



International Space Station Robotics Group Robotics Book - Flight Specific

ISS-19A

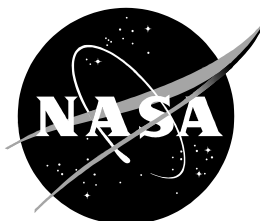
Mission Operations Directorate
Operations Division

20 NOV 09

This publication replaces
all previous publications.
These procedures are available
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National Aeronautics and
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Lyndon B. Johnson Space Center
Houston, Texas

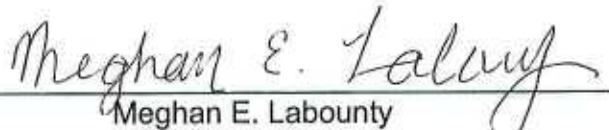


United Space Alliance

**INTERNATIONAL SPACE STATION
ROBOTICS GROUP
ROBOTICS BOOK - FLIGHT SPECIFIC
ISS-19A**

20 NOV 09

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None

**INTERNATIONAL SPACE STATION
ROBOTICS GROUP
ROBOTICS BOOK - FLIGHT SPECIFIC
ISS-19A**

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NOMINAL

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1. HAND CONTROLLER CALIBRATION

1.1 Translational Hand Controller (THC) Calibration

THC

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

1.2 Rotational Hand Controller (RHC) Calibration

RHC

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

2. SETUP

Verify SRMS 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	SSC 1 (MON 1)	SSC 2 (DTV)
03: S1 Lower Outboard (+55, +20)	13: LAB Stbd Zenith (-30, -20)	22: Base Elbow (-130, -10)	Camera D (-10, +10)	SRMS Elbow (-110, +5)

PCS MSS: SSRMS:

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

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

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

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

Verify SSRMS at 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					

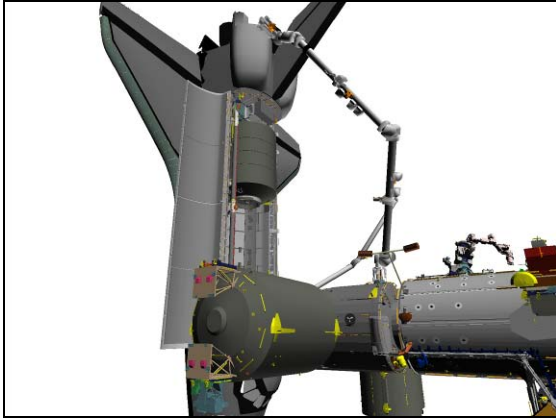


Figure 1.- Stage Park
(03: S1 Lower Outboard: +55, +20).



Figure 2.- Stage Park
(13: LAB Stbd Zenith: -30, -20).

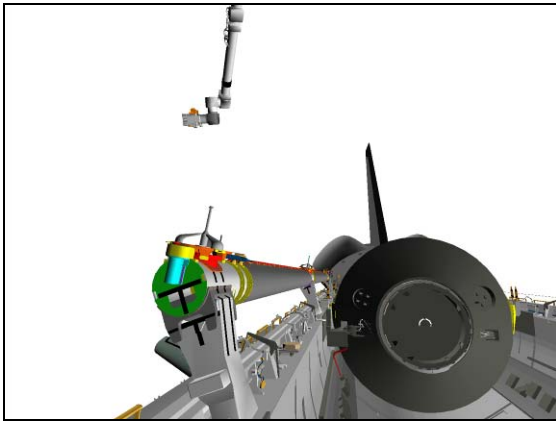


Figure 3.- Stage Park
(Camera D: -10, +10).

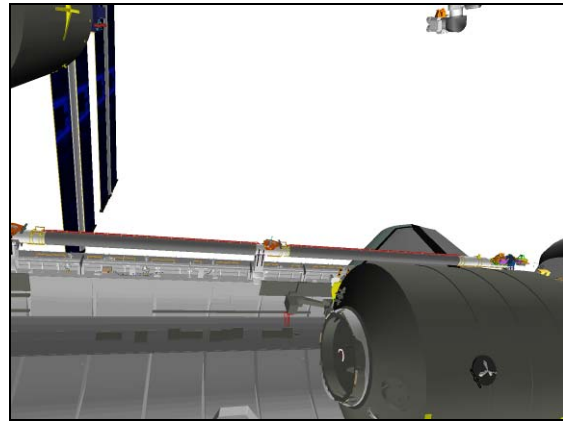


Figure 4.- Stage Park
(SRMS Elbow: -110, +5).

3. OBSS PRE-GRAPPLE JOINT OCAS

MSS: SSRMS: MSS Safing:

cmd 'SSRMS' Remove (Verify Not Safed)

DCP BRAKES SSRMS → OFF (Verify OFF)

RHC RATE → VERNIER (Verify Vernier on PCS)

PCS MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

pick File ► Menu 1 ► Menu 2

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

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

cmd Load (Verify Sequence Status – Confirm or Cancel)

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

	SR	SY	SP	EP	WP	WY	WR
(current)	+74.6	+220.0	-150.0	-50.0	-130.0	-121.0	+180.0
TGT	+74.6	+217.3	-161.0	-112.7	-162.3	-158.0	+210.6
ERR	0.0	+2.7	+11.0	+62.7	+32.3	+37.0	-30.6

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).

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

4. OBSS GRAPPLE

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
03: S1 Lower Outboard (+55, +20)	25: Tip LEE	22: Base Elbow (-90, -10)	Camera D (-10, +10)	SRMS Elbow (-110, +5)

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

4.1 Maneuvering to Grapple Envelope

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)

RHC/
THC

Maneuver to within grapple envelope.

PCS

4.2 Grapple

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

MSS: SSRMS: SSRMS

Verify Active Effector – SSRMS Tip LEE

RHC

TRIGGER → Press (momentarily)

PCS

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

Verify Capture to Latch – No (SCR 19282)

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

Verify 'Carriage' Retract – blue

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

4.3 Grapple Cleanup

Verify Posn Hold – Orange

DCP

BRAKES SSRMS → ON (Verify ON)

PCS

MSS: SSRMS: SSRMS

Verify Loaded Parameters – √

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Verify 'Loaded Parameters' (three) – OBSS Mid MPM, SSRMS, SR Held

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

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

Record OBSS Grapple joint angles and FOR.

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

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

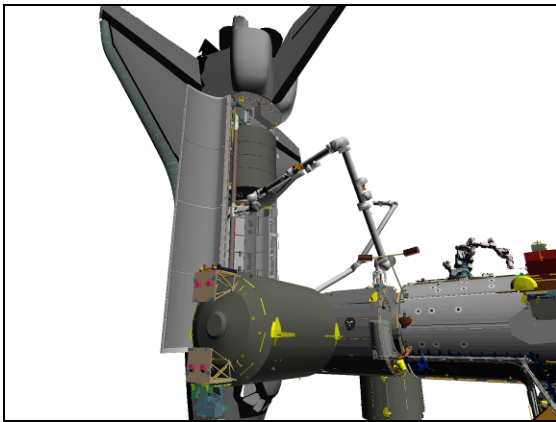


Figure 5.- OBSS Grapple
(03: S1 Lower Outboard: +55, +20).

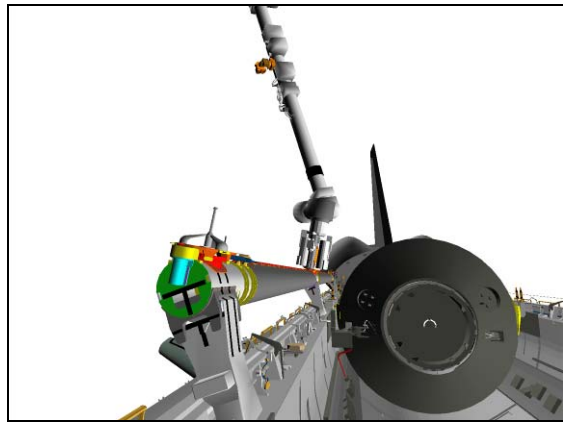


Figure 6.- OBSS Grapple
(Camera D: -10, +10).

5. OBSS UNBERTH

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
03: S1 Lower Outboard (+55, +20)	72(DNLK): Mux D/C (D: -25, 0) (C: +25, 0)	24: Tip Elbow (-40, +30)	Camera D (-25, 0)	SRMS Elbow (-110, +5)

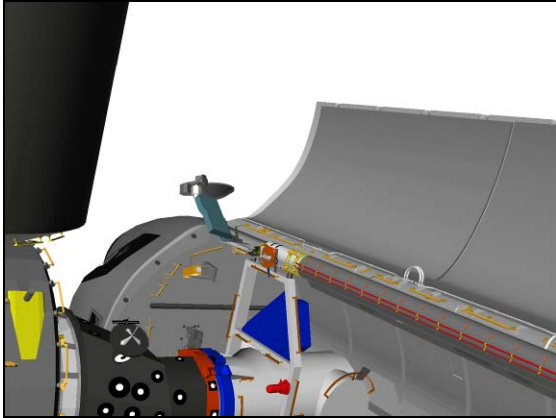


Figure 7.- OBSS Grapple
 (24: Tip Elbow: -40, +30).

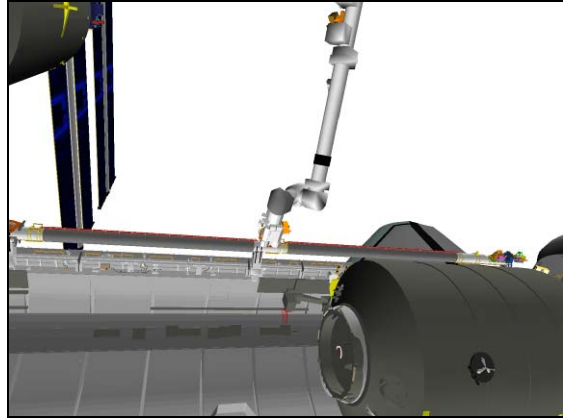


Figure 8.- OBSS Grapple
 (SRMS Elbow: -110, +5).

5.1 Attitude Control Configuration

MSS: SSRMS: Thrusters: Thruster Controls for MSS Ops

Verify 'Desat Request:' – Inh

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

5.2 MRL Release

Notify shuttle crew: "SSRMS Brakes on. GO to deactivate Starboard RMS heaters and release Starboard MRLs."

NOTE

Standby for OBSS thermal clock start time:
 ____/____:____:____

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

 * 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, "Starboard MRLs released, ready for OBSS unberth."

DCP
 PCS

BRAKES SSRMS → OFF (Verify OFF)

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: As Desired

<p>NOTE The minimum distance between the OBSS and Columbus is 110 cm (44 in) at Low Hover. This clearance may be monitored with the Tip Elbow Camera or the SRMS Elbow Camera.</p>
--

MSS: SSRMS:

√Vernier

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

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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	+223.7	-159.4	-109.2	-165.0	-159.7	217.2
X	Y	Z	Pitch	Yaw	Roll	
0	0	-150	0.0	0.0	0.0	
FOR	Loaded – OBSS Mid MPM, SSRMS, SR Held					
Disp	Orbiter>OBSS Mid MPM					

PCS MSS: SSRMS:

Enter Mode – Standby (Verify blue)

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

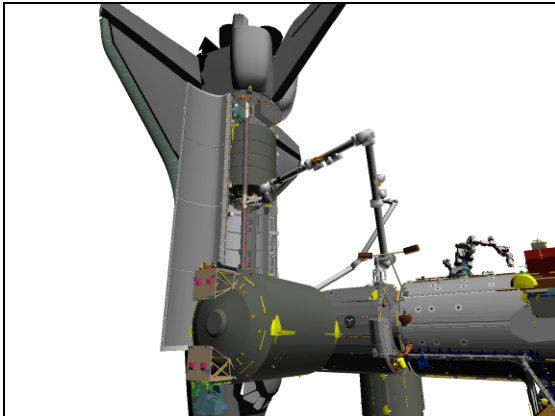


Figure 9.- OBSS Low Hover
(03: S1 Lower Outboard: +55, +20).

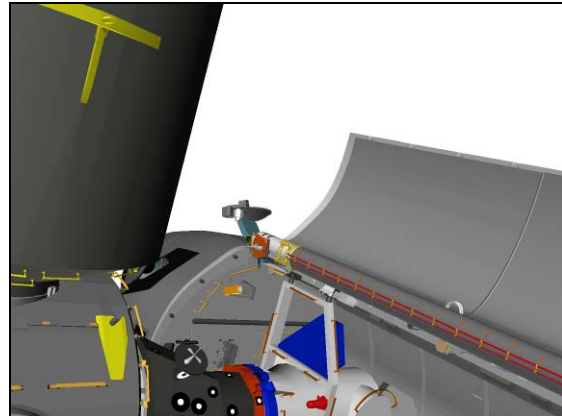


Figure 10.- OBSS Low Hover
(24: Tip Elbow: -40, +30).

6. OBSS INTERMEDIATE FOR OCAS

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
03: S1 Lower Outboard (+55, +20)	24: Tip Elbow (-40, +30)	22: Base Elbow (-115, +5)	Camera D (-25, +15)	SRMS Elbow (-110, +5)

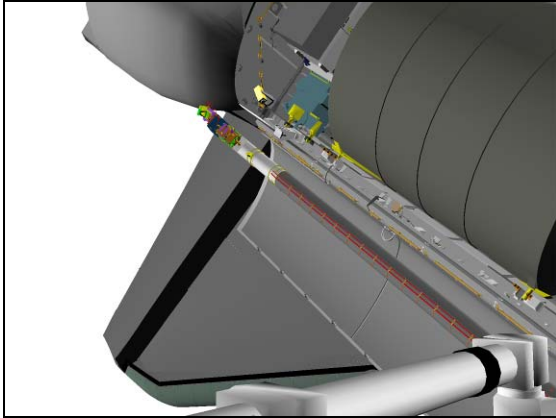


Figure 11.- OBSS Low Hover
 (22: Base Elbow: -115, +5).

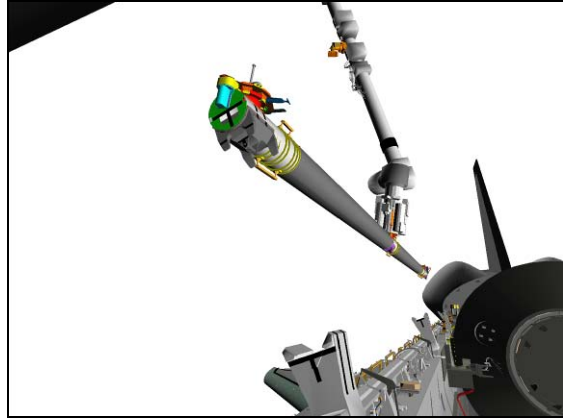


Figure 12.- OBSS Low Hover
 (Camera D: -25, +15).

MSS: SSRMS: Rate:

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

MSS: SSRMS:

Enter Mode – FOR OCAS (Verify blue)

MSS: SSRMS: SSRMS FOR OCAS: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

pick File ► Menu 1 ► Menu 2

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

X	Y	Z	Pitch	Yaw	Roll
+250	-200	-300	0.0	0.0	0.0

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON

Verify FOR and errors are correct on FOR Position overlay.

	X	Y	Z	Pitch	Yaw	Roll
FOR	0	0	-150	0.0	0.0	0.0
TGT	+250	-200	-300	0.0	0.0	0.0
ERR	-250	+200	+150	0.0	0.0	0.0

PCS

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

DCP

AUTO SEQ → PROC

PCS

MSS: SSRMS:

Verify Posn Hold – orange

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

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

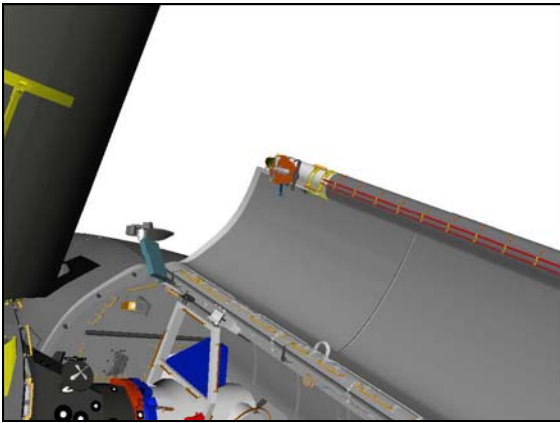


Figure 13.- OBSS Intermediate
 (24: Tip Elbow: -60, +30).

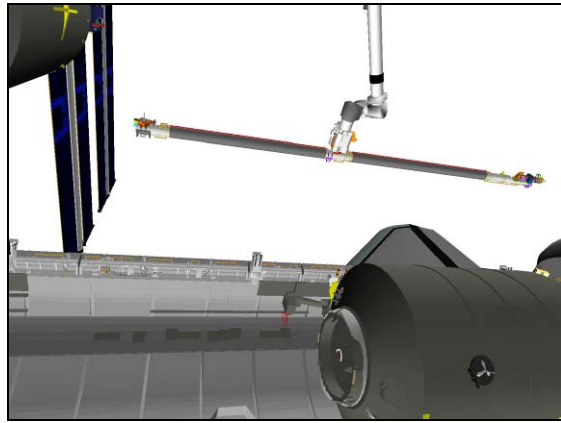


Figure 14.- OBSS Intermediate
 (SRMS Elbow: -110, +5).

7. OBSS HANDOFF FOR OCAS

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
03: S1 Lower Outboard (+55, +20)	24: Tip Elbow (-60, +30) 22: Base Elbow (-55, +5) [13: LAB Stbd Zenith (-30, -20)]	09: P1 Lower Outboard (+120, +25)	Camera A (0, +20)	SRMS Elbow (-100, +10)

SSRMS FOR OCAS

Verify SR – Locked

pick File ► Menu 1 ► Menu 2

Verify '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)

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

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

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, SSRMS, SR Held					
Disp	Orbiter>OBSS Mid MPM					

DCP BRAKES SSRMS → ON (Verify ON)

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

Notify SRMS operator, “SSRMS Brakes on. GO for OBSS grapple.”

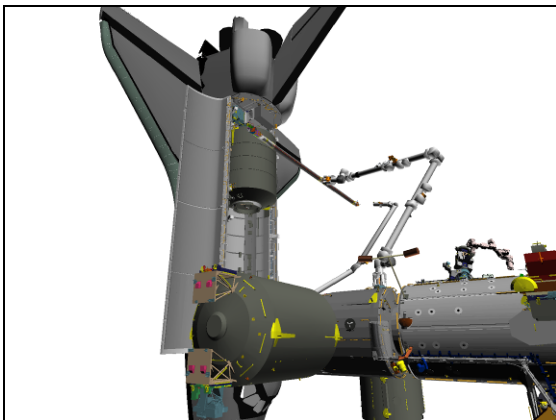


Figure 15.- OBSS Handoff
 (03: S1 Lower Outboard: +55, +20).

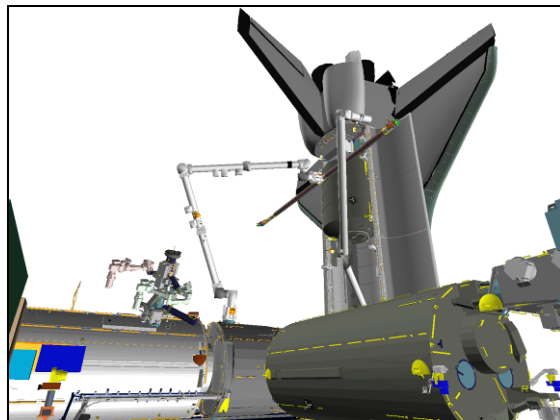


Figure 16.- OBSS Handoff
 (09: P1 Lower Outboard: +120, +25).

8. OBSS RELEASE SETUP

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
72(DNLK): Camera A (0, +20)	25: Tip LEE	09: P1 Lower Outboard (+120, +25)	Camera B (-10, +30)	SRMS Elbow (-60, 0)

NOTE

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

PCS

MSS: SSRMS:

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

Verify Display – Orbiter>OBSS Mid MPM

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

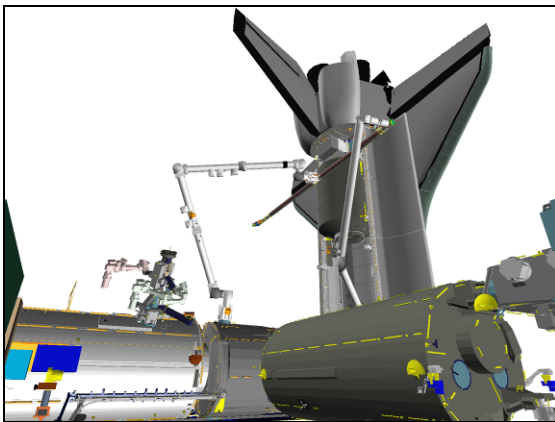


Figure 17.- OBSS Handoff
(09: P1 Lower Outboard: +120, +25).

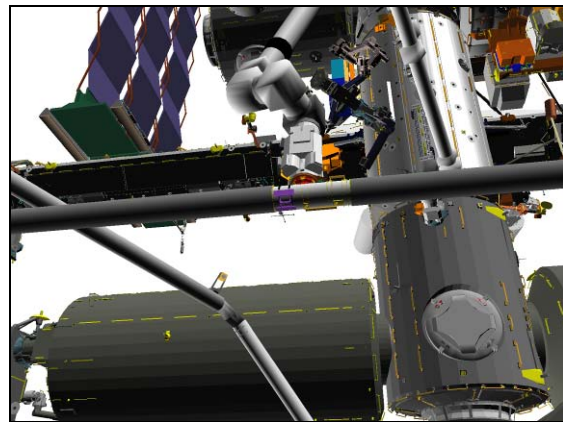


Figure 18.- OBSS Handoff
(Camera B: -10, +30).

9. OBSS RELEASE

On SRMS operator GO, "SRMS Brakes ON, ready for OBSS Release."

9.1 SSRMS Limp

DCP

BRAKES SSRMS → OFF (Verify OFF)

√Vernier

PCS

MSS: SSRMS: Limp:

cmd All Limp (Verify Limp – blue)

MSS: SSRMS:

Verify all joints – Limped

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9.2 Auto Release

MSS: SSRMS: Tip LEE:

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

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

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Auto Release

MSS: SSRMS:

Verify Active Effector – SSRMS Tip LEE

RHC TRIGGER → Press (momentarily)

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

9.3 SSRMS Backoff

MSS: SSRMS: Limp:

cmd None Limp (Verify Standby – blue)

MSS: SSRMS:

√Vernier

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)

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

Locked						
SR	SY	SP	EP	WP	WY	WR
+74.6	+160.7	-144.0	-109.6	-189.8	-159.5	+63.9
X	Y	Z	Pitch	Yaw	Roll	
+343	+725	-340	-75.4	-18.9	-85.7	
FOR	Unloaded – LEE Tip, SR Held					
Disp	Orbiter>OBSS Mid MPM					

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)

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

Give SRMS operator GO for Maneuver to MPLM Viewing position.

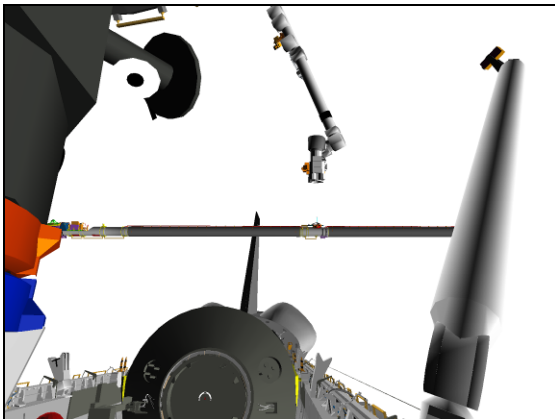


Figure 19.- OBSS Backoff
 (72: Camera A: 0, +20).

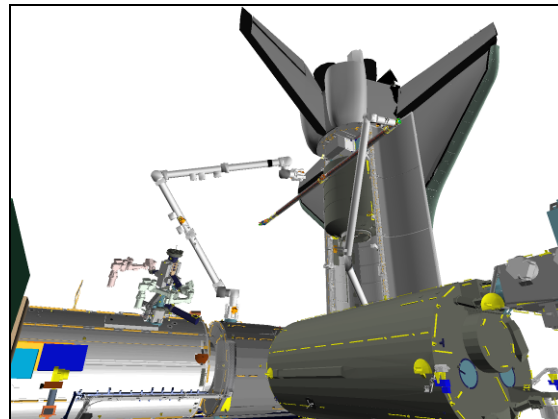


Figure 20.- OBSS Backoff
 (09: P1 Lower Outboard: +120, +25).

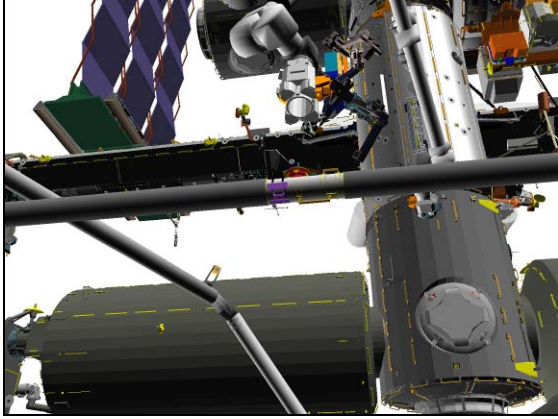


Figure 21.- OBSS Backoff
(Camera B: -10, +30).

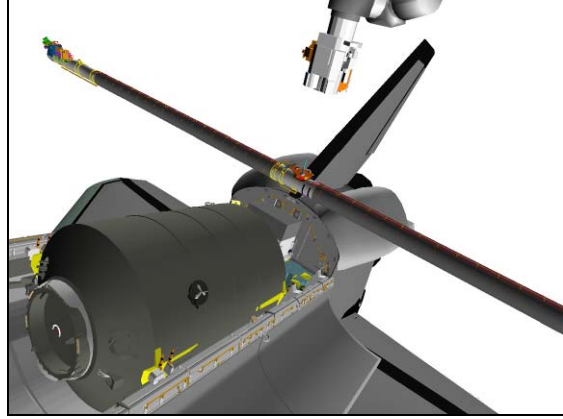


Figure 22.- OBSS Backoff
(SRMS Elbow: -60, 0).

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1. SETUP

Verify with SRMS operator, SRMS 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	SSC1 (MON1)	SSC2 (DTV)
09: P1 Lower Outboard (+130, +20)	24: Tip Elbow (-10, +10)	03: S1 Lower Outboard (+55, +20)	SRMS Elbow (-110, +30)	Camera B (0, +25)

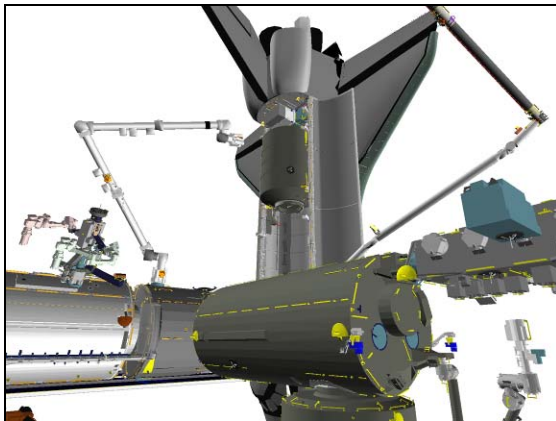


Figure 1.- OBSS Backoff Position
(09: P1 Lower Outboard: +130, +20).

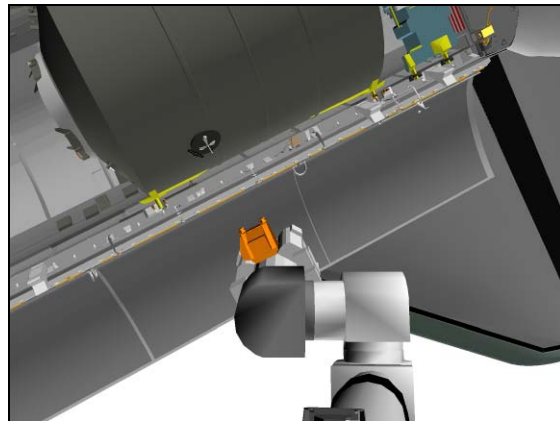


Figure 2.- OBSS Backoff Position
(24: Tip Elbow: -10, +10).

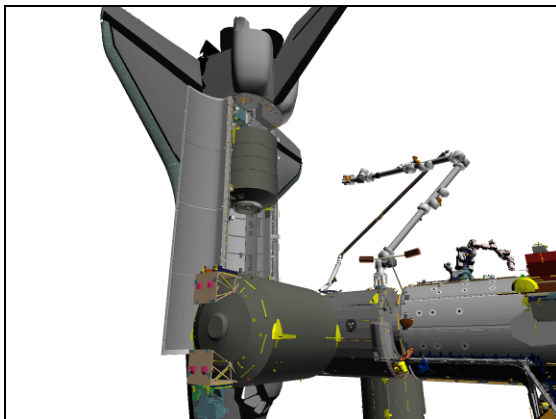


Figure 3.- OBSS Backoff Position
(03: S1 Lower Outboard: +55, +20).

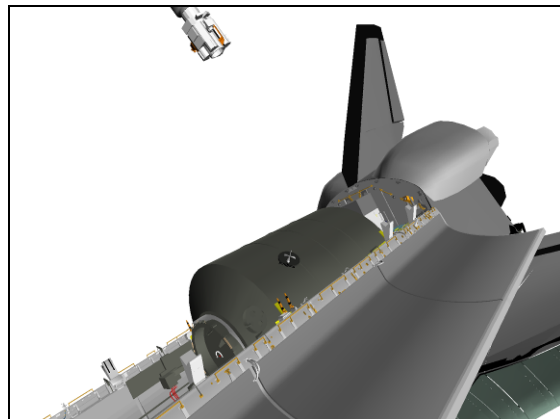


Figure 4.- OBSS Backoff Position
(SRMS Elbow: -110, +30).

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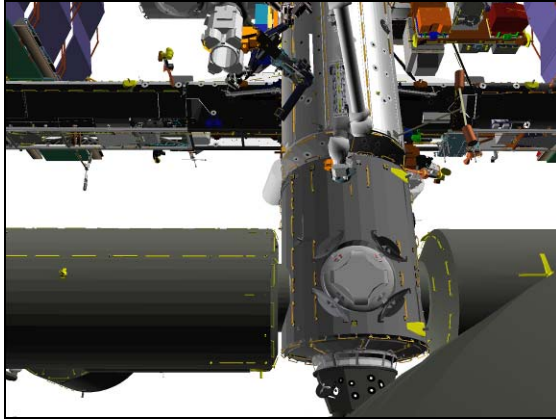


Figure 5.- OBSS Backoff Position
(Camera B: 0, +25).

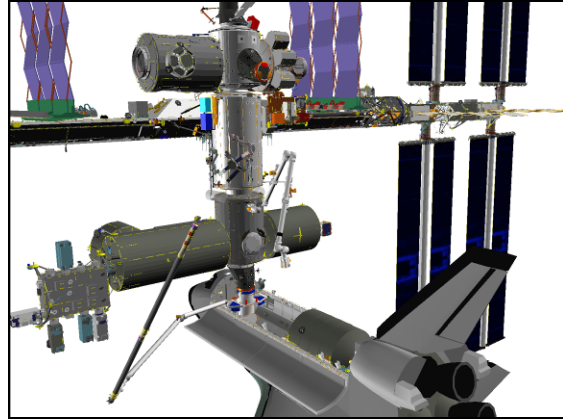


Figure 6.- OBSS Backoff Position
(ISS Angle).

PCS MSS: SSRMS:

Change Loaded Parameters ► MPLM ► MPLM Berth SRH
Verify 'Loaded Parameters' (three) – MPLM Berth, SSRMS, 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

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

SR	SY	SP	EP	WP	WY	WR
+74.6	+160.7	-144.0	-109.5	-189.8	-159.5	+63.9
X	Y	Z	Pitch	Yaw	Roll	
-425	+281	+124	+14.9	-49.8	+119.8	
FOR	Unloaded – LEE Tip, SR Held					
Disp	Orbiter>MPLM Port GF					

2. MPLM PRE-GRAPPLE POSITION JOINT OCAS

MSS: SSRMS: MSS Safing:

cmd 'SSRMS' Remove (Verify Not Safed)

DCP BRAKES SSRMS → OFF (Verify OFF)

PCS MSS: SSRMS:

RHC RATE → VERNIER (Verify Vernier on PCS)

PCS MSS: SSRMS: Rate:

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

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MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

pick File ► Menu 1 ► Menu 2

Verify '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	-144.0	-109.5	-189.8	-159.5	+63.9
TGT	+74.6	+163.9	-177.0	-91.5	-43.7	-55.8	+100.8
ERR	0.0	-3.2	+33.0	-18.0	-146.1	-103.7	-36.9

NOTE

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

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

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 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	0	0.0	0.0	0.0	
FOR	Unloaded – LEE Tip, SR Held					
Disp	Orbiter>MPLM Port GF					

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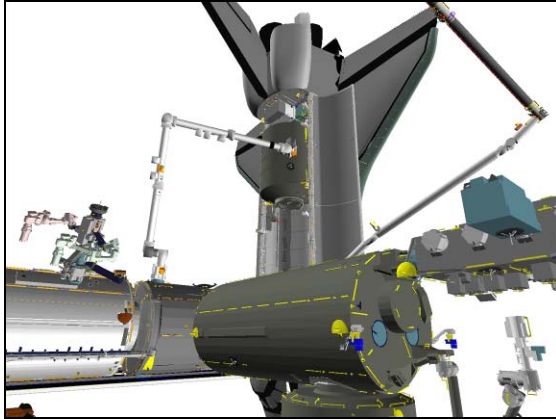


Figure 7.- MPLM Pre-Grapple Position
(09: P1 Lower Outboard: +130, +20).

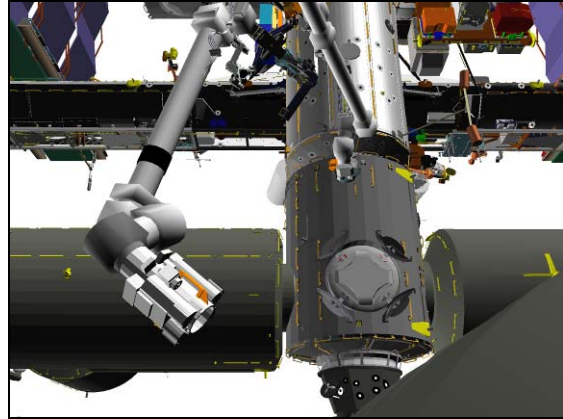


Figure 8.- MPLM Pre-Grapple Position
(Camera B: 0, +25).

