

1.110 OBSS UNBERTH & HANDOFF

(RBT FS/10A/FIN 1)

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

Verify SRMS is at the Pre-Cradle position.

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
91: Camera D (0, +25)	22: Base Elbow (+75, -20)	92: Camera C (0, +20) 03: S1 Lower Outboard (+85, +20)	Camera A (0, +35)

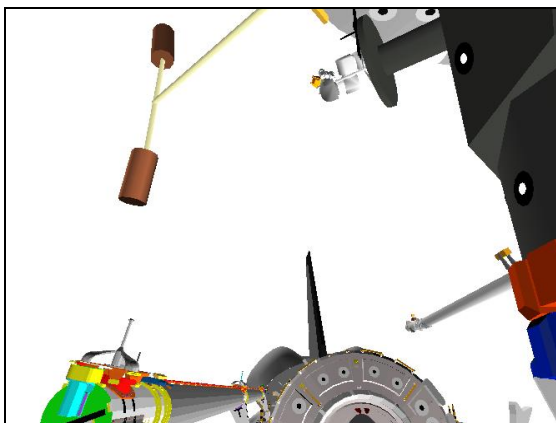


Figure 1. Dock Viewing
(91: Camera D: 0, +25).

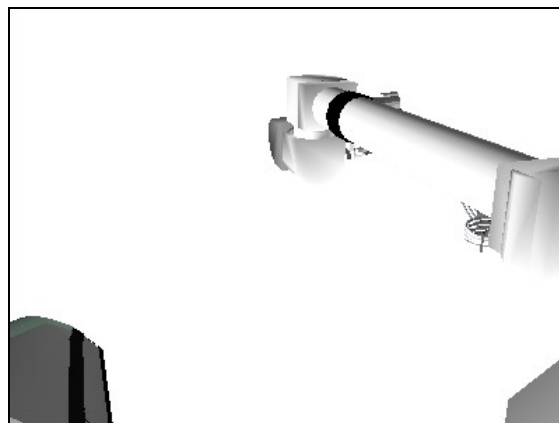


Figure 2.- Dock Viewing
(22: Base Elbow: +75, -20).

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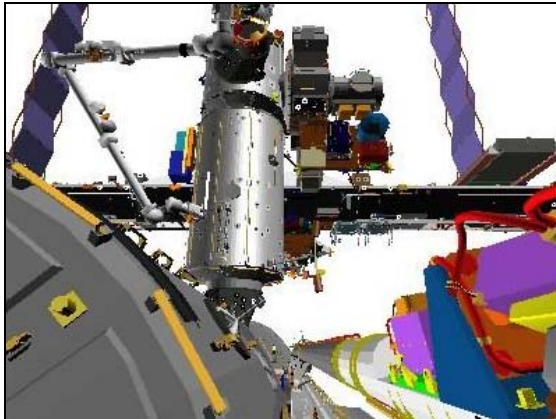


Figure 3.- Dock Viewing
(92: Camera C: 0, +20).

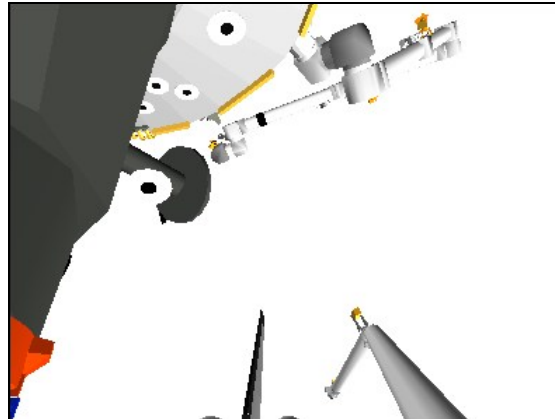


Figure 4.- Dock Viewing
(V10: Camera A: 0, +35).

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	-90.0	+5.0	+33.7
X	Y	Z	Pitch	Yaw	Roll	
+153	+548	-883	+59.5	+15.5	-66.5	
FOR	Unloaded – LEE Tip, SY Held					
Disp	LAB>Berthed OBSS MidMPM					

3. MANEUVERING TO OBSS PRE-GRAPPLE

MSS: SSRMS: SSRMS Safing:

cmd Remove (Verify Not Safed)

DCP

BRAKES SSRMS → OFF (Verify OFF)

PCS

MSS: SSRMS:

√Vernier

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MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

pick File ► LAB ► OBSS Pre-Grapple

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

SR	SY	SP	EP	WP	WY	WR
+78.1	+40.4	+31.7	+122.2	-179.6	-140.9	+33.7

<u>NOTE</u>
A singularity warning may flash when WY is approximately -94.0 deg.

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	-90.0	+5.0	+33.7
TGT	+78.1	+40.4	+31.7	+122.2	-179.6	-140.9	+33.7
ERR	+31.9	+14.6	-26.7	0.0	+89.6	+145.9	0.0

```

*****
* If joint angles or 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

PCS

MSS: SSRMS:

Verify Posn Hold – orange

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

SR	SY	SP	EP	WP	WY	WR
+78.1	+40.4	+31.7	+122.2	-179.6	-140.9	+33.7
X	Y	Z	Pitch	Yaw	Roll	
+23	+87	-176	-89.9	-30.1	+0.1	
FOR	Unloaded – LEE Tip, SY Held					
Disp	LAB>Berthed OBSS MidMPM					

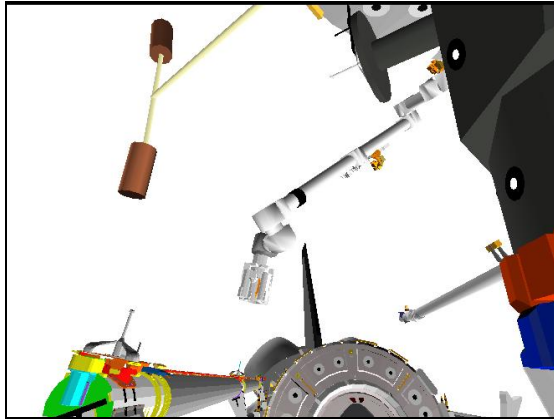


Figure 5.- OBSS Pre-Grapple
(91: Camera D: 0, +25).

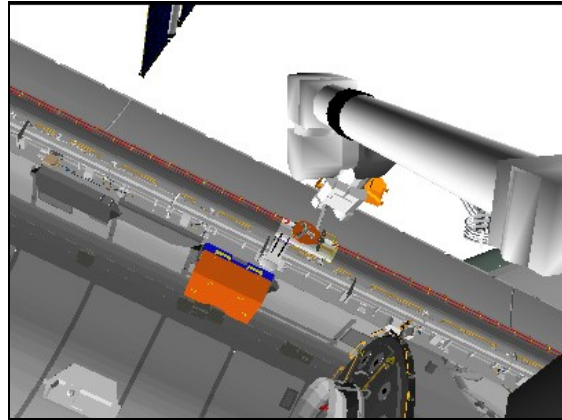


Figure 6.- OBSS Pre-Grapple
(22: Base Elbow: +75, -20).

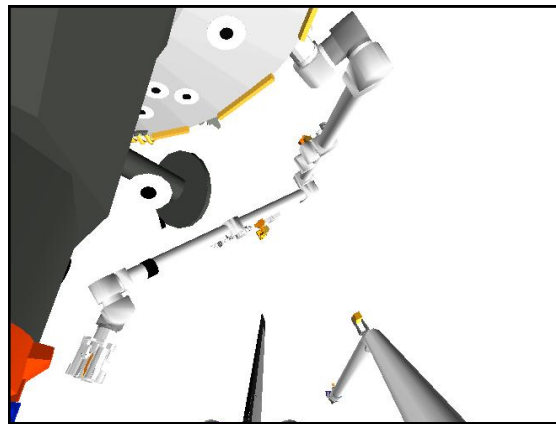


Figure 7.- OBSS Pre-Grapple
(V10: Camera A: 0, +35).

4. OBSS GRAPPLE SETUP AND CAPTURE

Configure Cameras and overlays for grapple.

Monitor 1	Monitor 2	Monitor 3	V10
91: Camera D (0, +15)	25: Tip LEE	92: Camera C (0, +20) 03: S1 Lower Outboard (+85, +20)	Camera A (0, +25)

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NOTE

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

4.1 Setup

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: as desired

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

4.2 Maneuvering to Within Grapple Envelope

Maneuver to within grapple envelope.

4.3 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

4.4 Grapple

TRIGGER → press (momentarily)

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

RHC/
THC

RHC

PCS

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4.5 Grapple Cleanup

Verify Posn Hold – orange

Verify Loaded Parameters – √

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

DCP

BRAKES SSRMS → ON (Verify ON)

Give SRMS operator GO for mnvr to OBSS PRE-GRAPPLE AT HANDOFF.

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

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)

Expected Berthed OBSS Grapple position.

SR	SY	SP	EP	WP	WY	WR
+68.6	+40.4	+38.3	+113.5	-188.4	-144.6	+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					

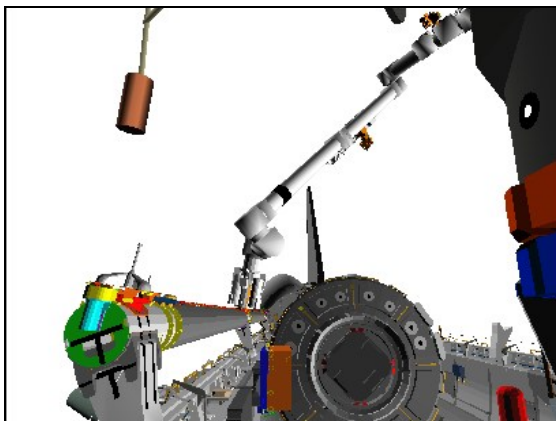


Figure 8.- Berthed OBSS Grapple (91: Camera D: 0, +15).

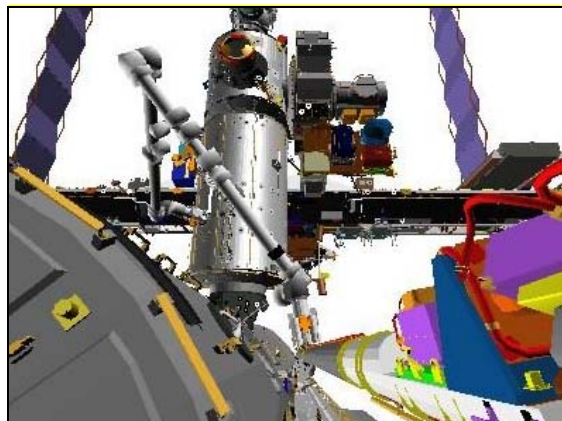


Figure 9.- Berthed OBSS Grapple (92: Camera C: 0, +20).

5. ATTITUDE CONTROL CONFIGURATION

Verify SRMS is at OBSS PRE-GRAPPLE AT HANDOFF position.

MSS: SSRMS: Thrusters:

Verify 'Desat Request:' – Inh

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

6. MRL RELEASE

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
91: Camera D (0, +15)	MUX: 22: Base Elbow (+60, 0) 24: Tip Elbow (-70, +25)	92: SRMS Elbow (-115, +20) 03: S1 Lower Outboard (+85, +20)	Camera A (0, +25)

Give shuttle crew GO to release STBD MRLs.

NOTE

SRMS SPEE power must be applied within 90 minutes to prevent sensor damage.

```

*****
*If 'R3Q - SSRMS LEE Uncommanded Derigidize' Caution was annunciated
* during MRL release or Carriage Tension < 4400 N
*
* MSS: SSRMS: Tip LEE: 
*
* cmd 'Carriage' Rigidize ► Slow (Verify Speed – Slow)
*
* Verify 'Confirm or Terminate' prompt.
*
* 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
*****
  
```

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7. MANEUVERING TO LOW HOVER POSITION

On shuttle crew GO for OBSS Unberth:

DCP BRAKES SSRMS → OFF (Verify OFF)

PCS MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: as desired

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

NOTE

1. Monitor clearance to UHF Antenna with the SRMS Elbow Camera. Clearance at Low Hover is approximately 96 cm (38 in).
2. Monitor clearance to Node 2 with Camera D. Minimum clearance is approximately 58 cm (23 in).

THC/
RHC

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

	Locked					
SR	SY	SP	EP	WP	WY	WR
+77.3	+40.4	+38.3	+116.2	-181.2	-141.1	+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					

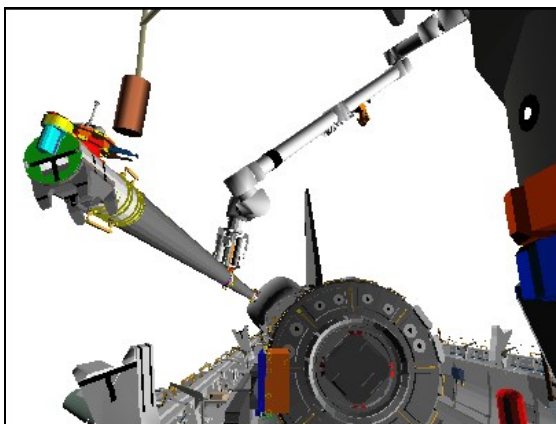


Figure 10.- OBSS Low Hover
(91: Camera D: 0, +15).

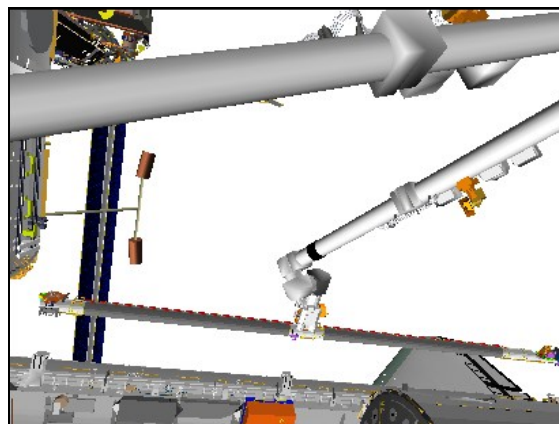


Figure 11.- OBSS Low Hover
(92: SRMS Elbow: -115, +20).

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8. ATTITUDE CONTROL CONFIGURATION

If using shuttle attitude control, coordinate with shuttle crewmembers:

If attitude maintenance required:

Configure DAP per RMS DAPs, then perform RATE DAMPING
(ORB OPS FS, DOCKED DAP REFERENCE)

9. 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)

pick File ► LAB ► OBSS Unberth Mnvr 1

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 or 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

Expect only Starboard motion of OBSS during this FOR OCAS.

PCS

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

DCP AUTO SEQ → PROC

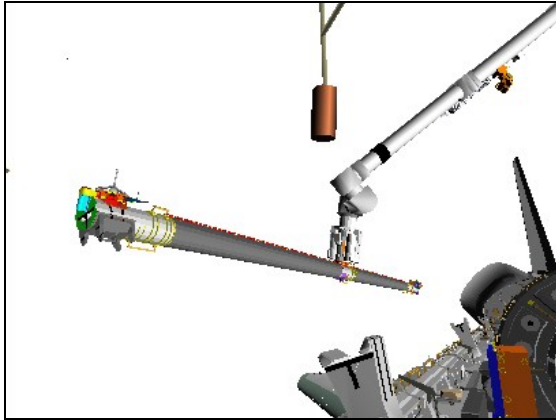


Figure 12.- Clear UHF Antenna
 (91: Camera D: -30, +15).

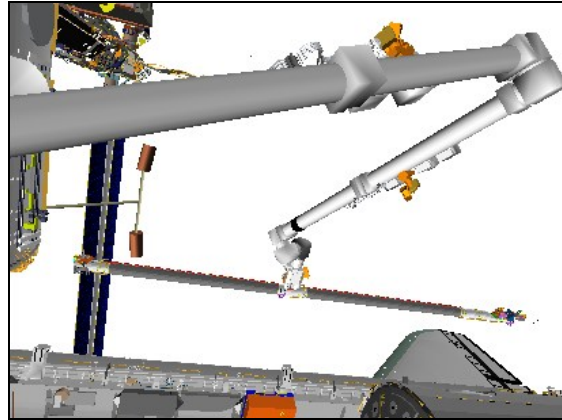


Figure 13.- Clear UHF Antenna
 (92: SRMS Elbow: -115, +20).

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	-138.7	+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					

10. MANEUVERING TO AFT POSITION

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
91: Camera C (+10, +25)	03: S1 Lower Outboard (+65, +30)	92: SRMS Elbow (-105, +20)	Camera A (0, +25)

RHC RATE → COARSE (Verify Coarse on PCS)

PCS MSS: SSRMS:

Verify SY – Locked

pick File ► LAB ► OBSS Unberth Mnvr 2

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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 or 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

Expect Starboard, Aft, and out of the bay motion of OBSS during this FOR OCAS.

PCS

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

DCP

AUTO SEQ → PROC

PCS

MSS: SSRMS: 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	-133.6	-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					

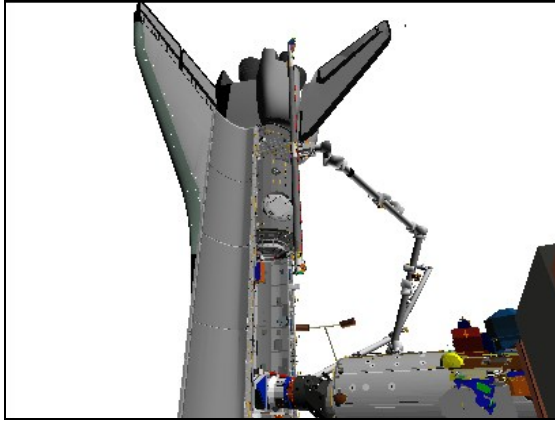


Figure 14.- Aft Position
 (03: S1 Lower Outboard: +65, +30).

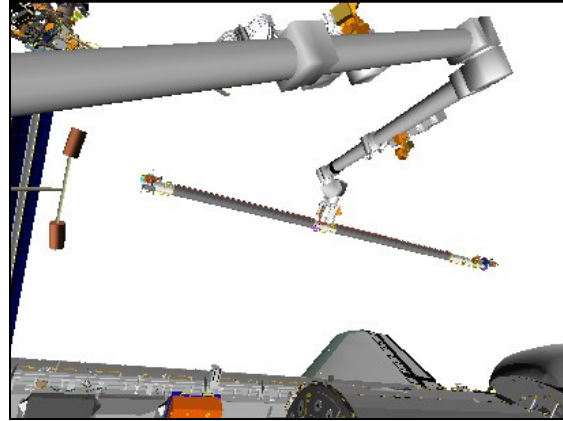


Figure 15.- Aft Position
 (92: SRMS Elbow: -105, +20).

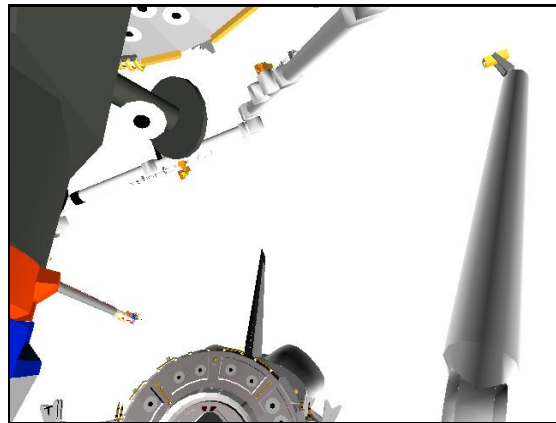


Figure 16.- Aft Position
 (V10: Camera A: 0, +25).

11. MANEUVERING TO HANDOFF POSITION

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
91: Camera C (+10, +25)	03: S1 Lower Outboard (+65, +35) 24: Tip Elbow (0, +70)	92: SRMS Elbow (-105, +20)	Camera A (0, +25)

MSS: SSRMS:

Verify SY – Locked

pick File ► LAB ► OBSS Unberth Mnvr 3

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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

* If FOR or 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

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	-167.8	-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)

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Figure 17.- OBSS Handoff
(24: Tip Elbow: 0, +70).

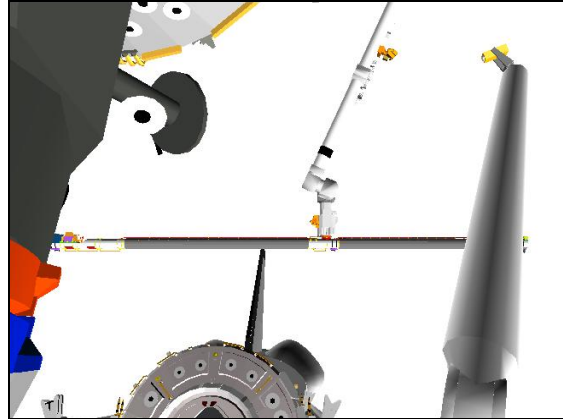


Figure 18.- OBSS Handoff
(V10: Camera A: 0, +25).

12. ATTITUDE CONTROL CONFIGURATION

PCS

MSS: SSRMS: Thrusters:

Verify 'Desat Request:' – Inh

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

13. SRMS GRAPPLE

Give SRMS operator GO for SRMS OBSS Grapple.

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1. SETUP

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
91: Camera C (-25, +25)	25: Tip LEE	92: SRMS Elbow (-60, +10) 03: S1 Lower Outboard (+75, +25)	Camera A (0, +45)

NOTE

1. The LEE Camera must be fully zoomed out to correspond to the target overlay.
2. The S1 Lower Outboard Camera views may be partially obstructed due to STBD TRRJ rotation.

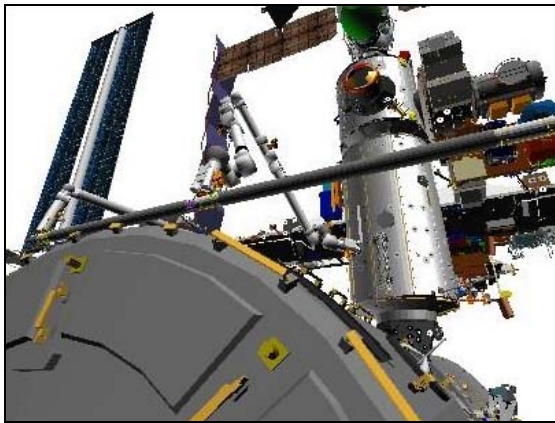


Figure 1.- OBSS Handoff
(91: Camera C: -25, +25).

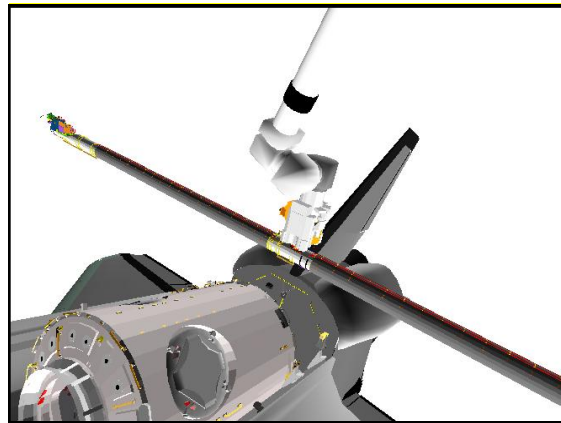


Figure 2.- OBSS Handoff
(92: SRMS Elbow: -60, +10).

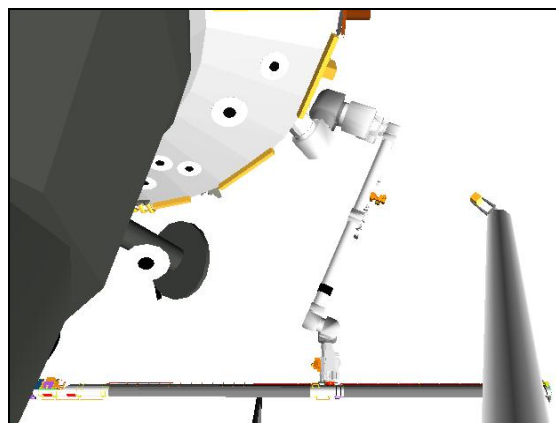


Figure 3.- OBSS Handoff
(V10: Camera A: 0, +45).

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PCS MSS: SSRMS:

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

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

RHC RATE → VERNIER (Verify Vernier on PCS)

PCS MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: as desired.

2. OBSS UNGRAPPLE (CARRIAGE PUSHOFF)

On SRMS operator GO for OBSS Ungrapple:

DCP BRAKES SSRMS → OFF (Verify OFF)

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.

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)

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

Verify Unloaded Parameters – √

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 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						

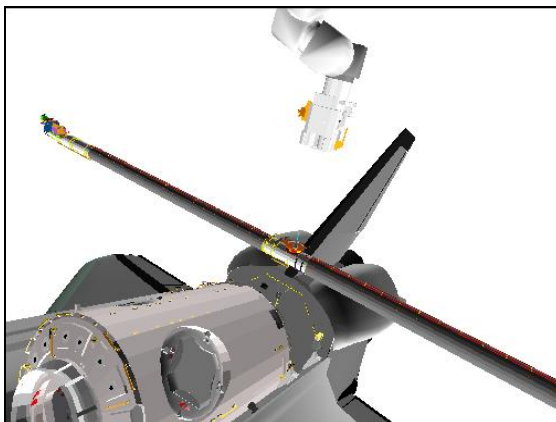


Figure 4.- OBSS Handoff
 (92: SRMS Elbow: -60, +10).

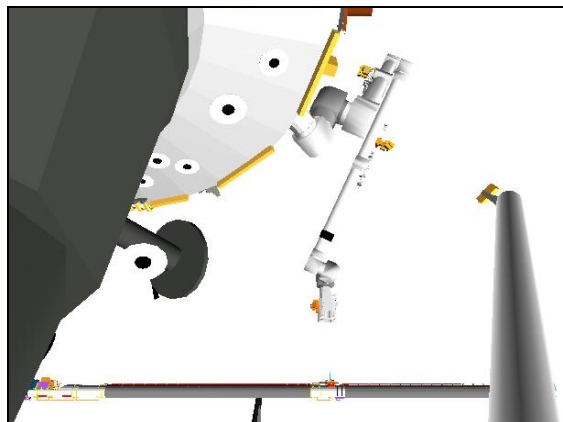


Figure 5.- OBSS Handoff
 (V10: Camera A: 0, +45).

DCP
 BRAKES SSRMS → ON (Verify ON)

Give SRMS operator GO for maneuver to Node2 VIEWING position.

3. ATTITUDE CONTROL CONFIGURATION

If using shuttle attitude control, coordinate with shuttle crewmembers:

| If attitude maintenance required:

| | Configure DAP per RMS DAPs, then perform RATE DAMPING
| | (ORB OPS FS, DOCKED DAP REFERENCE).

1.120 MANEUVER TO OBSS HANDOFF PRE-GRAPPLE

(RBT FS/10A/FIN 1)

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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

Verify SRMS at Node 2 Viewing position.

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
09: P1 Lower Outboard (+110, +20)	22: Base Elbow (+70, -15) 24: Tip Elbow (-5, +10)	91: Camera C (-25, +20)	Camera B (0, +30) OBSS ITVC (+80, -45)

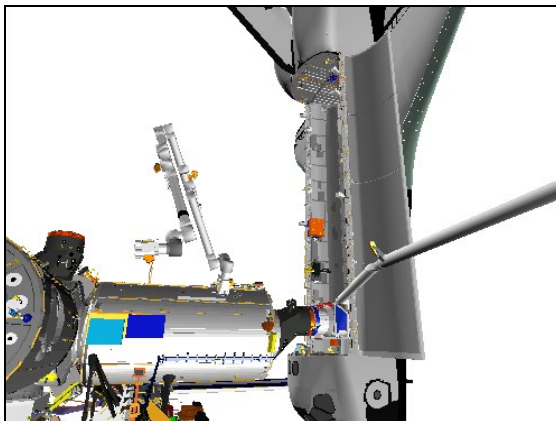


Figure 1.- Node 2 Clearance
(09: P1 Lower Outboard: +110, +20).

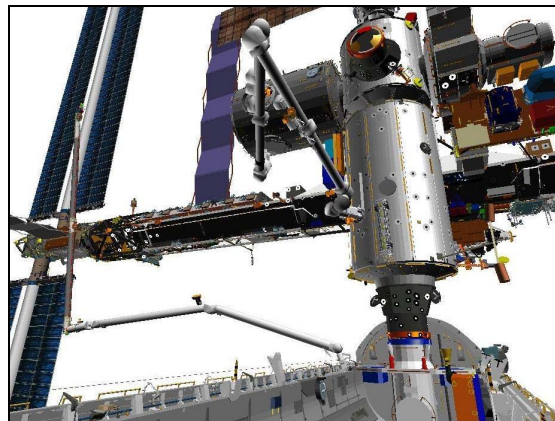


Figure 2.- Node 2 Clearance
(91: Camera C: -25, +20).

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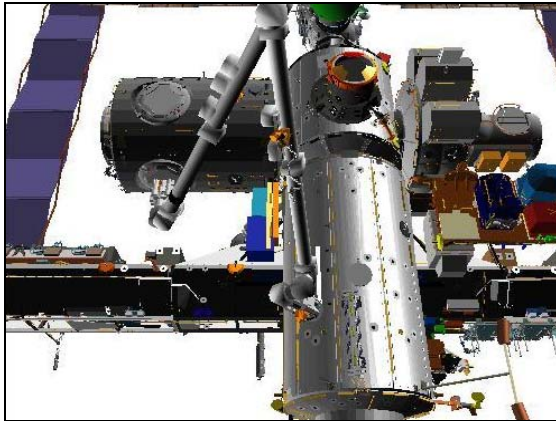


Figure 3.- Node 2 Clearance
(V10: Camera B: 0, +30).

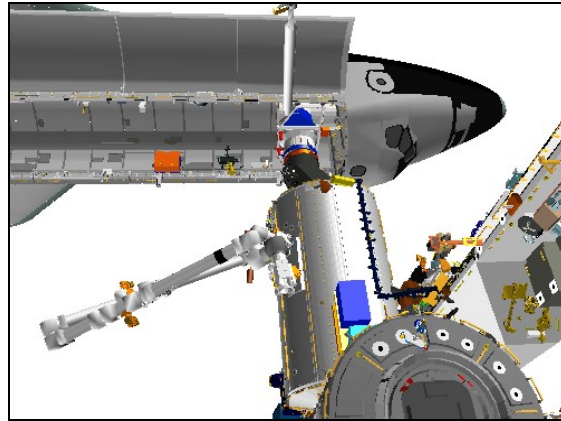


Figure 4.- Node 2 Clearance
(V10: OBSS ITVC: +80, -45).

NOTE

1. The P1 and S1 Lower Outboard Camera views may be partially obstructed due to TRRJ rotation.
2. The Cross Cluster Warning will annunciate while EP \geq +142.2 deg.

PCS

MSS: SSRMS:

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

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: 1.0

Verify SSRMS at Node 2 Clearance position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-88.1	-25.2	-27.9	+144.4	-109.3	-70.3	-45.6
X	Y	Z	Pitch	Yaw	Roll	
-501	+1143	-637	+98.5	+19.3	-2.7	
FOR	Unloaded – LEE Tip, SR Held					
Disp	LAB>Berthed OBSS MidMPM					

3. JOCAS TO INTERMEDIATE 1 POSITION

MSS: SSRMS: SSRMS Safing:

cmd Remove (Verify Not Safed)

DCP

BRAKES SSRMS → OFF (Verify OFF)

1.120 MANEUVER TO OBSS HANDOFF PRE-GRAPPLE

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PCS MSS: SSRMS:

√Vernier

Enter Mode – Joint OCAS (Verify blue)

pick File ► LAB ► OBSS Handoff Mnvr 1

Verify 'Joint Angles' 'Destination' for Intermediate 1 position.

SR	SY	SP	EP	WP	WY	WR
-75.0	-3.2	-15.0	+127.9	-152.2	-156.2	-82.0

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)	-88.1	-25.2	-27.9	+144.4	-109.3	-70.3	-45.6
TGT	-75.0	-3.2	-15.0	+127.9	-152.2	-156.2	-82.0
ERR	-13.1	-22.0	-12.9	+16.5	+42.9	+85.9	+36.4

* If joint angles or 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

PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify Joint Angle values.

SR	SY	SP	EP	WP	WY	WR
-75.0	-3.2	-15.0	+127.9	-152.2	-156.2	-82.0

1.120 MANEUVER TO OBSS HANDOFF PRE-GRAPPLE

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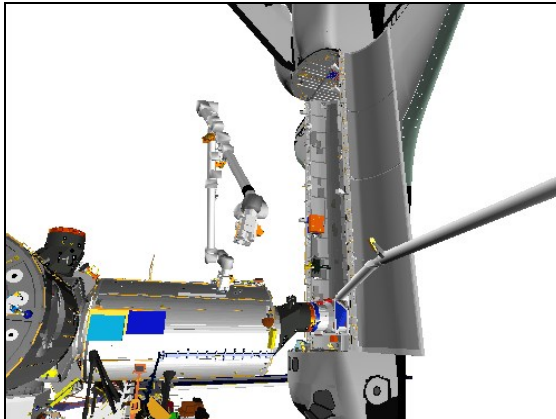


Figure 5.- Intermediate 1 Position
(09: P1 Lower Outboard: +110, +20).

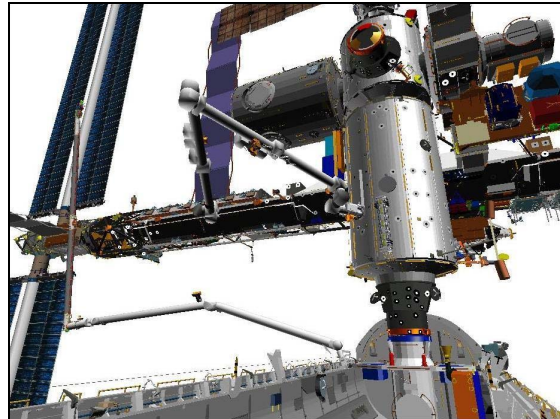


Figure 6.- Intermediate 1 Position
(91: Camera C: -25, +20).

4. JOCAS TO INTERMEDIATE 2 POSITION

SSRMS Joint OCAS

pick File ► LAB ► OBSS Handoff Mnv 2

Verify 'Joint Angles' 'Destination' for Intermediate 2 position.

SR	SY	SP	EP	WP	WY	WR
+5.0	-3.2	-45.0	+127.9	-152.2	-156.2	-82.0

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)	-75.0	-3.2	-15.0	+127.9	-152.2	-156.2	-82.0
TGT	+5.0	-3.2	-45.0	+127.9	-152.2	-156.2	-82.0
ERR	-80.0	0.0	+30.0	0.0	0.0	0.0	0.0

PCS

* If joint angles or 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

1.120 MANEUVER TO OBSS HANDOFF PRE-GRAPPLE

(RBT FS/10A/FIN 1)

PCS

MSS: SSRMS:

Verify Posn Hold – orange

Verify Joint Angle values.

SR	SY	SP	EP	WP	WY	WR
+5.0	-3.2	-45.0	+127.9	-152.2	-156.2	-82.0

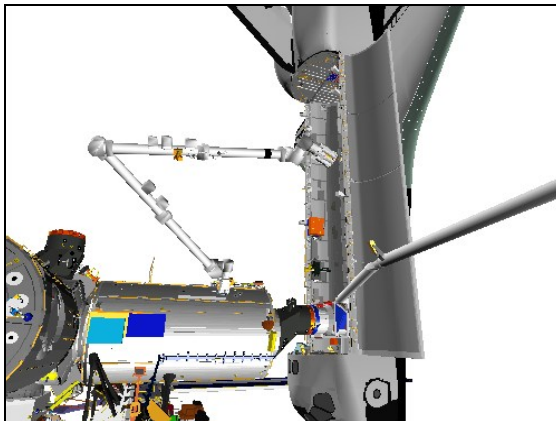


Figure 7.- Intermediate 2 Position
(09: P1 Lower Outboard: +110, +20).

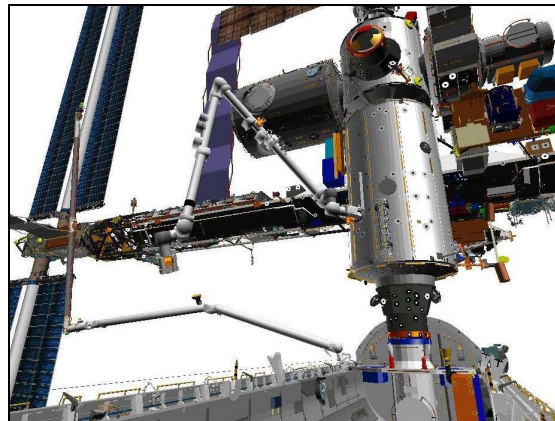


Figure 8.- Intermediate 2 Position
(91: Camera C: -25, +20).

5. JOCAS TO OBSS HANDOFF PRE-GRAPPLE

pick File ► LAB ► OBSS Handoff Mnvr 3

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

SR	SY	SP	EP	WP	WY	WR
+31.7	+46.6	-55.3	+127.9	-152.2	-156.2	-82.0

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)	+5.0	-3.2	-45.0	+127.9	-152.2	-156.2	-82.0
TGT	+31.7	+46.6	-55.3	+127.9	-152.2	-156.2	-82.0
ERR	-26.7	-49.8	+10.3	0.0	0.0	0.0	0.0

1.120 MANEUVER TO OBSS HANDOFF PRE-GRAPPLE

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```

*****
* If joint angles or 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

PCS MSS: SSRMS:

Verify Posn Hold – orange

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

SR	SY	SP	EP	WP	WY	WR
+31.7	+46.6	-55.3	+127.9	-152.2	-156.2	-82.0
X	Y	Z	Pitch	Yaw	Roll	
+259	+754	-407	-75.3	-18.8	-85.6	
FOR	Unloaded – LEE Tip, SR Held					
Disp	LAB>Berthed OBSS MidMPM					

DCP BRAKES SSRMS → ON (Verify ON)

Give SRMS operator GO for maneuver to OBSS Handoff position.



Figure 9.- OBSS Handoff Pre-Grapple
(09: P1 Lower Outboard: +110, +20).

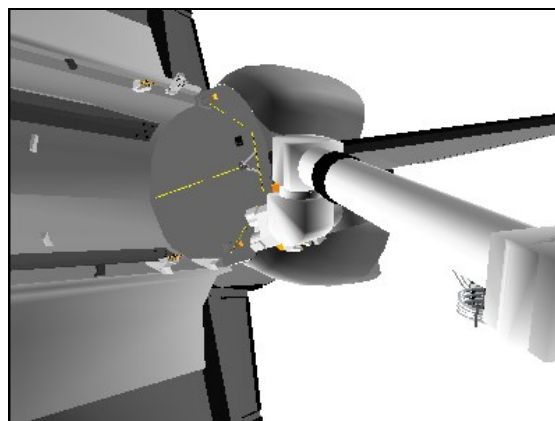


Figure 10.- OBSS Handoff Pre-Grapple
(22: Base Elbow: +70, -15).

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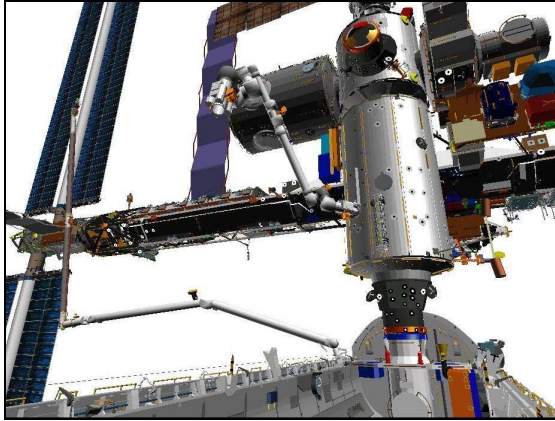


Figure 11.- OBSS Handoff Pre-Grapple
(91: Camera C: -25, +20).

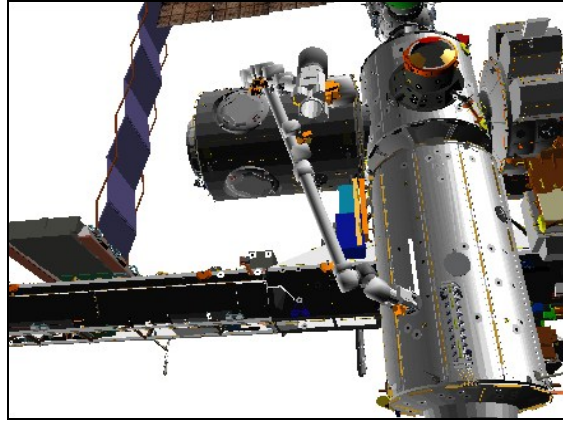


Figure 12.- OBSS Handoff Pre-Grapple
V10: Camera B: -10, +30).

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1.121 OBSS GRAPPLE & BERTH

(RBT FS/10A/FIN 1)

1. SETUP

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
92: Camera B (-20, +30) 09: P1 Lower Outboard (+110, +20)	25: Tip LEE	91: Camera A (+10, +40)	SRMS Elbow (-35, +5)

NOTE

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

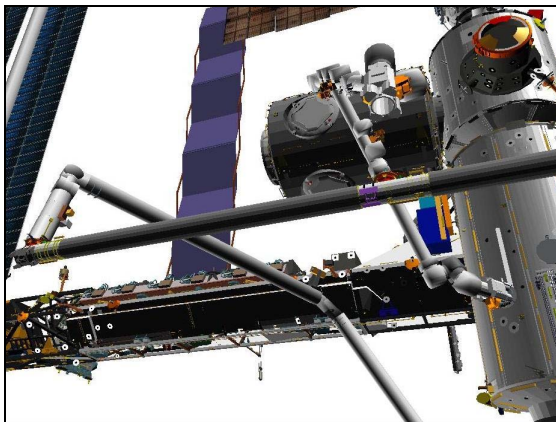


Figure 1.- OBSS Pre-Grapple
(92: Camera B: -20, +30).

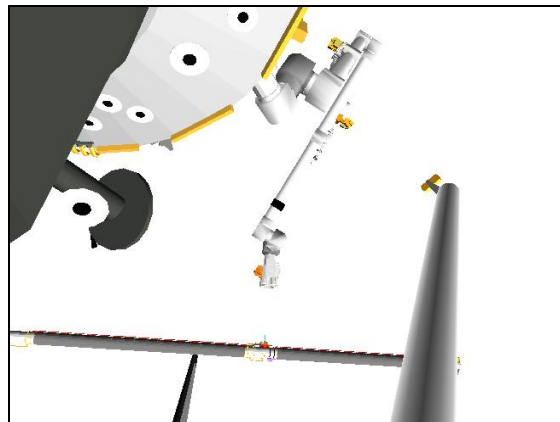


Figure 2.- OBSS Pre-Grapple
(91: Camera A: +10,+ 40).

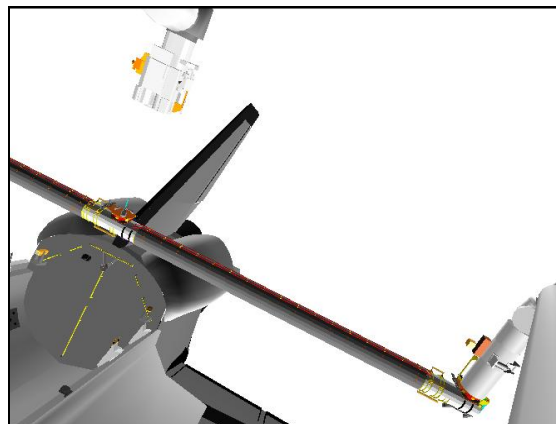


Figure 3.- OBSS Pre-Grapple
(V10: SRMS Elbow: -35, +5).

PCS

MSS: SSRMS:

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

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Verify Unloaded Parameters – √

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

Verify Display – LAB>Berthed OBSS MidMPM

Verify Command – SSRMS>Internal

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	-152.2	-156.2	-82.0
X	Y	Z	Pitch	Yaw	Roll	
+259	+754	-407	-75.3	-18.8	-85.6	
FOR	Unloaded – LEE Tip, SR Held					
Disp	LAB>Berthed OBSS MidMPM					

√Vernier

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: as desired.

2. ATTITUDE CONTROL CONFIGURATION

On SRMS operator GO for OBSS Grapple:

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

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 Maneuvering to Within Grapple Envelope

RHC/
THC

Maneuver to within grapple envelope.

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3.3 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 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

DCP 3.5 Cleanup
BRAKES SSRMS → ON (Verify ON)

PCS MSS: SSRMS:

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

Give SRMS operator GO for OBSS Ungrapple.

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

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

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Verify SSRMS at OBSS Grapple position (within 5 cm/1 deg and SY within 0.5 deg).

Locked						
SR	SY	SP	EP	WP	WY	WR
+31.7	+40.4	-39.3	+124.5	-167.8	-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					

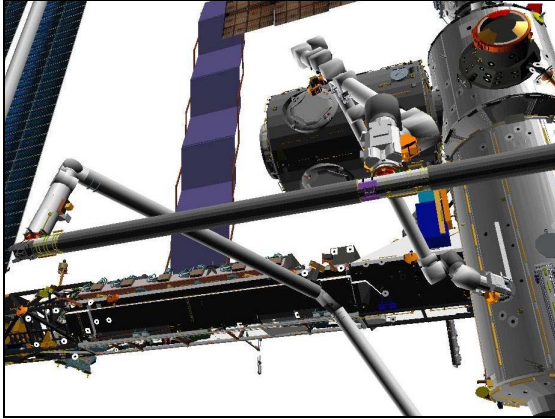


Figure 4.- OBSS Grapple
(92: Camera B: -20, +30).

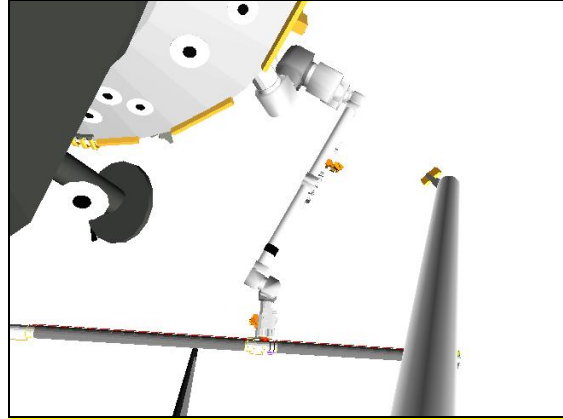


Figure 5.- OBSS Grapple
(91: Camera A: +10, +40).

4. MANEUVERING TO OBSS AFT POSITION

On SRMS operator GO for OBSS Berth:

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
03: S1 Lower Outboard (+85, +20)	92: Camera C (+10, +25) 24: Tip Elbow (0, +70)	91: Camera A (0, +20)	SRMS Elbow (-105, +20)

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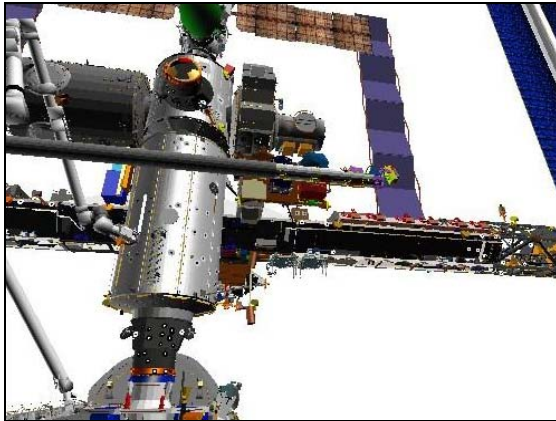


Figure 6.- OBSS Grapple
(92: Camera C: +10, +25).

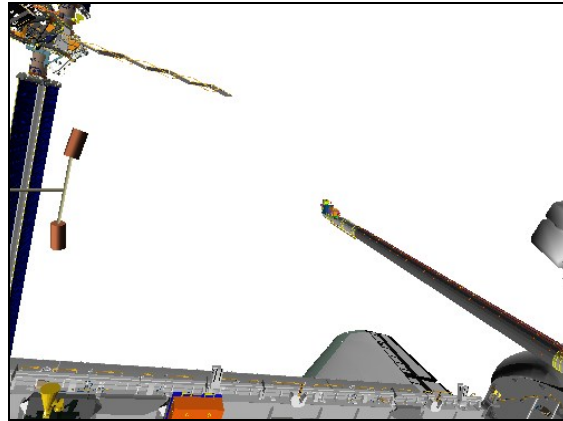


Figure 7.- OBSS Grapple
(V10: SRMS Elbow: -105, +20).

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 ► OBSS Berth 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	+325	+704	-198	+91.1	-70.6	+47.0
TGT	+327	-225	-447	0.0	0.0	0.0
ERR	-2	+929	+249	+91.1	-70.6	+47.0

- * If FOR or 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

PCS MSS: SSRMS:

Verify Posn Hold – orange

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

	Locked					
SR	SY	SP	EP	WP	WY	WR
+91.7	+40.4	+52.7	+72.6	-133.6	-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					

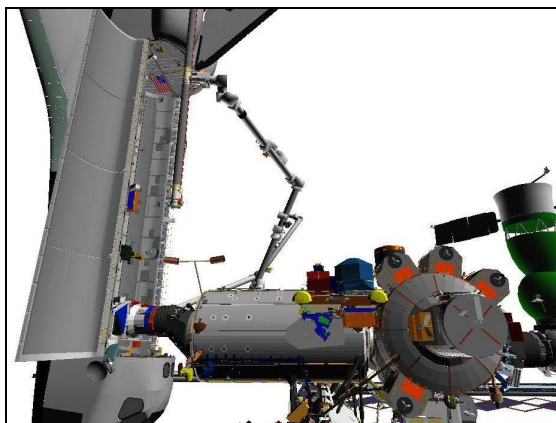


Figure 8.- OBSS Aft
 (03: S1 Lower Outboard: +85, +20).

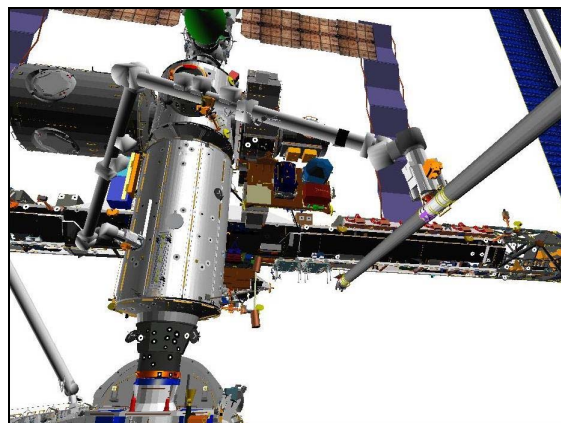


Figure 9.- OBSS Aft
 (91: Camera C: +10,+ 25).

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(RBT FS/10A/FIN 1)

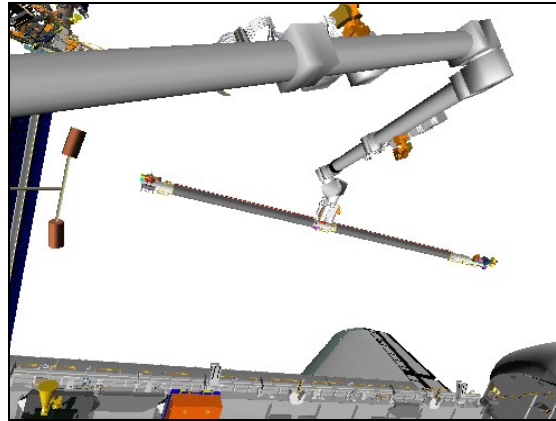


Figure 10.- OBSS Aft
(V10: SRMS Elbow: -105, +20).

5. MANEUVERING TO CLEAR UHF POSITION

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
03: S1 Lower Outboard (+85, +20)	92: Camera C (+25,+10)	13: LAB Stbd Zenith (-20, -15)	SRMS Elbow (-115, +15)

MSS: SSRMS:

Verify SY – Locked

pick File ► LAB ► OBSS Berth Mnvr 2

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	+327	-225	-447	0.0	0.0	0.0
TGT	0	-190	-167	0.0	0.0	0.0
ERR	+327	-35	-280	0.0	0.0	0.0

 * If FOR or 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

Expect Port, Forward, and into the bay motion of OBSS during this FOR OCAS.

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

DCP AUTO SEQ → PROC

PCS MSS: SSRMS: 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	-138.7	+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					

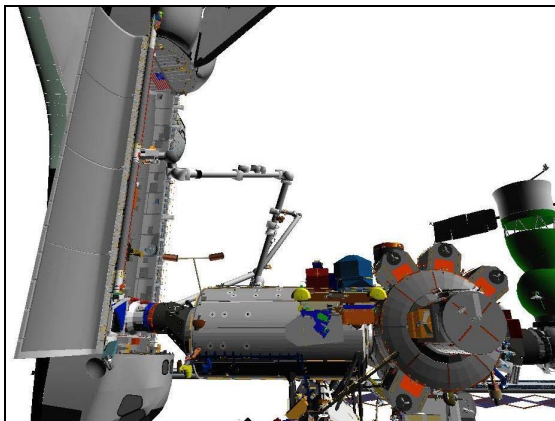


Figure 11.- Clear UHF Antenna
 (03: S1 Lower Outboard: +85, +20).

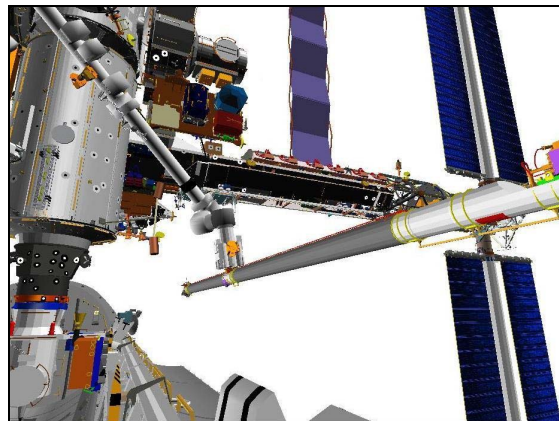


Figure 12.- Clear UHF Antenna
 (92: Camera C: +25, +10).

1.121 OBSS GRAPPLE & BERTH

(RBT FS/10A/FIN 1)

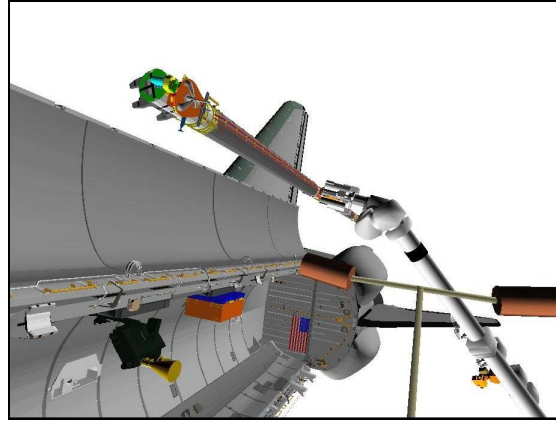


Figure 13.- Clear UHF Antenna
(13: LAB Stbd Zenith: -20, -15).

6. MANEUVERING TO LOW HOVER POSITION

RHC RATE → VERNIER (Verify Vernier on PCS)

PCS MSS: SSRMS: Rate:

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

NOTE

Monitor clearance to UHF Antenna using the Lab or S1 Lower Outboard Cameras. Clearance at Low Hover is approximately 91 cm (36 in).

MSS: SSRMS:

Verify SY – Locked

pick File ► LAB ► OBSS Berth Mnvr 3

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)

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	0	0	-100	0.0	0.0	0.0
ERR	0	-190	-67	0.0	0.0	0.0

 * If FOR or 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
Expect only Port motion of OBSS during this FOR OCAS.

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

DCP AUTO SEQ → PROC

PCS MSS: SSRMS:

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
+77.3	+40.4	+38.3	+116.2	-181.2	-141.1	+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					

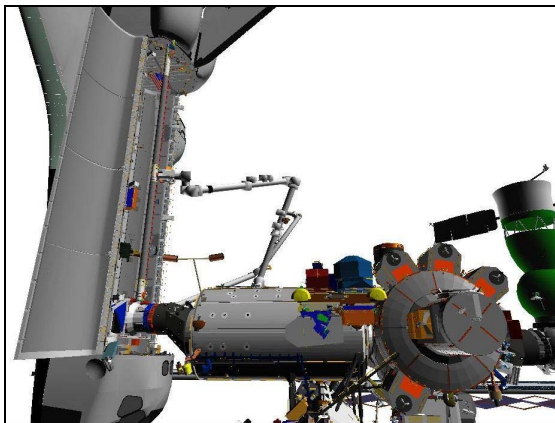


Figure 14.- OBSS Low Hover
 (03: S1 Lower Outboard: +85, +20).

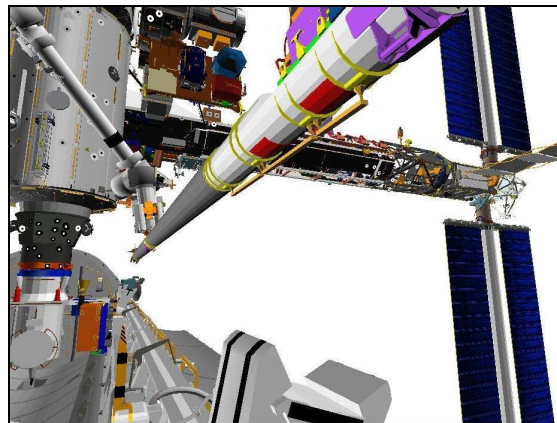


Figure 15.- OBSS Low Hover
 (92: Camera C: +25, +10).

1.121 OBSS GRAPPLE & BERTH

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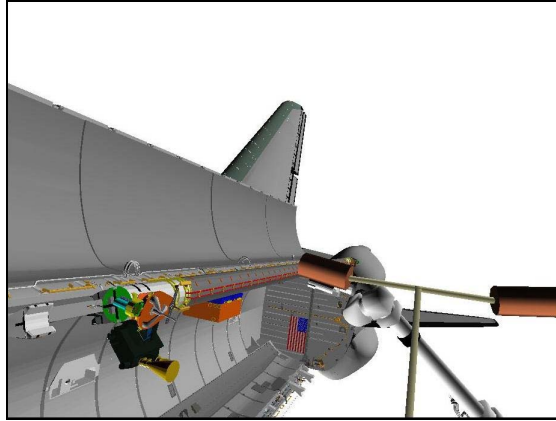


Figure 16.- OBSS Low Hover
(13: LAB Stbd Zenith: -20, -15).

7. ATTITUDE CONTROL CONFIGURATION

MSS: SSRMS: Thrusters:

Verify 'Desat Request:' – Inh

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

8. BERTHING OBSS

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
03: S1 Lower Outboard (+85, +20)	92: Mux D/C (D: -5, 0) (C: +3, 0)	13: LAB Stbd Zenith (-50, -25)	SRMS Elbow (-115, +15)

NOTE

To minimize the effects of parallax use Camera D to monitor the alignment between the aft MPM and the striker bar; use Camera C to monitor the alignment between the forward MPM and the striker bar.

Verify shuttle crew standing by for STBD RMS R-F-L callouts during berth.

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: 0.5

MSS: SSRMS:

Verify Command – LAB>Berthed OBSS MidMPM

Enter Mode – Manual (Verify blue)

1.121 OBSS GRAPPLE & BERTH

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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 three of three STBD RMS R-F-L to - gray, expected at Z = 0).

Expected OBSS Berthed position.

	Locked					
SR	SY	SP	EP	WP	WY	WR
+68.6	+40.4	+38.3	+113.5	-188.4	-144.6	+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					

PCS

MSS: SSRMS: SSRMS

Verify Posn Hold – orange

Enter Mode – Standby (Verify blue)

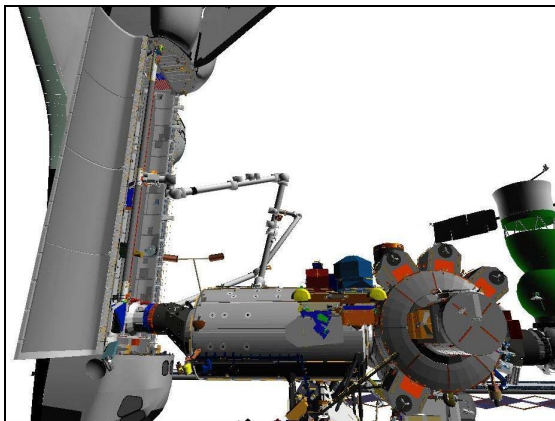


Figure 17.- OBSS Berth
(03: S1 Lower Outboard: +85, +20).

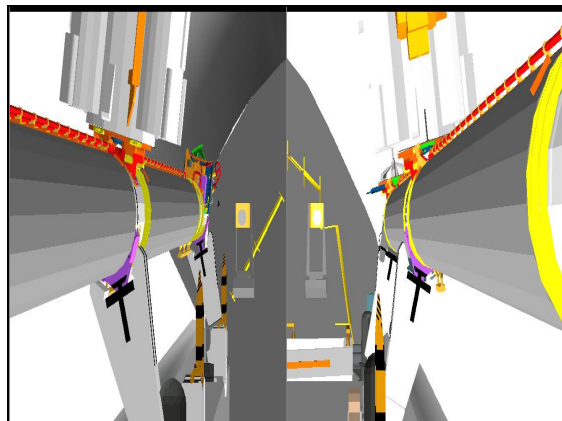


Figure 18.- OBSS Berth
(92: Mux D/C; FL = 45mm).

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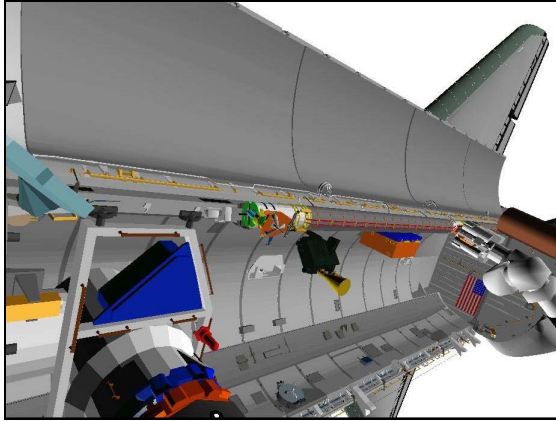


Figure 19.- OBSS Berth
(13: LAB Stbd Zenith: -50, -25).

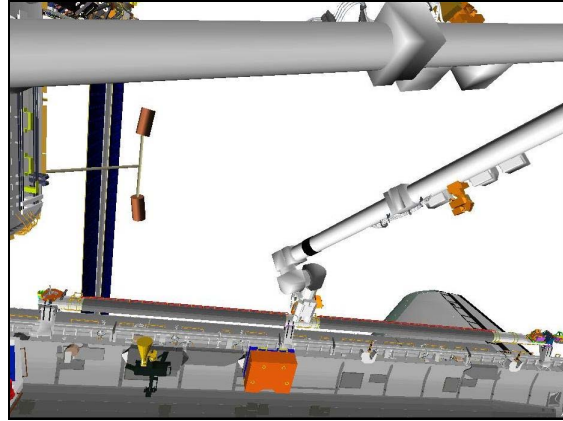


Figure 20.- OBSS Berth
(V10: SRMS Elbow: -115, +15).

9. MRL LATCHING SEQUENCE

9.1 Limp Wrist Joints

MSS: SSRMS: Limp:

sel WP, WY, WR

cmd Execute

MSS: SSRMS:

Verify Limp – blue

Verify WP, WY, WR – Limped

9.2 Latching MRLs to TC

Give SRMS operator GO to latch STBD MRLs to Topological Capture.

9.3 Carriage Derigidization

On SRMS operator GO to Limp all SSRMS Joints and Derigidize:

MSS: SSRMS: Limp:

cmd All Limp (Verify Limp – blue)

MSS: SSRMS:

Verify all joints – Limped

MSS: SSRMS: Tip LEE:

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

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

1.121 OBSS GRAPPLE & BERTH

(RBT FS/10A/FIN 1)

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cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Deridigize

RHC TRIGGER → press (momentarily) (SCR 19064)

PCS Verify 'Carriage' Derigidize – blue (90 s max)

Give SRMS operator GO to complete latching of STBD MRLs.

10. CLEANUP

NOTE

Carriage rigidization is performed in this step to reseat the SSRMS LEE over the OBSS GF prior to initiating a nominal push-off release operation

On SRMS operator GO for OBSS Ungrapple:

MSS: SSRMS: Tip LEE: SSRMS Tip LEE

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

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

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

DCP BRAKES SSRMS → ON (Verify ON)

11. ATTITUDE CONTROL CONFIGURATION

If using shuttle attitude control, coordinate with shuttle crewmembers:

 | If attitude maintenance required:

 | | Configure DAP per RMS DAPs, then perform RATE DAMPING
 | | (ORB OPS FS, DOCKED DAP REFERENCE).

1.122 BERTHED OBSS UNGRAPPLE
 (RBT FS/10A/FIN 1) Page 1 of 4 pages

1. SETUP

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
03: S1 Lower Outboard (+85, +20)	25: Tip LEE	92: Camera C (+10, +20) 13: LAB Stbd Zenith (-50, -25)	SRMS Elbow (-115, +15)

NOTE

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

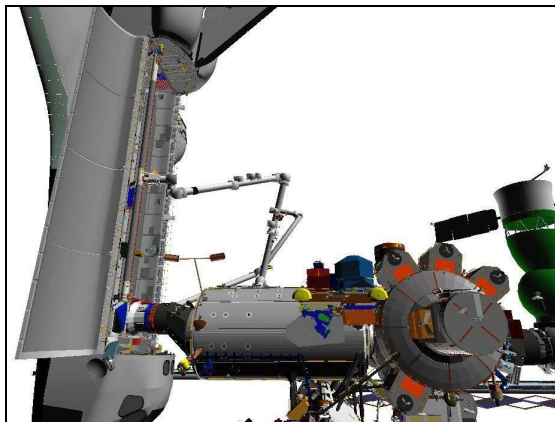


Figure 1.- OBSS Berth
 (03: S1 Lower Outboard: +85, +20).

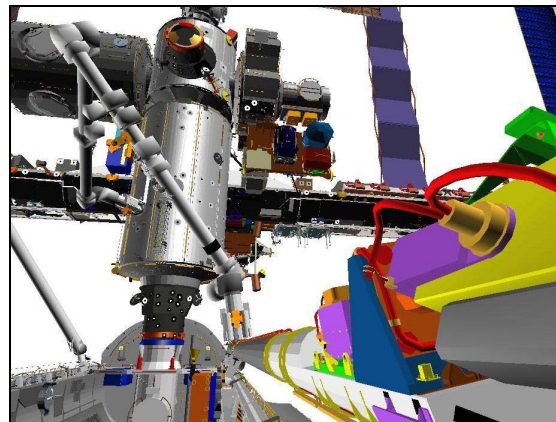


Figure 2.- OBSS Berth
 (92: Camera C: +10, +20).

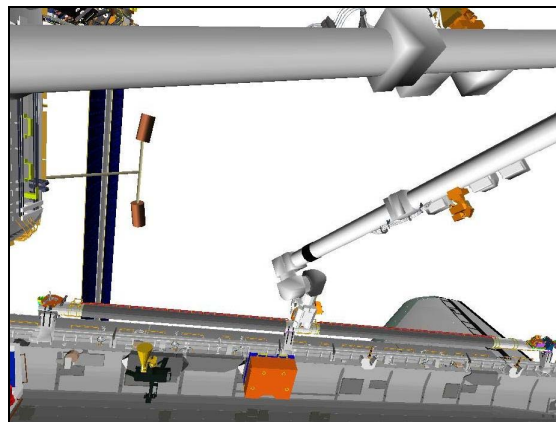


Figure 3.- OBSS Berth
 (V10:SRMS Elbow: -115, +15).

PCS

MSS: SSRMS:

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

1.122 BERTHED OBSS UNGRAPPLE

(RBT FS/10A/FIN 1)

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

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

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: as desired.

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

SR	SY	SP	EP	WP	WY	WR
+68.6	+40.4	+38.3	+113.5	-188.4	-144.6	+25.9
X	Y	Z	Pitch	Yaw	Roll	
+44	+11	+22	+90.0	0.0	-30.0	
FOR	Loaded – OBSS Mid MPM, SY Held					
Disp	LAB>Berthed OBSS FRGF					

2. UNGRAPPLING OBSS (PUSHOFF)

DCP BRAKES SSRMS → OFF (Verify OFF)

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.

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

1.122 BERTHED OBSS UNGRAPPLE

(RBT FS/10A/FIN 1)

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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)

Verify Unloaded Parameters – √

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).

	Locked					
SR	SY	SP	EP	WP	WY	WR
+78.0	+40.4	+31.7	+122.2	-179.6	-140.9	+33.6
X	Y	Z	Pitch	Yaw	Roll	
-150	0	0	0.0	0.0	0.0	
FOR	Unloaded – LEE Tip, SY Held					
Disp	LAB>Berthed OBSS FRGF					

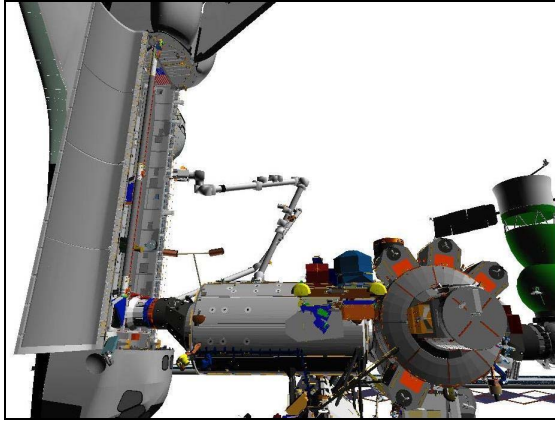


Figure 4.- OBSS Berthed Ungrapple
(03: S1 Lower Outboard: +85, +20).

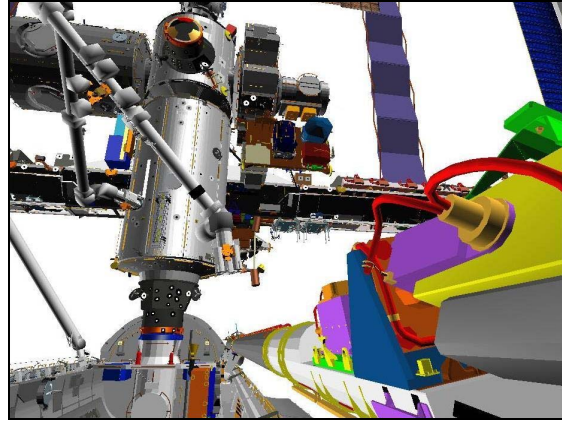


Figure 5.- OBSS Berthed Ungrapple
(92: Camera C: +10, +20).

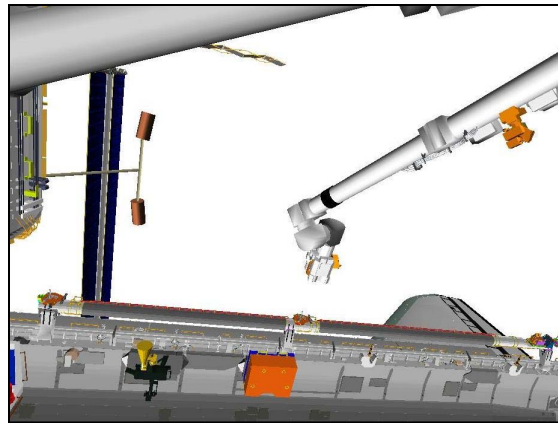


Figure 6.- OBSS Berthed Ungrapple
(V10: SRMS Elbow: -115, +15).

DCP BRAKES SSRMS → ON (Verify ON)

 Give SRMS operator GO to maneuver to Pre-Cradle.

1.210 SETUP FOR EVA1

(RBT FS/10A/FIN 1)

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1. SETUP

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
09: P1 Lower Outboard (+90, +20)	Mux 24/22 [24: Tip Elbow (0, -5), 22: Base Elbow (-5, 0)]	03: S1 Lower Outboard (+90, +20)	Camera C (0, +40) Camera B (+5, +30)

NOTE

The P1 Lower Outboard and S1 Lower Outboard views may be partially obstructed due to TRRJ rotation.

PCS

MSS: SSRMS:

Verify Unloaded Parameters – √

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

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

Verify Command – SSRMS>Internal

Verify SSRMS at OBSS Grapple Fixture Backoff 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	
+311	-311	+1491	-13.2	-0.1	+89.8	
FOR	Unloaded – LEE Tip, SR Held					
Disp	ISS>ISSACS					

√Vernier

MSS: SSRMS: Rate:

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

1.210 SETUP FOR EVA1

(RBT FS/10A/FIN 1)

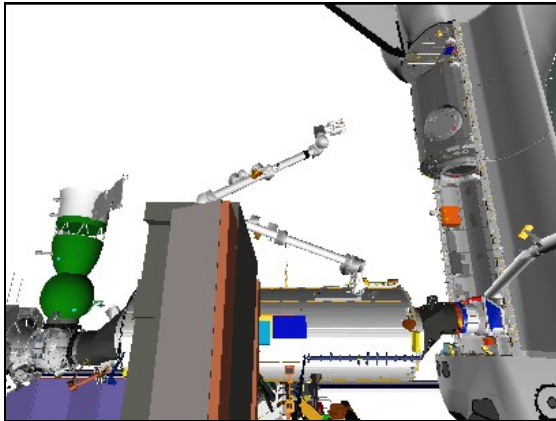


Figure 1.- OBSS Grapple Fixture Backoff (09: P1 Lower Outboard: +90, +20).

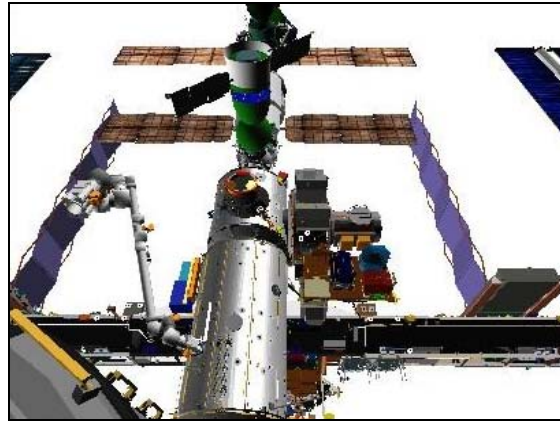


Figure 2.- OBSS Grapple Fixture Backoff (V10: Camera C: 0, 40).

2. MANEUVER TO AIRLOCK CLEARANCE 1 POSITION

2.1 Single Joint to Intermediate 1 Position

On SRMS operator GO for maneuver to EVA1 Setup 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.

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

Backoff
1: SP +
Intermediate 1

SR	SY	SP	EP	WP	WY	WR
+31.7	+46.6	-55.3	+127.9	-152.4	-156.2	-82.0
		-35.0				
+31.7	+46.6	-35.0	+127.9	-152.4	-156.2	-82.0
X	Y	Z	Pitch	Yaw	Roll	
+541	-229	+1449	+5.0	-4.0	+82.2	
FOR	Unloaded – LEE Tip, SR Held					
Disp	ISS>ISSACS					

1.210 SETUP FOR EVA1

(RBT FS/10A/FIN 1)

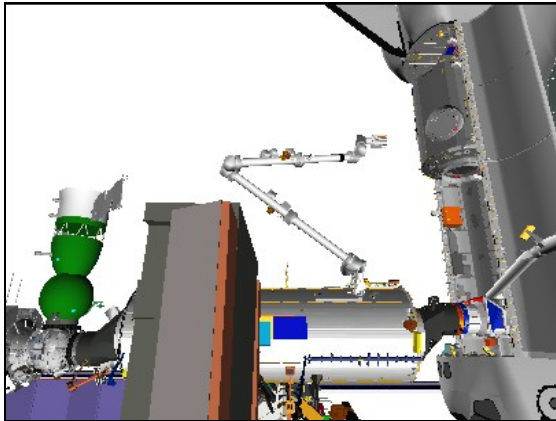


Figure 3.- Intermediate 1
(09: P1 Lower Outboard: +90, +20).

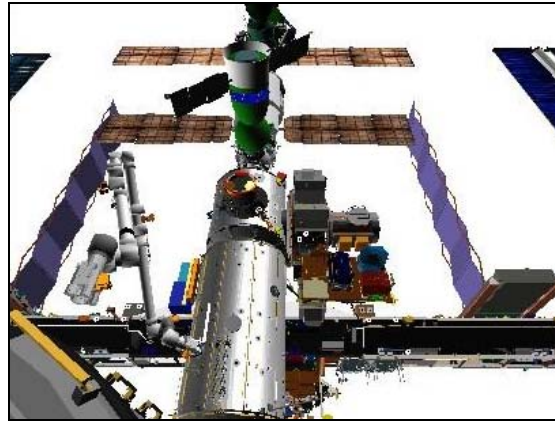


Figure 4.- Intermediate 1
(V10: Camera C: 0, +40).

2.2 JOCAS to Intermediate 2 Position

PCS

MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

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

SSRMS Joint OCAS

pick File ► LAB ► EVA Setup

Verify 'Joint Angles' 'Destination' for Intermediate 2 position.

SR	SY	SP	EP	WP	WY	WR
-73.4	+45.0	-75.0	-66.8	-54.2	+1.3	-0.8

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)	+31.7	+46.6	-35.0	+127.9	-152.4	-156.2	-82.0
TGT	-73.4	+45.0	-75.0	-66.8	-54.2	+1.3	-0.8
ERR	+105.1	+1.6	+40.0	+194.7	-98.2	-157.5	-81.2

1.210 SETUP FOR EVA1

(RBT FS/10A/FIN 1)

```

*****
* If joint angles or 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

PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at Intermediate 2 position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-73.4	+45.0	-75.0	-66.8	-54.2	+1.3	-0.8
X	Y	Z	Pitch	Yaw	Roll	
-463	+752	+1210	+123.9	+3.7	+52.9	
FOR	Unloaded – LEE Tip, SR Held					
Disp	ISS>ISSACS					

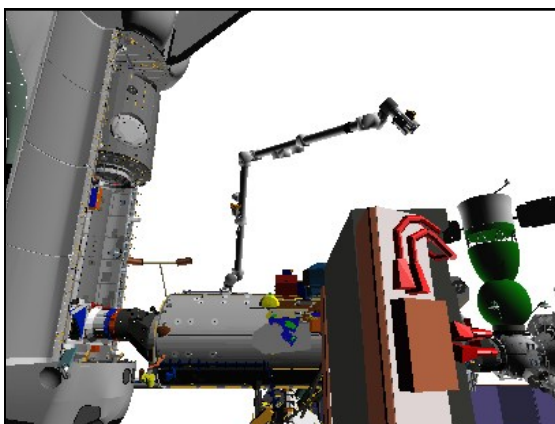


Figure 5.- Intermediate 2
(03: S1 Lower Outboard: +90, +20).

