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International Space Station Robotics Group Robotics Book - Flight Specific

ISS-20A

Mission Operations Directorate
Operations Division

15 JAN 10

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United Space Alliance

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**INTERNATIONAL SPACE STATION
ROBOTICS GROUP
ROBOTICS BOOK - FLIGHT SPECIFIC
ISS-20A**

15 JAN 10

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This document is under the configuration control of the Systems Operations Data File Control Board (SODFCB).

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Uplinked Messages (or Approved Flight Notes) replaced by this revision,
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None

**INTERNATIONAL SPACE STATION
ROBOTICS GROUP
ROBOTICS BOOK - FLIGHT SPECIFIC
ISS-20A**

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NOMINAL

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1.110 OBSS UNBERTH AND HANDOFF

(RBT FS/20A/FIN 1/SPN) Page 1 of 18 pages

NOTE
Callouts in gray are for shuttle crew.

THC/
RHC

1. HAND CONTROLLER CALIBRATION
Deflect each axis to positive and negative hard stops.

PCS

2. JOINT OCAS MANEUVER TO OBSS PRE-GRAPPLE
MSS: SSRMS: SSRMS

Change Loaded Parameters ► OBSS ► OBSS Mid MPM SRH
Verify 'Loaded Parameters' (two) – OBSS Mid MPM, SR Held

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

Change Display ► Orbiter ► OBSS FRGF (Verify Orbiter>OBSS FRGF)

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

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

SR	SY	SP	EP	WP	WY	WR
+90.1	+210.1	-139.5	-111.5	-109.3	-110.8	+210.6
X	Y	Z	Pitch	Yaw	Roll	
-557	-341	-261	-0.7	-79.4	-61.0	
FOR	Unloaded – LEE Tip, SR held					
Disp	Orbiter>OBSS FRGF					

On shuttle crew GO for OBSS Grapple:

NOTE
Verify SRMS at OBSS Handoff Pre-Grapple position:
SY= +22.7, +57.5, -27.5, -99.2, +11.7, -97.7 =WR

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
03: S1 Lower Outboard (+55, +20)	13: LAB Stbd Zenith (-15, -40)	72 (DNLK): Camera C (0, +25)	SRMS Elbow (-100, +20)	Camera D (-10, +25)

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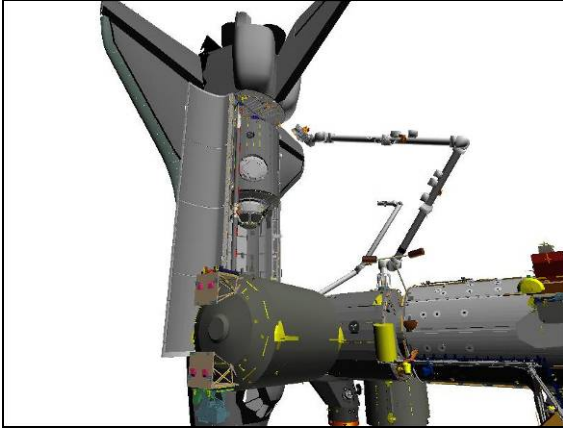


Figure 1.- SSRMS Docking Position
(03: S1 Lower Outboard: +55, +20).

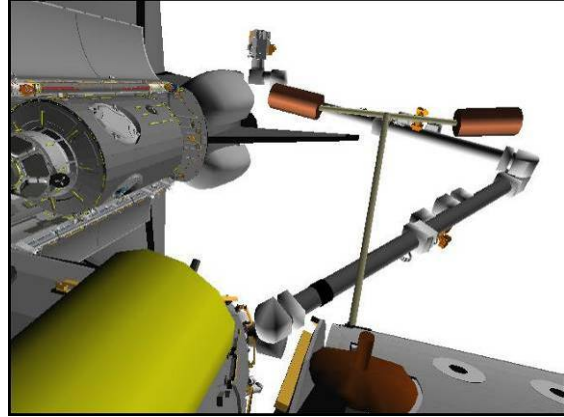


Figure 2.- SSRMS Docking Position
(13: LAB Stbd Zenith: -15, -40).

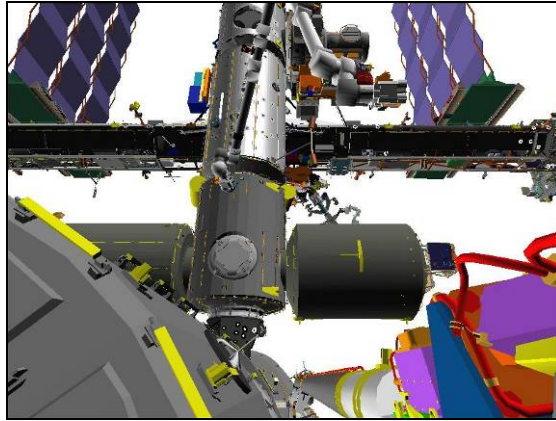


Figure 3.- SSRMS Docking Position
(72: Camera C: 0, +25).

NOTE
Joint OCAS duration approximately 2 minutes.

MSS: SSRMS: MSS Safing:

cmd 'SSRMS' Remove (Verify Not Safed)

DCP BRAKES SSRMS → OFF (Verify OFF)

PCS MSS: SSRMS:

√Vernier

Enter Mode – Joint OCAS (Verify blue)

pick File ► OBSS ► Berthed Pre-Grapple

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

SR	SY	SP	EP	WP	WY	WR
+74.6	+217.3	-161.0	-112.7	-162.3	-158.0	+210.6

cmd Load (Verify Sequence Status – Confirm or Cancel)

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

	SR	SY	SP	EP	WP	WY	WR
(current)	+90.1	+210.1	-139.5	-111.5	-109.3	-110.8	+210.6
TGT	+74.6	+217.3	-161.0	-112.7	-162.3	-158.0	+210.6
ERR	+15.5	-7.2	+21.5	+1.2	+53.0	+47.2	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 Berthed Pre-Grapple position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+74.6	+217.3	-161.0	-112.7	-162.3	-158.0	+210.6
X	Y	Z	Pitch	Yaw	Roll	
-150	0	0	0.0	0.0	0.0	
FOR	Unloaded – LEE Tip, SR Held					
Disp	Orbiter>OBSS FRGF					

3. OBSS GRAPPLE

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
03: S1 Lower Outboard (+55, +20)	25: Tip LEE (Zoom full out)	72 (DNLK): Camera C (0, +10) HFOV = 25 deg	SRMS Elbow (-100, +20)	Camera D (-10, +25)

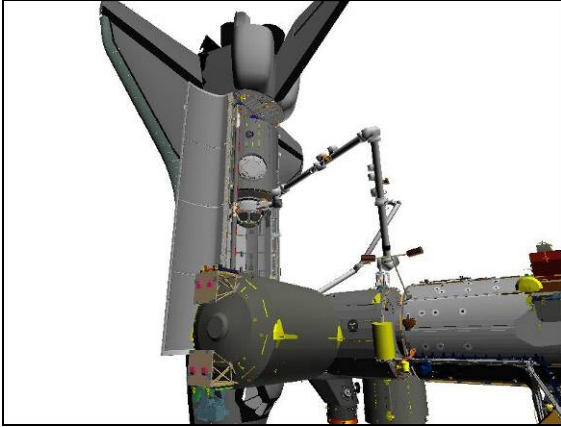


Figure 4.- OBSS Pre-Grapple
 (03: S1 Lower Outboard: +55, +20).

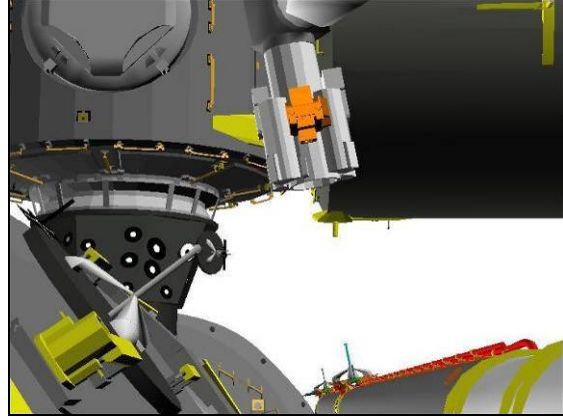


Figure 5.- OBSS Pre-Grapple
 (72: Camera C: 0, +10)
 HFOV = 25 deg.

3.1 Maneuvering to Grapple Envelope

√Vernier

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 Roll (Verify SR – Locked)

THC/
RHC

Maneuver to within grapple envelope (THC push, +X).

3.2 Grapple

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).

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Auto Capture

RHC TRIGGER → Press (momentarily)

PCS Verify 'Snare' Close, Capture (two) – blue (12 s max)
 Verify Capture to Latch – No (SCR 19282)
 Verify 'Carriage' Tension ~5500 N (90 s max)
 Verify 'Carriage' Retract – blue
 Verify 'Carriage' Brakes – On (15 s max)

3.3 Grapple Cleanup
 Verify Posn Hold – orange

DCP BRAKES SSRMS → ON (Verify ON)

PCS MSS: SSRMS: Rate: SSRMS Rate

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

MSS: SSRMS: SSRMS

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

Change Display ► Orbiter ► OBSS Mid MPM (Verify
 Orbiter>OBSS Mid MPM)

Change Command ► Orbiter ► OBSS Mid MPM (Verify
 Orbiter>OBSS Mid MPM)

Record OBSS Grapple position joint angles and FOR.

	SR	SY	SP	EP	WP	WY	WR	
Expected	+74.6	+222.7	-171.9	-100.2	-161.8	-159.4	+216.2	
	X	Y	Z	Pitch	Yaw	Roll		
Expected	0	0	0	0.0	0.0	0.0		
	FOR	Loaded – OBSS Mid MPM, SR Held						
	Disp	Orbiter>OBSS Mid MPM						

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Review [SSRMS LEE CUE CARD \(SSRMS IS LOADED AND LEE CAUTION IS ANNUNCIATED\)](#), all (SODF: RBT GEN: REFERENCE: CUE CARD).

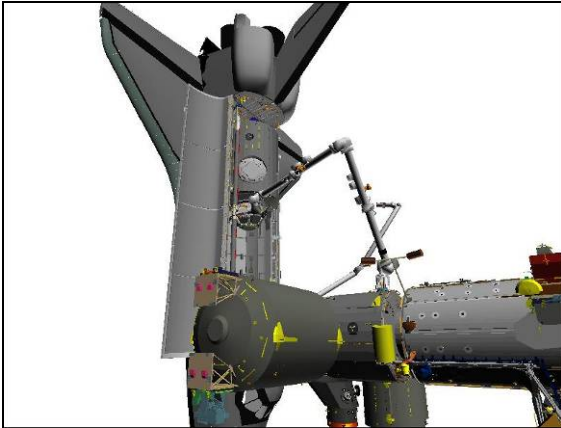


Figure 6.- OBSS Grappled
 (03: S1 Lower Outboard: +55, +20).

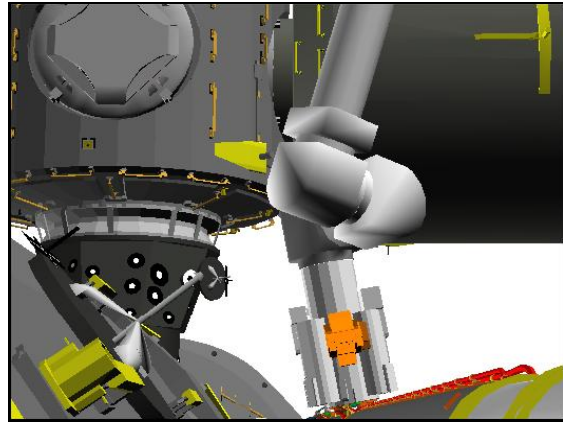


Figure 7.- OBSS Grappled
 (72: Camera C: 0, +10)
 HFOV = 25 deg.

4. OBSS UNBERTH

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
03: S1 Lower Outboard (+55, +20)	72 (DNLK): Mux C/D (C: +25, 0) (D: -15, 0)	24: Tip Elbow (-40, +20)	SRMS Elbow (-125, +20)	Camera B (+80, +10)

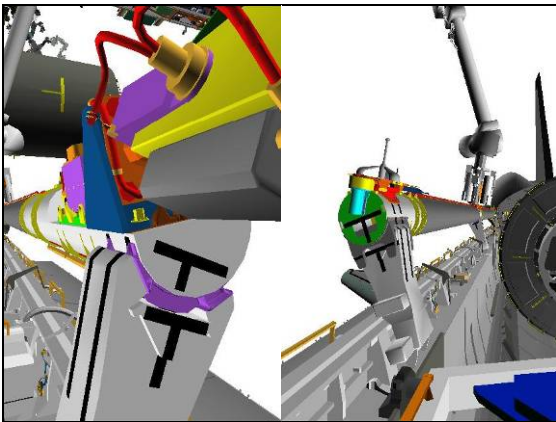


Figure 8.- OBSS Grappled
 (72: Mux C/D).

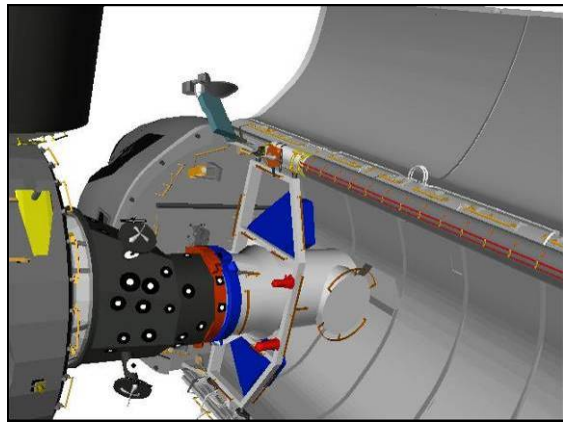


Figure 9.- OBSS Grappled
 (24: Tip Elbow: -40, +20).

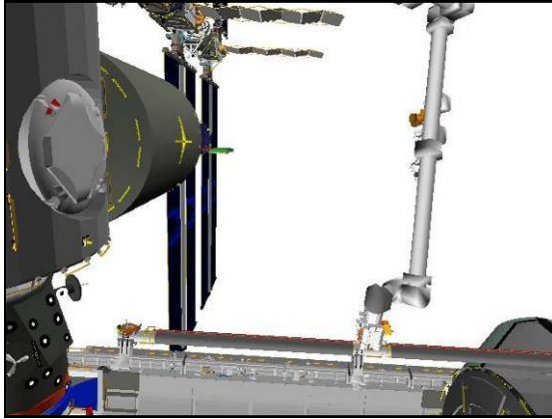


Figure 10.- OBSS Grappled
(SRMS Elbow: -125, +20).



Figure 11.- OBSS Grappled
(Camera B: +80, +10).

4.1 Attitude Control Configuration

MSS: SSRMS: Thrusters:

Verify 'Desat Request:' – Inh

* If using shuttle attitude control
* | Verify in attitude, then
* | DAP: FREE

4.2 MRL Release

Give shuttle crew GO to deactivate stbd RMS heaters and release stbd MRLs.

NOTE

1. Standby for OBSS thermal clock start time:

____/____:____:____

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

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```
*****
* If 'R3Q - SSRMS LEE Uncommanded Derigidize' Caution is
*   annunciated during MRL release
*   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
*
*   TRIGGER → Press (momentarily) (SCR 19064)
*
*   Verify 'Carriage' Tension ~5500 N (90 s max)
*   Verify 'Carriage' Retract – blue
*****
```

RHC

PCS

4.3 Maneuvering to Low Hover
 On shuttle crew GO for OBSS unberth:

NOTE

The minimum distance between the OBSS and Columbus is 110 cm (44 in) at Low Hover. Monitor this clearance with the Tip Elbow Camera or the SRMS Elbow Camera.

DCP

BRAKES SSRMS → OFF (Verify OFF)

PCS

MSS: SSRMS: SSRMS

√Vernier

Enter Mode – Manual (Verify blue)

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

cmd Shoulder Roll (Verify SR – Locked)

THC/
RHC

Maneuver OBSS to Low Hover position (within 5 cm/1 deg).
 (THC up, -Z)

Locked						
SR	SY	SP	EP	WP	WY	WR
+74.6	+223.7	-159.4	-109.2	-165.0	-159.7	+217.2
X	Y	Z	Pitch	Yaw	Roll	
0	0	-150	0.0	0.0	0.0	
FOR	Loaded – OBSS Mid MPM, SR Held					
Disp	Orbiter>OBSS Mid MPM					

PCS

MSS: SSRMS: SSRMS

Enter Mode – Standby (Verify blue)

4.4 Attitude Control Configuration

```
*****  
* If using shuttle attitude control and attitude maintenance required  
* | DAP: LVLH  
* |  
* | When rates damped  
* | | DAP: FREE > 2 seconds  
* | | DAP: AUTO  
*****
```

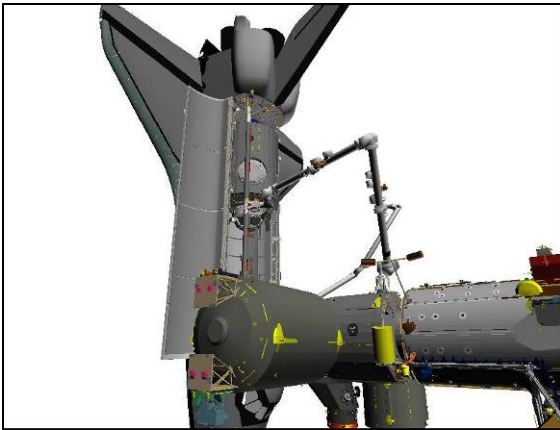


Figure 12.- OBSS Low Hover
(03: S1 Lower Outboard: +55, +20).

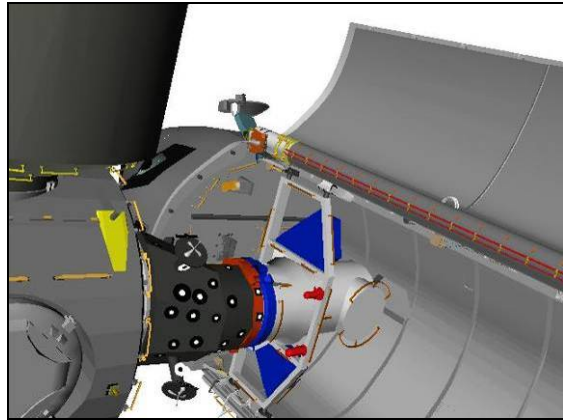


Figure 13.- OBSS Low Hover
(24: Tip Elbow: -40, +20).

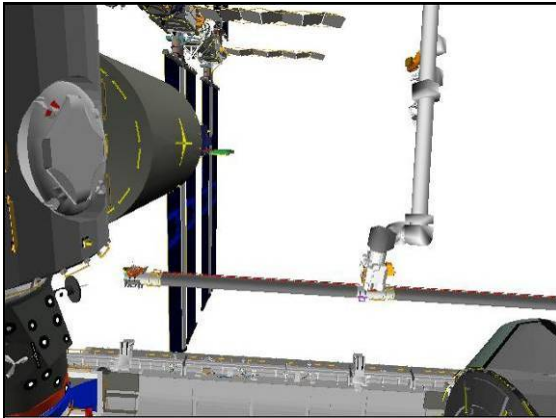


Figure 14.- OBSS Low Hover
(SRMS Elbow: -125, +20).



Figure 15.- OBSS Low Hover
(Camera B: +80, +10).

5. FOR OCAS TO OBSS INTERMEDIATE

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+120, +25)	72 (DNLK): SRMS Elbow (-120, +15)	24: Tip Elbow (-40, +20)	Camera D (-25, +10)	Camera A (0, +15)

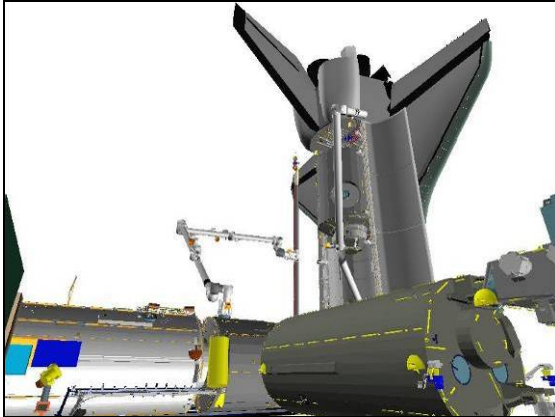


Figure 16.- OBSS Low Hover
 (09: P1 Lower Outboard: +120, +25).

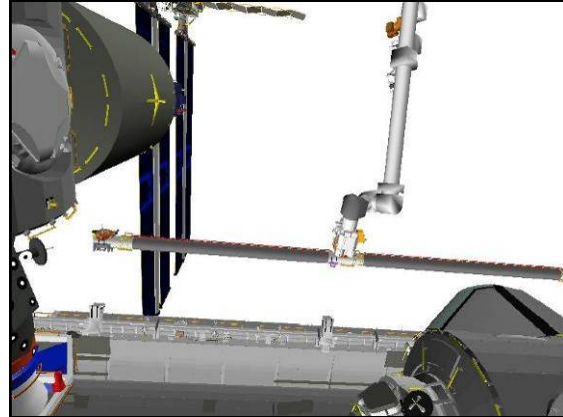


Figure 17.- OBSS Low Hover
 (72: SRMS Elbow: -120, +15).

NOTE
 FOR OCAS duration approximately 2 minutes.

MSS: SSRMS:

√Vernier

Enter Mode – FOR OCAS (Verify blue)

MSS: SSRMS: SSRMS FOR OCAS: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

SSRMS FOR OCAS

pick File ► OBSS ► OBSS Intermediate

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

X	Y	Z	Pitch	Yaw	Roll
+250	-200	-300	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	0	-150	0.0	0.0	0.0
TGT	+250	-200	-300	0.0	0.0	0.0
ERR	-250	+200	+150	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 OBSS Intermediate position (within 5 cm/1 deg).

Locked						
SR	SY	SP	EP	WP	WY	WR
+74.6	+225.7	-155.7	-83.5	-193.6	-160.3	+219.3
X	Y	Z	Pitch	Yaw	Roll	
+250	-200	-300	0.0	0.0	0.0	
FOR	Loaded – OBSS Mid MPM, SR Held					
Disp	Orbiter>OBSS Mid MPM					

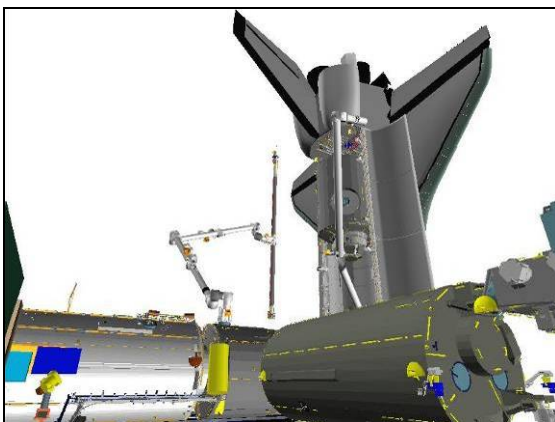


Figure 18.- OBSS Intermediate
 (09: P1 Lower Outboard: +120, +25).

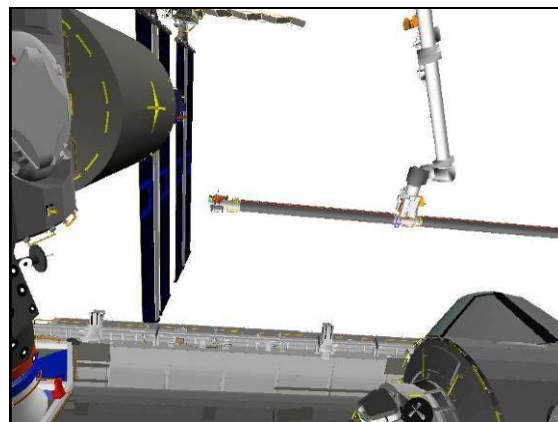


Figure 19.- OBSS Intermediate
 (72: SRMS Elbow: -120, +15).

6. FOR OCAS TO OBSS HANDOFF

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+120, +25)	72 (DNLK): SRMS Elbow (-120, +15)	03: S1 Lower Outboard (+60, +20)	Camera D (-5, +20)	Camera A (+5, +25)

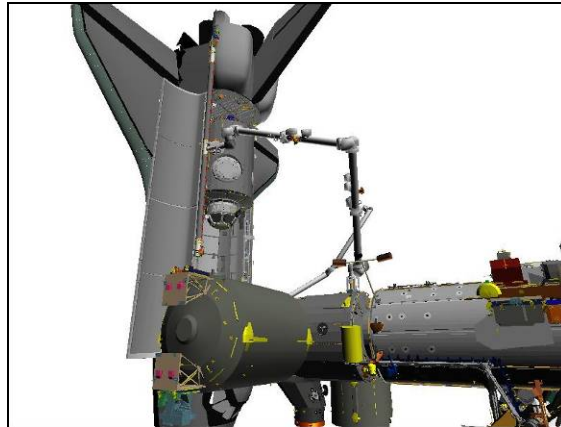


Figure 20.- OBSS Intermediate
 (03: S1 Lower Outboard: +60, +20).

NOTE
 FOR OCAS duration approximately 4 minutes.

SSRMS FOR OCAS

Verify SR – Locked

pick File ► OBSS ► OBSS Handoff

Verify 'FOR' 'Destination' for Handoff position.

X	Y	Z	Pitch	Yaw	Roll
+401	+684	-157	+91.5	-70.6	+47.6

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON

Verify FOR and errors are correct on FOR Position overlay.

	X	Y	Z	Pitch	Yaw	Roll
FOR	+250	-200	-300	0.0	0.0	0.0
TGT	+401	+684	-157	+91.5	-70.6	+47.6
ERR	-151	-884	-143	-91.5	+70.6	-47.6

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 * 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)
 *
 * 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 OBSS Handoff position (within 5 cm/1 deg).

Locked						
SR	SY	SP	EP	WP	WY	WR
+74.6	+164.8	-155.8	-101.5	-184.7	-160.0	+68.3
X	Y	Z	Pitch	Yaw	Roll	
+401	+684	-157	+91.5	-70.6	+47.6	
FOR	Loaded – OBSS Mid MPM, SR Held					
Disp	Orbiter>OBSS Mid MPM					

DCP BRAKES SSRMS → ON (Verify ON)

 * If using shuttle attitude control
 * | Verify in attitude, then
 * | DAP: FREE

Give SRMS operator GO for OBSS grapple.

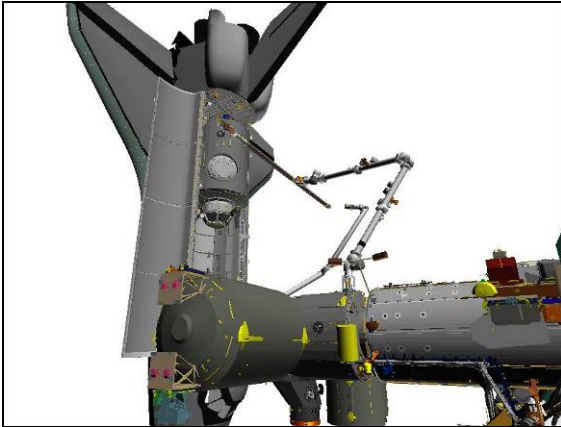


Figure 21.- OBSS Handoff
 (09: P1 Lower Outboard: +60, +20).

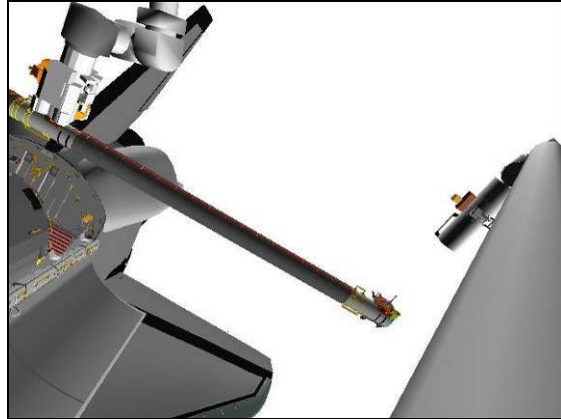


Figure 22.- OBSS Handoff
 (72: SRMS Elbow: -35, -15).

7. SETUP FOR OBSS RELEASE

PCS

MSS: SSRMS:

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

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

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

On RMS operator GO for OBSS Release:

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+120, +25)	25: Tip LEE (Zoom full out)	72 (DNLK): Camera A (+5, +22) HFOV = 24 deg	Camera B (-5, +40)	SRMS Elbow (-38, 0)

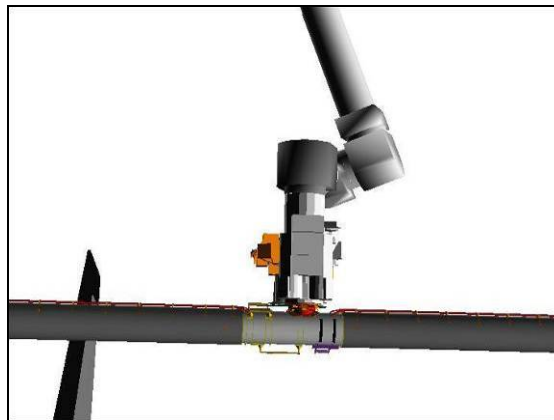


Figure 23.- OBSS Handoff
 (72: Camera A: +5, +22)
 HFOV = 24 deg.

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8. OBSS RELEASE

DCP BRAKES SSRMS → OFF (Verify OFF)

PCS MSS: SSRMS:

√Vernier

8.1 SSRMS Limp

MSS: SSRMS: Limp:

cmd All Limp (Verify Limp – blue)

MSS: SSRMS:

Verify all joints – Limped

8.2 Auto 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 'Carriage' Retract – gray (90 s max)
Verify 'Snare' Open – blue (12 s max)
Verify 'Carriage' Derigidize – blue (90 s max)
Verify 'Carriage' Extend – blue (90 s max)

Verify Unloaded Parameters – √

8.3 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)

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THC/
RHC Maneuver to OBSS Backoff position (within 5 cm/1 deg).
(THC pull, -X)

Locked						
SR	SY	SP	EP	WP	WY	WR
+74.6	+160.7	-144.1	-109.5	-189.8	-159.5	+63.9
X	Y	Z	Pitch	Yaw	Roll	
+1062	-307	+1575	-12.8	+0.1	+89.7	
FOR	Unloaded – LEE Tip, SR Held					
Disp	ISS>ISSACS					

PCS MSS: SSRMS:

Enter Mode – Standby (Verify blue)

```
*****
* If using shuttle attitude control and attitude maintenance required
* | DAP: LVLH
* |
* | When rates damped
* | | DAP: FREE > 2 seconds
* | | DAP: AUTO
*****
```

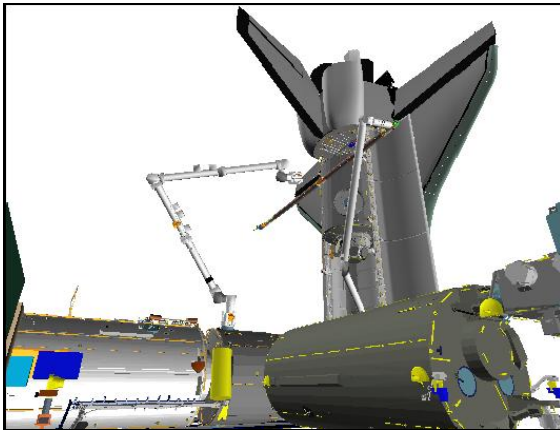


Figure 24.- OBSS Backoff
(09: P1 Lower Outboard: +120, +25).

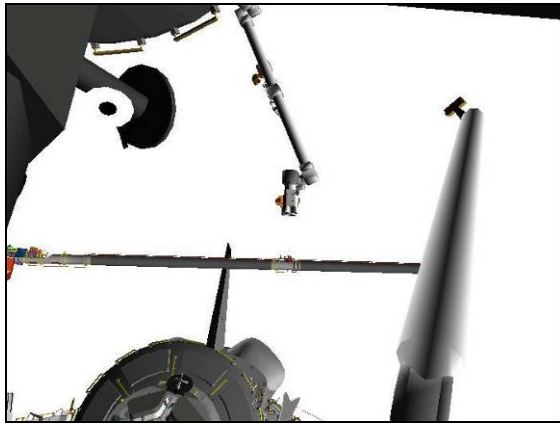


Figure 25.- OBSS Backoff
(72: Camera A: +5, +25).

9. MANEUVERING TO PARK POSITION

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3
09: P1 Lower Outboard (+120, +25)	13: LAB Starboard Zenith (-15, -40)	03: S1 Lower Outboard (+60, +20)

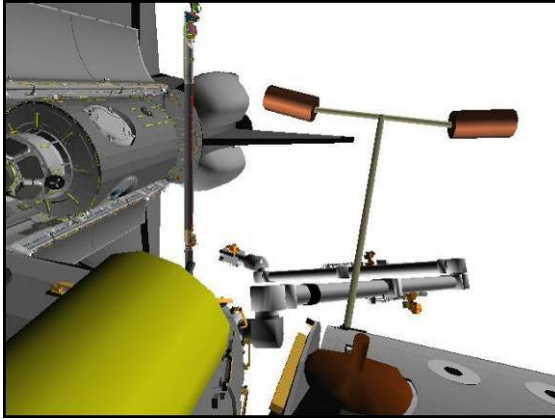


Figure 26.- OBSS Backoff
 (13: LAB Starboard Zenith: -15, -40).

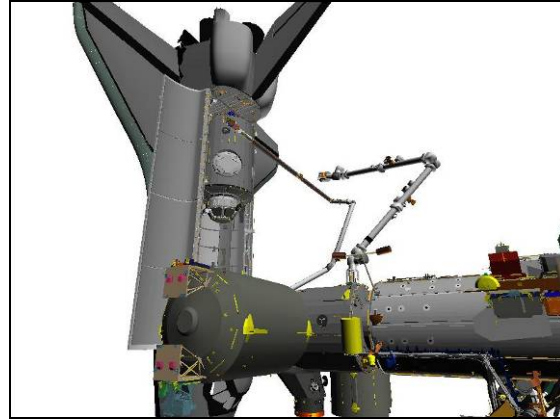


Figure 27.- OBSS Backoff
 (03: S1 Lower Outboard: +55, +20).

NOTE
 The duration of this Joint OCAS is approximately 2 minutes.

MSS: SSRMS:

√Vernier

Enter Mode – Joint OCAS (Verify blue)

pick File ► OBSS ► Park

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

SR	SY	SP	EP	WP	WY	WR
+90.1	+210.1	-139.5	-111.5	-109.3	-110.8	+89.8

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)	+74.6	+160.7	-144.1	-109.5	-189.8	-159.5	+63.9
TGT	+90.1	+210.1	-139.5	-111.5	-109.3	-110.8	+89.8
ERR	-15.5	-49.4	-4.6	+2.0	-80.5	-48.7	-25.9

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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 Joint Angle values.

SR	SY	SP	EP	WP	WY	WR
+90.1	+210.1	-139.5	-111.5	-109.3	-110.8	+89.8

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 for OBSS Maneuver to Node 3 Install Viewing.

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NOTE

1. Verify SRMS at Node 3 Install Viewing:
SY = +64.0, +44.7, -20.0, -10.0, +11.2, +30.0 = WR
2. Callouts in gray are for shuttle crew.

1. SETUP FOR JOINT OCAS MANEUVER TO PRE-GRAPPLE

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
03: S1 Lower Outboard (+60, +25)	13: LAB Stbd Zenith (-15, -25)	72 (DNLK): Camera C (0, +25)	Camera D (0, +20)	SRMS Elbow (-115, +30)

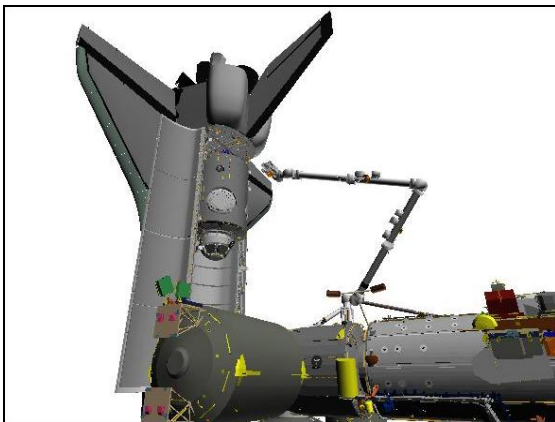


Figure 1.- SSRMS Park Position (03: S1 Lower Outboard: +60, +25).

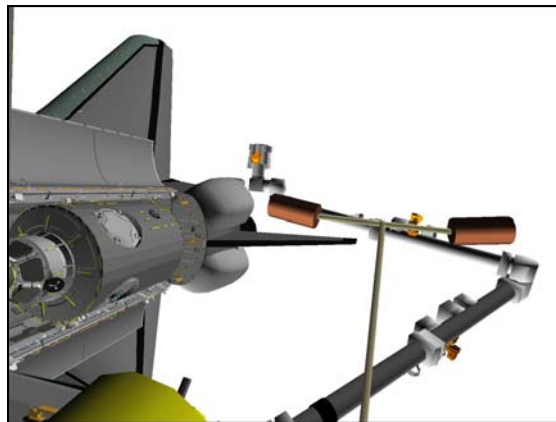


Figure 2.- SSRMS Park Position (13: LAB Stbd Zenith: -15, -25).

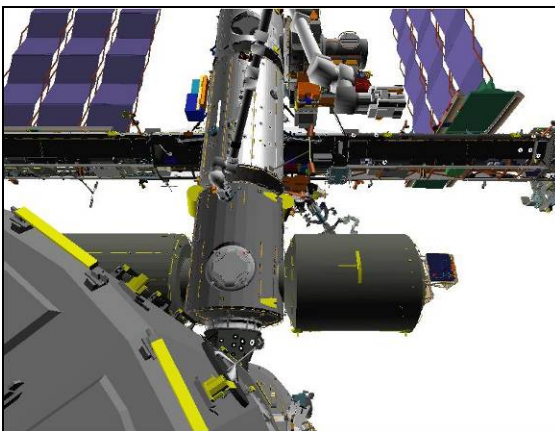


Figure 3.- SSRMS Park Position (72: Camera C: 0, +25).

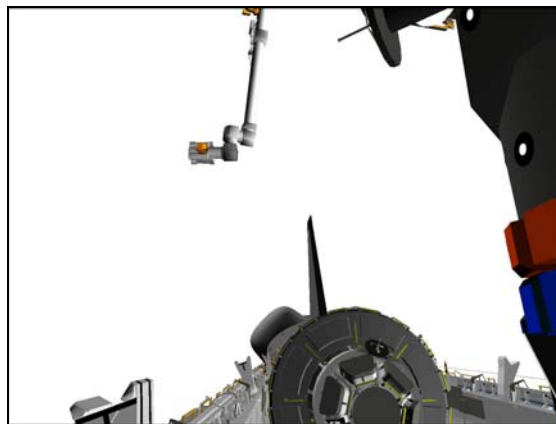


Figure 4.- SSRMS Park Position (Camera D: 0, +20).

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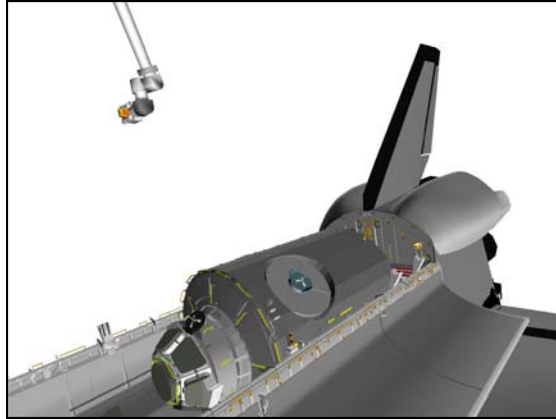


Figure 5.- SSRMS Park Position
(SRMS Elbow: -115, +30).

PCS

MSS: SSRMS:

Change Loaded Parameters ► Node 3 ► Node 3 Unberth SRH
Verify 'Loaded Parameters' (two) – Node 3 Unberth, SR Held

Verify 'Unloaded Parameters' (two) – LEE Tip, SR Held
Change Display ► Orbiter ► Berthed Node3 GF (Verify Orbiter>Berthed Node 3 GF)

Verify Command – SSRMS>Internal

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

SR	SY	SP	EP	WP	WY	WR
+90.1	+210.1	-139.5	-111.5	-109.3	-110.8	+89.8
X	Y	Z	Pitch	Yaw	Roll	
-629	+366	-278	-141.9	+0.1	+88.9	
FOR	Unloaded – LEE Tip, SR Held					
Disp	Orbiter>Berthed Node 3 GF					

2. JOINT OCAS MANEUVER TO NODE 3 PRE-GRAPPLE

MSS: SSRMS: MSS Safing:

cmd 'SSRMS' Remove (Verify Not Safed)

DCP

BRAKES SSRMS → OFF (Verify OFF)

NOTE

The duration of this Joint OCAS is approximately 3 minutes.

PCS

MSS: SSRMS:

√Vernier

Enter Mode – Joint OCAS (Verify blue)

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SSRMS Joint OCAS

pick File ► Node 3 ► Pre-Grapple

Verify 'Joint Angles' 'Destination' for Node 3 Pre-Grapple position.

SR	SY	SP	EP	WP	WY	WR
+90.1	+205.3	-185.4	-56.4	-48.7	+48.9	+115.0

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON

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

	SR	SY	SP	EP	WP	WY	WR
(current)	+90.1	+210.1	-139.5	-111.5	-109.3	-110.8	+89.8
TGT	+90.1	+205.3	-185.4	-56.4	-48.7	+48.9	+115.0
ERR	0.0	+4.8	+45.9	-55.1	-60.6	-159.7	-25.2

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: SSRMS

Verify Posn Hold – orange

Enter Mode – Standby (Verify blue)

Verify SSRMS at Node 3 Pre-Grapple position.

SR	SY	SP	EP	WP	WY	WR
+90.1	+205.3	-185.4	-56.4	-48.7	+48.9	+115.0
X	Y	Z	Pitch	Yaw	Roll	
-151	0	0	0	0	0	
FOR	Unloaded – LEE Tip, SR Held					
Disp	Orbiter>Berthed Node3 GF					

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3. NODE 3 GRAPPLE

3.1 Setup for Node 3 Grapple

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
07: P1 Lower Inboard (+140, +35)	25: Tip LEE (Zoom full out)	72 (DNLK): Camera C (0, +15)	Camera D (0, 0)	SRMS Elbow (-115, +30)

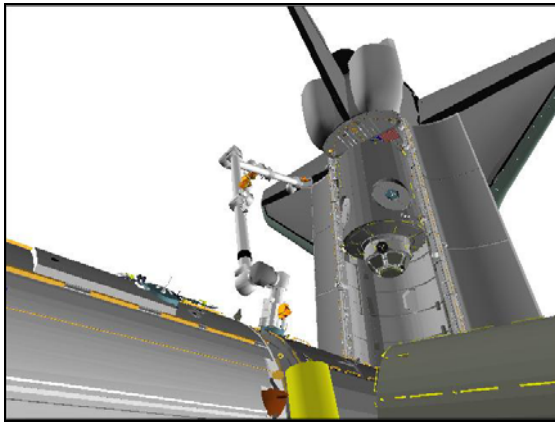


Figure 6.- Node 3 Pre-Grapple
(07: P1 Lower Inboard: +140, +35).

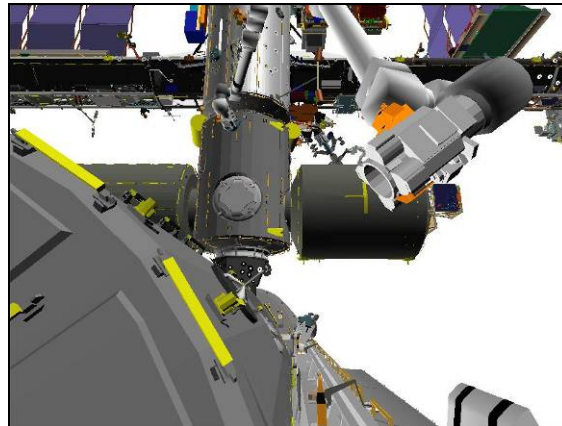


Figure 7.- Node 3 Pre-Grapple
(72: Camera C: 0, +15).

3.2 Maneuvering to Node 3 FRGF Grapple Envelope

NOTE

1. Monitor clearance between the Tip LEE and orbiter sill with Camera C. Minimum clearance during maneuver to grapple is approximately 93 cm (37 in).
2. Monitor clearance between Tip LEE and Aft V-Guide with Camera C. Minimum clearance during maneuver to grapple is approximately 67 cm (26 in).

MSS: SSRMS:

√Vernier

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 Roll (Verify SR – Locked)

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RHC/ THC Maneuver to within grapple envelope (THC push, +X).

3.3 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).

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Auto Capture

RHC TRIGGER → Press (momentarily)

PCS Verify 'Snare' Close, Capture (two) – blue (12 s max)
Verify Capture to Latch – No (SCR 19282)
Verify 'Carriage' Tension ~5500 N (90 s max)
Verify 'Carriage' Retract – blue
Verify 'Carriage' Brakes – On (15 s max)

3.4 Grapple Cleanup

DCP BRAKES SSRMS → ON (Verify ON)

PCS MSS: SSRMS:

Verify Loaded Parameters – √

Verify 'Loaded Parameters' (two) – Node3 Unberth, SR Held

Change Display ► Orbiter ► Node3 Unberth (Verify Orbiter> Node3 Unberth)

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

MSS: SSRMS: Rate:

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

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Review [SSRMS LEE CUE CARD \(SSRMS IS LOADED AND LEE CAUTION IS ANNUNCIATED\)](#), all (SODF: RBT GEN: REFERENCE: CUE CARD).

Expected Berthed Node 3 Grappled position joint:

SR	SY	SP	EP	WP	WY	WR
+90.1	+199.2	-192.2	-52.8	-38.6	+50.7	+106.0
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded – Node3 Unberth, SR Held					
Disp	Orbiter> Node3 Unberth					

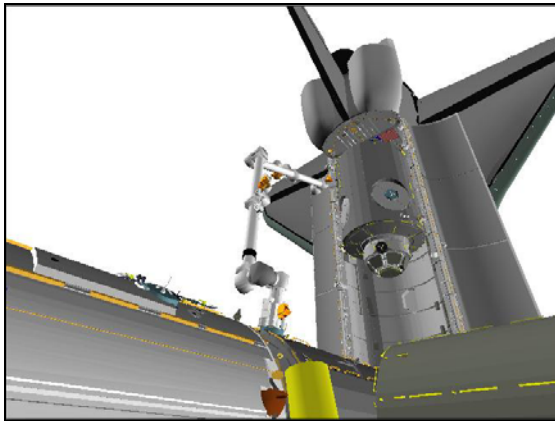


Figure 8.- Node 3 Grappled
(07: P1 Lower Inboard: +140, +35).

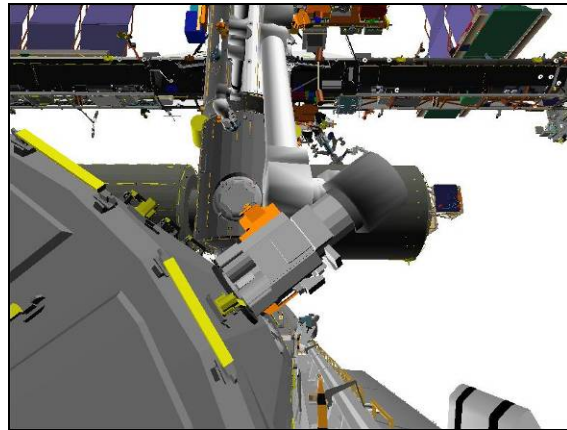


Figure 9.- Node 3 Grappled
(72: Camera C: 0, +15).

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1. SETUP FOR UNBERTH

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+120, +25)	72 (DNLK): Mux D/A (D: 0,0) (A: 0,0)	03: S1 Lower Outboard (+45, +25)	Camera C (-70, 0)	SRMS Elbow (-115, +30)

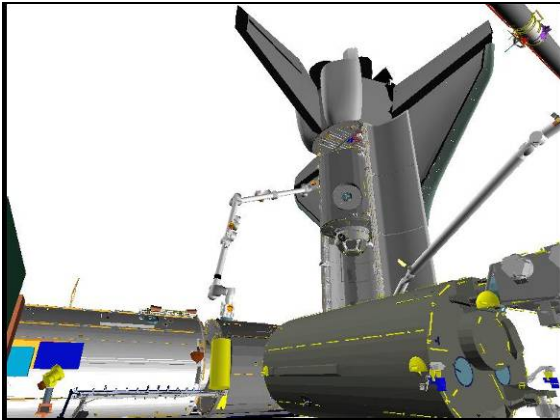


Figure 1.- Node 3 Unberth
(09: P1 Lower Outboard: +120, +25).

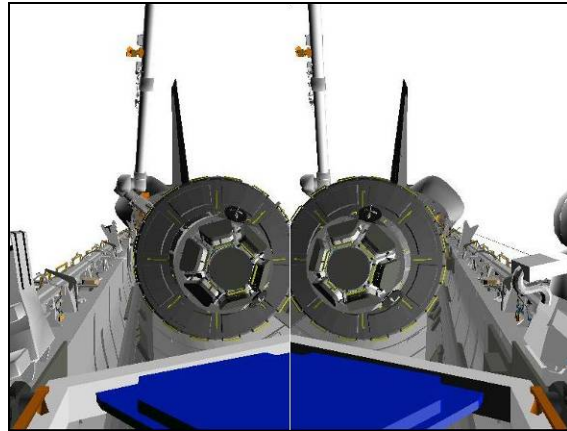


Figure 2.- Node 3 Unberth
(72: Mux D/A).

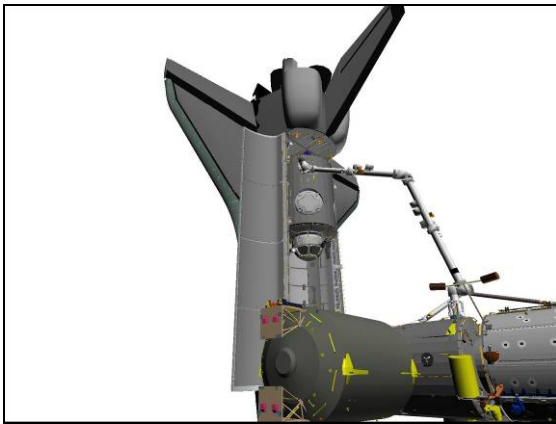


Figure 3.- Node 3 Unberth
(03: S1 Lower Outboard: +45, +25).

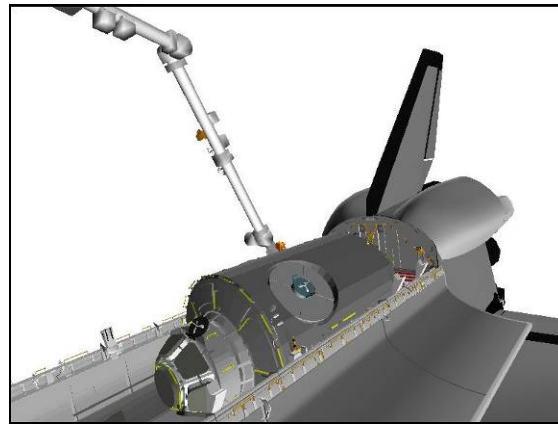


Figure 4.- Node 3 Unberth
(SRMS Elbow: -115, +30).

Verify CBCS setup completed.

PCS

MSS: SSRMS:

Verify Loaded Parameters – √

Verify 'Loaded Parameters' (two) – Node3 Unberth, SR Held

Verify Display – Orbiter>Node3 Unberth

Verify Command – ISS>OBAS

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Expected Berthed Node 3 Grappled position.

SR	SY	SP	EP	WP	WY	WR
+90.1	+199.2	-192.2	-52.8	-38.6	+50.7	+106.0
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded – Node3 Unberth, SR Held					
Disp	Orbiter> Node3 Unberth					

2. ATTITUDE CONTROL CONFIGURATION

On **MCC-H GO** and IV GO for Node 3 Unberth:

MSS: SSRMS: Thrusters: Thruster Controls for MSS Ops

Verify 'Desat Request:' – Inh

