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ISS-17A

Mission Operations Directorate
Operations Division

21 JUL 09

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Lyndon B. Johnson Space Center
Houston, Texas



United Space Alliance

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**INTERNATIONAL SPACE STATION
ROBOTICS GROUP
ROBOTICS BOOK - FLIGHT SPECIFIC
ISS-17A**

21 JUL 09

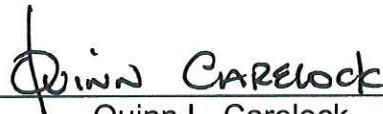
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Uplinked Messages (or Approved Flight Notes) replaced by this revision,
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None

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ISS-17A**

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NOMINAL

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1.110 OBSS UNBERTH AND HANDOFF

(RBT FS/17A/FIN)

1. HAND CONTROLLER CALIBRATION

1.1 Translational Hand Controller (THC) Calibration

THC

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

1.2 Rotational Hand Controller (RHC) Calibration

RHC

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

2. SETUP

Verify RMS is at OBSS Pre-Grapple at Handoff

SY	SP	EP	WP	WY	WR
+22.7	+57.5	-27.4	-99.3	+11.8	-97.9

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
03: S1 Lower Outboard (+60, +30)	22: Base Elbow (-130, -10)	13: LAB Stbd Zenith (-20, -30)	Camera C (+25, +35)	SRMS Elbow (-110, +50)



Figure 1.- Stage Park
(03: S1 Lower Outboard: +60, +30).

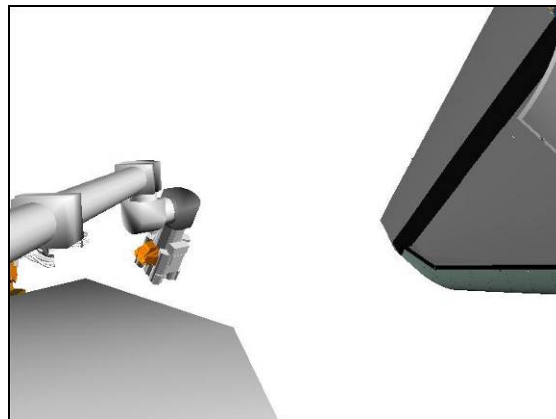


Figure 2.- Stage Park
(22: Base Elbow: -130, -10).

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Figure 3.- Stage Park
(13: LAB Stbd Zenith: -20, -30).

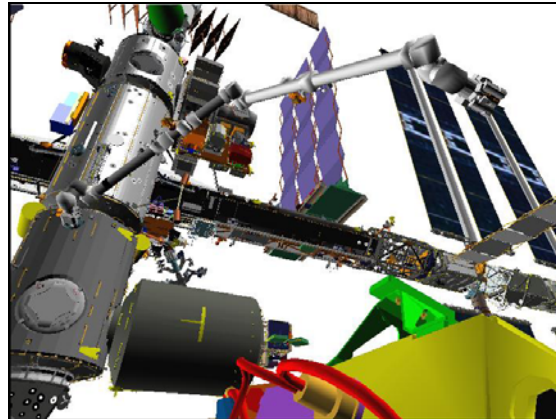


Figure 4.- Stage Park
(Camera C: +25, +35).

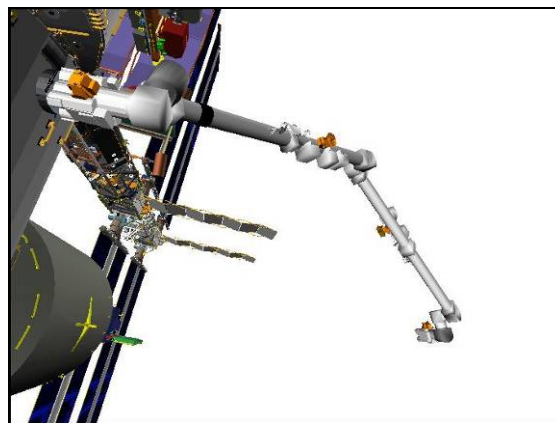


Figure 5.- Stage Park
(SRMS Elbow: -110, +50).

PCS

MSS: 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)

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

SR	SY	SP	EP	WP	WY	WR
+74.6	+220.0	-150.0	-50.0	-130.0	-121.0	+180.0
X	Y	Z	Pitch	Yaw	Roll	
-561	-733	-639	-15.2	-78.8	-129.1	
FOR	Unloaded – LEE Tip, SR Held					
Disp	Orbiter>OBSS FRGF					

3. FOR OCAS TO OBSS PRE-GRAPPLE

NOTE

The clearance between the Tip LEE and the OBSS is approximately 73 cm (29 in). This clearance may be monitored with Camera C.

MSS: SSRMS: MSS Safing:

cmd 'SSRMS' Remove (Verify Not Safed)

DCP BRAKES SSRMS → OFF (Verify OFF)

PCS √Vernier

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 OBSS Pre-Grapple position.

X	Y	Z	Pitch	Yaw	Roll
-100	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	-561	-733	-639	-15.2	-78.8	-129.1
TGT	-100	0	0	0.0	0.0	0.0
ERR	-461	-733	-639	-15.2	-78.8	-129.1

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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 Pre-Grapple position (within 5 cm/1 deg).

Locked						
SR	SY	SP	EP	WP	WY	WR
+74.6	+219.2	-164.7	-108.7	-161.8	-158.5	+212.6
X	Y	Z	Pitch	Yaw	Roll	
-100	0	0	0	0	0	
FOR	Unloaded – LEE Tip, SR Held					
Disp	Orbiter>OBSS FRGF					



Figure 6.- OBSS Pre-Grapple
 (03: S1 Lower Outboard: +60, +30).

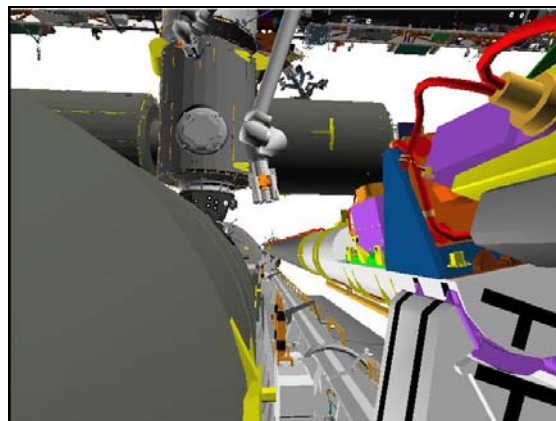


Figure 7.- OBSS Pre-Grapple
 (Camera C: +5, +5).

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4. OBSS GRAPPLE

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
03: S1 Lower Outboard (+60, +30)	25: Tip LEE	13: LAB Stbd Zenith (-50, -20)	Camera C (+5, +5)	SRMS Elbow (-110, 0)

NOTE

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

4.1 Maneuvering to Grapple Envelope

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 Roll (Verify SR – Locked)

THC/
RHC

Maneuver to within grapple envelope.

4.2 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)

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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 Motors – Inh

4.3 Grapple Cleanup
 Verify Posn Hold – orange

DCP
 BRAKES SSRMS → ON (Verify ON)

PCS
 MSS: 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)

MSS: SSRMS: Rate:

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

Expected OBSS Grapple position.

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					

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

5. OBSS UNBERTH

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
03: S1 Lower Outboard (+60, +30)	71: Mux D/C (D: -25, 0) (C: +25, 0)	13: LAB Stbd Zenith (-20, -30)	Camera C (+25, 0)	SRMS Elbow (-110, 0)

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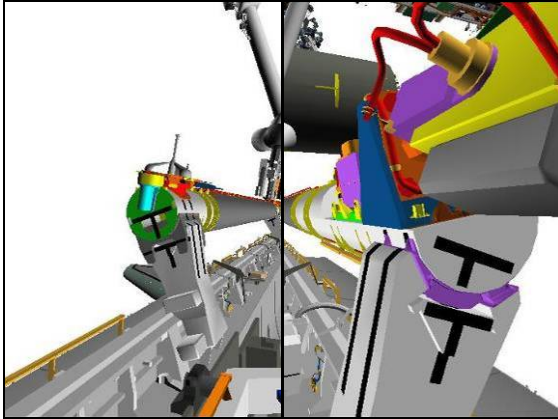


Figure 8.- OBSS Grapple
(71: Mux D/C).

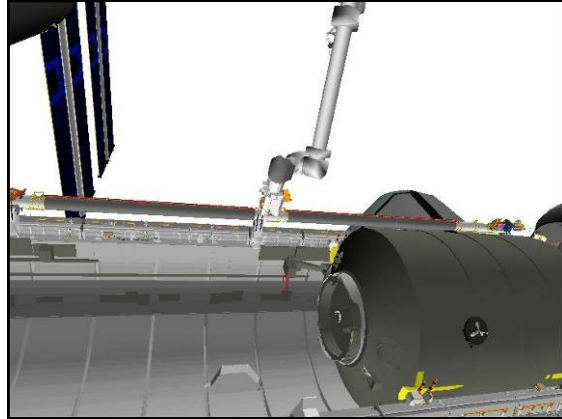


Figure 9.- OBSS Grapple
(SRMS Elbow: -110, 0).

5.1 Attitude Control Configuration

MSS: SSRMS: Thrusters:

Verify 'Desat Request:' – Inh

If using shuttle attitude control, coordinate with shuttle crew
DAP: FREE.

5.2 MRL Release

Give shuttle crew GO to release MRLs.

NOTE

Standby for OBSS thermal clock start time:

___/___:___:___

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
*   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
*
*   TRIGGER → Press (momentarily) (SCR 19064)
*
*   Verify 'Carriage' Tension ~5500 N (90 s max)
*   Verify 'Carriage' Retract – blue
*****
```

RHC

PCS

5.3 Maneuvering to Low Hover

On shuttle crew GO for OBSS unberth and SSRMS mnvr to Handoff:

DCP

BRAKES SSRMS → OFF (Verify OFF)

PCS

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

THC/
RHC

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

Locked						
SR	SY	SP	EP	WP	WY	WR
+74.6	+223.3	-163.6	-106.5	-163.6	-159.6	+216.8
X	Y	Z	Pitch	Yaw	Roll	
0	0	-100	0.0	0.0	0.0	
FOR	Loaded – OBSS Mid MPM, SR Held					
Disp	Orbiter>OBSS Mid MPM					

PCS

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

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

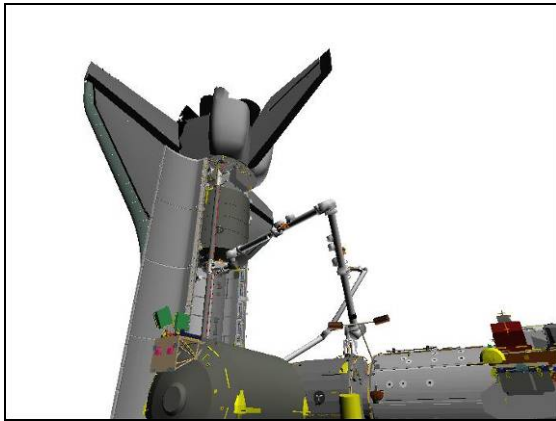


Figure 10.- Low Hover
(03: S1 Lower Outboard: +60, +30).

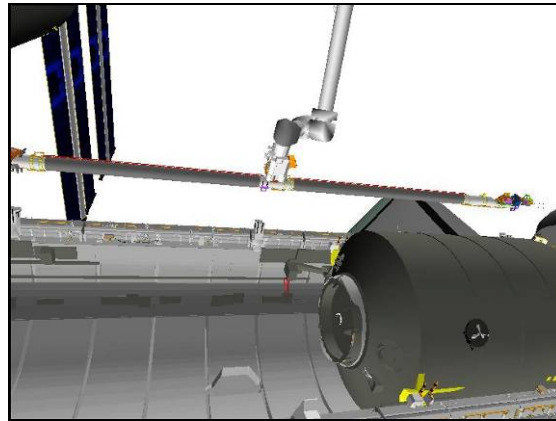


Figure 11.- Low Hover
(SRMS Elbow: -110, 0).

6. FOR OCAS TO OBSS UNBERTH 1

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
03: S1 Lower Outboard (+60, +30)	22: Base Elbow (-140, +10)	13: LAB Stbd Zenith (-20, -30)	Camera D (-20,+25)	SRMS Elbow (-80, 0)

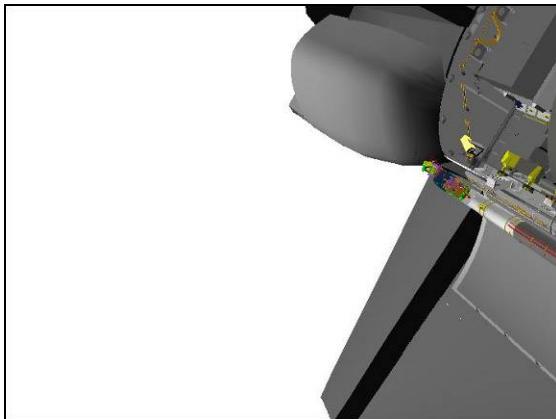


Figure 12.- Low Hover
(22: Base Elbow: -140, +10).

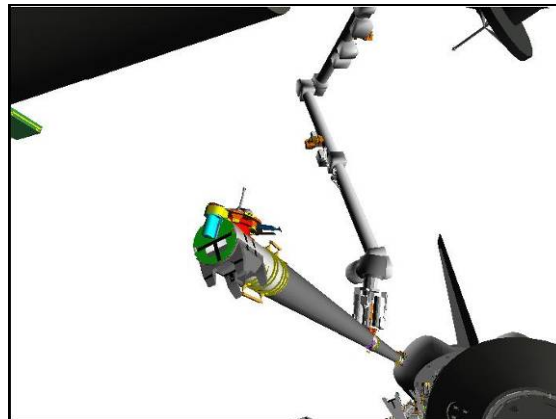


Figure 13.- Low Hover
(Camera D: -20, +25).

√Vernier

MSS: SSRMS: Rate:

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

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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 OBSS Unberth 1 position.

X	Y	Z	Pitch	Yaw	Roll
+200	-200	-250	0.0	0.0	0.0

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON

Verify FOR and errors are correct on FOR Position overlay.

	X	Y	Z	Pitch	Yaw	Roll
FOR	0	0	-100	0.0	0.0	0.0
TGT	+200	-200	-250	0.0	0.0	0.0
ERR	-200	+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

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

Locked						
SR	SY	SP	EP	WP	WY	WR
+74.6	+227.4	-157.9	-85.7	-188.8	-160.8	+221.0
X	Y	Z	Pitch	Yaw	Roll	
+200	-200	-250	0.0	0.0	0.0	
FOR	Loaded – OBSS Mid MPM, SR Held					
Disp	Orbiter>OBSS Mid MPM					



Figure 14.- OBSS Unberth 1
(03: S1 Lower Outboard: +60, +30).

7. FOR OCAS TO OBSS UNBERTH 2

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
03: S1 Lower Outboard (+60, +30)	24: Tip Elbow (-40, +20)	13: LAB Stbd Zenith (-20, -30)	Camera D (-20, +25)	SRMS Elbow (-110, +20)

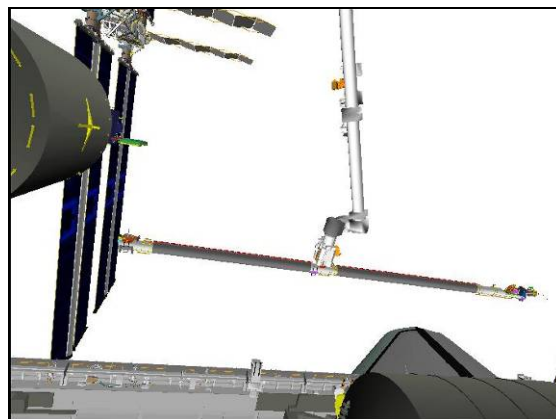


Figure 15.- OBSS Unberth 1
(SRMS Elbow: -110, +20).

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RHC RATE → COARSE (Verify Coarse on PCS)

PCS SSRMS FOR OCAS

Input 'FOR' 'Destination' for OBSS Unberth 2 position.

X	Y	Z	Pitch	Yaw	Roll
+600	+50	-1000	+90.0	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	-200	-250	0.0	0.0	0.0
TGT	+600	+50	-1000	+90.0	0.0	0.0
ERR	-400	-250	+750	-90.0	0.0	0.0

* If FOR or errors are incorrect

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

*
* Input correct Dest FOR per table above.

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

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

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

DCP AUTO SEQ → PROC

PCS MSS: SSRMS: SSRMS

Verify Posn Hold – orange

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

Locked	SR	SY	SP	EP	WP	WY	WR
	+74.6	+210.1	-115.4	-92.4	-153.2	-171.0	+175.6
	X	Y	Z	Pitch	Yaw	Roll	
	+600	+50	-1000	+90.0	0.0	0.0	
FOR	Loaded – OBSS Mid MPM, SR Held						
Disp	Orbiter>OBSS Mid MPM						

1.110 OBSS UNBERTH AND HANDOFF

(RBT FS/17A/FIN)



Figure 16.- OBSS Unberth 2
(03: S1 Lower Outboard: +60, +30).



Figure 17.- OBSS Unberth 2
(13: LAB Stbd Zenith: 0, -30).

8. FOR OCAS TO OBSS HANDOFF

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
03: S1 Lower Outboard (+60, +30)	22: Base Elbow (-80, 0)	13: LAB Stbd Zenith (0, -30)	Camera A (0, +20)	SRMS Elbow (-70, +20)

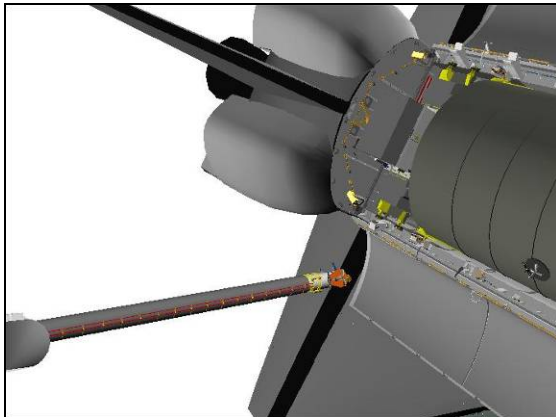


Figure 18.- OBSS Unberth 2
(22: Base Elbow: -80, 0).

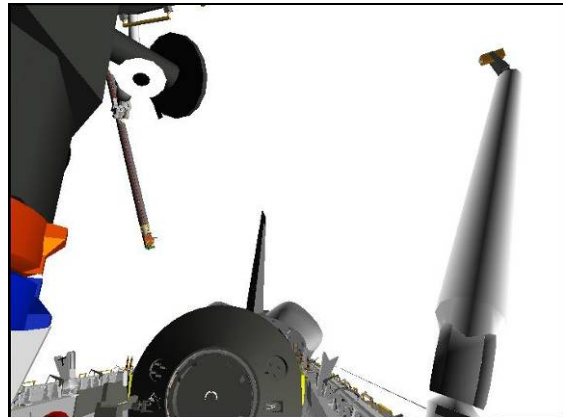


Figure 19.- OBSS Unberth 2
(Camera A: 0, +20).

NOTE

The clearance between the OBSS and SRMS EE is approximately 127 cm (50 in) at the end of this maneuver. This clearance may be monitored with the SRMS Elbow Camera.

RHC

RATE → VERNIER (Verify Vernier on PCS)

1.110 OBSS UNBERTH AND HANDOFF

(RBT FS/17A/FIN)

PCS SSRMS FOR OCAS

Input 'FOR' 'Destination' for OBSS 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	+600	+50	-1000	+90.0	0.0	0.0
TGT	+401	+684	-157	+91.5	-70.6	+47.6
ERR	+199	-634	-843	-1.5	+70.6	-47.6

* If FOR or errors are incorrect

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

* Input correct Dest FOR per table above.

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

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

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

DCP AUTO SEQ → PROC

PCS MSS: SSRMS: SSRMS

Verify Posn Hold – orange

Verify SSRMS at 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)

1.110 OBSS UNBERTH AND HANDOFF

(RBT FS/17A/FIN)

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Figure 20.- OBSS Handoff
(03: S1 Lower Outboard: +60, +30).

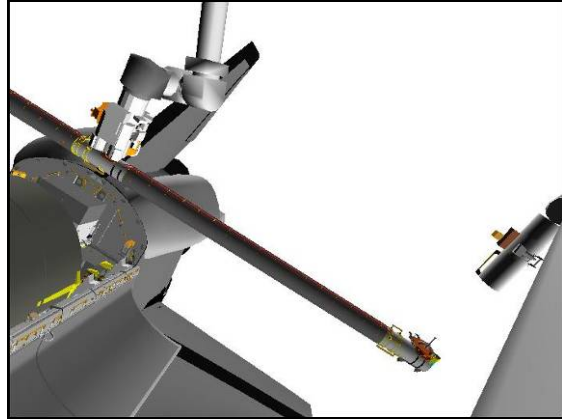


Figure 21.- OBSS Handoff
(72: SRMS Elbow: -40, -10).

9. VERIFICATION OF ATTITUDE CONTROL CONFIGURATION

PCS

MSS: SSRMS: Thrusters:

Verify 'Desat Request:' – Inh

If using shuttle attitude control, coordinate with shuttle crew
DAP: FREE.

Give RMS operator GO for OBSS grapple.

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1.111 OBSS RELEASE AT HANDOFF

(RBT FS/17A/FIN)

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1. SETUP

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
03: S1 Lower Outboard (+60, +30)	25: Tip LEE	13: LAB Stbd Zenith (0, -30)	Camera A (+5, +20)	Camera B (-30, +30)

Note

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

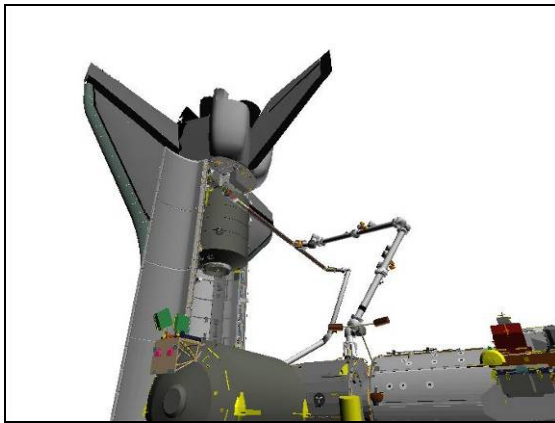


Figure 1.- OBSS Handoff
(03: S1 Lower Outboard: +60, +30).



Figure 2.- OBSS Handoff
(13: LAB Stbd Zenith: 0, -30).

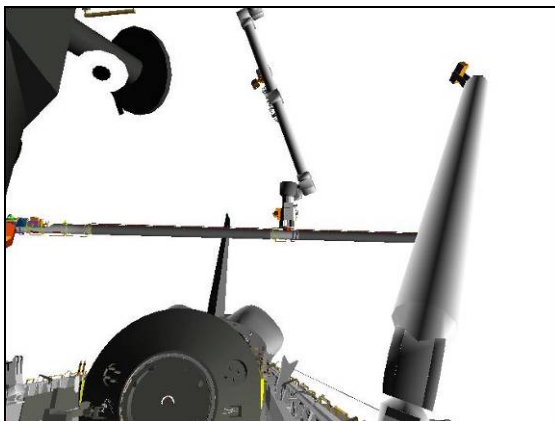


Figure 3.- OBSS Handoff
(Camera A: +5, +20).

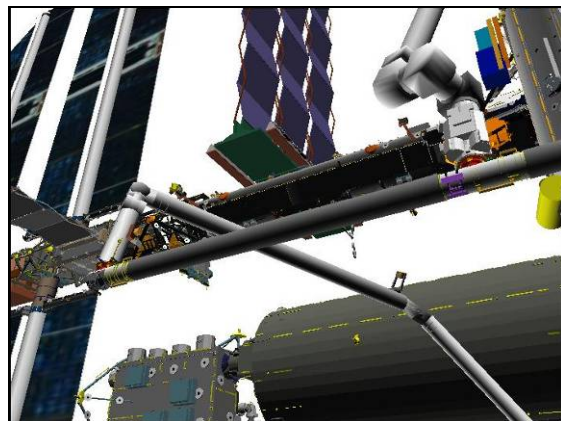


Figure 4.- OBSS Handoff
(Camera B: -30, +30).

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)

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1.111 OBSS RELEASE AT HANDOFF

(RBT FS/17A/FIN)

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√Vernier

MSS: SSRMS: Rate:

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

2. OBSS RELEASE (CARRIAGE PUSHOFF)

On RMS operator GO for OBSS Ungrapple:

DCP BRAKES SSRMS → OFF (Verify OFF)

2.1 SSRMS Limp

PCS MSS: SSRMS: Limp:

cmd All Limp (Verify Limp – blue)

MSS: SSRMS:

Verify all joints – Limped

2.2 Auto Release

MSS: SSRMS: Tip LEE:

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

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

CAUTION

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

NOTE

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

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Auto Release

RHC TRIGGER → Press (momentarily)

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

1.111 OBSS RELEASE AT HANDOFF

(RBT FS/17A/FIN)

MSS: SSRMS:

Verify Unloaded Parameters – ✓

2.3 SSRMS Backoff

MSS: SSRMS: Limp:

cmd None Limp (Verify Standby – blue)

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

THC/
RHC

Maneuver to OBSS Backoff position (within 5 cm/1 deg).
(Expect “-X” motion, THC out)

Locked						
SR	SY	SP	EP	WP	WY	WR
+74.6	+160.7	-144.1	-109.5	-189.9	-159.5	+64.0
X	Y	Z	Pitch	Yaw	Roll	
+1062	-307	+1575	-12.8	+0.1	+89.7	
FOR	Unloaded – LEE Tip, SR Held					
Disp	ISS>ISSACS					



Figure 5.- OBSS Backoff
(03: S1 Lower Outboard: +60, +30).



Figure 6.- OBSS Backoff
(13: LAB Stbd Zenith: 0, -30).

If using shuttle attitude control
Coordinate with shuttle crewmembers.
If attitude maintenance reqd
DAP: LVLH
When rates damped
DAP: FREE > 2 seconds, then
DAP: AUTO

1.111 OBSS RELEASE AT HANDOFF

(RBT FS/17A/FIN)

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NOTE

Expect the following message when safing is commanded:

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

This message should return to Norm.

DCP

SAFING → SAFE (Verify ON)

Give RMS operator GO for OBSS Mnvr to MPLM Viewing.

1.210 BERTHED MPLM GRAPPLE

(RBT FS/17A/FIN)

Page 1 of 6 pages

1. SETUP

Verify RMS is at MPLM Viewing position

SY	SP	EP	WP	WY	WR
+62.5	+25.0	-23.0	0.0	-13.2	-21.9

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
09: P1 Lower Outboard (+130, +20)	24: Tip Elbow (-10, +10)	03: S1 Lower Outboard (+70, +35)	SRMS Elbow (-140, +60)	Camera B (0, +40)

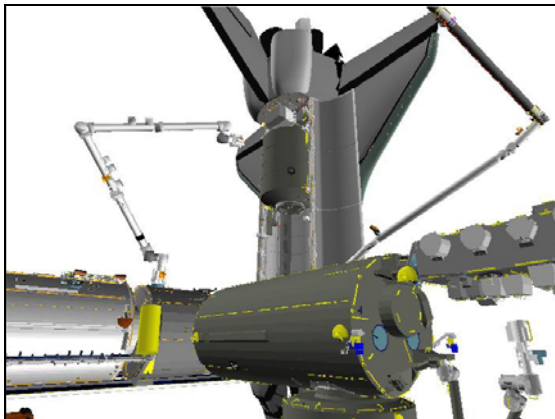


Figure 1.- OBSS Backoff Position
(09: P1 Lower Outboard: +130, +20).

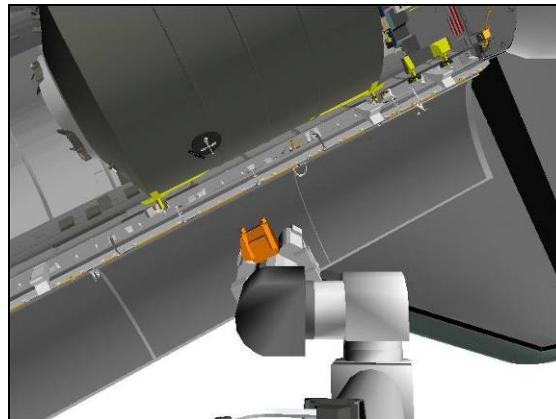


Figure 2.- OBSS Backoff Position
(24: Tip Elbow: -10, +10).

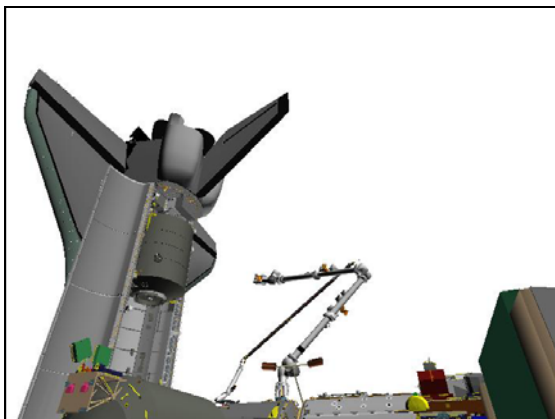


Figure 3.- OBSS Backoff Position
(03: S1 Lower Outboard: +70, +35).

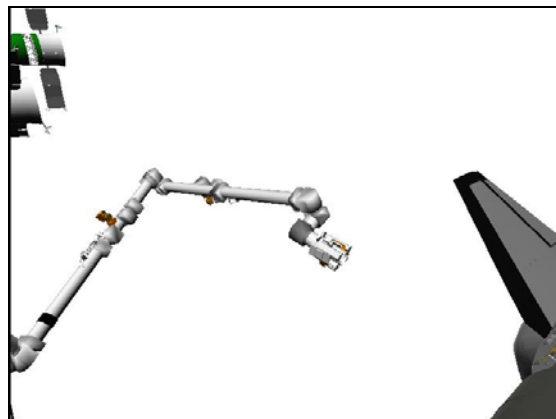


Figure 4.- OBSS Backoff Position
(SRMS Elbow: -140, +60).

1.210 BERTHED MPLM GRAPPLE

(RBT FS/17A/FIN)

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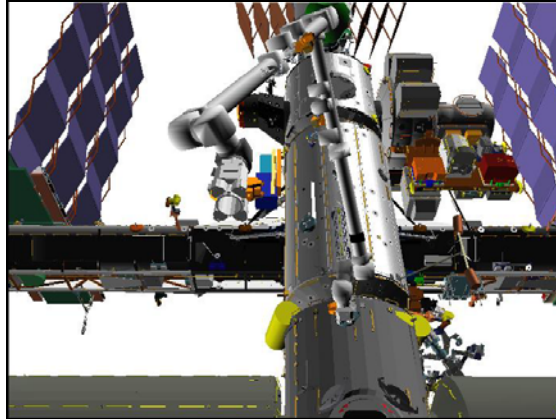


Figure 5.- OBSS Backoff Position
(Camera B: 0, +40).

PCS

MSS: SSRMS:

Change Loaded Parameters ► MPLM ► MPLM Berth SRH
Verify 'Loaded Parameters' (two) – MPLM Berth, SR Held

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

Change Display ► Orbiter ► MPLM Port GF (Verify Orbiter>MPLM Port GF)

Verify Command – SSRMS>Internal

√Vernier

MSS: SSRMS: Rate:

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

Verify SSRMS at OBSS Back-off position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+74.6	+160.7	-144.1	-109.5	-189.9	-159.5	+64.0
X	Y	Z	Pitch	Yaw	Roll	
-425	+280	+124	+14.9	-49.7	+120.0	
FOR	Unloaded – LEE Tip, SR Held					
Disp	Orbiter>MPLM Port GF					

1.210 BERTHED MPLM GRAPPLE

(RBT FS/17A/FIN)

2. JOINT OCAS TO MPLM PRE-GRAPPLE POSITION

NOTE

The closest clearances occur at the end of this maneuver and are as follows:

1. SSRMS Tip LEE to Grapple Pin approximately 150 cm (60 in). This clearance may be monitored with Camera B.
2. SSRMS Tip LEE to Orbiter PLB approximately 182 cm (72 in). This clearance may be monitored with Camera B.

PCS MSS: SSRMS: MSS Safing: MSS Safing

cmd 'SSRMS' Remove (Verify Not Safed)

DCP BRAKES SSRMS → OFF (Verify OFF)

PCS MSS: SSRMS: SSRMS

Enter Mode – Joint OCAS (Verify blue)

SSRMS Joint OCAS

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

SR	SY	SP	EP	WP	WY	WR
+74.6	+163.9	-177.0	-91.5	-43.7	-55.8	+100.8

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	-189.9	-159.5	+64.0
TGT	+74.6	+163.9	-177.0	-91.5	-43.7	-55.8	+100.8
ERR	0.0	-3.2	+32.9	-18.0	-146.2	-103.7	-36.8

* 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

1.210 BERTHED MPLM GRAPPLE

(RBT FS/17A/FIN)

PCS MSS: SSRMS:

Verify Posn Hold – orange

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

SR	SY	SP	EP	WP	WY	WR
+74.6	+163.9	-177.0	-91.5	-43.7	-55.8	+100.8
X	Y	Z	Pitch	Yaw	Roll	
-180	0	1	0	0	-0.1	
FOR	Unloaded – LEE Tip, SR Held					
Disp	Orbiter>MPLM Port GF					

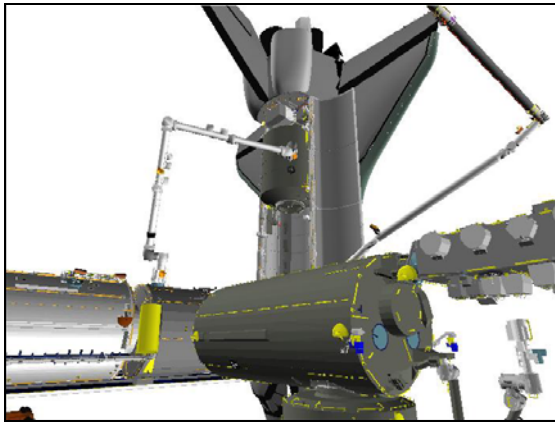


Figure 6.- MPLM Pre-Grapple Position
(09: P1 Lower Outboard: +130, +20).

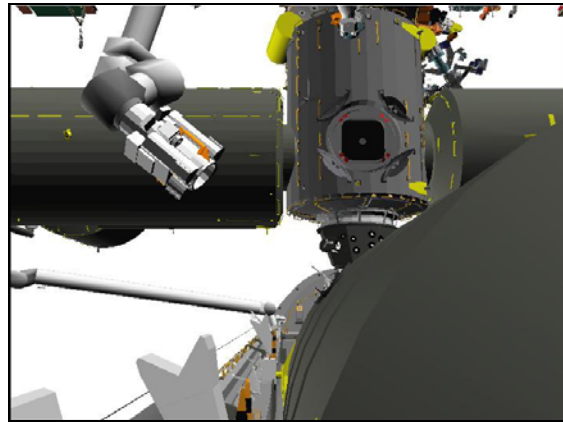


Figure 7.- MPLM Pre-Grapple Position
(Camera B: 0, +10).

3. MPLM GRAPPLE

3.1 Setup

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
09: P1 Lower Outboard (+130, +20)	25: Tip LEE	03: S1 Lower Outboard (+70, +35)	SRMS Elbow (-110, +30)	Camera B (0, +10)

NOTE

1. Tip LEE Camera must be fully zoomed out to correspond to target overlay.
2. The distance between the SSRMS Tip LEE and the Orbiter PLB is approximately 88 cm (35 in) at grapple. This clearance may be monitored with Camera B or SRMS Elbow Camera.

MSS: SSRMS:

√Vernier

1.210 BERTHED MPLM GRAPPLE

(RBT FS/17A/FIN)

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MSS: SSRMS: Rate:

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

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

RHC/
THC

3.2 Maneuvering to Grapple
Maneuver to within grapple envelope.

3.3 Slow Capture Commands

MSS: SSRMS: Tip LEE:

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

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

CAUTION

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

NOTE

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

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Auto Capture

RHC

3.4 Grapple
TRIGGER → Press (momentarily)

PCS

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

DCP

3.5 Grapple Cleanup
BRAKES SSRMS → ON (Verify ON)

PCS

MSS: SSRMS:

1.210 BERTHED MPLM GRAPPLE

(RBT FS/17A/FIN)

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Verify Loaded Parameters – √

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

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

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

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

Expected Berthed MPLM Grapple position.

SR	SY	SP	EP	WP	WY	WR
+74.6	+175.4	-184.4	-86.6	-25.3	-62.3	+119.4
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded – MPLM Berth, SR Held					
Disp	Orbiter>MPLM Berth					

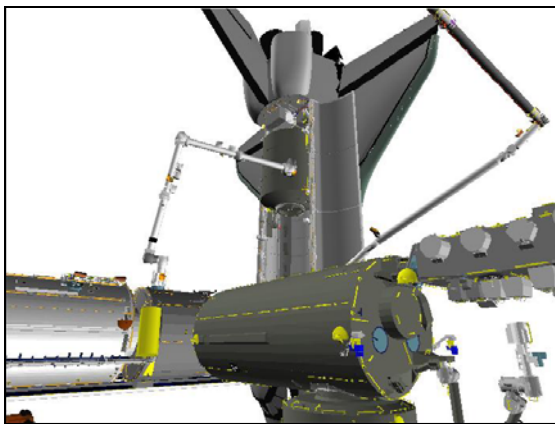


Figure 8.- MPLM Grapple Position
(09: P1 Lower Outboard: +130, +20).

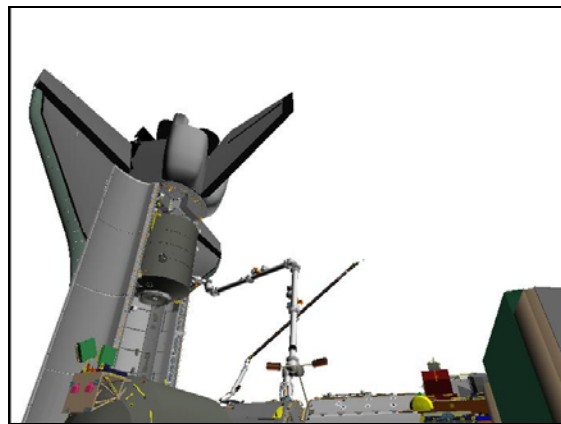


Figure 9.- MPLM Grapple Position
(03: S1 Lower Outboard: +70, +35).

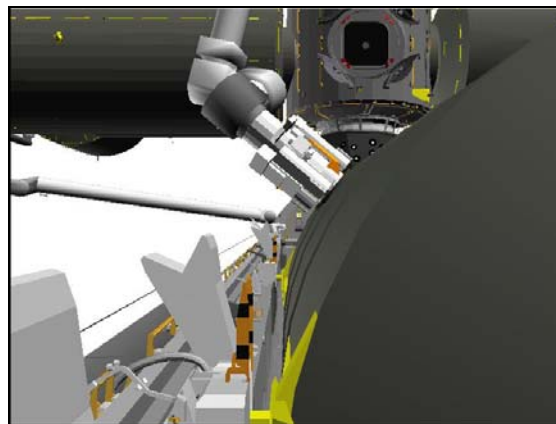


Figure 10.- MPLM Grapple Position
(Camera B: 0, 0).

1.220 MPLM UNBERTH TO INSTALL

(RBT FS/17A/FIN)

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1. ACTIVATING KEEL CAMERA

Notify shuttle crew ready to activate Keel CCTV.

NOTE

1. Steps highlighted in gray are performed by shuttle crew.
2. The Keel Camera is powered on to provide a reference of the Keel position during MPLM berth on FD11.

SSP2

√cb SW PWR 3 – cl

MPLM KEEL CAM PWR – ON

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

2. SETUP FOR UNBERTH

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
09: P1 Lower Outboard (+130, +20)	71: Mux B/C (B:-5, -10) (C:+5, -10)	03: S1 Lower Outboard (+70, +35)	SRMS Elbow (-110, +30)	OBSS ITVC (+130, -60)

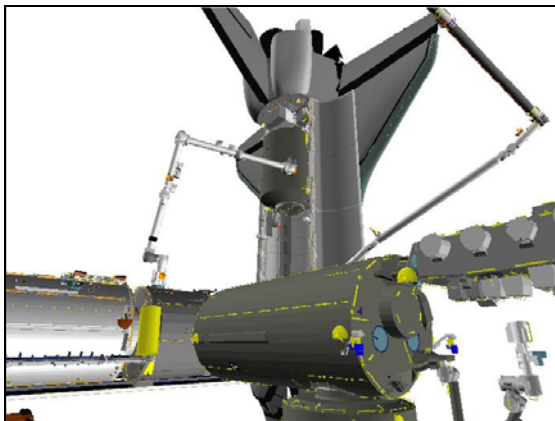


Figure 1.- MPLM Grapple
(09: P1 Lower Outboard: +130, +20).

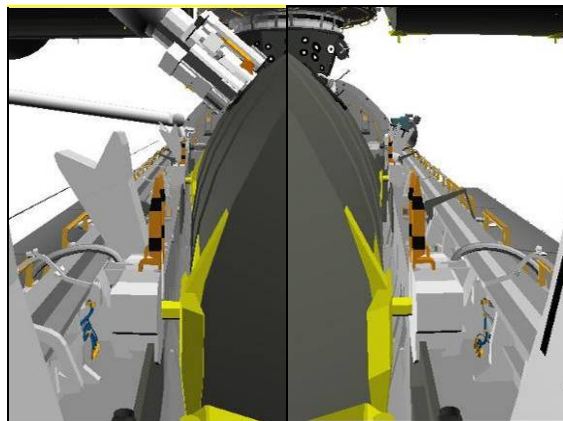


Figure 2.- MPLM Grapple
(71: Mux B/C).

1.220 MPLM UNBERTH TO INSTALL

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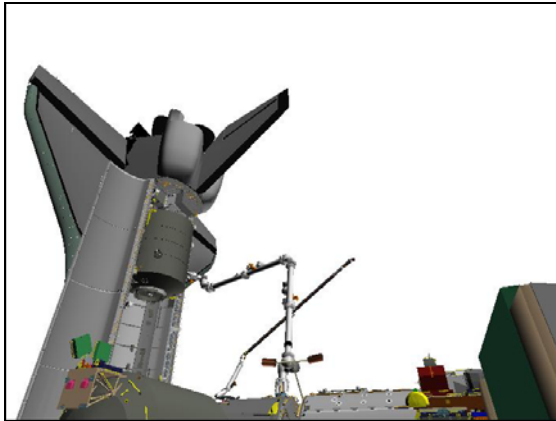


Figure 3.- MPLM Grapple
(03: S1 Lower Outboard: +70, +35).

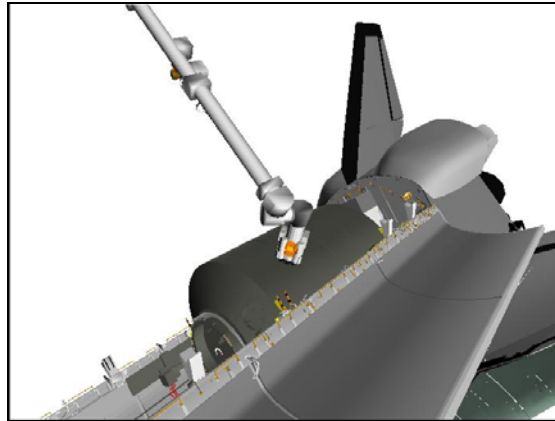


Figure 4.- MPLM Grapple
(SRMS Elbow: -110, +30).

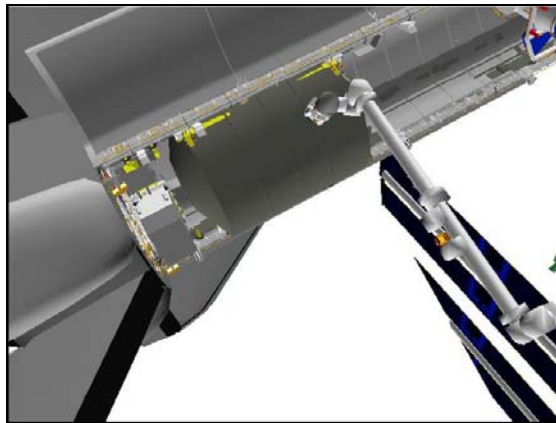


Figure 5.- MPLM Grapple
(OBSS ITVC: +130, -60).

Verify CBCS setup Complete

PCS

MSS: SSRMS:

Verify Loaded Parameters – √

Verify Loaded Parameters – MPLM Berth, SR Held

Verify Display – Orbiter>MPLM Berth

Verify Command – ISS>OBAS

√Vernier

MSS: SSRMS: Rate:

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

1.220 MPLM UNBERTH TO INSTALL

(RBT FS/17A/FIN)

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3. ATTITUDE CONTROL CONFIGURATION

MSS: SSRMS: Thrusters:

Verify 'Desat Request:' – Inh

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

4. ROEU DEMATE

4.1 Setup

Give shuttle crew GO for ROEU and PRLA Ops.

On SSRMS operator GO for ROEU and PRLA ops
CCTV – Config for ROEU demate

4.2 Deadfacing ROEU

SSP 1
A15

√MPLM CHAN 1,2 HTR PWR – OFF (tb-bp)

√APCU 1 OUTPUT – OFF

A6U

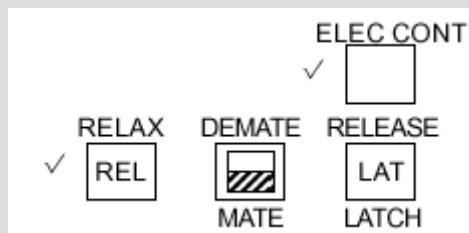
Install ROEU A6U PANEL OVERLAY.

√PL RETEN LAT (five) – OFF

PL RETEN PL SEL – 2

√REL 2,3 (four): 0

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



A6U
R13L

4.3 Activating ROEU

PL RETEN LOGIC PWR SYS 1,2 (two) – ON

BAY MECH PWR SYS 1,2 (two) – ON

4.4 Release Latches

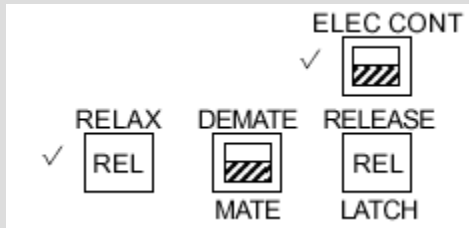
Note single motor time (> 20 seconds)

1.220 MPLM UNBERTH TO INSTALL

(RBT FS/17A/FIN)

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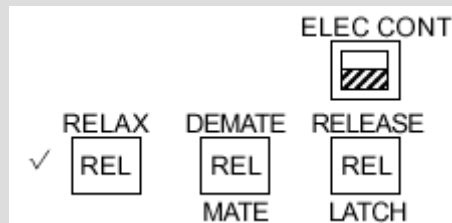
A6U RELEASE/LATCH – REL (tb–REL), 40 s max
– OFF



4.5 Demating ROEU

Note single motor time (> 18 seconds).

A6U DEMATE/MATE – DEMATE (tb–REL), 36 s max
– OFF



4.6 Deactivating ROEU

A6U PL RETEN LOGIC PWR SYS 1,2 (two) – OFF
R13L BAY MECH PWR SYS 1,2 (two) – OFF

A6U Remove ROEU A6U PANEL OVERLAY.

5. ACTIVATING LATCHES

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

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

SM 97 PL RETENTION

√RDY-FOR-LAT 1,2,3,4,5 (ten): 1

√LAT 1,2,3,4,5 (ten): 1

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

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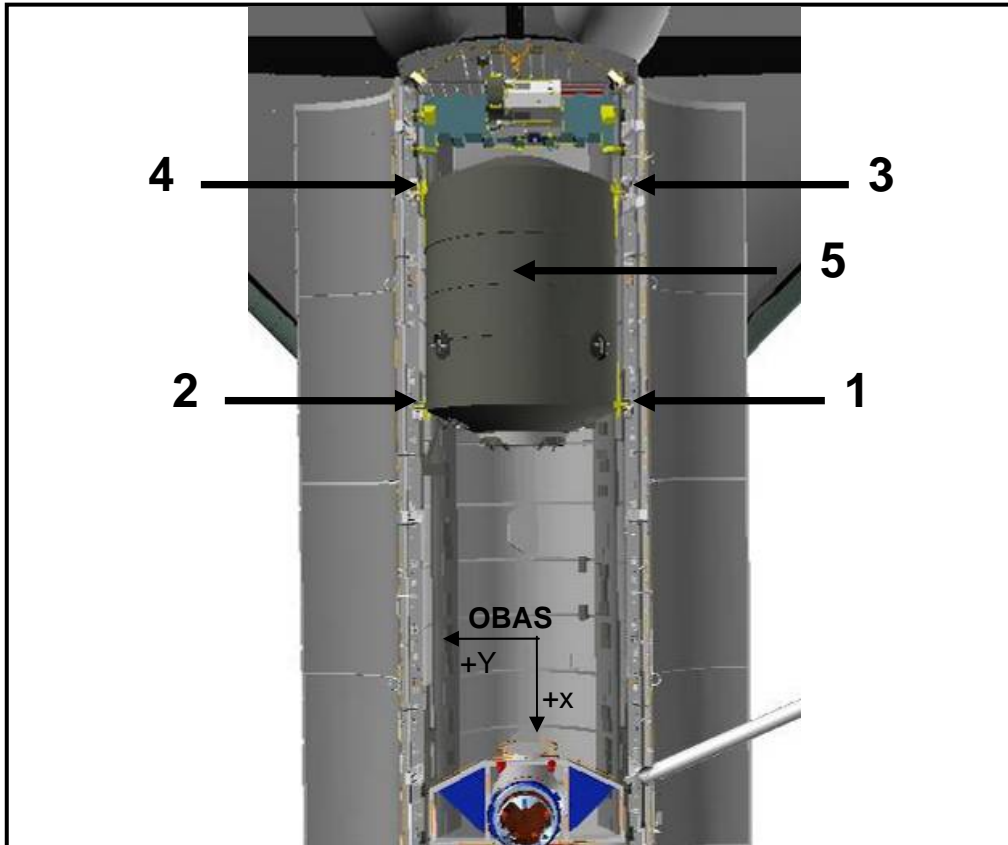


Figure 6.- MPLM PRLA Configuration.

6. AKA RELEASE

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

Note single motor drive times (> 30 seconds).

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

7. PRLA RELEASE

A6U
√PL RETEN LAT 1,2,3,4 tb (four) – LAT
√RDY 1,2,3,4 tb (four) – gray
Note single motor drive times (> 30 seconds).

PL RETEN LAT 1,2 (two) – REL (tb-REL), 60 s max
– OFF
3,4 (two) – REL (tb-REL), 60 s max
– OFF

8. DEACTIVATING LATCHES

A6U
R13L
PL RETEN LOGIC PWR SYS 1,2 (two) – OFF
BAY MECH PWR SYS 1,2 (two) – OFF

Give SSRMS operator GO for MPLM unberth.

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9. 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
* Verify Motors – Inh
*****
```

10. MANEUVERING MPLM TO LOW HOVER

NOTE

The clearance between the MPLM and New ATA is approximately 30 cm (12 in). This clearance may be monitored with the OBSS ITVC Camera.

On shuttle crew GO for MPLM unberth:

DCP BRAKES SSRMS → OFF (Verify – OFF)

PCS MSS: SSRMS:

Enter Mode – Manual (Verify – blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

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THC/
RHC

Maneuver to MPLM Low Hover position (within 5 cm/1 deg).
(Expect “-Z” motion, THC up)

Locked	SR	SY	SP	EP	WP	WY	WR
	+74.6	+163.8	-134.5	-117.7	-60.0	-55.7	+100.8
	X	Y	Z	Pitch	Yaw	Roll	
	0	0	-600	0.0	0.0	0.0	
FOR	Loaded –MPLM Berth, SR Held						
Disp	Orbiter> MPLM Berth						

PCS

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

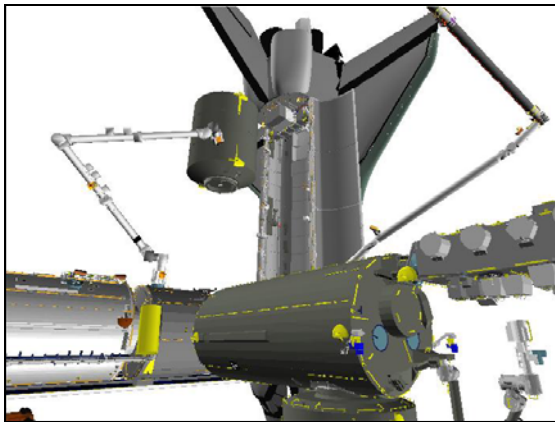


Figure 7.- MPLM Low Hover
(09: P1 Lower Outboard: +130, +20).

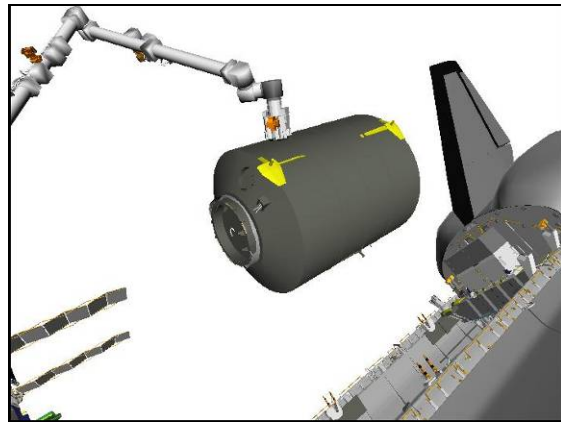


Figure 8.- MPLM Low Hover
(SRMS Elbow: -130, +40).

Notify shuttle crew that Keel Camera can be deactivated.