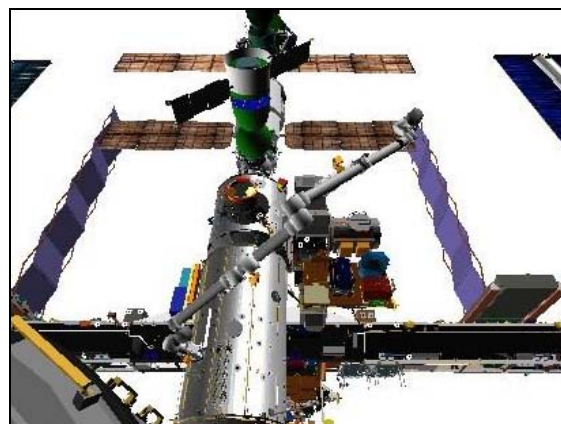


Figure 6.- Intermediate 2
(V10: Camera C: 0, +40).

2.3 Single Joint to Airlock Clearance 1

MSS: SSRMS:

Enter Mode – Single (Verify blue)

1.210 SETUP FOR EVA1

(RBT FS/10A/FIN 1)

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 Airlock Clearance 1 position (within 1 deg).

	SR	SY	SP	EP	WP	WY	WR
Intermediate 2	-73.4	+45.0	-75.0	-66.8	-54.2	+1.3	-0.8
1: SP -			-94.5				
2: WY +						+20.0	
A/L Clrnc 1	-73.4	+45.0	-94.5	-66.8	-54.2	+20.0	-0.8
	X	Y	Z	Pitch	Yaw	Roll	
	-602	+693	+813	+97.5	-0.2	+50.0	
FOR	Unloaded – LEE Tip, SR Held						
Disp	ISS>ISSACS						

<u>NOTE</u>
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)

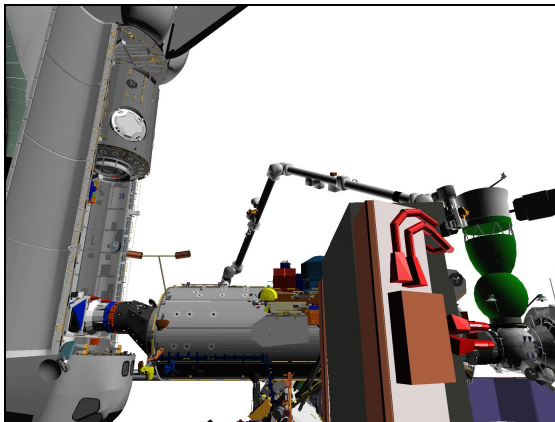


Figure 7.- Airlock Clearance 1
(03: S1 Lower Outboard: +90, +20).

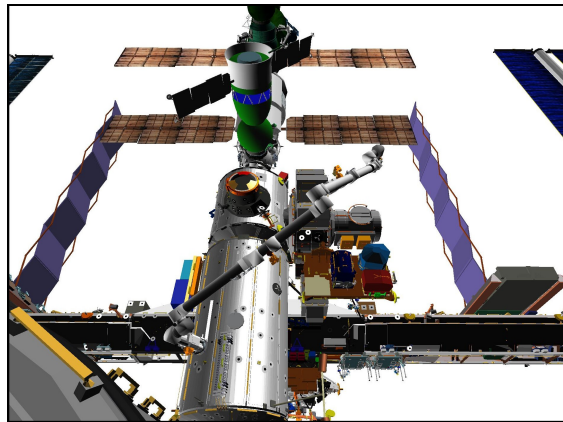


Figure 8.- Airlock Clearance 1
(V10: Camera C: 0, +40).

1.220 SASA STOW

(RBT FS/10A/FIN 1)

Page 1 of 20 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

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
03: S1 Lower Outboard (+95, +20)	24: Tip Elbow (-20, -5)	22: Base Elbow (-130, -10)	Camera C (0, +40)

NOTE

Throughout the procedure monitor clearances between the SSRMS tip boom and the Airlock O2-N2 tanks with the Base Elbow Camera.

Verify with **MCC-H** that the STBD TRRJ is parked at zero.

PCS

MSS: SSRMS:

Verify Unloaded Parameters – √

Change Unloaded Parameters ► Unloaded ► LEE Tip SYH

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

Verify Display – ISS>ISSACS

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

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

SR	SY	SP	EP	WP	WY	WR
-73.4	+45.0	-94.5	-66.8	-54.2	+20.0	-0.8
X	Y	Z	Pitch	Yaw	Roll	
-602	+693	+813	+97.5	-0.2	+50.0	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>ISSACS					

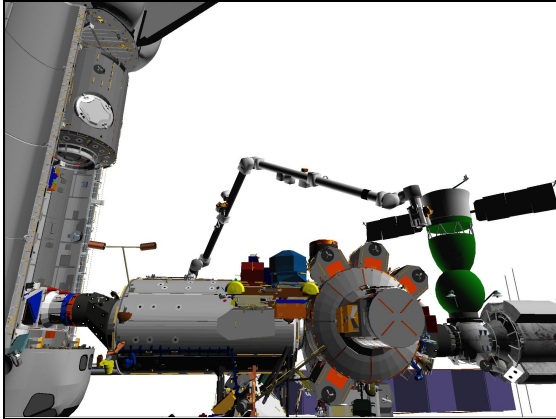


Figure 1.- Airlock Clearance 1
(03: S1 Lower Outboard: +95, +20).

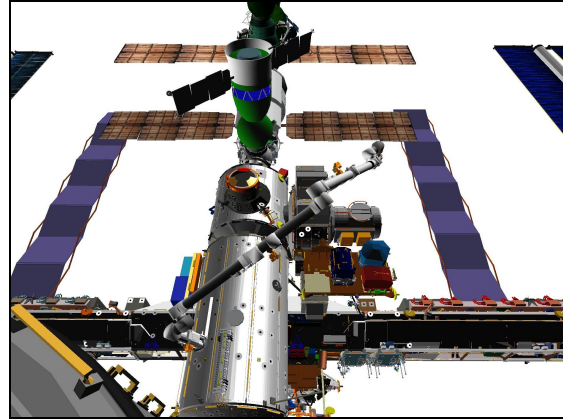


Figure 2.- Airlock Clearance 1
(V10: Camera C: 0, +40).

3. MANEUVER TO APFR INSTALL POSITION

MSS: SSRMS: SSRMS Safing:

cmd Remove (Verify Not Safed)

DCP BRAKES SSRMS → OFF (Verify OFF)

PCS MSS: SSRMS:

√Vernier

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 Airlock Clearance 2 position (within 1 deg).

	SR	SY	SP	EP	WP	WY	WR	
A/L Clmc 1	-73.4	+45.0	-94.5	-66.8	-54.2	+20.0	-0.8	
1: WY -						+1.3		
A/L Clmc 2	-73.4	+45.0	-94.5	-66.8	-54.2	+1.3	-0.8	
	X	Y	Z	Pitch	Yaw	Roll		
	-635	+665	+825	+112.2	-11.9	+51.6		
	FOR	Unloaded – LEE Tip, SY Held						
	Disp	ISS>ISSACS						

1.220 SASA STOW

(RBT FS/10A/FIN 1)

NOTE

1. APFR Setting is (12, PP, F, 6).
2. Continue to monitor clearances with the Base Elbow Camera, Tip Elbow Camera, and EV call. Minimum clearances are as follows:
 - a. Tip Boom to O2-N2 tanks: 145 cm (57 in)
 - b. Wrist cluster to Airlock circular Handrail: 94 cm (37 in)
 - c. Footplate (when APFR installed) to Airlock: 33 cm (13 in)

PCS

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

THC/
RHC

Maneuver to APFR Install position (within 5 cm/1 deg).

	Locked					
SR	SY	SP	EP	WP	WY	WR
-79.4	+45.0	-106.2	-66.9	-46.6	+3.9	-4.2
X	Y	Z	Pitch	Yaw	Roll	
-635	+665	+665	+112.2	-11.9	+51.5	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>ISSACS					

Notify IV/EVA, “SSRMS in position for APFR Install”

THC/
RHC

GCA per EVA call for APFR Install.

When APFR install complete, verify APFR setting with EV.

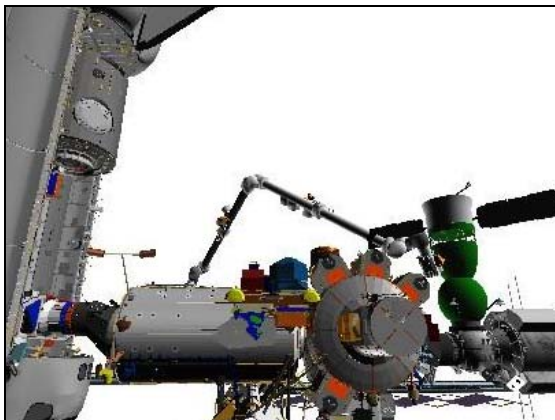


Figure 3.- APFR Install
(03: S1 Lower Outboard: +95, +20).

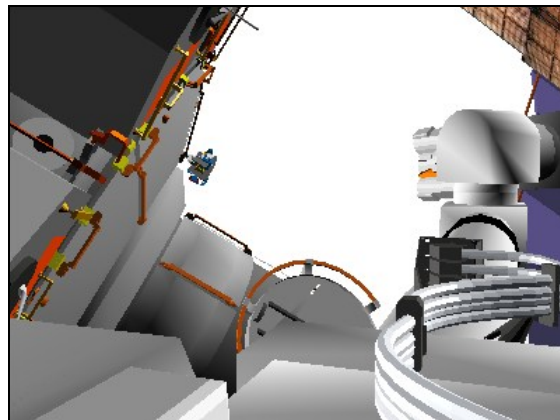


Figure 4.- APFR Install
(24: Tip Elbow: -20, -5).

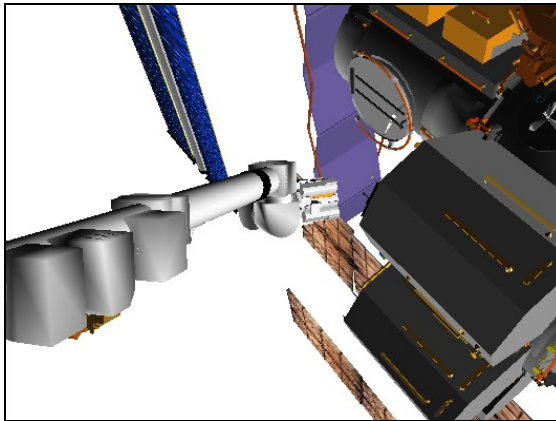


Figure 5.- APFR Install
(22: Base Elbow: -130, -10).

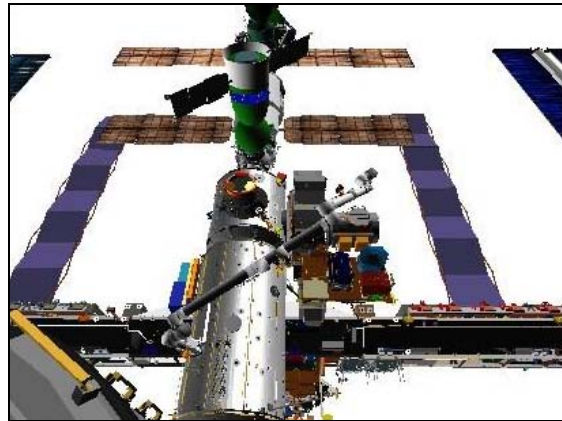


Figure 6.- APFR Install
(V10: Camera C: 0, +40).

4. APFR INGRESS

THC/
RHC

GCA per EVA call for APFR Ingress.

When APFR ingress complete:

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/Internal

5. SASA RETRIEVAL

On EVA GO for GCA for SASA Handoff:

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

1.220 SASA STOW

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NOTE

Maintaining clearances for SASA Handoff may be helped with the addition of body pitch down. Minimum clearances (with body pitch down) are as follows:

- a. Tip Boom to O2-N2 tanks: 97 cm (38 in.)
- b. Wrist cluster to Airlock circular handrail: 66 cm (26 in.)
- c. Footplate (when APFR installed) to Airlock: 51 cm (20 in.)

Notify EVA, "Ready for GCA for SASA handoff."

THC/
RHC

GCA per EV call for SASA handoff between EV crew.

Expected SSRMS at SASA Handoff position.

	Locked					
SR	SY	SP	EP	WP	WY	WR
-78.2	+45.0	-111.1	-62.5	-55.8	+7.2	-2.5
X	Y	Z	Pitch	Yaw	Roll	
-625	+535	+435	+1.5	-30.3	-21.1	
FOR	Unloaded – Chest 12/PP/F/6, SY Held					
Disp	ISS>ISSACS					

6. MANEUVER TO AIRLOCK CLEARANCE 2 POSITION

On IV/EV2 GO to maneuver to SASA sidewall carrier:

THC/
RHC

Maneuver to Airlock Clearance 2 position (SR, SP, EP within 2 deg).

Notify IV when EV1 no longer needed for monitoring clearances.

	Locked					
SR	SY	SP	EP	WP	WY	WR
-68.0	+45.0	-101.3	-40.0	-81.3	+2.0	+2.5
X	Y	Z	Pitch	Yaw	Roll	
-700	+625	+750	+1.5	-30.3	-21.1	
FOR	Unloaded – Chest 12/PP/F/6, SY Held					
Disp	ISS>ISSACS					

PCS

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

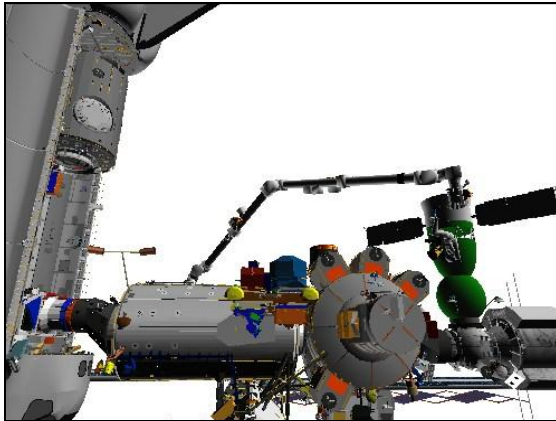


Figure 7.- Airlock Clearance 2
(03: S1 Lower Outboard: +95, +20).

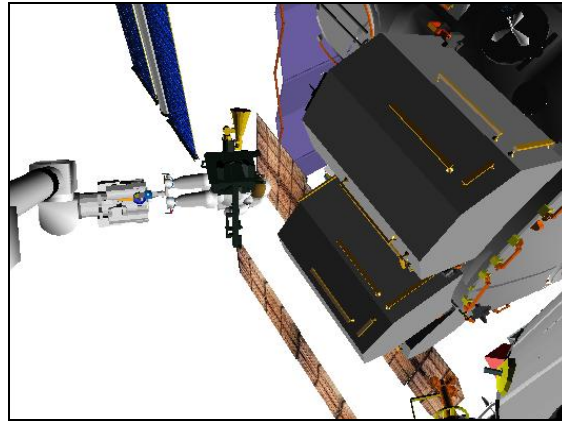


Figure 8.- Airlock Clearance 2
(22: Base Elbow: -130, -10).

7. MANEUVER TO SASA STOW WORKSITE SETUP

NOTE

The maneuvers to the Payload Bay will take approximately 25 minutes.

7.1 JOCAS 1 to Intermediate 1 Position

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
03: S1 Lower Outboard (+95, +20)	13: LAB Stbd Zenith (+45, -10)	22: Base Elbow (-130, -10)	Camera C (0, +45)

MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

pick File ► LAB ► SASA Stow Mnvr 1

Verify 'Joint Angles' 'Destination' for Intermediate 1 position.

SR	SY	SP	EP	WP	WY	WR
-68.0	+45.0	-85.0	-40.0	-130.0	+75.0	+75.0

cmd Load (Verify Sequence Status – Confirm or Cancel)

1.220 SASA STOW

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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)	-68.0	+45.0	-101.3	-40.0	-81.3	+2.0	+2.5
TGT	-68.0	+45.0	-85.0	-40.0	-130.0	+75.0	+75.0
ERR	0.0	0.0	-16.3	0.0	+48.7	-73.0	-72.5

PCS

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

MON

PCS

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

Notify EV2, “Starting SSRMS motion.”

DCP

AUTO SEQ → PROC

PCS

MSS: SSRMS:

Verify Posn Hold – orange

Verify Joint Angle values.

SR	SY	SP	EP	WP	WY	WR
-68.0	+45.0	-85.0	-40.0	-130.0	+75.0	+75.0

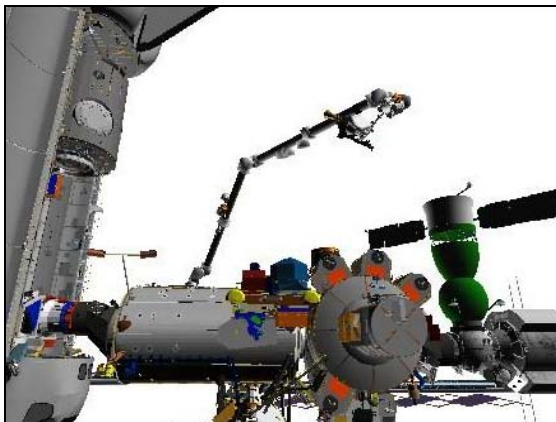


Figure 9.- Intermediate 1
 (03: S1 Lower Outboard: +95, +20).

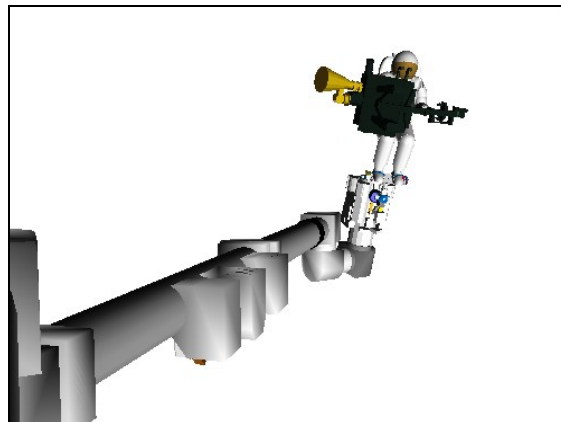


Figure 10.- Intermediate 1
 (22: Base Elbow: -155, -5).

1.220 SASA STOW

(RBT FS/10A/FIN 1)

7.2 JOCAS 2 to Intermediate 2 Position
Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
03: S1 Lower Outboard (+95, +20)	13: LAB Stbd Zenith (+15, -15)	22: Base Elbow (+170, -5)	Camera C (0, +45) Camera D (0, +10)

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

SSRMS Joint OCAS

pick File ► LAB ► SASA Stow Mnvr 2

Verify 'Joint Angles' 'Destination' for Intermediate 2 position.

SR	SY	SP	EP	WP	WY	WR
+33.5	+69.3	-15.0	+85.0	-130.0	+138.5	+133.2

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	+45.0	-85.0	-40.0	-130.0	+75.0	+75.0
TGT	+33.5	+69.3	-15.0	+85.0	-130.0	+138.5	+133.2
ERR	-101.5	-24.3	-70.0	-125.0	0.0	-63.5	-58.2

PCS

```
*****
* If joint angles or 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)

Notify EV2, "Starting SSRMS motion."

DCP

AUTO SEQ → PROC

PCS

MSS: SSRMS: **SSRMS**

Verify Posn Hold – orange

Verify SSRMS at Intermediate 2 position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+33.5	+69.3	-15.0	+85.0	-130.0	+138.5	+133.2
X	Y	Z	Pitch	Yaw	Roll	
+360	+494	+1646	-177.0	+43.2	+113.8	
FOR	Unloaded – Chest 12/PP/F/6, SY Held					
Disp	ISS>ISSACS					

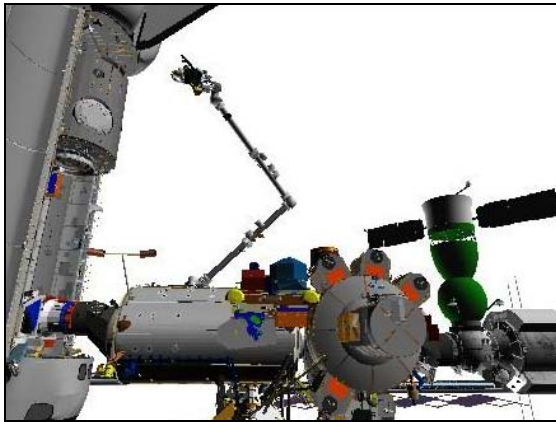


Figure 11.- Intermediate 2
(03: S1 Lower Outboard: +95, +20).

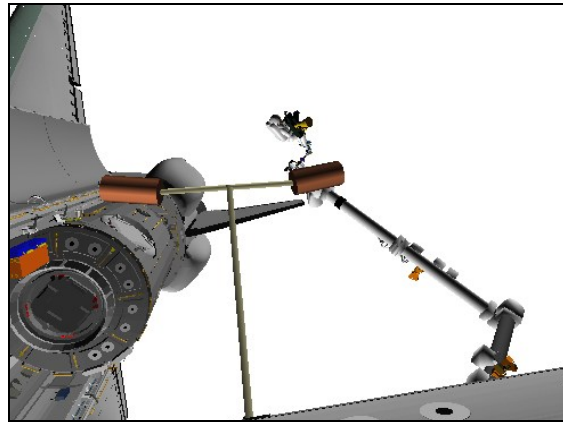


Figure 12.- Intermediate 2
(13: LAB Stbd Zenith: +10, -30).

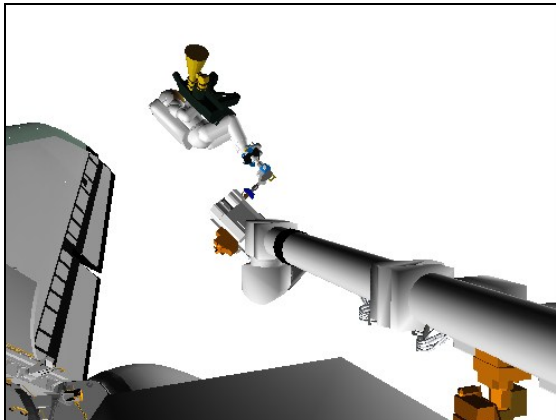


Figure 13.- Intermediate 2
(22: Base Elbow: +115, -5).

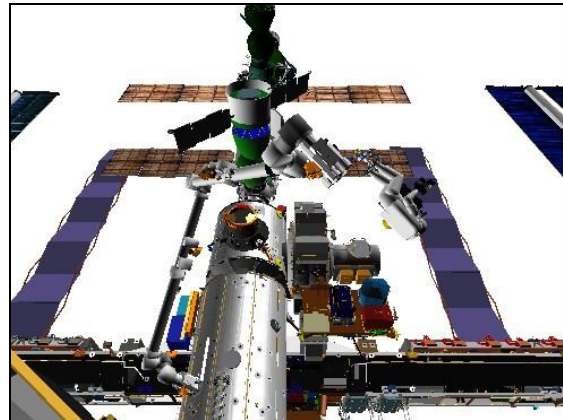


Figure 14.- Intermediate 2
(V10: Camera C: 0, +45).

7.3 Single Joint to SASA Stow Worksite Setup
Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
03: S1 Lower Outboard (+95, +20)	91: Camera D (0, +5)	22: Base Elbow (+115, -5) 24: Tip Elbow (0, 0)	OBSS ITVC (+90, -50) Camera C (0, +30)

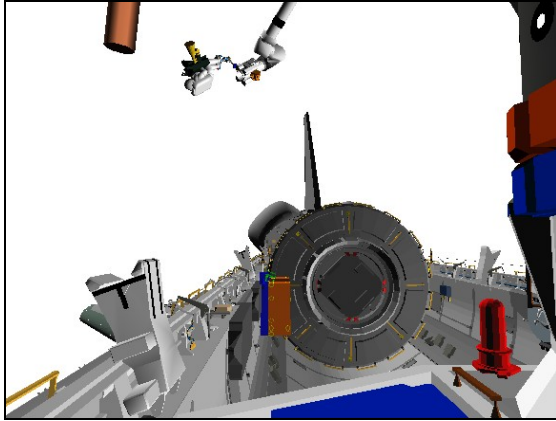


Figure 15.- Intermediate 2
(91: Camera D: 0, +5).

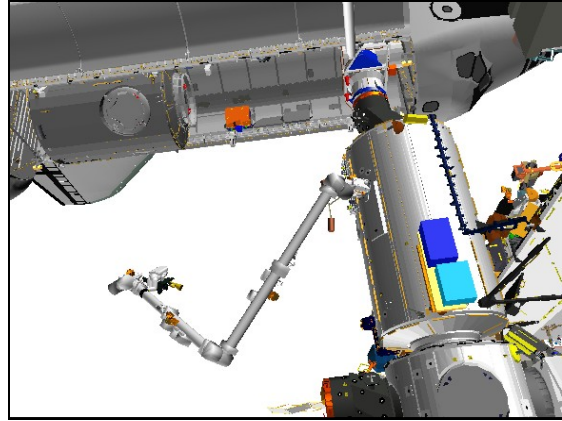


Figure 16.- Intermediate 2
(V10: OBSS ITVC: +90, -50).

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.

Notify EVA, “Starting SSRMS motion, 5 minutes to worksite setup position.”

THC

Perform Single Joint maneuver to SASA Worksite Setup position (within 1 deg).

	SR	SY	SP	EP	WP	WY	WR
Intermediate 2	+33.5	+69.3	-15.0	+85.0	-130.0	+138.5	+133.2
1: EP +				+133.6			
2: SP +			+5.0				
Worksite Setup	+33.5	+69.3	+5.0	+133.6	-130.0	+138.5	+133.2
	X	Y	Z	Pitch	Yaw	Roll	
	+792	+82	+905	-79.3	+78.5	+70.3	
FOR	Unloaded – Chest 12/PP/F/6, SY Held						
Disp	ISS>ISSACS						

PCS

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

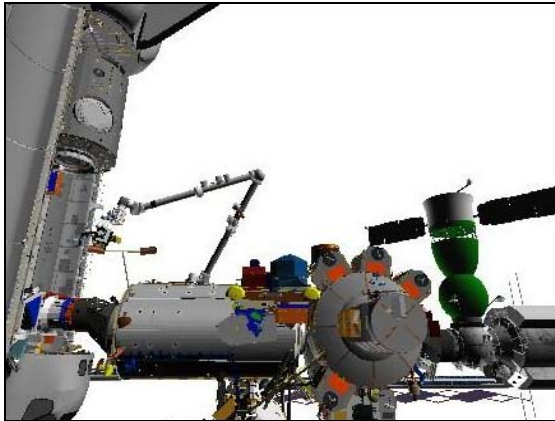


Figure 17.- SASA Stow Worksite Setup
(03: S1 Lower Outboard: +95, +20).

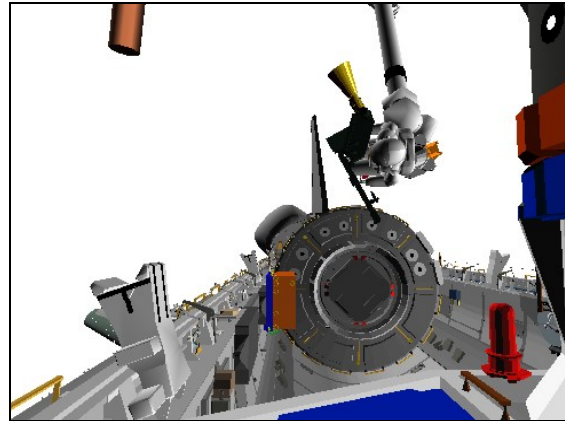


Figure 18.- SASA Stow Worksite Setup
(91: Camera D: 0, +5).

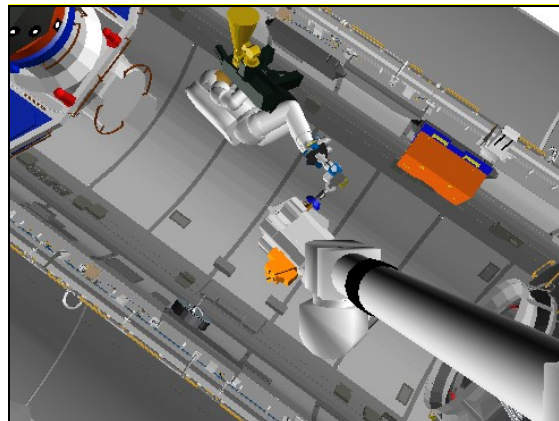


Figure 19.- SASA Stow Worksite Setup
(22: Base Elbow: +60, -5).

8. SASA STOW

MSS: SSRMS:

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

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

Verify SSRMS at SASA Stow Worksite Setup position
(within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+33.5	+69.3	+5.0	+133.6	-130.0	+138.5	+133.2
X	Y	Z	Pitch	Yaw	Roll	
-1994	+83	-1252	-170.0	+78.7	+70.1	
FOR	Unloaded – Chest 12/PP/F/6, SY Held					
Disp	ISS>OBAS					

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NOTE

While maneuvering in the Payload Bay, monitor clearances between the SSRMS and Node 2, as well as, the MBSU with the Base Elbow Camera, the S1 Lower Outboard Camera and Camera D. Clearances will be less than 150 cm.

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

Verify with EV that APFR ingress aid is stowed as required to remain clear of structure and that EV is not leaning back.

Notify EV, “Ready for GCA for SASA stow.”

THC/
RHC

GCA per EV call to SASA Stow location at Starboard, Bay 4.

THC/
RHC

GCA as required per EV call to access bolts.

9. APFR EGRESS AND REMOVAL

9.1 Maneuver to SASA Clearance

On EV GO for maneuver to SASA Clearance position:

THC/
RHC

Maneuver to SASA Clearance position.

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

	Locked						
SR	SY	SP	EP	WP	WY	WR	
+22.3	+69.3	+17.5	+117.9	-133.8	+138.8	+128.0	
X	Y	Z	Pitch	Yaw	Roll		
-1994	+75	-1020	-170.0	+78.7	+70.1		
FOR	Unloaded – Chest 12/PP/F/6, SY Held						
Disp	ISS>OBAS						

PCS

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

 * If PDGF Release Support required:
 * | Go to {2.220 PDGF RELEASE SUPPORT}, all
 * | (SODF: RBT FS: 10A: CONTINGENCY), >>

Notify IV/EVA, "GO to egress the APFR."

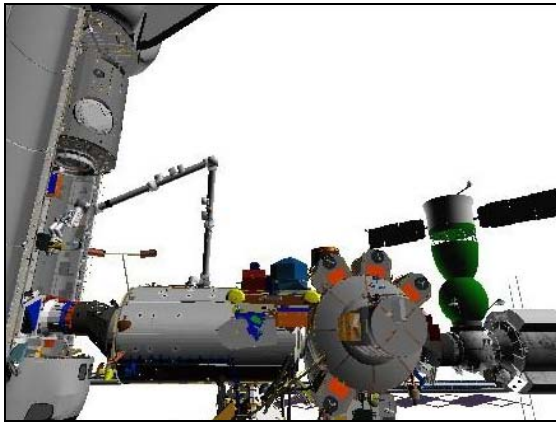


Figure 20.- SASA Clearance
(03: S1 Lower Outboard: +95, +20).

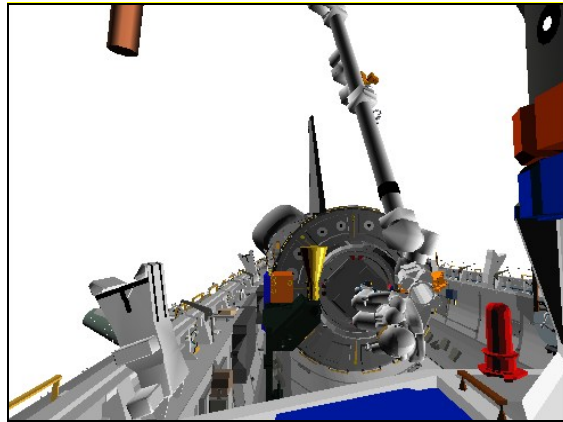


Figure 21.- SASA Clearance
(91: Camera D: 0, +5).

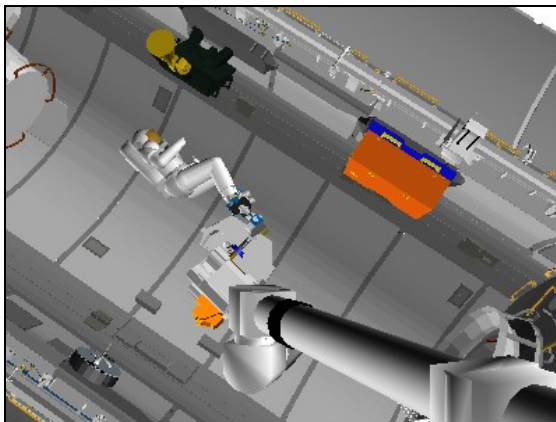


Figure 22.- SASA Clearance
(22: Base Elbow: +85, 0).

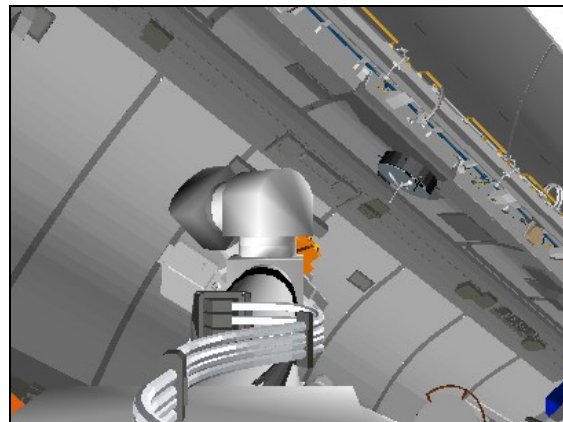


Figure 23.- SASA Clearance
(24: Tip Elbow: 0, 0).

9.2 APFR Egress

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
03: S1 Lower Outboard (+95, +20)	24: Tip Elbow (0, 0)	22: Base Elbow (+85, 0)	OBSS ITVC (+90, -50) Camera C (0, +30)

Verify Unloaded Parameters – ✓

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

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

SR	SY	SP	EP	WP	WY	WR
+22.3	+69.3	+17.5	+117.8	-133.8	+138.8	+128.0
X	Y	Z	Pitch	Yaw	Roll	
-2131	-40	-1051	-10.3	+10.6	-69.1	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>OBAS					

On EV GO (APFR egress complete):

NOTE
Monitor clearances with the Base Elbow Camera and the Tip Elbow Camera. Minimum clearances are as follows:
a. APFR foot plate to MBSU: 61 cm (24 in.)
b. APFR ingress aid to SASA: 89 cm (35 in.)
c. APFR to Orbiter starboard sill: 127 cm (50 in.)
d. WP to Orbiter port sill: 170 cm (67 in.)

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

Verify with EV that APFR ingress aid is stowed in the low profile configuration to remain clear of structure.

Notify EV, "Ready for GCA for APFR removal."

GCA for APFR Removal near the MBSU.

Expected APFR Removal position.

	Locked					
SR	SY	SP	EP	WP	WY	WR
+35.7	+69.3	+28.0	+115.8	-133.8	+138.4	+134.2
X	Y	Z	Pitch	Yaw	Roll	
-2131	+35	-1051	-10.3	+10.6	-69.1	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>OBAS					

THC/
RHC



Figure 24.- APFR Removal
(03: S1 Lower Outboard: +95, +20).



Figure 25.- APFR Removal
(24: Tip Elbow: 0, 0).

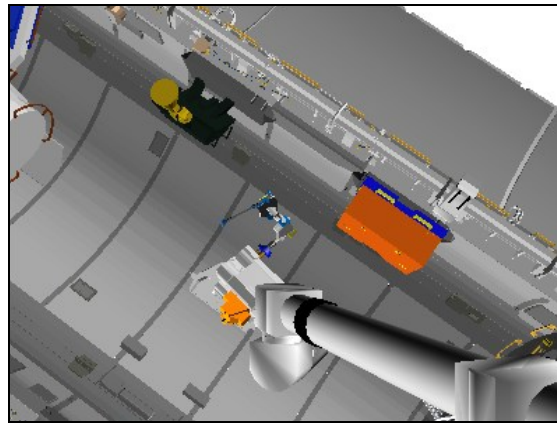


Figure 26.- APFR Removal
(22: Base Elbow: +85, 0).

10. MANEUVER TO NODE 2 PRE-GRAPPLE POSITION

10.1 Maneuver to Payload Bay Clearance Position

On IV GO for maneuver to Node 2 Pre-Grapple:

Verify APFR, WIF adapter, and Safety tether have been removed and EV crew is clear of the SSRMS.

THC/
RHC

Maneuver to Payload Bay Clearance position (SR, SP, EP within 2 deg).

	Locked					
SR	SY	SP	EP	WP	WY	WR
+51.2	+69.3	+4.4	+139.1	-123.8	+137.0	+141.4
X	Y	Z	Pitch	Yaw	Roll	
-2131	0	-1415	-10.3	+10.6	-69.1	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>OBAS					

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(RBT FS/10A/FIN 1)

Notify **MCC-H**, "GO for STBD TRRJ autotrack."

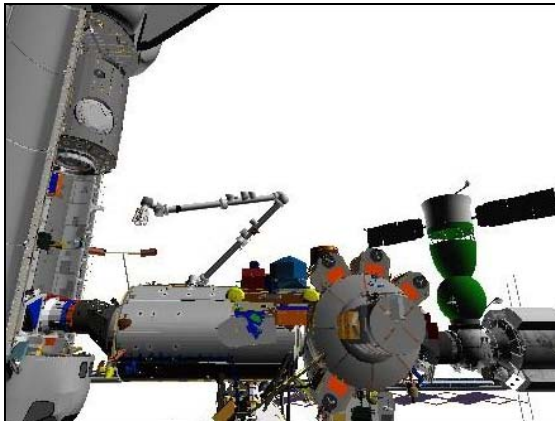


Figure 27.- Payload Bay Clearance
(03: S1 Lower Outboard: +95, +20).

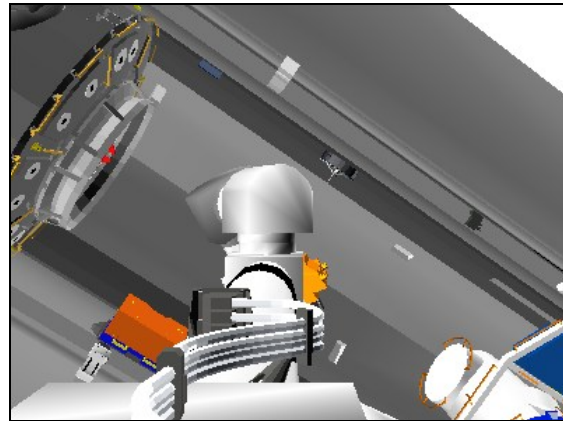


Figure 28.- Payload Bay Clearance
(24: Tip Elbow: 0, 0).

10.2 JOCAS to Node 2 Pre-Grapple Setup

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
03: S1 Lower Outboard (+95, +20)	24: Tip Elbow (+10, +5)	91: Camera D (0, +20)	Camera C (0, +35) OBSS ITVC (+90, -50)

PCS

MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

pick File ► LAB ► N2 Pre-Grapple

Verify 'Joint Angles' 'Destination' for Node2 Pre-Grapple Setup position.

SR	SY	SP	EP	WP	WY	WR
+29.7	+69.3	+10.0	+48.7	-88.3	-132.0	+146.5

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)	+51.2	+69.3	+4.4	+139.1	-123.8	+137.0	+141.4
TGT	+29.7	+69.3	+10.0	+48.7	-88.3	-132.0	+146.5
ERR	+21.5	0.0	-5.6	+90.4	-35.5	+269.0	-5.1


```

*****
* If joint angles or 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)

Notify EVA, "Maneuvering SSRMS to Node 2 Pre-Grapple Setup position."

DCP AUTO SEQ → PROC

PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at Node 2 Pre-Grapple Setup position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+29.7	+69.3	+10.0	+48.7	-88.3	-132.0	+146.5
X	Y	Z	Pitch	Yaw	Roll	
-3038	+302	-1472	-96.1	-46.4	-87.0	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>OBAS					

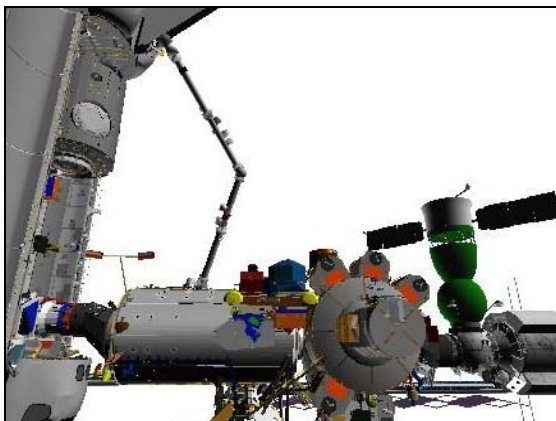


Figure 29.- Node 2 Pre-Grapple Setup (03: S1 Lower Outboard: +95, +20).

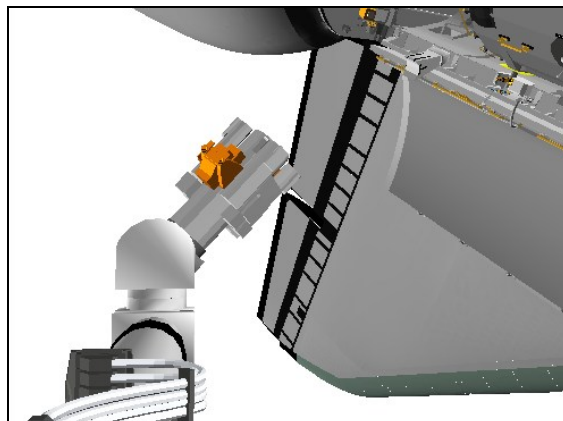


Figure 30.- Node 2 Pre-Grapple Setup (24: Tip Elbow: +10, +5).

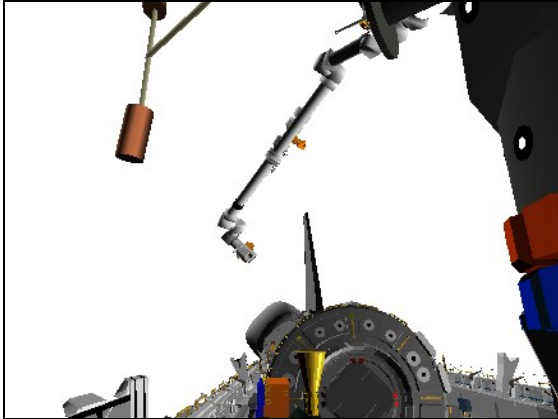


Figure 31.- Node 2 Pre-Grapple Setup
(91: Camera D: 0, +20).

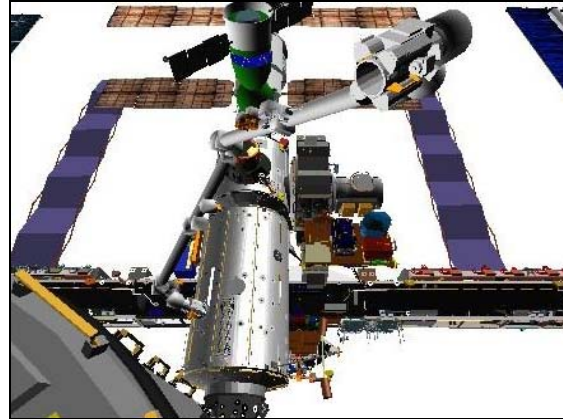


Figure 32.- Node 2 Pre-Grapple Setup
(V10: Camera C: 0, +35).

10.3 FOR OCAS to Node 2 Pre-Grapple

MSS: SSRMS:

Change Display ► LAB ► Berthed Node2 FRGF (Verify LAB>Berthed Node2 FRGF)

MSS: SSRMS:

Enter Mode – FOR OCAS (Verify blue)

MSS: SSRMS: SSRMS FOR OCAS: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

pick File ► LAB ► N2 Pre-Grapple

Verify 'FOR' 'Destination' for Node 2 Pre-Grapple position.

X	Y	Z	Pitch	Yaw	Roll
-150	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	-296	-73	-175	-5.5	-4.3	+7.5
TGT	-150	0	0	0.0	0.0	0.0
ERR	-146	-73	-175	-5.5	-4.3	+7.5

1.220 SASA STOW

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```

*****
* If FOR or 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

PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at Node 2 Pre-Grapple position
(within 5 cm/1 deg).

	Locked					
SR	SY	SP	EP	WP	WY	WR
+29.2	+69.3	+20.0	+48.7	-88.5	-132.2	+146.3
X	Y	Z	Pitch	Yaw	Roll	
-150	0	0	0.0	0.0	0.0	
FOR	Unloaded – LEE Tip, SY Held					
Disp	LAB>Berthed Node2 FRGF					

DCP BRAKES SSRMS → ON (Verify ON)

Notify EVA/IV, “SSRMS at Node 2 Pre-Grapple position.”

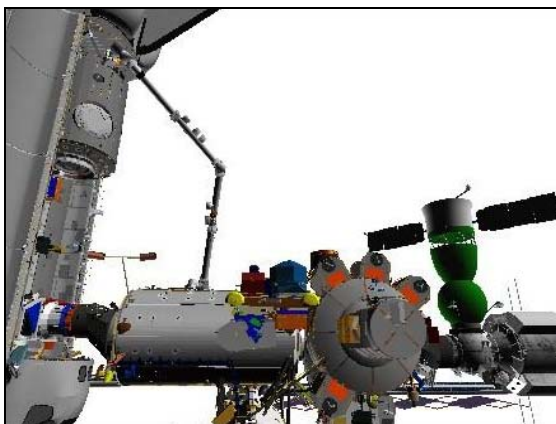


Figure 33.- Node 2 Pre-Grapple
(03: S1 Lower Outboard: +95, +20).

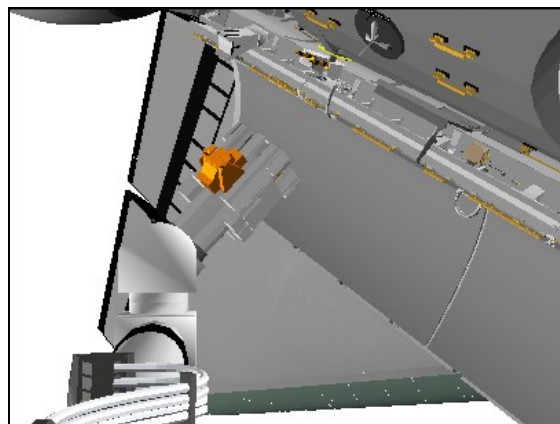


Figure 34.- Node 2 Pre-Grapple
(24: Tip Elbow: +10, +5).

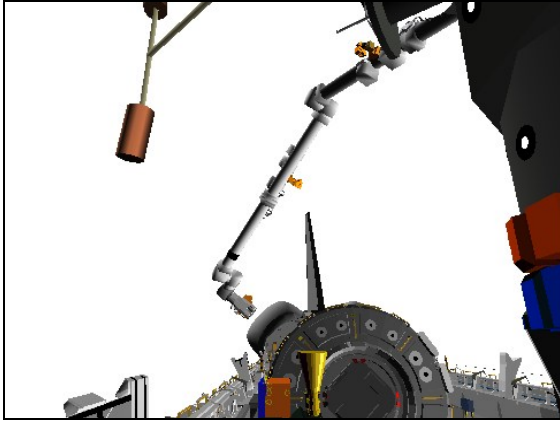


Figure 35.- Node 2 Pre-Grapple
(91: Camera D: 0, +20).

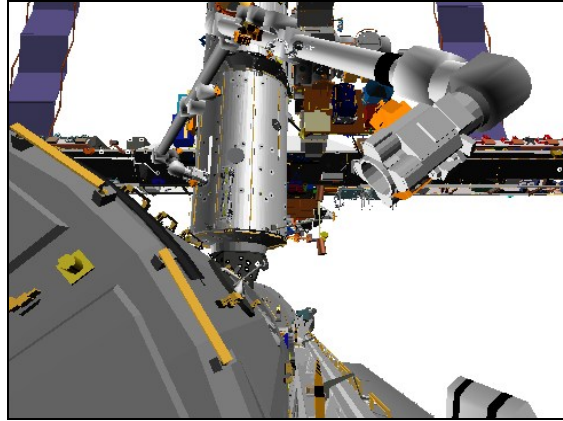


Figure 36.- Node 2 Pre-Grapple
(V10: Camera C: 0, +15).

1.310 BERTHED NODE 2 GRAPPLE

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1. SETUP

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
91: Camera C (0, +15)	25: Tip LEE	24: Tip Elbow (+15, +10)	Camera D (0, +20)

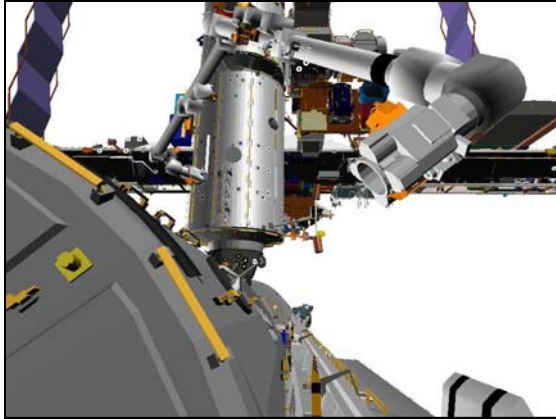


Figure 1.- Node 2 Pre-Grapple
(91: Camera C: 0, +15).

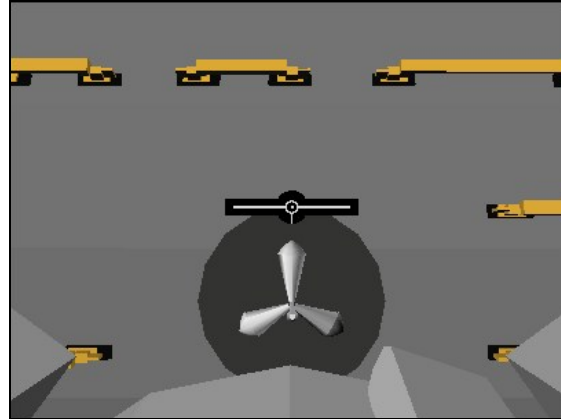


Figure 2.- Node 2 Pre-Grapple
(25: Tip LEE).

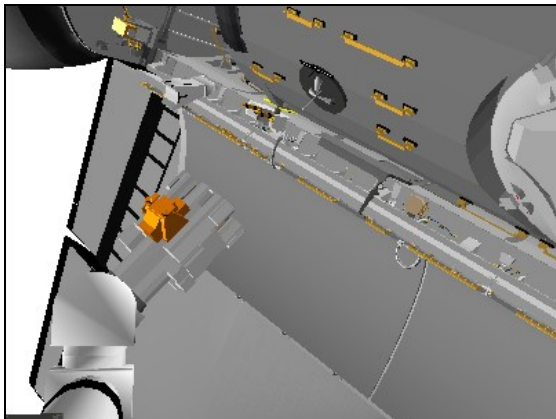


Figure 3.- Node 2 Pre-Grapple
(24: Tip Elbow: +15, +10).

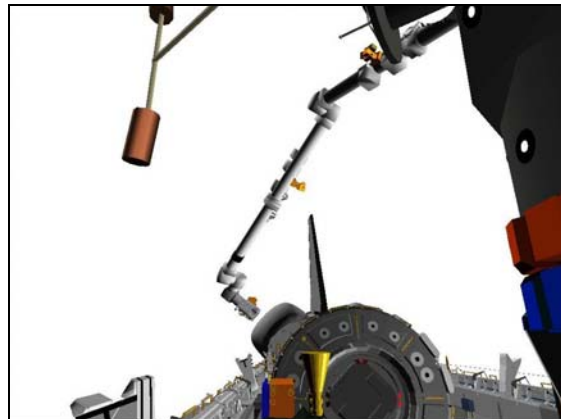


Figure 4.- Node 2 Pre-Grapple
(V10: Camera D: 0, +20).

PCS

MSS: SSRMS:

Change Loaded Parameters ► Node2 ► Node2 Unberth SRH

Verify 'Loaded Parameters' (two) – Node2 Unberth, SR Held

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

Verify Display - LAB>Berthed Node2 FRGF

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

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Verify SSRMS at Node 2 Pre-Grapple position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+29.2	+69.3	+20.0	+48.7	-88.5	-132.2	+146.3
X	Y	Z	Pitch	Yaw	Roll	
-150	0	0	0.0	0.0	0.0	
FOR	Unloaded – LEE Tip, SY Held					
Disp	LAB>Berthed Node2 FRGF					

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: as desired

2. NODE 2 GRAPPLE

2.1 Maneuvering to Within Grapple Envelope

NOTE

1. Monitor clearance between the Wrist Roll and Orbiter sill with Camera C. Minimum clearance during maneuver to grapple is approximately 93 cm (37 in).
2. Tip LEE Camera must be fully zoomed out to correspond to target overlay.

On IV GO for Node 2 Grapple:

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)

RHC/
THC

Maneuver to within grapple envelope.

2.2 Slow Capture Commands

MSS: SSRMS: Tip LEE:

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

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

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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 2.3 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
- DCP 2.4 Grapple Cleanup
 BRAKES SSRMS → ON (Verify ON)
- PCS MSS: SSRMS: SSRMS

Verify Loaded Parameters – √
 Verify 'Loaded Parameters' (two) – Node2 Unberth, SR Held

Change Display ► LAB ► Node2 Unberth (Verify LAB> Node2 Unberth)
 Change Command ► ISS ► OBAS (Verify ISS>OBAS)

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

Record Berthed Node 2 Grapple position joint angles and FOR.

	SR	SY	SP	EP	WP	WY	WR
Expected	+5.7	+69.3	+0.3	+56.8	-105.9	-136.8	+136.5
	X	Y	Z	Pitch	Yaw	Roll	
Expected	0	0	0	0.0	0.0	0.0	
	FOR	Loaded – Node2 Unberth, SR Held					
	Disp	LAB> Node2 Unberth					

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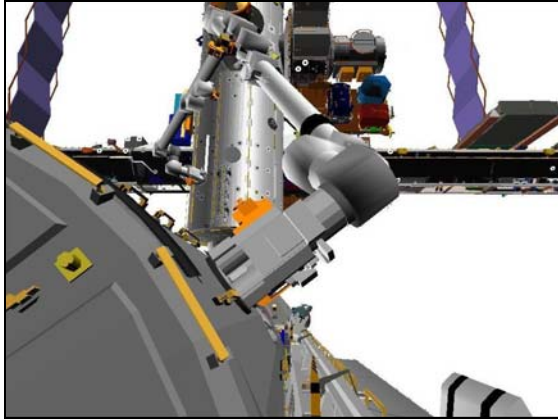


Figure 5.- Berthed Node 2 Grapple
(91: Camera C: 0, +15).

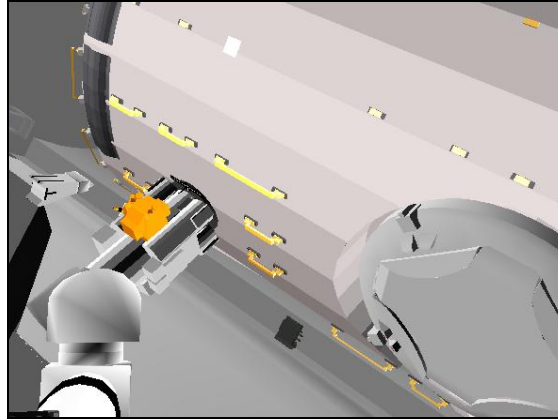


Figure 6.- Berthed Node 2 Grapple
(24: Tip Elbow: +15, +10).

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1. SETUP FOR UNBERTH

Verify that SRMS is at Node 2 Viewing position.

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
03: S1 Lower Outboard (+90, +25)	91: Mux B/C (B: 0, 0) (C: 0, 0)	13: LAB Stbd Zenith (+5, -45)	SRMS Elbow (-130, +35)

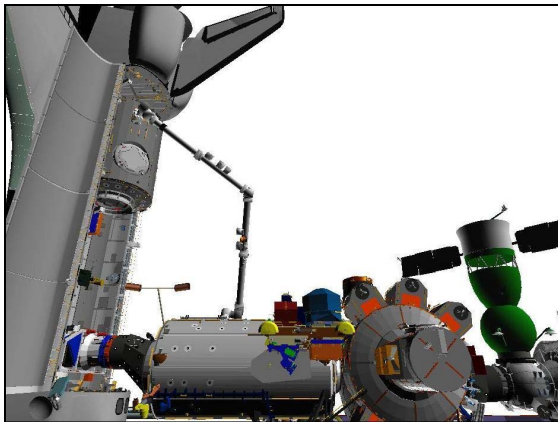


Figure 1.- Berthed Node 2 Grapple
(03: S1 Lower Outboard: +90, +25).

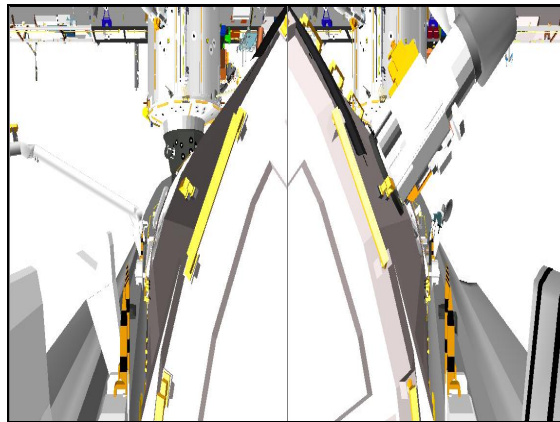


Figure 2.- Berthed Node 2 Grapple
(91: Mux B/C; FL = 8.4mm).

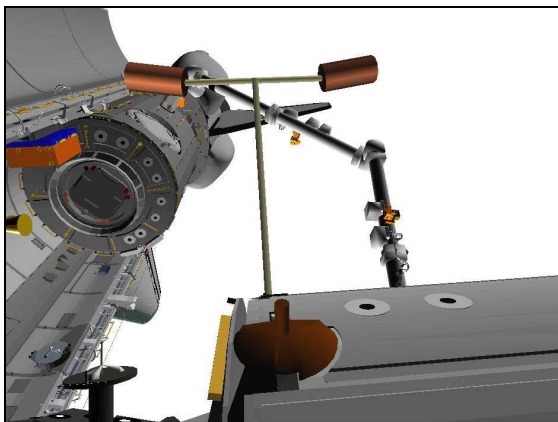


Figure 3.- Berthed Node 2 Grapple
(13: LAB Stbd Zenith: +5, -45).



Figure 4.- Berthed Node 2 Grapple
(V10: SRMS Elbow: -130, +35).

Verify CBCS setup Complete

PCS

MSS: SSRMS:

Verify Loaded Parameters – √

Verify Loaded Parameters – Node2 Unberth, SR Held

Verify Display – LAB>Node2 Unberth

Verify Command – ISS>OBAS

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√Vernier

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: as desired.

2. ATTITUDE CONTROL CONFIGURATION

On IV GO for Node 2 Unberth:

MSS: SSRMS: Thrusters:

Verify 'Desat Request:' – Inh

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

3. PRLA OPERATIONS

Give shuttle crew GO for PRLA Ops.

NOTE

Steps 4 to 7 will be performed by the shuttle crew to open Node 2 PRLA's.

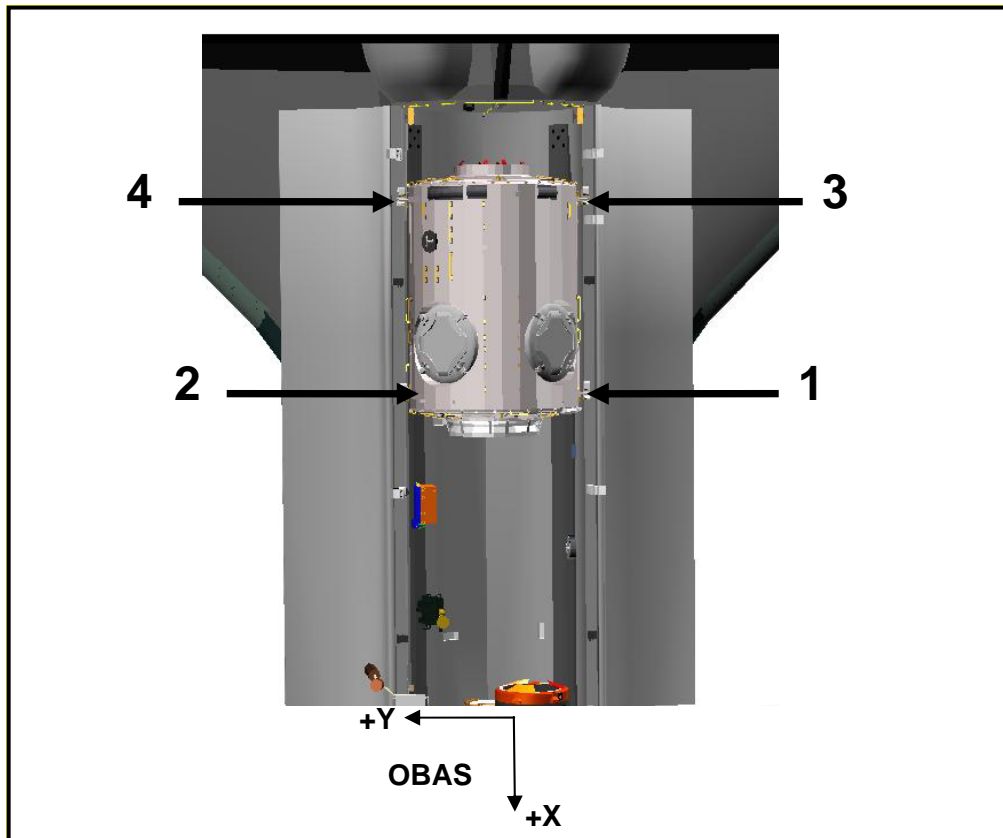


Figure 5.- Node 2 PRLA Configuration.