3. MPLM GRAPPLE

3.1 Setup

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC1 (MON1)	SSC2 (DTV)
09: P1 Lower Outboard (+130, +20)	25: Tip LEE	03: S1 Lower Outboard (+55, +20)	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 PLB Sill is approximately 88 cm (35 in) at grapple. This clearance may be monitored with Camera B or SRMS Elbow Camera.

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)

3.2 Maneuvering to Grapple

Maneuver to within grapple envelope.

RHC/
THC

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3.3 Slow Capture Commands

PCS

MSS: SSRMS: Tip LEE:

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

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

CAUTION

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

NOTE

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

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Auto Capture

MSS: SSRMS:

Verify Active Effector – SSRMS Tip LEE

RHC

TRIGGER → Press (momentarily)

3.4 Grapple

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

3.5 Grapple Cleanup

DCP

BRAKES SSRMS → ON (Verify ON)

PCS

MSS: SSRMS:

Verify Loaded Parameters – √

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

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

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

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

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Record Berthed MPLM Grapple joint angles and FOR.

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

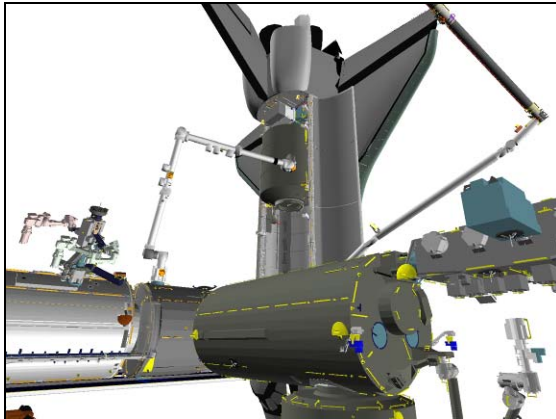


Figure 9.- MPLM Grapple Position
(09: P1 Lower Outboard: +130, +20).

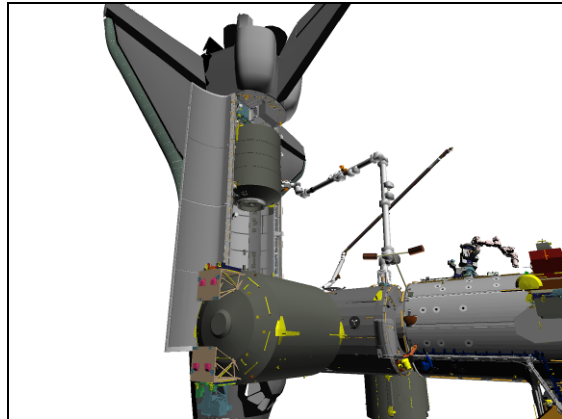


Figure 10.- MPLM Grapple Position
(03: S1 Lower Outboard: +55, +20).

4. KEEL CAMERA ACTIVATION

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)

5. UNBERTH SETUP

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC1 (MON1)	SSC2 (DTV)
09: P1 Lower Outboard (+130, +20)	72(DNLK): Keel Camera OBSS ITVC (+130, -60)	71(MON2): Mux B/C (B:-5, -10) (C:+5, -10)	SRMS Elbow (-110, +30)	OBSS ITVC (+130, -60)

*Leave the OBSS ITVC routed to 72 (DNLK) for use in step 27.

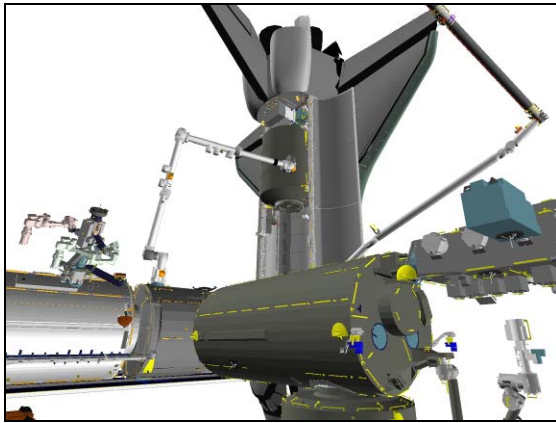


Figure 11.- MPLM Grapple
 (09: P1 Lower Outboard: +130, +20).

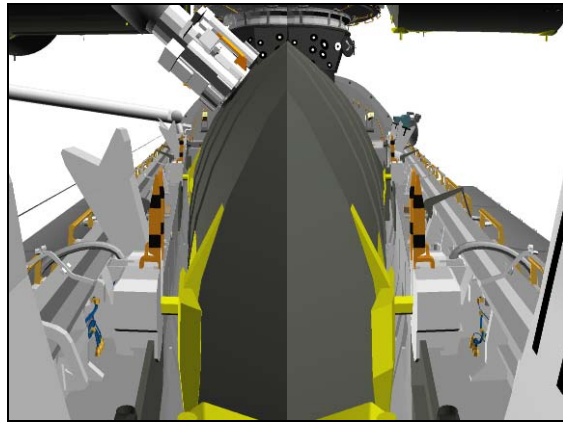


Figure 12.- MPLM Grapple
 (71: Mux B/C).

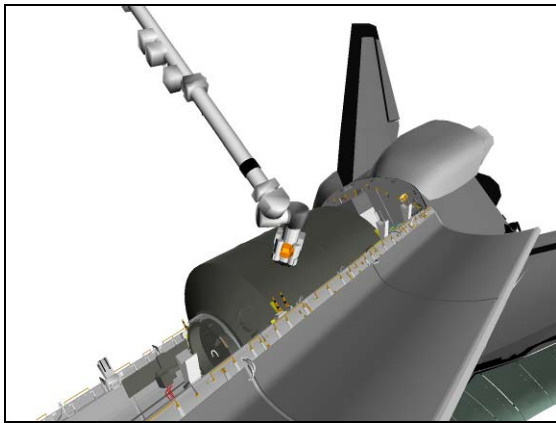


Figure 13.- MPLM Grapple
 (SRMS Elbow: -110, +30).

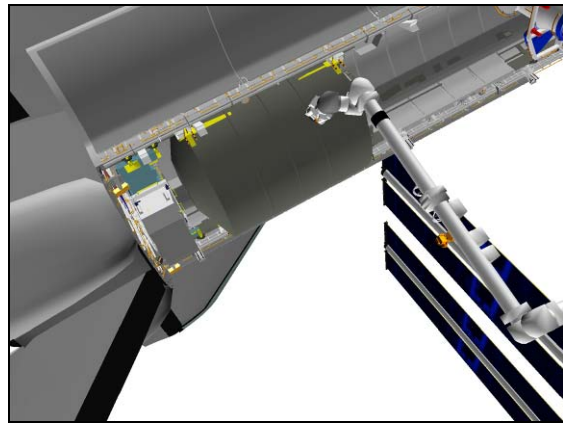


Figure 14.- MPLM Grapple
 (OBSS ITVC: +130, -60).

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.

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6. ATTITUDE CONTROL CONFIGURATION

MSS: SSRMS: Thrusters:

Verify 'Desat Request:' – Inh

If using shuttle attitude control

Coordinate with shuttle crewmembers.

DAP: FREE

7. ROEU DEMATE

7.1 Setup

Give shuttle crew GO for ROEU and PRLA Ops.

On SSRMS operator GO for ROEU and PRLA ops:

CCTV – Config for ROEU demate

DTV	D
-----	---

7.2 Deadfacing ROEU

SSP 1

√MPLM CHAN 1,2 HTR PWR – OFF (tb–bp)

A15

√APCU 1 OUTPUT – OFF

A6U

Install ROEU A6U PANEL OVERLAY.

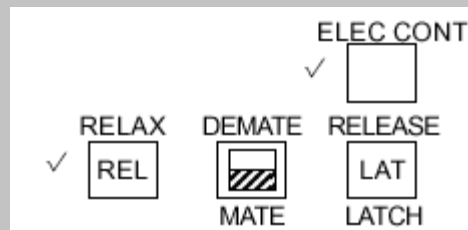
√PL RETEN LAT (five) – OFF

PL RETEN PL SEL – 2

SM 97 PL RETENTION

√REL 2,3 (four): 0

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



7.3 Activating ROEU

R13L

PL RETEN LOGIC PWR SYS 1,2 (two) – ON

BAY MECH PWR SYS 1,2 (two) – ON

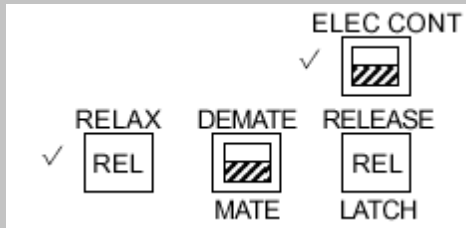
7.4 Releasing Latches

Note single motor time (> 20 seconds).

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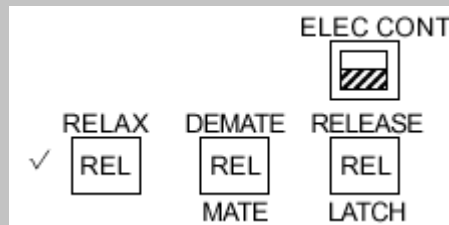
A6U RELEASE/LATCH – REL (tb–REL), 40 s max
– OFF



7.5 Demating ROEU

Note single motor time (> 18 seconds).

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



7.6 Deactivating ROEU

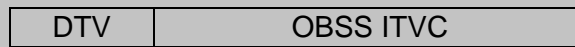
PL RETEN LOGIC PWR SYS 1,2 (two) – OFF
BAY MECH PWR SYS 1,2 (two) – OFF

R13L

A6U

Remove ROEU A6U PANEL OVERLAY.

CCTV – Config for SSRMS Ops



8. ACTIVATING LATCHES

√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).

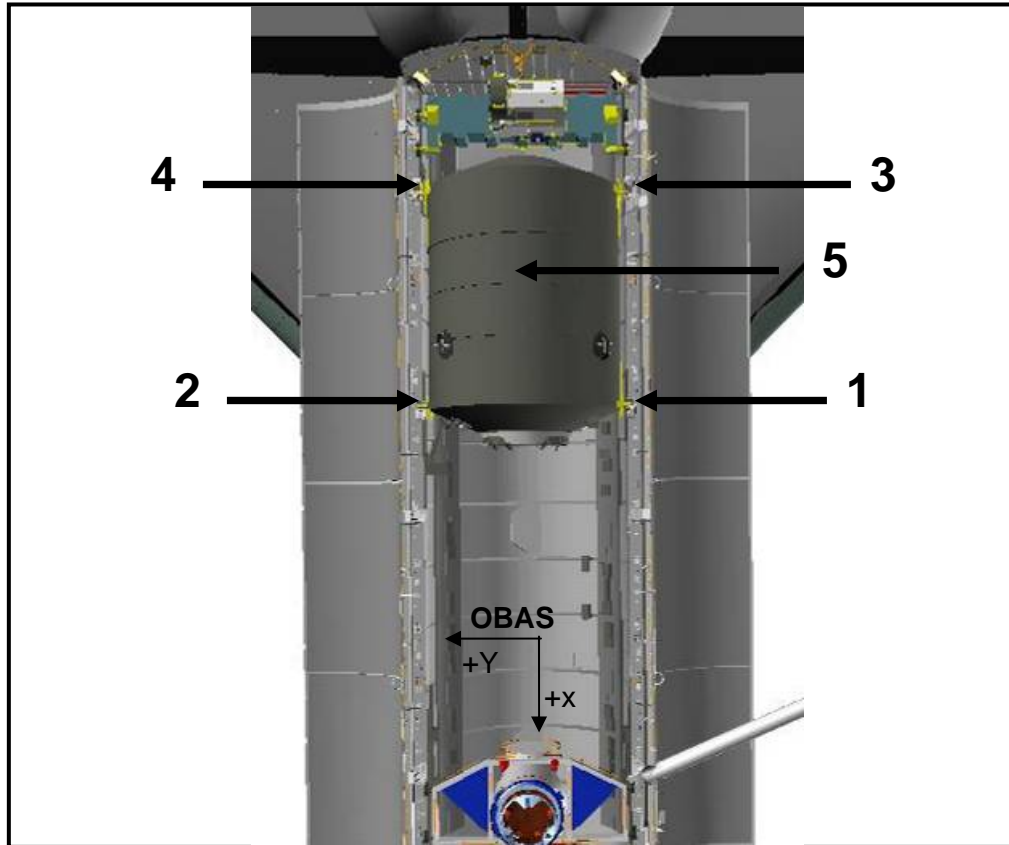


Figure 15.- MPLM PRLA Configuration.

9. 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

10. PRLA RELEASE

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

Note single motor drive times (> 30 seconds).

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

11. DEACTIVATING LATCHES

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

Notify SSRMS operator, “PRLAs released, GO for MPLM unberth.”