SSP2

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

12. ATTITUDE CONTROL CONFIGURATION
If using shuttle attitude control
Coordinate with shuttle crewmembers.
If attitude maintenance reqd
DAP: LVLH
When rates damped
DAP: FREE > 2 seconds, then
DAP: AUTO
When in attitude
DAP: FREE

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13. SETUP FOR MANEUVER TO MPLM PRE-INSTALL

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
09: P1 Lower Outboard (+130, +20)	22: Base Elbow (-80, -20)	03: S1 Lower Outboard (+70, +35)	SRMS Elbow (-160, +30)	OBSS ITVC (+110, -60)

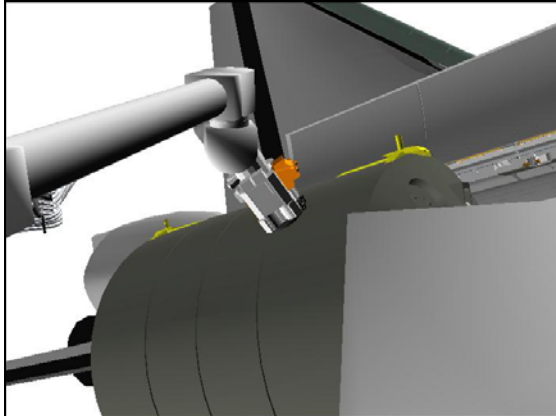


Figure 9.- MPLM Low Hover
(22: Base Elbow: -80, -20).

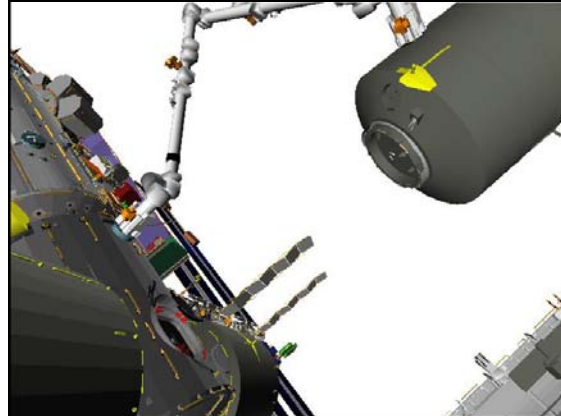


Figure 10.- MPLM Low Hover
(SRMS Elbow: -160, +30).

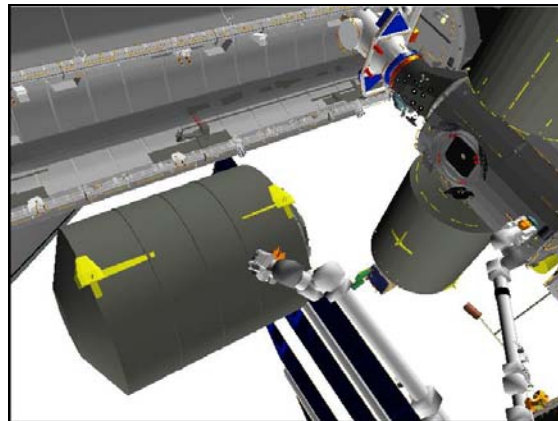


Figure 11.- MPLM Low Hover
(OBSS ITVC: +110, -60).

PCS

MSS: SSRMS:

Change Loaded Parameters ► MPLM ► MPLM CBCS Mate SRH
Verify 'Loaded Parameters' (two) – MPLM CBCS Mate, SR Held

Change Display ► Node2 ► MPLM Mate CBCS (Verify Node2>MPLM Mate CBCS)

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

RHC

RATE → COARSE (Verify Coarse on PCS)

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

SR	SY	SP	EP	WP	WY	WR
+74.6	+163.8	-134.5	-117.7	-60.0	-55.7	+100.8
X	Y	Z	Pitch	Yaw	Roll	
+708	+2	+18	-1.0	+0.1	-89.9	
FOR	Loaded – MPLM CBCS Mate, SR Held					
Disp	Node2>MPLM Mate CBCS					

14. FOR OCAS TO MPLM PRE-INSTALL

NOTE

At the end of this maneuver the clearance between the Tip Boom and MPLM is approximately 101 cm (40 in). This clearance may be monitored with the Base Elbow Camera.

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 MPLM 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	+708	+2	+18	-1.0	+0.1	-89.9
TGT	+200	0	0	0.0	0.0	0.0
ERR	+508	+2	+18	-1.0	+0.1	-89.9

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)

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DCP AUTO SEQ → PROC

PCS MSS: SSRMS:

Verify Posn Hold – orange

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

SR	SY	SP	EP	WP	WY	WR
+74.6	+151.3	-188.3	-117.8	-126.5	-18.0	+9.9
X	Y	Z	Pitch	Yaw	Roll	
+200	0	0	0.0	0.0	0.0	
FOR	Loaded – MPLM CBCS Mate, SR Held					
Disp	Node2>MPLM Mate CBCS					

Enter Mode – Standby (Verify blue)

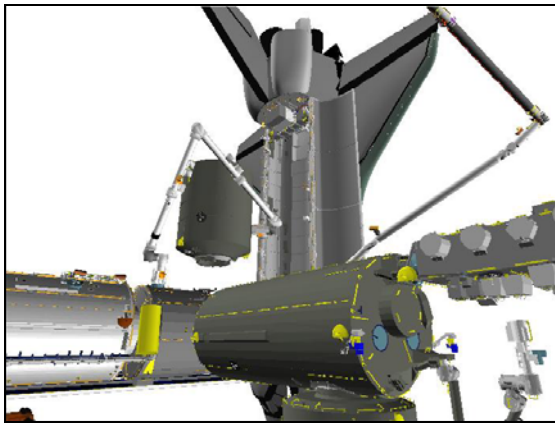


Figure 12.- MPLM Pre-Install
(09: P1 Lower Outboard: +130, +20).

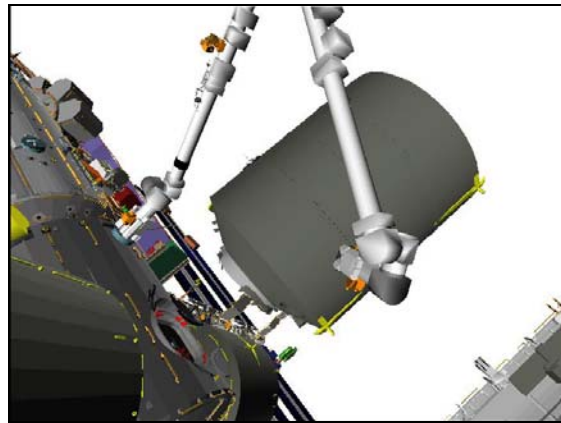


Figure 13.- MPLM Pre-Install
(SRMS Elbow: -160, +30).

15. ATTITUDE CONTROL CONFIGURATION

If using shuttle attitude control

Coordinate with shuttle crewmembers.

If attitude maintenance reqd

DAP: LVLH

When rates damped

DAP: FREE > 2 seconds, then

DAP: AUTO

When in attitude

DAP: FREE

16. MPLM INSTALL SETUP

Verify {1.511 MPLM CBM VERIFY PRE-MATE STATUS}, all
(SODF: S&M: NOMINAL: CBM), completed.

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

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Configure Cameras and CBCS MPLM overlay as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
09: P1 Lower Outboard (+130, +20)	15: CBCS	22: Base Elbow (-40, 0)	SRMS Elbow (-160, +30)	OBSS ITVC (+110, -60)

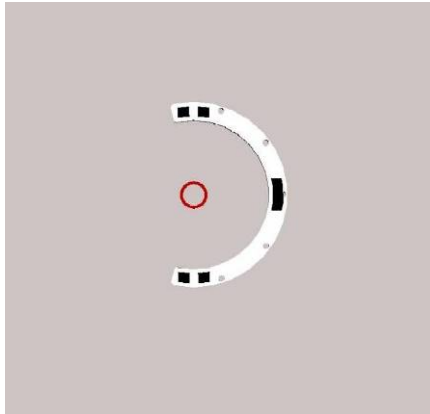


Figure 14.- MPLM Pre-Install (15: CBCS).

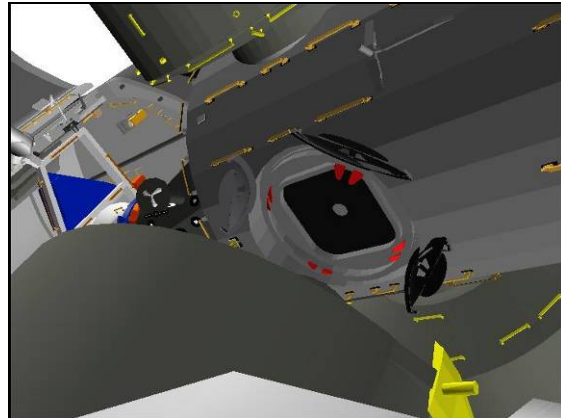


Figure 15.- MPLM Pre-Install (22: Base Elbow: -40, 0)

17. MANEUVERING MPLM TO READY-TO-LATCH POSITION

MPLM: 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 required

MSS: SSRMS:

Verify Command – SSRMS>Internal

Enter Mode – Manual (Verify – blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

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THC/
RHC

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

	Locked					
SR	SY	SP	EP	WP	WY	WR
+62.5	+151.3	-202.6	-122.8	-113.6	-7.7	+7.2
X	Y	Z	Pitch	Yaw	Roll	
+8	0	0	0.0	0.0	0.0	
FOR	Loaded – MPLM CBCS Mate, SR Held					
Disp	Node2>MPLM Mate CBCS					

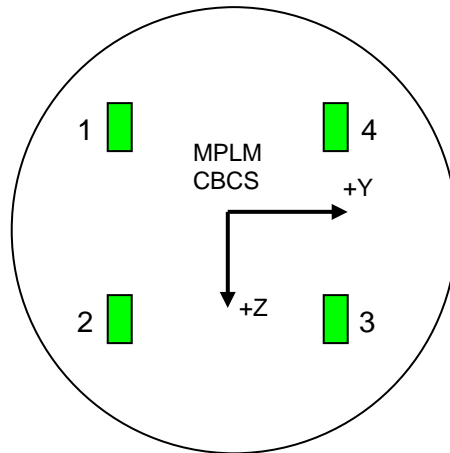


Figure 16.- RTL Locations Viewed From CBCS Camera.

Table 1. MPLM CBCS Install RTL Configuration (Refer to Figure 16.)

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

* All inputs with respect to MPLM CBCS Mate FOR frame.

PCS

MSS: SSRMS:

Verify Posn Hold – orange

MPLM: S&M: Nadir CBM:

Verify RTL (four) – green

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MSS: SSRMS:

Enter Mode – Standby (Verify blue)

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

18. SSRMS LIMPING

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.”

19. SSRMS BRAKING

On CBM operator, “GO for SSRMS brakes ON/Safing, can ungrapple element per timeline”:

DCP BRAKES SSRMS → ON (Verify – ON)

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PCS

MSS: SSRMS:

Expected MPLM Install position.

SR	SY	SP	EP	WP	WY	WR
+62.0	+151.3	-203.3	-122.9	-113.0	-7.2	+7.1
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded – MPLM CBCS Mate, SR Held					
Disp	Node2>MPLM Mate CBCS					

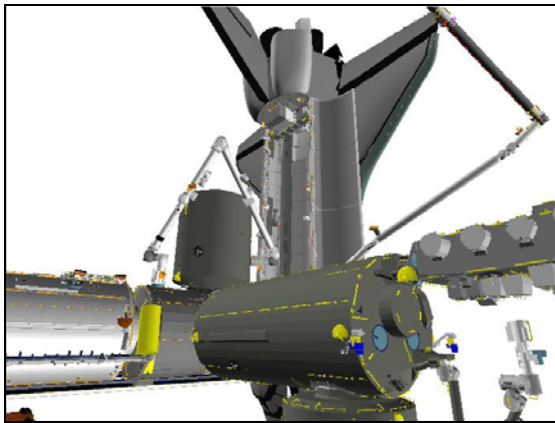


Figure 17.- MPLM Install
(09: P1 Lower Outboard: +130, +20).

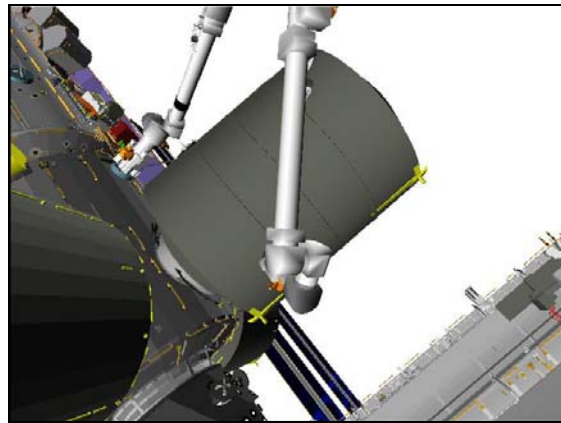


Figure 18.- MPLM Install
(SRMS Elbow: -160, +20).

20. ATTITUDE CONTROL CONFIGURATION

If using shuttle attitude control

Coordinate with shuttle crewmembers.

If attitude maintenance reqd

DAP: LVLH

When rates damped

DAP: FREE > 2 seconds, then

DAP: AUTO

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1. SETUP

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
09: P1 Lower Outboard (+130, +20)	25: Tip LEE	71: Camera B (0, +10)	SRMS Elbow (-160, +20)	OBSS ITVC (+95, -45)

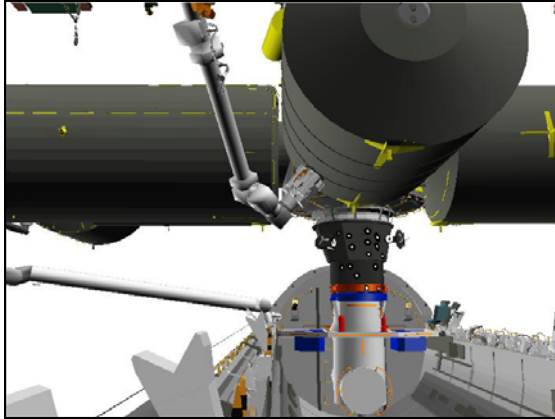


Figure 1.- MPLM Installed Node 2 (71: Camera B: 0, +10).

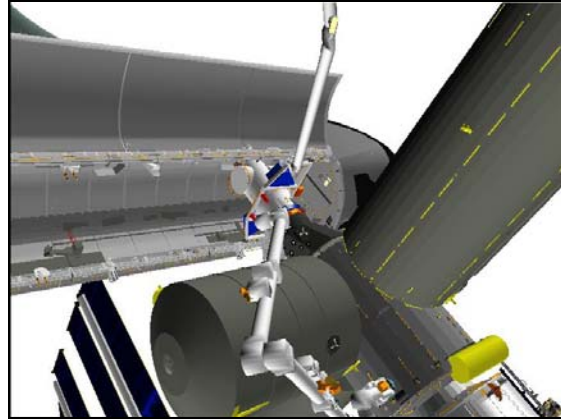


Figure 2.- MPLM Installed Node 2 (OBSS ITVC: +95, -45).

PCS

MSS: SSRMS:

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

Change Display ► Node2 ► MPLM Mated Port GF (Verify Node2>MPLM Mated Port GF)

Verify Command – SSRMS>Internal

√Vernier

MSS: SSRMS: Rate:

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

2. MPLM RELEASE

NOTE

1. The Tip LEE Camera must be fully zoomed out to correspond the target overlay.
2. Note the following clearances during this maneuver:
 - a) SSRMS Base boom to MPLM is approximately 104 cm (41 in). This clearance may be monitored with the SRMS Elbow Camera.
 - b) SSRMS Wrist cluster to Orbiter PLB is approximately 121 cm (48 in). This clearance may be monitored with Camera B.

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DCP BRAKES SSRMS → OFF (Verify OFF)

PCS 2.1 SSRMS Limp
MSS: SSRMS: Limp:

cmd All Limp (Verify Limp – blue)

MSS: SSRMS:

Verify all joints – Limped

2.2 Auto Release
MSS: SSRMS: Tip LEE:

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

Verify 'Confirm or Terminate' prompt.

CAUTION

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

NOTE

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

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Auto Release

RHC TRIGGER → Press (momentarily)

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

Verify Unloaded Parameters – √

2.3 SSRMS Backoff
MSS: SSRMS: Limp:

cmd None Limp (Verify Standby – blue)

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

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MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

THC/
RHC

Maneuver SSRMS to Mated MPLM Release position
(within 5 cm/1 deg).

	Locked					
SR	SY	SP	EP	WP	WY	WR
+60.3	+151.3	-209.9	-109.2	-121.0	-5.8	+6.9
X	Y	Z	Pitch	Yaw	Roll	
-150	0	0	0.0	0.0	0.0	
FOR	Unloaded – LEE Tip, SY Held					
Disp	Node2>MPLM Mated Port GF					

PCS

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

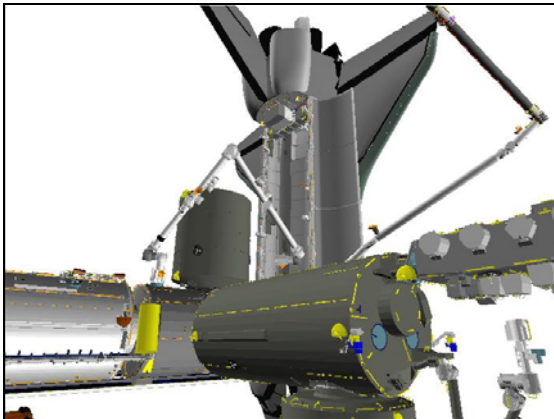


Figure 3.- Mated MPLM Release
(09: P1 Lower Outboard: +130, +20).

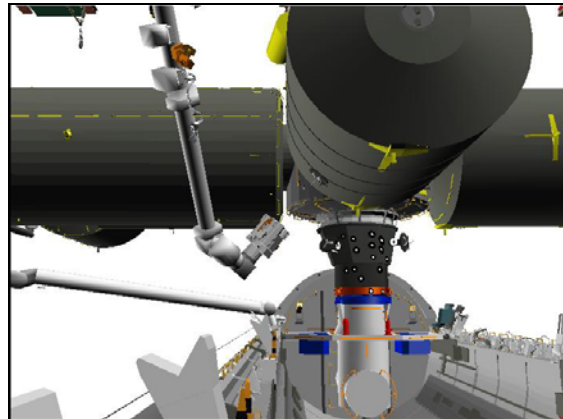


Figure 4.- Mated MPLM Release
(71: Camera B: 0, +10).

3. SINGLE JOINT TO MPLM CLEARANCE POSITION

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
09: P1 Lower Outboard (+120, +20)	22: Base Elbow (-90, -10)	71: Camera B (-10, +20)	SRMS Elbow (-160, +20)	OBSS ITVC (+95, -45)

√Vernier

MSS: SSRMS: Rate:

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

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MSS: SSRMS:

Enter Mode – Single (Verify blue)

WARNING

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

THC

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

	SR	SY	SP	EP	WP	WY	WR
Mated MPLM Release	+60.3	+151.3	-209.9	-109.2	-121.0	-5.8	+6.9
1: SP +			-140.0				
2: SR +	+120.0						
MPLM Clearance	+120.0	+151.3	-140.0	-109.2	-121.0	-5.8	+6.9
	X	Y	Z	Pitch	Yaw	Roll	
	+168	-101	+628	+46.5	+15.2	-49.9	
FOR	Unloaded – LEE Tip, SY Held						
Disp	Node2>MPLM Mated Port GF						

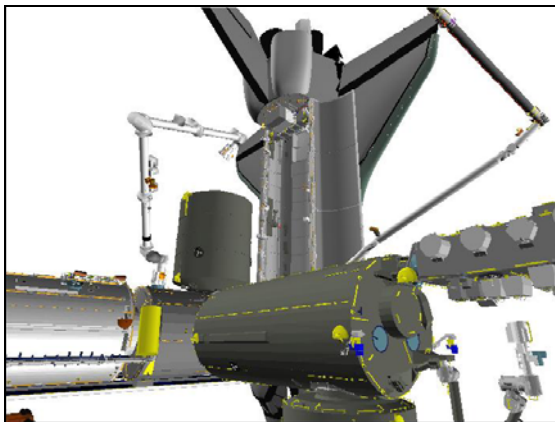


Figure 5.- MPLM Clearance
(09: P1 Lower Outboard: +130, +20).

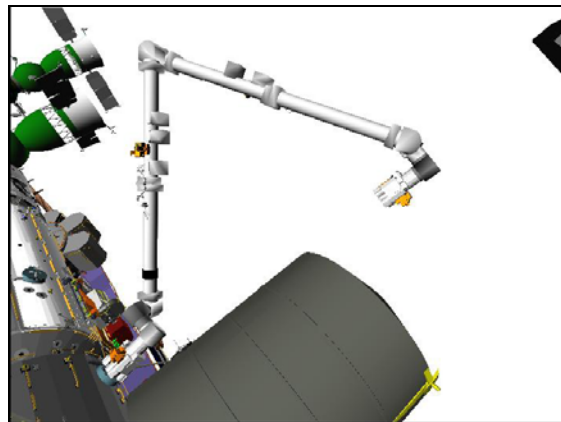


Figure 6.- MPLM Clearance
(SRMS Elbow: -160, +50).

4. JOCAS TO EVA1 SETUP POSITION

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
09: P1 Lower Outboard (+110, +20)	22: Base Elbow (-90, -10)	07: P1 Lower Inboard (-180, +40)	SRMS Elbow (+170, +60)	Camera B (-20, +40)

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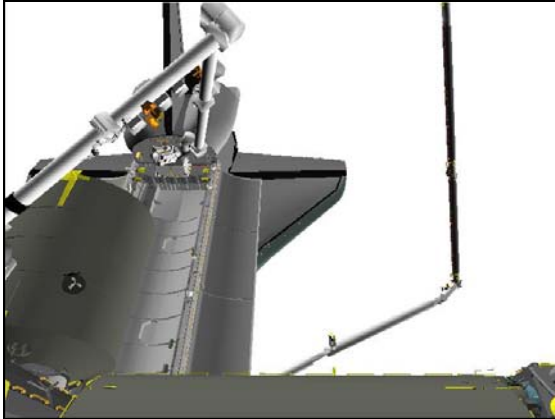


Figure 7.- MPLM Clearance
(07: P1 Lower Inboard: -180, +40).

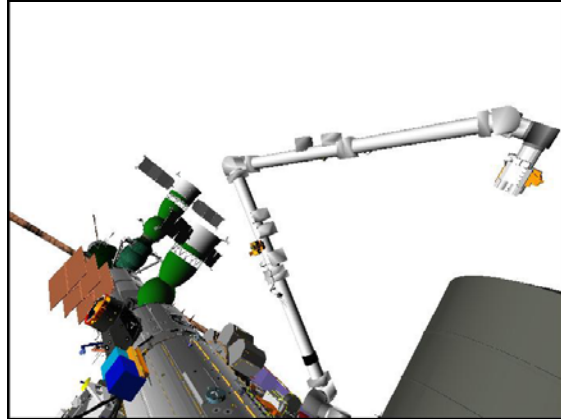


Figure 8.- MPLM Clearance
(SRMS Elbow: +170, +60).

PCS MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

Input 'Joint Angles' 'Destination' for EVA1 Setup position.

SR	SY	SP	EP	WP	WY	WR
+145.0	+20.0	-30.0	-85.0	-20.0	-20.0	+11.1

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)	+120.0	+151.3	-140.0	-109.2	-121.0	-5.8	+6.9
TGT	+145.0	+20.0	-30.0	-85.0	-20.0	-20.0	+11.1
ERR	-25.0	+131.3	-110.0	-24.2	-101.0	+14.1	-4.2

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

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PCS MSS: SSRMS: SSRMS

Verify Posn Hold – orange

Verify SSRMS at EVA1 Setup position.

SR	SY	SP	EP	WP	WY	WR
+145.0	+20.0	-30.0	-85.0	-20	-20	+11.1
X	Y	Z	Pitch	Yaw	Roll	
+216	+1235	+840	+152.7	+52.1	+52.2	
FOR	Unloaded – LEE Tip, SY Held					
Disp	Node2>MPLM Mated Port GF					

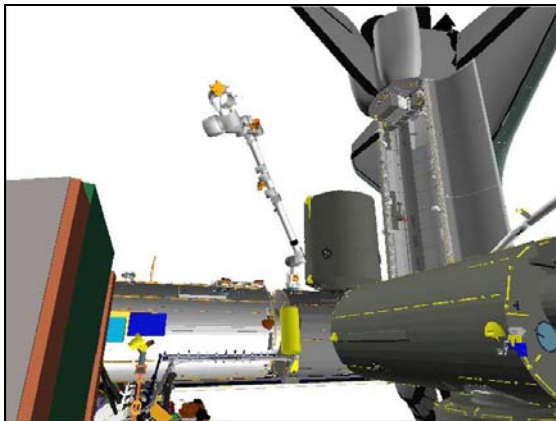


Figure 9.- EVA1 Setup Position
(09: P1 Lower Outboard: +110, +20)

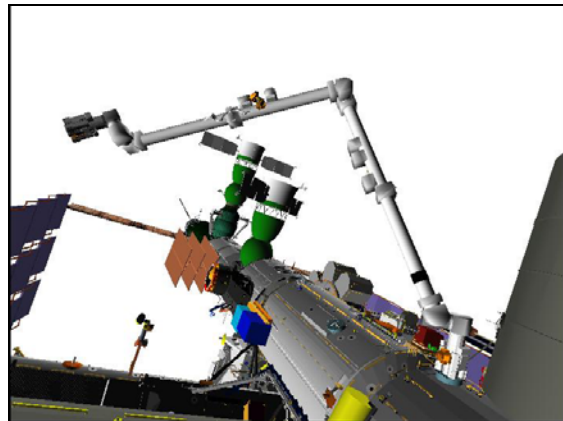


Figure 10.- EVA1 Setup Position
(71: SRMS Elbow: +150, +50).

NOTE

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

DCP SAFING → SAFE (Verify ON)

1.240 NODE 2 MATED MPLM GRAPPLE
 (RBT FS/17A/FIN) Page 1 of 9 pages

1. SETUP

Verify RMS is at MPLM Viewing position

SY	SP	EP	WP	WY	WR
+62.5	+25.0	-23.0	0.0	-13.2	-21.9

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
09: P1 Lower Outboard (+110, +25)	22: Base Elbow (+100, -15)	07: P1 Lower Inboard (+115, +40)	SRMS Elbow (+150, +45)	Camera C (-30, +45) Camera B (+10, +50)

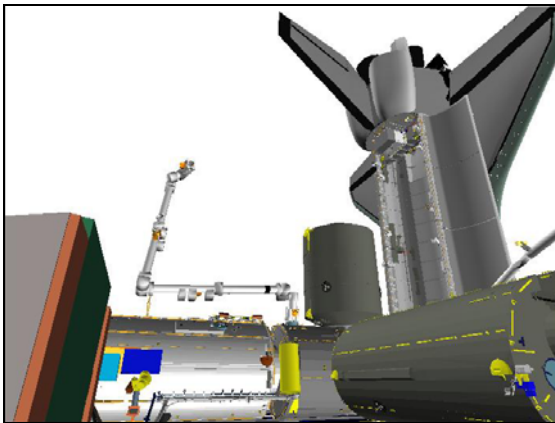


Figure 1.- EVA 3 Setup
 (09: P1 Lower Outboard: +110, +25).

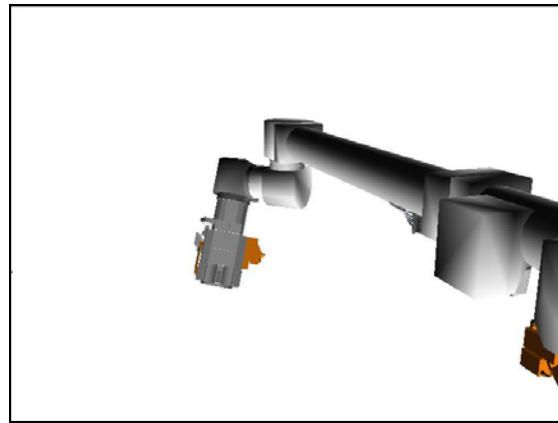


Figure 2.- EVA 3 Setup
 (22: Base Elbow: +100, -15).

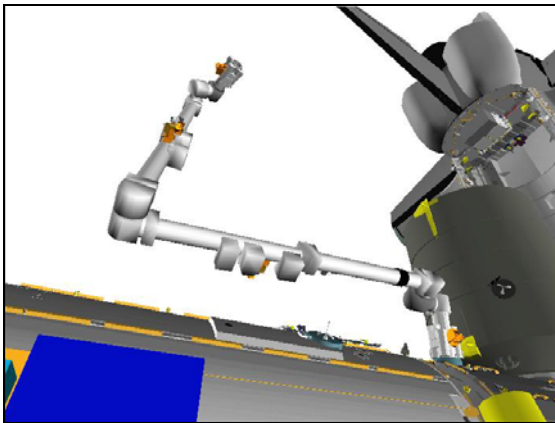


Figure 3.- EVA 3 Setup
 (07: P1 Lower Inboard: +115, +40).

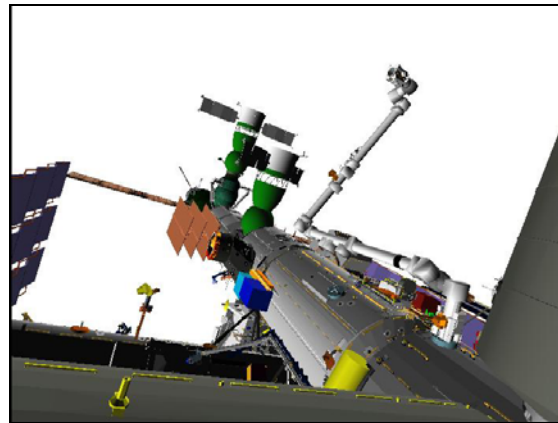


Figure 4.- EVA 3 Setup
 (SRMS Elbow: +150, +45).

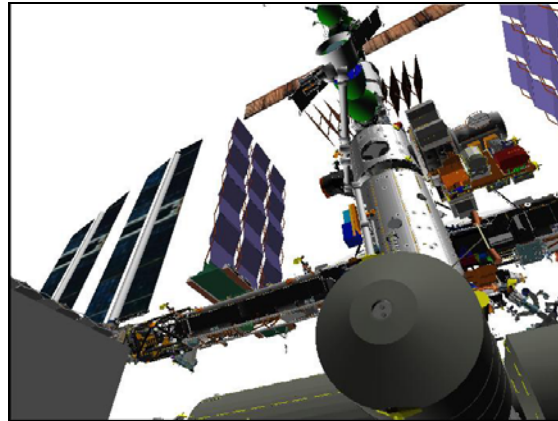


Figure 5.- EVA 3 Setup
 (Camera C: -30, +45).

PCS

MSS: SSRMS:

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

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

Change Display ► Node2 ► MPLM Mated Port GF (Verify Node2>MPLM Mated Port GF)

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

Verify SSRMS at EVA 3 Setup position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+90.0	+30.0	-95.0	+100.0	-45.0	-115.0	+150.0
X	Y	Z	Pitch	Yaw	Roll	
+904	+270	+918	-160.1	+28.6	+61.6	
FOR	Unloaded – LEE Tip, SY Held					
Disp	Node2> MPLM Mated Port GF					

2. SINGLE JOINT TO INTERMEDIATE 1 POSITION

MSS: SSRMS: MSS Safing:

cmd :SSRMS: Remove (Verify Not Safed)

DCP

BRAKES SSRMS → OFF (Verify OFF)

PCS

√Vernier

MSS: SSRMS:

Enter Mode – Single (Verify blue)

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

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

EVA 3 Setup 1: SP + Intermediate 1	SR	SY	SP	EP	WP	WY	WR
	+90.0	+30.0	-95.0	+100.0	-45.0	-115.0	+150.0
			-85.0				
	+90.0	+30.0	-85.0	+100.0	-45.0	-115.0	+150.0
	X	Y	Z	Pitch	Yaw	Roll	
	+831	+142	+938	-159.9	+32.8	+52.4	
	FOR	Unloaded – LEE Tip, SY Held					
Disp	Node2> MPLM Mated Port GF						

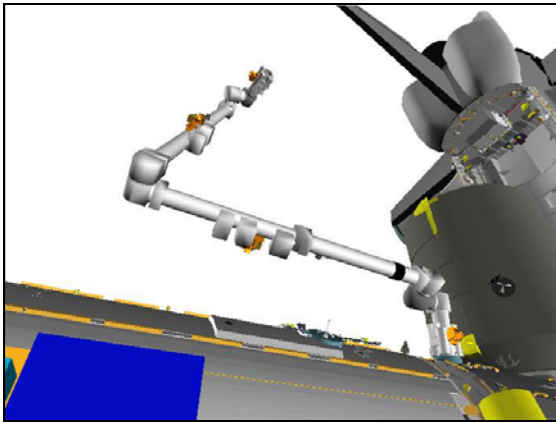


Figure 6.- Intermediate 1 Position
(07: P1 Lower Inboard: +115, +40).

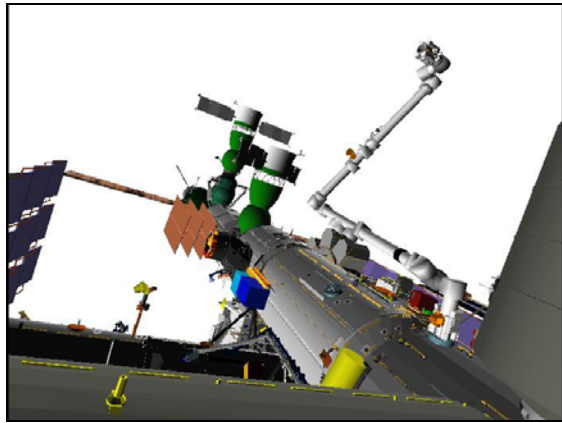


Figure 7.- Intermediate 1 Position
(SRMS Elbow: +150, +45).

3. JOINT OCAS TO INTERMEDIATE 2 POSITION

PCS MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

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

SR	SY	SP	EP	WP	WY	WR
+180.0	+160.0	-150.0	+50.0	-100.0	-80.0	+90.0

cmd Load (Verify Sequence Status – Confirm or Cancel)

1.240 NODE 2 MATED MPLM GRAPPLE
 (RBT FS/17A/FIN) Page 4 of 9 pages

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

	SR	SY	SP	EP	WP	WY	WR
(current)	+90.0	+30.0	-85.0	+100.0	-45.0	-115.0	+150.0
TGT	+180.0	+160.0	-150.0	+50.0	-100.0	-80.0	+90.0
ERR	-90.0	-130.0	+65.0	+50.0	+55.0	-35.0	+60.0

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
+180.0	+160.0	-150.0	+50.0	-100.0	-80.0	+90.0

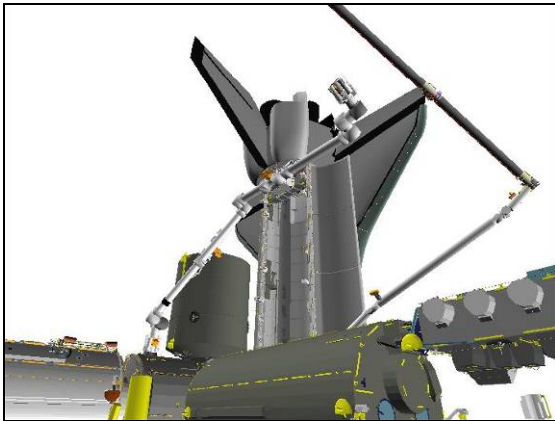


Figure 8.- Intermediate 2 Position
 (09: P1 Lower Outboard: +130, +30).

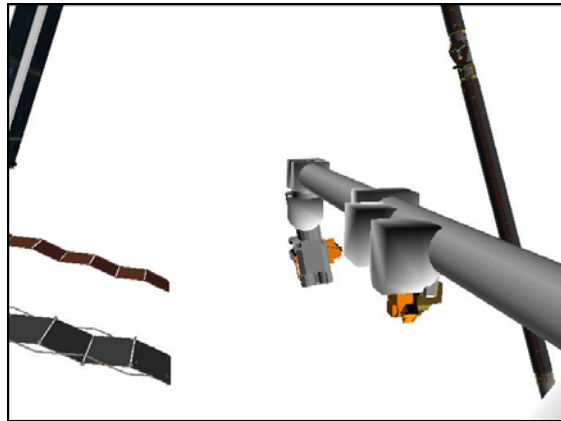


Figure 9.- Intermediate 2 Position
 (22: Base Elbow: +140, -10).

4. JOINT OCAS TO INTERMEDIATE 3 POSITION

<u>NOTE</u>
Expect singularity warning for EP between -15 and +15 deg.

SSRMS Joint OCAS

Input 'Joint Angles' 'Destination' for Intermediate 3 position.

SR	SY	SP	EP	WP	WY	WR
+60.3	+151.3	-150.0	-109.2	-121.0	-5.8	+6.9

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)	+180.0	+160.0	-150.0	+50.0	-100.0	-80.0	+90.0
TGT	+60.3	+151.3	-150.0	-109.2	-121.0	-5.8	+6.9
ERR	+119.7	+8.7	0.0	+159.2	+21.0	-74.2	+83.1

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

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

DCP AUTO SEQ → PROC

PCS MSS: SSRMS:

SSRMS

Verify Posn Hold – orange

Verify Joint Angle values.

SR	SY	SP	EP	WP	WY	WR
+60.3	+151.3	-150.0	-109.2	-121.0	-5.8	+6.9

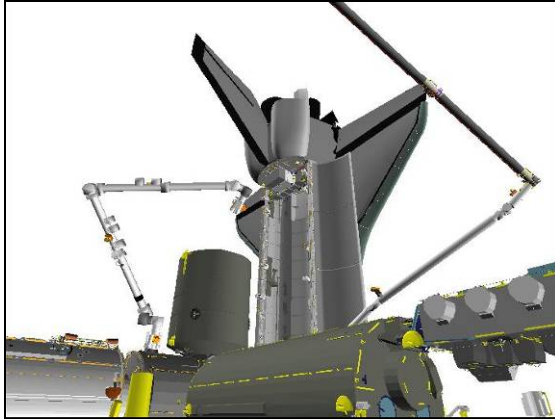


Figure 10.- Intermediate 3 Position
(09: P1 Lower Outboard: +130, +30).

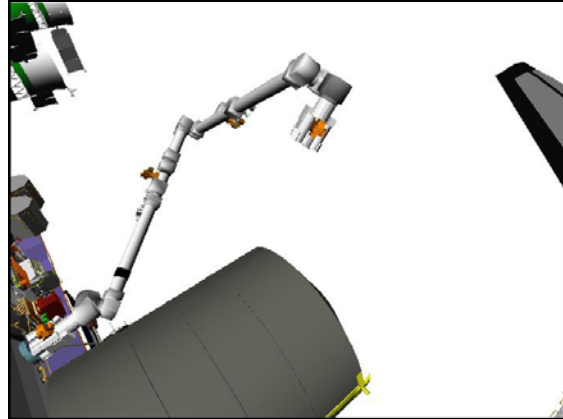


Figure 11.- Intermediate 3 Position
(SRMS Elbow: -150, +50).

5. SINGLE JOINT TO MPLM PRE-GRAPPLE

NOTE

Note the following clearances during this maneuver:

- a) SSRMS Base boom to MPLM approximately 104 cm (41 in). This may be monitored with the SRMS Elbow Camera.
- b) SSRMS Tip LEE to Orbiter sill approximately 124 cm (49 in). This may be monitored with Camera B.

MSS: SSRMS:

Enter Mode – Single (Verify blue)

WARNING

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

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

	SR	SY	SP	EP	WP	WY	WR	
Intermediate 2	+60.3	+151.3	-150.0	-109.2	-121.0	-5.8	+6.9	
1: SP –			-209.9					
MPLM	+60.3	+151.3	-209.9	-109.2	-121.0	-5.8	+6.9	
Pre-Grapple	X	Y	Z	Pitch	Yaw	Roll		
	-150	0	0	0.0	0.0	0.0		
	FOR	Unloaded – LEE Tip, SY Held						
	Disp	Node2> MPLM Mated Port GF						



Figure 12.- MPLM Pre-Grapple
 (09: P1 Lower Outboard: +130, +30).

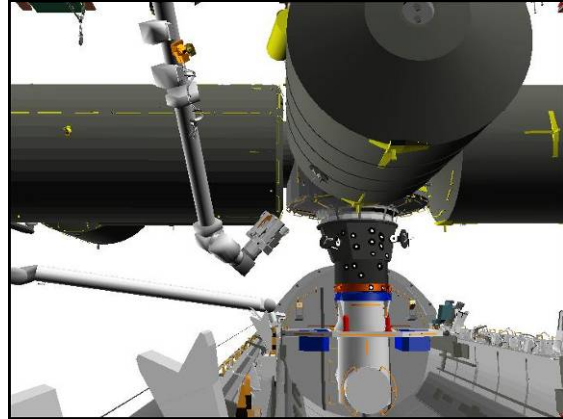


Figure 13.- MPLM Pre-Grapple
 (Camera B: 0, +10).

6. MPLM GRAPPLE

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
09: P1 Lower Outboard (+130, +30)	25: Tip LEE	24: Tip Elbow (-20, 0)	SRMS Elbow (-165, +25)	Camera B (0, +10)

NOTE

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

- 6.1 Setup
 PCS MSS: SSRMS:
 Enter Mode – Manual (Verify blue)
 MSS: SSRMS: SSRMS Manual: Joint Lock:
cmd Shoulder Yaw (Verify SY – Locked)
- 6.2 Maneuver
 RHC/THC Maneuver to within grapple envelope.
- 6.3 Auto Capture
 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 Motors – Inh

6.4 Cleanup

MSS: SSRMS: SSRMS

Enter Mode – Standby (Verify blue)

Change Display ► Node2 ► MPLM Mate CBCS (Verify Node2>MPLM Mate CBCS)

Verify Command – SSRMS>Internal

Expected Node 2 mated MPLM Grapple position.

SR	SY	SP	EP	WP	WY	WR
+62.0	+151.3	-203.3	-122.9	-113.0	-7.2	+7.1
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded – MPLM CBCS Mate, SY Held					
Disp	Node2> MPLM Mate CBCS					

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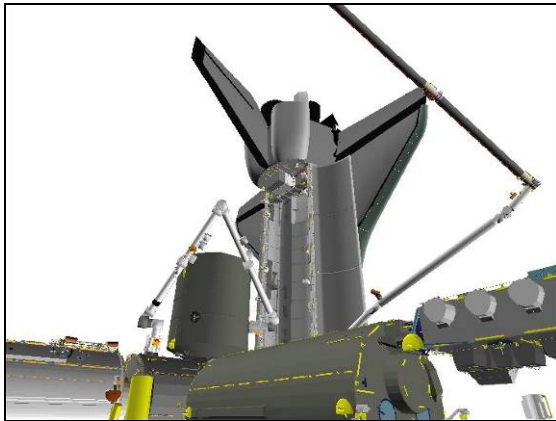


Figure 14.- Node 2 Mated MPLM Grapple
(09: P1 Lower Outboard: +130, +30).

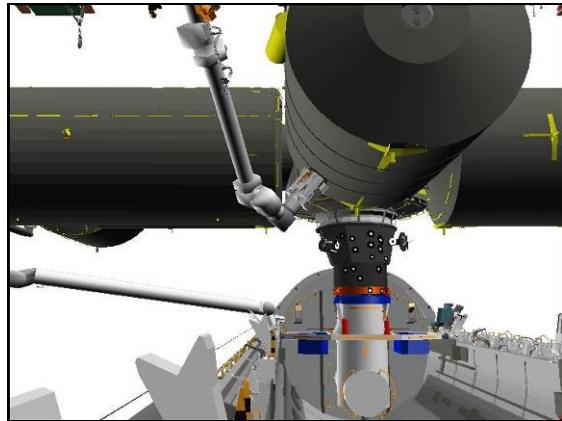


Figure 15.- Node 2 Mated MPLM Grapple
(Camera B: 0, +10).

DCP BRAKES SSRMS → ON (Verify ON)

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1.250 MPLM DEMATE TO BERTH
 (RBT FS/17A/FIN) Page 1 of 13 Pages

1. ACTIVATING KEEL CAMERA
 Notify shuttle crew ready to activate Keel CCTV.

NOTE
 Steps highlighted in gray are performed by shuttle crew.

SSP2 ✓cb SW PWR 3 – cl

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

2. SETUP FOR UNBERTH
 Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
09: P1 Lower Outboard (+130, +20)	22: Base Elbow (-40, 0)	03: S1 Lower Outboard (+60, +20)	SRMS Elbow (-150, +30)	Camera B (0, +10)

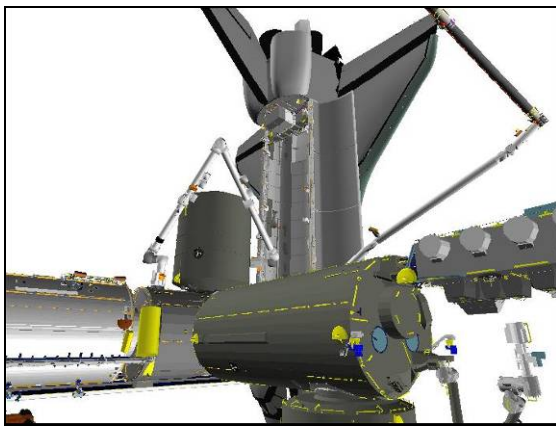


Figure 1.- MPLM Grapple
 (09: P1 Lower Outboard: +130, +20).

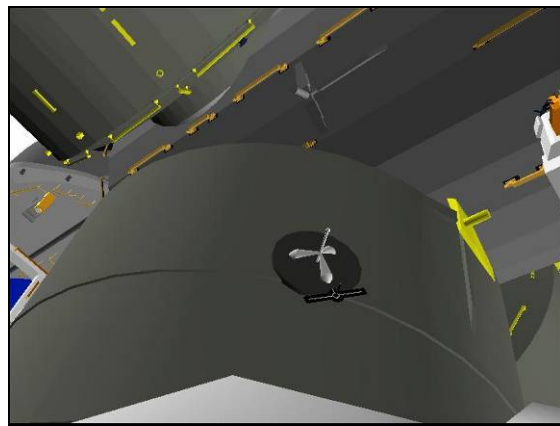


Figure 2.- MPLM Grapple
 (22: Base Elbow: -40, 0).

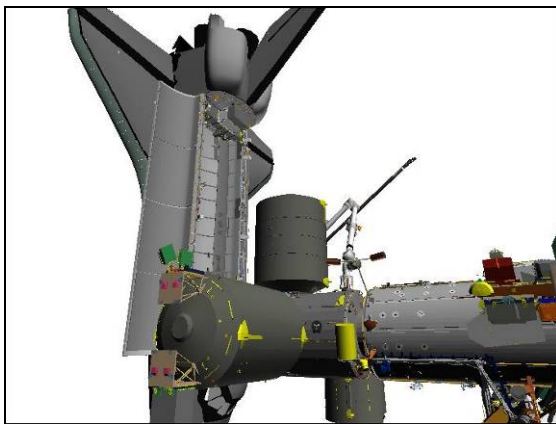


Figure 3.- MPLM Grapple
 (03: S1 Lower Outboard: +60, +20)

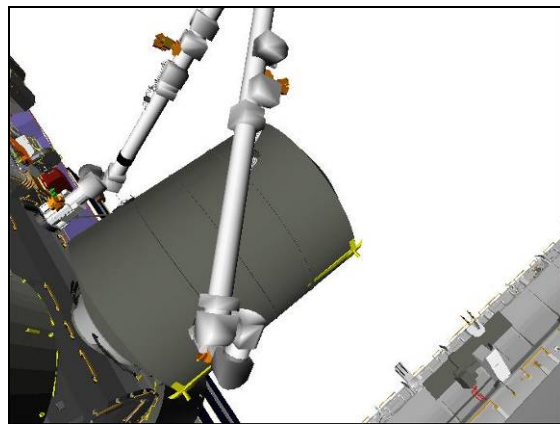


Figure 4.- MPLM Grapple
 (SRMS Elbow: -150, +30).

1.250 MPLM DEMATE TO BERTH

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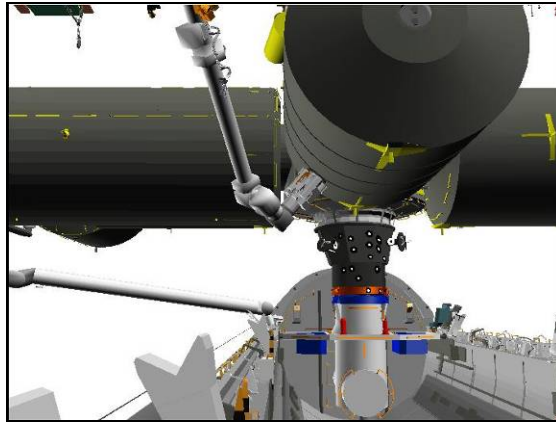


Figure 5.- MPLM Grapple
(Camera B: 0, +10).

PCS

MSS: SSRMS:

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

Verify Display – Node2>MPLM Mate CBCS

Verify Command – SSRMS>Internal

√Vernier

MSS: SSRMS: Rate:

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

3. ATTITUDE CONTROL CONFIGURATION

MSS: SSRMS: Thrusters:

Verify 'Desat Request:' – Inh

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

4. MANEUVERING MPLM TO DEMATE POSITION

On CBM operator, "Go for SSRMS to maneuver element."

DCP

BRAKES SSRMS → OFF (Verify OFF)

PCS

MSS: SSRMS:

Enter Mode – Manual (Verify – blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

1.250 MPLM DEMATE TO BERTH

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cmd Shoulder Yaw (Verify SY – Locked)

THC/
RHC

Maneuver to MPLM Backoff position (within 5 cm/1 deg).
(Expect “+X” motion, THC in)

	Locked					
SR	SY	SP	EP	WP	WY	WR
+74.6	+151.3	-188.3	-117.8	-126.5	-18.0	+9.9
X	Y	Z	Pitch	Yaw	Roll	
+200	0	0	0.0	0.0	0.0	
FOR	Loaded – MPLM CBCS Mate, SY Held					
Disp	Node2>MPLM Mate CBCS					

PCS

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

Notify CBM operator, “Clear of structure, Go to close petals.”

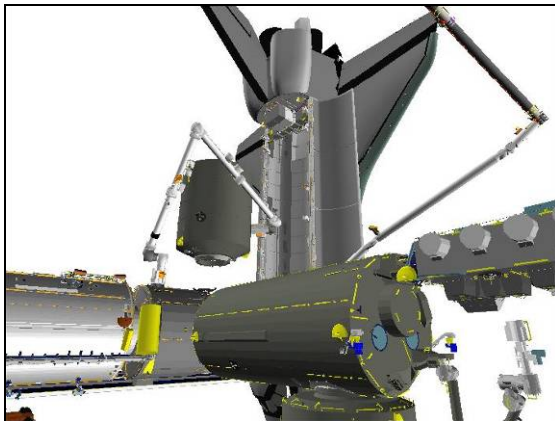


Figure 6.- MPLM Demate Position
(09: P1 Lower Outboard: +130, +20).

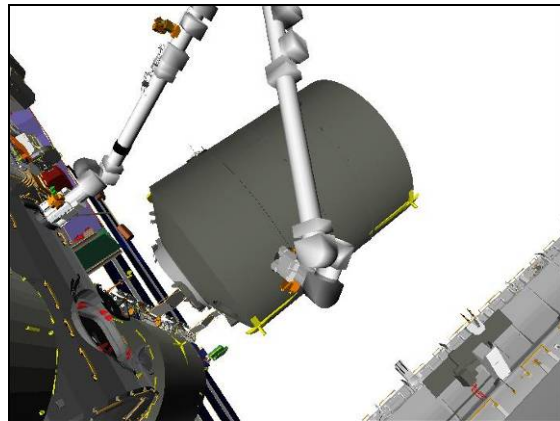


Figure 7.- MPLM Demate Position
(SRMS Elbow: -150, +30).

5. ATTITUDE CONTROL CONFIGURATION

If using shuttle attitude control

Coordinate with shuttle crewmembers.

If attitude maintenance reqd

DAP: LVLH

When rates damped

DAP: FREE > 2 seconds, then

DAP: AUTO

When in attitude

DAP: FREE

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(RBT FS/17A/FIN)

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6. MANEUVERING TO MPLM LOW HOVER

MSS: SSRMS:

Change Loaded Parameters ► MPLM ► MPLM Berth SRH

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

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

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

SR	SY	SP	EP	WP	WY	WR
+74.6	+151.3	-188.3	-117.8	-126.5	-18.0	+9.9
X	Y	Z	Pitch	Yaw	Roll	
+508	-34	-578	-1.0	0.0	-90.0	
FOR	Loaded – MPLM Berth, SR Held					
Disp	Orbiter>MPLM Berth					

RHC RATE → COARSE (Verify Coarse on PCS)

PCS MSS: SSRMS:

Enter Mode – FOR OCAS (Verify blue)

MSS: SSRMS: SSRMS FOR OCAS: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

Input 'FOR' 'Destination' for MPLM 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	+508	-34	-578	-1.0	0.0	-90.0
TGT	0	0	-600	0.0	0.0	0.0
ERR	+508	-34	+22	-1.0	0.0	-90.0

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

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

DCP AUTO SEQ → PROC

PCS MSS: SSRMS:

Verify Posn Hold – orange

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

SR	SY	SP	EP	WP	WY	WR
+74.6	+163.8	-134.5	-117.7	-60.0	-55.7	+100.8
X	Y	Z	Pitch	Yaw	Roll	
0	0	-600	0.0	0.0	0.0	
FOR	Loaded – MPLM Berth, SR Held					
Disp	Orbiter>MPLM Berth					

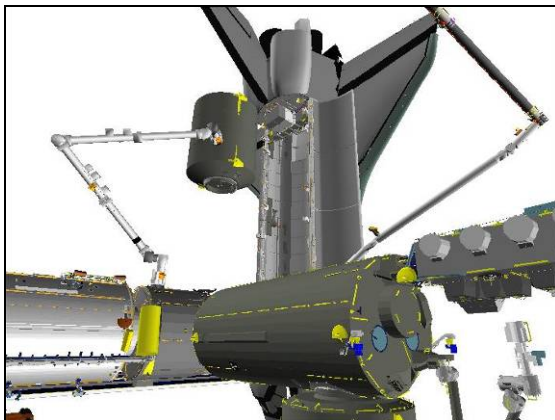


Figure 8.- MPLM Low Hover
 (09: P1 Lower Outboard: +130, +20).

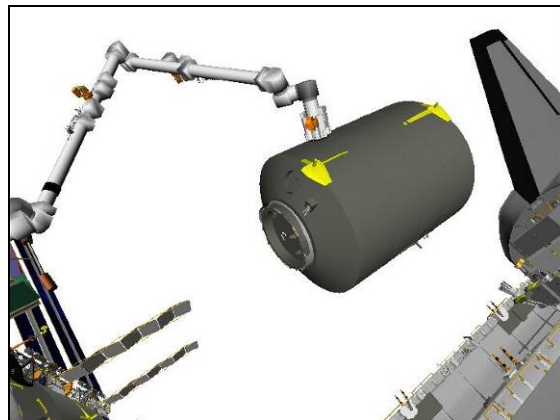


Figure 9.- MPLM Low Hover
 (SRMS Elbow: -140, +40).