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4. ACTIVATE LATCHES

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).
*****
```

5. 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

6. 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

7. 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 Node 2 unberth.

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8. RECOVERING LOADCELL TENSION

```

*****
* If 'R3Q - SSRMS LEE Uncommanded Derigidize' Caution was annunciated
* during PRLA release or Carriage tension < 4400 N:
*
PCS * MSS: SSRMS: Tip LEE: 
*
* cmd 'Carriage' Rigidize ► Slow (Verify Speed – Slow)
*
* Verify 'Confirm or Terminate' prompt.
*
* 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
*****

```

9. MANEUVERING NODE 2 TO LOW HOVER

NOTE
 Due to clearance concerns with Node 2 Handrails and V-guides during Node 2 Unberth, maintain FOR within 5 cm/1 deg to avoid contact.

On shuttle crew GO for Node 2 unberth:

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)

THC/
RHC Maneuver to Node 2 Low Hover position (within 5 cm/1 deg). (THC up)

Locked						
SR	SY	SP	EP	WP	WY	WR
+5.7	+70.0	-35.1	+70.5	-83.8	-137.3	+137.2
X	Y	Z	Pitch	Yaw	Roll	
0	0	-600	0.0	0.0	0.0	
FOR	Loaded – Node2 Unberth, SR Held					
Disp	LAB>Node2 Unberth					

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PCS

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

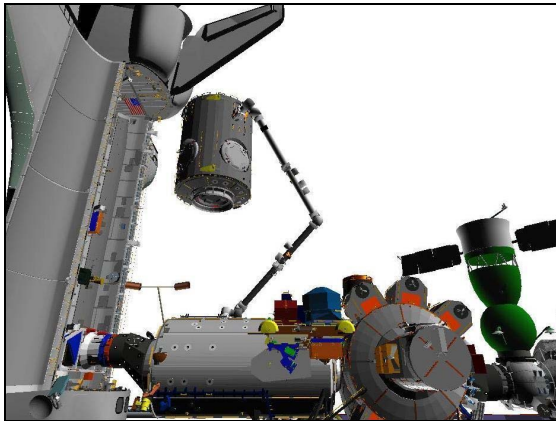


Figure 6.- Node 2 Low Hover
(03: S1 Lower Outboard: +90, +25).

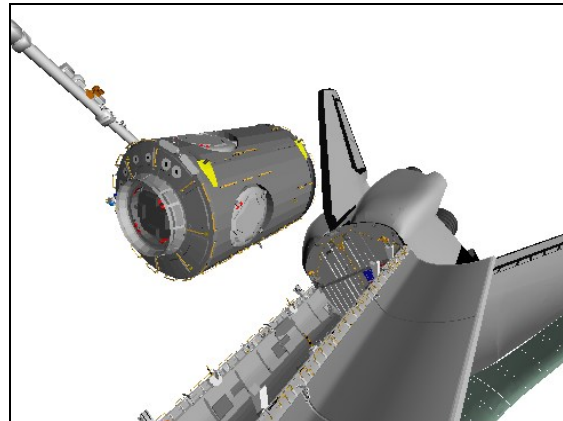


Figure 7.- Node 2 Low Hover
(V10: SRMS Elbow: -130, +35).

10. ATTITUDE CONTROL CONFIGURATION

If using shuttle attitude control, coordinate with shuttle crewmembers:

If attitude maintenance required:

Configure DAP per RMS DAPs, then

Perform RATE DAMPING (ORB OPS FS, DOCKED DAP REFERENCE), then:

When in attitude

DAP: FREE

11. SETUP FOR MANEUVER TO PORT HOVER

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
09: P1 Lower Outboard (+105, +30)	91: Camera C (-45, +25)	92: Camera A (+25, +20)	SRMS Elbow (-130, +50)

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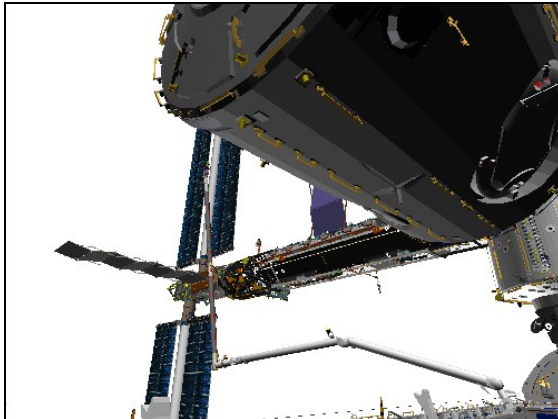


Figure 8.- Node 2 Low Hover
(91: Camera C: -45, +25).

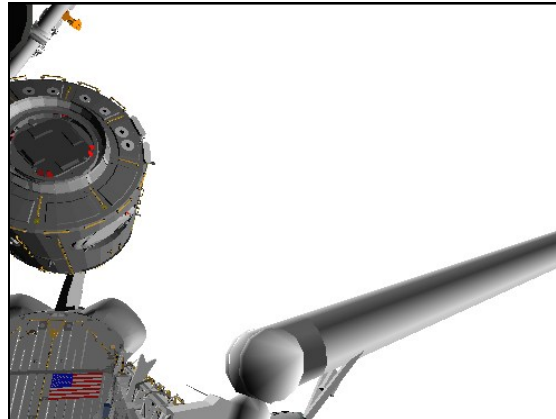


Figure 9.- Node 2 Low Hover
(92: Camera A: +25, +20).

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 Roll (Verify SR – Locked)

pick File ► LAB ► N2 Install Mnvr 2

Verify 'FOR' 'Destination' for Node 2 Port Hover position.

X	Y	Z	Pitch	Yaw	Roll
0	-700	-600	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	-600	0.0	0.0	0.0
TGT	0	-700	-600	0.0	0.0	0.0
ERR	0	+700	0	0.0	0.0	0.0

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```

*****
* If FOR or 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

PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at Node 2 Port Hover position (within 5 cm/1 deg).

Locked						
SR	SY	SP	EP	WP	WY	WR
+5.7	+36.4	-43.2	+85.5	-129.0	-123.4	+88.6
X	Y	Z	Pitch	Yaw	Roll	
0	-700	-600	0.0	0.0	0.0	
FOR	Loaded – Node2 Unberth, SR Held					
Disp	LAB>Node2 Unberth					

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

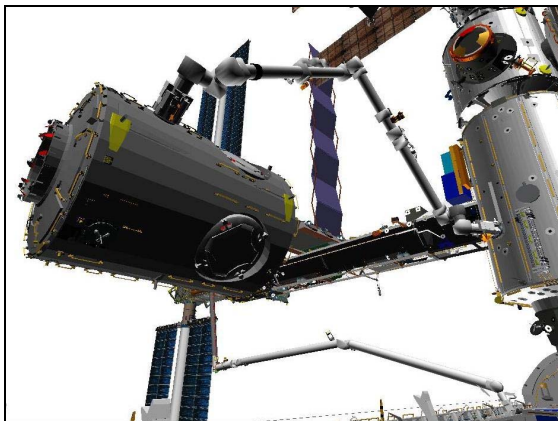


Figure 10.- Node 2 Port Hover
(91: Camera C: -45, +25).

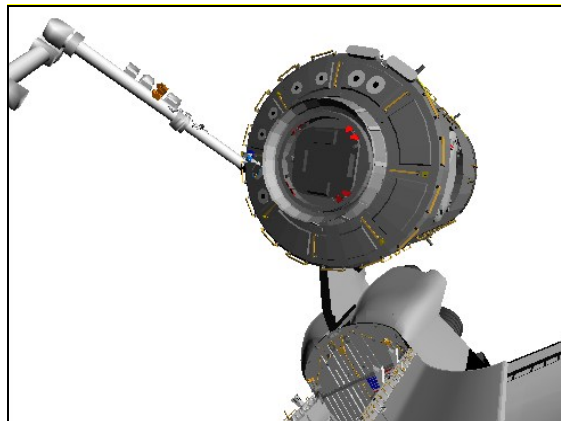


Figure 11.- Node 2 Port Hover
(V10: SRMS Elbow: -130, +50).

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12. ATTITUDE CONTROL CONFIGURATION

If using shuttle attitude control, coordinate with shuttle crewmembers:

If attitude maintenance required:

Configure DAP per RMS DAPs, then

Perform RATE DAMPING (ORB OPS FS, DOCKED DAP REFERENCE), then:

When in attitude

DAP: FREE

13. VERIFY PORT TRRJ LOCKED

Verify with **MCC-H** PORT TRRJ locked at 0 deg.

14. JOCAS FROM PORT HOVER TO INTERMEDIATE POSITION

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
09: P1 Lower Outboard (+105, +30)	91: Camera C (-45, +25)	92: Camera A (+50, +50)	SRMS Elbow (-75, +75)

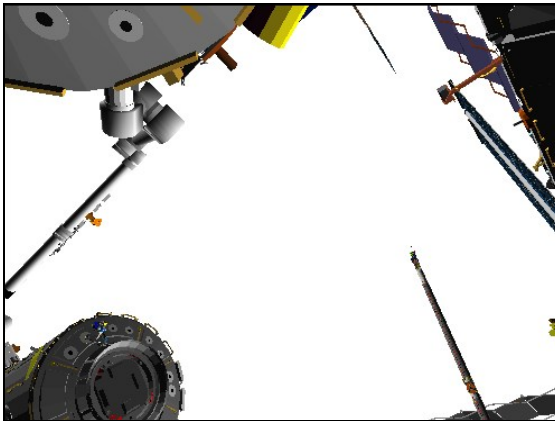


Figure 12.- Node 2 Port Hover
(92: Camera A: +50, +50).

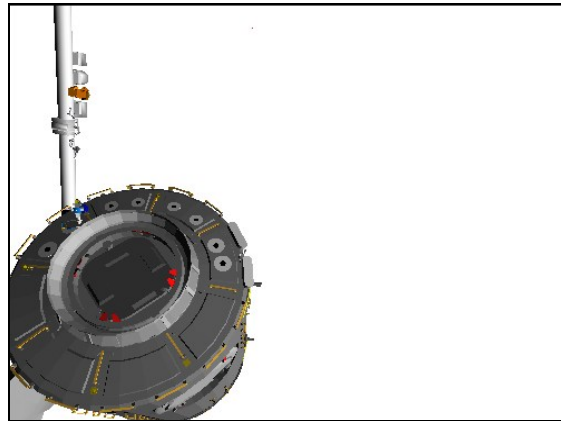


Figure 13.- Node 2 Port Hover
(V10: SRMS Elbow: -75, +75).

MSS: SSRMS:

Change Loaded Parameters ► Node2 ► Node2 Install CBCS SYH
Verify 'Loaded Parameters' (two) – Node2 Install CBCS, SY Held

Change Display ► LAB ► Node2 Install CBCS (Verify LAB>Node2 Install CBCS)

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

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Verify SSRMS at Node 2 Port Hover position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+5.7	+36.4	-43.2	+85.5	-129.0	-123.4	+88.6
X	Y	Z	Pitch	Yaw	Roll	
+506	+897	+1595	+90.2	-1.1	-135.1	
FOR	Loaded – Node2 Install CBCS, SY Held					
Disp	LAB>Node2 Install CBCS					

Enter Mode – Joint OCAS (Verify blue)

SSRMS Joint OCAS

pick File ► LAB ► N2 Install Mnvr 1

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

SR	SY	SP	EP	WP	WY	WR
-86.0	-25.2	-29.5	+109.1	-78.8	-70.4	-51.5

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)	+5.7	+36.4	-43.2	+85.5	-129.0	-123.4	+88.6
TGT	-86.0	-25.2	-29.5	+109.1	-78.8	-70.4	-51.5
ERR	+91.7	+61.6	-13.7	-23.4	-50.2	-53.0	+140.1

PCS

* If joint angles or 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

PCS

MSS: SSRMS: SSRMS

Verify Posn Hold – orange

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

SR	SY	SP	EP	WP	WY	WR
-86.0	-25.2	-29.5	+109.1	-78.8	-70.4	-51.5
X	Y	Z	Pitch	Yaw	Roll	
+500	0	+500	0.0	0.0	0.0	
FOR	Loaded – Node2 Install CBCS, SY Held					
Disp	LAB> Node2 Install CBCS					

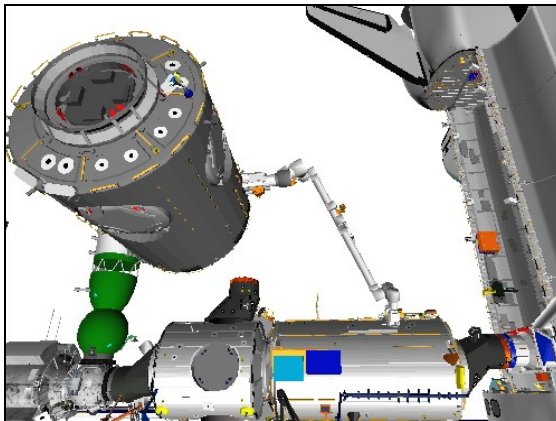


Figure 14.- Intermediate Position
(09: P1 Lower Outboard: +85, +25).

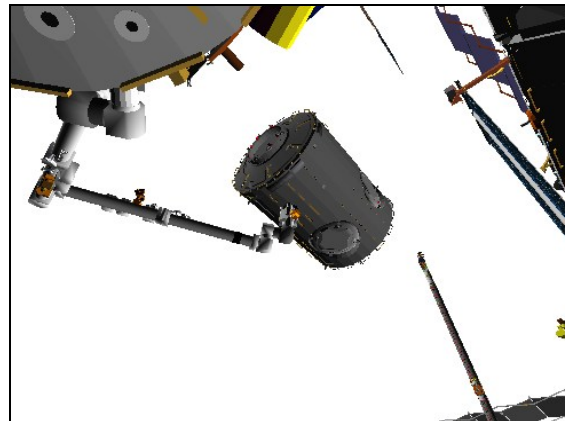


Figure 15.- Intermediate Position
(92: Camera A: +50, +50).

15. ATTITUDE CONTROL CONFIGURATION

If using shuttle attitude control, coordinate with shuttle crewmembers:

If attitude maintenance required:

Configure DAP per RMS DAPs, then

Perform RATE DAMPING (ORB OPS FS, DOCKED DAP REFERENCE), then:

When in attitude

DAP: FREE

16. FOR OCAS TO NODE 2 PRE-INSTALL

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
09: P1 Lower Outboard (+85,+25)	91: Camera C (-25, +35)	92: Camera B (-15,+30)	OBSS ITVC (+75, -70)

1.311 NODE 2 UNBERTH TO INSTALL

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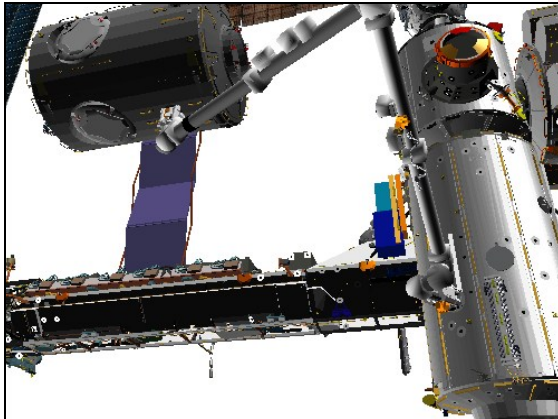


Figure 16.- Intermediate Position
(92: Camera B: -15, +30).

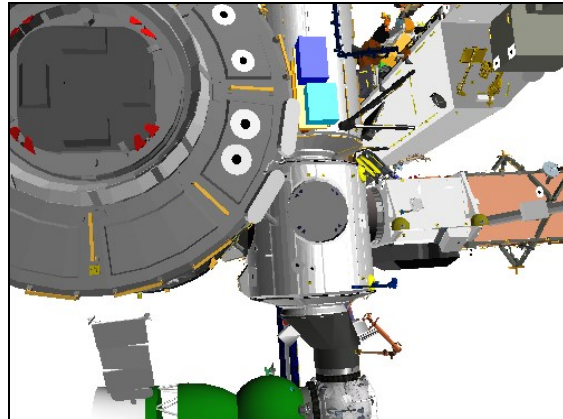


Figure 17.- Intermediate Position
(V10: OBSS ITVC: +75, -70).

RHC RATE → VERNIER (Verify Vernier 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 ► N2 Install Mnvr 3

MON Verify 'FOR' 'Destination' for Node2 Pre-Install position.

X	Y	Z	Pitch	Yaw	Roll
+200	0	0	0.0	0.0	0.0

cmd Load (Verify Sequence Status – Confirm or Cancel)

Verify FOR and errors are correct on FOR Position overlay.

	X	Y	Z	Pitch	Yaw	Roll
FOR	+500	0	+500	0.0	0.0	0.0
TGT	+200	0	0	0.0	0.0	0.0
ERR	+300	0	+500	0.0	0.0	0.0

1.311 NODE 2 UNBERTH TO INSTALL

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```

*****
* If FOR or 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

PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at Node 2 Pre-Install position (within 5 cm/1 deg).

	Locked					
SR	SY	SP	EP	WP	WY	WR
-116.6	-25.2	+12.6	+125.1	-75.9	-54.5	+1.0
X	Y	Z	Pitch	Yaw	Roll	
+200	0	0	0.0	0.0	0.0	
FOR	Loaded – Node2 Install CBCS, SY Held					
Disp	LAB>Node2 Install CBCS					

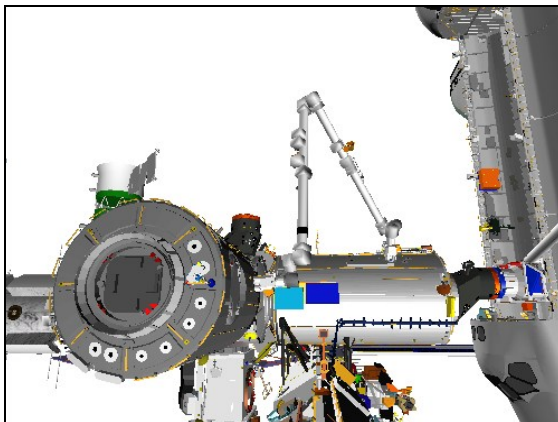


Figure 18.- Node 2 Pre-Install
(09: P1 Lower Outboard: +85, +15).

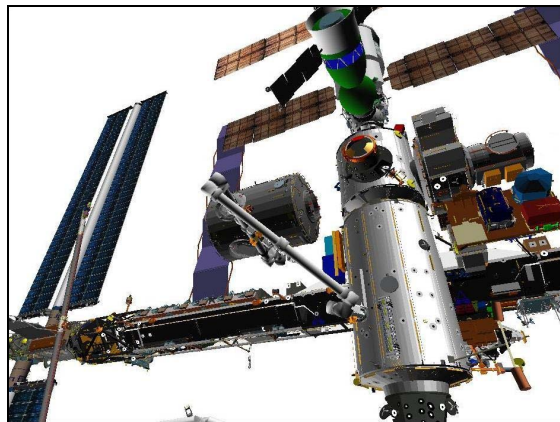


Figure 19.- Node 2 Pre-Install
(91: Camera C: -25, +35).

1.311 NODE 2 UNBERTH TO INSTALL

(RBT FS/10A/FIN 1)

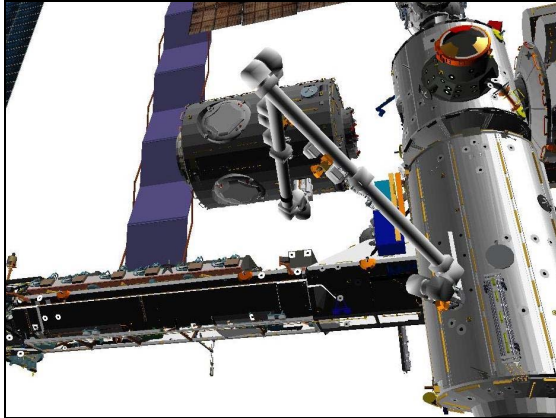


Figure 20.- Node 2 Pre-Install
(92: Camera B: -15, +30).

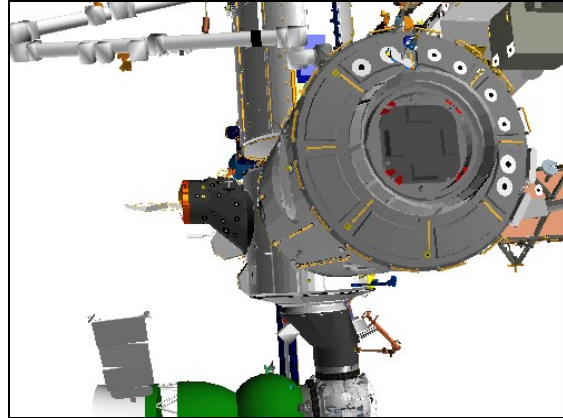


Figure 21.- Node 2 Pre-Install
(V10: OBSS ITVC: +75, -70).

17. ATTITUDE CONTROL CONFIGURATION

MSS: SSRMS: Thrusters: Thruster Controls for MSS Ops

Verify 'Desat Request:' Inhibit

If using shuttle attitude control, coordinate with shuttle crewmembers:

If attitude maintenance required:

Configure DAP per RMS DAPs, then

Perform RATE DAMPING (ORB OPS FS, DOCKED DAP REFERENCE), then:

When in attitude

DAP: FREE

18. NODE 2 INSTALL SETUP

NOTE

1. Monitor clearances between SSRMS and ESP-1 with the Tip Elbow and Base Elbow Cameras. Minimum clearance at install is approximately 25 cm (10 in).
2. Monitor clearance between Node 2 and the stanchion on Node 1 Zenith Aft with OBSS ITVC Camera. Minimum clearance is approximately 81 cm (32 in).

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

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
92: Camera B (-15,+30)	17: CBCS	24: Tip Elbow (+5, +15) 22: Base Elbow (+75, -20)	OBSS ITVC (+75, -70)

1.311 NODE 2 UNBERTH TO INSTALL

(RBT FS/10A/FIN 1)

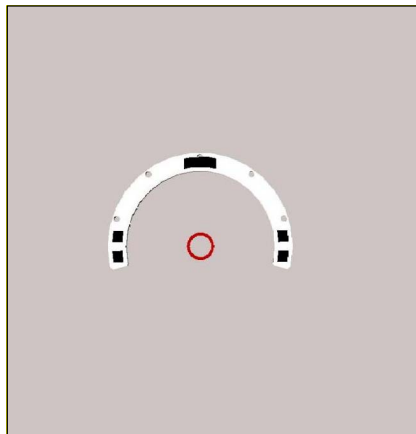


Figure 22.- Node 2 Install (17: CBCS).

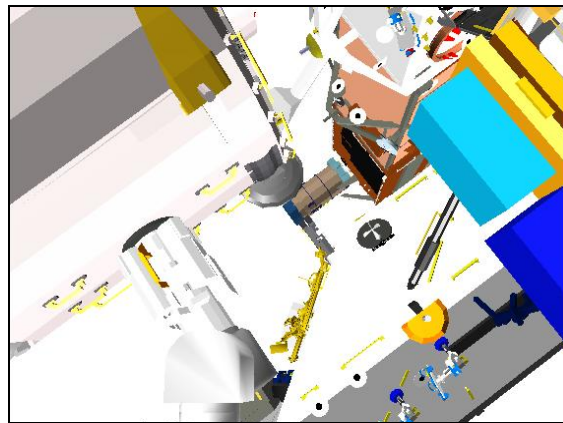


Figure 23.- Node 2 Install (24: Tip Elbow: +5, +15).

19. MANEUVERING NODE 2 TO READY-TO-LATCH POSITION

Monitor CBM RTLs using USOS Eff overlay.

MSS: SSRMS: Rate:

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

MSS: SSRMS:

Verify Command – SSRMS>Internal

Enter Mode – Manual (Verify – blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

THC/
RHC

Maneuver Node 2 to Ready-To-Latch position until RTL (four) – green

	Locked					
SR	SY	SP	EP	WP	WY	WR
-130.8	-25.2	+18.6	+133.3	-78.5	-42.6	+8.4
X	Y	Z	Pitch	Yaw	Roll	
+11	0	0	0.0	0.0	0.0	
FOR	Loaded – Node2 Install CBCS, SY Held					
Disp	LAB>Node2 Install CBCS					

1.311 NODE 2 UNBERTH TO INSTALL

(RBT FS/10A/FIN 1)

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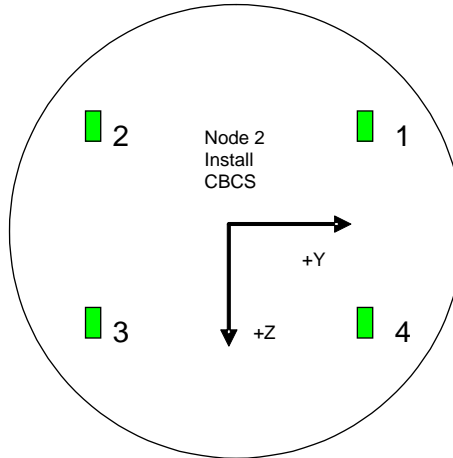


Figure 24.- Node 2 CBCS Install RTL Diagram.

PCS

MSS: SSRMS:

Verify Posn Hold – orange

Verify RTL (four) – green

Notify CBM operator, “Maneuver to RTL Complete, GO for first stage capture”.

20. FIRST STAGE CAPTURE

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

On CBM operator, “GO for SSRMS mode to limp.”

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

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).

MSS: SSRMS: Limp:

cmd All Limp (Verify Limp – blue)

MSS: SSRMS:

Verify all joints – Limped

1.311 NODE 2 UNBERTH TO INSTALL

(RBT FS/10A/FIN 1)

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WARNING

If SSRMS fails to brakes-on from limp mode, continuation of Second Stage Capture may cause structural failure of SSRMS or primary structure. If CBM stops unexpectedly (and Cmd Code changes to 'Stop') or SSRMS safes during Second Stage Capture, **√MCC-H** before proceeding.

Notify CBM operator, "Mode to limp complete, GO for Second Stage Capture."

21. SECOND STAGE CAPTURE AND ABOLTS

Verify {1.506 NODE 1 CBM CAPTURE/ABOLT}, steps 5 to 7 (SODF: S&M: NOMINAL: CBM), completed.

On CBM operator, "GO for SSRMS brakes ON":

DCP BRAKES SSRMS → ON (Verify – ON)

PCS MSS: SSRMS:

Expected Node 2 Install position.

SR	SY	SP	EP	WP	WY	WR
-131.8	-25.2	+19.2	+133.6	-78.8	-41.8	+8.7
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded – Node2 Install CBCS, SY Held					
Disp	LAB>Node2 Install CBCS					

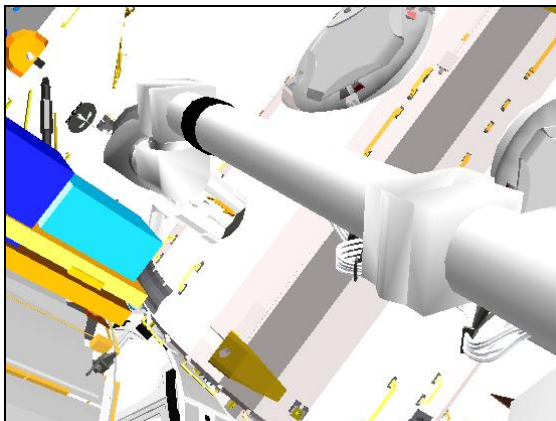


Figure 25.- Node 2 Install Position
(22: Base Elbow: +75, -20).

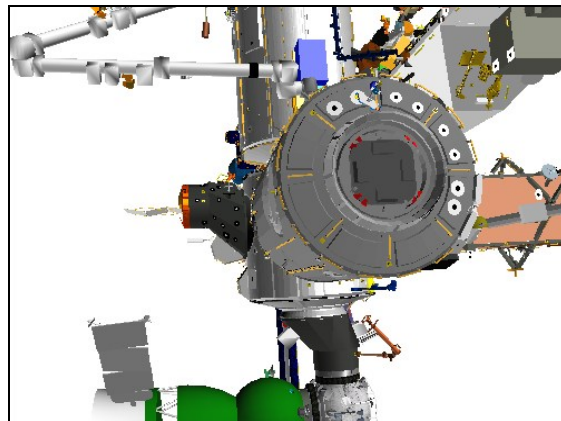


Figure 26.- Node 2 Install Position
(V10: OBSS ITVC: +75, -70).

1.311 NODE 2 UNBERTH TO INSTALL

(RBT FS/10A/FIN 1)

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22. ATTITUDE CONTROL CONFIGURATION

If using shuttle attitude control, coordinate with shuttle crewmembers:

| If attitude maintenance required:

| | Configure DAP per RMS DAPs, then

| | Perform RATE DAMPING (ORB OPS FS, DOCKED DAP
| | REFERENCE), then:

23. PORT TRRJ UNLOCK

Notify **MCC-H** GO for PORT TRRJ auto-track.

1.312 NODE 2 MATED UNGRAPPLE
(RBT FS/10A/FIN 1) Page 1 of 6 pages

1. SETUP

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
22: Base Elbow (+60, -20)	25: Tip LEE	24: Tip Elbow (0, 0)	Camera B (-5,+30)

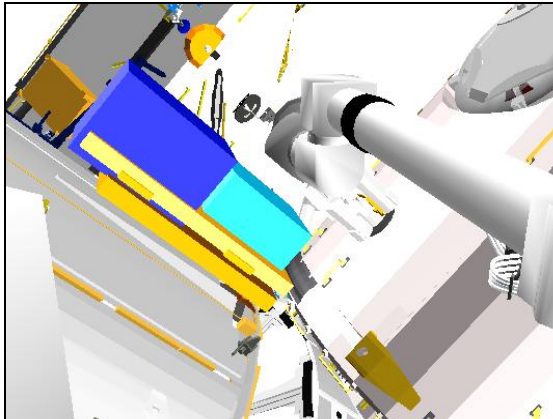


Figure 1.- Mated Node 2 Grapple
(22: Base Elbow: +60, -20).

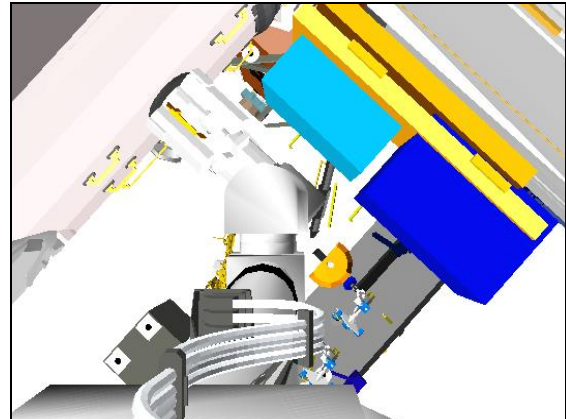


Figure 2.- Mated Node 2 Grapple
(24: Tip Elbow: 0, 0).

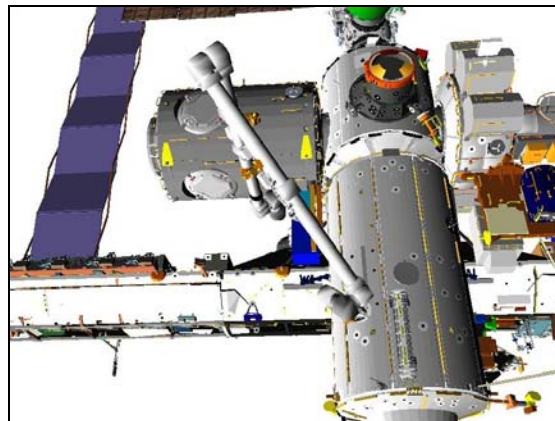


Figure 3.- Mated Node 2 Grapple
(V10: Camera B: -5,+30).

1.312 NODE 2 MATED UNGRAPPLE

(RBT FS/10A/FIN 1)

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PCS MSS: SSRMS:

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

Change Display ► LAB ► N1 Mated Node2 FRGF (Verify LAB>N1 Mated Node2 FRGF)

Verify Command – SSRMS>Internal

√Vernier

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: as desired.

2. [NODE 2 UNGRAPPLE](#)

DCP BRAKES SSRMS → OFF (Verify OFF)

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.

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

1.312 NODE 2 MATED UNGRAPPLE

(RBT FS/10A/FIN 1)

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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)

Verify Unloaded Parameters – √

2.3 SSRMS Backoff

NOTE

1. Monitor clearance between the wrist cluster and ESP-1 with the Tip Elbow or the Base Elbow Cameras. Minimum clearance is approximately 25 cm (10 in).
2. Due to clearance concerns between the wrist cluster and ESP-1 ORUs, the backoff position has been modified.

MSS: SSRMS: Limp: SSRMS Limp

cmd None Limp (Verify Standby – blue)

MSS: SSRMS: SSRMS

Enter Mode – Manual (Verify blue)

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

cmd Shoulder Yaw (Verify SY – Locked)

THC/
RHC Maneuver SSRMS to Mated Node 2 Ungrapple position (within 5 cm/1 deg).

	Locked					
SR	SY	SP	EP	WP	WY	WR
-125.8	-25.2	+15.3	+139.0	-84.5	-46.9	+6.4
X	Y	Z	Pitch	Yaw	Roll	
-65	0	0	0.0	0.0	0.0	
FOR	Unloaded – LEE Tip, SY Held					
Disp	LAB>N1 Mated Node2 FRGF					

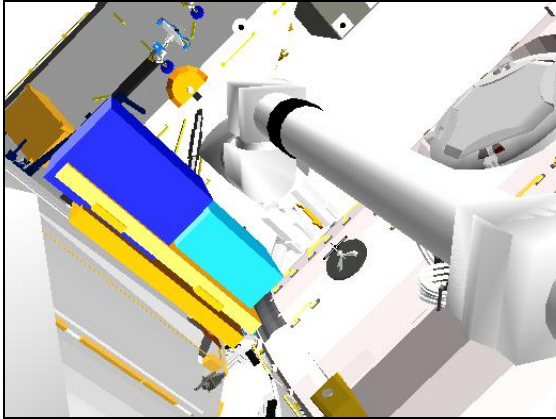


Figure 4.- Mated Node 2 Ungrapple
(22: Base Elbow: +60, -20)

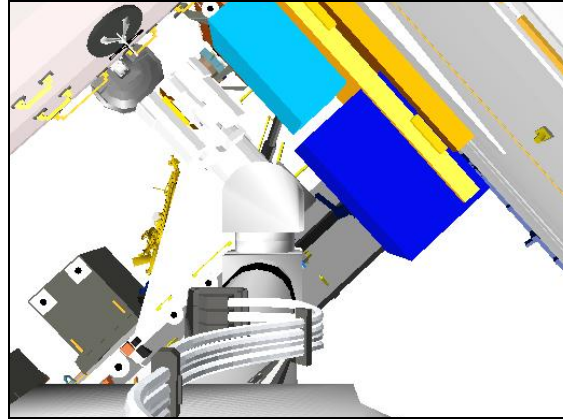


Figure 5.- Mated Node 2 Ungrapple
(24: Tip Elbow: 0, 0).

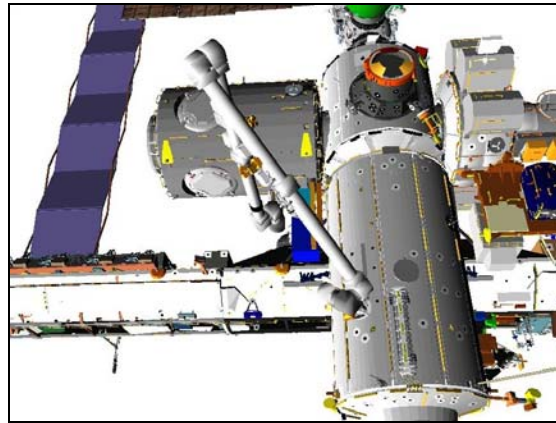


Figure 6.- Mated Node 2 Ungrapple
(V10: Camera B: -5, +30).

3. FOR OCAS NODE 2 CLEARANCE POSITION

NOTE

1. Clearance between wrist cluster and ESP-1 is approximately 25 cm (10 in). The clearance improves with this maneuver.
2. The cross cluster self-collision warning will annunciate during this maneuver when the Elbow Pitch angle is ≥ 142.0 deg.

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)

SSRMS FOR OCAS

pick File ► LAB ► N2 Clearance

Verify 'FOR' 'Destination' for Node 2 Clearance position.

X	Y	Z	Pitch	Yaw	Roll
-200	+200	+200	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	-65	0	0	0.0	0.0	0.0
TGT	-200	+200	+200	0.0	0.0	0.0
ERR	+135	-200	-200	0.0	0.0	0.0

PCS

* If FOR or 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

PCS

MSS: SSRMS: **SSRMS**

Verify Posn Hold – orange

Verify SSRMS at Node 2 Clearance position (within 5 cm/1 deg).

	Locked					
SR	SY	SP	EP	WP	WY	WR
-88.1	-25.2	-27.9	+144.4	-109.3	-70.3	-45.6
X	Y	Z	Pitch	Yaw	Roll	
-200	+200	+200	0.0	0.0	0.0	
FOR	Unloaded – LEE Tip, SY Held					
Disp	LAB>N1 Mated Node2 FRGF					

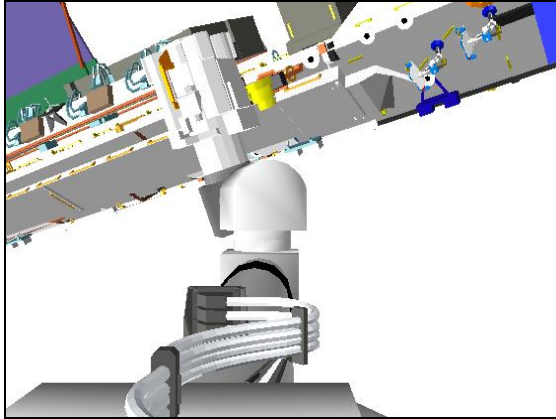


Figure 7.- Node 2 Clearance
(24: Tip Elbow: 0, 0).

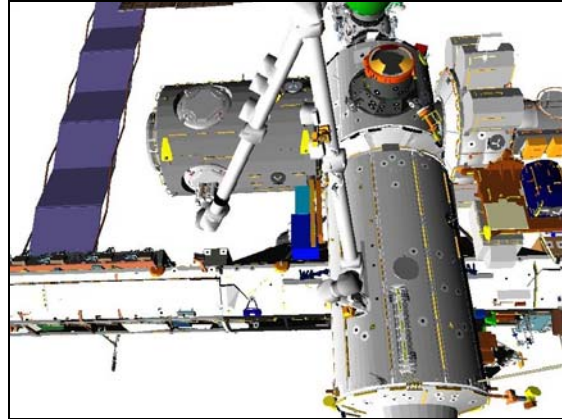


Figure 8.- Node 2 Clearance
(V10: Camera B: -5, +30).

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)

1. SETUP

Verify SRMS at Pre-cradle position.

Verify Camera for viewing out Orbiter window has been setup.

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
09: P1 Lower Outboard (+90, -10)	13: LAB Stbd Zenith (-175, -35)	MUX 22/24 [22: Base Elbow (+5, 0), 24: Tip Elbow (-5, 0)]	SRMS Elbow (+160, +10) Minicam W3

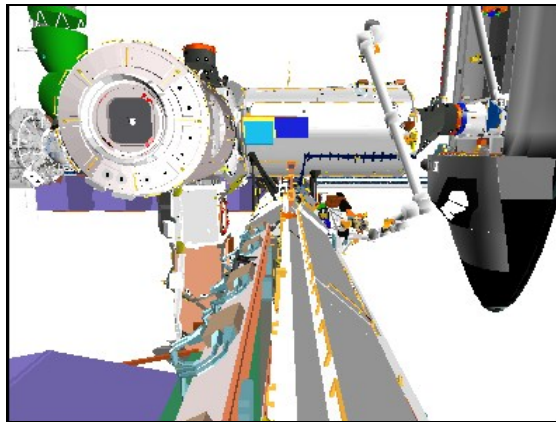


Figure 1.- LAB PDGF Backoff (09: P1 Lower Outboard: +90, -10).

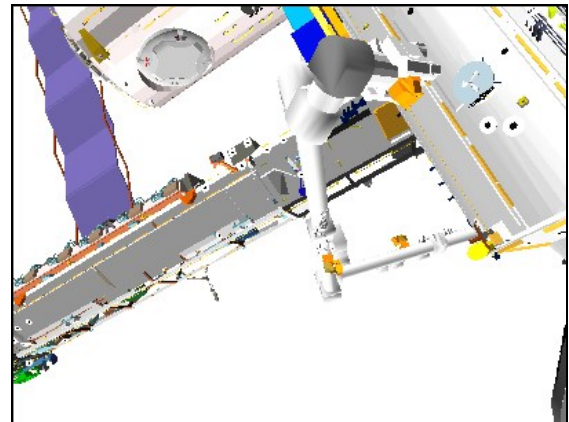


Figure 2.- LAB PDGF Backoff (V10: SRMS Elbow: +160, +10).

NOTE

1. During the maneuver to P6 PDGF grapple, monitor clearance between SSRMS shoulder and the POA with the LAB Zenith Camera or the Base Elbow Camera. Minimum clearance is 40 cm (16 in).
2. The Ku antenna needs to be parked to ensure 150 cm of clearance during P6 grapple and demate. There are no direct views that can monitor this clearance.

PCS

MSS: SSRMS:

Change Loaded Parameters ► P6 ► P6 Demate (PDGF) SYH
 Verify 'Loaded Parameters' (two) – P6 Demate (PDGF), SY Held

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

Change Display ► W4 ► Z1 Mated P6 PDGF (Verify W4>Z1 Mated P6 PDGF)

1.410 P6 PDGF GRAPPLE ON Z1

(RBT FS/10A/FIN 1)

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

SR	SY	SP	EP	WP	WY	WR
+64.9	+114.6	-97.7	+88.6	-57.5	+165.8	+99.9
X	Y	Z	Pitch	Yaw	Roll	
-314	-603	+1197	+53.9	-12.1	-74.0	
FOR	Unloaded - LEE Tip, SY Held					
Disp	W4>Z1 Mated P6 PDGF					

√Vernier

PCS

MSS: SSRMS: Rate:

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

2. MANEUVER TO P6 PDGF PRE-GRAPPLE ON Z1

2.1 JOCAS to P6 Pre-Grapple Setup

DCP

BRAKES SSRMS → OFF (Verify OFF)

PCS

MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

pick File ► W4 ► P6 Pre-Grapple

Verify 'Joint Angles' 'Destination' for P6 Pre-Grapple Setup position.

SR	SY	SP	EP	WP	WY	WR
+107.6	-1.4	-40.0	-70.0	-54.5	-17.2	-86.2

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON

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

(current)	SR	SY	SP	EP	WP	WY	WR
	+64.9	+114.6	-97.7	+88.6	-57.5	+165.8	+99.9
TGT	+107.6	-1.4	-40.0	-70.0	-54.5	-17.2	-86.2
ERR	-42.7	+116.0	-57.7	+158.6	-3.0	+183.0	+186.1

```

*****
* If joint angles or 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)

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

DCP AUTO SEQ → PROC

PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify Joint Angle values.

SR	SY	SP	EP	WP	WY	WR
+107.6	-1.4	-40.0	-70.0	-54.5	-17.2	-86.2

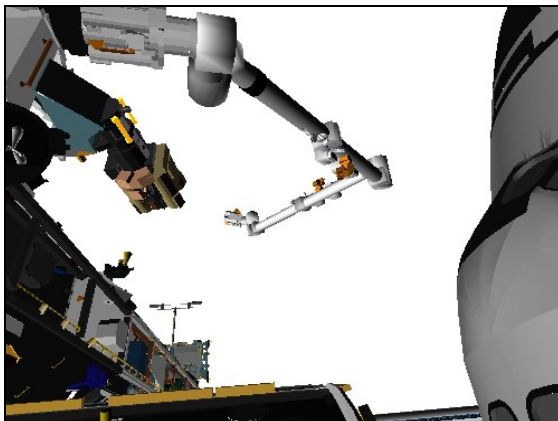


Figure 3.- P6 Pre-Grapple Setup
 (13: LAB Stbd Zenith: -175, -35).

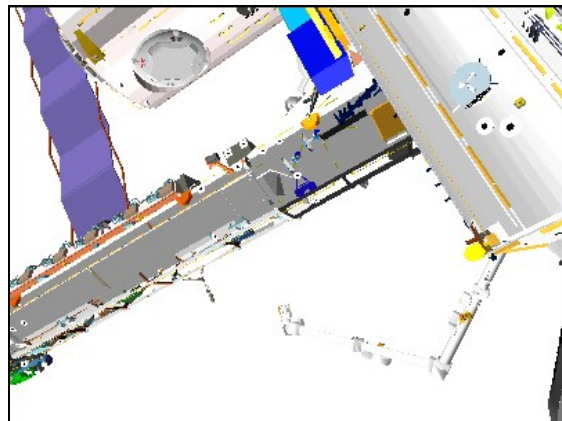


Figure 4.- P6 Pre-Grapple Setup
 (V10: SRMS Elbow: +160, +10).

1.410 P6 PDGF GRAPPLE ON Z1

(RBT FS/10A/FIN 1)

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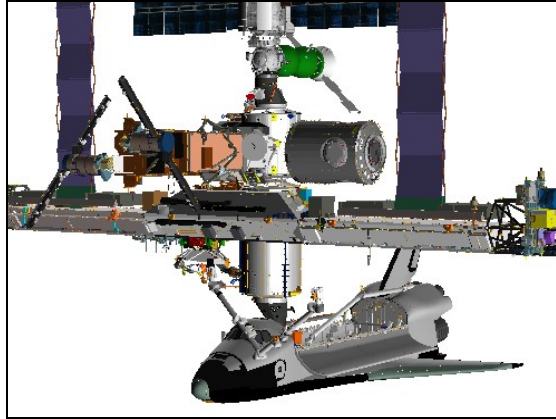


Figure 5.- P6 Pre-Grapple Setup
(ISS Zenith-Port).

2.2 Ku-Antenna Configuration

Verify with **MCC-H** Ku-antenna parked at the required configuration for P6 grapple and demate.

2.3 Single Joint to P6 PDGF Pre-Grapple on Z1

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
24: Tip Elbow (-10, 0)	13: LAB Stbd Zenith (-175, -35)	22: Base Elbow (-145, -10)	SRMS Elbow (+160, +10) Minicam W3

NOTE

Monitor clearance between the SSRMS Tip boom and the S0 truss with the Base Elbow Camera. Minimum clearance is 99 cm (39 in).

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 P6 PDGF GRAPPLE ON Z1

(RBT FS/10A/FIN 1)

THC

Perform Single Joint maneuver to P6 PDGF Pre-Grapple on Z1 position (within 1 deg).

	SR	SY	SP	EP	WP	WY	WR
P6 Pre-Grapple Setup	+107.6	-1.4	-40.0	-70.0	-54.5	-17.2	-86.2
1: EP -				-109.2			
2: SP -			-73.1				
P6 PDGF Pre-Grapple	+107.6	-1.4	-73.1	-109.2	-54.5	-17.2	-86.2
	X	Y	Z	Pitch	Yaw	Roll	
	-150	0	0	0.0	0.0	0.0	
FOR	Unloaded - LEE Tip, SY Held						
Disp	W4>Z1 Mated P6 PDGF						

PCS

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

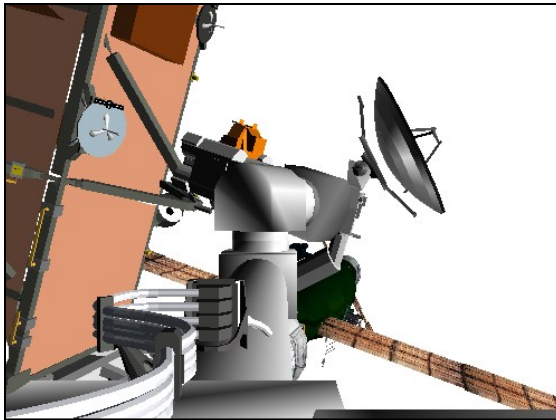


Figure 6.- P6 PDGF Pre-Grapple on Z1 (24: Tip Elbow: 0, 0).

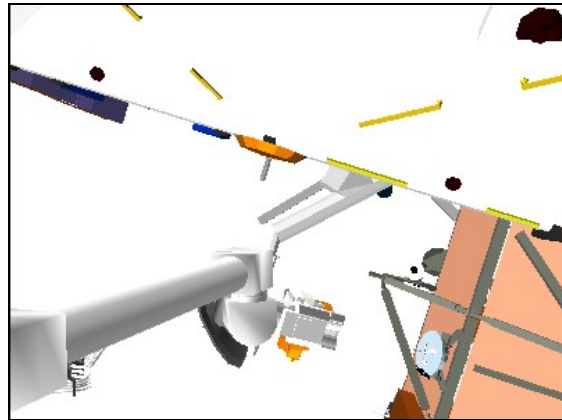


Figure 7.- P6 PDGF Pre-Grapple on Z1 (22: Base Elbow: -90, -3).

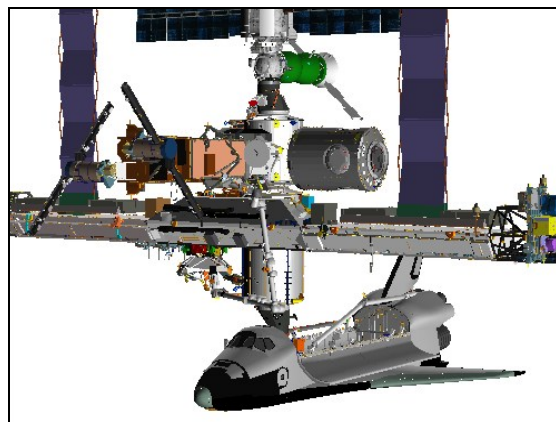


Figure 8.- P6 PDGF Pre-Grapple on Z1 (ISS Zenith-Port).

1.410 P6 PDGF GRAPPLE ON Z1

(RBT FS/10A/FIN 1)

Page 6 of 8 pages

3. P6 PDGF GRAPPLE SETUP AND CAPTURE

3.1 Setup

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
24: Tip Elbow (0, 0)	25: Tip LEE	22: Base Elbow (-90, -3)	SRMS Elbow (+160, +10) Minicam W3

NOTE

1. Tip LEE Camera must be fully zoomed out to correspond to target overlay.
2. Monitor clearance between the SSRMS Tip boom and the S0 truss with the Base Elbow Camera. Minimum clearance is 99 cm (39 in).
3. SSRMS Safing may occur and the following messages may be annunciated at the end of latching:
'R30 - SSRMS LEEMM Cmd Termination Msw Consistency Fail'
'R3Q - SSRMS LEE Uncommanded Derigidize'
'R9B - SSRMS LEE Inval LEEMM Cmd'
Notify **MCC** if safing occurs. If the signature is as expected, a directive may be given to execute procedure {8.112 SSRMS CAPTURE ABORT RECOVERY} (SODF: RBT GEN: CORRECTIVE) (SCR 32041).

MSS: SSRMS:

Verify Command – SSRMS>Internal

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: as desired

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

3.2 Maneuvering to Within Grapple Envelope

Maneuver to within grapple envelope.

RHC/
THC

1.410 P6 PDGF GRAPPLE ON Z1

(RBT FS/10A/FIN 1)

Page 7 of 8 pages

3.3 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 3.4 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)

DCP 3.5 Grapple Cleanup
BRAKES SSRMS → ON (Verify ON)

PCS MSS: SSRMS:

Verify Loaded Parameters – √

Verify 'Loaded Parameters' (two) – P6 Demate (PDGF), SY Held

Change Display ► W4 ► P6 Demate (Verify W4>P6 Demate)

Change Command ► W4 ► ISSACS (Verify W4>ISSACS)

Expected P6 PDGF Grapple on Z1 joint angles and FOR

SR	SY	SP	EP	WP	WY	WR
+111.5	-1.4	-81.2	-111.8	-43.2	-20.4	-84.0
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded – P6 Demate (PDGF), SY Held					
Disp	W4>P6 Demate					

Notify IV/EVA SSRMS P6 grapple is complete.

Give **MCC-H GO** to configure video system for DDCU powerdown.

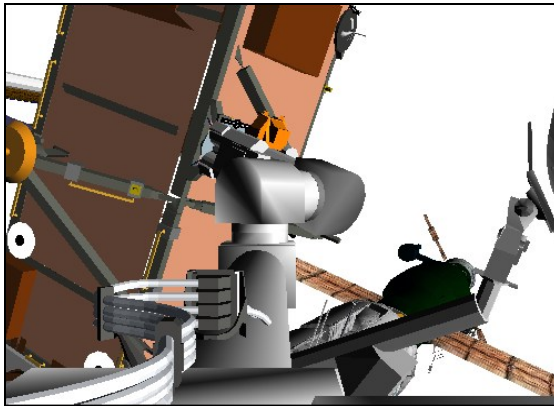


Figure 9.- P6 PDGF Grapple on Z1
 (24: Tip Elbow: 0, 0).

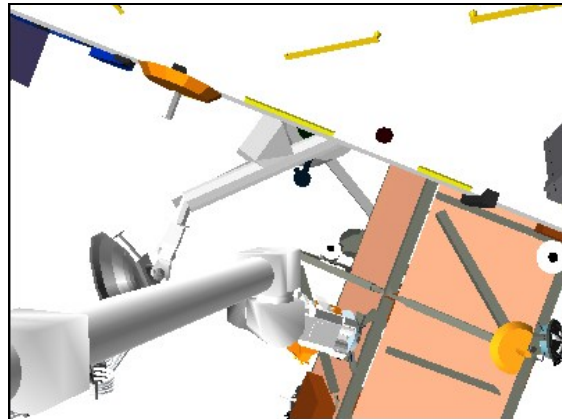


Figure 10.- P6 PDGF Grapple on Z1
 (22: Base Elbow: -90, -3).

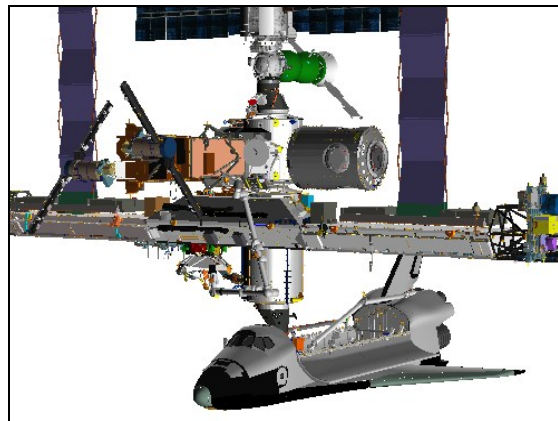


Figure 11.- P6 PDGF Grapple on Z1
 (ISS Zenith-Port).

1.411 P6 DEMATE

(RBT FS/10A/FIN 1)

1. SETUP

NOTE

Due to video system powerdowns to support RPCM S04B_C R&R, only two MSS Camera views are available during this procedure.

Verify with **MCC-H** Ku-antenna and Port TRRJ are parked in the required configuration and the video system configuration is complete.

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
09: P1 Lower Outboard (+75, -20)	24: Tip Elbow (-10, -5)	22: Base Elbow (-85, -10)	SRMS Elbow (+155, -10) Minicam W3

PCS

MSS: SSRMS:

Verify Loaded Parameters – √

Verify 'Loaded Parameters' (two) – P6 Demate (PDGF), SY Held

Verify Display – W4>P6 Demate

Verify Command – W4>ISSACS

√Vernier

MSS: SSRMS: Rate:

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

Verify SSRMS at P6 PDGF Grapple on Z1 position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+111.5	-1.4	-81.2	-111.8	-43.2	-20.4	-84.0
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded – P6 Demate (PDGF), SY Held					
Disp	W4>P6 Demate					

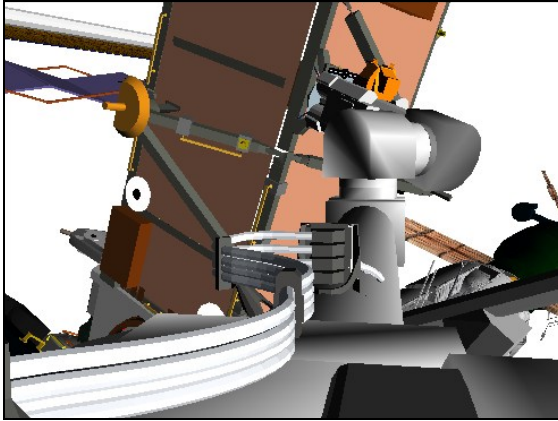


Figure 1.- P6 PDGF Grapple on Z1
(24: Tip Elbow: -10, -5).

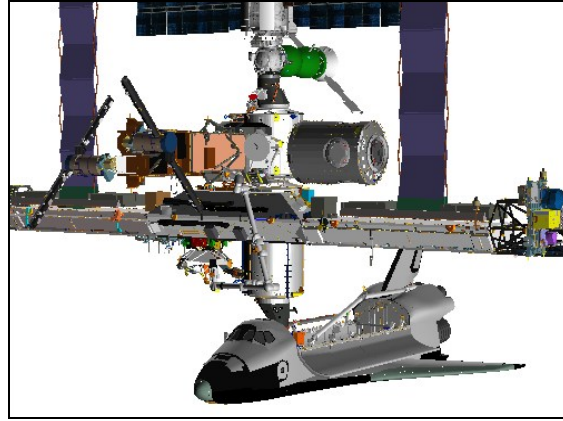


Figure 2.- P6 PDGF Grapple on Z1
(ISS Zenith-Port).

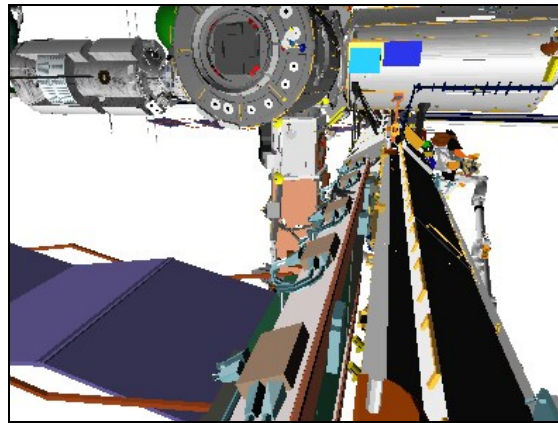


Figure 3.- P6 PDGF Grapple on Z1
(09: P1 Lower Outboard: +75, -20).

2. P6 CONTINGENCY DEMATE (RTAS SLEEVE REMOVAL)

If RTAS Sleeve Removal is required:

On IV, "Capture claw is partially open, GO for SSRMS Limp mode."

PCS

MSS: SSRMS: Thrusters:

Verify 'Desat Request:' – Inh

If using shuttle attitude control, coordinate with shuttle crewmembers:

DAP: FREE

DCP

BRAKES SSRMS → OFF (Verify OFF)

PCS

MSS: SSRMS: Limp:

cmd All Limp (Verify Limp – blue)

MSS: SSRMS:

Verify all joints – Limped

Notify IV "SSRMS Limped, GO for RTAS sleeve removal."

On IV, "RTAS sleeve removed, GO for SSRMS Brakes ON"

DCP

BRAKES SSRMS → ON (Verify ON)

Notify IV, "SSRMS Brakes ON, GO to open the claw."

On IV, "Claw open, GO for P6 demate."

Go to step 4.

1.411 P6 DEMATE

(RBT FS/10A/FIN 1)

3. ATTITUDE CONTROL CONFIGURATION

On IV GO to Demate P6:

PCS MSS: SSRMS: Thrusters:

Verify 'Desat Request:' – Inh

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

4. DEMATE P6 FROM Z1

NOTE
Monitor clearance between the P6 Keel pin and KU antenna with the Tip or Base Elbow Camera. Minimum clearance is 137 cm (54 in).

Verify EV crew in position to monitor separation.

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 P6 Demate position (within 5 cm/1 deg) (THC up)

	<input type="text" value="Locked"/>						
	SR	SY	SP	EP	WP	WY	WR
	+140.0	-1.4	-79.3	-84.4	-61.9	-42.8	-63.0
	X	Y	Z	Pitch	Yaw	Roll	
	0	0	-500	0.0	0.0	0.0	
	FOR	Loaded – P6 Demate (PDGF), SY Held					
	Disp	W4>P6 Demate					

PCS MSS: SSRMS:

Enter Mode – Standby (Verify blue)

Notify **MCC-H**, "GO for Port TRRJ Auto-track."

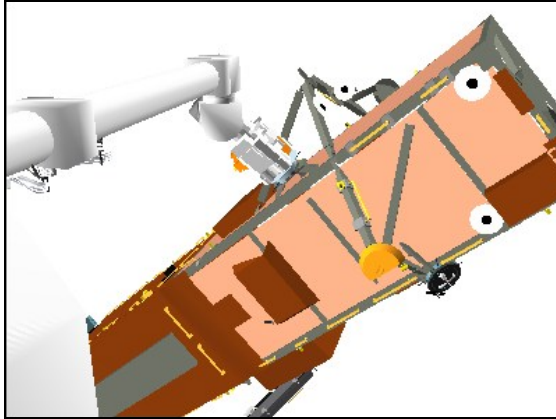


Figure 4.- P6 Demate
(22: Base Elbow: -110, -20).

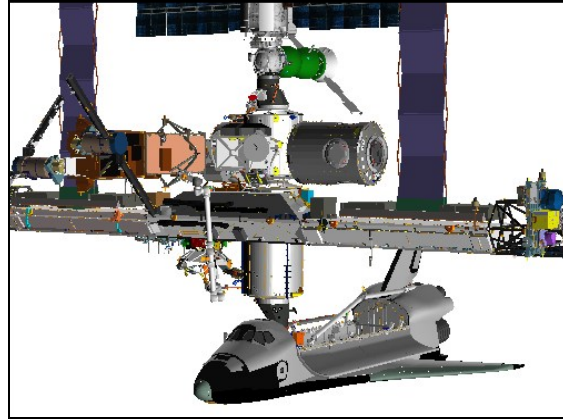


Figure 5.- P6 Demate
(ISS Zenith-Port).

5. ATTITUDE CONTROL CONFIGURATION

If using shuttle attitude control, coordinate with shuttle crewmembers:

If attitude maintenance required:

Configure DAP per RMS DAPs, then

Perform RATE DAMPING (ORB OPS FS, DOCKED DAP REFERENCE), then:

When in attitude
DAP: FREE

6. MANEUVER TO P6 HANDOFF TO SRMS

6.1 JOCAS 1 to Intermediate Position

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
37: MBS Mast (-68, -20)	24: Tip Elbow (-15, +5)	13: LAB Stbd Zenith (-180, 0)	SRMS Elbow (+155, -10)
09: P1 Lower Outboard (+160, -30)	22: Base Elbow (-105, -15)		

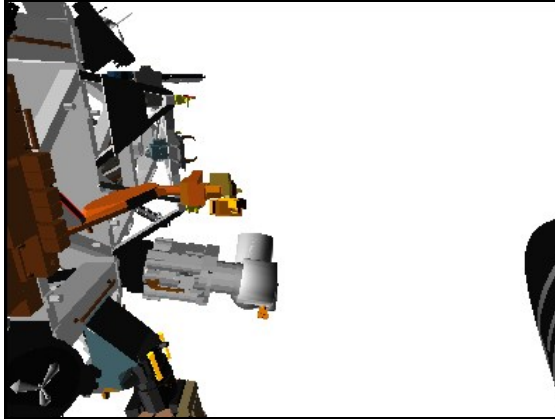


Figure 6.- P6 Demate
(13: LAB Stbd Zenith: -180, 0).

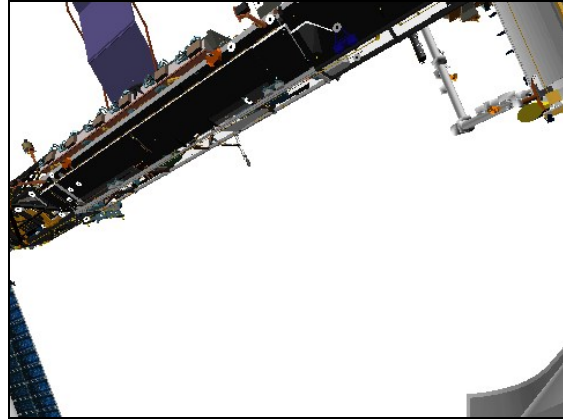


Figure 7.- P6 Demate
(V10: SRMS Elbow: +155, -10).

NOTE

1. Expect singularity warning for EP between -15 and +15 deg.
2. Monitor clearance between the SSRMS and P6 with the Tip Elbow Camera. Minimum clearance is 114 cm (45 in).

RHC

RATE → COARSE (Verify Coarse on PCS)

PCS

MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

pick File ► W4 ► P6 Demate Mnvr 1

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

SR	SY	SP	EP	WP	WY	WR
+140.0	+41.6	-63.0	+36.1	-100.0	-95.0	-63.0

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)	+140.0	-1.4	-79.3	-84.4	-61.9	-42.8	-63.0
TGT	+140.0	+41.6	-63.0	+36.1	-100.0	-95.0	-63.0
ERR	0.0	-43.0	-16.3	-120.5	+38.1	+52.2	0.0

