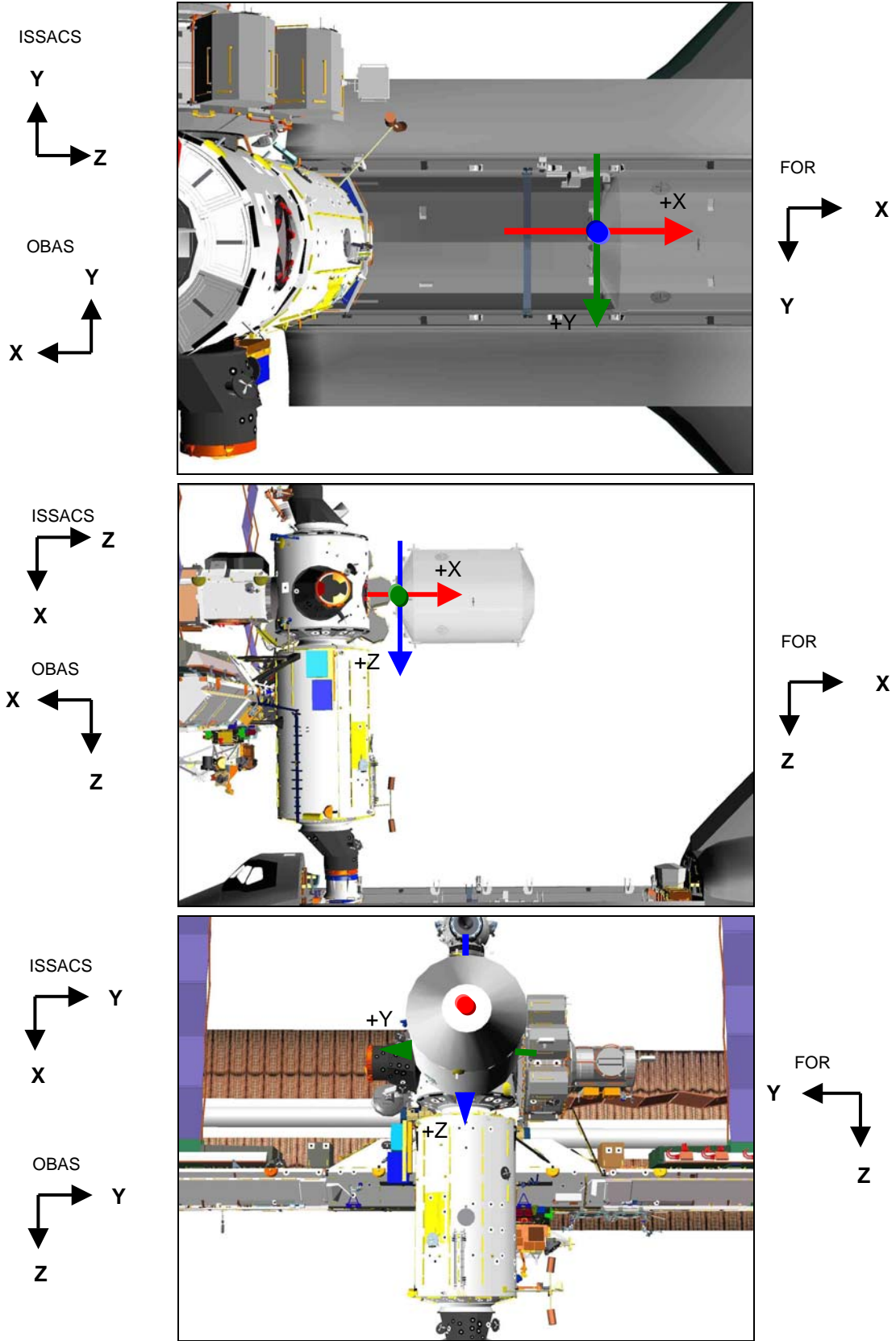


Figure 1.- MPLM Install CBCS Frame of Reference.

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3.410 FRAME OF REFERENCE (FOR): ESP2>ESP2 UNBERTH
 (RBT FS/LF1/FIN) Page 1 of 1 page