7. ATTITUDE CONTROL CONFIGURATION

If using shuttle attitude control
 Coordinate with shuttle crewmembers.
 If attitude maintenance reqd
 DAP: LVLH
 When rates damped
 DAP: FREE > 2 seconds, then
 DAP: AUTO
 When in attitude
 DAP: FREE

8. MPLM BERTH

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
72: Camera A (-10, +10)	71: Mux B/C (B: -5, -10) (C: +5, -10)	03: S1 Lower Outboard (+60, +20)	Keel	OBSS ITVC (+140, -60)

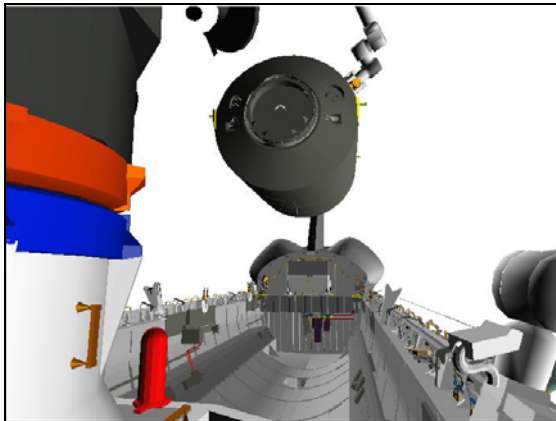


Figure 10.- MPLM Low Hover
(72: Camera A: -10, +10).



Figure 11.- MPLM Low Hover
(71: Mux B/C).

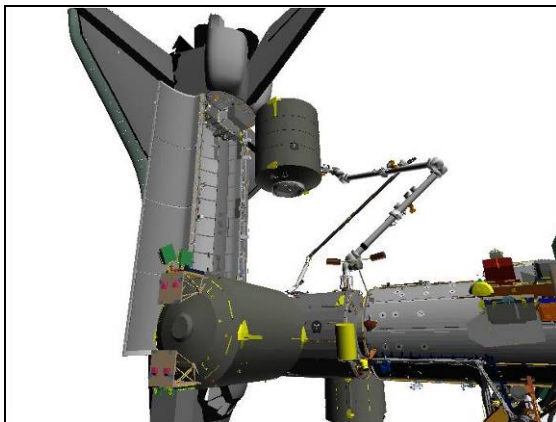


Figure 12.- MPLM Low Hover
(03: S1 Lower Outboard: +60, +20).

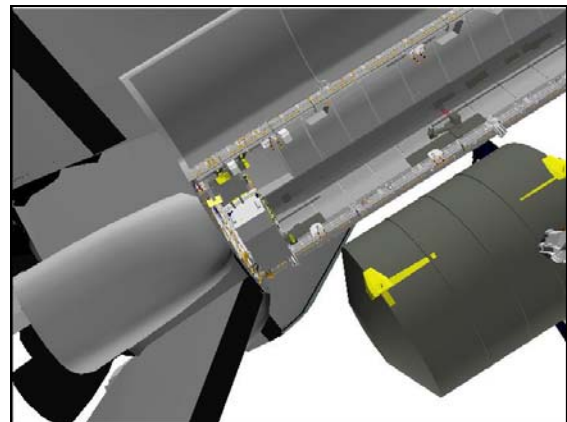


Figure 13.- MPLM Low Hover
(OBSS ITVC: +140, -60).

1.250 MPLM DEMATE TO BERTH

(RBT FS/17A/FIN)

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NOTE

1. Steps highlighted in gray are performed by the shuttle crew to latch MPLM PRLAs and AKA and mate ROEU.
2. The clearance between the MPLM and the ATA is approximately 30 cm (12 in). This clearance may be monitored with the OBSS ITVC Camera.

A6U

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

SM 97 PL RETENTION

√RDY-FOR-LAT 1,2,3,4 (eight): 0

Monitor the PL RETEN RDY 1,2,3,4 tb and provide R-F-L calls to SSRMS operator as each tb is acquired.

RHC

RATE → VERNIER (Verify Vernier on PCS)

PCS

MSS: SSRMS: Rate: **SSRMS Rate**

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

MSS: SSRMS: **SSRMS**

Enter Mode – Manual (Verify – blue)

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

cmd Shoulder Roll (Verify SR – Locked)

THC/
RHC

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

Locked	SR	SY	SP	EP	WP	WY	WR
	+74.6	+175.4	-184.4	-86.6	-25.3	-62.3	+119.4
	X	Y	Z	Pitch	Yaw	Roll	
	0	0	0	0.0	0.0	0.0	
FOR	Loaded – MPLM Berth, SR Held						
Disp	Orbiter>MPLM Berth						

Verify Posn Hold – orange

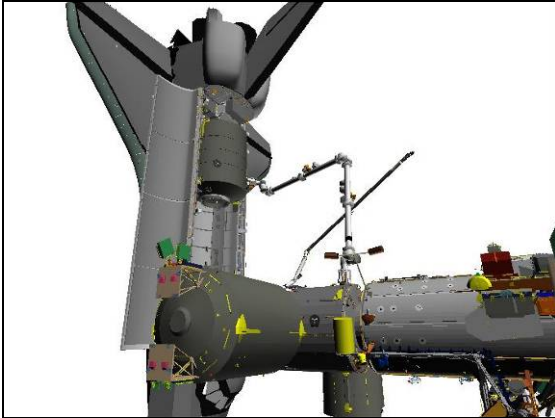


Figure 14.- MPLM Berth
 (03: S1 Lower Outboard: +60, +20).

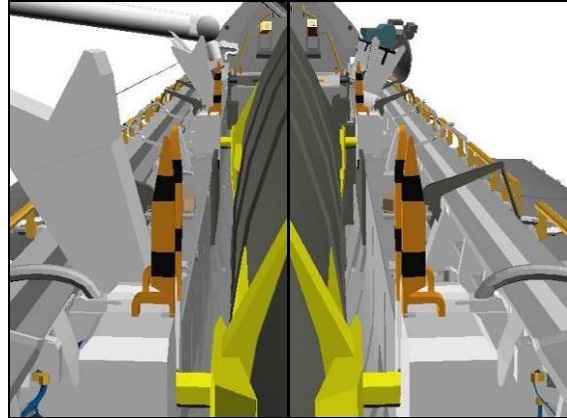


Figure 15.- MPLM Berth
 (71: Mux B/C: FL = 16 mm).

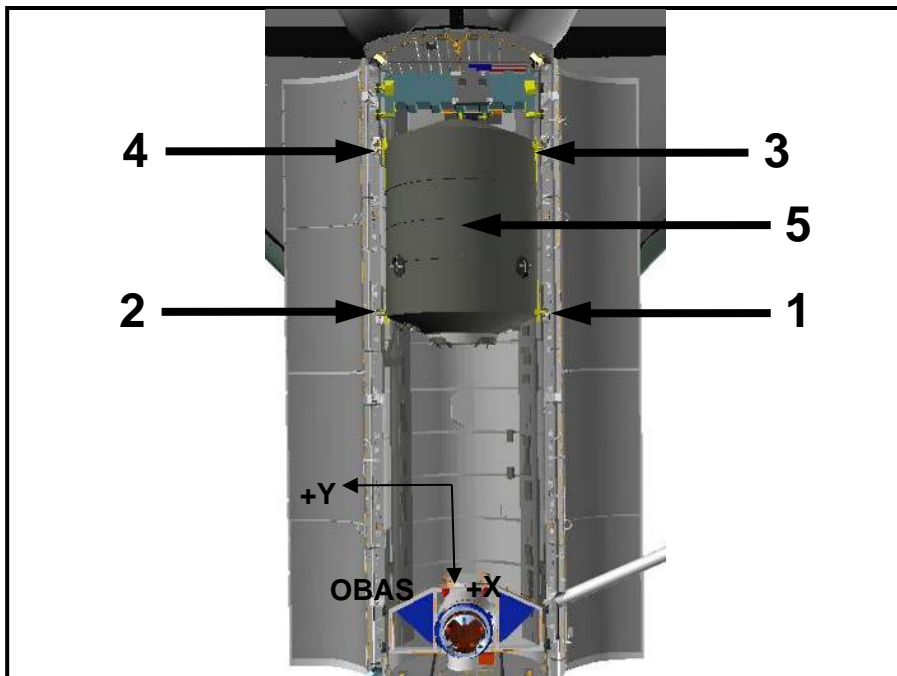


Figure 16.- MPLM PRLA Configuration.

9. PRLA SETUP

Give shuttle crew GO for PRLA steps.

√Payload Bay light status

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

1.250 MPLM DEMATE TO BERTH

(RBT FS/17A/FIN)

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

SM 97 PL RETENTION

√RDY-FOR-LAT 1,2,3,4 (eight): 1

√LAT 1,2,3,4,5 (ten): 0

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

10. ACTIVATING LATCHES

A6U √PL RETEN LAT (five) – OFF
 LOGIC PWR SYS 1,2 (two) – ON
R13L BAY MECH PWR SYS 1,2 (two) – ON

11. AKA LATCH

A6U √PL RETEN LAT 5 tb – REL

Note single motor drive times (> 30 seconds).

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

√PL RETEN RDY 5 tb – gray

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

PCS MSS: SSRMS: SSRMS

Verify Posn Hold – orange

If any PL RETEN RDY tb – bp
 √**MCC** for GO to perform the following off-nominal (starred block)

A6U * √PL RETEN LAT 5 tb – LAT
 *
 * Note single motor drive times (> 30 seconds).
 *
 * PL RETEN LAT 5 – REL (tb-REL), 60 s max
 * – OFF
 *
 * PL RETEN LOGIC PWR SYS 1,2 (two) – OFF
 R13L * BAY MECH PWR SYS 1,2 (two) – OFF
 *
 * Notify SSRMS operator, AKA Released.
 *

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

PCS * MSS: SSRMS:
 *
 *

Verify MPLM Berth Posn

Locked						
SR	SY	SP	EP	WP	WY	WR
+74.6	+175.4	-184.4	-86.6	-25.3	-62.3	+119.4
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded – MPLM Berth, SR Held					
Disp	Orbiter>MPLM Berth					

Verify Posn Hold – orange

Go to step 9.

12. PRLA LATCH

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

Note single motor drive times (> 30 seconds).

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

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

Give SSRMS operator GO for limping.

PCS MSS: SSRMS:

1.250 MPLM DEMATE TO BERTH

(RBT FS/17A/FIN) Page 11 of 13 Pages

Enter Mode – Standby (Verify blue)

MSS: SSRMS: Limp:

cmd All Limp (Verify Limp – blue)

MSS: SSRMS:

Verify all joints – Limped

Give PRLA operator GO for forward latches.

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

13. DEACTIVATING LATCHES

A6U
R13L
PL RETEN LOGIC PWR SYS 1,2 (two) – OFF
BAY MECH PWR SYS 1,2 (two) – OFF

14. DEACTIVATING MPLM KEEL CCTV

SSP2
MPLM KEEL CAM HTR/ILLUM PWR – Toggle until illuminator OFF
(leave sw in ON position)
MPLM KEEL CAM PWR – OFF

15. ROEU MATE

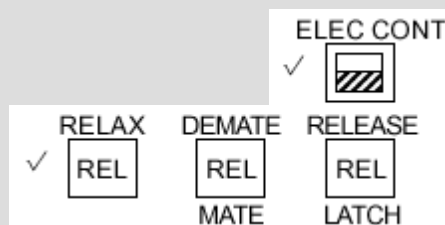
15.1 Setup
CCTV – config for ROEU mate

A6U
Install ROEU A6U PANEL OVERLAY.

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

√LAT 1,2,3 (six): 0

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



1.250 MPLM DEMATE TO BERTH

(RBT FS/17A/FIN)

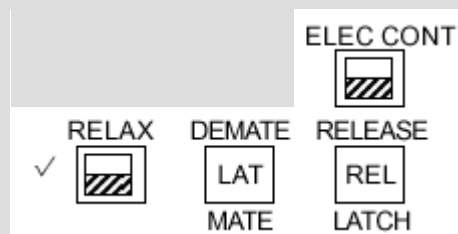
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15.2 Verifying ROEU Inhibits
 SSP1 √MPLM CH 1,2 HTR PWR – OFF (tb-bp)
 A15 √APCU 1 OUTPUT – OFF

15.3 Activating ROEU
 A6U PL RETEN LOGIC PWR SYS 1,2 (two) – ON
 R13L BAY MECH PWR SYS 1,2 (two) – ON

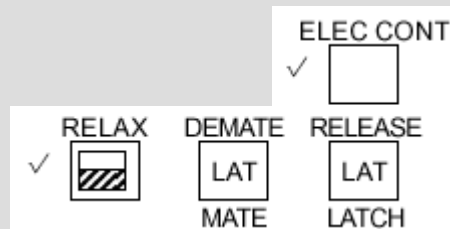
15.4 Mating ROEU
 Note single motor time (> 30 seconds).

A6U DEMATE/MATE – MATE (tb-LAT), 60 s max
 – OFF



15.5 Latching Latches
 Note single motor time (> 20 seconds).

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



15.6 Relaxing ROEU

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

Note single motor time (> 12 seconds).

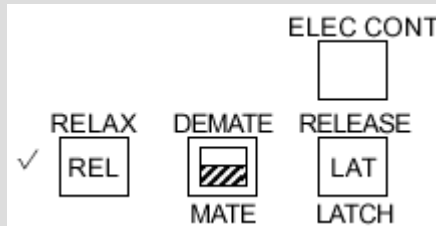
RELAX – RELAX (tb-REL), 24 s max

1.250 MPLM DEMATE TO BERTH

(RBT FS/17A/FIN)

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



A6U 15.7 Deactivating ROEU
PL RETEN LOGIC PWR SYS 1,2 (two) – OFF
PL SEL – MON

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

Give SSRMS operator GO for MPLM Ungrapple.

16. ATTITUDE CONTROL CONFIGURATION

If using shuttle attitude control

Coordinate with shuttle crewmembers.

If attitude maintenance reqd

DAP: LVLH

When rates damped

DAP: FREE > 2 seconds, then

DAP: AUTO

DCP BRAKES SSRMS → ON (Verify ON)

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1.260 BERTHED MPLM RELEASE

(RBT FS/17A/FIN)

Page 1 of 6 pages

1. SETUP

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
09: P1 Lower Outboard (+130, +20)	25: Tip LEE	24: Tip Elbow (0, +10)	SRMS Elbow (-100, +30)	Camera B (0, 0)

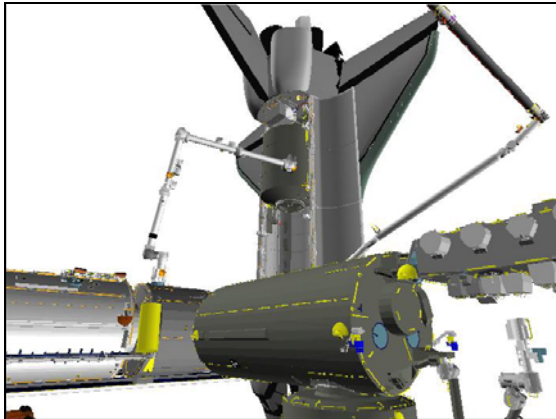


Figure 1.- MPLM Berthed
(09: P1 Lower Outboard: +130, +20)

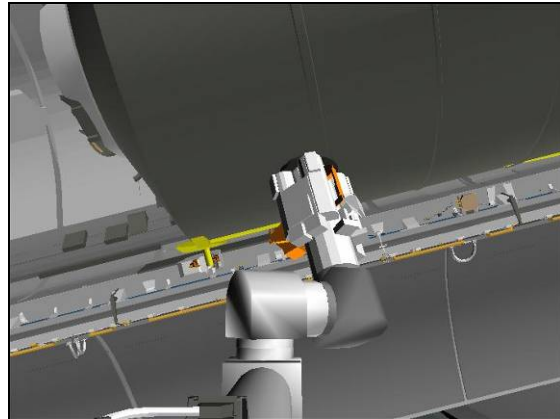


Figure 2.- MPLM Berthed
(24: Tip Elbow: 0, +10)

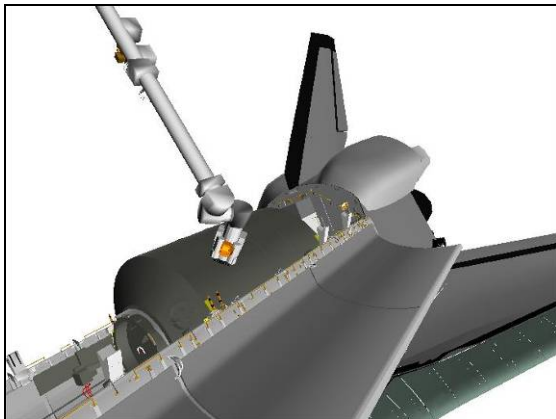


Figure 3.- MPLM Berthed
(SRMS Elbow:-100, +30).

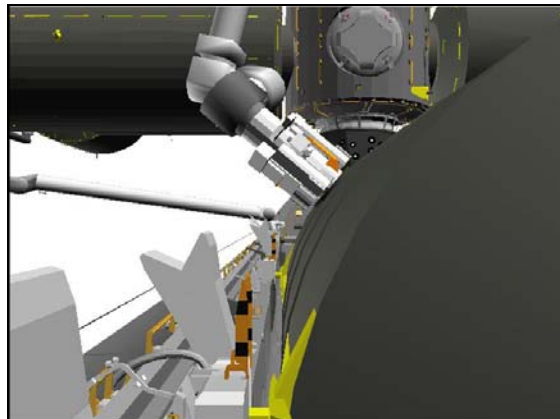


Figure 4.- MPLM Berthed
(Camera B: 0, 0).

PCS

MSS: SSRMS:

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

Change Unloaded Parameters ► Unloaded ► LEE Tip SRH

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

Change Display ► Orbiter ► MPLM Port GF (Verify Orbiter>MPLM Port GF)

Verify Command – SSRMS>Internal

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1.260 BERTHED MPLM RELEASE

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√Vernier

MSS: SSRMS: Rate:

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

DCP BRAKES SSRMS → OFF (Verify OFF)

2. MPLM RELEASE

2.1 SSRMS Limp

PCS MSS: SSRMS: Limp:

cmd All Limp (Verify Limp – blue)

MSS: SSRMS:

Verify all joints – Limped

2.2 Auto Release

MSS: SSRMS: Tip LEE:

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

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

CAUTION

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

NOTE

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

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Auto Release

RHC TRIGGER → Press (momentarily)

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

Verify Unloaded Parameters – √

1.260 BERTHED MPLM RELEASE

(RBT FS/17A/FIN)

2.3 SSRMS Backoff

MSS: SSRMS: Limp:

cmd None Limp (Verify Standby – blue)

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

THC/
RHC

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

Locked							
SR	SY	SP	EP	WP	WY	WR	
+74.6	+162.7	-176.3	-91.8	-45.5	-54.9	+99.3	
X	Y	Z	Pitch	Yaw	Roll		
-200	0	0	0.0	0.0	0.0		
FOR	Unloaded – LEE Tip, SR Held						
Disp	Orbiter> MPLM Port GF						

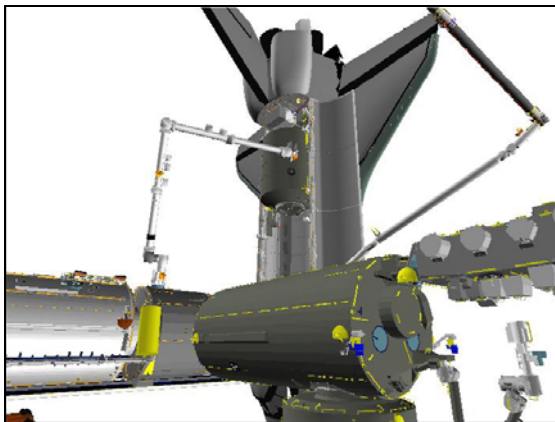


Figure 5.- Berthed MPLM Backoff Position (09: P1 Lower Outboard: +130, +20).

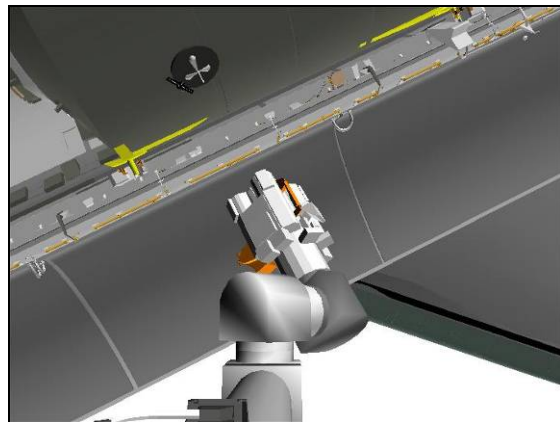


Figure 6.- Berthed MPLM Backoff Position (24: Tip Elbow: 0, +10).

1.260 BERTHED MPLM RELEASE

(RBT FS/17A/FIN)

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2.4 Cleanup
 PCS MSS: SSRMS:

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

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

SR	SY	SP	EP	WP	WY	WR
+74.6	+162.7	-176.3	-91.8	-45.5	-54.9	+99.3
X	Y	Z	Pitch	Yaw	Roll	
+1441	-329	+1601	+0.7	+50.2	-29.7	
FOR	Unloaded – LEE Tip, SR Held					
Disp	ISS>ISSACS					

3. SINGLE JOINT TO INTERMEDIATE POSITION

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
09: P1 Lower Outboard (+130, +20)	03: S1 Lower Outboard (+60, +20)	24: Tip Elbow (-10, +10)	SRMS Elbow (-140, +60)	Camera D (+10, +20)

MSS: SSRMS:

Enter Mode – Single (Verify blue)

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

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

MPLM Backoff 1: SP + Intermediate	SR	SY	SP	EP	WP	WY	WR
	+74.6	+162.7	-176.3	-91.8	-45.5	-54.9	+99.3
			-144.1				
	+74.6	+162.7	-144.1	-91.8	-45.5	-54.9	+99.3
	X	Y	Z	Pitch	Yaw	Roll	
	+928	-327	+1889	-17.4	+37.3	-43.5	
	FOR	Unloaded – LEE Tip, SR Held					
	Disp	ISS>ISSACS					

1.260 BERTHED MPLM RELEASE

(RBT FS/17A/FIN)

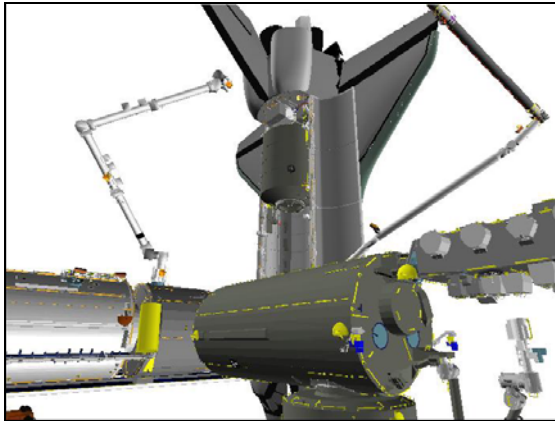


Figure 7.- Berthed MPLM Backoff Position (09: P1 Lower Outboard: +130, +20).



Figure 8.- Berthed MPLM Backoff Position (SRMS Elbow: -140, +60).

4. JOINT OCAS TO STAGE PARK

RHC RATE → COARSE (Verify Coarse on PCS)

PCS MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

Input 'Joint Angles' 'Destination' for Stage Park position.

SR	SY	SP	EP	WP	WY	WR
+74.6	+220.0	-150.0	-50.0	-130.0	-121.0	+180.0

cmd Load (Verify Sequence Status – Confirm or Cancel)

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

	SR	SY	SP	EP	WP	WY	WR
(current)	+74.6	+162.7	-144.1	-91.8	-45.5	-54.9	+99.3
TGT	+74.6	+220.0	-150.0	-50.0	-130.0	-121.0	+180.0
ERR	0.0	-57.3	+5.9	-41.8	+84.5	+66.1	-80.7

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.

1.260 BERTHED MPLM RELEASE

(RBT FS/17A/FIN)

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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 Stage Park position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+74.6	+220.0	-150.0	-50.0	-130.0	-121.0	+180.0
X	Y	Z	Pitch	Yaw	Roll	
+896	+885	+1901	+87.5	+87.3	-20.6	*
FOR	Unloaded – LEE Tip, SR Held					
Disp	ISS>ISSACS					

*Approaching display singularity.

RHC RATE → VERNIER (Verify Vernier on PCS)

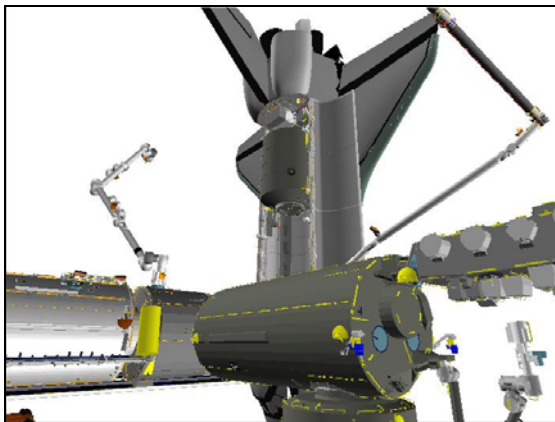


Figure 9.- Stage Park Position
(09: P1 Lower Outboard: +130, +20).

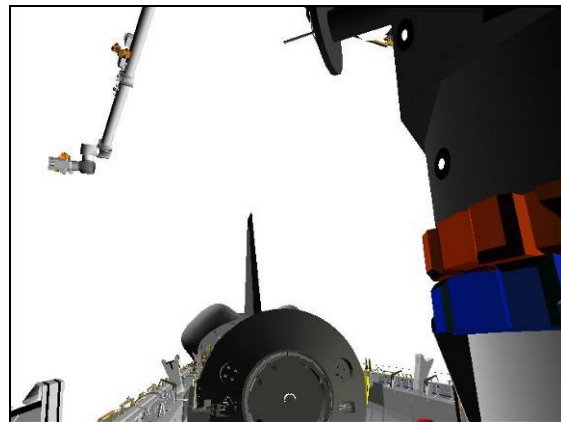


Figure 10.- Stage Park Position
(Camera D: +10, +20).

NOTE

Expect the following message when safing is commanded:

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

This message should return to Norm.

DCP SAFING → SAFE (Verify ON)

1.310 EVA1 - OLD ATA GRAPPLE AND EUTEF UNINSTALL
 (RBT FS/17A/FIN) Page 1 of 29 pages

1. SETUP

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
09: P1 Lower Outboard (+110, +20)	71: Camera B (-20, +50)	22: Base Elbow (-110, -10)	SRMS Elbow (+150, +50)	OBSS ITVC (+55, -80)



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

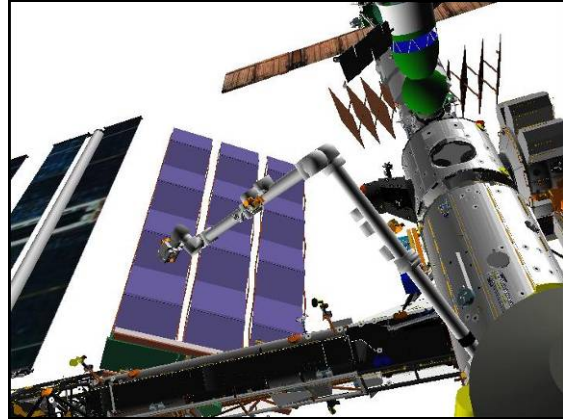


Figure 2.- EVA 1 Setup Position
 (71: Camera B: -20, +50).

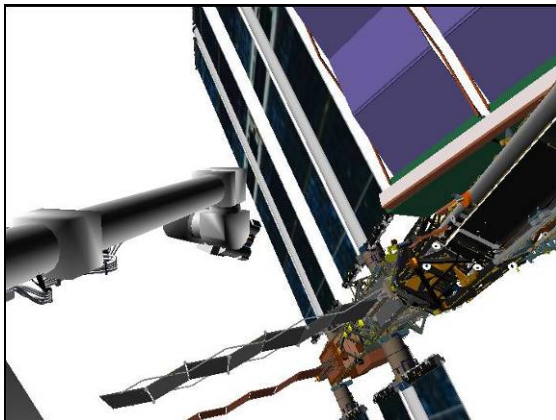


Figure 3.- EVA 1 Setup Position
 (22: Base Elbow: -110, -10).

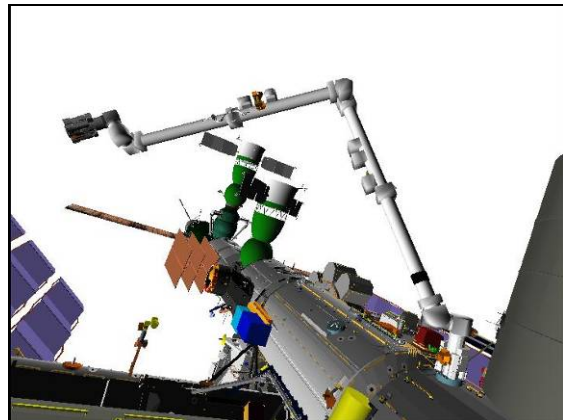


Figure 4.- EVA 1 Setup Position
 (SRMS Elbow: +150, +50).

1.310 EVA1 - OLD ATA GRAPPLE AND EUTEF UNINSTALL

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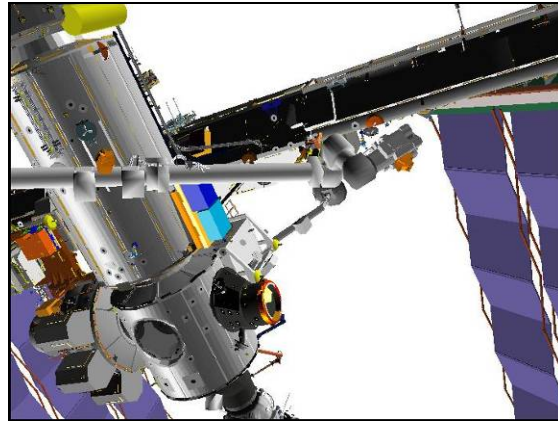


Figure 5.- EVA 1 Setup Position
(OBSS ITVC: +55, -80).

PCS

MSS: SSRMS:

Change Loaded Parameters ► ATA ► ATA Mnvr SRH
Verify 'Loaded Parameters' (two) – ATA Mnvr, SR Held

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

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

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

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

SR	SY	SP	EP	WP	WY	WR
+145.0	+20.0	-30.0	-85.0	-20.0	-20.0	+11.1
X	Y	Z	Pitch	Yaw	Roll	
+146	-1149	+1009	+83.8	-49.9	-46.3	
FOR	Unloaded – LEE Tip, SR Held					
Disp	ISS>ISSACS					

2. JOINT OCAS TO ATA PRE-GRAPPLE POSITION

Verify Port TRRJ locked at -40 degrees for old ATA uninstall.

MSS: SSRMS: MSS Safing:

cmd 'SSRMS' Remove (Verify Not Safed)

DCP

BRAKES SSRMS → OFF (Verify OFF)

RHC

RATE → VERNIER (Verify Vernier on PCS)

1.310 EVA1 - OLD ATA GRAPPLE AND EUTEF UNINSTALL

(RBT FS/17A/FIN)

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PCS MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

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

SR	SY	SP	EP	WP	WY	WR
+118.2	-5.5	-73.2	-61.7	-86.0	-30.1	+11.1

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)	+145.0	+20.0	-30.0	-85.0	-20.0	-20.0	+11.1
TGT	+118.2	-5.5	-73.2	-61.7	-86.0	-30.1	+11.1
ERR	+26.8	+25.5	+43.2	-23.3	+66.0	+10.1	0.0

* If joint angles or errors are incorrect

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

*
* Input correct Dest joint angles per table above.

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

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

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

DCP AUTO SEQ → PROC

PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at ATA Pre-Grapple position.

SR	SY	SP	EP	WP	WY	WR
+118.2	-5.5	-73.2	-61.7	-86.0	-30.1	+11.1
X	Y	Z	Pitch	Yaw	Roll	
-238	-724	+287	+45.0	-0.1	0.0	
FOR	Unloaded – LEE Tip, SR Held					
Disp	ISS>ISSACS					

DCP BRAKES SSRMS → ON (Verify ON)

1.310 EVA1 - OLD ATA GRAPPLE AND EUTEF UNINSTALL

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Figure 6.- ATA Pre-Grapple
(09: P1 Lower Outboard: +110, +20).

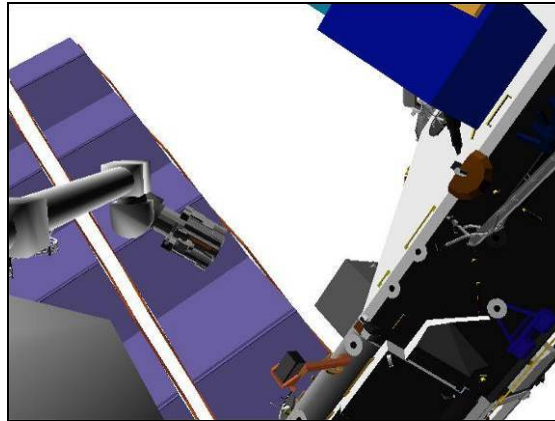


Figure 7.- ATA Pre-Grapple
(22: Base Elbow: -120, -10).

3. ATA GRAPPLE

3.1 Setup

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
09: P1 Lower Outboard (+110, 0)	25: Tip LEE	22: Base Elbow (-120, -10) 07: P1 Lower Inboard (+5, -75)	SRMS Elbow (+150, +50)	OBSS ITVC (+55, -85)

NOTE

1. Tip LEE Camera must be fully zoomed out to correspond to target overlay.
2. The clearance between the SSRMS Tip LEE and the P1 Truss is approximately 96 cm (38 in) at grapple. This clearance can be monitored with the OBSS ITVC or Base Elbow.

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

PCS

MSS: SSRMS:

√Vernier

MSS: SSRMS: Rate:

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

Wait for last bolt removal from ATA, then:

DCP

BRAKES SSRMS → OFF (Verify OFF)

1.310 EVA1 - OLD ATA GRAPPLE AND EUTEF UNINSTALL

(RBT FS/17A/FIN)

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PCS

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

3.2 Slow Capture Commands

MSS: SSRMS: Tip LEE:

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

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

CAUTION

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

NOTE

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

On EV GO, ready for ATA Grapple:

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Auto Capture

RHC/
THC

3.3 Maneuvering to Grapple Maneuver to within grapple envelope.

RHC

3.4 Grapple TRIGGER → Press (momentarily)

PCS

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

DCP

BRAKES SSRMS → ON (Verify ON)

Notify EV, old ATA grapple complete.

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3.5 Grapple Cleanup

PCS

MSS: SSRMS:

Verify Loaded Parameters – √

Verify 'Loaded Parameters' (two) – ATA Mnvr, SR Held

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

MSS: SSRMS: Rate:

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

Expected ATA Grapple position:

SR	SY	SP	EP	WP	WY	WR
+118.2	+4.2	-77.5	-68.3	-72.0	-22.5	+18.0
X	Y	Z	Pitch	Yaw	Roll	
-128	-724	+177	+45.0	-0.1	0.0	
FOR	Loaded – ATA Mnvr, SR Held					
Disp	ISS>ISSACS					

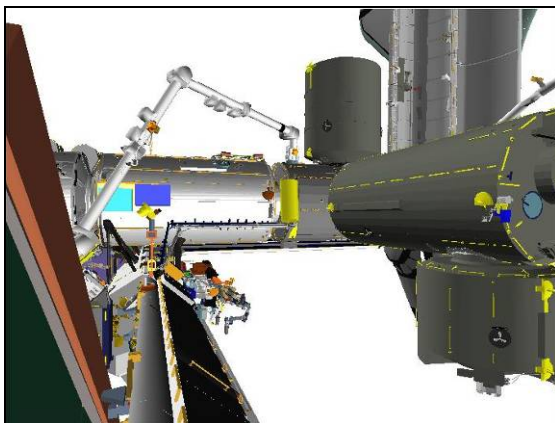


Figure 8.- ATA Grappled
(09: P1 Lower Outboard: +110, 0).

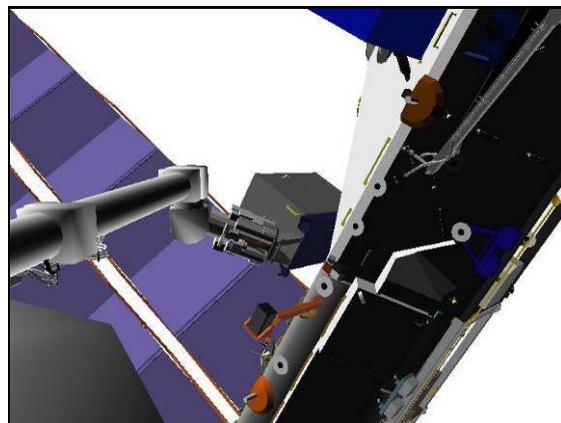


Figure 9.- ATA Grappled
(22: Base Elbow: -120, -10).

4. MANUAL MANEUVER TO APFR INSTALL POSITION

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
09: P1 Lower Outboard (+110, 0)	71: Camera B (-20, +40)	24: Tip Elbow (-20, +10) 22: Base Elbow (-120, -10)	SRMS Elbow (+150, +50)	OBSS ITVC (+55, -85)

NOTE

When the APFR is installed the clearance between the APFR and the P1 Truss is approximately 33 cm (13 in). This clearance can be monitored with the Tip Elbow or Base Elbow Camera.

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On EV GO, ready to maneuver to APFR install:

DCP BRAKES SSRMS → OFF (Verify OFF)

PCS MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

THC/
RHC Perform EVA GCA as required for APFR Install.
Expected APFR Install position:

Locked						
SR	SY	SP	EP	WP	WY	WR
+118.2	+4.2	-77.5	-68.3	-72.0	-22.5	+18.0
X	Y	Z	Pitch	Yaw	Roll	
-128	-724	+177	+45.0	-0.1	0.0	
FOR	Loaded – ATA Mnv, SR Held					
Disp	ISS>ISSACS					

DCP BRAKES SSRMS → ON (Verify ON)

Notify EV, brakes on ready, for APFR install.

NOTE

APFR settings are 12/NN/F/6 and 50 ft tether is being left attached between the APFR and Tip LEE.

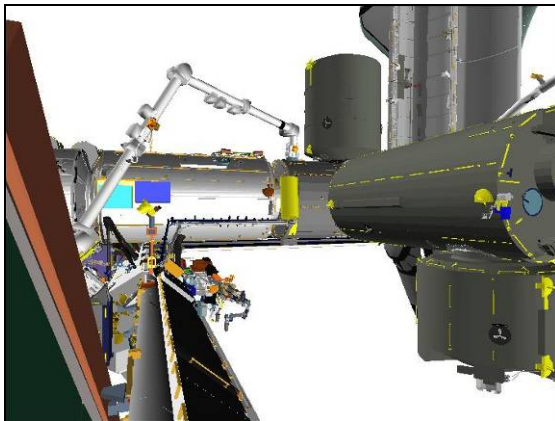


Figure 10.- APFR Install
(09: P1 Lower Outboard: +110, 0).

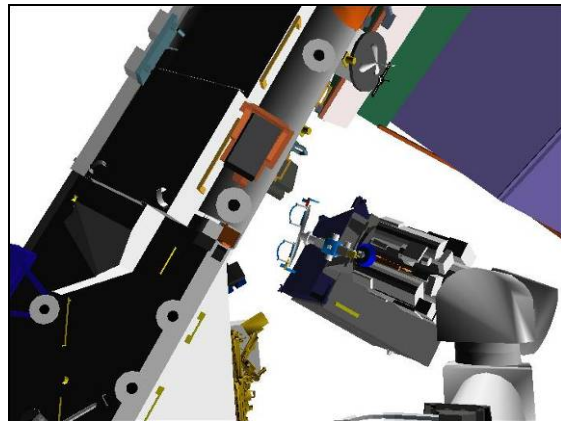


Figure 11.- APFR Install
(24: Tip Elbow: -20, +10).

5. MANUAL MANEUVER P1 BACKOFF POSITION

On EV GO, APFR installed, maneuver to EuTEF:

BRAKES SSRMS → OFF (Verify OFF)

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PCS MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

THC/
RHC Maneuver to P1 Backoff position (within 5 cm/1 deg).
(Expect “-X” motion, THC out)

Locked						
SR	SY	SP	EP	WP	WY	WR
+118.2	-5.8	-85.2	-45.5	-90.4	-30.3	+10.8
X	Y	Z	Pitch	Yaw	Roll	
-300	-724	+177	+45.0	-0.1	0.0	
FOR	Loaded – ATA Mnvr, SR Held					
Disp	ISS>ISSACS					

PCS MSS: SSRMS:

Enter Mode – Standby (Verify blue)

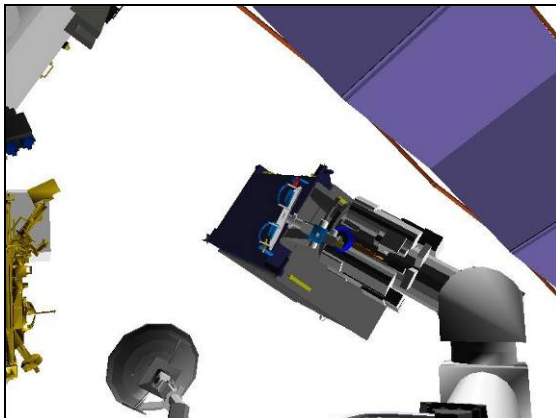


Figure 12.- P1 Backoff
(24: Tip Elbow: -20, +10).

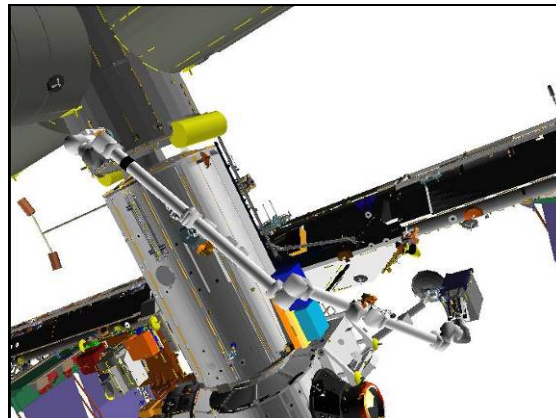


Figure 13.- P1 Backoff
(OBSS ITVC: +65, -70).

6. JOINT OCAS TO EUTEF INTERMEDIATE 1 POSITION

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
09: P1 Lower Outboard (+95, +30) 03: S1 Lower Outboard (+80, +35)	71: Camera C (-45, +50)	24: Tip Elbow (-20, +10) 22: Base Elbow (-130, -10)	SRMS Elbow (+150, +55)	OBSS ITVC (+65, -70)

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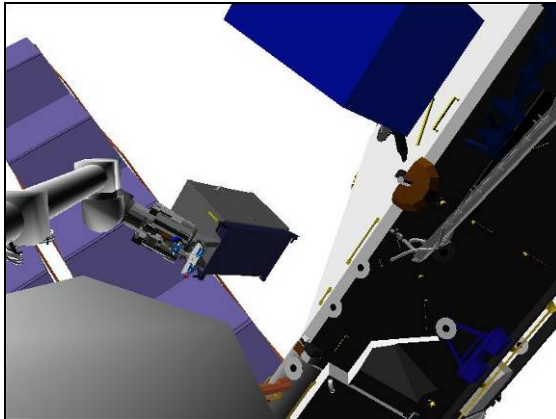


Figure 14.- P1 Backoff
(22: Base Elbow: -130, -10).

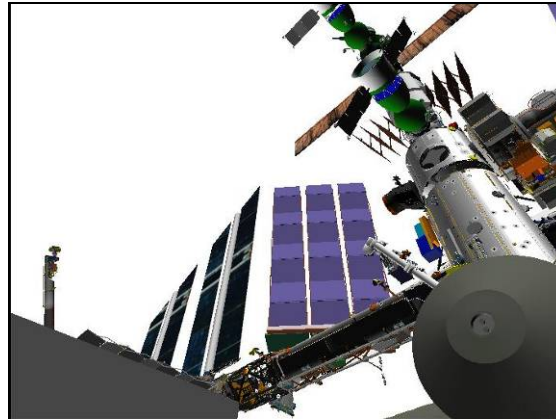


Figure 15.- P1 Backoff
(71: Camera C: -45, +50).

RHC RATE → COARSE (Verify Coarse on PCS)

PCS MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

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

SR	SY	SP	EP	WP	WY	WR
+108.0	-20.0	-10.0	-45.0	-160.0	-100.0	+100.0

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)	+118.2	-5.8	-85.2	-45.5	-90.4	-30.3	+10.8
TGT	+108.0	-20.0	-10.0	-45.0	-160.0	-100.0	+100.0
ERR	+10.2	+14.2	-75.2	-0.5	+69.7	+69.6	-89.1

* If joint angles or errors are incorrect

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

* Input correct Dest joint angles per table above.

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

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

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

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DCP AUTO SEQ → PROC

PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify Joint Angle values.

SR	SY	SP	EP	WP	WY	WR
+108.0	-20.0	-10.0	-45.0	-160.0	-100.0	+100.0



Figure 16.- EuTEF Intermediate 1
(03: S1 Lower Outboard: +80, +35).

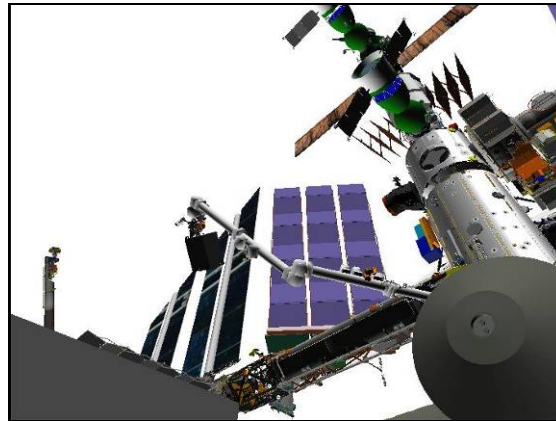


Figure 17.- EuTEF Intermediate 1
(71: Camera C: -45, +50).

7. JOINT OCAS TO EUTEF INTERMEDIATE 2 POSITION

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

SR	SY	SP	EP	WP	WY	WR
+10.0	-20.0	-30.0	-45.0	-160.0	-100.0	+100.0

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)	+108.0	-20.0	-10.0	-45.0	-160.0	-100.0	+100.0
TGT	+10.0	-20.0	-30.0	-45.0	-160.0	-100.0	+100.0
ERR	+98.0	0.0	+20.0	0.0	0.0	0.0	0.0

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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
+10.0	-20.0	-30.0	-45.0	-160.0	-100.0	+100.0

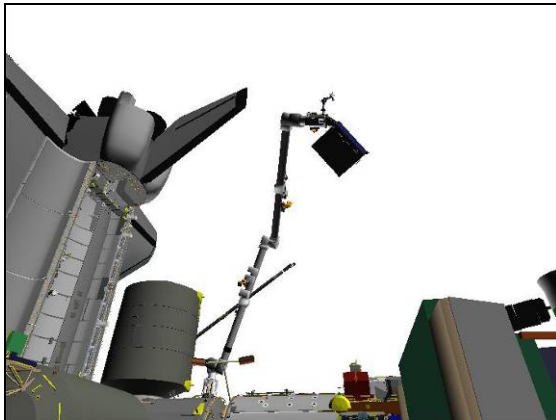


Figure 18.- EuTEF Intermediate 2
(03: S1 Lower Outboard: +80, +35).

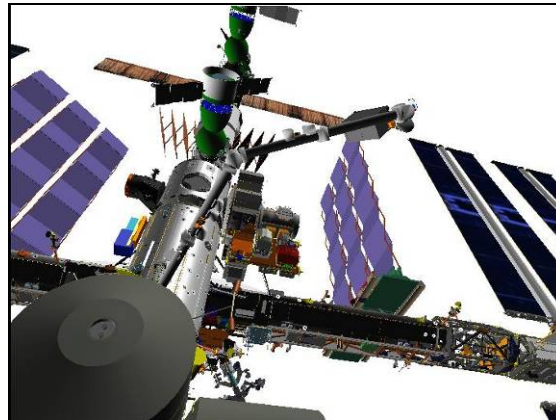


Figure 19.- EuTEF Intermediate 2
(71: Camera C: +15, +50).

8. JOINT OCAS TO EUTEF BACKOFF POSITION

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
03: S1 Lower Outboard (+80, +35) 22: Base Elbow (-120, -20)	24: Tip Elbow (-140, 0)	37: MBS Mast (+105, -10) 13: LAB Stbd Zenith (+10, -10)	Camera C (+15, +50)	OBSS ITVC (+95, -85)

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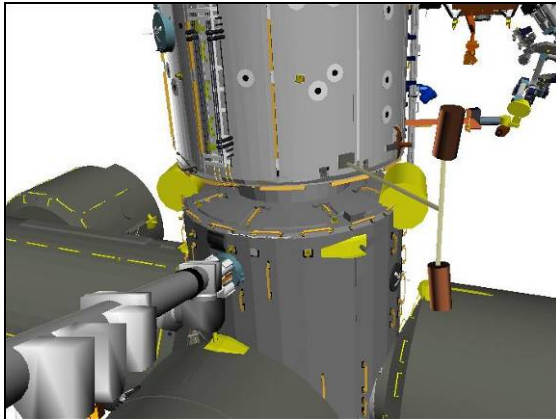


Figure 20.- EuTEF Intermediate 2
(24: Tip Elbow: -140, 0).

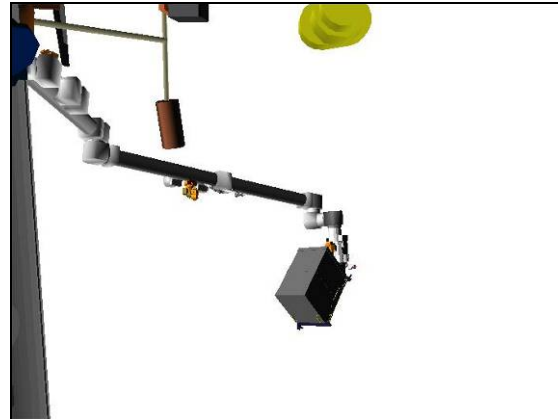


Figure 21.- EuTEF Intermediate 2
(37: MBS Mast: +105, -10).

NOTE

During the following maneuvers, the closest clearances are as follows:

- a. The APFR to Columbus, approximately 152 cm (60 in). This may be monitored with the MBS Mast Camera.
- b. The Base Boom to the UHF antennae, approximately 170 cm (67 in). This may be monitored with the Tip Elbow Camera.

MSS: SSRMS:

Input 'Joint Angles' 'Destination' for EuTEF Backoff position.

SR	SY	SP	EP	WP	WY	WR
-2.4	-0.7	-73.4	-86.9	-209.1	-179.8	+106.9

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)	+10.0	-20.0	-30.0	-45.0	-160.0	-100.0	+100.0
TGT	-2.4	-0.7	-73.4	-86.9	-209.1	-179.8	+106.9
ERR	+12.4	-19.3	+43.4	+41.9	+49.1	+79.8	-6.9

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.

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

DCP AUTO SEQ → PROC

PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at EuTEF Backoff position.

SR	SY	SP	EP	WP	WY	WR
-2.4	-0.7	-73.4	-86.9	-209.1	-179.8	+106.9
X	Y	Z	Pitch	Yaw	Roll	
+640	+929	+419	+89.8	-0.1	+19.4	
FOR	Loaded – ATA Mnvr, SR Held					
Disp	ISS>ISSACS					

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

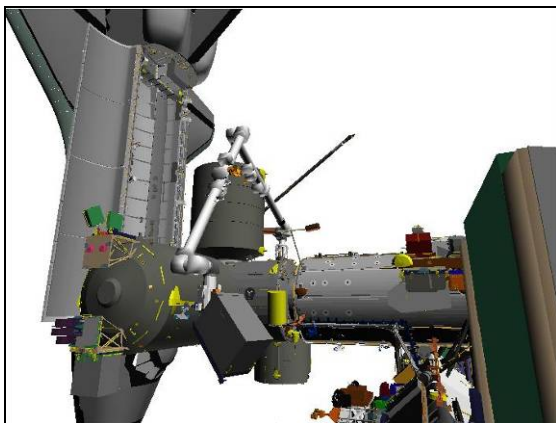


Figure 22.- EuTEF Backoff
(03: S1 Lower Outboard: +70, +15).

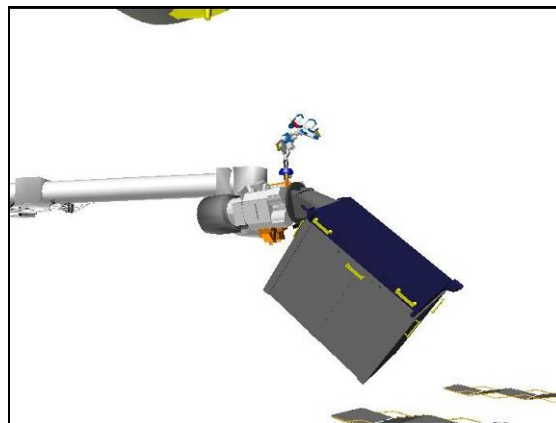


Figure 23.- EuTEF Backoff
(37: MBS Mast : +145, +10).

MSS: SSRMS: Thrusters:

Verify 'Desat Request:' – Inh

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

9. MANUAL MANEUVER TO APFR INGRESS POSITION

NOTE

The closest clearance during this maneuver is between the APFR and Columbus and is approximately 55 cm (22 in). This clearance may be monitored with the MBS Mast or LAB Stbd Zenith Cameras.

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On EV GO, ready to maneuver to APFR Ingress position:

RHC RATE → VERNIER (Verify Vernier on PCS)

PCS MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

THC/
RHC Perform EVA GCA as required for APFR Ingress.
(Expect “+X” motion, THC in)
Expected APFR Ingress position:

Locked						
SR	SY	SP	EP	WP	WY	WR
-2.4	-26.2	-71.8	-87.3	-211.3	-154.6	+102.4
X	Y	Z	Pitch	Yaw	Roll	
+840	+929	+419	+89.8	-0.1	+19.4	
FOR	Loaded – ATA Mnvr, SR Held					
Disp	ISS>ISSACS					

DCP BRAKES SSRMS → ON (Verify ON)

Notify EV, brakes on ready for APFR Ingress.