1.411 P6 DEMATE

(RBT FS/10A/FIN 1)

```

*****
* If joint angles or 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

PCS MSS: SSRMS:

Verify Posn Hold – orange

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

SR	SY	SP	EP	WP	WY	WR
+140.0	+41.6	-63.0	+36.1	-100.0	-95.0	-63.0
X	Y	Z	Pitch	Yaw	Roll	
+1580	-950	-945	-121.1	+39.8	-26.2	
FOR	Loaded – P6 Demate (PDGF), SY Held					
Disp	W4>P6 Demate					

Notify **MCC-H**, “GO for Ku Antenna Auto-track.”

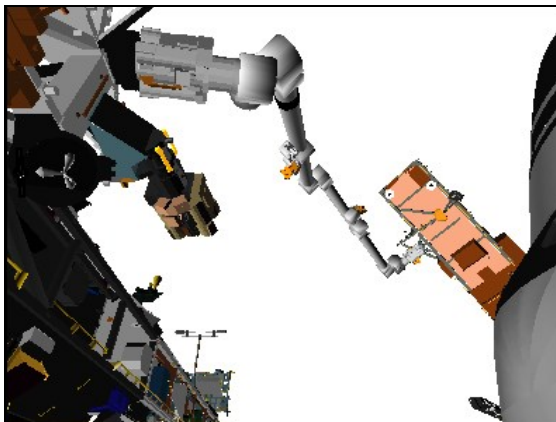


Figure 8.- Intermediate Position
(13: LAB Stbd Zenith: -180, -30).

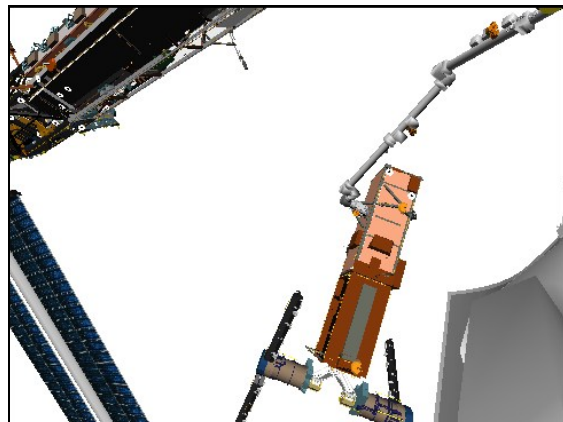


Figure 9.- Intermediate Position
(V10: SRMS Elbow: +155, -25).

6.2 Attitude Control Configuration

If using shuttle attitude control, coordinate with shuttle crewmembers:

If attitude maintenance required:

Configure DAP per RMS DAPs, then

Perform RATE DAMPING (ORB OPS FS, DOCKED DAP REFERENCE), then:

When in attitude
DAP: FREE

6.3 JOCAS 2 to P6 Handoff Position

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
09: P1 Lower Outboard (+160, -30)	91: SRMS Elbow (+155, -25)	13: LAB Stbd Zenith (-180, -30) 37: MBS Mast (-20, +5)	Camera A (+80, -10) Camera B (-15, 0)

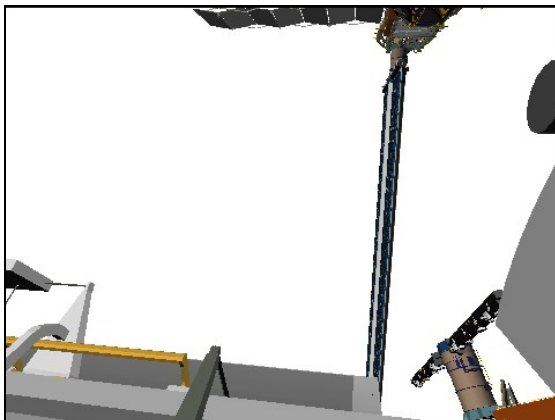


Figure 10.- Intermediate Position
(V10: Camera A: +80, -10).

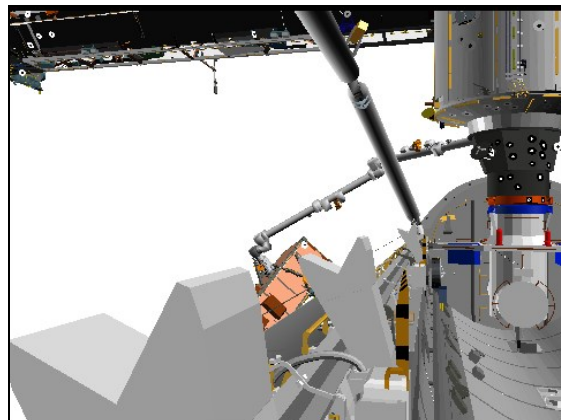


Figure 11.- Intermediate Position
(V10: Camera B: -15, 0).

NOTE

1. Monitor clearance between the Shoulder Yaw joint and the POA with LAB Stbd Zenith Camera or the MBS Mast Camera. Minimum clearance is 60 cm (24 in).
2. Monitor clearance between the SSRMS wrist and P6 with the LAB Stbd Zenith Camera or the MBS Mast Camera. Minimum clearance is 111 cm (44 in).
3. The singularity warning may momentarily flash when SR reaches approximately +133.5 degrees.

MSS: SSRMS:

pick File ► W4 ► P6 Demate Mnvr 2

Verify 'Joint Angles' 'Destination' for P6 Handoff position.

SR	SY	SP	EP	WP	WY	WR
+91.1	+41.6	-63.0	+36.1	-176.5	-124.9	-108.2

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)	+140.0	+41.6	-63.0	+36.1	-100.0	-95.0	-63.0
TGT	+91.1	+41.6	-63.0	+36.1	-176.5	-124.9	-108.2
ERR	+48.9	0.0	0.0	0.0	+76.5	+29.9	+45.2

PCS

* If joint angles or 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

PCS

MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at P6 Handoff position (within 1 deg).

SR	SY	SP	EP	WP	WY	WR
+91.1	+41.6	-63.0	+36.1	-176.5	-124.9	-108.2
X	Y	Z	Pitch	Yaw	Roll	
+1678	-1279	+3	-29.2	+83.0	-130.8	
FOR	Loaded – P6 Demate (PDGF), SY Held					
Disp	W4>P6 Demate					

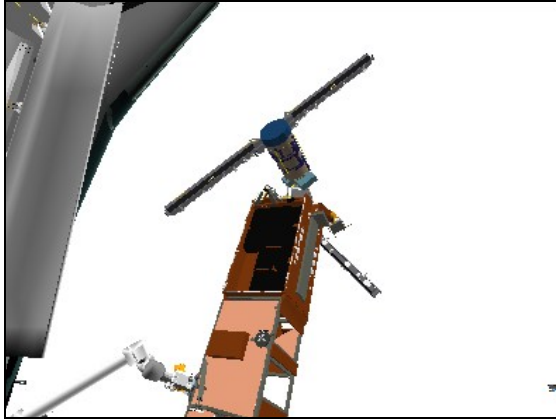


Figure 12.- P6 Handoff
(09: P1 Lower Outboard: +160, +20).

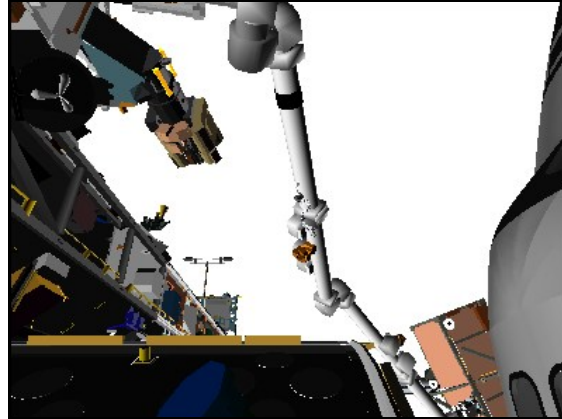


Figure 13.- P6 Handoff
(13: LAB Stbd Zenith: -180, -40).

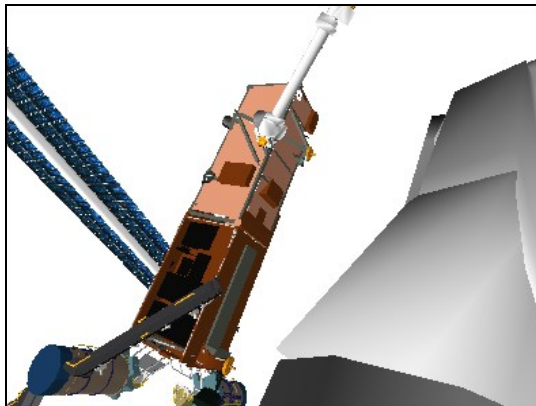


Figure 14.- P6 Handoff
(91: SRMS Elbow: +155, -50).

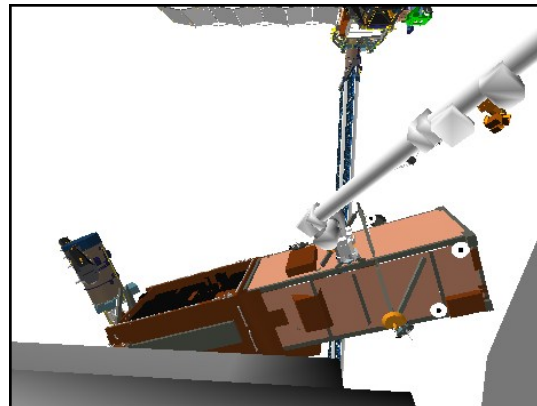


Figure 15.- P6 Handoff
(V10: Camera A: +85, -10).

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)

Notify **MCC-H**, IV and EV, "SSRMS safed at P6 handoff position."

7. ATTITUDE CONTROL CONFIGURATION

If using shuttle attitude control, coordinate with shuttle crewmembers:

If attitude maintenance required:

Configure DAP per RMS DAPs, then

Perform RATE DAMPING (ORB OPS FS, DOCKED DAP REFERENCE).

1.412 P6 UNGRAPPLE AT HANDOFF - WS4

(RBT FS/10A/FIN 1)

1. HAND CONTROLLER CALIBRATION

THC 1.1 Translational Hand Controller (THC) Calibration
 Deflect [X] Axis to positive hard stop where [X] =
 Deflect [X] Axis to negative hard stop.
 Repeat

RHC 1.2 Rotational Hand Controller (RHC) Calibration
 Deflect [X] Axis to positive hard stop where [X] =
 Deflect [X] Axis to negative hard stop.
 Repeat

2. SETUP

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
09: P1 Lower Outboard (+135, +5)	25: Tip LEE 24: Tip Elbow (-5, +10)	37: MBS Mast (-6, +8) 22: Base Elbow (0, 0)	Camera B (-20, +5) Camera A (+95, -5)

NOTE

1. Monitor clearances between the Shoulder Yaw joint and the POA with the MBS Mast Camera. Minimum clearance is approximately 53 cm (21 in).
2. Monitor clearances between the SSRMS wrist cluster and the SRMS tip boom with the P1 Lower Outboard Camera or the Tip Elbow Camera. Minimum clearance is approximately 130 cm (51 in).

PCS MSS: SSRMS:

Verify Loaded Parameters – √

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

Change Display ► W4 ► ISSACS (Verify W4>ISSACS)

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

Verify SSRMS at P6 Handoff position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+91.1	+41.6	-63.0	+36.1	-176.5	-124.9	-108.2
X	Y	Z	Pitch	Yaw	Roll	
+1224	-1280	-77	-29.2	+83.0	-130.9	
FOR	Loaded – P6 Demate (PDGF), SY Held					
Disp	W4>ISSACS					

1.412 P6 UNGRAPPLE AT HANDOFF - WS4
(RBT FS/10A/FIN 1) Page 2 of 5 pages

On SRMS operator GO to ungrapple P6:

MSS: SSRMS: SSRMS Safing:

cmd Remove (Verify Not Safed)

DCP BRAKES SSRMS → OFF (Verify – OFF)

RHC RATE → VERNIER (Verify Vernier on PCS)

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: as desired.

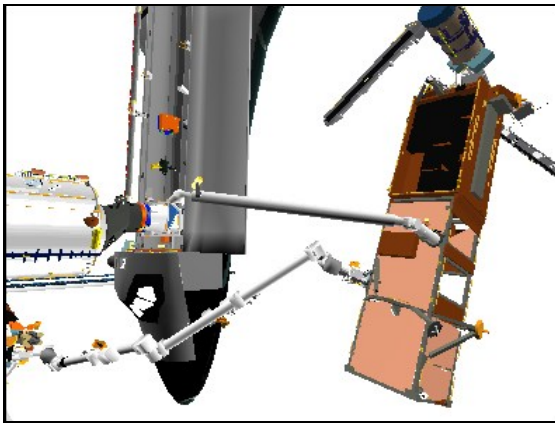


Figure 1.- P6 Handoff Position
(09: P1 Lower Outboard: +135, +5).

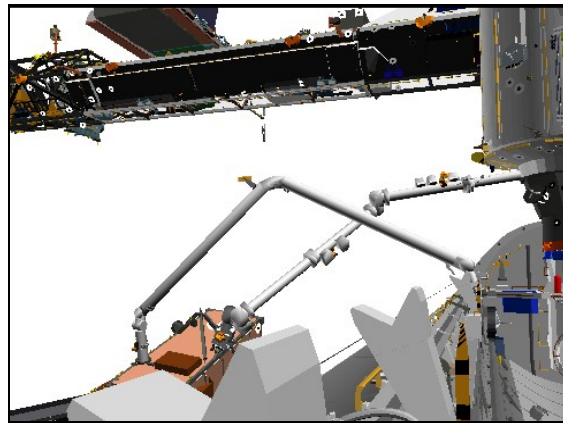


Figure 2.- P6 Handoff Position
(V10: Camera B: -20, +5).

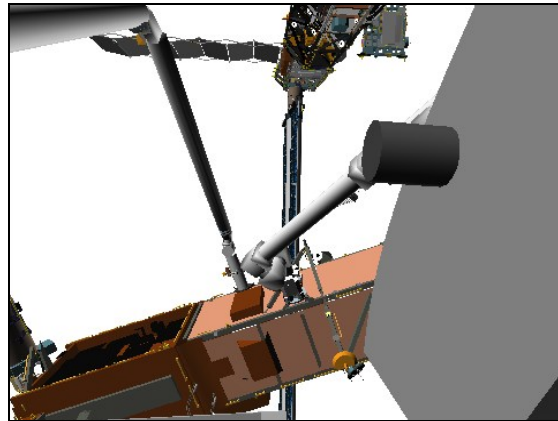


Figure 3.- P6 Handoff Position
(V10: Camera A: +95, -5).

3. P6 PDGF RELEASE (PUSHOFF)

- PCS 3.1 SSRMS Limp
MSS: SSRMS: Limp:
- cmd** All Limp (Verify Limp – blue)
- MSS: SSRMS:
- Verify all joints – Limped
- 3.2 P6 PDGF Release
MSS: SSRMS: Tip LEE:
- cmd** Release ► Automatic ► Slow (Verify Speed – Slow)
- Verify '**Confirm or Terminate**' prompt.
- cmd** Confirm (Verify RHC Trigger Hot icon)
- Verify LEE Mode – Auto Release
- RHC TRIGGER → press (momentarily)
- PCS Verify 'Umbilical' Demate – blue (10 s max)
Verify 'Latch' Unlatch – blue (65 s max)
Verify 'Carriage' Derigidize – blue (90 s max)
Verify 'Snare' Open – blue (12 s max)
Verify 'Carriage' Extend – blue (90 s max)
- Verify Unloaded Parameters – √
- 3.3 Backoff From P6 PDGF
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)

1.412 P6 UNGRAPPLE AT HANDOFF - WS4

(RBT FS/10A/FIN 1)

THC

Maneuver to SSRMS to P6 PDGF Backoff position
(within 5 cm/1 deg).

	Locked					
SR	SY	SP	EP	WP	WY	WR
+80.9	+41.6	-83.7	+60.0	-175.7	-122.1	-95.3
X	Y	Z	Pitch	Yaw	Roll	
+1056	-1094	+348	+22.0	-24.5	-174.2	
FOR	Unloaded – LEE Tip, SY Held					
Disp	W4>ISSACS					

DCP

BRAKES SSRMS → ON (Verify ON)

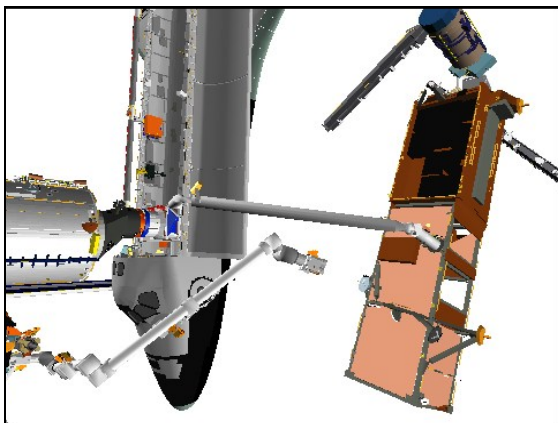


Figure 4.- P6 PDGF Backoff
(09: P1 Lower Outboard: +135, +5).

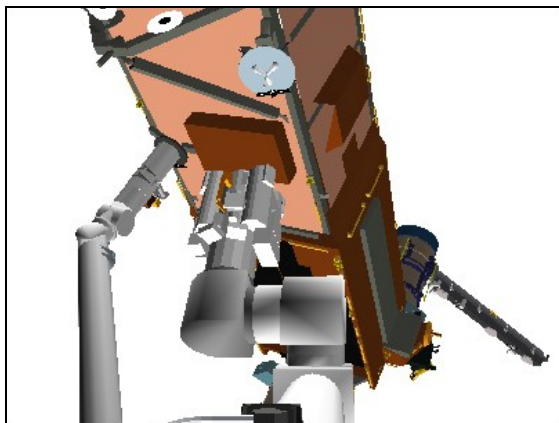


Figure 5.- P6 PDGF Backoff
(24: Tip Elbow: -5, +10).

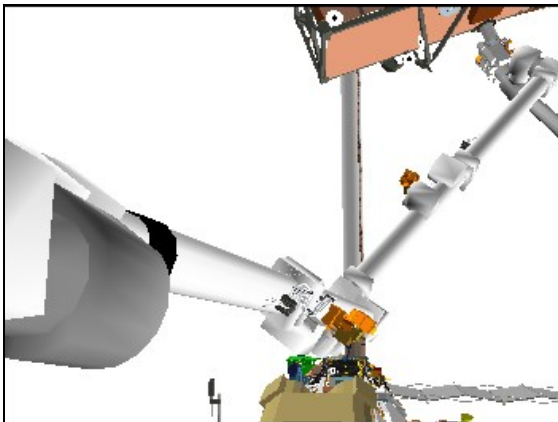


Figure 6.- P6 PDGF Backoff
(37: MBS Mast: -6, +8).

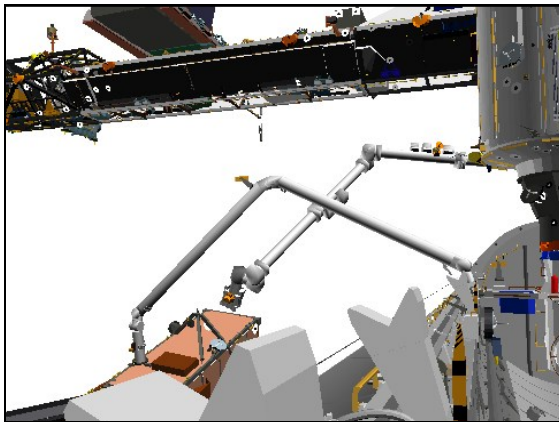


Figure 7.- P6 PDGF Backoff
(V10: Camera B: -20, +5).

4. ATTITUDE CONTROL CONFIGURATION

If using shuttle attitude control, coordinate with shuttle crewmembers:

 | If attitude maintenance required:

 | Configure DAP per RMS DAPs, then

 | Perform RATE DAMPING (ORB OPS FS, DOCKED DAP
 | REFERENCE),

1. SETUP

On **MCC-H GO**:

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
91: Camera B (-40, +5)	92: SRMS Elbow (+30, 0)	09: P1 Lower Outboard (-170, -25)	Camera A (+100, -5)

PCS

MSS: SSRMS:

Change Loaded Parameters ► P6 ► P6 Install SYH
 Verify 'Loaded Parameters' (two) – P6 Install, SY Held

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

Change Display ► W8 ► ISSACS (Verify W8>ISSACS)

Verify Command – SSRMS>Internal

√Vernier

Verify SSRMS at MT Translate Stow position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+110.0	-45.0	-10.0	+135.0	-100.0	+190.0	+68.8
X	Y	Z	Pitch	Yaw	Roll	
+557	-1879	-186	-153.6	-23.1	+129.0	
FOR	Unloaded - LEE Tip, SY Held					
Disp	W8>ISSACS					

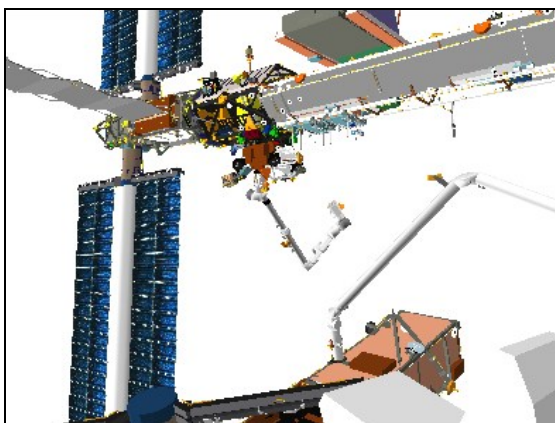


Figure 1.- MT Translation Stow
 (91: Camera B: -40, +5).

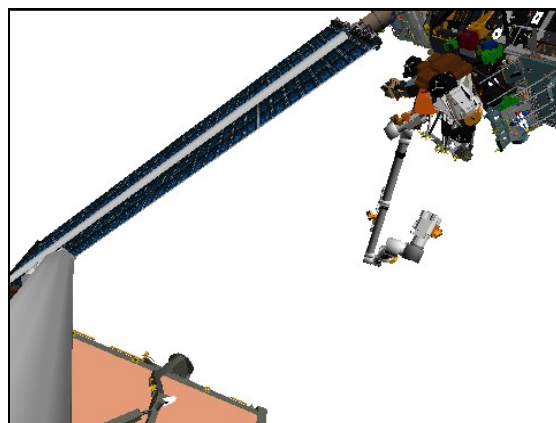


Figure 2.- MT Translation Stow
 (92: SRMS Elbow: +30, 0).

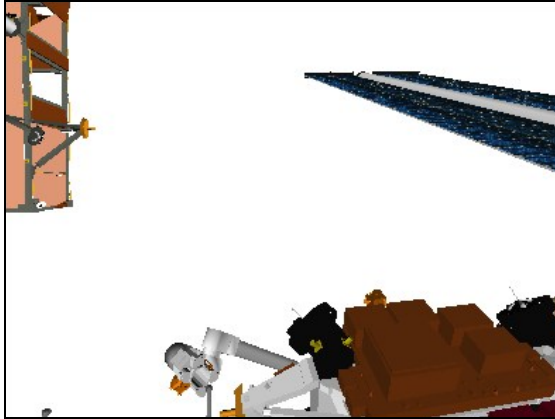


Figure 3.- MT Translation Stow
 (09: P1 Lower Outboard: -170, -25).

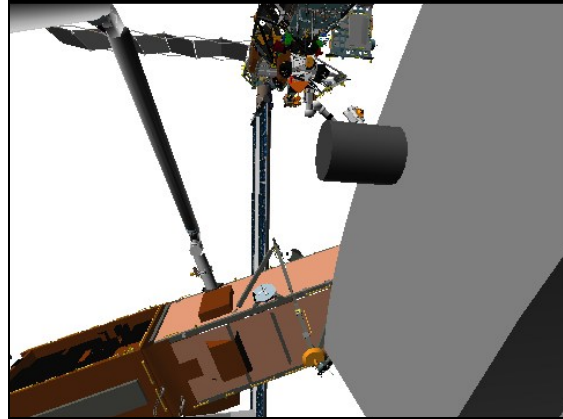


Figure 4.- MT Translation Stow
 (V10: Camera A: +100, -5).

2. MANEUVER TO P6 PRE-GRAPPLE HANDOFF FROM SRMS POSITION

NOTE

1. Monitor clearance between the SSRMS Shoulder and the POA with Camera B. Minimum clearance is approximately 41 cm (16 in).
2. Monitor clearance between the SSRMS SY and the MBS Mast Camera with Camera A. Minimum clearance is approximately 71 cm (28 in).

2.1 Pitch Plane to Intermediate 1 Position

Verify SRMS in P6 Handoff Position with brakes on.

MSS: SSRMS: SSRMS Safing:

cmd Remove (Verify Not Safed)

DCP BRAKES SSRMS → OFF (Verify OFF)

PCS MSS: SSRMS:

Enter Mode – Pitch Plane (Verify blue)

RHC Perform “-” Pitch Plane Change to SY: +20.0 (RHC Roll left)

Verify SSRMS at Intermediate 1 position (SY within 1 deg).

SR	SY	SP	EP	WP	WY	WR
+92.0	+20.0	+15.7	+134.9	-107.3	+143.8	+17.2
X	Y	Z	Pitch	Yaw	Roll	
+557	-1879	-186	-153.6	-23.1	+129.0	
FOR	Unloaded - LEE Tip, SY Held					
Disp	W8>ISSACS					

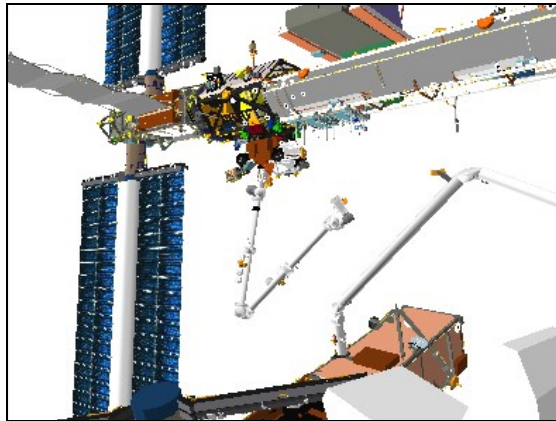


Figure 5.- Intermediate 1
 (91: Camera B: -40, +5).

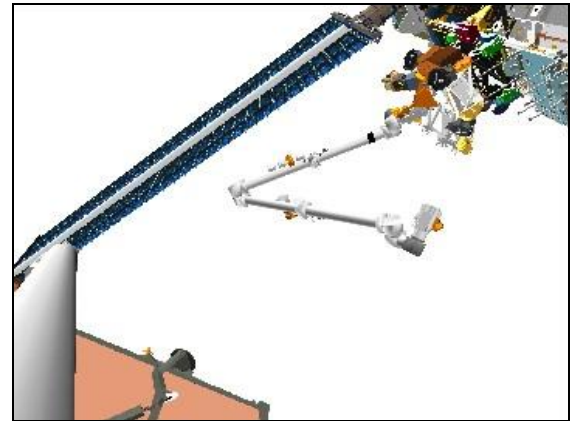


Figure 6.- Intermediate 1
 (92: SRMS Elbow: +30, 0).

2.2 JOCAS 1 to Intermediate 2 Position

PCS

MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

pick File ► W8 ► P6 Handoff Mnvr 1

Verify 'Joint Angles' 'Destination' for Intermediate 2 position.

SR	SY	SP	EP	WP	WY	WR
-10.0	+55.0	+10.0	+118.5	-107.3	+161.8	+59.2

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)	+92.0	+20.0	+15.7	+134.9	-107.3	+143.8	+17.2
TGT	-10.0	+55.0	+10.0	+118.5	-107.3	+161.8	+59.2
ERR	+102.0	-35.0	+5.7	+16.4	0.0	-18.0	-42.0

PCS

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

MON

1.413 P6 GRAPPLE FROM SRMS - WS8
 (RBT FS/10A/FIN 1) Page 4 of 8 pages

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

DCP AUTO SEQ → PROC

PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at Intermediate 2 position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-10.0	+55.0	+10.0	+118.5	-107.3	+161.8	+59.2
X	Y	Z	Pitch	Yaw	Roll	
+585	-2446	-730	-147.9	-17.8	-95.7	
FOR	Unloaded - LEE Tip, SY Held					
Disp	W8>ISSACS					

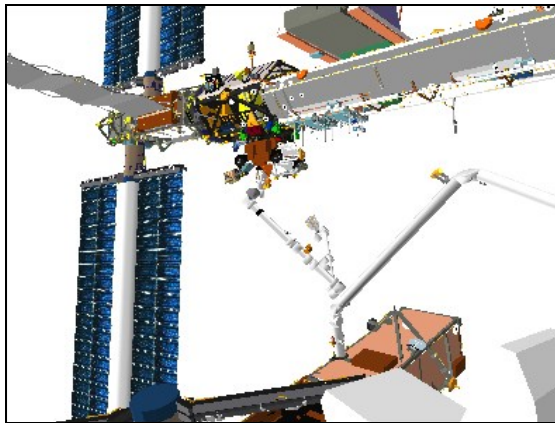


Figure 7.- Intermediate 2
 (91: Camera B: -40, +5).

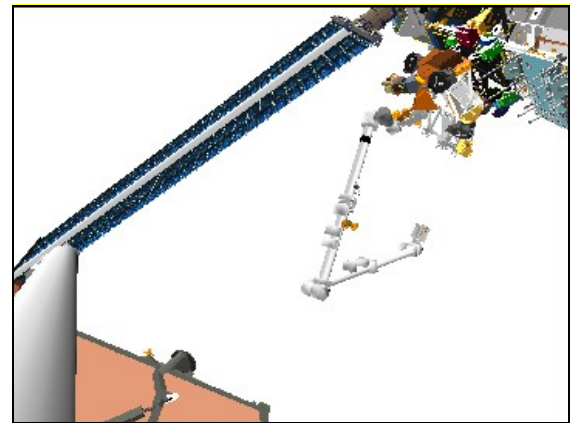


Figure 8.- Intermediate 2
 (92: SRMS Elbow: +30, 0).

2.3 JOCAS 2 to P6 Pre-Grapple at Handoff from SRMS

pick File ► W8 ► P6 Handoff Mnvr 2

Verify 'Joint Angles' 'Destination' for P6 Pre-Grapple at Handoff from SRMS position.

SR	SY	SP	EP	WP	WY	WR
-90.0	+140.0	-181.0	+118.5	-222.6	+161.8	+59.2

cmd Load (Verify Sequence Status – Confirm or Cancel)

1.413 P6 GRAPPLE FROM SRMS - WS8

(RBT FS/10A/FIN 1)

MON

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

	SR	SY	SP	EP	WP	WY	WR
(current)	-10.0	+55.0	+10.0	+118.5	-107.3	+161.8	+59.2
TGT	-90.0	+140.0	-181.0	+118.5	-222.6	+161.8	+59.2
ERR	+80.0	-85.0	+191.0	0.0	+115.3	0.0	0.0

PCS

* If joint angles or 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

PCS

MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at P6 Pre-Grapple at Handoff from SRMS position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-90.0	+140.0	-181.0	+118.5	-222.6	+161.8	+59.2
X	Y	Z	Pitch	Yaw	Roll	
+1120	-1642	+67	-60.3	+64.2	-10.5	
FOR	Unloaded - LEE Tip, SY Held					
Disp	W8>ISSACS					

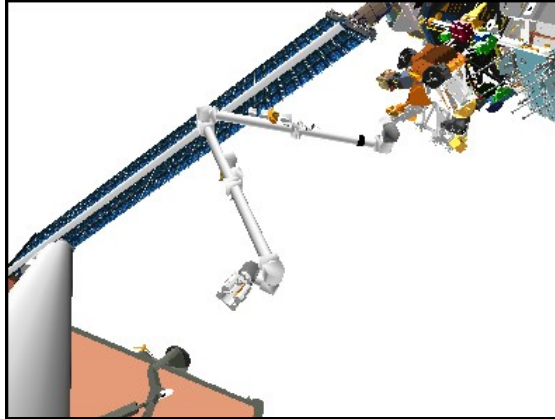


Figure 9.- P6 Pre-Grapple at Handoff from SRMS
 (92: SRMS Elbow: +30, 0).



Figure 10.- P6 Pre-Grapple at Handoff from SRMS
 (09: P1 Lower Outboard: -170, -25).

3. ATTITUDE CONTROL CONFIGURATION

MSS: SSRMS: Thrusters:

Verify 'Desat Request:' – Inh

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

4. P6 FRGF GRAPPLE SETUP AND CAPTURE

4.1 Setup

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
92: SRMS Elbow (+30, 0)	25: Tip LEE	09: P1 Lower Outboard (+160, -10)	Camera A (+80, 0) Camera B (-40, 5)

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

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: as desired

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

1.413 P6 GRAPPLE FROM SRMS - WS8

(RBT FS/10A/FIN 1)

Page 7 of 8 pages

Notify SRMS operator P6 grapple in work.

RHC/
THC

- 4.2 Maneuvering to Within Grapple Envelope
Maneuver to within grapple envelope.

- 4.3 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

- 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

- 4.5 Grapple Cleanup
MSS: SSRMS:

Verify Loaded Parameters – √
Verify 'Loaded Parameters' (two) – P6 Install, SY Held

1.413 P6 GRAPPLE FROM SRMS - WS8

(RBT FS/10A/FIN 1)

Page 8 of 8 pages

Expected P6 FRGF Grapple at Handoff joint angles and FOR.

SR	SY	SP	EP	WP	WY	WR
-84.2	+140.0	-164.1	+99.7	-216.6	+166.2	+58.2
X	Y	Z	Pitch	Yaw	Roll	
+1224	-1280	-77	-70.1	-5.3	+175.4	
FOR	Loaded - P6 Install, SY Held					
Disp	W8>ISSACS					

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)

Give SRMS operator GO to ungrapple P6 and maneuver to Pre-Cradle.

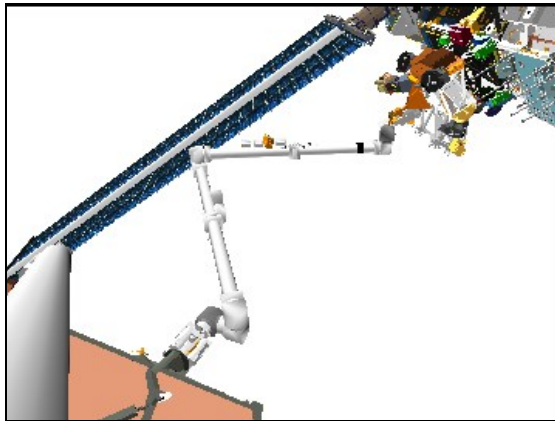


Figure 11.- P6 FRGF Grapple at Handoff (92: SRMS Elbow: +30, 0).

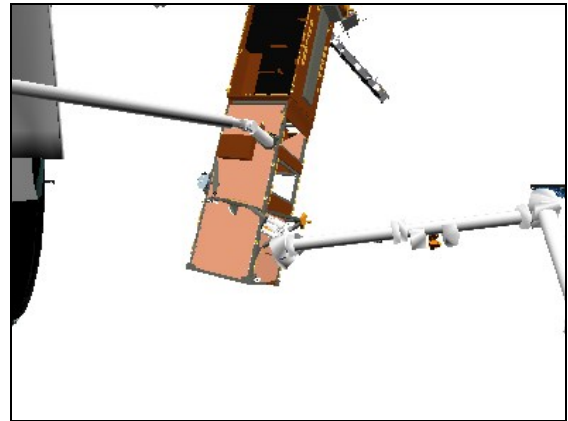


Figure 12.- P6 FRGF Grapple at Handoff (09: P1 Lower Outboard: +160, -10).

1.420 P6 INSTALL

(RBT FS/10A/FIN 1)

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

Verify SRMS at the Pre-Cradle position.

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
09: P1 Lower Outboard (-180, +5)	91: SRMS Elbow (+100, -45) 37: MBS Mast (-15, -5)	22: Base Elbow (+128, +15)	Camera B (-50, -8) Camera A (+80, -5)

PCS

MSS: SSRMS:

Verify Loaded Parameters – √

Verify 'Loaded Parameters' (two) – P6 Install, SY Held

Change Display ► W8 ► P6 Install (Verify W8>P6 Install)

Verify Command – SSRMS>Internal

MSS: SSRMS: Rate:

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

1.420 P6 INSTALL

(RBT FS/10A/FIN 1)

Page 2 of 14 pages

MSS: SSRMS: SSRMS

Verify SSRMS at P6 FRGF Grapple at Handoff position
(within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-84.2	+140.0	-164.1	+99.7	-216.6	+166.2	+58.2
X	Y	Z	Pitch	Yaw	Roll	
-2268	+1226	-39	-84.2	+19.8	-96.6	
FOR	Loaded - P6 Install, SY Held					
Disp	W8>P6 Install					

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

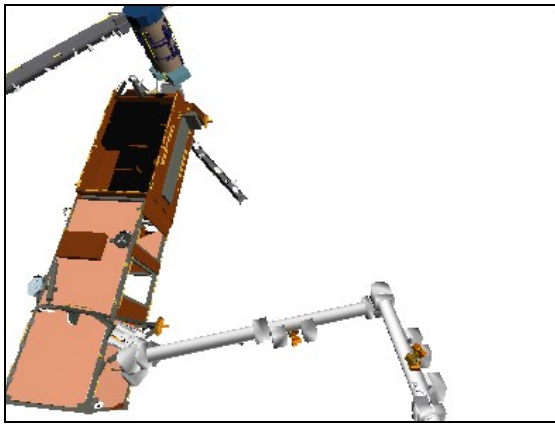


Figure 1.- P6 FRGF Grapple at Handoff
(09: P1 Lower Outboard: -180, +5).

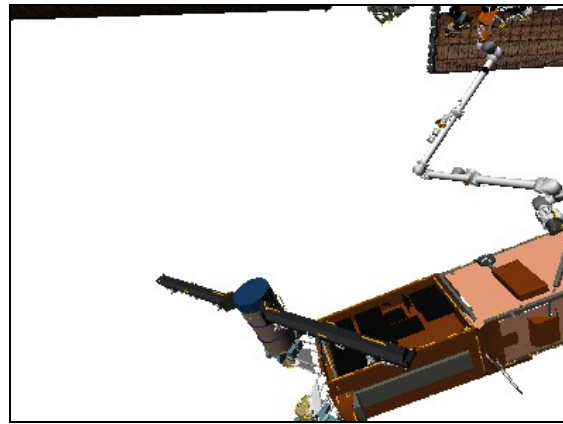


Figure 2.- P6 FRGF Grapple at Handoff
(91: SRMS Elbow: +100, -45).

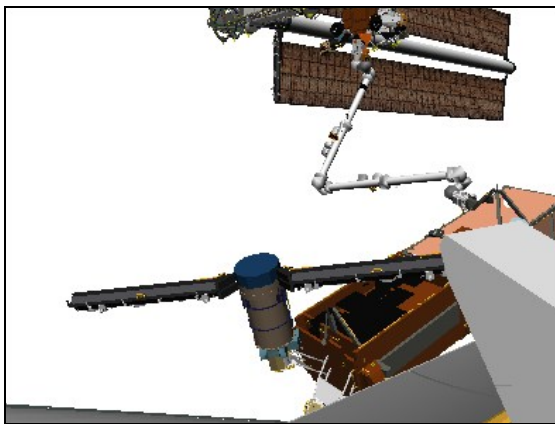


Figure 3.- P6 FRGF Grapple at Handoff
(V10: Camera B: -50, -8).

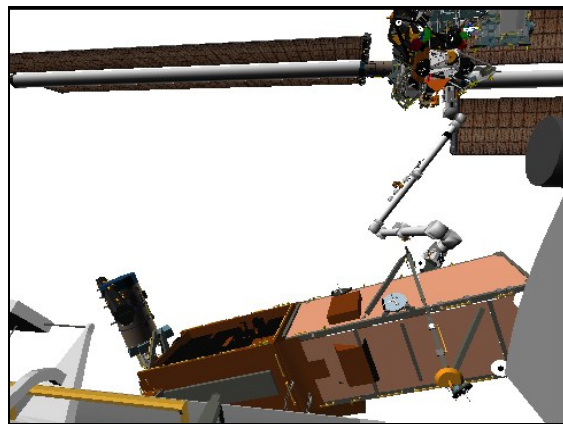


Figure 4.- P6 FRGF Grapple at Handoff
(V10: Camera A: +80, -5).

3. [PORT SARJ AND BGA CONFIGURATION](#)

Verify with **MCC-H**, Port SARJ and P4 BGAs locked for P6 Install.

1.420 P6 INSTALL

(RBT FS/10A/FIN 1)

4. ATTITUDE CONTROL CONFIGURATION

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

5. MANEUVER TO P6 PRE-INSTALL INTERMEDIATE POSITION

NOTE

1. Monitor clearance between the SSRMS shoulder and the POA with the SRMS Elbow Camera or the MBS Mast Camera. Minimum clearance is 40 cm (16 in).
2. Monitor clearance between the SSRMS wrist and P6 with the P1 Lower Outboard Camera or Camera B. Minimum clearance is 60 cm (24 in).
3. Pictures were taken assuming the following BGA positions: 4A at 90 deg. and 2A at 180 deg. However, due to changing Beta and attitude configurations the BGAs may be positioned differently for install. Clearances to the arrays can be monitored with EVA assistance and the SSRMS Base Elbow Camera.

5.1 JOCAS 1 to Pre-Install Intermediate 1 Position

PCS

MSS: SSRMS: SSRMS Safing:

cmd Remove (Verify Not Safed)

DCP

BRAKES SSRMS → OFF (Verify OFF)

RHC

RATE → COARSE (Verify Coarse on PCS)

PCS

MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

pick File ► W8 ► P6 Preinstall Mnvr 1

Verify 'Joint Angles' 'Destination' for Pre-Install Intermediate 1 position.

SR	SY	SP	EP	WP	WY	WR
+65.0	+155.0	-165.0	+45.0	-118.2	+142.2	+108.2

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)	-84.2	+140.0	-164.1	+99.7	-216.6	+166.2	+58.2
TGT	+65.0	+155.0	-165.0	+45.0	-118.2	+142.2	+108.2
ERR	-149.2	-15.0	+0.9	+54.7	-98.4	+24.0	-50.0

```

*****
* If joint angles or 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

PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify Joint Angle values.

SR	SY	SP	EP	WP	WY	WR
+65.0	+155.0	-165.0	+45.0	-118.2	+142.2	+108.2

Give SRMS operator GO to maneuver to P6 Install Viewing position.



Figure 5.- Pre-Install Intermediate 1
(09: P1 Lower Outboard: -120, -10).

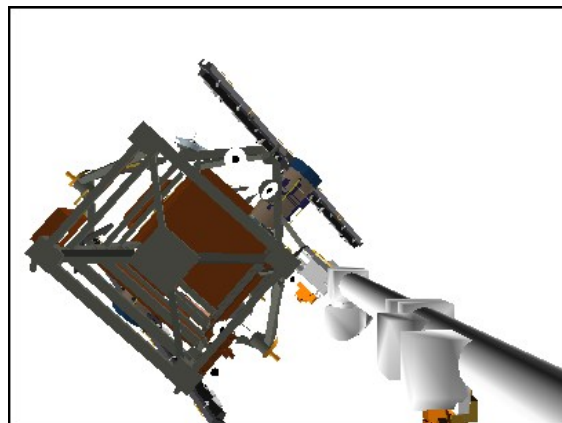


Figure 6.- Pre-Install Intermediate 1
(22: Base Elbow: +140, 0).

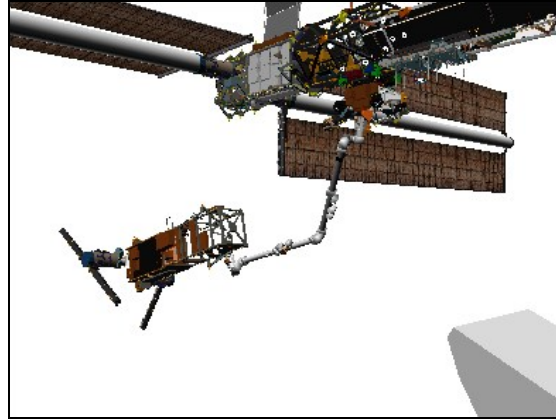


Figure 7.- Pre-Install Intermediate 1
(V10: Camera B: -50, 0).

5.2 Attitude Control Configuration

If using shuttle attitude control, coordinate with shuttle crewmembers:

 If attitude maintenance required:

 Configure DAP per RMS DAPs, then

 Perform RATE DAMPING (ORB OPS FS, DOCKED DAP REFERENCE).

5.3 JOCAS 2 to Pre-Install Intermediate 2 Position

On SRMS operator GO for P6 Install:

If using shuttle attitude control, coordinate with shuttle crewmembers:

 DAP: FREE

SSRMS Joint OCAS

pick File ► W8 ► P6 Preinstall Mnvr 2

Verify 'Joint Angles' 'Destination' for Pre-Install Intermediate 2 position.

SR	SY	SP	EP	WP	WY	WR
+82.7	+144.2	-123.4	+20.5	-118.2	+142.2	+108.2

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	+155.0	-165.0	+45.0	-118.2	+142.2	+108.2
TGT	+82.7	+144.2	-123.4	+20.5	-118.2	+142.2	+108.2
ERR	-17.7	+10.8	-41.6	+24.5	0.0	0.0	0.0

```

*****
* If joint angles or 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

PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at Pre-Install Intermediate 2 position
(within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+82.7	+144.2	-123.4	+20.5	-118.2	+142.2	+108.2
X	Y	Z	Pitch	Yaw	Roll	
+130	+475	0	0.0	0.0	0.0	
FOR	Loaded - P6 Install, SY Held					
Disp	W8>P6 Install					

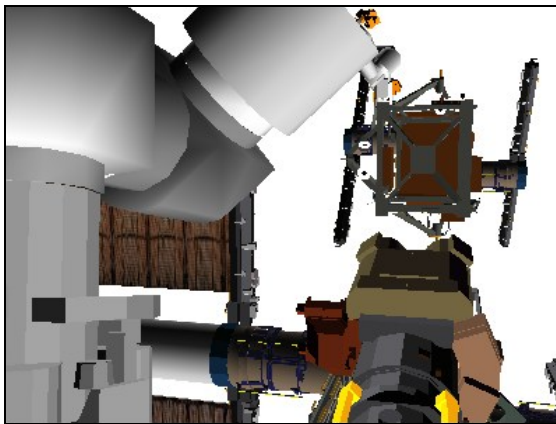


Figure 8.- Pre-Install Intermediate 2
(37: MBS Mast: -15, -5).

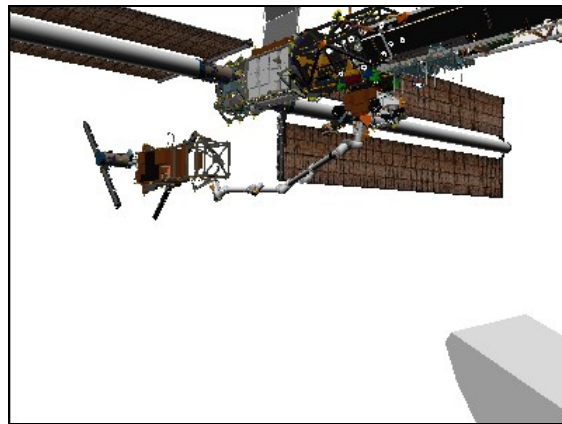


Figure 9.- Pre-Install Intermediate 2
(V10: Camera B: -50, 0).

6. ATTITUDE CONTROL CONFIGURATION

If using shuttle attitude control, coordinate with shuttle crewmembers:

If attitude maintenance required:

Configure DAP per RMS DAPs, then

Perform RATE DAMPING (ORB OPS FS, DOCKED DAP REFERENCE), then:

When in attitude

DAP: FREE

7. MANEUVER TO P6 PRE-INSTALL

7.1 FOR OCAS to Pre-Install Setup

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
24: Tip Elbow (+20, -5)	91: Camera B (-55, +10) 37: MBS Mast (-15, -5)	22: Base Elbow (+145, 0)	SRMS Elbow (+80, +25) Camera A (+100, +10)

RHC RATE → VERNIER (Verify Vernier 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 ► W8 ► P6 Preinstall Mnvr 3

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

X	Y	Z	Pitch	Yaw	Roll
+130	+200	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	+130	+475	0	0.0	0.0	0.0
TGT	+130	+200	0	0.0	0.0	0.0
ERR	0	+275	0	0.0	0.0	0.0

PCS * If FOR or 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

PCS MSS: SSRMS:

Verify Posn Hold – orange

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

	Locked					
SR	SY	SP	EP	WP	WY	WR
+91.4	+144.2	-113.3	+28.2	-134.7	+146.7	+114.8
X	Y	Z	Pitch	Yaw	Roll	
+130	+200	0	0.0	0.0	0.0	
FOR	Loaded - P6 Install, SY Held					
Disp	W8>P6 Install					

Notify EVA P6 at Pre-Install Setup position.

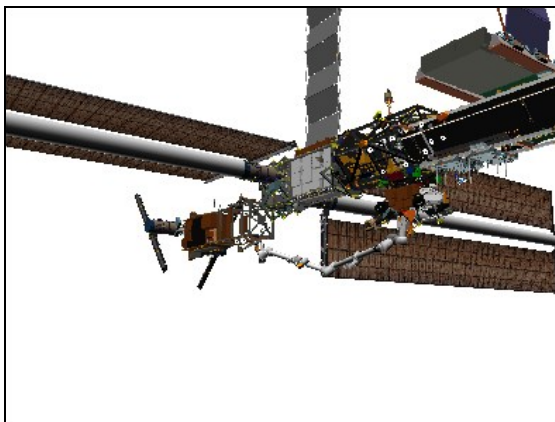


Figure 10.- Pre-Install Setup
(91: Camera B: -55, +10).

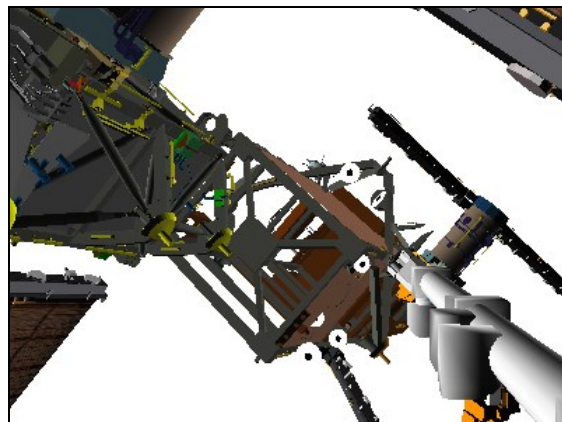


Figure 11.- Pre-Install Setup
(22: Base Elbow: +145, 0).

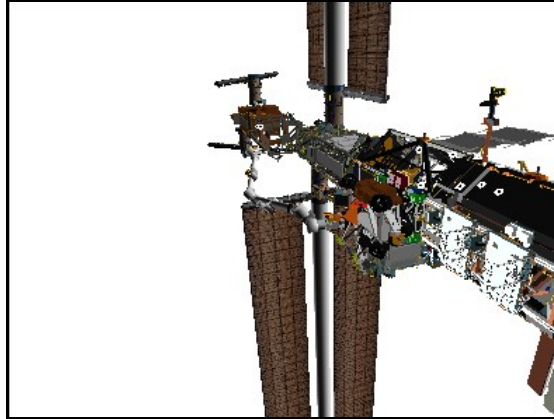


Figure 12.- Pre-Install Setup
(V10: SRMS Elbow: +80, +25).

7.2 Attitude Control Configuration

If using shuttle attitude control, coordinate with shuttle crewmembers:

 If attitude maintenance required:

 Configure DAP per RMS DAPs, then

 Perform RATE DAMPING (ORB OPS FS, DOCKED DAP REFERENCE).

7.3 Manual Maneuver to P6 Pre-Install

NOTE

Throughout maneuver to install, monitor clearance between the Tip Elbow boom and the 2A Solar Array with the Base Elbow Camera. If the 2A Solar Array BGA angle is 180 deg., minimum clearance is approximately 102 cm (40 in) at install.

On EVA GO to maneuver to Pre-Install:

MSS: SSRMS: Thrusters:

Verify 'Desat Request' – Inh

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

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

1.420 P6 INSTALL

(RBT FS/10A/FIN 1)

THC/
RHC

Maneuver to P6 Pre-Install position. (THC left)

Verify SSRMS at P6 Pre-Install position (within 5 cm/1 deg).

Locked						
SR	SY	SP	EP	WP	WY	WR
+97.3	+144.2	-99.5	+20.5	-139.6	+149.7	+119.1
X	Y	Z	Pitch	Yaw	Roll	
+130	0	0	0.0	0.0	0.0	
FOR	Loaded - P6 Install, SY Held					
Disp	W8>P6 Install					

Notify EVA SSRMS at Pre-Install position.

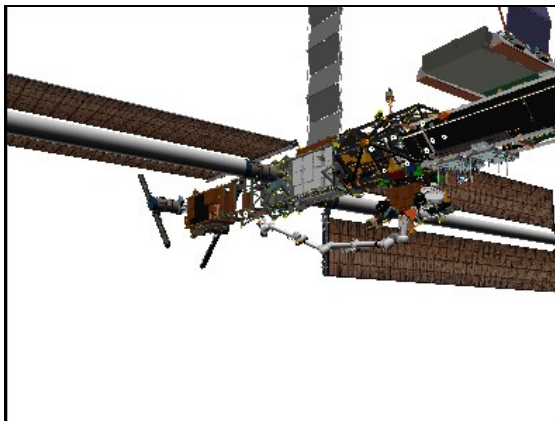


Figure 13.- P6 Pre-Install
(91: Camera B: -55, +10).

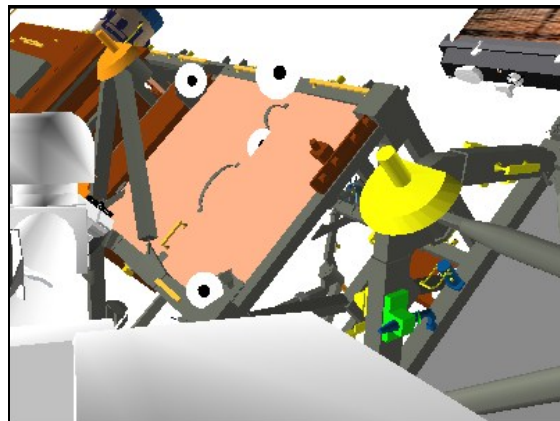


Figure 14.- P6 Pre-Install
(24: Tip Elbow: +20, -5).

8. MANEUVER P6 TO RTAS CAPTURE ENVELOPE POSITION ON P5

NOTE

Monitor clearance between the Tip Boom and the P5 Trunnion with the Tip Elbow camera or the Base Elbow Camera. Minimum clearance is approximately 101 cm (40 in.).

8.1 Maneuver to Install Alignment Check 30 cm

PCS

MSS: SSRMS: Rate:

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

On EVA GO for maneuver to X = +30 cm:

THC/
RHC

Maneuver P6 to Install Alignment Check 1 position, X = +30.
(THC out)

Maneuver per EVA GCA call to align P6 with P5.

1.420 P6 INSTALL

(RBT FS/10A/FIN 1)

Expected Install Alignment Check 30 cm position:

	Locked					
SR	SY	SP	EP	WP	WY	WR
+98.4	+144.2	-111.9	+47.7	-154.2	+150.3	+119.9
X	Y	Z	Pitch	Yaw	Roll	
+30	0	0	0.0	0.0	0.0	
FOR	Loaded - P6 Install, SY Held					
Disp	W8>P6 Install					

PCS

MSS: SSRMS:

Verify Posn Hold – orange

8.2 Maneuver to Install Alignment Check 15 CM

On EVA GO for maneuver to X = +15 cm:

MSS: SSRMS: Snapshot:

cmd Snapshot (Verify Display – Snapshot, Command – Snapshot)

Change Display ► W8 ► P6 Install (Verify W8>P6 Install)

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: 0.2 (Verify 0.2).

THC/
RHC

Maneuver P6 to Install Alignment Check 2 position, X = +15. (THC out)

Maneuver per EVA GCA call to align P6 with P5.

Expected Install Alignment Check 15 cm position:

	Locked					
SR	SY	SP	EP	WP	WY	WR
+98.6	+144.2	-113.1	+50.6	-155.8	+150.4	+120.1
X	Y	Z	Pitch	Yaw	Roll	
+15	0	0	0.0	0.0	0.0	
FOR	Loaded - P6 Install, SY Held					
Disp	W8>P6 Install					

PCS

MSS: SSRMS:

Verify Posn Hold – orange

8.3 Maneuver to First Contact

On EVA GO for maneuver to First Contact:

MSS: SSRMS: Snapshot:

cmd Snapshot (Verify Display – Snapshot, Command – Snapshot)

Change Display ► W8 ► P6 Install (Verify W8>P6 Install)

NOTE

EV crew will provide visual verification that the alignment pins are within the alignment cups. Therefore, they may call "Stop Motion" prior to reaching X value destination.

THC/
RHC

Maneuver P6 per GCA call to Install position until first contact called by EV1 or EV2. (THC out)

Verify with EV crew all four alignment pins are within their alignment cups.

 * If alignment correction needed:
 * | Maneuver P6 back to Install Alignment Check 2 position
 * | (X = +15).
 * |
 * | GCA per EVA call to correct alignment as required.
 * |
 * | **cmd** Snapshot
 * |
 * | Change Display ► W8 ► P6 Install (Verify W8>P6 Install)
 * |
 * | Repeat step 8.3.

PCS

MSS: SSRMS: SSRMS

Verify Posn Hold – orange

Expected position for First Contact.

SR	SY	SP	EP	WP	WY	WR
+98.7	+144.2	-113.8	+52.2	-156.7	+150.4	+120.1
X	Y	Z	Pitch	Yaw	Roll	
+6	0	0	0.0	0.0	0.0	
FOR	Loaded - P6 Install, SY Held					
Disp	W8>P6 Install					

Give IV GO to drive capture claw to just prior to contact with the capture bar.

9. PREPARE FOR INSTALL

WARNING
<p>The expected MSS configuration during 2nd Stage claw operations is as follows:</p> <ul style="list-style-type: none"> a. Status Overlay - 'Limped' b. RWS Status on DCP - Active c. Monitor number on RWS monitors flashing <p>Changes in any of the above during the capture claw operations indicates the SSRMS has safed. Monitor the above indicators while the capture claw is in motion and notify the EV crew that the SSRMS is nominal/OK every 5-6 seconds. However, if any of the above indications change, notify IV/EV with a "STOP PGT Driving" call.</p>

On IV GO to limp SSRMS:

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

MSS: SSRMS: Limp:

cmd All Limp (Verify Limp – blue)

MSS: SSRMS:

Verify all joints – Limped

Notify IV crew, "All joints limped - GO to drive capture claw to hard stop."

10. INSTALL COMPLETED

On IV GO for P6 Ungrapple:

Verify EVA crew, tools, and safety tethers are clear of SSRMS.

DCP

BRAKES SSRMS → ON (Verify ON)

Expected SSRMS at P6 Install position (within 5 cm/1 deg).

	Locked					
SR	SY	SP	EP	WP	WY	WR
+98.7	+144.2	-114.2	+53.3	-157.3	+150.5	+120.2
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded - P6 Install, SY Held					
Disp	W8>P6 Install					

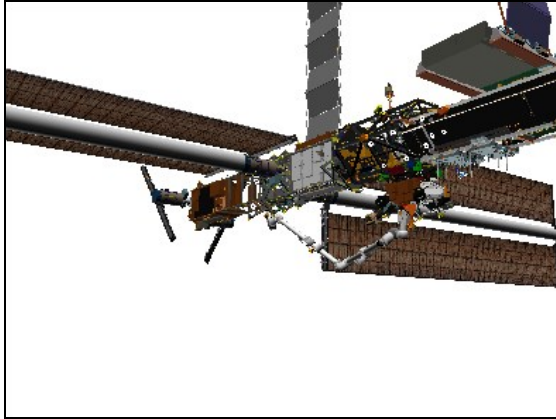


Figure 15.- P6 Install
(91: Camera B: -55, 10).

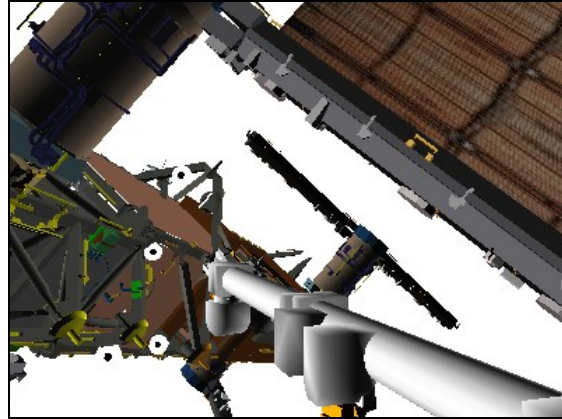


Figure 16.- P6 Install
(22: Base Elbow: +145, 0).

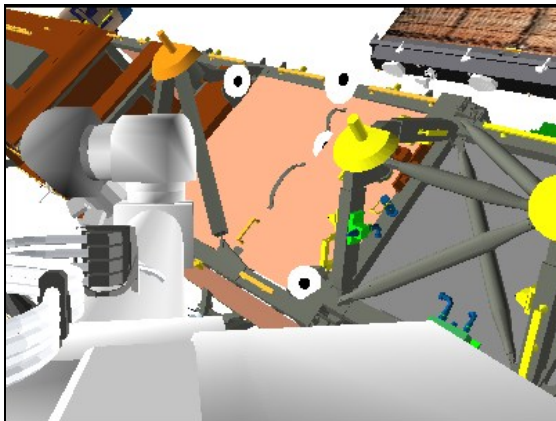


Figure 17.- P6 Install
(24: Tip Elbow: +10, -5).

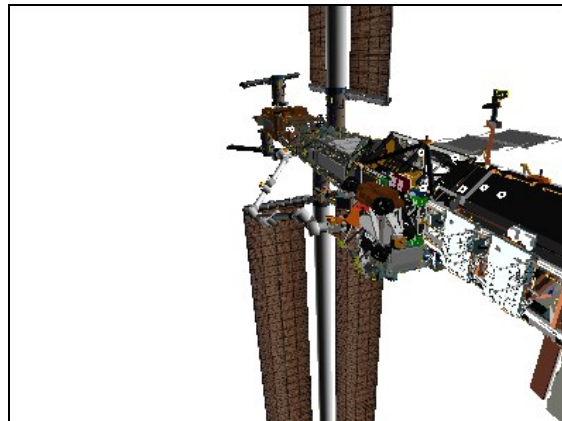


Figure 18.- P6 Install
(V10: SRMS Elbow: +80, +25).

11. ATTITUDE CONTROL CONFIGURATION

If using shuttle attitude control, coordinate with shuttle crewmembers:

 If attitude maintenance required:

 Configure DAP per RMS DAPs, then

 Perform RATE DAMPING (ORB OPS FS, DOCKED DAP REFERENCE).

1.421 P6 UNGRAPPLE AT INSTALL

(RBT FS/10A/FIN 1)

Page 1 of 3 pages

1. SETUP

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
91: Camera B (-55, +10)	25: Tip LEE	22: Base Elbow (+148, -10)	SRMS Elbow (+80, +25) Camera A (+95, -5)

NOTE

1. Monitor clearances between the Shoulder Yaw joint and the POA with Camera B. Minimum clearance is approximately 53 cm (21 in).
2. Monitor clearance between the Tip Elbow Boom and the 2A Solar Array with the Base Elbow Camera. If the 2A Solar Array BGA angle is 180 deg., minimum clearance is approximately 97 cm (38 in).

PCS

MSS: SSRMS:

Verify Loaded Parameters – √

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

Change Display ► W8 ► P5 Mated P6 FRGF2 (Verify W8> P5 Mated P6 FRGF2)

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

Verify SSRMS at P6 Install position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+98.7	+144.2	-114.2	+53.3	-157.3	+150.5	+120.2
X	Y	Z	Pitch	Yaw	Roll	
+74	+250	-120	+0.7	-69.9	-179.4	
FOR	Loaded – P6 Install, SYH					
Disp	W8>P5 Mated P6 FRGF2					

√Vernier

MSS: SSRMS: Rate:

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

DCP

BRAKES SSRMS → OFF (Verify – OFF)

2. P6 UNGRAPPLE

2.1 SSRMS Limp

PCS

MSS: SSRMS: Limp:

cmd All Limp (Verify Limp – blue)

1.421 P6 UNGRAPPLE AT INSTALL

(RBT FS/10A/FIN 1)

Page 2 of 3 pages

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)

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)

1.421 P6 UNGRAPPLE AT INSTALL

(RBT FS/10A/FIN 1)

Page 3 of 3 pages

THC/
RHC

Maneuver to P6 Ungrapple at Install position (within 5 cm/1 deg).

	Locked						
SR	SY	SP	EP	WP	WY	WR	
+94.8	+144.2	-127.3	+64.9	-156.7	+148.5	+117.3	
X	Y	Z	Pitch	Yaw	Roll		
-150	0	0	0.0	0.0	0.0		
FOR	Unloaded – LEE Tip, SY Held						
Disp	W8>P5 Mated P6 FRGF2						

DCP

BRAKES SSRMS → ON (Verify ON)

Notify IV/EVA P6 Ungrapple complete.

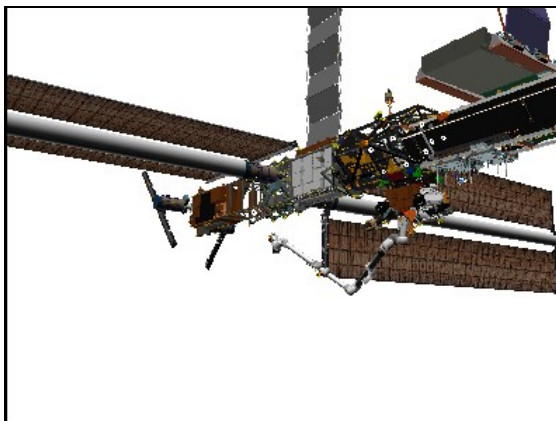


Figure 1.- P6 Ungrapple at Install
(91: Camera B: -55, +10).



Figure 2.- P6 Ungrapple at Install
(22: Base Elbow: +148, -10).

1.430 MNVR TO SAW VIEWING

(RBT FS/10A/FIN 1)

Page 1 of 5 pages

1. SETUP

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
91: Camera B (-55, +10)	22: Base Elbow (+145, -5)	24: Tip Elbow (+125, -5)	SRMS Elbow (+80, +25)

PCS

MSS: SSRMS:

Verify Unloaded Parameters – √

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

Change Display ► W8 ► ISSACS (Verify W8>ISSACS)

Verify Command – SSRMS>Internal

Verify SSRMS at P6 FRGF Backoff position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+94.8	+144.2	-127.3	+64.9	-156.7	+148.5	+117.3
X	Y	Z	Pitch	Yaw	Roll	
+298	-3708	-151	-180.0	-20.2	+0.0	
FOR	Unloaded - LEE Tip, SY Held					
Disp	W8> ISSACS					

√Vernier

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: 1.0

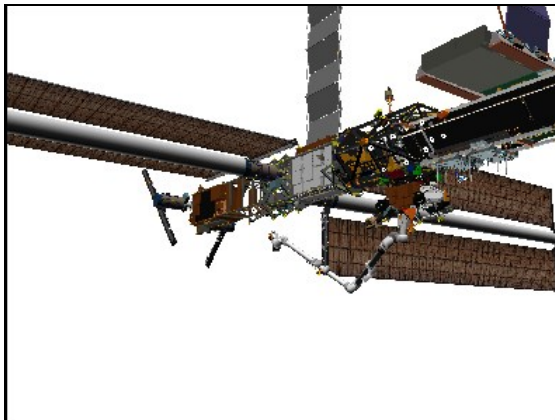


Figure 1.- P6 FRGF Backoff
(91: Camera B: -55, +10).



Figure 2.- P6 FRGF Backoff
(22: Base Elbow: +145, -5).

1.430 MNVR TO SAW VIEWING

(RBT FS/10A/FIN 1)

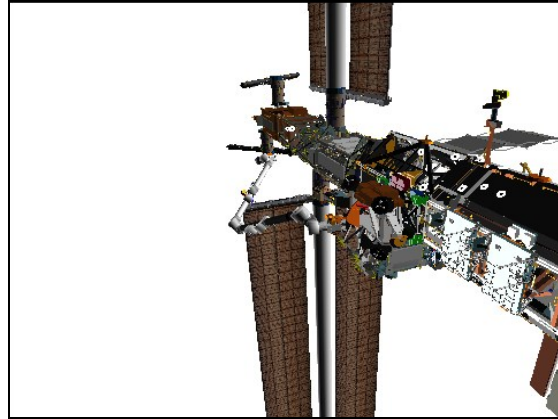


Figure 3.- P6 FRGF Backoff
(V10: SRMS Elbow: +80, +25).

2. MANEUVER TO SAW VIEWING POSITION

2.1 Pitch Plane to Clearance 1 Position

NOTE

1. Monitor clearances between the SSRMS Tip boom and the 2A Solar array with the Base Elbow Camera. Clearances improve with the maneuver.
2. Monitor clearance between the SSRMS Shoulder and the POA with Camera B. Minimum clearance is 38 cm (15 in.).

DCP

BRAKES SSRMS → OFF (Verify OFF)

PCS

MSS: SSRMS:

Enter Mode – Pitch Plane (Verify blue)

RHC

Perform “+” Pitch Plane Change to SY: +174.0 (RHC Roll right)

Verify SSRMS at Clearance 1 position (SY within 1 deg).

SR	SY	SP	EP	WP	WY	WR
+98.9	+174.0	-130.5	+65.6	-147.9	+175.1	+102.3
X	Y	Z	Pitch	Yaw	Roll	
+298	-3708	-151	-180.0	-20.2	+0.0	
FOR	Unloaded - LEE Tip, SY Held					
Disp	W8> ISSACS					

1.430 MNVR TO SAW VIEWING

(RBT FS/10A/FIN 1)

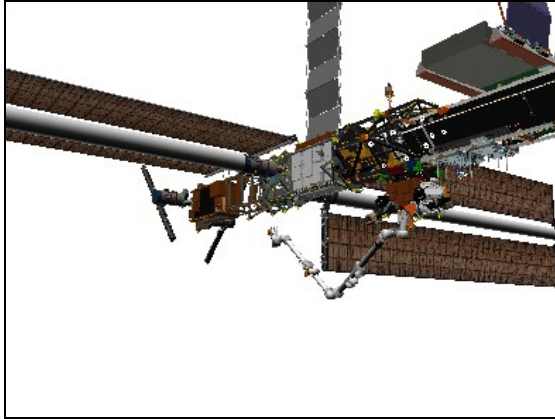


Figure 4.- Clearance 1 Position
(91: Camera B: -55, +10).



Figure 5.- Clearance 1 Position
(22: Base Elbow: +145, -5).

2.2 Single Joint to Clearance 2 Position

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 Clearance 2 position (within 1 deg).

	SR	SY	SP	EP	WP	WY	WR
Clearance 1	+98.9	+174.0	-130.5	+65.6	-147.9	+175.1	+102.3
1: SP –			-160.0				
2: EP –				+40.0			
Clearance 2	+98.9	+174.0	-160.0	+40.0	-147.9	+175.1	+102.3
	X	Y	Z	Pitch	Yaw	Roll	
	+1337	-3593	-295	+141.9	-70.2	-35.3	
FOR	Unloaded - LEE Tip, SY Held						
Disp	W8> ISSACS						

1.430 MNVR TO SAW VIEWING

(RBT FS/10A/FIN 1)

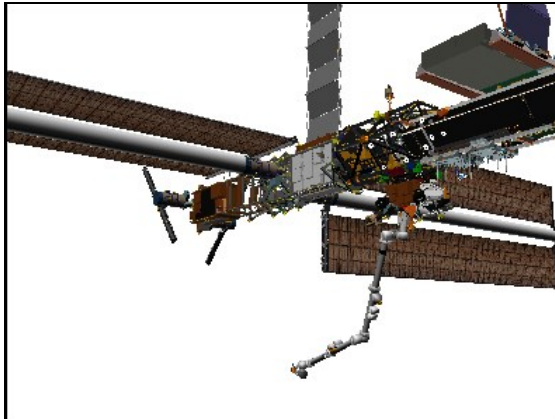


Figure 6.- Clearance 2 Position
(91: Camera B: -55, +10).

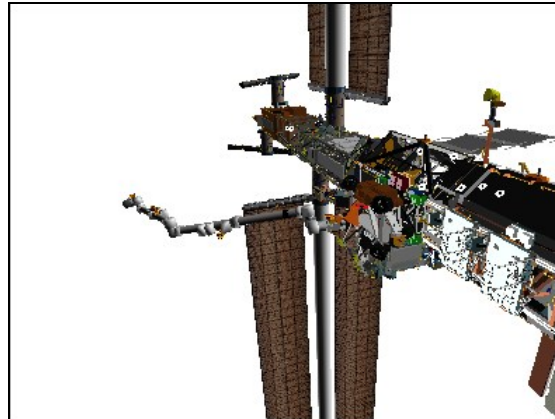


Figure 7.- Clearance 2 Position
(V10: SRMS Elbow: +80, +25).

2.3 Joint OCAS to SAW Viewing Position

PCS

MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

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

SR	SY	SP	EP	WP	WY	WR
+181.5	+128.5	-140.0	+40.0	-55.0	+205.0	+180.0

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)	+98.9	+174.0	-160.0	+40.0	-147.9	+175.1	+102.3
TGT	+181.5	+128.5	-140.0	+40.0	-55.0	+205.0	+180.0
ERR	-82.6	+45.5	-20.0	0.0	-93.0	-30.0	-77.8

PCS

* If joint angles or 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)

1.430 MNVR TO SAW VIEWING

(RBT FS/10A/FIN 1)

Page 5 of 5 pages

DCP AUTO SEQ → PROC

PCS MSS: SSRMS:

Verify Posn Hold – orange

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

SR	SY	SP	EP	WP	WY	WR
+181.5	+128.5	-140.0	+40.0	-55.0	+205.0	+180.0
X	Y	Z	Pitch	Yaw	Roll	
+944	-2134	-1373	-130.6	-58.8	+28.7	
FOR	Unloaded - LEE Tip, SY Held					
Disp	W8> ISSACS					

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)

Give SRMS operator GO to maneuver to APFR Install position.

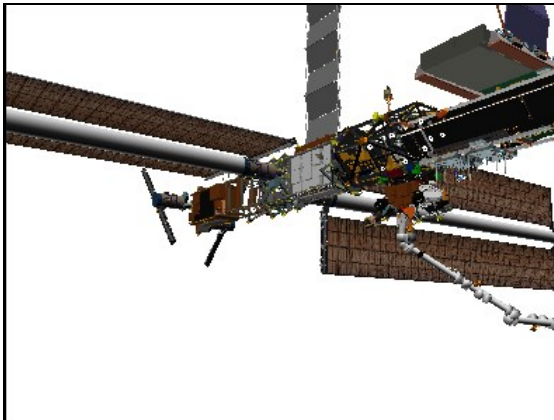


Figure 8.- SAW Viewing
(91: Camera B: -55, +10).

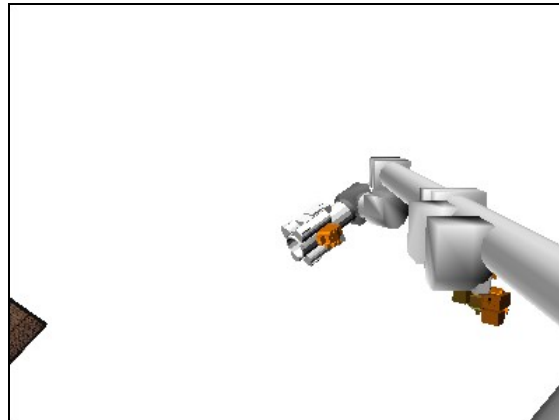


Figure 9.- SAW Viewing
(22: Base Elbow: +140, -10).

1.510 MNVR TO MT TRANSLATE STOW - WS4

(RBT FS/10A/FIN 1)

Page 1 of 7 pages

1. SETUP

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
09: P1 Lower Outboard (+135, -15)	37: MBS Mast (0, +10)	13: LAB Stbd Zenith (-170, -35)	Camera B (-20, +5)

PCS

MSS: SSRMS:

Verify Unloaded Parameters – √
 Verify 'Unloaded Parameters' (two) – LEE Tip, SY Held
 Verify Display – W4> ISSACS
 Verify Command – SSRMS>Internal

Verify SSRMS at P6 PDGF Backoff position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+80.9	+41.6	-83.7	+60.0	-175.7	-122.1	-95.3
X	Y	Z	Pitch	Yaw	Roll	
+1056	-1094	+348	+22.0	-24.5	-174.2	
FOR	Unloaded - LEE Tip, SY Held					
Disp	W4>ISSACS					

√Vernier

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: 1.0

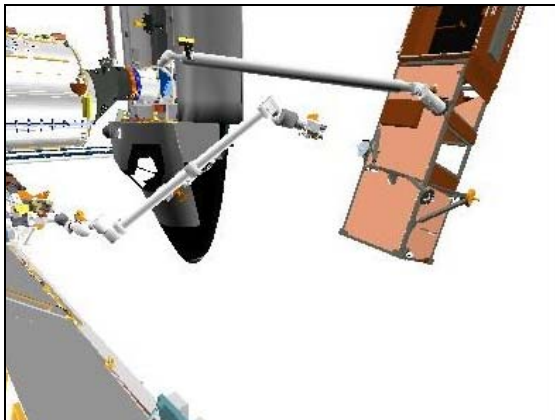


Figure 1.- P6 PDGF Backoff
(09: P1 Lower Outboard: +135, -15).

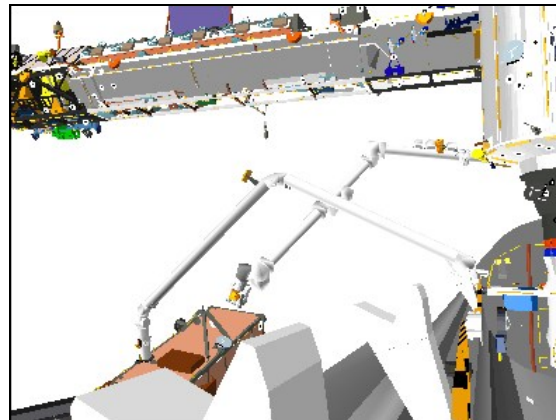


Figure 2.- P6 PDGF Backoff
(V10: Camera B: -20, +5).

1.510 MNVR TO MT TRANSLATE STOW - WS4

(RBT FS/10A/FIN 1)

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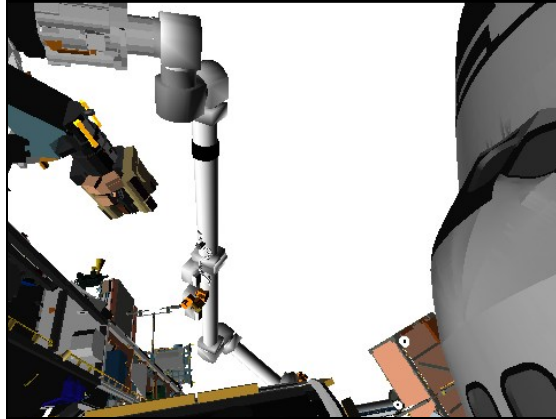


Figure 3.- P6 PDGF Backoff
(13: LAB Stbd Zenith: -170, -35).

2. MANEUVER TO MT TRANSLATE STOW POSITION

2.1 Single Joint to Intermediate Stow Position

NOTE

1. Throughout maneuver to MT Translate Stow, monitor clearance between the SSRMS shoulder and the POA with the LAB Stbd Zenith Camera. Minimum clearance is 53 cm (21 in).
2. Monitor clearance between the SSRMS Tip LEE and the P6 with the P1 Lower Outboard Camera or Camera B. Minimum clearance is 106 cm (42 in).

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.

1.510 MNVR TO MT TRANSLATE STOW - WS4

(RBT FS/10A/FIN 1)

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THC

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

P6 PDGF
Backoff
1: SR +
2: SY -
Intermediate
Stow

SR	SY	SP	EP	WP	WY	WR
+80.9	+41.6	-83.7	+60.0	-175.7	-122.1	-95.3
+110.0						
	0.0					
+110.0	0.0	-83.7	+60.0	-175.7	-122.1	-95.3
X	Y	Z	Pitch	Yaw	Roll	
+991	-1003	-791	+63.8	+0.7	-148.2	
FOR	Unloaded - LEE Tip, SY Held					
Disp	W4>ISSACS					

PCS

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

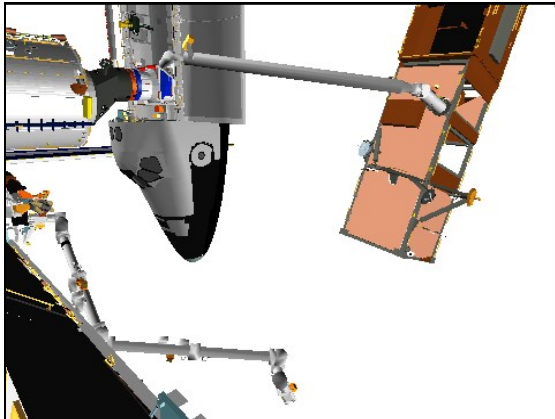


Figure 4.- Intermediate Stow (09: P1 Lower Outboard: +135, -15).

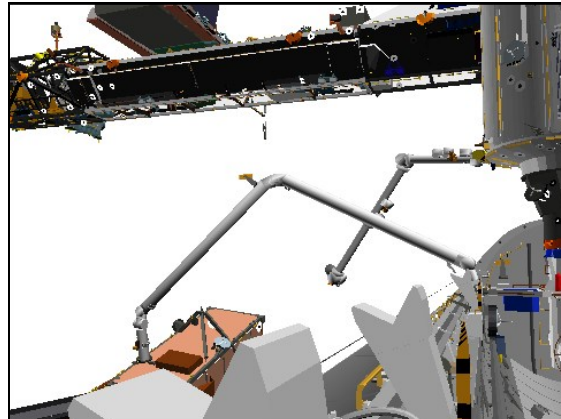


Figure 5.- Intermediate Stow (V10: Camera B: -20, +5).

2.2 JOCAS to Stow Setup

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
09: P1 Lower Outboard (+135, -15)	91: SRMS Elbow (+115, -55)	13: LAB Stbd Zenith (-175, -15)	Camera B (-20, +5) Camera C (-10, +15)

1.510 MNVR TO MT TRANSLATE STOW - WS4

(RBT FS/10A/FIN 1)



Figure 6.- Intermediate Stow
(91: SRMS Elbow: +115, -55).

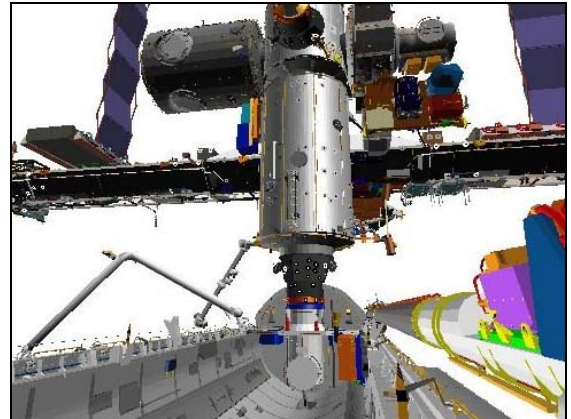


Figure 7.- Intermediate Stow
(V10: Camera C: -10, +15).

NOTE

1. During this maneuver, minimum clearance between the SSRMS and the Orbiter nose is 249 cm (98 in.).
2. A singularity warning may flash when SY is approximately -30.7 deg.

PCS

MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

pick File ► W4 ► Translate Stow

Verify 'Joint Angles' 'Destination' for Stow Setup position.

SR	SY	SP	EP	WP	WY	WR
+110.0	-45.0	-10.0	+60.0	-100.0	+190.0	+68.8

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)	+110.0	0.0	-83.7	+60.0	-175.7	-122.1	-95.3
TGT	+110.0	-45.0	-10.0	+60.0	-100.0	+190.0	+68.8
ERR	0	+45.0	-73.7	0.0	-75.7	-312.1	-164.1

1.510 MNVR TO MT TRANSLATE STOW - WS4

(RBT FS/10A/FIN 1)

```

*****
* If joint angles or 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

PCS MSS: SSRMS:

Verify Posn Hold – orange

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

SR	SY	SP	EP	WP	WY	WR
+110.0	-45.0	-10.0	+60.0	-100.0	+190.0	+68.8
X	Y	Z	Pitch	Yaw	Roll	
+1251	+755	-867	-122.7	+44.9	+136.9	
FOR	Unloaded - LEE Tip, SY Held					
Disp	W4>ISSACS					

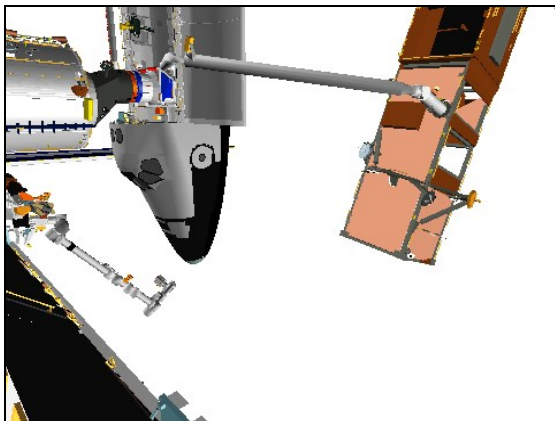


Figure 8.- Stow Setup
(09: P1 Lower Outboard: +135, -15).

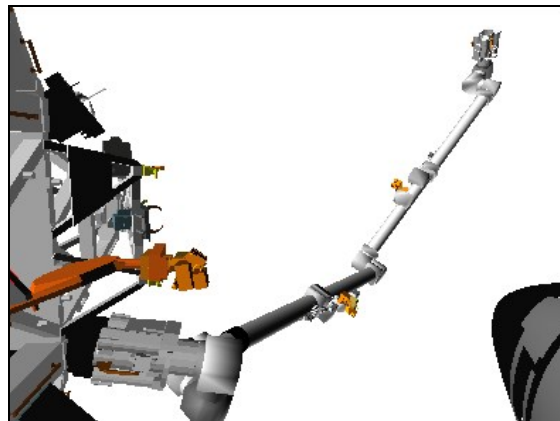


Figure 9.- Stow Setup
(13: LAB Stbd Zenith: -175, +10).

2.3 Single Joint to MT Translate Stow Position

MSS: SSRMS:

Enter Mode – Single (Verify blue)

1.510 MNVR TO MT TRANSLATE STOW - WS4

(RBT FS/10A/FIN 1)

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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 MT Translate Stow position (within 1 deg).

Stow Setup
1: EP +
MT Translate
Stow

SR	SY	SP	EP	WP	WY	WR
+110.0	-45.0	-10.0	+60.0	-100.0	+190.0	+68.8
			+135.0			
+110.0	-45.0	-10.0	+135.0	-100.0	+190.0	+68.8
X	Y	Z	Pitch	Yaw	Roll	
+557	+577	-186	-153.5	-23.1	+129.0	
FOR	Unloaded - LEE Tip, SY Held					
Disp	W4>ISSACS					

<u>NOTE</u>
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)

Give **MCC-H** GO to translate MT to worksite 8.

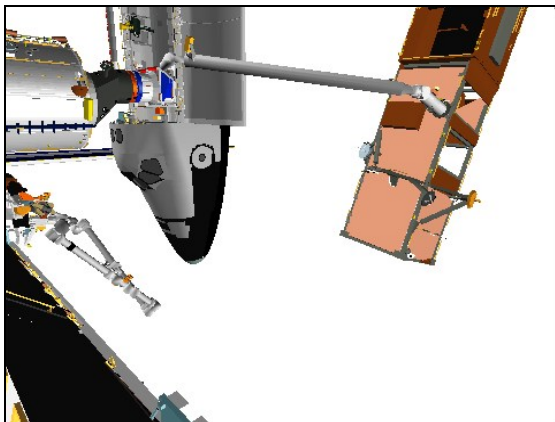


Figure 10.- MT Translate Stow
(09: P1 Lower Outboard: +135, -15).



Figure 11.- MT Translate Stow
(91: SRMS Elbow: +115, -55).

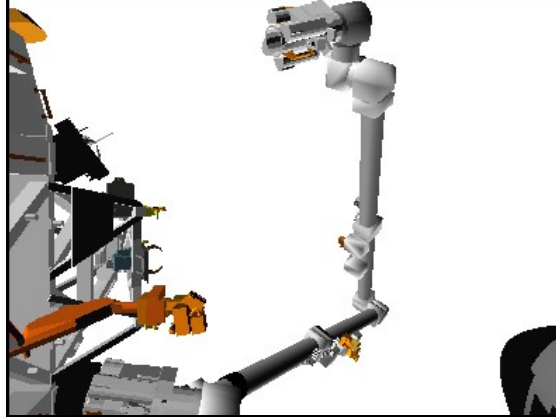


Figure 12.- MT Translate Stow
(13: LAB Stbd Zenith: -175, +17).