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12. 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
*****
```

13. MANEUVERING MPLM TO LOW HOVER

<p><u>NOTE</u> The clearance between the MPLM and New ATA on the LMC is approximately 30 cm (12 in). This clearance may be monitored with the OBSS ITVC Camera.</p>

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, SSRMS, SR Held						
Disp	Orbiter > MPLM Berth						

PCS

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

MSS: SSRMS: Rate:

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

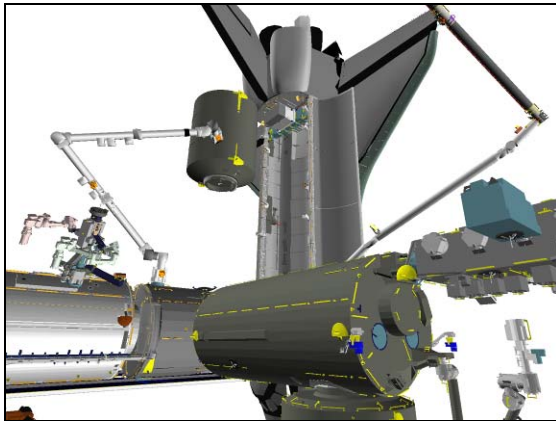


Figure 16.- MPLM Low Hover
(09: P1 Lower Outboard: +130, +20).

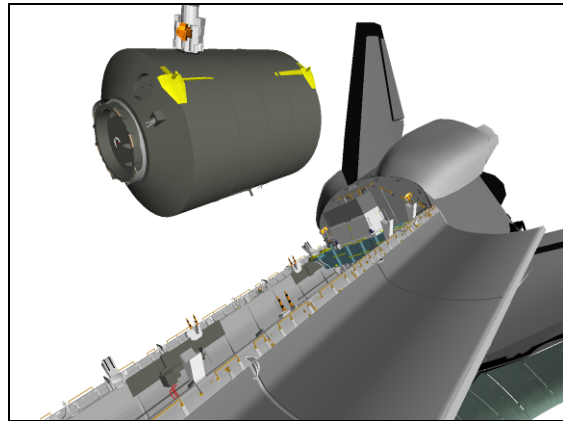


Figure 17.- MPLM Low Hover
(SRMS Elbow: -110, +30).

Notify shuttle crew: “MPLM Unberthed. Keel Camera can be deactivated.”

- SSP2
14. [DEACTIVATING KEEL CAMERA](#)
MPLM KEEL CAM HTR/ILLUM PWR – Toggle until illuminator OFF
(leave sw in ON position)
MPLM KEEL CAM PWR – OFF
 15. [ATTITUDE CONTROL CONFIGURATION](#)
If using shuttle attitude control
Coordinate with shuttle crewmembers.
If attitude maintenance required
DAP: LVLH
When rates damped
DAP: FREE > 2 seconds
DAP: AUTO
When in attitude
DAP: FREE

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16. MANEUVERING TO MPLM PRE-INSTALL SETUP

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC1 (MON1)	SSC2 (DTV)
09: P1 Lower Outboard (+130, +20)	22: Base Elbow (-80, -20)	03: S1 Lower Outboard (+55, +20)	SRMS Elbow (-160, +20)	OBSS ITVC (+100, -65)

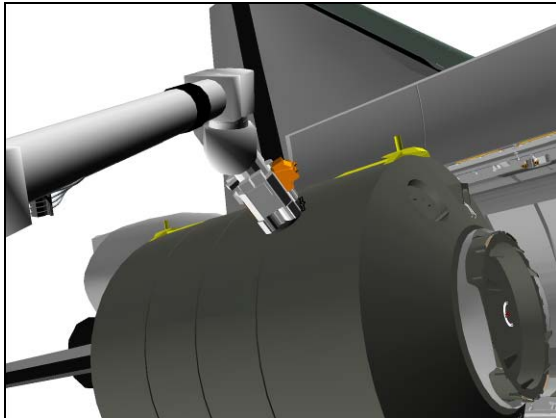


Figure 18.- MPLM Low Hover (22: Base Elbow: -80, -20).

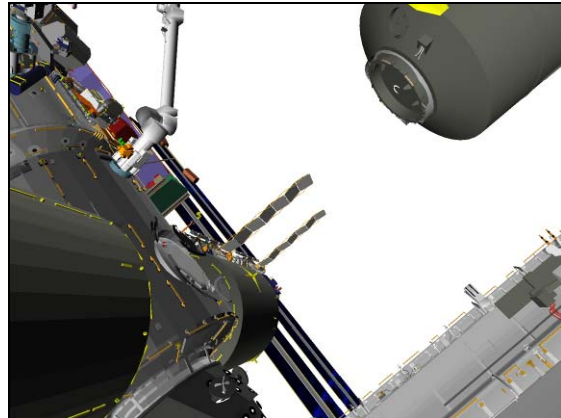


Figure 19.- MPLM Low Hover (SRMS Elbow: -160, +20).

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)

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, SSRMS, SR Held					
Disp	Node2>MPLM Mate CBCS					

17. MPLM PRE-INSTALL FOR OCAS

MSS: SSRMS:

Enter Mode – FOR OCAS (Verify blue)

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

cmd Shoulder Roll (Verify SR – Locked)

SSRMS FOR OCAS

pick File ► Menu 1 ► Menu 2

Verify '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

NOTE

At the end of this maneuver the clearance between the Tip Boom and MPLM is approximately 100 cm (39 in). This clearance may be monitored with the Base Elbow Camera.

PCS

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

DCP

AUTO SEQ → PROC

PCS

MSS: SSRMS: SSRMS

Verify Posn Hold – orange

Enter Mode – Standby (Verify blue)

Change Loaded Parameters ► MPLM ► MPLM CBCS Mate SYH

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

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, SSRMS, SY Held					
Disp	Node2>MPLM Mate CBCS					

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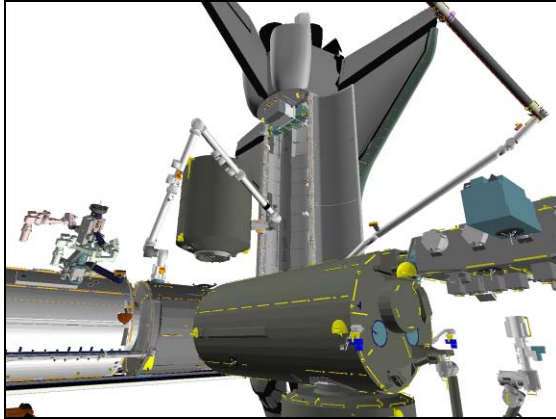


Figure 20.- MPLM Pre-Install
(09: P1 Lower Outboard: +130, +20).

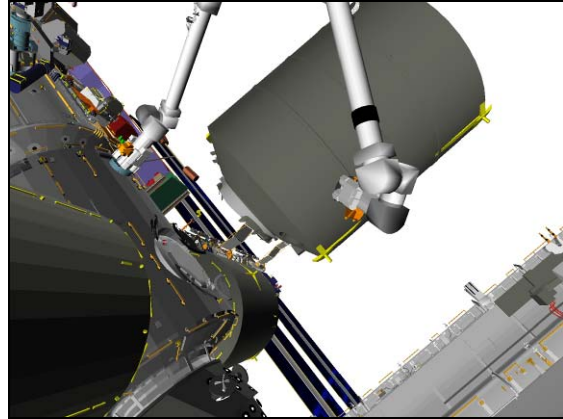


Figure 21.- MPLM Pre-Install
(SRMS Elbow: -160, +20).

18. ATTITUDE CONTROL CONFIGURATION

If using shuttle attitude control

Coordinate with shuttle crewmembers.

If attitude maintenance required

DAP: LVLH

When rates damped

DAP: FREE > 2 seconds

DAP: AUTO

When in attitude

DAP: FREE

19. MPLM INSTALL SETUP

Verify [1.511 MPLM CBM VERIFY PRE-MATE STATUS](#), all
(SODF: S&M: NOMINAL: CBM), completed, then:

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

Configure Cameras and CBCS MPLM overlay as required.

Monitor 1	Monitor 2	Monitor 3	SSC1 (MON1)	SSC2 (DTV)
09: P1 Lower Outboard (+130, +20)	15: CBCS	03: S1 Lower Outboard (+55, +20)	SRMS Elbow (-160, +20)	Camera B (0, +20)

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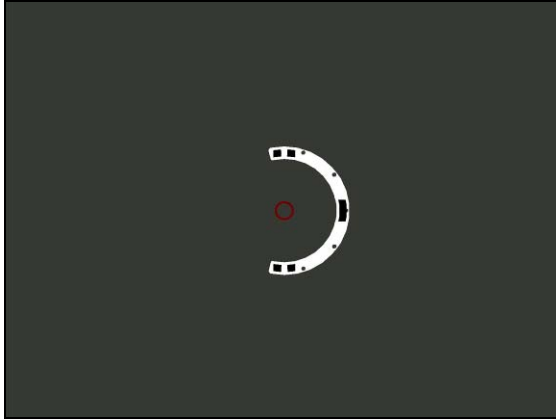


Figure 22.- MPLM Pre-Install
(15: CBCS).

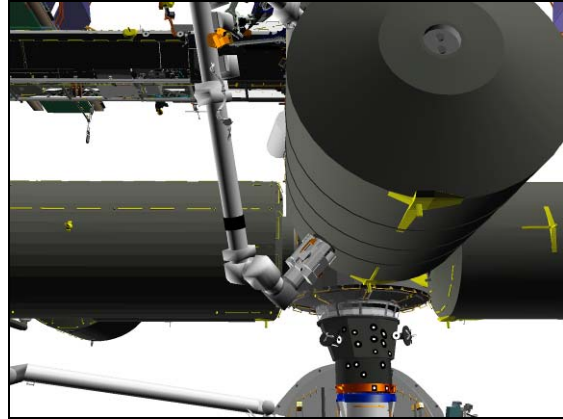


Figure 23.- MPLM Pre-Install
(Camera B: 0, +20)

20. MANEUVERING MPLM TO READY-TO-LATCH POSITION

PCS

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)

THC/
RHC

Maneuver MPLM to Ready-To-Latch position until RTL (four) – green
(Expect “-X” motion, THC in)

	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, SSRMS, SY Held					
Disp	Node2>MPLM Mate CBCS					

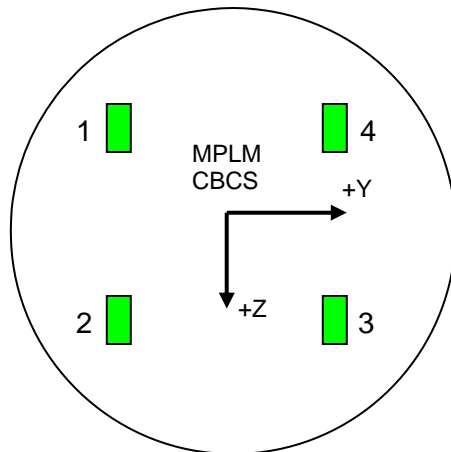


Figure 24.- RTL Locations Viewed From CBCS Camera.

Table 1. MPLM CBCS Install RTL Configuration (Refer to Figure 24.)

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

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

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

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21. 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, **√MCC-H** before proceeding.

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

22. SSRMS BRAKING

On CBM operator, "GO for SSRMS brakes ON; can ungrapple element per timeline."

DCP BRAKES SSRMS → ON (Verify – ON)

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, SSRMS, SR Held					
Disp	Node2>MPLM Mate CBCS					

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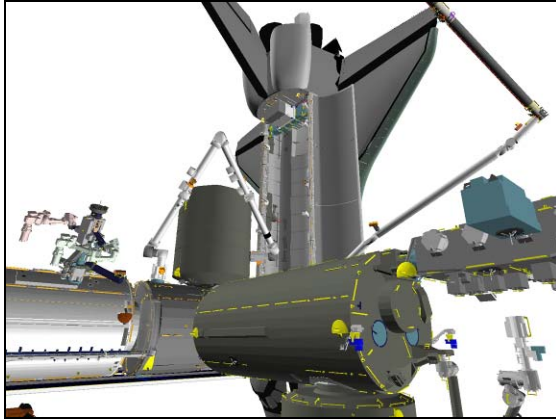


Figure 25.- MPLM Install
(09: P1 Lower Outboard: +130, +20).

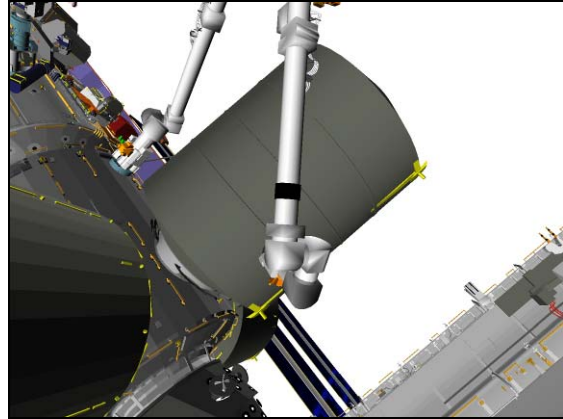


Figure 26.- MPLM Install
(SRMS Elbow: -160, +20).

23. ATTITUDE CONTROL CONFIGURATION

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

24. SETUP

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC1 (MON1)	SSC2 (DTV)
09: P1 Lower Outboard (+130, +20)	25: Tip LEE	03: S1 Lower Outboard (+55, +20)	SRMS Elbow (-160, +20)	Camera B (0, +20)

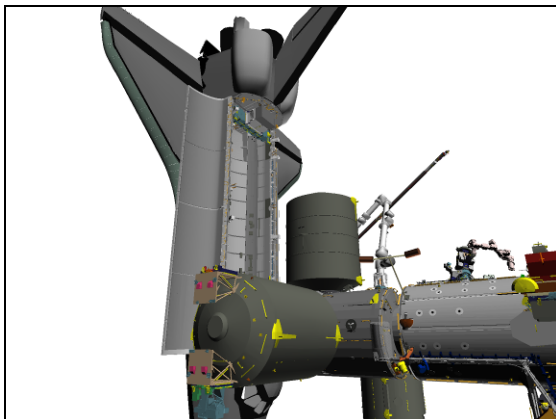


Figure 27.- MPLM Installed Node 2
(03: S1 Lower Outboard: +55, +20).

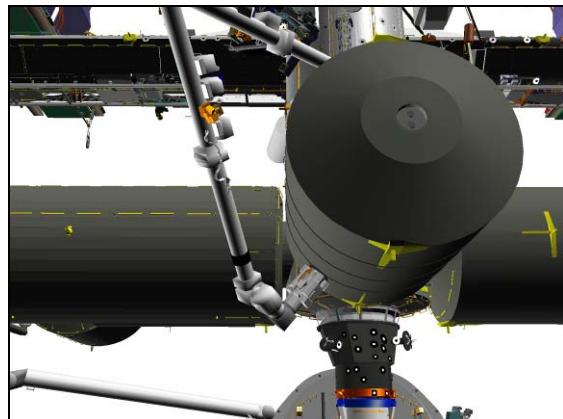


Figure 28.- MPLM Installed Node 2
(Camera B: 0, +20).

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

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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.

25. 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 PLB Sill is approximately 121 cm (48 in). This clearance may be monitored with Camera B.

DCP 25.1 SSRMS Limp
BRAKES SSRMS → OFF (Verify OFF)

PCS MSS: SSRMS: Limp:

cmd All Limp (Verify Limp – blue)

MSS: SSRMS:

Verify all joints – Limped

25.2 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).

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cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Auto Release

MSS: SSRMS:

Verify Active Effector – SSRMS Tip LEE

RHC

TRIGGER → Press (momentarily)

PCS

Verify 'Carriage' Retract – gray (90 s max)

Verify 'Snare' Open – blue (12 s max)

Verify 'Carriage' Derigidize – blue

Verify 'Carriage' Extend – blue (90 s max)

Verify Unloaded Parameters – √

25.3 SSRMS Backoff

MSS: SSRMS: Limp:

cmd None Limp (Verify Standby – blue)

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

THC/
RHC

Maneuver SSRMS to 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					

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

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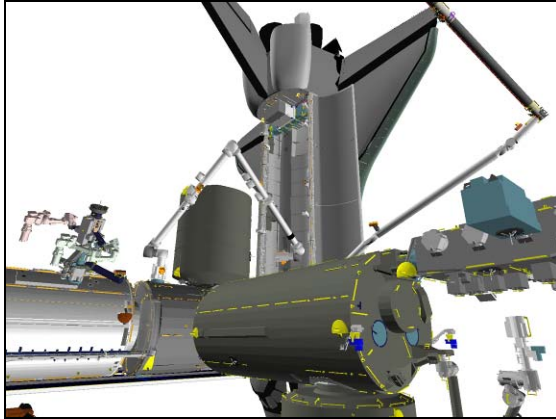


Figure 29.- Mated MPLM Release
(09: P1 Lower Outboard: +130, +20).

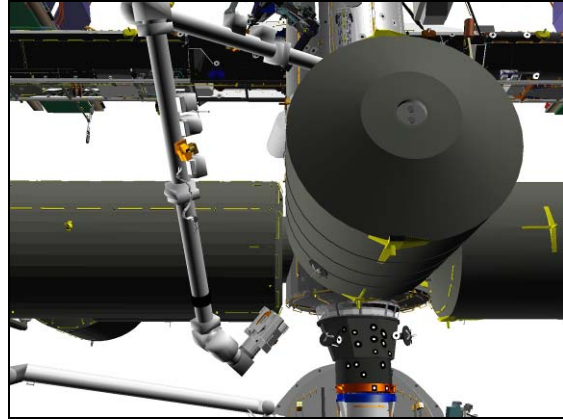


Figure 30.- Mated MPLM Release
(Camera B: 0, +20).

26. MPLM CLEARANCE POSITION SINGLE JOINT

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC1 (MON1)	SSC2 (DTV)
09: P1 Lower Outboard (+120, +20)	22: Base Elbow (-80, -20)	03: S1 Lower Outboard (+55, +20)	SRMS Elbow (-160, +20)	Camera B (0, +20)

MSS: SSRMS:

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

√Vernier

MSS: SSRMS: Rate:

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

MSS: SSRMS:

Enter Mode – Single (Verify blue)

WARNING

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

DCP JOINT SELECT → Shoulder Pitch (Verify SP – Selected on PCS)

THC Perform “+” Single Joint maneuver to SP: -180 (THC up).

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

SR	SY	SP	EP	WP	WY	WR
+60.3	+151.3	-180.0	-109.2	-121.0	-5.8	+6.9
X	Y	Z	Pitch	Yaw	Roll	
+1223	-394	+1186	+140.4	+52.6	+176.2	
FOR	Unloaded – LEE Tip, SY Held					
DISP	ISS>ISSACS					

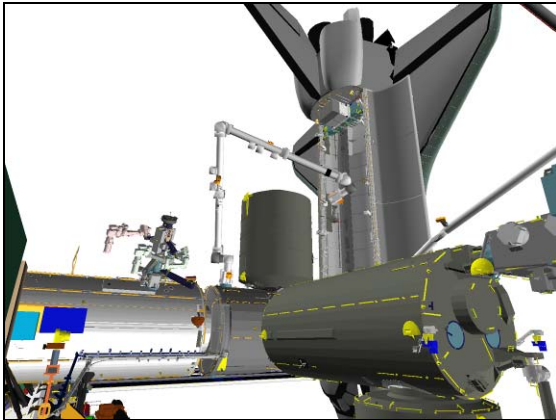


Figure 31.- MPLM Clear
(09: P1 Lower Outboard: +120, +20).

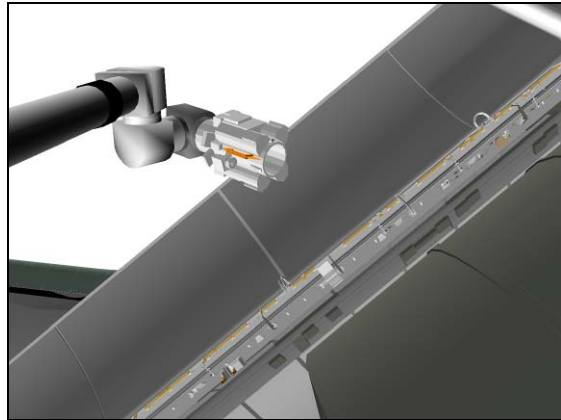


Figure 32.- MPLM Clear
(22: Base Elbow: -80, -20).

27. EV1 INTERMEDIATE POSITION JOINT OCAS

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC1 (MON1)	SSC2 (DTV)
09: P1 Lower Outboard (+120, +20)	03: S1 Lower Outboard (+70, +35)	72 (DNLK): OBSS ITVC (+100, -65)	SRMS Elbow (-160, +20)	Camera B (0, +20)

MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

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

pick File ► Menu 1 ► Menu 2

Verify 'Joint Angles' 'Destination' for EV1 Intermediate position.

SR	SY	SP	EP	WP	WY	WR
0.0	+105.0	-110.0	+25.0	-143.0	-80.0	-50.0

cmd Load (Verify Sequence Status – Confirm or Cancel)

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

	SR	SY	SP	EP	WP	WY	WR
(current)	+60.3	+151.3	-180.0	-109.2	-121.0	-5.8	+6.9
TGT	0.0	+105.0	-110.0	+25.0	-143.0	-80.0	-50.0
ERR	+60.3	+46.3	-70.0	-134.2	+22.0	+74.2	+56.9

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
0.0	+105.0	-110.0	+25.0	-143.0	-80.0	-50.0

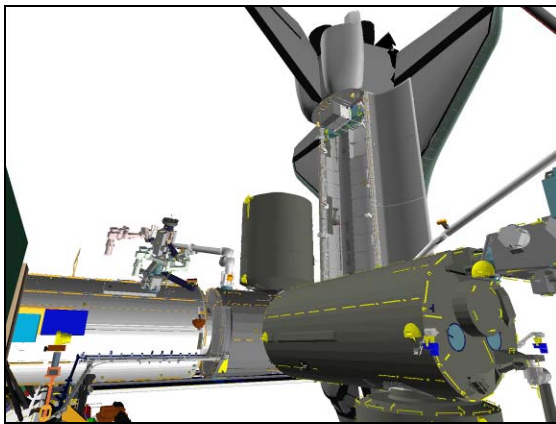


Figure 33.- EV1 Intermediate
(09: P1 Lower Outboard: +120, +20).

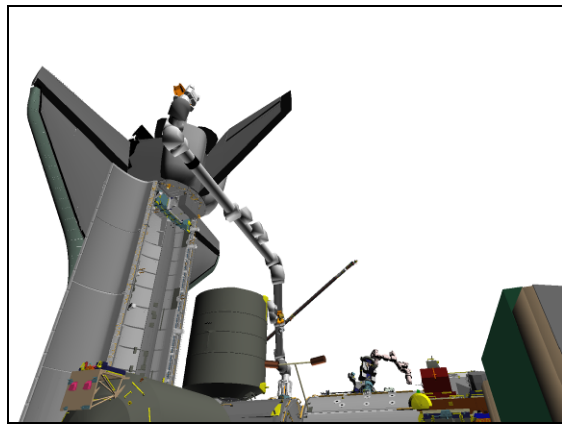


Figure 34.- EV1 Intermediate
(03: S1 Lower Outboard: +70, +35).

28. EV1 START POSITION JOINT OCAS

pick File ► Menu 1 ► Menu 2

Verify 'Joint Angles' 'Destination' for EV1 Start position.

SR	SY	SP	EP	WP	WY	WR
+146.1	-17.7	-15.7	+69.4	-165.1	-169.3	-105.6

cmd Load (Verify Sequence Status – Confirm or Cancel)

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

	SR	SY	SP	EP	WP	WY	WR
(current)	0.0	+105.0	-110.0	+25.0	-143.0	-80.0	-50.0
TGT	+146.1	-17.7	-15.7	+69.4	-165.1	-169.3	-105.6
ERR	-146.1	+122.7	-94.3	-44.4	+22.1	+89.3	+55.6

NOTE

1. Expect singularity warning for SP between +85 and +95 deg and WP between -85 and -95 deg.
2. During this maneuver, the clearance between the Base Boom and UHF decreases to approximately 109 cm (43 in). This clearance may be monitored with the S1 Lower Outboard Camera.

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

DCP AUTO SEQ → PROC

PCS MSS: SSRMS:

Verify Posn Hold – orange

Verify SSRMS at EV1 Start position.

SR	SY	SP	EP	WP	WY	WR
+146.1	-17.7	-15.7	+69.4	-165.1	-169.3	-105.6
X	Y	Z	Pitch	Yaw	Roll	
+1438	-207	+1953	-27.0	+33.0	+120.0	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>ISSACS					

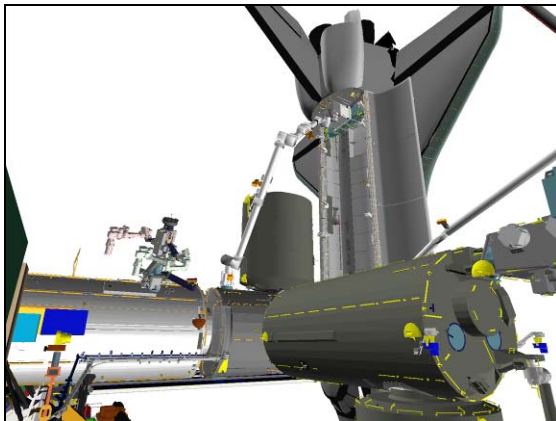


Figure 35.- EV1 Start
(09: P1 Lower Outboard: +120, +20)

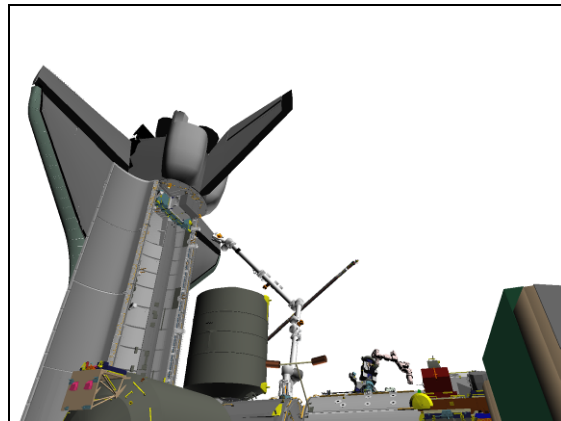


Figure 36.- EV1 Start
(03: S1 Lower Outboard: +70, +35).

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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)

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	SSC1 (MON1)	SSC2 (DTV)
09: P1 Lower Outboard (+120, +20)	24: Tip Elbow (-20, +10)	03: S1 Lower Outboard (+55, +20)	SRMS Elbow (-160, +20)	Camera B (0, +20)

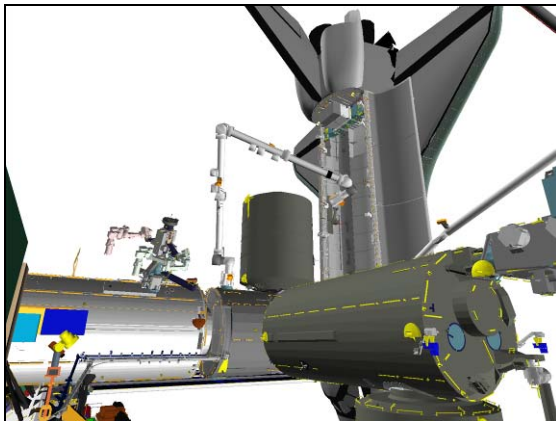


Figure 1.- Overnight Park
 (09: P1 Lower Outboard: +120, +20).

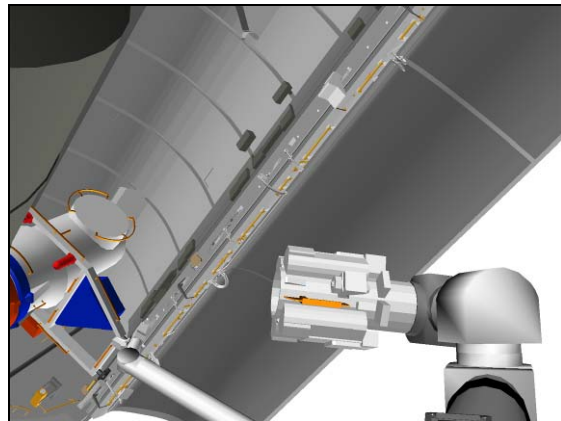


Figure 2.- Overnight Park
 (24: Tip Elbow: -20, +10).

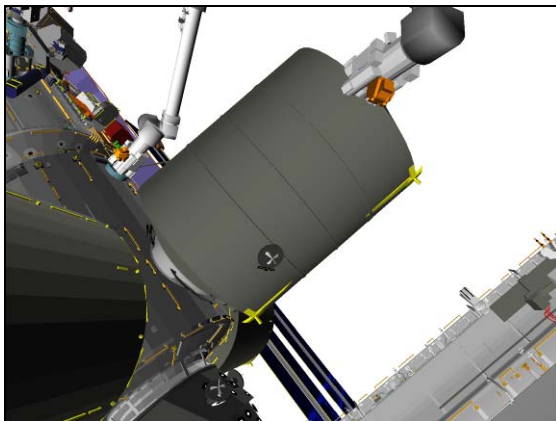


Figure 3.- Overnight Park
 (SRMS Elbow: -160, +20).

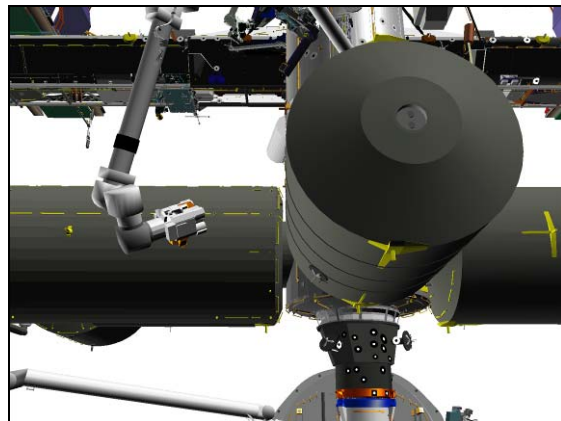


Figure 4.- Overnight Park
 (Camera B: 0, +20).

PCS MSS: SSRMS:

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

Change Unloaded Parameters ► Unloaded ► LEE Tip SYH

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

SR	SY	SP	EP	WP	WY	WR
+60.3	+151.3	-180.0	-109.2	-121.0	-5.8	6.9
X	Y	Z	Pitch	Yaw	Roll	
-125	+46	+357	+29.5	-4.2	-2.0	
FOR	Unloaded – LEE Tip, SY Held					
Disp	Node2> MPLM Mated Port GF					

2. SINGLE JOINT TO MPLM PRE-GRAPPLE

NOTE

Note the following clearances during this maneuver:

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

MSS: SSRMS: MSS Safing:

cmd 'SSRMS' Remove (Verify Not Safed)

DCP BRAKES SSRMS → OFF (Verify OFF)

RHC RATE → VERNIER (Verify Vernier on PCS)

PCS MSS: SSRMS: Rate:

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

MSS: SSRMS:

Enter Mode – Single (Verify blue)

WARNING

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

DCP JOINT SELECT → Shoulder Pitch (Verify SP – Selected on PCS)

THC Perform "-" Single Joint maneuver to SP: -209.9 (THC down).

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

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					

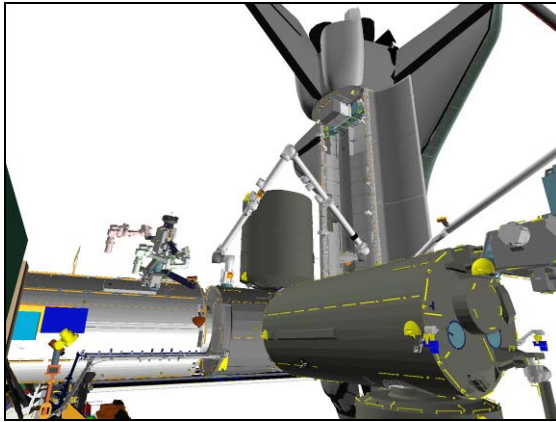


Figure 5.- MPLM Pre-Grapple
(09: P1 Lower Outboard: +120, +20).

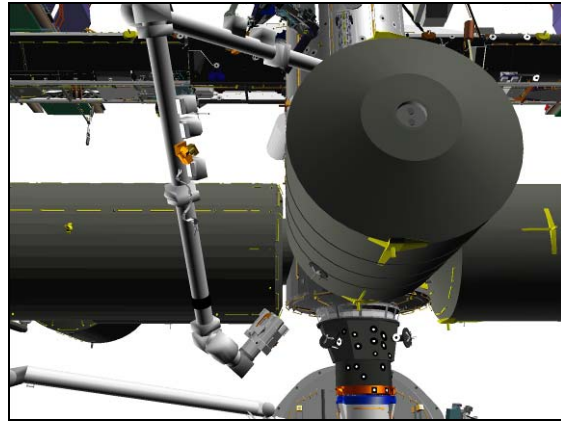


Figure 6.- MPLM Pre-Grapple
(Camera B: 0, +20).

3. MPLM GRAPPLE

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC1 (MON1)	SSC2 (DTV)
09: P1 Lower Outboard (+120, +20)	25: Tip LEE	24: Tip Elbow (-20, 0)	SRMS Elbow (-160, +20)	Camera B (0, +20)

NOTE

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

3.1 Setup

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

3.2 Maneuvering

Maneuver to within grapple envelope.

RHC/
THC

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- 3.3 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.

<u>NOTE</u>
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
- MSS: SSRMS:
- Verify Active Effector – SSRMS Tip LEE
- 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

- 3.4 Cleanup
 MSS: SSRMS:
- Enter Mode – Standby (Verify blue)
- Change Display ► Node2 ► MPLM Mate CBCS (Verify Node2>MPLM Mate CBCS)
- Verify Command – SSRMS>Internal

Expected Node2 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, SSRMS, SY Held					
Disp	Node2> MPLM Mate CBCS					

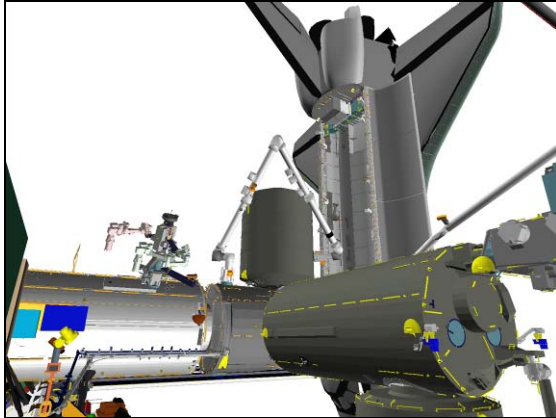


Figure 7.- Node 2 mated MPLM Grapple
 (09: P1 Lower Outboard: +120, +30).

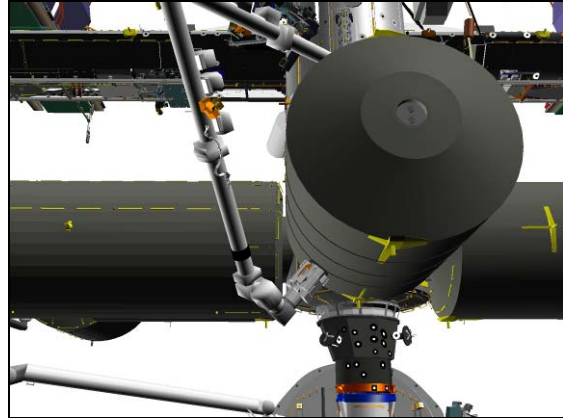


Figure 8.- Node 2 mated MPLM Grapple
 (Camera B: 0, +20).

DCP BRAKES SSRMS → ON (Verify ON)

4. 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)

5. SETUP FOR DEMATE

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC1 (MON1)	SSC2 (DTV)
09: P1 Lower Outboard (+120, +20)	22: Base Elbow (-80, -20)	03: S1 Lower Outboard (+55, +20)	SRMS Elbow (-160, +20)	Camera B (0, +20)

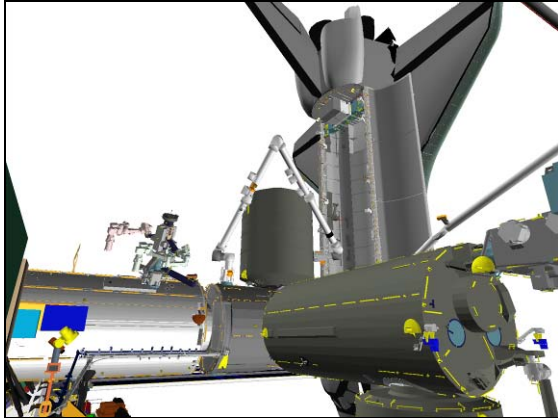


Figure 9.- MPLM Grapple
 (09: P1 Lower Outboard: +120, +20).

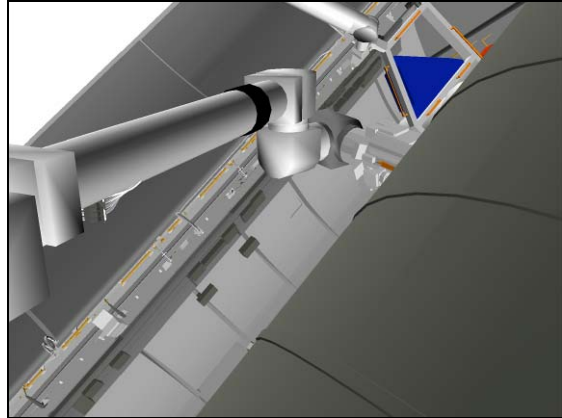


Figure 10.- MPLM Grapple
 (22: Base Elbow: -80, -20).

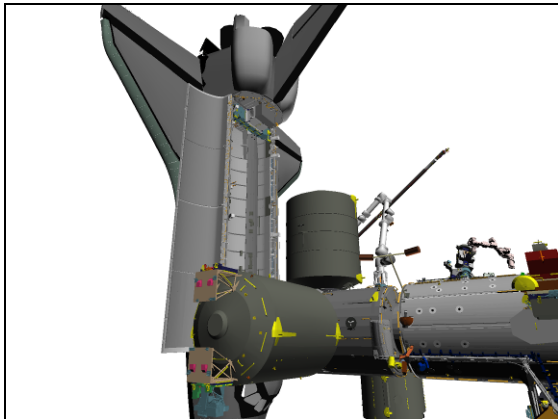


Figure 11.- MPLM Grapple
 (03: S1 Lower Outboard: +55, +20)

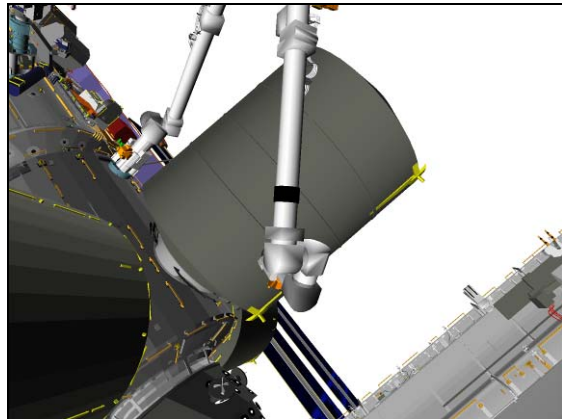


Figure 12.- MPLM Grapple
 (SRMS Elbow: -160, +20).

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.

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6. ATTITUDE CONTROL CONFIGURATION

MSS: SSRMS: Thrusters:

Verify 'Desat Request:' – Inh

If using shuttle attitude control
 Coordinate with shuttle crewmembers.
 DAP: FREE

7. 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:

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, SSRMS, 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."

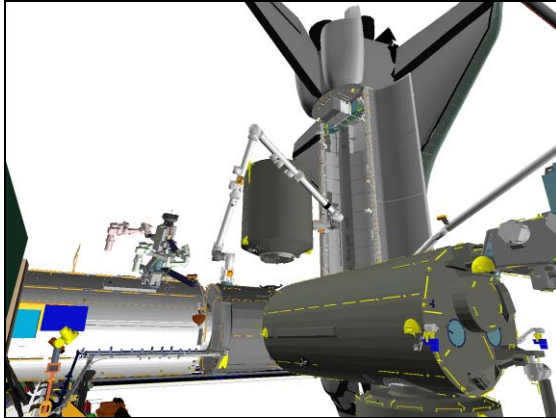


Figure 13.- MPLM Demate Position
 (09: P1 Lower Outboard: +120, +20).

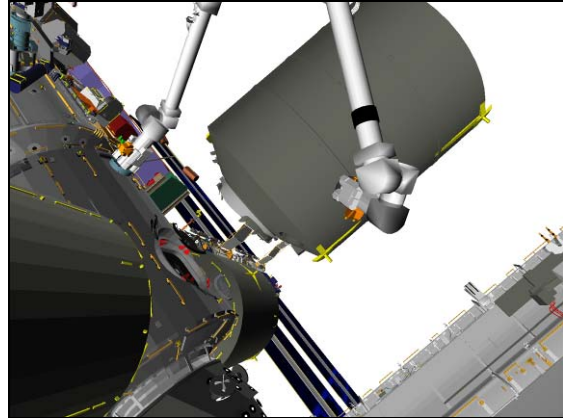


Figure 14.- MPLM Demate Position
 (SRMS Elbow: -160, +20).

8. ATTITUDE CONTROL CONFIGURATION

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

9. MANEUVERING TO MPLM LOW HOVER

PCS

MSS: SSRMS:

Change Loaded Parameters ► MPLM ► MPLM Berth SRH
 Verify 'Loaded Parameters' (three) – MPLM Berth, SSRMS, 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, SSRMS, 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:

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cmd Shoulder Roll (Verify SR – Locked)

SSRMS FOR OCAS

pick File ► Menu 1 ► Menu 2

Verify '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

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 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, SSRMS, SR Held					
Disp	Orbiter>MPLM Berth					

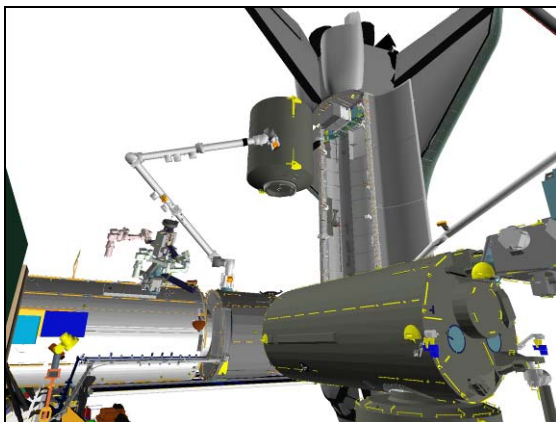


Figure 15.- MPLM Low Hover
(09: P1 Lower Outboard: +120, +20).

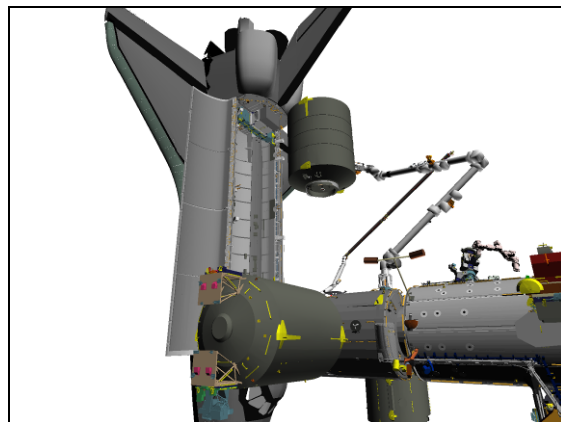


Figure 16.- MPLM Low Hover
(03: S1 Lower Outboard: +55, +20).

10. ATTITUDE CONTROL CONFIGURATION