```
*****
* If using shuttle attitude control and attitude maintenance required
* |
* |   DAP: LVLH
* |
* |   When rates damped
* |   |
* |   |   DAP: FREE > 2 seconds
* |   |   DAP: AUTO
* |   |
* |   |   When in attitude and rates damped
* |   |   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 3 PRLAs.

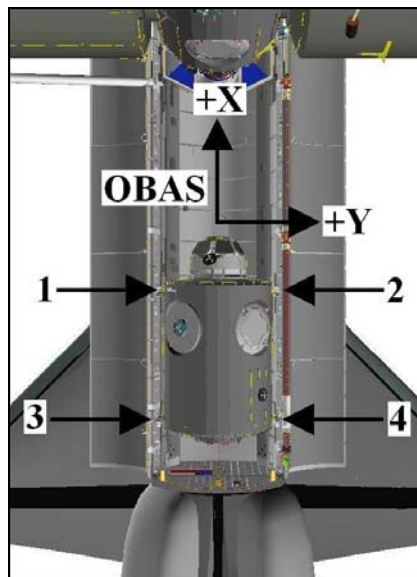


Figure 5.- Node 3 PRLA Configuration.

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4. ACTIVATING LATCHES

A6U √PL RETEN LAT (five) – OFF
 √PL SEL – 1
 LOGIC PWR SYS 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

√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. DEACTIVATING 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 3 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 3 TO LOW HOVER POSITION

NOTE Due to clearance concerns with Node 3 Handrails and V-guides during Node 3 Unberth, maintain FOR within 5 cm/1 deg to avoid contact.

On shuttle crew "GO for Node 3 unberth" (PRLAs released):

Verify EV crew clear of Node 3.

DCP BRAKES SSRMS → OFF (Verify OFF)

PCS MSS: SSRMS:

√Vernier

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 Roll (Verify SR – Locked)

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THC/
RHC Maneuver Node 3 to Low Hover position (within 5 cm/1 deg).
(THC up, -Z)

Locked						
SR	SY	SP	EP	WP	WY	WR
+90.1	+199.1	-147.1	-87.7	-48.7	+50.7	+105.8
X	Y	Z	Pitch	Yaw	Roll	
0	0	-600	0	0	0	
FOR	Loaded – Node3 Unberth, SR Held					
Disp	Orbiter>Node3 Unberth					

PCS MSS: SSRMS:

Enter Mode – Standby (Verify blue)

MSS: SSRMS: Rate:

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

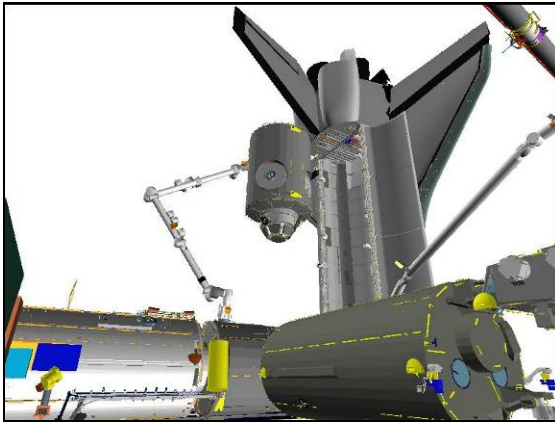


Figure 6.- Node 3 Low Hover
(09: P1 Lower Outboard: +120, +25).

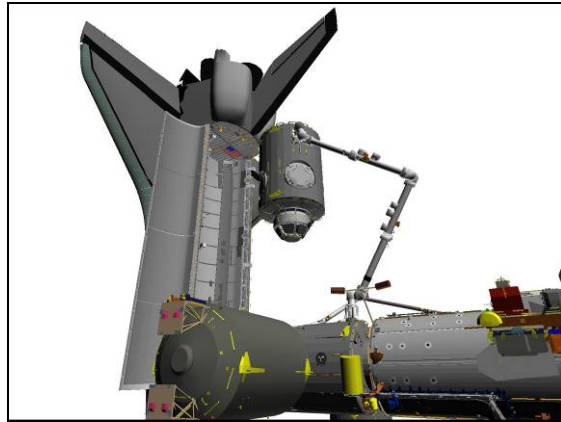


Figure 7.- Node 3 Low Hover
(03: S1 Lower Outboard: +60, +25).

```

*****
* If using shuttle attitude control and attitude maintenance required
* |
* |   DAP: LVLH
* |
* |   When rates damped
* |   |
* |   |   DAP: FREE > 2 seconds
* |   |   DAP: AUTO
* |   |
* |   |
* |   |   When in attitude and rates damped
* |   |   DAP: FREE
* |
*****
    
```

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10. MANEUVERING NODE 3 TO PORT HOVER POSITION

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+120, +25)	72 (DNLK): Camera A (+15, +20)	03: S1 Lower Outboard (+70, +25)	Camera C (-60, +35)	SRMS Elbow (-105, +40)

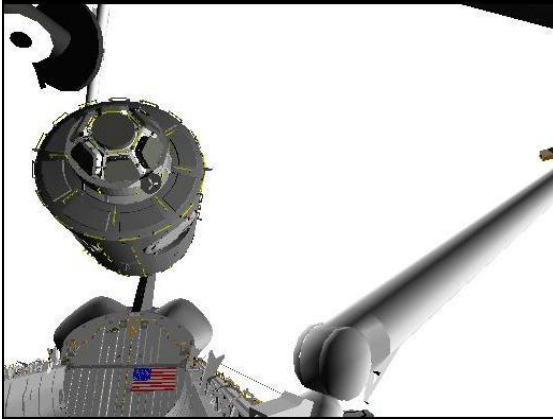


Figure 8.- Node 3 Low Hover (72: Camera A: +15, +20).



Figure 9.- Node 3 Low Hover (03: S1 Lower Outboard: +70, +25).

RHC RATE → COARSE (Verify Coarse on PCS)

NOTE

The duration of this FOR OCAS is approximately 7 minutes.

PCS MSS: SSRMS:

Enter Mode – FOR OCAS (Verify blue)

MSS: SSRMS: SSRMS FOR OCAS: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

pick File ► Node 3 ► Port Hover

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

X	Y	Z	Pitch	Yaw	Roll
0	-700	-600	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	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

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

Enter Mode – Standby (Verify blue)

Verify SSRMS at Node 3 Port Hover position (within 5 cm/1 deg).

Locked	SR	SY	SP	EP	WP	WY	WR
	+90.1	+161.6	-151.0	-85.2	-3.9	+44.8	+49.4
	X	Y	Z	Pitch	Yaw	Roll	
	0	-700	-600	0	0	0	
FOR	Loaded – Node3 Unberth, SR Held						
Disp	Orbiter>Node3 Unberth						

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Figure 10.- Node 3 Port Hover
(09: P1 Lower Outboard: +120, +25).

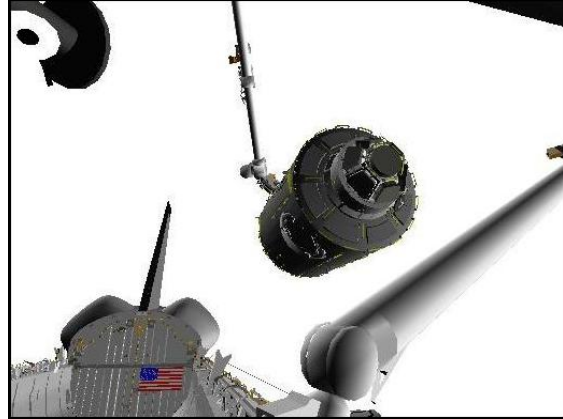


Figure 11.- Node 3 Port Hover
(72: Camera A: +15, +20).

```

*****
* If using shuttle attitude control and attitude maintenance required
* |
* |   DAP: LVLH
* |
* |   When rates damped
* |   |
* |   |   DAP: FREE > 2 seconds
* |   |   DAP: AUTO
* |   |
* |   |   When in attitude and rates damped
* |   |   DAP: FREE
* |
*****
    
```

11. JOINT OCAS FROM PORT HOVER TO INTERMEDIATE POSITION

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
07: P1 Lower Inboard (-180, +50)	72 (DNLK): Camera C (-45, +30)	03: S1 Lower Outboard (+70, +25)	Camera A (+30, +30)	OBSS ITVC (+110, -35)

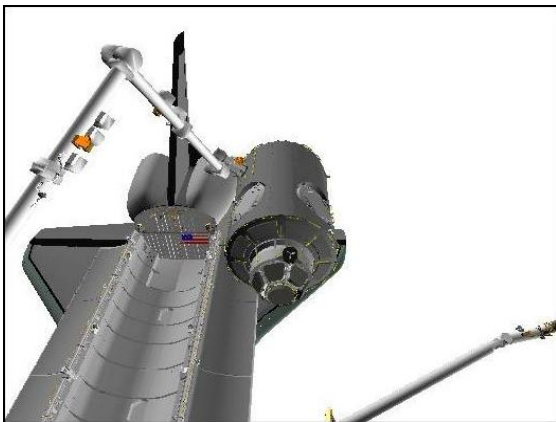


Figure 12.- Node 3 Port Hover
(07: P1 Lower Inboard: -180, +50).

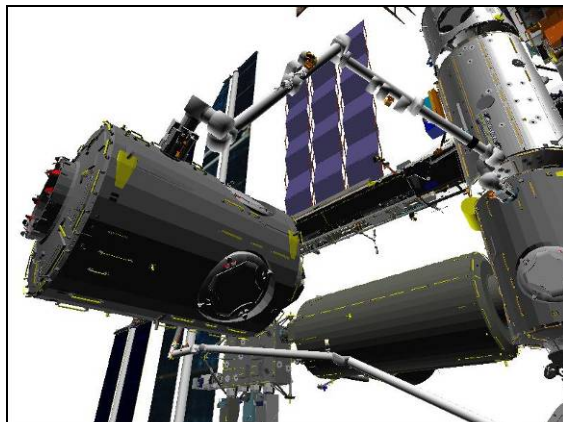


Figure 13.- Node 3 Port Hover
(72: Camera C: -45, +30).

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NOTE
The duration of this Joint OCAS is approximately 20 minutes.

RHC RATE → VERNIER (Verify Vernier on PCS)

PCS MSS: SSRMS: SSRMS

Enter Mode – Joint OCAS (Verify blue)

SSRMS Joint OCAS

pick File ► Node 3 ► Intermediate

Verify 'Joint Angles' 'Destination' for Node 3 Intermediate position.

SR	SY	SP	EP	WP	WY	WR
+128.9	+132.9	-140.9	-21.4	+16.3	-19.1	+64.6

cmd Load (Verify Sequence Status – Confirm or Cancel)

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

	SR	SY	SP	EP	WP	WY	WR
(current)	+90.1	+161.6	-151.0	-85.2	-3.9	+44.8	+49.4
TGT	+128.9	+132.9	-140.9	-21.4	+16.3	-19.1	+64.6
ERR	-38.8	+28.7	-10.1	-63.8	-20.2	+63.9	-15.2

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: SSRMS

Verify Posn Hold – orange

Enter Mode – Standby (Verify blue)

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Verify SSRMS at Node 3 Intermediate position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+128.9	+132.9	-140.9	-21.4	+16.3	-19.1	+64.6
X	Y	Z	Pitch	Yaw	Roll	
-73	-1572	-994	-97.0	-9.7	-5.1	
FOR	Loaded – Node3 Unberth, SR Held					
Disp	Orbiter>Node3 Unberth					

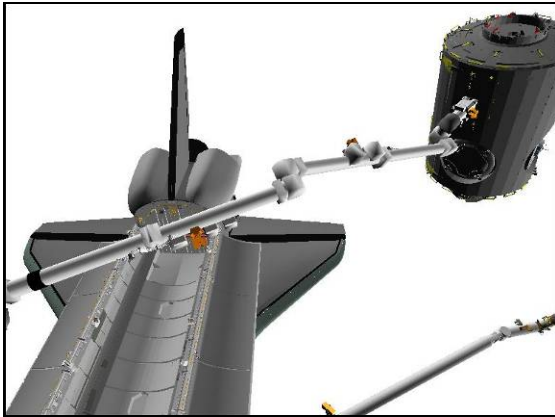


Figure 14.- Node 3 Intermediate
(07: P1 Lower Inboard: -180, +50).

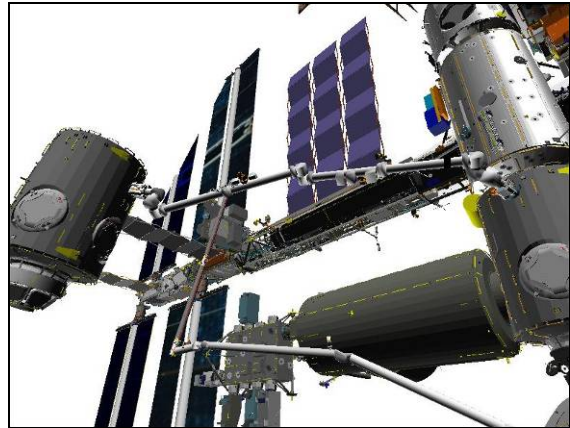


Figure 15.- Node 3 Intermediate
(72: Camera C: -45, +30).

```

*****
* If using shuttle attitude control and attitude maintenance required
* | DAP: LVLH
* |
* | When rates damped
* | | DAP: FREE > 2 seconds
* | | DAP: AUTO
* | |
* | | When in attitude and rates damped
* | | DAP: FREE
*****

```

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12. JOINT OCAS TO RADIATOR HOLD POSITION

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
07: P1 Lower Inboard (-180, +50)	72 (DNLK): Camera C (-45, +30)	22: Base Elbow (+175, +10)	SRMS Elbow (+10, +60)	OBSS ITVC (+110, -35)



Figure 16.- Node 3 Intermediate (22: Base Elbow: +175, +10).



Figure 17.- Node 3 Intermediate (SRMS Elbow: +10, +60).

MSS: SSRMS:

Change Loaded Parameters ► Node3 ► Node3 Install CBCS SYH
Verify 'Loaded Parameters' (two) – Node3 Install CBCS, SY Held

Change Display ► Node1 ► Node3 Install CBCS (Verify Node1>Node3 Install CBCS)

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

√Vernier

NOTE

1. Expect singularity warning for EP between -15 and +15 deg.
2. Maneuver duration is approximately 20 minutes.

Enter Mode – Joint OCAS (Verify blue)

Input 'Joint Angles' 'Destination' for Radiator Hold position.

SR	SY	SP	EP	WP	WY	WR
+128.9	+132.9	-140.9	+68.4	+16.3	-19.1	+64.6

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)	+128.9	+132.9	-140.9	-21.4	+16.3	-19.1	+64.6
TGT	+128.9	+132.9	-140.9	+68.4	+16.3	-19.1	+64.6
ERR	0.0	0.0	0.0	-89.8	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

PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify Joint Angle values.

SR	SY	SP	EP	WP	WY	WR
+128.9	+132.9	-140.9	+68.4	+16.3	-19.1	+64.6

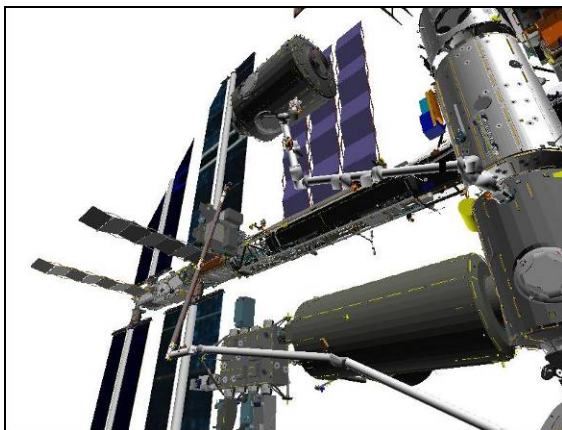


Figure 18.- Radiator Hold
(72: Camera C: -45, +30).

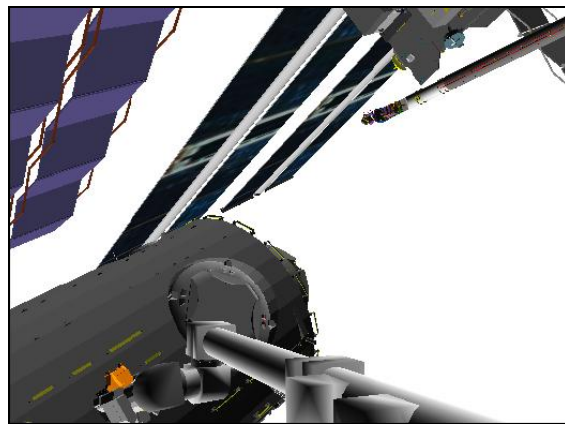


Figure 19.- Radiator Hold
(22: Base Elbow: +135, +5).

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```

*****
* If using shuttle attitude control and attitude maintenance required
* |√MCC-H for correct CNTL ACC
* |
* |   DAP: LVLH
* |
* |   When rates damped
* |   |   DAP: FREE > 2 seconds
* |   |   DAP: AUTO
* |
* |   When in attitude and rates damped
* |   |   DAP: FREE
*****

```

13. FOR OCAS TO PRE-INSTALL POSITION

<u>NOTE</u>	
1. Minimum clearance between the Tip Boom and P1 Lower Inboard Camera envelope is 43 cm (17 in). Monitor with the P1 Lower Outboard and Base Elbow Cameras.	
2. The duration of this FOR OCAS is approximately 12 minutes.	

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+80, +25)	72 (DNLK): Camera B (-10, +50)	22: Base Elbow (+105, -15)	SRMS Elbow (+95, +60)	OBSS ITVC (+105, -90)

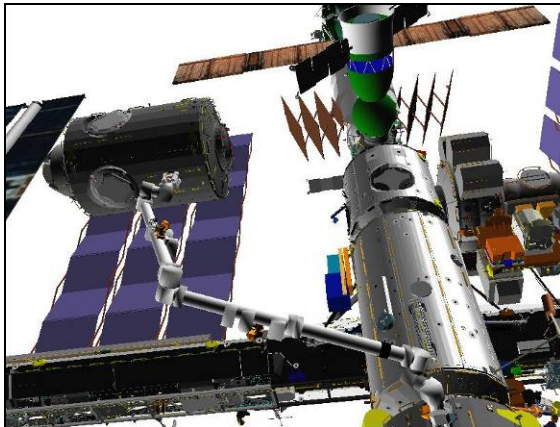


Figure 20.- Node 3 Radiator Hold (72: Camera B: -10, +50).

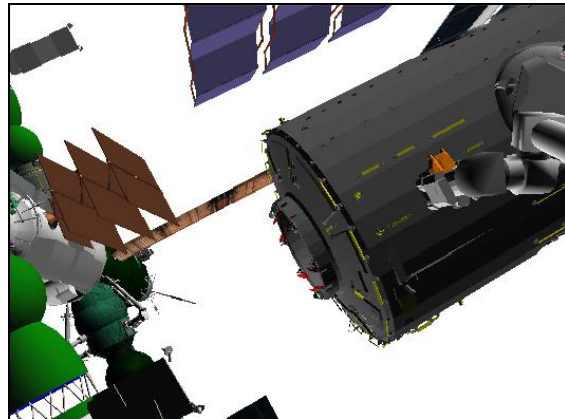


Figure 21.- Node 3 Radiator Hold (22: Base Elbow: +105, -15).

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

Verify EV crew clear of Node 1 Port CBM, then:

MSS: SSRMS:

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√Vernier

Enter Mode – FOR OCAS (Verify blue)

MSS: SSRMS: SSRMS FOR OCAS: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

pick File ► Node 3 ► Pre-Install

Verify 'FOR' 'Destination' for 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)

MON

Verify FOR and errors are correct on FOR Position overlay.

	X	Y	Z	Pitch	Yaw	Roll
FOR	+500	+500	-1	0.0	0.0	0.0
TGT	+200	0	0	0.0	0.0	0.0
ERR	+300	+500	-1	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)
 *
 * Verify FOR and errors are correct on FOR Position overlay.

MON

PCS

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

DCP

AUTO SEQ → PROC

PCS

MSS: SSRMS:

Verify Posn Hold – orange

Enter Mode – Standby (Verify blue)

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

	Locked					
SR	SY	SP	EP	WP	WY	WR
+153.2	+132.9	-106.4	+89.3	-15.7	-30.7	+77.6
X	Y	Z	Pitch	Yaw	Roll	
+200	0	0	0.0	0.0	0.0	
FOR	Loaded – Node3 Install CBCS, SY Held					
Disp	Node1>Node3 Install CBCS					

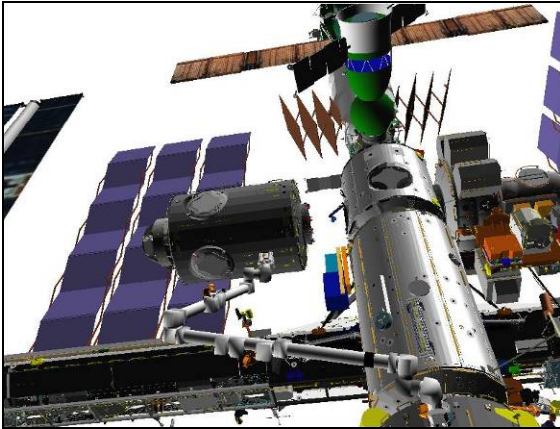


Figure 22.- Node 3 Pre-Install
(72: Camera B: -10, +50).

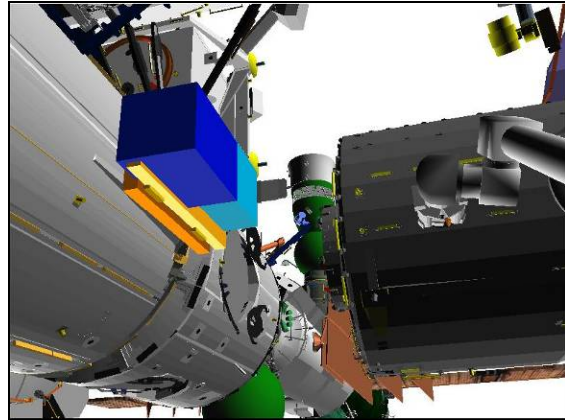


Figure 23.- Node 3 Pre-Install
(22: Base Elbow: +90, -15).

```

*****
* If using shuttle attitude control and attitude maintenance required
* | MCC-H for correct CNTL ACC
* |
* | DAP: LVLH
* |
* | When rates damped
* | | DAP: FREE > 2 seconds
* | | DAP: AUTO
* |
* | When in attitude and rates damped
* | | DAP: FREE
*****

```


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14. MANEUVERING NODE 3 TO READY-TO-LATCH POSITION

NOTE

Minimum clearances at Install position:

1. Node 3 to ESP-1 is 26 cm (10 in). Monitor with the Base Elbow Camera.
2. Tip LEE to ESP-1 is 48 cm (19 in). Monitor with the Base Elbow Camera.
3. Tip Boom to P1 Lower Inboard Camera is 60 cm (24 in). Monitor with the P1 Lower Outboard Camera.
4. Node 3 to Node 1 Zenith Aft Stanchion is 52 cm (20 in). No Camera view is available.

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+80, +10)	17: CBCS	22: Base Elbow (+90, -15)	SRMS Elbow (+115, +50)	Camera B (-10, +50)

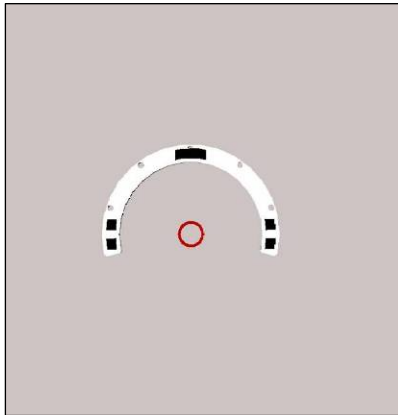


Figure 24.- Node 3 Pre-Install (17: CBCS).

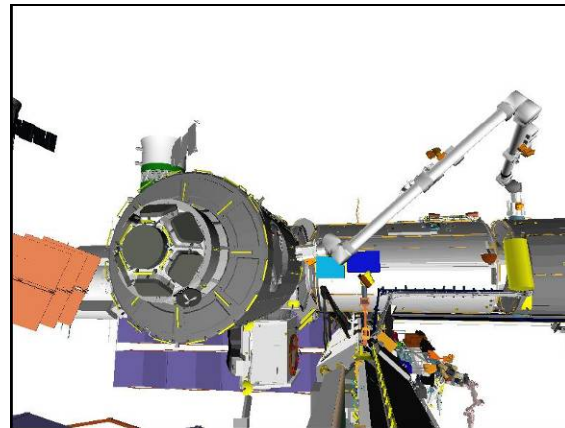


Figure 25.- Node 3 Pre-Install (09: P1 Lower Outboard: +80, +10).

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

On CBM operator "GO for maneuver to Ready-to-Latch position":

Node 1: S&M: Port CBM:

Monitor CBM RTLs using PCS.

Monitor CBM RTLs using USOS Eff overlay.

MSS: SSRMS:

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Verify 'Loaded Parameters' (two) – Node3 Install CBCS, SY Held

Verify Display – Node1>Node3 Install CBCS

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)

THC/
RHC

Maneuver Node 3 to Ready-To-Latch position until RTL (four) – green
(THC pull, -X)

	Locked					
SR	SY	SP	EP	WP	WY	WR
+149.3	+132.9	-105.3	+99.4	-30.9	-29.2	+75.0
X	Y	Z	Pitch	Yaw	Roll	
+11	0.0	0.0	0.0	0.0	0.0	
FOR	Loaded – Node3 Install CBCS, SY Held					
Disp	Node1>Node3 Install CBCS					

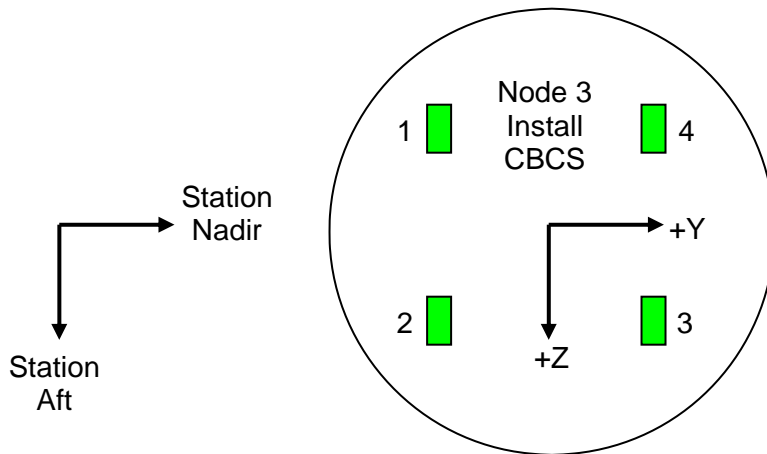


Figure 26.- Node 3 Install CBCS RTL Diagram.

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Table 1.- Node 3 Install CBCS Missing
RTL Configuration
(Refer to Figure 26.)

Missing RTLs	RHC Input*
1	+ Pitch, - Yaw
2	- Pitch, - Yaw
3	- Pitch, + Yaw
4	+ Pitch, + Yaw
1,2	- Yaw
3,4	+ Yaw
1,4	+ Pitch
2,3	- Pitch

* All inputs with respect to Node 3 Install
CBCS FOR.

PCS

MSS: SSRMS:

Verify Posn Hold – orange

Node 1: S&M: Port CBM:

Verify RTL (four) – green

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

Notify CBM operator, “Maneuver to RTL complete.”

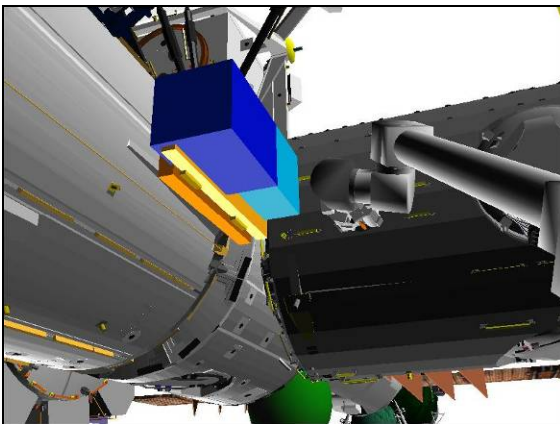


Figure 27.- Node 3 Ready-To-Latch
(22: Base Elbow: +90, -15).

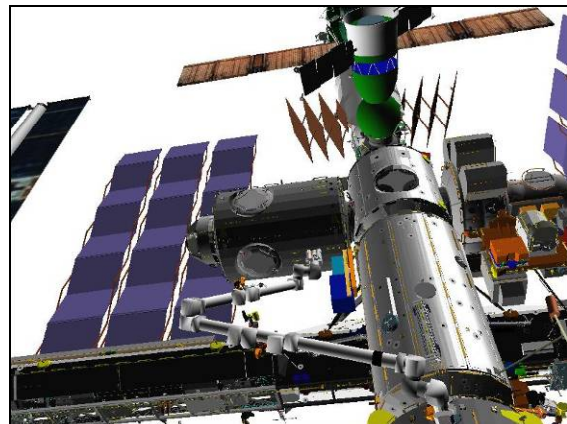


Figure 28.- Node 3 Ready-To-Latch
(Camera B: -10, +50).

15. 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.”

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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, $\sqrt{\text{MCC-H}}$ before proceeding.

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

16. 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."

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)

PCS MSS: SSRMS:

Expected Node 3 Install Position.

SR	SY	SP	EP	WP	WY	WR
+149.0	+132.9	-105.2	+99.8	-31.8	-29.0	+74.9
X	Y	Z	Pitch	Yaw	Roll	
0	0	0.0	0.0	0.0	0.0	
FOR	Loaded – Node3 Install CBCS, SY Held					
Disp	Node1>Node3 Install CBCS					

1.220 SSRMS NODE 3 UNBERTH TO INSTALL

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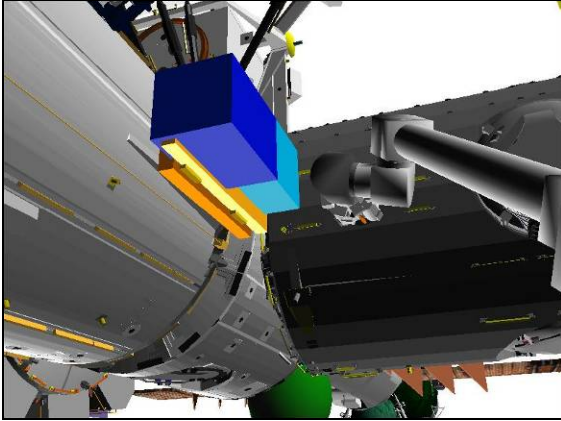


Figure 29.- Node 3 Installed
(22: Base Elbow: +90, -15).

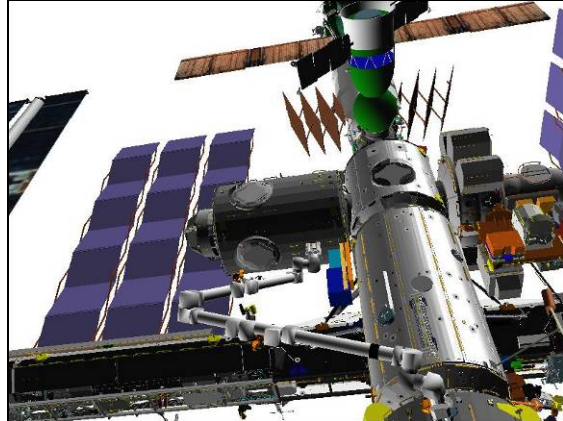


Figure 30.- Node 3 Installed
(Camera B: -10, +50).