1.520 MNVR TO MT TRANSLATE STOW - WS8

(RBT FS/10A/FIN 1)

Page 1 of 3 pages

1. SETUP

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3
13: LAB Stbd Zenith (+160, -35)	37: MBS Mast (-90, +25)	22: Base Elbow (0, 0)

PCS

MSS: SSRMS:

Verify Unloaded Parameters – √
 Verify 'Unloaded Parameters' (two) – LEE Tip, SY Held
 Verify Display – W8>ISSACS
 Verify Command – SSRMS>Internal

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

SR	SY	SP	EP	WP	WY	WR
+181.5	+128.5	-140.0	+40.0	-55.0	+205.0	+180.0
X	Y	Z	Pitch	Yaw	Roll	
+944	-2134	-1373	-130.6	-58.8	+28.7	
FOR	Unloaded - LEE Tip, SY Held					
Disp	W8>ISSACS					

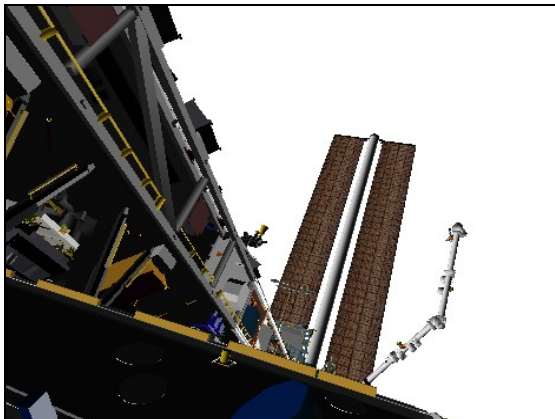


Figure 1.- SAW Viewing
(13: LAB Stbd Zenith: +160, -35).

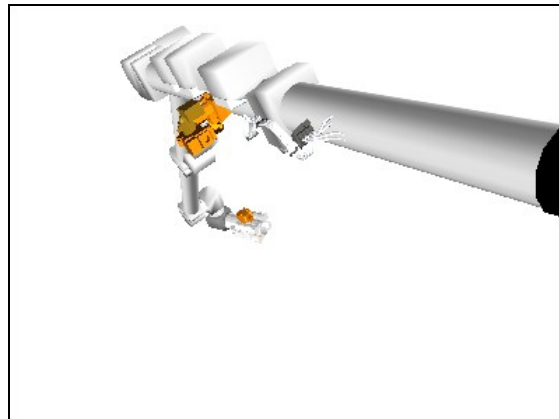


Figure 2.- SAW Viewing
(37: MBS Mast: -90, +25).

2. MANEUVER TO MT TRANSLATE STOW POSITION

PCS

MSS: SSRMS: SSRMS Safing:

cmd Remove (Verify Not Safed)

DCP

BRAKES SSRMS → OFF (Verify OFF)

√Vernier

1.520 MNVR TO MT TRANSLATE STOW - WS8

(RBT FS/10A/FIN 1)

PCS MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

Input 'Joint Angles' 'Destination' for MT Translate Stow position.

SR	SY	SP	EP	WP	WY	WR
+230.0	+85.0	-105.0	+130.0	-57.5	+70.0	+99.9

NOTE
A singularity warning will flash when SY is approximately 94.0 deg.

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)	+181.5	+128.5	-140.0	+40.0	-55.0	+205.0	+180.0
TGT	+230.0	+85.0	-105.0	+130.0	-57.5	+70.0	+99.9
ERR	-48.5	+43.5	-35.0	-90.0	+2.5	+135.0	+80.1

PCS * If joint angles or 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

PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at MT Translate Stow position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+230.0	+85.0	-105.0	+130.0	-57.5	+70.0	+99.9
X	Y	Z	Pitch	Yaw	Roll	
+515	-2364	-780	+161.2	+5.5	+20.8	
FOR	Unloaded - LEE Tip, SY Held					
Disp	W8>ISSACS					

1.520 MNVR TO MT TRANSLATE STOW - WS8

(RBT FS/10A/FIN 1)

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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)

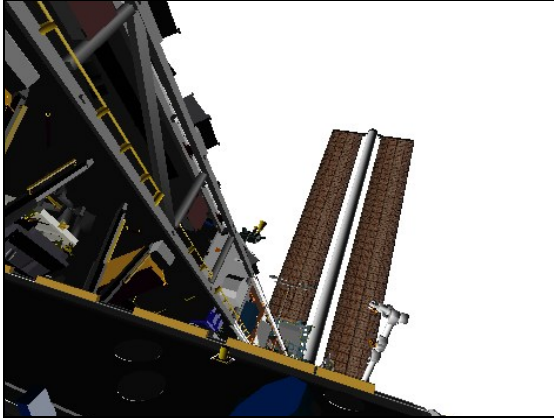


Figure 3.- MT Translate Stow
(13: LAB Stbd Zenith: +160, -35).

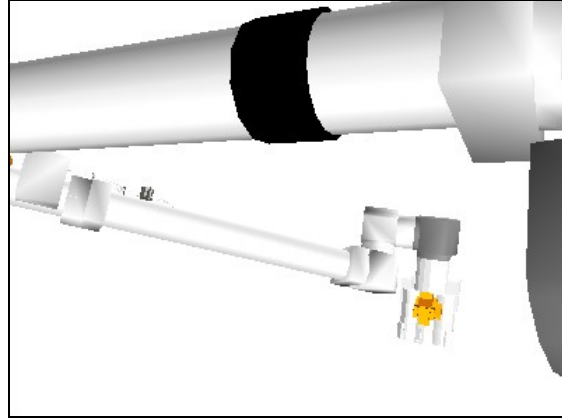


Figure 4.- MT Translate Stow
(37: MBS Mast: -90, +15).

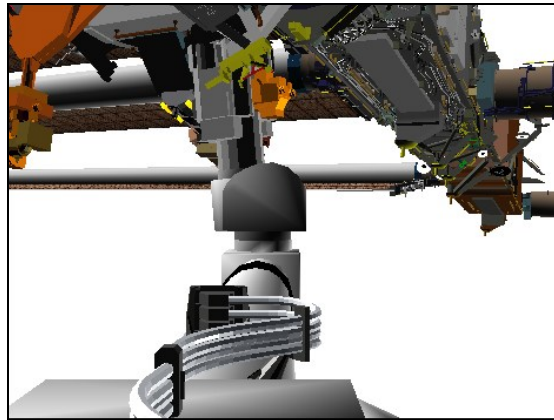


Figure 5.- MT Translate Stow
(22: Base Elbow: 0, 0).

3. MSS CAMERA RECONFIG FOR CONTAMINATION AVOIDANCE

Configure cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3
24: Tip Elbow (0, 0)	37: MBS Mast (-175, -90)	22: Base Elbow (0, 0)

1.530 MT PRE-TRANSLATION SURVEY – WS4 TO WS8

(RBT FS/10A/FIN 1)

Page 1 of 3 pages

Configure the ISS Downlink per the following table:

1 Base Elbow (-20, +30) FL = 9.0 mm
--

Verify SSRMS is at the P6 Handoff position (within 1 deg).

SR	SY	SP	EP	WP	WY	WR
+91.1	+41.6	-63.0	+36.1	-176.5	-124.9	-108.2

NOTE

1. **'PTU not following commands'** error messages may be generated when MSS Cameras are powered.
2. Due to MCCST command latency, the pan/tilt stop command should be issued 6 deg before the destination is reached.

1. SSRMS BASE ELBOW CAMERA SURVEY

MCCST ROBO Camera Commander
'MSS Cameras'

sel SSRMS Base Elb

cmd Activate Position (Verify Activated)

cmd Activate Commanding

Keyboard Commanding Window

Verify Current Camera: SSRMS Base Elb

	Base Elb	Stop at	Survey Notes	Complete
Start Config	(-20, +30) FL = 9 mm	-	MT Translation Path	
1: Pan Left	(-105, +30)	-99	MT Translation Path	
2: Zoom In	FL = 15 mm	-	MT Translation Path	
3: Tilt Down	(-105, +20)	+26	MT Translation Path	
4: Pan Left	(-130, +20)	-124	MT Translation Path	
5: Tilt Down	(-130, +5)	+11	MT Translation Path	
6: Pan Left	(-150, +5)	-144	MT Translation Path	
7: Tilt Down	(-150, 0)	-	MT Translation Path	
8: Zoom In	FL = 35 mm	-	MT Translation Path	

Keyboard Commanding Window

cmd Finished Commanding

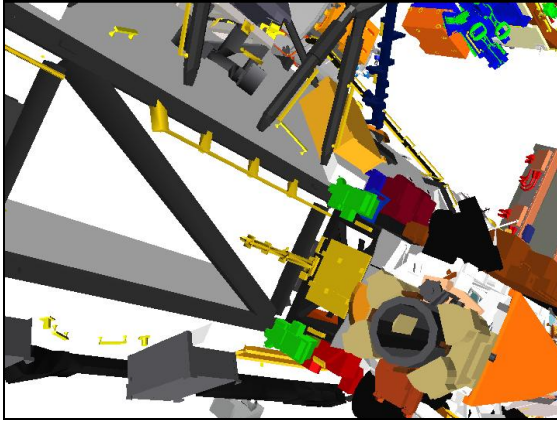


Figure 1.- Base Elbow Start
(Base Elbow: -20, +30).

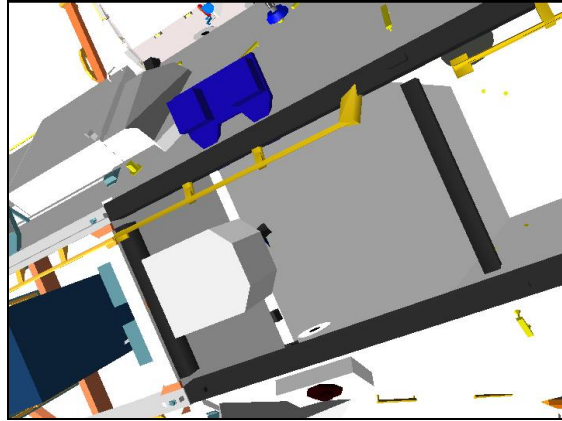


Figure 2.- Base Elbow - Step 1
(Base Elbow: -105, +30).

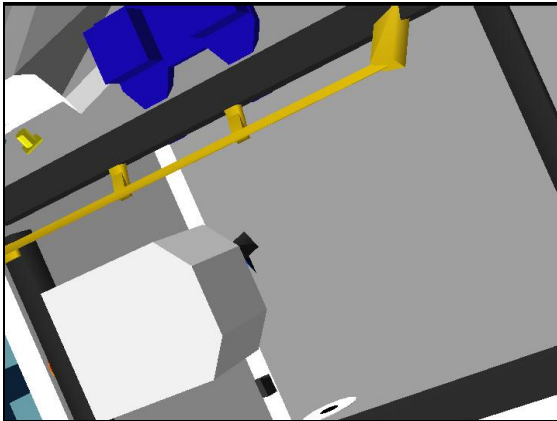


Figure 3.- Base Elbow - Step 2
(Base Elbow: -105, +30; FL = 15 mm).

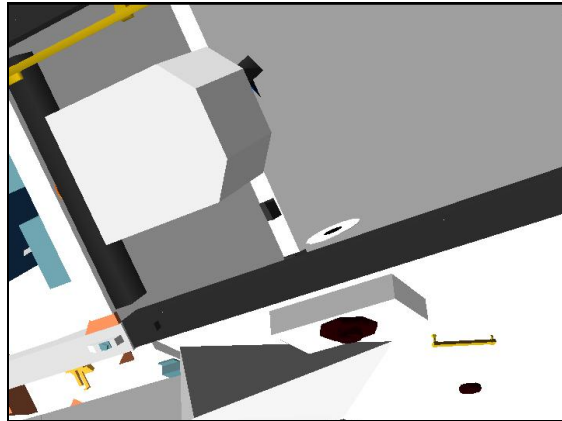


Figure 4.- Base Elbow - Step 3
(Base Elbow: -105, +20).

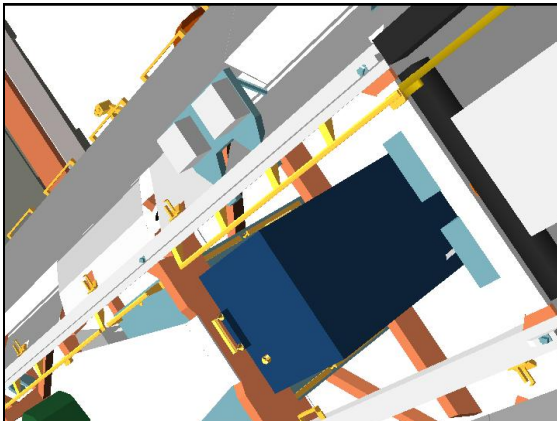


Figure 5.- Base Elbow - Step 4
(Base Elbow: -130, +20).

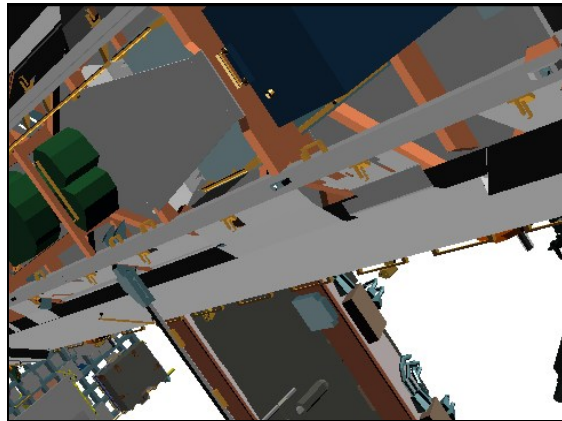


Figure 6.- Base Elbow - Step 5
(Base Elbow: -130, +5).

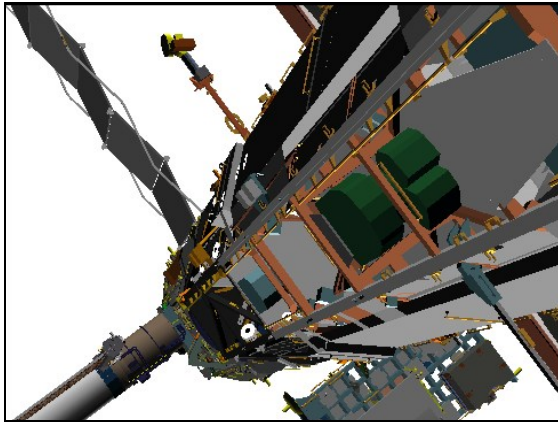


Figure 7.- Base Elbow - Step 6
(Base Elbow: -150, +5).

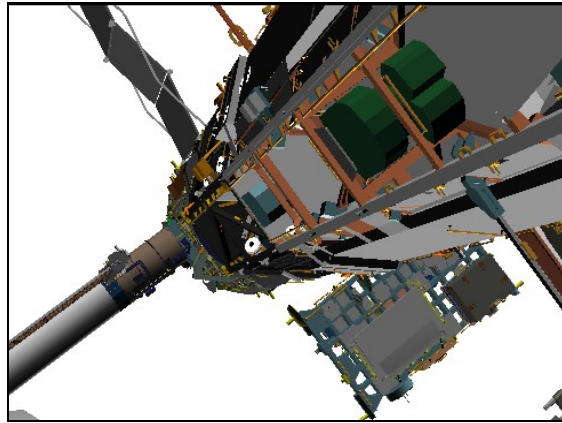


Figure 8.- Base Elbow - Step 7
(Base Elbow: -150, 0).

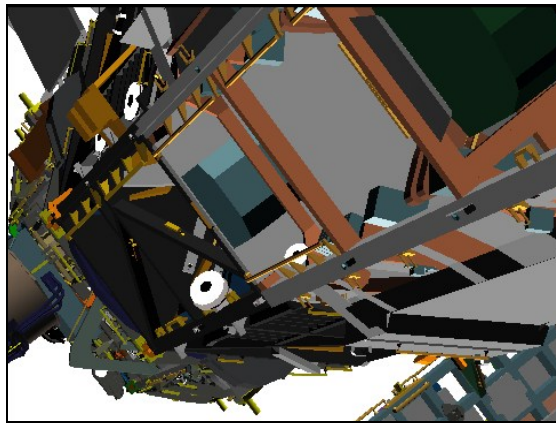


Figure 9.- Base Elbow - Step 8
(Base Elbow: -150, 0; FL = 35 mm).

1.610 WALKOFF TO MBS PDGF 3

(RBT FS/10A/FIN 1)

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1. SETUP

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
09: P1 Lower Outboard (+120, +25)	22: Base Elbow (+70, -20)	92: Camera C (-30, +20)	Camera A (0, +25)

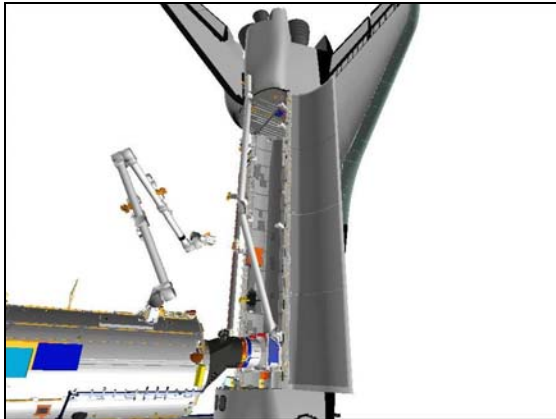


Figure 1.- OBSS Backoff Position (09: P1 Lower Outboard: +120, +25).

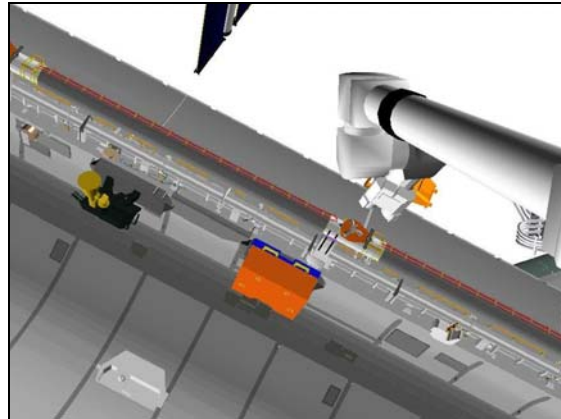


Figure 2.- OBSS Backoff Position (22: Base Elbow: +70, -20).

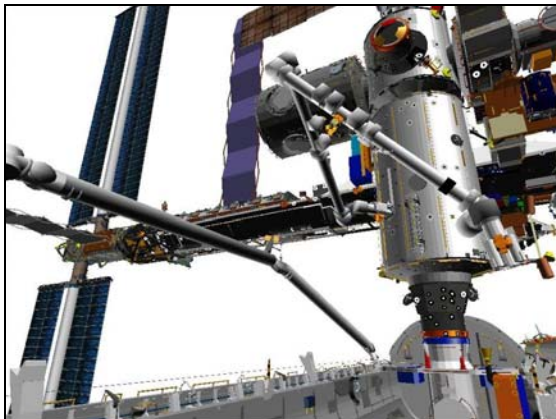


Figure 3.- OBSS Backoff Position (92: Camera C: -30, +20).

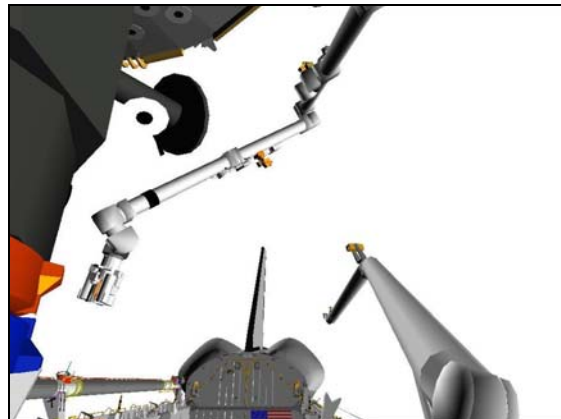


Figure 4.- OBSS Backoff Position (V10: Camera A: 0, +25).

PCS

MSS: SSRMS:

Change Loaded Parameters ► Walk Off ► MBS PDGF 3
Verify 'Loaded Parameters' (two) – MBS PDGF 3, SR Held

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

Change Display ► ISS ► W4MBS PDGF 3 (Verify ISS>W4MBS PDGF 3)

1.610 WALKOFF TO MBS PDGF 3

(RBT FS/10A/FIN 1)

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

SR	SY	SP	EP	WP	WY	WR
+78.0	+40.4	+31.7	+122.2	-179.6	-140.9	+33.6
X	Y	Z	Pitch	Yaw	Roll	
-242	-132	+1364	-175.6	-22.6	+1.3	
FOR	Unloaded – LEE Tip, SR Held					
Disp	ISS> W4MBS PDGF3					

√Vernier

MSS: SSRMS: Rate:

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

2. SINGLE JOINT TO INTERMEDIATE POSITION

On SRMS operator GO for maneuver to MBS PDGF3 Pre-Grapple:

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 Intermediate position (within 1 deg).

	SR	SY	SP	EP	WP	WY	WR
Backoff	+78.0	+40.4	+31.7	+122.2	-179.6	-140.9	+33.6
1: SP -			-30.0				
2: WP +					-76.7		
3: WY +						-119.7	
4: EP -				+20.0			
5: SY -		-40.0					
Intermediate	+78.0	-40.0	-30.0	+20.0	-76.7	-119.7	+33.6
	X	Y	Z	Pitch	Yaw	Roll	
	-1154	+1263	+1210	+163.5	-51.0	+72.4	
FOR	Unloaded – LEE Tip, SR Held						
Disp	ISS> W4MBS PDGF3						

PCS MSS: SSRMS:

Enter Mode – Standby (Verify blue)

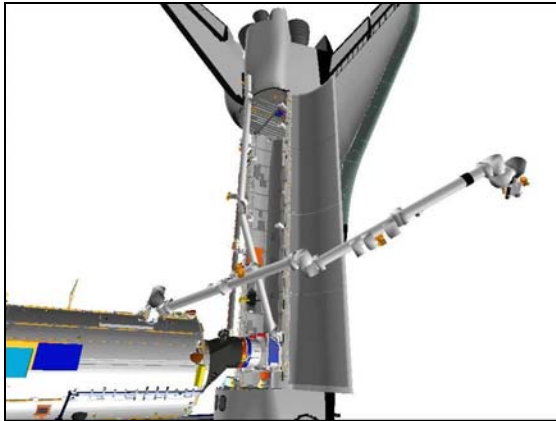


Figure 5.- Intermediate Position
 (09: P1 Lower Outboard: +120, +25).

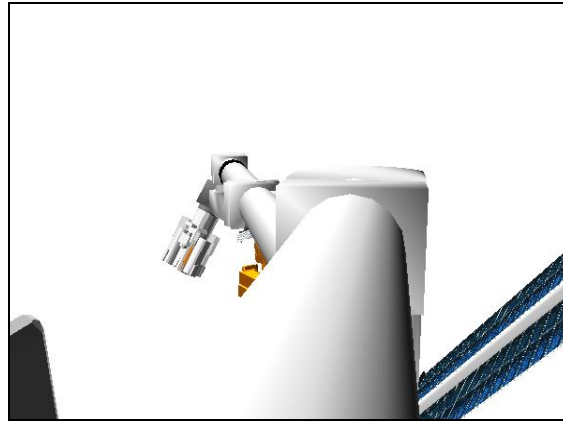


Figure 6.- Intermediate Position
 (22: Base Elbow: +170, 0).

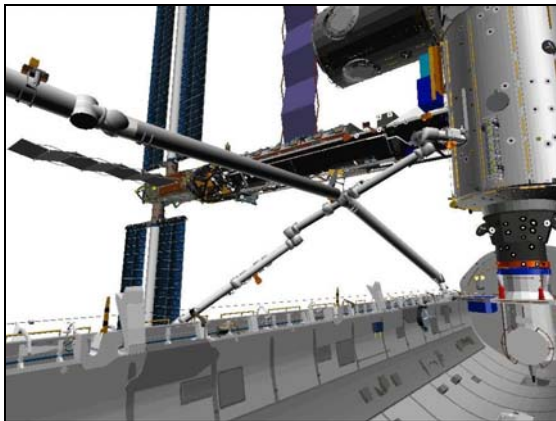


Figure 7.- Intermediate Position
 (92: Camera C: -40, +10).

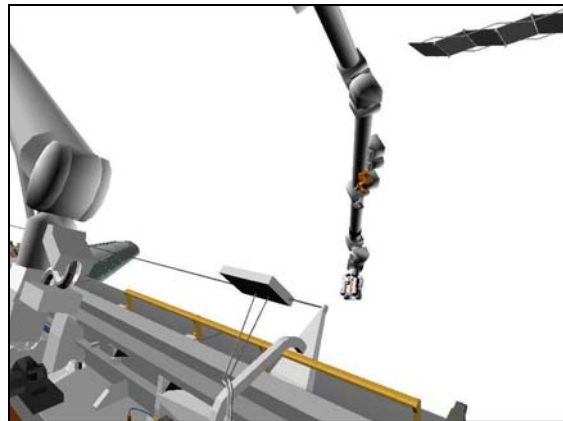


Figure 8.- Intermediate Position
 (V10: Camera A: +50, -5).

3. SINGLE JOINT TO PRE-GRAPPLE

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
09: P1 Lower Outboard (+120, +25)	22: Base Elbow (+170, 0)	37: MBS Mast (+20, +20) 13: LAB Stbd Zenith (-175, -30)	Camera B (-20, +10)

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.

1.610 WALKOFF TO MBS PDGF 3

(RBT FS/10A/FIN 1)

NOTE

During the maneuver in Line 4:

- a. Monitor clearance between the SSRMS Tip boom and the nose of the orbiter with the LAB Stbd Zenith Camera. Minimum clearance is approximately 185 cm (73 in).
- b. Monitor clearance between the Tip LEE and the MBS with the Base Elbow Camera. Minimum clearance is approximately 109 cm (43 in).

THC

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

	SR	SY	SP	EP	WP	WY	WR
Intermediate	+78.0	-40.0	-30.0	+20.0	-76.7	-119.7	+33.6
1: SP -			-68.8				
2: SR +	+98.5						
3: SY -		-154.7					
4: EP +				+99.0			
5: WR +							+86.9
Pre-Grapple	+98.5	-154.7	-68.8	+99.0	-76.7	-119.7	+86.9
	X	Y	Z	Pitch	Yaw	Roll	
	-150	0	0	0.0	0.0	0.0	
FOR	Unloaded – LEE Tip, SR Held						
Disp	ISS> W4MBS PDGF3						

PCS

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

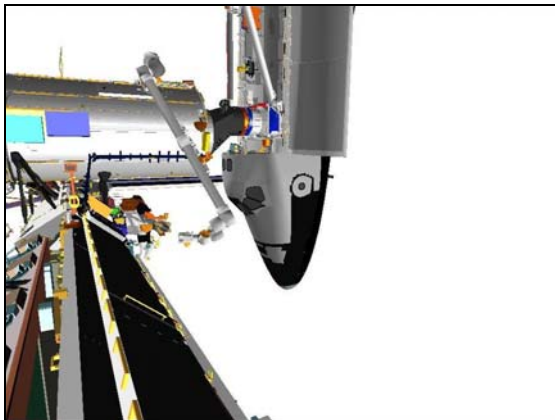


Figure 9.- MBS PDGF3 Pre-Grapple (09: P1 Lower Outboard: +120, -10).



Figure 10.- MBS PDGF3 Pre-Grapple (22: Base Elbow: +100, -10).

1.610 WALKOFF TO MBS PDGF 3

(RBT FS/10A/FIN 1)



Figure 11.- MBS PDGF3 Pre-Grapple
(13: LAB Stbd Zenith: -170, -30).

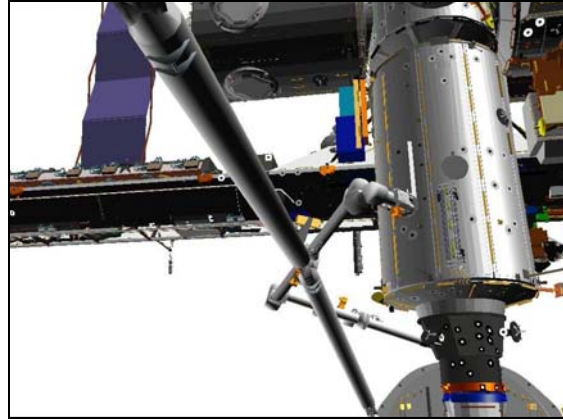


Figure 12.- MBS PDGF3 Pre-Grapple
(V10: Camera B: -10, +20).

4. PDGF3 GRAPPLE SETUP AND CAPTURE

4.1 Setup

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
09: P1 Lower Outboard (+120, -10)	25: Tip LEE	13: LAB Stbd Zenith (-170, -25) 37: MBS Mast (-35, -20)	Camera B (-10,+20)

NOTE

1. Tip LEE Camera must be fully zoomed out for Grapple Target overlay to be correct.
2. Monitor clearance between the Tip LEE and POA, as well as, the MCAS V-Guide with the LAB Stbd Zenith Camera. Minimum clearance is approximately 43 cm (17 in) at grapple.
3. SSRMS Safing may occur and the following messages may be annunciated at the end of latching:
'R30 - SSRMS LEEMM Cmd Termination Msw Consistency Fail'
'R3Q - SSRMS LEE Uncommanded Derigidize'
'R9B - SSRMS LEE Inval LEEMM Cmd'
 Notify **MCC-H** if safing occurs. If the signature is as expected, you may be directed to execute procedure **{8.112 SSRMS CAPTURE ABORT RECOVERY}** (SODF: RBT GEN: CORRECTIVE). (SCR 32041)

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: as desired.

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MSS: SSRMS:

Verify Command – SSRMS>Internal

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

RHC/
THC

- 4.2 Maneuvering to Within Grappling Envelope
Maneuver to within grapple envelope.

PCS

- 4.3 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

- 4.4 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)

1.610 WALKOFF TO MBS PDGF 3

(RBT FS/10A/FIN 1)

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4.5 Mate Umbilicals

√**MCC-H** - PDGF power is confirmed Off.

NOTE

Expect '**R2O - MBS CRPCM 3P(R) Output Voltage 1 Stat Err**' Robotics Advisory message while umbilicals are mated. Message should return to norm.

Expect '**R3L - SSRMS Pwr Flags Fail**' Robotics Advisory message while Tip LEE is mated (SCR 19019).

MSS: SSRMS: Tip LEE:

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

4.6 Derigidize Carriage

MSS: SSRMS: Tip LEE:

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)

4.7 Grapple Cleanup

MSS: SSRMS:

Verify Posn Hold – orange

Verify Loaded Parameters – √

Verify 'Loaded Parameters' (two) – MBS PDGF 3, SR Held

1.610 WALKOFF TO MBS PDGF 3

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Expected SSRMS Grapple position (within 5 cm/1 deg).

Locked						
SR	SY	SP	EP	WP	WY	WR
+98.5	-163.1	-67.7	+103.8	-95.7	-114.6	+72.2
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded – MBS PDGF3, SR Held					
Disp	ISS> W4MBS PDGF3					

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)

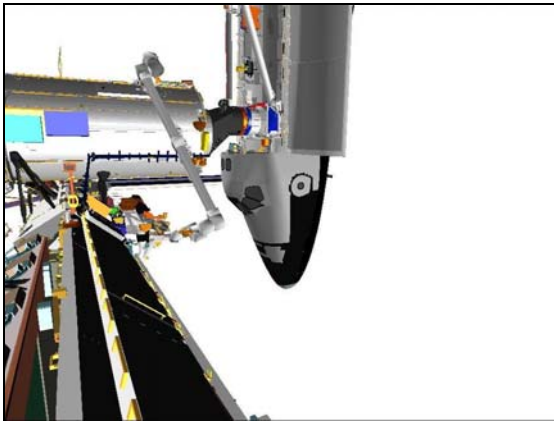


Figure 13.- PDGF 3 Grapple
(09: P1 Lower Outboard: +120, -10).

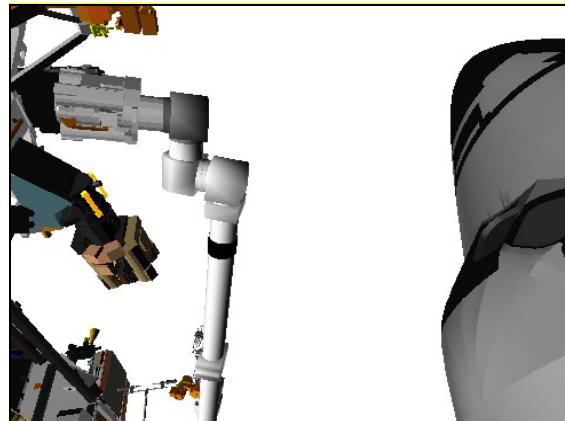


Figure 14.- PDGF 3 Grapple
(13: LAB Stbd Zenith: -170, -25).

NOTE

Steps 5 to 9 may be performed by ground.

5. SSRMS REDUNDANT (PRIME) STRING POWERDOWN TO OFF

NOTE

1. Expect the following messages when Off is commanded:

'R1E - MSS OCS SSRMS Redun(Prime) ACU SRT Comm Fail' (SCR 17730)

'R1E - LAB(CUP) RWS CEU PLB ACU Cmd Resp Sync Msg Err' (SCR 31294)

These messages should return to Norm.

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

1.610 WALKOFF TO MBS PDGF 3

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PCS MSS: SSRMS: Power:

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

6. OPERATING BASE CHANGE

MSS: SSRMS:

MSS: SSRMS: Base LEE:

cmd B

MSS: SSRMS:

Verify Base LEE – B

Verify PDGF – MBS3

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

NOTE

It might take up to 30 seconds for the Keep-Alive status indication to appear on PCS.

MSS: SSRMS: Power:

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

8. POWERUP REDUNDANT(PRIME) 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.

MSS: SSRMS: Power:

cmd 'SSRMS' Redundant (Prime) – Operational

Verify 'Systems State' – Operational

9. VIDEO COMPONENTS POWERUP

MSS: SSRMS: Base LEE VDU icon:

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)

1.610 WALKOFF TO MBS PDGF 3

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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

As required, power up the SSRMS lights.

1.611 LAB PDGF UNGRAPPLE

(RBT FS/10A/FIN 1)

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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 FOR LAB PDGF UNGRAPPLE

Verify SRMS at Pre-Cradle position.

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
09: P1 Lower Outboard (+90, 0)	25: Tip LEE	MUX 24/22: [24: Tip Elbow (+5, 0), 22: Base Elbow (+5, 0)]	SRMS Elbow (+160, +20) Camera C (0,+20)

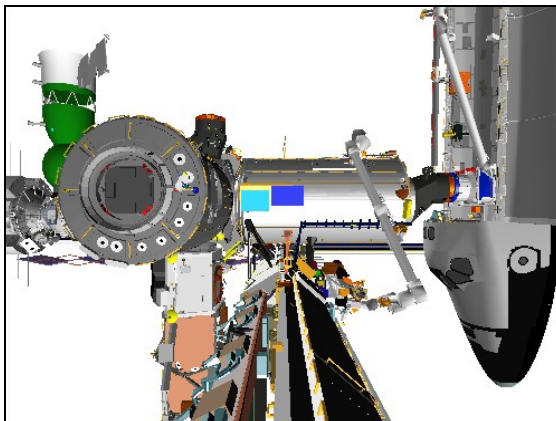


Figure 1.- LAB PDGF Grapple
(09: P1 Lower Outboard: +90, 0)

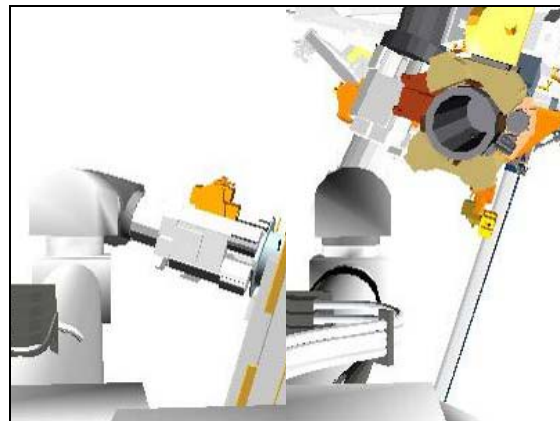


Figure 2.- LAB PDGF Grapple
[MUX 24: Tip Elbow (+5, 0), 22: Base Elbow (+5, 0)]

1.611 LAB PDGF UNGRAPPLE

(RBT FS/10A/FIN 1)

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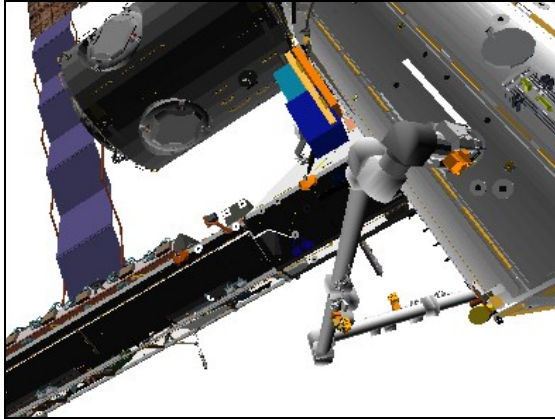


Figure 3.- LAB PDGF Grapple
(V10: SRMS Elbow:+160, +20).

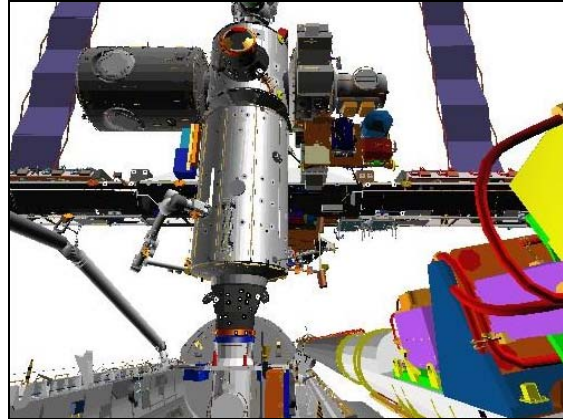


Figure 4.- LAB PDGF Grapple
(V10: Camera C: 0, +20).

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

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

SR	SY	SP	EP	WP	WY	WR
+72.2	+114.6	-95.7	+103.8	-67.7	+163.1	+98.5
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)

PCS MSS: SSRMS:

√Vernier

MSS: SSRMS: Rate:

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

1.611 LAB PDGF UNGRAPPLE

(RBT FS/10A/FIN 1)

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3. LAB PDGF RELEASE (PUSHOFF)

3.1 SSRMS Limp

MSS: SSRMS: Limp:

cmd All Limp (Verify Limp – blue)

MSS: SSRMS:

Verify all joints – Limped

3.2 Carriage Rigidization

MSS: SSRMS: Tip LEE:

cmd 'Carriage' Rigidize ► 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 – Rigidize

RHC TRIGGER → press (momentarily) (SCR 19064)

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

3.3 LAB PDGF Release

MSS: SSRMS: Tip LEE:

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

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

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Auto Release

RHC TRIGGER → press (momentarily)

1.611 LAB PDGF UNGRAPPLE

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- PCS
- Verify 'Umbilical' Demate – blue (10 s max)
 - Verify 'Latch' Unlatch – blue (65 s max)
 - Verify 'Carriage' Derigidize – blue (90 s max)
 - Verify 'Snare' Open – blue (12 s max)
 - Verify 'Carriage' Extend – blue (90 s max)

Verify Unloaded Parameters – ✓

3.4 Backoff From LAB PDGF

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

	Locked					
SR	SY	SP	EP	WP	WY	WR
+64.9	+114.6	-97.7	+88.6	-57.5	+165.8	+99.9
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)

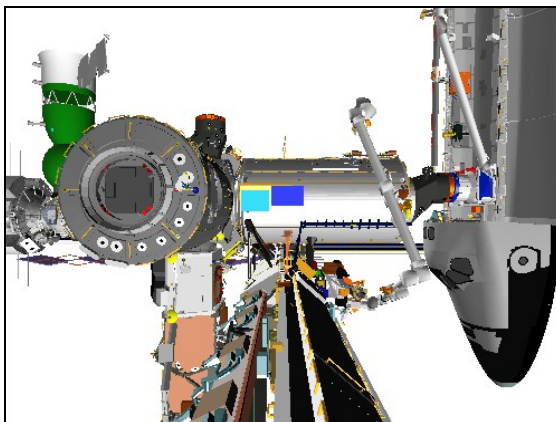


Figure 5.- LAB PDGF Backoff (09: P1 Lower Outboard: +90, 0).

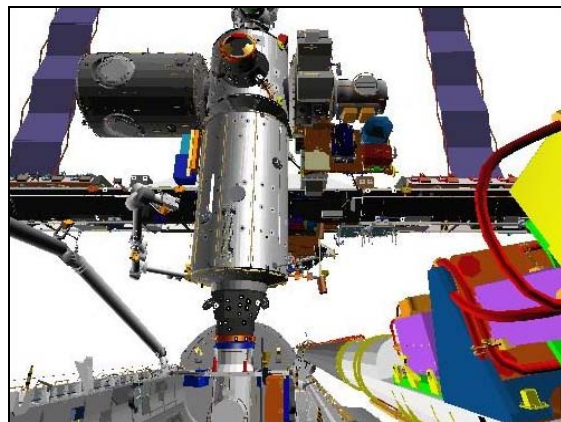


Figure 6.- LAB PDGF Backoff (V10: Camera C: 0, +20).

1.611 LAB PDGF UNGRAPPLE

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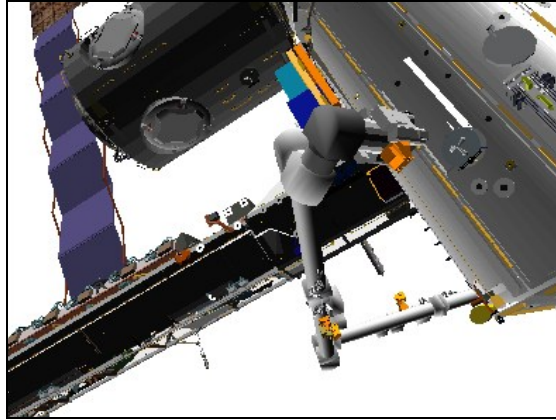


Figure 7.- LAB PDGF Backoff
(V10: SRMS Elbow: +160, +20).

2.110 MANEUVER TO SURVEY SUPPORT VIEWING (FI)

(RBT FS/10A/FIN 1)

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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

Verify SRMS at Node 2 Viewing Position.

Verify Orbiter Starboard Radiator is not deployed.

NOTE

- The P1 Lower Outboard Camera views may be partially obstructed due to Port TRRJ rotation.
- The Cross Cluster warning will annunciate while $EP \geq +142.0$ deg.

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
09: P1 Lower Outboard (+110, +20)	24: Tip Elbow (0,0)	91: Camera C (-25, +20)	OBSS ITVC (+105, -60) Camera B (0, +30)



Figure 1.- Node Clearance Position
(09: P1 Lower Outboard: +110, +20).

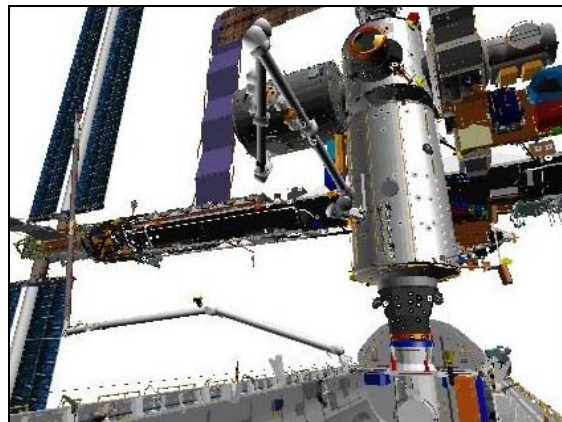


Figure 2.- Node Clearance Position
(91: Camera C: -25, +20).

2.110 MANEUVER TO SURVEY SUPPORT VIEWING (FI)

(RBT FS/10A/FIN 1)

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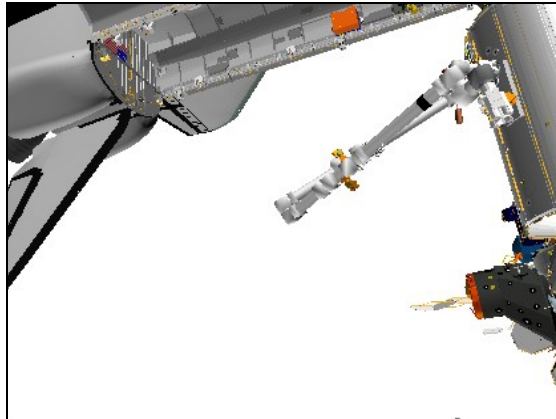


Figure 3.- Node Clearance Position
(OBSS ITVC: +105, -60).

PCS

MSS: SSRMS:

Verify Unloaded Parameters – √

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

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

Verify Command – SSRMS>Internal

√Vernier

Verify SSRMS at Node 2 Clearance position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-88.1	-25.2	-27.9	+144.4	-109.3	-70.3	-45.6
X	Y	Z	Pitch	Yaw	Roll	
-47	-600	+735	+172.9	0.0	+180.0	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>ISSACS					

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: 1.0.

MSS: SSRMS: SSRMS Safing:

cmd Remove (Verify Not Safed)

DCP

BRAKES SSRMS → OFF (Verify OFF)

2.110 MANEUVER TO SURVEY SUPPORT VIEWING (FI)

(RBT FS/10A/FIN 1)

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3. SINGLE JOINT TO INTERMEDIATE 1 POSITION

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 1 position (within 1 deg).

	SR	SY	SP	EP	WP	WY	WR	
Clearance	-88.1	-25.2	-27.9	+144.4	-109.3	-70.3	-45.6	
1: SR +	-75.0							
2: SP -			-70.0					
3: EP -				+17.0				
Intermediate 1	-75.0	-25.2	-70.0	+17.0	-109.3	-70.3	-45.6	
	X	Y	Z	Pitch	Yaw	Roll		
	-528	+439	+1881	+140.1	+20.7	-10.8		
	FOR	Unloaded – LEE Tip, SY Held						
	Disp	ISS>ISSACS						

PCS

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

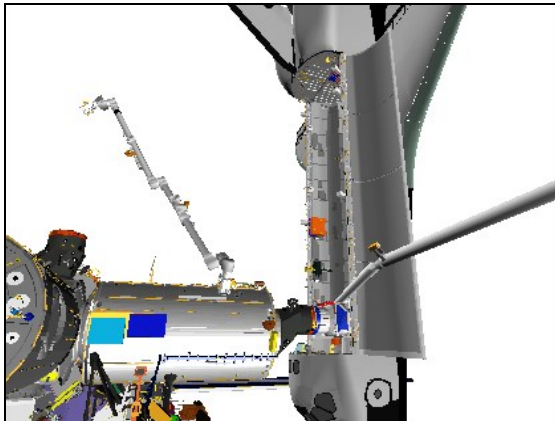


Figure 4.- Intermediate 1 Position
(09: P1 Lower Outboard: +110, +20).

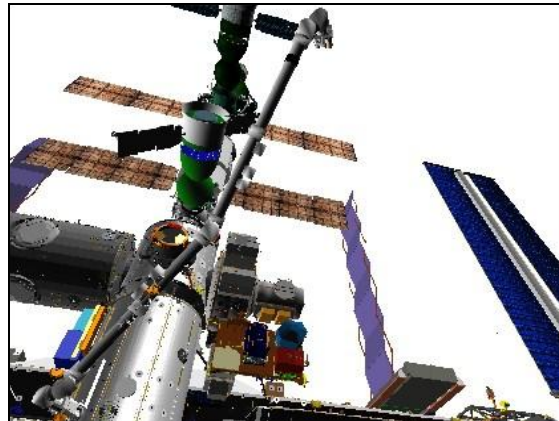


Figure 5.- Intermediate 1 Position
(91: Camera C: +15, +50).

2.110 MANEUVER TO SURVEY SUPPORT VIEWING (FI)

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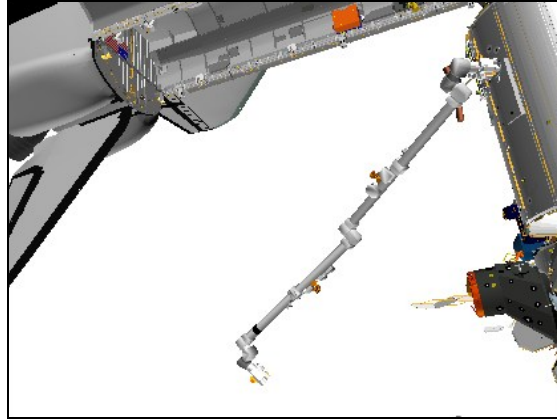


Figure 6.- Intermediate 1 Position
(OBSS ITVC: +105, -60).

4. SINGLE JOINT TO SURVEY SUPPORT VIEWING

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
03: S1 Lower Outboard (+70, +30)	24: Tip Elbow (0, 0) 22: Base Elbow (+160, 0)	13: LAB Stbd Zenith (+25, -30)	Camera D (-30, +30) Camera C (+10, +50)

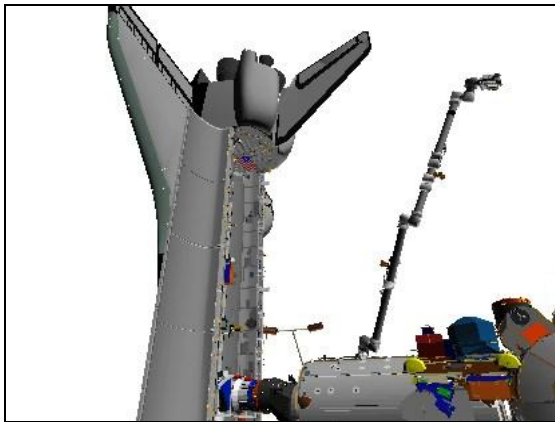


Figure 7.- Intermediate 1 Position
(03: S1 Lower Outboard: +70, +30).

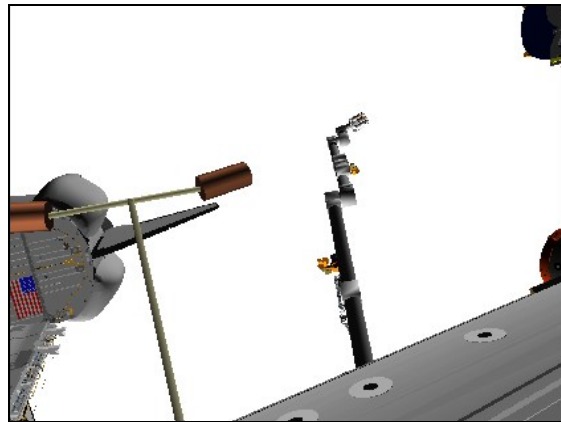


Figure 8.- Intermediate 1 Position
(13: LAB Stbd Zenith: +25, -30).

2.110 MANEUVER TO SURVEY SUPPORT VIEWING (FI)

(RBT FS/10A/FIN 1)

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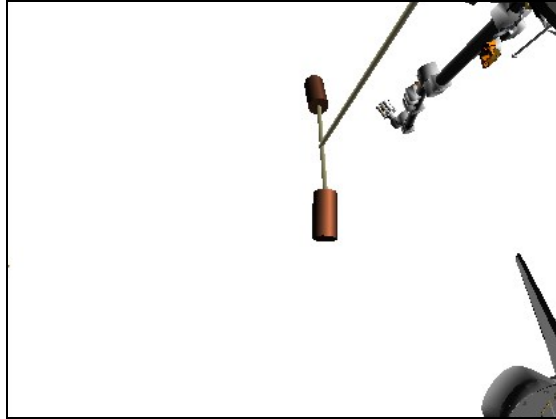


Figure 9.- Intermediate 1 Position
(V10: Camera D: -30, +30).

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

During the maneuver in Line 5:

- a. Monitor clearance between the SSRMS Base boom and the UHF antenna with the Base Elbow Camera. Minimum clearance is approximately 91 cm (36 in).
- b. Monitor clearance between the SSRMS Base boom and the orbiter starboard sill with Camera D. Minimum clearance is approximately 144 cm (57 in).
- c. Monitor clearance between the Tip Elbow Camera and the Payload Bay Door with the LAB Stbd Zenith Camera or Camera D. Minimum clearance is approximately 81 cm (32 in).

2.110 MANEUVER TO SURVEY SUPPORT VIEWING (FI)

(RBT FS/10A/FIN 1)

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THC Perform Single Joint maneuver to Survey Support Viewing position (within 1 deg).

	SR	SY	SP	EP	WP	WY	WR	
Intermediate 1	-75.0	-25.2	-70.0	+17.0	-109.3	-70.3	-45.6	
1: WY -						-130.0		
2: WP +					-2.4			
3: SY +		+139.9						
4: SR -	-103.8							
5: SP +			-56.7					
6: WR +							+79.6	
Survey Support	-103.8	+139.9	-56.7	+17.0	-2.4	-130.0	+79.6	
	X	Y	Z	Pitch	Yaw	Roll		
	+1364	+724	+841	-66.2	-65.3	+25.7		
	FOR	Unloaded – LEE Tip, SY Held						
	Disp	ISS>ISSACS						

DCP BRAKES SSRMS → ON (Verify ON)

Notify SRMS operator, "SSRMS is at survey support viewing position, GO for focused inspection operations."

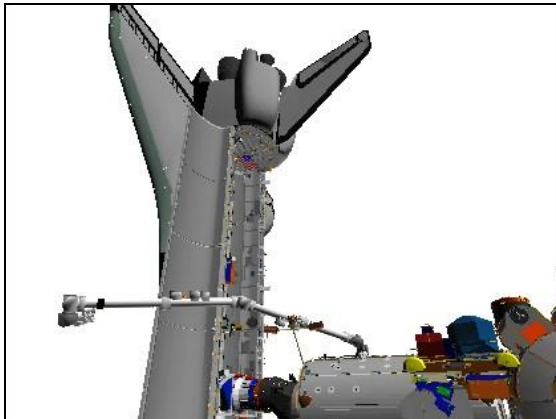


Figure 10.- Survey Support Viewing (03: S1 Lower Outboard: +70, +30).

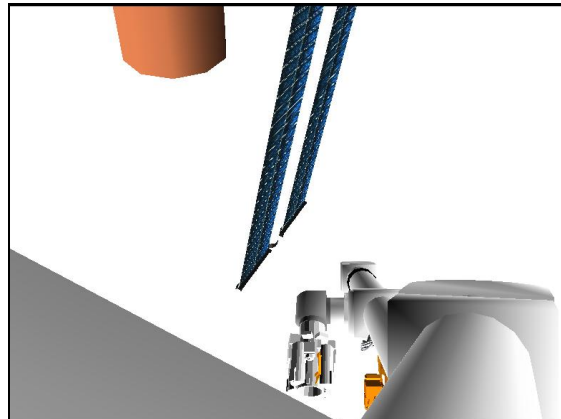


Figure 11.- Survey Support Viewing (22: Base Elbow: +160, 0).

2.110 MANEUVER TO SURVEY SUPPORT VIEWING (FI)

(RBT FS/10A/FIN 1)

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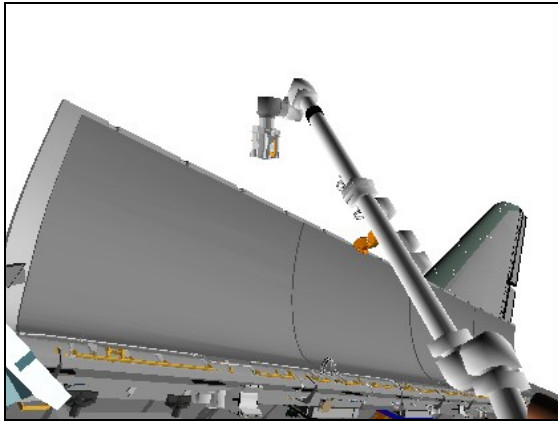


Figure 12.- Survey Support Viewing
(13: LAB Stbd Zenith: -50, 0).

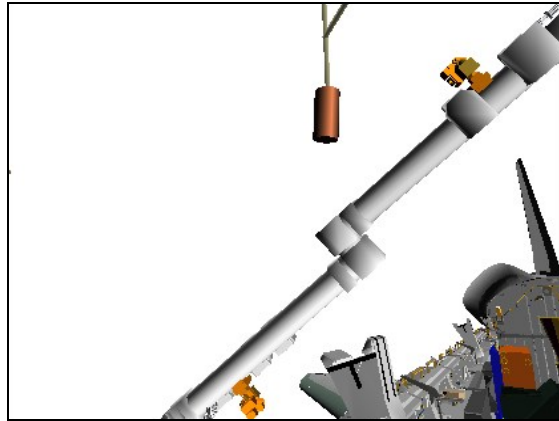


Figure 13.- Survey Support Viewing
(Camera D: -30, +15).

5. SURVEY SUPPORT VIEWING

The survey support position provides mid area of orbiter viewing



Figure 14.- Orbiter Mid Viewing Position
(25: Tip LEE).

5.1 Viewing Areas of Orbiter with Tip LEE Camera (Optional)

NOTE

To view other areas of the orbiter with the Tip LEE Camera, the WP and WY joints can be reconfigured in single joint mode.

- a. Orbiter Forward: Negative WP, Negative WY
- b. Orbiter Aft: Postive WP, Negative WY

DCP

BRAKES SSRMS → OFF (Verify OFF)

PCS

MSS: SSRMS:

Enter Mode – Single (Verify blue)

2.110 MANEUVER TO SURVEY SUPPORT VIEWING (FI)

(RBT FS/10A/FIN 1)

Page 8 of 10 pages

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 viewing the aft area of orbiter

THC

Perform Single Joint maneuver to Orbiter Aft Viewing position.

Survey
Support
1: WP +
2: WY -
Orbiter Aft

SR	SY	SP	EP	WP	WY	WR
-103.8	+139.9	-56.7	+17.0	-2.4	-130.0	+79.6
				+70.0		
					-135.0	
-103.8	+139.9	-56.7	+17.0	+70.0	-135.0	+79.6
X	Y	Z	Pitch	Yaw	Roll	
+1318	+769	+967	-76.0	-18.5	-38.2	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>ISSACS					

DCP

BRAKES SSRMS → ON (Verify ON)

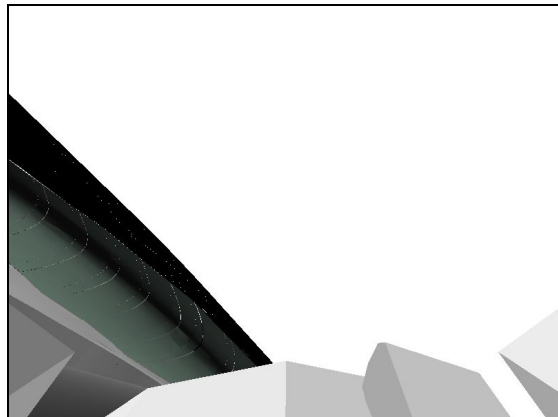


Figure 15.- Orbiter Aft Viewing Position
(25: Tip LEE).

2.110 MANEUVER TO SURVEY SUPPORT VIEWING (FI)

(RBT FS/10A/FIN 1)

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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.

If viewing fwd area of orbiter

THC

Perform Single Joint maneuver to Orbiter Fwd Viewing position.

Survey Support
1: WP -
2: WY -
Orbiter Fwd

SR	SY	SP	EP	WP	WY	WR
-103.8	+139.9	-56.7	+17.0	-2.4	-130.0	+79.6
				-50.0		
					-160.0	
-103.8	+139.9	-56.7	+17.0	-50.0	-160.0	+79.6
X	Y	Z	Pitch	Yaw	Roll	
+1371	+772	+747	+86.2	-65.2	-155.2	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>ISSACS					

DCP

BRAKES SSRMS → ON (Verify ON)

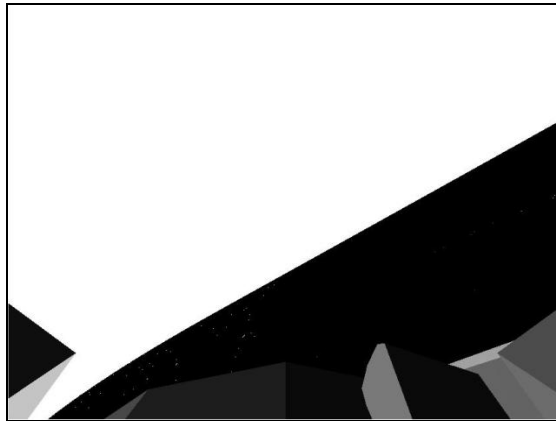


Figure 16.- Orbiter Fwd Viewing Position
(25: Tip LEE).

5.2 Returning to Survey Support Viewing Position

On SRMS operator GO for maneuver to OBSS Handoff
Pre-Grapple position, Focused Inspection complete:

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.

2.110 MANEUVER TO SURVEY SUPPORT VIEWING (FI)

(RBT FS/10A/FIN 1)

If WP not -2.4
 DCP | JOINT SELECT → WRIST PITCH (Verify WP – Selected on PCS)
 THC | Perform Single Joint maneuver to WP: -2.4

If WY not -130.0
 DCP | JOINT SELECT → WRIST YAW (Verify WY – Selected on PCS)
 THC | Perform Single Joint maneuver to WY: -130.0

Verify SSRMS at Survey Support Viewing position
 (within 5 cm/1 deg)

SR	SY	SP	EP	WP	WY	WR
-103.8	+139.9	-56.7	+17.0	-2.4	-130.0	+79.6
X	Y	Z	Pitch	Yaw	Roll	
+1364	+724	+841	-66.2	-65.3	+25.7	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>ISSACS					

DCP BRAKES SSRMS → ON (Verify ON)

2.120 MANEUVER TO OBSS HANDOFF PRE-GRAPPLE (FI)

(RBT FS/10A/FIN 1)

Page 1 of 4 pages

1. SETUP

Verify SRMS is at Node 2 Viewing position.

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
03: S1 Lower Outboard (+70, +30)	24: Tip Elbow (+15, +10)	22: Base Elbow (+160, 0)	Camera C (+10, +15) OBSS ITVC (+105, -55)

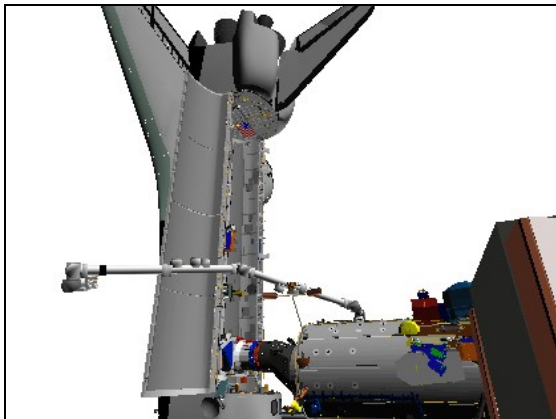


Figure 1.- Survey Support Viewing (03: S1 Lower Outboard: +70, +30).

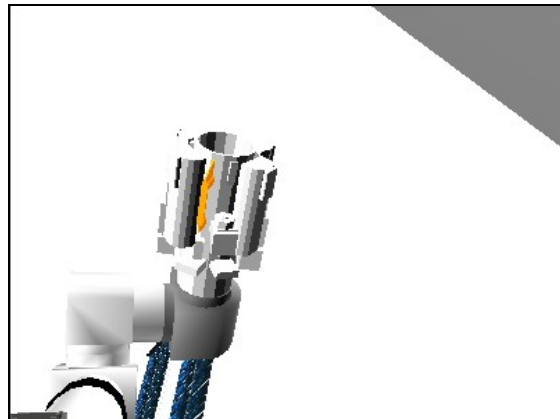


Figure 2.- Survey Support Viewing (24: Tip Elbow: +20, +20).

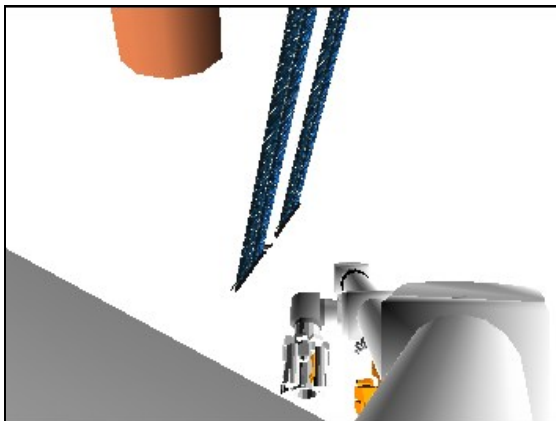


Figure 3.- Survey Support Viewing (22: Base Elbow: +160, 0).

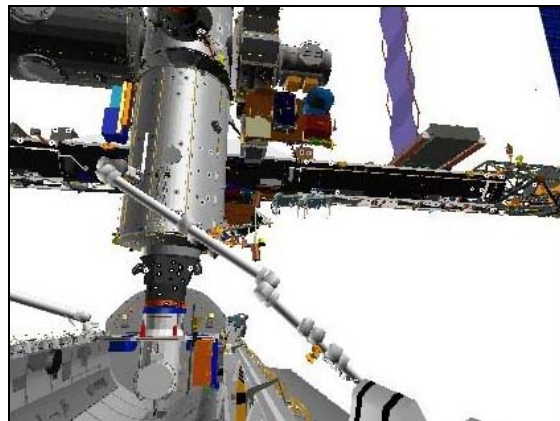


Figure 4.- Survey Support Viewing (V10: Camera C: +10, +15).

PCS

MSS: SSRMS:

Verify Unloaded Parameters – √

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

Verify Display – ISS>ISSACS

Verify Command – SSRMS>Internal

2.120 MANEUVER TO OBSS HANDOFF PRE-GRAPPLE (FI)

(RBT FS/10A/FIN 1)

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√Vernier

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

SR	SY	SP	EP	WP	WY	WR
-103.8	+139.9	-56.7	+17.0	-2.4	-130.0	+79.6
X	Y	Z	Pitch	Yaw	Roll	
+1364	+724	+841	-66.2	-65.3	+25.7	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>ISSACS					

DCP BRAKES SSRMS → OFF (Verify OFF)

2. SINGLE JOINT TO INTERMEDIATE 1 POSITION

NOTE	
Monitor clearance between the SSRMS Base boom and the UHF antenna with the Base Elbow Camera and the S1 Lower Outboard Camera. Minimum clearance is 91 cm (36 in.).	

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 1 position (within 1 deg).

	SR	SY	SP	EP	WP	WY	WR
Survey Support	-103.8	+139.9	-56.7	+17.0	-2.4	-130.0	+79.6
1: WP -					-152.2		
2: WY -						-156.2	
3: SR +	-50.0						
4: SY -		+46.6					
Intermediate 1	-50.0	+46.6	-56.7	+17.0	-152.2	-156.2	+79.6
	X	Y	Z	Pitch	Yaw	Roll	
	+38	+284	+2281	-80.3	-14.4	-138.9	
	FOR	Unloaded – LEE Tip, SY Held					
	Disp	ISS>ISSACS					

PCS MSS: SSRMS:

Enter Mode – Standby (Verify blue)

2.120 MANEUVER TO OBSS HANDOFF PRE-GRAPPLE (FI)

(RBT FS/10A/FIN 1)

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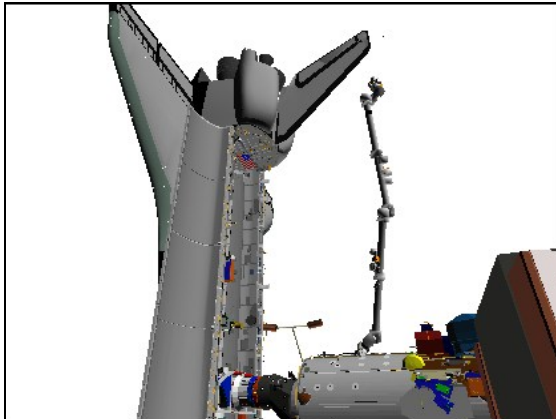


Figure 5.- Intermediate 1 Position
(03: S1 Lower Outboard: +70, +30).



Figure 6.- Intermediate 1 Position
(24: Tip Elbow: +15, +10).

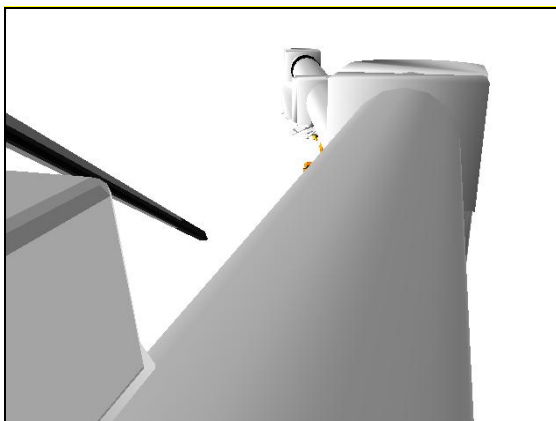


Figure 7.- Intermediate 1 Position
(22: Base Elbow: +165, -20).

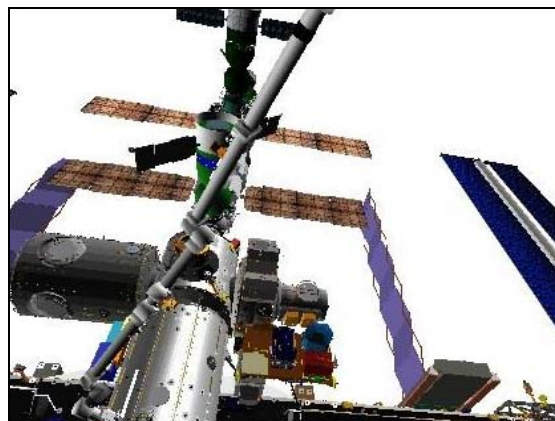


Figure 8.- Intermediate 1 Position
(V10: Camera C: +10, +50).

3. SINGLE JOINT TO OBSS PRE-GRAPPLE POSITION

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
09: P1 Lower Outboard (+75, +30)	24: Tip Elbow (+15, +10)	22: Base Elbow (+165, -20)	Camera C (+10, +50)

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.

2.120 MANEUVER TO OBSS HANDOFF PRE-GRAPPLE (FI)

(RBT FS/10A/FIN 1)

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NOTE

In line 2, near the end of the maneuver, the clearance between the SSRMS Elbow pitch and Node 2 is approximately 210cm (83 in) This clearance can be monitored with the P1 Lower Outboard Camera.

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

	SR	SY	SP	EP	WP	WY	WR	
Intermediate 1	-50.0	+46.6	-56.7	+17.0	-152.2	-156.2	+79.6	
1: EP +				+37.0				
2: SR +	+31.7							
3: EP +				+127.9				
4: SP +			-55.3					
5: WR -							-82.0	
Pre-Grapple	+31.7	+46.6	-55.3	+127.9	-152.2	-156.2	-82.0	
	X	Y	Z	Pitch	Yaw	Roll		
	+311	-311	+1491	-13.0	-0.1	+89.8		
	FOR	Unloaded – LEE Tip, SY Held						
	Disp	ISS>ISSACS						

DCP BRAKES SSRMS → ON (Verify ON)

Give SRMS operator GO for maneuver to OBSS Handoff position.

PCS MSS: SSRMS:

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)

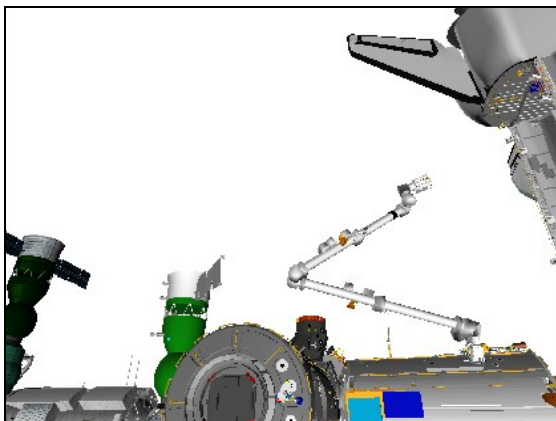


Figure 9.- OBSS Pre-Grapple Position
(09: P1 Lower Outboard: +75, +30).

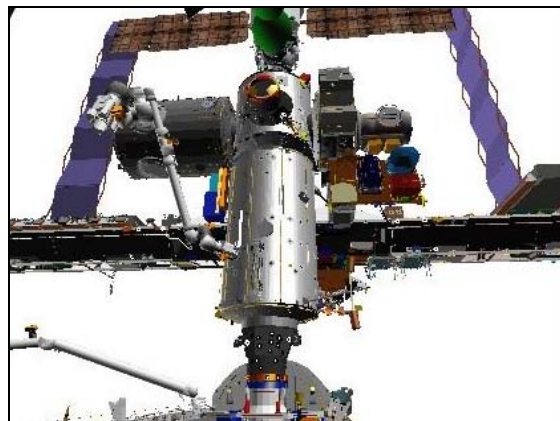


Figure 10.- OBSS Pre-Grapple Position
(91: Camera C: -5, +25).

2.666 CBM LATCH STALL RECOVERY

(RBT FS/10A/BAS)

Page 1 of 1 page

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 s

PCS

MSS: SSRMS:

Verify Posn Hold – orange

Enter Mode – Standby (Verify blue)

MSS: SSRMS: Limp:

cmd All Limp (Verify Limp – blue)

MSS: SSRMS:

Verify all joints – Limped

Give CBM operator GO to reattempt CBM Second Stage Capture.