PCS MSS: SSRMS:

Change Loaded Parameters ► ATA ► Chest 12/NN/F/6 EuTEF SRH
Verify ‘Loaded Parameters’ (two) – Chest 12/NN/F/6 EuTEF, SR Held

Expected APFR Ingress position:

SR	SY	SP	EP	WP	WY	WR
-2.4	-26.2	-71.8	-87.3	-211.3	-154.6	+102.4
X	Y	Z	Pitch	Yaw	Roll	
+982	+923	+274	-18.1	-2.2	-0.8	
FOR	Loaded – Chest 12/NN/F/6 EuTEF, SR Held					
Disp	ISS>ISSACS					

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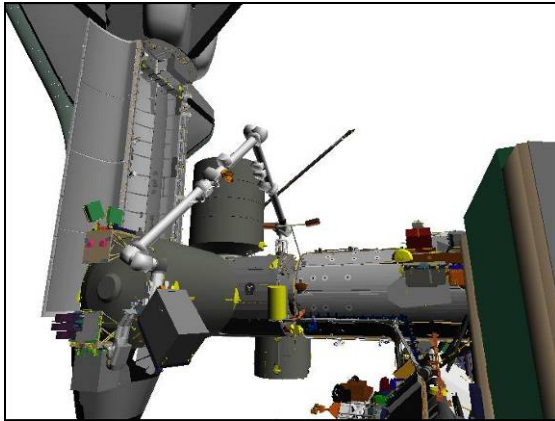


Figure 24.- APFR Ingress
(03: S1 Lower Outboard: +70, +15).

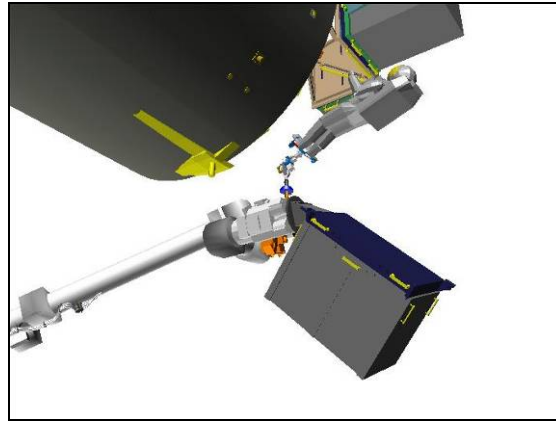


Figure 25.- APFR Ingress
(37: MBS Mast: +145, +25).

10. MANUAL MANEUVER TO EUTEF REMOVAL POSITION

On EV GO, ready to maneuver to EuTEF Removal position:

DCP BRAKES SSRMS → OFF (Verify OFF)

PCS MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

THC/ Perform EVA GCA as required for EuTEF Removal.

RHC (Expect “+Y” motion, THC right)

Expected EuTEF Removal position:

Locked						
SR	SY	SP	EP	WP	WY	WR
-2.4	-25.0	-75.0	-79.0	-216.4	-155.8	+102.7
X	Y	Z	Pitch	Yaw	Roll	
+982	+993	+274	-18.1	-2.2	-0.8	
FOR	Loaded – Chest 12/NN/F/6 EuTEF, SR Held					
Disp	ISS>ISSACS					

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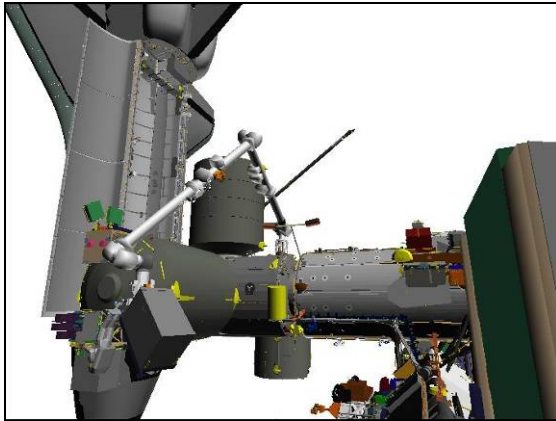


Figure 26.- EuTEF Removal
(03: S1 Lower Outboard: +70, +15).

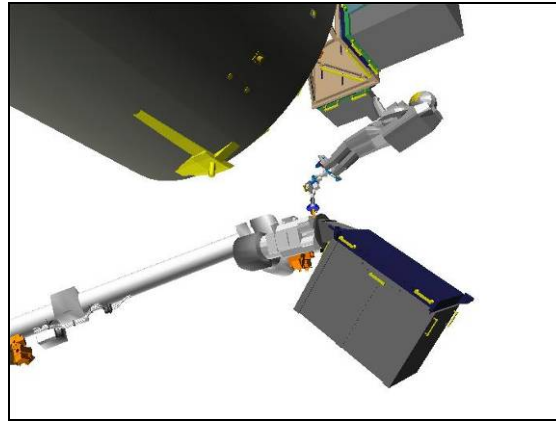


Figure 27.- EuTEF Removal
(37: MBS Mast: +145, +25).

11. MANUAL MANEUVER TO COLUMBUS BACKOFF

On EV GO, ready to maneuver to Columbus Backoff position:

THC/
RHC

Perform EVA GCA as required to clear Columbus, then:
Maneuver to Columbus Backoff position (within 5 cm/1 deg).
(Expect “-X” and “+Y” motion, THC out and right)

Locked						
SR	SY	SP	EP	WP	WY	WR
-2.4	+4.9	-82.9	-64.6	-222.0	-185.3	+107.8
X	Y	Z	Pitch	Yaw	Roll	
+741	+1094	+274	-18.1	-2.2	-0.8	
FOR	Loaded – Chest 12/NN/F/6 EuTEF, SR Held					
Disp	ISS>ISSACS					

PCS

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

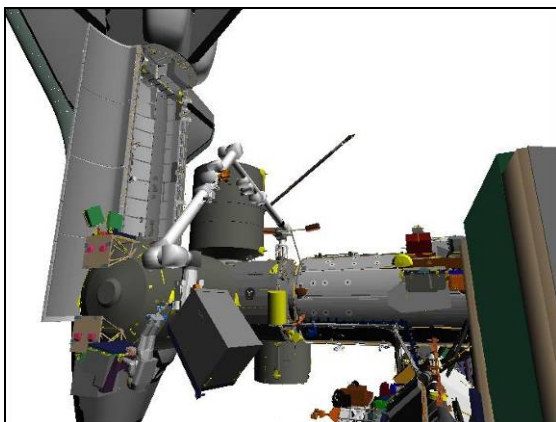


Figure 28.- Columbus Backoff
(03: S1 Lower Outboard: +70, +15).

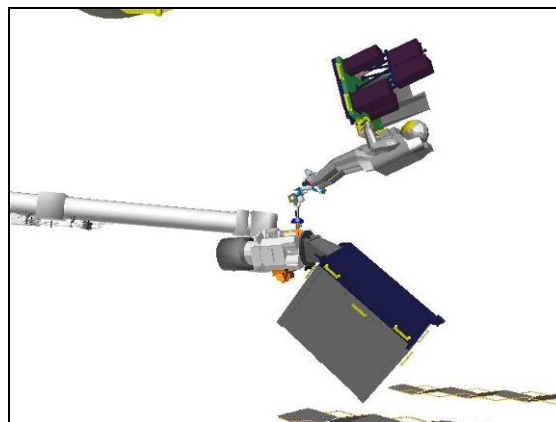


Figure 29.- Columbus Backoff
(37: MBS Mast: +150, +10).

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If using shuttle attitude control
 Coordinate with shuttle crewmembers.
 If attitude maintenance reqd
 DAP: LVLH
 When rates damped
 DAP: FREE > 2 seconds, then
 DAP: AUTO

12. JOINT OCAS TO LMC INTERMEDIATE POSITION

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
03: S1 Lower Outboard (+70, +15) 09: P1 Lower Outboard (+115, +30)	24: Tip Elbow (-130, 0)	37: MBS Mast (+150, +10) 22: Base Elbow (-120, -5)	Camera C (+15, +30)	SRMS Elbow (-150, +50)

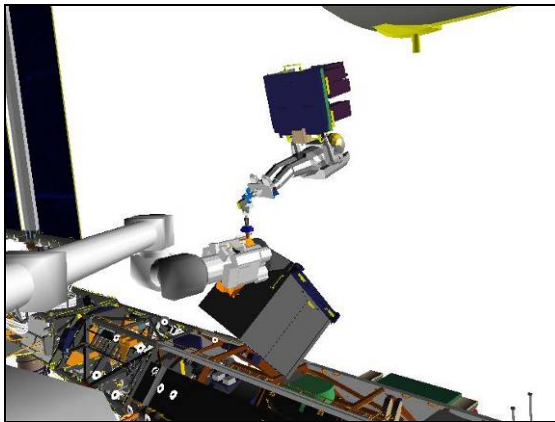


Figure 30.- Columbus Backoff (22: Base Elbow: -120, -5).

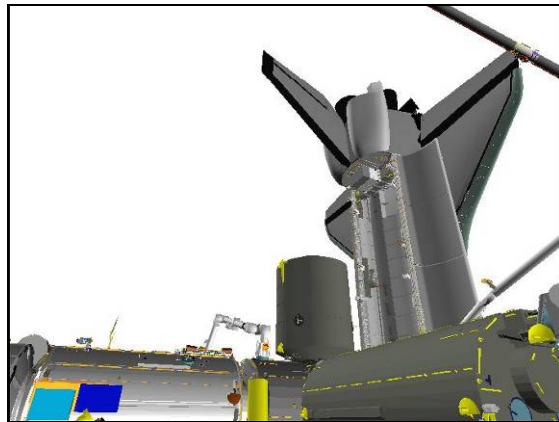


Figure 31.- Columbus Backoff (09: P1 Lower Outboard: +115, +30).

NOTE

1. Expect singularity warning for EP between -15 and +15 deg.
2. The clearance between the old ATA and the Tip Boom is approximately 73 cm (29 in). This may be monitored with the Base Elbow Camera.

On EV GO, ready to maneuver to LMC:

RHC RATE → COARSE (Verify Coarse on PCS)

PCS MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

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

SR	SY	SP	EP	WP	WY	WR
+70.0	-0.3	-40.0	+90.0	-160.3	-156.4	+203.0

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)	-2.4	+4.9	-82.9	-64.6	-222.0	-185.3	+107.8
TGT	+70.0	-0.3	-40.0	+90.0	-160.3	-156.4	+203.0
ERR	-72.4	+5.2	-42.9	-154.6	-61.7	-28.9	-95.2

PCS

* If joint angles or errors are incorrect

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

* Input correct Dest joint angles per table above.

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

MON

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

PCS

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

DCP

AUTO SEQ → PROC

PCS

MSS: SSRMS:

Verify Posn Hold – orange

Verify Joint Angle values.

SR	SY	SP	EP	WP	WY	WR
+70.0	-0.3	-40.0	+90.0	-160.3	-156.4	+203.0

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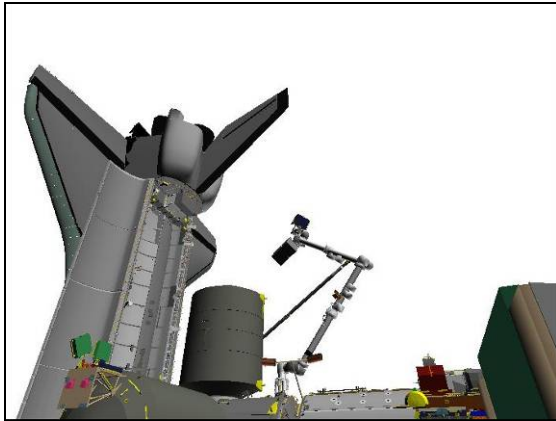


Figure 32.- LMC Intermediate
(03: S1 Lower Outboard: +70, +35)

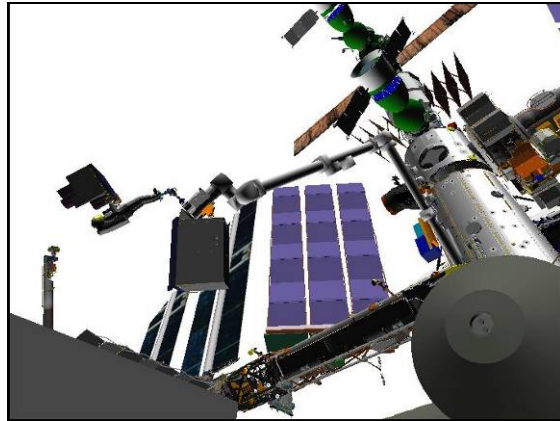


Figure 33.- LMC Intermediate
(Camera C: -45, +50)

13. JOINT OCAS TO PAYLOAD BAY BACKOFF POSITION

NOTE

The closest clearance for this maneuver is between the Old ATA and the MPLM and is approximately 160 cm (63 in). This clearance may be monitored with the SRMS Elbow Camera.

SSRMS Joint OCAS

Input 'Joint Angles' 'Destination' for Payload Bay Backoff position.

SR	SY	SP	EP	WP	WY	WR
+115.1	+12.7	-24.8	+104.7	-160.3	-156.4	+203.0

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)	+70.0	-0.3	-40.0	+90.0	-160.3	-156.4	+203.0
TGT	+115.1	+12.7	-24.8	+104.7	-160.3	-156.4	+203.0
ERR	-45.1	-13.0	-15.2	-14.7	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)

1.310 EVA1 - OLD ATA GRAPPLE AND EUTEF UNINSTALL

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DCP AUTO SEQ → PROC

PCS MSS: SSRMS: SSRMS

Verify Posn Hold – orange

Verify SSRMS at LMC Payload Bay Backoff position.

SR	SY	SP	EP	WP	WY	WR
+115.1	+12.7	-24.8	+104.7	-160.3	-156.4	+203.0
X	Y	Z	Pitch	Yaw	Roll	
+1344	-28	+1851	-104.6	0.0	+0.6	
FOR	Loaded – Chest 12/NN/F/6 EuTEF, SR Held					
Disp	ISS>ISSACS					

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

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

Verify SSRMS at LMC Payload Bay Backoff position.

SR	SY	SP	EP	WP	WY	WR
+115.1	+12.7	-24.8	+104.7	-160.3	-156.4	+203.0
X	Y	Z	Pitch	Yaw	Roll	
-2937	-25	-1390	+164.3	+0.2	+0.5	
FOR	Loaded – Chest 12/NN/F/6 EuTEF, SR Held					
Disp	ISS>OBAS					

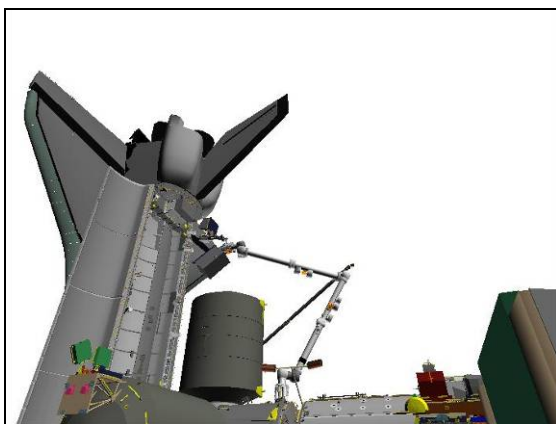


Figure 34- Payload Bay Backoff
(03: S1 Lower Outboard: +70, +35).

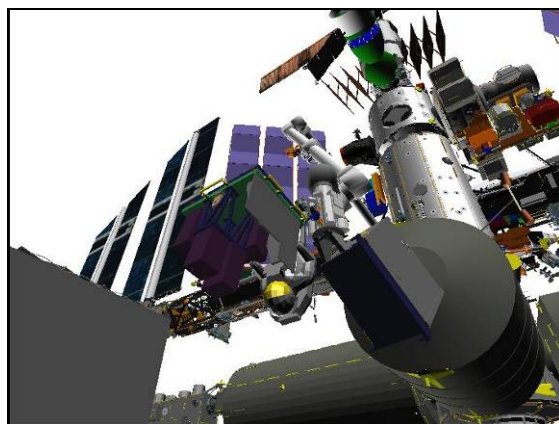


Figure 35- Payload Bay Backoff
(Camera C: -35, +40) .

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14. MANUAL MANEUVER TO LMC BACKOFF

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
03: S1 Lower Outboard (+70, +35)	24: Tip Elbow (0, +10) 22: Base Elbow (+90, -10)	71: Camera D (0, 0) 72: Camera A (0, 0)	OBSS ITVC (+130, -60)	SRMS Elbow (-150, +50)

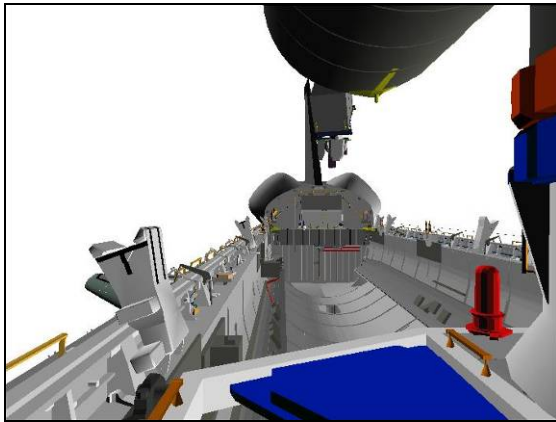


Figure 36.- Payload Bay Backoff (71: Camera D: 0, 0).

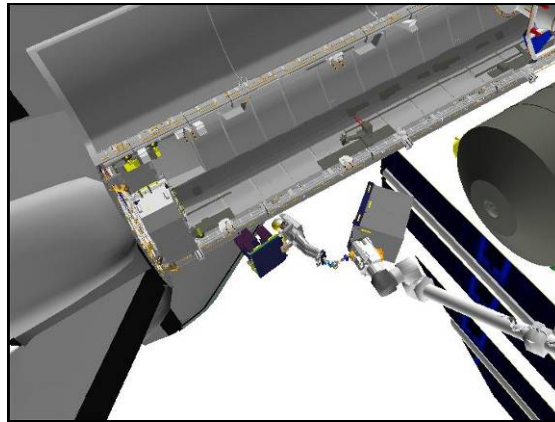


Figure 37.- Payload Bay Backoff (OBSS ITVC: +130, -60).

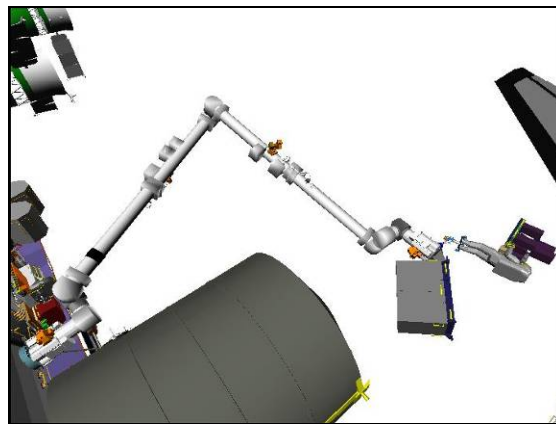


Figure 38.- Payload Bay Backoff (SRMS Elbow: -150, +50).

NOTE

- During the following maneuver, the closest clearances are as follows:
- The MPLM to the Base Boom, approximately 129 cm (51 in). This may be monitored with the S1 Lower Outboard Camera.
 - Old ATA to the Payload Bay, approximately 134 cm (53 in). This may be monitored with Camera D or the Tip Elbow Camera.

RHC

RATE → VERNIER (Verify Vernier on PCS)

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PCS MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

THC/
RHC Maneuver to LMC Backoff position (within 5 cm/1 deg).
(Expect “+Z” motion, THC down)

Locked						
SR	SY	SP	EP	WP	WY	WR
+115.1	+0.7	+6.5	+78.0	-170.4	-155.0	+189.9
X	Y	Z	Pitch	Yaw	Roll	
-2937	-25	-970	+164.3	+0.2	+0.5	
FOR	Loaded – Chest 12/NN/F/6 EuTEF, SR Held					
Disp	ISS>OBAS					

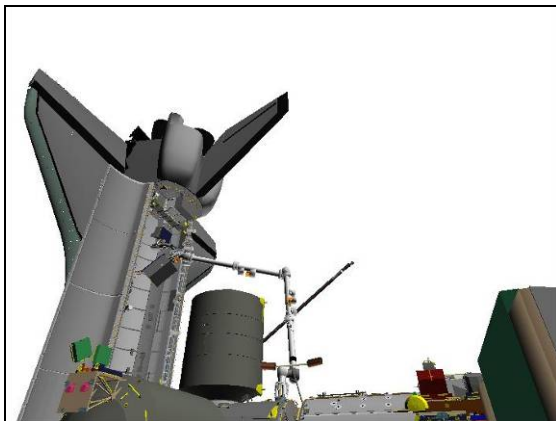


Figure 39.- LMC Backoff
(03: S1 Lower Outboard: +70, +35).

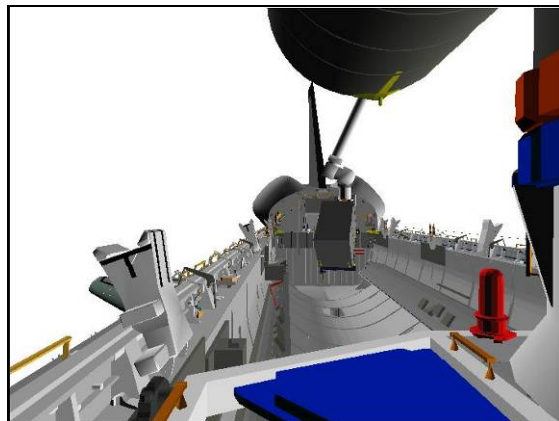


Figure 40.- LMC Backoff
(71: Camera D: 0, 0).

PCS MSS: SSRMS: Thrusters:

Verify ‘Desat Request:’ – Inh

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

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15. MANUAL MANEUVER TO EUTEF BERTH POSITION

NOTE

- During the following maneuver, the closest clearances are as follows:
- The APFR to the LMC, approximately 45 cm (18 in). This may be monitored with the OBSS ITVC.
 - The MPLM to the Base Boom, approximately 58 cm (23 in). This may be monitored with the SRMS Elbow or S1 Lower Outboard Cameras.
 - Old ATA to the Payload Bay, approximately 88 cm (35 in). This may be monitored with Camera D or the Tip Elbow Camera.

On EV GO, ready to maneuver to EuTEF Berth position:

THC/
RHC

Perform EVA GCA as required for EuTEF Berth.

(Expect "-X" motion, THC out)

Expected EuTEF Berth position:

Locked	SR	SY	SP	EP	WP	WY	WR
	+115.1	+2.0	+12.2	+54.9	-152.3	-155.1	+191.4
	X	Y	Z	Pitch	Yaw	Roll	
	-3140	-25	-970	+164.3	+0.2	+0.5	
FOR	Loaded – Chest 12/NN/F/6 EuTEF, SR Held						
Disp	ISS>OBAS						

DCP

BRAKES SSRMS → ON (Verify ON)

Notify EV, brakes on, ready for EuTEF berth.

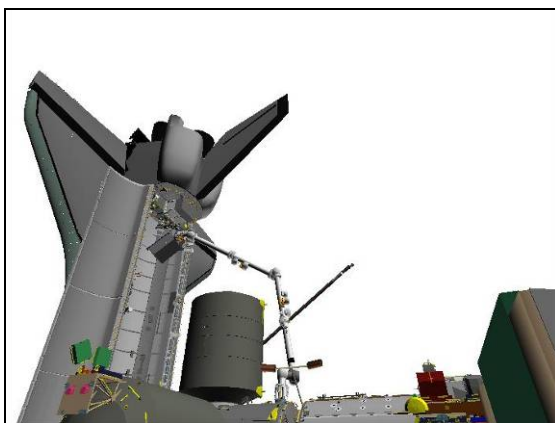


Figure 41.- EuTEF Berth
(03: S1 Lower Outboard: +70, +35).

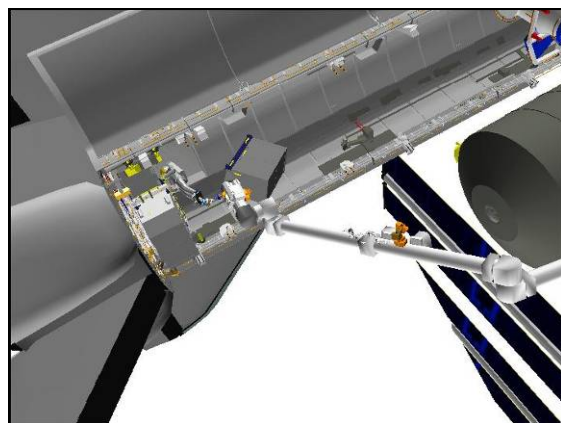


Figure 42.- EuTEF Berth
(OBSS ITVC: +130, -60).

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16. MANUAL MANEUVER TO APFR EGRESS POSITION

On EV GO, ready to maneuver to APFR Egress position:

DCP BRAKES SSRMS → OFF (Verify OFF)

PCS MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

THC/
RHC Perform EVA GCA to APFR Egress position.
Expected APFR Egress position:

Locked						
SR	SY	SP	EP	WP	WY	WR
+115.1	+2.0	+12.2	+54.9	-152.3	-155.1	+191.4
X	Y	Z	Pitch	Yaw	Roll	
-3140	-25	-970	+164.3	+0.2	+0.5	
FOR	Loaded – Chest 12/NN/F/6 EuTEF, SR Held					
Disp	ISS>OBAS					

DCP BRAKES SSRMS → ON (Verify ON)

Notify EV, brakes on, ready for APFR egress.

PCS MSS: SSRMS:

Change Loaded Parameters ► ATA ► ATA Mnvr SRH
Verify 'Loaded Parameters' (two) – ATA Mnvr, SR Held

Expected APFR Egress position:

SR	SY	SP	EP	WP	WY	WR
+115.1	+2.0	+12.2	+54.9	-152.3	-155.1	+191.4
X	Y	Z	Pitch	Yaw	Roll	
-3005	-26	-1122	-87.7	+0.4	+16.7	
FOR	Loaded – ATA Mnvr, SR Held					
Disp	ISS>OBAS					

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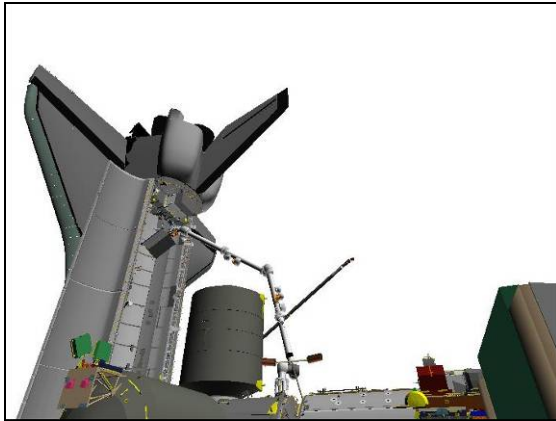


Figure 43.- APFR Egress position
(03: S1 Lower Outboard: +70, +35).

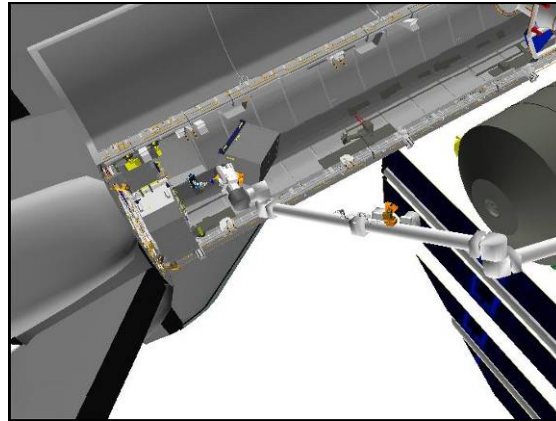


Figure 44.- APFR Egress position
(OBSS ITVC: +130, -60).

17. MANUAL MANEUVER TO APFR RECONFIGURATION POSITION

DCP BRAKES SSRMS → OFF (Verify OFF)

PCS MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

THC/
RHC Perform EVA GCA to APFR Reconfiguration position.
Expected APFR Reconfiguration position:

Locked						
SR	SY	SP	EP	WP	WY	WR
+115.1	+2.0	+12.2	+54.9	-152.3	-155.1	+191.4
X	Y	Z	Pitch	Yaw	Roll	
-3005	-26	-1122	-87.7	+0.4	+16.7	
FOR	Loaded – ATA Mnvr, SR Held					
Disp	ISS>OBAS					

DCP BRAKES SSRMS → ON (Verify ON)

Notify EV, brakes on, ready for APFR Reconfiguration.

NOTE
New APFR Settings for stow are 12/FF/A/6.

1.310 EVA1 - OLD ATA GRAPPLE AND EUTEF UNINSTALL

(RBT FS/17A/FIN)

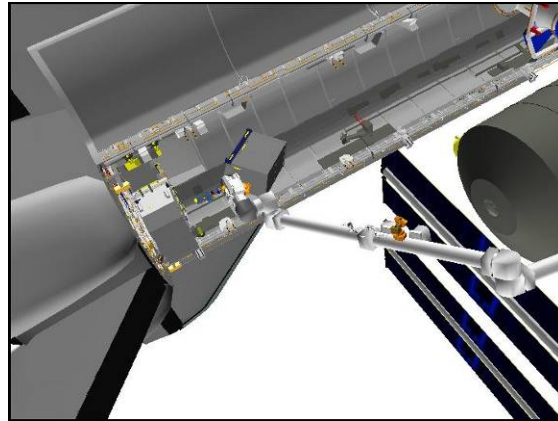


Figure 45.- APFR Reconfig
(OBSS ITVC: +130, -60).

18. MANUAL MANEUVER TO JOINT OCAS START POSITION

NOTE

During the following maneuvers, the closest clearances are as follows:

- a. The APFR to the LMC, approximately 50 cm (20 in). This may be monitored with the OBSS ITVC.
- b. The MPLM to the Base Boom, approximately 93 cm (37 in). This may be monitored with the S1 Lower Outboard Camera.

On EV GO, ready to maneuver to Overnight Park:

DCP BRAKES SSRMS → OFF (Verify OFF)

PCS MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

THC/
RHC Maneuver to Joint OCAS Start position (within 5 cm/1 deg).
(Expect “-Z” motion, THC up)

Locked						
SR	SY	SP	EP	WP	WY	WR
+115.1	+9.3	-11.3	+78.7	-149.2	-155.9	+199.4
X	Y	Z	Pitch	Yaw	Roll	
-3005	-26	-1436	-87.7	+0.4	+16.7	
FOR	Loaded – ATA Mnvr, SR Held					
Disp	ISS>OBAS					

PCS MSS: SSRMS:

Enter Mode – Standby (Verify blue)

1.310 EVA1 - OLD ATA GRAPPLE AND EUTEF UNINSTALL

(RBT FS/17A/FIN)

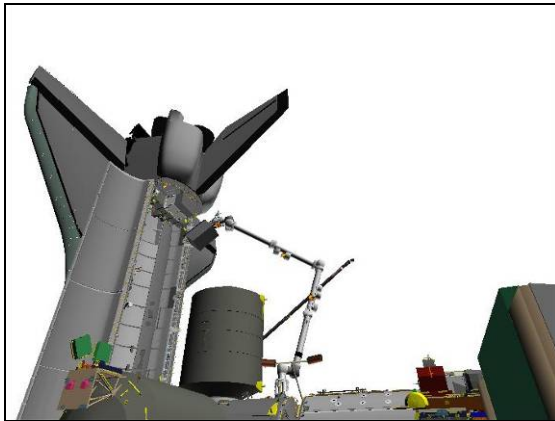


Figure 46.- Joint OCAS Start
(03: S1 Lower Outboard: +70, 35).

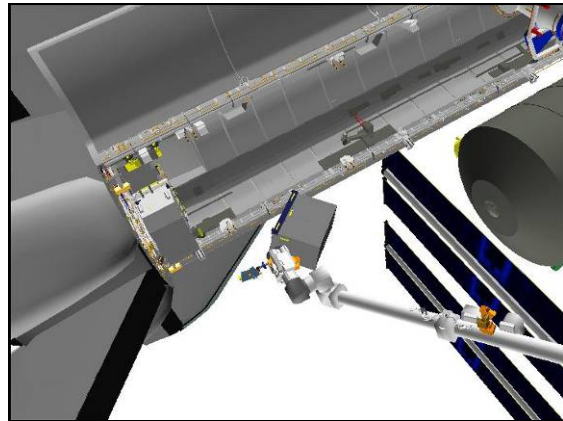


Figure 47.- Joint OCAS Start
(OBSS ITVC: +130, -60).

If using shuttle attitude control
 Coordinate with shuttle crewmembers.
 If attitude maintenance reqd
 DAP: LVLH
 When rates damped
 DAP: FREE > 2 seconds, then
 DAP: AUTO

19. JOINT OCAS TO OVERNIGHT PARK POSITION

RHC RATE → COARSE (Verify Coarse on PCS)

PCS MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

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

SR	SY	SP	EP	WP	WY	WR
+115.1	+78.6	-16.2	+43.6	-163.3	-122.8	-6.9

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)	+115.1	+9.3	-11.3	+78.7	-149.2	-155.9	+199.4
TGT	+115.1	+78.6	-16.2	+43.6	-163.3	-122.8	-6.9
ERR	0.0	-69.3	+4.9	+35.1	+14.1	-33.1	+206.3

1.310 EVA1 - OLD ATA GRAPPLE AND EUTEF UNINSTALL

(RBT FS/17A/FIN)

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

SR	SY	SP	EP	WP	WY	WR
+115.1	+78.6	-16.2	+43.6	-163.3	-122.8	-6.9
X	Y	Z	Pitch	Yaw	Roll	
-2660	+1072	-2484	-166.3	+11.9	+155.9	
FOR	Loaded – ATA Mnvr, SR Held					
Disp	ISS>OBAS					

RHC RATE → VERNIER (Verify Vernier on PCS)

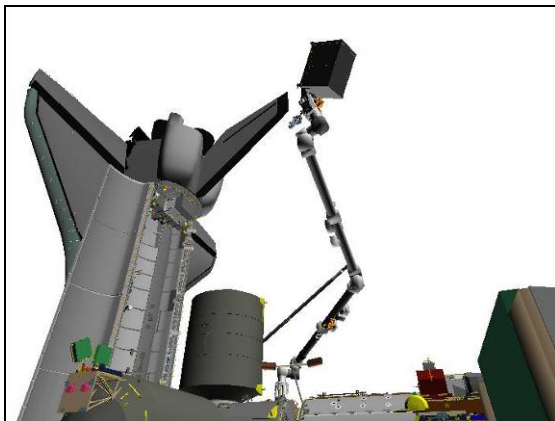


Figure 48.- Overnight Park Position (03: S1 Lower Outboard: +70, +35).

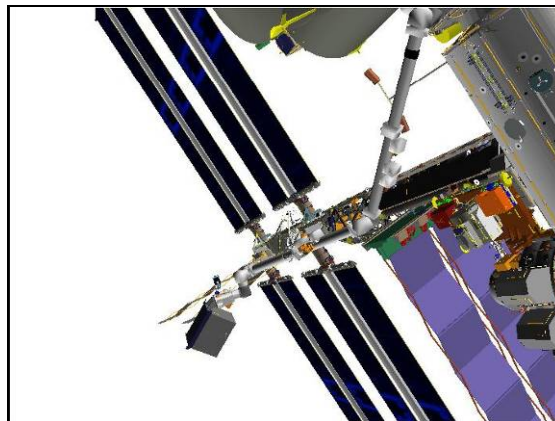


Figure 49.- Overnight Park Position (OBSS ITVC: +100, -85).

1.310 EVA1 - OLD ATA GRAPPLE AND EUTEF UNINSTALL

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NOTE

Expect the following message when safing is commanded:

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

This message should return to Norm.

DCP

SAFING → SAFE (Verify ON)

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1.410 EVA2 - ATA UNBERTH AND INSTALL

(RBT FS/17A/FIN)

1. SETUP

Verify SRMS at MPLM viewing position.

SY	SP	EP	WP	WY	WR
+62.5	+25.0	-23.0	0.0	-13.2	-21.9

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
09: P1 Lower Outboard (+110, +20)	22: Base Elbow (+150, -10)	03: S1 Lower Outboard (+70, +35)	Camera C (+20, +60)	OBSS ITVC (+100, -85)

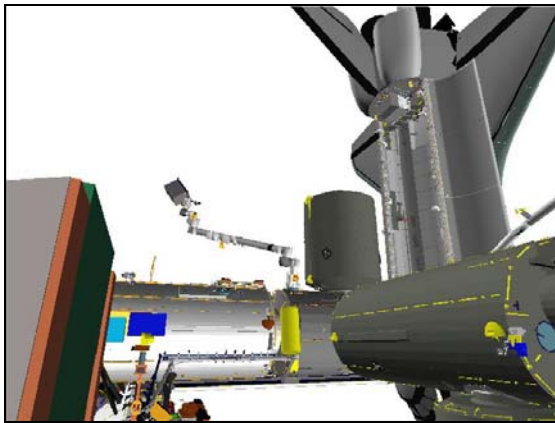


Figure 1.- Overnight Park Position (09: P1 Lower Outboard: +110, +20).

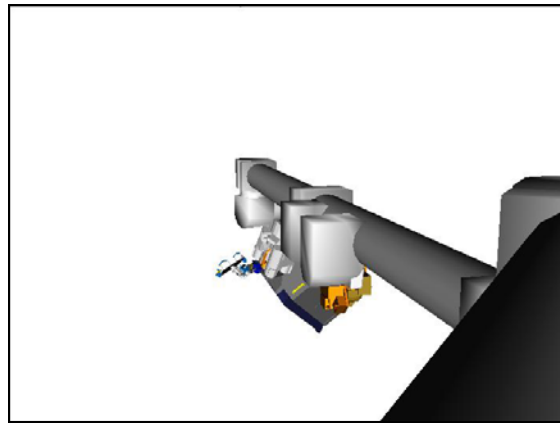


Figure 2.- Overnight Park Position (22: Base Elbow: +150, -10).

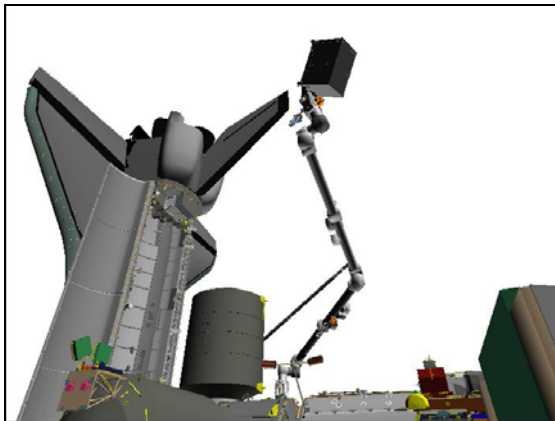


Figure 3.- Overnight Park Position (03: S1 Lower Outboard: +70, +35).

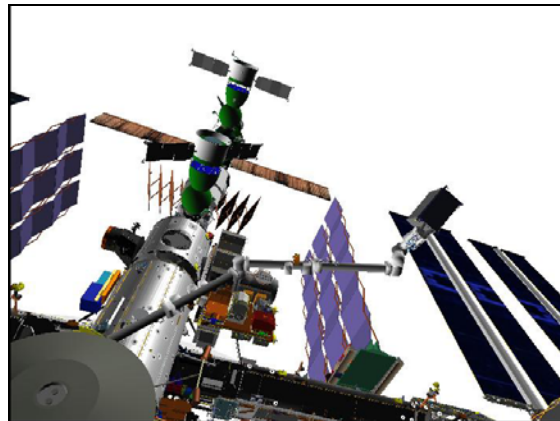


Figure 4.- Overnight Park Position (Camera C: +20, +60).

1.410 EVA2 - ATA UNBERTH AND INSTALL

(RBT FS/17A/FIN)

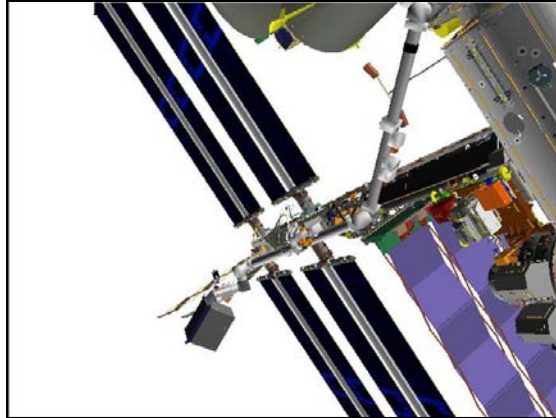


Figure 5.- Overnight Park Position
(OBSS ITVC: +100, -85).

PCS

MSS: SSRMS:

Verify Loaded Parameters – √

Verify 'Loaded Parameters' (two) – ATA Mnvr, SR Held

√Display – ISS>OBAS

√Command – ISS>OBAS/Internal

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

SR	SY	SP	EP	WP	WY	WR
+115.1	+78.6	-16.2	+43.6	-163.3	-122.8	-6.9
X	Y	Z	Pitch	Yaw	Roll	
-2660	+1072	-2484	-166.3	+11.9	+155.9	
FOR	Loaded – ATA Mnvr, SR Held					
Disp	ISS>OBAS					

2. JOINT OCAS TO EVA 2 START POSITION

MSS: SSRMS: MSS Safing:

cmd 'SSRMS' Remove (Verify Not Safed)

DCP

BRAKES SSRMS → OFF (Verify OFF)

RHC

RATE → COARSE (Verify Coarse on PCS)

PCS

MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

1.410 EVA2 - ATA UNBERTH AND INSTALL

(RBT FS/17A/FIN)

SSRMS Joint OCAS

Input 'Joint Angles' 'Destination' for EVA 2 Start position.

SR	SY	SP	EP	WP	WY	WR
+157.4	-16.5	-21.2	+56.0	-105.5	-188.6	-114.1

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)	+115.1	+78.6	-16.2	+43.6	-163.3	-122.8	-6.9
TGT	+157.4	-16.5	-21.2	+56.0	-105.5	-188.6	-114.1
ERR	-42.3	+95.1	+5.0	-12.4	-57.8	+65.8	+107.2

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 SSRMS at EVA 2 Start position.

SR	SY	SP	EP	WP	WY	WR
+157.4	-16.5	-21.2	+56.0	-105.5	-188.6	-114.1
X	Y	Z	Pitch	Yaw	Roll	
-3106	-227	-1438	-52.0	+79.4	+48.6	
FOR	Loaded – ATA Mnvr, SR Held					
Disp	ISS>OBAS					

MSS: SSRMS: SSRMS

Enter Mode – Standby (Verify blue)

RHC

RATE → VERNIER (Verify Vernier on PCS)

1.410 EVA2 - ATA UNBERTH AND INSTALL

(RBT FS/17A/FIN)

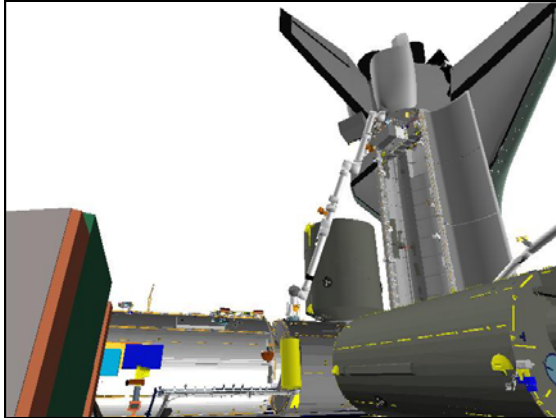


Figure 6.- EVA 2 Start
(09: P1 Lower Outboard: +110, +25).

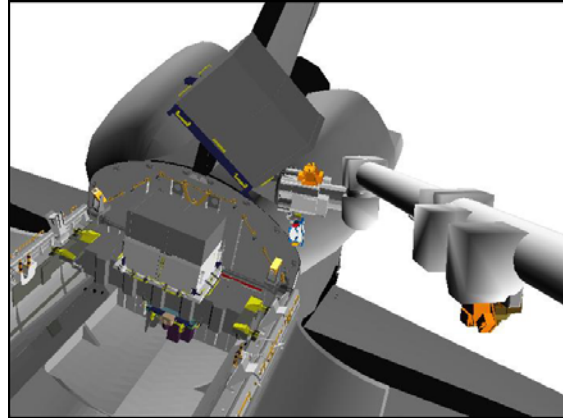


Figure 7.- EVA 2 Start
(22: Base Elbow: +130, -10).

3. MANUAL MANEUVER TO APFR RECONFIG POSITION

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
09: P1 Lower Outboard (+120, +25)	22: Base Elbow (+130, -10)	03: S1 Lower Outboard (+70, +35)	Camera A (0, +5) Camera B (-10, +50)	SRMS Elbow (-130, +50)

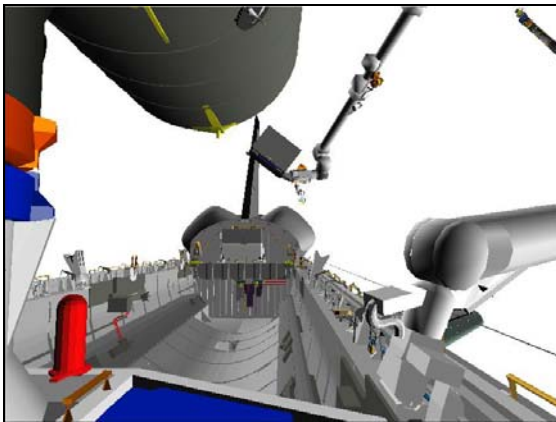


Figure 8.- EVA 2 Start
(Camera A: 0, +5).

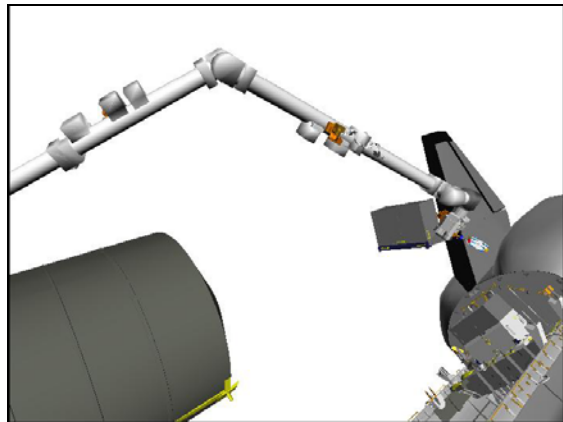


Figure 9.- EVA 2 Start
(SRMS Elbow: -130, +50).

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- NOTE
1. For this maneuver the clearances are as follows:
 - a) APFR to aft MPM approximately 40 cm (16 in). This clearance may be monitored with Camera A or Camera B.
 - b) Old ATA to new ATA approximately 76 cm (30 in). This clearance may be monitored with Camera A.
 - c) Base Boom to MPLM approximately 68 cm (27 in). This clearance may be monitored with the SRMS Elbow Camera.
 2. Once the APFR is reconfigured, the clearance to the aft MPM will then be approximately 48 cm (19 in).

On EV GO, ready to maneuver to APFR Reconfig position:

PCS

MSS: SSRMS: SSRMS

Enter Mode – Manual (Verify blue)

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

cmd Shoulder Roll (Verify SR – Locked)

THC/
RHC

Perform EVA GCA as required for APFR Reconfig.
(Expect “+Z” motion, THC down)
Expected APFR Reconfig position:

Locked						
SR	SY	SP	EP	WP	WY	WR
+157.4	-23.9	-9.2	+37.5	-98.1	-186.1	-121.1
X	Y	Z	Pitch	Yaw	Roll	
-3106	-227	-1239	-52.0	+79.4	+48.6	
FOR	Loaded – ATA Mnvr, SR Held					
Disp	ISS>OBAS					

DCP

BRAKES SSRMS → ON (Verify ON)

Notify EV, brakes on, ready for APFR Reconfig.

NOTE
APFR Settings are 12/PP/F/8.

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Figure 10.- APFR Reconfig
(03: S1 Lower Outboard: +70, +35).

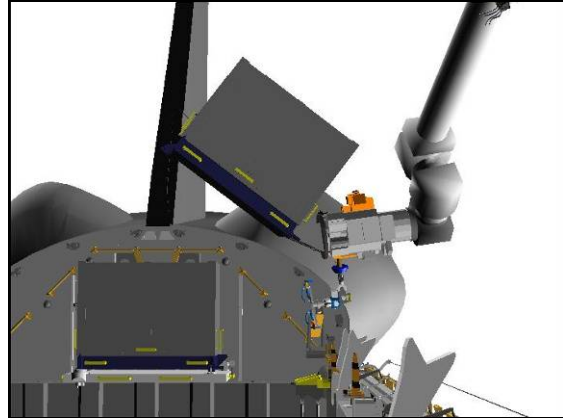


Figure 11.- APFR Reconfig
(Camera A: 0, +5, FL=20 mm).

PCS MSS: SSRMS: Thrusters:

Verify 'Desat Request:' – Inh

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

4. MANUAL MANEUVER TO APFR INGRESS POSITION

On EV GO, ready to maneuver to APFR ingress position:

BRAKES SSRMS → OFF (Verify OFF)

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

THC/
RHC

Perform EVA GCA as required for APFR Ingress.

Expected APFR Ingress position:

Locked						
SR	SY	SP	EP	WP	WY	WR
+157.4	-23.9	-9.2	+37.5	-98.1	-186.1	-121.1
X	Y	Z	Pitch	Yaw	Roll	
-3106	-227	-1239	-52.0	+79.4	+48.6	
FOR	Loaded – ATA Mnvr, SR Held					
Disp	ISS>OBAS					

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DCP BRAKES SSRMS → ON (Verify ON)

Notify EV, brakes on, ready for APFR Ingress.

PCS MSS: SSRMS:

Change Loaded Parameters ► ATA ► Chest 12/PP/F/8 ATA SRH
Verify 'Loaded Parameters' (two) – Chest 12/PP/F/8 ATA, SR Held

Expected APFR Ingress position:

SR	SY	SP	EP	WP	WY	WR
+157.4	-23.9	-9.2	+37.5	-98.1	-186.1	-121.1
X	Y	Z	Pitch	Yaw	Roll	
-3119	-79	-1135	-170.0	+5.0	+80.7	
FOR	Loaded – Chest 12/PP/F/8 ATA, SR Held					
Disp	ISS>OBAS					

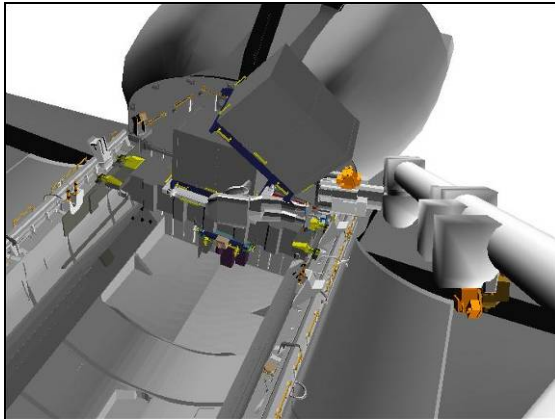


Figure 12.- APFR Ingress
(22: Base Elbow: +140, -10).

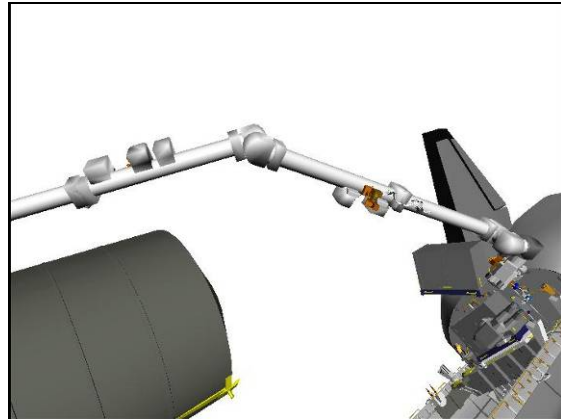


Figure 13.- APFR Ingress
(SRMS Elbow: -130, +50).

5. MANUAL MANEUVER TO ATA ON LMC POSITION

On EV GO, ready to maneuver to ATA on LMC position:

DCP BRAKES SSRMS → OFF (Verify OFF)

PCS MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

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THC/
RHC Perform EVA GCA as required for reaching ATA.
Expected ATA on LMC position:

Locked						
SR	SY	SP	EP	WP	WY	WR
+157.4	-23.9	-9.2	+37.5	-98.1	-186.1	-121.1
X	Y	Z	Pitch	Yaw	Roll	
-3119	-79	-1135	-170.0	+5.0	+80.7	
FOR	Loaded – Chest 12/PP/F/8 ATA, SR Held					
Disp	ISS>OBAS					

DCP BRAKES SSRMS → ON (Verify ON)

Notify EV, brakes on, ready to unbolt ATA.

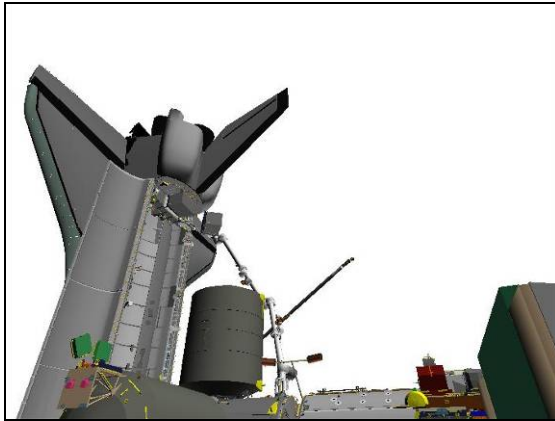


Figure 14.- ATA on LMC
(03: S1 Lower Outboard: +70, +35).

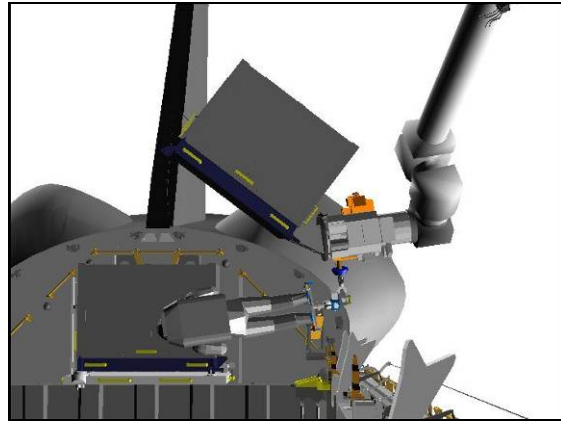


Figure 15.- ATA on LMC
(Camera A: 0, +5, FL=20 mm).