```
*****
* If using shuttle attitude control and attitude maintenance required
* |  $\sqrt{\text{MCC-H}}$  for correct CNTL ACC
* |
* | DAP: LVLH
* |
* | When rates damped
* | | DAP: FREE > 2 seconds
* | | DAP: AUTO
*****
```

1.310 SSRMS NODE 3 RELEASE AND WALKOFF TO LAB PDGF

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1. SETUP FOR NODE 3 RELEASE

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+100, +15) 71: OBSS ITVC (+85, -60)	25: Tip LEE (Zoom full out)	72 (DNLK): Camera B (-5, +45) HFOV = 10 deg	Camera C (-20, +45)	SRMS Elbow (+130, +60)

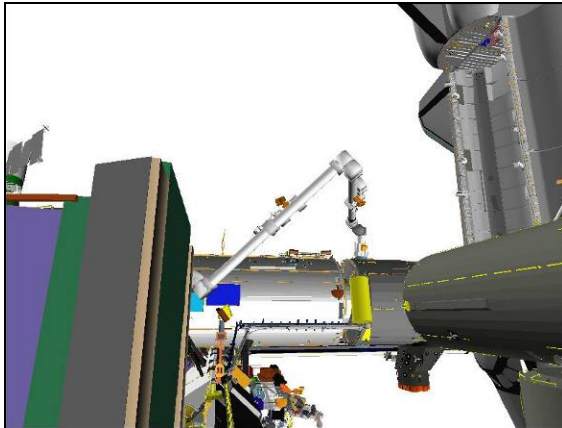


Figure 1.- Node 3 Installed
(09: P1 Lower Outboard: +100, +15).

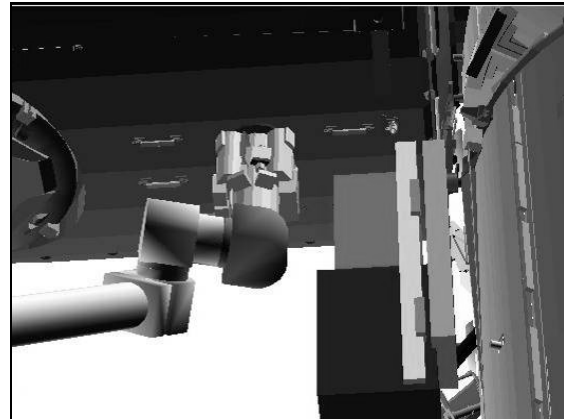


Figure 2.- Node 3 Installed
(72: Camera B: -5, +45)
HFOV = 10 deg.

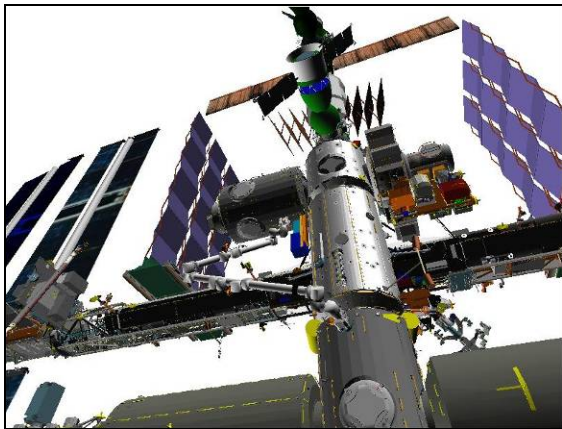


Figure 3.- Node 3 Installed
(Camera C: -20, +45).

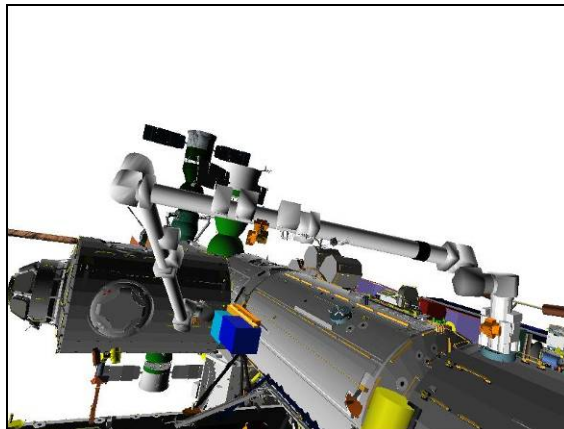


Figure 4.- Node 3 Installed
(SRMS Elbow: +130, +60).

PCS

MSS: SSRMS:

Verify Loaded Parameters – √

Verify 'Loaded Parameters' (two) – Node3 Install CBCS, SY Held

Change Unloaded Parameters ► Unloaded ► LEE Tip SYH

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

1.310 SSRMS NODE 3 RELEASE AND WALKOFF TO LAB PDGF

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Change Display ► Node1 ► Node3 Mated GF (Verify Node1>Node3 Mated GF)

Verify Command – SSRMS>Internal

Verify SSRMS at Node 3 Installed position.

SR	SY	SP	EP	WP	WY	WR
+149.0	+132.9	-105.2	+99.8	-31.8	-29.0	+74.9
X	Y	Z	Pitch	Yaw	Roll	
+227	-155	0	+69.5	+90.0*	-76.6	
FOR	Loaded – Node3 Install CBCS, SY Held					
Disp	Node1>Node3 Mated GF					

*Display singularity

2. NODE 3 FRGF RELEASE

MSS: SSRMS: MSS Safing:

cmd 'SSRMS' Remove (Verify Not Safed)

DCP BRAKES SSRMS → OFF (Verify OFF)

PCS MSS: SSRMS:

√Vernier

MSS: SSRMS: Rate:

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

2.1 SSRMS Limp

PCS MSS: SSRMS: Limp:

cmd All Limp (Verify Limp – blue)

MSS: SSRMS:

Verify all joints – Limped

2.2 Auto Release (Carriage Pushoff)

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.

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NOTE

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

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Auto Release

RHC TRIGGER → Press (momentarily)

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

2.3 SSRMS Backoff

NOTE

1. Due to clearance concerns between the wrist cluster and ESP-1, the backoff position has been modified.
2. Minimum clearance between the Tip LEE and ESP-1 is 22 cm (9 in); monitor with Camera B.

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 Node 3 Backoff position (within 5 cm/1 deg).

	Locked					
SR	SY	SP	EP	WP	WY	WR
+152.7	+132.9	-106.1	+105.6	-32.8	-30.5	+77.2
X	Y	Z	Pitch	Yaw	Roll	
-65	0	0	0.0	0.0	0.0	
FOR	Unloaded – LEE Tip, SY Held					
Disp	Node1>Node3 Mated GF					

1.310 SSRMS NODE 3 RELEASE AND WALKOFF TO LAB PDGF

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PCS

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

MSS: SSRMS: Rate:

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

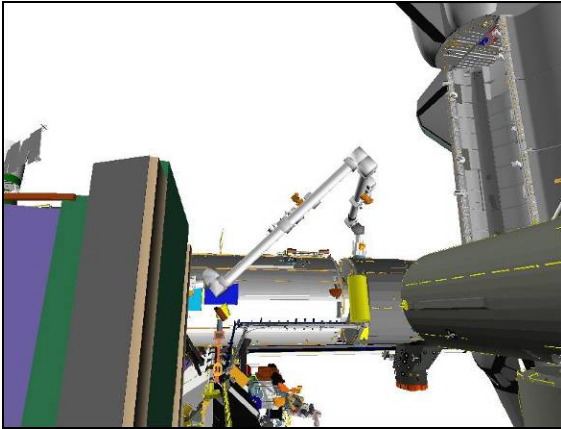


Figure 5.- Node 3 Backoff
(09: P1 Lower Outboard: +100, +15).

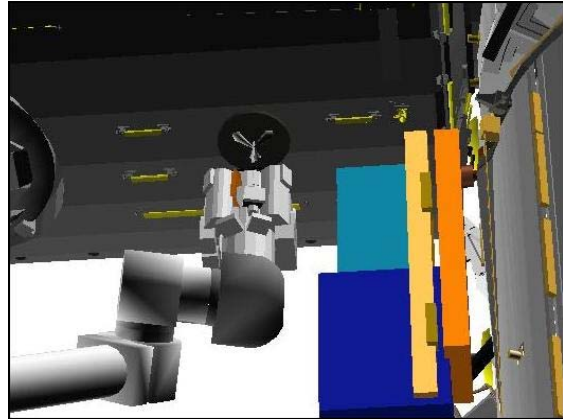


Figure 6.- Node 3 Backoff
(72: Camera B: -5, +45)
HFOV = 10 deg.

3. FOR OCAS TO LAB CLEARANCE

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+100, +15) 71: OBSS ITVC (+85, -60)	24: Tip Elbow (0, 0)	72 (DNLK): Camera B (-5, +45)	Camera C (-20, +45)	SRMS Elbow (+130, +60)

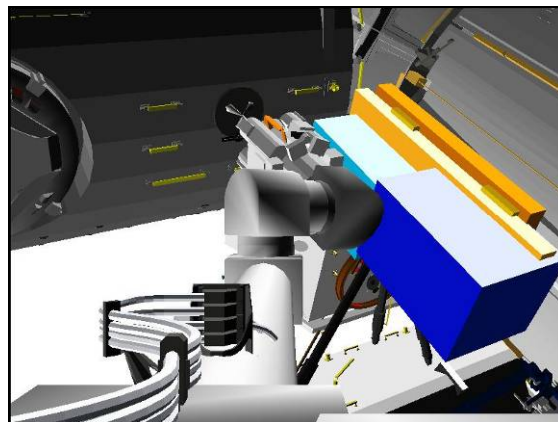


Figure 7.- Node 3 Backoff
(24: Tip Elbow: 0, 0).

1.310 SSRMS NODE 3 RELEASE AND WALKOFF TO LAB PDGF

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NOTE

1. Clearance between the Tip LEE and ESP-1 is 22 cm (9 in) and increases throughout the maneuver. Monitor with Camera B.
2. Clearance between the Tip LEE and the Node 3 FRGF pin increases throughout the maneuver. Monitor with the P1 Lower Outboard or OBSS ITVC Camera.
3. Maneuver duration is ~1 minute.

MSS: SSRMS:

Enter Mode – FOR OCAS (Verify blue)

MSS: SSRMS: SSRMS FOR OCAS: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

pick File ► Node2 ► LAB Clearance

Verify 'FOR' 'Destination' for LAB 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

1.310 SSRMS NODE 3 RELEASE AND WALKOFF TO LAB PDGF

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PCS MSS: SSRMS:

Verify Posn Hold – orange

Enter Mode – Standby (Verify blue)

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

	Locked					
SR	SY	SP	EP	WP	WY	WR
+146.3	+132.9	-134.1	+109.1	-14.8	-27.9	+73.2
X	Y	Z	Pitch	Yaw	Roll	
-200	+200	+200	0.0	0.0	0.0	
FOR	Unloaded – LEE Tip, SY Held					
Disp	Node1>Node3 Mated GF					

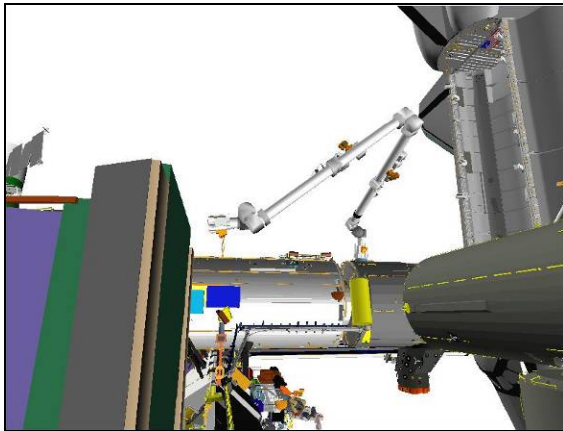


Figure 8.- LAB Clearance
(09: P1 Lower Outboard: +100, +15).

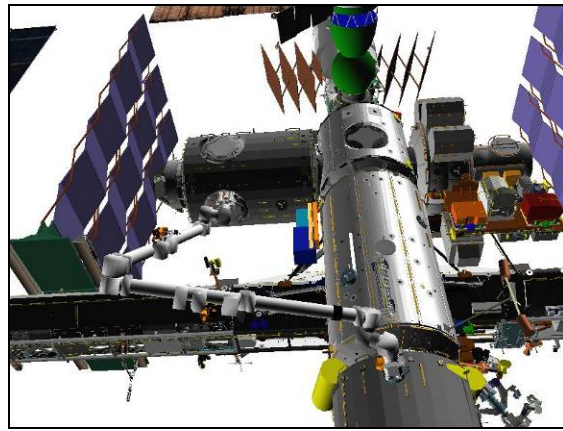


Figure 9.- LAB Clearance
(Camera B: -5, +45).

4. JOINT OCAS TO LAB PRE-GRAPPLE

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+100, +15)	24: Tip Elbow (0, 0)	07: P1 Lower Inboard (+135, +55)	Camera C (-20, +45)	SRMS Elbow (+130, +60)

MSS: SSRMS:

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

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

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

SR	SY	SP	EP	WP	WY	WR
+146.3	+132.9	-134.1	+109.1	-14.8	-27.9	+73.2
X	Y	Z	Pitch	Yaw	Roll	
-327	+323	+399	-84.4	+4.2	+37.4	
FOR	Unloaded – LEE Tip, SY Held					
Disp	LAB>PDGF					

NOTE
Maneuver duration is ~3.5 minutes.

RHC RATE → COARSE (Verify Coarse on PCS)

PCS MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

SSRMS Joint OCAS

pick File ► Node2 ► LAB Pre-Grapple

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

SR	SY	SP	EP	WP	WY	WR
+138.9	+162.2	-178.2	+153.7	+225.4	-178.3	-134.1

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)	+146.3	+132.9	-134.1	+109.1	-14.8	-27.9	+73.2
TGT	+138.9	+162.2	-178.2	+153.7	+225.4	-178.3	-134.1
ERR	+7.4	-29.3	+44.1	-44.6	-240.2	+150.4	+207.3

```
*****
* 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

1.310 SSRMS NODE 3 RELEASE AND WALKOFF TO LAB PDGF

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PCS MSS: SSRMS:

Verify Posn Hold – orange

Enter Mode – Standby (Verify blue)

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

SR	SY	SP	EP	WP	WY	WR
+138.9	+162.2	-178.2	+153.7	+225.4	-178.3	-134.1
X	Y	Z	Pitch	Yaw	Roll	
-150	0	0	0.0	0.0	0.0	
FOR	Unloaded – LEE Tip, SY Held					
Disp	LAB>PDGF					

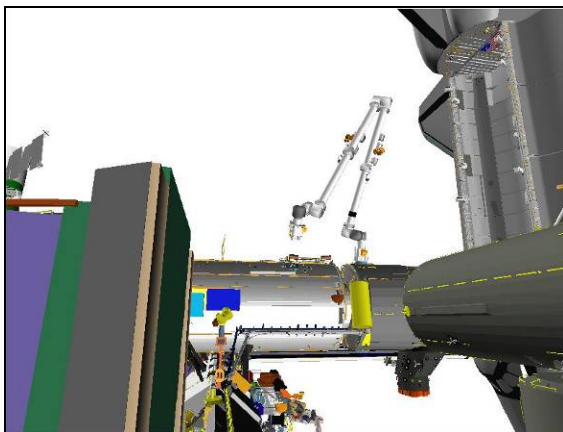


Figure 10.- LAB Pre-Grapple
(09: P1 Lower Outboard: +100, +15).

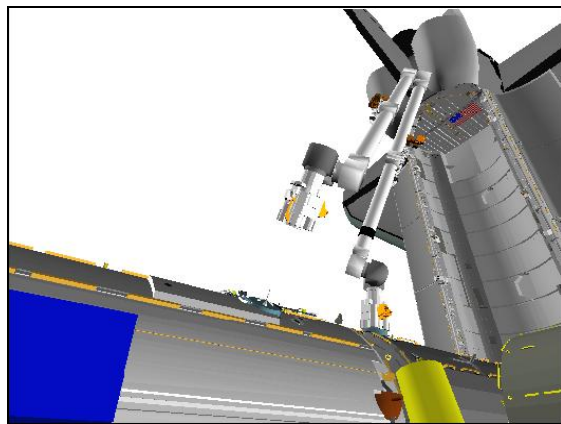


Figure 11.- LAB Pre-Grapple
(07: P1 Lower Inboard: +125, +35).

5. LAB PDGF CAPTURE

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+100, +15)	25: Tip LEE (Zoom full out)	07: P1 Lower Inboard (+125, +35)	Camera C (-20, +45)	SRMS Elbow (+130, +60)

5.1 LAB PDGF Grapple

RHC RATE → VERNIER (Verify Vernier on PCS)

PCS MSS: SSRMS: Rate:

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

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

1.310 SSRMS NODE 3 RELEASE AND WALKOFF TO LAB PDGF

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

cmd Shoulder Yaw (Verify SY – Locked)

RHC/
THC

Maneuver to within grapple envelope.

PCS

MSS: SSRMS: Tip LEE: 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

TRIGGER → Press (momentarily)

PCS

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

Verify Capture to Latch – Yes (SCR 19282)

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

Verify 'Carriage' Retract – blue

Verify 'Latch' Latch – blue (65 s max)

5.2 Mating Umbilicals

Verify with **MCC-H** - Payload and PDGF power inhibits have been confirmed.

MSS: SSRMS: Tip LEE: SSRMS Tip LEE

cmd 'Umbilical' Mate (Verify '**Confirm or Terminate**' prompt)

NOTE

Expect '**R3L - SSRMS Pwr Flags Fail**' Robotics Advisory message when mating umbilicals (SCR 19019).

cmd Confirm (Verify RHC Trigger Hot icon)

1.310 SSRMS NODE 3 RELEASE AND WALKOFF TO LAB PDGF

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Verify LEE Mode – Mate

RHC TRIGGER → Press (momentarily)

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

5.3 Derigidizing 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 – Deridigize

RHC TRIGGER → Press (momentarily) (SCR 19064)

PCS Verify 'Carriage' Retract – gray (90 s max)
Verify 'Carriage' Tension < 555 N
Verify 'Carriage' Brakes – On (90 s max)

5.4 Grapple Cleanup

Verify Loaded Parameters – √

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

Expected LAB Grapple position.

SR	SY	SP	EP	WP	WY	WR
+138.2	+162.2	-153.0	+157.6	+196.0	-178.1	-134.7
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded – LAB PDGF, SR Held					
Disp	LAB>PDGF					

MSS: SSRMS: Rate:

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

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)

Notify **MCC-H**, GO for base change.

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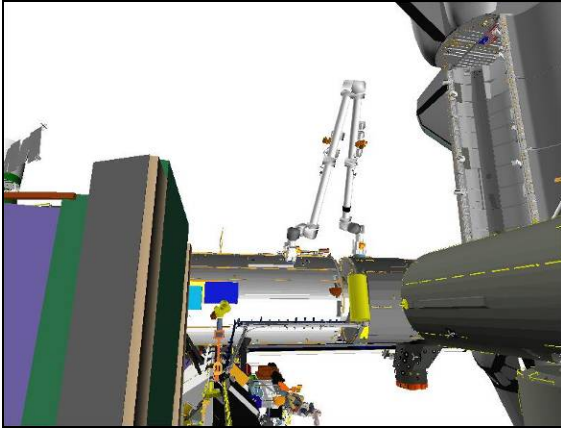


Figure 12.- LAB Grapple
(09: P1 Lower Outboard: +100, +15).

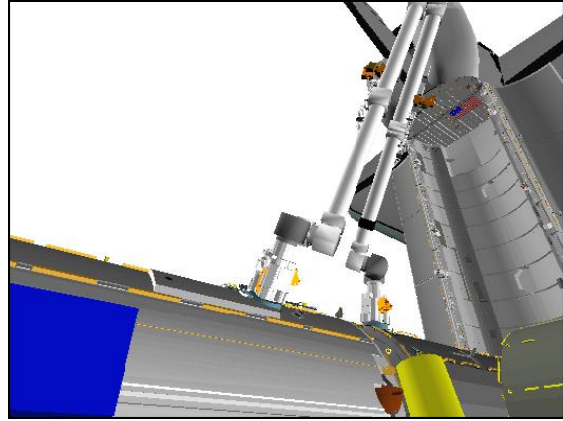


Figure 13.- LAB Grapple
(07: P1 Lower Inboard: +125, +35).

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1.320 SSRMS NODE 2 RELEASE AND MANEUVER TO OVERNIGHT PARK
 (RBT FS/20A/FIN 1/SPN) Page 1 of 7 pages

1. SETUP FOR NODE 2 RELEASE

On MCC-H GO, SSRMS Base Change complete:

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+100, +15)	25: Tip LEE (Zoom full out)	07: P1 Lower Inboard (+140, +25)	Camera C (-20, +40)	SRMS Elbow (+130, +60)

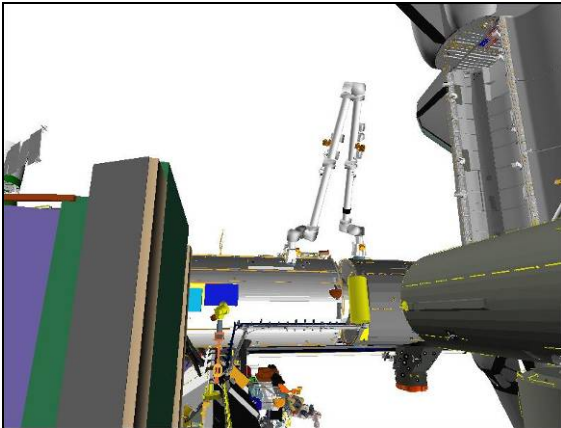


Figure 1.- Double Grappled
 (09: P1 Lower Outboard: +100, +15).

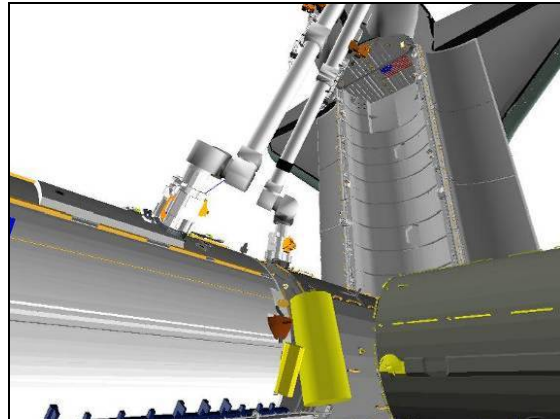


Figure 2.- Double Grappled
 (07: P1 Lower Inboard: +140, +25).

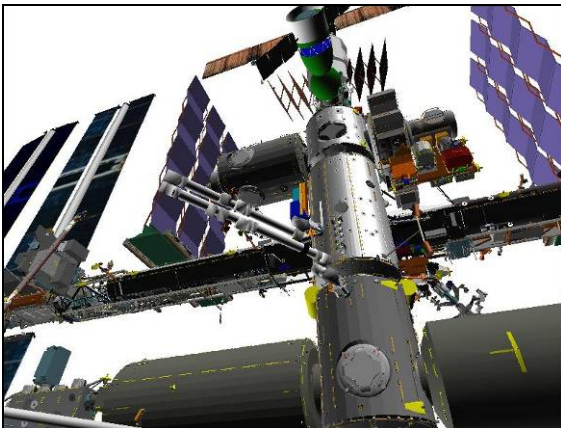


Figure 3.- Double Grappled
 (Camera C: -20, +40).

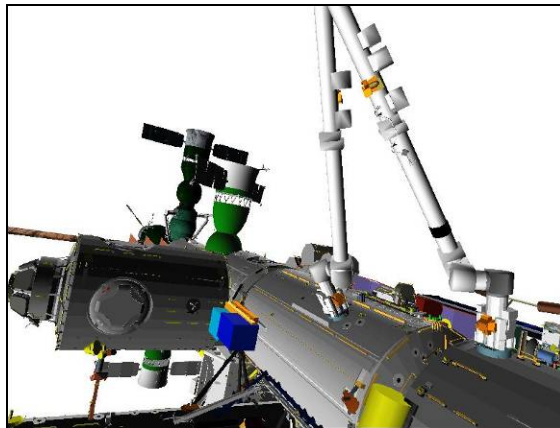


Figure 4.- Double Grappled
 (SRMS Elbow: +130, +60).

PCS

MSS: SSRMS:

Change Loaded Parameters ► Walk Off ► Node 2 PDGF
 Verify 'Loaded Parameters' (two) – Node 2 PDGF, SR Held

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

Change Display ► Node2 ► PDGF (Verify Node2>PDGF)

Verify Command – SSRMS>Internal

1.320 SSRMS NODE 2 RELEASE AND MANEUVER TO OVERNIGHT PARK

(RBT FS/20A/FIN 1/SPN) Page 2 of 7 pages

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

SR	SY	SP	EP	WP	WY	WR
-134.7	+178.1	+196.0	+157.6	-153.0	-162.2	+138.2
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded – Node 2 PDGF, SR Held					
Disp	Node2>PDGF					

2. NODE 2 PDGF RELEASE

NOTE

The '**R3Q - SSRMS LEE Uncommanded Derigidize**' Caution will annunciate when SSRMS Safing is removed (SCR 38011).

MSS: SSRMS: MSS Safing:

cmd 'SSRMS' Remove (Verify Not Safed)

DCP BRAKES SSRMS → OFF (Verify OFF)

PCS MSS: SSRMS:

√Vernier

2.1 SSRMS Limp

MSS: SSRMS: Limp:

cmd All Limp (Verify Limp – blue)

MSS: SSRMS:

Verify all joints – Limped

2.2 Carriage Rigidize

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).

1.320 SSRMS NODE 2 RELEASE AND MANEUVER TO OVERNIGHT PARK

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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
Verify 'Carriage' Brakes – On (15 s max)

2.3 Auto Release (Carriage Pushoff)

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 'Umbilical' Demate – blue (10 s max)
Verify 'Latch' Unlatch – blue (65 s max)
Verify 'Carriage' Retract – gray (90 s max)
Verify 'Snare' Open – blue (12 s max)
Verify 'Carriage' Derigidize – blue
Verify 'Carriage' Extend – blue (90 s max)

2.4 SSRMS Backoff

MSS: SSRMS: Limp:

cmd None Limp (Verify Standby – blue)

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

1.320 SSRMS NODE 2 RELEASE AND MANEUVER TO OVERNIGHT PARK
 (RBT FS/20A/FIN 1/SPN) Page 4 of 7 pages

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

cmd Shoulder Yaw (Verify SY – Locked)

THC

Maneuver SSRMS to Node 2 Backoff position (within 5 cm/1 deg).

	Locked					
SR	SY	SP	EP	WP	WY	WR
-129.0	+178.1	+174.0	+153.0	-124.5	-164.3	+143.8
X	Y	Z	Pitch	Yaw	Roll	
-150	0	0	0.0	0.0	0.0	
FOR	Unloaded – LEE Tip, SY Held					
Disp	Node2>PDGF					

PCS

MSS: SSRMS: SSRMS

Enter Mode – Standby (Verify blue)

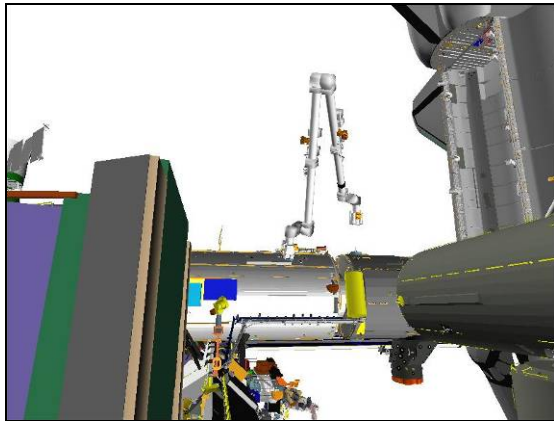


Figure 5.- Node 2 Backoff
(09: P1 Lower Outboard: +100, +15).

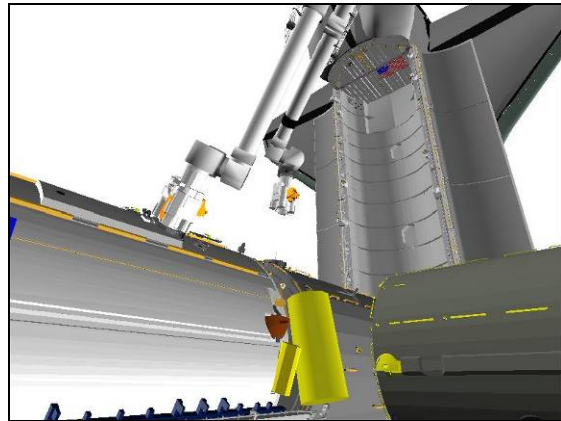


Figure 6.- Node 2 Backoff
(07: P1 Lower Inboard: +140, +25).

3. JOINT OCAS TO NODE 3 CLEARANCE

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+100, +15) 71: OBSS ITVC (+95, -65)	24: Tip Elbow (0, 0)	72 (DNLK): SRMS Elbow (+130, +60)	Camera C (-20, +40)	Camera B (-5, +45)

RHC

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

1.320 SSRMS NODE 2 RELEASE AND MANEUVER TO OVERNIGHT PARK

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NOTE

1. Maneuver duration is ~2 minutes in Coarse rates.
2. All clearances during the following maneuver are greater than 150 cm (60 in).

PCS MSS: SSRMS: SSRMS

Enter Mode – Joint OCAS (Verify blue)

SSRMS Joint OCAS

pick File ► LAB ► Node 3 Clearance

Verify 'Joint Angles' 'Destination' for Node 3 Clearance position.

SR	SY	SP	EP	WP	WY	WR
+56.7	+178.1	+174.0	+108.0	-28.7	-133.5	+150.0

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)	-129.0	+178.1	+174.0	+153.0	-124.5	-164.3	+143.8
TGT	+56.7	+178.1	+174.0	+108.0	-28.7	-133.5	+150.0
ERR	-185.7	0.0	0.0	+45.0	-95.8	-30.8	-6.2

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: SSRMS

Verify Posn Hold – orange

Verify Joint Angle values.

SR	SY	SP	EP	WP	WY	WR
+56.7	+178.1	+174.0	+108.0	-28.7	-133.5	+150.0

1.320 SSRMS NODE 2 RELEASE AND MANEUVER TO OVERNIGHT PARK
 (RBT FS/20A/FIN 1/SPN) Page 6 of 7 pages

4. JOINT OCAS TO OVERNIGHT PARK

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+70, +15) 71: OBSS ITVC (+95, -65)	24: Tip Elbow (0, 0)	72 (DNLK): SRMS Elbow (+90, +55)	Camera C (-20, +40)	Camera B (-5, +45)

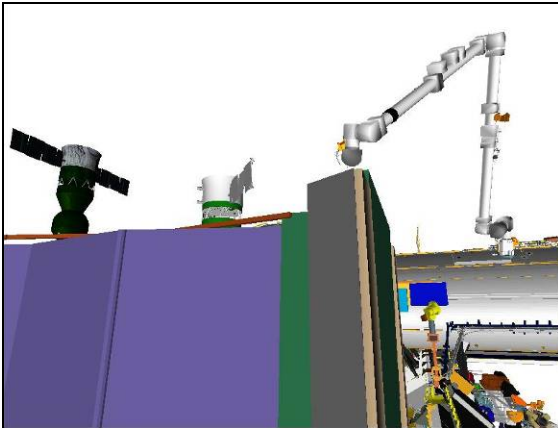


Figure 7.- Node 3 Clearance
 (09: P1 Lower Outboard: +70, +15).

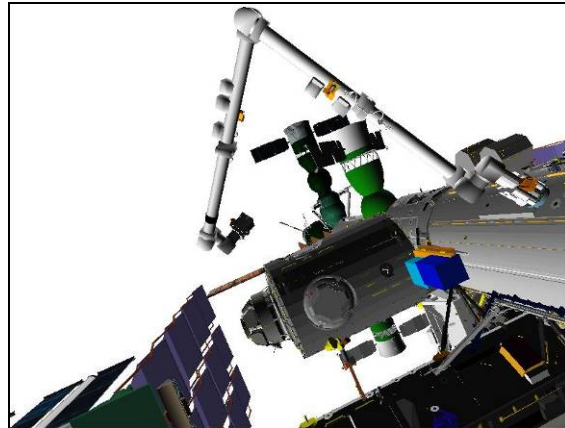


Figure 8.- Node 3 Clearance
 (72: SRMS Elbow: +90, +55).

RHC RATE – as desired (VERNIER within 1.5 m of structure)

<u>NOTE</u>	
1.	Maneuver duration is ~1 minute in Coarse rates.
2.	All clearances during the following maneuver are greater than 150 cm (60 in).

PCS SSRMS Joint OCAS

pick File ► LAB ► Park

Verify 'Joint Angles' 'Destination' for Overnight Park position.

SR	SY	SP	EP	WP	WY	WR
+56.7	+215.0	+208.0	+45.2	-28.7	-133.5	+150.0

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)	+56.7	+178.1	+174.0	+108.0	-28.7	-133.5	+150.0
TGT	+56.7	+215.0	+208.0	+45.2	-28.7	-133.5	+150.0
ERR	0.0	-36.9	-34.0	+62.8	0.0	0.0	0.0

1.320 SSRMS NODE 2 RELEASE AND MANEUVER TO OVERNIGHT PARK
 (RBT FS/20A/FIN 1/SPN) Page 7 of 7 pages

```

*****
* 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 Overnight Park position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+56.7	+215.0	+208.0	+45.2	-28.7	-133.5	+150.0
X	Y	Z	Pitch	Yaw	Roll	
-216	+1513	-871	-63.4	-0.1	+153.3	
FOR	Unloaded – LEE Tip, SY Held					
Disp	Node2>PDGF					

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)

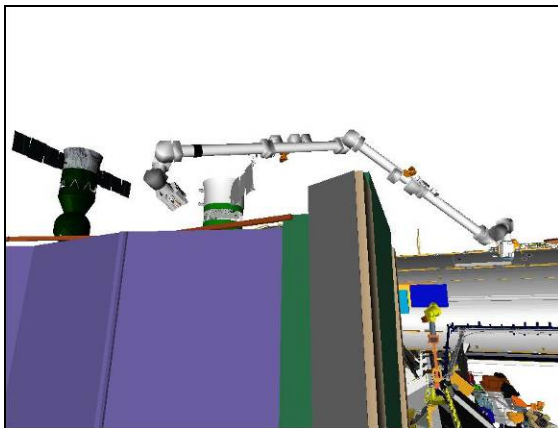


Figure 9.- Overnight Park
 (09: P1 Lower Outboard: +70, +15).

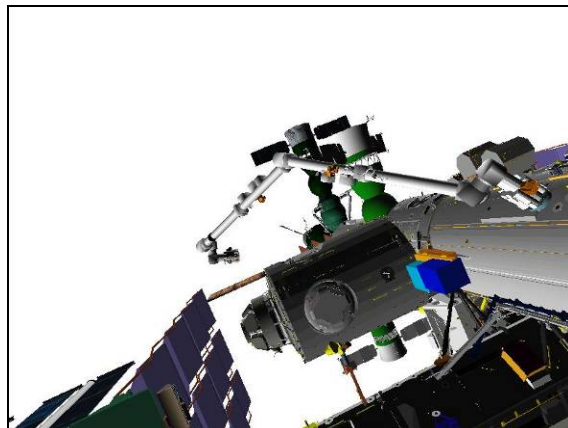


Figure 10.- Overnight Park
 (72: SRMS Elbow: +90, +55).

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 (RBT FS/20A/FIN 1/SPN) Page 1 of 18 pages

1. SETUP

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+80, +5)	51: JEM EXT A (-100, -5)	24: Tip Elbow (+30, +20)	Camera B (-25, +40)	SRMS Elbow (+85, +40)

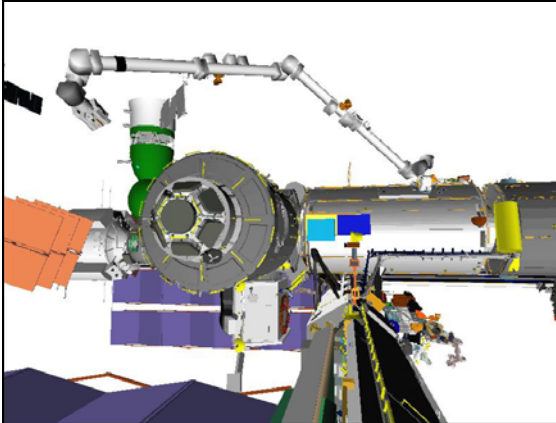


Figure 1.- Overnight Park
 (09: P1 Lower Outboard: +80, +5).

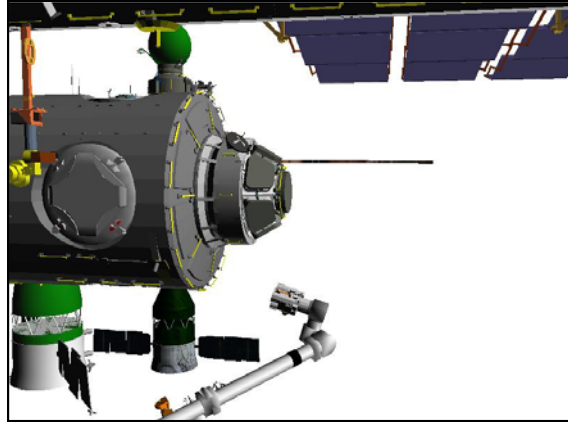


Figure 2.- Overnight Park
 (51: JEM EXT A: -100, -5).

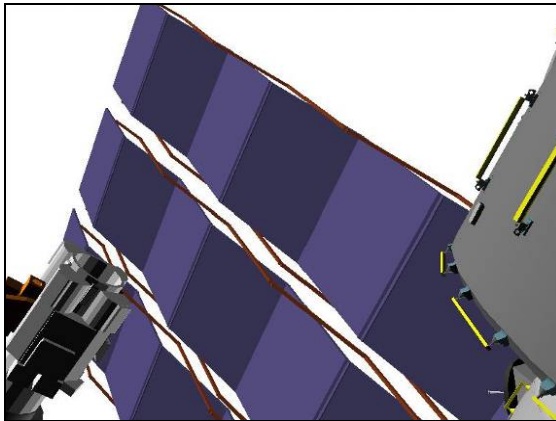


Figure 3.- Overnight Park
 (24: Tip Elbow: +30, +20).

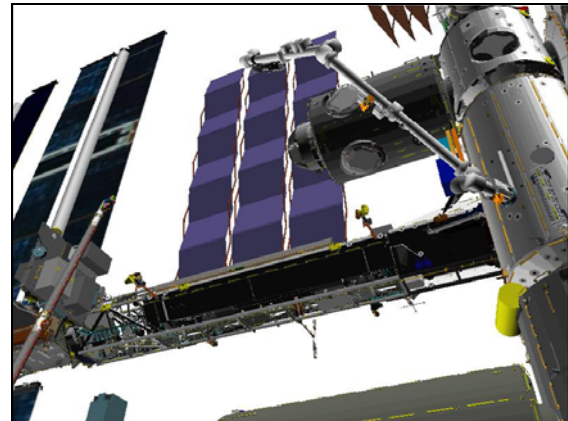


Figure 4.- Overnight Park
 (Camera B: -25, +40).

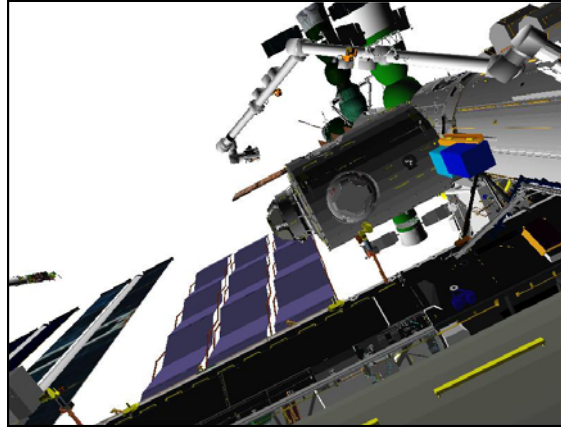


Figure 5.- Overnight Park
 (SRMS Elbow: +85, +40).

PCS

MSS: SSRMS:

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

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

Change Display ► Node3 ► CUP Port Mated GF (Verify Node3>CUP
 Port Mated GF)

Verify 'Command' – SSRMS>Internal

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

SR	SY	SP	EP	WP	WY	WR
+56.7	+215.0	+208.0	+45.2	-28.7	-133.5	+150.0
X	Y	Z	Pitch	Yaw	Roll	
+422	-116	-351	-65.2	-8.4	+2.0	
FOR	Unloaded – LEE Tip, SY Held					
Disp	Node3>CUP Port Mated GF					

2. [JOINT OCAS TO CLEARANCE POSITION](#)

Verify with **MCC-H** the Port TRRJ is locked at zero degrees.

MSS: SSRMS: MSS Safing:

cmd 'SSRMS' Remove (Verify Not Safed)

DCP

BRAKES SSRMS → OFF (Verify OFF)

NOTE
Maneuver duration is ~1 minute.

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PCS MSS: SSRMS:

√Vernier

Enter Mode – Joint OCAS (Verify blue)

pick File ► Cupola ► Clearance

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

SR	SY	SP	EP	WP	WY	WR
+66.7	+170.0	+229.4	+45.2	-28.7	-133.5	+150.0

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)	+56.7	+215.0	+208.0	+45.2	-28.7	-133.5	+150.0
TGT	+66.7	+170.0	+229.4	+45.2	-28.7	-133.5	+150.0
ERR	-10.0	+45.0	-21.4	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

PCS MSS: SSRMS:

Verify Posn Hold – orange

Enter Mode – Standby (Verify blue)

Verify Joint Angle values.

SR	SY	SP	EP	WP	WY	WR
+66.7	+170.0	+229.4	+45.2	-28.7	-133.5	+150.0

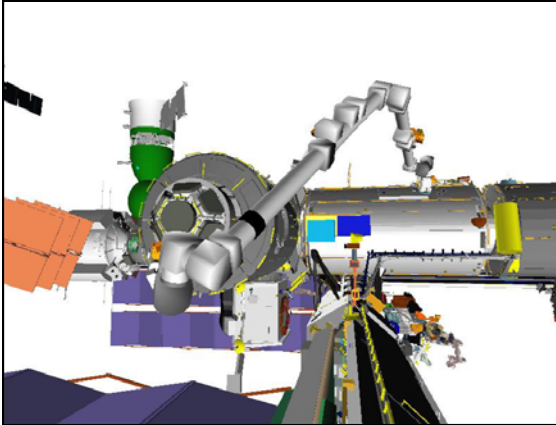


Figure 6.- Clearance
 (09: P1 Lower Outboard: +80, +5).

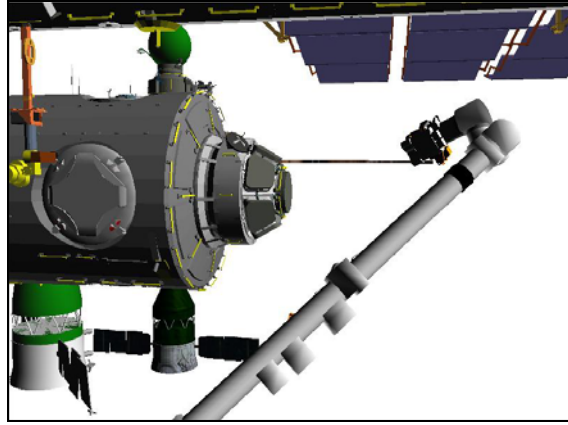


Figure 7.- Clearance
 (51: JEM EXT A: -100, -5).

3. SINGLE JOINT MANEUVER TO PRE-GRAPPLE

NOTE

Clearance between Wrist Cluster and P1 Truss reaches a minimum of 76 cm (30 in); monitor with P1 Lower Inboard Camera.

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+80, +5)	51: JEM EXT A (-100, -5)	07: P1 Lower Inboard (-50, -10)	Camera B (-25, +40)	SRMS Elbow (+85, +40)

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 Pre-Grapple position (within 1 deg).

Clearance 1: EP + Pre-Grapple	SR	SY	SP	EP	WP	WY	WR
	+66.7	+170.0	+229.4	+45.2	-28.7	-133.5	+150.0
				+70.0			
	+66.7	+170.0	+229.4	+70.0	-28.7	-133.5	+150.0
	X	Y	Z	Pitch	Yaw	Roll	
	-150	0	+1	0.0	0.0	0.0	
FOR	Unloaded – LEE Tip, SY Held						
Disp	Node3>CUP Port Mated GF						

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PCS MSS: SSRMS:

Enter Mode – Standby (Verify blue)

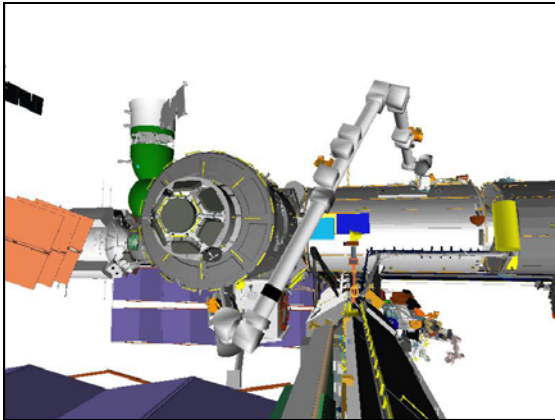


Figure 8.- Pre-Grapple
 (09: P1 Lower Outboard: +80, +5).

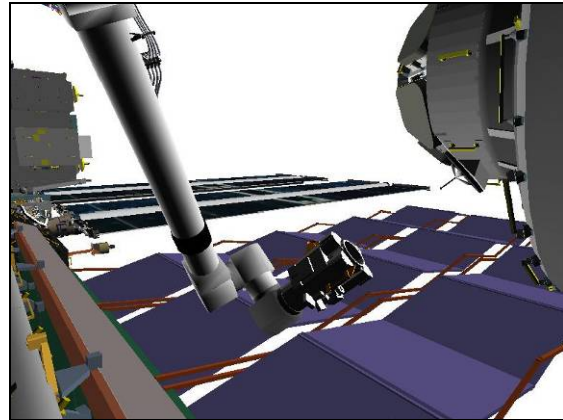


Figure 9.- Pre-Grapple
 (07: P1 Lower Inboard: -50, -10).

4. CUPOLA FRGF CAPTURE

NOTE

Clearance between Wrist Cluster and P1 Truss increases throughout capture maneuver.

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+80, +5)	25: Tip LEE (Zoom full out)	07: P1 Lower Inboard (-50, -10)	OBSS ITVC (+70, -95)	SRMS Elbow (+85, +40)

4.1 FRGF Grapple
 MSS: SSRMS:

√Vernier

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)

RHC/
 THC

Maneuver to within grapple envelope.

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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).

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Auto Capture

RHC

TRIGGER → Press (momentarily)

PCS

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

Verify Capture to Latch – No (SCR 19282)

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

Verify 'Carriage' Retract – blue

Verify Loaded Parameters – √

DCP

4.2 Grapple Cleanup

BRAKES SSRMS → ON (Verify ON)

Notify CBM operator: "Cupola grappled, SSRMS brakes on. GO for demate."

PCS

MSS: SSRMS:

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

Change Display ► Node3 ► Cupola Demate (Verify Node3>Cupola Demate)

Change Command ► Node3 ► Cupola Demate (Verify Node3>Cupola Demate)

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Expected Cupola Grapple position:

SR	SY	SP	EP	WP	WY	WR
+61.1	+170.0	+222.5	+80.7	-33.5	-128.0	+150.0
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded – Cupola Demate, SY Held					
Disp	Node3>Cupola Demate					

Review [SSRMS LEE CUE CARD \(SSRMS IS LOADED AND LEE CAUTION IS ANNUNCIATED\)](#), all (SODF: RBT GEN: REFERENCE: CUE CARD).

MSS: SSRMS: Rate:

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

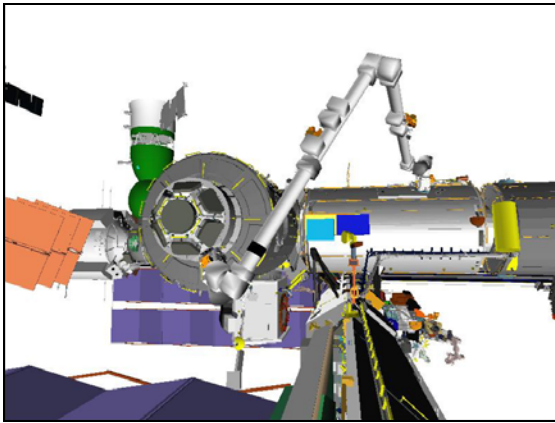


Figure 10.- Cupola Grappled
 (09: P1 Lower Outboard: +80, +5).

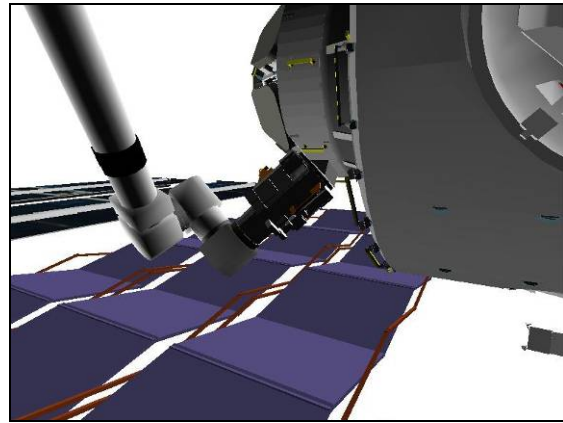


Figure 11.- Cupola Grappled
 (07: P1 Lower Inboard: -30, -10).

5. ATTITUDE CONTROL CONFIGURATION

MSS: SSRMS: Thrusters:

Verify 'Desat Request:' – Inh

 *If using shuttle attitude control, verify DAP: FREE

6. MANEUVERING TO DEMATE POSITION

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+80, +5)	24: Tip Elbow (+15, +30)	07: P1 Lower Inboard (-30, 0)	OBSS ITVC (+70, -95)	SRMS Elbow (+85, +40)

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Verify [1.539 CBM CUPOLA RELOCATE: NODE 3 PORT TO NODE 3 NADIR](#), step 1 (SODF: S&M: NOMINAL: CBM) completed.

On CBM operator: "Latches deployed. GO for Cupola Deberth."

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 Cupola to Demate position (within 5 cm/1 deg).
(-Y, THC left)

	Locked					
SR	SY	SP	EP	WP	WY	WR
+63.6	+170.0	+228.4	+59.0	-17.3	-130.4	+150.0
X	Y	Z	Pitch	Yaw	Roll	
0	-200	0	0.0	0.0	0.0	
FOR	Loaded – Cupola Demate, SY Held					
Disp	Node3>Cupola Demate					

PCS MSS: SSRMS:

Enter Mode – Standby (Verify blue)

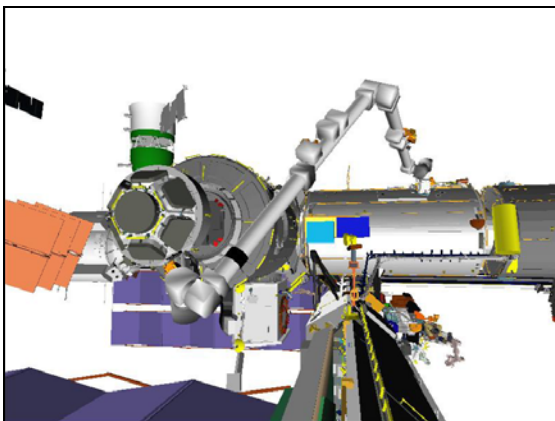


Figure 12.- Demate
(09: P1 Lower Outboard: +80, +5).

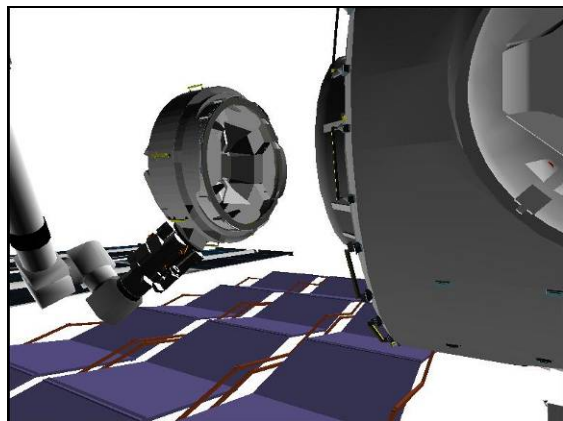


Figure 13.- Demate
(07: P1 Lower Inboard: -30, 0).

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```
*****
* If using shuttle attitude control and attitude maintenance required
* | DAP: LVLH
* |
* | When rates damped
* | | DAP: FREE > 2 seconds
* | | DAP: AUTO
* |
* | When in attitude and rates damped
* | | DAP: FREE
*****
```