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

11. MPLM BERTH

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC1 (MON1)	SSC2 (DTV)
09: P1 Lower Outboard (+130, +20)	72 (DNLK): Keel Camera	71 (MON2): Mux B/C (B: -5, -10) (C: +5, -10)	SRMS Elbow (-110, +30)	OBSS ITVC (+130, -60)

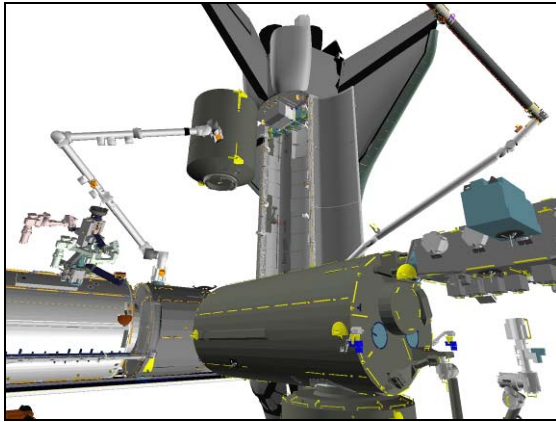


Figure 17.- MPLM Low Hover (09: P1 Lower Outboard: +130, +20).

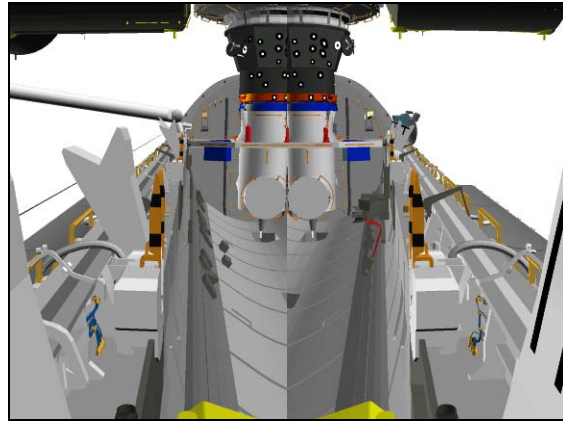


Figure 18.- MPLM Low Hover (71: Mux B/C).

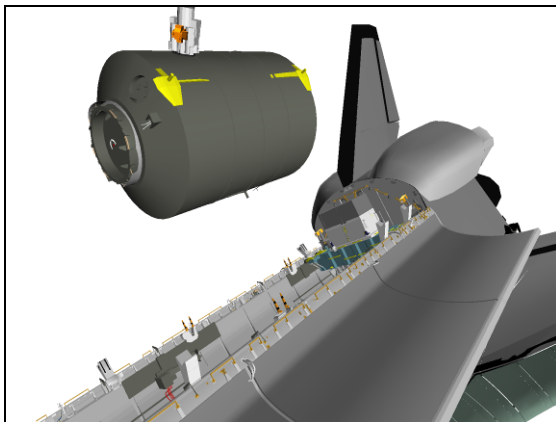


Figure 19.- MPLM Low Hover (SRMS Elbow: -110, +30).

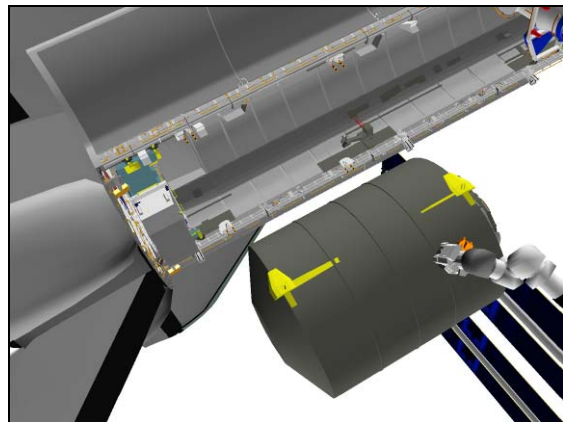


Figure 20.- MPLM Low Hover (OBSS ITVC: +130, -60).

Verify Posn Hold – orange



Figure 21.- MPLM Berth
(09: P1 Lower Outboard: +130, +20).

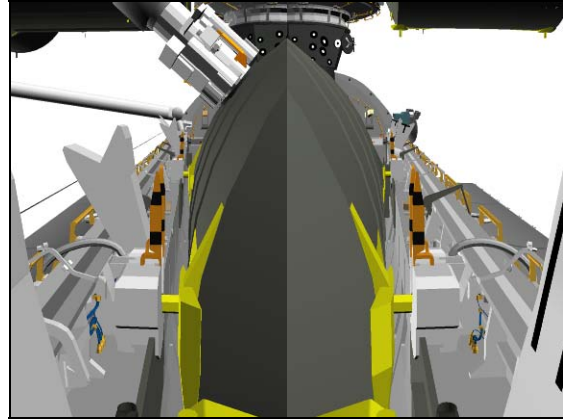


Figure 22.- MPLM Berth
(71 (MON2): Mux B/C).

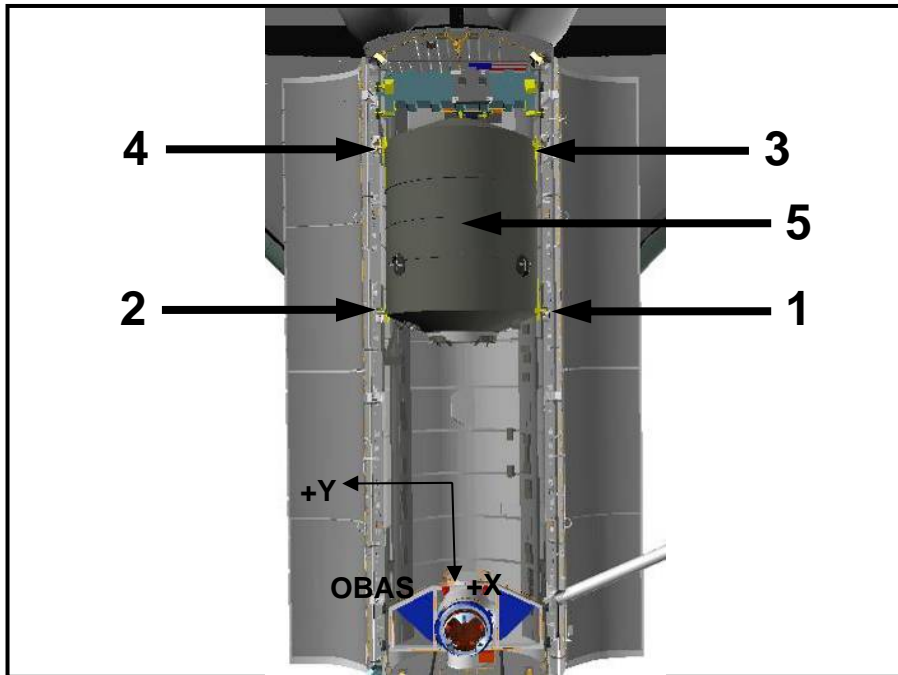


Figure 23.- MPLM PRLA Configuration.

12. PRLA SETUP

Give shuttle crew GO for PRLA steps.

√Payload Bay light status

WARNING

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

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

SM 97 PL RETENTION

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

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

13. ACTIVATING LATCHES

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

14. 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

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If any PL RETEN RDY tb – bp, $\sqrt{\text{MCC}}$ for go to perform starred block.

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

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

PCS * MSS: SSRMS:
*
* Verify MPLM Berth position.
*

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 12.

15. PRLA LATCH

$\sqrt{\text{PL RETEN RDY 1,2,3,4 tb (four) – gray}}$
 $\sqrt{\text{LAT 1,2,3,4 tb (four) – REL}}$

Note single motor drive times (> 30 seconds).

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

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

Give SSRMS operator GO for limping.

PCS MSS: SSRMS:

Enter Mode – Standby (Verify blue)

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MSS: SSRMS: Limp: SSRMS Limp

cmd All Limp (Verify Limp – blue)

MSS: SSRMS: 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

16. DEACTIVATING LATCHES

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

17. 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

18. ROEU MATE

18.1 Setup
CCTV – config for ROEU mate

MON 2 A

A6U
Install ROEU A6U PANEL OVERLAY.

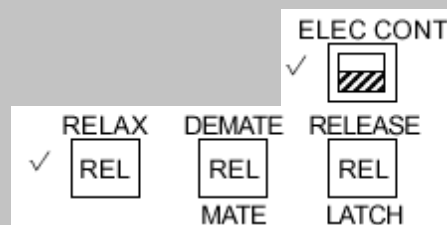
√PL RETEN LAT (five) – OFF

PL RETEN PL SEL – 2

SM 97 PL RETENTION

√LAT 1,2,3 (six): 0

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



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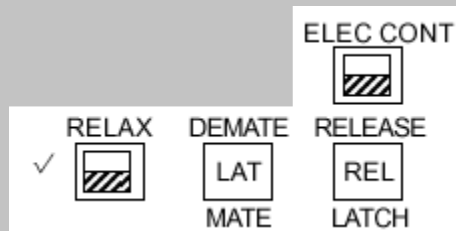
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18.2 Verifying ROEU Inhibits
SSP1 ✓MPLM CH 1,2 HTR PWR – OFF (tb-bp)
A15 ✓APCU 1 OUTPUT – OFF

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

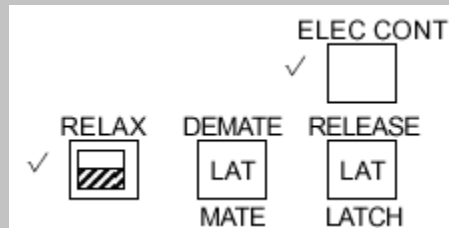
18.4 Mating ROEU
Note single motor time (> 30 seconds).

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



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

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



18.6 Relaxing ROEU

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

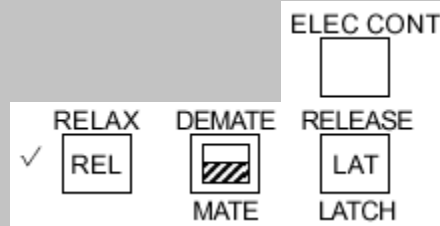
Note single motor time (> 12 seconds).

RELAX – RELAX (tb-REL), 24 s max

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

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18.7 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.

19. ATTITUDE CONTROL CONFIGURATION

If using shuttle attitude control

Coordinate with shuttle crewmembers.

If attitude maintenance required

DAP: LVLH

When rates damped

DAP: FREE > 2 seconds

DAP: AUTO

DCP BRAKES SSRMS → ON (Verify ON)

20. SETUP

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC1 (MON1)	SSC2 (DTV)
09: P1 Lower Outboard (+130, +20)	25: Tip LEE	24: Tip Elbow (0, +10)	SRMS Elbow (-110, +30)	Camera B (0, +10)

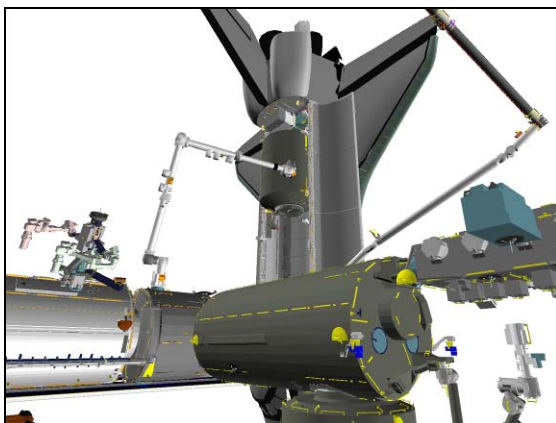


Figure 24.- MPLM Berthed
(09: P1 Lower Outboard: +130, +20)



Figure 25.- MPLM Berthed
(24: Tip Elbow: 0, +10)

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PCS MSS: SSRMS:

Verify 'Loaded Parameters' (three) – MPLM Berth, SSRMS, 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

√Vernier

MSS: SSRMS: Rate:

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

DCP BRAKES SSRMS → OFF (Verify OFF)

21. MPLM RELEASE

21.1 SSRMS Limp

MSS: SSRMS: Limp:

cmd All Limp (Verify Limp – blue)

MSS: SSRMS:

Verify all joints – Limped

21.2 Auto Release

MSS: SSRMS: Tip LEE:

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

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

CAUTION

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

NOTE

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

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cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Auto Release

MSS: SSRMS:

Verify Active Effector – SSRMS Tip LEE

RHC TRIGGER → Press (momentarily)

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

Verify Unloaded Parameters – √

21.3 SSRMS Backoff

MSS: SSRMS: Limp:

cmd None Limp (Verify Standby – blue)

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder 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					

21.4 Cleanup

PCS MSS: SSRMS:

Enter Mode – Standby (Verify blue)

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

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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					

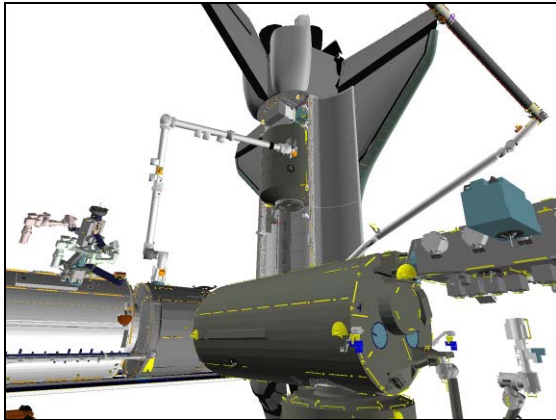


Figure 26.- Berthed MPLM Backoff
(09: P1 Lower Outboard: +130, +20).

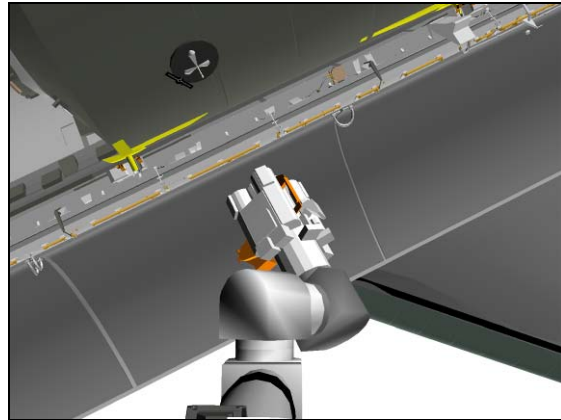


Figure 27.- Berthed MPLM Backoff
(24: Tip Elbow: 0, +10).

22. SINGLE JOINT TO INTERMEDIATE POSITION

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC1 (MON1)	SSC2 (DTV)
09: P1 Lower Outboard (+130, +20)	03: S1 Lower Outboard (+55, +20)	24: Tip Elbow (-10, +10)	SRMS Elbow (-110, +60)	Camera D (+10, +20)

Enter Mode – Single (Verify blue)

WARNING

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

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

	SR	SY	SP	EP	WP	WY	WR
MPLM Backoff	+74.6	+162.7	-176.3	-91.8	-45.5	-54.9	+99.3
1: SP + Intermediate			-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						

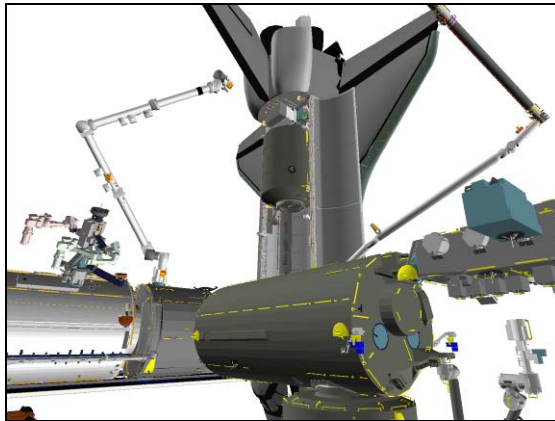


Figure 28.- Berthed MPLM Backoff Position (09: P1 Lower Outboard: +130, +20).

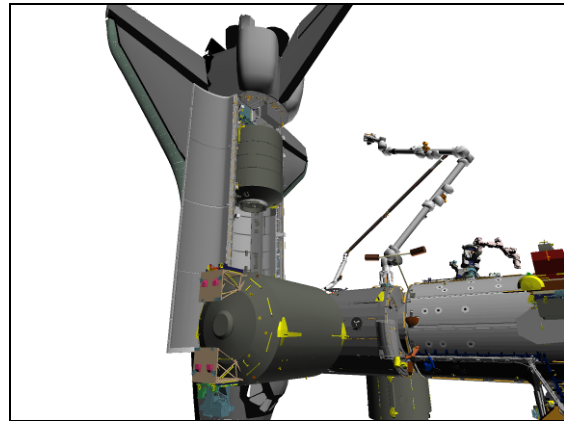


Figure 29.- Berthed MPLM Backoff Position (03: S1 Lower Outboard: +55, +20).

23. [JOINT OCAS TO STAGE PARK](#)

PCS MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

pick File ► Menu 1 ► Menu 2

Verify 'Joint Angles' 'Destination' for 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

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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.

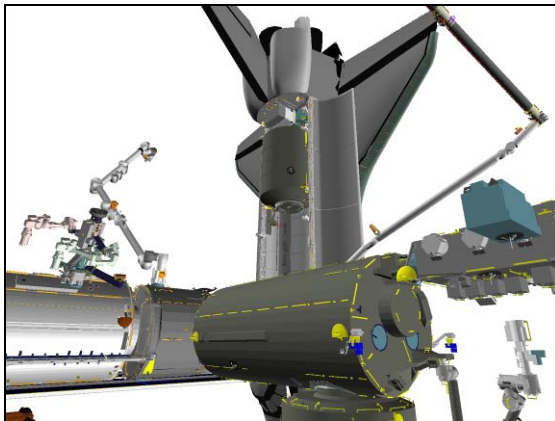


Figure 30.- Stage Park Position
(09: P1 Lower Outboard: +130, +20).

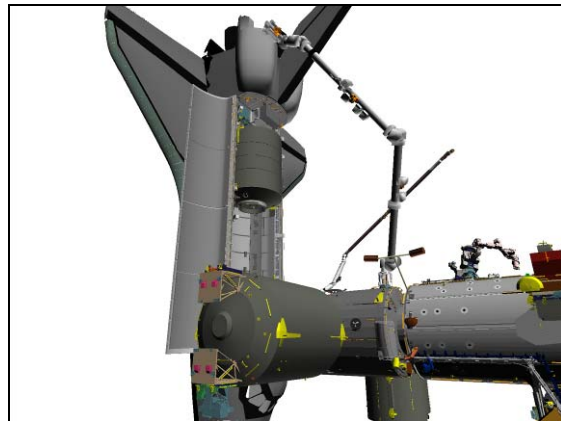


Figure 31.- Stage Park Position
(03: S1 Lower Outboard: +55, +20).

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)

1.300 EVA 1 SUPPORT

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 with shuttle crew that SRMS at 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	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+130, +30)	25: Tip LEE (Zoomed Out)	71 (MON2): Camera A (0, +5) (HFOV=15)	SRMS Elbow (-135, +40)	OBSS ITVC (+140, -60)

NOTE

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

PCS MSS: SSRMS:

Change Loaded Parameters ► ATA ► ATA Mnv Cntr SRH
Verify 'Loaded Parameters' (three) – ATA Mnv Cntr, SSRMS, SR Held

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

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

Verify Command – SSRMS>Internal

MSS: SSRMS: MSS Safing:

cmd 'SSRMS' Remove (Verify Not Safed)

1.300 EVA 1 SUPPORT

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DCP BRAKES SSRMS → OFF (Verify OFF)

RHC RATE → VERNIER (Verify Vernier on PCS)

PCS MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: As Desired

Verify SSRMS at EV1 Start position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+146.1	-17.7	-15.7	+69.4	-165.1	-169.3	-105.6
X	Y	Z	Pitch	Yaw	Roll	
-3041	-203	-1299	-117.8	+33.1	+119.7	
FOR	Unloaded – LEE Tip, SR Held					
Disp	ISS>OBAS					

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

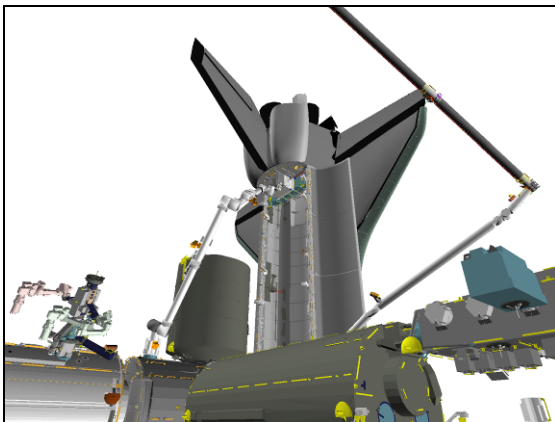


Figure 1.- EV1 Start
(07: P1 Lower Inboard: +130, +30).

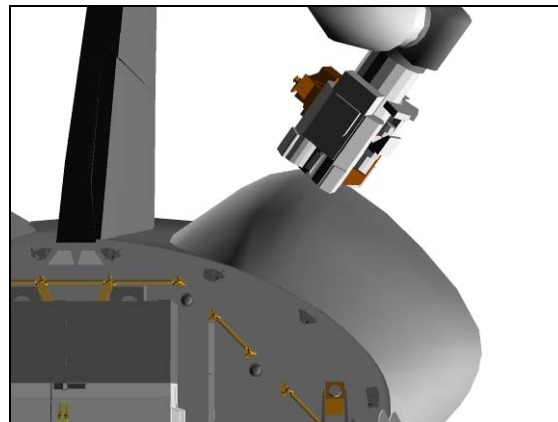


Figure 2.- EV1 Start
(71: Camera A: 0, +5, HFOV = 15).

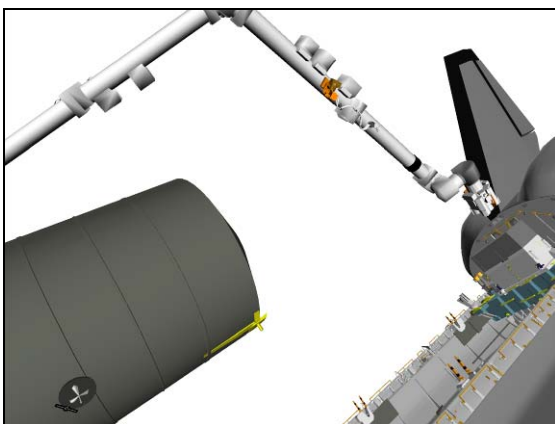


Figure 3.- EV1 Start
(SRMS Elbow: -140, +40).

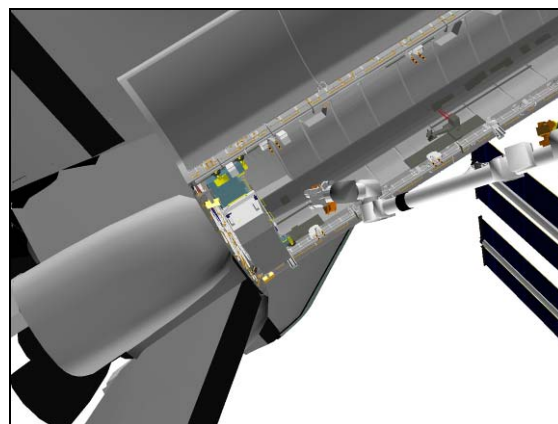


Figure 4.- EV1 Start
(OBSS ITVC: +140, -60).

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3. ATA GRAPPLE

NOTE

1. Base Boom ► MPLM, decrease to 93 cm (37 in), SRMS Elbow.
2. LEE ► V-guides, 107 cm (42 in), OBSS ITVC.
3. Due to uncertainty in the ATA position during grappling, the following is the maximum OBAS position that can be reached before the clearance from the Base Boom to the MPLM falls below 60 cm (24 in): X = -3130, Y = -55, Z = -1155.

When EVA crew has ATA Bolt #3 in work

3.1 Setup for Capture

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

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

MSS: SSRMS:

Verify Active Effector – SSRMS Tip LEE

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3.2 ATA Auto Capture On EVA crew GO, "ATA ready for Grapple."

RHC/
THC

Maneuver to within grapple envelope.

Notify EVA crew when over the grapple pin.

Give EVA crew notice of trigger pull.

RHC

TRIGGER → Press (momentarily)

PCS

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

Verify Capture to Latch – No (SCR 19282)

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

Verify 'Carriage' Retract – blue

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

MSS: SSRMS: SSRMS

Enter Mode – Standby (Verify blue)

Notify EVA crew that SSRMS has the ATA, and EVA crew is clear to egress the APFR.

3.3 Grapple Cleanup

Verify Loaded Parameters – √

Verify 'Loaded Parameters' (three) – ATA Mnvr Cntr, SSRMS, SR Held

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

Expected ATA Grapple position:

SR	SY	SP	EP	WP	WY	WR
+146.1	-19.0	-2.4	+52.8	-161.9	-169.7	-106.8
X	Y	Z	Pitch	Yaw	Roll	
-3167	-16	-1153	-171.4	+64.3	+162.7	
FOR	Loaded – ATA Mnvr Cntr, SSRMS, SR Held					
Disp	ISS>OBAS					

1.300 EVA 1 SUPPORT

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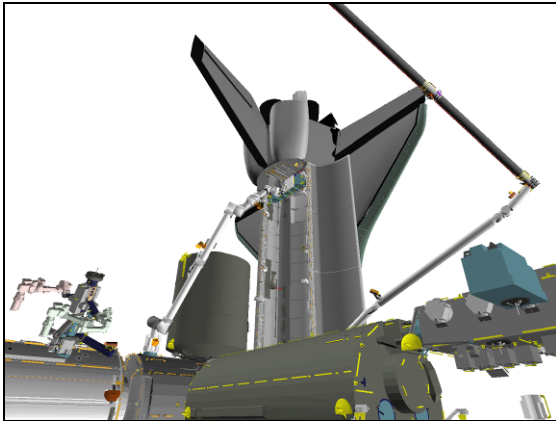


Figure 5.- ATA Grapple
(09: P1 Lower Outboard: +130, +30).

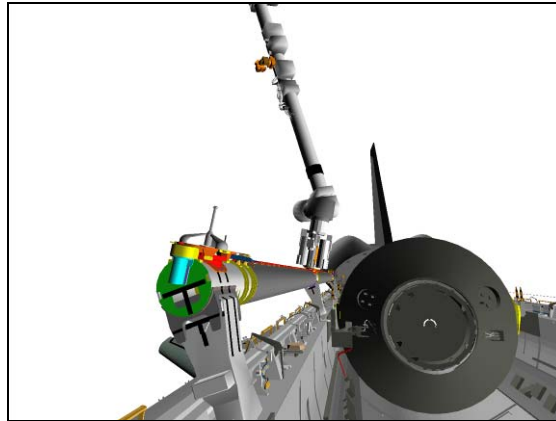


Figure 6.- ATA Grapple
(OBSS ITVC: +140, -60).

4. PAYLOAD BAY CLEARANCE MANEUVER

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+130, +30)	71(MON2): Camera A (-5, +10) (Zoomed Out)	03: S1 Lower Outboard (+55, +30)	SRMS Elbow (-135, +40)	OBSS ITVC (+140, -60)

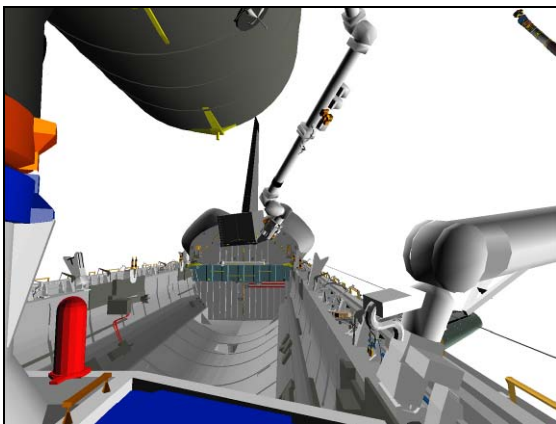


Figure 7.- ATA Grapple
(71: Camera A: -5, +10).

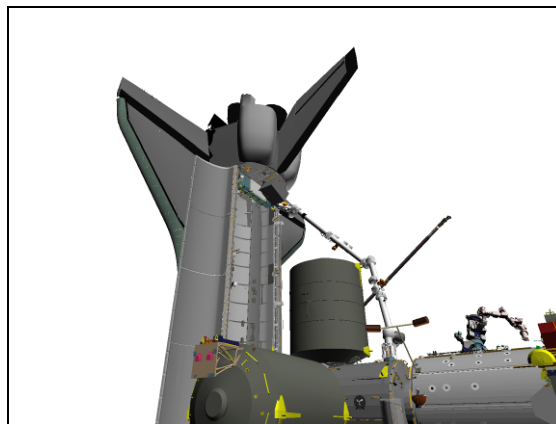


Figure 8.- ATA Grapple
(03: S1 Lower Outboard: +55, +30).

NOTE

1. ATA ► Aft Bulkhead, 56 cm (22 in) and increases, OBSS ITVC.
2. Base Boom ► MPLM, 93 cm (37 in) and increases, SRMS Elbow.

MSS: SSRMS: Rate:

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

1.300 EVA 1 SUPPORT

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On EVA crew clear of ATA, GO for Payload Bay Clearance Maneuver:

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

THC/
RHC

Maneuver New ATA to PLB Clearance position (within 5 cm/5 deg).
Expect +X and -Z motion (THC In and Up).

Locked						
SR	SY	SP	EP	WP	WY	WR
+146.1	-12.4	-26.3	+95.4	-179.4	-167.4	-100.6
X	Y	Z	Pitch	Yaw	Roll	
-2950	-16	-1400	-171.5	+64.3	+162.7	
FOR	Loaded – ATA Mnvr Cntr, SSRMS, SR Held					
Disp	ISS>OBAS					

PCS

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

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

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

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

5. ESP-2 CLEARANCE JOINT OCAS

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+105, +35)	22: Base Elbow (+110, +5) 13: LAB Stbd Zenith (+25, -40)	03: S1 Lower Outboard (+65, +20)	SRMS ELB (+160, +35)	OBSS ITVC (+70, -65)

NOTE

Have shuttle crew route Camera B to MON2 (ISS Channel 71) with a pan/tilt of -10, +40 and Camera C to DNLK (ISS Channel 72) with a pan/tilt of +10, +50 and have both Cameras zoomed out full. These Cameras will be used throughout the remainder of the procedure.

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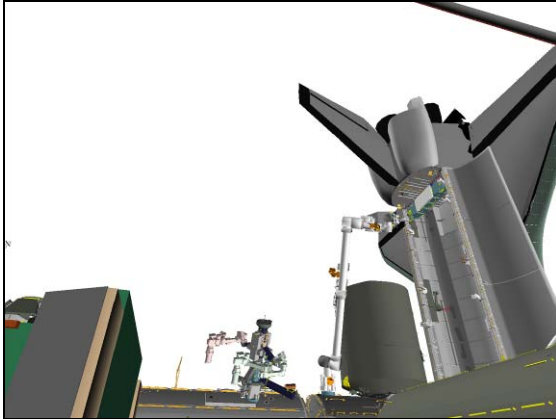


Figure 9.- Payload Bay Clearance
(09: P1 Lower Outboard: +105, +35).



Figure 10.- Payload Bay Clearance
(03: S1 Lower Outboard: +55, +30).

RHC RATE → COARSE (Verify Coarse on PCS)

PCS MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

pick File ► Menu 1 ► Menu 2

Verify 'Joint Angles' 'Destination' for ESP-2 Clearance position.

SR	SY	SP	EP	WP	WY	WR
+15.4	-6.4	-61.0	-81.1	-210.7	-128.2	-66.8

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)	+146.1	-12.4	-26.3	+95.4	-179.4	-167.4	-100.6
TGT	+15.4	-6.4	-61.0	-81.1	-210.7	-128.2	-66.8
ERR	+130.7	-6.0	+34.7	+176.5	+31.3	-39.2	-33.8

NOTE

1. Expect singularity warning for EP between -15 and +15 deg.
2. Base Boom ► SPDM closest approach 142 in (56 in), SRMS Elbow.
3. This OCAS will take approximately 13 minutes to complete in coarse rates.

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 ESP-2 Clearance position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+15.4	-6.4	-61.0	-81.1	-210.7	-128.2	-66.9
X	Y	Z	Pitch	Yaw	Roll	
+220	+940	+555	+90.0	0.0	±180.0	
FOR	Loaded – ATA Mnvr Cntr, SSRMS, SY Held					
Disp	ISS>ISSACS					

6. AGB INSTALLATION APPROACH MANEUVER

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
37: MBS Mast (+130, -15) [13: LAB Stbd Zenith (+40, +35)]	24: Tip Elbow (-10, +10) [72(DNLK): Camera C (+10, +50)]	03: S1 Lower Outboard (+75, +20)	SRMS ELB (+160, +35)	OBSS ITVC (+70, -65)

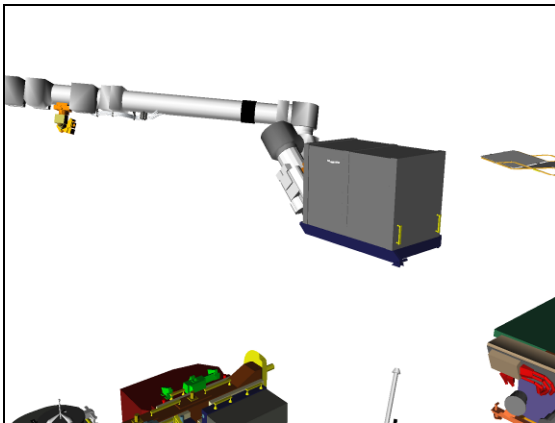


Figure 11.- ESP-2 Clearance
(37: MBS Mast: +130, -15).



Figure 12.- ESP-2 Clearance
(03: S1 Lower Outboard: +75, +20).

RHC RATE → VERNIER (Verify Vernier on PCS)

NOTE

ATA ► ESP-2, decrease to 134 cm (53 in), Tip Elbow/OBSS ITVC.

On EVA crew GO, Ready for ATA approach to ESP-2.

PCS MSS: SSRMS: SSRMS

Enter Mode – Manual (Verify blue)

1.300 EVA 1 SUPPORT

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

THC/
RHC

Maneuver New ATA to AGB Install position.
Expect -Y motion (THC Right).

	Locked					
SR	SY	SP	EP	WP	WY	WR
+24.1	-6.4	-40.7	-121.1	-181.6	-130.0	-53.4
X	Y	Z	Pitch	Yaw	Roll	
+220	+520	+555	+90.0	0.0	±180.0	
FOR	Loaded – ATA Mnvr Cntr, SSRMS, SY Held					
Disp	ISS>ISSACS					

7. AGB INSTALL GCA

THC/
RHC

Maneuver ATA per EVA GCA to AGB Install position.
Expect -X motion (THC Out).

Expected AGB Install Position.

	Locked					
SR	SY	SP	EP	WP	WY	WR
+27.8	-6.4	-41.2	-118.4	-180.0	-131.1	-48.1
X	Y	Z	Pitch	Yaw	Roll	
+170	+520	+555	+90.0	0.0	±180.0	
FOR	Loaded – ATA Mnvr Cntr, SSRMS, SY Held					
Disp	ISS>ISSACS					

PCS

MSS: SSRMS:

Enter Mode – Standby (Verify blue).

Give EVA crew GO, “In Standby Mode, Ready for AGB install.”

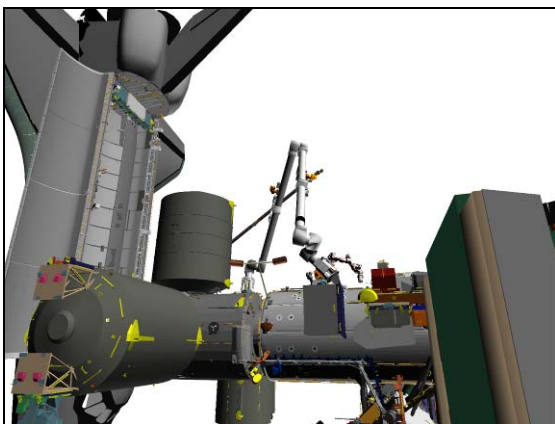


Figure 13.- AGB Install
(03: S1 Lower Outboard: +75, +20).



Figure 14.- AGB Install
(OBSS ITVC: +70, -65).

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8. ESP-2 CLEARANCE 2 MANEUVER

On EVA crew GO, AGB install complete.

<u>NOTE</u>	
1.	AGB ► ESP-2, 96 cm (38 in) and increases, MBS Mast.
2.	ATA ► ESP-2, 134 cm (53 in) and increases, MBS Mast.
3.	ATA ► UHF Antenna, closest approach 121 cm (48 in), MBS Mast.

MSS: SSRMS:

√Vernier

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

THC/
RHC

Maneuver New ATA to ESP-2 Clearance 2 position (within 5 cm/1 deg).
Expect +X then +Z motion (THC In then Down).

		Locked						
		SR	SY	SP	EP	WP	WY	WR
		+27.8	-6.4	-41.2	-118.4	-180.0	-131.1	-48.1
		X	Y	Z	Pitch	Yaw	Roll	
AGB Install		+170	+520	+555	+90.0	0.0	±180.0	
1: X +		+220						