3.111 PMA2 RELOCATE TO NODE2

(RBT FS/10A/FIN 1)

Page 1 of 17 pages

1. HAND CONTROLLER CALIBRATION

- THC 1.1 Translational Hand Controller (THC) Calibration
- Deflect [X] Axis to positive hard stop where [X] =
- Deflect [X] Axis to negative hard stop.
- Repeat
- RHC 1.2 Rotational Hand Controller (RHC) Calibration
- Deflect [X] Axis to positive hard stop where [X] =
- Deflect [X] Axis to negative hard stop.
- Repeat

2. SETUP

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3
09: P1 Lower Outboard (+95, +15)	37: MBS Mast (+65, +25)	24: Tip Elbow (+5, 0)

Verify CBCS setup complete.

PCS MSS: SSRMS:

Verify 'Loaded Parameters' (two) – PMA2 Demate, SY Held
 Verify Display – LAB>PMA2 Demate
 Verify Command – ISS>ISSACS

MSS: SSRMS: Rate:

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

MSS: SSRMS:

Verify SSRMS at PMA2 Grapple on LAB FWD position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+38.0	+9.7	+26.7	+148.0	-16.0	-10.2	+128.6
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded – PMA2 Demate, SY Held					
Disp	LAB>PMA2 Demate					

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

3.111 PMA2 RELOCATE TO NODE2

(RBT FS/10A/FIN 1)

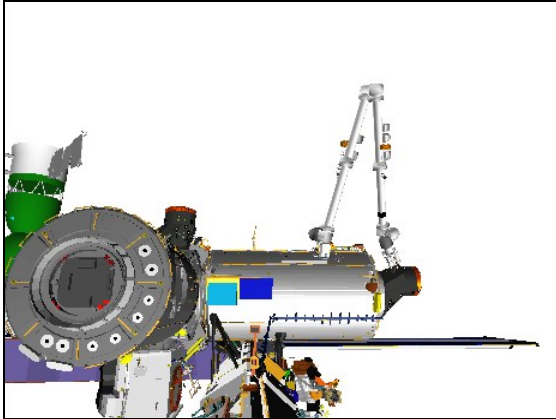


Figure 1.- PMA2 Grapple on LAB FWD
(09: P1 Lower Outboard: +95, +15).

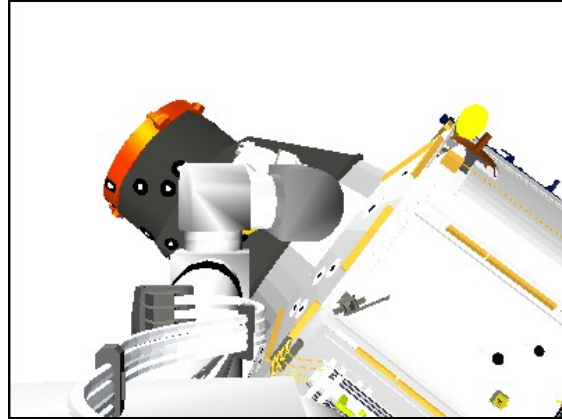


Figure 2.- PMA2 Grapple on LAB FWD
(24: Tip Elbow: +5, 0).

3. DEMATE PMA2 FROM LAB FWD

On CBM operator GO for PMA2 demate:

Verify {1.533 CBM PMA2 RELOCATE: LAB FWD TO NODE 2 FWD},
step 1 (SODF: S&M: NOMINAL: CBM), complete.

MSS: SSRMS: SSRMS Safing:

cmd Remove (Verify Not Safed)

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)

THC/
RHC Maneuver to PMA2 Demate position (within 5 cm/1 deg) (THC in)

	Locked					
SR	SY	SP	EP	WP	WY	WR
+23.3	+9.7	+31.0	+131.4	-7.9	-4.5	+115.2
X	Y	Z	Pitch	Yaw	Roll	
+175	0	0	0.0	0.0	0.0	
FOR	Loaded – PMA2 Demate, SY Held					
Disp	LAB>PMA2 Demate					

3.111 PMA2 RELOCATE TO NODE2

(RBT FS/10A/FIN 1)

PCS

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

Notify CBM operator, “Clear of structure, GO to transition modes.”

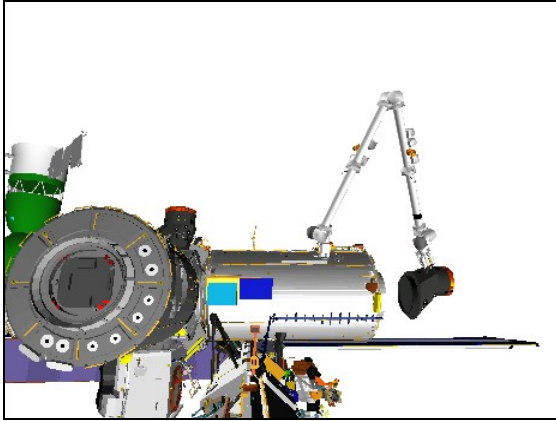


Figure 3.- PMA2 Demate
(09: P1 Lower Outboard: +95, +15).



Figure 4.- PMA2 Demate
(37: MBS Mast: +65, +25).

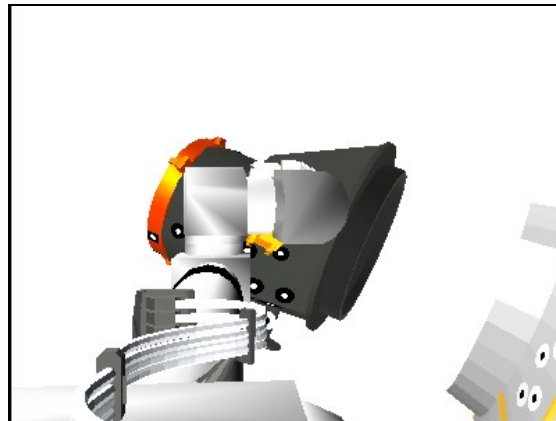


Figure 5.- PMA2 Demate
(24: Tip Elbow: +5, 0).

4. MANEUVER TO PMA2 PRE-INSTALL

4.1 FOR OCAS To Intermediate Position

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3
09: P1 Lower Outboard (+95, +15)	37: MBS Mast (+45, +25)	24: Tip Elbow (+5, 0)

NOTE

The FOR OCAS includes a negative roll of the PMA by 10 degrees to help improve wrist cluster clearances.

3.111 PMA2 RELOCATE TO NODE2

(RBT FS/10A/FIN 1)

Page 4 of 17 pages

MSS: SSRMS:

Enter Mode – FOR OCAS (Verify blue)

MSS: SSRMS: SSRMS FOR OCAS: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

pick File ► LAB ► PMA2 Install Mnvr 1

Verify 'FOR' 'Destination' for Intermediate position.

X	Y	Z	Pitch	Yaw	Roll
+175	-700	0	0.0	0.0	-10.0

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	+175	0	0	0.0	0.0	0.0
TGT	+175	-700	0	0.0	0.0	-10.0
ERR	0	+700	0	0.0	0.0	+10.0

PCS

* If FOR or 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

PCS

MSS: SSRMS:

Verify Posn Hold – orange

3.111 PMA2 RELOCATE TO NODE2

(RBT FS/10A/FIN 1)

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

	Locked					
SR	SY	SP	EP	WP	WY	WR
-36.7	+9.7	+14.2	+103.1	+31.1	+16.1	+58.6
X	Y	Z	Pitch	Yaw	Roll	
+175	-700	0	0.0	0.0	-10.0	
FOR	Loaded – PMA2 Demate, SY Held					
Disp	LAB>PMA2 Demate					

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

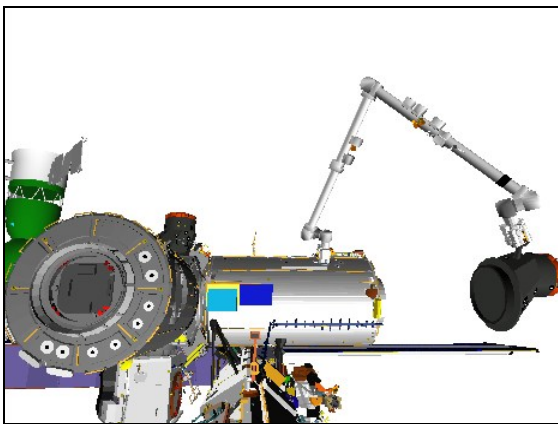


Figure 6.- Intermediate Position
(09: P1 Lower Outboard: +95, +15).

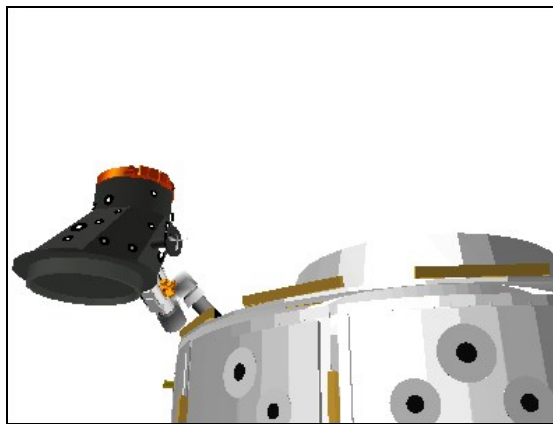


Figure 7.- Intermediate Position
(37: MBS Mast: +45, +25).

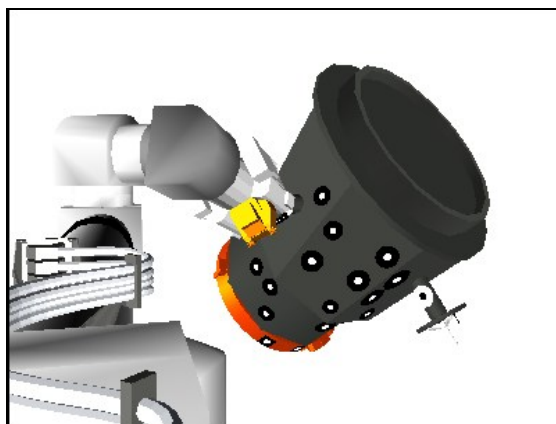


Figure 8.- Intermediate Position
(24: Tip Elbow: +15, -5).

3.111 PMA2 RELOCATE TO NODE2

(RBT FS/10A/FIN 1)

- 4.2 JOCAS to PMA2 CBM Survey Position
Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3
09: P1 Lower Outboard (+95, +20)	22: Base Elbow (+85, -15)	24: Tip Elbow (+15, -5)

MSS: SSRMS:

Change Loaded Parameters ► PMA2 ► PMA2 Install CBCS, SYH
Verify 'Loaded Parameters' (two) – PMA2 Install CBCS, SY Held

Change Display ► LAB ► PMA2 Install CBCS (Verify LAB>PMA2
Install CBCS)

NOTE

1. Monitor clearance between the PMA2 and the SSRMS Tip Boom with the Tip Elbow Camera. Minimum clearance is approximately 96 cm (38 in).
2. The survey of the PMA2 Passive CBM may be done during the maneuver. Refer to step 4.3 for information pertaining to the survey.

Verify with **MCC-H**, Port TRRJ locked at zero.

MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

Input 'Joint Angles' 'Destination' for PMA2 CBM Survey position.

SR	SY	SP	EP	WP	WY	WR
-24.5	-15.0	-3.5	+20.0	+100.0	-30.0	+89.2

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)	-36.7	+9.7	+14.2	+103.1	+31.1	+16.1	+58.6
TGT	-24.5	-15.0	-3.5	+20.0	+100.0	-30.0	+89.2
ERR	-12.2	+24.7	+17.7	+83.1	-68.9	+46.1	-30.6

3.111 PMA2 RELOCATE TO NODE2

(RBT FS/10A/FIN 1)

```

*****
* If joint angles or 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

PCS MSS: SSRMS: 

Verify Posn Hold – orange
    
```

Verify SSRMS at PMA2 CBM Survey position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-24.5	-15.0	-3.5	+20.0	+100.0	-30.0	+89.2
X	Y	Z	Pitch	Yaw	Roll	
+409	+722	+705	-0.7	+34.2	-12.6	
FOR	Loaded – PMA2 Install CBCS, SY Held					
Disp	LAB>PMA2 Install CBCS					

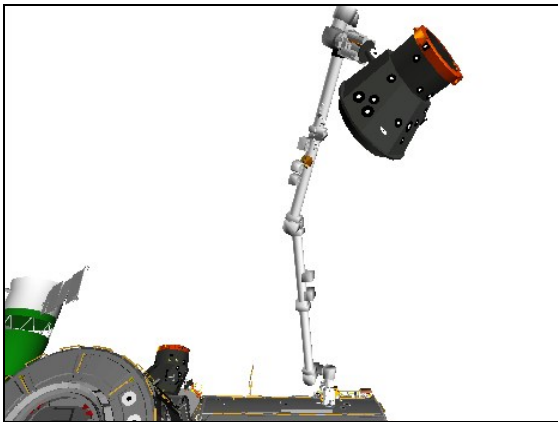


Figure 9.- PMA2 CBM Survey
(09: P1 Lower Outboard: +95, +35).

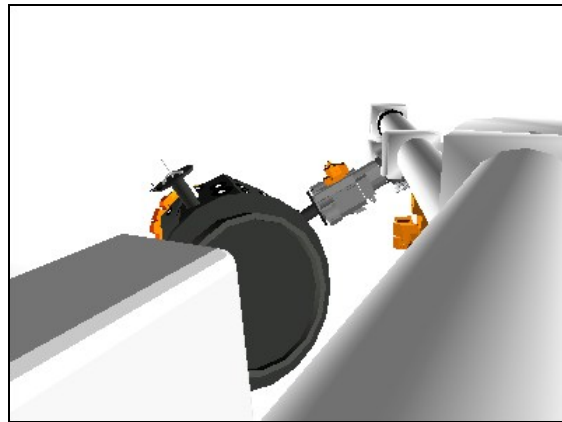


Figure 10.- PMA2 CBM Survey
(22: Base Elbow: +155, -15).

3.111 PMA2 RELOCATE TO NODE2

(RBT FS/10A/FIN 1)

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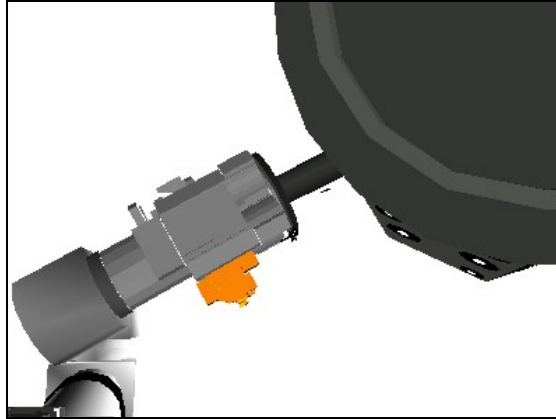


Figure 11.- PMA2 CBM Survey
(24: Tip Elbow: +15, +10).

4.3 PMA2 Passive CBM Survey

NOTE

1. [{A.6 PASSIVE CBM INSPECTION REFERENCE}](#) (SODF: S&M: REFERENCE) provides detailed inspection and acceptance criteria as well as data on historically accepted debris and damage.
2. **MCC-H** will coordinate to record the CBM survey on-board if Ku LOS.

If not already performed

Inspect the CBM ring using the SSRMS Tip Elbow Camera to verify ring and seal are clear of FOD by performing [{A.6 PASSIVE CBM INSPECTION REFERENCE}](#), all (SODF; S&M; REFERENCE), then:

If any verifications in A.6 procedure are not met, **√MCC-H**.

Notify **MCC-H** when survey is complete.

3.111 PMA2 RELOCATE TO NODE2

(RBT FS/10A/FIN 1)

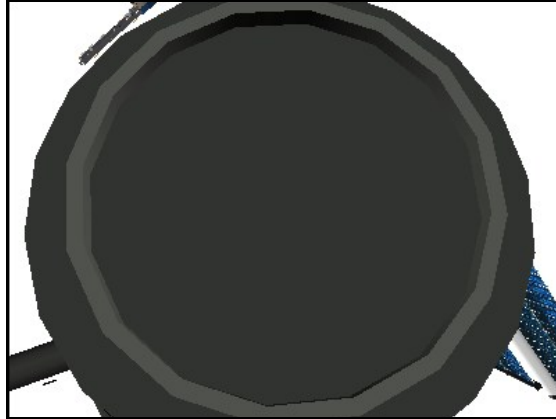


Figure 12.- PMA2 Passive CBM Survey
(24: Tip Elbow: +40, +28).

4.4 JOCAS to PMA2 Pre-Install Setup Position Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3
09: P1 Lower Outboard (+95, +35)	22: Base Elbow (-175, -20)	24: Tip Elbow (+15, +10)

SSRMS Joint OCAS

pick File ► LAB ► PMA2 Install Mnr2

Verify 'Joint Angles' 'Destination' for PMA2 Pre-Install Setup position.

SR	SY	SP	EP	WP	WY	WR
-15.6	-32.5	-15.4	-37.3	+132.8	-44.5	+89.2

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)	-24.5	-15.0	-3.5	+20.0	+100.0	-30.0	+89.2
TGT	-15.6	-32.5	-15.4	-37.3	+132.8	-44.5	+89.2
ERR	-8.9	+17.5	+11.9	+57.3	-32.8	+14.5	0.0

3.111 PMA2 RELOCATE TO NODE2

(RBT FS/10A/FIN 1)

```

*****
* If joint angles or 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.
*****

```

NOTE

1. At the start of the maneuver, minimum clearance between the PMA2 and Tip Elbow Camera is approximately 244 cm (96 in). At the end of the maneuver, minimum clearance is approximately 129 cm (51 in) and may be monitored using the P1 Lower Outboard Camera.
2. Monitor clearance between the PMA2 and the SSRMS Tip Boom with the Tip Elbow Camera. Minimum clearance is approximately 99 cm (39 in.).
3. Expect singularity warning for EP between -15 and +15 deg.

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

DCP AUTO SEQ → PROC

PCS MSS: SSRMS: SSRMS

Verify Posn Hold – orange

Verify SSRMS at PMA2 Pre-Install Setup position
(within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-15.6	-32.5	-15.4	-37.3	+132.8	-44.5	+89.2
X	Y	Z	Pitch	Yaw	Roll	
+175	0	+400	0.0	0.0	0.0	
FOR	Loaded – PMA2 Install CBCS, SY Held					
Disp	LAB>PMA2 Install CBCS					

3.111 PMA2 RELOCATE TO NODE2

(RBT FS/10A/FIN 1)

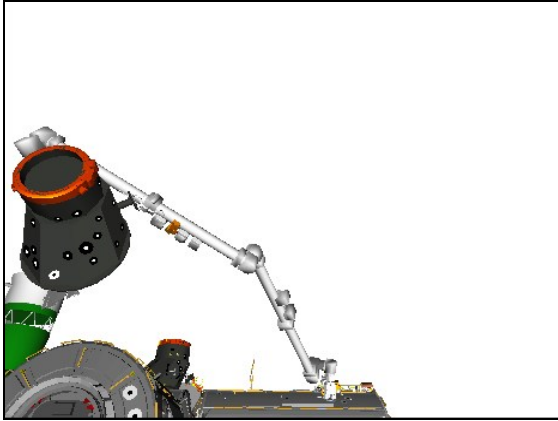


Figure 13.- PMA2 Pre-Install Setup
(09: P1 Lower Outboard: +95, +35).

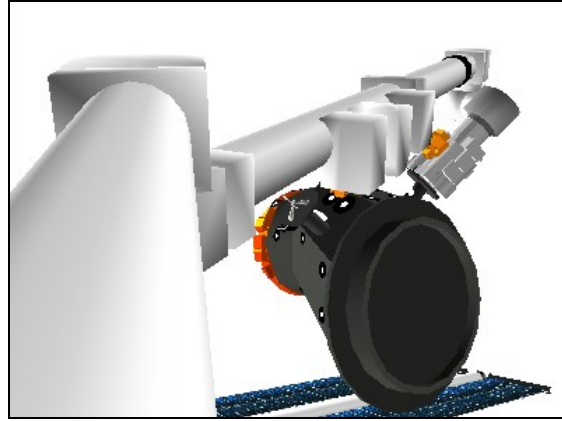


Figure 14.- PMA2 Pre-Install Setup
(22: Base Elbow: -170, -20).

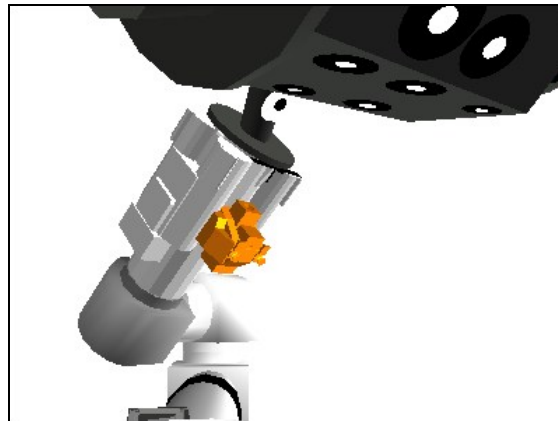


Figure 15.- PMA2 Pre-Install Setup
(24: Tip Elbow: +5, +10).

4.5 FOR OCAS to PMA2 Pre-Install Position Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3
09: P1 Lower Outboard (+90, +20)	17: CBCS	24: Tip Elbow (+5, +10) 22: Base Elbow (-150, -20)

√Vernier

MSS: SSRMS:

Enter Mode – FOR OCAS (Verify blue)

MSS: SSRMS: SSRMS FOR OCAS: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

3.111 PMA2 RELOCATE TO NODE2

(RBT FS/10A/FIN 1)

SSRMS FOR OCAS

pick File ► LAB ► PMA2 Install Mnvr 3

Verify 'FOR' 'Destination' for PMA2 Pre-Install position.

X	Y	Z	Pitch	Yaw	Roll
+175	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	+175	0	+400	0.0	0.0	0.0
TGT	+175	0	0	0.0	0.0	0.0
ERR	0	0	+400	0.0	0.0	0.0

PCS

* If FOR or 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

PCS

MSS: SSRMS: SSRMS

Verify Posn Hold – orange

Verify SSRMS at PMA2 Pre-Install position (within 5 cm/1 deg).

	Locked						
	SR	SY	SP	EP	WP	WY	WR
	+11.2	-32.5	-30.2	-50.6	+133.3	-65.3	+73.5
	X	Y	Z	Pitch	Yaw	Roll	
	+175	0	0	0.0	0.0	0.0	
FOR	Loaded – PMA2 Install CBCS, SY Held						
Disp	LAB>PMA2 Install CBCS						

3.111 PMA2 RELOCATE TO NODE2

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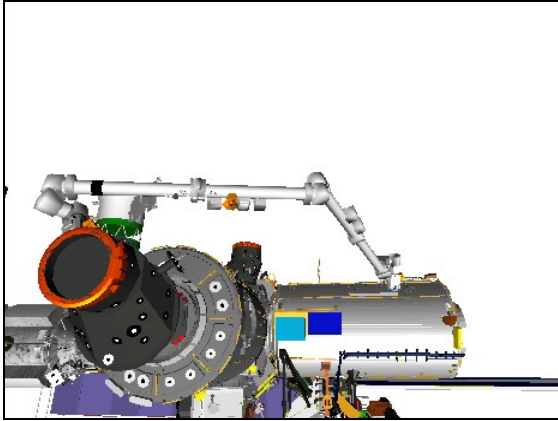


Figure 16.- PMA2 Pre-Install
(09: P1 Lower Outboard: +85, +20).

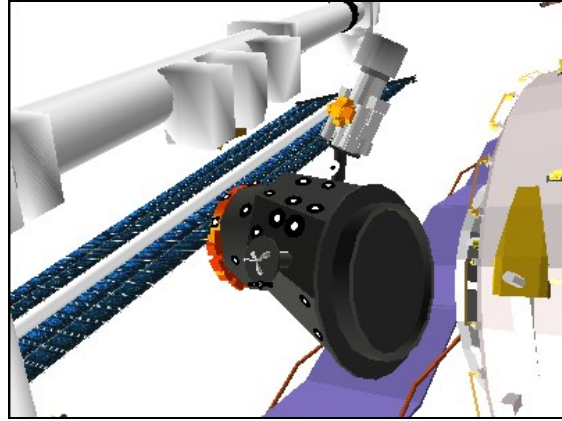


Figure 17.- PMA2 Pre-Install
(22: Base Elbow: -150, -25).

5. PMA2 INSTALL SETUP

Verify {1.533 CBM PMA2 RELOCATE: LAB FWD TO NODE 2 FWD}, steps 2 and 3 (SODF: S&M: NOMINAL: CBM), complete.

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3
09: P1 Lower Outboard (+85, +5)	17: CBCS	24: Tip Elbow (-45, +35) 22: Base Elbow (-130, -25)

NOTE

Figure 18 and Figure 19 illustrate the expected PMA2 overlay configuration at Hardware meshing and RTLs. Use the Tip Elbow Camera to monitor when PMA2 breaks the plane of the Node 2 stovepipe. Do not perform any further misalignment corrections from this point.

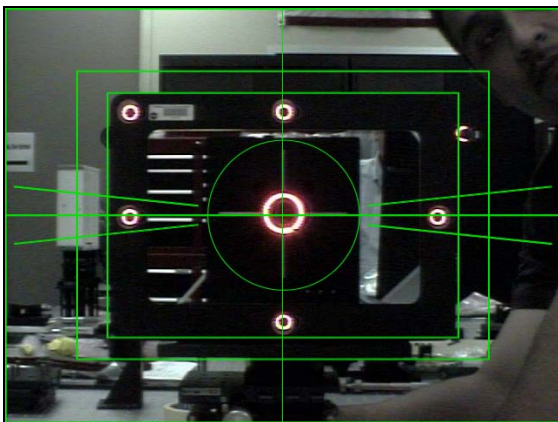


Figure 18.- PMA2 Overlay Configuration at Hardware Meshing
(17: CBCS).

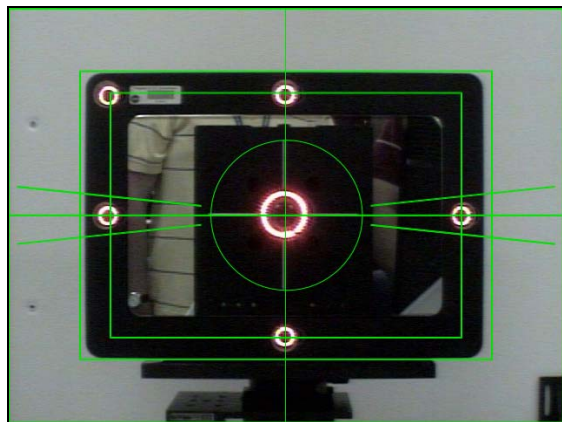


Figure 19.- PMA2 Overlay Configuration at RTLs
(17: CBCS).

3.111 PMA2 RELOCATE TO NODE2

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MSS: SSRMS:

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

MSS: SSRMS: Rate:

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

6. ATTITUDE CONTROL CONFIGURATION

Verify with **MCC-H** thrusters inhibited.

MSS: SSRMS: Thrusters:

Verify Desat Request: – Inh

Verify Auto Att Control Handover to RS – Inh

7. MANEUVER TO PMA2 READY-TO-LATCH POSITION

NOTE

At install, clearance between the Tip LEE and the Node 2 EVA handrails is approximately 51 cm (20 in.). This clearance may be monitored with the Tip Elbow Camera.

MSS: SSRMS:

Enter Mode – Manual (Verify – blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

THC/
RHC

Maneuver PMA2 to Ready-To-Latch position until RTL (four) – green

PCS

Expected Ready-To-Latch position

	Locked					
SR	SY	SP	EP	WP	WY	WR
+7.7	-32.5	-24.5	-68.3	+150.5	-62.9	+77.3
X	Y	Z	Pitch	Yaw	Roll	
+11	0	0	0.0	0.0	0.0	
FOR	Loaded – PMA2 Install CBCS, SY Held					
Disp	LAB>PMA2 Install CBCS					

3.111 PMA2 RELOCATE TO NODE2

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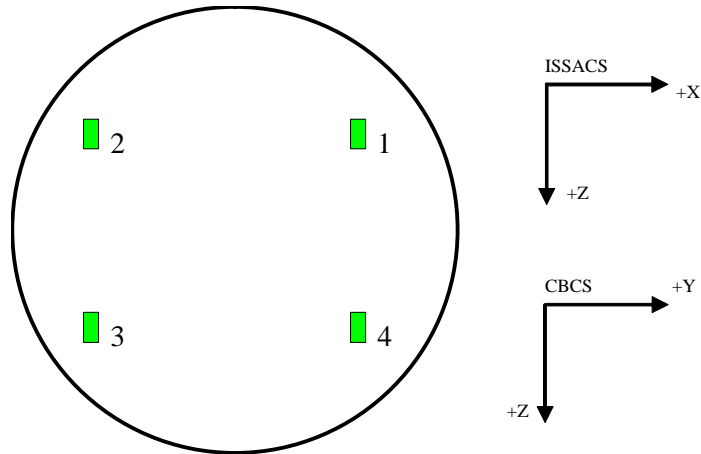


Figure 20.- PMA2 CBCS Install RTL Diagram.

MSS: SSRMS:

Verify Posn Hold – orange

Verify RTL (four) – green

Enter Mode – Standby (Verify blue)

Notify CBM operator, “Maneuver to RTL capture complete, GO for mechanism autosafing enable and first stage capture.”

8. FIRST STAGE CAPTURE

Verify {1.533 CBM PMA2 RELOCATE: LAB FWD TO NODE 2 FWD}, steps 4.1 to 4.4 (SODF: S&M: NOMINAL: CBM), completed.

On GO from CBM operator, mode to Limp:

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).

MSS: SSRMS: Limp:

cmd All Limp (Verify Limp – blue)

MSS: SSRMS:

Verify all joints – Limped

3.111 PMA2 RELOCATE TO NODE2

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WARNING

If SSRMS fails to brakes-on from limp mode, continuation of Second Stage Capture may cause structural failure of SSRMS or primary structure. If CBM stops unexpectedly (and Cmd Code changes to 'Stop') or SSRMS safes during Second Stage Capture, **√MCC-H** before proceeding.

Notify CBM operator "Mode to limp complete, GO for second stage capture."

9. SECOND STAGE CAPTURE AND ABOLTS

Verify {1.533 CBM PMA2 RELOCATE: LAB FWD TO NODE 2 FWD}, steps 4.5 to 4.8 (SODF: S&M: NOMINAL: CBM), complete.

On CBM operator GO for SSRMS brakes ON:

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)

Notify **MCC-H**, "GO for Port TRRJ Auto-track."

PCS MSS: SSRMS: SSRMS

Expected PMA2 Install on Node 2 position.

SR	SY	SP	EP	WP	WY	WR
+7.5	-32.5	-24.2	-69.3	+151.6	-62.7	+77.6
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded – PMA2 Install CBCS, SY Held					
Disp	LAB>PMA2 Install CBCS					

3.111 PMA2 RELOCATE TO NODE2

(RBT FS/10A/FIN 1)

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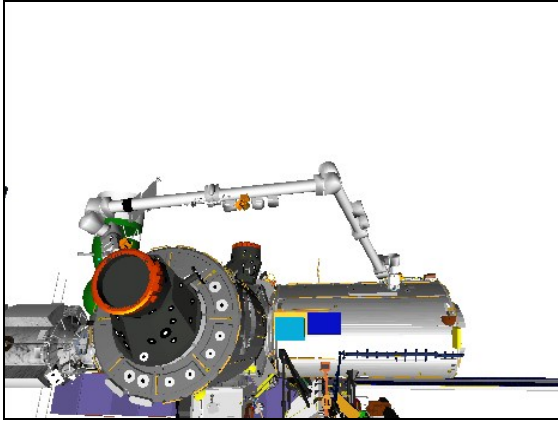


Figure 21.- PMA2 Install Position
(09: P1 Lower Outboard: +85, +20).

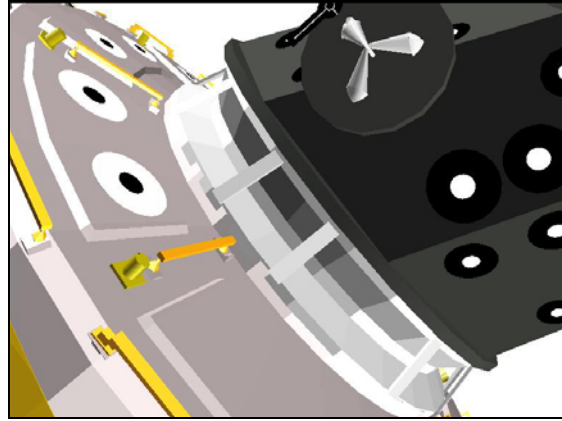


Figure 22.- PMA2 Install Position
(24: Tip Elbow: -40, +40).

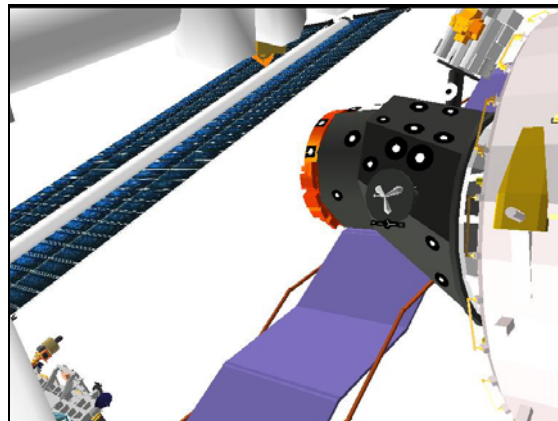


Figure 23.- PMA2 Install Position
(22: Base Elbow: -145, -35).

3.211 NODE 2/PMA2 RELOCATE

(RBT FS/10A/FIN 1)

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1. HAND CONTROLLER CALIBRATION AND SETUP

THC 1.1 Translational Hand Controller (THC) Calibration
 Deflect [X] Axis to positive hard stop where [X] =
 Deflect [X] Axis to negative hard stop.
 Repeat

RHC 1.2 Rotational Hand Controller (RHC) Calibration
 Deflect [X] Axis to positive hard stop where [X] =
 Deflect [X] Axis to negative hard stop.
 Repeat

1.3 Setup
 Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3
09: P1 Lower Outboard (+90, +10)	24: Tip Elbow (-15, 0)	22: Base Elbow (-65, -25)

Verify CBCS setup Complete

PCS MSS: SSRMS:

Verify 'Loaded Parameters' (two) – Node2PMA2 Demate, SY Held

Verify Display – LAB>Node2PMA2 Demate

Verify Command – ISS>ISSACS

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: as desired

Verify SSRMS at Node 2 PDGF Grapple position
 (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-7.7	+7.2	-20.8	-119.3	-55.9	-28.2	-14.1
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded – Node2PMA2 Demate, SY Held					
Disp	LAB>Node2PMA2 Demate					

3.211 NODE 2/PMA2 RELOCATE

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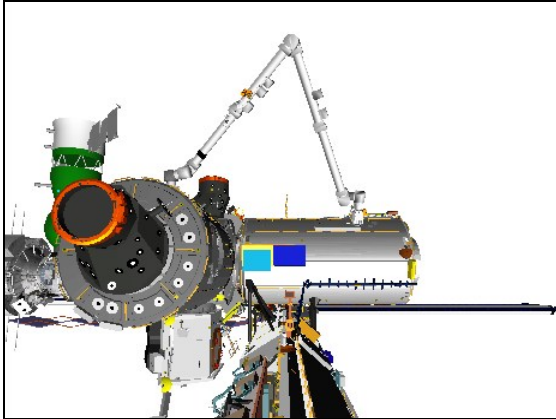


Figure 1.- Node 2 PDGF Grapple
(09: P1 Lower Outboard: +90, +10).

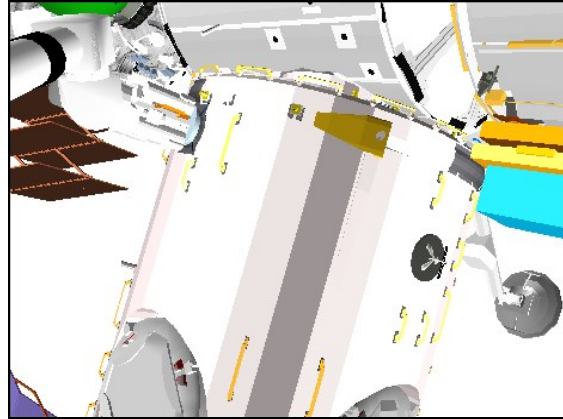


Figure 2- Node 2 PDGF Grapple
(22: Base Elbow: -65, -25).

2. DEMATE NODE 2/PMA2 FROM NODE 1 PORT CBM

Verify {1.535 CBM NODE2/PMA2 STACK RELOCATE: NODE1 PORT TO LAB FWD}, step 1 (SODF: S&M: NOMINAL: CBM), complete.

On CBM operator GO for Demate:

Verify with **MCC-H** Port TRRJ locked at zero.

Monitor CBM RTLs using USOS Eff overlay.

PCS MSS: SSRMS: SSRMS Safing:

cmd Remove (Verify Not Safed)

DCP BRAKES SSRMS → OFF (Verify OFF)

NOTE

Minimum clearance between the stanchion on Node 1 Zenith Aft and mated Node 2 is 81 cm (32 in). This clearance can not be monitored but does improve during demate.

PCS MSS: SSRMS:

√Vernier

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

3.211 NODE 2/PMA2 RELOCATE

(RBT FS/10A/FIN 1)

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RHC/THC Maneuver to Node 2/PMA2 Demate position (within 5 cm/1 deg).
(THC left)

	Locked					
SR	SY	SP	EP	WP	WY	WR
+3.9	+7.2	-14.9	-114.8	-58.4	-30.6	-1.1
X	Y	Z	Pitch	Yaw	Roll	
0	-200	0	0.0	0.0	0.0	
FOR	Loaded – Node2PMA2 Demate, SY Held					
Disp	LAB>Node2PMA2 Demate					

PCS MSS: SSRMS:

Enter Mode – Standby (Verify blue)

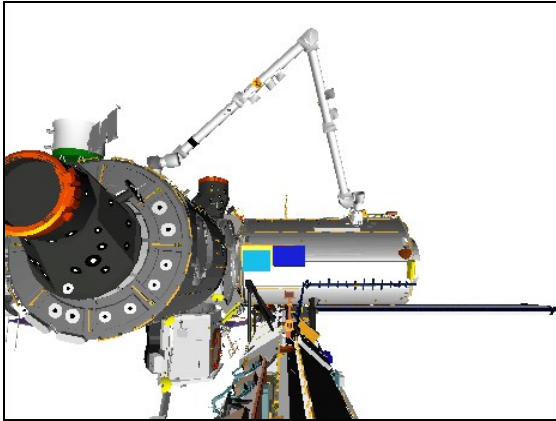


Figure 3.- Node 2/PMA2 Demate
(09: P1 Lower Outboard: +90, +10).

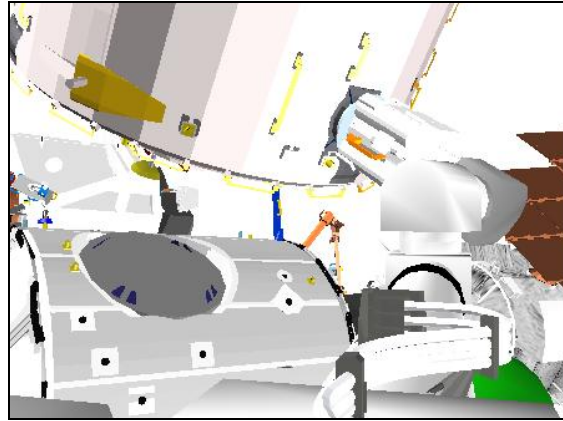


Figure 4.- Node 2/PMA2 Demate
(24: Tip Elbow: -15, 0).

3. JOCAS TO NODE 2/PMA2 CLEARANCE POSITION

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3
09: P1 Lower Outboard (+85, +10)	24: Tip Elbow (-20, 0)	22: Base Elbow (-60, -20) 37: MBS Mast (+120, -10)

MSS: SSRMS:

RHC RATE → COARSE (Verify Coarse on PCS)

Enter Mode – Joint OCAS (Verify blue)

3.211 NODE 2/PMA2 RELOCATE

(RBT FS/10A/FIN 1)

SSRMS Joint OCAS

pick File ► LAB ► N2 Relocate Mnvr 1

Verify 'Joint Angles' 'Destination' for Node 2/PMA2 Clearance position.

SR	SY	SP	EP	WP	WY	WR
+3.9	+7.2	+45.0	-107.2	-85.7	-30.6	-1.1

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)	+3.9	+7.2	-14.9	-114.8	-58.4	-30.6	-1.1
TGT	+3.9	+7.2	+45.0	-107.2	-85.7	-30.6	-1.1
ERR	0.0	0.0	-59.9	-7.6	+27.3	0.0	0.0

PCS

* If joint angles or 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

Notify CBM operator, "Clear of structure, GO to close CBM petals and transition modes."

PCS

MSS: SSRMS: SSRMS

Verify Posn Hold – orange

Verify Joint Angle values.

SR	SY	SP	EP	WP	WY	WR
+3.9	+7.2	+45.0	-107.2	-85.7	-30.6	-1.1

3.211 NODE 2/PMA2 RELOCATE

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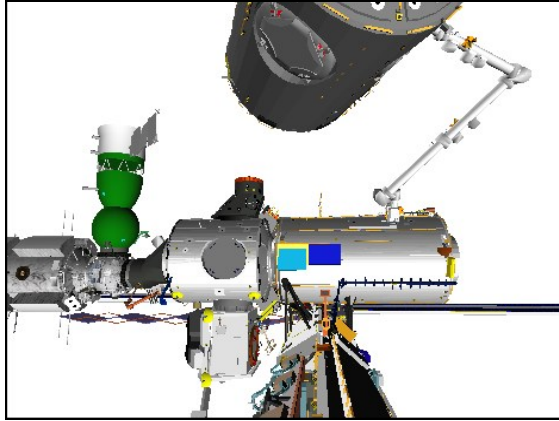


Figure 5.- Node 2/PMA2 Clearance Position
(09: P1 Lower Outboard: +85, +10).

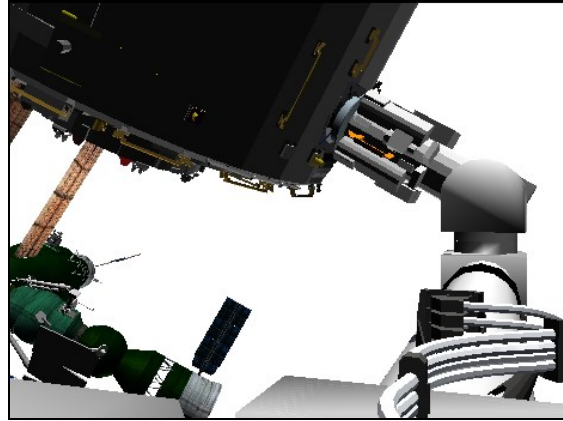


Figure 6.- Node 2/PMA2 Clearance Position
(24: Tip Elbow: -20, 0).

4. JOCAS TO NODE 2 PASSIVE CBM SURVEY POSITION

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3
09: P1 Lower Outboard (+115, +10) 03: S1 Lower Outboard (+80, +10)	24: Tip Elbow (-15, 0) 22: Base Elbow (-65,-10)	37: MBS Mast (+120, -10)

NOTE

1. During the maneuver, the Node 2 Stack appears to move towards the Truss segment, however, clearances greater than 4.5 m (177 in.) are maintained.
2. The survey of the Passive Node 2 CBM may be done during the maneuver. Refer to step 5 for information pertaining to the survey.

SSRMS Joint OCAS

pick File ► LAB ► N2 Relocate Mnr 2

Verify 'Joint Angles' 'Destination' for Node 2 Passive CBM Survey position.

SR	SY	SP	EP	WP	WY	WR
+144.1	-15.0	+29.2	-107.2	-85.7	+8.1	+80.0

cmd Load (Verify Sequence Status – Confirm or Cancel)

3.211 NODE 2/PMA2 RELOCATE

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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
	+3.9	+7.2	+45.0	-107.2	-85.7	-30.6	-1.1
TGT	+144.1	-15.0	+29.2	-107.2	-85.7	+8.1	+80.0
ERR	-140.2	+22.2	+15.8	0.0	0.0	-38.7	-81.1

PCS * If joint angles or 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

PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at Node 2 Passive CBM Survey position
 (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+144.1	-15.0	+29.2	-107.2	-85.7	+8.1	+80.0
X	Y	Z	Pitch	Yaw	Roll	
+1288	-348	+509	+2.0	+65.3	+2.1	
FOR	Loaded – Node2PMA2 Demate, SY Held					
Disp	LAB>Node2PMA2 Demate					

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

3.211 NODE 2/PMA2 RELOCATE

(RBT FS/10A/FIN 1)

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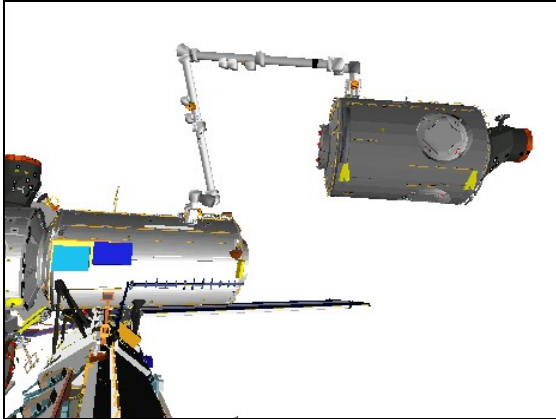


Figure 7.- Node 2 Passive CBM Survey
(09: P1 Lower Outboard: +115, +10).

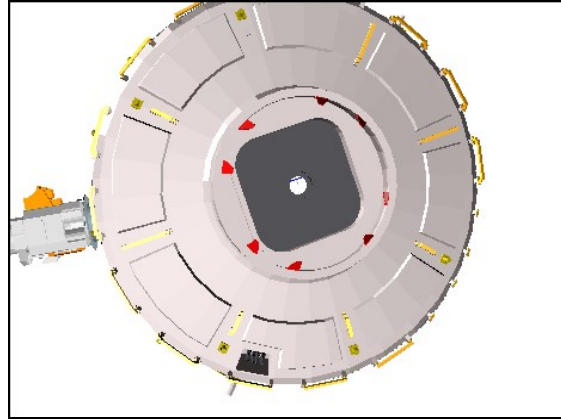


Figure 8.- Node 2 Passive CBM Survey
(22: Base Elbow: -65, -10).

5. PASSIVE NODE 2 CBM SURVEY

NOTE

1. [{A.6 PASSIVE CBM INSPECTION REFERENCE}](#) (SODF: S&M: REFERENCE) provides detailed inspection and acceptance criteria as well as data on historically accepted debris or damage.
2. **MCC-H** will coordinate to record the CBM survey on-board if Ku LOS.

If not already performed

Inspect the CBM ring using the SSRMS Base Elbow Camera to verify ring and seal are clear of FOD by performing [{A.6 PASSIVE CBM INSPECTION REFERENCE}](#), all (SODF: S&M: REFERENCE), then:

If any verifications in A.6 procedure are not met, **√MCC-H**.

Notify **MCC-H** when survey complete.

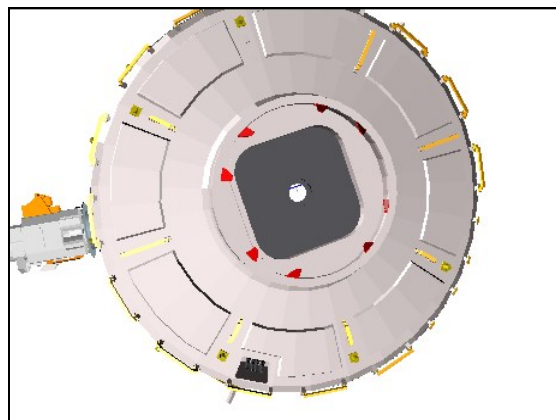


Figure 9.- Node 2 Passive CBM Survey
(22: Base Elbow: -65, -10).

3.211 NODE 2/PMA2 RELOCATE

(RBT FS/10A/FIN 1)

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6. FOR OCAS TO NODE 2/PMA2 PRE-INSTALL POSITION

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3
09: P1 Lower Outboard (+105, +20)	24: Tip Elbow (-15, 0) 22: Base Elbow (-40, -5)	37: MBS Mast (+150, +10)

MSS: SSRMS:

Change Loaded Parameters ► Node2PMA2 ► Node2PMA2 Inst CBCS, SYH

Verify 'Loaded Parameters' (two) – Node2PMA2 Inst CBCS, SY Held

Change Display ► LAB ► Node2PMA2 Inst CBCS (Verify LAB> Node2PMA2 Inst CBCS)

Verify SSRMS at Node2 Passive CBM Survey position
(within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+144.1	-15.0	+29.2	-107.2	-85.7	+8.1	+80.0
X	Y	Z	Pitch	Yaw	Roll	
+212	-547	+509	+4.3	-24.7	+1.0	
FOR	Loaded – Node2PMA2 Inst CBCS, SY Held					
Disp	LAB>Node2PMA2 Inst CBCS					

MSS: SSRMS:

√Coarse

Enter Mode – FOR OCAS (Verify blue)

MSS: SSRMS: SSRMS FOR OCAS: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

pick File ► LAB ► N2 Relocate Mnvr 3

Verify 'FOR' 'Destination' for Node 2/PMA2 Pre-Install position.

X	Y	Z	Pitch	Yaw	Roll
+200	0	0	0.0	0.0	0.0

cmd Load (Verify Sequence Status – Confirm or Cancel)

3.211 NODE 2/PMA2 RELOCATE

(RBT FS/10A/FIN 1)

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

	X	Y	Z	Pitch	Yaw	Roll
FOR	+212	-547	+509	+4.3	-24.7	+1.0
TGT	+200	0	0	0.0	0.0	0.0
ERR	+12	-547	+509	+4.3	-24.7	+1.0

PCS * If FOR or 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

PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at Node 2/PMA2 Pre-Install position (within 5 cm/1 deg).

	Locked					
SR	SY	SP	EP	WP	WY	WR
+182.0	-15.0	-19.3	-141.3	-20.3	+13.2	+91.9
X	Y	Z	Pitch	Yaw	Roll	
+200	0	0	0.0	0.0	0.0	
FOR	Loaded – Node2PMA2 Inst CBCS, SY Held					
Disp	LAB>Node2PMA2 Inst CBCS					

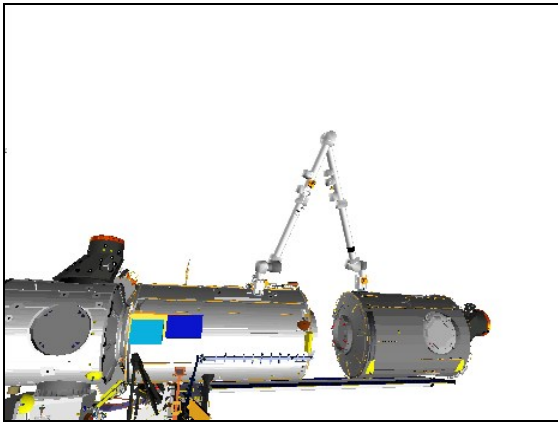


Figure 10.- Node 2/PMA2 Pre-Install (09: P1 Lower Outboard: +105, +20).

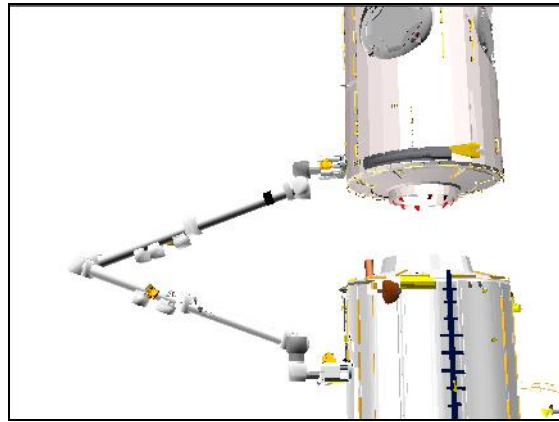


Figure 11.- Node 2/PMA2 Pre-Install (37: MBS Mast: +150, +10).

3.211 NODE 2/PMA2 RELOCATE

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7. ATTITUDE CONTROL CONFIGURATION

Verify with **MCC-H** thrusters inhibited.

MSS: SSRMS: Thrusters:

Verify 'Desat Request' – Inh

Verify Auto Att Control Handover to RS – Inh

8. SETUP FOR NODE 2/PMA2 INSTALL ON FWD LAB CBM

Verify {1.535 CBM NODE2/PMA2 STACK RELOCATE: NODE1 PORT TO LAB FWD}, steps 3 and 4 (SODF: S&M: NOMINAL: CBM), complete.

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3
09: P1 Lower Outboard (+105, +20)	17: CBCS	24: Tip Elbow (-20, 0) 37: MBS Mast (+150, +10) 22: Base Elbow (-40, -5)

MSS: SSRMS:

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

RHC

RATE → VERNIER (Verify Vernier on PCS)

MSS: SSRMS: Rate:

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

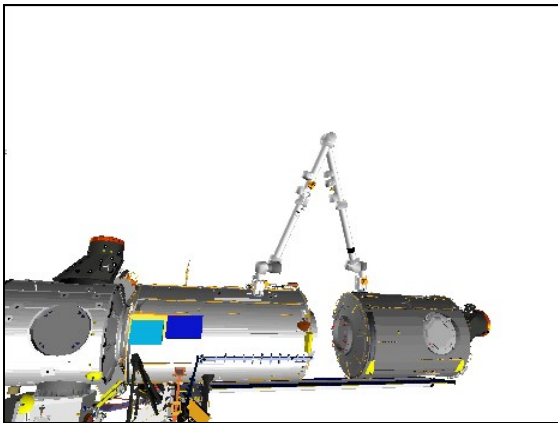


Figure 12.- Node 2/PMA2 Install Setup (09: P1 Lower Outboard: +105, +20).

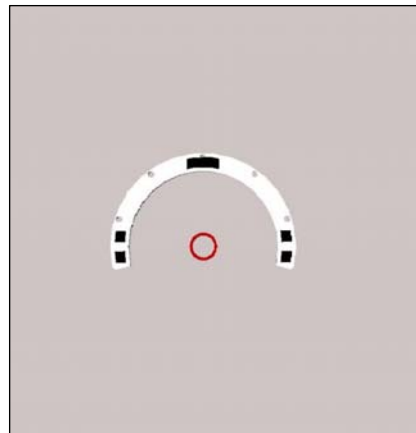


Figure 13.- Node 2/PMA2 Install Setup (17: CBCS).

3.211 NODE 2/PMA2 RELOCATE

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9. INSTALL NODE 2/PMA2 ONTO LAB FWD CBM

NOTE

A Cross-Cluster warning will be annunciated during the install maneuver when the EP joint ≤ -142.2 .

Monitor RTLs on PCS GUI page.

PCS

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

THC/
RHC

Maneuver Node 2/PMA2 to Ready-To-Latch position until RTL (four) – green

PCS

Expected Ready-To-Latch position

	Locked					
SR	SY	SP	EP	WP	WY	WR
+182.9	-15.0	-11.4	-156.9	-13.1	+13.2	+92.8
X	Y	Z	Pitch	Yaw	Roll	
+11	0	0	0.0	0.0	0.0	
FOR	Loaded – Node2PMA2 Inst CBCS, SY Held					
Disp	LAB>Node2PMA2 Inst CBCS					

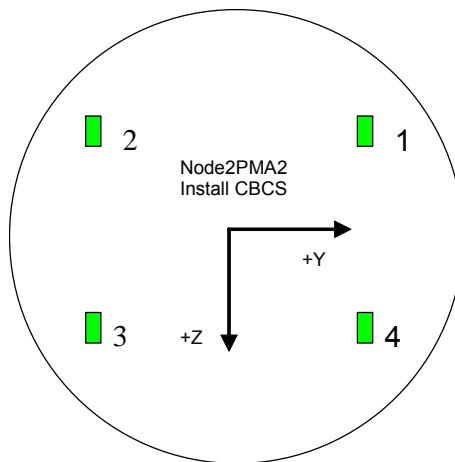


Figure 14.- Node 2/PMA2 CBCS Install RTL Diagram.

3.211 NODE 2/PMA2 RELOCATE

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MSS: SSRMS:

Verify Posn Hold – orange

Verify RTL (four) – green

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

Notify CBM operator, “Maneuver to RTL capture complete, GO for mechanism autosafing enable and first stage capture.”

10. FIRST STAGE CAPTURE

Verify {1.535 CBM NODE2/PMA2 STACK RELOCATE: NODE1 PORT TO LAB FWD}, step 5.4 (SODF: S&M: NOMINAL: CBM), complete.

On GO from CBM operator, mode to Limp

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).

MSS: SSRMS: Limp:

cmd All Limp (Verify Limp – blue)

MSS: SSRMS:

Verify all joints – Limped

WARNING

If SSRMS fails to brakes-on from limp mode, continuation of Second Stage Capture may cause structural failure of SSRMS or primary structure. If CBM stops unexpectedly (and Cmd Code changes to ‘Stop’) or SSRMS safes during Second Stage Capture, **√MCC-H** before proceeding.

Notify CBM operator, “Mode to limp complete, GO for second stage capture.”

11. SECOND STAGE CAPTURE AND ABOLTS

Verify {1.535 CBM NODE2/PMA2 STACK RELOCATE: NODE1 PORT TO LAB FWD}, step 5.8 (SODF: S&M: NOMINAL: CBM), complete.

On CBM operator GO for SSRMS brakes ON:

3.211 NODE 2/PMA2 RELOCATE

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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)

Notify **MCC-H**, "GO for Port TRRJ Auto-track."

PCS MSS: SSRMS: SSRMS

Expected Node 2/PMA2 Install on LAB FWD CBM position .

SR	SY	SP	EP	WP	WY	WR
+183.0	-15.0	-10.9	-157.8	-12.7	+13.2	+92.9
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded – Node2PMA2 Inst CBCS, SY Held					
Disp	LAB>Node2PMA2 Inst CBCS					

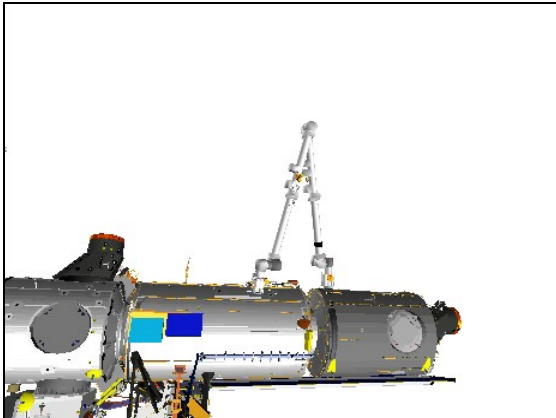


Figure 15.- Node 2/PMA2 Installed on LAB (09: P1 Lower Outboard: +105, +20).

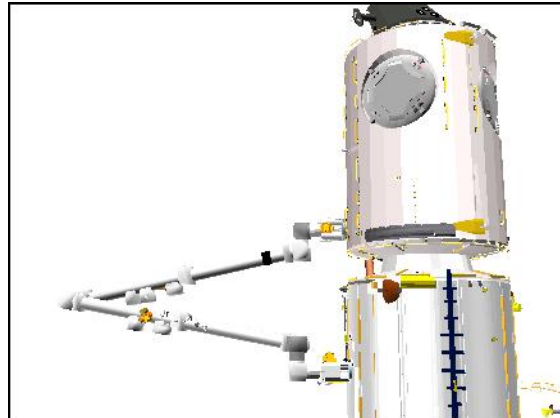


Figure 16.- Node 2/PMA2 Installed on LAB (37: MBS Mast: +150, +10).

3.211 NODE 2/PMA2 RELOCATE

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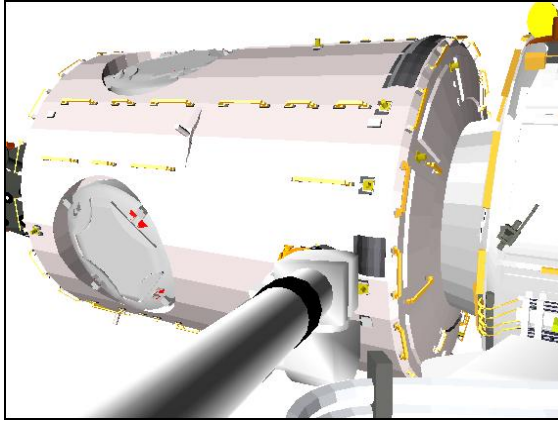


Figure 17.- Node 2/PMA2 Installed on LAB
(22: Base Elbow: -40, -5).

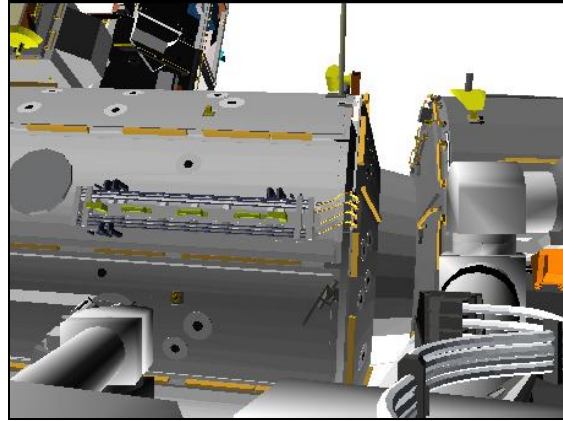


Figure 18.- Node 2/PMA2 Installed on LAB
(24: Tip Elbow: -20 0).

1.535 MT PRE-TRANSLATION SURVEY – WS8 TO WS4

(RBT FS/10A/FIN 1)

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Configure the ISS Downlink per the following table:

1	2
MBS Mast (-175, -20) FL = 19 mm	Base Elbow (-110, +45) FL = 19 mm

Verify SSRMS is at the MT Translate Stow position (within 1 deg).

SR	SY	SP	EP	WP	WY	WR
+230.0	+85.0	-105.0	+130.0	-57.5	+70.0	+99.9

NOTE

1. 'PTU not following commands' error messages may be generated when MSS cameras are powered.
2. Due to MCCST command latency, the pan/tilt stop command should be issued 6 degrees before the destination is reached.

1. MBS MAST CAMERA SURVEY

MCCST

ROBO Camera Commander

'MSS Cameras'

sel MBS Mast

cmd Activate Position (Verify Activated)

cmd Activate Commanding

Keyboard Commanding Window

Verify Current Camera: MBS Mast

	Mast	Stop at	Survey Notes	Complete
Start Config	(-175, -20) FL = 19 mm		MT Translation Path	
1: Tilt Up	(-175, -12)	(-175, -18)	MT Translation Path	
2: Zoom In	FL = 30 mm	-	MT Translation Path	
3: Tilt Up	(-175, -7)	(-175, -12)	MT Translation Path	

Keyboard Commanding Window

cmd Finished Commanding

1.535 MT PRE-TRANSLATION SURVEY – WS8 TO WS4

(RBT FS/10A/FIN 1)

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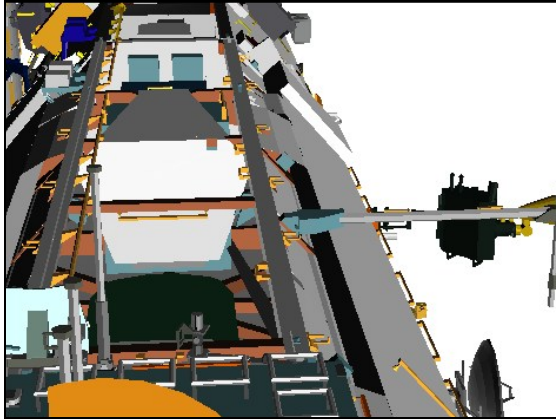


Figure 1.- MBS Mast Survey - Start
(37: MBS Mast: -175, -20, FL = 19 mm).

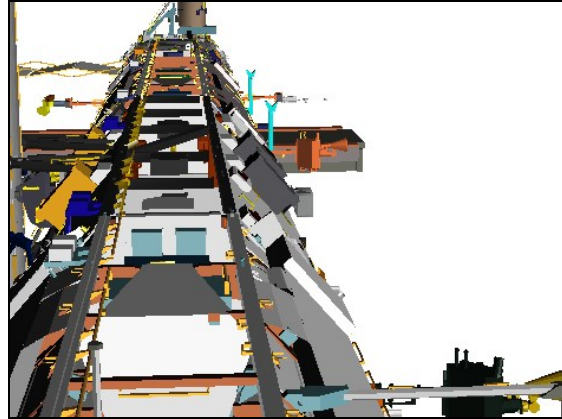


Figure 2.- MBS Mast Survey - Step 1
(37: MBS Mast: -175, -12).

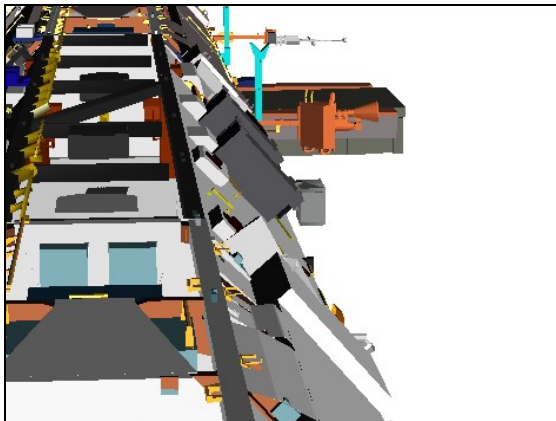


Figure 3.- MBS Mast Survey - Step 2
(37: MBS Mast: -175, -12, FL = 30 mm).

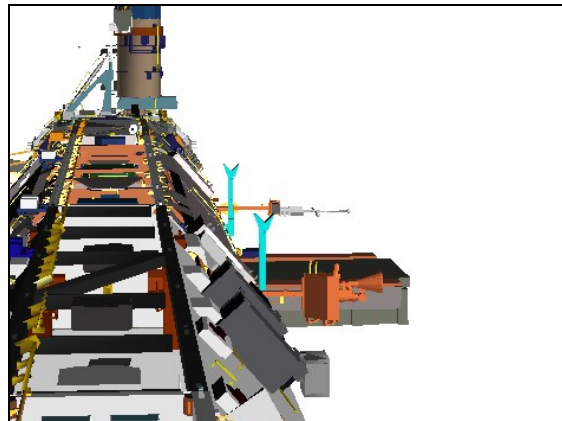


Figure 4.- MBS Mast Survey - Step 3
(37: MBS Mast: -175, -7).

2. SSRMS BASE ELBOW CAMERA SURVEY

ROBO Camera Commander
'MSS Cameras'

sel SSRMS Base Elb

cmd Activate Position (Verify Activated)

cmd Activate Commanding

Keyboard Commanding Window

Verify Current Camera: SSRMS Base Elb

1.535 MT PRE-TRANSLATION SURVEY – WS8 TO WS4

(RBT FS/10A/FIN 1)

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	Base Elb	Stop at	Survey Notes	Complete
Start Config	(-110, +45) FL = 19 mm		MT Translation Path	
1: Pan Left	(-125, +45)	(-119, +45)	MT Translation Path	
2: Tilt Down	(-125, +30)	(-125, +36)	MT Translation Path	
3: Pan Left	(-140, +30)	(-134, +30)	MT Translation Path	
4: Tilt Down	(-140, +20)	(-140, +26)	MT Translation Path	

Keyboard Commanding Window

cmd Finished Commanding

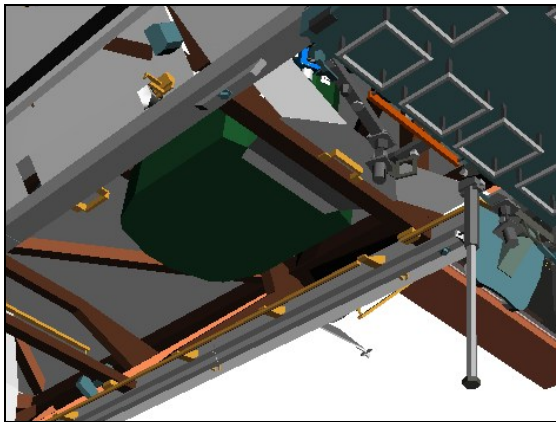


Figure 5.- Base Elbow - Start
(Base Elbow: -110, +45).

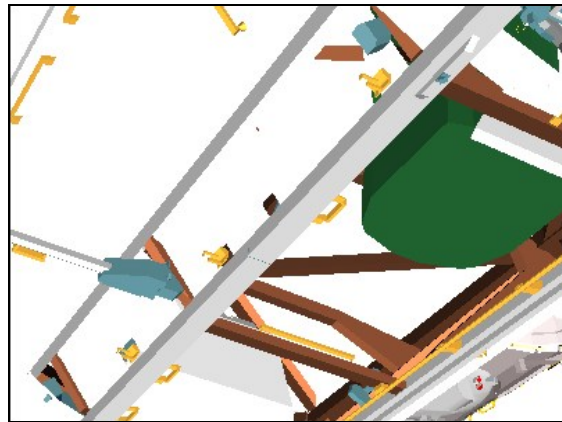


Figure 6.- Base Elbow - Step 1
(Base Elbow: -125, +45).

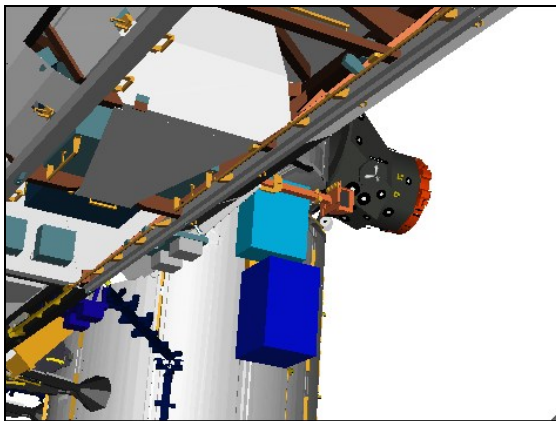


Figure 7.- Base Elbow - Step 2
(Base Elbow: -125, +30).

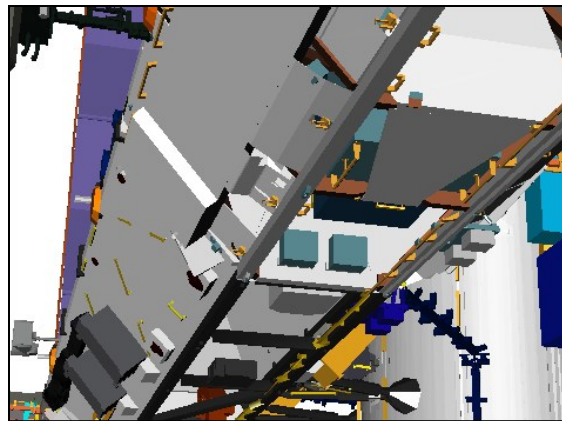


Figure 8.- Base Elbow - Step 3
(Base Elbow: -140, +30).

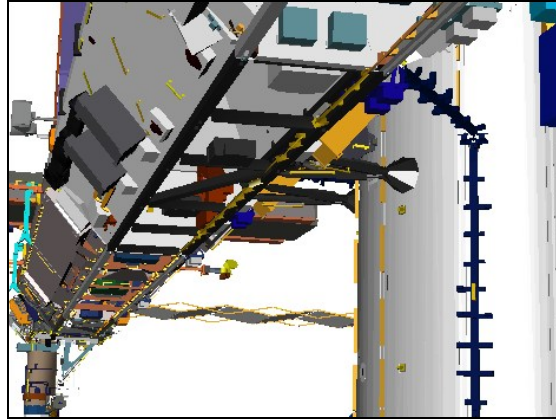


Figure 9.- Base Elbow - Step 4
(Base Elbow: -140, +20).

1.431 P6 SAW DEPLOY VIEWING SUPPORT CAMERA MATRIX

(RBT FS/10A/FIN 1)

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NOTE

This following assumptions are made for this camera matrix:

- a. Port SARJ = 90 deg/locked
- b. BGA 2A = 110 deg, BGA 4A = 75 deg
- c. BGA 2B = 200 deg, BGA 4B = 180 deg

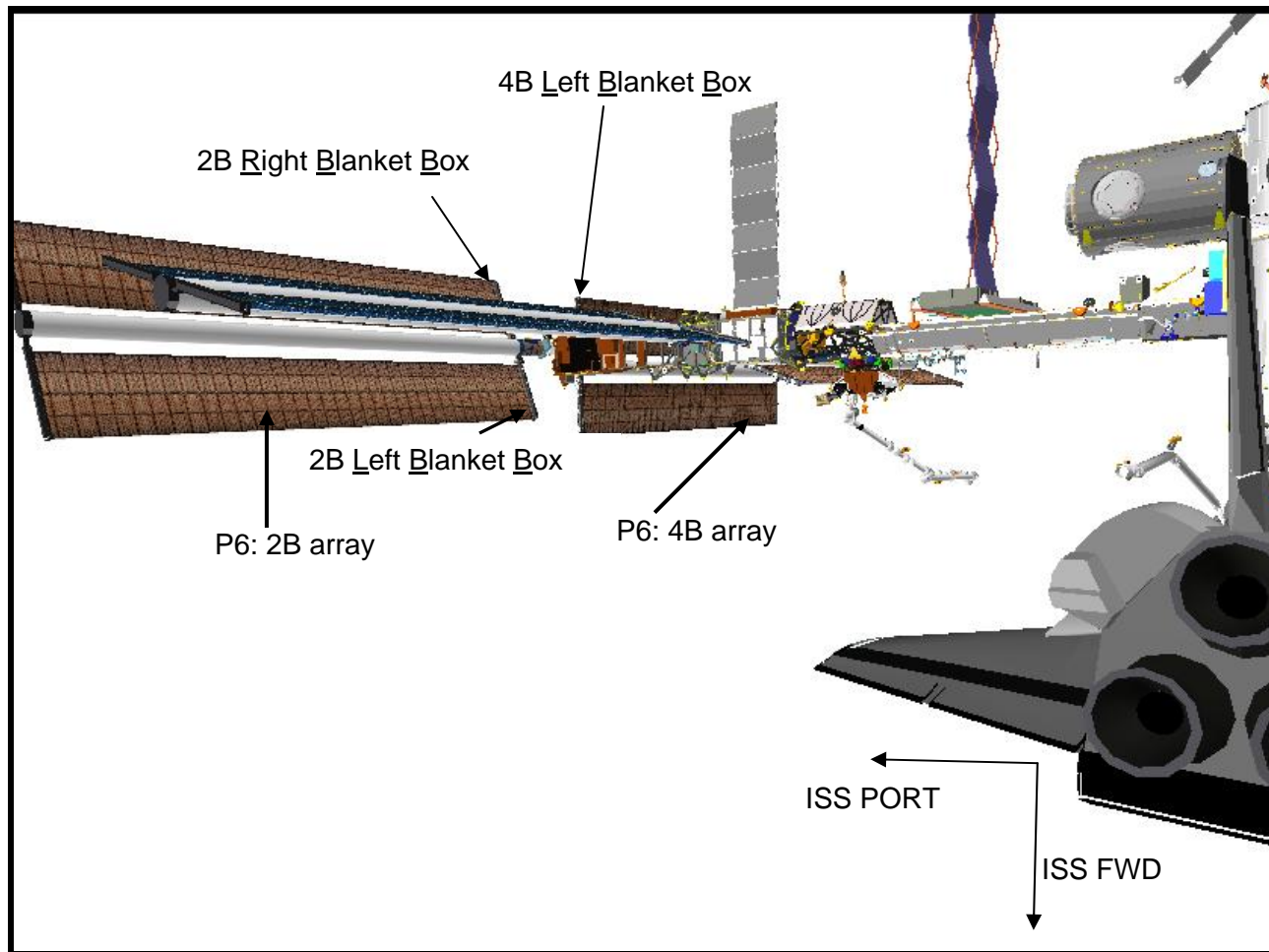


Figure 1.- 2B & 4B Arrays Deployed in Relation to the Orbiter and ISS (ISS Ang).