7. MANEUVERING CUPOLA TO INTERMEDIATE POSITION
Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+80, +15)	24: Tip Elbow (+35, +35)	07: P1 Lower Inboard (-30, +20)	Camera C (-30, +45)	SRMS Elbow (+85, +40)

NOTE

- At beginning of maneuver, the SSRMS is inside the Port TRRJ Rotation Envelope. At end of maneuver, the SSRMS is 243 cm (96 in) outside the envelope.
- Maneuver duration is ~2.5 minutes.

Verify CBCS setup is complete.

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 ► Cupola ► Intermediate

Verify 'FOR' 'Destination' for Intermediate position.

X	Y	Z	Pitch	Yaw	Roll
0	-250	+450	0.0	0.0	-45.0

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	-200	0	0.0	0.0	0.0
TGT	0	-250	+450	0.0	0.0	-45.0
ERR	0	+50	-450	0	0	+45.0

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 Intermediate position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+52.0	+170.0	+200.4	+58.4	-51.4	-139.4	+118.4
X	Y	Z	Pitch	Yaw	Roll	
0	-250	+450	0.0	0.0	-45.0	
FOR	Loaded – Cupola Demate, SY Held					
Disp	Node3>Cupola Demate					

DCP BRAKES SSRMS → ON (Verify ON)

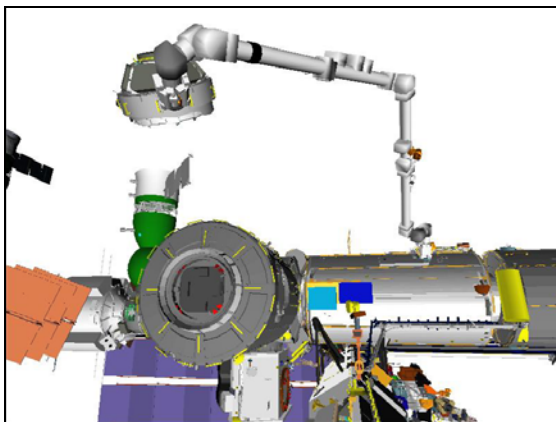


Figure 14.- Intermediate
 (09: P1 Lower Outboard: +80, +15).

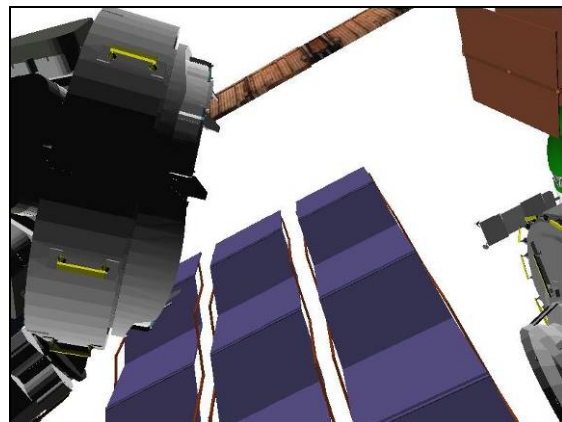


Figure 15.- Intermediate
 (24: Tip Elbow: +35, +25).

```

*****
* If using shuttle attitude control and attitude maintenance required
*   | DAP: LVLH
*   |
*   | When rates damped
*   |   | DAP: FREE > 2 seconds
*   |   | DAP: AUTO
*   |
*   | When in attitude and rates damped
*   |   | DAP: FREE
*****
  
```

8. CUPOLA PASSIVE CBM SURVEY

NOTE

1. [A.6 PASSIVE CBM INSPECTION REFERENCE](#) (SODF: S&M: REFERENCE: CBM) 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.

DCP/
MON

Configure Cameras as required.

Monitor 3
07: P1 Lower Inboard (-35, +40)



Figure 16.- CBM Survey
 (07: P1 Lower Inboard: -35, +40).

Inspect the CBM ring using the P1 Lower Inboard Camera to verify ring and seal are clear of FOD by performing [A.6 PASSIVE CBM INSPECTION REFERENCE](#), all (SODF: S&M: REFERENCE: CBM), then:

If any verifications in A.6 procedure are not met, **√MCC-H**.

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Notify **MCC-H** when survey is completed.

9. MANEUVERING TO PRE-INSTALL POSITION

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+80, +15) 71: Camera B (-25, +40)	24: Tip Elbow (+35, +25) 22: Base Elbow (+90, -20)	07: P1 Lower Inboard (-35, +40)	Camera C (-30, +45)	SRMS Elbow (+90, +55)

9.1 FOR OCAS Maneuver

NOTE
Maneuver duration is ~2.5 minutes.

DCP BRAKES SSRMS → OFF (Verify OFF)

PCS MSS: SSRMS: SSRMS

√Coarse

Enter Mode – FOR OCAS (Verify blue)

MSS: SSRMS: SSRMS FOR OCAS: Joint Lock: Joint Lock

cmd Shoulder Yaw (Verify SY – Locked)

SSRMS FOR OCAS

pick File ► Cupola ► Pre-Install

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

X	Y	Z	Pitch	Yaw	Roll
0	+210	+400	0.0	0.0	-90.0

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	-250	+450	0.0	0.0	-45.0
TGT	0	+210	+400	0.0	0.0	-90.0
ERR	0	-460	+50	0	0	+45.0

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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: SSRMS

Verify Posn Hold – orange

Enter Mode – Standby (Verify blue)

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

SR	SY	SP	EP	WP	WY	WR
+31.7	+170.0	+174.6	+108.1	-117.8	-171.3	+99.9
X	Y	Z	Pitch	Yaw	Roll	
0	+210	+400	0.0	0.0	-90.0	
FOR	Loaded – Cupola Demate, SY Held					
Disp	Node3>Cupola Demate					

9.2 Maneuver Cleanup

Change Loaded Parameters ► Cupola ► Cupola Install CBCS
SYH

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

Change Display ► Node3 ► Cupola Install CBCS (Verify
Node3>Cupola Install CBCS)

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

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

SR	SY	SP	EP	WP	WY	WR
+31.7	+170.0	+174.6	+108.1	-117.8	-171.3	+99.9
X	Y	Z	Pitch	Yaw	Roll	
+200	+1	0	0.0	0.0	0.0	
FOR	Loaded – Cupola Install CBCS, SY Held					
Disp	Node3>Cupola Install CBCS					

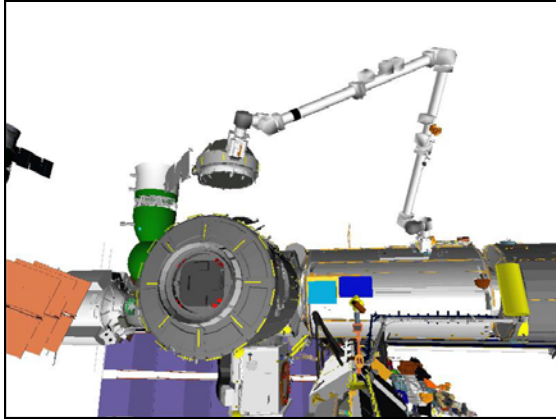


Figure 17.- Pre-Install
 (09: P1 Lower Outboard: +80, +15).

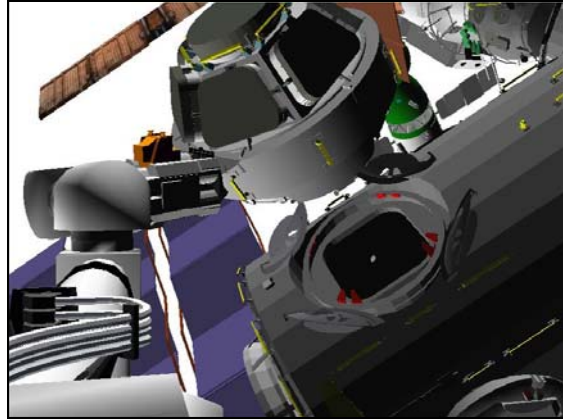


Figure 18.- Pre-Install
 (24: Tip Elbow: +15, 0).

```

*****
* If using shuttle attitude control and attitude maintenance required
* |   DAP: LVLH
* |
* |   When rates damped
* |   |   DAP: FREE > 2 seconds
* |   |   DAP: AUTO
* |
* |   When in attitude and rates damped
* |   |   DAP: FREE
*****
  
```

10. MANEUVERING TO CUPOLA RTL POSITION

Verify 1.539 CBM CUPOLA RELOCATE: NODE 3 PORT TO NODE 3 NADIR, step 3 (SODF: S&M: NOMINAL: CBM), completed.

On CBM operator, "GO for maneuver to Ready-to-Latch position."

NOTE

1. Minimum clearance of 17 cm (7 in) between the Tip LEE and the Node 3 Nadir CBM Petals occurs at the Cupola RTL position. Monitor with the SRMS Elbow Camera.
2. The current video software load does not recognize the Node 3 video components. Coordinate with **MCC-H** for routing of the Node 3 CBCS Camera.

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Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+80, +15) 71: Camera B (-25, +40)	XX: CBCS	72 (DNLK): SRMS Elbow (+90, +55) HFOV = 20 51: JEM EXT A (-115, -15)	Camera C (-30, +45)	OBSS ITVC (+95, -90)

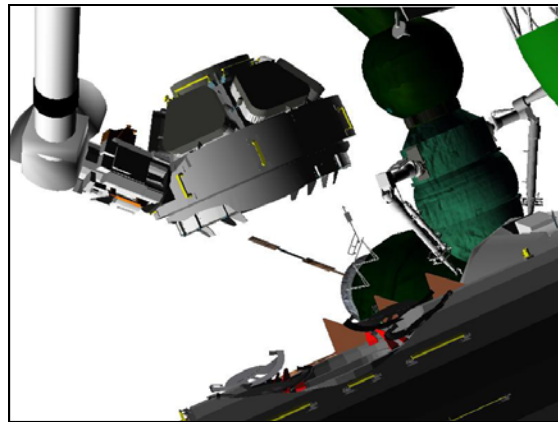


Figure 19.- Pre-Install
(72: SRMS Elbow: +90, +55)
HFOV = 20 deg.

Node 3: S&M: Nadir CBM:

Monitor CBM RTLs using PCS.

RHC RATE → VERNIER (Verify Vernier on PCS)

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)

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THC/
RHC

Maneuver Cupola until RTL (four) – green (-X, THC pull)
Expected Cupola RTL position:

	Locked					
SR	SY	SP	EP	WP	WY	WR
+40.5	+170.0	+183.5	+112.4	-127.9	-169.2	+108.4
X	Y	Z	Pitch	Yaw	Roll	
+8	0	0	0.0	0.0	0.0	
FOR	Loaded – Cupola Install CBCS, SY Held					
Disp	Node3>Cupola Install CBCS					

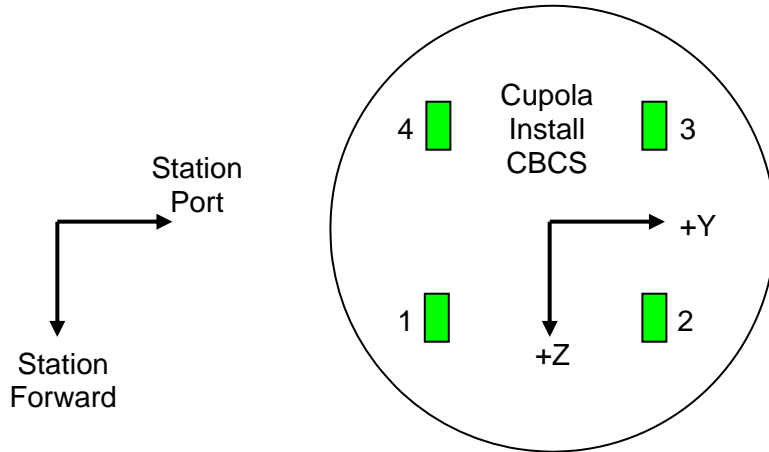


Figure 20.- Cupola Install CBCS RTL Diagram.

Table 1. Cupola Install CBCS Missing RTL Configuration
(Refer to Figure 20).

Missing RTLs	RHC Input*
1	- Pitch, - Yaw
2	- Pitch, + Yaw
3	+ Pitch, + Yaw
4	+ Pitch, - Yaw
1,2	- Pitch
3,4	+ Pitch
1,4	- Yaw
2,3	+ Yaw

* All inputs with respect to Cupola Install CBCS FOR.

PCS

MSS: SSRMS:

Verify Posn Hold – orange

Verify RTL (four) – green

Enter Mode – Standby (Verify blue)

Notify CBM operator: “Maneuver to RTL complete.”

11. POST FIRST STAGE CAPTURE

Verify [1.539 CBM CUPOLA RELOCATE: NODE 3 PORT TO NODE 3 NADIR](#), steps 4.1 to 4.4 (SODF: S&M: NOMINAL: CBM) completed.

On CBM operator, "GO for SSRMS 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: "SSRMS Mode to Limp complete. GO for Second Stage Capture."

12. POST SECOND STAGE CAPTURE

NOTE

Minimum clearance of 10 cm (4 in) between the Tip LEE and Node 3 Nadir CBM Petals occurs after Second Stage Capture at the Cupola Installed position. Monitor with the SRMS Elbow Camera.

Verify [1.539 CBM CUPOLA RELOCATE: NODE 3 PORT TO NODE 3 NADIR](#), steps 4.5 to 4.8 (SODF: S&M: NOMINAL: CBM) completed.

On CBM operator, "GO for SSRMS Brakes ON."

DCP BRAKES SSRMS → ON (Verify ON)

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Expected Cupola Install position:

SR	SY	SP	EP	WP	WY	WR
+40.8	+170.0	+184.0	+112.4	-128.3	-169.2	+108.7
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded – Cupola Install CBCS, SY Held					
Disp	Node3>Cupola Install CBCS					

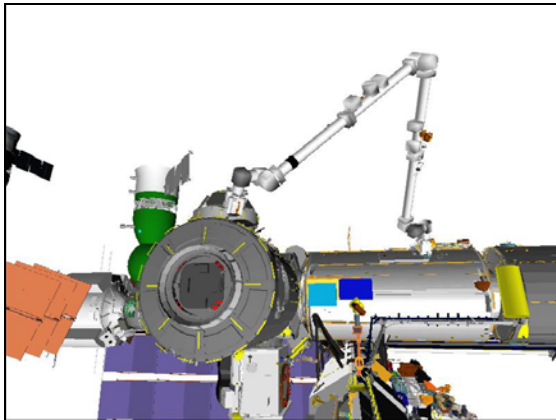


Figure 21.- Cupola Install
 (09: P1 Lower Outboard: +80, +15).

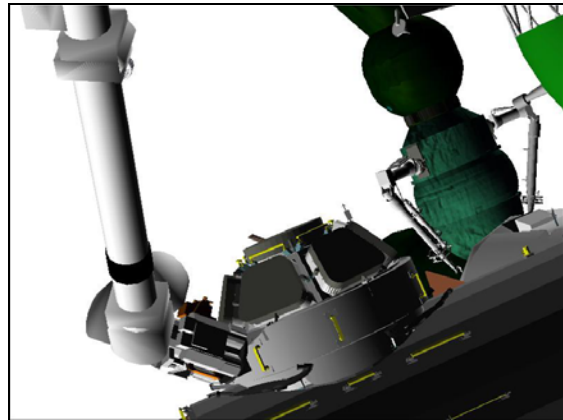


Figure 22.- Cupola Install
 (72: SRMS Elbow: +90, +55)
 HFOV = 20 deg.

```

*****
* If using shuttle attitude control and attitude maintenance required
* | DAP: LVLH
* |
* | When rates damped
* | | DAP: FREE > 2 seconds
* | | DAP: AUTO
*****
  
```

1.510 SSRMS CUPOLA RELEASE AND PMA3 RELOCATE

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1. SETUP FOR RELEASE

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+80, +20)	25: Tip LEE (Zoom full out)	07: P1 Lower Inboard (-10, +50)	OBSS ITVC (+100, -90)	SRMS Elbow (+100, +60)

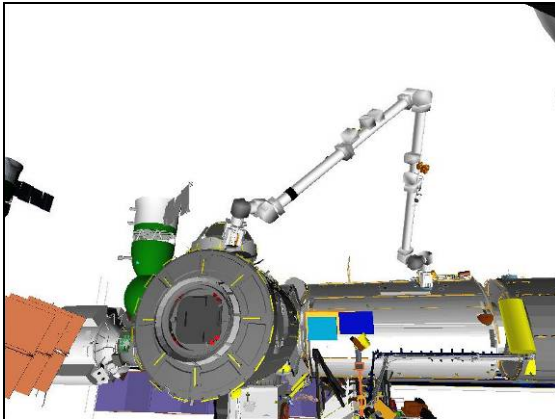


Figure 1.- Cupola Install
(09: P1 Lower Outboard: +80, +20).

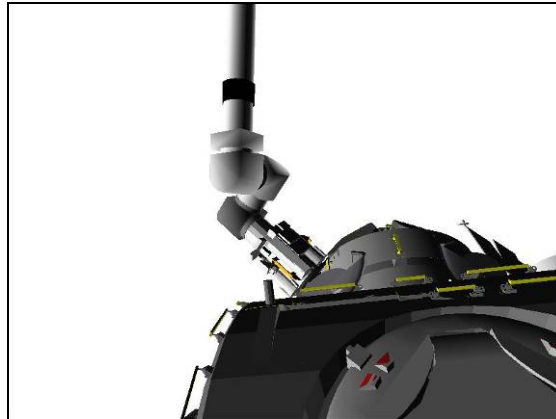


Figure 2.- Cupola Install
(07: P1 Lower Inboard: -10, +50).

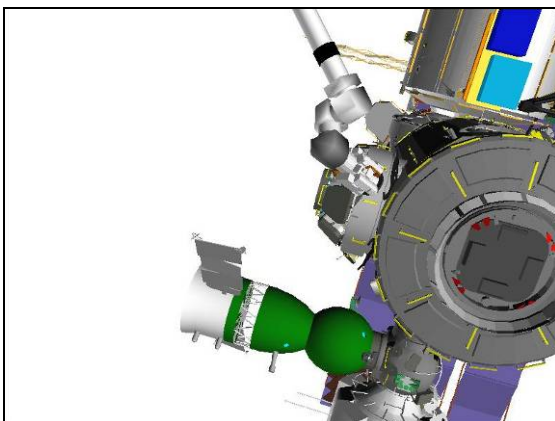


Figure 3.- Cupola Install
(OBSS ITVC: +100, -90).

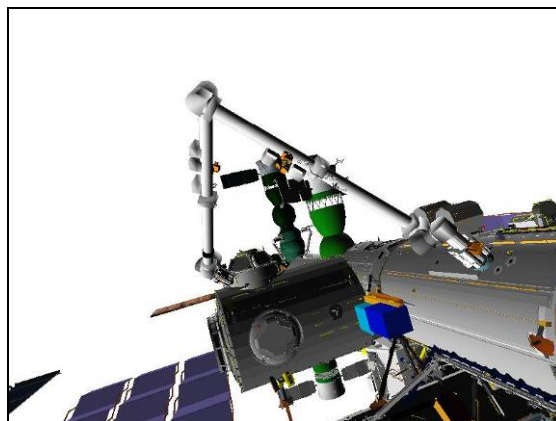


Figure 4.- Cupola Install
(SRMS Elbow: +100, +60).

PCS MSS: SSRMS:

Verify Loaded Parameters – ✓

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

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

Change Display ► Node3 ► CUP Nadir Mated GF (Verify Node3>CUP Nadir Mated GF)

Verify Command – SSRMS>Internal

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MSS: SSRMS: Rate:

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

Expected Cupola Install position:

SR	SY	SP	EP	WP	WY	WR
+40.8	+170.0	+184.0	+112.4	-128.3	-169.2	+108.7
X	Y	Z	Pitch	Yaw	Roll	
+109	0	-68	+130.0	+0.1	-119.5	
FOR	Loaded – Cupola Install CBCS, SY Held					
Disp	Node3>CUP Nadir Mated GF					

2. CUPOLA FRGF RELEASE (PUSHOFF)

NOTE

Clearance between the Tip LEE and Node 3 Nadir CBM Petals increases throughout this maneuver.

2.1 SSRMS Limping

DCP

BRAKES SSRMS → OFF (Verify OFF)

PCS

MSS: SSRMS:

√Vernier

MSS: SSRMS: Limp:

cmd All Limp (Verify Limp – blue)

MSS: SSRMS:

Verify all joints – Limped

2.2 Auto Release (Carriage Pushoff)

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).

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cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Auto Release

RHC TRIGGER → Press (momentarily)

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

Verify Unloaded Parameters – √

2.3 SSRMS Backoff

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

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 Cupola Backoff position (within 5 cm/1 deg).

	Locked					
SR	SY	SP	EP	WP	WY	WR
+42.9	+170.0	+177.2	+107.2	-115.6	-168.8	+110.8
X	Y	Z	Pitch	Yaw	Roll	
-150	0	0	0.0	0.0	0.0	
FOR	Unloaded – LEE Tip, SY Held					
Disp	Node3>CUP Nadir Mated GF					

PCS MSS: SSRMS:

Enter Mode – Standby (Verify blue)

MSS: SSRMS: Rate:

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

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2.4 SSRMS LEE Checkout

MSS: SSRMS: Tip LEE: SSRMS Tip LEE

cmd Checkout ► 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 14662, 23262, 29337).

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Checkout LEE

RHC

TRIGGER → Press (momentarily)

PCS

Verify 'Snare' Close	– blue (12 s max)
Verify 'Carriage' Retract	– blue (90 s max)
Verify 'Latch' Latch	– blue (65 s max)
Verify 'Umbilical' Mate	– blue (10 s max)
Verify 'Umbilical' Demate	– blue (10 s max)
Verify 'Latch' Unlatch	– blue (65 s max)
Verify 'Carriage' Retract	– gray (90 s max)
Verify 'Snare' Open	– blue (12 s max)
Verify 'Carriage' Derigidize	– blue
Verify 'Carriage' Extend	– blue (90 s max)

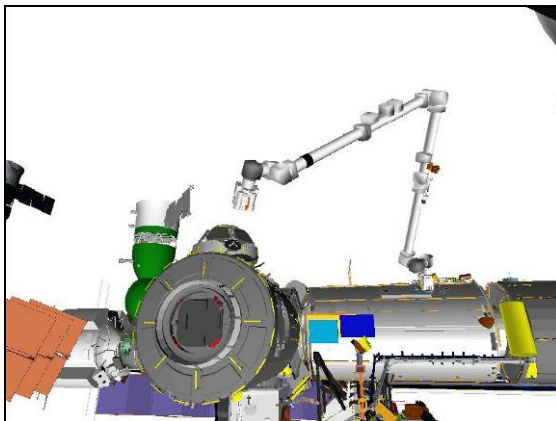


Figure 5.- Cupola Backoff
(09: P1 Lower Outboard: +80, +20).

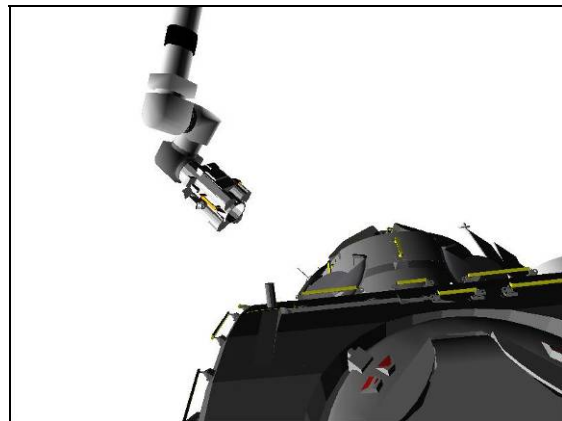


Figure 6.- Cupola Backoff
(07: P1 Lower Inboard: -10, +50).

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3. JOINT OCAS TO PMA3 PRE-GRAPPLE INTERMEDIATE POSITION

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+110, +20)	22: Base Elbow (+80, -10)	07: P1 Lower Inboard (-20, +60)	Camera B (-20, +40)	SRMS Elbow (+80, +70)

NOTE
Maneuver duration is ~2 minutes.

RHC RATE → COARSE (Verify Coarse on PCS)

PCS MSS: SSRMS: SSRMS

Enter Mode – Joint OCAS (Verify blue)

SSRMS Joint OCAS

Input 'Joint Angles' 'Destination' for PMA3 Pre-Grapple Intermediate position.

SR	SY	SP	EP	WP	WY	WR
+124.3	+210.0	+156.0	+116.6	+14.9	+15.3	+146.1

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)	+42.9	+170.0	+177.2	+107.2	-115.6	-168.8	+110.8
TGT	+124.3	+210.0	+156.0	+116.6	+14.9	+15.3	+146.1
ERR	-81.4	-40.0	+21.2	-9.4	-130.5	-184.1	-35.3

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: SSRMS

Verify Posn Hold – orange

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Verify Joint Angle values.

SR	SY	SP	EP	WP	WY	WR
+124.3	+210.0	+156.0	+116.6	+14.9	+15.3	+146.1

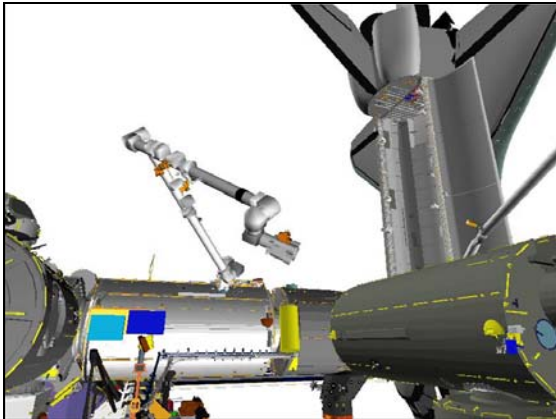


Figure 7.- Pre-Grapple Intermediate
(09: P1 Lower Outboard: +110, +20).

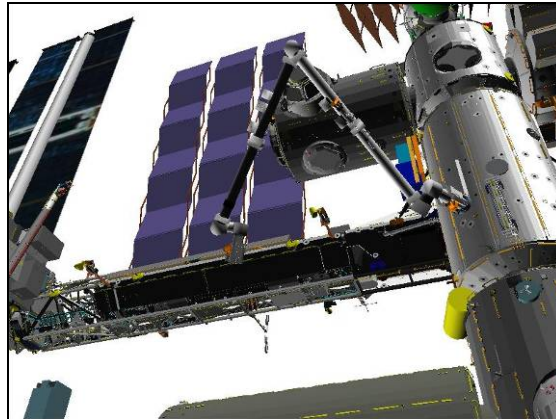


Figure 8.- Pre-Grapple Intermediate
(Camera B: -20, +40).

4. JOINT OCAS TO PMA3 PRE-GRAPPLE

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+115, 0)	22: Base Elbow (+80, -10)	37: MBS Mast (+20, +5) 07: P1 Lower Inboard (+160, -10)	Camera B (-20, +40)	OBSS ITVC (+60, -50)

NOTE

1. Minimum clearance between the Tip LEE and JEM is 86 cm (34 in) at the end of this maneuver. Monitor with the Base Elbow Camera.
2. Maneuver duration is ~2 minutes.

RHC RATE → VERNIER (Verify Vernier on PCS)

PCS MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: 0.7 (Verify 0.7)

Input 'Joint Angles' 'Destination' for PMA3 Pre-Grapple position.

SR	SY	SP	EP	WP	WY	WR
+124.3	+223.2	+242.3	+116.6	+14.9	+15.3	+146.1

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)	+124.3	+210.0	+156.0	+116.6	+14.9	+15.3	+146.1
TGT	+124.3	+223.2	+242.3	+116.6	+14.9	+15.3	+146.1
ERR	0.0	-13.2	-86.3	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

PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify Joint Angle values.

SR	SY	SP	EP	WP	WY	WR
+124.3	+223.2	+242.3	+116.6	+14.9	+15.3	+146.1

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

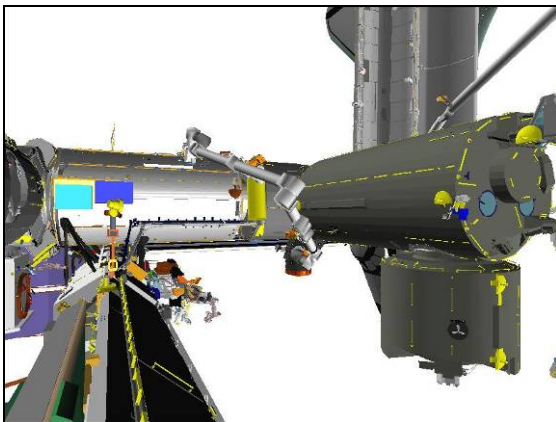


Figure 9.- PMA3 Pre-Grapple
 (09: P1 Lower Outboard: +115, 0).

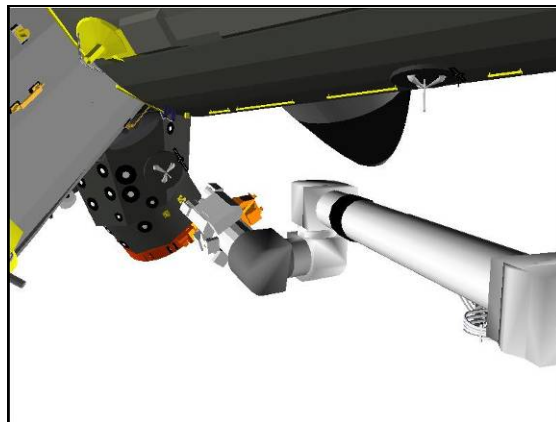


Figure 10.- PMA3 Pre-Grapple
 (22: Base Elbow: +80, -10).

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5. PMA3 GRAPPLE

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
22: Base Elbow (+80, -10)	25: Tip LEE (Zoom full out)	37: MBS Mast (+30, +45) 13: LAB Stbd Zenith (-130, -40)	Camera B (-20, +40)	OBSS ITVC (+60, -50)

NOTE

Minimum clearance between the SSRMS Tip Boom and the JEM is 40 cm (16 in). Monitor with the Base Elbow Camera.

MSS: SSRMS:

Change Loaded Parameters ► PMA3 ► PMA3 Mate BCS SRH
Verify 'Loaded Parameters' (two) – PMA3 Mate BCS, SR Held

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

Change Display ► Node2 ► PMA3 Mated Zen GF (Verify Node2>PMA3 Mated Zen GF)

Verify Command – SSRMS>Internal

Verify SSRMS at PMA3 Pre-Grapple position.

SR	SY	SP	EP	WP	WY	WR
+124.3	+223.2	+242.3	+116.6	+14.9	+15.3	+146.1
X	Y	Z	Pitch	Yaw	Roll	
-150	0	0	+0.1	0.0	-0.1	
FOR	Unloaded – LEE Tip, SR Held					
Disp	Node2>PMA3 Mated Zen GF					

✓Vernier

MSS: SSRMS: Rate:

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

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5.1 Maneuvering to PMA3 FRGF Grapple Envelope

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

RHC/
THC

Maneuver to within grapple envelope.

5.2 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).

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Auto Capture

RHC

TRIGGER → Press (momentarily)

PCS

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

Verify Capture to Latch – No (SCR 19282)

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

Verify 'Carriage' Retract – blue

Verify 'Carriage' Brakes – On (15 s max)

Verify Loaded Parameters – √

5.3 Grapple Cleanup

DCP

BRAKES SSRMS → ON (Verify ON)

Notify CBM operator: "PMA3 grappled, SSRMS brakes on. GO for demate."

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PCS MSS: SSRMS:

Verify 'Loaded Parameters' (two) – PMA3 Mate BCS, SR Held

Change Display ► Node2 ► PMA3 Zen Mate BCS (Verify Node2>PMA3 Zen Mate BCS)

Verify Command – SSRMS>Internal

MSS: SSRMS: Rate:

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

Expected PMA3 Grapple position.

SR	SY	SP	EP	WP	WY	WR
+124.3	+227.7	+253.9	+112.1	+7.5	+10.9	+147.2
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded – PMA3 Mate BCS, SR Held					
Disp	Node2>PMA3 Zen Mate BCS					

Review [SSRMS LEE CUE CARD \(SSRMS IS LOADED AND LEE CAUTION IS ANNUNCIATED\)](#), all (SODF: RBT GEN: REFERENCE: CUE CARD).

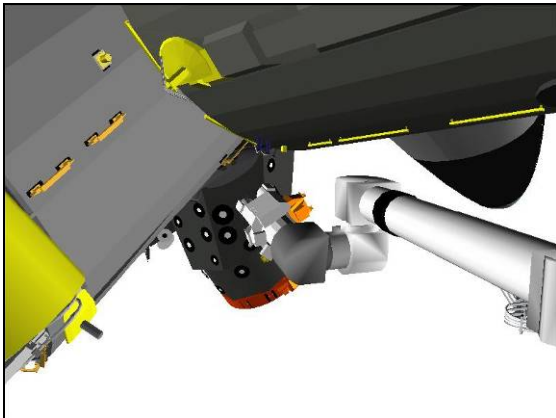


Figure 11.- PMA3 Grapple (22: Base Elbow: +80, -10).