2: Z +				+1225				
ESP-2 Clear		+220	+530	+1225	+90.0	0.0	±180.0	
		SR	SY	SP	EP	WP	WY	WR
		+15.3	-6.4	-6.3	-99.1	-247.5	-128.1	-67.0
FOR	Loaded – ATA Mnvr Cntr, SSRMS, SY Held							
Disp	ISS>ISSACS							

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(RBT FS/19A/FIN/SPN)



Figure 15.- ESP Clearance 2
(37: MBS Mast: +100, -15).



Figure 16.- ESP Clearance 2
(03: S1 Lower Outboard: +75, +20).

9. POA INTERMEDIATE JOINT OCAS

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+105, +20) [71: Camera B (-10, +40)]	22: Base Elbow (-90, -20)	03: S1 Lower Outboard (+75, +20) [72: Camera C (+10, +50)]	SRMS ELB (+160, +35)	OBSS ITVC (+70, -65)

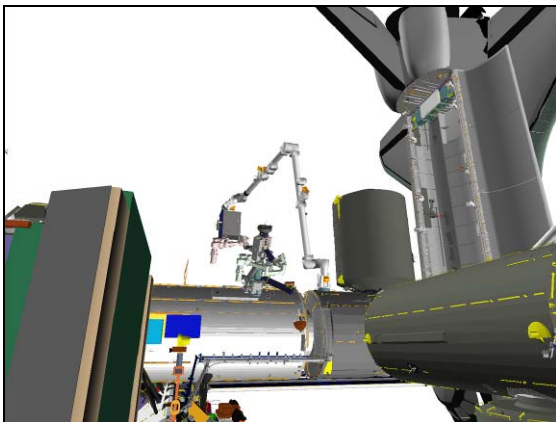


Figure 17.- ESP Clearance 2
(09: P1 Lower Outboard: +105, +20).

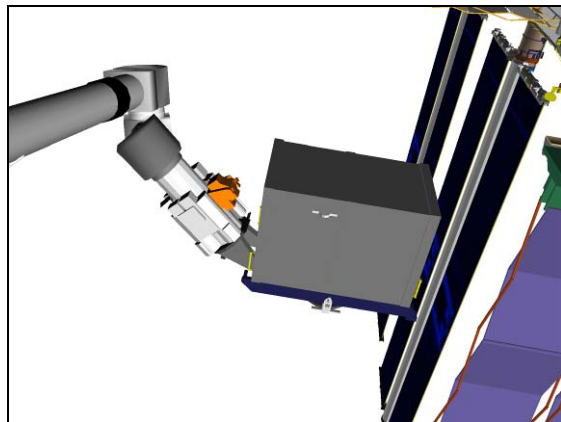


Figure 18.- ESP Clearance 2
(22: Base Elbow: -90, -20).

PCS

MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

RHC

RATE → COARSE (Verify Coarse on PCS)

pick File ► Menu 1 ► Menu 2

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(RBT FS/19A/FIN/SPN)

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

SR	SY	SP	EP	WP	WY	WR
+145.0	0.0	-5.0	-95.0	-120.0	0.0	65.0

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)	+18.0	-6.4	-5.2	-99.6	-245.0	-128.6	-62.8
TGT	+145.0	0.0	-5.0	-95.0	-120.0	0.0	65.0
ERR	-127.0	-6.4	-0.2	-4.6	-125.0	-128.6	-127.2

NOTE

This OCAS will take approximately 7 minutes to complete in Coarse rates.

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
+145.0	0.0	-5.0	-95.0	-120.0	0.0	+65.0

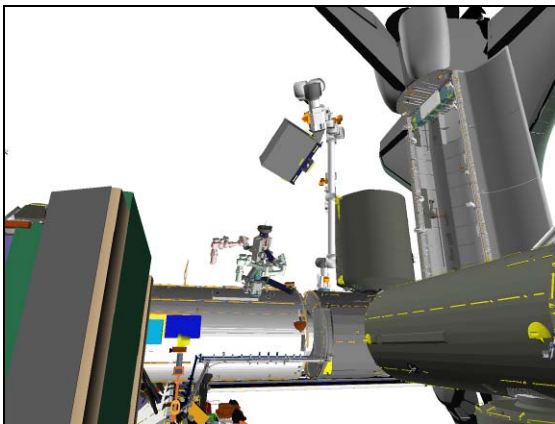


Figure 19.- POA Intermediate
(09: P1 Lower Outboard: +105, +20).

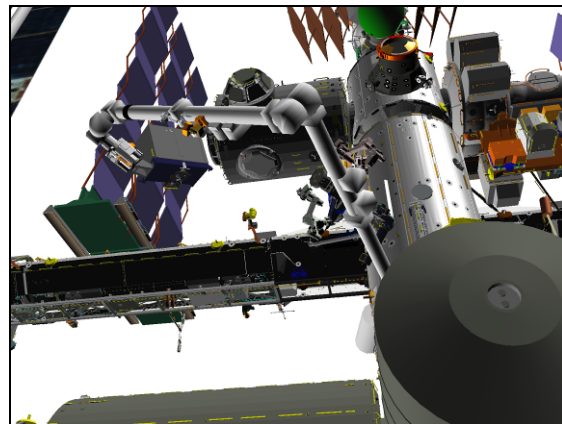


Figure 20.- POA Intermediate
(Camera B: -10, +40).

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10. ATA PRE-STOW JOINT OCAS

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+105, +20)	22: Base Elbow (-90, 0) 24: Tip Elbow (-170, 0)	07: P1 Lower Inboard (+160, +55) [71: Camera B (-10, +40)]	SRMS ELB (+160, +35)	OBSS ITVC (+70, -65)

RHC RATE → VERNIER (Verify Vernier on PCS)

pick File ► Menu 1 ► Menu 2

Verify 'Joint Angles' 'Destination' for ATA Pre-Stow position.

SR	SY	SP	EP	WP	WY	WR
+175.0	-13.5	-101.7	-110.7	-27.2	+55.0	+65.0

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)	+145.0	0.0	-5.0	-95.0	-120.0	0.0	+65.0
TGT	+175.0	-13.5	-101.7	-110.7	-27.2	+55.0	+65.0
ERR	-30.0	+13.5	+96.7	+15.7	-92.8	-55.0	0.0

NOTE

1. Base Boom ► JEM, decrease to 88 cm (35 in), Tip Elbow/OBSS ITVC.
2. This OCAS wil take approximately 8 minutes to complete in Vernier rates.

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
+175.0	-13.5	-101.7	-110.7	-27.2	+55.0	+65.0

MSS: SSRMS:

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Enter Mode – Standby (Verify blue)

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)

MSS: SSRMS: MBS:

Change POA Payload ► ATA ► ATA AGB GF

Verify 'POA Payload' – ATA

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

SR	SY	SP	EP	WP	WY	WR
+175.0	-13.5	-101.7	-110.7	-27.2	+55.0	+65.0
X	Y	Z	Pitch	Yaw	Roll	
-200	0	0	0.0	0.0	0.0	
FOR	Loaded – ATA Stow, SSRMS, SR Held					
Disp	MBS>POA					

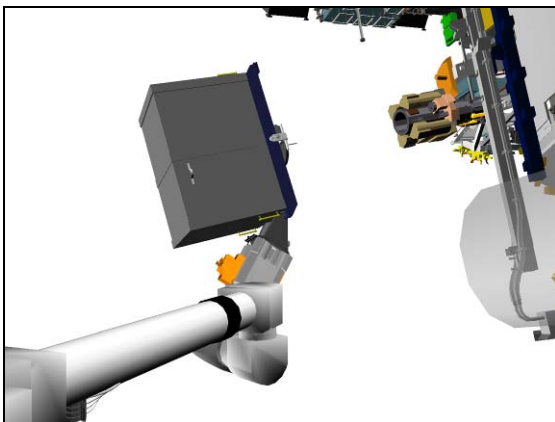


Figure 21.- ATA Pre-Stow
(22: Base Elbow: -90, 0).

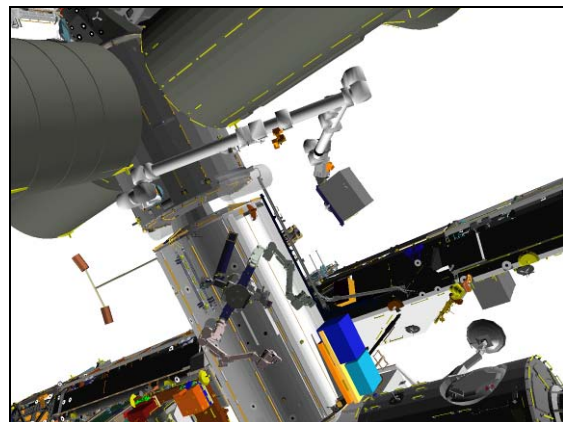


Figure 22.- ATA Pre-Stow
(OBSS ITVC: +70, -65).

11. ATA STOW MANEUVER

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+105, -5) [71: Camera B (-10, +40)]	32: MBS POA (Zoomed Out)	22: Base Elbow (-90, 0) [07: P1 Lower Inboard (+135, -30)]	SRMS ELB (+160, +35)	OBSS ITVC (+70, -65)

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NOTE

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

MSS: SSRMS: MSS Safing:

cmd 'MBS' Remove (Verify Not Safed)

√Vernier

MSS: SSRMS: Rate:

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

MSS: SSRMS:

11.1 Grapple Envelope

NOTE

SSRMS Elbow ► JEM, increase to 124 cm (49 in),
Camera C/OBSS ITVC.

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

Maneuver ATA to within grapple envelope.

RHC/
THC

11.2 POA Grapple

PCS

MSS: MBS: POA:

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)

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Verify POA Mode – Auto Capture

MSS: SSRMS:

Verify Active Effector – POA

RHC TRIGGER → Press (momentarily)

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

Expected POA Grapple position:

SR	SY	SP	EP	WP	WY	WR
175.0	-16.4	-115.0	-112.3	-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, SSRMS, SR Held					
Disp	MBS>POA					

11.3 POA Grapple Cleanup

MSS: SSRMS:

Change Display ► MBS ► ATA Stowed FGB-2 (Verify MBS>ATA Stowed FGB-2)

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

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: As Desired for Release

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, SSRMS, SR Held					
Disp	MBS>ATA Stowed FGB-2					

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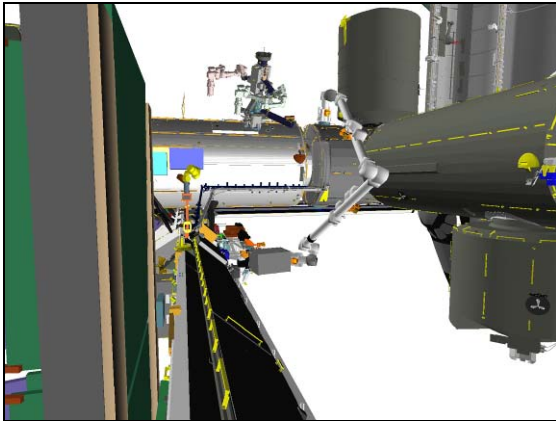


Figure 23.- ATA Stow
(09: P1 Lower Outboard: +105, -5).

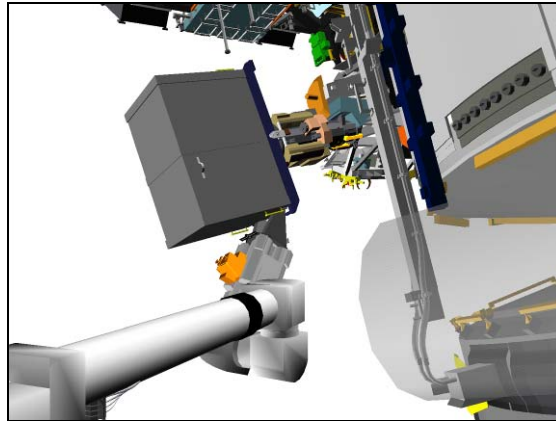


Figure 24.- ATA Stow
(22: Base Elbow: -90, 0).

12. ATA BACKOFF MANEUVER

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+105, -5) [71: Camera B (-10, +40)]	25: Tip LEE (Zoomed Out)	22: Base Elbow (-90, 0) [07: P1 Lower Inboard (+135, -30)]	SRMS ELB (+160, +35)	OBSS ITVC (+70, -65)

NOTE

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

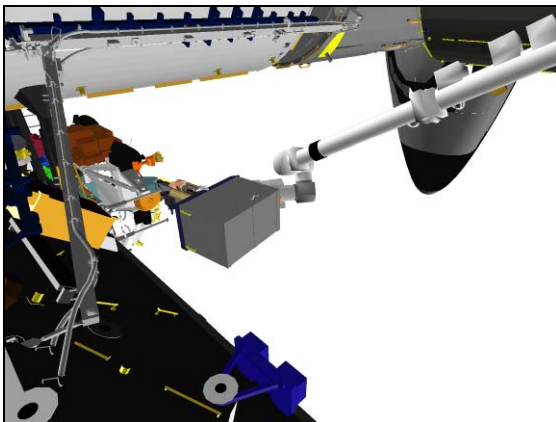


Figure 25.- ATA Stow
(07: P1 Lower Inboard: +135, -30).

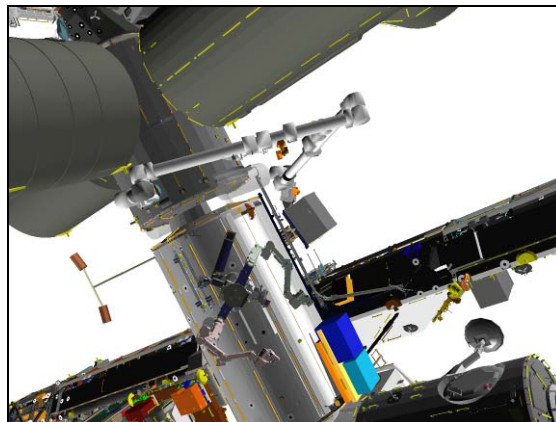


Figure 26.- ATA Stow
(OBSS ITVC: +70, -65).

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12.1 SSRMS Limp

MSS: SSRMS: Limp:

cmd All Limp (Verify Limp – blue)

MSS: SSRMS:

Verify all joints – Limped

12.2 Auto Release

MSS: SSRMS: Tip LEE:

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

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

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Auto Release

MSS: SSRMS:

Verify Active Effector – SSRMS Tip LEE

RHC

TRIGGER → Press (momentarily)

PCS

Verify 'Carriage' Retract – gray (90 s max)

Verify 'Snare' Open – blue (12 s max)

Verify 'Carriage' Derigidize – blue

Verify 'Carriage' Extend – blue (90 s max)

12.3 SSRMS Backoff

MSS: SSRMS: Limp:

cmd None Limp (Verify Standby – blue)

NOTE

Tip Boom ► JEM, decrease to 83 cm (33 in), OBSS ITVC.

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

Locked						
SR	SY	SP	EP	WP	WY	WR
+175.0	-9.8	-109.7	-113.0	-21.8	+56.6	+71.0
X	Y	Z	Pitch	Yaw	Roll	
-120	0	0	0.0	0.0	0.0	
FOR	Unloaded – LEE Tip, SR Held					
Disp	MBS>ATA Stowed FGB-2					

PCS

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

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

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

SR	SY	SP	EP	WP	WY	WR
+175.0	-9.8	-109.7	-113.0	-21.8	+56.6	+71.0
X	Y	Z	Pitch	Yaw	Roll	
+642	-132	-22	-179.9	+35.1	-90.1	
FOR	Unloaded – LEE Tip, SR Held					
Disp	ISS>ISSACS					

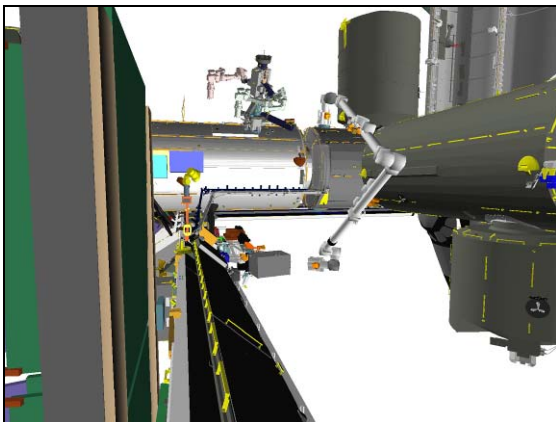


Figure 27.- ATA Backoff
(09: P1 Lower Outboard: +105, -5).

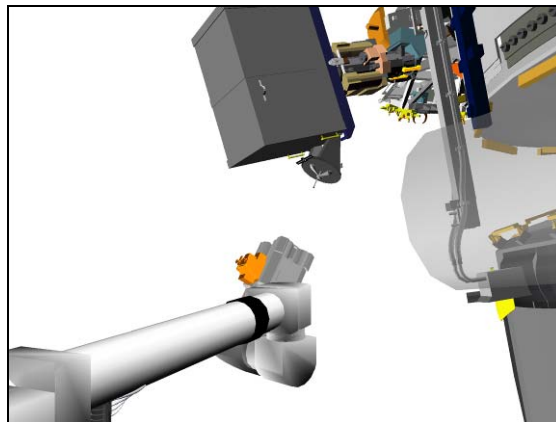


Figure 28.- ATA Backoff
(22: Base Elbow: -90, 0).

1.300 EVA 1 SUPPORT

13. JEM CLEARANCE JOINT OCAS

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+105, +10)	71: Camera B (-10, +40)	03: S1 Lower Outboard (+65, +20)	SRMS ELB (+160, +35)	OBSS ITVC (+70, -65)

MSS: SSRMS: Rate:

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

MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

pick File ► Menu 1 ► Menu 2

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

SR	SY	SP	EP	WP	WY	WR
+145.0	0.0	-5.0	-95.0	-40.0	0.0	+75.0

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	-9.8	-109.7	-113.0	-21.8	+56.6	+71.0
TGT	+145.0	0.0	-5.0	-95.0	-40.0	0.0	+75.0
ERR	+30.0	-9.8	-104.7	-18.0	+18.2	+56.6	-4.0

NOTE

1. Base Boom ► JEM, 83 cm (33 in) and increases, OBSS ITVC.
2. LEE ► POA ATA, 93 cm (37 in) and increases, OBSS ITVC.

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
+145.0	0.0	-5.0	-95.0	-40.0	0.0	+75.0

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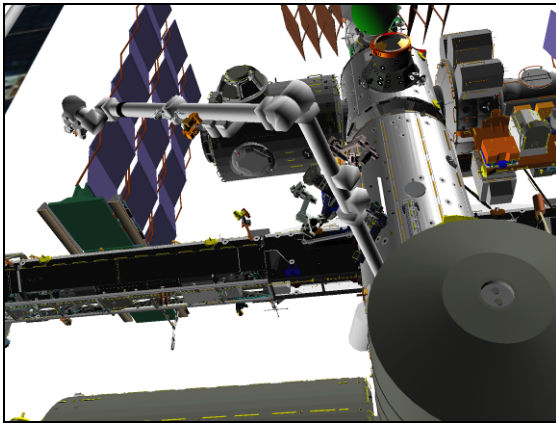


Figure 29.- JEM Clearance
(Camera B: -10, +40).

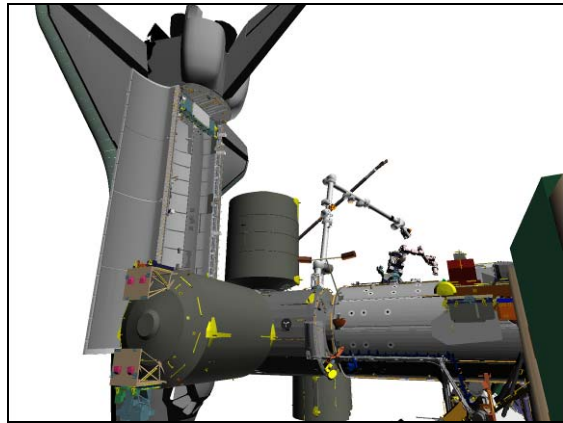


Figure 30.- JEM Clearance
(03: S1 Lower Outboard: +65, +20).

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)

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1.310 EVA 2 SUPPORT

1. HAND CONTROLLER CALIBRATION

1.1 Translational Hand Controller (THC) Calibration

THC

- Deflect [X] Axis to positive hard stop where [X] = X Y Z
- 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] = P Y R
- Deflect [X] Axis to negative hard stop.
- Repeat

2. SETUP

Verify SRMS at EV2 Viewing position.

SY	SP	EP	WP	WY	WR
+159.6	+22.7	-10.2	-21.0	-24.3	+70.4

Verify with **MCC-H** that Starboard TRRJ is locked and that Ammonia venting is complete.

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
24: Tip Elbow (-35, +10) [22: Base Elbow (-75, -5)]	03: S1 Lower Outboard (+70, -20)	13: LAB Stbd Zenith (-180, +25)	SRMS Elbow (+90, -20)	OBSS ITVC (+75, -70)

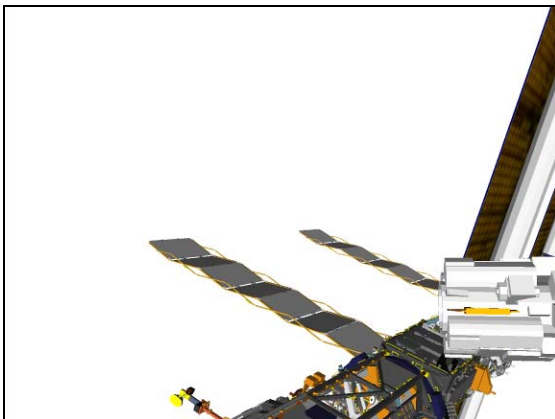


Figure 1.- Overnight Park (24: Tip Elbow: -35, +10).

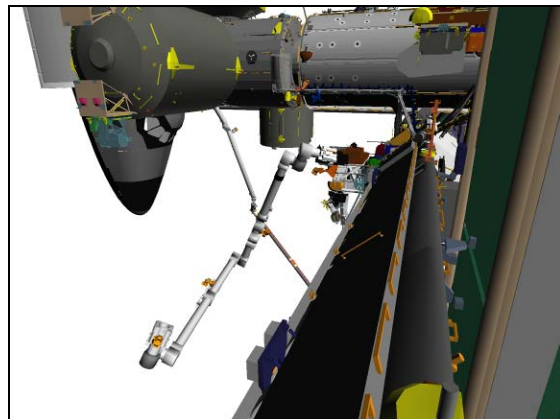


Figure 2.- Overnight Park (03: S1 Lower Outboard: +70, -20).

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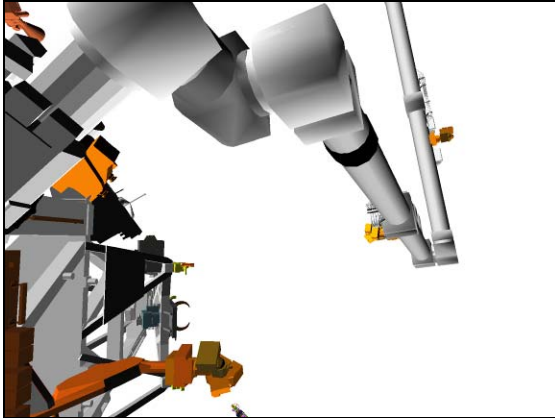


Figure 3.- Overnight Park
(13: LAB Stbd Zenith: -180, +25).

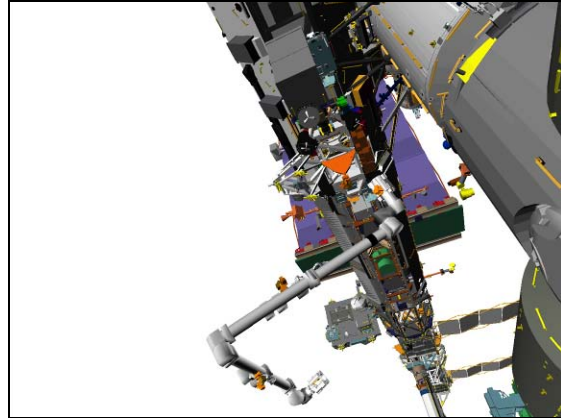


Figure 4.- Overnight Park
(SRMS Elbow: +90, +20).

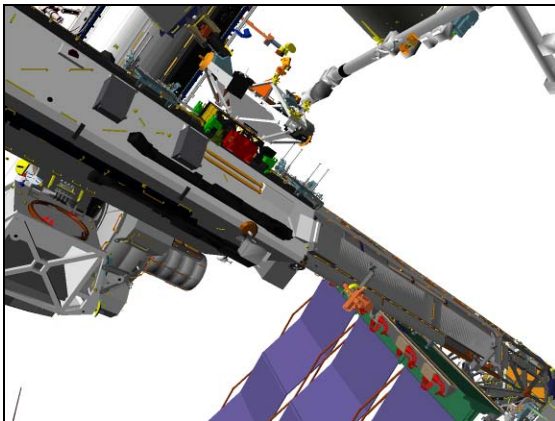


Figure 5.- Overnight Park
(OBSS ITVC: +75, -70).

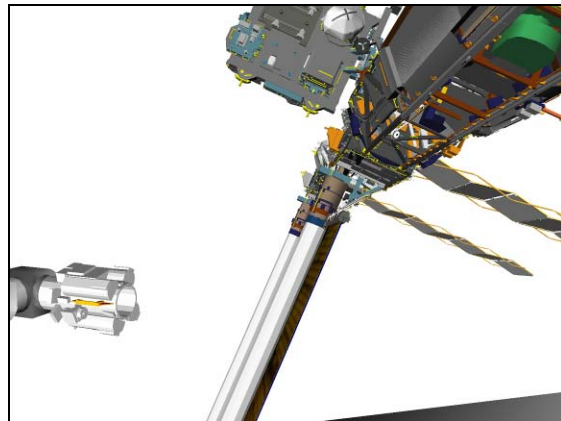


Figure 6.- Overnight Park
(22: Base Elbow: -75, -5).

PCS

MSS: SSRMS:

Change Loaded Parameters ► ATA ► ATA Mnvr Cntr SRH
Verify 'Loaded Parameters' (three) – ATA Mnvr Cntr, SSRMS, SR Held

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

SR	SY	SP	EP	WP	WY	WR
-150.0	+115.0	-90.0	-99.9	-114.7	-1.0	+12.6
X	Y	Z	Pitch	Yaw	Roll	
+800	+1079	-418	-109.7	-22.1	+112.8	
FOR	Unloaded – LEE Tip, SR Held					
Disp	ISS>ISSACS					

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

3. [S1 ATA PREGRAPPLE SINGLE JOINT](#)

MSS: SSRMS: MSS Safing:

cmd 'SSRMS' Remove (Verify Not Safed)

DCP BRAKES SSRMS → OFF (Verify OFF)

RHC RATE → VERNIER (Verify Vernier on PCS)

PCS MSS: SSRMS: Rate:

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

NOTE

LEE ► S1 S-Band Antenna, closest approach: 142 cm (56 in), Tip Elbow.

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 S1 ATA Pre-Grapple position (within 1 deg).

	SR	SY	SP	EP	WP	WY	WR	
Overnight Park	-150.0	+115.0	-90.0	-99.9	-114.7	-1.0	+12.6	
1: SY –		+39.2						
2: SP –			-127.2					
S1 ATA Pre-Grapple	-150.0	+39.2	-127.2	-99.9	-114.7	-1.0	+12.6	
	X	Y	Z	Pitch	Yaw	Roll		
	-214	+725	-267	-45.0	0.0	±180.0		
	FOR	Unloaded – LEE Tip, SR Held						
	Disp	ISS>ISSACS						

PCS MSS: SSRMS:

Enter Mode – Standby (Verify blue)

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(RBT FS/19A/FIN/SPN)

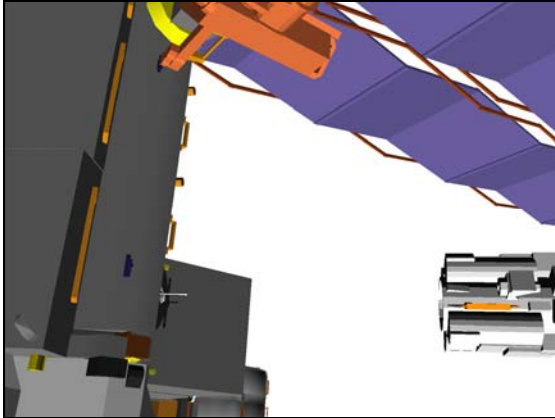


Figure 7.- S1 ATA Pre-Grapple
(24: Tip Elbow: -35, +10).

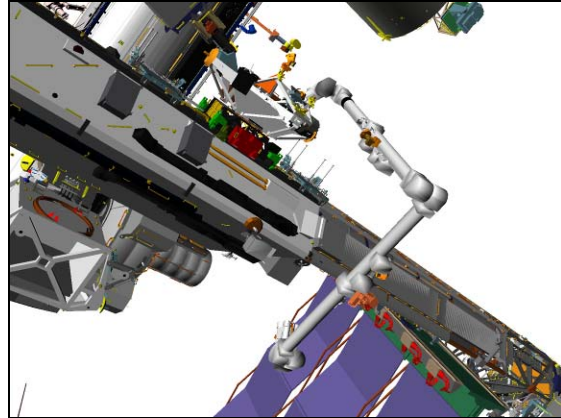


Figure 8.- S1 ATA Pre-Grapple
(OBSS ITVC: +75, -70).

4. S1 ATA GRAPPLE

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
24: Tip Elbow (-25, +10)	25: Tip LEE (Zoomed Out)	22: Base Elbow (-90, -15) [13: LAB Stbd Zenith (-180, +25)]	SRMS Elbow (+90, -20)	OBSS ITVC (+75, -70)

NOTE

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

√Vernier

MSS: SSRMS: Rate:

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

When ATA bolt #3 in work

4.1 S1 ATA Grapple Setup

NOTE

LEE ► S1 Truss, decrease to 45 cm (18 in), Tip Elbow or OBSS ITVC.

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

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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

MSS: SSRMS:

Verify Active Effector – SSRMS Tip LEE

4.2 ATA Auto Capture

On EVA crew GO, Ready for S1 ATA Grapple:

RHC/
THC

Maneuver to within grapple envelope.
Notify EVA crew when over the grapple pin.
Notify EVA crew of Trigger Pull.

RHC

TRIGGER → Press (momentarily)

PCS

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

Notify EVA crew that SSRMS has the ATA.

4.3 Grapple Cleanup

Verify Loaded Parameters – √
Verify 'Loaded Parameters' (three) – ATA Mnvr Cntr, SSRMS, SR Held

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Expected S1 ATA Grapple position:

SR	SY	SP	EP	WP	WY	WR
-150.0	+39.5	-122.0	-118.6	-101.1	-1.2	+12.7
X	Y	Z	Pitch	Yaw	Roll	
-45	+714	0	-90.0	0.0	±180.0	
FOR	Loaded – ATA Mnvr Cntr, SSRMS, SR Held					
Disp	ISS>ISSACS					

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

MSS: SSRMS: Rate:

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

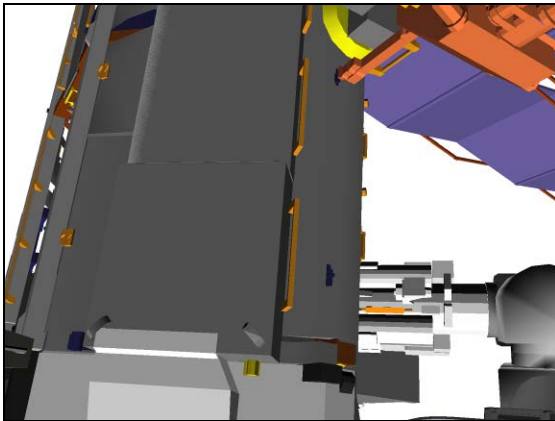


Figure 9.- S1 ATA Grapple
(24: Tip Elbow: -25, +10).

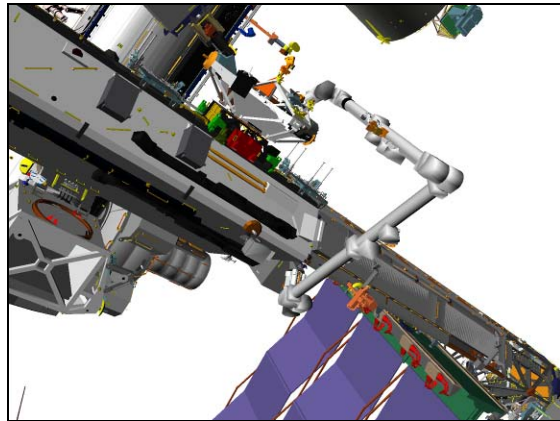


Figure 10.- S1 ATA Grapple
(OBSS ITVC: +75, -70).

5. S1 BACKOFF MANEUVER

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
24: Tip Elbow (-25, +10)	03: S1 Lower Outboard (+70, -20)	22: Base Elbow (-90, -15) [13: LAB Stbd Zenith (-180, +25)]	SRMS Elbow (+90, -20)	OBSS ITVC (+75, -70)

On EVA crew GO, Ready for maneuver to S1 Backoff:

<u>NOTE</u>
1. ATA ► S1 Truss, increase to 76 cm (30 in) then increase greater than 152 cm (60 in), EVA Crew/OBSS ITVC.
2. ATA ► S1 S-Band Antenna, closest approach 91 cm (36 in), Base Elbow.

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MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

THC/
RHC

Maneuver ATA to S1 Clearance position (within 5 cm/1 deg).
Expect -X then -Z motion (THC Out then Up).

		Locked							
		SR	SY	SP	EP	WP	WY	WR	
		-150.0	+39.5	-122.0	-118.6	-101.1	-1.2	+12.7	
		X	Y	Z	Pitch	Yaw	Roll		
		-45	+714	0	-90.0	0.0	±180.0		
ATA Grapple		-125							
1: X –									
2: Z –				-605					
S1 Clear		-125	+714	-605	-90.0	0.0	±180.0		
		SR	SY	SP	EP	WP	WY	WR	
		-150.0	+43.2	-122.9	-66.8	-152.1	-4.7	+13.9	
		FOR	Loaded – ATA Mnvr Cntr, SSRMS, SR Held						
		Disp	ISS>ISSACS						

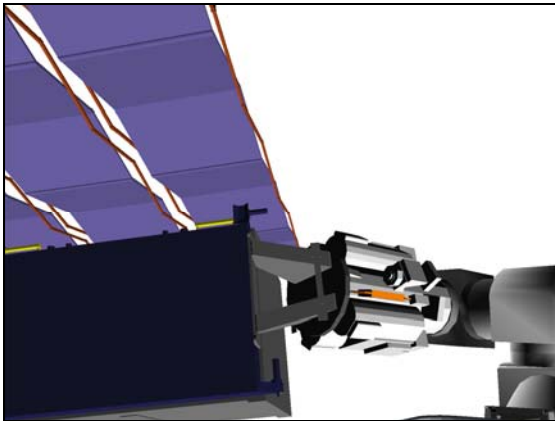


Figure 11.- S1 Clearance
(24: Tip Elbow: -25, +10).

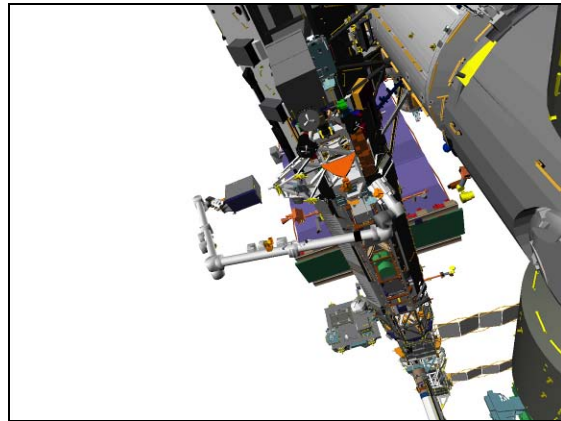


Figure 12.- S1 Clearance
(SRMS Elbow: +90, -20).

6. PORT CLEARANCE 1 JOINT OCAS

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
03: S1 Lower Outboard (+70, -20) 09: P1 Lower Outboard (+105, -10)	51: JEM EF A (+115, +20) 07: P1 Lower Inboard (+145, -35)	13: LAB Stbd Zenith (-180, +25)	SRMS Elbow (+80, +20)	OBSS ITVC (+95, -45)

PCS

MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

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RHC RATE → COARSE (Verify Coarse on PCS)

SSRMS Joint OCAS

pick File ► Menu 1 ► Menu 2

Verify 'Joint Angles' 'Destination' for Port Clearance 1 position.

SR	SY	SP	EP	WP	WY	WR
-150.0	+140.7	-57.0	+69.3	-68.9	+68.0	-137.7

cmd Load (Verify Sequence Status – Confirm or Cancel)

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

	SR	SY	SP	EP	WP	WY	WR
(current)	-150.0	+43.2	-122.9	-66.8	-152.1	-4.8	+13.9
TGT	-150.0	+140.7	-57.0	+69.3	-68.9	+68.0	-137.7
ERR	0.0	-97.5	-65.9	-136.1	-83.2	-72.8	+151.6

NOTE

1. Expect singularity warning for EP between +15 and -15 degrees.
2. Base Boom ► MBS Mast Camera, decrease to 81 cm (32 in), LAB Starboard Zenith.
3. This OCAS will take approximately 10 minutes in Coarse rates.

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 Port Clearance 1 position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-150.0	+140.7	-57.0	+69.3	-68.9	+68.0	-137.7
X	Y	Z	Pitch	Yaw	Roll	
+300	-725	-375	+90.0	0.0	±180.0	
FOR	Loaded – ATA Mnvr Cntr, SSRMS, SR Held					
Disp	ISS>ISSACS					

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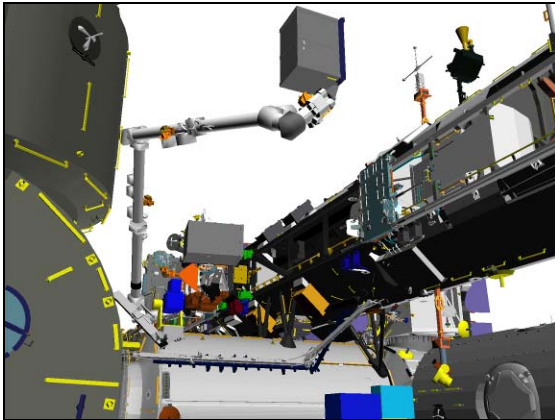


Figure 13.- Port Clearance 1
(51: JEM EF A: +115, +20).

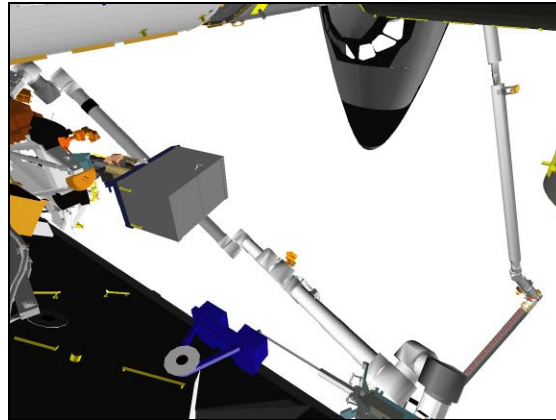


Figure 14.- Port Clearance 1
(07: P1 Lower Inboard: +145, -35).

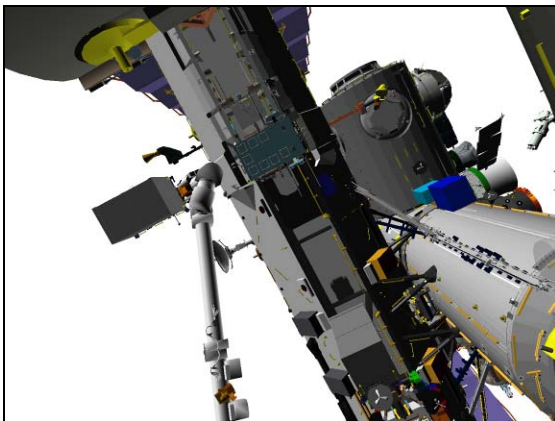


Figure 15.- Port Clearance 1
(SRMS Elbow: +80, +20).

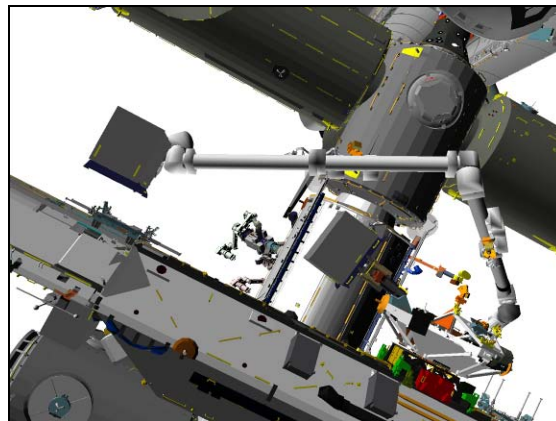


Figure 16.- Port Clearance 1
(OBSS ITVC: +95, -45).