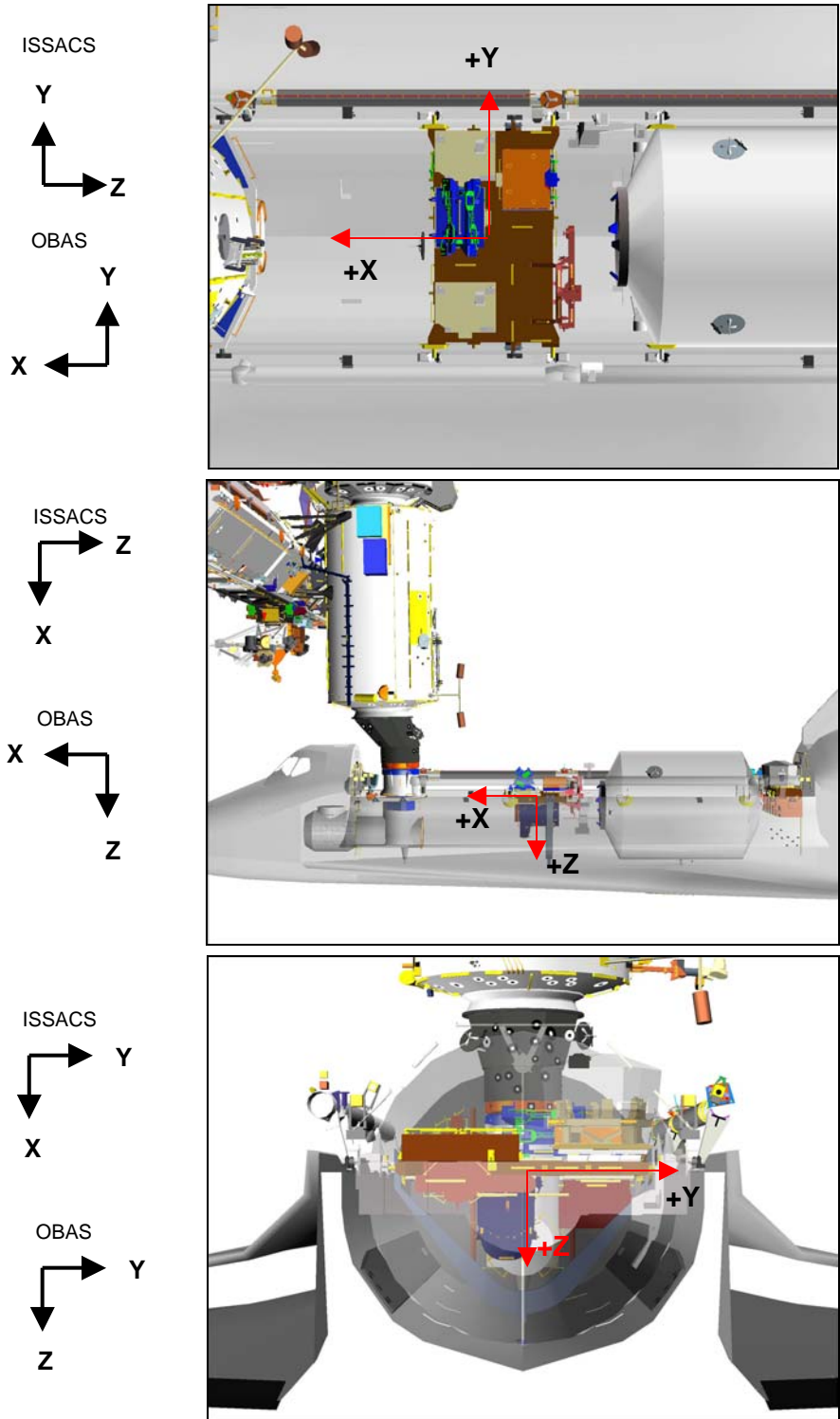


Figure 1.- ESP2 Unberth Frame of Reference and Display Frame.

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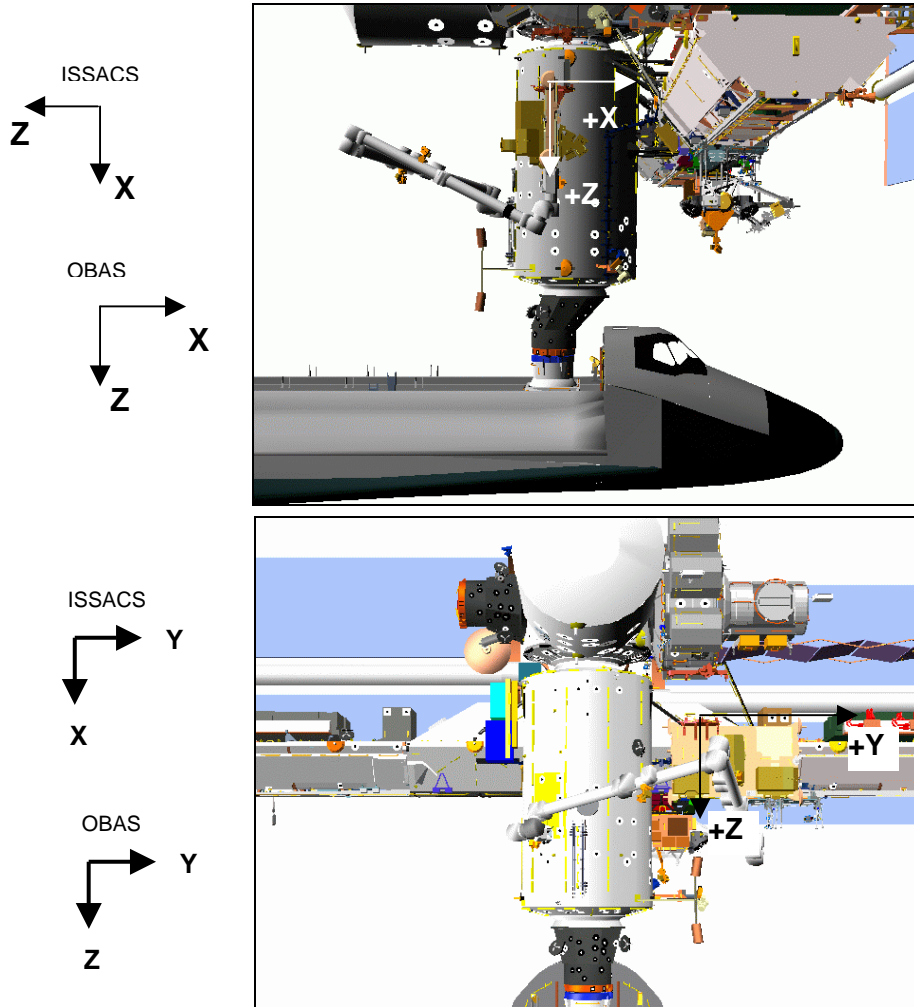


Figure 1.- ESP2 Install OBAS Frame of Reference.