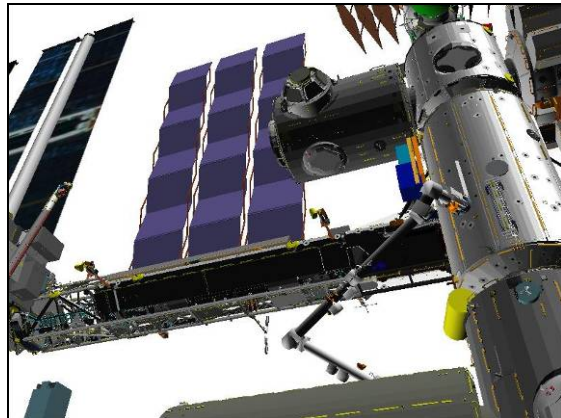


Figure 12.- PMA3 Grapple (Camera B: -20, +40).

6. [ATTITUDE CONTROL CONFIGURATION](#)

MSS: SSRMS: Thrusters:

Verify 'Desat Request:' – Inh

 * If using shuttle attitude control
 * Verify DAP: FREE

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7. MANEUVERING PMA3 TO DEMATE

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
22: Base Elbow (+100, -5)	07: P1 Lower Inboard (+155, -15)	37: MBS Mast (+30, +55) 13: LAB Stbd Zenith (-130, -40)	Camera B (-20, +40)	OBSS ITVC (+60, -50)

NOTE

During this maneuver the SP joint will approach its soft stop limit of 270 degrees.

Verify 1.561 CBM PMA3 RELOCATE: NODE 2 ZENITH TO NODE 3 PORT, step 1 (SODF: S&M: NOMINAL: CBM) is completed.

On CBM operator: "Latches deployed. GO for PMA3 maneuver."

DCP BRAKES SSRMS → OFF (Verify OFF)

PCS MSS: SSRMS:

√Vernier

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

THC/
RHC Maneuver PMA3 to Demate position (within 5 cm/1 deg).
(+X, THC push)

Locked	SR	SY	SP	EP	WP	WY	WR
	+124.3	+215.2	+261.2	+100.4	+13.0	+23.0	+144.1
	X	Y	Z	Pitch	Yaw	Roll	
	+150	0	0	0.0	0.0	0.0	
FOR	Loaded – PMA3 Mate BCS, SR Held						
Disp	Node2>PMA3 Zen Mate BCS						

PCS MSS: SSRMS:

Enter Mode – Standby (Verify blue)

Notify CBM operator: "Clear of structure. GO to close petals."

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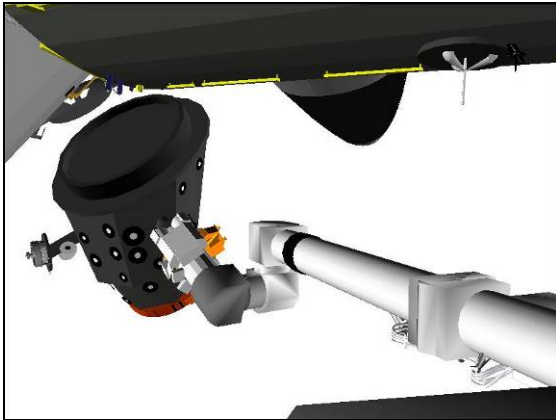


Figure 13.- PMA3 Demate
(22: Base Elbow: +100, -5).



Figure 14.- PMA3 Demate
(07: P1 Lower Inboard: +155, -15).

```

*****
* If using shuttle attitude control and attitude maintenance required
* |   DAP: LVLH
* |
* |   When rates damped
* |   |   DAP: FREE > 2 seconds
* |   |   DAP: AUTO
* |
* |   When in attitude and rates damped
* |   |   DAP: FREE
*****
    
```

8. JOINT OCAS TO PMA3 INTERMEDIATE 1

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
22: Base Elbow (+100, -5)	07: P1 Lower Inboard (+155, -15)	09: P1 Lower Outboard (+115, 0)	Camera B (-20, +40)	OBSS ITVC (+60, -50)

NOTE
Maneuver duration is ~7 minutes.

MSS: SSRMS: SSRMS

Enter Mode – Joint OCAS (Verify blue)

SSRMS Joint OCAS

Input 'Joint Angles' 'Destination' for PMA3 Intermediate 1 position.

SR	SY	SP	EP	WP	WY	WR
+110.0	+190.0	+228.0	+110.0	0.0	-10.0	+50.0

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)	+124.3	+215.2	+261.2	+100.4	+13.0	+23.0	+144.1
TGT	+110.0	+190.0	+228.0	+110.0	0.0	-10.0	+50.0
ERR	+14.3	+25.2	+33.2	-9.6	+13.0	+33.0	+94.1

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
+110.0	+190.0	+228.0	+110.0	0.0	-10.0	+50.0

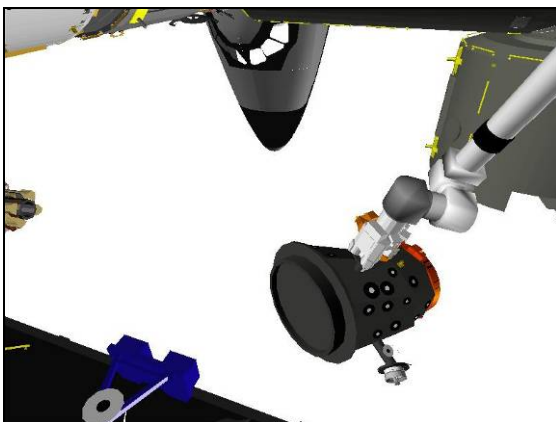


Figure 15.- PMA3 Intermediate 1 (07: P1 Lower Inboard: +160, -35).

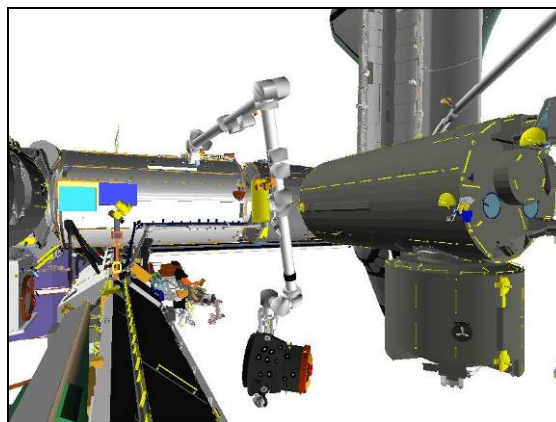


Figure 16.- PMA3 Intermediate 1 (09: P1 Lower Outboard: +115, 0).

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```

*****
* If using shuttle attitude control and attitude maintenance required
* | DAP: LVLH
* |
* | When rates damped
* | | DAP: FREE > 2 seconds
* | | DAP: AUTO
* |
* | When in attitude and rates damped
* | | DAP: FREE
*****
    
```

9. JOINT OCAS TO PMA3 INTERMEDIATE 2

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
37: MBS Mast (+5, +5)	07: P1 Lower Inboard (-170, -45)	09: P1 Lower Outboard (+135, 0)	Camera B (-20, +40)	OBSS ITVC (+60, -50)

NOTE Maneuver duration is ~5 minutes.

RHC RATE → COARSE (Verify Coarse on PCS)

PCS MSS: SSRMS:

SSRMS

SSRMS Joint OCAS

Input 'Joint Angles' 'Destination' for PMA3 Intermediate 2 position.

SR	SY	SP	EP	WP	WY	WR
+110.0	+180.0	+165.0	+95.0	-60.0	-60.0	0.0

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)	+110.0	+190.0	+228.0	+110.0	0.0	-10.0	+50.0
TGT	+110.0	+180.0	+165.0	+95.0	-60.0	-60.0	0.0
ERR	0.0	+10.0	+63.0	+15.0	+60.0	+50.0	+50.0

1.510 SSRMS CUPOLA RELEASE AND PMA3 RELOCATE

```
*****
* 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
+110.0	+180.0	+165.0	+95.0	-60.0	-60.0	0.0

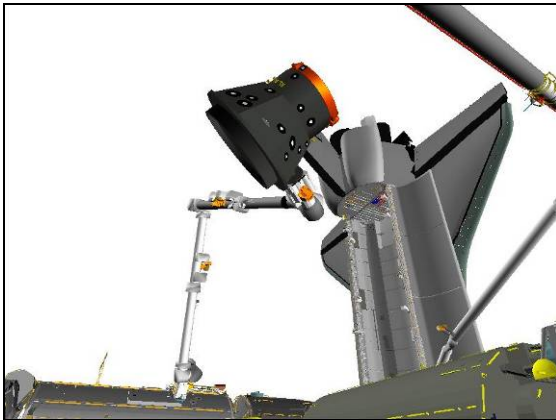


Figure 17.- PMA3 Intermediate 2
(09: P1 Lower Outboard: +115, +35).

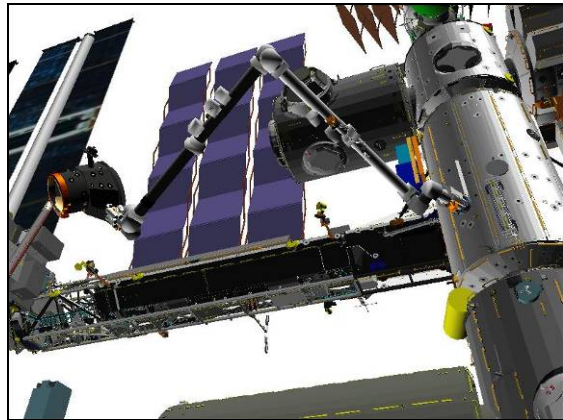


Figure 18.- PMA3 Intermediate 2
(Camera B: -20, +40).

```
*****
* If using shuttle attitude control and attitude maintenance required
* | DAP: LVLH
* |
* | When rates damped
* | | DAP: FREE > 2 seconds
* | | DAP: AUTO
* |
* | When in attitude and rates damped
* | | DAP: FREE
*****
```

1.510 SSRMS CUPOLA RELEASE AND PMA3 RELOCATE

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10. [PMA3 PASSIVE CBM SURVEY](#)
Configure Camera as required for survey.

Monitor 2
07: P1 Lower Inboard (-110, +45)



Figure 19.- CBM Survey
(07: P1 Lower Inboard: -110, +45).

NOTE

1. A.6 PASSIVE CBM INSPECTION REFERENCE (SODF: S&M: REFERENCE: CBM) 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.

Inspect the CBM ring using the P1 Lower Inboard Camera to verify ring and seal are clear of FOD by performing A.6 PASSIVE CBM INSPECTION REFERENCE, all (SODF: S&M: REFERENCE: CBM), then:

If any verifications in A.6 procedure are not met, $\sqrt{\text{MCC-H}}$.

Notify **MCC-H** when survey complete.

11. [JOINT OCAS TO PMA3 PRE-INSTALL](#)
Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
24: Tip Elbow (-10, +20)	07: P1 Lower Inboard (-110, +45)	09: P1 Lower Outboard (+85, +35)	Camera B (-30, +50)	SRMS Elbow (+70, +50)

NOTE

Maneuver duration is ~3 minutes.

Verify with **MCC-H** Port TRRJ locked at 0 degrees.

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√Coarse

SSRMS Joint OCAS

Input 'Joint Angles' 'Destination' for PMA3 Pre-Install position.

SR	SY	SP	EP	WP	WY	WR
+59.7	+170.0	+197.0	+95.9	-166.0	-152.7	-107.8

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	+180.0	+165.0	+95.0	-60.0	-60.0	0.0
TGT	+59.7	+170.0	+197.0	+95.9	-166.0	-152.7	-107.8
ERR	+50.3	+10.0	-32.0	-0.9	+106.0	+92.7	+107.8

* 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: SSRMS

Verify Posn Hold – orange

Enter Mode – Standby (Verify blue)

Verify SSRMS at PMA3 Pre-Install position.

SR	SY	SP	EP	WP	WY	WR
+59.7	+170.0	+197.0	+95.9	-166.0	-152.7	-107.8

1.510 SSRMS CUPOLA RELEASE AND PMA3 RELOCATE

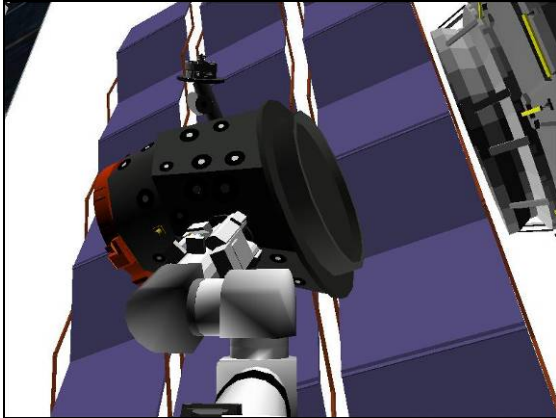


Figure 20.- PMA3 Pre-Install
(24: Tip Elbow: 0, +10).

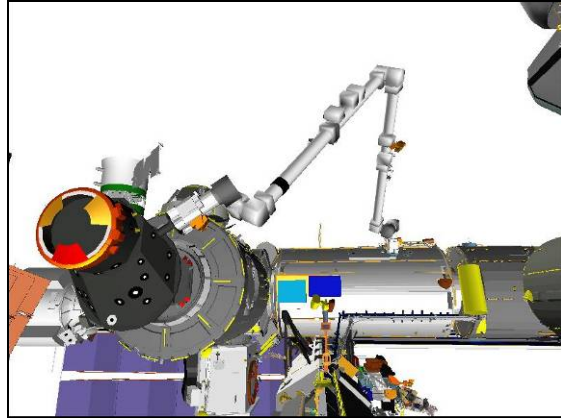


Figure 21.- PMA3 Pre-Install
(09: P1 Lower Outboard: +80, +15).

```

*****
* If using shuttle attitude control and attitude maintenance required
* |   DAP: LVLH
* |
* |   When rates damped
* |   |   DAP: FREE > 2 seconds
* |   |   DAP: AUTO
* |
* |   When in attitude and rates damped
* |   |   DAP: FREE
*****
    
```

12. SETUP FOR PMA3 INSTALL

<u>NOTE</u>	
1. The current video software load does not recognize the Node 3 video components. Coordinate with MCC-H for routing of the Node 3 CBCS Camera.	
2. Configure the CBCS Target Overlay on Monitor 2.	

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
24: Tip Elbow (0, +10)	XX: CBCS	09: P1 Lower Outboard (+80, +15)	Camera B (-20, +45)	SRMS Elbow (+85, +40)

MSS: SSRMS:

Change Loaded Parameters ► PMA3 ► PMA3 Mate BCS SYH
Verify 'Loaded Parameters' (two) – PMA3 Mate BCS, SY Held

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

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Change Display ► Node3 ► PMA3 Port Mate BCS (Verify Node3>PMA3 Port Mate BCS)

Verify Command – SSRMS>Internal

RHC RATE → VERNIER (Verify Vernier on PCS)

PCS MSS: SSRMS: Rate:

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

MSS: SSRMS:

Verify SSRMS at PMA3 Pre-Install position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+59.7	+170.0	+197.0	+95.9	-166.0	-152.7	-107.8
X	Y	Z	Pitch	Yaw	Roll	
+201	-1	0	0.0	0.0	+0.1	
FOR	Loaded – PMA3 Mate BCS, SY Held					
Disp	Node3>PMA3 Port Mate BCS					

13. MANEUVERING PMA3 TO RTL POSITION

NOTE

1. Clearance between the Tip LEE and Node 3 is 52 cm (21 in) at the PMA3 Install position. Monitor with the Tip Elbow Camera.
2. If all four RTLs are not green by the time X=+8, stop motion and refer to Table 1 to try and gain the missing RTL(s).

On CBM operator, "GO for maneuver to Ready-to-Latch position."

Node 3: S&M: Port CBM:

Monitor CBM RTLs using PCS.

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

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THC/
RHC Maneuver PMA3 until RTL (four) – green (-X, THC pull).
Expected RTL position:

	Locked					
SR	SY	SP	EP	WP	WY	WR
+56.0	+170.0	+193.2	+111.9	-179.8	-155.5	-110.2
X	Y	Z	Pitch	Yaw	Roll	
+12	0	0	0.0	0.0	0.0	
FOR	Loaded – PMA3 Mate BCS, SY Held					
Disp	Node3>PMA3 Port Mate BCS					

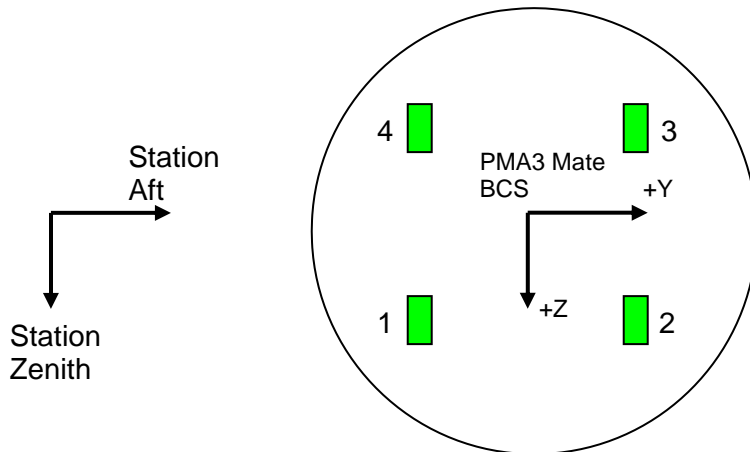


Figure 22.- RTL Locations Viewed From CBCS Camera.

Table 1. PMA3 BCS Install RTL Configuration (Refer to Figure 22).

Missing RTL's	RHC Input*
1	- Pitch & - Yaw
2	- Pitch & + Yaw
3	+ Pitch & + Yaw
4	+Pitch & - Yaw
1,4	-Yaw
1,2	-Pitch
2,3	+Yaw
3,4	+Pitch

* All inputs with respect to PMA3 Mate BCS FOR frame.

PCS MSS: SSRMS:

Verify Posn Hold – orange

Enter Mode – Standby (Verify blue)

Notify CBM operator: "Maneuver to RTL complete."

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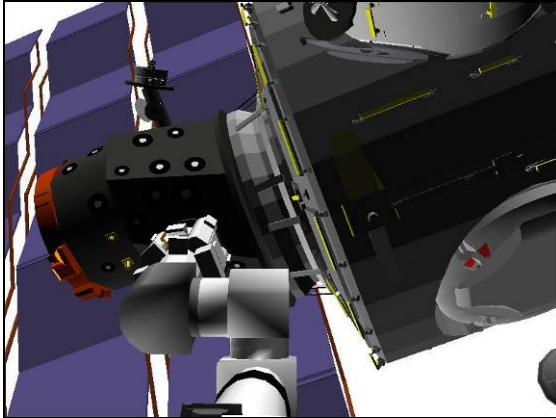


Figure 23.- RTL
(24: Tip Elbow: 0, +10).

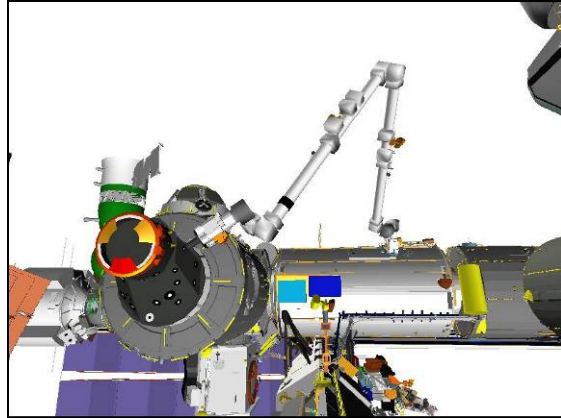


Figure 24.- RTL
(09: P1 Lower Outboard: +85, +15).

14. POST FIRST STAGE CAPTURE

On CBM operator, "GO for SSRMS 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.

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, $\sqrt{\text{MCC-H}}$ before proceeding.

Notify CBM operator: "SSRMS Mode to Limp complete. GO for Second Stage Capture."

15. POST SECOND STAGE CAPTURE

On CBM operator, "GO for SSRMS Brakes ON."

DCP BRAKES SSRMS → ON (Verify ON)

1.510 SSRMS CUPOLA RELEASE AND PMA3 RELOCATE

Expected PMA3 Installed position joint angles and FOR:

SR	SY	SP	EP	WP	WY	WR
+55.7	+170.0	+193.0	+112.8	-180.7	-155.7	-110.4
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded – PMA3 Mate BCS, SY Held					
Disp	Node3>PMA3 Port Mate BCS					

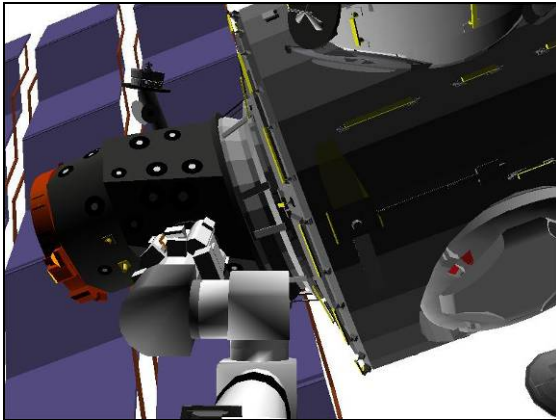


Figure 25.- PMA3 Installed
(24: Tip Elbow: 0, +10).

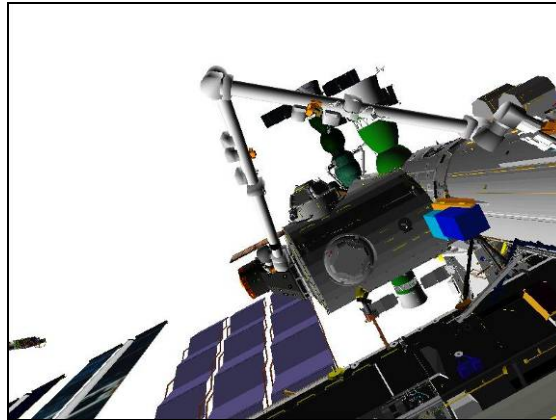


Figure 26.- PMA3 Installed
(SRMS Elbow: +85, +50).

```
*****
* If using shuttle attitude control and attitude maintenance required
* | DAP: LVLH
* |
* | When rates damped
* | | DAP: FREE > 2 seconds
* | | DAP: AUTO
*****
```

16. PMA3 FRGF RELEASE (PUSHOFF)

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
72: OBSS ITVC (+80, -90)	25: Tip LEE (Zoom full out)	09: P1 Lower Outboard (+85, +15)	Camera B (-20, +45)	SRMS Elbow (+85, +50)

DCP BRAKES SSRMS → OFF (Verify OFF)

PCS MSS: SSRMS:

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

Change Display ► Node3 ► PMA3 Mated Port GF (Verify Node3>PMA3 Mated Port GF)

Verify Command – SSRMS>Internal

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√Vernier

MSS: SSRMS: Rate:

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

16.1 SSRMS Limping

MSS: SSRMS: Limp:

cmd All Limp (Verify Limp – blue)

MSS: SSRMS:

Verify all joints – Limped

16.2 Auto Release (Carriage Pushoff)

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

Verify Unloaded Parameters – √

16.3 SSRMS Backoff

MSS: SSRMS: Limp:

cmd None Limp (Verify Standby – blue)

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MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

THC/
RHC

Maneuver SSRMS to PMA3 Backoff position (within 5 cm/1 deg).
(-X, THC pull)

	Locked					
SR	SY	SP	EP	WP	WY	WR
+62.6	+170.0	+176.4	+122.2	-170.2	-150.3	-105.9
X	Y	Z	Pitch	Yaw	Roll	
-200	0	0	0.0	0.0	0.0	
FOR	Unloaded – LEE Tip, SY Held					
Disp	Node3>PMA3 Mated Port GF					

DCP BRAKES SSRMS → ON (Verify ON)

PCS MSS: SSRMS: Rate:

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

16.4 SSRMS LEE Checkout

MSS: SSRMS: Tip LEE:

cmd Checkout ► 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 14662, 23262, 29337).

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Checkout LEE

RHC TRIGGER → Press (momentarily)

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PCS	Verify 'Snare' Close	- blue (12 s max)
	Verify 'Carriage' Retract	- blue (90 s max)
	Verify 'Latch' Latch	- blue (65 s max)
	Verify 'Umbilical' Mate	- blue (10 s max)
	Verify 'Umbilical' Demate	- blue (10 s max)
	Verify 'Latch' Unlatch	- blue (65 s max)
	Verify 'Carriage' Retract	- gray (90 s max)
	Verify 'Snare' Open	- blue (12 s max)
	Verify 'Carriage' Derigidize	- blue
	Verify 'Carriage' Extend	- blue (90 s max)

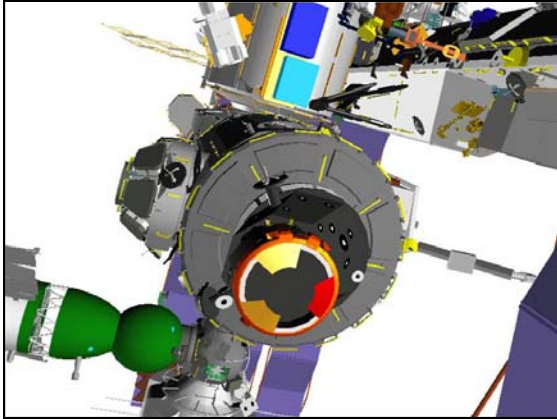


Figure 27.- PMA3 Backoff
(72: OBSS ITVC: +80, -90).

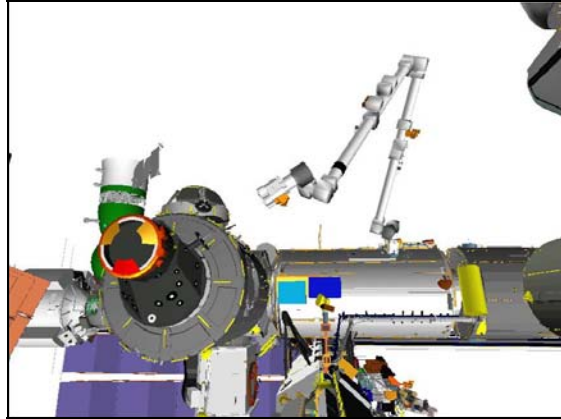


Figure 28.- PMA3 Backoff
(09: P1 Lower Outboard: +85, +15).

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1.520 SSRMS MANEUVER TO TRRJ VIEWING AND NODE 2 GRAPPLE

(RBT FS/20A/FIN/SPN) Page 1 of 10 pages

1. SETUP FOR RELEASE

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+100, +10)	07: P1 Lower Inboard (-65, +45)	24: Tip Elbow (-10, +10)	Camera B (-20, +40)	SRMS Elbow (-100, +125)

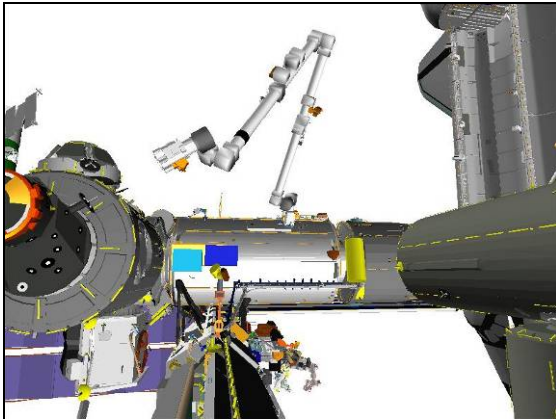


Figure 1.- PMA3 Backoff (09: P1 Lower Outboard: +100, +10).



Figure 2.- PMA3 Backoff (07: P1 Lower Inboard: -65, +45).

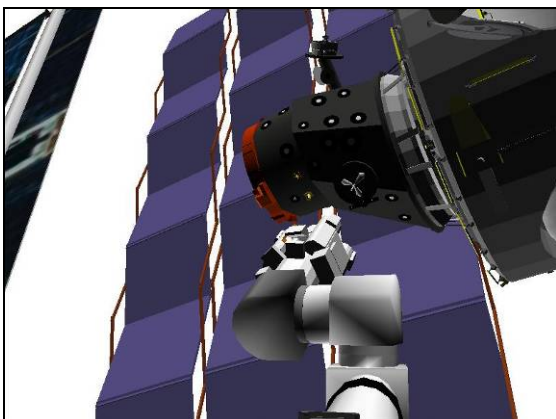


Figure 3.- PMA3 Backoff (24: Tip Elbow: -10, +10).

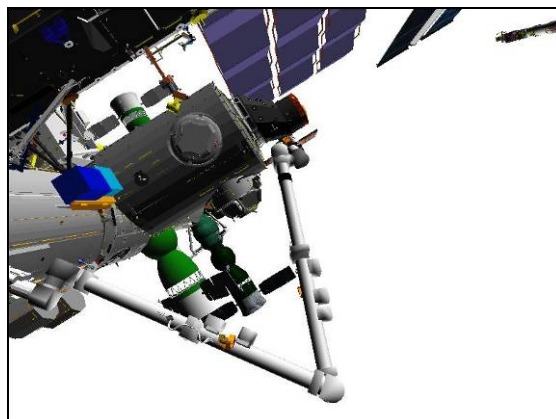


Figure 4.- PMA3 Backoff (SRMS Elbow: -100, +125).

PCS

MSS: SSRMS:

Change Loaded Parameters ► Walk Off ► Node 2 PDGF
Verify 'Loaded Parameters' (two) – Node 2 PDGF, SR Held

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

Change Display ► Node2 ► PDGF (Verify Node2>PDGF)

Verify Command – SSRMS>Internal

1.520 SSRMS MANEUVER TO TRRJ VIEWING AND NODE 2 GRAPPLE

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Verify SSRMS at PMA3 Backoff position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+62.6	+170.0	+176.4	+122.2	-170.3	-150.3	-105.9
X	Y	Z	Pitch	Yaw	Roll	
-135	+912	-908	+9.0	+56.2	-88.9	
FOR	Unloaded – LEE Tip, SY Held					
Disp	Node2>PDGF					

2. JOINT OCAS TO PORT TRRJ ROTATION VIEWING POSITION

Verify with **MCC-H** Port TRRJ locked at 0 degrees.

DCP BRAKES SSRMS → OFF (Verify OFF)

PCS MSS: SSRMS:

√Vernier

Enter Mode – Joint OCAS (Verify blue)

NOTE
The duration of this Joint OCAS is approximately 2 minutes.

Input 'Joint Angles' 'Destination' for Port TRRJ Rotation Viewing position.

SR	SY	SP	EP	WP	WY	WR
+100.0	+181.5	+199.7	+112.0	-199.6	-79.6	-84.5

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)	+62.6	+170.0	+176.4	+122.2	-170.3	-150.3	-105.9
TGT	+100.0	+181.5	+199.7	+112.0	-199.6	-79.6	-84.5
ERR	-37.4	-11.5	-23.3	+10.2	+29.3	-70.7	-21.4

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)

1.520 SSRMS MANEUVER TO TRRJ VIEWING AND NODE 2 GRAPPLE

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DCP AUTO SEQ → PROC

PCS MSS: SSRMS: SSRMS

Verify Posn Hold – orange

Verify Joint Angle values.

SR	SY	SP	EP	WP	WY	WR
+100.0	+181.5	+199.7	+112.0	-199.6	-79.6	-84.5

DCP BRAKES SSRMS → ON (Verify ON)

Notify **MCC-H**: “Brakes ON, SSRMS clear of structure, ready for Port TRRJ Rotation.”

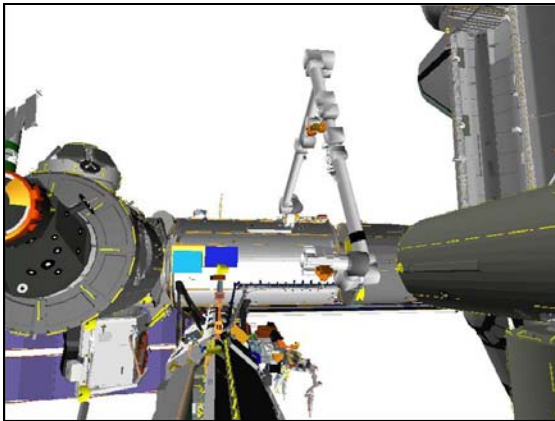


Figure 5.- Port TRRJ Rotation Viewing
(09: P1 Lower Outboard: +100, +10).

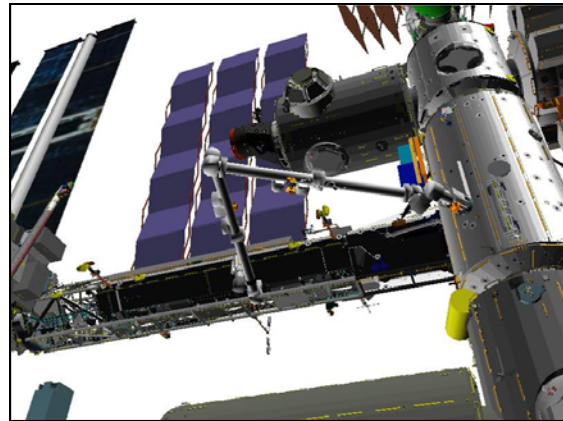


Figure 6.- Port TRRJ Rotation Viewing
(Camera B: -20, +40).

3. JOINT OCAS TO NODE 2 INTERMEDIATE POSITION

On **MCC-H**: “Port TRRJ rotation viewing complete. GO for maneuver to Node 2 Grapple”:

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+110, +25)	71: OBSS ITVC (+85, -55)	24: Tip Elbow (-10, +10)	Camera B (-20, +40)	SRMS Elbow (-100, +135)

1.520 SSRMS MANEUVER TO TRRJ VIEWING AND NODE 2 GRAPPLE

(RBT FS/20A/FIN/SPN) Page 4 of 10 pages

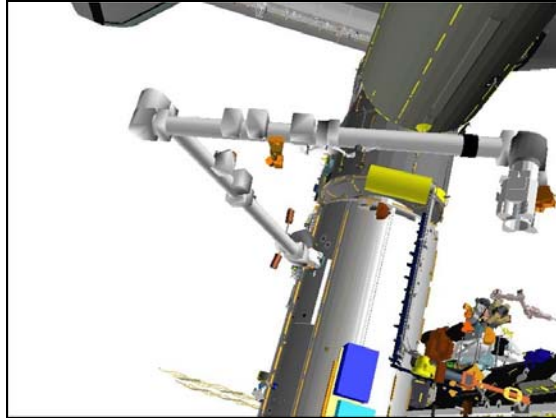


Figure 7.- Port TRRJ Rotation Viewing
(71: OBSS ITVC: +85, -55).

NOTE
The duration of this Joint OCAS is approximately 2 minutes.

DCP BRAKES SSRMS → OFF (Verify OFF)

PCS MSS: SSRMS: SSRMS

√Vernier

Enter Mode – Joint OCAS (Verify blue)

SSRMS Joint OCAS

Input 'Joint Angles' 'Destination' for Node 2 Intermediate position.

SR	SY	SP	EP	WP	WY	WR
+170.0	+174.4	+140.0	+153.2	-127.0	-100.0	+80.0

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)	+100.0	+181.5	+199.7	+112.0	-199.6	-79.6	-84.5
TGT	+170.0	+174.4	+140.0	+153.2	-127.0	-100.0	+80.0
ERR	-70.0	+7.1	+59.7	-41.2	-72.6	+20.4	-164.5

1.520 SSRMS MANEUVER TO TRRJ VIEWING AND NODE 2 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 Joint Angle values.

SR	SY	SP	EP	WP	WY	WR
+170.0	+174.4	+140.0	+153.2	-127.0	-100.0	+80.0

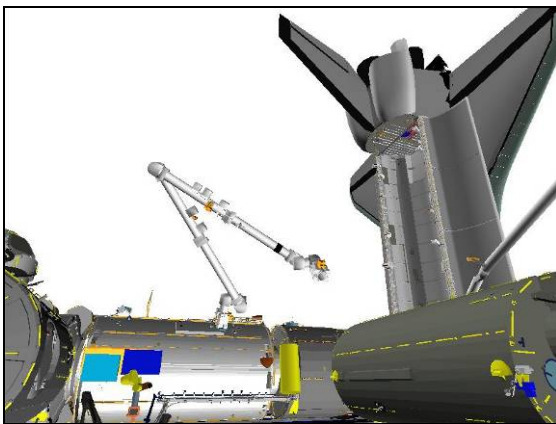


Figure 8.- Node 2 Intermediate
 (09: P1 Lower Outboard: +110, +25).

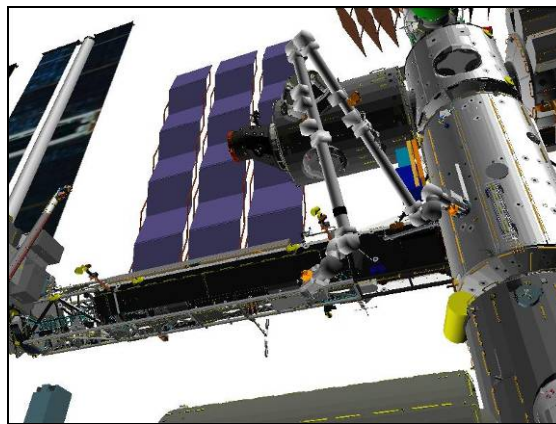


Figure 9.- Node 2 Intermediate
 (Camera B: -20, +40).

4. JOINT OCAS TO NODE 2 PRE-GRAPPLE POSITION

NOTE
 The duration of this Joint OCAS is approximately 2 minutes.

MSS: SSRMS:

√Vernier

1.520 SSRMS MANEUVER TO TRRJ VIEWING AND NODE 2 GRAPPLE

(RBT FS/20A/FIN/SPN) Page 6 of 10 pages

SSRMS Joint OCAS

Input 'Joint Angles' 'Destination' for Node 2 Pre-Grapple position.

SR	SY	SP	EP	WP	WY	WR
+230.4	+174.4	+175.7	+153.2	-127.0	-167.5	+141.8

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)	+170.0	+174.4	+140.0	+153.2	-127.0	-100.0	+80.0
TGT	+230.4	+174.4	+175.7	+153.2	-127.0	-167.5	+141.8
ERR	-60.4	0.0	-35.7	0.0	0.0	+67.5	-61.8

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)

DCP

AUTO SEQ → PROC

PCS

MSS: SSRMS: SSRMS

Verify Posn Hold – orange

Verify SSRMS at Node 2 Pre-Grapple position.

SR	SY	SP	EP	WP	WY	WR
+230.4	+174.4	+175.7	+153.2	-127.0	-167.5	+141.8
X	Y	Z	Pitch	Yaw	Roll	
-150	0	0	0.0	0.0	0.0	
FOR	Unloaded – LEE Tip, SY Held					
Disp	Node2>PDGF					

1.520 SSRMS MANEUVER TO TRRJ VIEWING AND NODE 2 GRAPPLE

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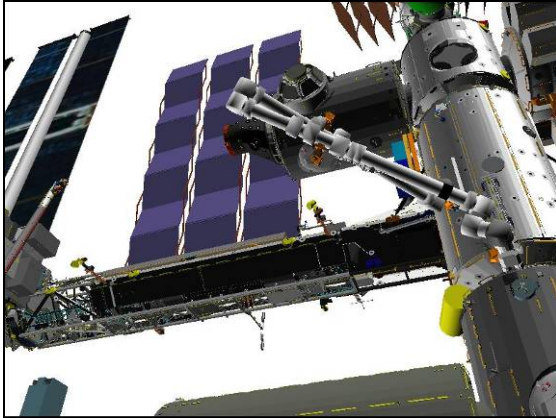


Figure 10.- Node 2 Pre-Grapple
(Camera B: -20, +40).

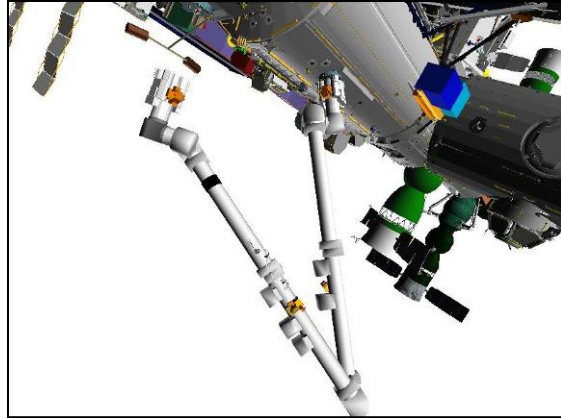


Figure 11.- Node 2 Pre-Grapple
(SRMS Elbow: -30, +115).

5. NODE 2 GRAPPLE

5.1 Grapple Setup

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+110, +25)	25: Tip LEE (Zoom full out)	07: P1 Lower Inboard (+135, +20)	Camera B (-5, +40)	SRMS Elbow (-30, +115)

MSS: SSRMS:

√Vernier

MSS: SSRMS: Rate:

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

5.2 Maneuvering to Node 2 Grapple Envelope

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.

5.3 Slow Capture Commands

PCS

MSS: SSRMS: Tip LEE:

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

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

1.520 SSRMS MANEUVER TO TRRJ VIEWING AND NODE 2 GRAPPLE

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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 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 (80s max)

5.4 Mating Umbilicals

Verify with **MCC-H** - Payload and PDGF power inhibits have been confirmed.

MSS: SSRMS: Tip LEE:

cmd 'Umbilical' Mate (Verify '**Confirm or Terminate**' prompt)

NOTE

Expect '**R3L - SSRMS Pwr Flags Fail**' Robotics Advisory message when mating is complete (SCR 19019).

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Mate

RHC TRIGGER → Press (momentarily)

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

5.5 Derigidizing Carriage

MSS: SSRMS: Tip LEE:

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

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

1.520 SSRMS MANEUVER TO TRRJ VIEWING AND NODE 2 GRAPPLE

(RBT FS/20A/FIN/SPN) Page 9 of 10 pages

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Deridigize

RHC TRIGGER → Press (momentarily) (SCR 19064)

PCS
Verify 'Carriage' Retract – gray (90 s max)
Verify 'Carriage' Tension < 555 N
Verify 'Carriage' Brakes – On (90 s max)

5.6 Grapple Cleanup

MSS: SSRMS:

Verify Loaded Parameters – √

Verify 'Loaded Parameters' (two) – Node 2 PDGF, SR Held

Expected Node 2 Grapple position.

SR	SY	SP	EP	WP	WY	WR
+225.7	+174.4	+198.3	+157.6	-155.5	-165.8	+137.3
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded – Node 2 PDGF, SR Held					
Disp	Node2>PDGF					

MSS: SSRMS: Rate:

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

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)



Figure 12.- Node 2 Grapple
(09: P1 Lower Outboard: +110, +25).