7. CETA DROPOFF GCA START MANEUVER Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+105, -10)	51: JEM EF A (+115, +20) [07: P1 Lower Inboard (+160, -40)]	13: LAB Stbd Zenith (-180, +15)	SRMS Elbow (+80, +20)	OBSS ITVC (+95, -45)

RHC

RATE → VERNIER (Verify Vernier on PCS)

NOTE

1. ATA ► CETA Cart, decrease to 88 cm (35 in), OBSS ITVC.
2. Tip Boom ► ATA in the POA, decrease to 91 cm (36 in), OBSS ITVC.
3. Base Boom ► MBS Mast, decrease to 60 cm (24 in), LAB Starboard Zenith.

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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 ATA to CETA Dropoff GCA Start position (within 5 cm/1 deg).
Expect +Z Motion (THC Down).

Locked						
SR	SY	SP	EP	WP	WY	WR
-150.0	+132.3	-42.7	+74.7	-109.4	+71.3	-115.6
X	Y	Z	Pitch	Yaw	Roll	
+300	-725	-15	+90.0	0.0	±180.0	
FOR	Loaded – ATA Mnvr Cntr, SSRMS, SR Held					
Disp	ISS>ISSACS					

NOTE

During the GCA to CETA Dropoff, please be aware of the following:

- a) EVA crew will be required to monitor clearance from the ATA to the CETA cart.
- b) ATA ► CETA, decrease to 60 cm (24 in), EVA crew.
- c) Tip Boom ► POA ATA, decrease to 86 cm (34 in), OBSS ITVC.
- d) Base Boom ► MBS Mast, decrease to 55 cm (22 in), LAB Starboard Zenith.

THC/
RHC

Maneuver ATA per EVA GCA to CETA Dropoff position.
Expect -X motion (THC Out).

Expected ATA Dropoff position:

SR	SY	SP	EP	WP	WY	WR
-150.0	+133.6	-42.0	+74.2	-106.2	+71.1	-119.2
X	Y	Z	Pitch	Yaw	Roll	
+270	-725	-15	+90.0	0.0	±180.0	
FOR	Loaded – ATA Mnvr Cntr, SSRMS, SR Held					
Disp	ISS>ISSACS					

PCS MSS: SSRMS:

Enter Mode – Standby (Verify blue)

Give EVA crew GO for teathering to the ATA.

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

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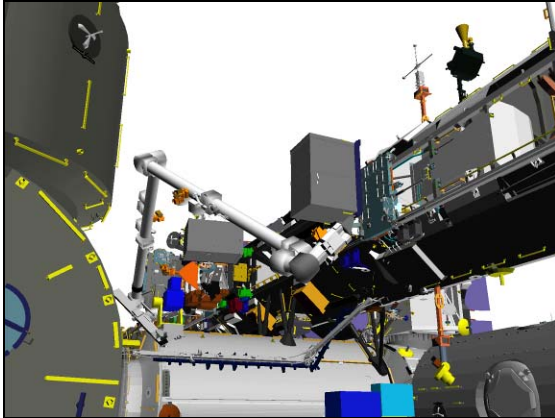


Figure 17.- CETA Dropoff
(51: JEM EF A: +115, +20).

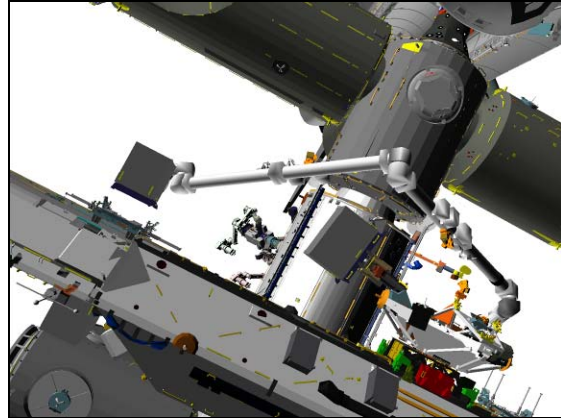


Figure 18.- CETA Dropoff
(OBSS ITVC: +95, -45).

8. ATA RELEASE

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
07: P1 Lower Inboard (+160, -35) [09: P1 Lower Outboard (+105, -10)]	25: Tip LEE (Zoomed Out)	51: JEM EF A (+115, +20) [13: LAB Stbd Zenith (-180, +15)]	SRMS Elbow (+80, +20)	OBSS ITVC (+90, -45)

NOTE

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

MSS: SSRMS: Rate:

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

On GO from EVA crew, Ready for ATA Release.

8.1 AUTO RELEASE SETUP

MSS: SSRMS:

√Vernier

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

MSS: SSRMS: Tip LEE:

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

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

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Auto Release

MSS: SSRMS:

Verify Active Effector – SSRMS Tip LEE

8.2 SSRMS RELEASE AND BACKOFF

NOTE

1. Base Boom ► ATA in the POA, increase to 106 cm (42 in), OBSS ITVC.
2. Base Boom ► MBS Mast, increases to 63 cm (25 in), LAB Starboard Zenith.

Notify EVA crew of Trigger Pull.

RHC TRIGGER → Press (momentarily)

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

Notify EVA Crew when beginning back-off maneuver and when clear of the grapple pin.

THC/
RHC Maneuver SSRMS to ATA Release position (within 20 cm/1 deg).
Expect +X and +Z motion (THC Out).

Locked	SR	SY	SP	EP	WP	WY	WR
	-150.0	+126.8	-37.9	+73.2	-129.5	+71.8	-98.0
	X	Y	Z	Pitch	Yaw	Roll	
	+404	-714	+217	+135.0	0.0	±180.0	
FOR	Unloaded – LEE Tip, SR Held						
Disp	ISS>ISSACS						

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

MSS: SSRMS:

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

Notify EVA crew, SSRMS is clear of the ATA.

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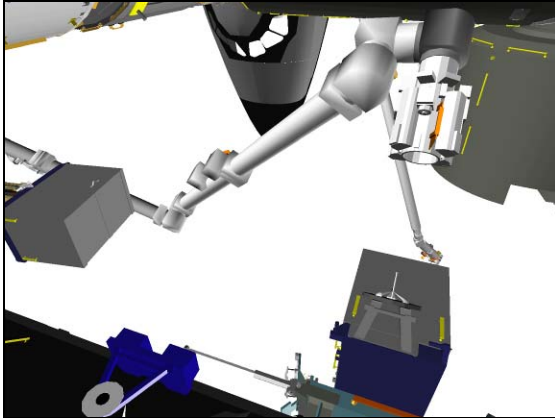


Figure 19.- ATA Release
(07: P1 Lower Inboard: +160, -35).

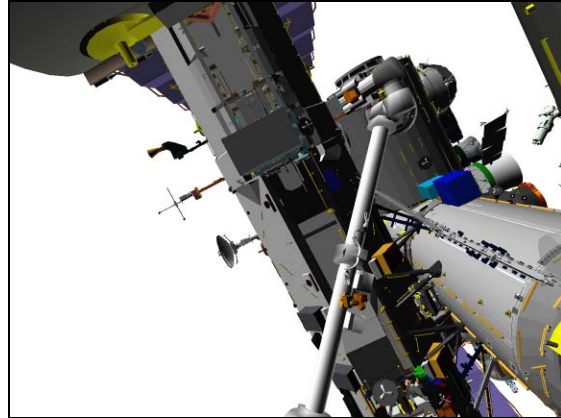


Figure 20.- ATA Release
(SRMS Elbow: +80, +20).

9. POA ATA PRE-GRAPPLE JOINT OCAS

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
07: P1 Lower Inboard (+155, -25) 13: LAB Stbd Zenith (-170, +15)	37: MBS Mast (+10, 0)	22: Base Elbow (+130, -15)	SRMS Elbow (+80, +20)	OBSS ITVC (+95, -45)

NOTE

1. Base Boom ► POA ATA and MBS Mast, increase to greater than 152 cm (60 in), OBSS ITVC.
2. LEE ► CETA ATA, closest approach 132 cm (52 in) then increase to greater than 152 cm (60 in), SRMS Elbow Camera.

MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

MSS: SSRMS: Rate:

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

pick File ► Menu 1 ► Menu 2

Verify 'Joint Angles' 'Destination' for POA ATA Pre-Grapple position.

SR	SY	SP	EP	WP	WY	WR
-150.0	+120.3	-91.5	+117.6	-67.5	+135.7	-53.0

cmd Load (Verify Sequence Status – Confirm or Cancel)

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

	SR	SY	SP	EP	WP	WY	WR
(current)	-150.0	+126.8	-37.9	+73.2	-129.5	+71.8	-98.0
TGT	-150.0	+120.3	-91.5	+117.6	-67.5	+135.7	-53.0
ERR	0.0	+6.5	+53.6	-44.2	-62.1	-64.1	-45.0

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
-150.0	+120.3	-91.5	+117.6	-67.5	+135.7	-53.0

Change Display ► MBS ► ATA Stowed FGB-2 (Verify MBS>ATA Stowed FGB-2)

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

SR	SY	SP	EP	WP	WY	WR
-150.0	+120.3	-91.5	+117.6	-67.5	+135.7	-53.0
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					

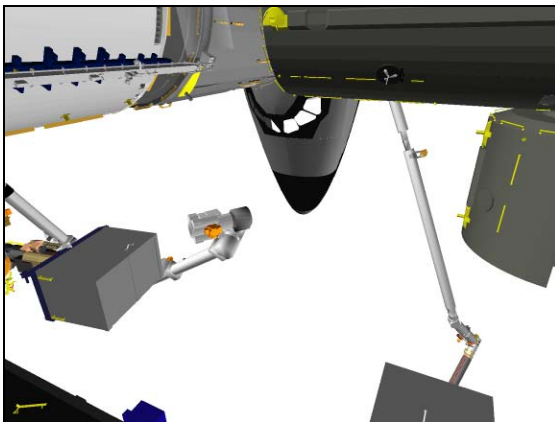


Figure 21.- POA ATA Pre-Grapple
(07: P1 Lower Inboard: +155, -25).

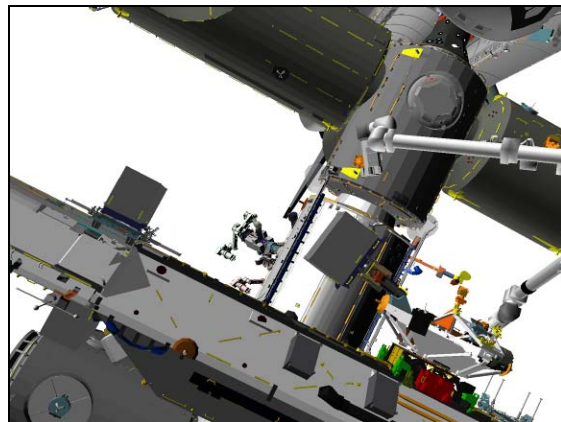


Figure 22.- POA ATA Pre-Grapple
(OBSS ITVC: +95, -45).

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10. POA ATA GRAPPLE MANEUVER

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
13: LAB Stbd Zenith (-170, +15)	25: Tip LEE (Zoomed Out)	22: Base Elbow (+70, -5)	SRMS Elbow (+80, +20)	OBSS ITVC (+95, -45)

NOTE

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

MSS: SSRMS: Rate:

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

10.1 POA ATA Grapple Maneuver

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

RHC/
THC

Maneuver to within grapple envelope.

10.2 POA ATA Auto Capture

PCS

MSS: SSRMS: Tip LEE:

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

MSS: SSRMS:

Verify Active Effector – SSRMS Tip LEE

RHC

TRIGGER → Press (momentarily)

PCS

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

Verify Capture to Latch – No (SCR 19282)

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

Verify 'Carriage' Retract – blue

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

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10.3 Grapple Cleanup

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

Verify Loaded Parameters – √

Change Loaded Parameters ► ATA ► ATA Stow SRH
Verify 'Loaded Parameters' (three) – ATA Stow, SSRMS, SR Held

Change Display ► MBS ► POA (Verify MBS>POA)

Change Command ► MBS ► POA Fly Camera (Verify MBS>POA Fly Camera)

MSS: MBS:

Verify 'POA Payload' – ATA

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

SR	SY	SP	EP	WP	WY	WR
-150.0	+130.6	-96.8	+129.6	-82.4	+128.6	-42.1
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded – ATA Stow, SSRMS, SR Held					
Disp	MBS>POA					

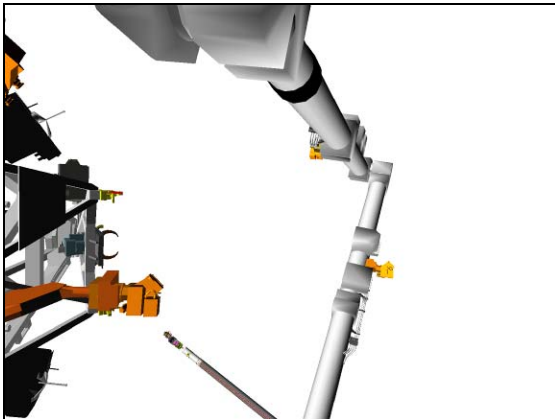


Figure 23.- POA ATA Grapple
(13: LAB Stbd Zenith: +170, +15).

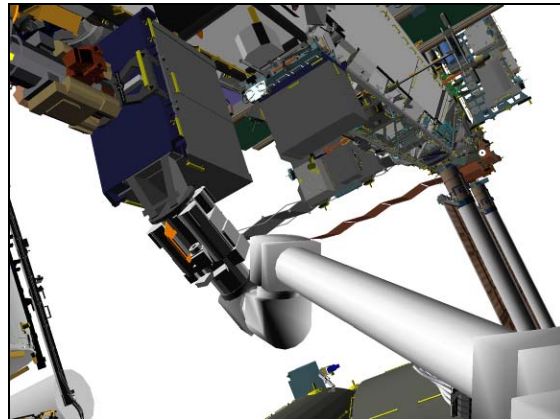


Figure 24.- POA ATA Grapple
(22: Base Elbow: +70, -5).

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11. POA ATA RELEASE

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
13: LAB Stbd Zenith (-170, +5)	32: MBS POA (Zoomed Out)	22: Base Elbow (+60, +5)	SRMS Elbow (+80, +20)	OBSS ITVC (+95, -45)

NOTE

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

MSS: SSRMS: MSS Safing:

cmd 'MBS' Remove (Verify Not Safed)

11.1 SSRMS Limp

MSS: SSRMS: Limp:

cmd All Limp (Verify Limp – blue)

MSS: SSRMS:

Verify all joints – Limped

11.2 Auto Release

MSS: MBS: POA:

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 POA operations (SCR 23262, 14662).

cmd Confirm (Verify RHC Trigger Hot icon)

Verify POA Mode – Auto Release

MSS: SSRMS:

Verify Active Effector – POA

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RHC TRIGGER → Press (momentarily)

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

11.3 POA 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)

√Vernier

THC/
RHC

Maneuver SSRMS to POA Backoff position (within 5 cm/1 deg).
 Expect +X motion (THC Out).

Locked						
SR	SY	SP	EP	WP	WY	WR
-150.0	+127.5	-86.5	+115.6	-75.8	+130.7	-45.7
X	Y	Z	Pitch	Yaw	Roll	
+150	0	0	0.0	0.0	0.0	
FOR	Loaded – ATA Stow, SSRMS, SR Held					
Disp	MBS>POA					

PCS MSS: SSRMS:

Enter Mode – Standby (Verify blue)

Change Loaded Parameters ► ATA ► ATA Mnv Cntr SRH
 Verify 'Loaded Parameters' (three) – ATA Mnv Cntr, SSRMS, SR Held

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

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

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

SR	SY	SP	EP	WP	WY	WR
-150.0	+127.5	-86.5	+115.6	-75.8	+130.7	-45.7
X	Y	Z	Pitch	Yaw	Roll	
+441	-205	-10	-179.9	-9.9	-90.1	
FOR	Loaded – ATA Mnvr Cntr, SSRMS, SR Held					
Disp	ISS>ISSACS					

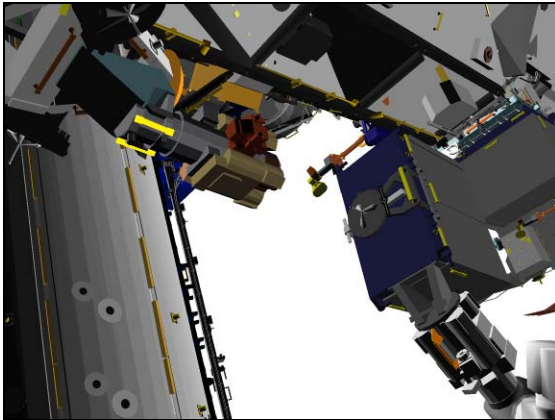


Figure 25.- POA Backoff
(22: Base Elbow: +60, +5).

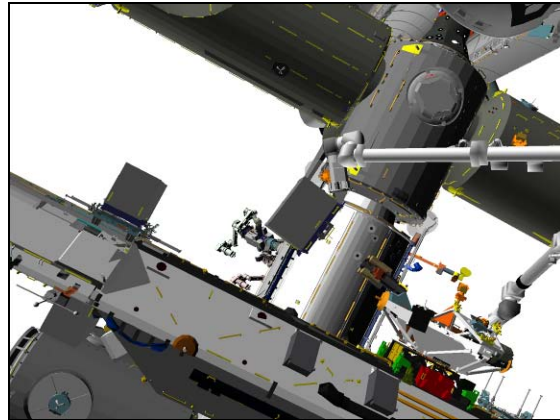


Figure 26.- POA Backoff
(OBSS ITVC: +95, -45).

12. AGB REMOVAL GCA START JOINT OCAS

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
13: LAB Stbd Zenith (-180, +15)	51: JEM EF A (+115, +20) [07: P1 Lower Inboard (+145, -25)]	22: Base Elbow (+75, 0)	SRMS Elbow (+80, +20)	OBSS ITVC (+95, -45)

MSS: SSRMS: Rate:

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

MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

pick File ► Menu 1 ► Menu 2

Verify 'Joint Angles' 'Destination' for AGB Removal GCA Start position.

SR	SY	SP	EP	WP	WY	WR
-150.0	+144.6	-79.2	+105.7	-133.9	+166.6	+110.5

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cmd Load (Verify Sequence Status – Confirm or Cancel)

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

	SR	SY	SP	EP	WP	WY	WR
(current)	-150.0	+127.5	-86.5	+115.6	-75.8	+130.7	-45.7
TGT	-150.0	+144.6	-79.2	+105.7	-133.9	+166.6	+110.5
ERR	0.0	-17.1	-7.3	+9.9	+58.1	-35.9	-156.2

<u>NOTE</u>
This OCAS will take approximately 7 minutes in Vernier rates.

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 Removal GCA Start position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-150.0	+144.6	-79.2	+105.7	-133.9	+166.6	+110.5
X	Y	Z	Pitch	Yaw	Roll	
+350	-410	+30	-90.0	0.0	0.0	
FOR	Loaded – ATA Mnvr Cntr, SSRMS, SR Held					
Disp	ISS>ISSACS					

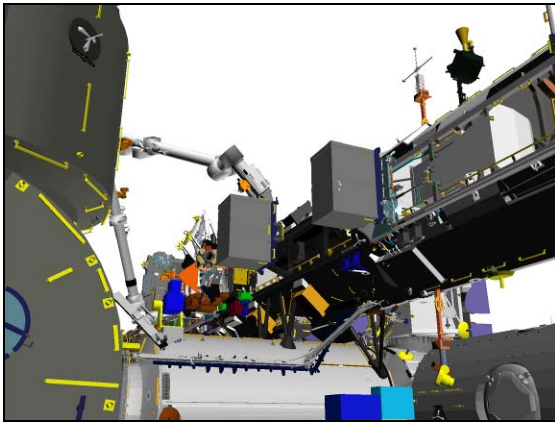


Figure 27.- AGB Removal GCA Start (51: JEM EF A: +115, +20).

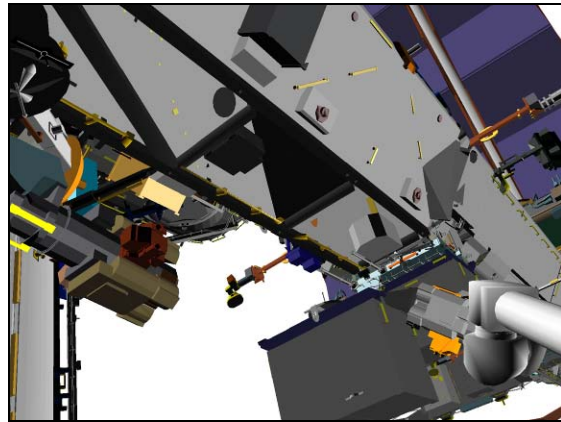


Figure 28.- AGB Removal GCA Start (22: Base Elbow: +75, 0).

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13. AGB REMOVAL GCA

NOTE

When at the expected AGB removal position:

a) AGB ► S0 Truss, decrease to 45 cm (18 in), OBSS ITVC.

b) ATA ► S0 Truss, decrease to 78 cm (31 in), OBSS ITVC.

Notify EVA crew: "ATA in position. Ready for GCA to AGB Removal position."

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

THC/
RHC

Maneuver ATA per EVA GCA to AGB Removal position.
Expect -X motion (THC Out).

Locked						
SR	SY	SP	EP	WP	WY	WR
-150.0	+149.4	-75.7	+105.0	-137.8	+168.1	+115.2
X	Y	Z	Pitch	Yaw	Roll	
+260	-410	+30	-90.0	0.0	0.0	
FOR	Loaded – ATA Mnvr Cntr, SSRMS, SR Held					
Disp	ISS>ISSACS					

PCS

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

Give EVA crew GO: "In Standby Mode. Ready for AGB Removal."

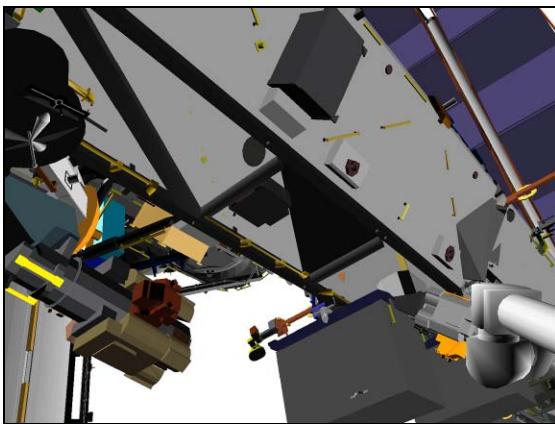


Figure 29.- AGB Removal
(22: Base Elbow: +75, 0).

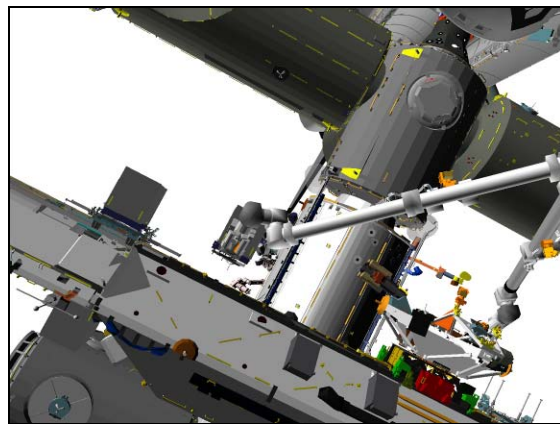


Figure 30.- AGB Removal
(OBSS ITVC: +95, -45).

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14. PORT CLEARANCE 2 MANEUVER

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
13: LAB Stbd Zenith (-180, +15) [51: JEM EF A (+115, +20)]	07: P1 Lower Inboard (+145, -35)	22: Base Elbow (+90, -20) [37: MBS Mast (-5, 0)]	SRMS Elbow (+80, +20)	OBSS ITVC (+95, -45)

On EVA crew GO: AGB Removal Complete.

NOTE

ATA ► S0 truss, increases to greater than 152 cm (60 in), OBSS ITVC.

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

THC/
RHC

Maneuver ATA to Port Clearance 2 position (within 5 cm/1 deg).
Expect +X and -Z motion (THC In and Up).

Locked	SR	SY	SP	EP	WP	WY	WR
	-150.0	+153.1	-86.1	+94.7	-117.8	+169.2	+118.7
	X	Y	Z	Pitch	Yaw	Roll	
	+350	-410	-225	-90.0	0.0	0.0	
FOR	Loaded – ATA Mnvr Cntr, SSRMS, SR Held						
Disp	ISS>ISSACS						

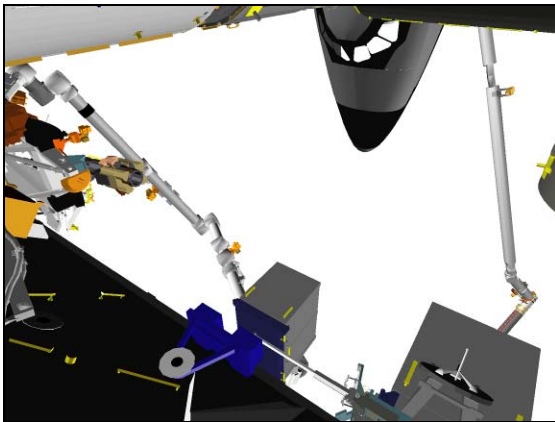


Figure 31.- Port Clearance 2
(07: P1 Lower Inboard: +145, -35).

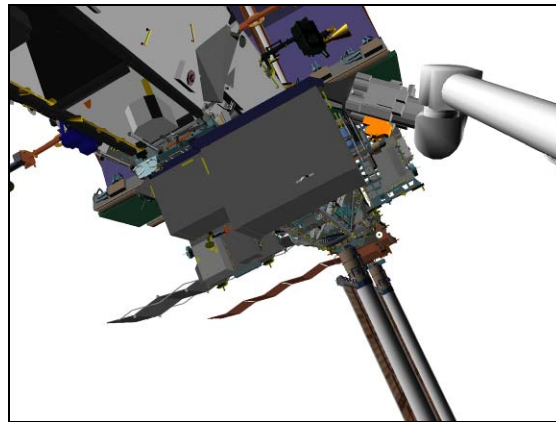


Figure 32.- Port Clearance 2
(22: Base Elbow: +90, -20).

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15. S1 CLEARANCE JOINT OCAS

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
13: LAB Stbd Zenith (-180, +15)	07: P1 Lower Inboard (+145, -30) 03: S1 Lower Outboard (+70, -20)	51: JEM EF F (+115, +20) 09: P1 Lower Outboard (+115, -25) 22: Base Elbow (-150, +5)	SRMS Elbow (+90, -20)	OBSS ITVC (+75, -75)

PCS MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

RHC RATE → COARSE (Verify Coarse on PCS)

pick File ► Menu 1 ► Menu 2

Verify 'Joint Angles' 'Destination' for S1 Clearance position.

SR	SY	SP	EP	WP	WY	WR
-150.0	+43.2	-122.9	-66.8	-152.1	-4.7	+13.9

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)	-150.0	+153.1	-86.1	+94.7	-117.8	+169.2	+118.7
TGT	-150.0	+43.2	-122.9	-66.8	-152.1	-4.8	+13.9
ERR	0.0	+109.9	+36.8	+161.5	+34.3	+173.9	+104.8

NOTE

1. Expect singularity warning for EP between +15 and -15 deg.
2. This OCAS will take approximately 10 minutes in Coarse rates.

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 S1 Clearance position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-150.0	+43.2	-122.9	-66.8	-152.1	-4.7	+13.9
X	Y	Z	Pitch	Yaw	Roll	
-125	+714	-605	-90.0	0.0	±180.0	
FOR	Loaded – ATA Mnvr Cntr, SSRMS, SR Held					
Disp	ISS>ISSACS					

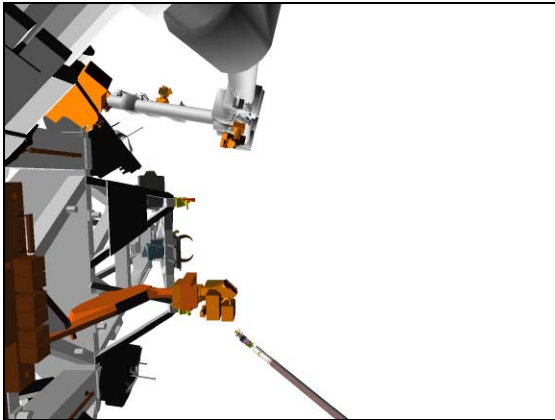


Figure 33.- S1 Clearance
(13: LAB Stbd Zenith: -180, +15).

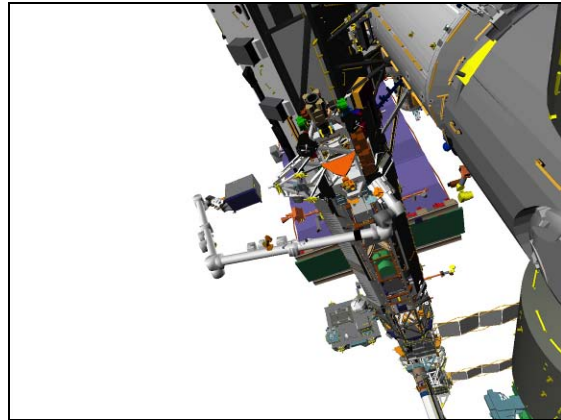


Figure 34.- S1 Clearance
(SRMS Elbow: +90, -20).

16. [S1 APPROACH MANEUVER](#)

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
24: Tip Elbow (-60, 0)	03: S1 Lower Outboard (+70, -20)	22: Base Elbow (-105, -15)	SRMS Elbow (+90, -20)	OBSS ITVC (+75, -75)

RHC

RATE → VERNIER (Verify Vernier on PCS)

NOTE

1. ATA ► S1 Truss decrease to 76 cm (30 in), Tip Elbow/OBSS ITVC/EVA crewmember.
2. ATA ► S1 S-Band Antenna, closest approach 91 cm (36 in), Base Elbow.

On EVA crew GO: In position for clearance monitoring.

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 ATA to S1 Approach position (within 5 cm/1 deg).
Expect +Z motion (THC Down).

Locked						
SR	SY	SP	EP	WP	WY	WR
-150.0	+38.6	-127.8	-112.0	-102.0	-0.4	+12.5
X	Y	Z	Pitch	Yaw	Roll	
-125	+715	0	-90.0	0.0	±180.0	
FOR	Loaded – ATA Mnvr Cntr, SSRMS, SR Held					
Disp	ISS>ISSACS					

On EVA crew GO: Ready for GCA to ATA Release.

THC/
RHC

Maneuver ATA per EVA GCA to ATA Release position.
Expect +X motion (THC in).

Expected ATA to ATA Release position:

Locked						
SR	SY	SP	EP	WP	WY	WR
-150.0	+39.1	-123.9	-116.6	-101.3	-0.9	+12.7
X	Y	Z	Pitch	Yaw	Roll	
-70	+715	0	-90.0	0.0	±180.0	
FOR	Loaded – ATA Mnvr Cntr, SSRMS SR Held					
Disp	ISS>ISSACS					

PCS

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

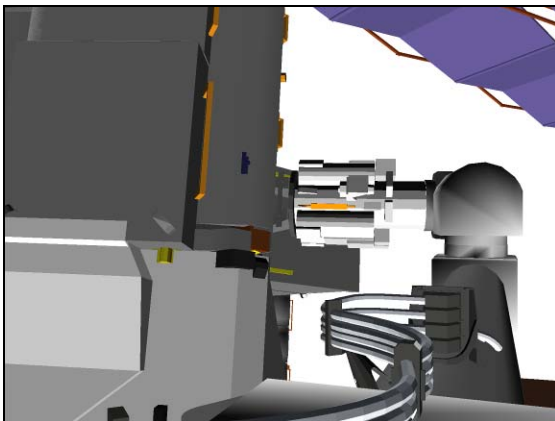


Figure 35.- S1 Approach
(24: Tip Elbow: -20, 0).

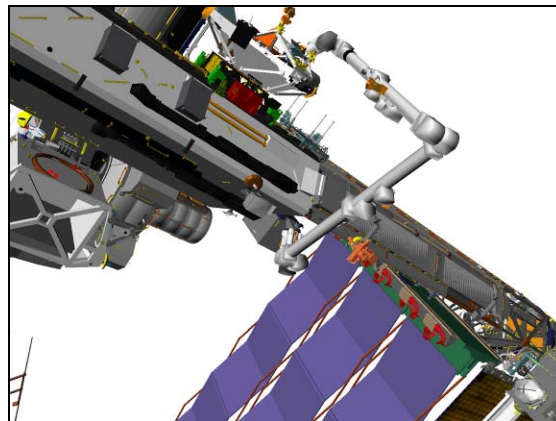


Figure 36.- S1 Approach
(OBSS ITVC: +75, -75).

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17. ATA RELEASE AT S1

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
24: Tip Elbow (-30, 0)	25: Tip LEE (Zoomed Out)	22: Base Elbow (-95, -15)	SRMS Elbow (+90, -20)	OBSS ITVC (+75, -75)

NOTE

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

MSS: SSRMS: Rate:

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

On EVA crew GO: Ready for Release.

17.1 AUTO RELEASE SETUP

MSS: SSRMS:

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

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

√Vernier

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

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

MSS: SSRMS:

Verify Active Effector – SSRMS Tip LEE

17.2 SSRMS RELEASE AND BACKOFF

Notify EVA crew of Trigger Pull.