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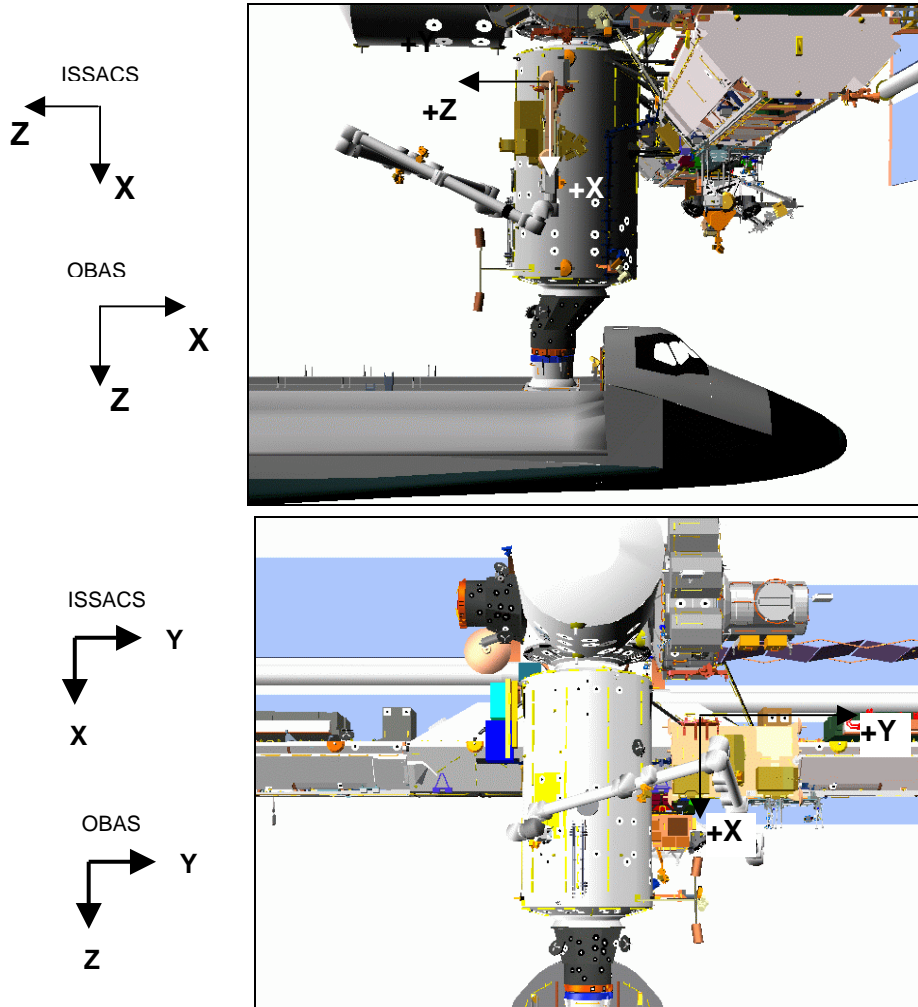


Figure 1.- ESP2 Install Frame of Reference.

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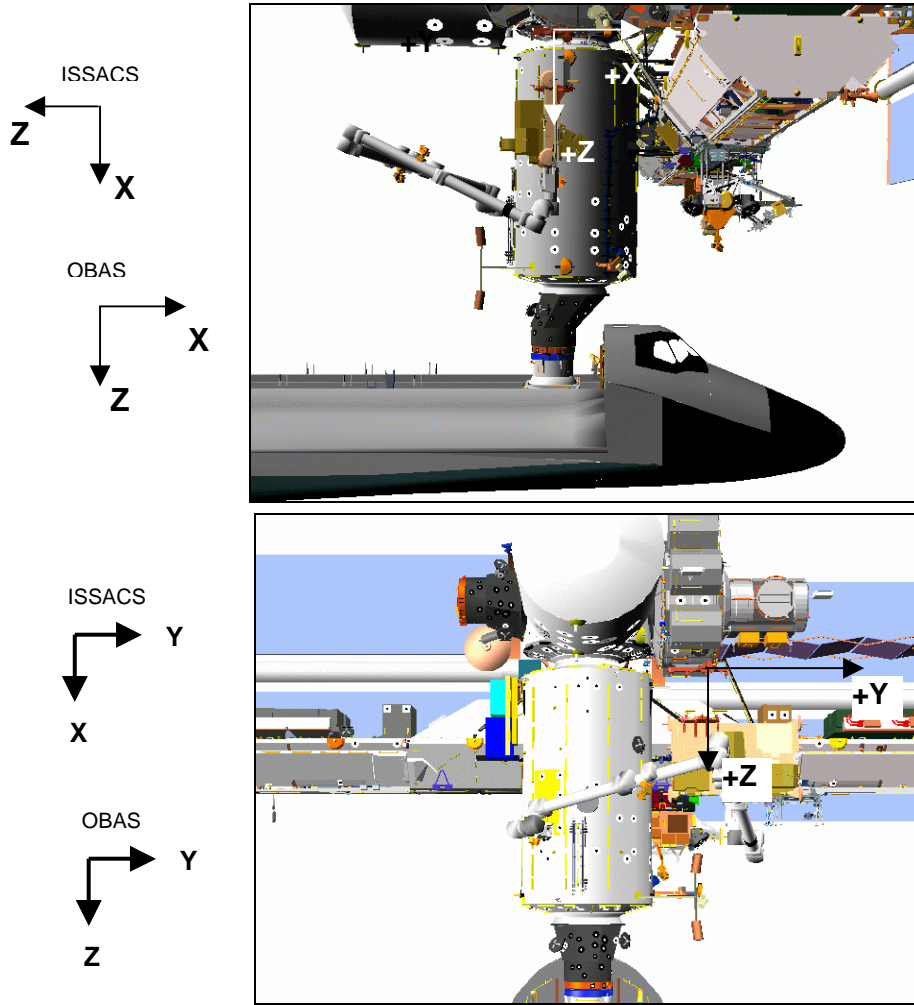


Figure 1.- LAB>ESP2 Install OBAS Display Frame.