6. MANUAL MANEUVER TO ATA UNBERTH POSITION

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
09: P1 Lower Outboard (+120, +25)	03: S1 Lower Outboard (+70, +35)	71: Camera B (+90, +5)	Camera A (0, +5)	SRMS Elbow (-130, +50)

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Figure 16.- ATA on LMC
(71: Camera B: +90, +5).

NOTE

For this maneuver, the clearance between the new ATA and the Aft Bulkhead is approximately 6 cm (2 in). This clearance may be monitored with Camera B.

On EV GO, ready to maneuver to ATA Unberth position:

DCP BRAKES SSRMS → OFF (Verify OFF)

PCS MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

THC/
RHC Perform EVA GCA as required to clear LMC and maneuver to ATA Unberth position (within 5 cm/1 deg).
(Expect “+X” and “-Z” motion, THC in and up)

Locked						
SR	SY	SP	EP	WP	WY	WR
+157.4	-15.3	-38.8	+86.5	-118.6	-189.0	-112.9
X	Y	Z	Pitch	Yaw	Roll	
-2919	-79	-1432	-170.0	+5.0	+80.7	
FOR	Loaded – Chest 12/PP/F/8 ATA, SR Held					
Disp	ISS>OBAS					

PCS MSS: SSRMS:

Enter Mode – Standby (Verify blue)

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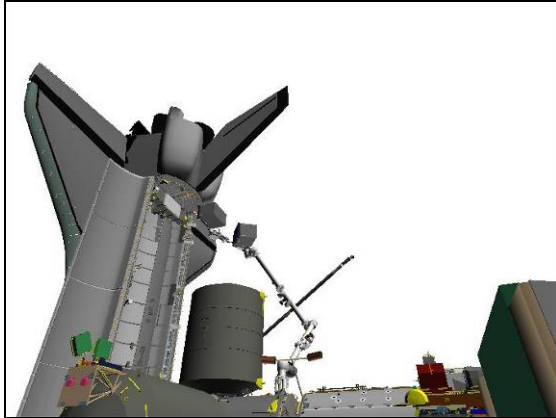


Figure 17.- ATA Unberth
(03: S1 Lower Outboard: +70, +35).

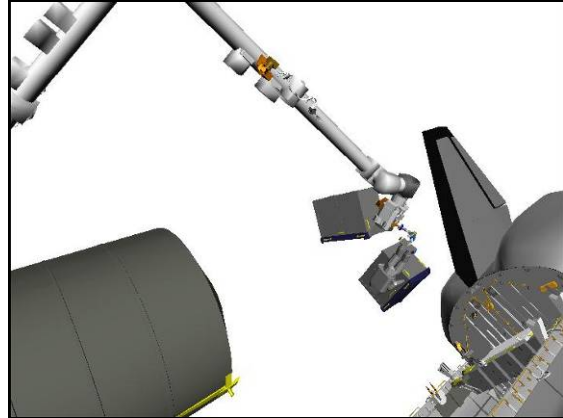


Figure 18.- ATA Unberth
(SRMS Elbow: -130, +50).

If using shuttle attitude control
 Coordinate with shuttle crewmembers.
 If attitude maintenance reqd
 DAP: LVLH
 When rates damped
 DAP: FREE > 2 seconds, then
 DAP: AUTO

7. JOINT OCAS TO P1 WORKSITE INT 1 POSITION

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
09: P1 Lower Outboard (+120, +40)	22: Base Elbow (+100, -10) 24: Tip Elbow (+5, -5)	03: S1 Lower Outboard (+70, +35)	Camera B (+30, +40)	SRMS Elbow (-130, +60)

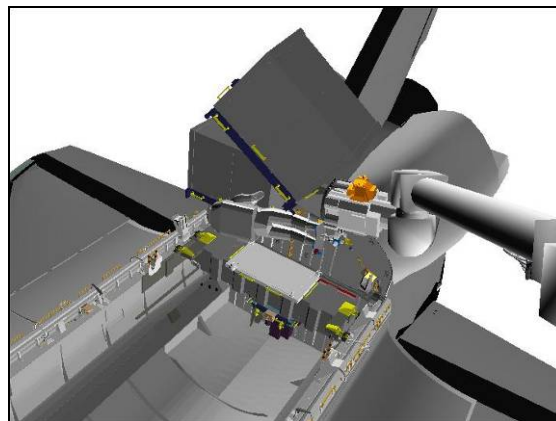


Figure 19.- ATA Unberth
(22: Base Elbow: +100, -10).

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MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

Input 'Joint Angles' 'Destination' for P1 Worksite Int 1 position.

SR	SY	SP	EP	WP	WY	WR
+130.0	+15.0	-54.0	+86.5	-118.6	-159.0	-112.9

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)	+157.4	-15.3	-38.8	+86.5	-118.6	-189.0	-112.9
TGT	+130.0	+15.0	-54.0	+86.5	-118.6	-159.0	-112.9
ERR	+27.4	-30.3	+15.2	0.0	0.0	-30.0	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
+130.0	+15.0	-54.0	+86.5	-118.6	-159.0	-112.9

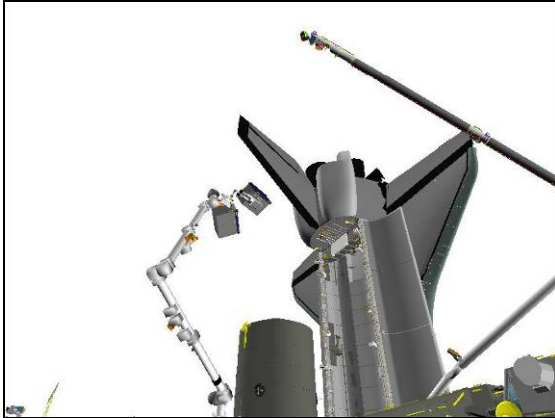


Figure 20.- P1 Worksite Int 1
(09: P1 Lower Outboard: +120, +40).

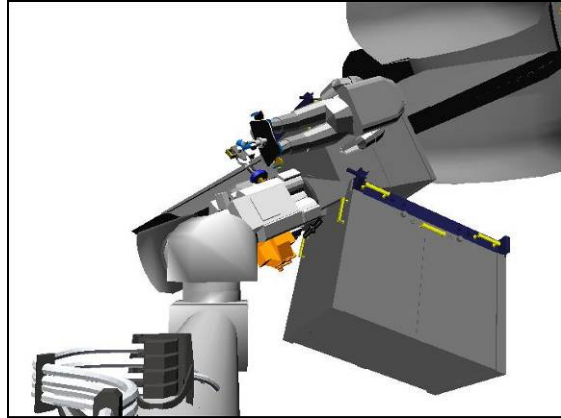


Figure 21.- P1 Worksite Int 1
(24: Tip Elbow: +5, +5).

8. JOINT OCAS TO P1 WORKSITE BACKOFF POSITION

NOTE

1. Expect singularity warning for EP between +15 and -15 deg.
2. The clearance at the end of the Joint OCAS between the SSRMS Tip Boom and the P1 Lower Inboard Camera is approximately 167 cm (66 in). This clearance may be monitored with the P1 Lower Outboard Camera.

Verify with **MCC-H** Port TRRJ locked at -40 degrees.

SSRMS Joint OCAS

Input 'Joint Angles' 'Destination' for P1 Worksite Backoff position.

SR	SY	SP	EP	WP	WY	WR
+117.2	+6.7	-87.2	-38.9	-52.9	-10.5	+22.1

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)	+130.0	+15.0	-54.0	+86.5	-118.6	-159.0	-112.9
TGT	+117.2	+6.7	-87.2	-38.9	-52.9	-10.5	+22.1
ERR	+12.8	+8.3	+33.2	+125.4	-65.7	-148.5	-135.0

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

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

DCP AUTO SEQ → PROC

PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at P1 Worksite Backoff position.

SR	SY	SP	EP	WP	WY	WR
+117.2	+6.7	-87.2	-38.9	-52.9	-10.5	+22.1

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

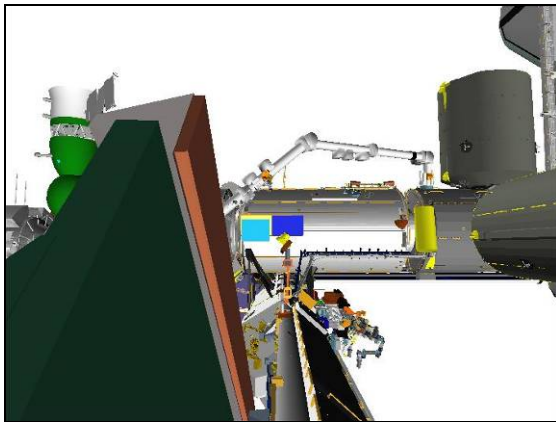


Figure 22.- P1 Worksite Backoff
 (09: P1 Lower Outboard: +90, +5).

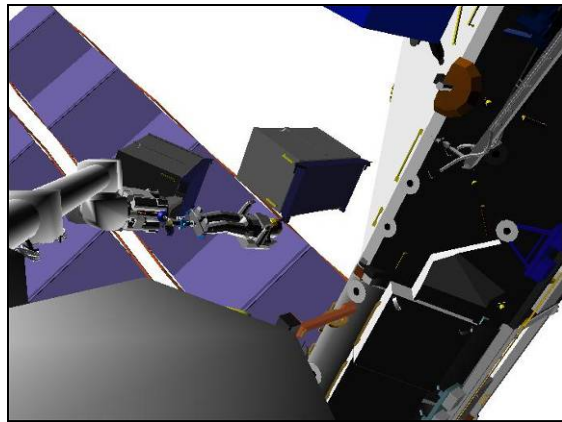


Figure 23.- P1 Worksite Backoff
 (22: Base Elbow: -135, -10).

9. SETUP FOR MANEUVER TO ATA INSTALL
 Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
09: P1 Lower Outboard (+90, +5)	22: Base Elbow (-135, -10)	24: Tip Elbow (-30, 0) 07: P1 Lower Inboard (+5, -50)	Camera B (-20, +50) OBSS ITVC (+65, -75)	SRMS Elbow (-30, +150)

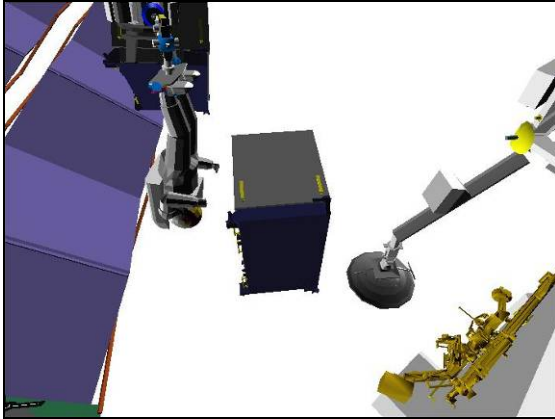


Figure 24.- P1 Worksite Backoff (07: P1 Lower Inboard: +5, -50).

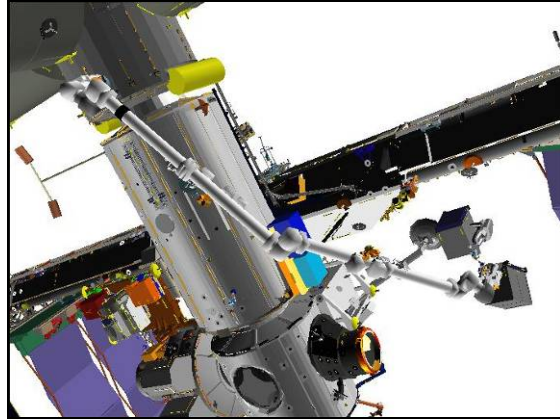


Figure 25.- P1 Worksite Backoff (OBSS ITVC: +65, -75).

MSS: SSRMS:

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

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

Verify SSRMS at P1 Worksite Backoff position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+117.2	+6.7	-87.2	-38.9	-52.9	-10.5	+22.1
X	Y	Z	Pitch	Yaw	Roll	
-300	-825	+76	+31.5	+79.7	-38.9	
FOR	Loaded – Chest 12/PP/F/8 ATA, SR Held					
Disp	ISS>ISSACS					

MSS: SSRMS: Thrusters:

Verify 'Desat Request:' – Inh

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

10. MANUAL MANEUVER TO ATA INSTALL POSITION

- NOTE
1. May require additional GCA to drive bolts.
 2. The clearance between the APFR and P1 Truss is approximately 55 cm (22 in). This clearance may be monitored with the Tip Elbow Camera.
 3. The clearance between the SSRMS Tip Boom and P1 Lower Inboard Camera is approximately 83 cm (33 in). This clearance may be monitored with the P1 Lower Outboard Camera.

On EV GO, ready to maneuver to ATA Install position:

Enter Mode – Manual (Verify blue)

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

cmd Shoulder Roll (Verify SR – Locked)

THC/
RHC

Perform EVA GCA as required for ATA Install.
 (Expect “+X” motion, THC in)
 Expected ATA Install/Bolt 1 Drive position:

Locked						
SR	SY	SP	EP	WP	WY	WR
+117.2	+19.7	-78.4	-67.2	-33.4	+2.5	+21.9
X	Y	Z	Pitch	Yaw	Roll	
-90	-825	+76	+31.5	+79.7	-38.9	
FOR	Loaded – Chest 12/PP/F/8 ATA, SR Held					
Disp	ISS>ISSACS					

DCP BRAKES SSRMS → ON (Verify ON)

Notify EV, brakes on, ready for ATA install.

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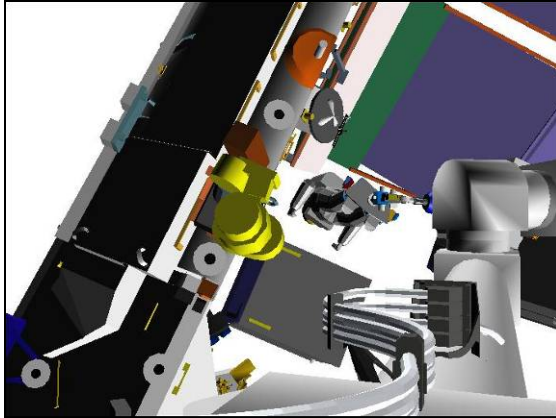


Figure 26.- ATA Install
(24: Tip Elbow: -20, 0).

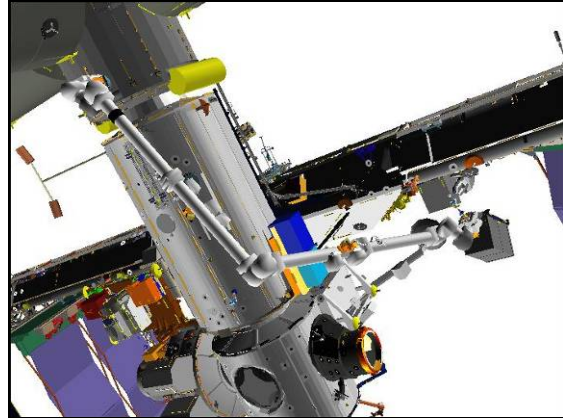


Figure 27.- ATA Install
(OBSS ITVC: +65, -75).

11. MANUAL MANEUVER TO P1 BACKOFF 1 POSITION

On EV GO, ready to maneuver to P1 Backoff position:

DCP BRAKES SSRMS → OFF (Verify OFF)

PCS MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

THC/
RHC GCA as required to clear the truss, then:
Maneuver to P1 Backoff 1 position (within 5 cm/1 deg).
(Expect “-X” motion, THC out)

Locked						
SR	SY	SP	EP	WP	WY	WR
+117.2	+6.7	-87.2	-38.9	-52.9	-10.5	+22.1
X	Y	Z	Pitch	Yaw	Roll	
-300	-825	+76	+31.5	+79.7	-38.9	
FOR	Loaded – Chest 12/PP/F/8 ATA, SR Held					
Disp	ISS>ISSACS					

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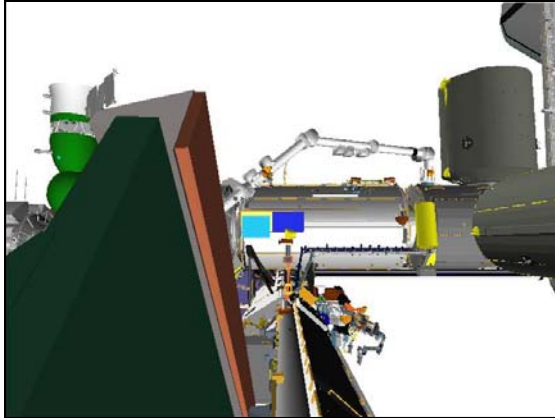


Figure 28.- P1 Backoff 1
(09: P1 Lower Outboard: +90, +5).

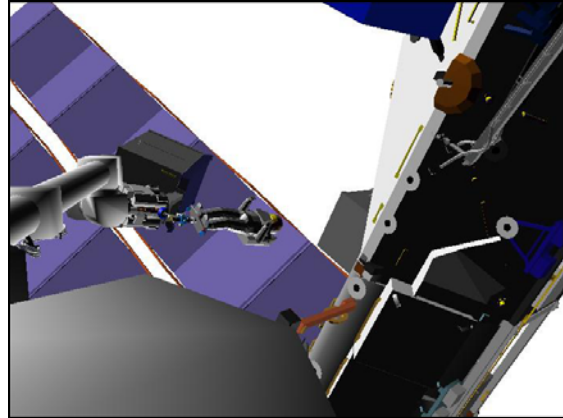


Figure 29.- P1 Backoff 1
(22: Base Elbow: -135, -10).

12. SINGLE JOINT TO P1 BACKOFF 2 POSITION

PCS

MSS: SSRMS:

Enter Mode – Single (Verify blue)

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

THC

Perform Single Joint maneuver to P1 Backoff 2 position (within 1 deg).

	SR	SY	SP	EP	WP	WY	WR
P1 Backoff 1	+117.2	+6.7	-87.2	-38.9	-52.9	-10.5	+22.1
1: SP +			-70.0				
P1 Backoff 2	+117.2	+6.7	-70.0	-38.9	-52.9	-10.5	+22.1
	X	Y	Z	Pitch	Yaw	Roll	
	-449	-914	+472	+69.7	+73.8	-62.3	
FOR	Loaded – Chest 12/PP/F/8 ATA, SR Held						
Disp	ISS>ISSACS						

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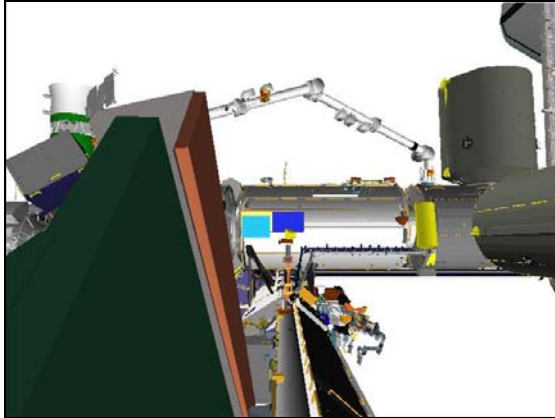


Figure 30.- P1 Backoff 2
(09: P1 Lower Outboard: +90, +5).



Figure 31.- P1 Backoff 2
(SRMS Elbow: -30, +140).

13. JOINT OCAS TO OLD ATA SETUP POSITION

NOTE

The clearance between the Tip Boom and Old ATA is approximately 43 cm (17 in) for the following maneuvers. This may be monitored with the Base Elbow Camera.

RHC RATE → COARSE (Verify Coarse on PCS)

PCS MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

Input 'Joint Angles' 'Destination' for Old ATA Setup position.

SR	SY	SP	EP	WP	WY	WR
+132.6	+27.7	-47.9	-72.7	-63.6	+11.3	+106.1

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)	+117.2	+6.7	-70.0	-38.9	-52.9	-10.5	+22.1
TGT	+132.6	+27.7	-47.9	-72.7	-63.6	+11.3	+106.1
ERR	-15.4	-21.0	-22.1	+33.8	+10.7	-21.8	-84.0

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

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

DCP AUTO SEQ → PROC

PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at Old ATA Setup position.

SR	SY	SP	EP	WP	WY	WR
+132.6	+27.7	-47.9	-72.7	-63.6	+11.3	+106.1
X	Y	Z	Pitch	Yaw	Roll	
+8	-1073	+600	-14.2	+13.8	0.0	
FOR	Loaded – Chest 12/PP/F/8 ATA, SR Held					
Disp	ISS>ISSACS					

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

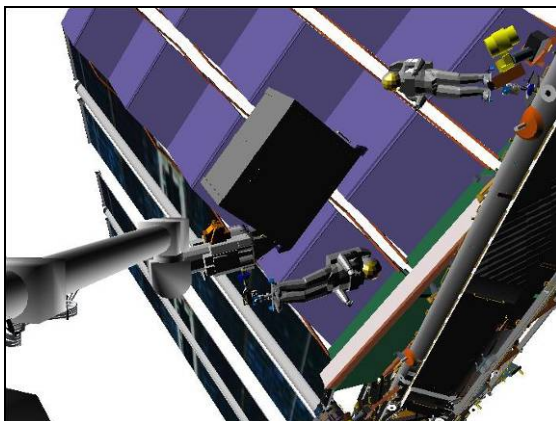


Figure 32.- Old ATA Setup
(22: Base Elbow: -115, -5).

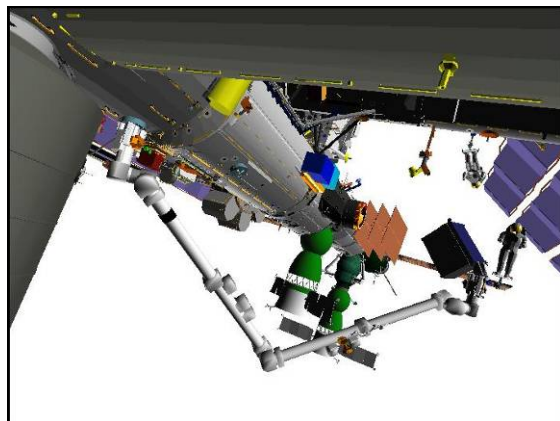


Figure 33.- Old ATA Setup
(SRMS Elbow: -30, +140).

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14. MANUAL MANEUVER TO OLD ATA RELEASE POSITION

<u>NOTE</u>	
1.	The clearance between the Old ATA and P1 Lower Inboard Camera is approximately 116 cm (46 in). This clearance may be monitored with the Base Elbow Camera.
2.	The clearance between the EV crewmember and the P1 Truss is approximately 91 cm (36 in). This clearance may be monitored with the P1 Lower Outboard Camera or SRMS Elbow Camera.

RHC RATE → VERNIER (Verify Vernier on PCS)

PCS MSS: SSRMS:

Change Loaded Parameters ► ATA ► ATA Mnvr SYH
Verify 'Loaded Parameters' (two) – ATA Mnvr, SY Held

√Command – ISS>ISSACS/Internal

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

SR	SY	SP	EP	WP	WY	WR
+132.6	+27.7	-47.9	-72.7	-63.6	+11.3	+106.1
X	Y	Z	Pitch	Yaw	Roll	
-90	-1010	+740	+75.8	0.0	+63.2	
FOR	Loaded – ATA Mnvr, SY Held					
Disp	ISS>ISSACS					

On EV GO, ready to maneuver to Old ATA Release position:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

THC/
RHC Perform EVA GCA as required to reach Old ATA Release position.
(Expect “-Z” motion, THC up)

Expected Old ATA Release position:

	Locked					
SR	SY	SP	EP	WP	WY	WR
+129.0	+27.7	-60.0	-71.0	-54.2	+11.6	+102.9
X	Y	Z	Pitch	Yaw	Roll	
-90	-1010	+537	+75.8	0.0	+63.2	
FOR	Loaded – ATA Mnvr, SY Held					
Disp	ISS>ISSACS					

PCS MSS: SSRMS:

Enter Mode – Standby (Verify blue)

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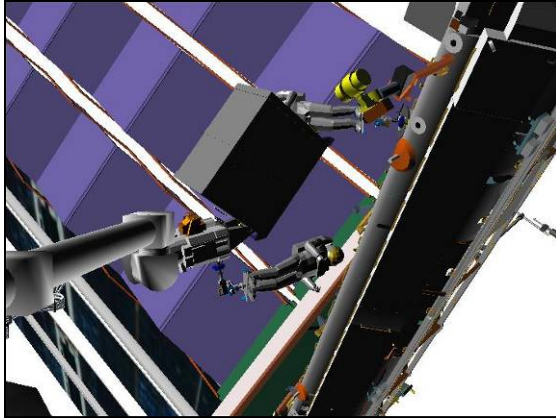


Figure 34.- Old ATA Release
(22: Base Elbow: -115, -5).

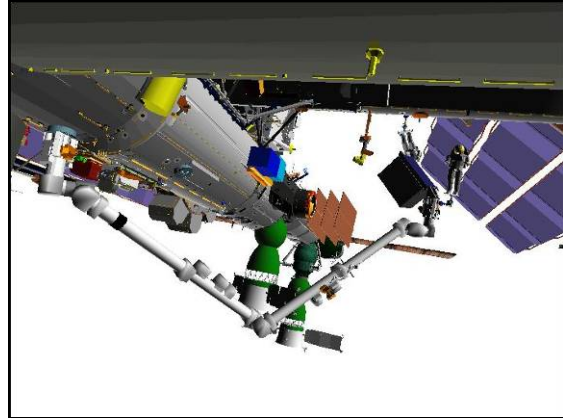


Figure 35.- Old ATA Release
(SRMS Elbow: -40, +140).

15. OLD ATA RELEASE AND BACKOFF

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
09: P1 Lower Outboard (+90, +5)	25: Tip LEE	22: Base Elbow (-115, -5) 07: P1 Lower Inboard (-60, 0)	Camera B (-20, +45) OBSS ITVC (+65, -80)	SRMS Elbow (-40, +140)

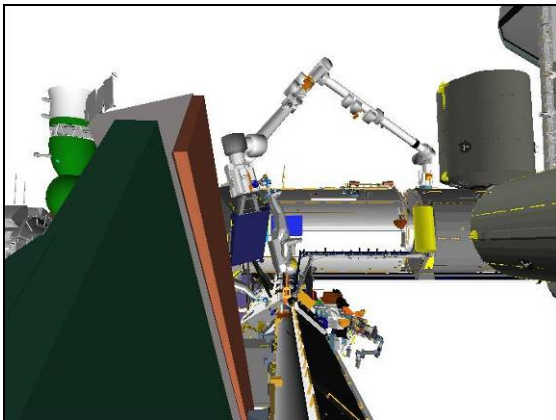


Figure 36.- Old ATA Release
(09: P1 Lower Outboard: +90, +5).

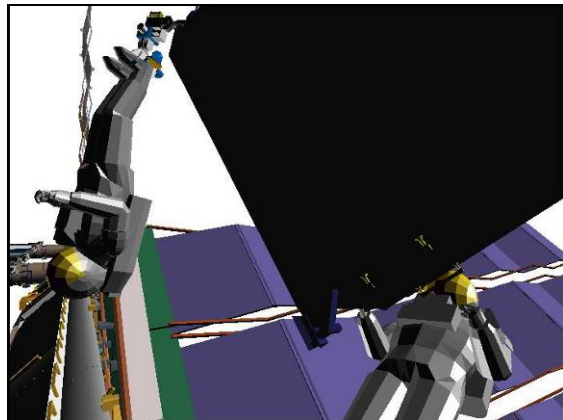


Figure 37.- Old ATA Release
(07: P1 Lower Inboard: -60, 0).

NOTE

1. The Tip LEE Camera must be fully zoomed out to correspond the target overlay.
2. For this maneuver the clearance between the APFR and the Fixed Grapple Bar is approximately 27 cm (11 in). This clearance may be monitored with the P1 Lower Inboard Camera.

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MSS: SSRMS:

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

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

MSS: SSRMS: Rate:

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

15.1 Auto Release

On EV GO, ready to ungrapple Old ATA:

MSS: SSRMS: Tip LEE:

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

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

CAUTION

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

NOTE

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

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Auto Release

RHC TRIGGER → Press (momentarily)

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

Verify Unloaded Parameters – ✓

15.2 SSRMS Backoff

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

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MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

NOTE

Perform “THC down” maneuver only after clearing the Grapple Pin. The Grapple Pin may be viewed with the P1 Lower Outboard Camera of the Base Elbow Camera.

THC/
RHC

Maneuver to Old ATA Release Backoff position (within 5 cm/1 deg).
(Expect THC out then down)

	Locked					
SR	SY	SP	EP	WP	WY	WR
+134.2	+27.7	-58.3	-65.2	-60.3	+11.2	+107.6
X	Y	Z	Pitch	Yaw	Roll	
-61	-1099	+606	+75.8	0.0	+63.2	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>ISSACS					

PCS

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

15.3 Release Cleanup

Change Unloaded Parameters ► EVA ► Chest 12/PP/F/8 SYH

Verify ‘Unloaded Parameters’ (two) – Chest 12/PP/F/8, SY Held

MSS: SSRMS: Rate:

Set ‘Scale’ ‘Vernier’ Rate Scale: 1.0 (Verify 1.0)

Verify SSRMS at Old ATA Release Backoff position.

SR	SY	SP	EP	WP	WY	WR
+134.2	+27.7	-58.3	-65.2	-60.3	+11.2	+107.6
X	Y	Z	Pitch	Yaw	Roll	
+37	-1162	+466	-14.2	+13.8	0.0	
FOR	Unloaded – Chest 12/PP/F/8, SY Held					
Disp	ISS>ISSACS					

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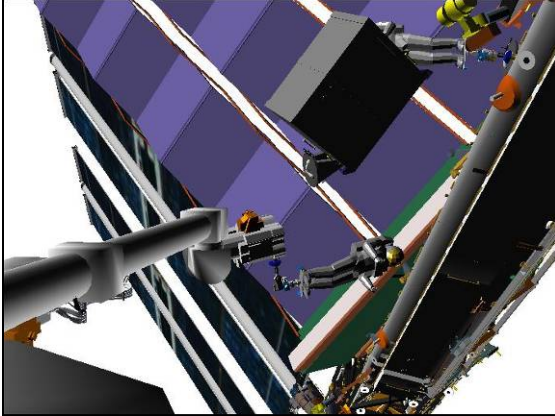


Figure 38.- Old ATA Release Backoff
(22: Base Elbow: -125, -5).

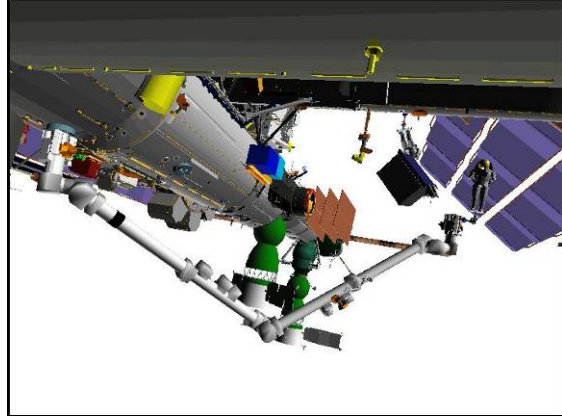


Figure 39.- Old ATA Release Backoff
(SRMS Elbow: -40, +140).

16. MANUAL MANEUVER TO OLD ATA HANDOFF INTERMEDIATE POSITION

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
09: P1 Lower Outboard (+90, +5)	24: Tip Elbow (-20, -5)	22: Base Elbow (-125, -5)	OBSS ITVC (+50, -75)	SRMS Elbow (-40, +140)

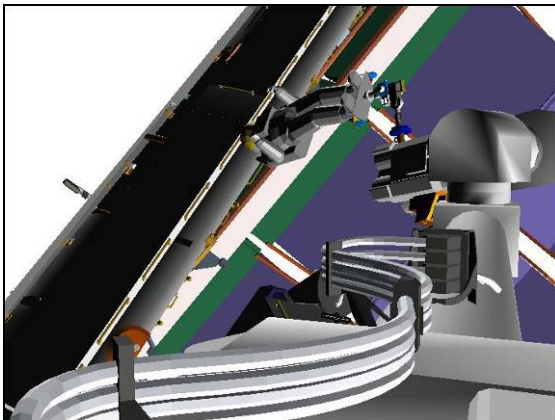


Figure 40.- Old ATA Release Backoff
(24: Tip Elbow: -20, -5).

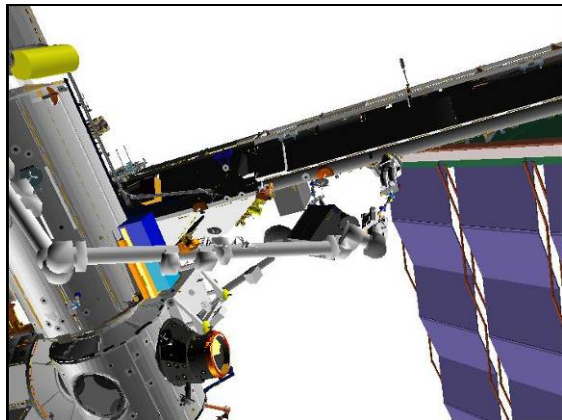


Figure 41.- Old ATA Release Backoff
(OBSS ITVC: +50, -75).

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 to Old ATA Handoff Intermediate position (within 5 cm/1 deg).
(Expect "+Yaw" motion, RHC twist right)

	Locked					
SR	SY	SP	EP	WP	WY	WR
+140.2	+27.7	-64.6	-49.3	-68.0	+11.0	-9.2
X	Y	Z	Pitch	Yaw	Roll	
+37	-1162	+466	+165.9	+44.1	-180.0	
FOR	Unloaded – Chest 12/PP/F/8, SY Held					
Disp	ISS>ISSACS					

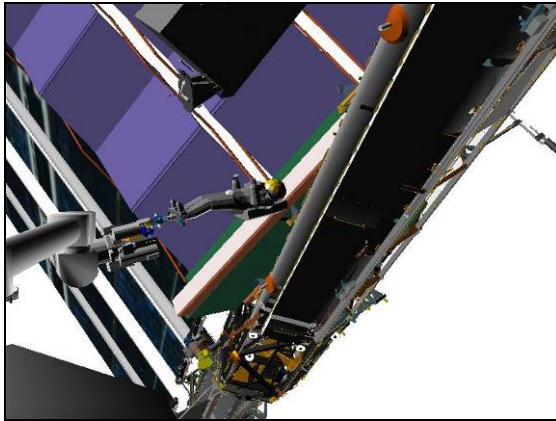


Figure 42.- Old ATA Handoff Int
(22: Base Elbow: -125, -5).

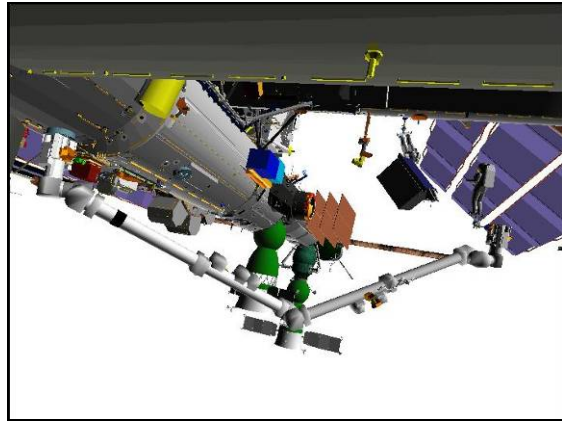


Figure 43.- Old ATA Handoff Int
(SRMS Elbow: -40, +140).

If using shuttle attitude control
Coordinate with shuttle crewmembers.
If attitude maintenance reqd
DAP: LVLH
When rates damped
DAP: FREE > 2 seconds, then
DAP: AUTO

17. MANUAL MANEUVER TO OLD ATA HANDOFF POSITION

On EV GO, ready to maneuver to Old ATA Handoff position:

THC/
RHC

Perform EVA GCA as required for ATA Handoff.
Expected Old ATA Handoff position:

	Locked					
SR	SY	SP	EP	WP	WY	WR
+126.5	+27.7	-68.3	-45.0	-72.6	+11.9	+57.2
X	Y	Z	Pitch	Yaw	Roll	
-164	-1048	+480	-14.1	+57.1	0.0	
FOR	Unloaded – Chest 12/PP/F/8, SY Held					
Disp	ISS>ISSACS					

DCP

BRAKES SSRMS → ON (Verify ON)

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Notify EV, brakes on, ready for ATA Handoff.

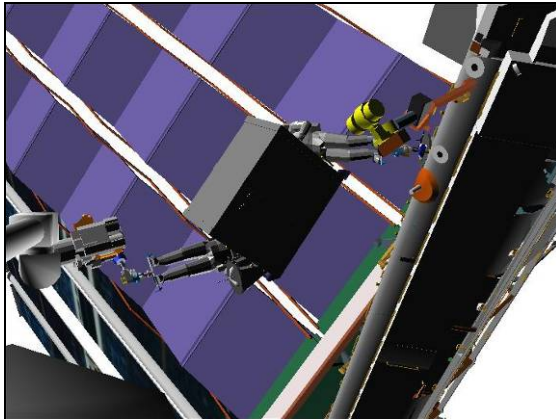


Figure 44.- Old ATA Handoff
(22: Base Elbow: -125, -5).

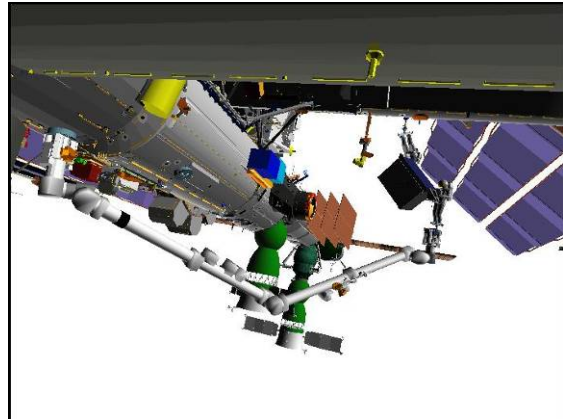


Figure 45.- Old ATA Handoff
(SRMS Elbow: -40, +140).

18. MANUAL MANEUVER TO ATA HANDOFF CLEARANCE POSITION

On EV GO, ready to maneuver to ATA Handoff Clearance position:

DCP BRAKES SSRMS → OFF (Verify OFF)

PCS MSS: SSRMS:

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

MSS: SSRMS: Rate:

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

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

GCA, as required, to clear EV crewmember on P1 Truss, then:

THC/
RHC Maneuver to ATA Handoff Clearance position (within 5 cm/1 deg).
(Expect "+Z" motion, THC down)

	Locked					
SR	SY	SP	EP	WP	WY	WR
+129.1	+27.7	-59.9	-45.3	-80.0	+11.6	+59.6
X	Y	Z	Pitch	Yaw	Roll	
-164	-1048	+650	-14.1	+57.1	0.0	
FOR	Unloaded – Chest 12/PP/F/8, SY Held					
Disp	ISS>ISSACS					

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PCS

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

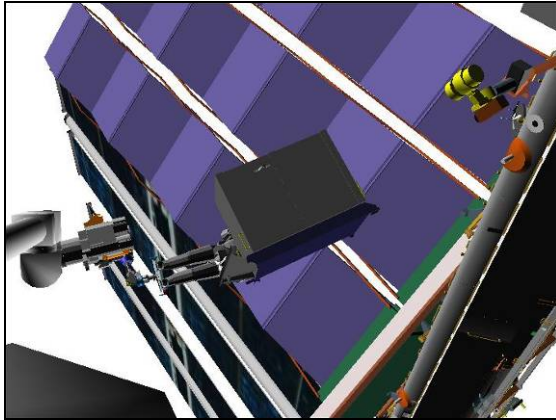


Figure 46.- ATA Handoff Clearance
(22: Base Elbow: -125, -5).

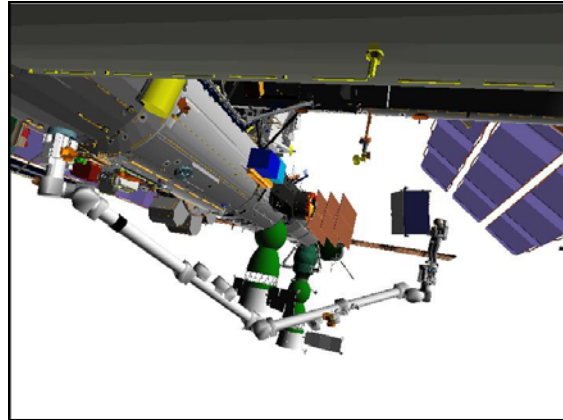


Figure 47.- ATA Handoff Clearance
(SRMS Elbow: -40, +140).

19. JOINT OCAS TO OLD ATA RETURN INT 1 POSITION

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
09: P1 Lower Outboard (+90, +25)	24: Tip Elbow (-35, 0)	03: S1 Lower Outboard (+70, +35)	Camera C (-40, +50)	SRMS Elbow (-40, +140)



Figure 48.- ATA Handoff Clearance
(03: S1 Lower Outboard: +70, +35).

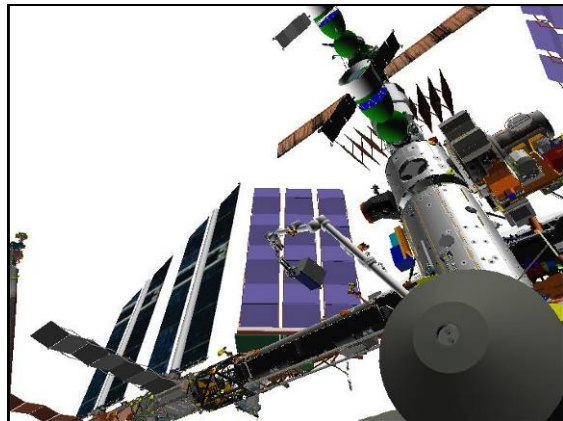


Figure 49.- ATA Handoff Clearance
(Camera C: -40, +50).

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

NOTE
Camera C can be used for snare cable viewing at the end of this Joint OCAS. If KU available, route Camera C to downlink.

MSS: SSRMS: SSRMS

Enter Mode – Joint OCAS (Verify blue)

SSRMS Joint OCAS

Input 'Joint Angles' 'Destination' for Old ATA Return Int 1 position.

SR	SY	SP	EP	WP	WY	WR
+130.0	+15.0	-54.0	+86.5	-118.6	-159.0	+247.0

cmd Load (Verify Sequence Status – Confirm or Cancel)

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

(current)	SR	SY	SP	EP	WP	WY	WR
	+129.1	+27.7	-59.9	-45.3	-80.0	+11.6	+59.6
TGT	+130.0	+15.0	-54.0	+86.5	-118.6	-159.0	+247.0
ERR	-0.9	+12.7	-5.9	-131.8	+38.6	+170.6	-187.4

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)

DCP AUTO SEQ → PROC

PCS MSS: SSRMS: SSRMS

Verify Posn Hold – orange

Verify Joint Angle values.

SR	SY	SP	EP	WP	WY	WR
+130.0	+15.0	-54.0	+86.5	-118.6	-159.0	+247.0

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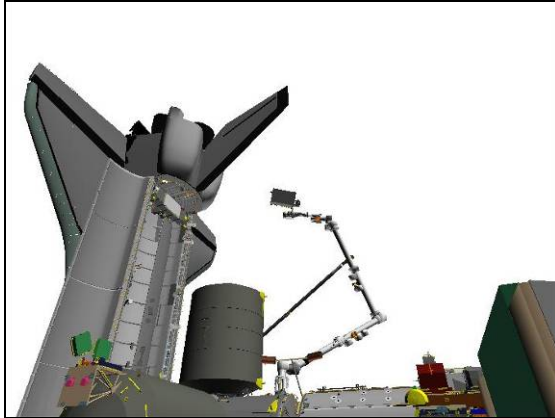


Figure 50.- Old ATA Return Int 1
(03: S1 Lower Outboard: +70, +35).

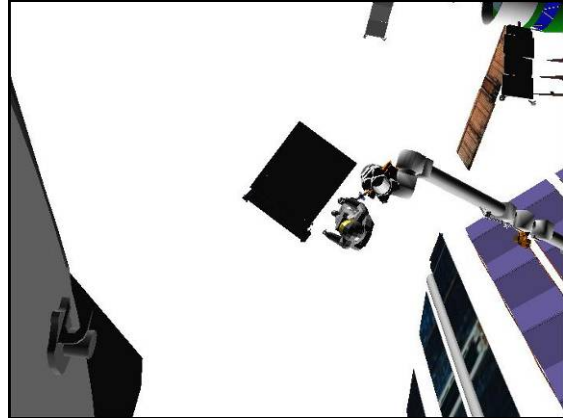


Figure 51.- Old ATA Return Int 1
(Camera C: -80, +60).

20. JOINT OCAS TO OLD ATA RETURN INT 2 POSITION

SSRMS Joint OCAS

Input 'Joint Angles' 'Destination' for Old ATA Return Int 2 position.

SR	SY	SP	EP	WP	WY	WR
+157.4	-15.4	-38.8	+86.5	-118.6	-189.0	+247.0

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)	+130.0	+15.0	-54.0	+86.5	-118.6	-159.0	+247.0
TGT	+157.4	-15.4	-38.8	+86.5	-118.6	-189.0	+247.0
ERR	-27.4	+30.4	-15.2	0.0	0.0	+30.0	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

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Verify Posn Hold – orange

Verify SSRMS at Old ATA Return Int 2 position.

SR	SY	SP	EP	WP	WY	WR
+157.4	-15.4	-38.8	+86.5	-118.6	-189.0	+247.0
X	Y	Z	Pitch	Yaw	Roll	
+1304	-82	+1833	-79.0	+4.8	+80.9	
FOR	Unloaded – Chest 12/PP/F/8, SY Held					
Disp	ISS>ISSACS					

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

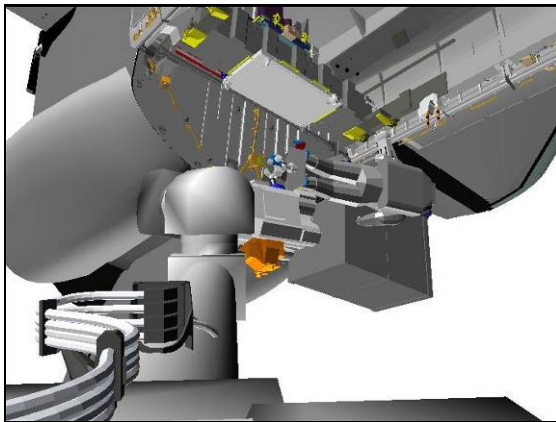


Figure 52.- Old ATA Return Int 2
(24: Tip Elbow: +5, 0).



Figure 53.- Old ATA Return Int 2
(03: S1 Lower Outboard: +70, +35).

21. SETUP FOR MANEUVER TO OLD ATA PRE-BERTH

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
03: S1 Lower Outboard (+70, +35)	22: Base Elbow (+100, -10)	71: Camera A (0, +5)	Camera B (+40, +40)	SRMS Elbow (-145, +55)
09: P1 Lower Outboard (+110, +35)			Camera C (-50, +40)	

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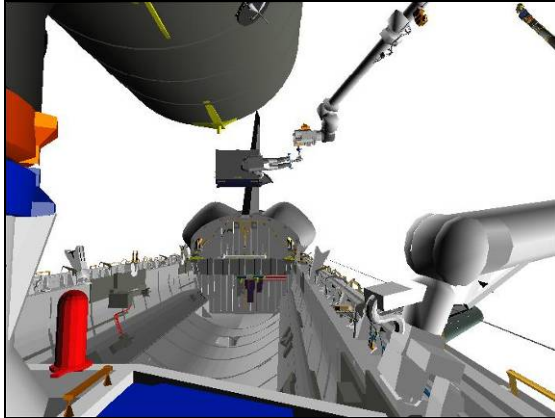


Figure 54.- Old ATA Return Int 2
(71: Camera A: 0, +5).

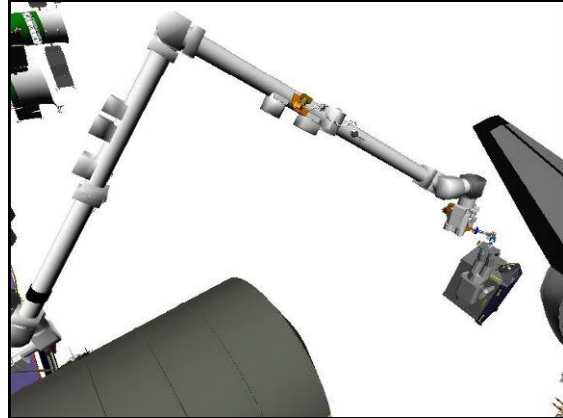


Figure 55.- Old ATA Return Int 2
(SRMS Elbow: -145, +55).

MSS: SSRMS:

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

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

√Vernier

Verify SSRMS at Old ATA Return Int 2 position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+157.4	-15.4	-38.8	+86.5	-118.6	-189.0	+247.0
X	Y	Z	Pitch	Yaw	Roll	
-2918	-79	-1430	-170.0	+5.0	+80.7	
FOR	Unloaded – Chest 12/PP/F/8, SY Held					
Disp	ISS>OBAS					

22. [MANUAL MANEUVER TO OLD ATA PRE-BERTH POSITION](#)

NOTE

For this maneuver, the clearances are as follows:

- APFR to aft MPM approximately 106 cm (42 in). This clearance may be monitored with Camera A.
- Base Boom to MPLM approximately 86 cm (34 in). This clearance may be monitored with the SRMS Elbow Camera.
- Old ATA to Aft Bulkhead approximately 78 cm (31 in). This clearance may be monitored with Camera C or Camera B.

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

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cmd Shoulder Roll (Verify SR – Locked)

THC/
RHC

Maneuver to Old ATA Pre-Berth position (within 5 cm/1 deg).
(Expect “-X” and “+Z” motion, THC out and down)

Locked						
SR	SY	SP	EP	WP	WY	WR
+157.4	-21.6	-21.1	+58.7	-107.6	-186.9	+241.1
X	Y	Z	Pitch	Yaw	Roll	
-3050	-79	-1230	-170.0	+5.0	+80.7	
FOR	Unloaded – Chest 12/PP/F/8, SY Held					
Disp	ISS>OBAS					



Figure 56.- Old ATA Pre-Berth
(03: S1 Lower Outboard: +70, +35).

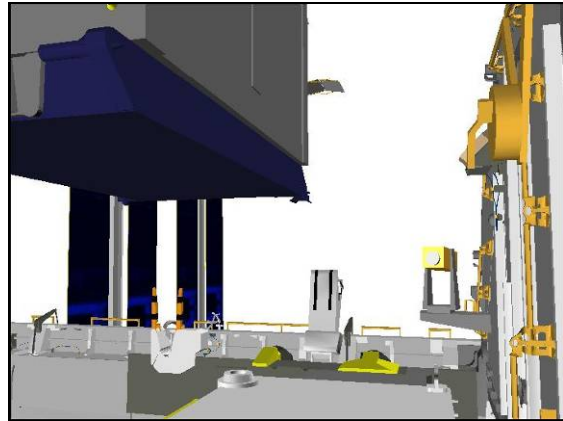


Figure 57.- Old ATA Pre-Berth
(Camera B: +75, +5).

PCS

MSS: SSRMS: Thrusters: Thruster Controls for MSS Ops

Verify ‘Desat Request:’ – Inh

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

23. MANUAL MANEUVER TO OLD ATA BERTH POSITION

NOTE

For this maneuver the clearances are as follows:

- a) APFR to aft MPM approximately 48 cm (19 in). This clearance may be monitored with Camera A.
- b) Base Boom to MPLM approximately 68 cm (27 in). This clearance may be monitored with the SRMS Elbow Camera.
- c) Old ATA to Aft Bulkhead approximately 7 cm (3 in). This clearance may be monitored with Camera C or Camera B.

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On EV GO, ready to maneuver to Old ATA Berth position:

THC/
RHC

Perform EVA GCA, as required, for Old ATA Berth.
(Expect “-X” and “+Z” motion, THC out and down)

Expected Old ATA Berth position:

Locked						
SR	SY	SP	EP	WP	WY	WR
+157.4	-24.0	-8.8	+36.8	-97.8	-186.1	+238.8
X	Y	Z	Pitch	Yaw	Roll	
-3120	-79	-1130	-170.0	+5.0	+80.7	
FOR	Unloaded – Chest 12/PP/F/8, SY Held					
Disp	ISS>OBAS					

DCP

BRAKES SSRMS → ON (Verify ON)

Notify EV, brakes on, ready for Old ATA Berth.

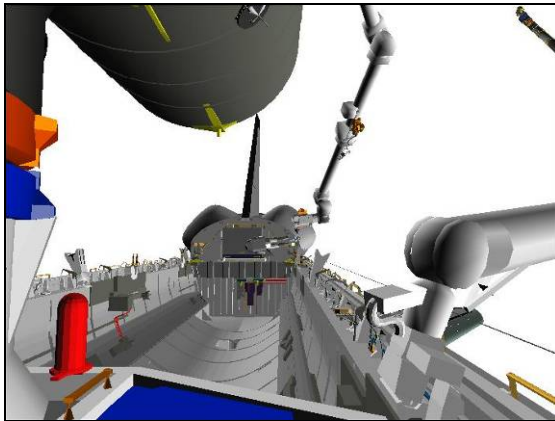


Figure 58.- Old ATA Berth
(71: Camera A: 0, +5).

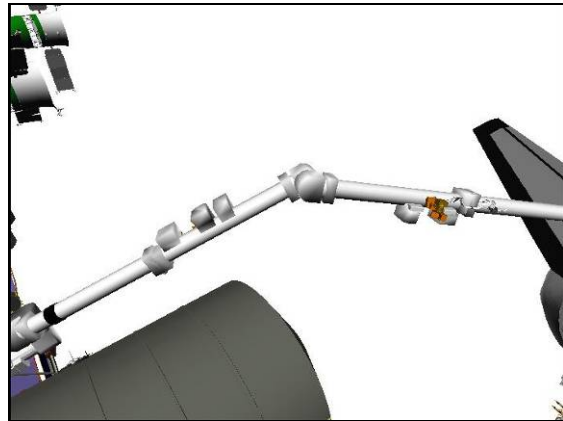


Figure 59.- Old ATA Berth
(SRMS Elbow: -145, +55).