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RHC TRIGGER → Press (momentarily)

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

Notify EVA crew when beginning backoff maneuver and when clear of the grapple pin.

THC/
RHC Maneuver SSRMS to ATA Backoff position (within 20 cm/1 deg).

Locked						
SR	SY	SP	EP	WP	WY	WR
-150.0	+38.9	-129.1	-97.6	-115.1	-0.7	+12.6
X	Y	Z	Pitch	Yaw	Roll	
-240	+725	-267	-45.0	0.0	±180.0	
FOR	Unloaded – LEE Tip, SR Held					
Disp	ISS>ISSACS					

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

Notify EVA crew: SSRMS is clear of the ATA.



Figure 37.- ATA Release
(24: Tip Elbow: -30, 0).

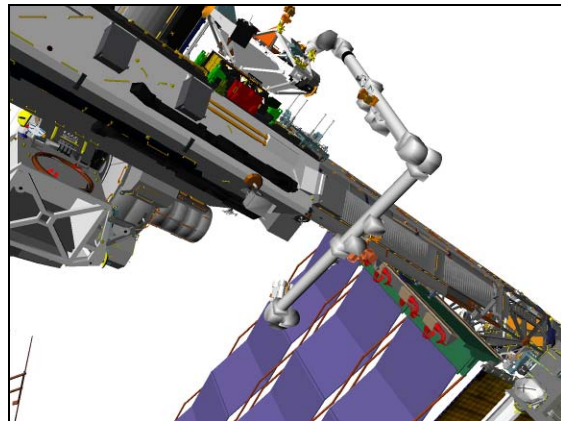


Figure 38.- ATA Release
(OBSS ITVC: +75, -75).

18. PORT CLEARANCE 3 JOINT OCAS

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
03: S1 Lower Outboard (+70, -20) 09: P1 Lower Outboard (+105, -10)	51: JEM EF A (+115, +20) 07: P1 Lower Inboard (+145, -35)	13: LAB Stbd Zenith (-180, +15)	SRMS Elbow (+80, +20)	OBSS ITVC (+95, -45)

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MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

RHC RATE → COARSE (Verify Coarse on PCS)

pick File ► Menu 1 ► Menu 2

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

SR	SY	SP	EP	WP	WY	WR
-150.0	+128.7	-62.2	+70.4	-96.7	+71.8	-104.0

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)	-150.0	+38.9	-129.1	-97.6	-115.1	-0.7	+12.6
TGT	-150.0	+128.7	-62.2	+70.4	-96.7	+71.8	-104.0
ERR	0.0	-89.8	-66.9	-168.0	-18.4	-72.5	+116.6

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

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

DCP AUTO SEQ → PROC

PCS MSS: SSRMS:

Verify Posn Hold – orange

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

SR	SY	SP	EP	WP	WY	WR
-150.0	+128.7	-62.2	+70.4	-96.7	+71.8	-104.0
X	Y	Z	Pitch	Yaw	Roll	
+600	-714	-250	+135.0	0.0	±180.0	
FOR	Unloaded – LEE Tip, SR Held					
Disp	ISS>ISSACS					

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

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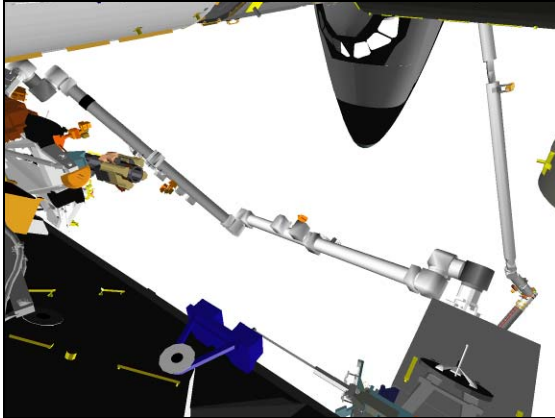


Figure 39.- Port Clearance 3
(07: P1 Lower Inboard: +145, -35).

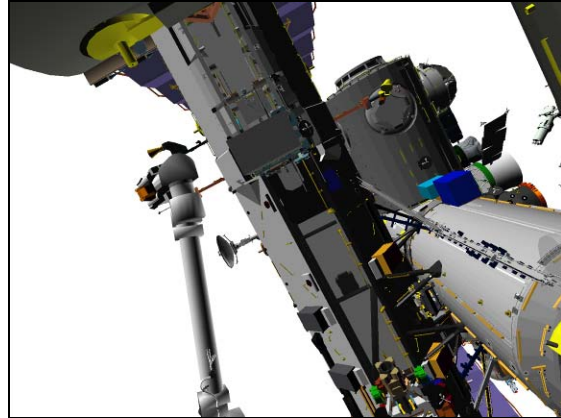


Figure 40.- Port Clearance 3
(SRMS Elbow: +80, +20).

19. CETA ATA PRE-GRAPPLE MANEUVER

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+105, -10)	51: JEM EF A (+115, +20) [07: P1 Lower Inboard (+160, -30)]	13: LAB Stbd Zenith (-180, +15) [22: Base Elbow (+135, +5)]	SRMS Elbow (+80, +20)	OBSS ITVC (+95, -45)

RHC RATE → VERNIER (Verify Vernier on PCS)

PCS MSS: SSRMS: Rate:

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

NOTE

Base Boom ► MBS Mast, decrease to 58 cm (23 in), LAB Starboard Zenith.

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 SSRMS to CETA ATA PreGrapple position (within 5 cm/1 deg).
Expect +Z then -X motion (THC Down then Out).

Port Clear 3 1: Z + 2: X - CETA ATA Pre-Grapple	Locked						
	SR	SY	SP	EP	WP	WY	WR
	-150.0	+128.7	-62.2	+70.4	-96.7	+71.8	-104.0
	X	Y	Z	Pitch	Yaw	Roll	
	+600	-714	-250	+135.0	0.0	±180.0	
			+217				
	+404						
	+404	-714	+217	+135.0	0.0	±180.0	
	SR	SY	SP	EP	WP	WY	WR
	-150.0	+126.8	-37.9	+73.2	-129.5	-71.8	-98.0
FOR	Unloaded – LEE Tip, SR Held						
Disp	ISS>ISSACS						

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

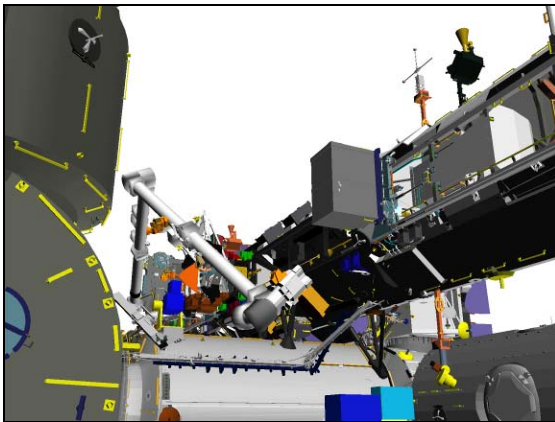


Figure 41.- CETA ATA Pre-Grapple
(51: JEM EF A: +115, +20).

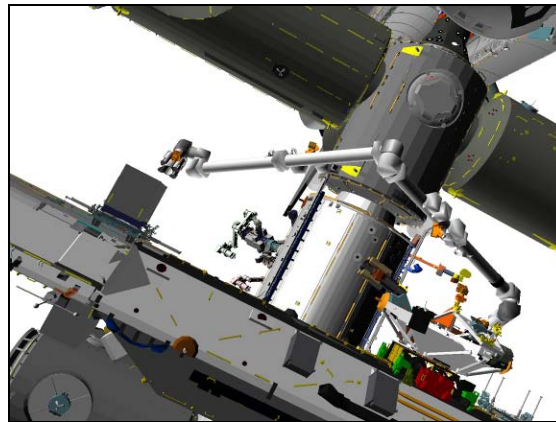


Figure 42.- CETA ATA Pre-Grapple
(OBSS ITVC: +95, -45).

20. CETA ATA GRAPPLE

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
07: P1 Lower Inboard (+160, -35) [09: P1 Lower Outboard (+105, -15)	25: Tip LEE (Zoomed Out)	51: JEM EF A (+115, +20) 13: LAB Stbd Zenith (-180, -5)	SRMS Elbow (+80, +20)	OBSS ITVC (+95, -45)

NOTE

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

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PCS MSS: SSRMS: Rate:

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

20.1 CETA ATA Grapple Maneuver

NOTE

Base Boom ► MBS Mast, decrease to 45 cm (18 in),
LAB Starboard Zenith

MSS: SSRMS: Tip LEE:

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

MSS: SSRMS:

Verify Active Effector – SSRMS Tip LEE

20.2 ATA Auto Capture

On EVA crew GO: Ready for ATA Grapple.

RHC/
THC

Maneuver to within grapple envelope.
Notify EVA crew when over the grapple pin.
Notify EVA crew of Trigger pull.

RHC

TRIGGER → Press (momentarily)

PCS

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

20.3 Grapple Cleanup

Verify Loaded Parameters – √

Verify 'Loaded Parameters' (three) – ATA Mnvr Cntr, SSRMS, SR
Held

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

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Expected CETA ATA Grapple position.

SR	SY	SP	EP	WP	WY	WR
-150.0	+133.6	-42.0	+74.2	-106.2	+71.1	-119.2
X	Y	Z	Pitch	Yaw	Roll	
+270	-725	-15	+90.0	0.0	±180.0	
FOR	Loaded – ATA Mnvr Cntr, SSRMS, SR Held					
Disp	ISS>ISSACS					

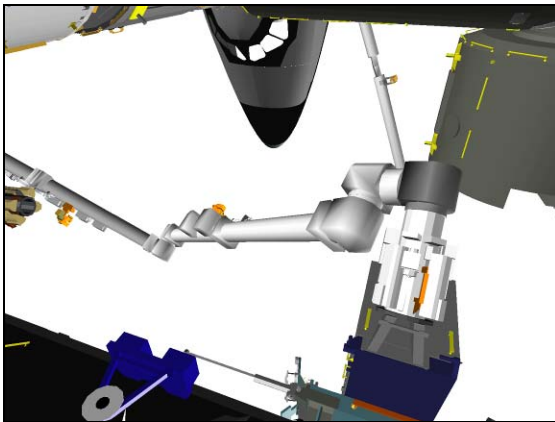


Figure 43.- CETA ATA Grapple
(07: P1 Lower Inboard: +160, -35).

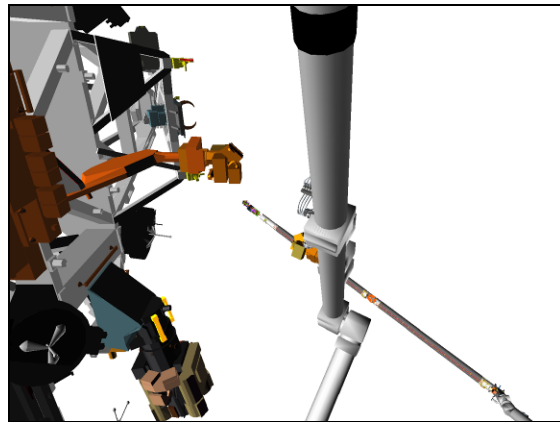


Figure 44.- CETA ATA Grapple
(13: LAB Stbd Zenith: -180, -5).

21. AGB INSTALL GCA START MANEUVER

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+105, -10)	51: JEM EF A (+115, +20) [07: P1 Lower Inboard (+160, -40)]	13: LAB Stbd Zenith (-180, -5)	SRMS Elbow (+80, +20)	OBSS ITVC (+95, -45)

On EVA crew GO: Ready for GCA to AGB Install.

<u>NOTE</u>
1. ATA ► CETA, increase beyond 152 cm (60 in), JEM EF A.
2. ATA ► Truss, increase to 119 cm (47 in), JEM EF A.
3. Base Boom ► MBS Mast, increase beyond 152 cm (60 in), LAB Starboard Zenith.
4. SSRMS WP ► LAB NH3 Trays, decrease to 142 cm (56 in), SRMS Elbow.

PCS

MSS: SSRMS: Rate:

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

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

cmd Shoulder Roll (Verify SR – Locked)

THC/
RHC

Maneuver ATA to AGB Install GCA Start position (within 5 cm/1 deg).
Expect + X and +Y motion (THC In and Left).

CETA Grap
1: X +
2: Y +
AGB Install
GCA Start

Locked	SR	SY	SP	EP	WP	WY	WR	
	-150.0	+133.6	-42.0	+74.2	-106.2	+71.1	-119.2	
	X	Y	Z	Pitch	Yaw	Roll		
	+270	-725	-15	+90.0	0.0	+180.0		
	+400							
		-410						
	+400	-410	-15	+90.0	0.0	+180.0		
	SR	SY	SP	EP	WP	WY	WR	
	-150.0	+129.4	-60.6	+110.6	-136.2	+71.8	-106.3	
	FOR	Loaded – ATA Mnvr Cntr, SSRMS, SR Held						
	Disp	ISS>ISSACS						

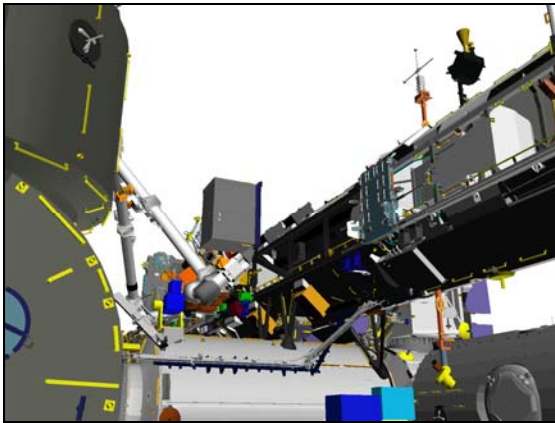


Figure 45.- AGB Install GCA Start
(51: JEM EF A: +115, +20).

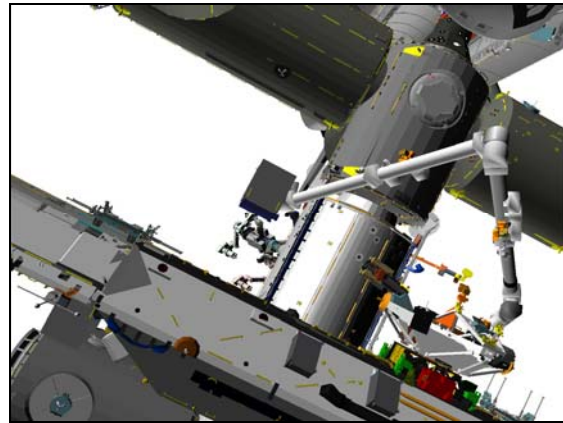


Figure 46.- AGB Install GCA Start
(OBSS ITVC: +95, -45).

22. [AGB INSTALL GCA](#)

NOTE

1. ATA ► Truss, decrease to 78 cm (31 in), JEM EF A.
2. AGB (when installed) ► Truss, 45 cm (18 in), JEM EF A.

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THC/
RHC Maneuver ATA per EVA GCA to AGB Install position.
Expect +X motion (THC In).

Expected AGB Install Position:

Locked						
SR	SY	SP	EP	WP	WY	WR
-150.0	+137.3	-57.4	+109.1	+115.9	+69.7	-129.7
X	Y	Z	Pitch	Yaw	Roll	
+260	-410	-15	+90.0	0.0	±180.0	
FOR	Loaded – ATA Mnvr Cntr, SSRMS, SR Held					
Disp	ISS>ISSACS					

PCS MSS: SSRMS:

Enter Mode – Standby (Verify blue)

Give EVA crew GO: “In Standby Mode, GO for AGB Install.”

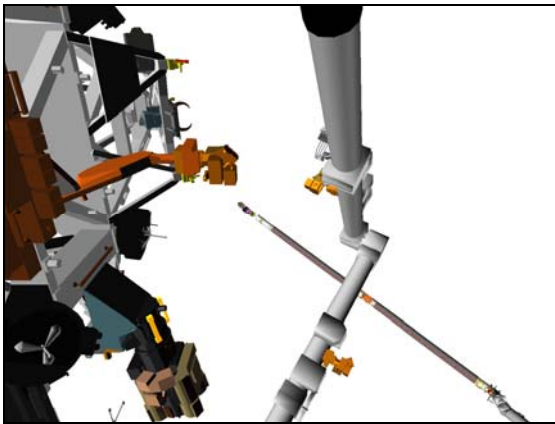


Figure 47.- AGB Install
(13: LAB Stbd Zenith: -180, -5).

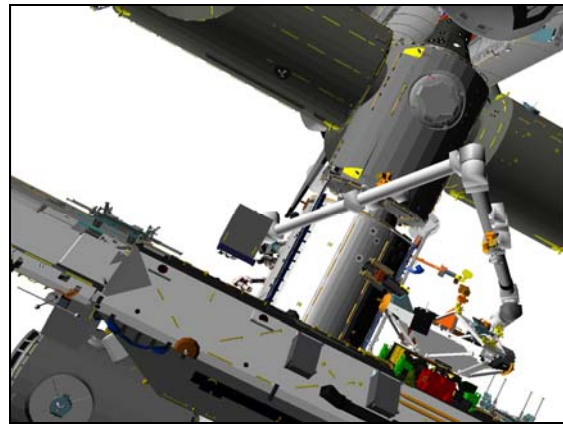


Figure 48.- AGB Install
(OBSS ITVC: +95, -45).

23. TRUSS CLEARANCE MANEUVER

On EVA crew GO: “AGB Install Complete. Ready for maneuver to CETA Clearance position.”

NOTE

CETA Cart ► AGB on the ATA, increases to greater than 152 cm (60 in), OBSS ITVC.

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 ATA to Truss Clearance position (within 5 cm/1 deg).
Expect +X and -Z motion (THC In and Up).

Locked						
SR	SY	SP	EP	WP	WY	WR
-150.0	+129.9	-73.3	+110.6	-122.1	+71.7	-107.9
X	Y	Z	Pitch	Yaw	Roll	
+475	-410	-175	+90.0	0.0	±180.0	
FOR	Loaded – ATA Mnvr Cntr, SSRMS, SR Held					
Disp	ISS>ISSACS					

PCS

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

Change Loaded Parameters ► ATA ► ATA Stow SRH
Verify 'Loaded Parameters' (three) – ATA Stow, SSRMS, SR Held

Change Display ► MBS ► POA (Verify MBS>POA)

Change Command ► MBS ► POA Fly Camera (Verify MBS>POA Fly Camera)

MSS: MBS:

Verify 'POA Payload' – ATA



Figure 49.- Truss Clearance
(09: P1 Lower Outboard: +105, -10).



Figure 50.- Truss Clearance
(13: LAB Stbd Zenith: -180, -5).

24. [POA ATA PRESTOW JOINT OCAS](#)

MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

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SSRMS Joint OCAS

pick File ► Menu 1 ► Menu 2

Verify 'Joint Angles' 'Destination' for POA ATA Pre-Stow position.

SR	SY	SP	EP	WP	WY	WR
-150.0	+127.5	-86.5	+115.6	-75.8	+130.7	-45.7

cmd Load (Verify Sequence Status – Confirm or Cancel)

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

	SR	SY	SP	EP	WP	WY	WR
(current)	-150.0	+129.9	-73.3	+110.6	-122.1	+71.7	-107.9
TGT	-150.0	+127.5	-86.5	+115.6	-75.8	+130.7	-45.7
ERR	0.0	+2.4	+13.2	-5.0	-46.3	-59.0	-62.2

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 POA ATA Pre-Stow position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-150.0	+127.5	-86.5	+115.6	-75.8	+130.7	-45.7
X	Y	Z	Pitch	Yaw	Roll	
+150	0	0	0.0	0.0	0.0	
FOR	Loaded – ATA Stow, SSRMS, SR Held					
Disp	MBS>POA					

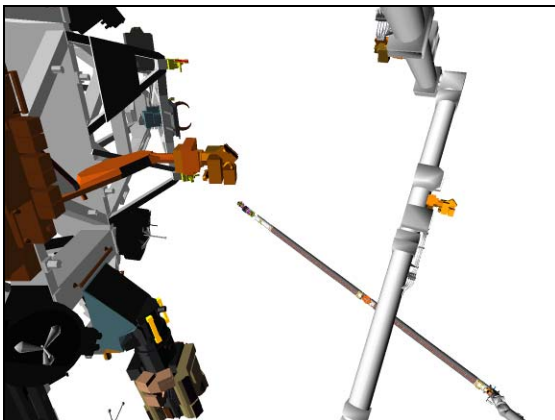


Figure 51.- POA ATA Pre-Stow
(13: LAB Stbd Zenith: -180, -5).

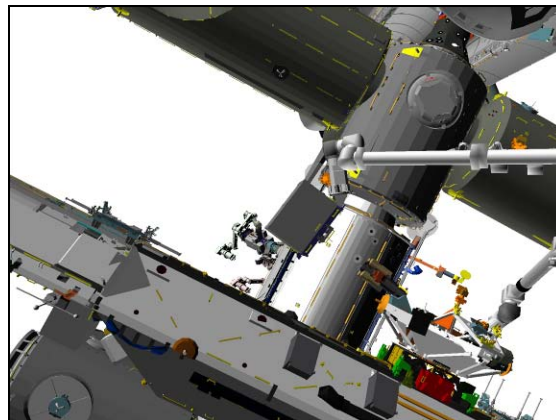


Figure 52.- POA ATA Pre-Stow
(OBSS ITVC: +95, -45).

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25. ATA STOW MANEUVER

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
22: Base Elbow (+70, +5)	32: MBS POA (Zoomed Out)	13: LAB Stbd Zenith (-180, -35)	SRMS Elbow (+80, +20)	OBSS ITVC (+95, -45)

NOTE

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

MSS: SSRMS:

√Vernier

MSS: SSRMS: Rate:

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

25.1 Grapple Envelope

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

RHC/
THC

Maneuver ATA to within grapple envelope.

PCS

25.2 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 POA Mode – Auto Capture

MSS: SSRMS:

Verify Active Effector - POA

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 'Carriage' Brakes – On (15 s max)

Expected POA Grapple position:

SR	SY	SP	EP	WP	WY	WR
-150.0	+130.6	-96.8	+129.6	-82.4	+128.6	-42.1
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded – ATA Stow, SSRMS, SR Held					
Disp	MBS>POA					

25.3 POA Grapple Cleanup

MSS: SSRMS:

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
-150.0	+130.6	-96.8	+129.6	-82.4	+128.6	-42.1
X	Y	Z	Pitch	Yaw	Roll	
+123	+21	-56	+135.1	+0.1	-89.9	
FOR	Loaded – ATA Stow, SSRMS, SR Held					
Disp	MBS>ATA Stowed FGB-2					

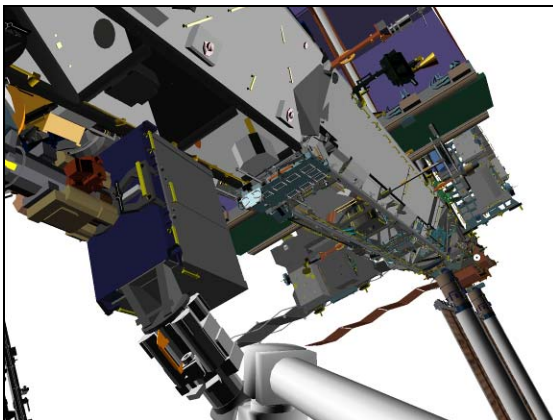


Figure 53.- ATA Stow
(22: Base Elbow: +70, +5).

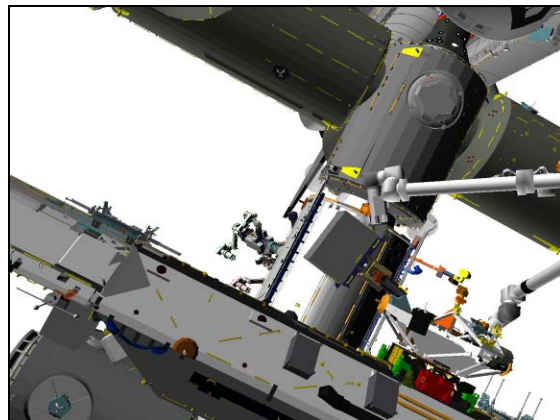


Figure 54.- ATA Stow
(OBSS ITVC: +95, -45).

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26. STOWED ATA RELEASE

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
22: Base Elbow (+70, +5)	25: Tip LEE (Zoomed Out)	13: LAB Stbd Zenith (-180, -30)	SRMS Elbow (+80, +20)	OBSS ITVC (+95, -45)

26.1 SSRMS LIMP

MSS: SSRMS: Limp:

cmd All Limp (Verify Limp – blue)

MSS: SSRMS:

Verify all joints – Limped

26.2 AUTO RELEASE

MSS: SSRMS: Tip LEE:

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

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

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Auto Release

MSS: SSRMS:

Verify Active Effector – SSRMS Tip LEE

RHC TRIGGER → Press (momentarily)

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

26.3 SSRMS BACKOFF

MSS: SSRMS: Limp:

cmd None Limp (Verify Standby – blue)

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

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cmd Shoulder Roll (Verify SR – Locked)

√Vernier

THC/
RHC

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

Locked						
SR	SY	SP	EP	WP	WY	WR
-150.0	+117.4	-89.3	+113.1	-63.5	+138.0	-55.5
X	Y	Z	Pitch	Yaw	Roll	
-200	0	0	0.0	0.0	0.0	
FOR	Unloaded – LEE Tip, SR Held					
Disp	MBS>ATA Stowed FGB-2					

PCS

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

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

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

SR	SY	SP	EP	WP	WY	WR
-150.0	+117.4	-89.3	+113.1	-63.5	+138.0	-55.5
X	Y	Z	Pitch	Yaw	Roll	
+708	-178	-22	-179.9	+35.1	-90.1	
FOR	Unloaded – LEE Tip, SR Held					
Disp	ISS>ISSACS					



Figure 55.- Stowed ATA Release
(22: Base Elbow: +70, +5).

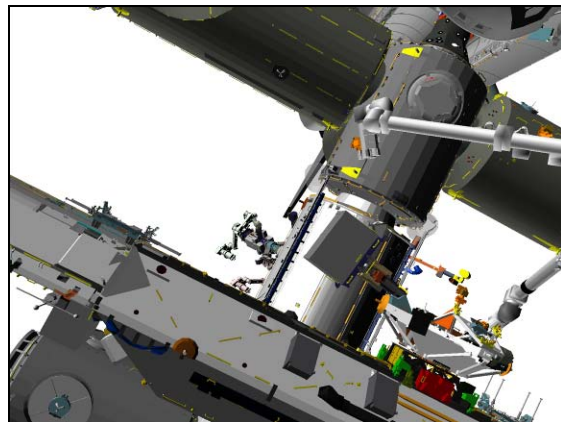


Figure 56.- Stowed ATA Release
(OBSS ITVC: +95, -45).

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27. OVERNIGHT PARK JOINT OCAS

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3
03: S1 Lower Outboard (+70, -20)	09: P1 Lower Outboard (+105, -10)	13: LAB Stbd Zenith (-180, -30)

RHC RATE → COARSE (Verify Coarse on PCS)

PCS MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

pick File ► Menu 1 ► Menu 2

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

SR	SY	SP	EP	WP	WY	WR
-150.0	+115.0	-90.0	-99.9	-114.7	-1.0	+12.6

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)	-150.0	+117.4	-89.3	+113.1	-63.5	+138.0	-55.5
TGT	-150.0	+115.0	-90.0	-99.9	-114.7	-1.0	+12.6
ERR	0.0	+2.4	+0.7	+213.0	+51.2	+139.0	-68.1

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

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
-150.0	+115.0	-90.0	-99.9	-114.7	-1.0	+12.6
X	Y	Z	Pitch	Yaw	Roll	
+800	+1079	-417	-109.7	-22.2	+112.8	
FOR	Unloaded – LEE Tip, SR Held					
Disp	ISS>ISSACS					

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NOTE

Expect the following message when safing is commanded:

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

This message should return to Norm.

DCP

SAFING → SAFE (Verify ON)

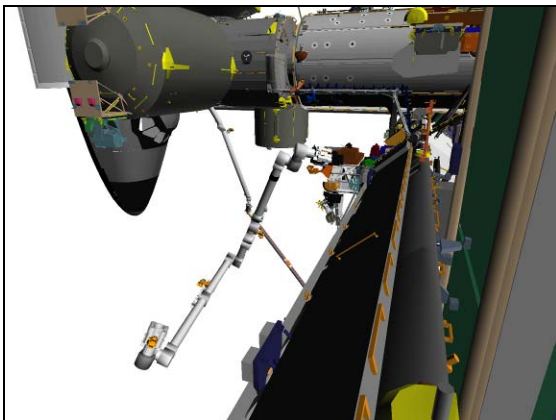


Figure 57.- Overnight Park
(03: S1 Lower Outboard: +70, -20).

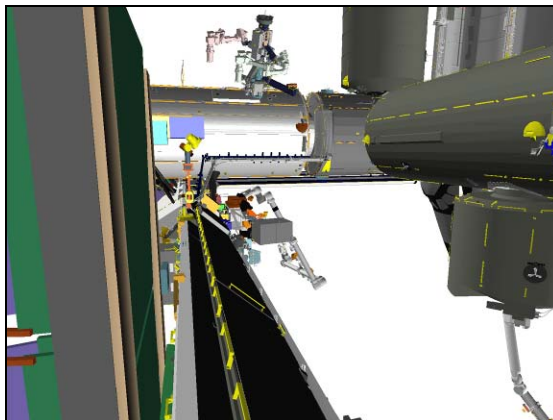


Figure 58.- Overnight Park
(09: P1 Lower Outboard: +105, -10).

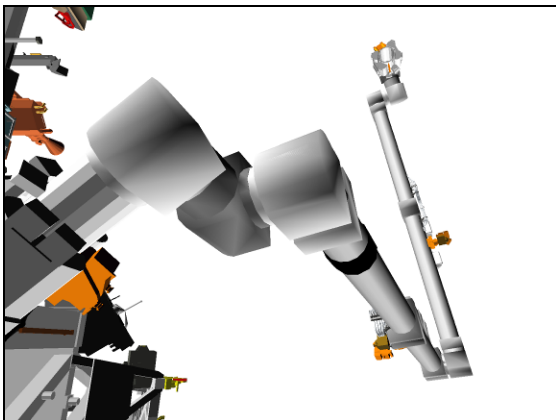


Figure 59.- Overnight Park
(13: LAB Stbd Zenith: -180, +40).

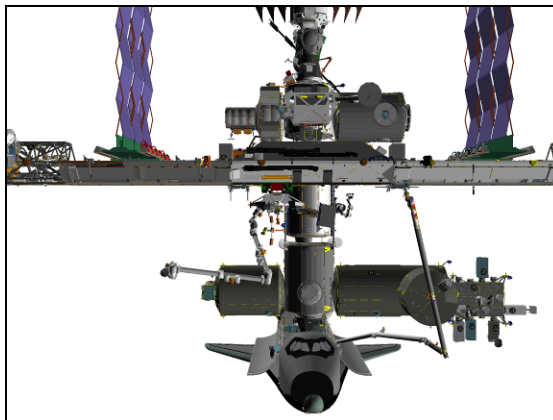


Figure 60.- Overnight Park
(ISS Zenith)

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1. HAND CONTROLLER CALIBRATION

1.1 Translational Hand Controller (THC) Calibration

THC

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

1.2 Rotational Hand Controller (RHC) Calibration

RHC

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

2. SETUP

Verify with shuttle crew that SRMS at Viewing position.

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

NOTE

Have shuttle crew route Camera B to MON2 (ISS Channel 71) with a pan/tilt of -10, +30 and Camera C to DNLK (ISS Channel 72) with a pan/tilt of +10, +40 and have both Cameras zoomed out full.

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
24: Tip Elbow (-20, 0) [13: LAB Stbd Zenith (-5, -30)]	72(DNLK): Camera C (+10, +40)	03: S1 Lower Outboard (+70, +5)	SRMS Elbow (+160, +35)	OBSS ITVC (+80, -65)

PCS

MSS: SSRMS:

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

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

Verify Command – SSRMS>Internal

MSS: SSRMS: MSS Safing:

cmd 'SSRMS' Remove (Verify Not Safed)

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DCP BRAKES SSRMS → OFF (Verify OFF)

Verify SSRMS at EV3 Start position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-19.6	+12.3	-102.1	-107.8	-41.1	-30.0	+82.7
X	Y	Z	Pitch	Yaw	Roll	
+480	+505	+136	+161.6	-33.5	-135.8	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>ISSACS					

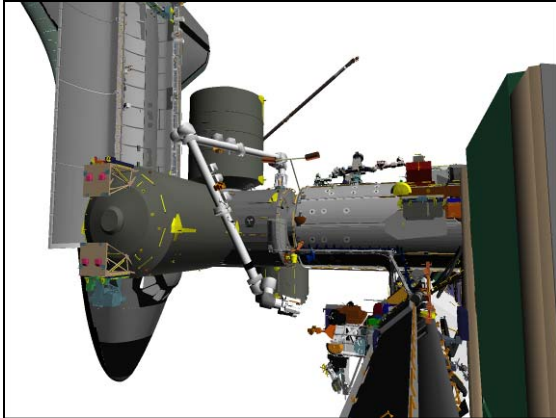


Figure 1.- EV3 Start
(03: S1 Lower Outboard: +70, +5).

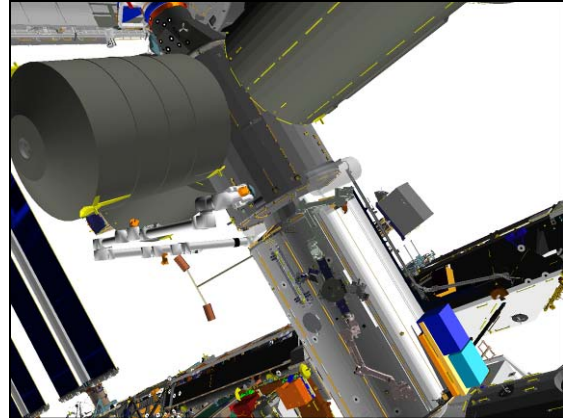


Figure 2.- EV3 Start
(OBSS ITVC: +80, -65).

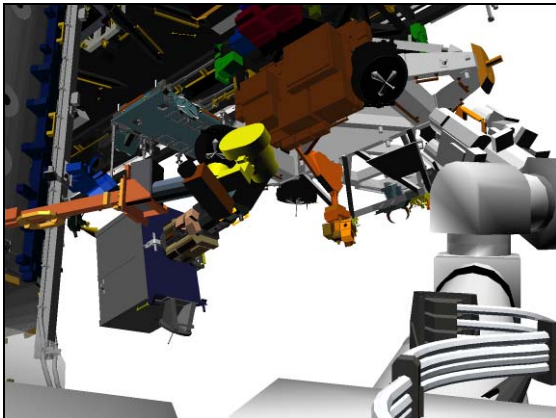


Figure 3.- EV3 Start
(24: Tip Elbow: -20, 0).

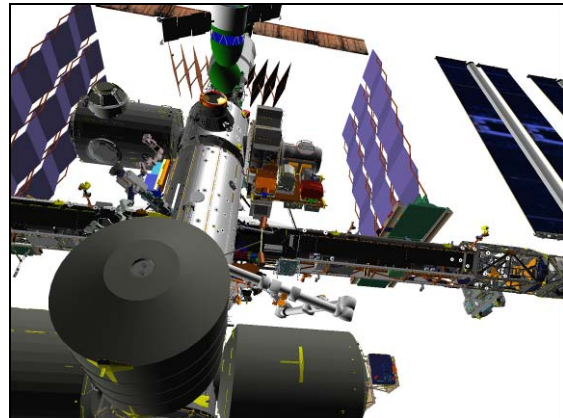


Figure 4.- EV3 Start
(72: Camera C: +10, +40).

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3. LAB CLEAR FOR OCAS

NOTE

1. Base boom ► UHF Antenna, 97 cm (38 in) and increases, OBSS ITVC.
2. Tip Boom ► Columbus, 76 cm (30 in) and increases, Camera C.
3. WR Joint ► LAB Stbd Zenith Camera, 94 cm (37 in) and increases, Tip Elbow.