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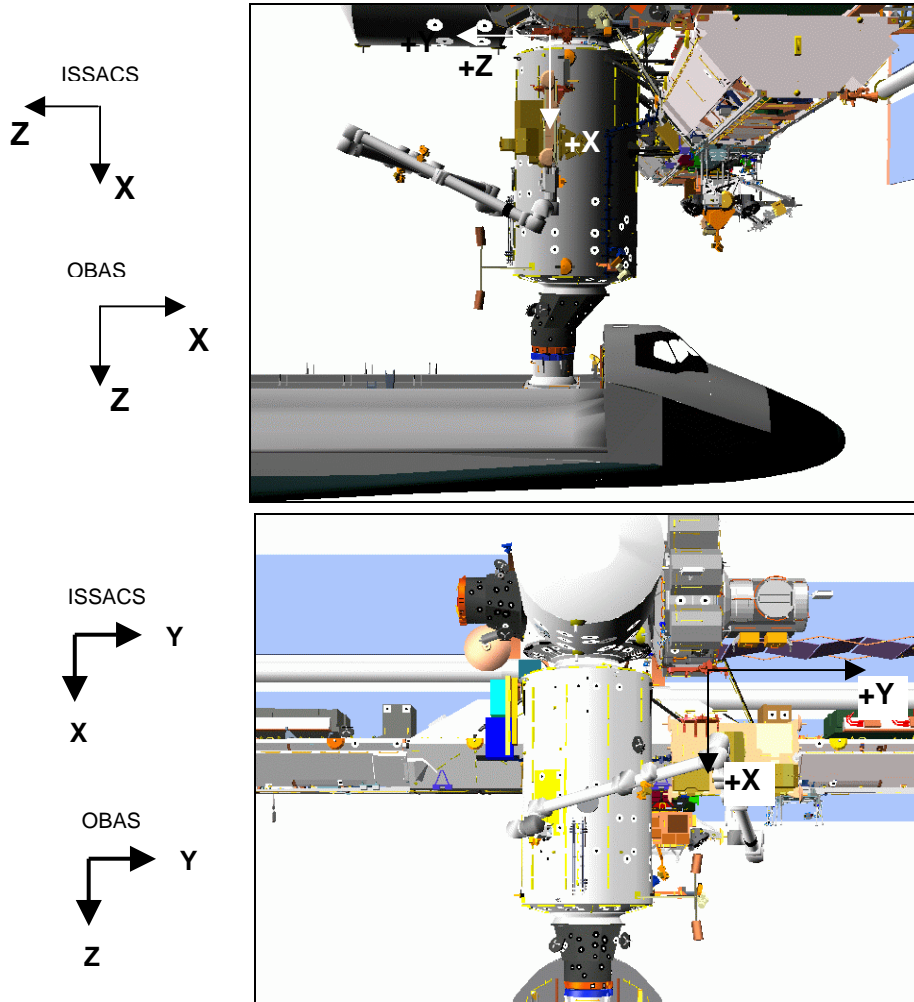


Figure 1.- LAB>ESP2 Install Display Frame.

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3.510 COMMAND AND DISPLAY FRAME: LAB>OBAS
 (RBT FS/LF1/FIN) Page 1 of 1 page