24. MANUAL MANEUVER TO APFR EGRESS POSITION

On EV GO, ready to maneuver to APFR Egress position:

DCP

BRAKES SSRMS → OFF (Verify OFF)

PCS

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

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THC/
RHC Perform EVA GCA, as required, for APFR Egress.
Expected APFR Egress Position:

Locked						
SR	SY	SP	EP	WP	WY	WR
+157.4	-24.0	-8.8	+36.8	-97.8	-186.1	+238.8
X	Y	Z	Pitch	Yaw	Roll	
-3120	-79	-1130	-170.0	+5.0	+80.7	
FOR	Unloaded – Chest 12/PP/F/8, SY Held					
Disp	ISS>OBAS					

DCP BRAKES SSRMS → ON (Verify ON)

Notify EV, brakes on, ready for APFR Egress.

PCS MSS: SSRMS:

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

Expected APFR Egress position:

SR	SY	SP	EP	WP	WY	WR
+157.4	-24.0	-8.8	+36.8	-97.8	-186.1	+238.8
X	Y	Z	Pitch	Yaw	Roll	
-3107	-227	-1235	-52.1	+79.5	+48.7	
FOR	Unloaded – LEE Tip, SR Held					
Disp	ISS>OBAS					



Figure 60.- APFR Egress
(03: S1 Lower Outboard: +70, +35).

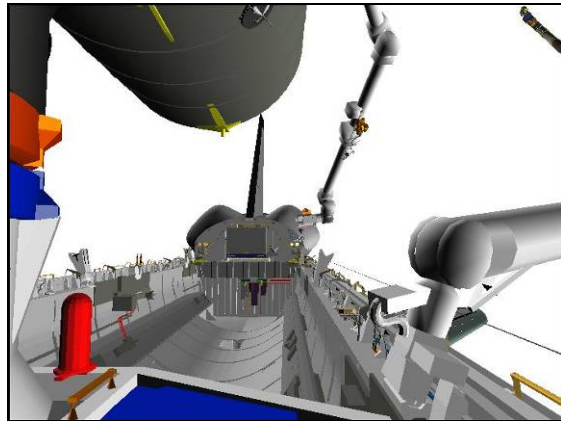


Figure 61.- APFR Egress
(71: Camera A: 0, +5).

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If using shuttle attitude control
 Coordinate with shuttle crewmembers.
 If attitude maintenance reqd
 DAP: LVLH
 When rates damped
 DAP: FREE > 2 seconds, then
 DAP: AUTO

25. MANUAL MANEUVER TO APFR UNINSTALL POSITION

On EV GO, ready to maneuver to APFR Uninstall position:

DCP BRAKES SSRMS → OFF (Verify OFF)

PCS MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

THC/
RHC Perform EVA GCA as required for APFR Uninstall.
 Expected APFR Uninstall position:

Locked						
SR	SY	SP	EP	WP	WY	WR
+157.4	-24.0	-8.8	+36.8	-97.8	-186.1	+238.8
X	Y	Z	Pitch	Yaw	Roll	
-3107	-227	-1235	-52.1	+79.5	+48.7	
FOR	Unloaded – LEE Tip, SR Held					
Disp	ISS>OBAS					

DCP BRAKES SSRMS → ON (Verify ON)

Notify EV, brakes on, ready for APFR Uninstall

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Figure 62.- APFR Uninstall
(22: Base Elbow: +140, -5).

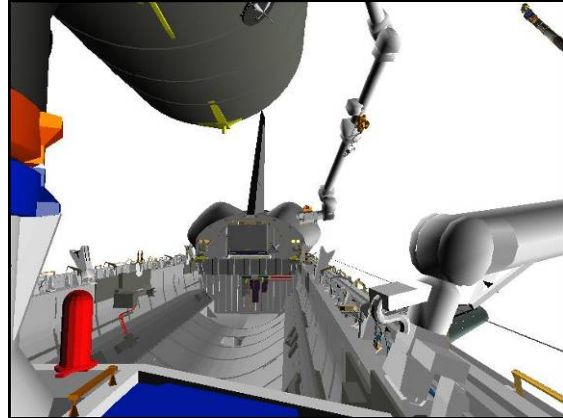


Figure 63.- APFR Uninstall
(71: Camera A: 0, +5).

26. MANUAL MANEUVER TO PLB CLEARANCE POSITION

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
09: P1 Lower Outboard (+110, +35) 07: P1 Lower Inboard (+140, +50)	22: Base Elbow (+140, -5)	03: S1 Lower Outboard (+70, +35)	Camera B (-25, +30)	SRMS Elbow (-145, +55)

NOTE

For this maneuver the clearance between the Tip LEE and the aft MPM is approximately 101 cm (40 in). This clearance may be monitored with Camera B.

On EV GO, ready to maneuver to PLB Clearance position:

DCP BRAKES SSRMS → OFF (Verify OFF)

PCS MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

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THC/
RHC

Maneuver to PLB Clearance position (within 5 cm/1 deg).
(Expect “-Z” motion, THC up)

Locked						
SR	SY	SP	EP	WP	WY	WR
+157.4	-12.7	-25.6	+61.7	-107.4	-189.9	+249.6
X	Y	Z	Pitch	Yaw	Roll	
-3107	-227	-1535	-52.1	+79.5	+48.7	
FOR	Unloaded – LEE Tip, SR Held					
Disp	ISS>OBAS					



Figure 64.- PLB Clearance
(03: S1 Lower Outboard: +70, +35).

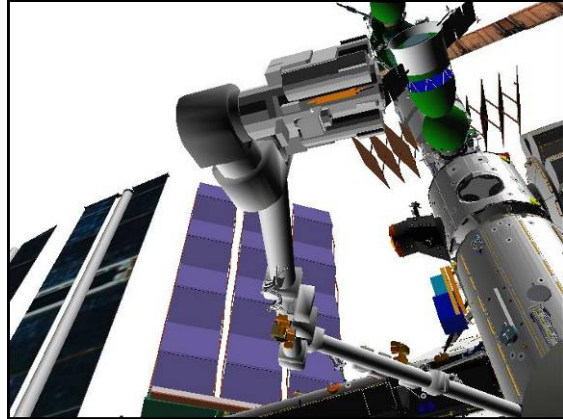


Figure 65.- PLB Clearance
(Camera B: -25, +55).

27. JOINT OCAS TO EVA 3 INTERMEDIATE POSITION

PCS

MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

Input ‘Joint Angles’ ‘Destination’ for EVA 3 Intermediate position.

SR	SY	SP	EP	WP	WY	WR
+90.0	+30.0	-85.0	+100.0	-45.0	-115.0	+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)	+157.4	-12.7	-25.6	+61.7	-107.4	-189.9	+249.6
TGT	+90.0	+30.0	-85.0	+100.0	-45.0	-115.0	+150.0
ERR	+67.4	-42.7	+59.4	-38.3	-62.4	-74.9	+99.6

```
*****
* 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
+90.0	+30.0	-85.0	+100.0	-45.0	-115.0	+150.0

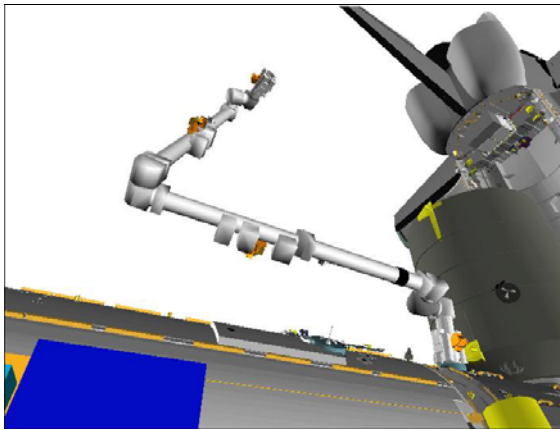


Figure 66.- EVA 3 Intermediate
 (09: P1 Lower Inboard: +115, +40).

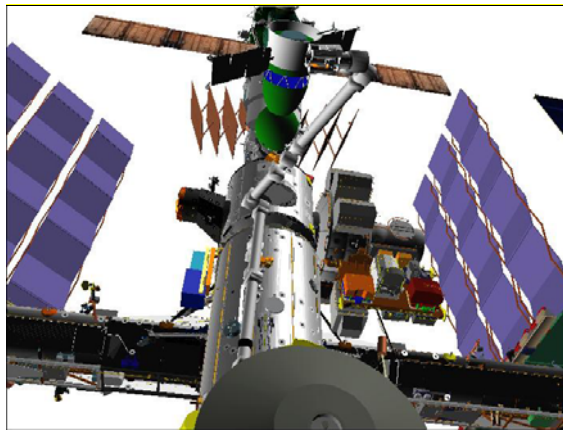


Figure 67.- EVA 3 Intermediate
 (Camera B: +10, +50).

28. SINGLE JOINT TO EVA 3 SETUP POSITION

NOTE

The clearance between the Base Boom and the LAB is approximately 91 cm (36 in). This clearance may be monitored with the P1 Lower Inboard Camera.

MSS: SSRMS:

Enter Mode – Single (Verify blue)

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

THC Perform Single Joint maneuver to EVA 3 Setup position (within 1 deg).

EVA 3 Intermediate
1: SP –
EVA 3 Setup

SR	SY	SP	EP	WP	WY	WR
+90.0	+30.0	-85.0	+100.0	-45.0	-115.0	+150.0
		-95.0				
+90.0	+30.0	-95.0	+100.0	-45.0	-115.0	+150.0
X	Y	Z	Pitch	Yaw	Roll	
-2625	-93	-2600	-95.3	-74.3	-87.1	
FOR	Unloaded – LEE Tip, SR Held					
Disp	ISS>OBAS					

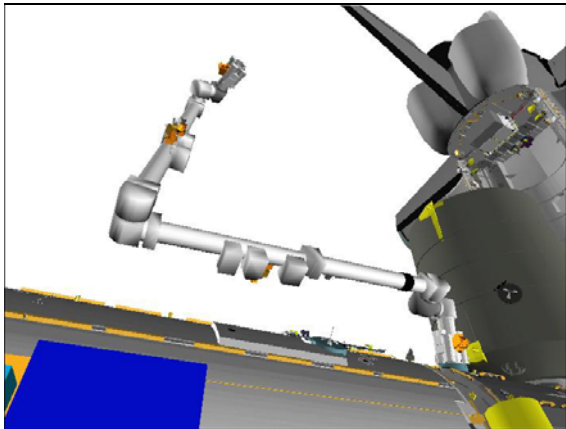


Figure 68.- EVA3 Setup
(09: P1 Lower Inboard: +115, +40).

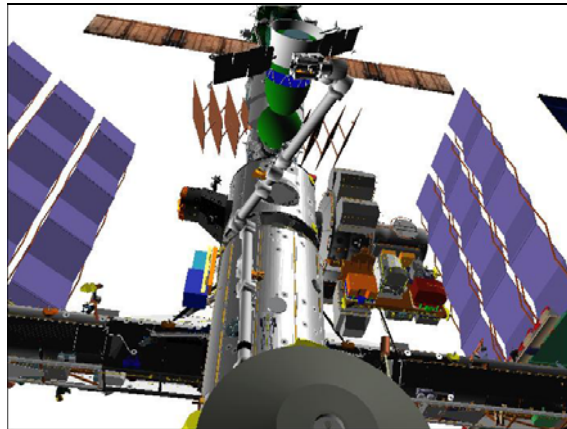


Figure 69.- EVA3 Setup
(Camera B: -10, +50).

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

DCP SAFING → SAFE (Verify ON)

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CONTINGENCY

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1. SETUP

NOTE
 Shaded boxes in Camera callout tables are for shuttle activity.

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
03: S1 Lower Outboard (+60, +30)	09: P1 Lower Outboard (+120, +30)	13: LAB Stbd Zenith (0, -30)	Camera B (+20, +40)	Camera C (+15, +45)



Figure 1.- Stage Park Position
 (03: S1 Lower Outboard: +60, +30).

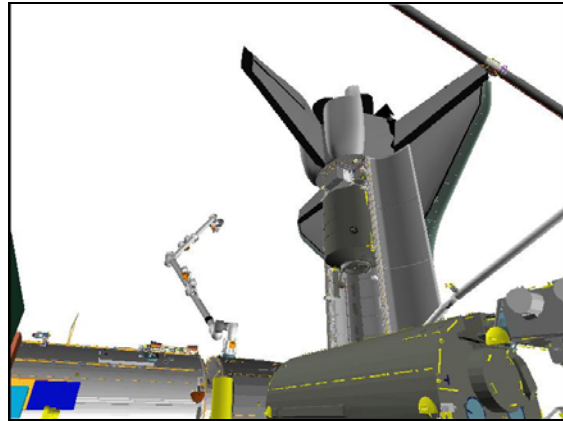


Figure 2.- Stage Park Position
 (09: P1 Lower Outboard: +120, +30).

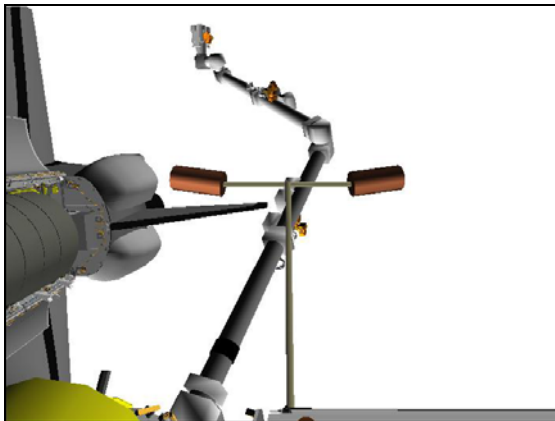


Figure 3.- Stage Park Position
 (13: LAB Stbd Zenith: 0, -30).

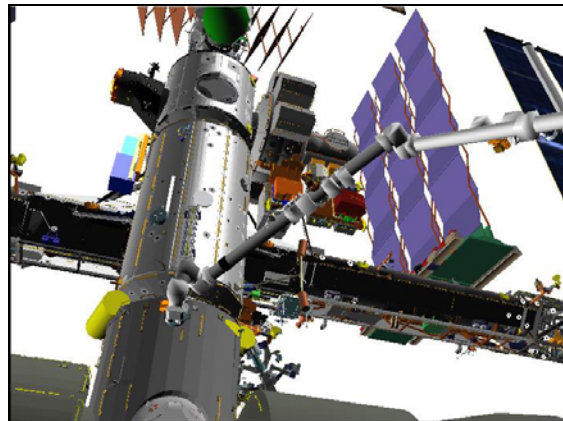


Figure 4.- Stage Park Position
 (Camera B: +20, +40).

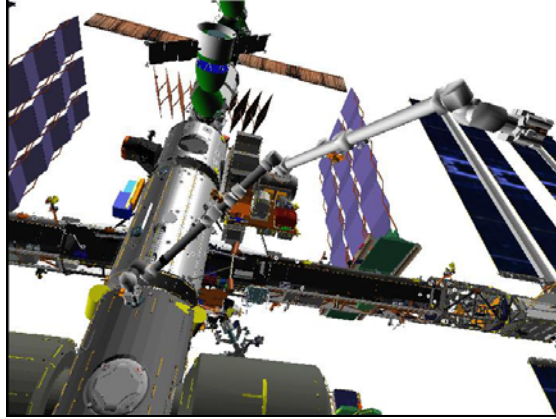


Figure 5.- Stage Park Position
 (Camera C: +15, +45).

PCS

MSS: SSRMS:

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

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

Verify Display – ISS>ISSACS

Verify Command – SSRMS>Internal

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

SR	SY	SP	EP	WP	WY	WR
+74.6	+220.0	-150.0	-50.0	-130.0	-121.0	+180.0
X	Y	Z	Pitch	Yaw	Roll	
+896	+885	+1901	+87.5	+87.3	-20.6	*
FOR	Unloaded – LEE Tip, SR Held					
Disp	ISS>ISSACS					

*Approaching display singularity

2. [JOINT OCAS TO OBSS PRE-GRAPPLE POSITION](#)

MSS: SSRMS: MSS Safing:

cmd SSRMS: Remove (Verify Not Safed)

DCP

BRAKES SSRMS → OFF (Verify OFF)

PCS

MSS: SSRMS:

✓Vernier

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Enter Mode – Joint OCAS (Verify blue)

SSRMS Joint OCAS

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

SR	SY	SP	EP	WP	WY	WR
+74.6	+160.7	-144.1	-109.5	-189.9	-159.5	+64.0

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)	+74.6	+220.0	-150.0	-50.0	-130.0	-121.0	+180.0
TGT	+74.6	+160.7	-144.1	-109.5	-189.9	-159.5	+64.0
ERR	0.0	+59.3	-5.9	+59.5	+59.9	+38.5	+116.0

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
+74.6	+160.7	-144.1	-109.5	-189.9	-159.5	+64.0

Give RMS operator GO for maneuver to OBSS Handoff position.

NOTE

Configure and route 22: Base Elbow (-47, +22) Camera view to Orbiter for monitoring PDRS clearance to JEM.



Figure 6.- OBSS Pre-Grapple Position
(03: S1 Lower Outboard: +60, +30).

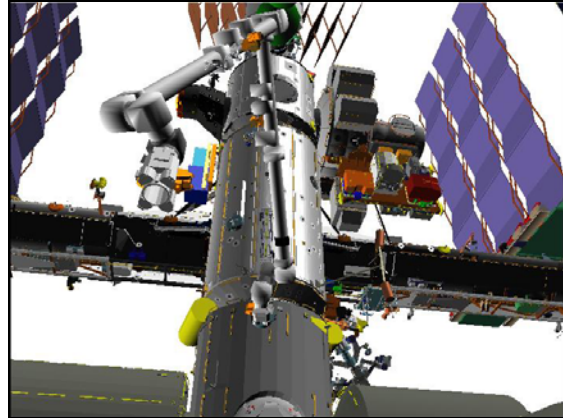


Figure 7.- OBSS Pre-Grapple Position
(Camera B: +10, +40).

3. VERIFICATION OF ATTITUDE CONTROL CONFIGURATION

MSS: SSRMS: Thrusters:

Verify 'Desat Request:' – Inh

If using shuttle attitude control, coordinate with shuttle crew
DAP: FREE.

4. OBSS GRAPPLE

On RMS operator, GO for OBSS Grapple:

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
03: S1 Lower Outboard (+60, +30)	25: Tip LEE	13: LAB Stbd Zenith (0, -30)	Camera A (+5, +20)	Camera B (-10, +40)

NOTE

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

4.1 Maneuvering to Grapple Envelope

MSS: SSRMS:

√Vernier

MSS: SSRMS: Rate:

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

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

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

cmd Shoulder Roll (Verify SR – Locked)

THC/
RHC

Maneuver to within grapple envelope.

4.2 Slow Capture Commands

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

4.3 Grapple

RHC

TRIGGER → Press (momentarily)

PCS

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

4.4 Grapple Cleanup

Verify Posn Hold – orange

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

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	
+1248	-330	+1629	+110.1	+89.7	-62.9	*
FOR	Loaded – OBSS Mid MPM, SR Held					
Disp	ISS>ISSACS					

* Approaching display singularity



Figure 8.- OBSS Grapple
 (03: S1 Lower Outboard: +60, +30).

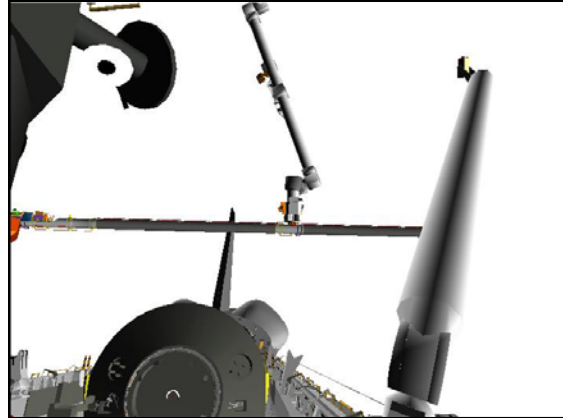


Figure 9.- OBSS Grapple
 (Camera A: +5, +20).

DCP BRAKES SSRMS → ON (Verify ON)

Give RMS operator GO for OBSS ungrapple.

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

5. MANEUVER SETUP

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
03: S1 Lower Outboard (+60, +30)	22: Base Elbow (-90, +10)	13: LAB Stbd Zenith (0, -30)	Camera A (0, +20)	SRMS Elbow (-40, -10)

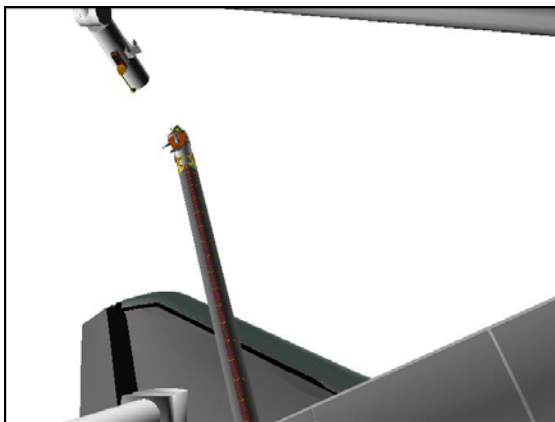


Figure 10.- OBSS Grapple
 (22: Base Elbow: -90, +10).

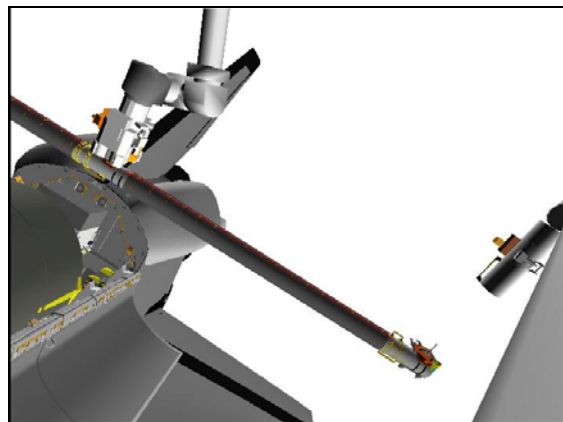


Figure 11.- OBSS Grapple
 (SRMS Elbow: -40, -10).

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PCS MSS: 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)

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

6. FOR OCAS TO OBSS UNBERTH 2

On RMS operator, GO for OBSS Berth Sequence:

DCP BRAKES SSRMS → OFF (Verify OFF)

RHC RATE → COARSE (Verify Coarse on PCS)

PCS MSS: SSRMS:

Enter Mode – FOR OCAS (Verify blue)

MSS: SSRMS: SSRMS FOR OCAS: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

Input 'FOR' 'Destination' for OBSS Unberth 2 position.

X	Y	Z	Pitch	Yaw	Roll
+600	+50	-1000	+90.0	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	+401	+684	-157	+91.5	-70.6	+47.6
TGT	+600	+50	-1000	+90.0	0.0	0.0
ERR	-199	+634	+843	+1.5	-70.6	+47.6

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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 OBSS Unberth 2 position (within 5 cm/1 deg).

Locked						
SR	SY	SP	EP	WP	WY	WR
+74.6	+210.1	-115.4	-92.4	-153.2	-171.0	+175.6
X	Y	Z	Pitch	Yaw	Roll	
+600	+50	-1000	+90.0	0.0	0.0	
FOR	Loaded – OBSS Mid MPM, SR Held					
Disp	Orbiter>OBSS Mid MPM					



Figure 12.- OBSS Unberth 2
 (03: S1 Lower Outboard: +60, +30).

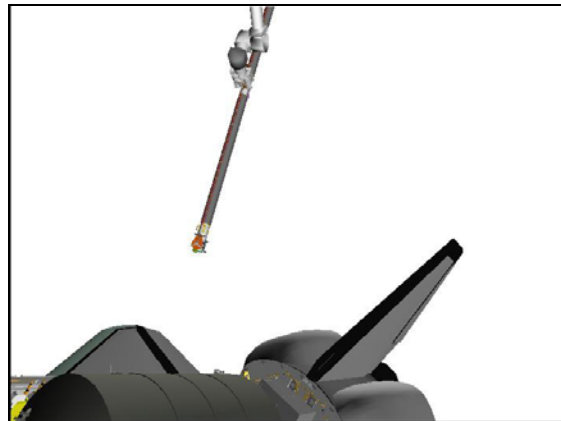


Figure 13.- OBSS Unberth 2
 (SRMS Elbow: -70, +20).

7. FOR OCAS TO OBSS UNBERTH 1

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
03: S1 Lower Outboard (+60, +30)	24: Tip Elbow (-40, +10)	13: LAB Stbd Zenith (0, -30)	Camera D (-10, +20)	SRMS Elbow (-70, +20)

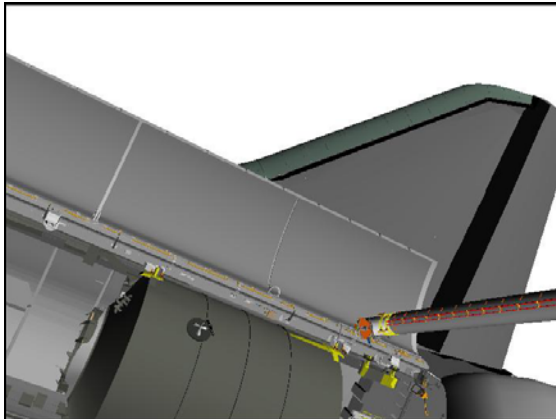


Figure 14.- OBSS Unberth 2
 (24: Tip Elbow: -40, +10).



Figure 15.- OBSS Unberth 2
 (Camera D: -10, +20).

SSRMS FOR OCAS

Input 'FOR' 'Destination' for OBSS Unberth 1 position.

X	Y	Z	Pitch	Yaw	Roll
+200	-200	-250	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	+600	+50	-1000	+90.0	0.0	0.0
TGT	+200	-200	-250	0.0	0.0	0.0
ERR	+400	+250	-750	+90.0	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

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PCS MSS: SSRMS:

Verify Posn Hold – orange

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

Locked						
SR	SY	SP	EP	WP	WY	WR
+74.6	+227.4	-157.9	-85.7	-188.8	-160.8	+221.0
X	Y	Z	Pitch	Yaw	Roll	
+200	-200	-250	0.0	0.0	0.0	
FOR	Loaded – OBSS Mid MPM, SR Held					
Disp	Orbiter>OBSS Mid MPM					



Figure 16.- OBSS Unberth 1
(03: S1 Lower Outboard: +60, +30).

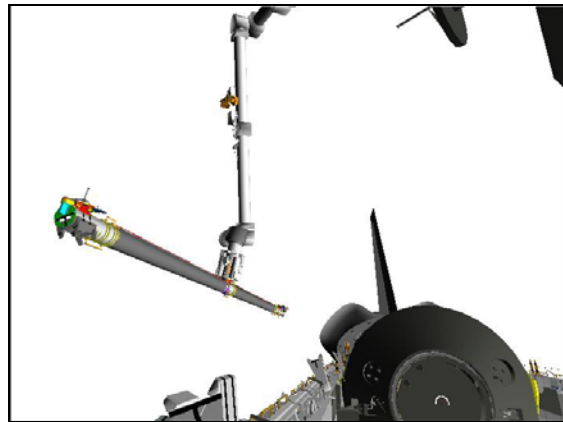


Figure 17.- OBSS Unberth 1
(Camera D: -10, +20).

8. FOR OCAS TO OBSS LOW HOVER

RHC RATE → VERNIER (Verify Vernier on PCS)

PCS MSS: SSRMS: Rate:

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

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

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

cmd Load (Verify Sequence Status – Confirm or Cancel)

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

	X	Y	Z	Pitch	Yaw	Roll
FOR	+200	-200	-250	0.0	0.0	0.0
TGT	0	0	-100	0.0	0.0	0.0
ERR	+200	-200	-150	0.0	0.0	0.0

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

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

DCP AUTO SEQ → PROC

PCS MSS: SSRMS:

Verify Posn Hold – orange

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

Locked						
SR	SY	SP	EP	WP	WY	WR
+74.6	+223.3	-163.6	-106.5	-163.6	-159.6	+216.8
X	Y	Z	Pitch	Yaw	Roll	
0	0	-100	0.0	0.0	0.0	
FOR	Loaded – OBSS Mid MPM, SR Held					
Disp	Orbiter>OBSS Mid MPM					



Figure 18.- OBSS Low Hover
(03: S1 Lower Outboard: +60, +30).

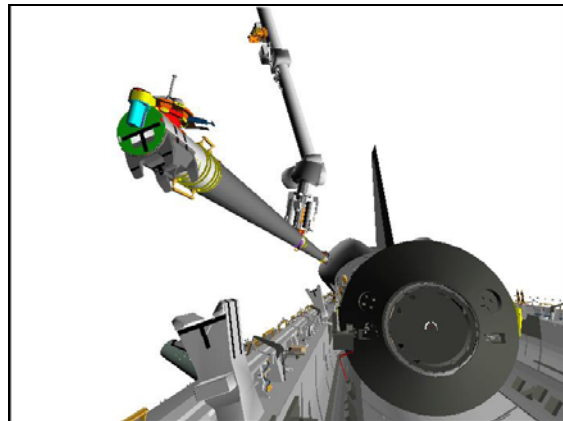


Figure 19.- OBSS Low Hover
(Camera D: -10, +10).

9. ATTITUDE CONTROL CONFIGURATION

MSS: SSRMS: Thrusters:

Verify 'Desat Request:' – Inh

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If using shuttle attitude control, coordinate with shuttle crew
 DAP: FREE.

10. BERTH OBSS

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

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
03: S1 Lower Outboard (+60, +30)	71: Mux D/C (D: -25, 0) (C: +25, 0)	13: LAB Stbd Zenith (-20, -30)	Camera C (+25, 0)	SRMS Elbow (-110, +5)

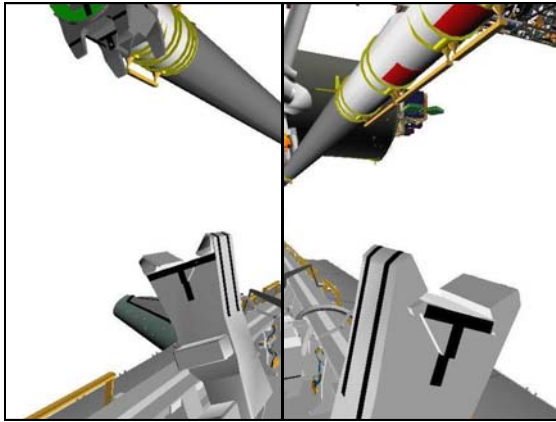


Figure 20.- OBSS Low Hover (71: Mux D/C).

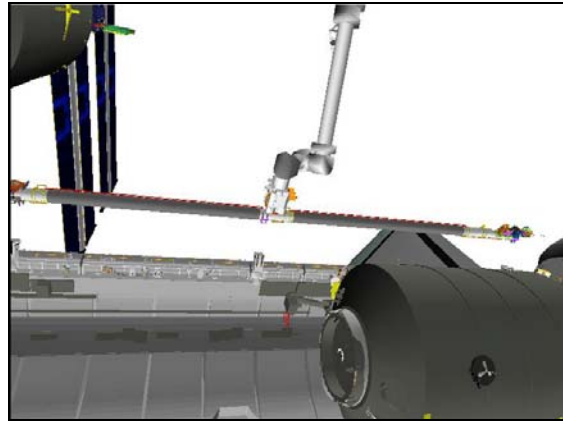


Figure 21.- OBSS Low Hover (SRMS Elbow: -110, +5).

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

THC/
RHC

Maneuver to OBSS Berthed position (until shuttle crew callout that three of three STBD RMS R-F-L tb - gray).

Expected OBSS Berthed position.

Locked	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						

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PCS MSS: SSRMS:

Verify Posn Hold – orange

Enter Mode – Standby (Verify blue)



Figure 22.- OBSS Berthed
(03: S1 Lower Outboard: +60, +30).

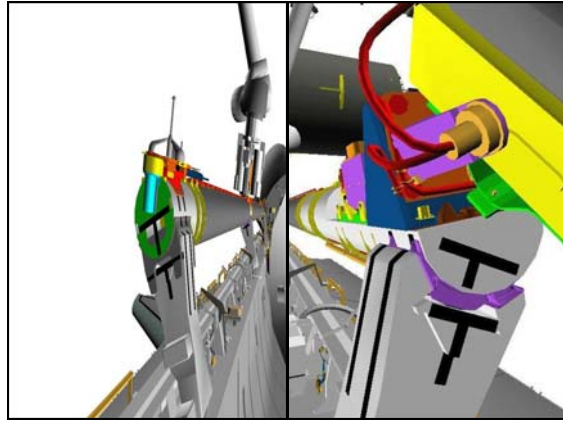


Figure 23.- OBSS Berthed
(71: Mux D/C).

11. MRL LATCHING SEQUENCE

11.1 Limp Wrist Joints

MSS: SSRMS: Limp:

sel WP, WY, WR

cmd Execute

MSS: SSRMS:

Verify Limp – blue

Verify WP, WY, WR – Limped

11.2 Latching MRLs to TC

Give shuttle crew GO to latch STBD MRLs to Topological Capture.

11.3 Carriage Derigidization

On shuttle crew GO to Limp all SSRMS Joints and Derigidize:

MSS: SSRMS: Limp:

cmd All Limp (Verify Limp – blue)

MSS: SSRMS:

Verify all joints – Limped

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MSS: SSRMS: Tip LEE: SSRMS Tip LEE

cmd 'Carriage' Derigidize ► 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 – Derigidize

RHC TRIGGER → Press (momentarily) (SCR 19064)

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

11.4 Complete MRL Latching

Give shuttle crew GO to complete latching of STBD MRLs

11.5 Carriage Rigidization

NOTE

Carriage rigidization is performed to re-seat the SSRMS LEE over the OBSS GF prior to initiating a push-off release operation.

On shuttle crew GO for OBSS 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

RHC TRIGGER → Press (momentarily) (SCR 19064)

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

Verify 'Carriage' Retract – blue

Verify Motors – Inh

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MSS: SSRMS: Limp:

cmd None Limp (Verify Standby – blue)

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

12. UNGRAPPLE SETUP

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
03: S1 Lower Outboard (+60, +30)	25: Tip LEE	13: LAB Stbd Zenith (-20, -30)	Camera C (+25, +25)	SRMS Elbow (-110, +20)

NOTE

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

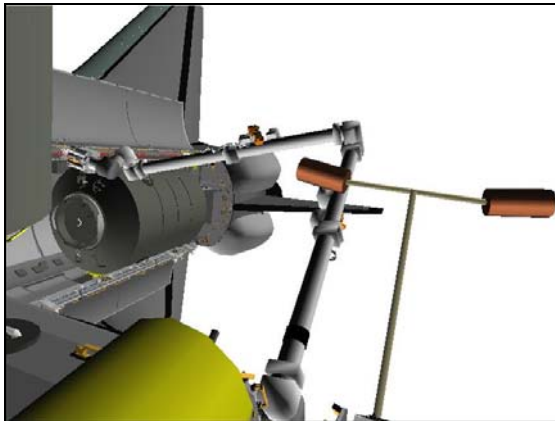


Figure 24.- OBSS Berthed
 (13: LAB Stbd Zenith: -20, -30).

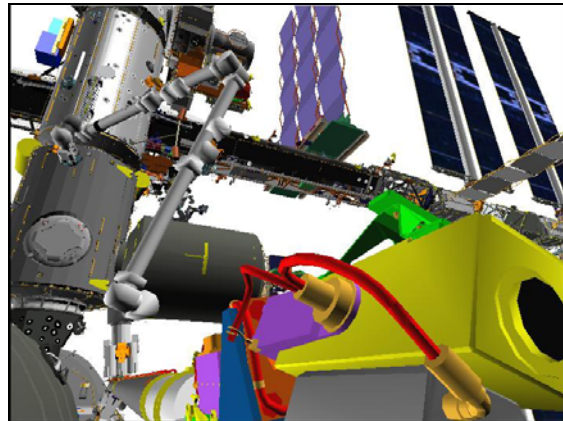


Figure 25.- OBSS Berthed
 (Camera C: +25, +25).

MSS: SSRMS:

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

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

√Vernier

MSS: SSRMS: Rate:

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

MSS: SSRMS: Limp:

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cmd All Limp (Verify Limp – blue)

MSS: SSRMS:

Verify all joints – Limped

13. OBSS UNGRAPPLE (CARRIAGE PUSHOFF)

13.1 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' Derigidize – blue (90 s max)

Verify 'Snare' Open – blue (12 s max)

Verify 'Carriage' Extend – blue (90 s max)

Verify Unloaded Parameters – ✓

13.2 SSRMS Backoff

MSS: SSRMS: Limp:

cmd None Limp (Verify Standby – blue)

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

THC/
RHC

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

Locked						
SR	SY	SP	EP	WP	WY	WR
+74.6	+219.2	-164.7	-108.7	-161.8	-158.5	+212.6
X	Y	Z	Pitch	Yaw	Roll	
-100	0	0	0.0	0.0	0.0	
FOR	Unloaded – LEE Tip, SR Held					
Disp	Orbiter>OBSS FRGF					



Figure 26.- OBSS Backoff
(03: S1 Lower Outboard: +60, +30).

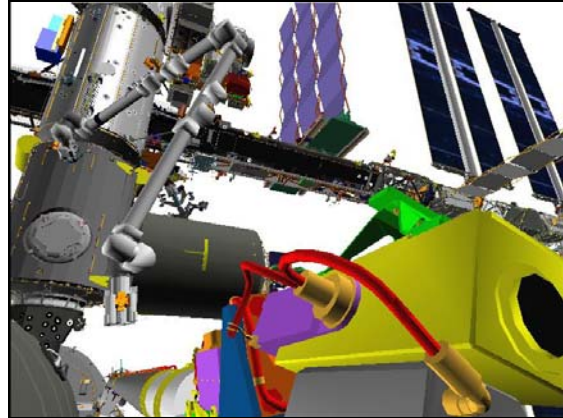


Figure 27.- OBSS Backoff
(Camera C: +25, +25).

14. FOR OCAS TO STAGE PARK

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
03: S1 Lower Outboard (+60, +30)	22: Base Elbow (-90, -10)	13: LAB Stbd Zenith (-20, -30)	Camera C (+5, +30)	SRMS Elbow (-110, +30)

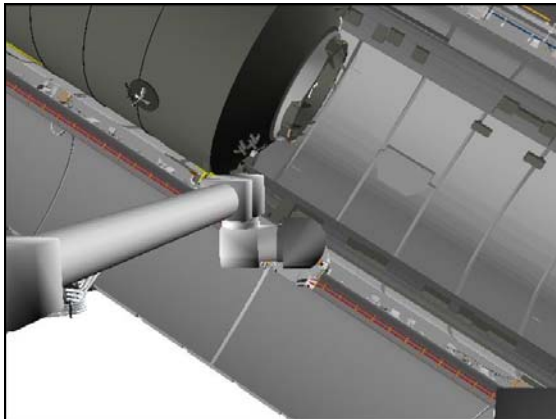


Figure 28.- OBSS Backoff
(22: Base Elbow: -90, -10).

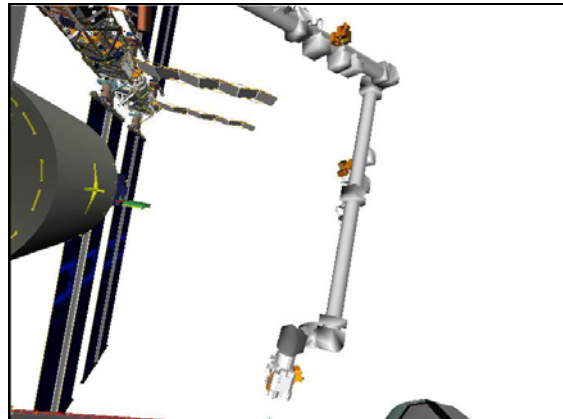


Figure 29.- OBSS Backoff
(SRMS Elbow: -110, +30).

PCS

MSS: SSRMS:

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

Enter Mode – FOR OCAS (Verify blue)

MSS: SSRMS: SSRMS FOR OCAS: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

SSRMS FOR OCAS

Input 'FOR' 'Destination' for Stage Park position.

X	Y	Z	Pitch	Yaw	Roll
+896	+885	+1901	+87.5	+87.3	-20.6

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	+1472	+251	+1249	+1.0	+10.6	-179.8
TGT	+896	+885	+1901	+87.5	+87.3	-20.6
ERR	+576	-634	-652	-86.5	-76.7	-159.2

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: SSRMS

Verify Posn Hold – orange

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

Locked	SR	SY	SP	EP	WP	WY	WR
	+74.6	+220.0	-150.0	-50.0	-130.0	-121.0	+180.0
	X	Y	Z	Pitch	Yaw	Roll	
	+896	+885	+1901	+87.5	+87.3	-20.6	*
FOR	Unloaded – LEE Tip, SR Held						
Disp	ISS>ISSACS						

* Approaching display singularity



Figure 30.- Stage Park
(03: S1 Lower Outboard: +60, +30).



Figure 31.- Stage Park
(13: LAB Stbd Zenith: -20, -30).

NOTE

Expect the following message when safing is commanded:

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

This message should return to Norm.

DCP

SAFING → SAFE (Verify ON)

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1. SETUP

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
09: P1 Lower Outboard (+110, +20)	71: Camera B (-20, +50)	22: Base Elbow (-110, -10)	SRMS Elbow (+150, +50)	OBSS ITVC (+55, -80)



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

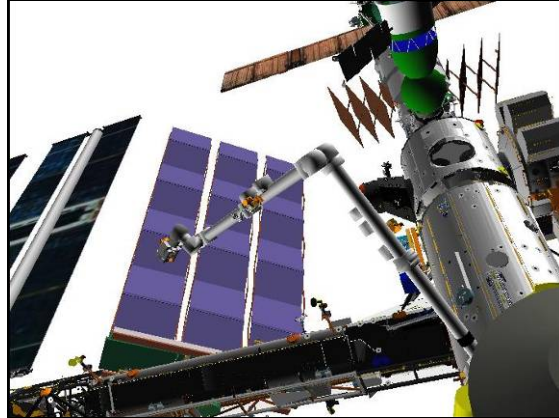


Figure 2.- EVA 1 Setup Position
(71: Camera B: -20, +50).

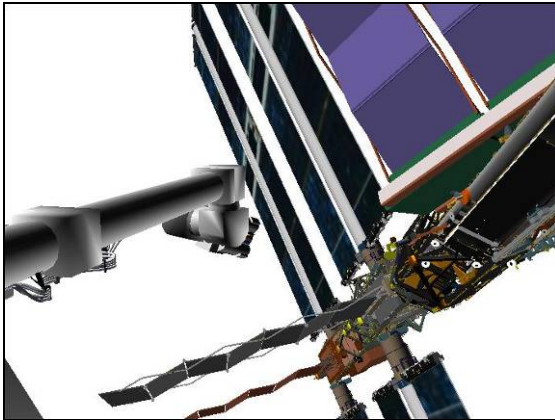


Figure 3.- EVA 1 Setup Position
(22: Base Elbow: -110, -10).

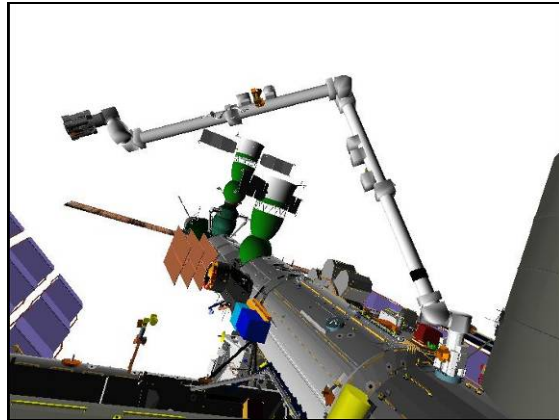


Figure 4.- EVA 1 Setup Position
(SRMS Elbow: +150, +50).

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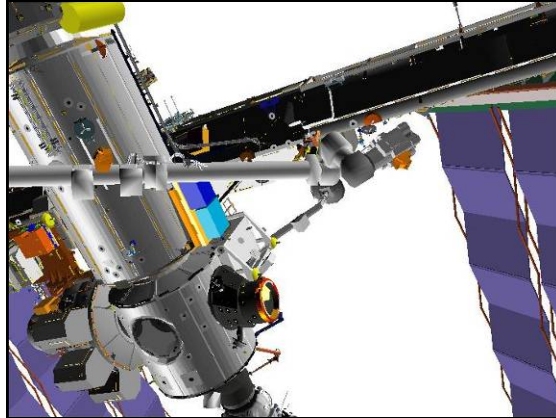


Figure 5.- EVA 1 Setup Position
(OBSS ITVC: +55, -80).

PCS

MSS: SSRMS:

Change Loaded Parameters ► ATA ► ATA Mnvr SYH
Verify 'Loaded Parameters' (two) – ATA Mnvr, SY Held

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

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

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

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

SR	SY	SP	EP	WP	WY	WR
+145.0	+20.0	-30.0	-85.0	-20.0	-20.0	+11.1
X	Y	Z	Pitch	Yaw	Roll	
-2077	-1146	-2576	-7.1	-50.1	-46.2	
FOR	Unloaded – LEE Tip, SR Held					
Disp	ISS>OBAS					

2. JOINT OCAS TO EVA CONTINGENCY START POSITION

NOTE

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

MSS: SSRMS: MSS Safing:

cmd 'SSRMS' Remove (Verify Not Safed)

DCP BRAKES SSRMS → OFF (Verify OFF)

RHC RATE → COARSE (Verify Coarse on PCS)

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PCS MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

Input 'Joint Angles' 'Destination' for EVA Contingency Start position.

SR	SY	SP	EP	WP	WY	WR
+157.4	-16.5	-21.2	+56.0	-105.5	-188.6	-114.1

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)	+145.0	+20.0	-30.0	-85.0	-20.0	-20.0	+11.1
TGT	+157.4	-16.5	-21.2	+56.0	-105.5	-188.6	-114.1
ERR	-12.4	+36.5	-8.8	-141.0	+85.5	+168.6	+125.2

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

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

DCP AUTO SEQ → PROC

PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at EVA Contingency Start position.

SR	SY	SP	EP	WP	WY	WR
+157.4	-16.5	-21.2	+56.0	-105.5	-188.6	-114.1
X	Y	Z	Pitch	Yaw	Roll	
-3106	-227	-1438	-52.0	+79.4	+48.6	
FOR	Unloaded – LEE Tip, SR Held					
Disp	ISS>OBAS					

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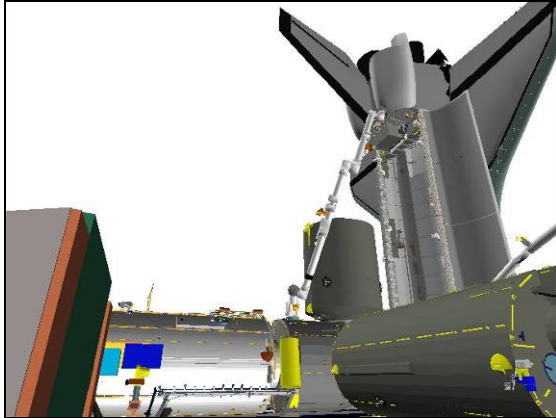


Figure 6.- Contingency EVA Start
(09: P1 Lower Outboard: +110, +25).

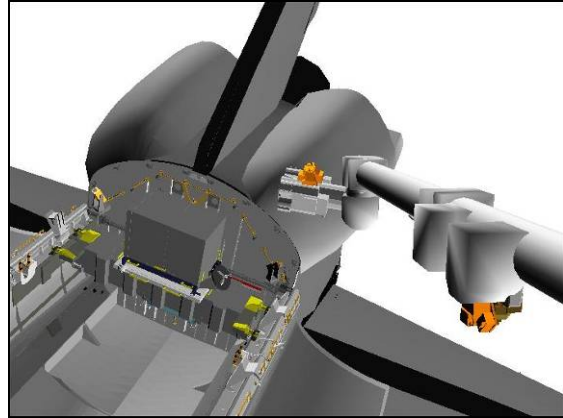


Figure 7.- Contingency EVA Start
(22: Base Elbow: +130, -10).

3. MANUAL MANEUVER TO APFR INSTALL POSITION

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
09: P1 Lower Outboard (+120, +25)	22: Base Elbow (+130, -10)	03: S1 Lower Outboard (+70, +35)	SRMS Elbow (-130, +50)	Camera A (0, +5) Camera B (-10, +50)

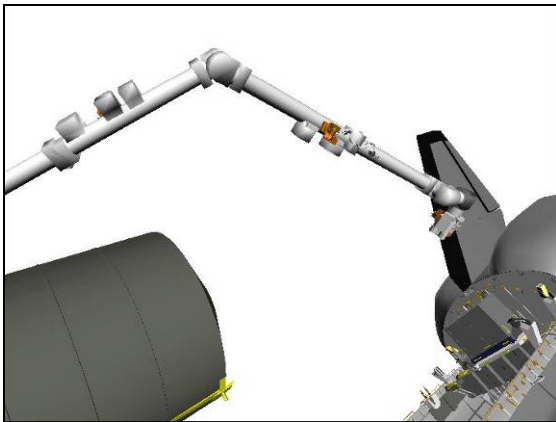


Figure 8.- Contingency EVA Start
(SRMS Elbow: -130, +50).

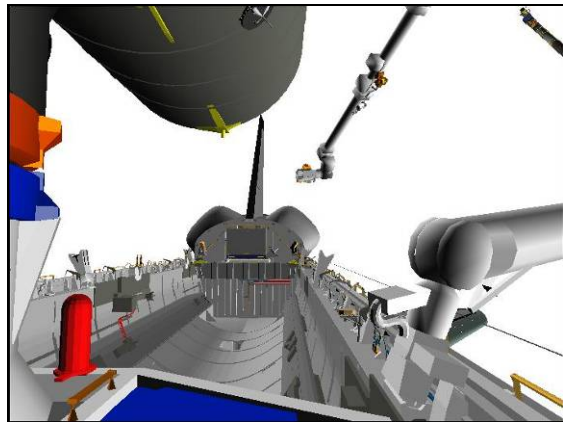


Figure 9.- Contingency EVA Start
(Camera A: 0, +5).

NOTE

For this maneuver the clearances are as follows:

- a) Base Boom to MPLM approximately 68 cm (27 in). This clearance may be monitored with the SRMS Elbow Camera.
- b) Once the APFR is installed, the clearance to the aft MPM will then be approximately 48 cm (19 in).

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On EV GO, ready to maneuver to APFR Install position:

RHC RATE → VERNIER (Verify Vernier on PCS)

PCS MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

THC/
RHC Perform EVA GCA, as required, for APFR Install.
(Expect “+Z” motion, THC down)
Expected APFR Install position:

Locked	SR	SY	SP	EP	WP	WY	WR
	+157.4	-23.9	-9.2	+37.5	-98.1	-186.1	-121.1
	X	Y	Z	Pitch	Yaw	Roll	
	-3106	-227	-1239	-52.0	+79.4	+48.6	
FOR	Unloaded – LEE Tip, SR Held						
Disp	ISS>OBAS						

DCP BRAKES SSRMS → ON (Verify ON)

Notify EV, brakes on, ready for APFR Reconfig.

NOTE APFR Settings are 12/PP/F/8.



Figure 10.- APFR Install
(03: S1 Lower Outboard: +70, +35).

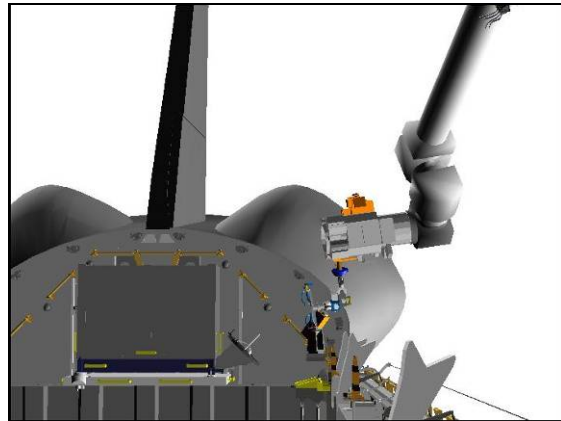


Figure 11.- APFR Install
(Camera A: 0, +5, FL=20 mm).

PCS MSS: SSRMS: Thrusters:

Verify ‘Desat Request:’ – Inh

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

4. MANUAL MANEUVER TO APFR INGRESS POSITION

On EV GO, ready to maneuver to APFR ingress position:

BRAKES SSRMS → OFF (Verify OFF)

PCS

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

THC/
RHC

Perform EVA GCA, as required, for APFR Ingress.
Expected APFR Ingress Position:

Locked						
SR	SY	SP	EP	WP	WY	WR
+157.4	-23.9	-9.2	+37.5	-98.1	-186.1	-121.1
X	Y	Z	Pitch	Yaw	Roll	
-3106	-227	-1239	-52.0	+79.4	+48.6	
FOR	Unloaded – LEE Tip, SR Held					
Disp	ISS>OBAS					

DCP

BRAKES SSRMS → ON (Verify ON)

Notify EV, brakes on ready for APFR Ingress.

PCS

MSS: SSRMS:

Change Unloaded Parameters ► EVA ► Chest 12/PP/F/8 SRH
Verify 'Unloaded Parameters' (two) – Chest 12/PP/F/8, SR Held

Expected APFR Ingress position.

SR	SY	SP	EP	WP	WY	WR
+157.4	-23.9	-9.2	+37.5	-98.1	-186.1	-121.1
X	Y	Z	Pitch	Yaw	Roll	
-3119	-79	-1135	-170.0	+5.0	+80.7	
FOR	Unloaded – Chest 12/PP/F/8, SR Held					
Disp	ISS>OBAS					

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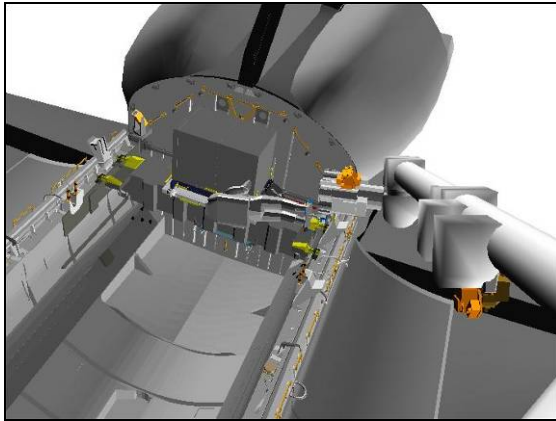


Figure 12.- APFR Ingress
(22: Base Elbow: +140, -10).

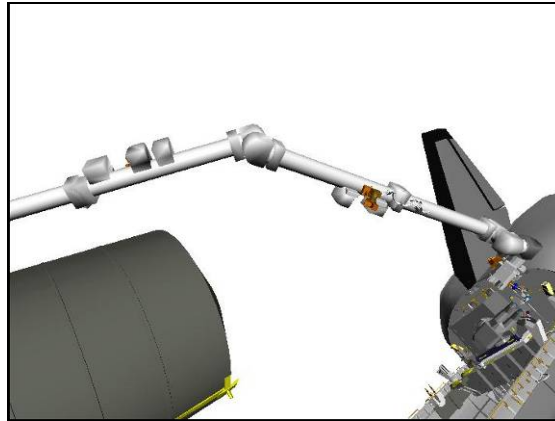


Figure 13.- APFR Ingress
(SRMS Elbow: -130, +50).

5. MANUAL MANEUVER TO ATA ON LMC POSITION

On EV GO, ready to maneuver to ATA on LMC position:

DCP BRAKES SSRMS → OFF (Verify OFF)

PCS MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

THC/ Perform EVA GCA, as required, for reaching ATA.

RHC

Expected ATA on LMC position:

Locked						
SR	SY	SP	EP	WP	WY	WR
+157.4	-23.9	-9.2	+37.5	-98.1	-186.1	-121.1
X	Y	Z	Pitch	Yaw	Roll	
-3119	-79	-1135	-170.0	+5.0	+80.7	
FOR	Unloaded – Chest 12/PP/F/8, SR Held					
Disp	ISS>OBAS					

DCP BRAKES SSRMS → ON (Verify ON)

Notify EV, brakes on, ready to unbolt ATA.

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Figure 14.- ATA on LMC
(03: S1 Lower Outboard: +70, +35).

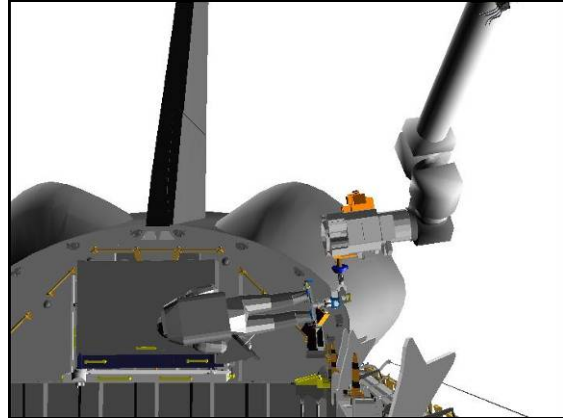


Figure 15.- ATA on LMC
(Camera A: 0, +5, FL=20 mm).

6. MANUAL MANEUVER TO ATA UNBERTH POSITION

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
09: P1 Lower Outboard (+120, +25)	71: Camera B (+90, +5)	03: S1 Lower Outboard (+70, +35)	SRMS Elbow (-130, +50)	Camera A (0, +5)



Figure 16.- ATA on LMC
(71: Camera B: +90, +5).

NOTE

For this maneuver the clearance between the new ATA and the Aft Bulkhead is approximately 6 cm (2 in). This clearance may be monitored with Camera B.

On EV GO, ready to maneuver to ATA Unberth position:

DCP BRAKES SSRMS → OFF (Verify OFF)

PCS MSS: SSRMS: Rate:

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

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MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

THC/
RHC

Perform EVA GCA, as required, to clear LMC and maneuver to ATA

Unberth position (within 5 cm/1 deg).

(Expect "+X" and "-Z" motion, THC in and up)

Locked	SR	SY	SP	EP	WP	WY	WR
	+157.4	-15.3	-38.8	+86.5	-118.6	-189.0	-112.9
	X	Y	Z	Pitch	Yaw	Roll	
	-2919	-79	-1432	-170.0	+5.0	+80.7	
FOR	Unloaded – Chest 12/PP/F/8, SR Held						
Disp	ISS>OBAS						

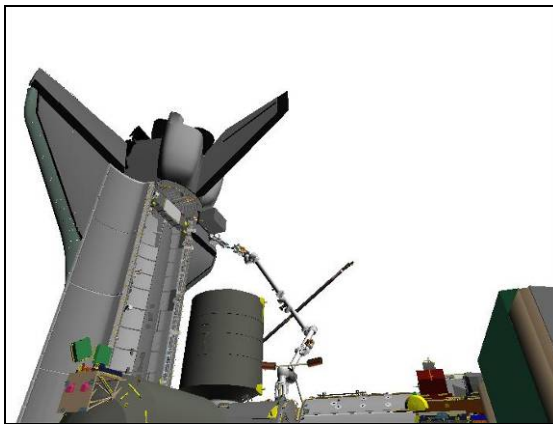


Figure 17.- ATA Unberth
(03: S1 Lower Outboard: +70, +35).

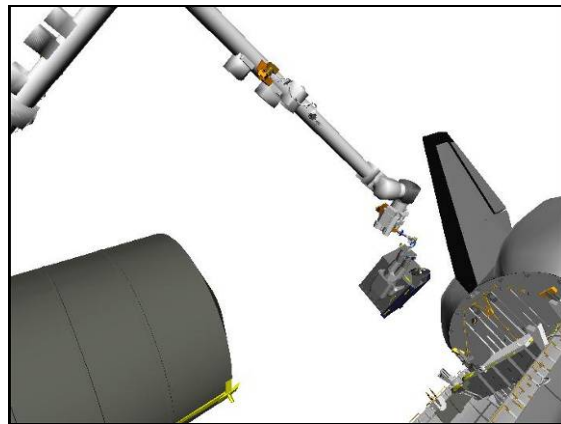


Figure 18.- ATA Unberth
(SRMS Elbow: -130, +50).

If using shuttle attitude control
Coordinate with shuttle crewmembers.
If attitude maintenance reqd
DAP: LVLH
When rates damped
DAP: FREE > 2 seconds, then
DAP: AUTO

7. JOINT OCAS TO ATA HANDOFF INT 1 POSITION

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
09: P1 Lower Outboard (+120, +40)	22: Base Elbow (+100, -10) 24: Tip Elbow (+5, -5)	03: S1 Lower Outboard (+70, +35)	SRMS Elbow (-130, +60)	Camera B (+30, +40)

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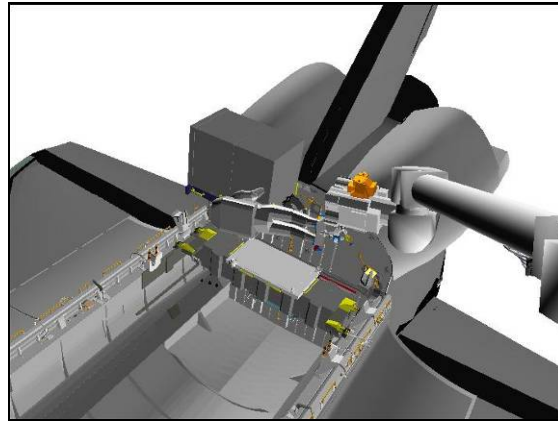


Figure 19.- ATA Unberth
(22: Base Elbow: +100, -10).

PCS

MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

Input 'Joint Angles' 'Destination' for ATA Handoff Int 1 position.

SR	SY	SP	EP	WP	WY	WR
+130.0	+15.0	-54.0	+86.5	-118.6	-159.0	-112.9

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)	+157.4	-15.3	-38.8	+86.5	-118.6	-189.0	-112.9
TGT	+130.0	+15.0	-54.0	+86.5	-118.6	-159.0	-112.9
ERR	+27.4	-30.3	+15.2	0.0	0.0	-30.0	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

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PCS MSS: SSRMS: SSRMS

Verify Posn Hold – orange

Verify Joint Angle values.

SR	SY	SP	EP	WP	WY	WR
+130.0	+15.0	-54.0	+86.5	-118.6	-159.0	-112.9

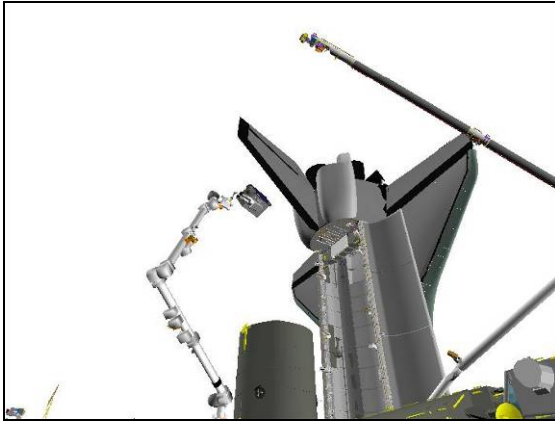


Figure 20.- ATA Handoff Int 1
(09: P1 Lower Outboard: +120, +40).

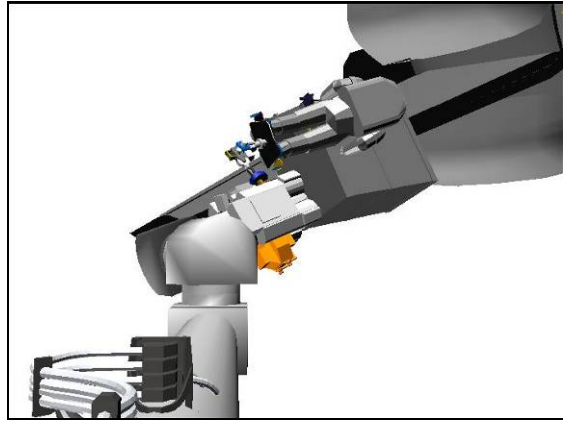


Figure 21.- ATA Handoff Int 1
(24: Tip Elbow: +5, +5).

8. JOINT OCAS TO ATA HANDOFF BACKOFF POSITION

NOTE

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

Verify Port TRRJ locked at -40 degrees.

SSRMS Joint OCAS

Input 'Joint Angles' 'Destination' for ATA Handoff Backoff position.

SR	SY	SP	EP	WP	WY	WR
+129.1	+27.7	-59.9	-45.3	-80.0	+11.6	+59.6

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)	+130.0	+15.0	-54.0	+86.5	-118.6	-159.0	-112.9
TGT	+129.1	+27.7	-59.9	-45.3	-80.0	+11.6	+59.6
ERR	+0.9	-12.7	+5.9	+131.8	-38.6	-170.6	-172.5

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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 ATA Handoff Backoff position.

SR	SY	SP	EP	WP	WY	WR
+129.1	+27.7	-59.9	-45.3	-80.0	+11.6	+59.6
X	Y	Z	Pitch	Yaw	Roll	
-1712	-1046	-2878	-104.8	+57.1	-0.4	
FOR	Unloaded – Chest 12/PP/F/8, SR Held					
Disp	ISS>OBAS					

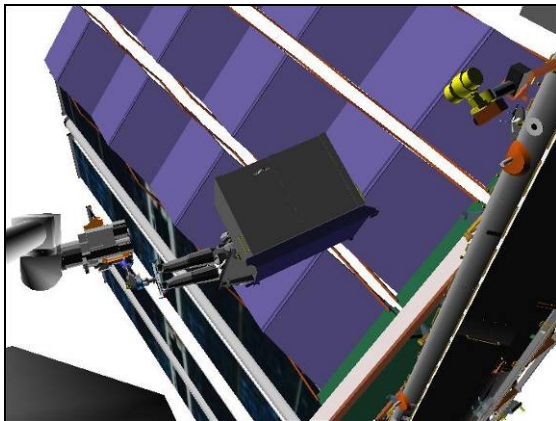


Figure 22.- ATA Handoff Backoff
 (22: Base Elbow: -125, -5).

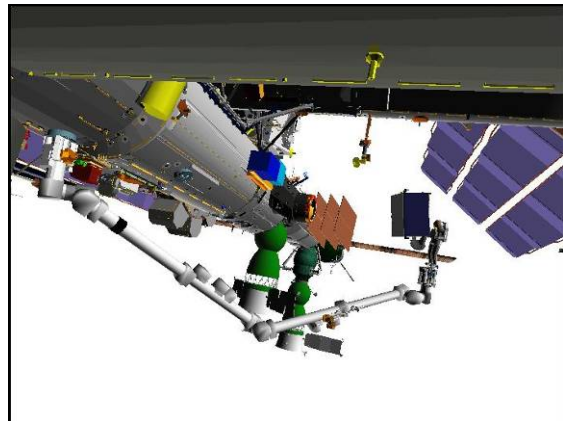


Figure 23.- ATA Handoff Backoff
 (SRMS Elbow: -40, +140).

9. MANUAL MANEUVER TO ATA HANDOFF POSITION

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
09: P1 Lower Outboard (+90, +5)	24: Tip Elbow (-35, -5)	22: Base Elbow (-125, -5)	SRMS Elbow (-40, +140)	OBSS ITVC (+50, -75)

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MSS: SSRMS:

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

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

Verify SSRMS at ATA Handoff Backoff position.

SR	SY	SP	EP	WP	WY	WR
+129.1	+27.7	-59.9	-45.3	-80.0	+11.6	+59.6
X	Y	Z	Pitch	Yaw	Roll	
-164	-1048	+650	-14.1	+57.1	0.0	
FOR	Unloaded – Chest 12/PP/F/8, SR Held					
Disp	ISS>ISSACS					

On EV GO, ready to maneuver to ATA Handoff position:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

THC/
RHC

Perform EVA GCA as required for ATA Handoff.

(Expect “-Z” motion, THC up)

Expected ATA Handoff position:

	Locked					
SR	SY	SP	EP	WP	WY	WR
+126.5	+27.7	-68.3	-45.0	-72.6	+11.9	+57.2
X	Y	Z	Pitch	Yaw	Roll	
-164	-1048	+480	-14.1	+57.1	0.0	
FOR	Unloaded – Chest 12/PP/F/8, SR Held					
Disp	ISS>ISSACS					

DCP BRAKES SSRMS → ON (Verify ON)

Notify EV, brakes on, ready for ATA Handoff

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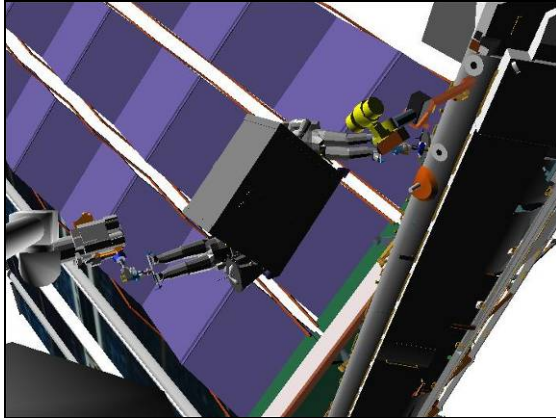


Figure 24.- ATA Handoff
(22: Base Elbow: -125, -5).

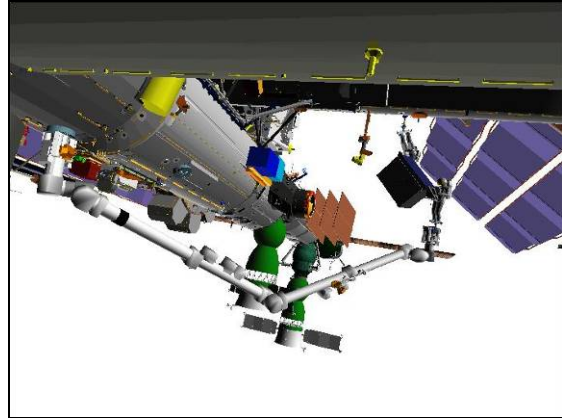


Figure 25.- ATA Handoff
(SRMS Elbow: -40, +140).

10. MANUAL MANEUVER TO APFR EGRESS INT 1 POSITION

On EV GO, ready to maneuver to APFR Egress Int 1 position:

DCP BRAKES SSRMS → OFF (Verify OFF)

PCS MSS: SSRMS: Rate:

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

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

THC/
RHC Maneuver to APFR Egress Int 1 position (within 5 cm/1 deg).
(Expect “-X” motion, THC out)

	Locked						
SR	SY	SP	EP	WP	WY	WR	
+124.3	+27.7	-77.9	-25.6	-83.1	+12.0	+55.3	
X	Y	Z	Pitch	Yaw	Roll		
-260	-1048	+480	-14.1	+57.1	0.0		
FOR	Unloaded – Chest 12/PP/F/8, SR Held						
Disp	ISS>ISSACS						

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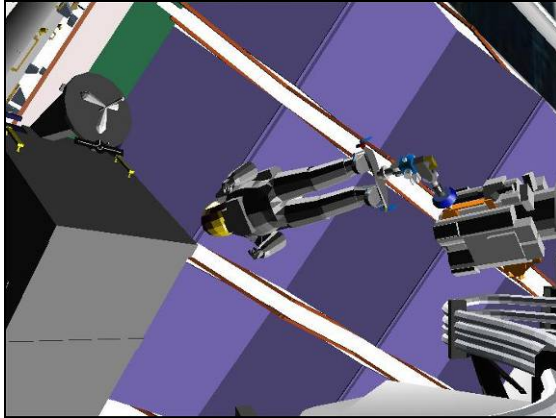


Figure 26.- APFR Egress Int 1
(24: Tip Elbow: -30, 0).

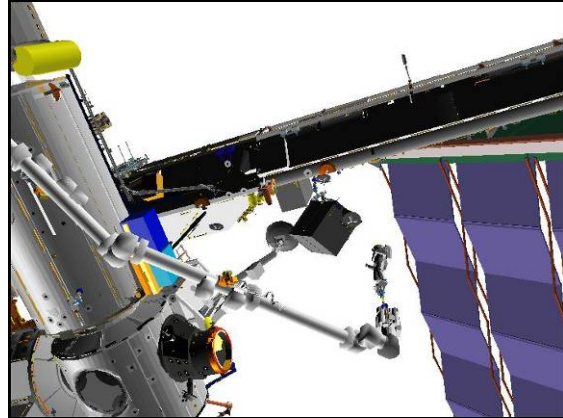


Figure 27.- APFR Egress Int 1
(OBSS ITVC: +50, -75).

11. JOINT OCAS TO APFR EGRESS BACKOFF POSITION

PCS

MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

Input 'Joint Angles' 'Destination' for APFR Egress Backoff position.

SR	SY	SP	EP	WP	WY	WR
+138.2	-5.8	-72.0	-33.7	-75.7	0.0	+111.8

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)	+124.3	+27.7	-77.9	-25.6	-83.1	+12.0	+55.3
TGT	+138.2	-5.8	-72.0	-33.7	-75.7	0.0	+111.8
ERR	-13.9	+33.5	-5.9	+8.1	-7.4	+12.0	-56.5

PCS

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

* Input correct Dest joint angles per table above.

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

MON

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

PCS

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

DCP

AUTO SEQ → PROC

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PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at APFR Egress Backoff position.

SR	SY	SP	EP	WP	WY	WR
+138.2	-5.8	-72.0	-33.7	-75.7	0.0	+111.8
X	Y	Z	Pitch	Yaw	Roll	
-79	-1262	+359	-0.1	+13.6	+14.7	
FOR	Unloaded – Chest 12/PP/F/8, SR Held					
Disp	ISS>ISSACS					

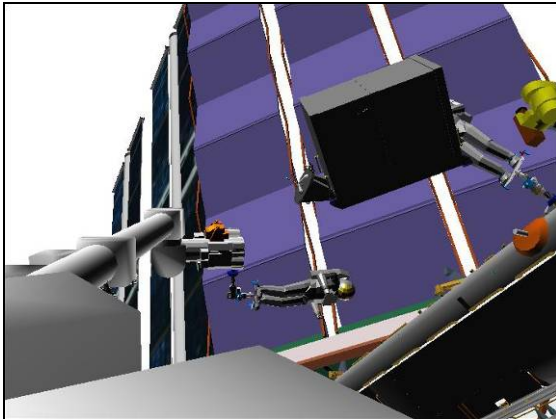


Figure 28.- APFR Egress Backoff
(22: Base Elbow: -145, -5).

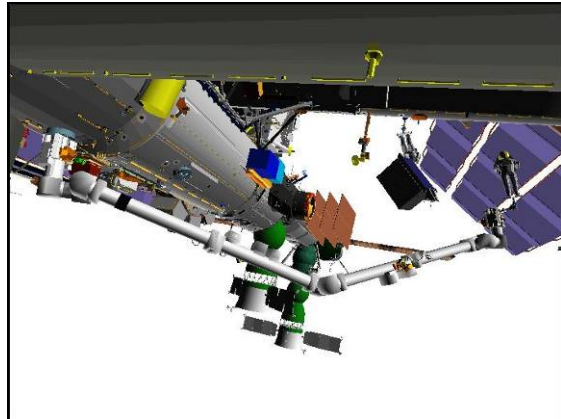


Figure 29.- APFR Egress Backoff
(SRMS Elbow: -40, +140).

MSS: SSRMS: Thrusters:

Verify 'Desat Request:' – Inh

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

12. MANUAL MANEUVER TO APFR EGRESS POSITION

On EV GO, ready to maneuver to APFR Egress position:

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 Perform EVA GCA, as required, to Egress APFR.
(Expect “-Z” motion, THC up)
Expected APFR Egress position:

Locked						
SR	SY	SP	EP	WP	WY	WR
+139.3	-5.8	-82.0	-25.7	-73.9	0.0	+112.9
X	Y	Z	Pitch	Yaw	Roll	
-79	-1262	+214	-0.1	+13.6	+14.7	
FOR	Unloaded – Chest 12/PP/F/8, SR Held					
Disp	ISS>ISSACS					

DCP BRAKES SSRMS → ON (Verify ON)

Notify EV, brakes on, ready for APFR Egress

PCS MSS: SSRMS:

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

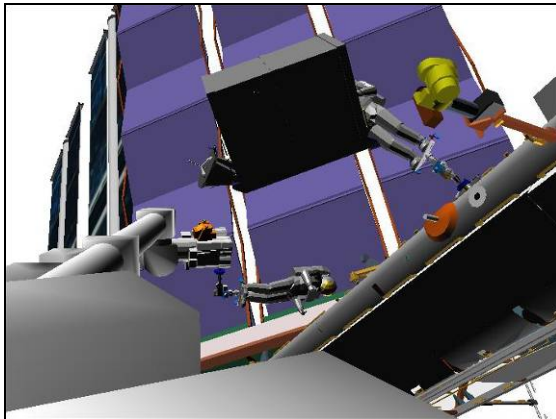


Figure 30.- APFR Egress
(22: Base Elbow: -150, -5).

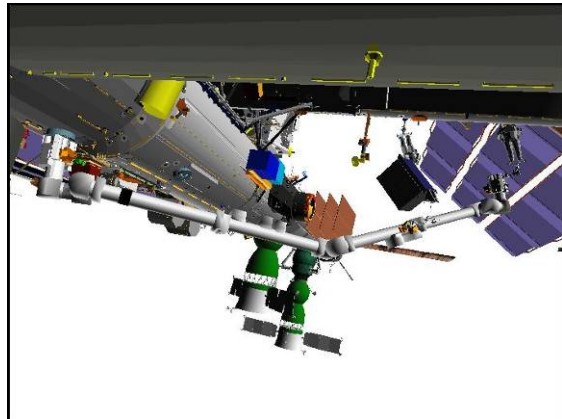


Figure 31.- APFR Egress
(SRMS Elbow: -40, +140).

If using shuttle attitude control
Coordinate with shuttle crewmembers.
If attitude maintenance reqd
DAP: LVLH
When rates damped
DAP: FREE > 2 seconds, then
DAP: AUTO

13. JOINT OCAS TO ATA PRE-GRAPPLE POSITION

DCP BRAKES SSRMS → OFF (Verify OFF)

PCS MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

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SSRMS Joint OCAS

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

SR	SY	SP	EP	WP	WY	WR
+130.5	+27.7	-52.9	-69.2	-62.6	+11.5	+104.2

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON

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

	SR	SY	SP	EP	WP	WY	WR
(current)	+139.3	-5.8	-82.0	-25.7	-73.9	0.0	+112.9
TGT	+130.5	+27.7	-52.9	-69.2	-62.6	+11.5	+104.2
ERR	+8.8	-33.5	-29.1	+43.5	-11.3	-11.5	+8.7

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
+130.5	+27.7	-52.9	-69.2	-62.6	+11.5	+104.2

Notify EV, SSRMS at ATA Pre-Grapple, prepare for grapple.

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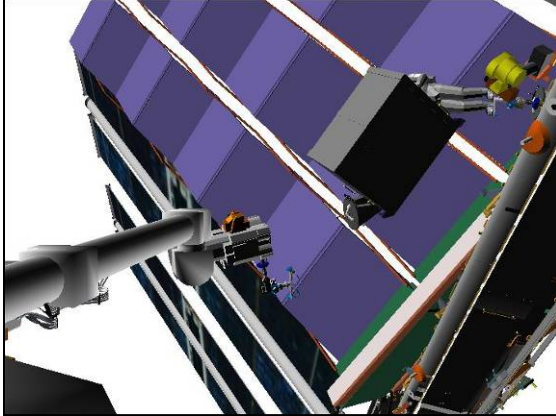


Figure 32.- ATA Pre-Grapple
(22: Base Elbow: -120, -5).

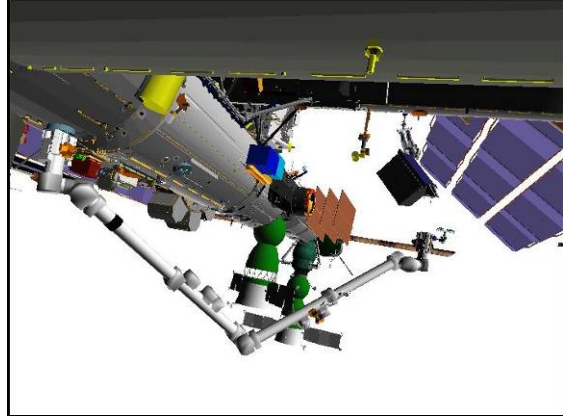


Figure 33.- ATA Pre-Grapple
(SRMS Elbow: -40, +140).

14. ATA GRAPPLE

14.1 Setup

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
09: P1 Lower Outboard (+90, +5)	25: Tip LEE	22: Base Elbow (-120, -5) 24: Tip Elbow (-20, 0)	SRMS Elbow (-40, +140)	OBSS ITVC (+50, -75)

NOTE

1. Tip LEE Camera must be fully zoomed out to correspond to target overlay.
2. The clearance between the APFR and FGB is approximately 30 cm (12 in). This clearance can be monitored with the Base Elbow Camera.

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

MSS: SSRMS:

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

√Vernier

MSS: SSRMS: Rate:

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

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

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14.2 Slow Capture Commands

MSS: SSRMS: Tip LEE:

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

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

CAUTION

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

NOTE

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

On EV GO, ready for ATA Grapple:

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Auto Capture

14.3 Maneuvering to Grapple

RHC/
THC

Maneuver to within grapple envelope.

14.4 Grapple

RHC

TRIGGER → Press (momentarily)

PCS

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

DCP

BRAKES SSRMS → ON (Verify ON)

Notify EV, ATA grapple complete.

14.5 Grapple Cleanup

PCS

MSS: SSRMS:

Verify Loaded Parameters – √
Verify 'Loaded Parameters' (two) – ATA Mnvr, SY Held

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

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MSS: SSRMS: Rate:

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

Expected ATA Grapple position.

SR	SY	SP	EP	WP	WY	WR
+129.0	+27.7	-60.0	-71.0	-54.2	+11.6	+102.9
X	Y	Z	Pitch	Yaw	Roll	
-90	-1010	+537	+75.8	0.0	+63.2	
FOR	Loaded – ATA Mnvr, SY Held					
Disp	ISS>ISSACS					

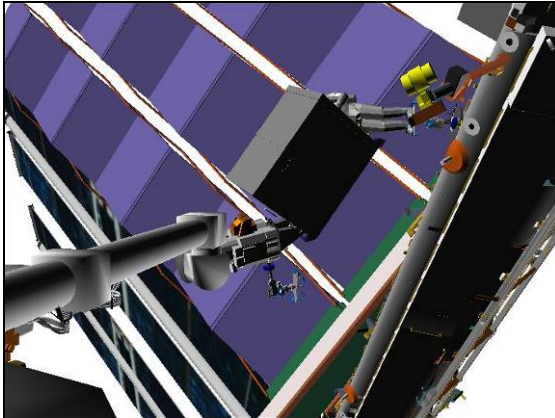


Figure 34.- ATA Grappled
(22: Base Elbow: -120, -5).

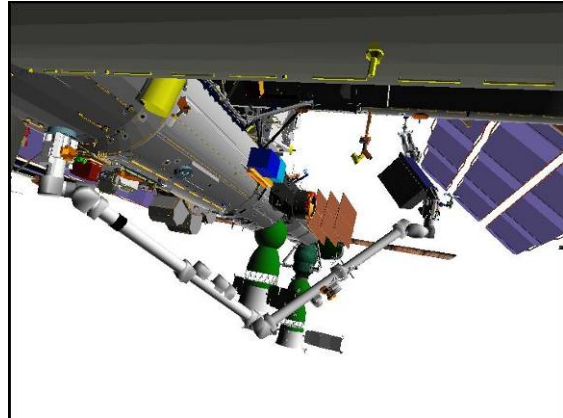


Figure 35.- ATA Grappled
(SRMS Elbow: -40, +140).

15. MANUAL MANEUVER TO AGB INSTALL INT 1 POSITION

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
09: P1 Lower Outboard (+90, +5)	24: Tip Elbow (-20, 0)	22: Base Elbow (-120, -5)	SRMS Elbow (-40, +140)	OBSS ITVC (+50, -75)

On EV GO, ready to maneuver to AGB Install Int 1 position:

DCP BRAKES SSRMS → OFF (Verify OFF)

PCS MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

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THC/
RHC Maneuver to AGB Install Int 1 position (within 5 cm/1 deg).
(Expect "+Z" motion, THC down)

	Locked					
SR	SY	SP	EP	WP	WY	WR
+131.7	+27.7	-50.7	-72.7	-61.1	+11.4	+105.3
X	Y	Z	Pitch	Yaw	Roll	
-90	-1010	+690	+75.8	0.0	+63.2	
FOR	Loaded – ATA Mnvr, SY Held					
Disp	ISS>ISSACS					

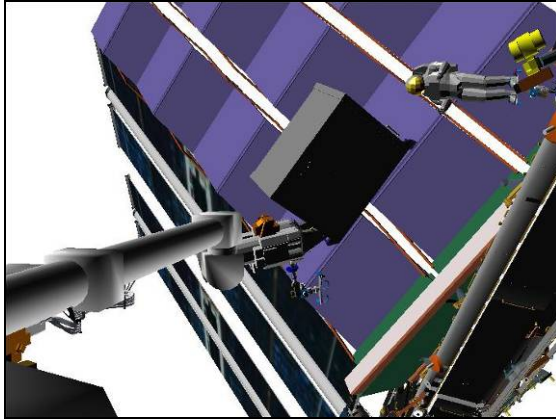


Figure 36.- AGB Install Int 1
(22: Base Elbow: +110, 0).

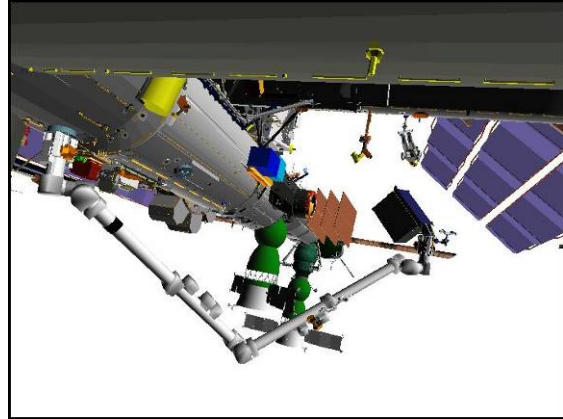


Figure 37.- AGB Install Int 1
(SRMS Elbow: -40, +140).

16. JOINT OCAS TO AGB INSTALL BACKOFF POSITION

PCS MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

Input 'Joint Angles' 'Destination' for AGB Install Backoff position.

SR	SY	SP	EP	WP	WY	WR
+114.9	+27.7	-53.4	-85.3	-187.3	-163.7	+86.5

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)	+131.7	+27.7	-50.7	-72.7	-61.1	+11.4	+105.3
TGT	+114.9	+27.7	-53.4	-85.3	-187.3	-163.7	+86.5
ERR	+16.8	0.0	+2.7	+12.6	+126.2	+175.1	+18.8

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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 AGB Install Backoff position.

SR	SY	SP	EP	WP	WY	WR
+114.9	+27.7	-53.4	-85.3	-187.3	-163.7	+86.5
X	Y	Z	Pitch	Yaw	Roll	
-138	-771	+600	+108.0	-43.1	-108.8	
FOR	Loaded – ATA Mnvr, SY Held					
Disp	ISS>ISSACS					

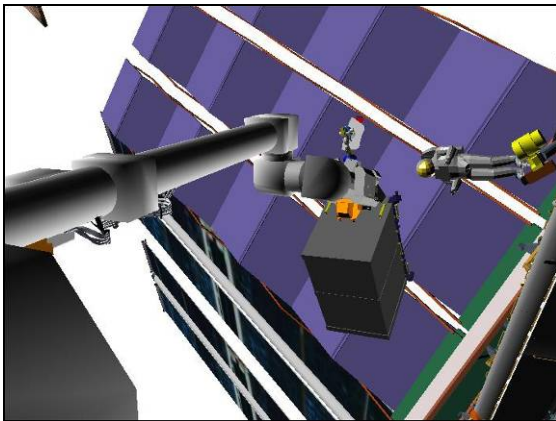


Figure 38.- AGB Install Backoff
 (22: Base Elbow: -115, -5).

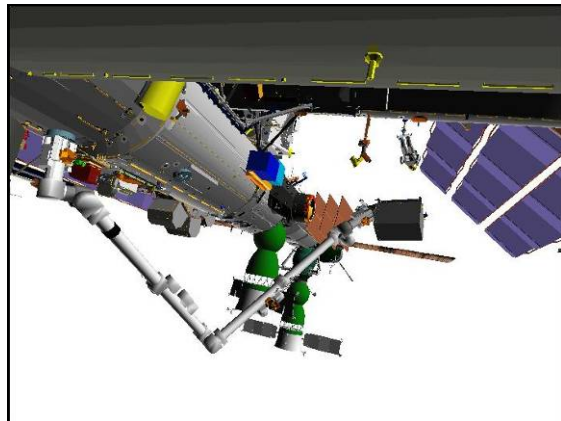


Figure 39.- AGB Install Backoff
 (SRMS Elbow: -40, +140).

17. MANUAL MANEUVER TO AGB INSTALL POSITION

NOTE

The clearance between the ATA and the P1 Lower Inboard Camera is approximately 91 cm (36 in). This clearance may be monitored with the Base Elbow Camera.

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On EV GO, ready to maneuver to AGB install:

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

THC/
RHC

Perform EVA GCA, as required, for AGB Install.

(Expect “-Z” motion, THC up)

Expected APFR Install position:

	Locked					
SR	SY	SP	EP	WP	WY	WR
+111.4	+27.7	-65.9	-81.0	-181.5	-162.0	+83.8
X	Y	Z	Pitch	Yaw	Roll	
-138	-771	+427	+108.0	-43.1	-108.8	
FOR	Loaded – ATA Mnvr, SY Held					
Disp	ISS>ISSACS					

DCP

BRAKES SSRMS → ON (Verify ON)

Notify EV, brakes on, ready for AGB install.

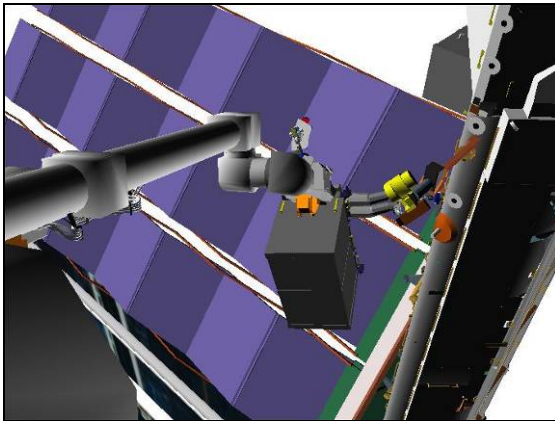


Figure 40.- AGB Install
(22: Base Elbow: -115, -5).

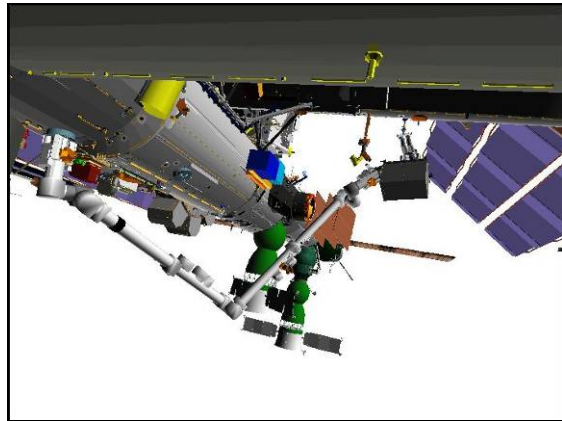


Figure 41.- AGB Install
(SRMS Elbow: -40, +140).

18. MANUAL MANEUVER TO AGB CLEARANCE POSITION

On EV GO, AGB installed ready for backoff maneuver:

DCP

BRAKES SSRMS → OFF (Verify OFF)

PCS

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

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MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

THC/
RHC

Maneuver to AGB Clearance position (within 5 cm/1 deg).
(Expect “+Z” motion, THC down)

	Locked					
SR	SY	SP	EP	WP	WY	WR
+114.9	+27.7	-53.4	-85.3	-187.3	-163.7	+86.5
X	Y	Z	Pitch	Yaw	Roll	
-138	-771	+600	+108.0	-43.1	-108.8	
FOR	Loaded – ATA Mnvr, SY Held					
Disp	ISS>ISSACS					

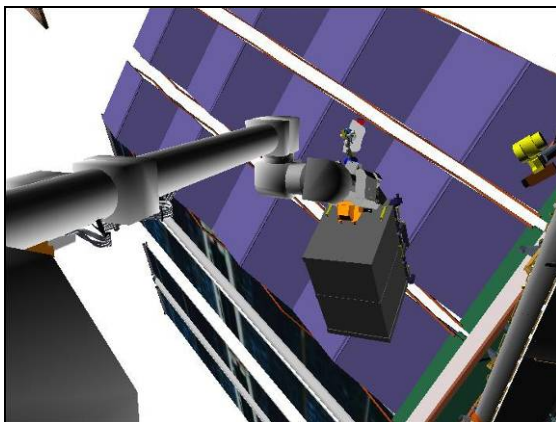


Figure 42.- AGB Clearance
(22: Base Elbow: -115, -5).

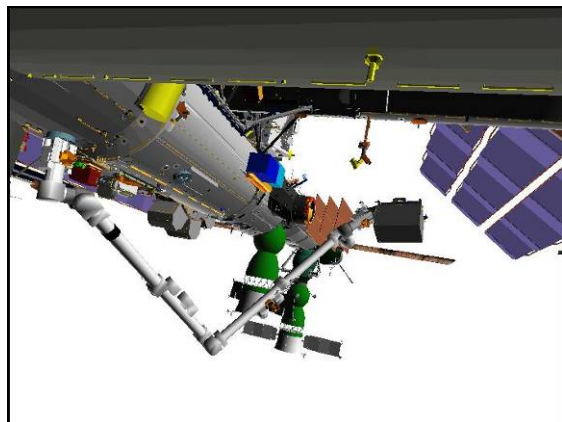


Figure 43.- AGB Clearance
(SRMS Elbow: -40, +140).

19. [JOINT OCAS TO P1 WORKSITE BACKOFF INT 1 POSITION](#)

RHC

RATE → COARSE (Verify Coarse on PCS)

PCS

MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

Input ‘Joint Angles’ ‘Destination’ for P1 Worksite Backoff position.

SR	SY	SP	EP	WP	WY	WR
+117.2	+6.7	-65.0	-38.9	-52.9	-10.5	+22.1

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)	+114.9	+27.7	-53.4	-85.3	-187.3	-163.7	+86.5
TGT	+117.2	+6.7	-65.0	-38.9	-52.9	-10.5	+22.1
ERR	-2.3	+21.0	+11.6	-46.4	-134.4	-153.2	+64.4

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)

DCP AUTO SEQ → PROC

PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at P1 Worksite Backoff Int 1 position.

SR	SY	SP	EP	WP	WY	WR
+117.2	+6.7	-65.0	-38.9	-52.9	-10.5	+22.1

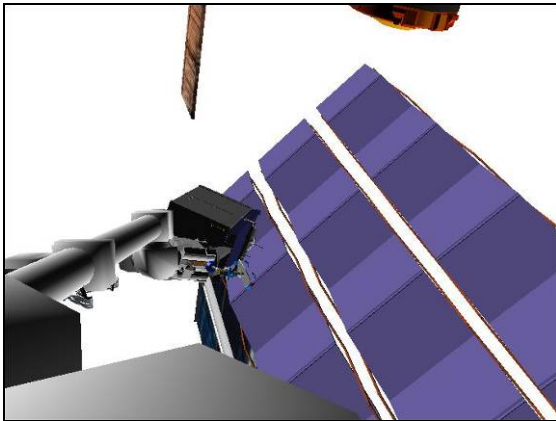


Figure 44.- P1 Worksite Backoff Int 1 (22: Base Elbow: -140, -5).

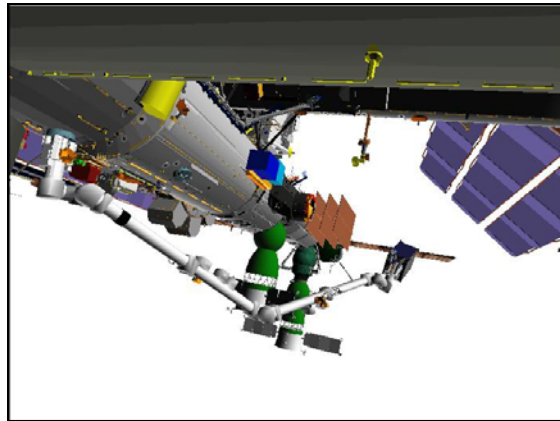


Figure 45.- P1 Worksite Backoff Int 1 (SRMS Elbow: -40, +140).

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20. SINGLE JOINT MANEUVER TO P1 WORKSITE BACKOFF POSITION

MSS: SSRMS:

Enter Mode – Single (Verify blue)

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

THC

Perform Single Joint maneuver to P1 Worksite Backoff position (within 1 deg).

P1 Int 1
1: SP –
P1 Backoff

SR	SY	SP	EP	WP	WY	WR
+117.2	+6.7	-65.0	-38.9	-52.9	-10.5	+22.1
		-87.2				
+117.2	+6.7	-87.2	-38.9	-52.9	-10.5	+22.1
X	Y	Z	Pitch	Yaw	Roll	
-400	-840	+228	+83.0	-6.4	-5.0	
FOR	Loaded – ATA Mnvr, SY Held					
Disp	ISS>ISSACS					

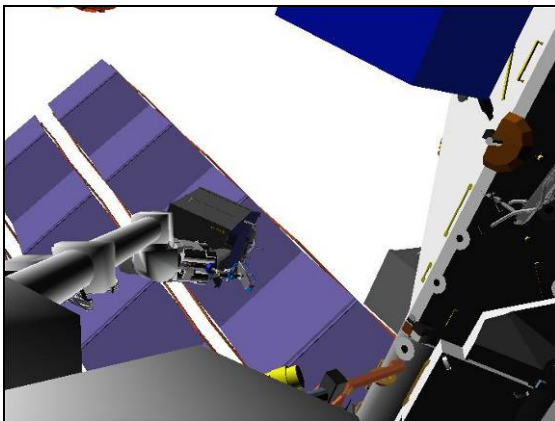


Figure 46.- P1 Worksite Backoff (22: Base Elbow: -140, -5).

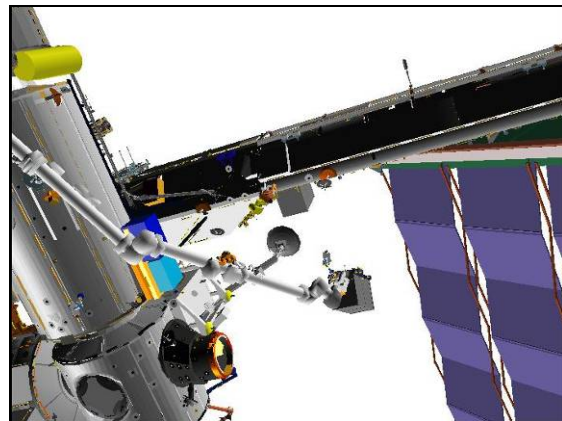


Figure 47.- P1 Worksite Backoff (OBSS ITVC: +50, -75).

PCS

MSS: SSRMS: Thrusters:

Verify 'Desat Request:' – Inh