P6: 2B ARRAY DEPLOY VIEWING SUPPORT

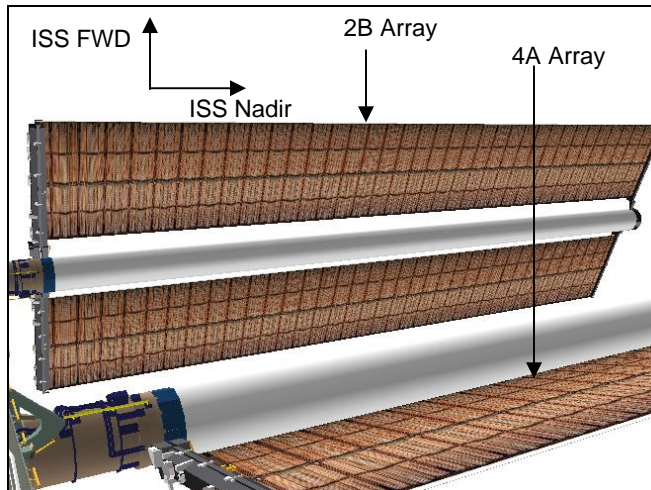


Figure 2.- Big Picture View for 2B Deploy
 (37: MBS Mast: +30, -10).

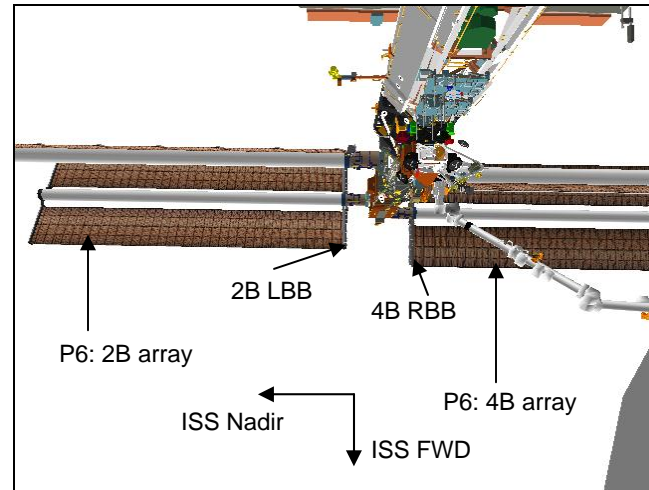


Figure 3.- Big Picture View for 2B Deploy
 (91: Camera A: +90, +5).

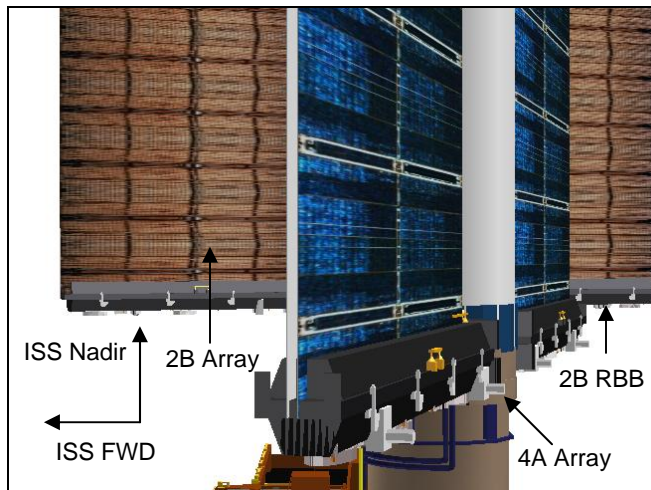


Figure 4.- Tension Bar Monitoring for 2B Array
 (09: P1 Lower Outboard: -90, 0).

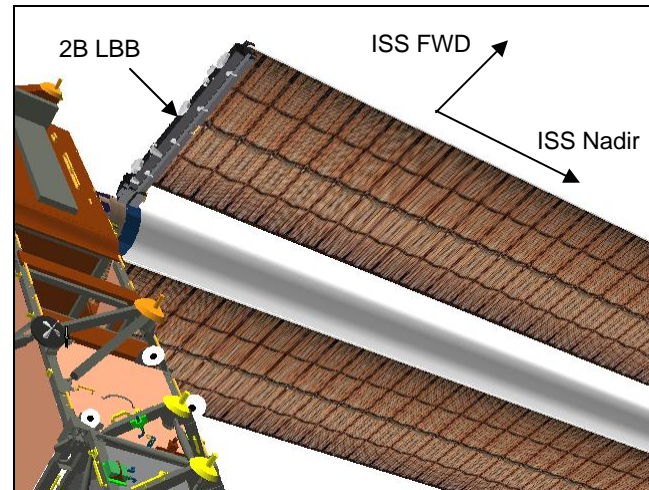


Figure 5.- Bay Count for 2B Array
 (24: Tip Elbow: +135, +25).

P6: 4B ARRAY DEPLOY VIEWING SUPPORT

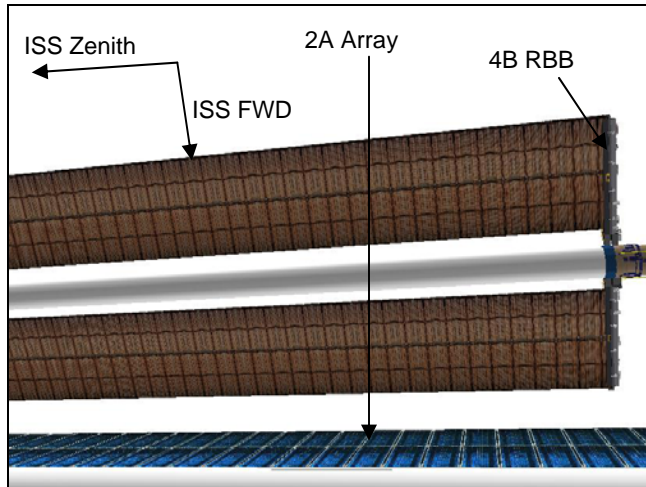


Figure 6.- Bay Count for 4B Array
(24: Tip Elbow:+85, +35).

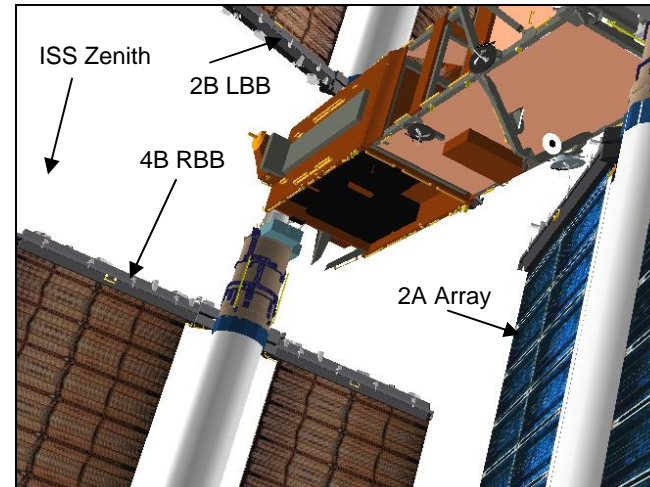


Figure 7.- Tension Bar Monitoring for 4B Array
(25: Tip LEE).

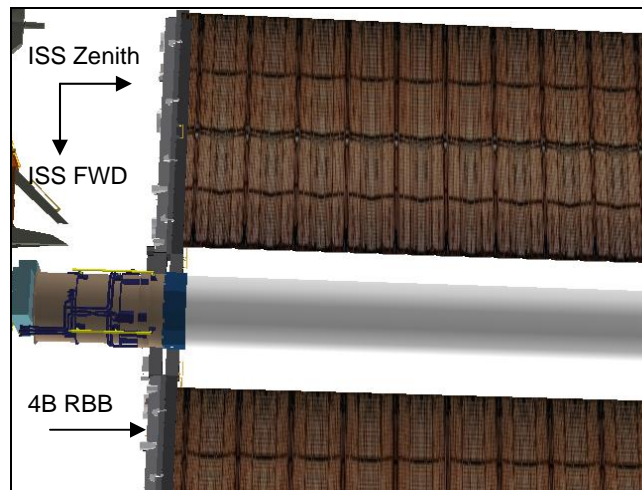


Figure 8.- Big Picture View for 4B Deploy
(22: Base Elbow: +45, -35).

P6 DEPLOY VIEWING SUPPORT BACKUP CAMERAS

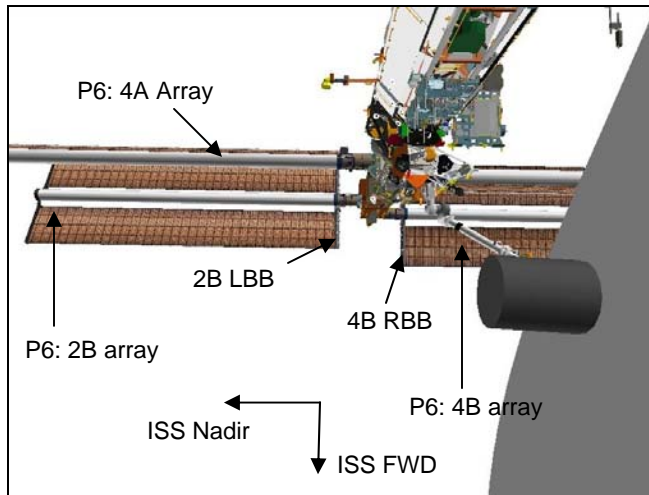


Figure 9.- Big Picture View for Deploy
(Camera A: +90, +5).

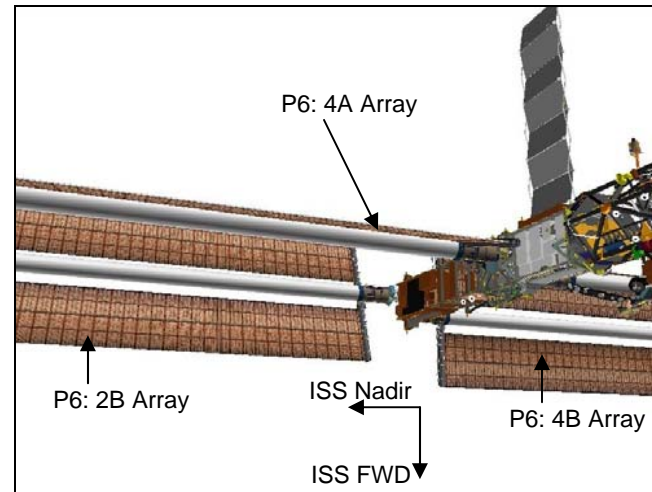


Figure 10.- Big Picture View for Deploy
(Camera B: -70, +15).

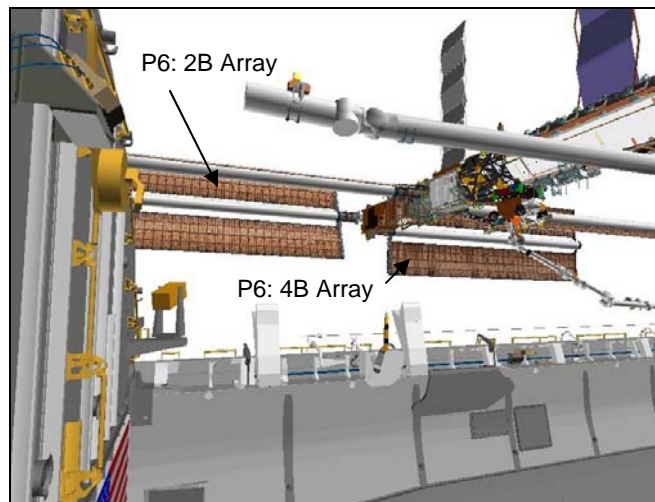


Figure 11.- Big Picture View for Deploy
(Camera C: -70, +5).

P6 DEPLOY VIEWING SUPPORT BACKUP CAMERAS

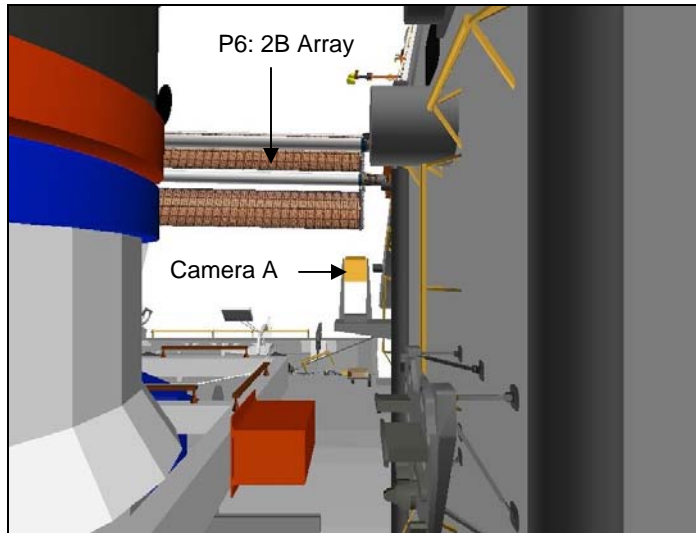


Figure 12.- Big Picture View for Deploy
(Camera D: +90, 0).

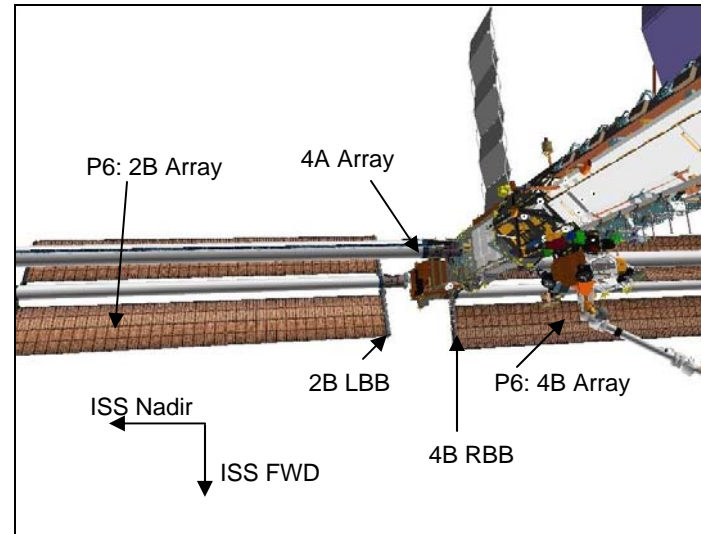


Figure 13.- Big Picture View for Deploy
(SRMS ELB: +100, -15).

2.220 PDGF RELEASE SUPPORT

(RBT FS/10A/FIN 1)

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1. SETUP

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
03: S1 Lower Outboard (+95, +20)	92: Camera A (0, +10)	22: Base Elbow (+85, 0) 24: Tip Elbow (-5, 0)	OBSS ITVC (+90, -50)

PCS

MSS: SSRMS:

Verify 'Unloaded Parameters' (two) – Chest 12/PP/F/6, SY Held

Verify Display

– ISS>OBAS

Verify Command

– ISS>OBAS/Internal

√Vernier

Verify SSRMS at SASA Clearance position (within 5 cm).

Locked		SR	SY	SP	EP	WP	WY	WR	
		+22.3	+69.3	+17.5	+117.9	-133.8	+138.8	+128.0	
		X	Y	Z	Pitch	Yaw	Roll		
		-1994	+75	-1020	-170.0	+78.7	+70.1		
FOR	Unloaded – Chest 12/PP/F/6, SY Held								
Disp	ISS>OBAS								

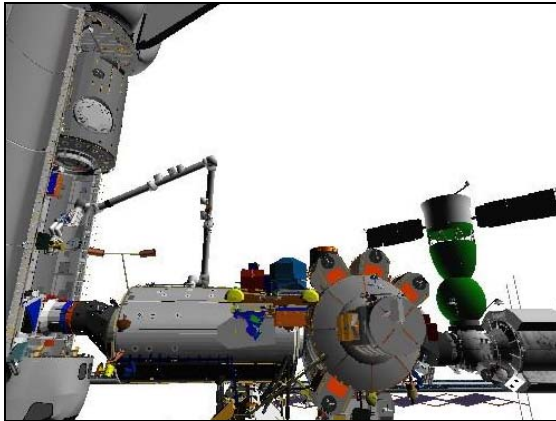


Figure 1.- SASA Clearance
(03: S1 Lower Outboard: +95, +20).

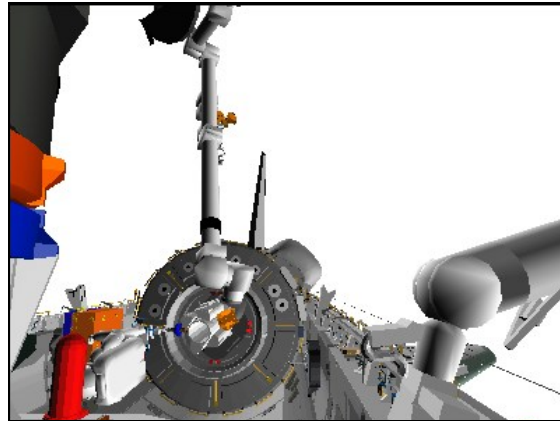


Figure 2.- SASA Clearance
(92: Camera A: 0, +10).

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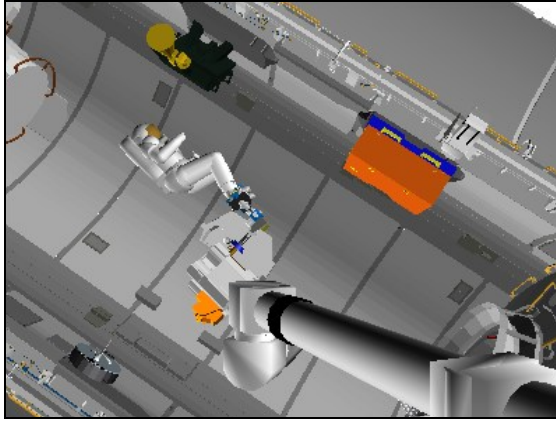


Figure 3.- SASA Clearance
(22: Base Elbow: +85, 0).

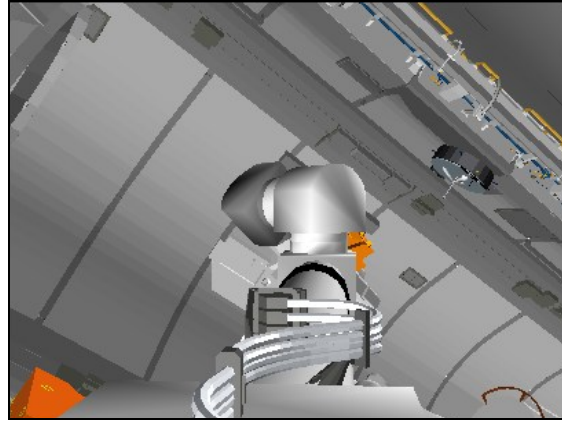


Figure 4.- SASA Clearance
(24: Tip Elbow: -5, 0).

2. PDGF RELEASE SUPPORT

2.1 Maneuver to Payload Bay Clearance 1

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

THC/
RHC

Maneuver to Payload Bay Clearance 1 position.

Verify SSRMS at Payload Bay Clearance 1 position (within 5 cm).

	Locked					
SR	SY	SP	EP	WP	WY	WR
+31.7	+69.3	+3.3	+134.0	-129.8	+138.6	+132.4
X	Y	Z	Pitch	Yaw	Roll	
-1994	+75	-1255	-170.0	+78.7	+70.1	
FOR	Unloaded – Chest 12/PP/F/6, SY Held					
Disp	ISS>OBAS					

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Figure 5.- Payload Bay Clearance 1
(03: S1 Lower Outboard: +95, +20).

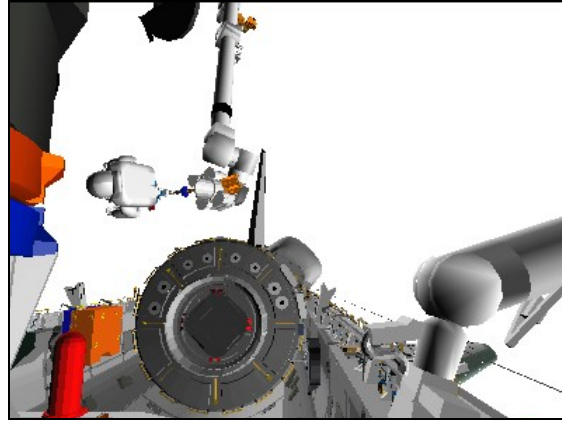


Figure 6.- Payload Bay Clearance 1
(92: Camera A: 0, +10).

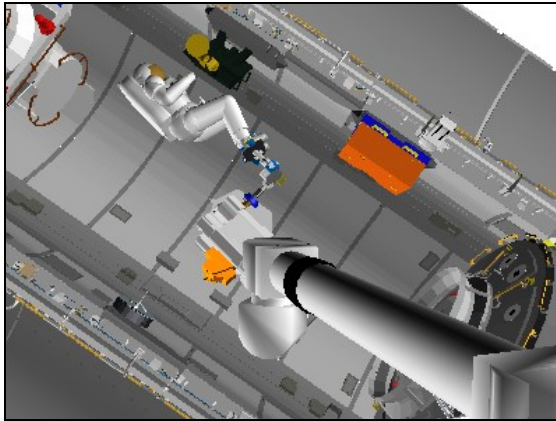


Figure 7.- Payload Bay Clearance 1
(22: Base Elbow: +65, -5).

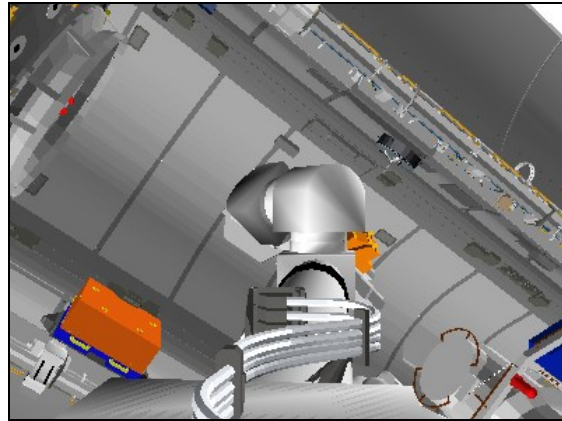


Figure 8.- Payload Bay Clearance 1
(24: Tip Elbow: -5, 0).

2.2 JOCAS to PDGF Release Setup Position

PCS

MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

Input 'Joint Angles' 'Destination' for PDGF Release Setup position.

SR	SY	SP	EP	WP	WY	WR
+46.4	+69.3	+4.6	+140.7	-158.9	+168.2	-52.6

cmd Load (Verify Sequence Status – Confirm or Cancel)

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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)	+31.7	+69.3	+3.3	+134.0	-129.8	+138.6	+132.4
TGT	+46.4	+69.3	+4.6	+140.7	-158.9	+168.2	-52.6
ERR	-14.7	0.0	-1.3	-6.7	+29.1	-29.6	+185.0

PCS * If joint angles or 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

PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at PDGF Release Setup position (within 1 deg).

SR	SY	SP	EP	WP	WY	WR
+46.4	+69.3	+4.6	+140.7	-158.9	+168.2	-52.6
X	Y	Z	Pitch	Yaw	Roll	
-2090	-125	-1190	-138.5	-71.4	+1.1	
FOR	Unloaded – Chest 12/PP/F/6, SY Held					
Disp	ISS>OBAS					

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Figure 9.- PDGF Release Setup
(03: S1 Lower Outboard: +95, +20).

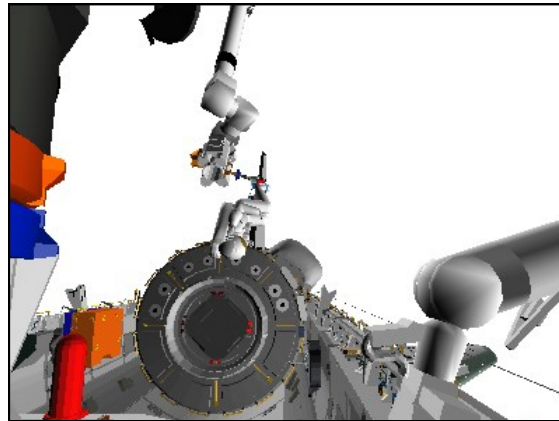


Figure 10.- PDGF Release Setup
(92: Camera A: 0, +10).

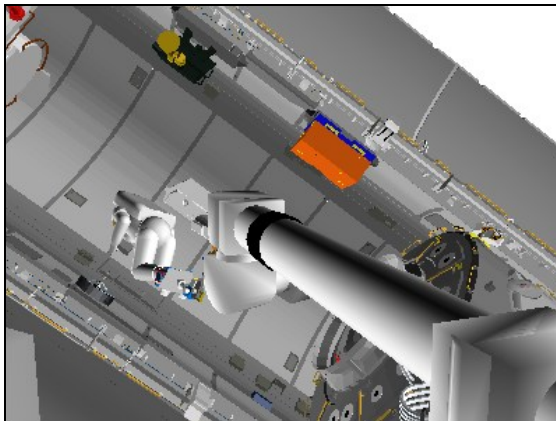


Figure 11.- PDGF Release Setup
(22: Base Elbow: +60, -10).

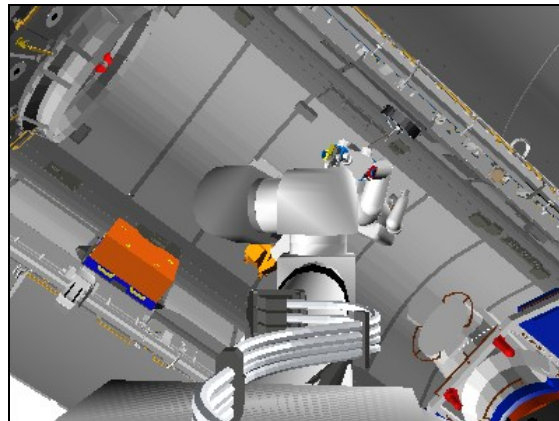


Figure 12.- PDGF Release Setup
(24: Tip Elbow: -5, 0).

2.3 Maneuver to PDGF Release Position

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

THC/
RHC

Maneuver to PDGF Release position.
GCA as required to release the PDGF bolts.

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Expected SSRMS at PDGF Release position.

	Locked					
SR	SY	SP	EP	WP	WY	WR
+35.1	+69.3	+13.5	+131.7	-168.5	+166.9	-56.5
X	Y	Z	Pitch	Yaw	Roll	
-2090	-125	-1030	-138.5	-71.4	+1.2	
FOR	Unloaded – Chest 12/PP/F/6, SY Held					
Disp	ISS>OBAS					



Figure 13.- PDGF Release
(03: S1 Lower Outboard: +95, +20).

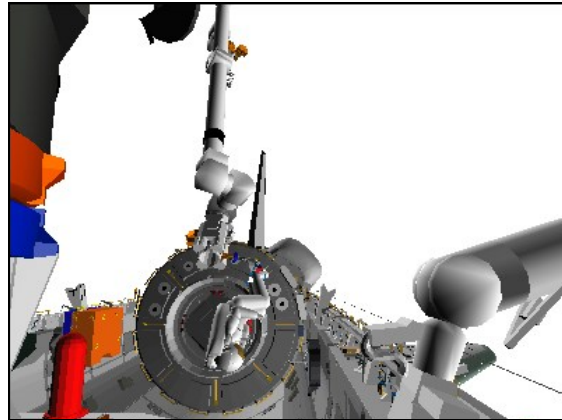


Figure 14.- PDGF Release
(92: Camera A: 0, +10).

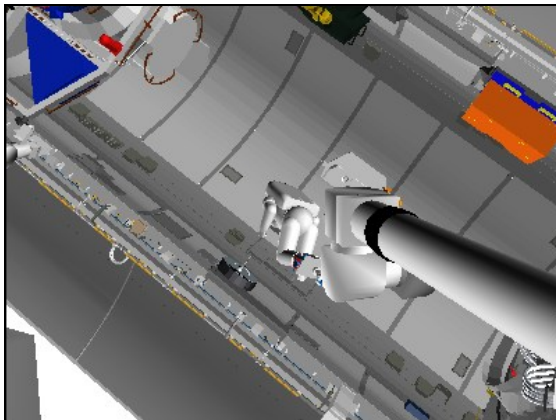


Figure 15.- PDGF Release
(22: Base Elbow: +60 -10).

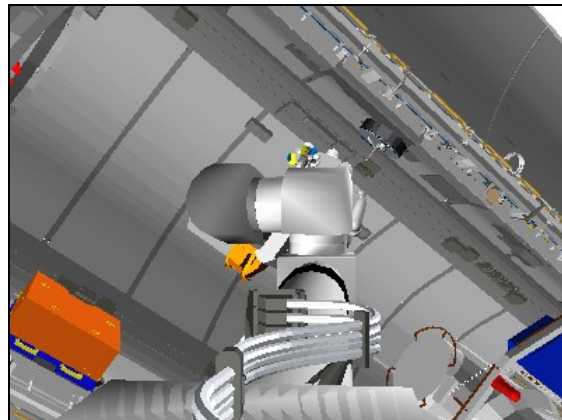


Figure 16.- PDGF Release
(24: Tip Elbow: -5, 0).

3. APFR EGRESS AND REMOVAL

On EVA GO:

THC/
RHC

GCA to APFR Egress position.

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Expected SSRMS at APFR Egress position.

	Locked					
SR	SY	SP	EP	WP	WY	WR
+11.6	+69.3	-14.5	+141.3	-170.3	+162.4	-63.6
X	Y	Z	Pitch	Yaw	Roll	
-2090	-225	-1135	-138.5	-71.4	+1.2	
FOR	Unloaded – Chest 12/PP/F/6, SY Held					
Disp	ISS>OBAS					

On EVA GO (APFR Egress complete):

PCS

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

Change Unloaded Parameters ► Unloaded ► LEE Tip SYH
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

GCA to APFR Removal position.

Expected SSRMS at APFR Removal position.

	Locked					
SR	SY	SP	EP	WP	WY	WR
+9.4	+69.3	-5.5	+134.7	-174.7	+161.8	-64.2
X	Y	Z	Pitch	Yaw	Roll	
-2173	-143	-1175	-49.6	+0.4	+88.4	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>OBAS					

4. MANEUVER TO NODE 2 PRE-GRAPPLE SETUP POSITION

4.1 Maneuver to Payload Bay clearance 2 position

On IV GO for maneuver to Node 2 Pre-Grapple:

Verify APFR, WIF adapter, and Safety tether have been removed and EV crew is clear of the SSRMS.

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THC/
RHC

Maneuver to Payload Bay Clearance 2 position (SR, SP, EP within 2 deg).

	Locked					
SR	SY	SP	EP	WP	WY	WR
+70.4	+69.3	+22.4	+137.6	-152.9	+168.7	-44.0
X	Y	Z	Pitch	Yaw	Roll	
-2172	+50	-1350	-49.6	+0.4	+88.4	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>OBAS					

Notify **MCC-H**, "GO for STBD TRRJ auto-track."



Figure 17.- Payload Bay Clearance 2 (03: S1 Lower Outboard: +95, +20).

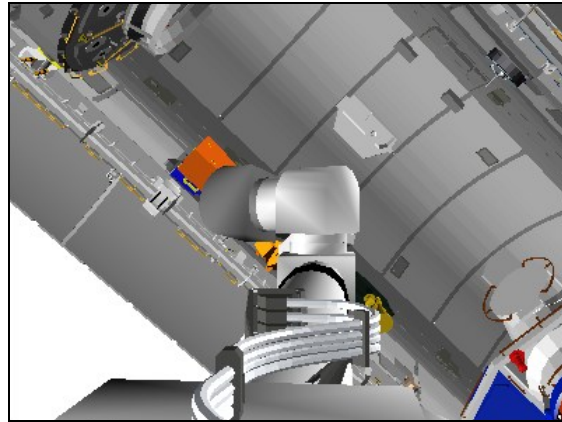


Figure 18.- Payload Bay Clearance 2 (24: Tip Elbow: -5, 0).

4.2 JOCAS to Node 2 Pre-Grapple Setup

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
03: S1 Lower Outboard (+95, +20)	24: Tip Elbow (+10, +5)	91: Camera D (0, +20)	Camera C (0, +35) OBSS ITVC (+90, -50)

PCS

MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

pick File ► LAB ► N2 Pre-Grapple

Verify 'Joint Angles' 'Destination' for Node2 Pre-Grapple Setup position.

SR	SY	SP	EP	WP	WY	WR
+29.7	+69.3	+10.0	+48.7	-88.3	-132.0	+146.5

cmd Load (Verify Sequence Status – Confirm or Cancel)

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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)	+70.4	+69.3	+22.4	+137.6	-152.9	+168.7	-44.0
TGT	+29.7	+69.3	+10.0	+48.7	-88.3	-132.0	+146.5
ERR	+40.7	0.0	+12.4	+88.9	-64.6	+300.7	-190.5

PCS * If joint angles or 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)

Notify EVA, "Maneuvering SSRMS to Node 2 Pre-Grapple Setup position."

DCP AUTO SEQ → PROC

PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at Node 2 Pre-Grapple Setup position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+29.7	+69.3	+10.0	+48.7	-88.3	-132.0	+146.5
X	Y	Z	Pitch	Yaw	Roll	
-3038	+302	-1472	-96.1	-46.4	-87.0	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>OBAS					

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Figure 19.- Node 2 Pre-Grapple Setup
(03: S1 Lower Outboard: +95, +20).

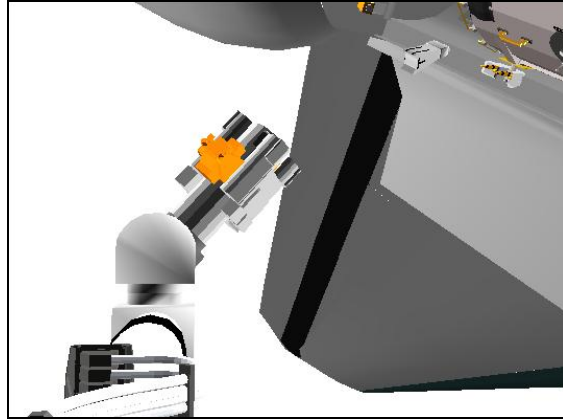


Figure 20.- Node 2 Pre-Grapple Setup
(24: Tip Elbow: 0, +5).

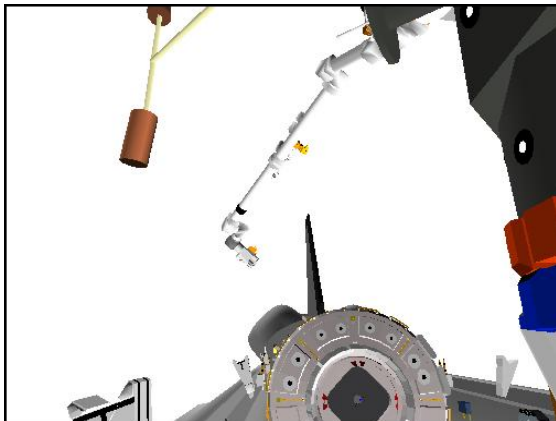


Figure 21.- Node 2 Pre-Grapple Setup
(91: Camera D: 0, +20).

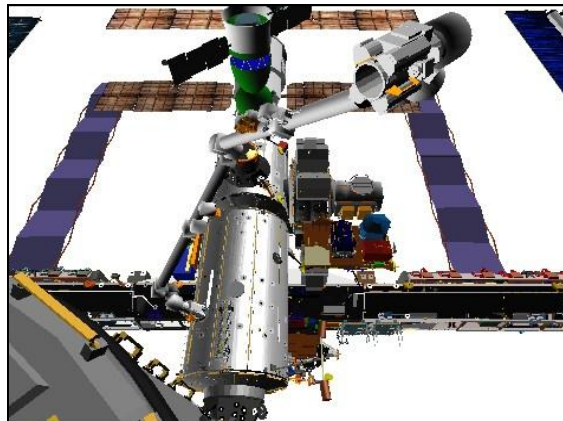


Figure 22.- Node 2 Pre-Grapple Setup
(V10: Camera C: 0, +35).

4.3 FOR OCAS to Node 2 Pre-Grapple

MSS: SSRMS:

Change Display ► LAB ► Berthed Node2 FRGF (Verify LAB>Berthed Node2 FRGF)

MSS: SSRMS:

Enter Mode – FOR OCAS (Verify blue)

MSS: SSRMS: SSRMS FOR OCAS: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

pick File ► LAB ► N2 Pre-Grapple

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Verify 'FOR' 'Destination' for Node 2 Pre-Grapple position.

X	Y	Z	Pitch	Yaw	Roll
-150	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	-296	-73	-175	-5.5	-4.3	+7.5
TGT	-150	0	0	0.0	0.0	0.0
ERR	-146	-73	-175	-5.5	-4.3	+7.5

PCS

- * If FOR or 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

PCS

MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at Node 2 Pre-Grapple position (within 5 cm/1 deg).

Locked		SR	SY	SP	EP	WP	WY	WR
		+29.2	+69.3	+20.0	+48.7	-88.5	-132.2	+146.3
		X	Y	Z	Pitch	Yaw	Roll	
		-150	0	0	0.0	0.0	0.0	
FOR	Unloaded – LEE Tip, SY Held							
Disp	LAB>Berthed Node2 FRGF							

DCP

BRAKES SSRMS → ON (Verify ON)

Notify EVA/IV, “SSRMS at Node 2 Pre-Grapple position.”

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Figure 23.- Node 2 Pre-Grapple
(03: S1 Lower Outboard: +95, +20).

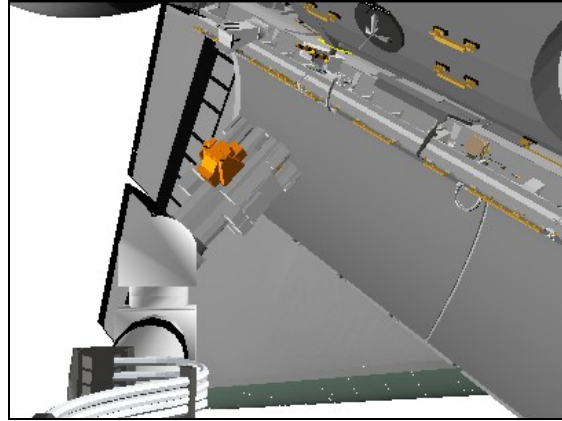


Figure 24.- Node 2 Pre-Grapple
(24: Tip Elbow: +10, +5).

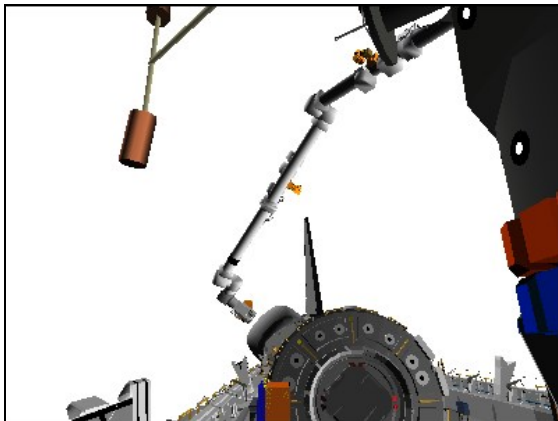


Figure 25.- Node 2 Pre-Grapple
(91: Camera D: 0, +20).

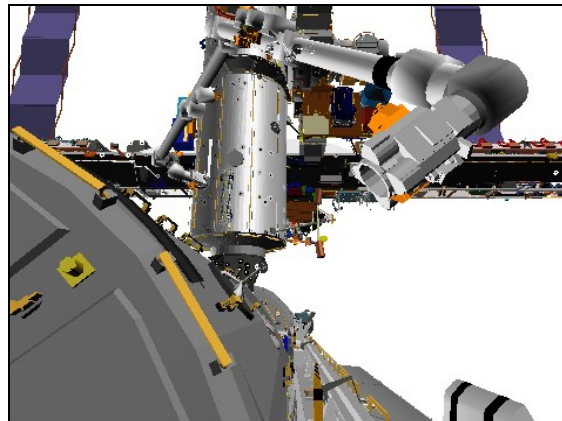


Figure 26.- Node 2 Pre-Grapple
(V10: Camera C: 0, +15).

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1. SETUP

Verify with **MCC-H** Port TRRJ locked at 0 deg

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
22: Base Elbow (+60, -20)	25: Tip LEE	24: Tip Elbow (0, 0)	Camera B (-5, +30)

PCS

MSS: SSRMS:

Change Loaded Parameters ► Node2 ► Node2 Install CBCS SYH

Verify 'Loaded Parameters' (two) – Node2 Install CBCS, SY Held

Verify Unloaded Parameters – √

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

Verify Display – LAB>N1 Mated Node2 FRGF

Verify Command – SSRMS>Internal

Verify SSRMS at Node 2 Clearance position (within 5 cm/1 deg).

	Locked					
SR	SY	SP	EP	WP	WY	WR
-88.1	-25.2	-27.9	+144.4	-109.3	-70.3	-45.6
X	Y	Z	Pitch	Yaw	Roll	
-200	+200	+200	0.0	0.0	0.0	
FOR	Unloaded – LEE Tip, SY Held					
Disp	LAB>N1 Mated Node2 FRGF					

√Vernier

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: as desired

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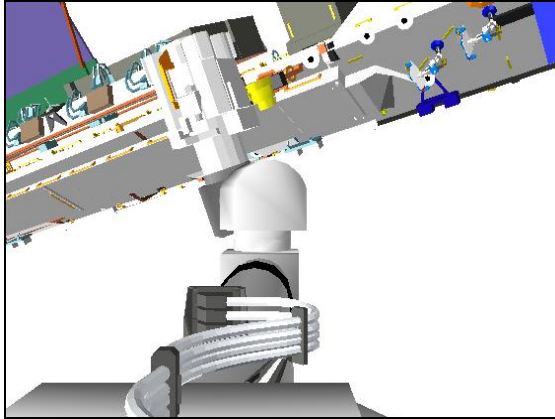


Figure 1.- Node 2 Clearance Position
(24: Tip Elbow: 0, 0).

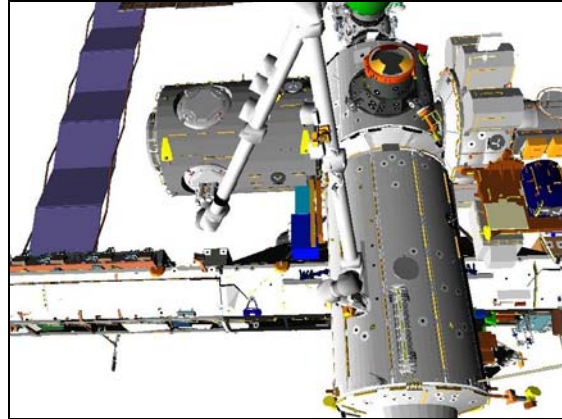


Figure 2.- Node 2 Clearance Position
(V10: Camera B: -5, +30).

2. FOR OCAS TO PRE-GRAPPLE POSITION

NOTE

1. Clearance between wrist cluster and ESP-1 is approximately 25 cm (10 in) at the pre-grapple position. The clearance can be monitored with the Tip Elbow Camera or the Base Elbow Camera.
2. The cross cluster self-collision warning is in alarm at the beginning of this maneuver. The warning will disappear during this maneuver when the Elbow Pitch angle is $\leq +142.0$ deg.

DCP BRAKES SSRMS → OFF (Verify OFF)

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 Node 2 Pre-Grapple position.

X	Y	Z	Pitch	Yaw	Roll
-65	0	0	0.0	0.0	0.0

cmd Load (Verify Sequence Status – Confirm or Cancel)

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

	X	Y	Z	Pitch	Yaw	Roll
FOR	-200	+200	+200	0.0	0.0	0.0
TGT	-65	0	0	0.0	0.0	0.0
ERR	-135	+200	+200	0.0	0.0	0.0

PCS * If FOR or 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

PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at Node 2 Pre-Grapple position (within 5 cm/1 deg).

	Locked					
SR	SY	SP	EP	WP	WY	WR
-125.8	-25.2	+15.3	+139.0	-84.5	-46.9	+6.4
X	Y	Z	Pitch	Yaw	Roll	
-65	0	0	0.0	0.0	0.0	
FOR	Unloaded – LEE Tip, SY Held					
Disp	LAB>N1 Mated Node2 FRGF					

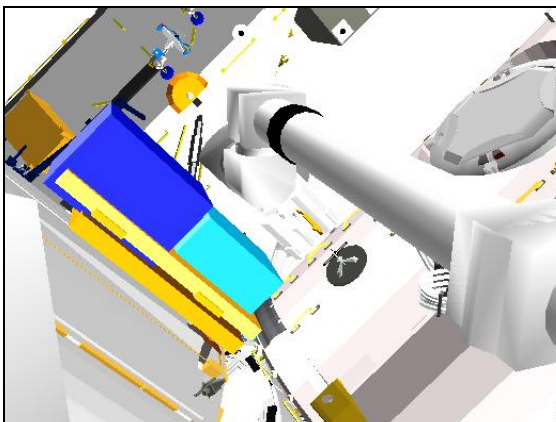


Figure 3.- Node 2 Pre-Grapple Position
(22: Base Elbow: +60, -20).

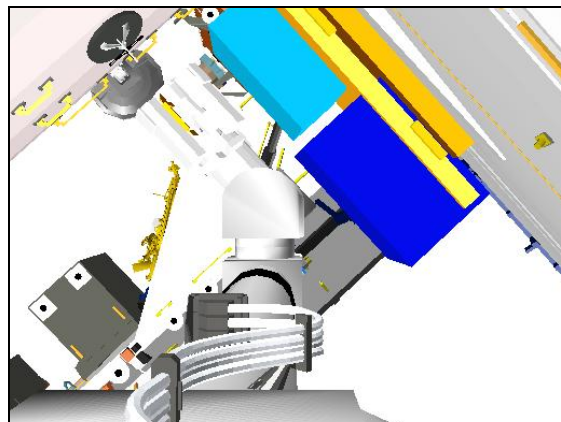


Figure 4.- Node 2 Pre-Grapple Position
(24: Tip Elbow: 0, 0).

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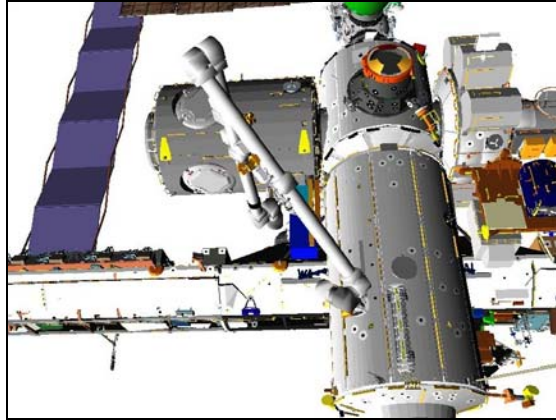


Figure 5.- Node 2 Pre-Grapple Position
(V10: Camera B: -5, +30).

3. MATED NODE 2 GRAPPLE

3.1 Maneuvering to Within Grapple Envelope

PCS

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

RHC/
THC

Maneuver to within grapple envelope.

3.2 Slow Capture Commands

PCS

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)

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cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Auto Capture

RHC 3.3 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

DCP 3.4 Grapple Cleanup
BRAKES SSRMS → ON (Verify ON)

PCS MSS: SSRMS:

Verify Loaded Parameters – √

Verify 'Loaded Parameters' (two) – Node2 Install CBCS, SY Held

Change Display ► LAB ► Node2 Install CBCS (Verify
LAB>Node2 Install CBCS)

Verify Command – SSRMS>Internal

Expected Mated Node 2 Grapple position.

SR	SY	SP	EP	WP	WY	WR
-131.8	-25.2	+19.2	+133.6	-78.8	-41.8	+8.7
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded – Node2 Install CBCS, SY Held					
Disp	LAB>Node2 Install CBCS					

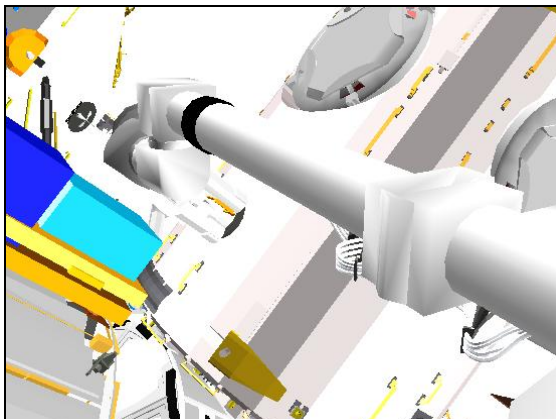


Figure 6.- Node 2 Install Position
(22: Base Elbow: +75, -20).

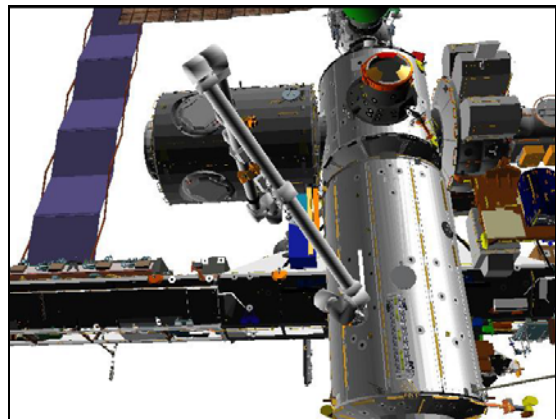


Figure 7.- Node 2 Install Position
(V10: Camera B: -5, +30).

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4. ATTITUDE CONTROL CONFIGURATION

MSS: SSRMS: Thrusters:

Verify 'Desat Request:' Inhibit

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

5. MANEUVER TO NODE 2 PRE-INSTALL

On CBM operator GO to demate Node 2 (Verify latches deployed):

NOTE	
1.	Monitor clearances between SSRMS and ESP-1 with the Tip Elbow and Base Elbow Cameras. Minimum clearance at the start is approximately 25 cm (10 in), but increases with the maneuver.
2.	Monitor clearance between Node 2 and the stanchion on Node 1 Zenith Aft with OBSS ITVC Camera. Minimum clearance at the start is approximately 81 cm (32 in), but increases with the maneuver.

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
92: Camera B (-5,+30)	17: CBCS	22: Base Elbow (+75, -20) 24: Tip Elbow (+5, +15)	OBSS ITVC (+75, -70)

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 Node 2 to Node 2 Pre-Install position

		Locked					
SR	SY	SP	EP	WP	WY	WR	
-116.6	-25.2	+12.6	+125.1	-75.9	-54.5	+1.0	
X	Y	Z	Pitch	Yaw	Roll		
+200	0	0	0.0	0.0	0.0		
FOR	Loaded – Node2 Install CBCS, SY Held						
Disp	LAB>Node2 Install CBCS						

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PCS

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

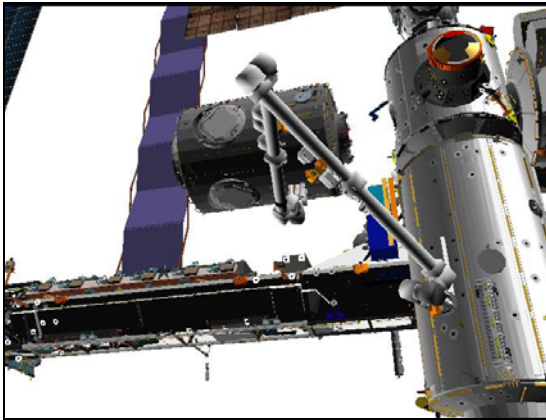


Figure 8.- Node 2 Pre-Install
(92: Camera B: -15, +30).

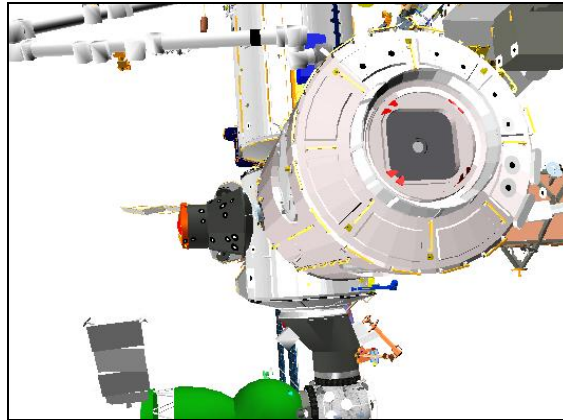


Figure 9.- Node 2 Pre-Install
(V10: OBSS ITVC: +75, -70).

6. ATTITUDE CONTROL CONFIGURATION

If using shuttle attitude control, coordinate with shuttle crewmembers:

If attitude maintenance required:

Configure DAP per RMS DAPs, then

Perform RATE DAMPING (ORB OPS FS, DOCKED DAP REFERENCE), then:

When in attitude

DAP: FREE

7. FOR OCAS TO INTERMEDIATE STEP

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
09: P1 Lower Outboard (+80, +20)	91: Camera C (-25, +35)	22: Base Elbow (+70, -30)	Camera A (+50, +50)

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)

2.311 NODE 2 REBERTH

(RBT FS/10A/FIN 1)

SSRMS FOR OCAS

Input 'FOR' 'Destination' for Intermediate position.

X	Y	Z	Pitch	Yaw	Roll
+500	0	+500	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	+200	0	0	0.0	0.0	0.0
TGT	+500	0	+500	0.0	0.0	0.0
ERR	-300	0	-500	0.0	0.0	0.0

* If FOR or 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

PCS

MSS: SSRMS: **SSRMS**

Verify Posn Hold – orange

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

	Locked					
SR	SY	SP	EP	WP	WY	WR
-86.0	-25.2	-29.5	+109.0	-78.8	-70.4	-51.5
X	Y	Z	Pitch	Yaw	Roll	
+500	0	+500	0.0	0.0	0.0	
FOR	Loaded – Node2 Install CBCS, SY Held					
Disp	LAB>Node2 Install CBCS					

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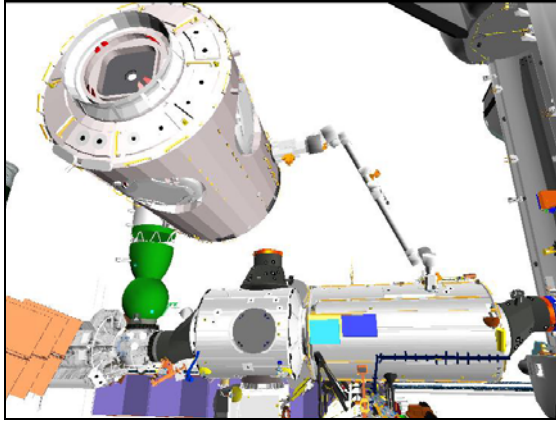


Figure 10.- Intermediate Position
(09: P1 Lower Outboard: +80, +20).

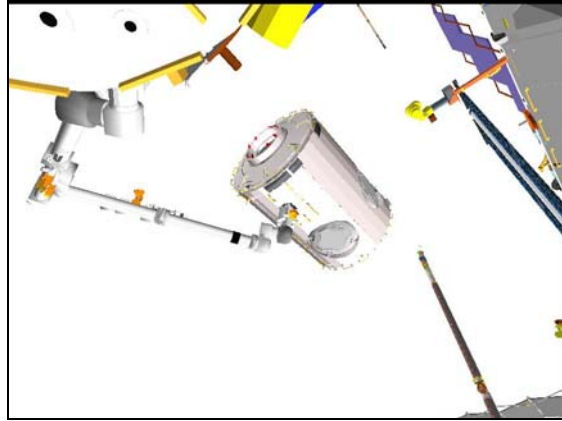


Figure 11.- Intermediate Position
(92: Camera A: +50, +50).

8. ATTITUDE CONTROL CONFIGURATION

If using shuttle attitude control, coordinate with shuttle crewmembers:

If attitude maintenance required:

Configure DAP per RMS DAPs, then

Perform RATE DAMPING (ORB OPS FS, DOCKED DAP REFERENCE), then:

When in attitude

DAP: FREE

9. JOCAS TO NODE 2 PORT HOVER

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
09: P1 Lower Outboard (+80, +20)	91: Camera C (-25, +35)	24: Tip Elbow (-20, +20)	Camera A (+20, +30)

RHC RATE → COARSE (Verify Coarse on PCS)

PCS MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

Input 'Joint Angles' 'Destination' for Node 2 Port Hover position.

SR	SY	SP	EP	WP	WY	WR
+5.7	+36.4	-43.2	+85.5	-129.0	-123.4	+88.6

cmd Load (Verify Sequence Status – Confirm or Cancel)

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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)	-86.0	-25.2	-29.5	+109.0	-78.8	-70.4	-51.5
TGT	+5.7	+36.4	-43.2	+85.5	-129.0	-123.4	+88.6
ERR	-91.7	-61.6	+13.7	+23.5	+50.2	+53.0	-140.1

PCS * If joint angles or 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

PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify Joint Angle values.

SR	SY	SP	EP	WP	WY	WR
+5.7	+36.4	-43.2	+85.5	-129.0	-123.4	+88.6

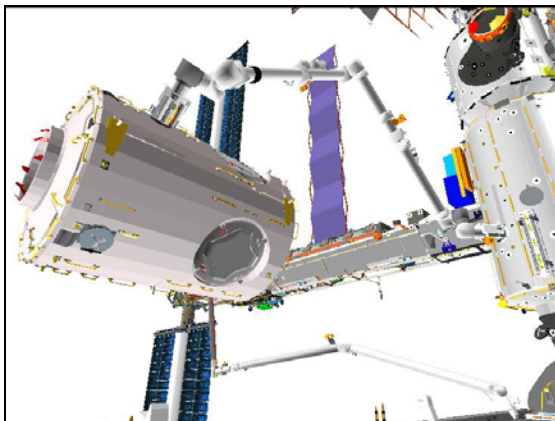


Figure 12.- Node 2 Port Hover
(91: Camera C: -45, +25).



Figure 13.- Node 2 Port Hover
(V10: Camera A: +20, +30).

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(RBT FS/10A/FIN 1)

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10. ATTITUDE CONTROL CONFIGURATION

If using shuttle attitude control, coordinate with shuttle crewmembers:

If attitude maintenance required:

Configure DAP per RMS DAPs, then

Perform RATE DAMPING (ORB OPS FS, DOCKED DAP REFERENCE), then:

When in attitude

DAP: FREE

11. FOR OCAS TO NODE 2 LOW HOVER

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
09: P1 Lower Outboard (+105, +30)	91: Camera C (-45, +25)	03: S1 Lower Outboard (+90, +25)	SRMS Elbow (-130, +35)

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

Change Loaded Parameters ► Node2 ► Node2 Unberth SRH

Verify 'Loaded Parameters' (two) – Node2 Unberth, SR Held

Change Display ► LAB ► Node2 Unberth (Verify LAB>Node2 Unberth)

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

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 Node 2 Low Hover position.

X	Y	Z	Pitch	Yaw	Roll
0	0	-600	0.0	0.0	0.0

cmd Load (Verify Sequence Status – Confirm or Cancel)

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

	X	Y	Z	Pitch	Yaw	Roll
FOR	0	-700	-600	0.0	0.0	0.0
TGT	0	0	-600	0.0	0.0	0.0
ERR	0	-700	0	0.0	0.0	0.0

PCS * If FOR or 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

PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at Node 2 Low Hover position (within 5 cm/1 deg).

Locked	SR	SY	SP	EP	WP	WY	WR
	+5.7	+70.0	-35.1	+70.5	-83.8	-137.3	+137.2
	X	Y	Z	Pitch	Yaw	Roll	
	0	0	-600	0.0	0.0	0.0	
FOR	Loaded – Node2 Unberth, SR Held						
Disp	LAB>Node2 Unberth						

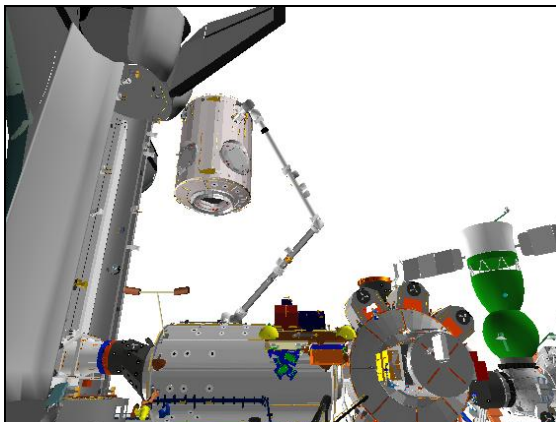


Figure 14.- Node 2 Low Hover
 (03: S1 Lower Outboard: +90, +25).

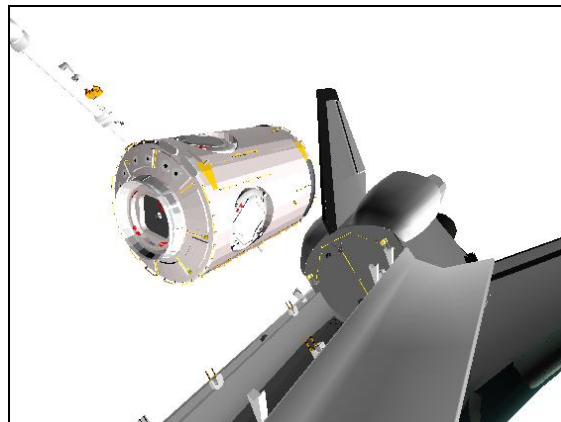


Figure 15.- Node 2 Low Hover
 (V10 SRMS Elbow: -130, +35).

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NOTE

1. Due to clearance concerns with Node 2 Handrails and V-guides during Node 2 Reberth, maintain FOR within 5 cm/1 deg to avoid contact.
2. Use previously recorded Node 2 Unberth Joint Angles / FOR values for Joint Angle/FOR bias.

RHC RATE → VERNIER (Verify Vernier on PCS)

PCS MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

THC/
RHC Maneuver to Node 2 Reberth position (within 5 cm/1 deg). (THC down)
(until Shuttle callout of PL RETEN RDY 1,2,3,4 to -gray)

	Locked							
	SR	SY	SP	EP	WP	WY	WR	
Expected	+5.7	+69.3	+0.3	+56.8	-105.9	-136.8	+136.5	
	X	Y	Z	Pitch	Yaw	Roll		
Expected	0	0	0	0.0	0.0	0.0		
	FOR	Loaded – Node2 Unberth, SR Held						
	Disp	LAB>Node2 Unberth						



Figure 16.- Node 2 Reberth Position
(03: S1 Lower Outboard: +90, +25).

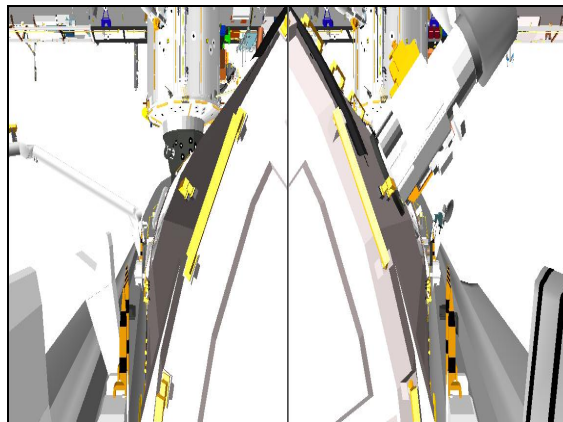


Figure 17.- Node 2 Reberth Position
(91: Mux B/C; FL = 8.4 mm).

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PCS MSS: SSRMS:

Verify Posn Hold – orange

If any PL RETEN RDY tb – bp, $\sqrt{\text{MCC}}$ for go to perform off-nominal situation (starred block).

* A6U $\sqrt{\text{PL RETEN LAT 5 tb – LAT}}$
*
* Note single motor drive times (> 30 seconds)
*
* PL RETEN LAT 5 – REL (tb-REL), 60 s max
* – OFF
*
* Notify SSRMS operator, AKA Released.
*

* THC/
* RHC Maneuver to Node 2 Berthed position (Until shuttle
 callout of PL RETEN RDY 1,2,3,4 tb – gray).

* PCS MSS: SSRMS:

* Verify Node 2 Berth Posn (Y within 2.5cm)

Locked						
SR	SY	SP	EP	WP	WY	WR
+5.7	+69.3	+0.3	+56.8	-105.9	-136.8	+136.5
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded – Node2 Unberth, SR Held					
Disp	LAB>Node2 Unberth					

* Verify Posn Hold – orange

* Go to step 17.

18. [PRLA LATCH](#)

$\sqrt{\text{PL RETEN RDY 1,2,3,4 tb (four) – gray}}$
 $\sqrt{\text{LAT 1,2,3,4 tb (four) – REL}}$

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.

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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

19. 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 Node 2 Ungrapple

20. NODE 2 UNGRAPPLE

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
03: S1 Lower Outboard (+90, +25)	25: Tip LEE	13: LAB Stbd Zenith (+5, -45) 24: Tip Elbow (+15, +10)	Camera C (0, +15)

NOTE

1. Monitor clearance between the Wrist Roll and orbiter sill with Camera C. Minimum clearance during maneuver to grapple is approximately 93 cm (37 in).
2. Tip LEE Camera must be fully zoomed out to correspond to target overlay.

PCS MSS: SSRMS: Limp:

cmd None Limp (Verify Standby – blue)

MSS: SSRMS:

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

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Change Display ► LAB ► Berthed Node2 FRGF (Verify LAB>Berthed Node2 FRGF)

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

√Vernier

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: as desired

21. BERTHED NODE 2 UNGRAPPLE

21.1 SSRMS LIMP

MSS: SSRMS: Limp:

cmd All Limp (Verify Limp – blue)

MSS: SSRMS:

Verify all joints – Limped

21.2 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)

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)
Verify Unloaded Parameters – √

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21.3 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)

Maneuver SSRMS to Node 2 Ungrapple position
(within 5 cm/1 deg).

THC/
RHC

	Locked					
SR	SY	SP	EP	WP	WY	WR
+29.2	+69.3	+19.9	+48.7	-88.5	-132.2	+146.3
X	Y	Z	Pitch	Yaw	Roll	
-150	0	0	0.0	0.0	0.0	
FOR	Unloaded – LEE Tip, SY Held					
Disp	LAB>Berthed Node2 FRGF					



Figure 20.- Node 2 Ungrapple
(03: S1 Lower Outboard: +90, +25).

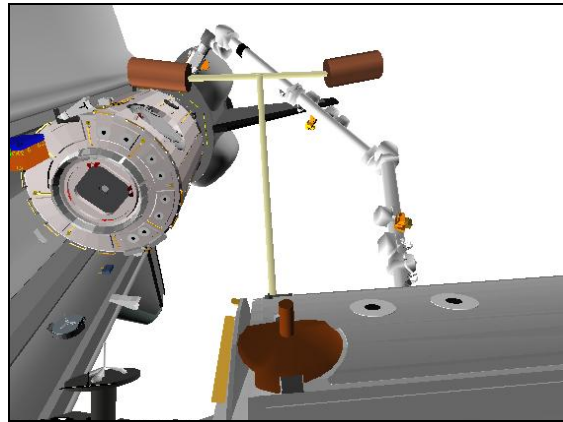


Figure 21.- Node 2 Ungrapple
(13: LAB Stbd Zenith: +5, -45).

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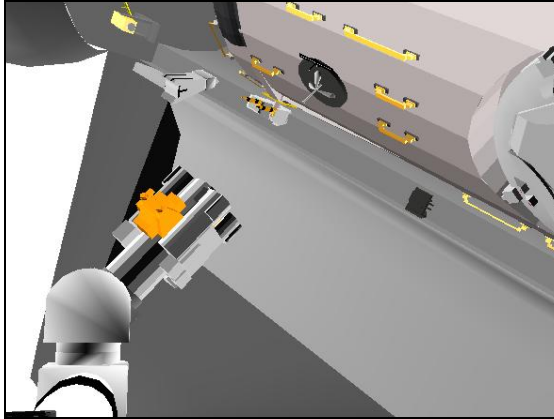


Figure 22.- Node 2 Ungrapple
(24: Tip Elbow: +15, +10).

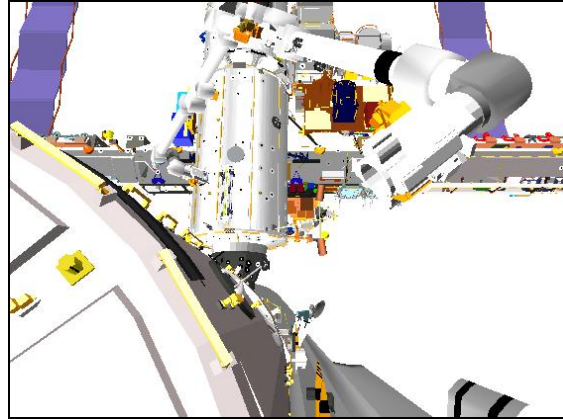


Figure 23.- Node 2 Ungrapple
(V10: Camera C: 0, +15).

22. JOCAS TO CLEARANCE POSITION

NOTE

Clearance between the SSRMS Tip LEE and the Node 2 FRGF is approximately 124 cm (49 in.). This clearance will increase during the maneuver.

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10
03: S1 Lower Outboard (+90, +25) 09: P1 Lower Outboard (+105, +30)	13: LAB Stbd Zenith (+15, -35)	24: Tip Elbow (+5, 0)	Camera C (0, +35)

PCS

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: 1.0

MSS: SSRMS:

√Vernier

Enter Mode – Joint OCAS (Verify blue)

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

SR	SY	SP	EP	WP	WY	WR
+31.7	+46.6	-55.3	+127.9	-90.0	+6.0	-82.0

cmd Load (Verify Sequence Status – Confirm or Cancel)

2.311 NODE 2 REBERTH

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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)	+29.2	+69.3	+19.9	+48.7	-88.5	-132.2	+146.3
TGT	+31.7	+46.6	-55.3	+127.9	-90.0	+6.0	-82.0
ERR	-2.5	+22.7	+75.2	-79.2	+1.5	-138.2	+228.3

PCS * If joint angles or 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

PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify Joint Angle values.

SR	SY	SP	EP	WP	WY	WR
+31.7	+46.6	-55.3	+127.9	-90.0	+6.0	-82.0

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)

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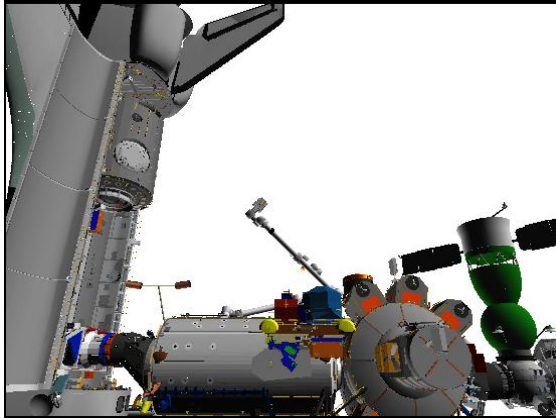


Figure 24.- Clearance Position
(03: S1 Lower Outboard : +90, +25).

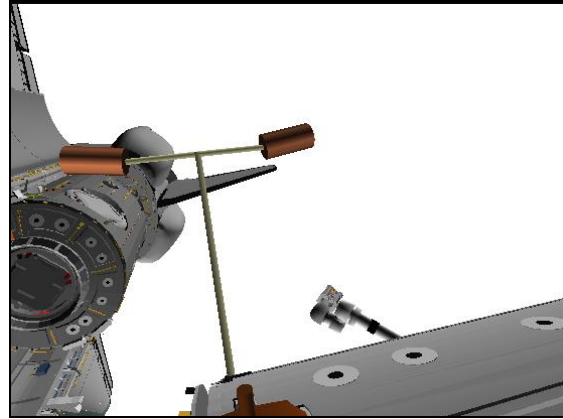


Figure 25.- Clearance Position
(13: LAB Stbd Zenith: +15, -35).