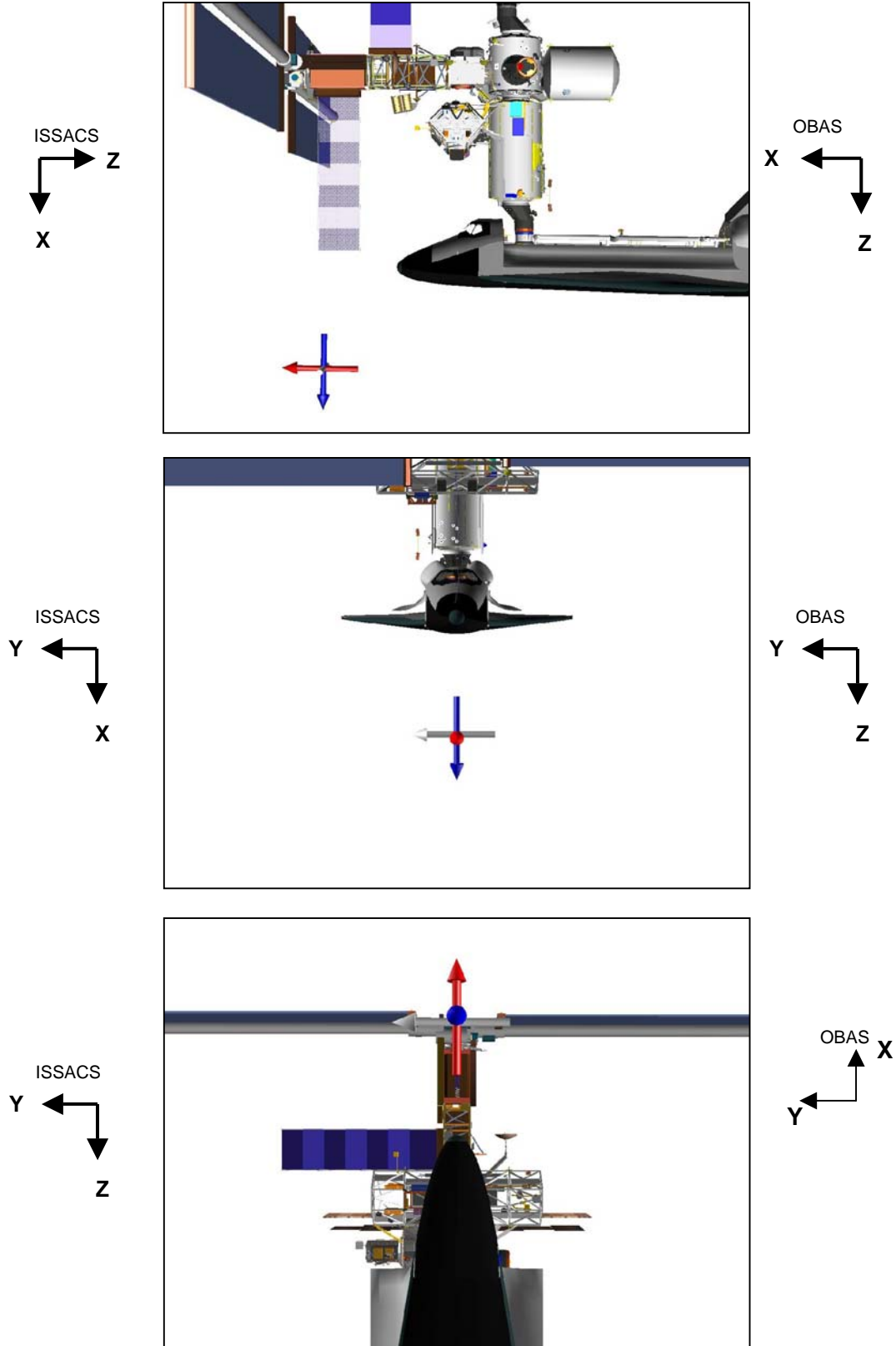


Figure 1.- LAB>OBAS Command/Display Frame.

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3.520 COMMAND AND DISPLAY FRAME: LAB>ISSACS
(RBT FS/LF1/FIN)