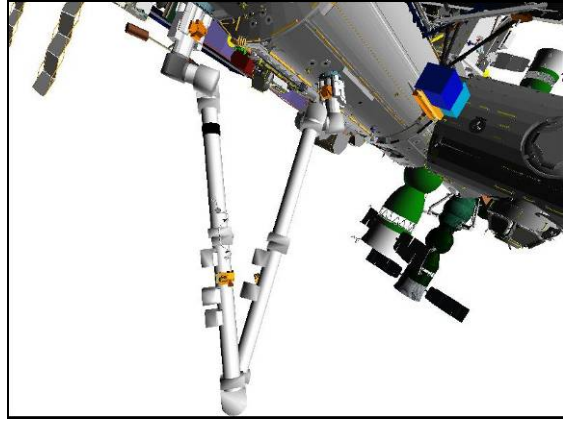


Figure 13.- Node 2 Grapple
(SRMS Elbow: -30, +115).

CONTINGENCY

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2.220 SSRMS RETURN NODE 3 TO LOW HOVER

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1. SETUP

On **MCC-H GO** to perform Contingency Node 3 Payload Bay Hover:

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

Verify SRMS is at Node 3 Install Viewing.

PCS MSS: SSRMS: MSS Safing:

cmd 'SSRMS' Remove (Verify Not Safed)

DCP BRAKES SSRMS → OFF (Verify OFF)

√**MCC-H** for next step to execute based on current SSRMS position

2. MANUAL TO RETURN TO PRE-INSTALL POSITION

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
22: Base Elbow (+90, -15)	72 (DNLK): SRMS Elbow (+95, +50)	09: P1 Lower Outboard (+80, +15)	Camera B (-10, +50)	OBSS ITVC (+80, -90)

NOTE

1. Monitor clearances between SSRMS to ESP-1 and Node 3 to ESP-1 with the Base Elbow Camera. Minimum clearance at install is approximately 48 cm (19 in) for both.
2. Monitor clearance between SSRMS and P1 Lower Inboard Camera with P1 Lower Outboard Camera. Minimum clearance is 60 cm (24 in).
3. Clearance between Node 3 and Node 1 Zenith Aft Stanchion decreases to 52 cm (20 in) at install, no Camera view available.

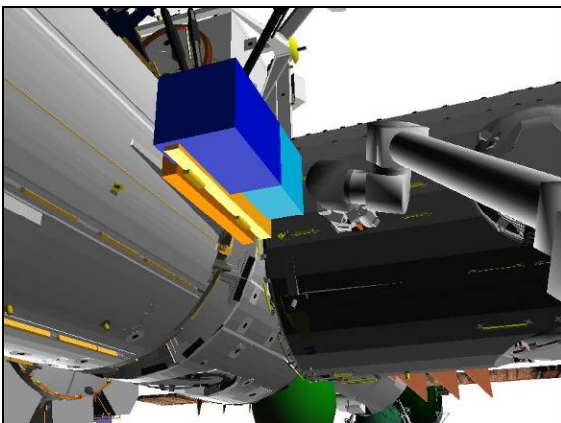


Figure 1.- Node 3 Ready-To-Latch
(22: Base Elbow: +90, -15).

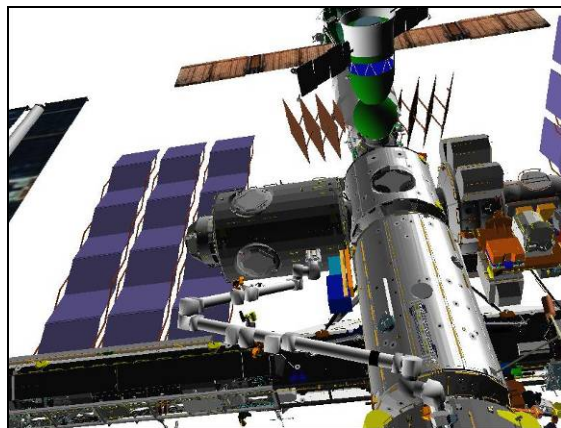


Figure 2.- Node 3 Ready-To-Latch
(Camera B: -10, +50).

2.220 SSRMS RETURN NODE 3 TO LOW HOVER

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PCS MSS: SSRMS:

√Vernier

Verify Loaded Parameters – √
 Verify 'Loaded Parameters' (two) – Node3 Install CBCS, SY Held

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

Verify Display – Node1>Node3 Install CBCS

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 3 to Pre-Install position (within 5 cm/1 deg).
(+X, THC push).

	Locked						
SR	SY	SP	EP	WP	WY	WR	
+153.2	+132.9	-106.4	+89.3	-15.7	-30.7	+77.6	
X	Y	Z	Pitch	Yaw	Roll		
+200	0	0	0.0	0.0	0.0		
FOR	Loaded – Node3 Install CBCS, SY Held						
Disp	Node1>Node3 Install CBCS						

PCS MSS: SSRMS:

Enter Mode – Standby (Verify blue)

```

*****
* If using shuttle attitude control and attitude maintenance required
* | DAP: LVLH
* |
* | When rates damped
* | | DAP: FREE > 2 seconds
* | | DAP: AUTO
* |
* | When in attitude and rates damped
* | | DAP: FREE
*****
    
```

2.220 SSRMS RETURN NODE 3 TO LOW HOVER

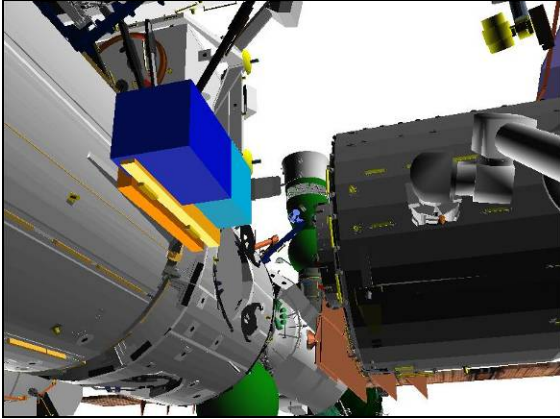


Figure 3.- Node 3 Pre-Install
(22: Base Elbow: +90, -15).

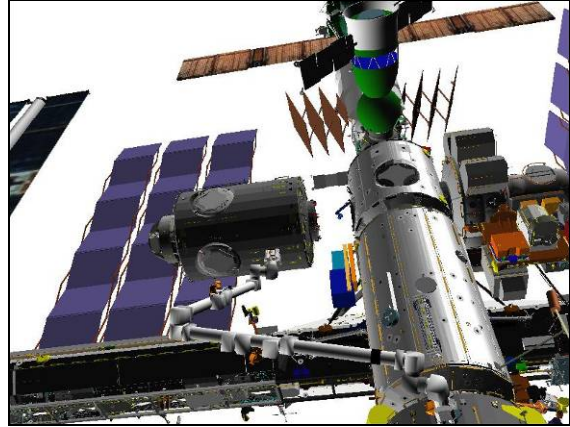


Figure 4.- Node 3 Pre-Install
(Camera B: -10, +50).

3. FOR OCAS TO RETURN TO RADIATOR HOLD POSITION

NOTE
The duration of this FOR OCAS is approximately 12 minutes.

MSS: SSRMS:

√Vernier

Enter Mode – FOR OCAS (Verify blue)

MSS: SSRMS: SSRMS FOR OCAS: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

Input 'FOR' 'Destination' for Radiator Hold position.

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

2.220 SSRMS RETURN NODE 3 TO LOW HOVER

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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 Radiator Hold position (within 5 cm/1 deg).

	Locked					
SR	SY	SP	EP	WP	WY	WR
+128.9	+132.9	-140.8	+68.4	+16.3	-19.1	+64.6
X	Y	Z	Pitch	Yaw	Roll	
+500	+500	0	0.0	0.0	0.0	
FOR	Loaded – Node3 Install CBCS, SY Held					
Disp	Node1>Node3 Install CBCS					

```
*****
* If using shuttle attitude control and attitude maintenance required
* | DAP: LVLH
* |
* | When rates damped
* | | DAP: FREE > 2 seconds
* | | DAP: AUTO
* |
* | When in attitude and rates damped
* | | DAP: FREE
*****
```



Figure 5.- Node 3 Radiator Hold
 (22: Base Elbow: +105, -15).

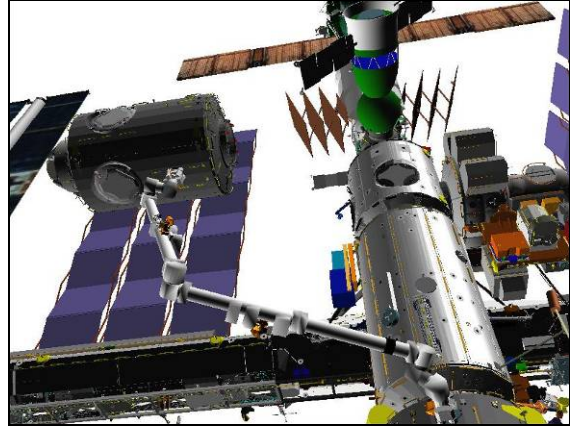


Figure 6.- Node 3 Radiator Hold
 (Camera B: -10, +50).

4. JOINT OCAS MANEUVER TO INTERMEDIATE POSITION

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
07: P1 Lower Inboard (-115, +50)	72 (DNLK): Camera C (-45, +30)	09: P1 Lower Outboard (+85, +35)	SRMS Elbow (+70, +65)	OBSS ITVC (+110, -80)

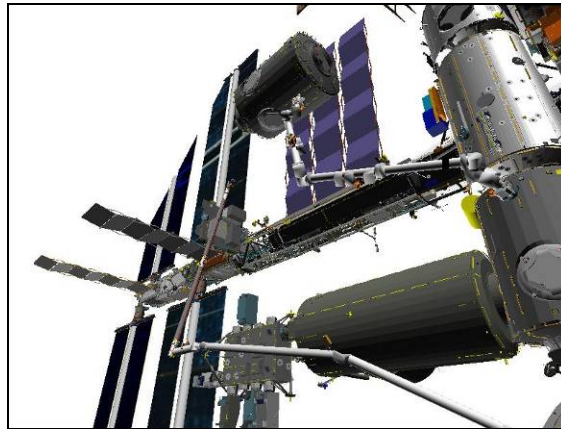


Figure 7.- Node 3 Radiator Hold
 (72: Camera C: -45, +30).

NOTE

1. Expect singularity warning for EP between -15 and +15 deg.
2. Maneuver duration is approximately 20 minutes.

MSS: SSRMS:

√Vernier

Enter Mode – Joint OCAS (Verify blue)

2.220 SSRMS RETURN NODE 3 TO LOW HOVER

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SSRMS Joint OCAS

Input 'Joint Angles' 'Destination' for Radiator Hold position.

SR	SY	SP	EP	WP	WY	WR
+128.9	+132.9	-140.9	-21.4	+16.3	-19.1	+64.6

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)	+128.9	+132.9	-140.8	+68.4	+16.3	-19.1	+64.6
TGT	+128.9	+132.9	-140.9	-21.4	+16.3	-19.1	+64.6
ERR	0.0	0.0	+0.1	+89.8	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

PCS

MSS: SSRMS: **SSRMS**

Verify Posn Hold – orange

Verify Joint Angle values.

SR	SY	SP	EP	WP	WY	WR
+128.9	+132.9	-140.9	-21.4	+16.3	-19.1	+64.6

* If using shuttle attitude control and attitude maintenance required

* DAP: LVLH

* When rates damped

* DAP: FREE > 2 seconds

* DAP: AUTO

* When in attitude and rates damped

* DAP: FREE

2.220 SSRMS RETURN NODE 3 TO LOW HOVER

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Figure 8.- Node 3 Intermediate
(07: P1 Lower Inboard: -165, +50).

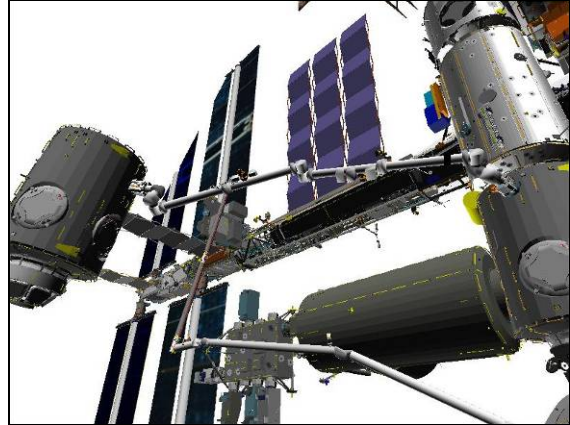


Figure 9.- Node 3 Intermediate
(72: Camera C: -45, +30).

5. JOINT OCAS TO RETURN TO PORT HOVER POSITION

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
07: P1 Lower Inboard (-165, +50)	72 (DNLK): Camera C (-50, +30)	03: S1 Lower Outboard (+70, +25)	Camera A (+20, +30)	OBSS ITVC (+115, -35)

NOTE

The duration of this Joint OCAS is approximately 20 minutes.

MSS: SSRMS:

√Vernier

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

SR	SY	SP	EP	WP	WY	WR
+90.1	+161.6	-151.0	-85.2	-3.9	+44.7	+49.4

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON

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

	SR	SY	SP	EP	WP	WY	WR
(current)	+128.9	+132.9	-140.9	-21.4	+16.3	-19.1	+64.6
TGT	+90.1	+161.6	-151.0	-85.2	-3.9	+44.7	+49.4
ERR	+38.8	-28.7	+10.1	+63.8	+20.2	-63.8	+15.2

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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

Enter Mode – Standby (Verify blue)

Verify Joint Angle values.

SR	SY	SP	EP	WP	WY	WR
+90.1	+161.6	-151.0	-85.2	-3.9	+44.7	+49.4

```

*****
* If using shuttle attitude control and attitude maintenance required
* | DAP: LVLH
* |
* | When rates damped
* | | DAP: FREE > 2 seconds
* | | DAP: AUTO
* |
* | When in attitude and rates damped
* | | DAP: FREE
*****

```


2.220 SSRMS RETURN NODE 3 TO LOW HOVER

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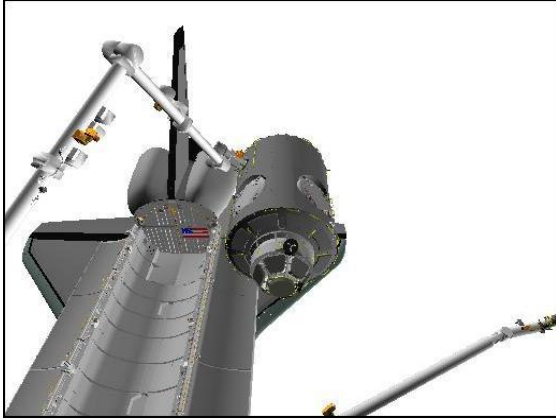


Figure 10.- Node 3 Port Hover
(07: P1 Lower Inboard: -180, +50).

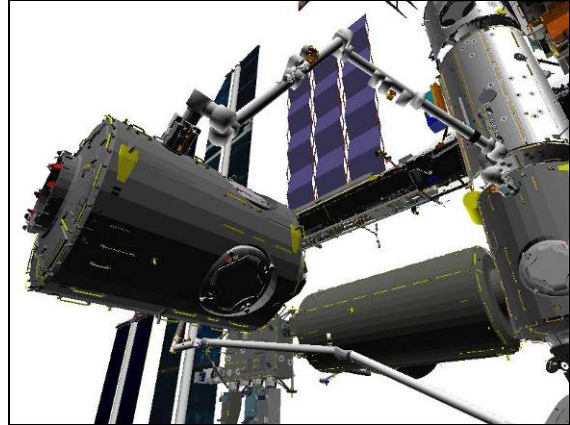


Figure 11.- Node 3 Port Hover
(72: Camera C: -45, +30).

6. FOR OCAS TO RETURN TO LOW HOVER POSITION

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
71 (MON2): Camera C (-50, +30)	72 (DNLK): Camera A (+5, +20)	03: S1 Lower Outboard (+70, +25)	SRMS Elbow (-80, +45)	OBSS ITVC (+105, -35)

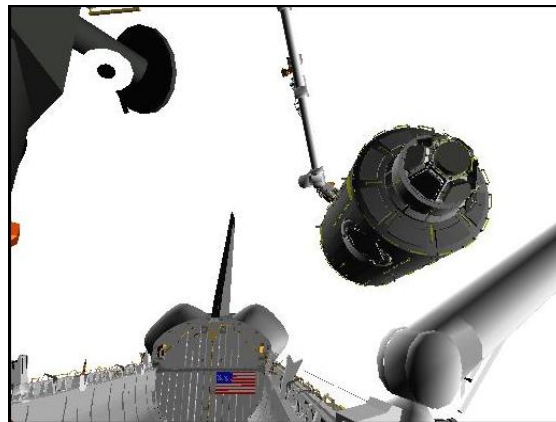


Figure 12.- Node 3 Port Hover
(72: Camera A: +5, +20).

MSS: SSRMS:

Change Loaded Parameters ► Node3 ► Node3 Unberth SRH
Verify 'Loaded Parameters' (two) – Node3 Unberth, SR Held

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

Change Display ► Orbiter ► Node3 Unberth (Verify Orbiter>Node3
Unberth)

2.220 SSRMS RETURN NODE 3 TO LOW HOVER

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Verify Command – SSRMS>Internal

RHC RATE → COARSE (Verify Coarse on PCS)

NOTE
The duration of this FOR OCAS is approximately 7 minutes.

PCS MSS: SSRMS:

Enter Mode – FOR OCAS (Verify blue)

MSS: SSRMS: SSRMS FOR OCAS: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

Input 'FOR' 'Destination' for Node 3 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)

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

* 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

2.220 SSRMS RETURN NODE 3 TO LOW HOVER

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Verify SSRMS at Node 3 Low Hover position (within 5 cm/1 deg).

Locked						
SR	SY	SP	EP	WP	WY	WR
+90.1	+199.1	-147.1	-87.7	-48.7	+50.7	+105.8
X	Y	Z	Pitch	Yaw	Roll	
0	0	-600	0.0	0.0	0.0	
FOR	Loaded – Node3 Unberth, SR Held					
Disp	Orbiter>Node3 Unberth					

RHC

RATE → VERNIER (Verify Vernier on PCS)

```

*****
* If using shuttle attitude control and attitude maintenance required
* | DAP: LVLH
* |
* | When rates damped
* | | DAP: FREE > 2 seconds
* | | DAP: AUTO
*****

```

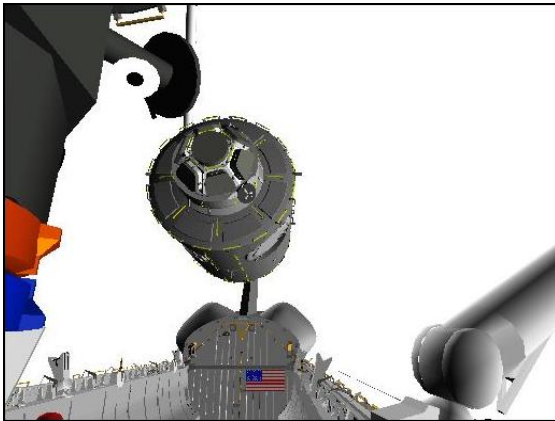


Figure 13.- Node 3 Low Hover
(72: Camera A: 0, +20).

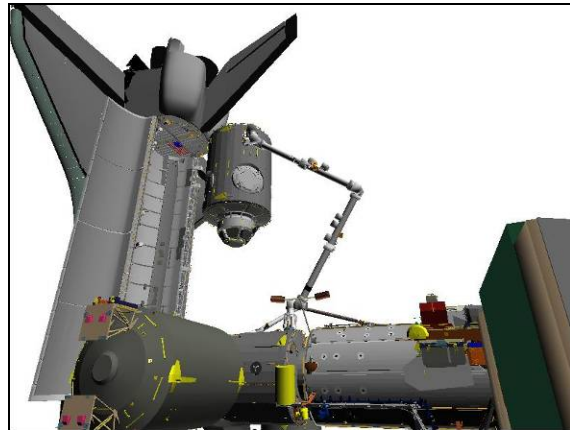


Figure 14.- Node 3 Low Hover
(03: S1 Lower Outboard: +70, +25).

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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2.310 SSRMS NODE 3 RELEASE AND MANEUVER TO FI SUPPORT

(RBT FS/20A/FIN 1/SPN) Page 1 of 14 pages

1. SETUP FOR NODE 3 RELEASE

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+100, +15) 71: OBSS ITVC (+85, -60)	25: Tip LEE (Zoom full out)	72 (DNLK): Camera B (-5, +45) HFOV = 10 deg	Camera C (-20, +45)	SRMS Elbow (+130, +60)

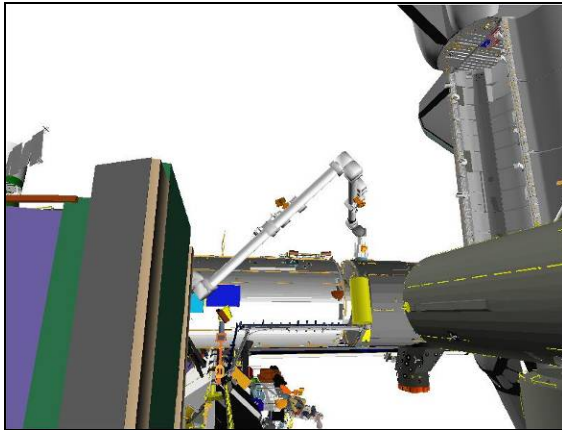


Figure 1.- Node 3 Installed
(09: P1 Lower Outboard: +100, +15).

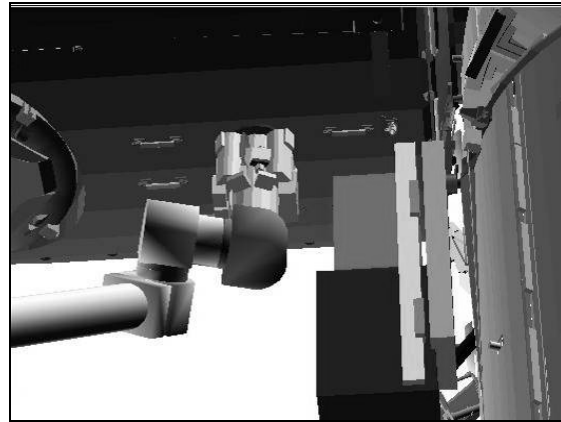


Figure 2.- Node 3 Installed
(72: Camera B: -5, +45)
HFOV = 10 deg.



Figure 3.- Node 3 Installed
(Camera C: -20, +45).

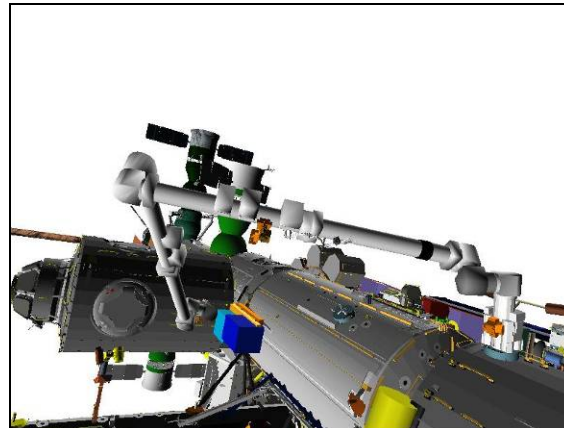


Figure 4.- Node 3 Installed
(SRMS Elbow: +130, +60).

PCS

MSS: SSRMS:

Verify Loaded Parameters – √

Verify 'Loaded Parameters' (two) – Node3 Install CBCS, SY Held

Change Unloaded Parameters ► Unloaded ► LEE Tip SYH

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

2.310 SSRMS NODE 3 RELEASE AND MANEUVER TO FI SUPPORT

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Change Display ► Node1 ► Node3 Mated GF (Verify Node1>Node3 Mated GF)

Verify Command – SSRMS>Internal

Verify SSRMS at Node 3 Installed position.

SR	SY	SP	EP	WP	WY	WR
+149.0	+132.9	-105.2	+99.8	-31.8	-29.0	+74.9
X	Y	Z	Pitch	Yaw	Roll	
+227	-154	0	+69.5	+90.0*	-76.6	
FOR	Loaded – Node3 Install CBCS, SY Held					
Disp	Node1>Node3 Mated GF					

*Display singularity

2. NODE 3 FRGF RELEASE

MSS: SSRMS: MSS Safing:

cmd 'SSRMS' Remove (Verify Not Safed)

DCP BRAKES SSRMS → OFF (Verify OFF)

PCS MSS: SSRMS:

√Vernier

MSS: SSRMS: Rate:

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

2.1 SSRMS Limp

MSS: SSRMS: Limp:

cmd All Limp (Verify Limp – blue)

MSS: SSRMS:

Verify all joints – Limped

2.2 Auto Release (Carriage Pushoff)

MSS: SSRMS: Tip LEE:

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

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

CAUTION

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

2.310 SSRMS NODE 3 RELEASE AND MANEUVER TO FI SUPPORT

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NOTE

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

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Auto Release

RHC TRIGGER → Press (momentarily)

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

2.3 SSRMS Backoff

NOTE

1. Due to clearance concerns between the wrist cluster and ESP-1, the backoff position has been modified.
2. Minimum clearance between the Tip LEE and ESP-1 is 22 cm (9 in); monitor with Camera B.

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 Node 3 Backoff position (within 5 cm/1 deg).

	Locked					
SR	SY	SP	EP	WP	WY	WR
+152.7	+132.9	-106.1	+105.6	-32.8	-30.5	+77.2
X	Y	Z	Pitch	Yaw	Roll	
-65	0	0	0.0	0.0	0.0	
FOR	Unloaded – LEE Tip, SY Held					
Disp	Node1>Node3 Mated GF					

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PCS

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

MSS: SSRMS: Rate:

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

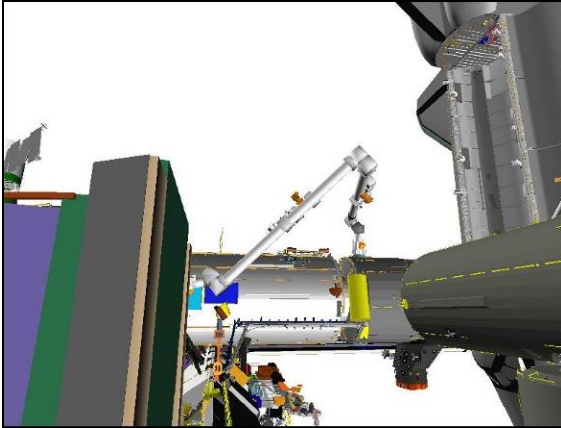


Figure 5.- Node 3 Backoff
(09: P1 Lower Outboard: +100, +15).

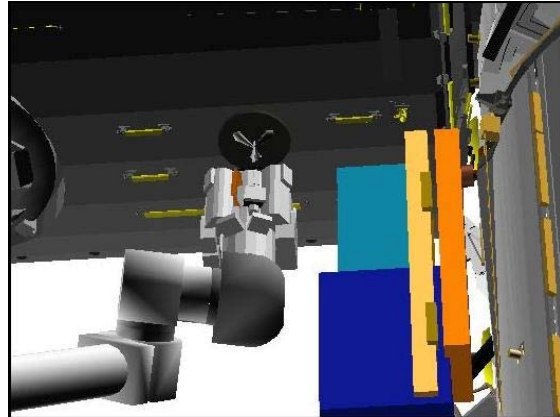


Figure 6.- Node 3 Backoff
(72: Camera B: -5, +45)
HFOV = 10 deg.

3. FOR OCAS TO LAB CLEARANCE

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+100, +15) 71: OBSS ITVC (+85, -60)	24: Tip Elbow (0, 0)	72 (DNLK): Camera B (-5, +45)	Camera C (-20, +45)	SRMS Elbow (+130, +60)

NOTE

1. Clearance between the Tip LEE and ESP-1 is 22 cm (9 in) and increases throughout the maneuver. Monitor with Camera B.
2. Clearance between the Tip LEE and the Node 3 FRGF pin increases throughout the maneuver. Monitor with the P1 Lower Outboard or OBSS ITVC Camera.
3. Maneuver duration is ~1 minute.

MSS: SSRMS:

Enter Mode – FOR OCAS (Verify blue)

2.310 SSRMS NODE 3 RELEASE AND MANEUVER TO FI SUPPORT

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MSS: SSRMS: SSRMS FOR OCAS: Joint Lock: Joint Lock

cmd Shoulder Yaw (Verify SY – Locked)

SSRMS FOR OCAS

pick File ► Node 2 ► LAB Clearance

Verify 'FOR' 'Destination' for LAB 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

* 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

Enter Mode – Standby (Verify blue)

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

	Locked					
SR	SY	SP	EP	WP	WY	WR
+146.3	+132.9	-134.1	+109.1	-14.9	-27.9	+73.2
X	Y	Z	Pitch	Yaw	Roll	
-200	+200	+200	0.0	0.0	0.0	
FOR	Unloaded – LEE Tip, SY Held					
Disp	Node1>Node3 Mated GF					

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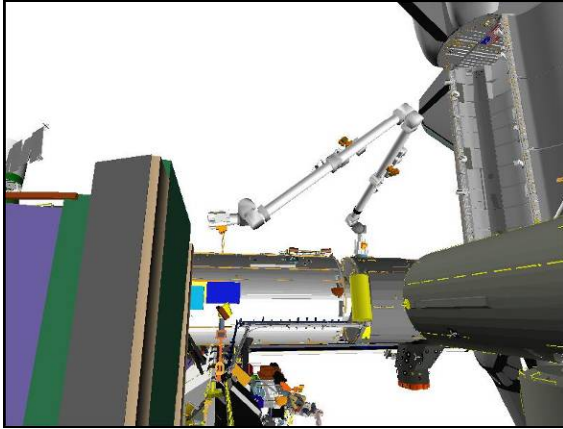


Figure 7.- LAB Clearance
(09: P1 Lower Outboard: +100, +15).

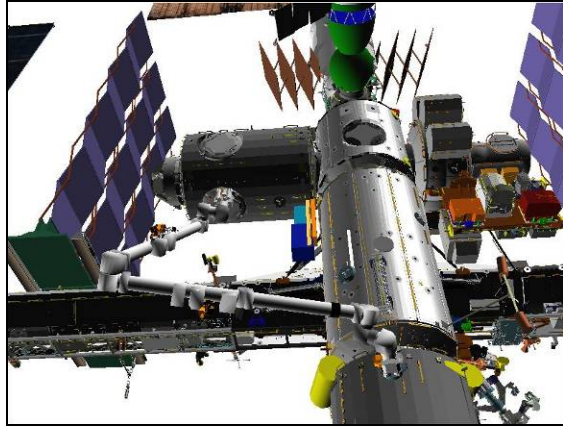


Figure 8.- LAB Clearance
(Camera B: -5, +45).

4. FOR OCAS TO VIEWING RECONFIG

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+100, +15) 71: OBSS ITVC (+85, -60)	24: Tip Elbow (0, 0)	07: P1 Lower Inboard (+110, +50)	Camera C (-20, +45)	SRMS Elbow (+130, +60)

NOTE

Maneuver duration is ~2 minutes.

MSS: SSRMS:

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

Enter Mode – FOR OCAS (Verify blue)

MSS: SSRMS: SSRMS FOR OCAS: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

pick File ► FI Support ► Viewing Reconfig

Verify 'FOR' 'Destination' for Viewing Reconfig position.

X	Y	Z	Pitch	Yaw	Roll
+50	+150	+1300	-135.0	+40.0	+135.0

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	-46	-600	+735	+173.0	0.0	+179.9
TGT	+50	+150	+1300	-135.0	+40.0	+135.0
ERR	-96	-750	-565	+308.0	-40.0	+44.9

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 Viewing Reconfig position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+62.0	+132.9	-185.8	+120.8	-25.9	-35.2	+35.5
X	Y	Z	Pitch	Yaw	Roll	
+50	+150	+1300	-135.0	+40.0	+135.0	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>ISSACS					

5. JOINT OCAS TO VIEWING HOVER

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)
03: S1 Lower Outboard (+60, +20)	72 (DNLK): Camera C (+10, +35)	71 (MON2): OBSS ITVC (+90, -50)	SRMS Elbow (-170, +50)

2.310 SSRMS NODE 3 RELEASE AND MANEUVER TO FI SUPPORT

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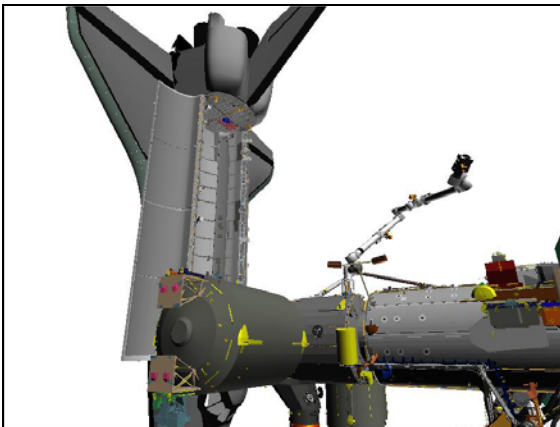


Figure 9.- Viewing Reconfig
(03: S1 Lower Outboard: +60, +20).

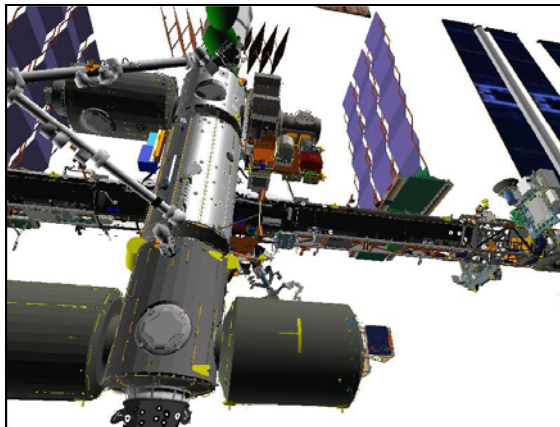


Figure 10.- Viewing Reconfig
(72: Camera C: +10, +35).

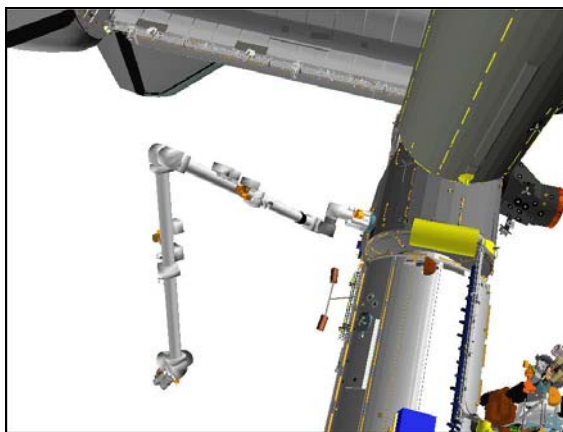


Figure 11.- Viewing Reconfig
(71: OBSS ITVC: +90, -50).

NOTE

1. Minimum clearance between the Base Boom and the LAB UHF Antenna is 142 cm (56 in). Monitor with the OBSS ITVC.
2. Maneuver duration is ~3.5 minutes.

MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

pick File ► FI Support ► Viewing Hover

Verify 'Joint Angles' 'Destination' for Viewing Hover position.

SR	SY	SP	EP	WP	WY	WR
-15.0	+100.0	-90.0	+17.0	-58.9	-160.0	+10.0

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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)	+62.0	+132.9	-185.8	+120.8	-25.9	-35.2	+35.5
TGT	-15.0	+100.0	-90.0	+17.0	-58.9	-160.0	+10.0
ERR	+77.0	+32.9	-95.8	+103.8	+33.0	+124.8	+25.5

* 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
-15.0	+100.0	-90.0	+17.0	-58.9	-160.0	+10.0

6. SINGLE JOINT TO VIEWING SUPPORT

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
72 (DNLK): SRMS Elbow (-170, +20)	24: Tip Elbow (+20, 0) 22: Base Elbow (+160, -10)	71 (MON2): Camera D (-30, -10)	Camera C (+20, +10)	OBSS ITVC (+90, -50)

2.310 SSRMS NODE 3 RELEASE AND MANEUVER TO FI SUPPORT

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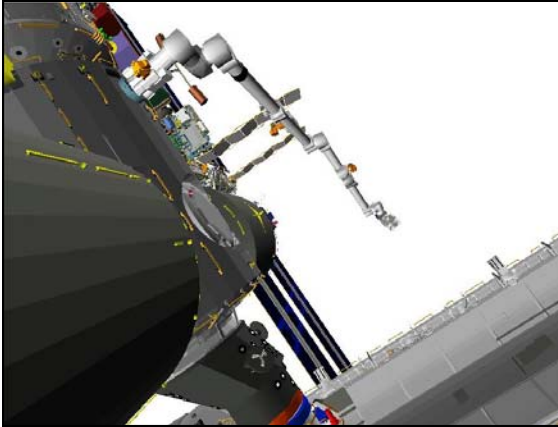


Figure 12.- Viewing Hover
(72: SRMS Elbow: -170, +20).

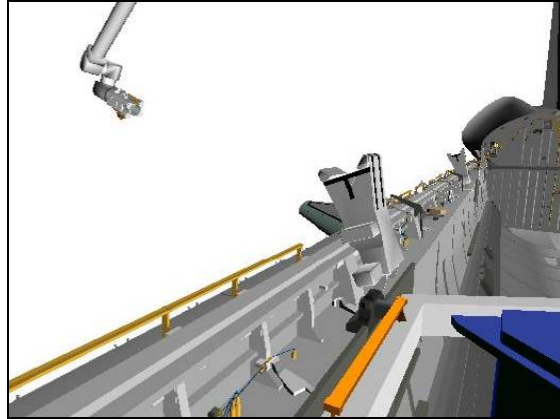


Figure 13.- Viewing Hover
(71: Camera D: -30, -10).

NOTE

Approximate clearances at the Viewing Support position:
 a) Tip Boom to Stbd PLBD: 121 cm (48 in).
 b) Base Elbow Camera to Columbus: 152 cm (60 in).
 c) Tip LEE to Stbd PLBD: 177 cm (70 in).

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 Viewing Support position (within 1 deg).

	SR	SY	SP	EP	WP	WY	WR
Viewing Hover	-15.0	+100.0	-90.0	+17.0	-58.9	-160.0	+10.0
1: SP +			-56.7				
Viewing Support	-15.0	+100.0	-56.7	+17.0	-58.9	-160.0	+10.0
	X	Y	Z	Pitch	Yaw	Roll	
	+2027	+624	+997	-107.8	-80.7	-18.9	
FOR	Unloaded – LEE Tip, SY Held						
Disp	ISS>ISSACS						

DCP

BRAKES SSRMS → ON (Verify ON)

Give SRMS operator GO to perform focused inspection.

2.310 SSRMS NODE 3 RELEASE AND MANEUVER TO FI SUPPORT

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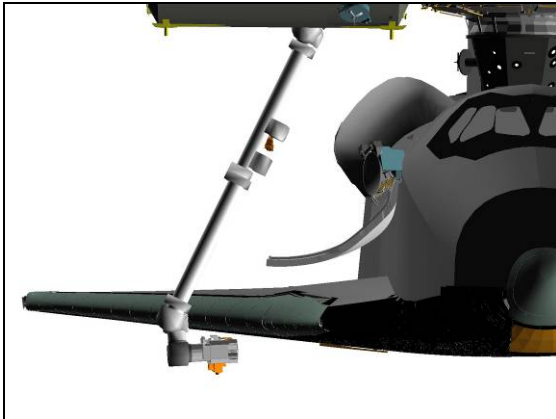


Figure 14.- Viewing Support Orbiter Forward.

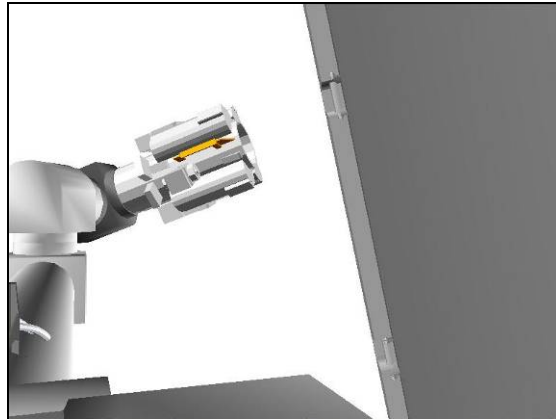


Figure 15.- Viewing Support (24: Tip Elbow: +20, 0).

7. FI SUPPORT

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: Positive WP, Positive WY

The Viewing Support position provides viewing for the mid area of the orbiter.

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
72 (DNLK): SRMS Elbow (-170, +20)	25: Tip LEE	24: Tip Elbow (+20, 0) 22: Base Elbow (+160, -10)	Camera C (+20, +10)	OBSS ITVC (+90, -50)

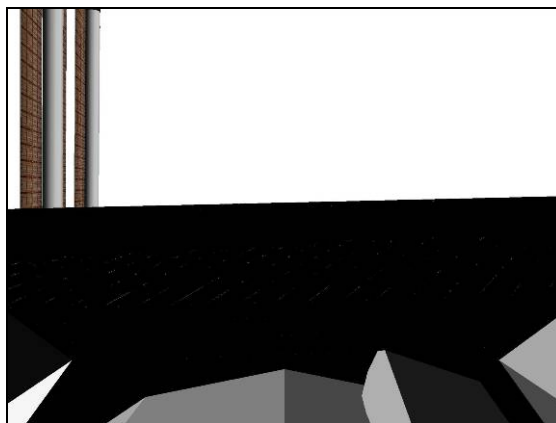


Figure 16.- Orbiter Mid Viewing Position (25: Tip LEE).

2.310 SSRMS NODE 3 RELEASE AND MANEUVER TO FI SUPPORT

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7.1 Viewing Aft Area of Orbiter with Tip LEE Camera (Optional)
 DCP BRAKES SSRMS → OFF (Verify OFF)

PCS MSS: SSRMS:

Enter Mode – Single (Verify blue)

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

If viewing the aft area of orbiter

THC

Survey Support
 1: WP +
 2: WY +
 Orbiter Aft

Perform Single Joint maneuver to Orbiter Aft Viewing position.