```

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

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21. MANUAL MANEUVER TO APFR INGRESS/ATA UNINSTALL POSITION

<u>NOTE</u>						
1. May require additional GCA to drive bolts.						
2. The clearance between the APFR and P1 Truss is approximately 55 cm (22 in). This clearance may be monitored with the Tip Elbow Camera.						
3. The clearance between the SSRMS Tip Boom and P1 Lower Inboard Camera is approximately 83 cm (33 in). This clearance may be monitored with the P1 Lower Outboard Camera.						
4. The clearance between the AGB and the Old ATA is approximately 83 cm (33 in). This may be monitored with the Base Elbow Camera.						

On EV GO, ready to maneuver to APFR Ingress/ATA Uninstall position:

RHC RATE → VERNIER (Verify Vernier on PCS)

PCS MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

THC/RHC Perform EVA GCA, as required, for APFR Ingress/ATA Uninstall.
(Expect “+X” motion, THC in)

Expected APFR Ingress/ATA Uninstall position:

Locked						
SR	SY	SP	EP	WP	WY	WR
+117.2	+19.7	-78.4	-67.2	-33.4	+2.5	+21.9
X	Y	Z	Pitch	Yaw	Roll	
-190	-840	+228	+83.0	-6.4	-5.0	
FOR	Loaded – ATA Mnvr, SY Held					
Disp	ISS>ISSACS					

DCP BRAKES SSRMS → ON (Verify ON)

Notify EV, brakes on, ready for APFR Ingress/ATA Uninstall.

PCS MSS: SSRMS:

Change Loaded Parameters ► ATA ► Chest 12/PP/F/8 ATA SRH
Verify ‘Loaded Parameters’ (two) – Chest 12/PP/F/8 ATA, SR Held

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Verify SSRMS at APFR Ingress/ATA Uninstall position.

SR	SY	SP	EP	WP	WY	WR
+117.2	+19.7	-78.4	-67.2	-33.4	+2.5	+21.9
X	Y	Z	Pitch	Yaw	Roll	
-90	-825	+76	+31.5	+79.7	-38.9	
FOR	Loaded – Chest 12/PP/F/8 ATA, SR Held					
Disp	ISS>ISSACS					

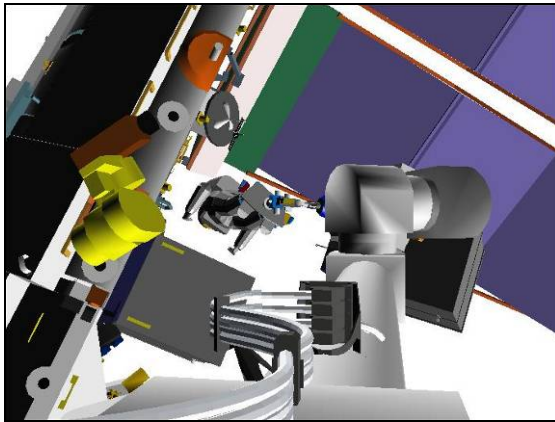


Figure 48.- APFR Ingress/ATA Uninstall
(24: Tip Elbow: -10, 0).

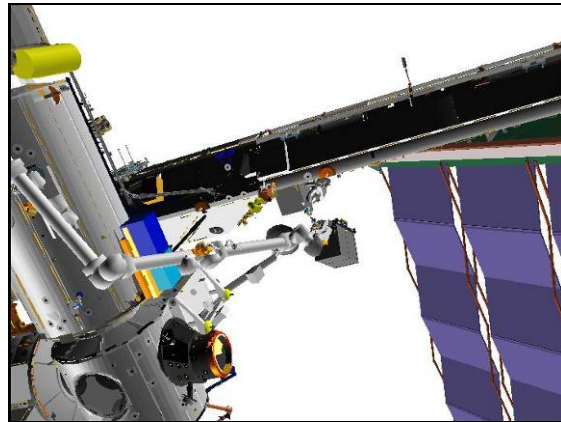


Figure 49.- APFR Ingress/ATA Uninstall
(OBSS ITVC: +50, -75).

22. MANUAL MANEUVER P1 BACKOFF POSITION

On EV GO, ready to maneuver to P1 Backoff position:

DCP BRAKES SSRMS → OFF (Verify OFF)

PCS MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

GCA as required to clear the truss, then:

THC/
RHC Maneuver to P1 Backoff position (within 5 cm/1 deg).
(Expect “-X”, THC out)

Locked						
SR	SY	SP	EP	WP	WY	WR
+117.2	+6.7	-87.2	-38.9	-52.9	-10.5	+22.1
X	Y	Z	Pitch	Yaw	Roll	
-300	-825	+76	+31.5	+79.7	-38.9	
FOR	Loaded – Chest 12/PP/F/8 ATA, SR Held					
Disp	ISS>ISSACS					

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PCS

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

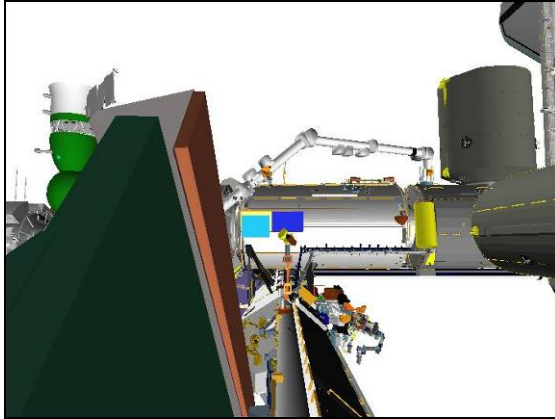


Figure 50.- P1 Backoff
(09: P1 Lower Outboard: +90, +5).

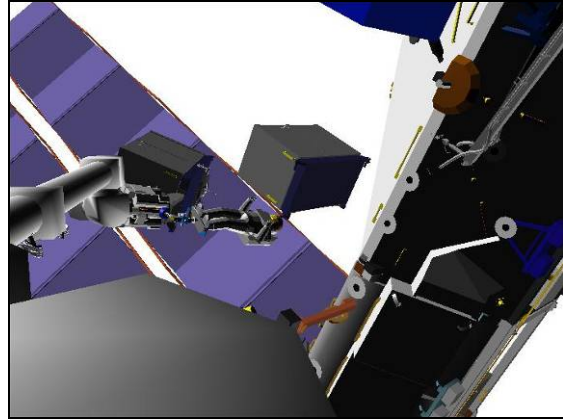


Figure 51.- P1 Backoff
(22: Base Elbow: -135, -10).

If using shuttle attitude control
Coordinate with shuttle crewmembers.
If attitude maintenance reqd
DAP: LVLH
When rates damped
DAP: FREE > 2 seconds, then
DAP: AUTO

23. JOINT OCAS TO OLD ATA RETURN INT 1 POSITION

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
09: P1 Lower Outboard (+90, +5)	24: Tip Elbow (-10, 0)	03: S1 Lower Outboard (+70, +35)	SRMS Elbow (-40, +140)	Camera C (-50, +50)

NOTE

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

MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

Input 'Joint Angles' 'Destination' for Old ATA Return Int 1 position.

SR	SY	SP	EP	WP	WY	WR
+130.0	+15.0	-54.0	+86.5	-118.6	-159.0	-112.9

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.

(current)	SR	SY	SP	EP	WP	WY	WR
	+117.2	+6.7	-87.2	-38.9	-52.9	-10.5	+22.1
TGT	+130.0	+15.0	-54.0	+86.5	-118.6	-159.0	-112.9
ERR	-12.8	-8.3	-33.2	-125.3	+65.6	+148.5	+135.0

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
+130.0	+15.0	-54.0	+86.5	-118.6	-159.0	-112.9



Figure 52.- Old ATA Return Int 1 (09: P1 Lower Outboard: +110, +35).

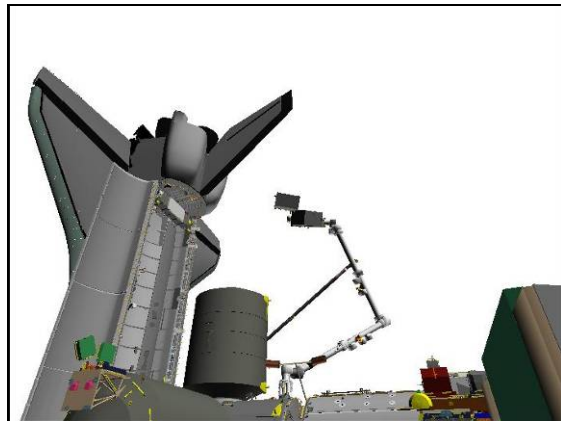


Figure 53.- Old ATA Return Int 1 (03: S1 Lower Outboard: +70, +35).

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24. JOINT OCAS TO OLD ATA RETURN INT 2 POSITION

SSRMS Joint OCAS

Input 'Joint Angles' 'Destination' for Old ATA Return Int 2 position.

SR	SY	SP	EP	WP	WY	WR
+157.4	-15.3	-38.8	+86.5	-118.6	-189.0	-112.9

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON

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

	SR	SY	SP	EP	WP	WY	WR
(current)	+130.0	+15.0	-54.0	+86.5	-118.6	-159.0	-112.9
TGT	+157.4	-15.3	-38.8	+86.5	-118.6	-189.0	-112.9
ERR	-27.4	+30.3	-15.2	0.0	0.0	30.0	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 SSRMS at Old ATA Return Int 2 position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+157.4	-15.3	-38.8	+86.5	-118.6	-189.0	-112.9
X	Y	Z	Pitch	Yaw	Roll	
+1304	-82	+1833	-79.0	+4.8	+80.9	
FOR	Loaded – Chest 12/PP/F/8 ATA, SR Held					
Disp	ISS>ISSACS					

MSS: SSRMS: SSRMS

Enter Mode – Standby (Verify blue)

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Figure 54.- Old ATA Return Int 2
(03: S1 Lower Outboard: +70, +35).