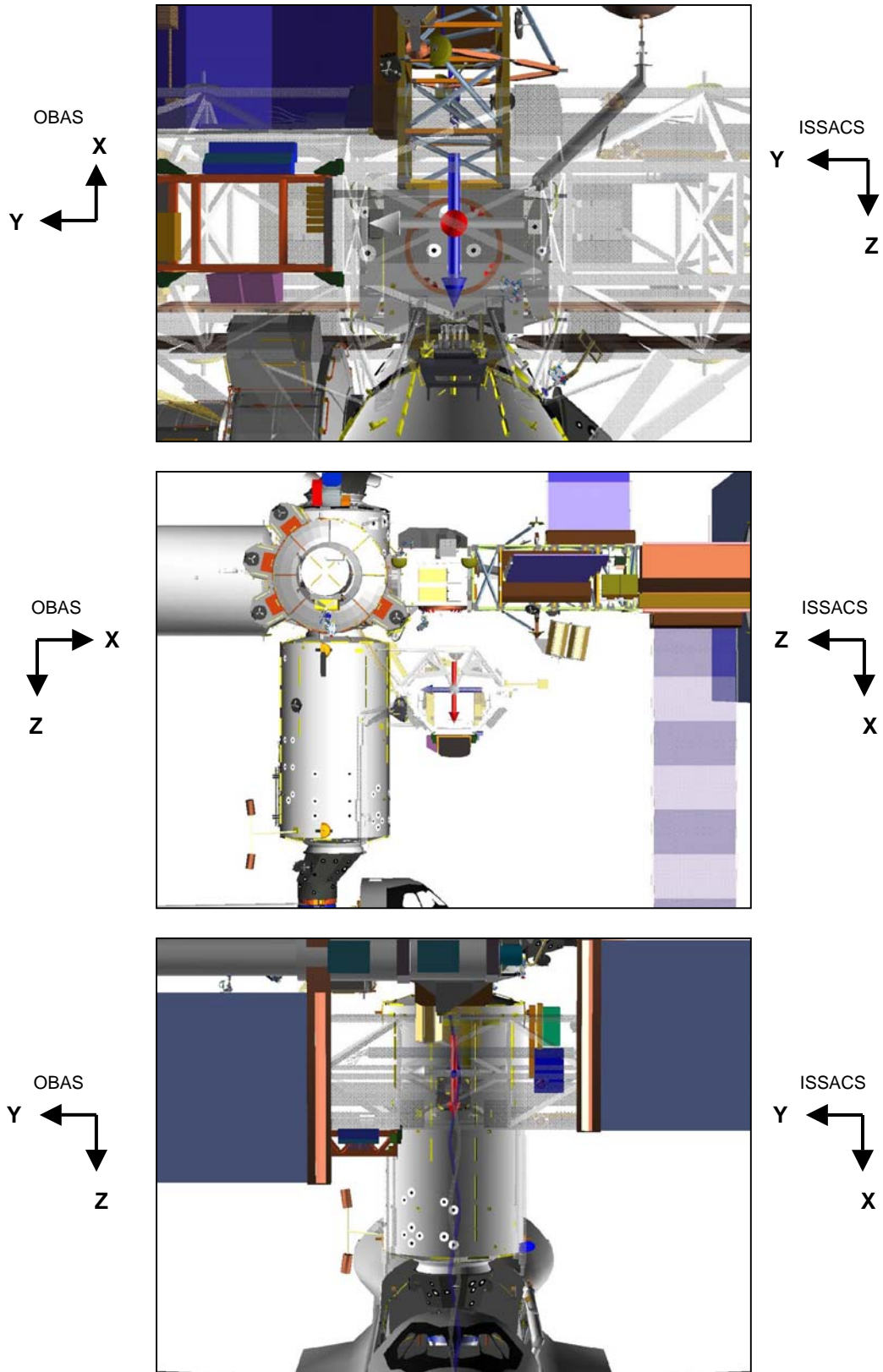
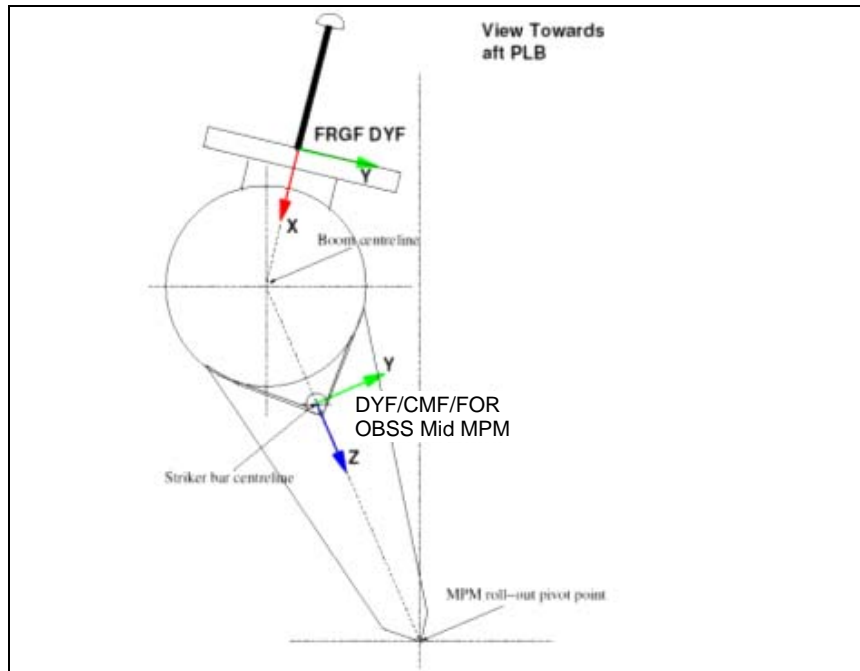
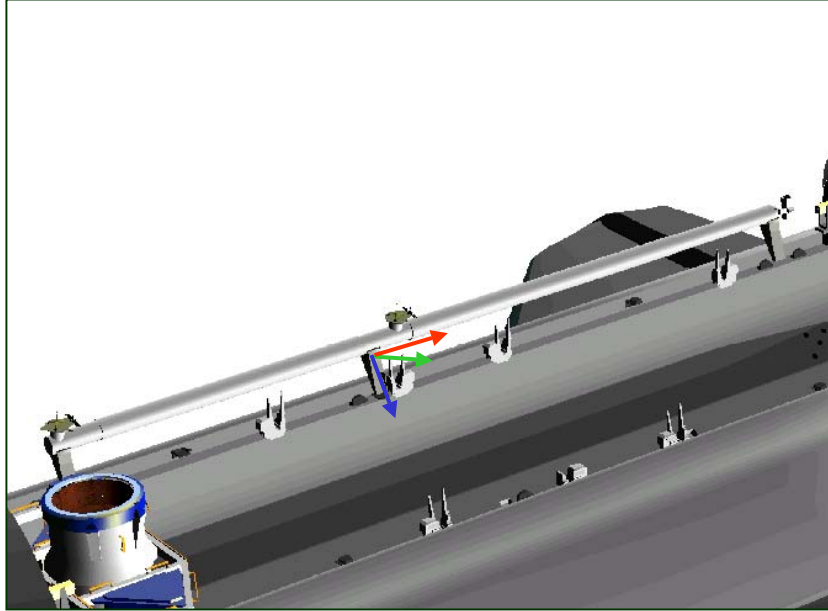


Figure 1.- LAB>ISSACS Command/Display Frame.

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OBSS Mid MPM Command Frame, Display Frame, and FOR.