SR	SY	SP	EP	WP	WY	WR
-15.0	+100.0	-56.7	+17.0	-58.9	-160.0	+10.0
				-47.1		
					-98.4	
-15.0	+100.0	-56.7	+17.0	-47.1	-98.4	+10.0
X	Y	Z	Pitch	Yaw	Roll	
+2047	+699	+1100	-82.7	-19.8	-7.1	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>ISSACS					

DCP

BRAKES SSRMS → ON (Verify ON)

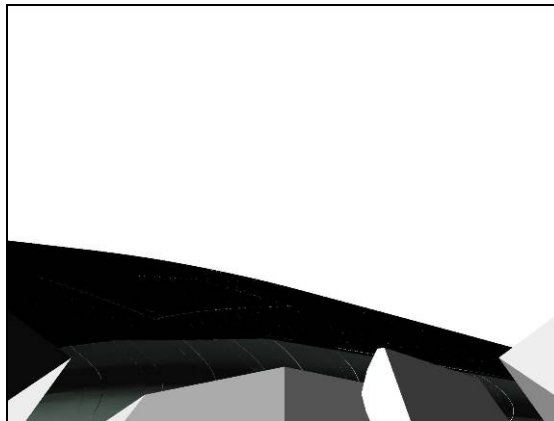


Figure 17.- Orbiter Aft Viewing Position
 (25: Tip LEE).

7.2 Viewing Forward Area of Orbiter with Tip LEE Camera (Optional)
 DCP BRAKES SSRMS → OFF (Verify OFF)

PCS MSS: SSRMS:

Enter Mode – Single (Verify blue)

2.310 SSRMS NODE 3 RELEASE AND MANEUVER TO FI SUPPORT

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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 the forward area of orbiter

THC

Perform Single Joint maneuver to Orbiter Forward Viewing position.

Survey Support
 1: WP –
 2: WY –
 Orbiter Forward

SR	SY	SP	EP	WP	WY	WR
-15.0	+100.0	-56.7	+17.0	-58.9	-160.0	+10.0
				-68.5		
					-204.2	
-15.0	+100.0	-56.7	+17.0	-68.5	-204.2	+10.0
X	Y	Z	Pitch	Yaw	Roll	
+2031	+661	+898	+92.0	-53.7	-178.3	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>ISSACS					

DCP

BRAKES SSRMS → ON (Verify ON)

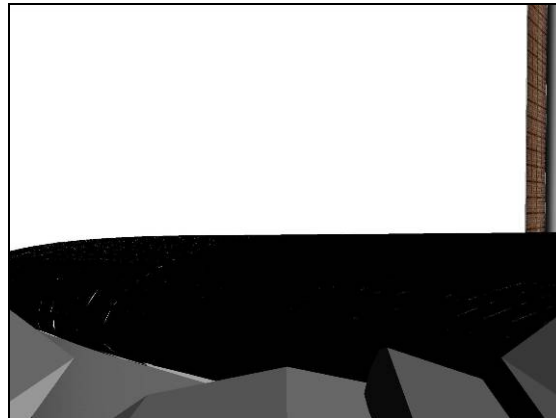


Figure 18.- Orbiter Forward Viewing Position
 (25: Tip LEE).

7.3 Returning to Viewing Support Position On SRMS operator GO, OBSS survey complete:

DCP

BRAKES SSRMS → OFF (Verify OFF)

PCS

MSS: SSRMS:

Enter Mode – Single (Verify blue)

2.310 SSRMS NODE 3 RELEASE AND MANEUVER TO FI SUPPORT

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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 WP not -58.9

DCP

JOINT SELECT → WRIST PITCH (Verify WP – Selected on PCS)

THC

Perform Single Joint maneuver to WP: -58.9.

If WY not -160.0

DCP

JOINT SELECT → WRIST YAW (Verify WY – Selected on PCS)

THC

Perform Single Joint maneuver to WY: -160.0.

DCP

JOINT SELECT → WRIST ROLL (Verify WR – Selected on PCS)

BRAKES SSRMS → ON (Verify ON)

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

SR	SY	SP	EP	WP	WY	WR
-15.0	+100.0	-56.7	+17.0	-58.9	-160.0	+10.0
X	Y	Z	Pitch	Yaw	Roll	
+2027	+624	+997	-107.8	-80.7	-18.9	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>ISSACS					

2.315 SSRMS MANEUVER FROM FI SUPPORT TO LAB PDGF

(RBT FS/20A/FIN 1/SPN) Page 1 of 9 pages

1. SETUP

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
72 (DNLK): SRMS Elbow (-170, +20)	24: Tip Elbow (+20, 0) 22: Base Elbow (+160, -10)	71 (MON2): Camera D (-30, -10)	Camera C (+20, +10)	OBSS ITVC (+90, -50)

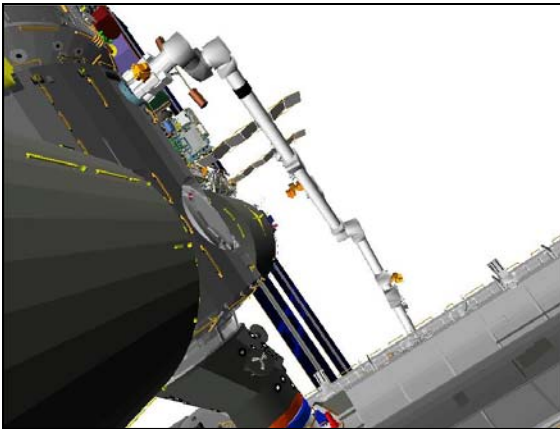


Figure 1.- Viewing Support
(72: SRMS Elbow: -170, +20).

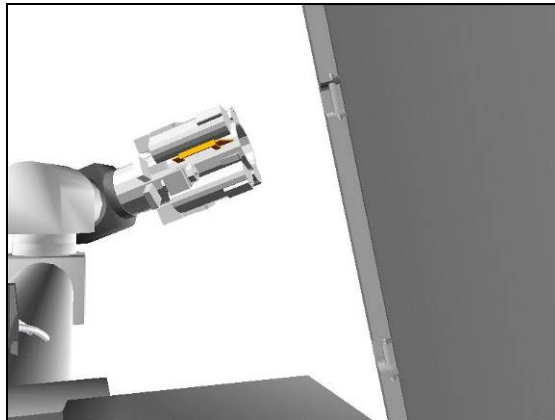


Figure 2.- Viewing Support
(24: Tip Elbow: +20, 0).

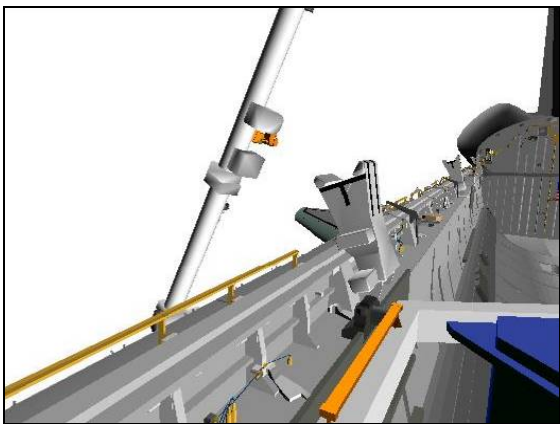


Figure 3.- Viewing Support
(71: Camera D: -30, -10).

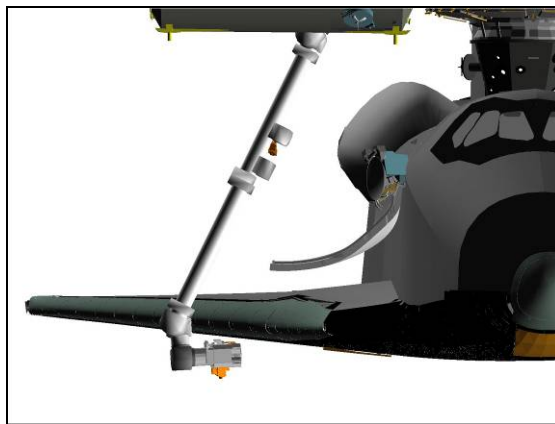


Figure 4.- Viewing Support
Orbiter Forward.

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

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

Verify Display – ISS>ISSACS

Verify Command – SSRMS>Internal

2.315 SSRMS MANEUVER FROM FI SUPPORT TO LAB PDGF

(RBT FS/20A/FIN 1/SPN) Page 2 of 9 pages

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

SR	SY	SP	EP	WP	WY	WR
-15.0	+100.0	-56.7	+17.0	-58.9	-160.0	+10.0
X	Y	Z	Pitch	Yaw	Roll	
+2027	+624	+997	-107.8	-80.7	-18.9	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>ISSACS					

2. JOINT OCAS MANEUVER TO VIEWING HOVER

NOTE

Approximate clearances at the Viewing Support position:

- a) Tip Boom to Stbd PLBD: 121 cm (48 in).
- b) Base Elbow Camera to Columbus: 152 cm (60 in).
- c) Tip LEE to Stbd PLBD: 177 cm (70 in).

The above clearances increase throughout the maneuver.

DCP BRAKES SSRMS → OFF (Verify OFF)

PCS MSS: SSRMS:

√Vernier

Enter Mode – Joint OCAS (Verify blue)

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

SR	SY	SP	EP	WP	WY	WR
-15.0	+100.0	-90.0	+17.0	-58.9	-150.0	+10.0

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)	-15.0	+100.0	-56.7	+17.0	-58.9	-160.0	+10.0
TGT	-15.0	+100.0	-90.0	+17.0	-58.9	-150.0	+10.0
ERR	0.0	0.0	+33.3	0.0	0.0	-10.0	0.0

2.315 SSRMS MANEUVER FROM FI SUPPORT TO LAB PDGF

(RBT FS/20A/FIN 1/SPN) Page 3 of 9 pages

```

*****
* 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
-15.0	+100.0	-90.0	+17.0	-58.9	-150.0	+10.0

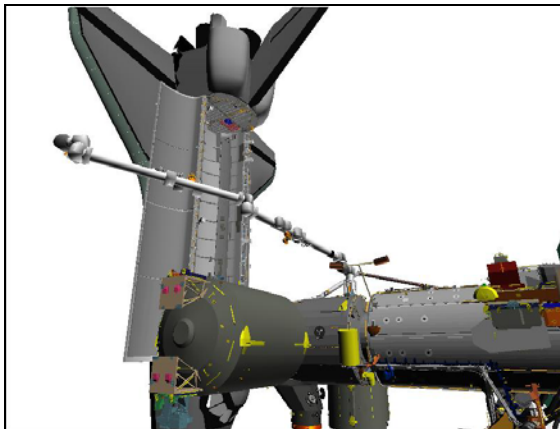


Figure 5.- Viewing Hover
(03: S1 Lower Outboard: +60, +20).

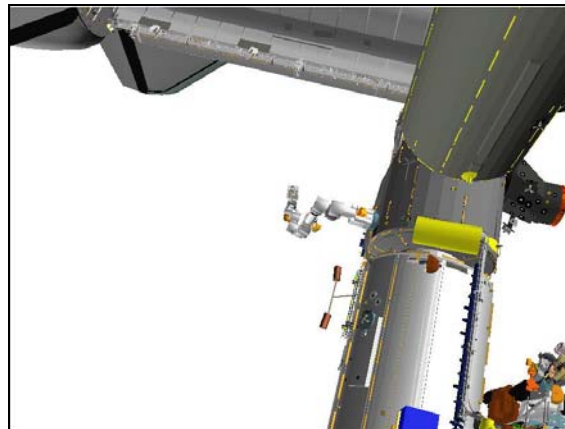


Figure 6.- Viewing Hover
(OBSS ITVC: +90, -50).

3. JOINT OCAS TO LAB RECONFIG

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
03: S1 Lower Outboard (+60, +20)	24: Tip Elbow (0, 0)	72 (DNLK): OBSS ITVC (+90, -50)	Camera C (+15, +30)	SRMS Elbow (+170, +60)

2.315 SSRMS MANEUVER FROM FI SUPPORT TO LAB PDGF

(RBT FS/20A/FIN 1/SPN) Page 4 of 9 pages

RHC RATE → COARSE (Verify Coarse on PCS)

NOTE
Maneuver duration is ~1.5 minutes.

PCS SSRMS Joint OCAS

pick File ► FI Support ► LAB Reconfig

Verify 'Joint Angles' 'Destination' for LAB Reconfig position.

SR	SY	SP	EP	WP	WY	WR
0.0	+162.2	-178.2	+110.0	+150.0	-160.0	-45.0

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)	-15.0	+100.0	-90.0	+17.0	-58.9	-150.0	+10.0
TGT	0.0	+162.2	-178.2	+110.0	+150.0	-160.0	-45.0
ERR	-15.0	-62.2	+88.2	-93.0	-208.9	+10.0	+55.0

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: SSRMS

Verify Posn Hold – orange

Verify Joint Angle values.

SR	SY	SP	EP	WP	WY	WR
0.0	+162.2	-178.2	+110.0	+150.0	-160.0	-45.0

2.315 SSRMS MANEUVER FROM FI SUPPORT TO LAB PDGF

(RBT FS/20A/FIN 1/SPN) Page 5 of 9 pages

4. JOINT OCAS TO LAB PRE-GRAPPLE

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+100, +15)	24: Tip Elbow (0, 0)	07: P1 Lower Inboard (+125, +35)	Camera C (-20, +40)	SRMS Elbow (+170, +60)

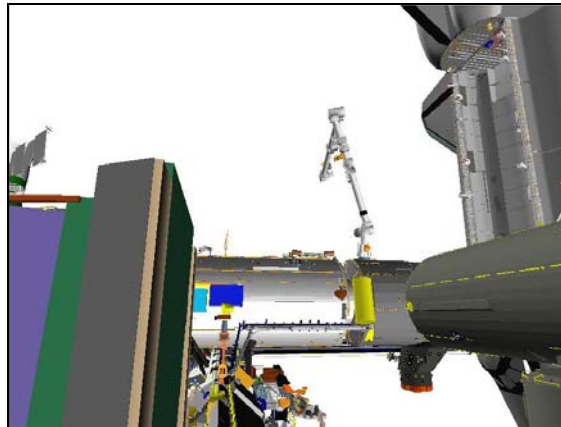


Figure 7.- LAB Reconfig
(09: P1 Lower Outboard: +100, +15).

RHC RATE → VERNIER (Verify Vernier on PCS)

NOTE Maneuver duration is ~4 minutes.

PCS SSRMS Joint OCAS

pick File ► Node 2 ► LAB Pre-Grapple

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

SR	SY	SP	EP	WP	WY	WR
+138.9	+162.2	-178.2	+153.7	+225.4	-178.3	-134.1

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)	0.0	+162.2	-178.2	+110.0	+150.0	-160.0	-45.0
TGT	+138.9	+162.2	-178.2	+153.7	+225.4	-178.3	-134.1
ERR	-138.9	0.0	0.0	-43.7	-75.4	+18.3	+89.1

2.315 SSRMS MANEUVER FROM FI SUPPORT TO LAB PDGF

(RBT FS/20A/FIN 1/SPN) Page 6 of 9 pages

```

*****
* 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

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

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

SR	SY	SP	EP	WP	WY	WR
+138.9	+162.2	-178.2	+153.7	+225.4	-178.3	-134.1
X	Y	Z	Pitch	Yaw	Roll	
-150	0	0	0.0	0.0	0.0	
FOR	Unloaded – LEE Tip, SY Held					
Disp	LAB>PDGF					

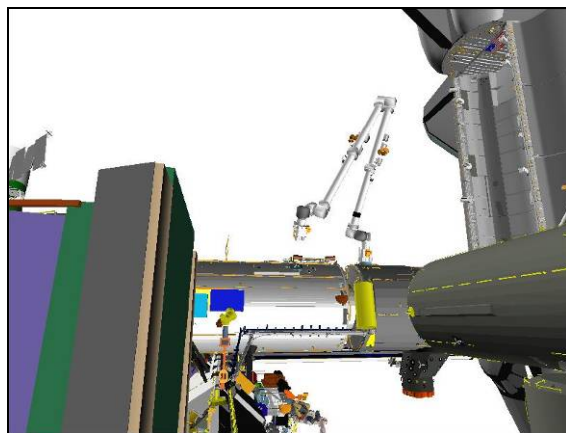


Figure 8.- LAB Pre-Grapple
(09: P1 Lower Outboard: +100, +15).

2.315 SSRMS MANEUVER FROM FI SUPPORT TO LAB PDGF

(RBT FS/20A/FIN 1/SPN) Page 7 of 9 pages

5. LAB PDGF CAPTURE

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+100, +15)	25: Tip LEE (Zoom full out)	07: P1 Lower Inboard (+125, +35)	Camera C (-20, +40)	SRMS Elbow (+140, +50)

5.1 LAB PDGF Grapple

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.

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).

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Auto Capture

RHC

TRIGGER → Press (momentarily)

PCS

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

Verify Capture to Latch – Yes (SCR 19282)

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

Verify 'Carriage' Retract – blue

Verify 'Latch' Latch – blue (65 s max)

2.315 SSRMS MANEUVER FROM FI SUPPORT TO LAB PDGF

(RBT FS/20A/FIN 1/SPN) Page 8 of 9 pages

5.2 Mating Umbilicals

Verify with **MCC-H** - Payload and PDGF power inhibits have been confirmed.

MSS: SSRMS: Tip LEE:

cmd 'Umbilical' Mate (Verify '**Confirm or Terminate**' prompt)

NOTE

Expect '**R3L - SSRMS Pwr Flags Fail ...**' message when mating umbilicals (SCR 19019).

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Mate

RHC TRIGGER → Press (momentarily)

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

5.3 Derigidizing 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)
Verify 'Carriage' Brakes – On (90 s max)

5.4 Grapple Cleanup

Verify Loaded Parameters – ✓

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

Expected LAB Grapple position:

SR	SY	SP	EP	WP	WY	WR
+138.2	+162.2	-153.0	+157.6	+196.0	-178.1	-134.7
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded – LAB PDGF, SR Held					
Disp	LAB>PDGF					

2.315 SSRMS MANEUVER FROM FI SUPPORT TO LAB PDGF

(RBT FS/20A/FIN 1/SPN) Page 9 of 9 pages

NOTE

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

DCP

SAFING → SAFE (Verify ON)

Notify **MCC-H**, GO for base change.

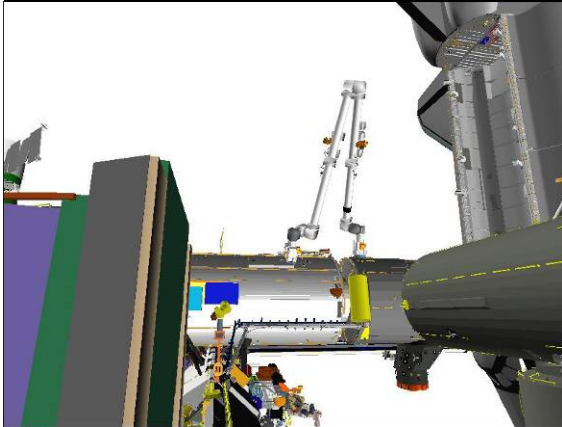


Figure 9.- LAB Grapple
(09: P1 Lower Outboard: +100, +15).

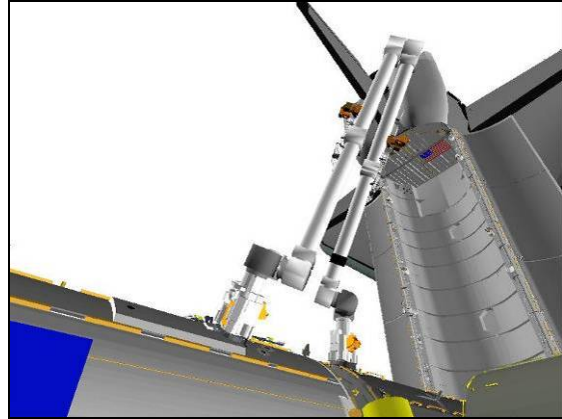


Figure 10.- LAB Grapple
(07: P1 Lower Inboard: +125, +35).

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2.666 CBM LATCH STALL RECOVERY

(RBT FS/20A/FIN 1)

Page 1 of 2 pages

1. SSRMS SAFING AND BRAKES STATUS

On CBM operator: "GO to perform 2.666 CBM LATCH STALL RECOVERY, all (SODF: RBT FS: CONTINGENCY) to pull CBM halves together," then:

PCS MSS: SSRMS:

√MSS 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 pull) for 5 seconds

PCS MSS: SSRMS:

Verify Posn Hold – orange

Enter Mode – Standby (Verify blue)

2.666 CBM LATCH STALL RECOVERY

(RBT FS/20A/FIN 1)

Page 2 of 2 pages

MSS: SSRMS: Limp:

cmd All Limp (Verify Limp – blue)

MSS: SSRMS:

Verify all joints – Limped

Give CBM operator: “GO to reattempt Second Stage Capture. SSRMS Mode to Limp complete.”

REFERENCE

REFERENCE

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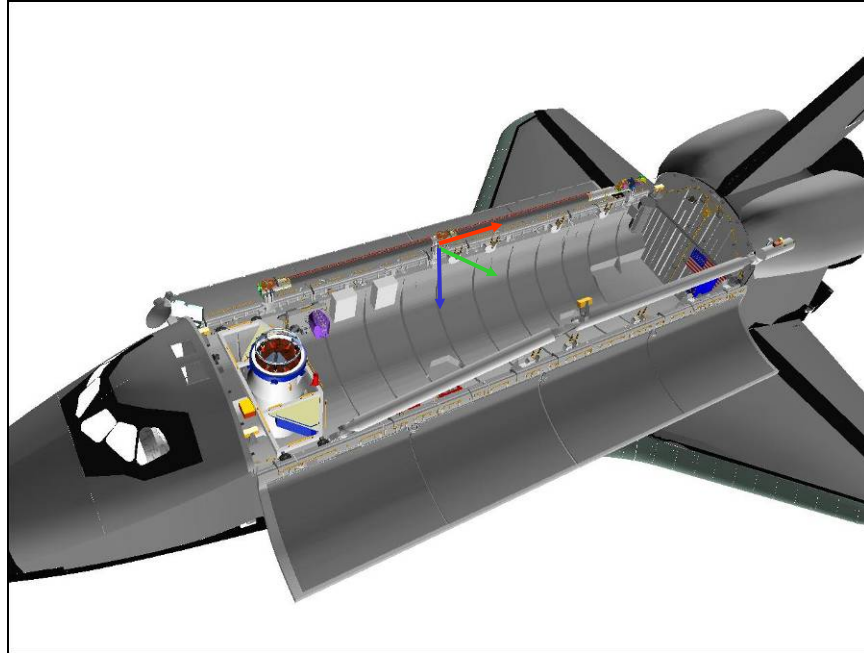


Figure 1.- OBSS Mid MPM FOR.

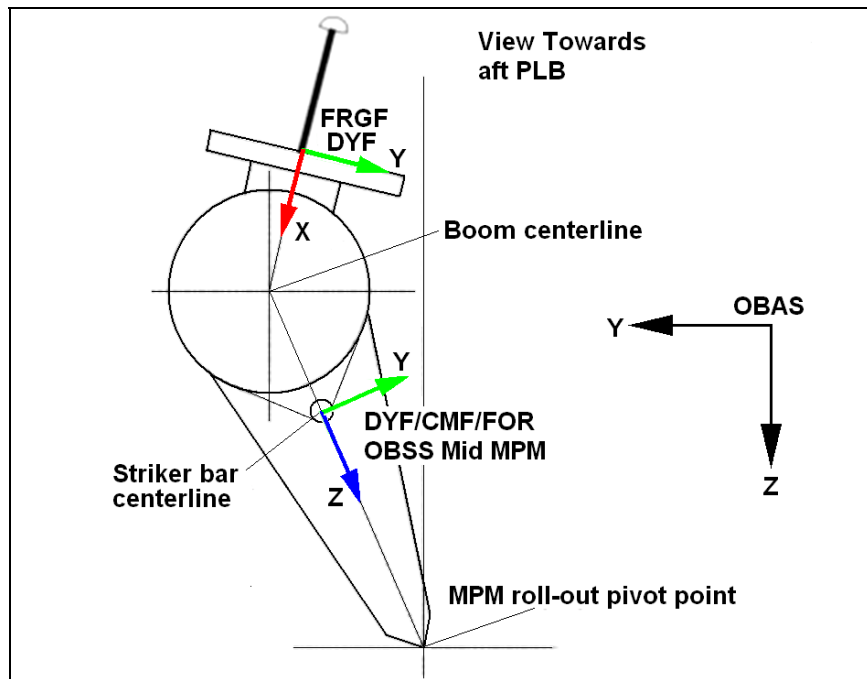


Figure 2.- OBSS Mid MPM Command Frame, Display Frame, and FOR.

Location:

Located at MID MRL, midpoint of OBSS striker bar centerline, when OBSS is deployed and berthed onto orbiter Stbd MPMs.

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3.200 FOR AND DISPLAY - NODE 3 UNBERTH

(RBT FS/20A/FIN 1)

Page 1 of 1 page

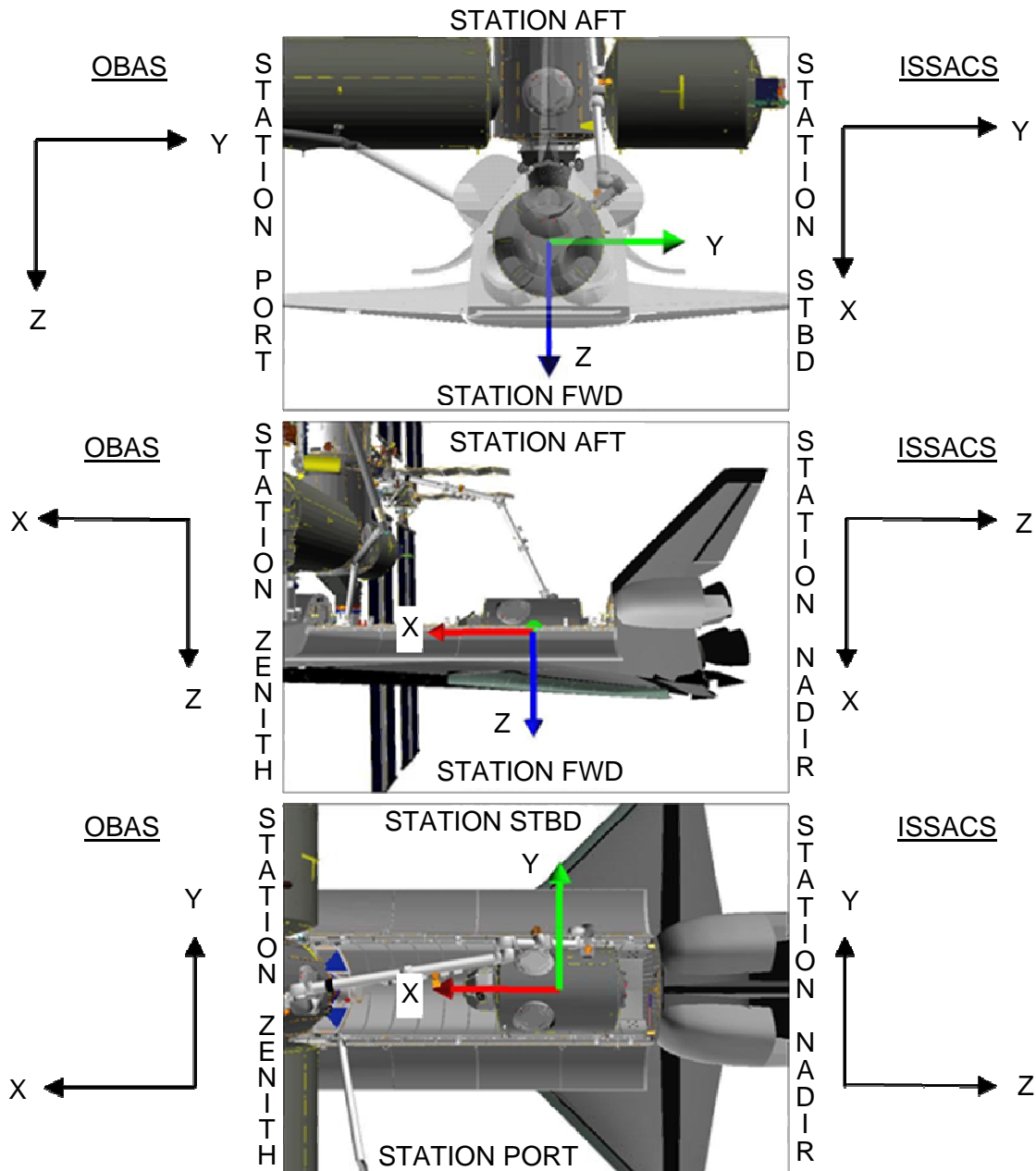


Figure 1.- Node 3 Unberth.

FOR: Node 3 Unberth
 Display: Orbiter>Node3 Unberth
 Command: ISS>OBAS

Location: Node 3 trunnion plane center, midway between FWD and AFT trunnion pins, at trunnion level, when Node 3 is berthed in Cargo Bay.
 Orientation: Matches OBAS when Node 3 is berthed in P/L Bay.

Table 1.

	Translational (cm/s)	Rotational (deg/s)
Coarse	2.37	0.20
Vernier	1.18	0.10

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3.210 FOR AND DISPLAY - NODE 3 INSTALL

(RBT FS/20A/FIN 1)

Page 1 of 1 page

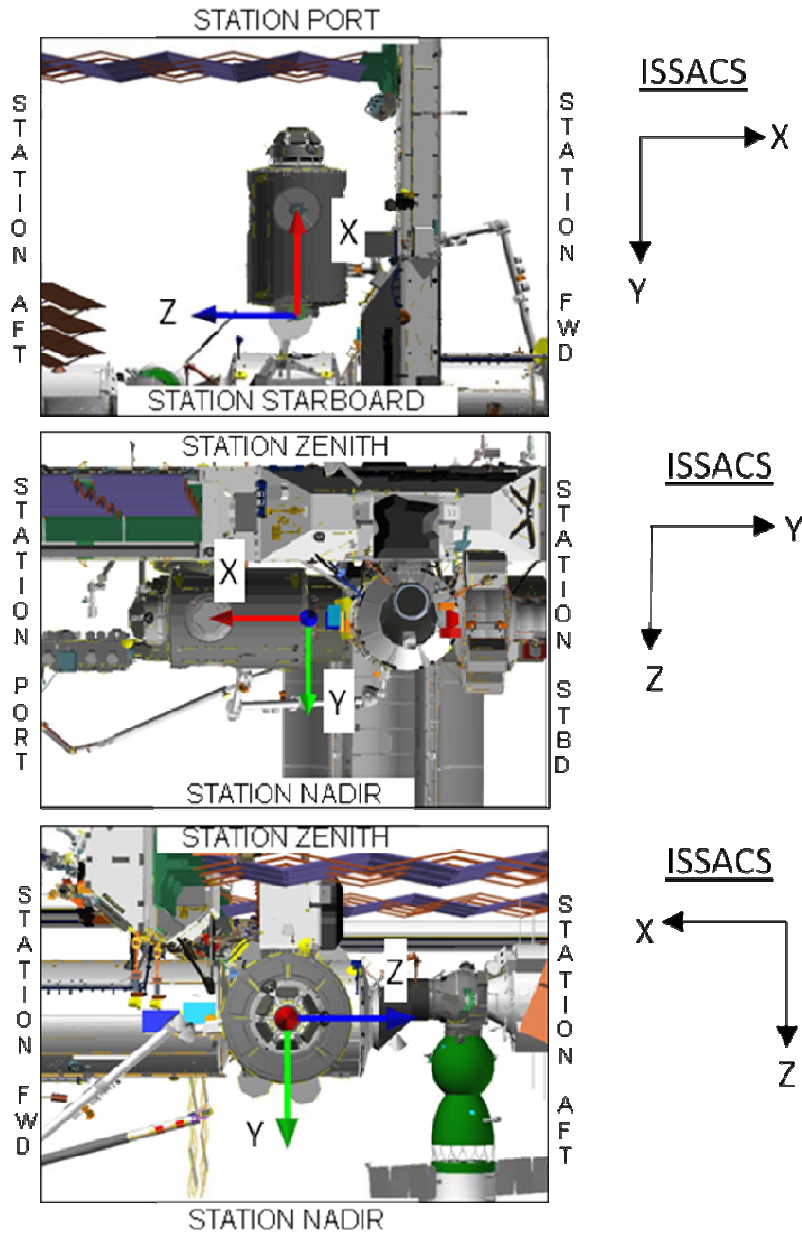


Figure 1.- Node 3 Install.

FOR: Node 3 Install CBCS

Display: Node1>Node3 Install CBCS

Command: SSRMS>Internal

Location: Node 3 CBM interface origin (geometric center).

Orientation: Matches the following when Node 3 is fully mated to Node 1 Port CBM:

$$+X = -Y_{ISSACS}, +Y = +Z_{ISSACS}, +Z = -X_{ISSACS}$$

Table 1.

	Translational (cm/s)	Rotational (deg/s)
Coarse	2.37	0.20
Vernier	1.18	0.10

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3.300 FOR AND DISPLAY - CUPOLA DEMATE

(RBT FS/20A/FIN 1)

Page 1 of 1 page

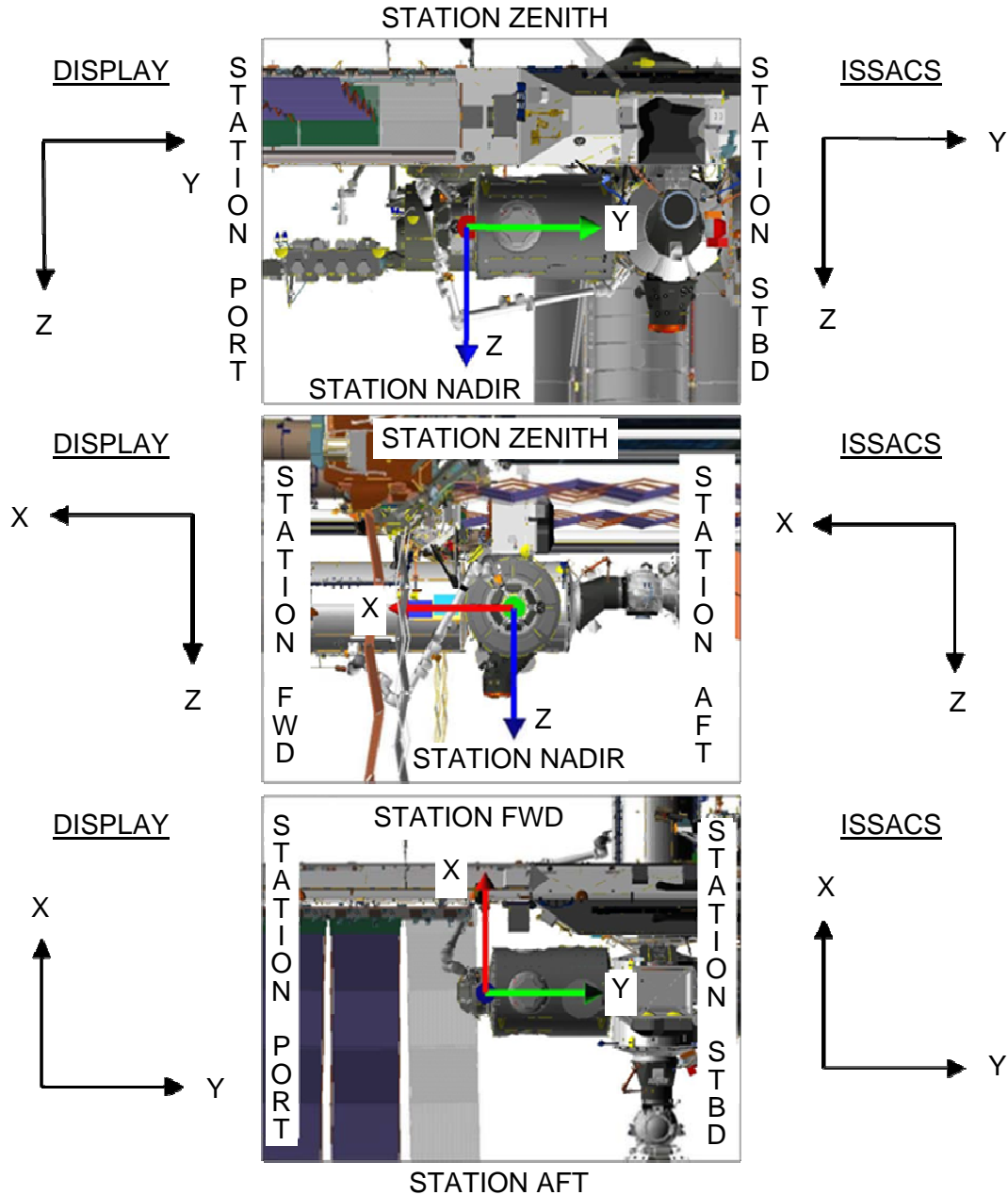


Figure 1.- Cupola Demate.

FOR: Cupola Demate

Display: Node3>Cuploa Demate

Command: Node3>Cupola Demate

Location: Cupola CBM interface origin (geometric center) when Cupola is fully mated to Node 3 Port CBM.

Orientation: Aligned with ISSACS when Cupola is fully mated to Node 3 Port CBM.

Table 1.

	Translational (cm/s)	Rotational (deg/s)
Coarse	5.67	0.47
Vernier	2.84	0.24

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3.310 FOR AND DISPLAY - CUPOLA INSTALL

(RBT FS/20A/FIN 1)

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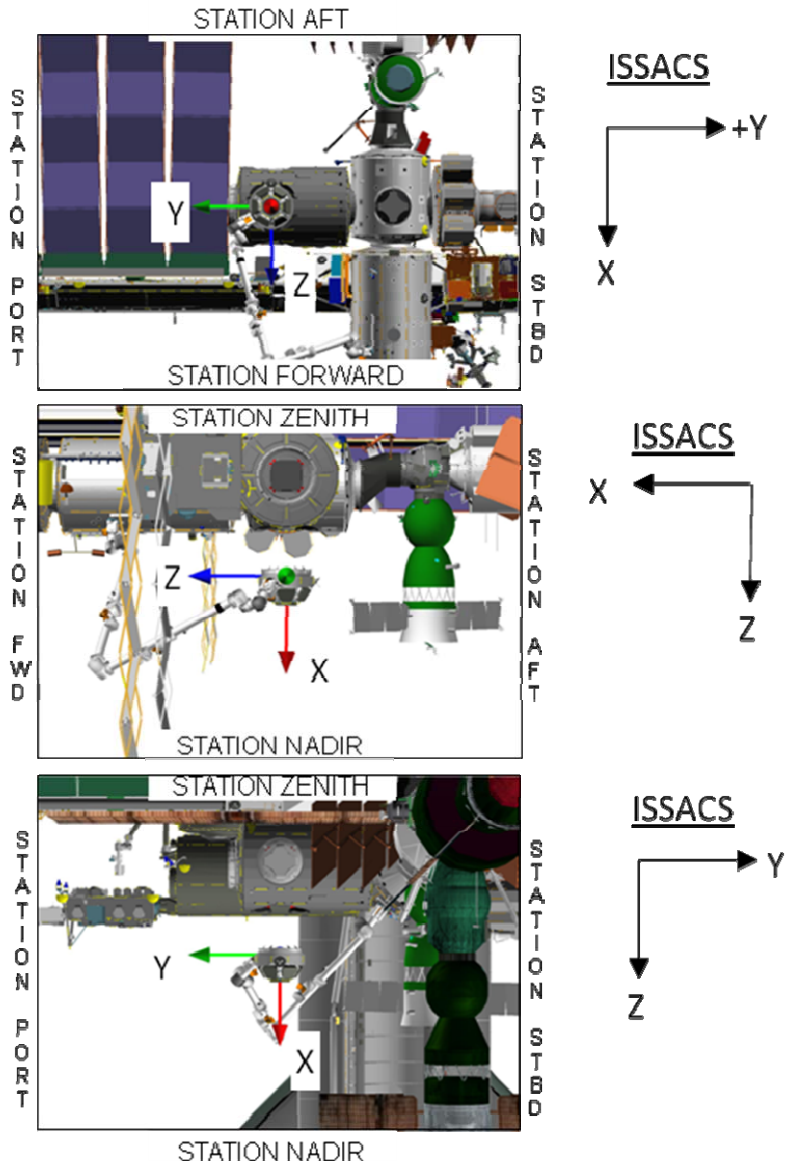


Figure 1.- Cupola Install.

FOR: Cupola Install CBCS

Display: Node3>Cupola Install CBCS

Command: Node3>Cupola Install CBCS

Location: Cupola CBM interface origin (geometric center) when Cupola is fully mated to Node 3 Nadir CBM.

Orientation: Matches the following when Cupola is fully mated to Node 3 Nadir CBM:

$$+X = +Z_{ISSACS}, +Y = -Y_{ISSACS}, +Z = +X_{ISSACS}$$

Table 1.

	Translational (cm/s)	Rotational (deg/s)
Coarse	5.67	0.47
Vernier	2.84	0.24

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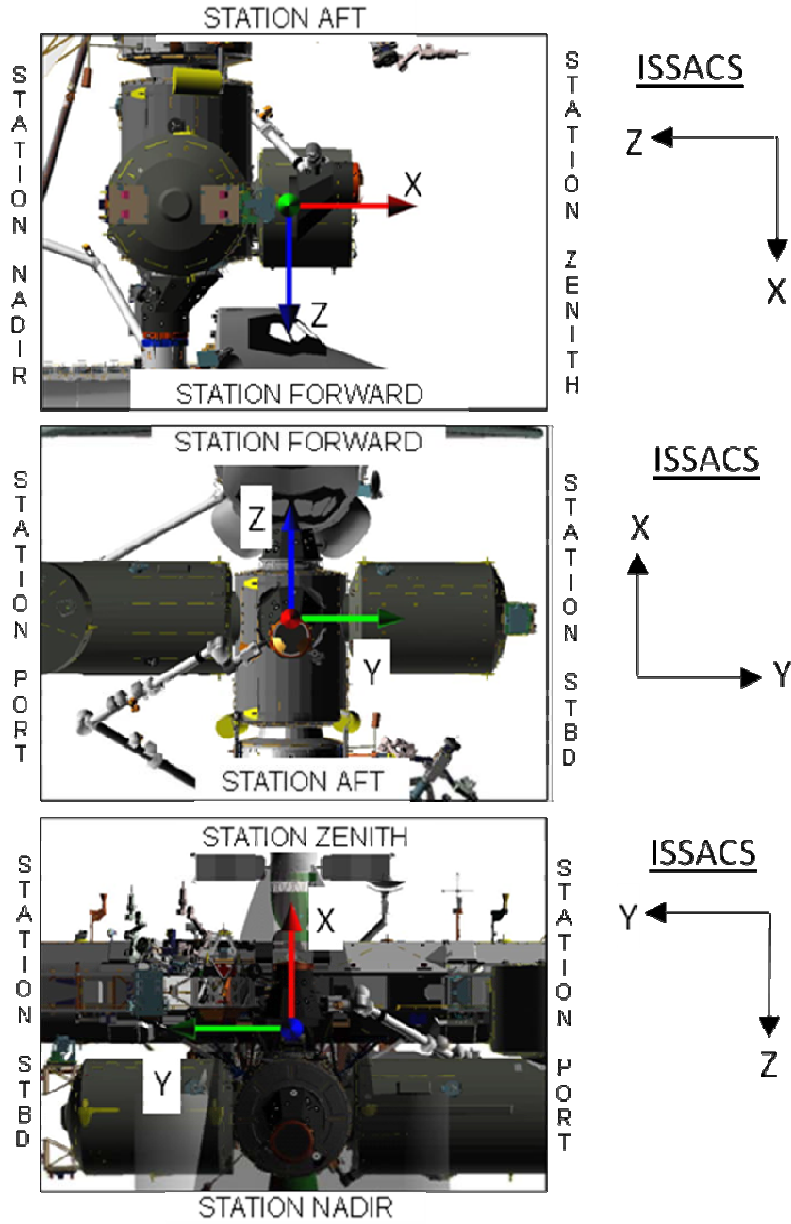


Figure 1.- PMA 3 Demate.