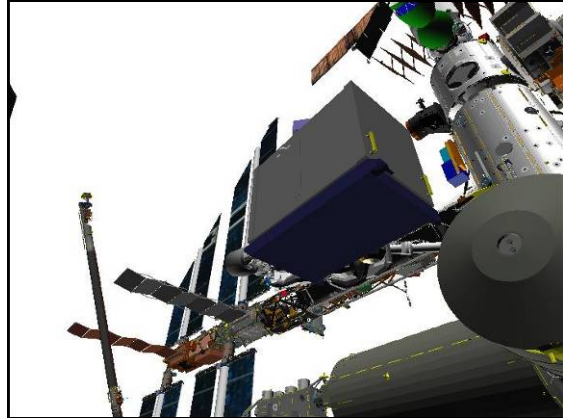


Figure 55.- Old ATA Return Int 2
(71: Camera C: -50, +40).

25. SETUP FOR MANEUVER TO OLD ATA PRE-BERTH

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
03: S1 Lower Outboard (+70, +35) 09: P1 Lower Outboard (+110, +35)	22: Base Elbow (+100, -10)	71: Camera A (0, +5)	SRMS Elbow (-145, +55)	Camera B (+40, +40) Camera C (-50, +40)

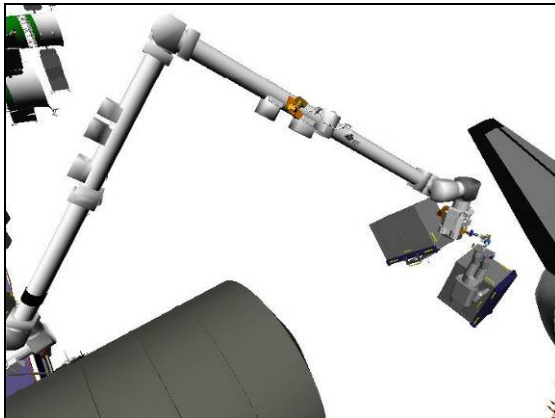


Figure 56.- Old ATA Return Int 2
(SRMS Elbow: -145, +55).

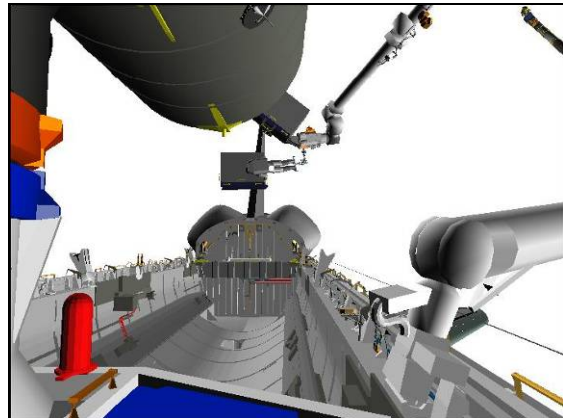


Figure 57.- Old ATA Return Int 2
(71: Camera A: 0, +5).

MSS: SSRMS:

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

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

√Vernier

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Verify SSRMS at Old ATA Return Int 2 position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+157.4	-15.3	-38.8	+86.5	-118.6	-189.0	-112.9
X	Y	Z	Pitch	Yaw	Roll	
-2919	-78	-1432	-170.0	+5.0	+80.7	
FOR	Loaded – Chest 12/PP/F/8 ATA, SR Held					
Disp	ISS>OBAS					

26. MANUAL MANEUVER TO OLD ATA PRE-BERTH POSITION

NOTE
For this maneuver, the clearances are as follows:
<ul style="list-style-type: none"> a) APFR to aft MPM approximately 106 cm (42 in). This clearance may be monitored with Camera A. b) Base Boom to MPLM approximately 86 cm (34 in). This clearance may be monitored with the SRMS Elbow Camera. c) Old ATA to Aft Bulkhead approximately 78 cm (31 in). This clearance may be monitored with Camera C or Camera B.

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

THC/
RHC

Maneuver to Old ATA Pre-Berth position (within 5 cm/1 deg).
(Expect “-X” and “+Z” motion, THC out and down)

Locked						
SR	SY	SP	EP	WP	WY	WR
+157.4	-21.6	-21.1	+58.7	-107.6	-186.9	-118.9
X	Y	Z	Pitch	Yaw	Roll	
-3050	-79	-1230	-170.0	+5.0	+80.7	
FOR	Loaded – Chest 12/PP/F/8 ATA, SR Held					
Disp	ISS>OBAS					

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Figure 58.- Old ATA Pre-Berth
(03: S1 Lower Outboard: +70, +35).

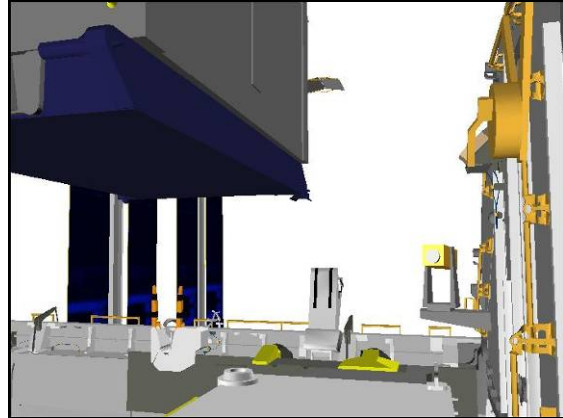


Figure 59.- Old ATA Pre-Berth
(Camera B: +75, +5).

PCS MSS: SSRMS: Thrusters: Thruster Controls for MSS Ops

Verify 'Desat Request:' – Inh

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

27. MANUAL MANEUVER TO OLD ATA BERTH POSITION

NOTE

For this maneuver, the clearances are as follows:

- a) APFR to aft MPM approximately 48 cm (19 in). This clearance may be monitored with Camera A.
- b) Base Boom to MPLM approximately 68 cm (27 in). This clearance may be monitored with the SRMS Elbow Camera.
- c) Old ATA to Aft Bulkhead approximately 7 cm (3 in). This clearance may be monitored with Camera C or Camera B.

On EV GO, ready to maneuver to Old ATA Berth position:

THC/
RHC Perform EVA GCA, as required, for Old ATA Berth.
 (Expect "-X" and "+Z" motion, THC out and down)
 Expected Old ATA Berth position:

Locked						
SR	SY	SP	EP	WP	WY	WR
+157.4	-24.0	-8.8	+36.8	-97.8	-186.1	-121.2
X	Y	Z	Pitch	Yaw	Roll	
-3120	-79	-1130	-170.0	+5.0	+80.7	
FOR	Loaded – Chest 12/PP/F/8 ATA, SR Held					
Disp	ISS>OBAS					

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DCP BRAKES SSRMS → ON (Verify ON)

Notify EV, brakes on, ready for Old ATA Berth.

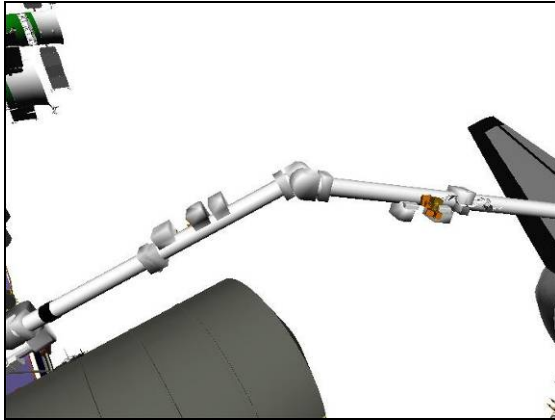


Figure 60.- Old ATA Berth
(SRMS Elbow: -145, +55).

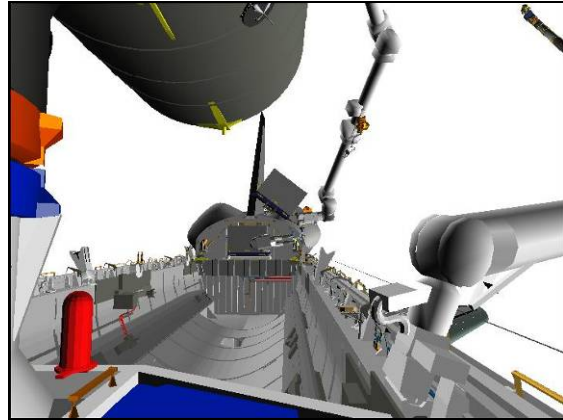


Figure 61.- Old ATA Berth
(71: Camera A: 0, +5).

28. MANUAL MANEUVER TO APFR EGRESS POSITION

On EV GO, ready to maneuver to APFR Egress position:

BRAKES SSRMS → OFF (Verify OFF)

PCS MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

THC/
RHC Perform EVA GCA, as required, for APFR Egress.
Expected APFR Egress Position:

Locked						
SR	SY	SP	EP	WP	WY	WR
+157.4	-24.0	-8.8	+36.8	-97.8	-186.1	-121.2
X	Y	Z	Pitch	Yaw	Roll	
-3120	-79	-1130	-170.0	+5.0	+80.7	
FOR	Unloaded – Chest 12/PP/F/8, SY Held					
Disp	ISS>OBAS					

DCP BRAKES SSRMS → ON (Verify ON)

Notify EV, brakes on, ready for APFR Egress.

PCS MSS: SSRMS:

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Change Loaded Parameters ► ATA ► ATA Mnvr SRH
Verify 'Loaded Parameters' (two) – ATA Mnvr, SR Held

Expected APFR Egress position:

SR	SY	SP	EP	WP	WY	WR
+157.4	-24.0	-8.8	+36.8	-97.8	-186.1	-121.2
X	Y	Z	Pitch	Yaw	Roll	
-3107	-227	-1235	-52.1	+79.5	+48.7	
FOR	Loaded – ATA Mnvr, SR Held					
Disp	ISS>OBAS					

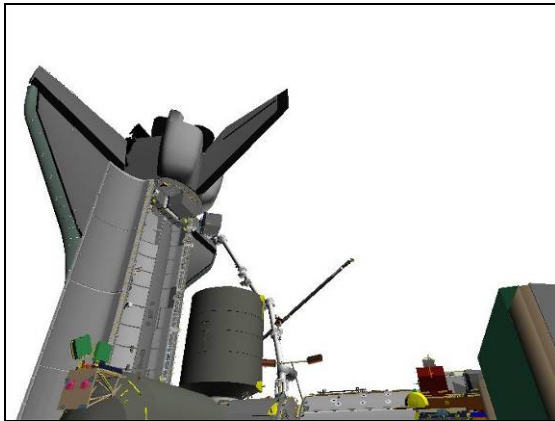


Figure 62.- APFR Egress
(03: S1 Lower Outboard: +70, +35).

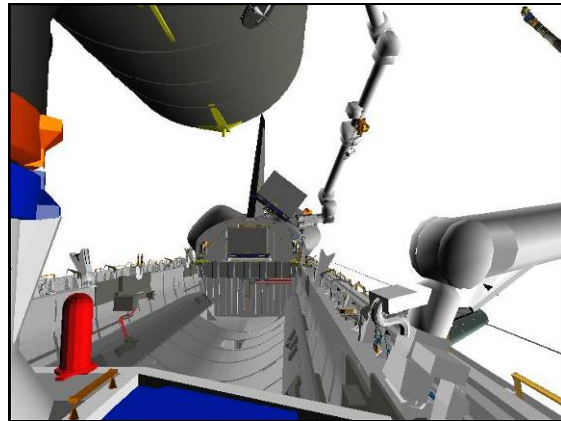


Figure 63.- APFR Egress
(71: Camera A: 0, +5).

29. MANUAL MANEUVER TO APFR UNINSTALL POSITION

On EV GO, ready to maneuver to APFR Uninstall position:

DCP BRAKES SSRMS → OFF (Verify OFF)

PCS MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

THC/
RHC Perform EVA GCA, as required, for APFR Uninstall.
Expected APFR Uninstall position:

Locked	SR	SY	SP	EP	WP	WY	WR
	+157.4	-24.0	-8.8	+36.8	-97.8	-186.1	-121.2
	X	Y	Z	Pitch	Yaw	Roll	
	-3107	-227	-1235	-52.1	+79.5	+48.7	
FOR	Loaded – ATA Mnvr, SR Held						
Disp	ISS>OBAS						

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DCP BRAKES SSRMS → ON (Verify ON)

Notify EV, brakes on, ready for APFR Uninstall.



Figure 64.- APFR Uninstall
(22: Base Elbow: +140, -5).

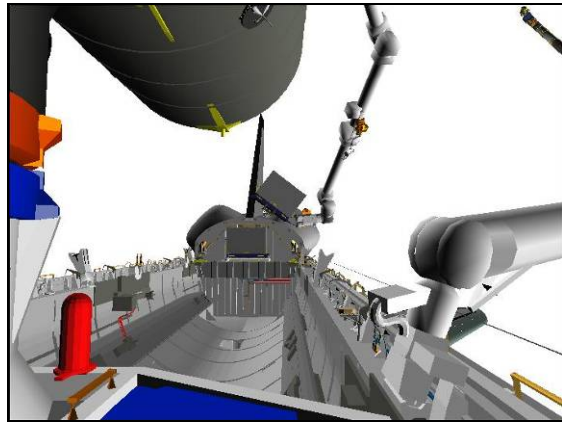


Figure 65.- APFR Uninstall
(71: Camera A: 0, +5).

If using shuttle attitude control
Coordinate with shuttle crewmembers.
If attitude maintenance reqd
DAP: LVLH
When rates damped
DAP: FREE > 2 seconds, then
DAP: AUTO

30. MANUAL MANEUVER TO PLB CLEARANCE POSITION

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
09: P1 Lower Outboard (+110, +35)	22: Base Elbow (+140, -5)	03: S1 Lower Outboard (+70, +35)	SRMS Elbow (-145, +55)	Camera B (-25, +30)

NOTE

For this maneuver, the clearance between the Tip LEE and the aft MPM is approximately 101 cm (40 in). This clearance may be monitored with Camera B.

On EV GO, ready to maneuver to PLB Clearance position:

DCP BRAKES SSRMS → OFF (Verify OFF)

PCS MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

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cmd Shoulder Roll (Verify SR – Locked)

THC/
RHC

Maneuver to PLB Clearance position (within 5 cm/1 deg).
(Expect “-Z” motion, THC up)

Locked						
SR	SY	SP	EP	WP	WY	WR
+157.4	-12.7	-25.6	+61.7	-107.4	-189.9	-110.4
X	Y	Z	Pitch	Yaw	Roll	
-3107	-227	-1535	-52.1	+79.5	+48.7	
FOR	Loaded – ATA Mnvr, SR Held					
Disp	ISS>OBAS					

PCS

MSS: SSRMS:

Enter Mode – Standby (Verify blue)



Figure 66.- PLB Clearance
(03: S1 Lower Outboard: +70, +35).

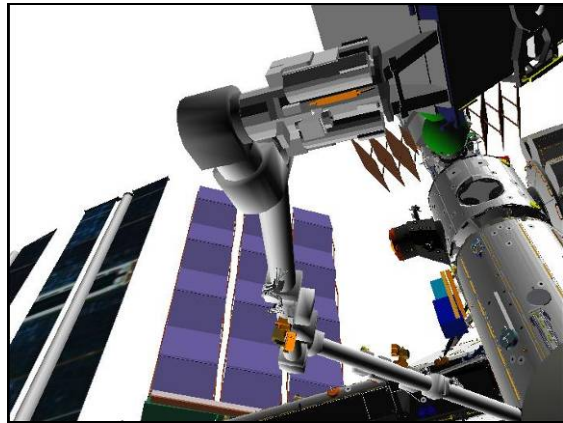


Figure 67.- PLB Clearance
(Camera B: -25, +55).

31. JOINT OCAS POA STOW INTERMEDIATE 1 POSITION

NOTE

1. The clearance between the New ATA and OBSS is approximately 162 cm (64 in). This clearance may be monitored with the P1 Lower Outboard Camera.
2. The clearance between the Tip Boom and JEM is approximately 157 cm (62 in). This clearance may be monitored with Camera B.

MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

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Input 'Joint Angles' 'Destination' for POA Stow Intermediate 1 position.

SR	SY	SP	EP	WP	WY	WR
+170.0	-13.6	-101.7	+61.7	-26.9	-20.0	-20.0

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)	+157.4	-12.7	-25.6	+61.7	-107.4	-189.9	-110.4
TGT	+170.0	-13.6	-101.7	+61.7	-26.9	-20.0	-20.0
ERR	-12.6	+0.9	+76.1	0.0	-80.5	-169.9	-90.4

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)

DCP

AUTO SEQ → PROC

PCS

MSS: SSRMS:

Verify Posn Hold – orange

Verify Joint Angle values.

SR	SY	SP	EP	WP	WY	WR
+170.0	-13.6	-101.7	+61.7	-26.9	-20.0	-20.0

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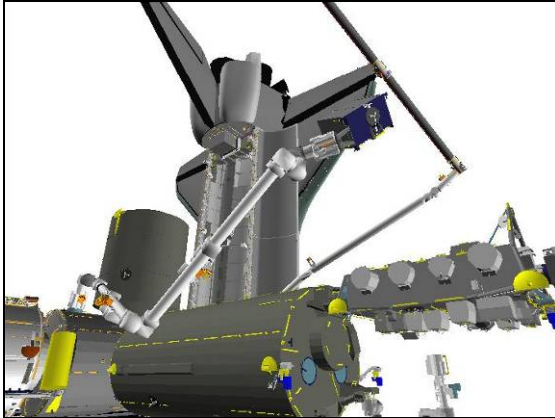


Figure 68.- POA Stow Intermediate 1
(09: P1 Lower Outboard: +140, +25).

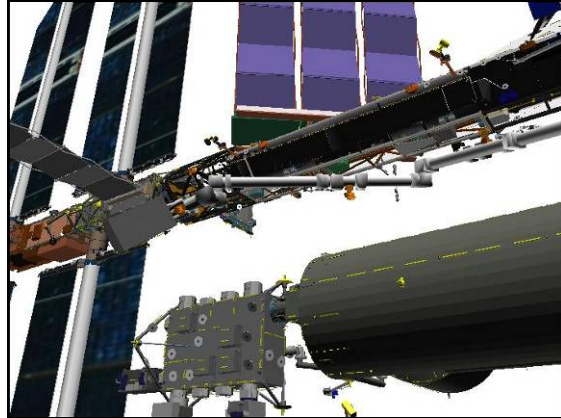


Figure 69.- POA Stow Intermediate 1
(Camera B: -35, +25).

32. JOINT OCAS TO POA STOW INTERMEDIATE 2 POSITION

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
09: P1 Lower Outboard (+140, +25)	24: Tip Elbow (0, +10) 22: Base Elbow (+135, -15)	37: MBS Mast (+20, +5) 13: LAB Stbd Zenith (-170, -40)	OBSS ITVC (+50, -35)	Camera B (-35, +25)

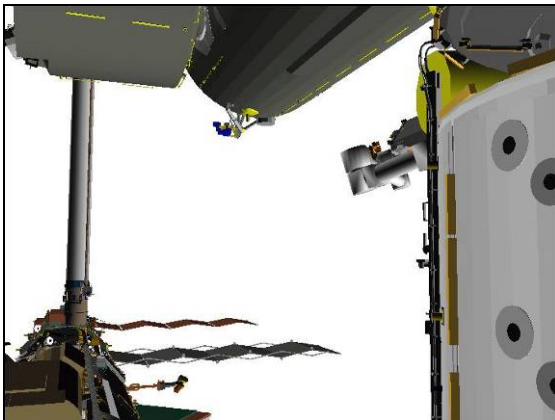


Figure 70.- POA Stow Intermediate 1
(37: MBS Mast: +20, +5).

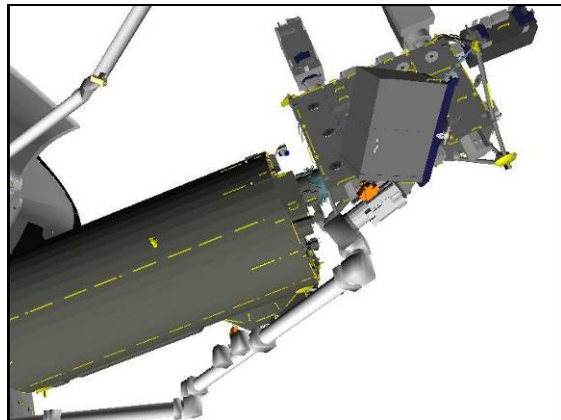


Figure 71.- POA Stow Intermediate 1
(71: OBSS ITVC: +50, -35).

NOTE

1. The clearance between the New ATA and JEF is approximately 129 cm (51 in). This clearance may be monitored with the Tip Elbow Camera.
2. The clearance between the Tip Boom and JEM is approximately 93 cm (37 in). This clearance may be monitored with the OBSS ITVC Camera.
3. Expect singularity warning for EP between +15 and -15 deg.

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SSRMS Joint OCAS

Input 'Joint Angles' 'Destination' for POA Stow Intermediate 2 position.

SR	SY	SP	EP	WP	WY	WR
+175.0	-13.6	-101.7	-110.7	-26.9	+10.0	+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)	+170.0	-13.6	-101.7	+61.7	-26.9	-20.0	-20.0
TGT	+175.0	-13.6	-101.7	-110.7	-26.9	+10.0	+10.0
ERR	-5.0	0.0	0.0	+172.4	0.0	-30.0	-30.0

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
+175.0	-13.6	-101.7	-110.7	-26.9	+10.0	+10.0

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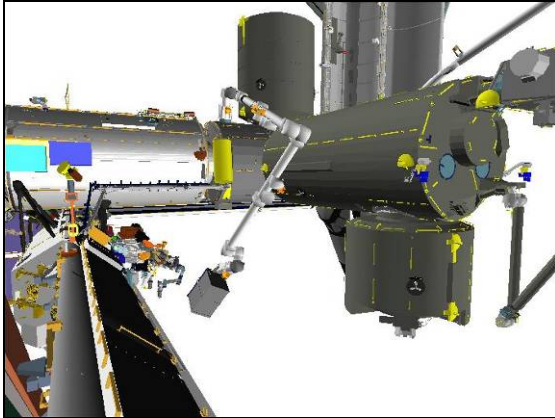


Figure 72.- POA Stow Intermediate 2
(09: P1 Lower Outboard: +120, -5).

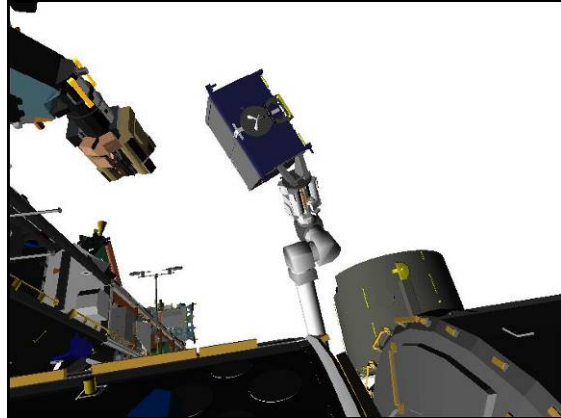


Figure 73.- POA Stow Intermediate 2
(13: LAB Stbd Zenith: -170, -40).

33. SINGLE JOINT TO POA PRE-GRAPPLE POSITION

MSS: SSRMS:

Enter Mode – Single (Verify blue)

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

THC

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

	SR	SY	SP	EP	WP	WY	WR
POA Int 2	+175.0	-13.6	-101.7	-110.7	-26.9	+10.0	+10.0
1: WY +						+54.8	
2: WR +							+65.0
POA Pre-Grapple	+175.0	-13.6	-101.7	-110.7	-26.9	+54.8	+65.0
	X	Y	Z	Pitch	Yaw	Roll	
	-1051	-261	-2124	+88.7	+35.3	-89.5	
FOR	Loaded – ATA Mnvr, SR Held						
Disp	ISS>OBAS						

PCS

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

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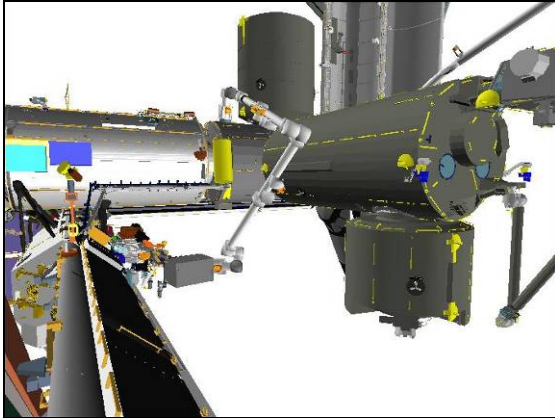


Figure 74.- POA Pre-Grapple
(09: P1 Lower Outboard: +120, -5).

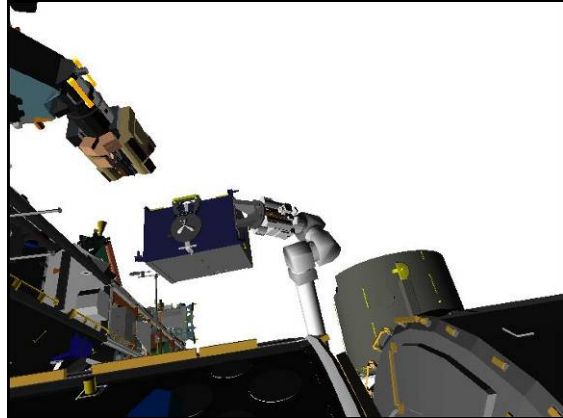


Figure 75.- POA Pre-Grapple
(13: LAB Stbd Zenith: -170, -40).

PCS MSS: SSRMS: Thrusters: Thruster Controls for MSS Ops

Verify 'Desat Request:' – Inh

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

34. ATA STOW IN POA

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
09: P1 Lower Outboard (+120, -5)	32: MBS POA	22: Base Elbow (-85, +5) 13: LAB Stbd Zenith (-170, -40)	OBSS ITVC (+70, -65)	Camera B (-15, +25)

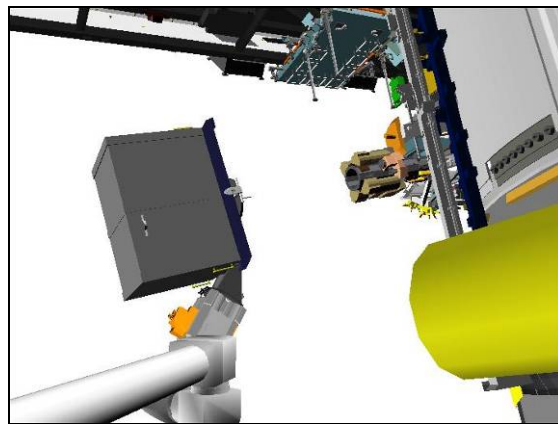


Figure 76.- POA Pre-Grapple
(22: Base Elbow: -85, +5).

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NOTE

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

PCS

MSS: SSRMS: MBS: MSS Safing:

cmd 'MBS' Remove (Verify Not Safed)

MSS: SSRMS: MBS:

Change POA Payload ► ATA ► ATA AGB GF
Verify 'POA Payload' – ATA

MSS: SSRMS:

Change Loaded Parameters ► ATA ► ATA Stow SRH
Verify 'Loaded Parameters' (two) – ATA Stow, SR Held

Change Display ► MBS ► POA (Verify MBS>POA)

Change Command ► MBS ► POA Fly Camera (Verify MBS>POA Fly Camera)

√Vernier

MSS: SSRMS: Rate:

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

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

SR	SY	SP	EP	WP	WY	WR
+175.0	-13.6	-101.7	-110.7	-26.9	+54.8	+65.0
X	Y	Z	Pitch	Yaw	Roll	
+200	-1	-1	-0.3	-0.1	0.0	
FOR	Loaded – ATA Stow, SR Held					
Disp	MBS>POA					

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

34.1 Maneuvering to Within Grapple Envelope
Maneuver ATA to within grapple envelope.

RHC/
THC

10 JUL 09

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PCS 34.2 POA Grapple
MSS: MBS: POA:

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

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

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

Expected POA Grapple position:

SR	SY	SP	EP	WP	WY	WR
175.0	-16.4	-115.0	-112.4	-8.8	+53.5	+60.8
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded – ATA Stow, SR Held					
Disp	MBS>POA					

DCP 34.3 POA Grapple Cleanup
BRAKES SSRMS → ON (Verify ON)

PCS MSS: SSRMS:

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

Change Display ► MBS ► ATA Stowed FGB-2 (Verify MBS>ATA Stowed FGB-2)

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

Expected POA Grapple position:

SR	SY	SP	EP	WP	WY	WR
175.0	-16.4	-115.0	-112.4	-8.8	+53.5	+60.8
X	Y	Z	Pitch	Yaw	Roll	
+123	+21	-56	+135.1	+0.1	-89.9	
FOR	Loaded – ATA Stow, SR Held					
Disp	MBS>ATA Stowed FGB-2					

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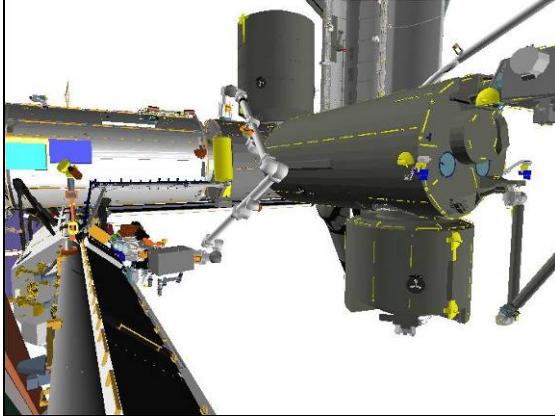


Figure 77.- POA Grapple
(09: P1 Lower Outboard: +120, -5).

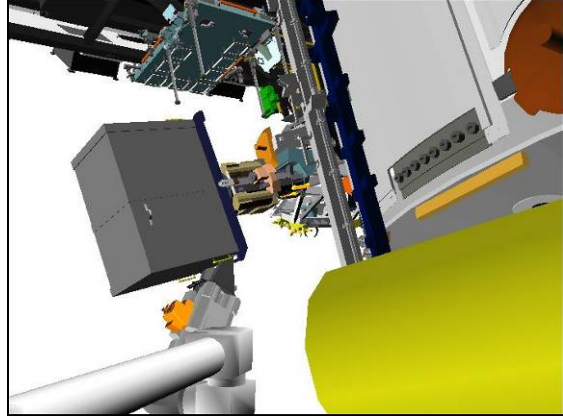


Figure 78.- POA Grapple
(22: Base Elbow: -85, +5).

35. SSRMS ATA RELEASE AND BACKOFF

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
09: P1 Lower Outboard (+120, -5)	25: Tip LEE	22: Base Elbow (-85, +5) 13: LAB Stbd Zenith (-170, -40)	OBSS ITVC (+70, -65)	Camera B (-15, +25)

NOTE

1. The Tip LEE Camera must be fully zoomed out to correspond the target overlay.
2. The clearance between the Tip Boom and the JEM is approximately 78 cm (31 in). This clearance may be monitored with the OBSS ITVC Camera.

35.1 SSRMS Limp

DCP

BRAKES SSRMS → OFF (Verify OFF)

PCS

MSS: SSRMS: Limp:

cmd All Limp (Verify Limp – blue)

MSS: SSRMS:

Verify all joints – Limped

35.2 Auto Release

MSS: SSRMS: Tip LEE:

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

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

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CAUTION

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

NOTE

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

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Auto Release

RHC TRIGGER → Press (momentarily)

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

Verify Unloaded Parameters – √

35.3 SSRMS Backoff

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 Roll (Verify SR – Locked)

THC/
RHC Maneuver to ATA Stow Backoff position (within 5 cm/1 deg).

Locked						
SR	SY	SP	EP	WP	WY	WR
+175.0	-7.9	-108.4	-112.8	-26.0	+57.6	+74.1
X	Y	Z	Pitch	Yaw	Roll	
-150	0	0	0.0	0.0	0.0	
FOR	Unloaded – LEE Tip, SR Held					
Disp	MBS>ATA Stowed FGB-2					

PCS MSS: SSRMS: SSRMS

Enter Mode – Standby (Verify blue)

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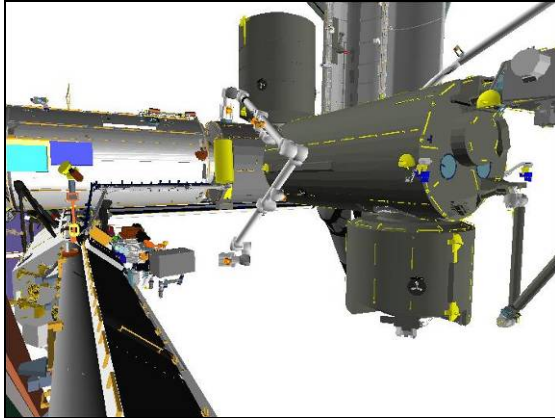


Figure 79.- ATA Stow Backoff
(09: P1 Lower Outboard: +120, -5).

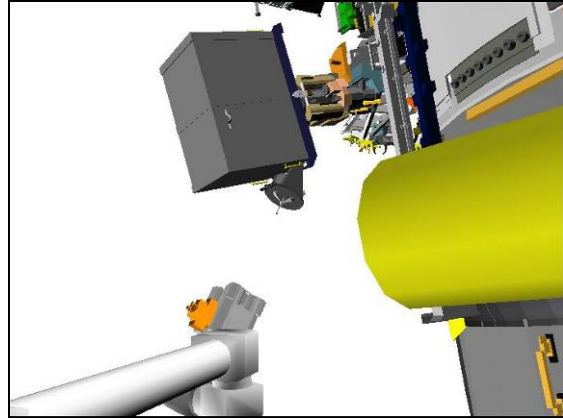


Figure 80.- ATA Stow Backoff
(22: Base Elbow: -85, +5).

If using shuttle attitude control
Coordinate with shuttle crewmembers.
If attitude maintenance reqd
DAP: LVLH
When rates damped
DAP: FREE > 2 seconds, then
DAP: AUTO

36. JOINT OCAS TO PARK INT 1 POSITION

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
09: P1 Lower Outboard (+120, -5)	24: Tip Elbow (0, 0)	37: MBS Mast (+10, +20) 22: Base Elbow (-85, +5)	OBSS ITVC (+60, -55) SRMS Elbow (-45, +140)	Camera B (-15, +25)

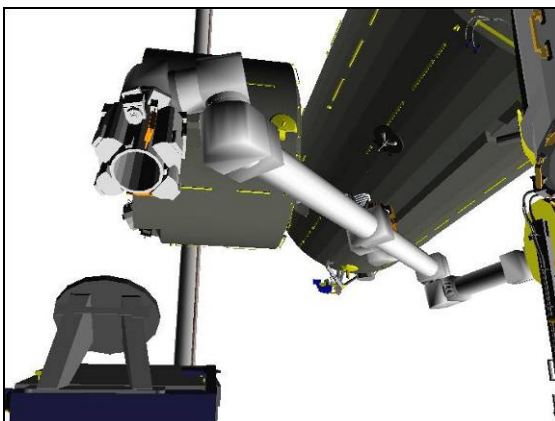


Figure 81.- ATA Stow Backoff
(37: MBS Mast: +10, +20).

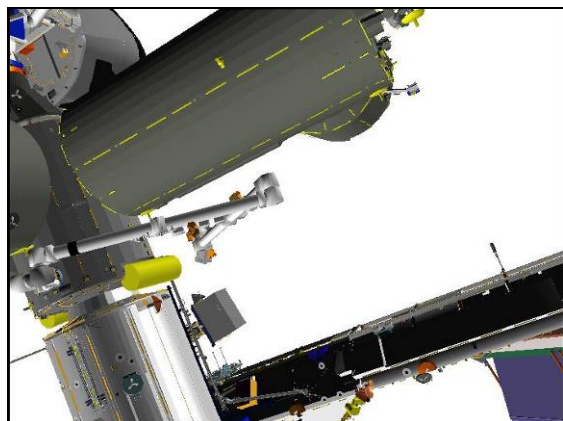


Figure 82.- ATA Stow Backoff
(OBSS ITVC: +60, -55).

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NOTE

1. The closest clearance is at the beginning of the maneuver and is between the Tip Boom and the JEM. It is approximately 78 cm (31 in). This clearance may be monitored with the OBSS ITVC Camera.
2. Expect singularity warning for EP between -15 and +15 deg.

MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

Input 'Joint Angles' 'Destination' for Park Int 1 position.

SR	SY	SP	EP	WP	WY	WR
+170.0	-12.0	-70.0	+50.0	-100.0	-80.0	+90.0

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)	+175.0	-7.9	-108.4	-112.8	-26.0	+57.6	+74.1
TGT	+170.0	-12.0	-70.0	+50.0	-100.0	-80.0	+90.0
ERR	+5.0	+4.1	-38.4	-162.8	+74.0	+137.6	-15.9

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
+170.0	-12.0	-70.0	+50.0	-100.0	-80.0	+90.0

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Figure 83.- Park Int 1
(09: P1 Lower Outboard: +120, +35).

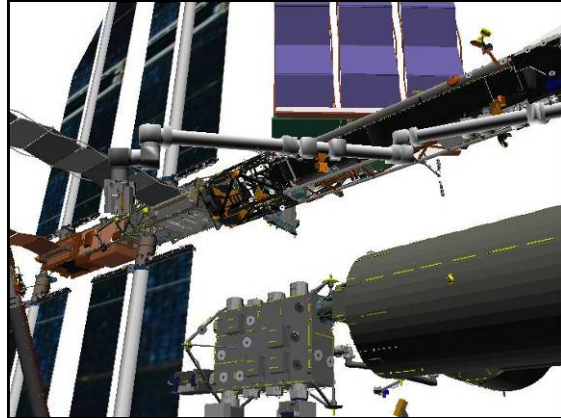


Figure 84.- Park Int 1
(Camera B: -40, +25).

37. JOINT OCAS TO PARK INT 2 POSITION

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	V10 L	V10 R
09: P1 Lower Outboard (+120, 35)	24: Tip Elbow (0, +10)	22: Base Elbow (+155, -15)	SRMS Elbow (-45, +140)	Camera B (-40, +25)



Figure 85.- Park Int 1
(22: Base Elbow: +155, -15).

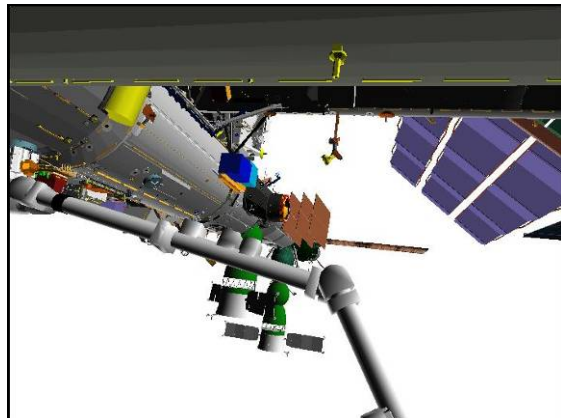


Figure 86.- Park Int 1
(SRMS Elbow: -45, +140).

NOTE

The clearance between the Tip Boom and the JEM is approximately 154 cm (61 in). This clearance may be monitored with the P1 Lower Outboard Camera or SRMS Elbow Camera.

RHC RATE → COARSE (Verify Coarse on PCS)

PCS MSS: SSRMS:

2.410 NEW ATA STOW IN POA

(RBT FS/17A/FIN)

Input 'Joint Angles' 'Destination' for Park Int 2 position.

SR	SY	SP	EP	WP	WY	WR
+150.0	+160.0	-150.0	+50.0	-100.0	-80.0	+90.0

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)	+170.0	-12.0	-70.0	+50.0	-100.0	-80.0	+90.0
TGT	+150.0	+160.0	-150.0	+50.0	-100.0	-80.0	+90.0
ERR	+20.0	-172.0	+80.0	0.0	0.0	0.0	0.0

PCS

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

* Input correct Dest joint angles per table above.

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

MON

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

PCS

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

DCP

AUTO SEQ → PROC

PCS

MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at Park Int 2 position.

SR	SY	SP	EP	WP	WY	WR
+150.0	+160.0	-150.0	+50.0	-100.0	-80.0	+90.0

2.410 NEW ATA STOW IN POA

(RBT FS/17A/FIN)

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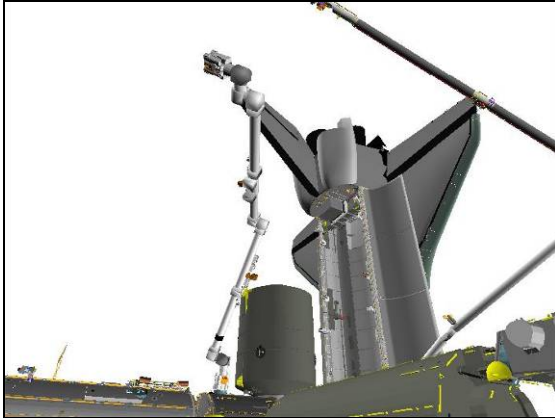


Figure 87.- Park Int 2
(09: P1 Lower Outboard: +120, +35).

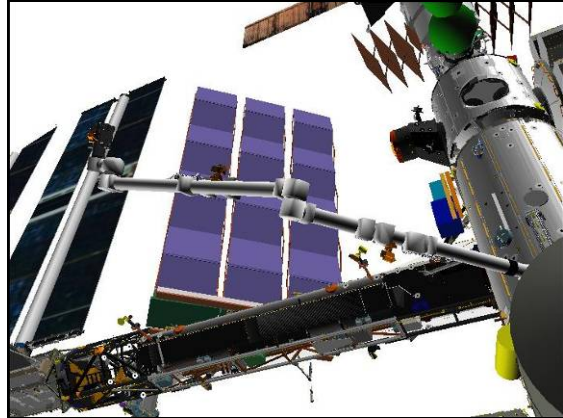


Figure 88.- Park Int 2
(Camera B: -25, +45).

38. SINGLE JOINT TO PARK POSITION

MSS: SSRMS:

Enter Mode – Single (Verify blue)

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

THC

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

Park Int 2
1: SR +
Park

SR	SY	SP	EP	WP	WY	WR
+150.0	+160.0	-150.0	+50.0	-100.0	-80.0	+90.0
+180.0						
+180.0	+160.0	-150.0	+50.0	-100.0	-80.0	+90.0
X	Y	Z	Pitch	Yaw	Roll	
-912	+1514	-948	+36.4	+29.4	+101.0	
FOR	Unloaded – LEE Tip, SR Held					
Disp	MBS>ATA Stowed FGB-2					

RHC

RATE → VERNIER (Verify Vernier on PCS)

2.410 NEW ATA STOW IN POA

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Figure 89.- Park
(09: P1 Lower Outboard: +120, +35).



Figure 90.- Park
(Camera B: -45, +35).

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)

2.666 CBM LATCH STALL RECOVERY

(RBT FS/17A/FIN)

Page 1 of 2 pages

1. SSRMS SAFING AND BRAKES STATUS

On CBM operator, "Go to perform {2.666 CBM LATCH STALL RECOVERY - SSRMS}, 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 out) for 5 s

PCS MSS: SSRMS:

Verify Posn Hold – orange

Enter Mode – Standby (Verify blue)

2.666 CBM LATCH STALL RECOVERY

(RBT FS/17A/FIN)

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MSS: SSRMS: Limp:

cmd All Limp (Verify Limp – blue)

MSS: SSRMS:

Verify all joints – Limped

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

REFERENCE

REFERENCE

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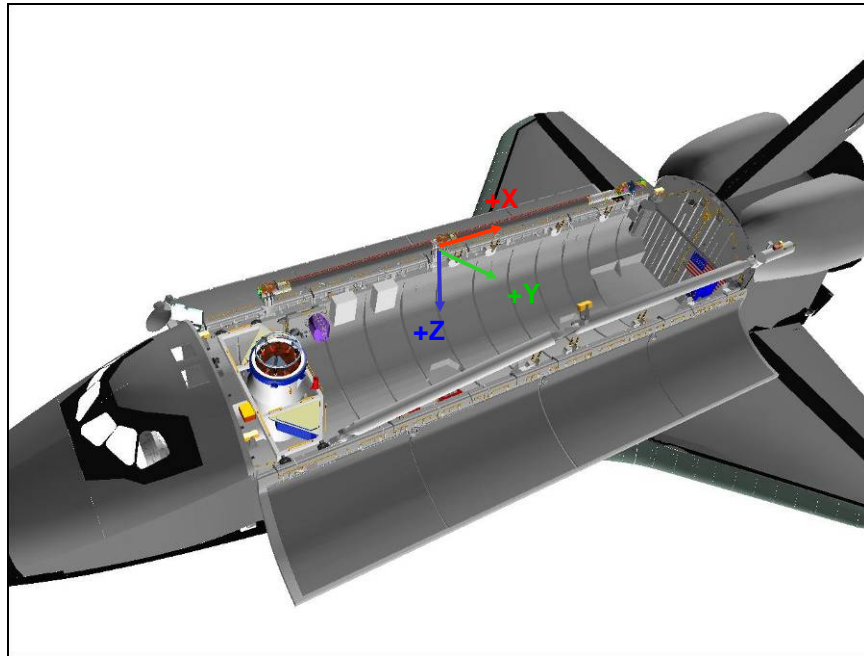


Figure 1.- OBSS Mid MPM FOR.

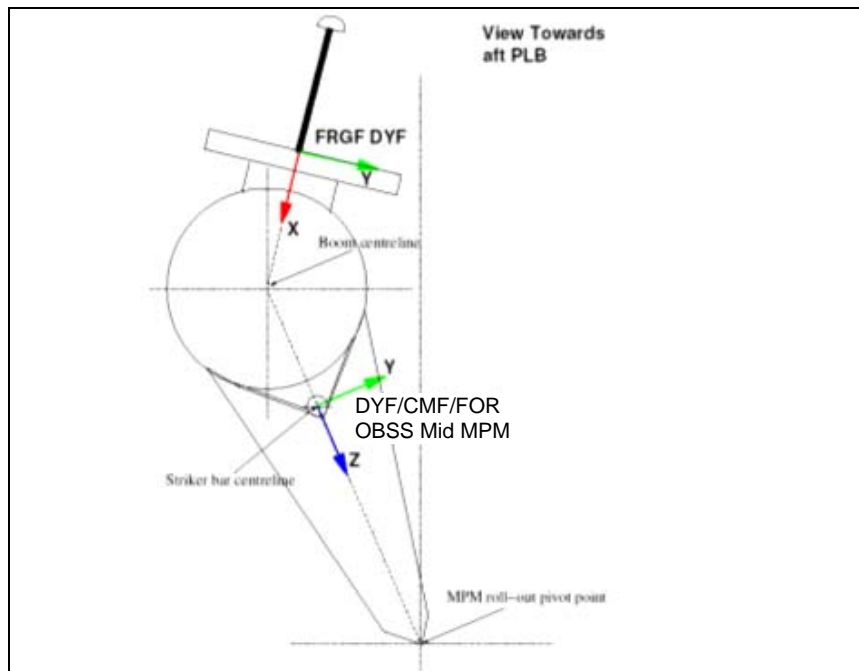


Figure 2.- OBSS Mid MPM Command Frame, Display Frame, and FOR.

Location:

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

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3.200 DISPLAY FRAME AND FOR: MPLM MATE CBCS

(RBT FS/17A/FIN)

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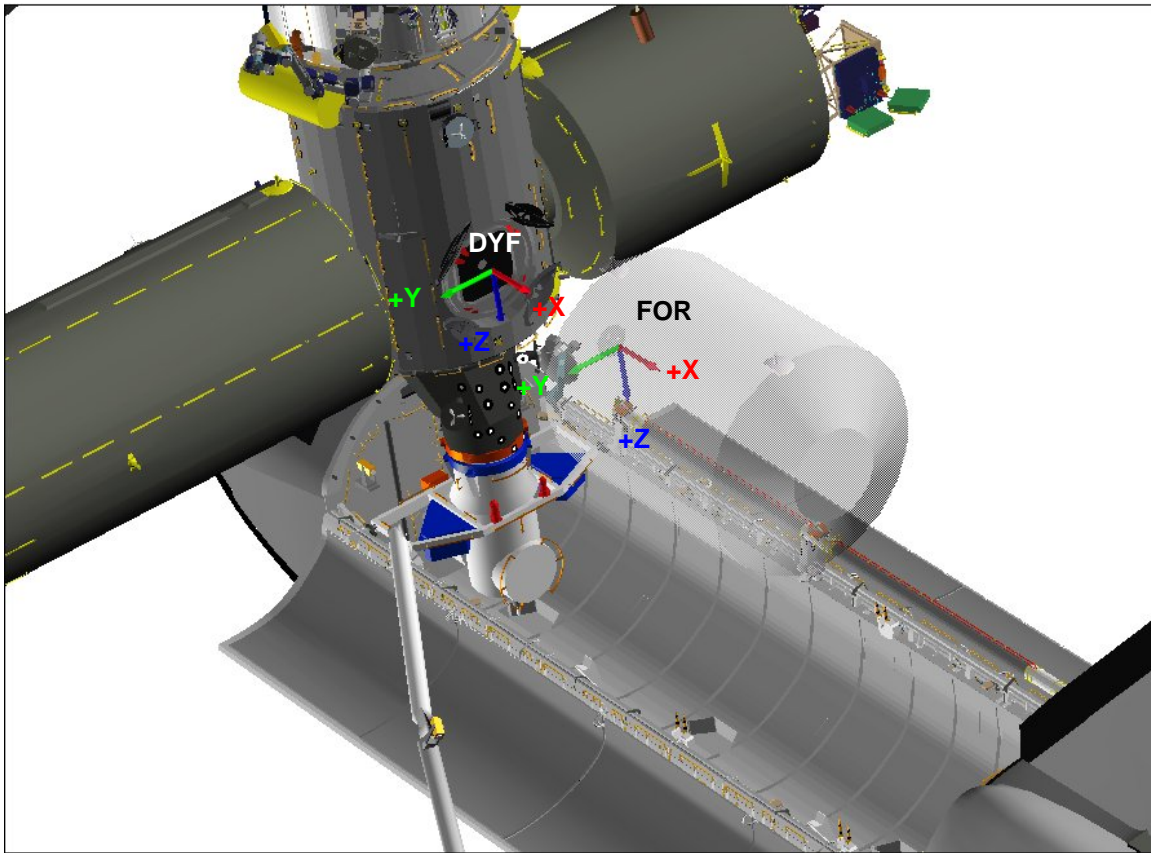


Figure 1.- MPLM Mate CBCS Display Frame and FOR.

Location:

FOR is located at the CBCS target origin.

The orientation is $+X = +Z_{ISSACS}$, $+Y = -Y_{ISSACS}$, and $+Z = +X_{ISSACS}$ when the MPLM is fully mated to Node 2 Nadir CBM.

Display frame and FOR are colocated and coaligned when MPLM is berthed.

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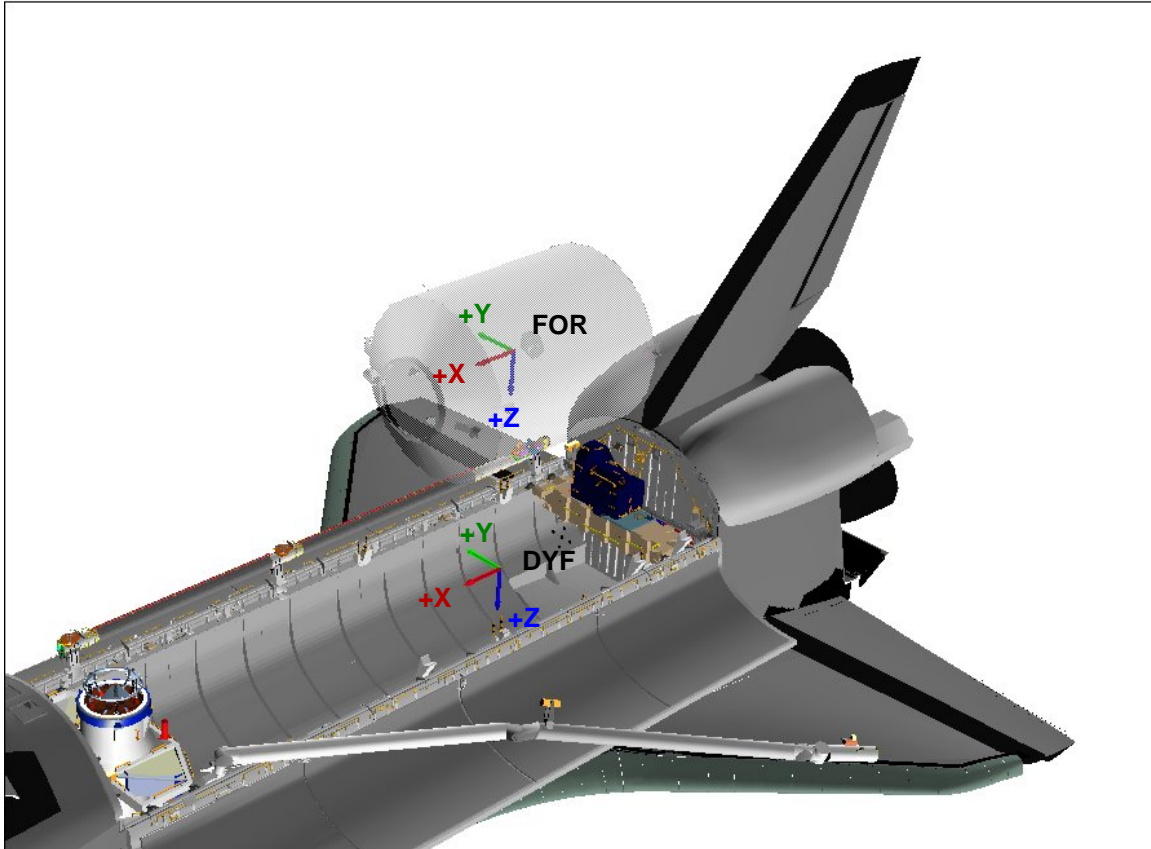


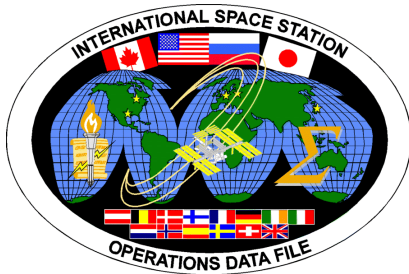
Figure 1.- MPLM Berth Display Frame and FOR.

Location:

FOR is located at trunnion plane center, midway between aft and fwd trunnion pins, at trunnion level and aligned with OBAS when fully berthed.

Display frame and FOR are colocated and coaligned when MPLM is berthed.

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