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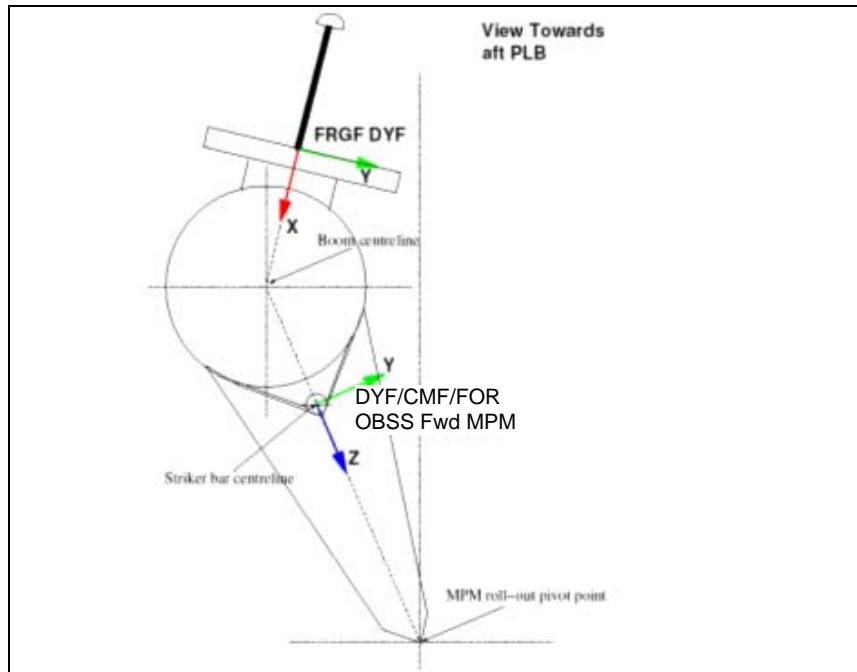
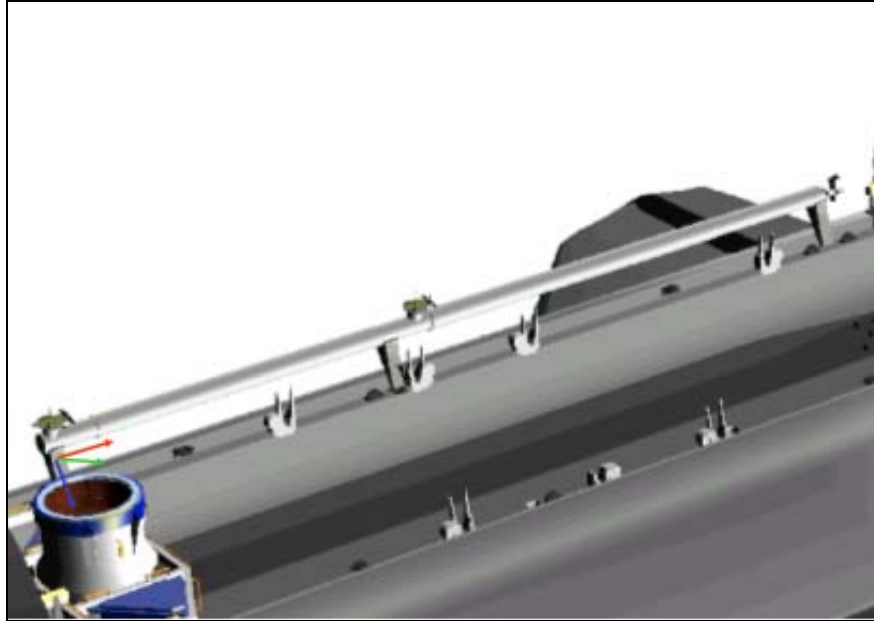


Figure 1.- OBSS Fwd MPM Command Frame, Display Frame, and FOR.

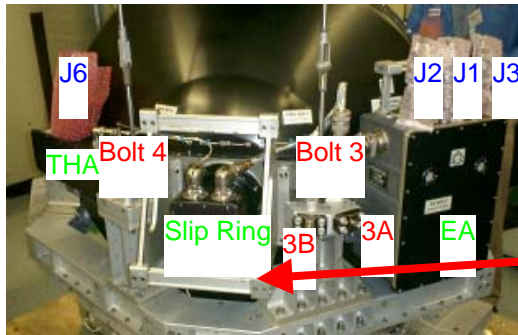
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3.710 CMG PULLOUT PAGE

(RBT FS/LF1/FIN)

Page 1 of 1 page

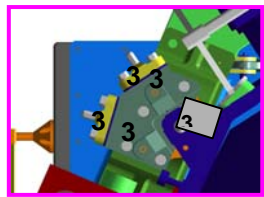
443



CMG on FSE(Aft-STBD)

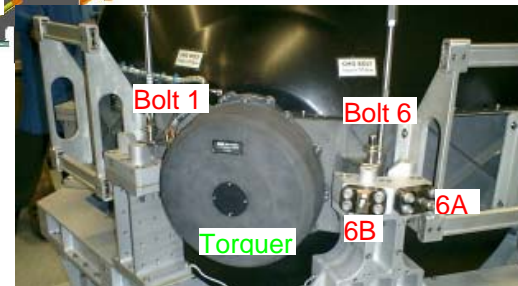
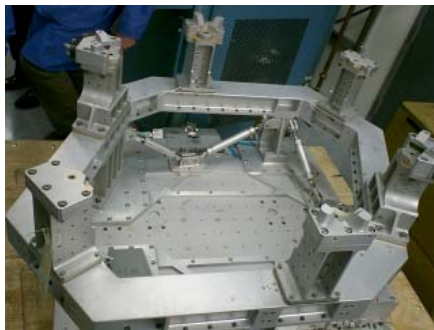
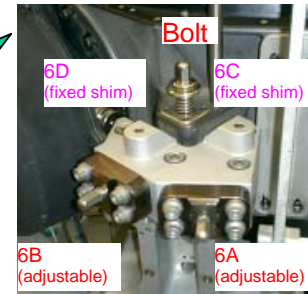
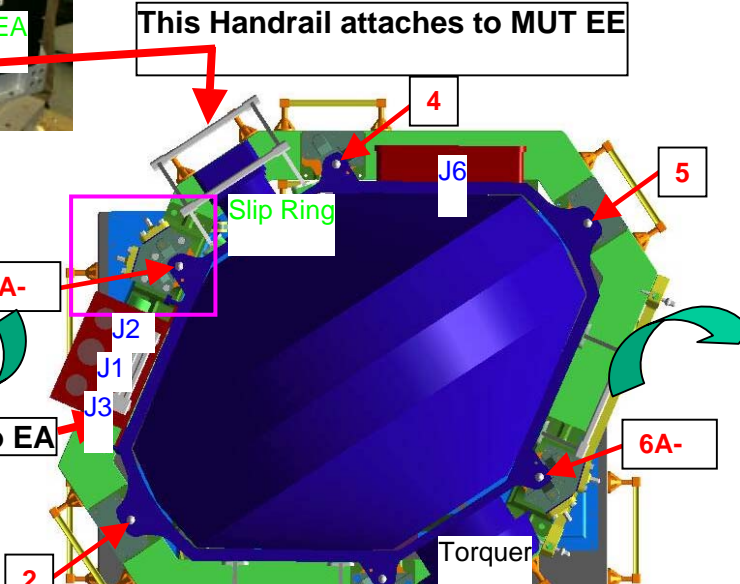