FOR: PMA3 Mate BCS
 Display: Node2>PMA3 Zen Mate BCS
 Command: SSRMS>Internal

Location: PMA3 CBM interface origin (geometric center).
 Orientation: Matches the following when PMA3 is fully mated to Node 2 Zenith CBM:
 $+X = -Z_{ISSACS}$, $+Y = +Y_{ISSACS}$, $+Z = +X_{ISSACS}$

Table 1.

	Translational (cm/s)	Rotational (deg/s)
Coarse	6.6	0.54
Vernier	3.3	0.27

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3.330 FOR AND DISPLAY - PMA 3 INSTALL

(RBT FS/20A/FIN)

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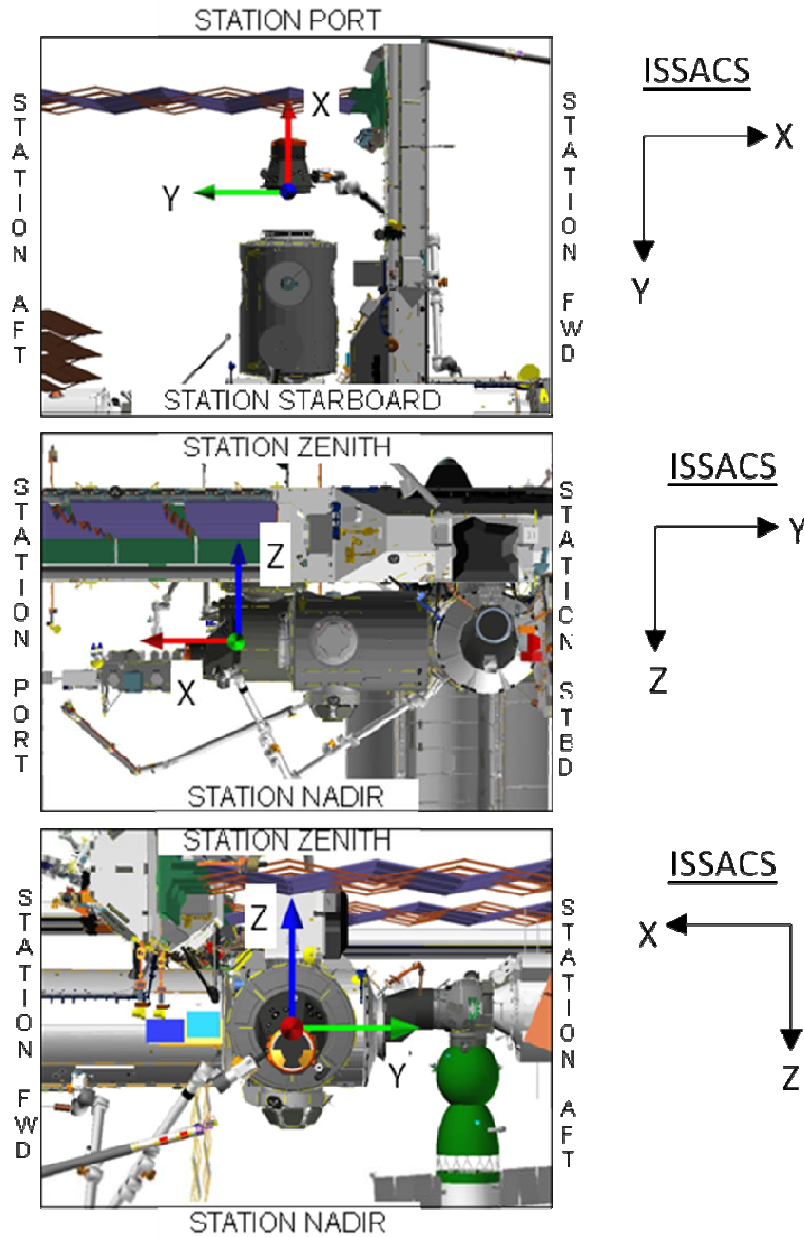


Figure 1.- PMA 3 Install.

FOR: PMA3 Mate BCS

Display: Node3>PMA3 Port Mate BCS

Command: SSRMS>Internal

Location: PMA3 CBM interface origin (geometric center).

Orientation: Matches the following when PMA3 is fully mated to Node 3 Port CBM:

$$+X = -Y_{ISSACS}, +Y = -X_{ISSACS}, +Z = -Z_{ISSACS}$$

Table 1.

	Translational (cm/s)	Rotational (deg/s)
Coarse	6.6	0.54
Vernier	3.3	0.27

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3.400 NODE 3 CBM RTL REFERENCE SHEET

(RBT FS/20A/FIN 1)

Page 1 of 1 page

OBJECTIVE:

Node 3 Install on Node 1 Port.

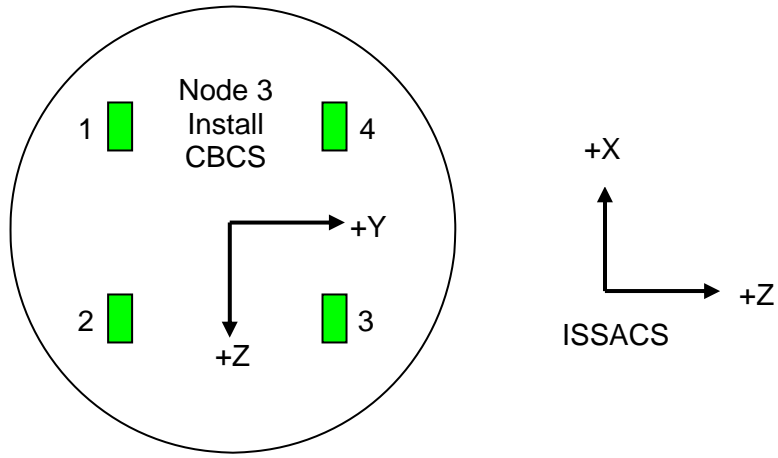


Figure 1.- Node 3 Install CBCS RTL Diagram.

Table 1.- Node 3 Install CBCS Missing RTL Configuration (Refer to Figure 1.)

Missing RTLs	RHC Input*
1	+ Pitch, - Yaw
2	- Pitch, - Yaw
3	- Pitch, + Yaw
4	+ Pitch, + Yaw
1,2	- Yaw
3,4	+ Yaw
1,4	+ Pitch
2,3	- Pitch

* All inputs with respect to Node 3 Install CBCS FOR.

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3.410 CUPOLA CBM RTL REFERENCE SHEET

(RBT FS/20A/FIN 1)

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OBJECTIVE:

Cupola Install on Node 3 Nadir.

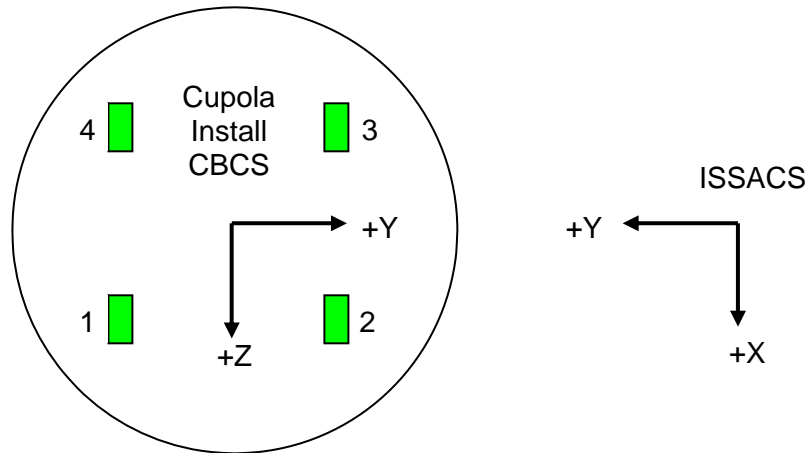


Figure 1.- Cupola Install CBCS RTL Diagram.

Table 1. Cupola Install CBCS Missing RTL Configuration
(Refer to Figure 1.)

Missing RTLs	RHC Input*
1	- Pitch, - Yaw
2	- Pitch, + Yaw
3	+ Pitch, + Yaw
4	+ Pitch, - Yaw
1,2	- Pitch
3,4	+ Pitch
1,4	- Yaw
2,3	+ Yaw

* All inputs with respect to Cupola Install CBCS FOR.

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3.420 PMA3 CBM RTL REFERENCE SHEET

(RBT FS/20A/FIN)

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OBJECTIVE:

PMA3 Install on Node 3 Port.

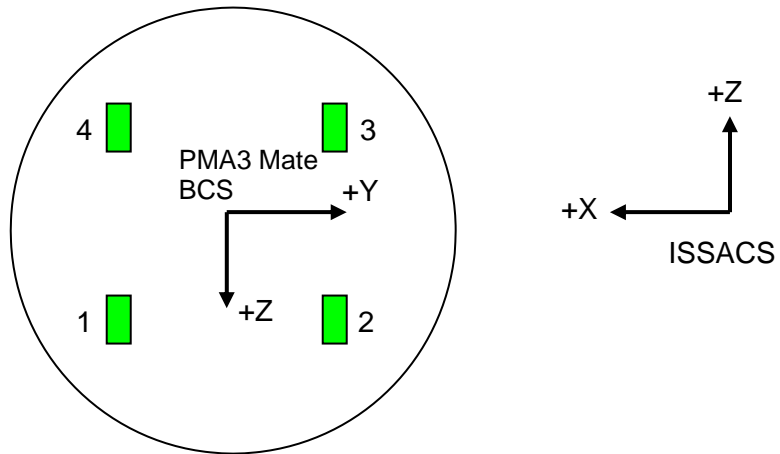


Figure 1.- RTL Locations Viewed from CBCS Camera.

Table 1. PMA3 BCS Install RTL Configuration (Refer to Figure 1).

Missing RTL's	RHC Input*
1	- Pitch & - Yaw
2	- Pitch & + Yaw
3	+ Pitch & + Yaw
4	+Pitch & - Yaw
1,4	-Yaw
1,2	-Pitch
2,3	+Yaw
3,4	+Pitch

* All inputs with respect to PMA3 Mate BCS FOR frame.

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3.500 OBSS BERTHING ALIGNMENT CUES

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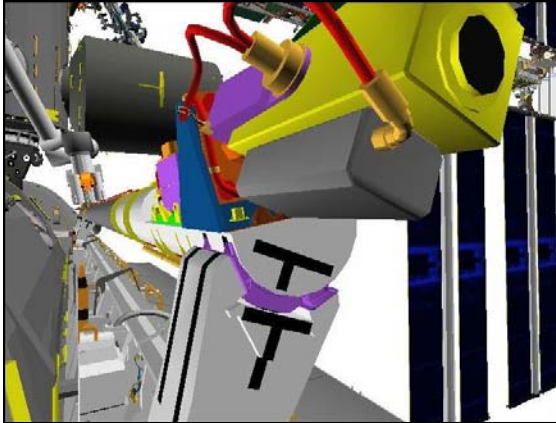


Figure 1.- OBSS Latched
Aft MPM
(Camera C: +30, 0).

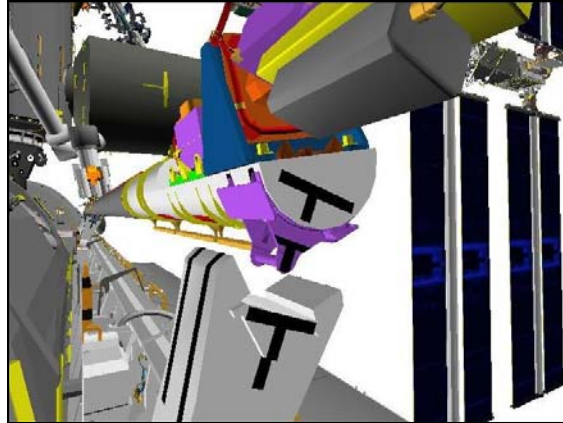


Figure 2.- OBSS 15 cm from Latched
Aft MPM
(Camera C: +30, 0).

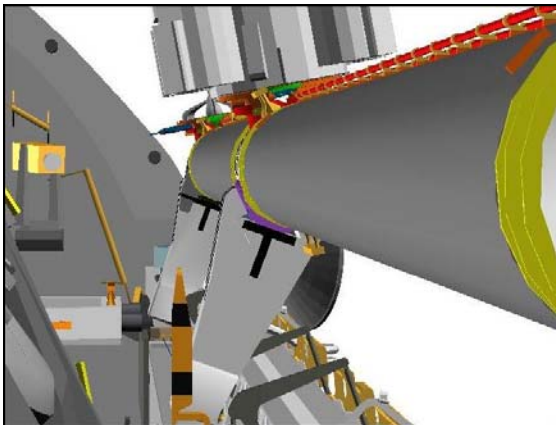


Figure 3.- OBSS Latched
Mid and Fwd MPM
(Camera C: +2, -1).

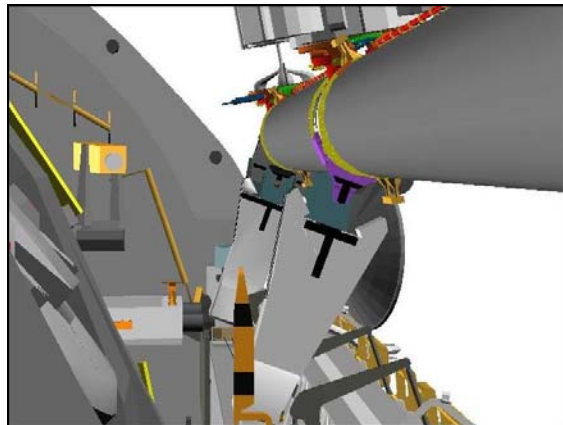


Figure 4.- OBSS 15 cm from Latched
Mid and Fwd MPM
(Camera C: +2, -1).

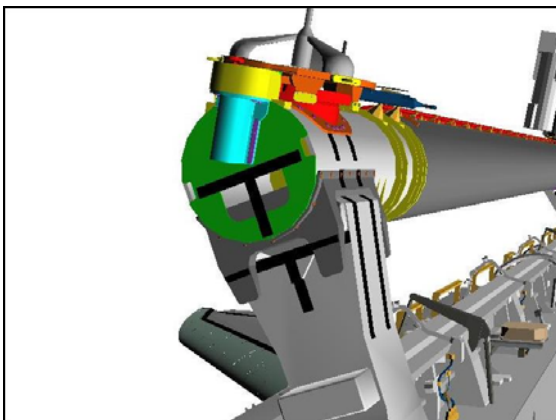


Figure 5.- OBSS Latched
Fwd MPM
(Camera D: -22, -3).

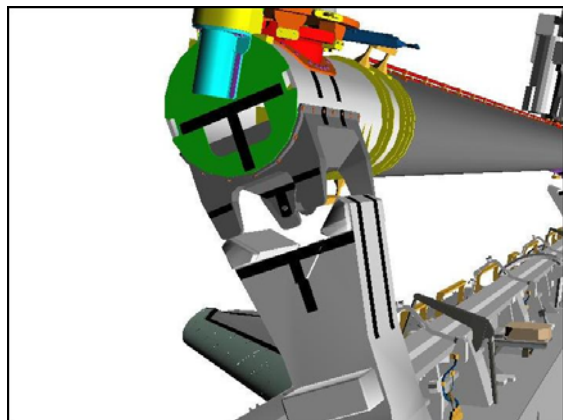


Figure 6.- OBSS 15 cm from Latched
Fwd MPM
(Camera D: -22, -3).

3.500 OBSS BERTHING ALIGNMENT CUES

(RBT FS/20A/FIN 1) Page 2 of 2 pages

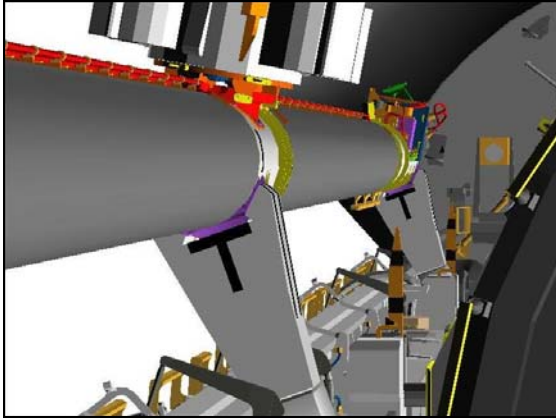


Figure 7.- OBSS Latched
Mid and Aft MPM
(Camera D: -5, -1).

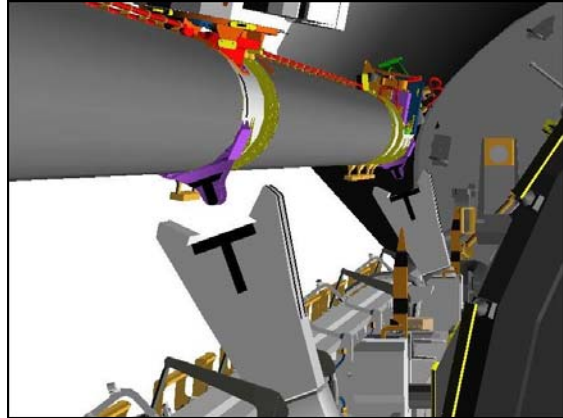


Figure 8.- OBSS 15 cm from Latched
Mid and Aft MPM
(Camera D: -5, -1).

3.600 NODE 3 PRLA CONFIGURATION
(RBT FS/20A/FIN 1) Page 1 of 1 page

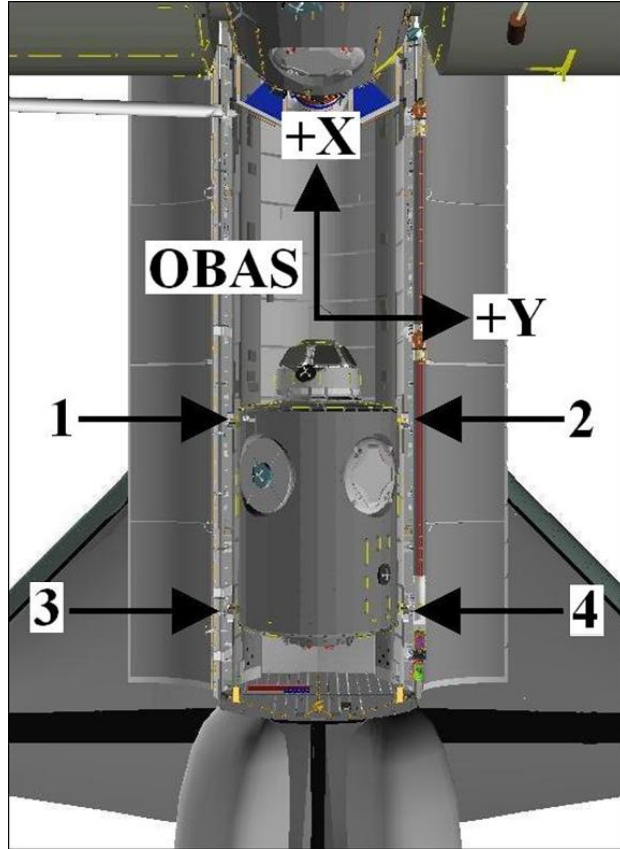


Figure 1.- Node 3 PRLA Configuration.

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3.700 PUBLISHED POSITIONS

(RBT FS/20A/FIN 1)

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1.110 OBSS UNBERTH AND HANDOFF

Docking

SR	SY	SP	EP	WP	WY	WR
+90.1	+210.1	-139.5	-111.5	-109.3	-110.8	+210.6
X	Y	Z	Pitch	Yaw	Roll	
-557	-341	-261	-0.7	-79.4	-61.0	
FOR	Unloaded – LEE Tip, SR Held					
Disp	Orbiter>OBSS FRGF					

OBSS Pre-Grapple

SR	SY	SP	EP	WP	WY	WR
+74.6	+217.3	-161.0	-112.7	-162.3	-158.0	+210.6
X	Y	Z	Pitch	Yaw	Roll	
-150	0	0	0.0	0.0	0.0	
FOR	Unloaded – LEE Tip, SR Held					
Disp	Orbiter>OBSS FRGF					

OBSS Grappled in Payload Bay

SR	SY	SP	EP	WP	WY	WR
+74.6	+222.7	-171.9	-100.2	-161.8	-159.4	+216.1
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded – OBSS Mid MPM, SR Held					
Disp	Orbiter>OBSS Mid MPM					

OBSS Low Hover

SR	SY	SP	EP	WP	WY	WR
+74.6	+223.7	-159.4	-109.2	-165.0	-159.7	+217.2
X	Y	Z	Pitch	Yaw	Roll	
0	0	-150	0.0	0.0	0.0	
FOR	Loaded – OBSS Mid MPM, SR Held					
Disp	Orbiter>OBSS Mid MPM					

OBSS Intermediate

SR	SY	SP	EP	WP	WY	WR
+74.6	+225.7	-155.7	-83.5	-193.6	-160.3	+219.3
X	Y	Z	Pitch	Yaw	Roll	
+250	-200	-300	0.0	0.0	0.0	
FOR	Loaded – OBSS Mid MPM, SR Held					
Disp	Orbiter>OBSS Mid MPM					

3.700 PUBLISHED POSITIONS

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OBSS Handoff

SR	SY	SP	EP	WP	WY	WR
+74.6	+164.8	-155.8	-101.5	-184.7	-160.0	+68.3
X	Y	Z	Pitch	Yaw	Roll	
+401	+684	-157	+91.5	-70.6	+47.6	
FOR	Loaded – OBSS Mid MPM, SR Held					
Disp	Orbiter>OBSS Mid MPM					

OBSS Backoff

SR	SY	SP	EP	WP	WY	WR
+74.6	+160.7	-144.0	-109.6	-189.9	-159.5	+63.9
X	Y	Z	Pitch	Yaw	Roll	
+1062	-307	+1575	-12.8	+0.1	+89.7	
FOR	Unloaded – LEE Tip, SR Held					
Disp	ISS>ISSACS					

Park

SR	SY	SP	EP	WP	WY	WR
+90.1	+210.1	-139.5	-111.5	-109.3	-110.8	+89.8
X	Y	Z	Pitch	Yaw	Roll	
+965	+501	+1520	-96.1	+90.0*	+96.1	
FOR	Unloaded – LEE Tip, SR Held					
Disp	ISS>ISSACS					

*Display Singularity

1.210 SSRMS BERTHED NODE 3 GRAPPLE

Node 3 Pre-Grapple

SR	SY	SP	EP	WP	WY	WR
+90.1	+205.3	-185.4	-56.4	-48.7	+48.9	+115.0
X	Y	Z	Pitch	Yaw	Roll	
-150	0	0	0.0	0.0	0.0	
FOR	Unloaded – LEE Tip, SR Held					
Disp	Orbiter>Berthed Node 3 GF					

Node 3 Grappled

SR	SY	SP	EP	WP	WY	WR
+90.1	+199.3	-192.1	-52.8	-38.7	+50.7	+106.0
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded – Node3 Unberth, SR Held					
Disp	Orbiter> Node3 Unberth					

3.700 PUBLISHED POSITIONS

(RBT FS/20A/FIN 1)

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1.220 SSRMS NODE 3 UNBERTH TO INSTALL

Node 3 Low Hover

SR	SY	SP	EP	WP	WY	WR
+90.1	+199.1	-147.1	-87.7	-48.7	+50.7	+105.8
X	Y	Z	Pitch	Yaw	Roll	
0	0	-600	0.0	0.0	0.0	
FOR	Loaded – Node3 Unberth, SR Held					
Disp	Orbiter>Node3 Unberth					

Node 3 Port Hover

SR	SY	SP	EP	WP	WY	WR
+90.1	+161.6	-151.0	-85.2	-3.9	+44.7	+49.4
X	Y	Z	Pitch	Yaw	Roll	
0	-700	-600	0.0	0.0	0.0	
FOR	Loaded – Node3 Unberth, SR Held					
Disp	Orbiter>Node3 Unberth					

Node 3 Intermediate

SR	SY	SP	EP	WP	WY	WR
+128.9	+132.9	-140.9	-21.4	+16.3	-19.1	+64.6
X	Y	Z	Pitch	Yaw	Roll	
-73	-1572	-993	-97.0	-9.7	-5.1	
FOR	Loaded – Node3 Unberth, SR Held					
Disp	Orbiter>Node3 Unberth					

Node 3 Radiator Hold

SR	SY	SP	EP	WP	WY	WR
+128.9	+132.9	-140.9	+68.4	+16.3	-19.1	+64.6
X	Y	Z	Pitch	Yaw	Roll	
+500	+500	0	0.0	0.0	0.0	
FOR	Loaded – Node3 Install CBCS, SY Held					
Disp	Node1>Node3 Install CBCS					

Node 3 Pre-Install

SR	SY	SP	EP	WP	WY	WR
+153.2	+132.9	-106.4	+89.3	-15.7	-30.7	+77.6
X	Y	Z	Pitch	Yaw	Roll	
+200	0	0	0.0	0.0	0.0	
FOR	Loaded – Node3 Install CBCS, SY Held					
Disp	Node1>Node3 Install CBCS					

3.700 PUBLISHED POSITIONS

(RBT FS/20A/FIN 1)

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Node 3 Ready-to-Latch

SR	SY	SP	EP	WP	WY	WR
+149.3	+132.9	-105.3	+99.4	-30.9	-29.2	+75.0
X	Y	Z	Pitch	Yaw	Roll	
+11	0	0	0.0	0.0	0.0	
FOR	Loaded – Node3 Install CBCS, SY Held					
Disp	Node1>Node3 Install CBCS					

Node 3 Installed at Node 1 Port

SR	SY	SP	EP	WP	WY	WR
+149.0	+132.9	-105.2	+99.8	-31.8	-29.0	+74.9
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded – Node3 Install CBCS, SY Held					
Disp	Node1>Node3 Install CBCS					

1.310 SSRMS NODE 3 RELEASE AND WALKOFF TO LAB PDGF (NO FI)

Node 3 Backoff

SR	SY	SP	EP	WP	WY	WR
+152.7	+132.9	-106.1	+105.6	-32.8	-30.5	+77.2
X	Y	Z	Pitch	Yaw	Roll	
-65	0	0	0.0	0.0	0.0	
FOR	Unloaded – LEE Tip, SY Held					
Disp	Node1>Node3 Mated GF					

LAB Clearance

SR	SY	SP	EP	WP	WY	WR
+146.3	+132.9	-134.1	+109.1	-14.8	-27.9	+73.2
X	Y	Z	Pitch	Yaw	Roll	
-200	+200	+200	0.0	0.0	0.0	
FOR	Unloaded – LEE Tip, SY Held					
Disp	Node1>Node3 Mated GF					

LAB Pre-Grapple

SR	SY	SP	EP	WP	WY	WR
+138.9	+162.2	-178.2	+153.7	+225.4	-178.3	-134.1
X	Y	Z	Pitch	Yaw	Roll	
-150	0	0	0.0	0.0	0.0	
FOR	Unloaded – LEE Tip, SY Held					
Disp	LAB>PDGF					

3.700 PUBLISHED POSITIONS

(RBT FS/20A/FIN 1)

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LAB Grappled

SR	SY	SP	EP	WP	WY	WR
+138.2	+162.2	-153.0	+157.6	+196.0	-178.1	-134.7
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded – LAB PDGF, SR Held					
Disp	LAB>PDGF					

1.320 SSRMS NODE 2 RELEASE AND MANEUVER TO OVERNIGHT PARK

Node 2 Backoff

SR	SY	SP	EP	WP	WY	WR
-129.0	+178.1	+174.0	+153.0	-124.5	-164.3	+143.8
X	Y	Z	Pitch	Yaw	Roll	
-150	0	0	0.0	0.0	0.0	
FOR	Unloaded – LEE Tip, SY Held					
Disp	Node2>PDGF					

Node 3 Clearance

SR	SY	SP	EP	WP	WY	WR
+56.7	+178.1	+174.0	+108.0	-28.7	-133.5	+150.0
X	Y	Z	Pitch	Yaw	Roll	
-324	+950	-741	-108	+14.5	+161.1	
FOR	Unloaded – LEE Tip, SY Held					
Disp	Node2>PDGF					

Overnight Park

SR	SY	SP	EP	WP	WY	WR
+56.7	+215.0	+208.0	+45.2	-28.7	-133.5	+150.0
X	Y	Z	Pitch	Yaw	Roll	
-216	+1513	-871	-63.4	-0.1	+153.3	
FOR	Unloaded – LEE Tip, SY Held					
Disp	Node2>PDGF					

1.410 SSRMS CUPOLA RELOCATE

Clearance

SR	SY	SP	EP	WP	WY	WR
+66.7	+170.0	+229.4	+45.2	-28.7	-133.5	+150.0
X	Y	Z	Pitch	Yaw	Roll	
-235	+52	-270	-13.3	-10.6	16.9	
FOR	Unloaded – LEE Tip, SY Held					
Disp	Node3>CUP Port Mated GF					

3.700 PUBLISHED POSITIONS

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Cupola Pre-Grapple

SR	SY	SP	EP	WP	WY	WR
+66.7	+170.0	+229.4	+70.0	-28.7	-133.5	+150.0
X	Y	Z	Pitch	Yaw	Roll	
-150	0	0	0.0	0.0	0.0	
FOR	Unloaded – LEE Tip, SY Held					
Disp	Node3>CUP Port Mated GF					

Cupola Grapple at Node 3 Port

SR	SY	SP	EP	WP	WY	WR
+61.1	+170.0	+222.5	+80.8	-33.5	-128.0	+150.0
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded – Cupola Demate, SY Held					
Disp	Node3>Cupola Demate					

Cupola Demate

SR	SY	SP	EP	WP	WY	WR
+63.6	+170.0	+228.4	+59.1	-17.3	-130.4	+150.0
X	Y	Z	Pitch	Yaw	Roll	
0	-200	0	0.0	0.0	0.0	
FOR	Loaded – Cupola Demate, SY Held					
Disp	Node3>Cupola Demate					

Cupola Intermediate

SR	SY	SP	EP	WP	WY	WR
+52.0	+170.0	+200.4	+58.4	-51.4	-139.4	+118.4
X	Y	Z	Pitch	Yaw	Roll	
0	-250	+450	0.0	0.0	-45.0	
FOR	Loaded – Cupola Demate, SY Held					
Disp	Node3>Cupola Demate					

Cupola Pre-Install

SR	SY	SP	EP	WP	WY	WR
+31.7	+170.0	+174.6	+108.2	-117.8	-171.3	+99.9
X	Y	Z	Pitch	Yaw	Roll	
+200	0	0	0.0	0.0	0.0	
FOR	Loaded – Cupola Install CBCS, SY Held					
Disp	Node3>Cupola Install CBCS					

3.700 PUBLISHED POSITIONS

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Cupola Ready-To-Latch Position

SR	SY	SP	EP	WP	WY	WR
+40.5	+170.0	+183.5	+112.4	-127.9	-169.2	+108.4
X	Y	Z	Pitch	Yaw	Roll	
+8	0	0	0.0	0.0	0.0	
FOR	Loaded – Cupola Install CBCS, SY Held					
Disp	Node3>Cupola Install CBCS					

Cupola Installed at Node 3 Nadir

SR	SY	SP	EP	WP	WY	WR
+40.8	+170.0	+184.0	+112.4	-128.3	-169.2	+108.7
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded – Cupola Install CBCS, SY Held					
Disp	Node3>Cupola Install CBCS					

1.510 SSRMS CUPOLA RELEASE AND PMA3 RELOCATE

Cupola Backoff

SR	SY	SP	EP	WP	WY	WR
+42.9	+170.0	+177.2	+107.2	-115.6	-168.8	+110.8
X	Y	Z	Pitch	Yaw	Roll	
-150	0	0	0.0	0.0	0.0	
FOR	Unloaded – LEE Tip, SY Held					
Disp	Node3>CUP Nadir Mated GF					

PMA3 Pre-Grapple Intermediate

SR	SY	SP	EP	WP	WY	WR
+124.3	+210.0	+156.0	+116.6	+14.9	+15.3	+146.1

PMA3 Pre-Grapple

SR	SY	SP	EP	WP	WY	WR
+124.3	+223.2	+242.3	+116.6	+14.9	+15.3	+146.1
X	Y	Z	Pitch	Yaw	Roll	
-150	0	0	+0.1	0.0	-0.1	
FOR	Unloaded – LEE Tip, SR Held					
Disp	Node2>PMA3 Mated Zen GF					

3.700 PUBLISHED POSITIONS

(RBT FS/20A/FIN 1)

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PMA3 Grapple

SR	SY	SP	EP	WP	WY	WR
+124.3	+227.7	+253.9	+112.1	+7.5	+10.9	+147.2
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded - PMA3 Mate BCS, SR Held					
Disp	Node2>PMA3 Zen Mate BCS					

PMA3 Demate

SR	SY	SP	EP	WP	WY	WR
+124.3	+215.2	+261.2	+100.4	+13.0	+23.0	+144.1
X	Y	Z	Pitch	Yaw	Roll	
+150	0	0	0.0	0.0	0.0	
FOR	Loaded - PMA3 Mate BCS, SR Held					
Disp	Node2>PMA3 Zen Mate BCS					

PMA3 Intermediate 1

SR	SY	SP	EP	WP	WY	WR
+110.0	+190.0	+228.0	+110.0	0.0	-10.0	+50.0

PMA3 Intermediate 2

SR	SY	SP	EP	WP	WY	WR
+110.0	+180.0	+165.0	+95.0	-60.0	-60.0	0.0

PMA3 Pre-Install

SR	SY	SP	EP	WP	WY	WR
+59.7	+170.0	+197.0	+95.9	-166.0	-152.7	-107.8
X	Y	Z	Pitch	Yaw	Roll	
+201	-1	0	0.0	0.0	+0.1	
FOR	Loaded - PMA3 Mate BCS, SY Held					
Disp	Node3>PMA3 Port Mate BCS					

PMA3 RTL

SR	SY	SP	EP	WP	WY	WR
+56.0	+170.0	+193.2	+111.9	-179.8	-155.5	-110.2
X	Y	Z	Pitch	Yaw	Roll	
+12	0	0	0.0	0.0	0.0	
FOR	Loaded - PMA3 Mate BCS, SY Held					
Disp	Node3>PMA3 Port Mate BCS					

PMA3 Installed

SR	SY	SP	EP	WP	WY	WR
+55.7	+170.0	+193.0	+112.8	-180.7	-155.7	-110.4
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded - PMA3 Mate BCS, SY Held					
Disp	Node3>PMA3 Port Mate BCS					

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PMA3 Backoff

SR	SY	SP	EP	WP	WY	WR
+62.6	+170.0	+176.4	+122.2	-170.2	-150.3	-105.9
X	Y	Z	Pitch	Yaw	Roll	
-200	0	0	0.0	0.0	0.0	
FOR	Unloaded – LEE Tip, SY Held					
Disp	Node3>PMA3 Mated Port GF					

1.520 SSRMS MANEUVER TO TRRJ VIEWING AND NODE 2 GRAPPLE

Port TRRJ Viewing

SR	SY	SP	EP	WP	WY	WR
+100.0	+181.5	+199.7	+112.0	-199.6	-79.6	-84.5

Node 2 Intermediate

SR	SY	SP	EP	WP	WY	WR
+170.0	+174.4	+140.0	+153.2	-127.0	-100.0	+80.0

Node 2 Pre-Grapple

SR	SY	SP	EP	WP	WY	WR
+230.4	+174.4	+175.7	+153.2	-127.0	-167.5	+141.8
X	Y	Z	Pitch	Yaw	Roll	
-150	0	0	0.0	0.0	0.0	
FOR	Unloaded – LEE Tip, SY Held					
Disp	Node2>PDGF					

Node 2 Grapple position.

SR	SY	SP	EP	WP	WY	WR
+225.7	+174.4	+198.3	+157.6	-155.5	-165.8	+137.3
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded - Node 2 PDGF, SR Held					
Disp	Node2>PDGF					

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2.220 SSRMS RETURN NODE 3 TO LOW HOVER

Node 3 Pre-Install

SR	SY	SP	EP	WP	WY	WR
+153.2	+132.9	-106.4	+89.3	-15.7	-30.7	+77.6
X	Y	Z	Pitch	Yaw	Roll	
+200	0	0	0.0	0.0	0.0	
FOR	Loaded – Node3 Install CBCS, SY Held					
Disp	Node1>Node3 Install CBCS					

Radiator Hold

SR	SY	SP	EP	WP	WY	WR
+128.9	+132.9	-140.9	+68.4	+16.3	-19.1	+64.6
X	Y	Z	Pitch	Yaw	Roll	
+500	+500	0	0.0	0.0	0.0	
FOR	Loaded – Node3 Install CBCS, SY Held					
Disp	Node1>Node3 Install CBCS					

Node 3 Intermediate

SR	SY	SP	EP	WP	WY	WR
+128.9	+132.9	-140.9	-21.4	+16.3	-19.1	+64.6
X	Y	Z	Pitch	Yaw	Roll	
+1278	+839	+1335	-31.5	+78.7	-17.9	
FOR	Loaded – Node3 Install CBCS, SY Held					
Disp	Node1>Node3 Install CBCS					

Node 3 Port Hover

SR	SY	SP	EP	WP	WY	WR
+90.1	+161.6	-151.0	-85.2	-3.9	+44.7	+49.4
X	Y	Z	Pitch	Yaw	Roll	
0	-700	-600	0	0	0	
FOR	Loaded – Node3 Unberth, SR Held					
Disp	Orbiter>Node3 Unberth					

Verify SSRMS at Node 3 Low Hover position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+90.1	+199.1	-147.1	-87.7	-48.7	+50.7	+105.8
X	Y	Z	Pitch	Yaw	Roll	
0	0	-600	0.0	0.0	0.0	
FOR	Loaded – Node3 Unberth, SR Held					
Disp	Orbiter>Node3 Unberth					

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2.310 SSRMS NODE 3 RELEASE AND MANEUVER TO FI SUPPORT

Node 3 Backoff

SR	SY	SP	EP	WP	WY	WR
+152.7	+132.9	-106.1	+105.6	-32.8	-30.5	+77.2
X	Y	Z	Pitch	Yaw	Roll	
-65	0	0	0.0	0.0	0.0	
FOR	Unloaded – LEE Tip, SY Held					
Disp	Node1>Node3 Mated GF					

LAB Clearance

SR	SY	SP	EP	WP	WY	WR
+146.3	+132.9	-134.1	+109.1	-14.8	-27.9	+73.2
X	Y	Z	Pitch	Yaw	Roll	
-200	+200	+200	0.0	0.0	0.0	
FOR	Unloaded – LEE Tip, SY Held					
Disp	Node1>Node3 Mated GF					

Viewing Reconfig

SR	SY	SP	EP	WP	WY	WR
+62.0	+132.9	-185.8	+120.8	-25.9	-35.2	+35.5
X	Y	Z	Pitch	Yaw	Roll	
+50	+150	+1300	-135.0	+40.0	+135.0	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>ISSACS					

Viewing Hover

SR	SY	SP	EP	WP	WY	WR
-15.0	+100.0	-90.0	+17.0	-58.9	-160.0	+10.0
X	Y	Z	Pitch	Yaw	Roll	
+1485	+1167	+1205	-10.5	-61.2	+87.8	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>ISSACS					

Viewing Support

SR	SY	SP	EP	WP	WY	WR
-15.0	+100.0	-56.7	+17.0	-58.9	-160.0	+10.0
X	Y	Z	Pitch	Yaw	Roll	
+2027	+624	+997	-107.8	-80.7	-18.9	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>ISSACS					

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2.315 SSRMS MANEUVER FROM FI SUPPORT TO LAB PDGF

Viewing Hover

SR	SY	SP	EP	WP	WY	WR
-15.0	+100.0	-90.0	+17.0	-58.9	-150.0	+10.0

LAB Reconfig

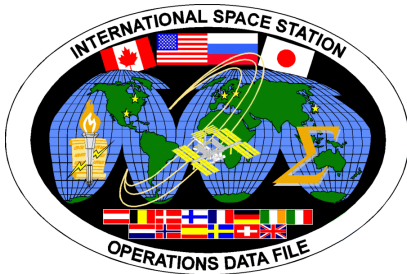
SR	SY	SP	EP	WP	WY	WR
0.0	+162.2	-178.2	+110.0	+150.0	-160.0	-45.0
X	Y	Z	Pitch	Yaw	Roll	
+790	+705	+1561	-53.3	+61.7	+173.2	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>ISSACS					

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

SR	SY	SP	EP	WP	WY	WR
+138.9	+162.2	-178.2	+153.7	+225.4	-178.3	-134.1
X	Y	Z	Pitch	Yaw	Roll	
-150	0	0	0.0	0.0	0.0	
FOR	Unloaded – LEE Tip, SY Held					
Disp	LAB>PDGF					

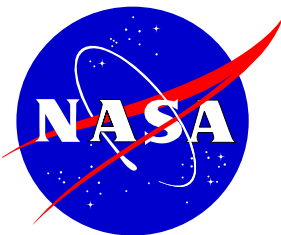
Expected LAB Grapple position.

SR	SY	SP	EP	WP	WY	WR
+138.2	+162.2	-153.0	+157.6	+196.0	-178.1	-134.7
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded – LAB PDGF, SR Held					
Disp	LAB>PDGF					



INTERNATIONAL SPACE STATION

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Return on
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