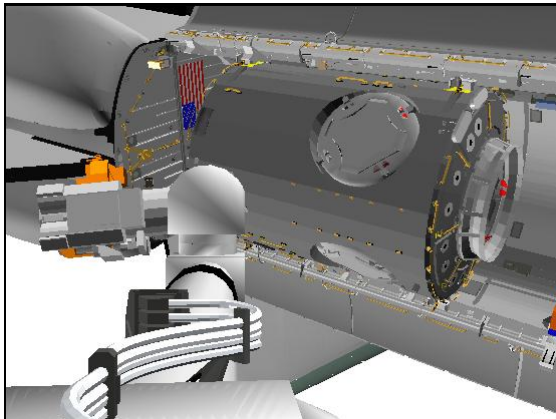


Figure 26.- Clearance Position
(24: Tip Elbow: +5, 0).

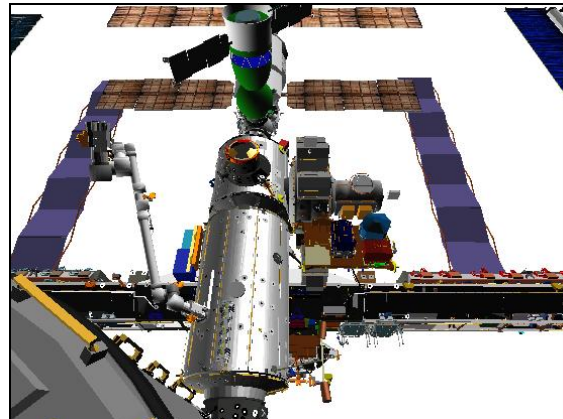


Figure 27.- Clearance Position
(V10: Camera C: 0, +35).

2.431 P6 SAW DEPLOY VIEWING SUPPORT CAMERA MATRIX (CONTINGENCY)

(RBT FS/10A/FIN 1)

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NOTE

This following assumptions are made for this camera matrix:

- a. Port SARJ = 20 deg/locked
- b. BGA 2A = 180 deg, BGA 4A = 105 deg
- c. BGA 2B = 200 deg, BGA 4B = 180 deg

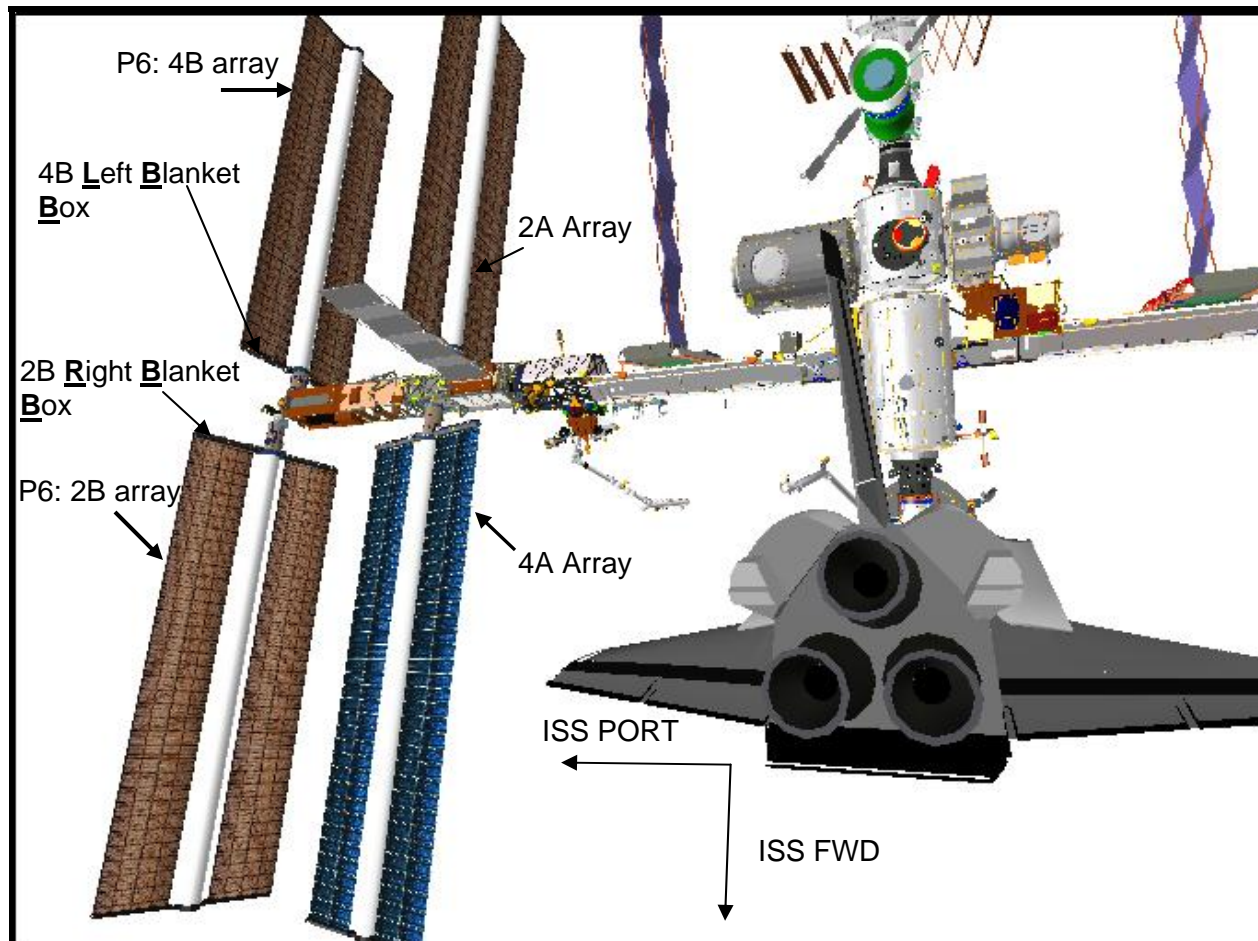


Figure 1.- 2B and 4B Arrays Deployed in Relation to the Obiter and ISS (ISS Ang).

2.431 P6 SAW DEPLOY VIEWING SUPPORT CAMERA MATRIX (CONTINGENCY)

(RBT FS/10A/FIN 1)

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P6: 2B ARRAY DEPLOY VIEWING SUPPORT

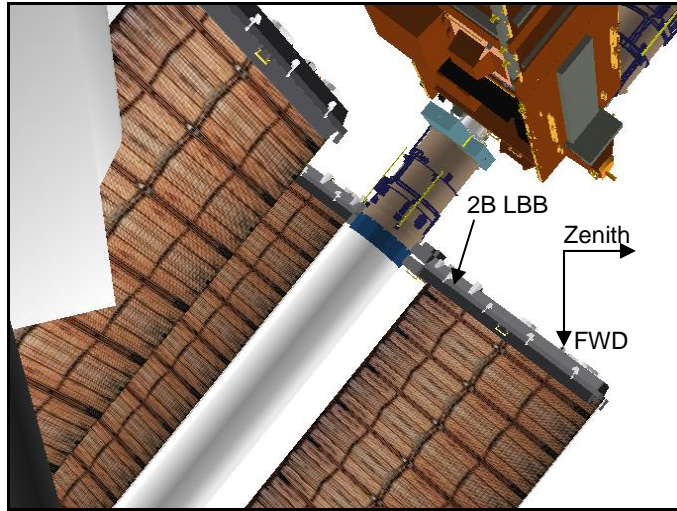


Figure 2.- Bay Count for 2B Array
(22: Base Elbow: +20, -40).

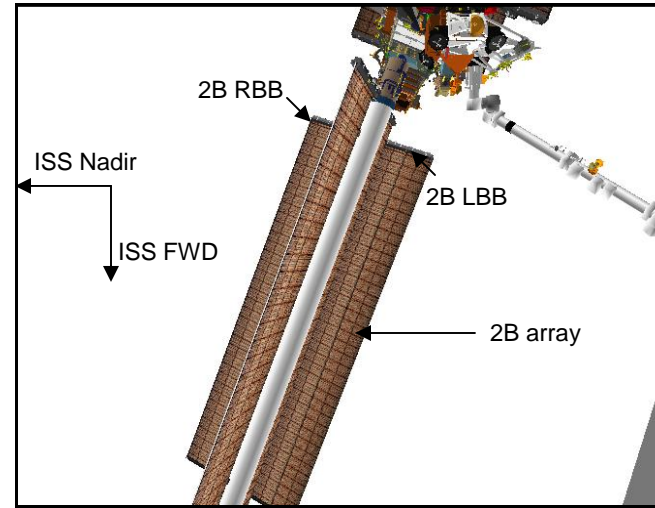


Figure 3.- Big Picture View for 2B Deploy
(91: Camera A: +90, -5).

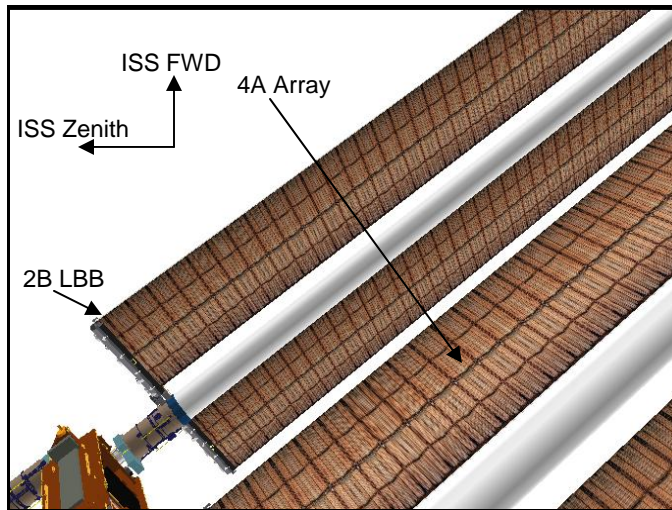


Figure 4.- Tension Bar Monitoring for 2B Array
(24: Tip Elbow: +140, +45).

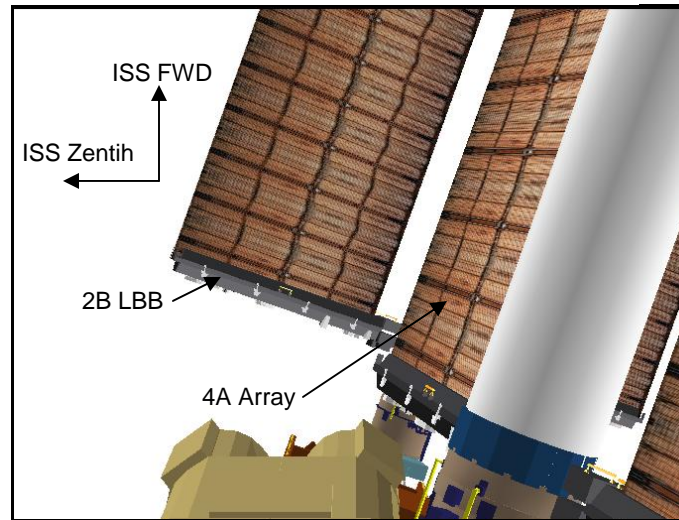


Figure 5.- Tension Bar Monitoring for 2B Array
(37: MBS Mast: 0, 0).

2.431 P6 SAW DEPLOY VIEWING SUPPORT CAMERA MATRIX (CONTINGENCY)

(RBT FS/10A/FIN 1)

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P6: 4B ARRAY DEPLOY VIEWING SUPPORT

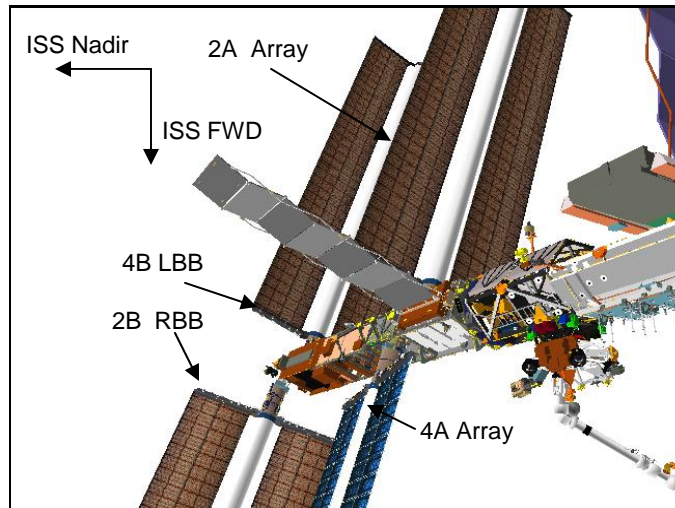


Figure 6.- Big Picture View for 4B Deploy
(91: Camera B:-60, +20).

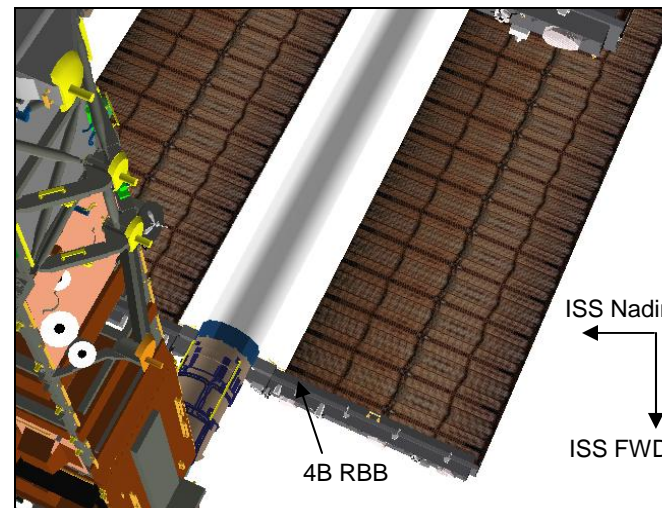


Figure 7.- Bay Count for 4B Array
(22: Base Elbow:+40, -25).

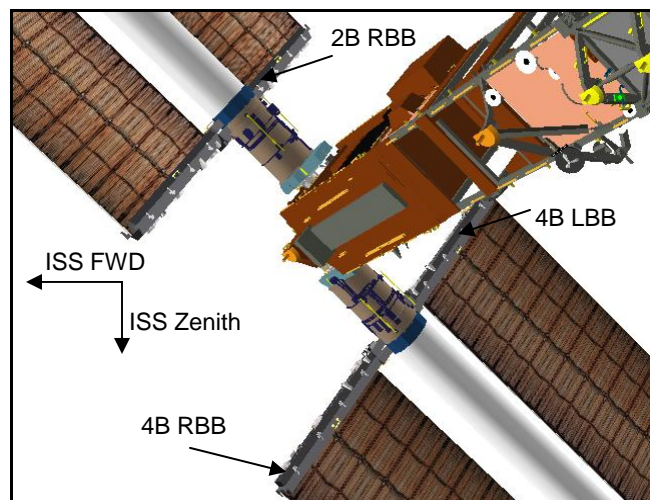


Figure 8.- Tension Bar Monitoring for 4B Array
(25: Tip LEE).

2.431 P6 SAW DEPLOY VIEWING SUPPORT CAMERA MATRIX (CONTINGENCY)

(RBT FS/10A/FIN 1)

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P6 DEPLOY VIEWING SUPPORT BACKUP CAMERAS

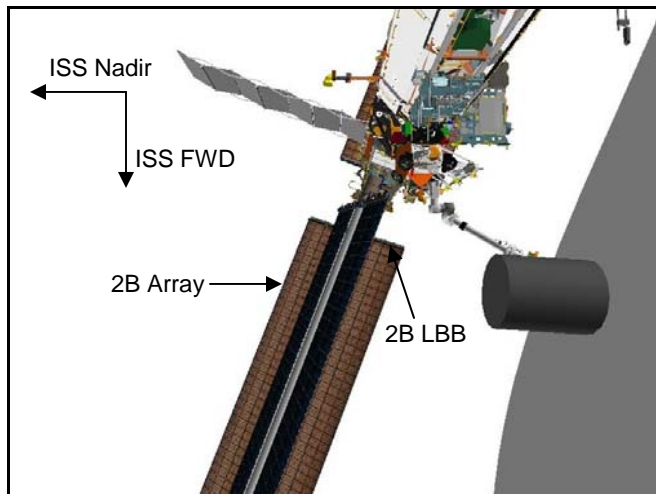


Figure 9.- Big Picture View for Deploy
(Camera A: +90, +5).

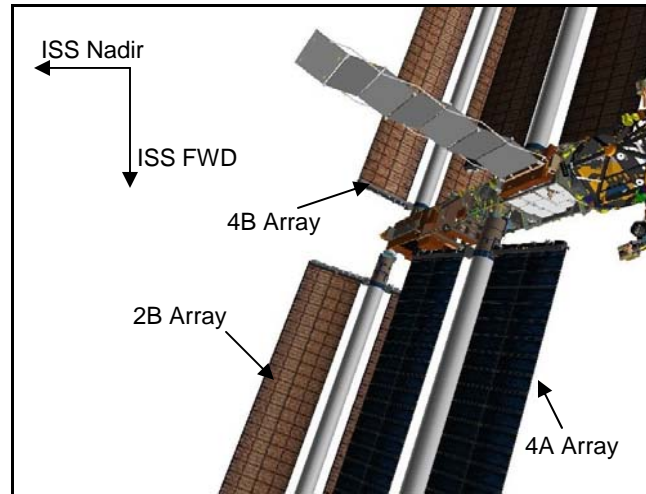


Figure 10.- Big Picture View for Deploy
(Camera B: -70, +10).

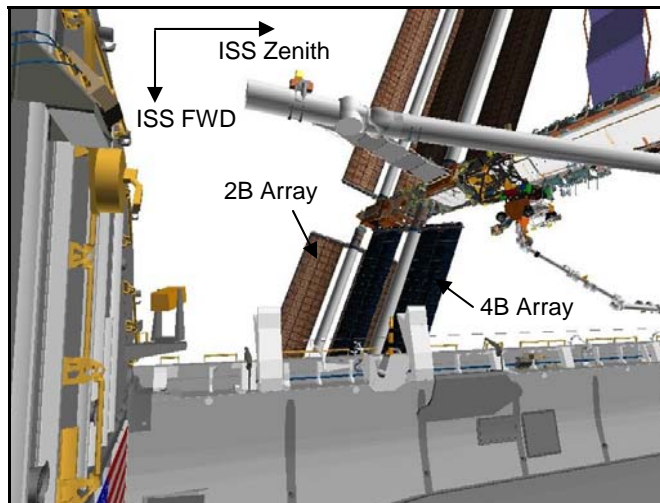


Figure 11.- Big Picture View for Deploy
(Camera C: -70, +5).

2.431 P6 SAW DEPLOY VIEWING SUPPORT CAMERA MATRIX (CONTINGENCY)

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P6 DEPLOY VIEWING SUPPORT BACKUP CAMERAS

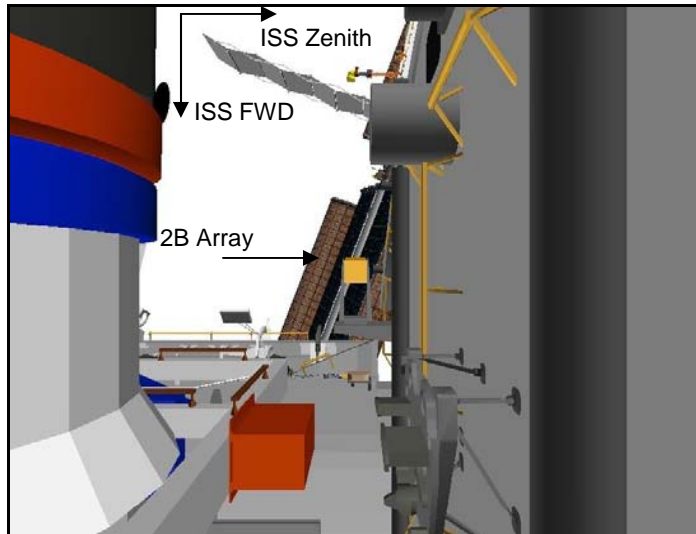


Figure 12.- Big Picture View for Deploy
(Camera D: +90, 0).

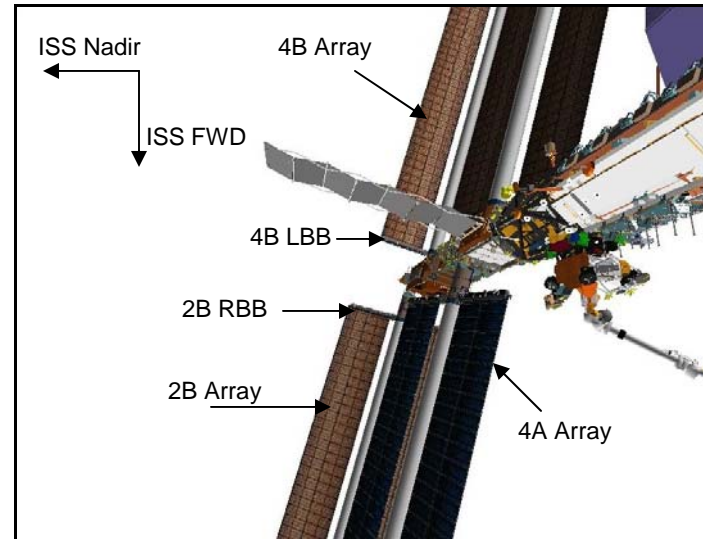


Figure 13.- Big Picture View for Deploy
(SRMS ELB: +100, -15).

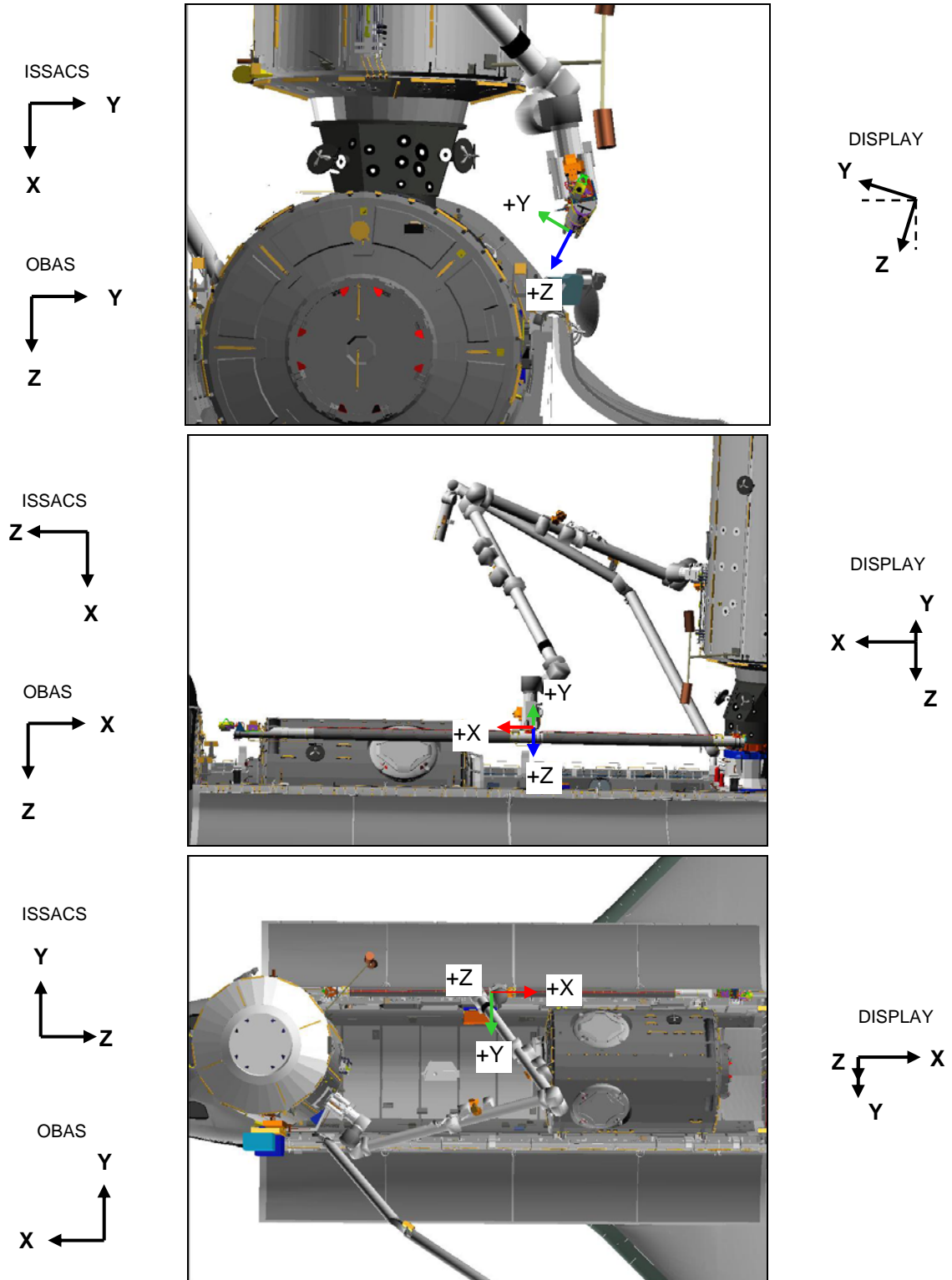


Figure 1.- Berthed OBSS MidMPM FOR and Display Frame.
 FOR: OBSS>Berthed OBSS MidMPM
 Display: LAB>Berthed OBSS MidMPM

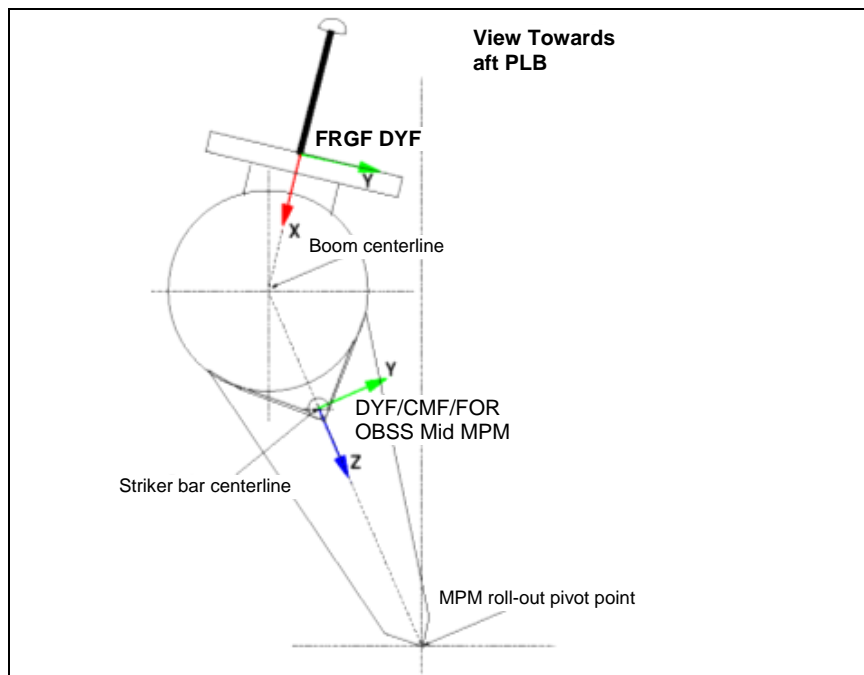
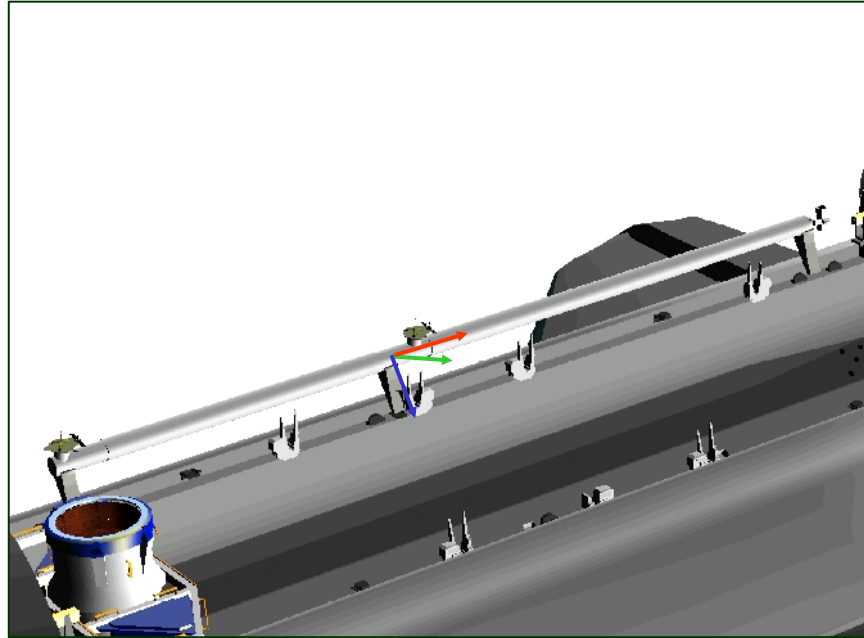


Figure 2.- Berthed OBSS MidMPM Command Frame,
Display Frame and FOR.

6.210 DISPLAY FRAME AND FOR: NODE 2 UNBERTH

(RBT FS/10A/FIN 1)

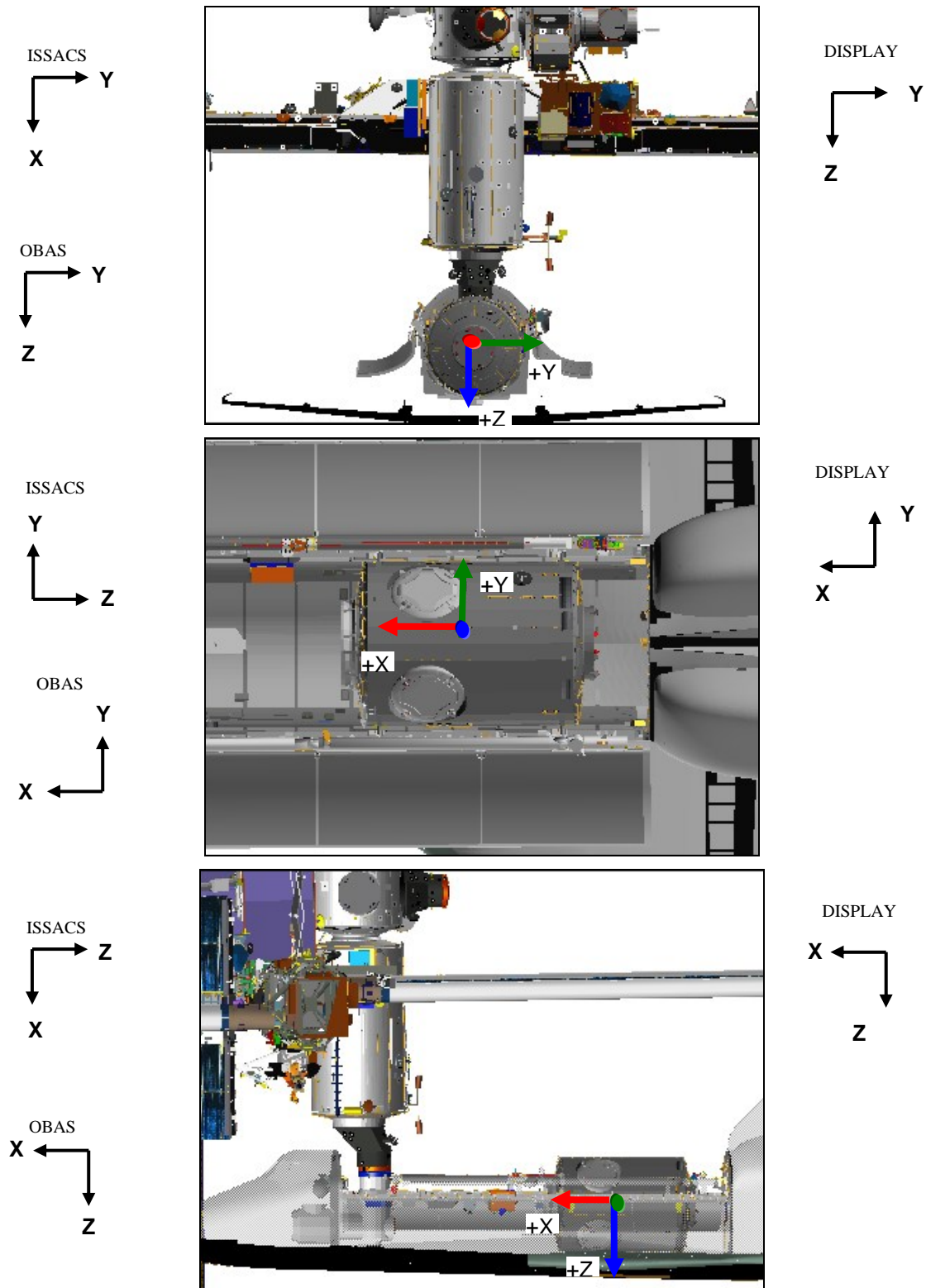


Figure 1.- Node 2 Unberth FOR and Display Frames.

FOR: Node2>Node2 Unberth

Display: LAB>Node2 Unberth

6.220 DISPLAY FRAME AND FOR: NODE 2 INSTALL CBCS
 (RBT FS/10A/FIN 1) Page 1 of 1 page

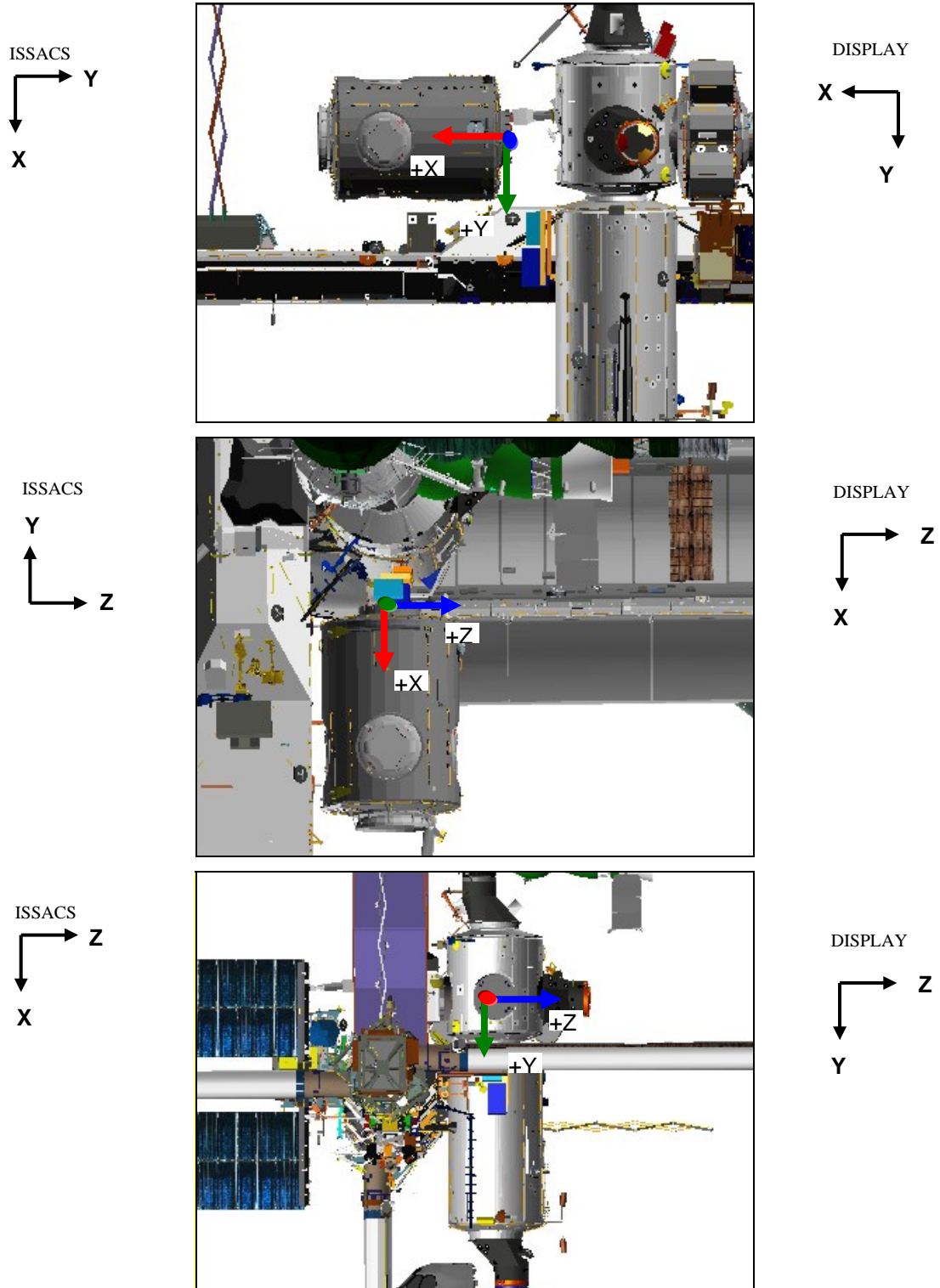


Figure 1.- Node 2 Install FOR and Display Frames.
 FOR: Node2>Node2 Install CBCS
 Display: LAB>Node2 Install CBCS

6.310 DISPLAY FRAME AND FOR: P6 DEMATE

(RBT FS/10A/FIN 1)

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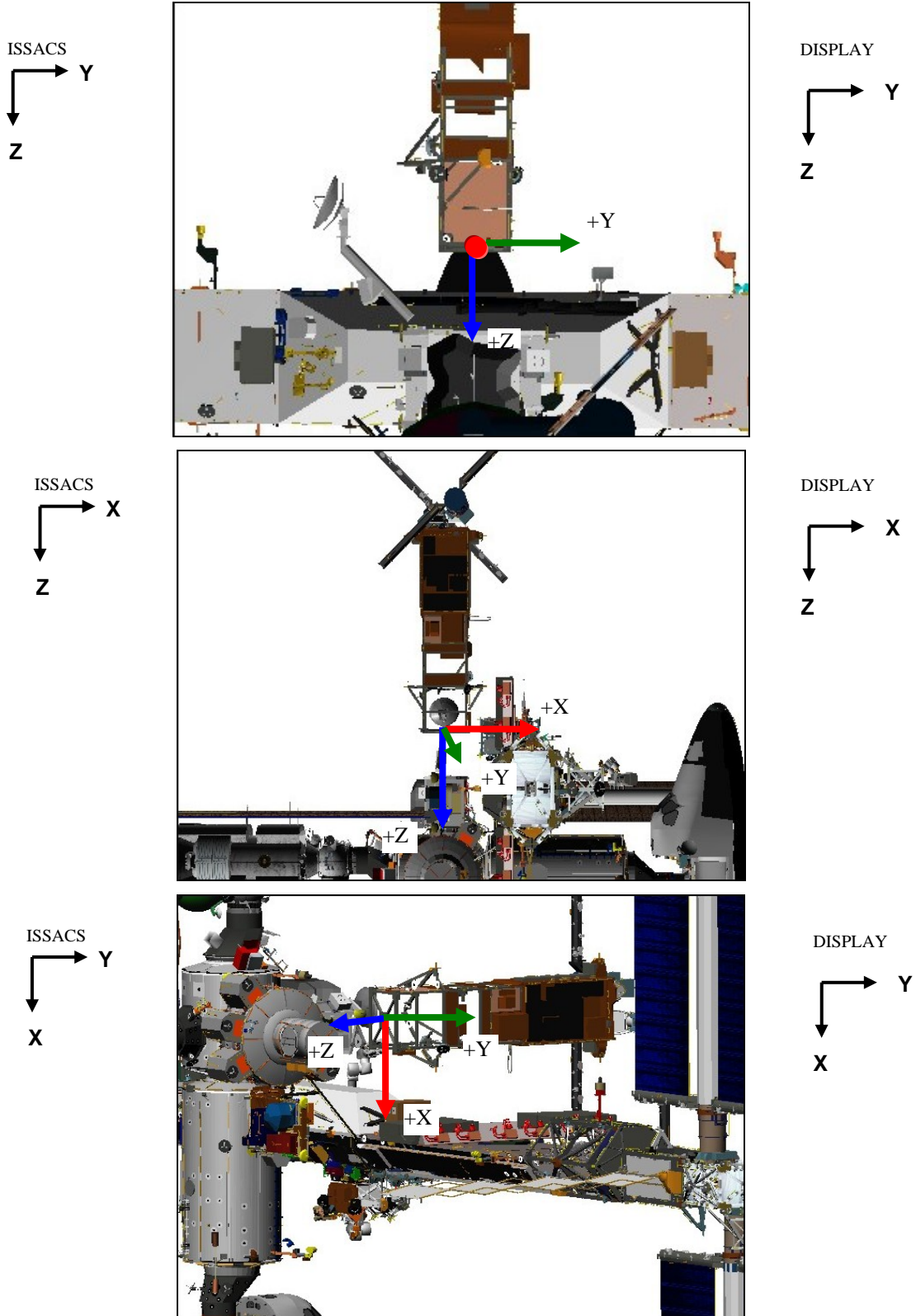


Figure 1.- P6 Demate FOR and Display Frames.

FOR: P6>P6 Demate (PDGF)

Display: W4>P6 Demate

6.320 DISPLAY FRAME AND FOR: P6 INSTALL

(RBT FS/10A/FIN 1)

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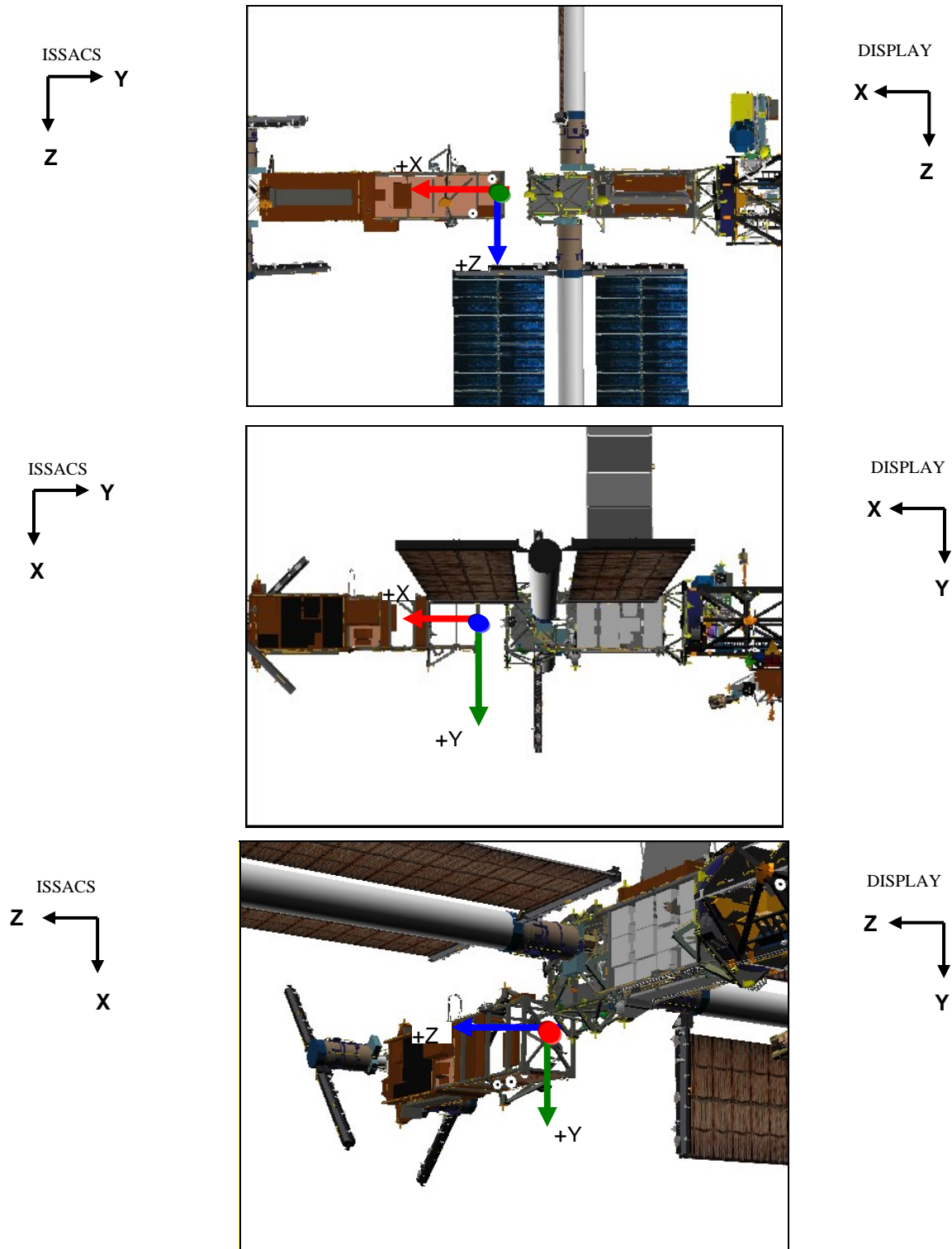


Figure 1.- P6 Install FOR and Display Frames.

FOR: P6>P6 Install

Display: W8>P6 Install

6.330 DISPLAY FRAME AND FOR: P6 INSTALL ISSACS

(RBT FS/10A/FIN 1)

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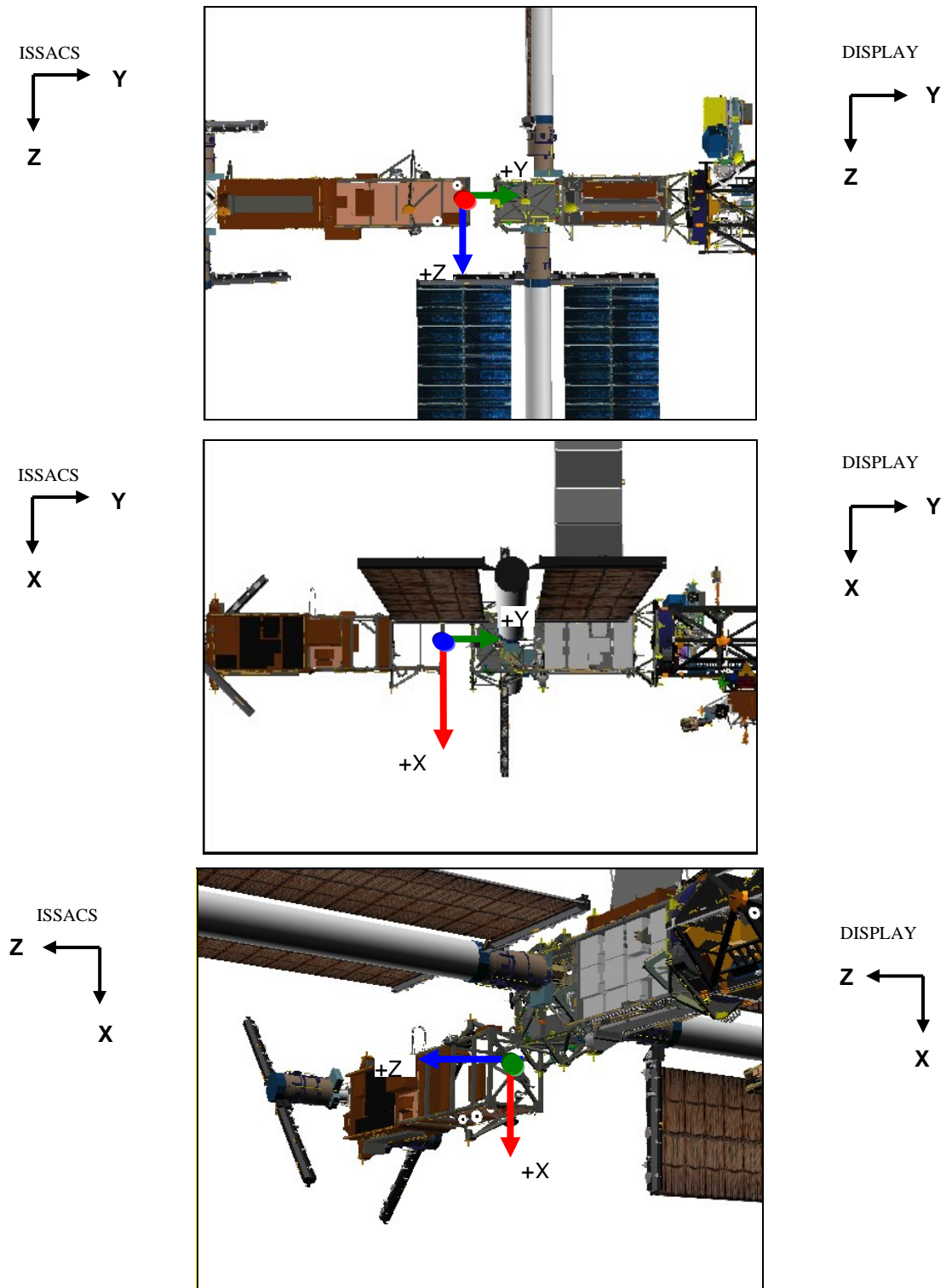


Figure 1.- P6 Install FOR and Display Frames.

FOR: P6>P6 Install ISSACS

Display: W8>P6 Install ISSACS

6.340 P5 INTERFACE WITH P6

(RBT FS/10A/FIN 1)

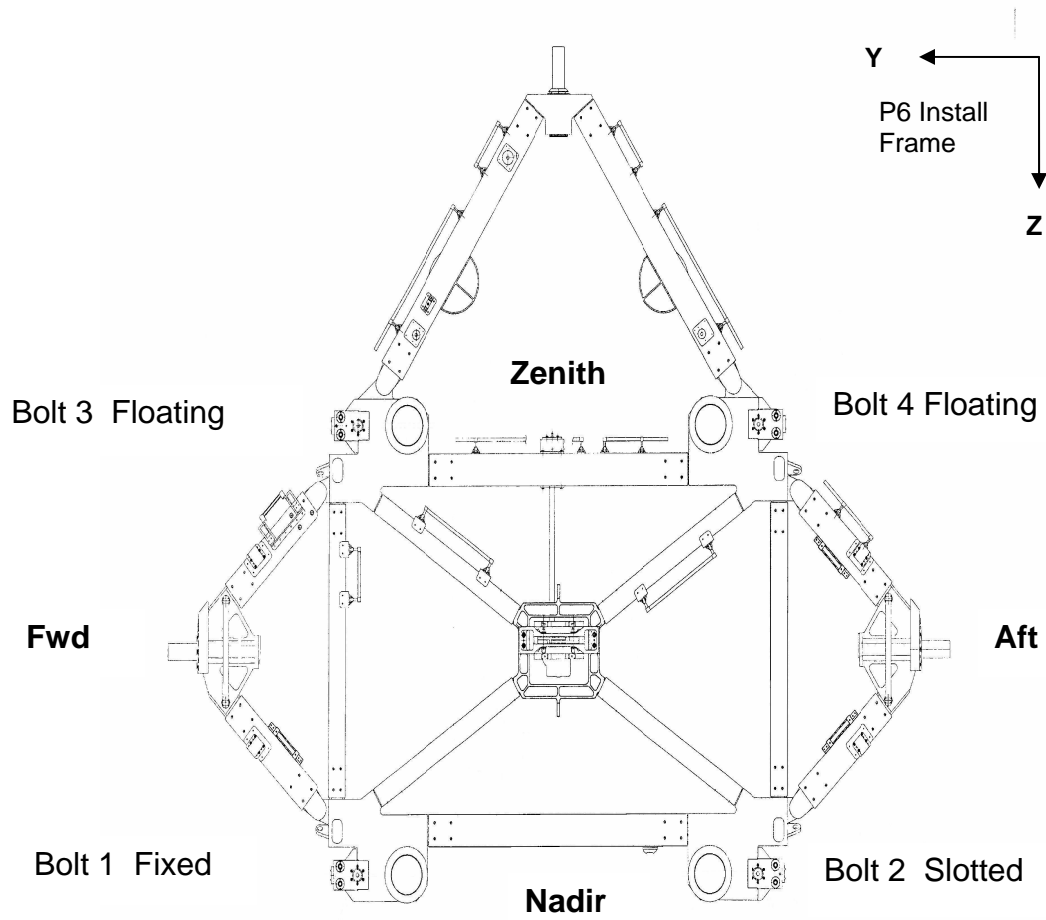


Figure 1.- P5 - Port Side Looking Stbd (Bolts on P5 Side).

6.410 DISPLAY FRAME AND FOR: PMA2 DEMATE

(RBT FS/10A/FIN 1)

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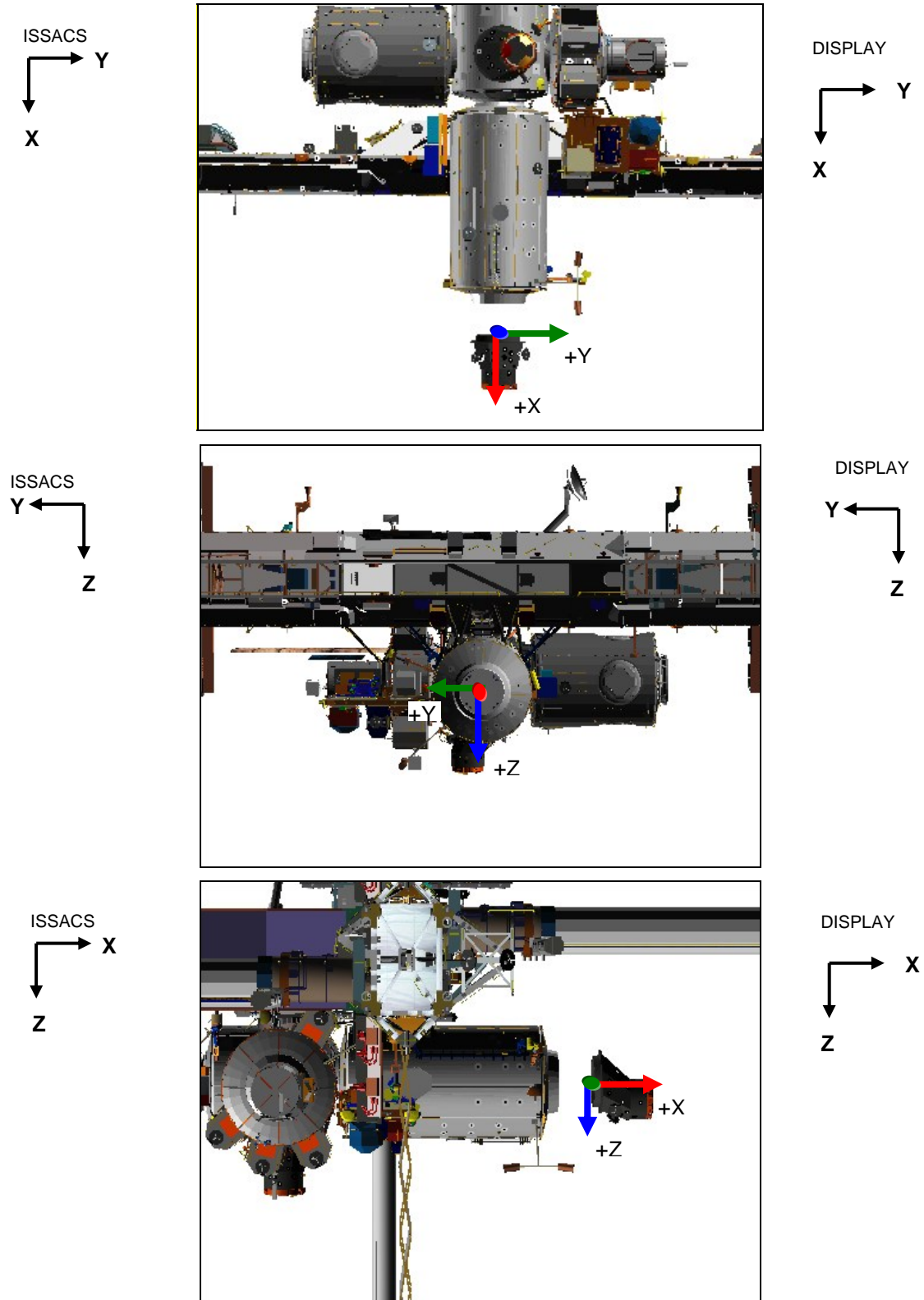


Figure 1.- PMA2 Demate FOR and Display Frames.

FOR: PMA2>PMA2 Demate

Display: LAB>PMA2 Demate

6.420 DISPLAY FRAME AND FOR: PMA2 INSTALL CBCS

(RBT FS/10A/FIN 1)

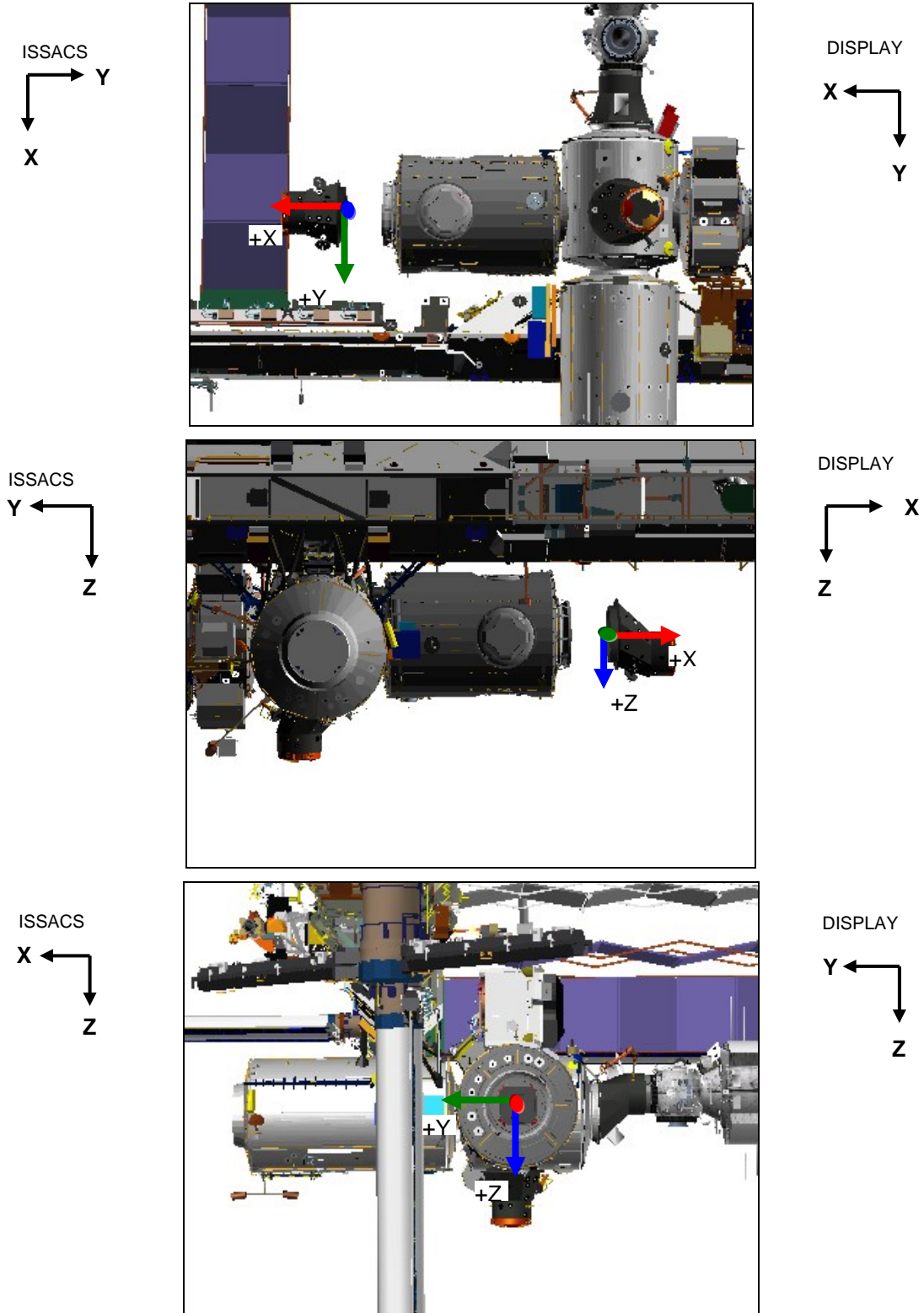


Figure 1.- PMA2 Install FOR and Display Frames.

FOR: PMA2> PMA2 Install CBCS

Display: LAB>PMA2 Install CBCS

6.430 DISPLAY FRAME AND FOR: NODE 2/PMA2 DEMATE
 (RBT FS/10A/FIN 1) Page 1 of 1 page

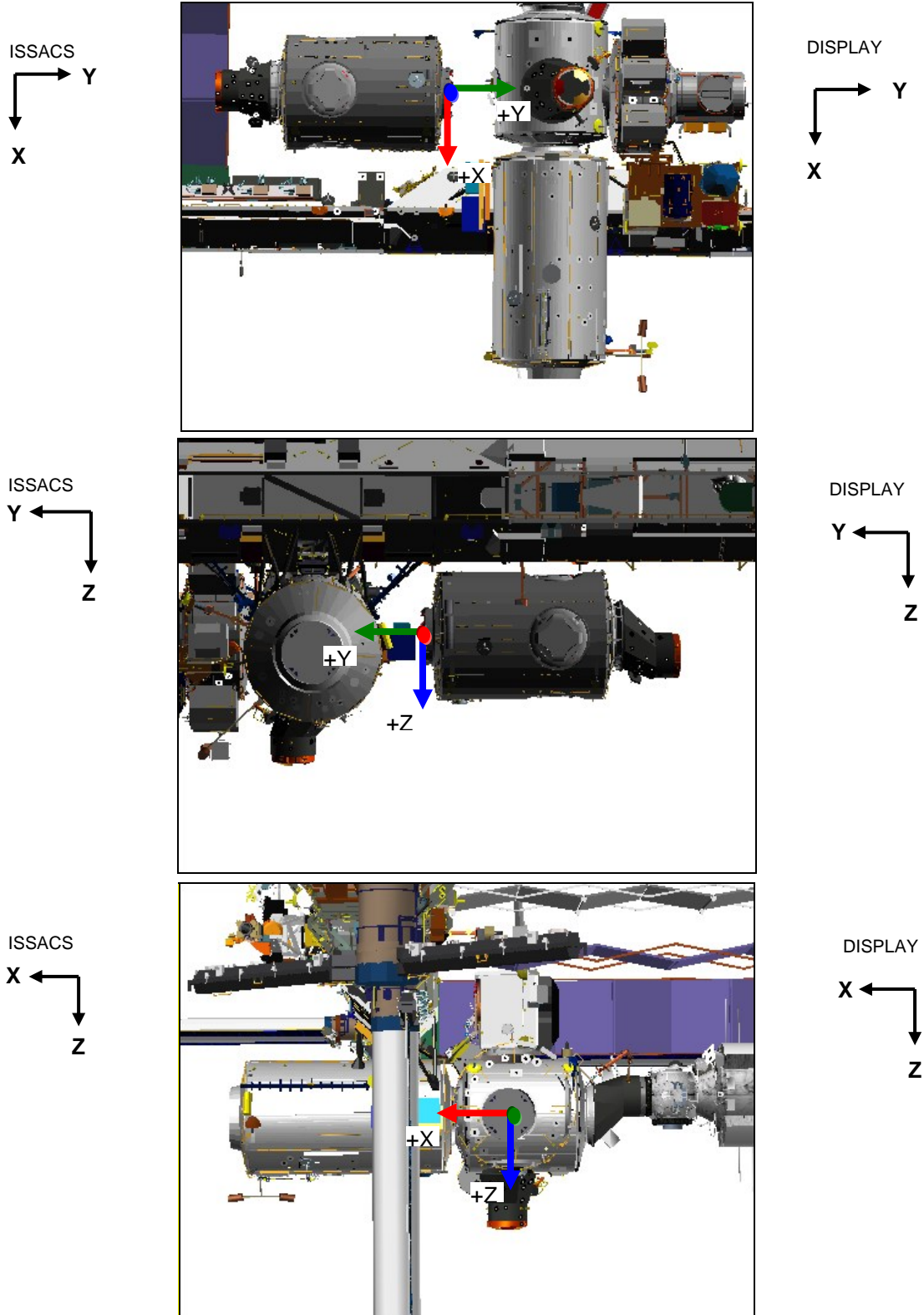


Figure 1.- Node 2/PMA2 Demate FOR and Display Frames.
 FOR: Node2/PMA2> Node2PMA2 Demate
 Display: LAB>Node2PMA2 Demate

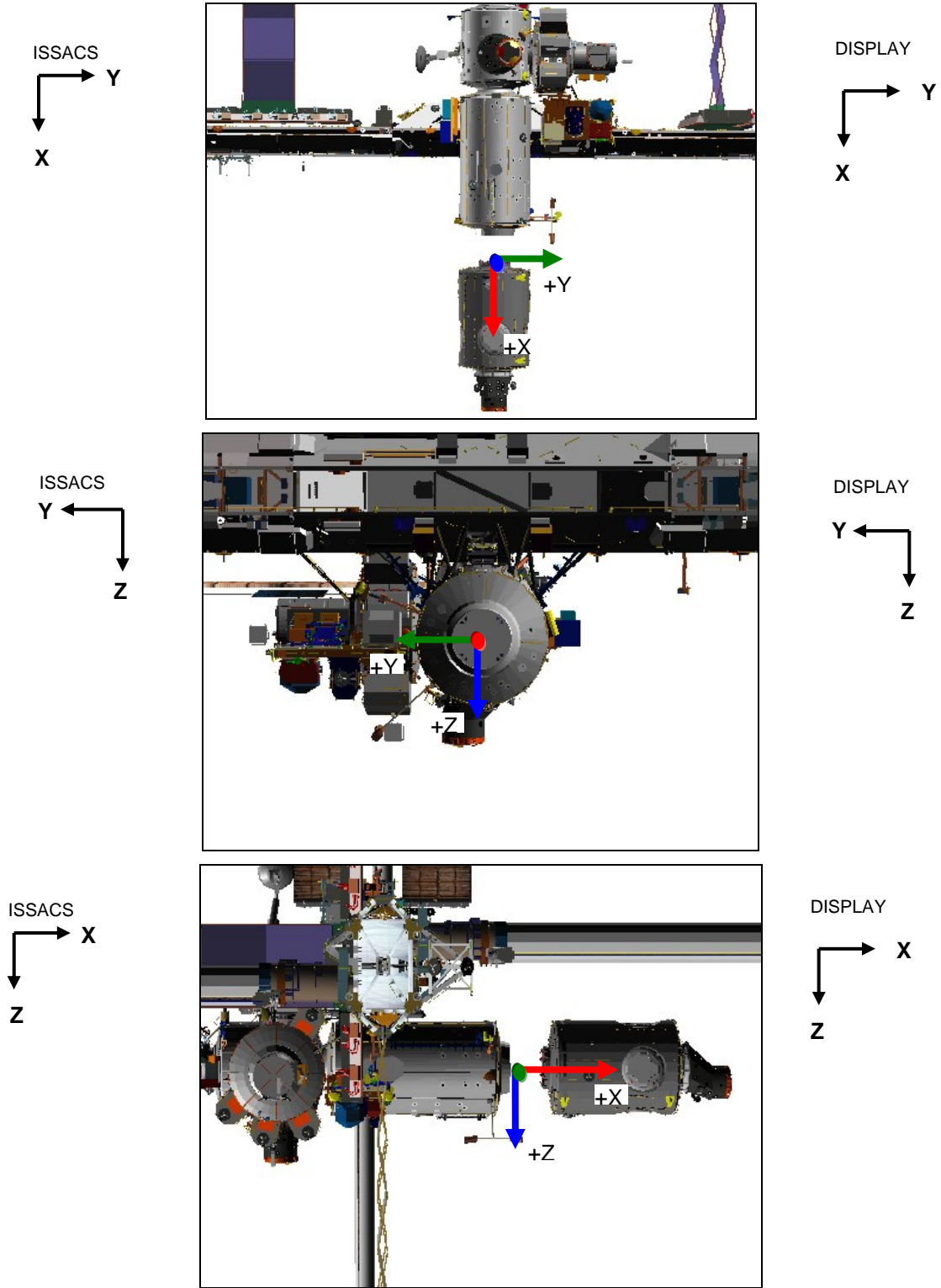
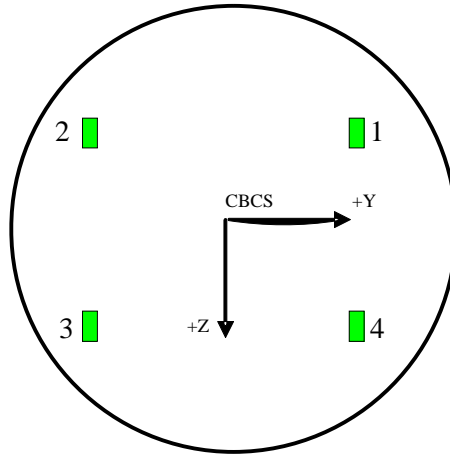


Figure 1.- Node 2/PMA2 Install FOR and Display Frames.
 FOR: Node2PMA2>Node2PMA2 Inst CBCS
 DPF: LAB>Node2PMA2 Inst CBCS

6.510 10A AND 10A STAGE CBM RTL REFERENCE SHEET
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Missing RTLs	RHC Input*
1	+ Pitch and + Yaw
2	+ Pitch and - Yaw
3	- Pitch and - Yaw
4	- Pitch and + Yaw
1, 2	+ Pitch
2, 3	- Yaw
3, 4	- Pitch
1, 4	+ Yaw

* All inputs with respect to CBCS Install FOR frame.

6.520 10A AND 10A STAGE AUTO-SEQUENCE MANEUVER TIMES

(RBT FS/10A/FIN 1)

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NOTE

Maneuver times listed correspond to the ideal kinematic trajectory. Actual maneuver times may be longer, especially for heavier payloads, depending on the on-orbit dynamic response of the SSRMS.

Procedure	Step	Position Name	File GUI name	Type	Mnvr Time (min.)
1.110	3	Berthed OBSS Pre-grapple	LAB>OBSS Pre-Grapple	JOCAS	3
	9	Clear UHF Antenna	LAB> OBSS Unberth Mnvr 1	FOCAS	1
	10	Aft position	LAB> OBSS Unberth Mnvr 2	FOCAS	1
	11	OBSS Handoff	LAB> OBSS Unberth Mnvr 3	FOCAS	2
1.120	3	Intermediate 1	LAB> OBSS Handoff Mnvr 1	JOCAS	2
	4	Intermediate 2	LAB> OBSS Handoff Mnvr 2	JOCAS	2
	5	OBSS Handoff Pre-grapple	LAB> OBSS Handoff Mnvr 3	JOCAS	1
1.121	4	OBSS Aft	LAB> OBSS Berth Mnvr 1	FOCAS	2
	5	Clear UHF Antenna	LAB> OBSS Berth Mnvr 2	FOCAS	1
	6	Low Hover	LAB> OBSS Berth Mnvr 3	FOCAS	1
1.210	2.2	Intermediate 2	LAB> EVA Setup	JOCAS	4
1.220	7.1	Intermediate 1	LAB> SASA Stow Mnvr 1	JOCAS	2
	7.2	Intermediate 2	LAB> SASA Stow Mnvr 2	JOCAS	4
	10.2	Node 2 Pre-grapple Setup	LAB> N2 Pre-Grapple	JOCAS	4
	10.3	Node 2 Pre-grapple	LAB> N2 Pre-Grapple	FOCAS	1
1.311	11	Node 2 Port Hover	LAB> N2 Install Mnvr 2	FOCAS	7
	14	Intermediate	LAB> N2 Install Mnvr 1	JOCAS	22
	16	Node 2 Pre-install	LAB> N2 Install Mnvr 3	FOCAS	11

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6.520 10A AND 10A STAGE AUTO-SEQUENCE MANEUVER TIMES

(RBT FS/10A/FIN 1)

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Procedure	Step	Position Name	File GUI name	Type	Mnvr Time (min.)
1.312	3	Node 2 Clearance	LAB> N2 Clearance	FOCAS	1
1.410	2.1	P6 Pre-grapple Setup	W4> P6 Pre-Grapple	JOCAS	5
1.411	6.1	Intermediate	W4> P6 Demate Mnvr 1	JOCAS	15
	6.3	P6 Handoff	W4> P6 Demate Mnvr 2	JOCAS	6
1.413	2.2	Intermediate 2	W8> P6 Handoff Mnvr 1	JOCAS	2
	2.3	P6 Pre-grapple at Handoff from SRMS	W8> P6 Handoff Mnvr 2	JOCAS	4
1.420	5.1	Pre-install Intermediate 1	W8> P6 Preinstall Mnvr 1	JOCAS	21
	5.3	Pre-install Intermediate 2	W8> P6 Preinstall Mnvr 2	JOCAS	5
	7.1	Pre-Install Setup	W8> P6 Preinstall Mnvr 3	FOCAS	7
1.430	2.3	SAW Viewing	n/a	JOCAS	3
1.510	2.2	Stow Setup	W4> Translate Stow	JOCAS	6
1.520	2	MT Translate Stow	n/a	JOCAS	3
3.111	4.1	Intermediate	LAB> PMA2 Install Mnvr 1	FOCAS	3
	4.2	PMA2 CBM Survey	n/a	JOCAS	4
	4.4	PMA2 Pre-Install Setup	LAB> PMA2 Install Mnvr 2	JOCAS	3
	4.5	PMA2 Pre-Install	LAB> PMA2 Install Mnvr 3	FOCAS	2
3.211	3	Node 2/PMA2 Clearance	LAB> N2 Relocate Mnvr 1	JOCAS	8
	4	Node2 Passive CBM Survey	LAB> N2 Relocate Mnvr 2	JOCAS	10
	6	Node 2/PMA2 Pre-Install	LAB> N2 Relocate Mnvr 3	FOCAS	8