Simulated CCTV B view
(From orbiter Aft-Port looking STBD)



EV1 Tether(sm/lg) attaches to EA

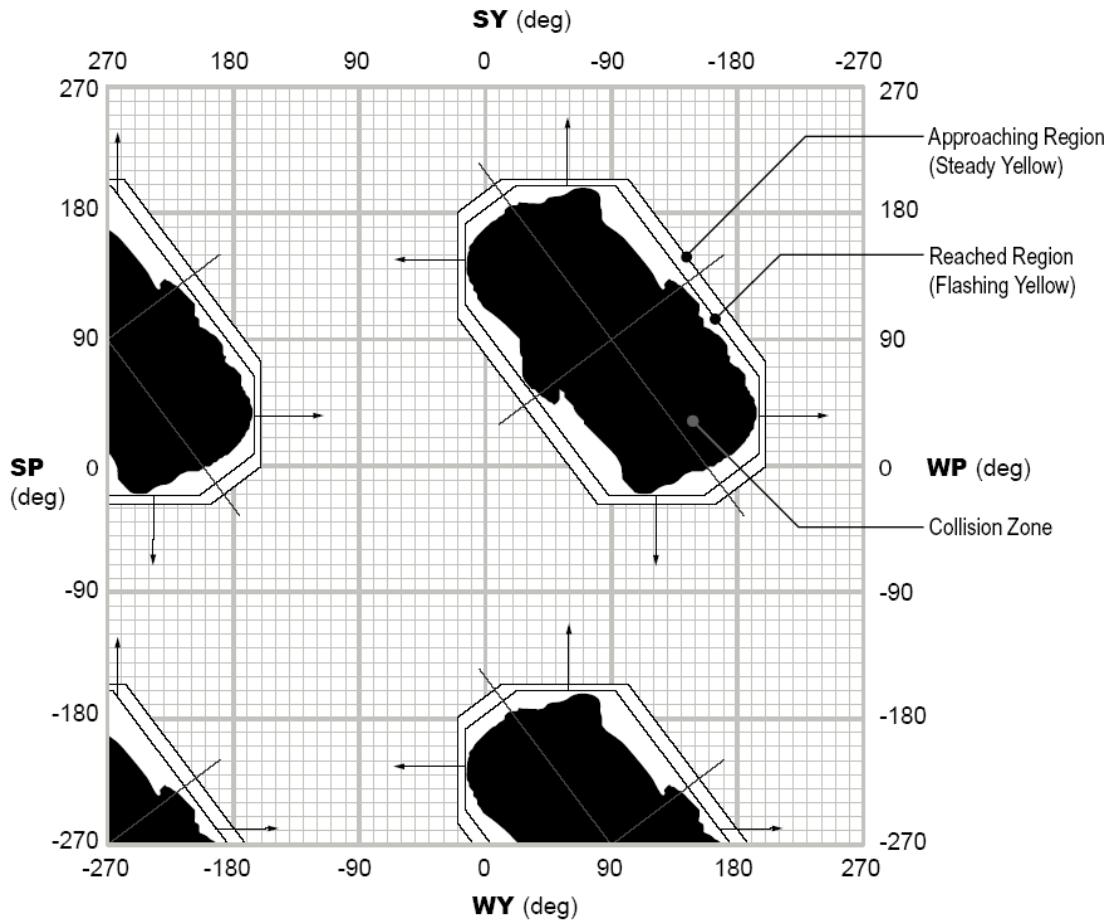
This Handrail attaches to MUT EE



CMG on FSE(Fwd-Port)

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SSRMS Shoulder Cluster and Wrist Cluster Self-Collision Chart



When in the approaching region (Steady Yellow), any arm commands will be allowed as long as it is away from the puddle. Any THC/RHC command which would take the cluster further towards the entered region will not be resolved by SACS.

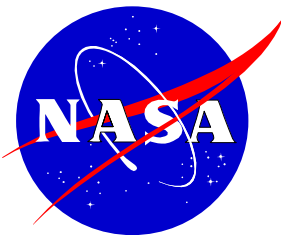
When in the reached region (Flashing Yellow), only single mode may be entered, and only the command direction which takes the current cluster away from the center of the puddle in that quadrant is allowed.

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INTERNATIONAL SPACE STATION

ROBOTICS BOOK FLIGHT SPECIFIC





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