√Vernier

PCS MSS: SSRMS: Rate:

√'Scale' 'Vernier' Current: 1.0

MSS: SSRMS:

Enter Mode – FOR OCAS (Verify blue)

MSS: SSRMS: SSRMS FOR OCAS: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

pick File ► Menu 1 ► Menu 2

Verify 'FOR' 'Destination' for LAB Clear position.

X	Y	Z	Pitch	Yaw	Roll
+200	+650	+1000	161.6	-33.5	-135.8

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	+480	+505	+136	+161.6	-33.5	-135.8
TGT	+200	+650	+1000	161.6	-33.5	-135.8
ERR	+280	-145	-864	0.0	0.0	0.0

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 LAB Clear position (within 5 cm/1 deg).

	Locked					
SR	SY	SP	EP	WP	WY	WR
+19.5	+12.3	-29.1	-113.0	-76.3	-62.2	+114.4
X	Y	Z	Pitch	Yaw	Roll	
+200	+650	+1000	161.6	-33.5	-135.8	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>ISSACS					

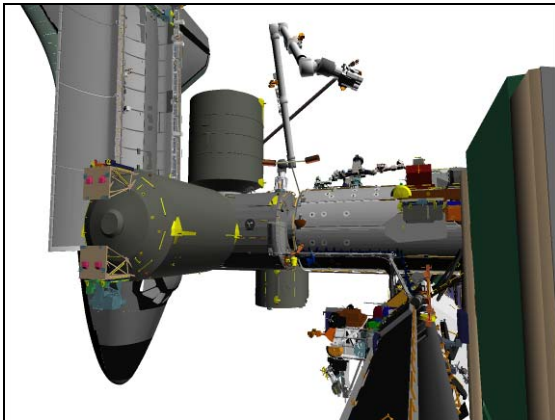


Figure 5.- LAB Clear
(03: S1 Lower Outboard: +75, +20).

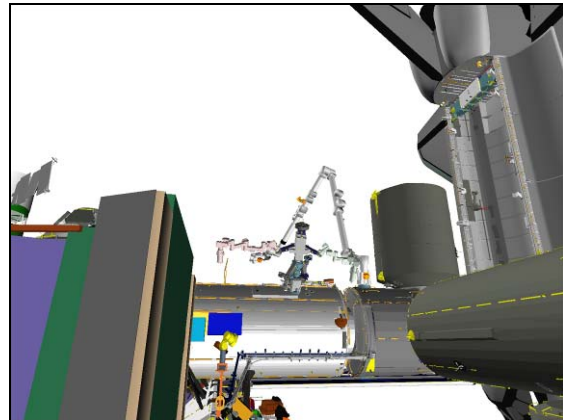


Figure 6.- LAB Clear
(09: P1 Lower Outboard: +100, +20).

4. PORT CLEAR JOINT OCAS

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+100, +20)	72(DNLK): Camera C (+10, +40) [71(MON 2): Camera B (-10, +30)]	03: S1 Lower Outboard (+70, +20)	SRMS Elbow (+160, +35)	OBSS ITVC (+80, -65)

PCS

MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

pick File ► Menu 1 ► Menu 2

Verify 'Joint Angles' 'Destination' for Port Clear position.

SR	SY	SP	EP	WP	WY	WR
+145.0	+0.0	-5.0	-95.0	-40.0	+30.0	+80.0

cmd Load (Verify Sequence Status – Confirm or Cancel)

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

	SR	SY	SP	EP	WP	WY	WR
(current)	+19.5	+12.3	-29.1	-113.0	-76.3	-62.2	+114.4
TGT	+145.0	+0.0	-5.0	-95.0	-40.0	+30.0	+80.0
ERR	-125.5	+12.3	-24.1	-18.0	-36.3	-92.2	+34.4

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
+145.0	+0.0	-5.0	-95.0	-40.0	+30.0	+80.0

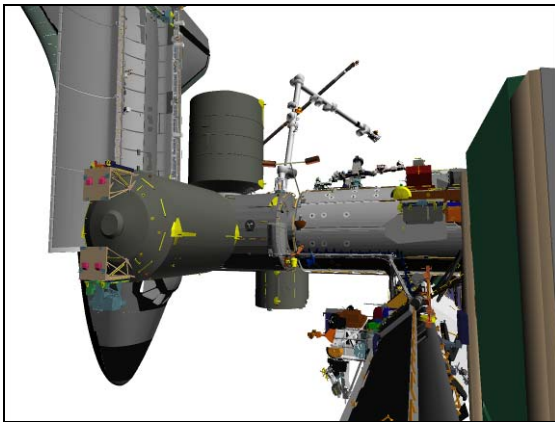


Figure 7.- Port Clear
(03: S1 Lower Outboard: +75, +20).

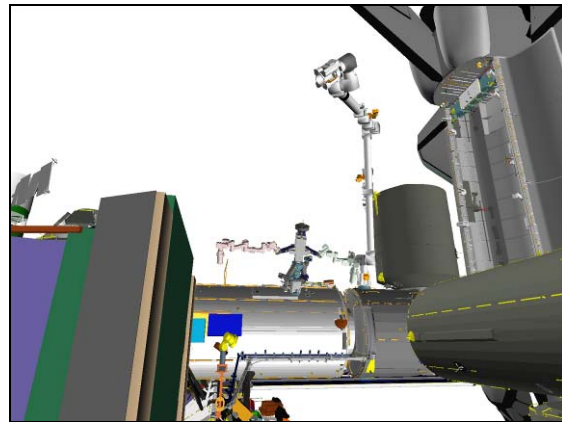


Figure 8.- Port Clear
(09: P1 Lower Outboard: +100, +20).

5. ATA PRE-GRAPPLE JOINT OCAS

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+100, +20)	22: Base Elbow (-90, 0) [24: Tip Elbow (-120, -5)]	71(MON 2): Camera B (-10, +30) [07: P1 Lower Inboard (+170, +50)]	SRMS Elbow (+160, +35)	OBSS ITVC (+80, -65)

NOTE

1. Tip Boom ► JEM, decreases to 76 cm (30 in), OBSS ITVC.
2. Base Boom ► SPDM Arm 2, closest approach 119 cm (47 in), OBSS ITVC, Camera B.

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SSRMS Joint OCAS

pick File ► Menu 1 ► Menu 2

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

SR	SY	SP	EP	WP	WY	WR
+175.0	-9.7	-109.6	-113.0	-21.7	+56.9	+70.9

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)	+145.0	+0.0	-5.0	-95.0	-40.0	+30.0	+80.0
TGT	+175.0	-9.7	-109.6	-113.0	-21.7	+56.9	+70.9
ERR	-30.0	+9.7	+104.6	+18.0	-18.3	-26.9	+9.1

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	-9.7	-109.6	-113.0	-21.7	+56.9	+70.9

MSS: SSRMS: SSRMS

Enter Mode – Standby (Verify blue)

Change Loaded Parameters ► ATA ► ATA Stow SRH

Verify 'Loaded Parameters' (three) – ATA Stow, SSRMS, SR Held

Change Unloaded Parameters ► Unloaded ► LEE Tip SRH

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

Change Display ► MBS ► Stowed ATA FGB-2 (Verify MBS>Stowed ATA FGB-2)

Verify Command – SSRMS>Internal

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

SR	SY	SP	EP	WP	WY	WR
+175.0	-9.7	-109.6	-113.0	-21.7	+56.9	+70.9
X	Y	Z	Pitch	Yaw	Roll	
-120	0	0	0.0	0.0	0.0	
FOR	Unloaded – LEE Tip, SR Held					
Disp	MBS>Stowed ATA FGB-2					

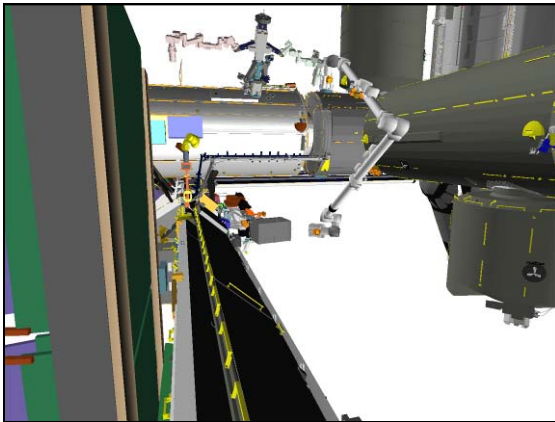


Figure 9.- ATA Pre-Grapple
(09: P1 Lower Outboard: +105, -10).

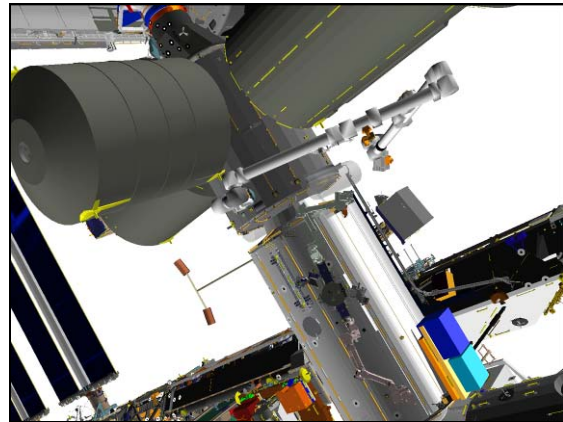


Figure 10.- ATA Pre-Grapple
(OBSS ITVC: +80, -65).

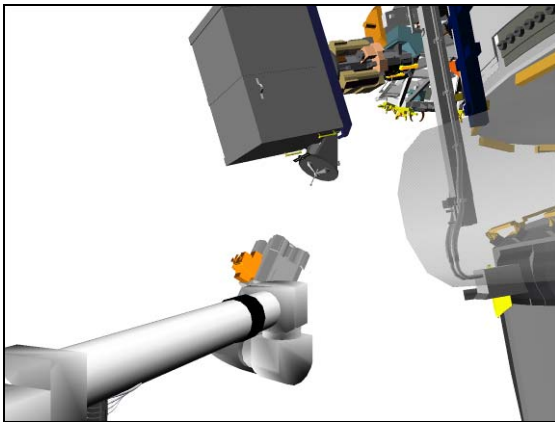


Figure 11.- ATA Pre-Grapple
(22: Base Elbow: -90, 0).

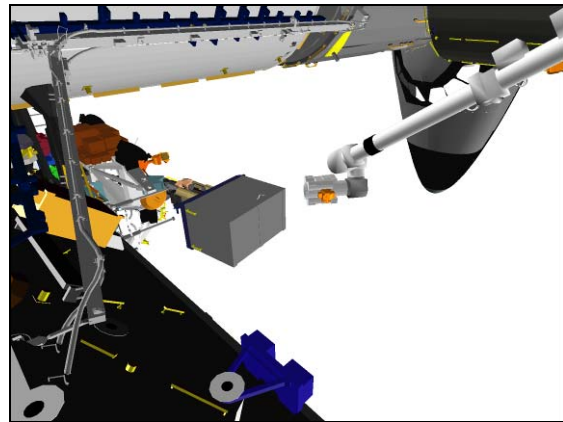


Figure 12.- ATA Pre-Grapple
(07: P1 Lower Inboard: +135, -30).

6. ATA GRAPPLE ON POA

Configure Cameras and overlays for grapple.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+105, -10) [71(MON 2): Camera B (-10, +30)]	25: Tip LEE (Zoomed out)	22: Base Elbow (-90, 0) [07: P1 Lower Inboard (+135, -30)]	SRMS Elbow (+160, +35)	OBSS ITVC (+80, -65)

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NOTE

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

- a) Tip Boom ► JEM, 76 cm (30 in) and increases, OBSS ITVC.
- b) Base Boom ► SPDM, decreases to 104 cm (41 in), OBSS ITVC.

6.1 Maneuvering to ATA Grapple

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

√Vernier

MSS: SSRMS: Rate:

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

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

Maneuver to within grapple envelope.

RHC/
THC

6.2 ATA 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

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MSS: SSRMS:

Verify Active Effector – SSRMS Tip LEE

RHC TRIGGER → Press (momentarily)

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

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

6.3 Grapple Cleanup

Verify Loaded Parameters – √

Verify 'Loaded Parameters' (three) – ATA Stow, SSRMS, SR Held

Expected ATA Grapple position:

SR	SY	SP	EP	WP	WY	WR
+175.0	-16.6	-115.2	-112.3	-8.7	+53.2	+60.8
X	Y	Z	Pitch	Yaw	Roll	
+123	+21	-56	+135.1	+0.1	-89.9	
FOR	Loaded – ATA Stow, SSRMS, SR Held					
Disp	MBS>Stowed ATA FGB-2					

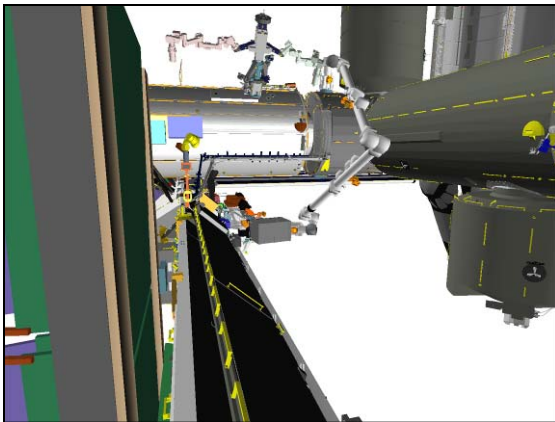


Figure 13.- ATA Grapple
(09: P1 Lower Outboard: +105, -10).

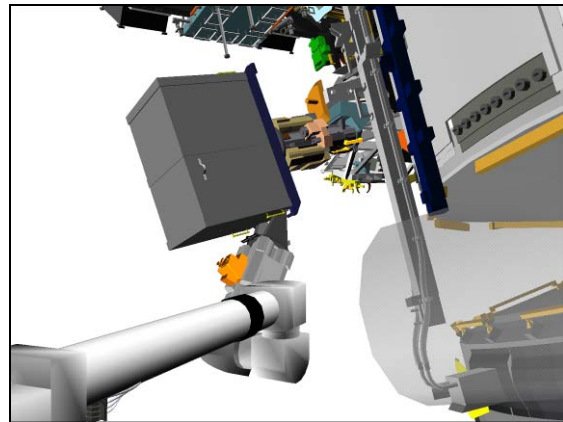


Figure 14.- ATA Grapple
(22: Base Elbow: -90, 0).

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7. POA RELEASE

7.1 Setup

Configure Cameras and overlays for ungrapple.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+105, -10) [71(MON 2): Camera B (-10, +30]	32: MBS POA (Zoomed out)	22: Base Elbow (-95, +5) [07: P1 Lower Inboard (+135, -30)]	SRMS Elbow (+160, +35)	OBSS ITVC (+80, -65)

NOTE

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

MSS: SSRMS:

Change Display ► MBS ► POA (Verify MBS>POA)

Change Command ► MBS ► POA Fly Camera (Verify MBS>POA Fly Camera)

MSS: MBS:

Verify 'POA Payload' – ATA

7.2 SSRMS Limp

MSS: SSRMS: Limp:

cmd All Limp (Verify Limp – blue)

MSS: SSRMS:

Verify all joints – Limped

7.3 POA Auto-Release

MSS: MBS: POA:

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

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

CAUTION

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

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NOTE

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

cmd Confirm (Verify RHC Trigger Hot icon)

Verify POA Mode – Auto Release

MSS: SSRMS:

Verify Active Effector – POA

RHC TRIGGER → Press (momentarily)

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

7.4 ATA Backoff

MSS: SSRMS: Limp:

cmd None Limp (Verify Standby – blue)

√Vernier

MSS: SSRMS: Rate:

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

NOTE

1. Tip Boom ► JEM, decreases to 89 cm (35 in), OBSS ITVC.
2. Base boom ► SPDM, 140 cm (55 in) and increases, OBSS ITVC.

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

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MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

THC/
RHC

Maneuver ATA to POA ATA Backoff position (within 5 cm/1 deg).
Expect THC Out.

Locked						
SR	SY	SP	EP	WP	WY	WR
+175.0	-13.5	-101.7	-110.7	-27.2	+55.0	+65.0
X	Y	Z	Pitch	Yaw	Roll	
+200	0	0	0.0	0.0	0.0	
FOR	Loaded – ATA Stow, SSRMS, SR Held					
Disp	MBS>POA					

PCS

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

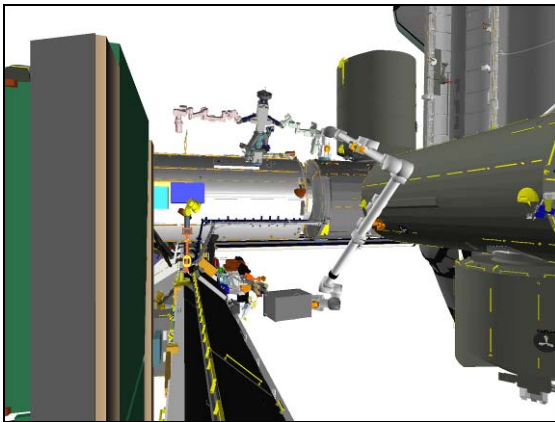


Figure 15.- ATA Backoff
(09: P1 Lower Outboard: +105, 0).

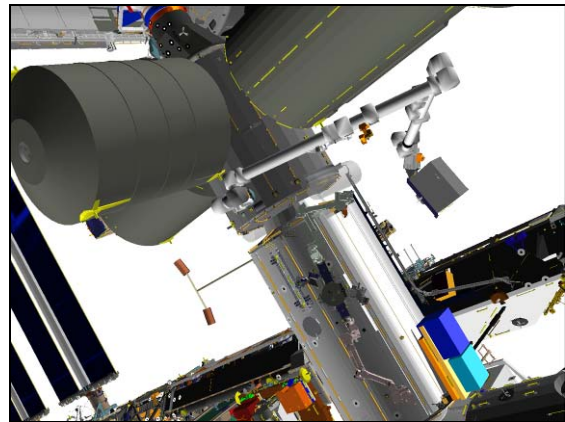


Figure 16.- ATA Backoff
(OBSS ITVC: +80, -65).

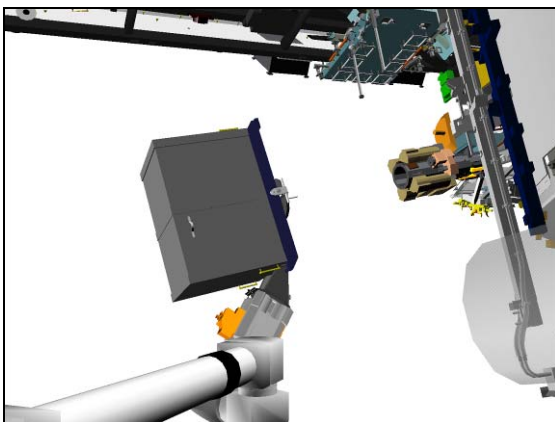


Figure 17.- ATA Backoff
(22: Base Elbow: -90, +5).

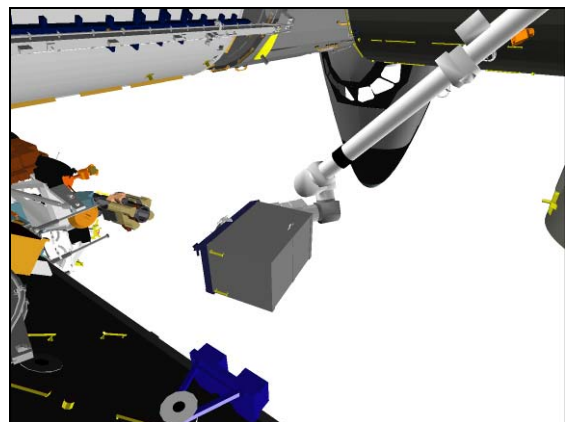


Figure 18.- ATA Backoff
(07: P1 Lower Inboard: +145, -30).

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8. POA INTERMEDIATE JOCAS

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+105, 0)	07: P1 Lower Inboard: (+155, -30) [71(MON 2): Camera B (-10, +30)]	22: Base Elbow (-95, +5)	SRMS Elbow (+160, +35)	OBSS ITVC (+80, -65)

NOTE

1. Tip Boom ► JEM, 89 cm (35 in) and increases, OBSS ITVC.
2. ATA ► CETA Cart, closest approach 107 cm (42 in), P1 Lower Inboard and P1 Lower Outboard.
3. Base Boom ► SPDM Arm 2, closest approach 130 cm (51 in), OBSS ITVC.

Change Loaded Parameters ► ATA ► ATA Mnvr Cntr SYH
Verify 'Loaded Parameters' (three) – ATA Mnvr Cntr, SSRMS, SY Held

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

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

√Vernier

MSS: SSRMS: Rate:

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

MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

pick File ► Menu 1 ► Menu 2

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

SR	SY	SP	EP	WP	WY	WR
+145.0	+0.0	-5.0	-95.0	-120.0	+0.0	+65.0

cmd Load (Verify Sequence Status – Confirm or Cancel)

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

	SR	SY	SP	EP	WP	WY	WR
(current)	+175.0	-13.5	-101.7	-110.7	-27.2	+55.0	+65.0
TGT	+145.0	+0.0	-5.0	-95.0	-120.0	+0.0	+65.0
ERR	+30.0	-13.5	-96.7	-15.7	+92.8	+55.0	+0.0

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
+145.0	+0.0	-5.0	-95.0	-120.0	+0.0	+65.0

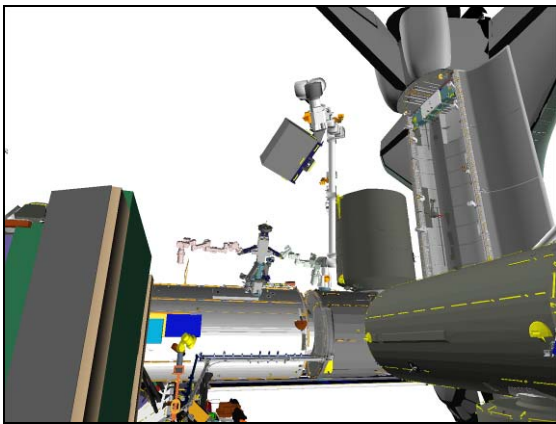


Figure 19.- POA Intermediate
(09: P1 Lower Outboard: +105, +20).

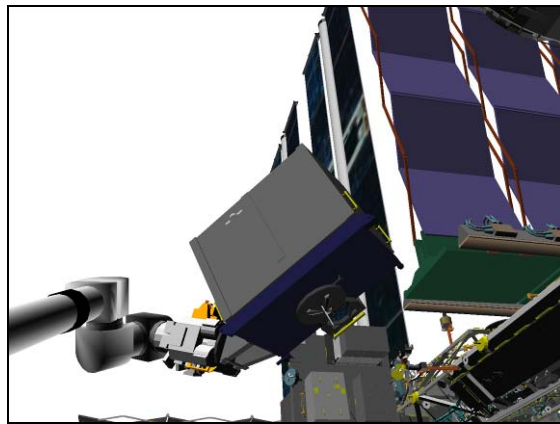


Figure 20.- POA Intermediate
(22: Base Elbow: -90, 0).

9. ESP 2 CLEARANCE 2 JOINT OCAS

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+105, +20)	22: Base Elbow (-90, 0)	03: S1 Lower Outboard (+70, +20)	SRMS Elbow (+160, +35)	OBSS ITVC (+80, -65)

NOTE

1. ATA ► SPDM, closest approach 170 cm (67 in), P1 Lower Outboard.
2. Expect Joint Auto overlay bars to appear when WP < -250.0

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RHC RATE → COARSE (Verify Coarse on PCS)

SSRMS Joint OCAS

pick File ► Menu 1 ► Menu 2

Verify 'Joint Angles' 'Destination' for ESP-2 Clearance 2 position.

SR	SY	SP	EP	WP	WY	WR
+7.7	-6.4	-2.7	-103.9	-255.1	-127.7	-79.3

cmd Load (Verify Sequence Status – Confirm or Cancel)

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

	SR	SY	SP	EP	WP	WY	WR
(current)	+145.0	+0.0	-5.0	-95.0	-120.0	+0.0	+65.0
TGT	+7.7	-6.4	-2.7	-103.9	-255.1	-127.7	-79.3
ERR	+137.3	+6.4	-2.3	+8.9	+135.1	+127.7	+144.3

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 ESP 2 Clearance 2 position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+7.7	-6.4	-2.7	-103.9	-255.1	-127.7	-79.3
X	Y	Z	Pitch	Yaw	Roll	
+320	+520	+1225	+90	0.0	±180.0	
FOR	Loaded – ATA Mnvr Cntr, SSRMS, SY Held					
Disp	ISS>ISSACS					

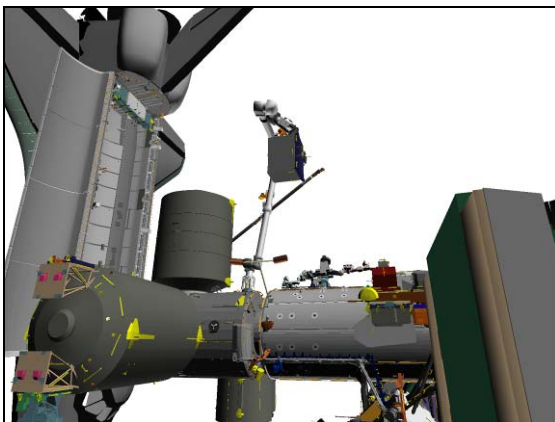


Figure 21.- ESP 2 Clearance 2
(03: S1 Lower Outboard: +75, +20).

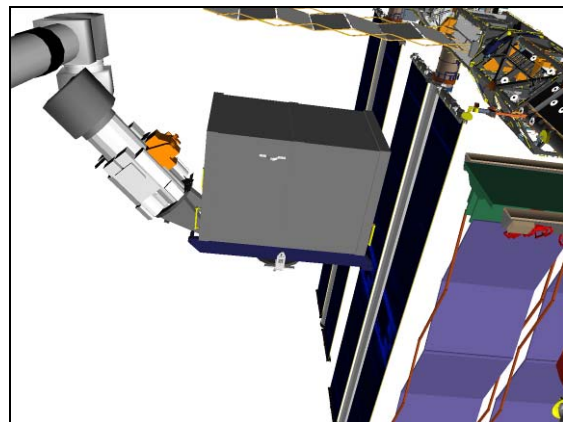


Figure 22.- ESP 2 Clearance 2
(22: Base Elbow: -80, -25).

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10. ESP 2 APPROACH MANEUVER

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
37: MBS Mast (+105. 0) [13: LAB Stbd Zenith (+25, -10)]	22: Base Elbow (-80, -25) [72(DNLK): Camera C (+10, +40)]	03: S1 Lower Outboard (+75, +20)	SRMS Elbow (+160, +35)	OBSS ITVC (+80, -65)

NOTE

1. ATA ► UHF Antenna, closest approach 94 cm (37 in), MBS Mast.
2. ATA ► LAB Stbd Zenith Camera, decreases to 127 cm (50 in), S1 Lower Outboard.

RHC RATE → VERNIER (Verify Vernier on PCS)

PCS MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

THC/
RHC Maneuver ATA to ESP 2 Approach position (within 5 cm/1 deg).
Expect -Z motion (THC up).

	Locked					
SR	SY	SP	EP	WP	WY	WR
+16.0	-6.4	-40.2	-125.6	-186.3	-128.2	-65.9
X	Y	Z	Pitch	Yaw	Roll	
+320	+520	+555	+90	0.0	±180.0	
FOR	Loaded – ATA Mnvr Cntr, SSRMS, SY Held					
Disp	ISS>ISSACS					

DCP BRAKES SSRMS → ON (Verify ON)

Notify EVA, “Ready for GCA to AGB removal.”

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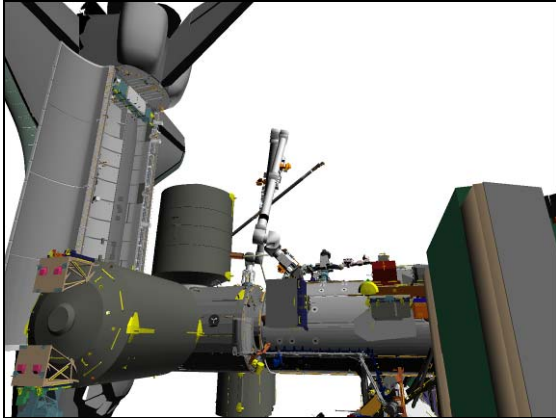


Figure 23.- ESP-2 Approach
(03: S1 Lower Outboard: +75, +20).

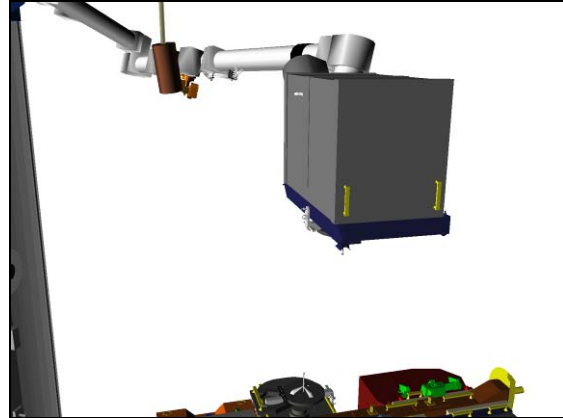


Figure 24.- ESP-2 Approach
(37: MBS Mast: +105, -15).

11. AGB REMOVAL GCA MANEUVER

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
37: MBS Mast (+105, -15) [13: LAB Stbd Zenith (+40, 0)]	24: Tip Elbow (-5, +20)	03: S1 Lower Outboard (+75, +20)	SRMS Elbow (+160, +35)	OBSS ITVC (+80, -65)

NOTE

1. ATA ► ESP 2, decreases to 86 cm (34 in), S1 Lower Outboard, Tip Elbow.
2. AGB ► ESP 2, decreases to 48 cm (19 in), S1 Lower Outboard, Tip Elbow.

On EVA GO, maneuver to AGB Removal position.

DCP BRAKES SSRMS → OFF (Verify OFF)

PCS MSS: SSRMS:

Enter Mode – Manual (Verify blue)

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

cmd Shoulder Yaw (Verify SY – Locked)

THC/
RHC

Maneuver old ATA, per EVA GCA, to AGB Removal position.
Expect -X motion (THC out).

	Locked					
SR	SY	SP	EP	WP	WY	WR
+27.8	-6.4	-41.2	-118.4	-180.0	-131.1	-48.1
X	Y	Z	Pitch	Yaw	Roll	
+170	+520	+555	+90	0.0	±180.0	
FOR	Loaded – ATA Mnvr Cntr, SSRMS, SY Held					
Disp	ISS>ISSACS					

PCS

MSS: SSRMS: SSRMS

DCP

BRAKES SSRMS → ON (Verify ON)

Give EVA GO: “Brakes on, ready for AGB removal.”

12. ESP 2 CLEARANCE POSITION MANEUVER

On EVA GO, AGB removal complete and EVA clear of ATA, maneuver to ESP 2 Clearance position:

NOTE
1. ATA ► LAB Stbd Zenith Camera, closest approach 127 cm (50 in), S1 Lower Outboard.
2. Tip Boom ► UHF Antenna, closest approach 137 cm (54 in), S1 Lower Outboard, Tip Elbow.

BRAKES SSRMS → OFF (Verify OFF)

PCS

MSS: SSRMS: SSRMS

Enter Mode – Manual (Verify blue)

1.320 EVA 3 ATA RETRIEVE

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

cmd Shoulder Yaw (Verify SY – Locked)

THC/
RHC

Maneuver ATA to ESP 2 Clearance position (within 5 cm/1 deg).
Expect +X then +Y motion (THC In then Right).

	Locked					
SR	SY	SP	EP	WP	WY	WR
+27.8	-6.4	-41.2	-118.4	-180.0	-131.1	-48.1
X	Y	Z	Pitch	Yaw	Roll	
+170	+520	+555	+90.0	0.0	±180.0	
+320						
	+940					
+320	+940	+555	+90.0	0.0	±180.0	
SR	SY	SP	EP	WP	WY	WR
+10.0	-6.4	-59.8	-85.0	-214.1	-127.7	-75.5
FOR	Loaded – ATA Mnvr Cntr, SSRMS, SY Held					
Disp	ISS>ISSACS					

AGB Install
1: X +
2: Y +
ESP 2 Clear

Enter Mode – Standby (Verify blue)



Figure 25.- ESP 2 Clearance
(03: S1 Lower Outboard: +75, +20).

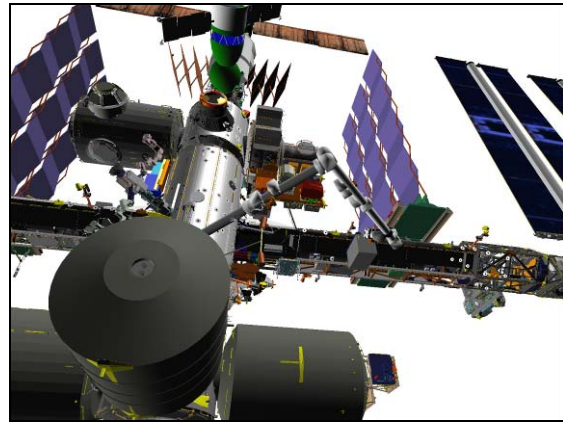


Figure 26.- ESP 2 Clearance
(72(DNLK): Camera C: +10, +40).

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13. PAYLOAD BAY PORT CLEAR JOINT OCAS

NOTE

Have shuttle crew route Camera A to MON2 (ISS Channel 71) with a pan/tilt of -5, +10.

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+100, +30)	72(DNLK): Camera C (+10, +40)	03: S1 Lower Outboard (+75, +20)	SRMS Elbow (-135, +40)	OBSS ITVC (+140, -60)
	71(MON2): Camera A (-5, +10)			

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

Change Loaded Parameters ► ATA ► ATA Mnvr Cntr SRH

Verify 'Loaded Parameters' (three) – ATA Mnvr Cntr, SSRMS, SR Held

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

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

NOTE

- Expect singularity warning for EP between +15 and -15 degrees.
- Base Boom ► SPDM Arm 2, closest approach 123 cm (48 in), S1 Lower Outboard, P1 Lower Outboard.

RHC RATE → COARSE (Verify Coarse on PCS)

PCS MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

SSRMS Joint OCAS

pick File ► Menu 1 ► Menu 2

Verify 'Joint Angles' 'Destination' for Payload Bay Port Clear position.

SR	SY	SP	EP	WP	WY	WR
+146.1	-15.5	-26.4	+71.1	-155.6	-168.5	-103.5

cmd Load (Verify Sequence Status – Confirm or Cancel)

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

	SR	SY	SP	EP	WP	WY	WR
(current)	+10.0	-6.4	-59.8	-85.0	-214.1	-127.7	-75.5
TGT	+146.1	-15.5	-26.4	+71.1	-155.6	-168.5	-103.5
ERR	-136.1	+9.1	-33.4	-156.1	-58.5	+40.8	+28.0

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 Payload Bay Port Clear position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+146.1	-17.0	-24.1	+72.5	-159.6	-169.0	-104.9
X	Y	Z	Pitch	Yaw	Roll	
-3110	-210	-1350	-171.5	+64.3	+162.7	
FOR	Loaded – ATA Mnvr Cntr, SSRMS, SR Held					
Disp	ISS>OBAS					

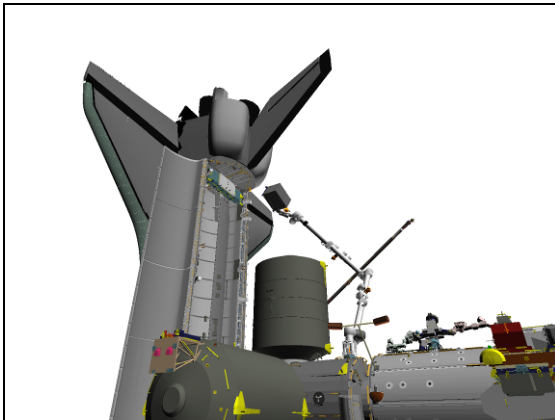


Figure 27.- Payload Bay Port Clear (03: S1 Lower Outboard: +60, +30).

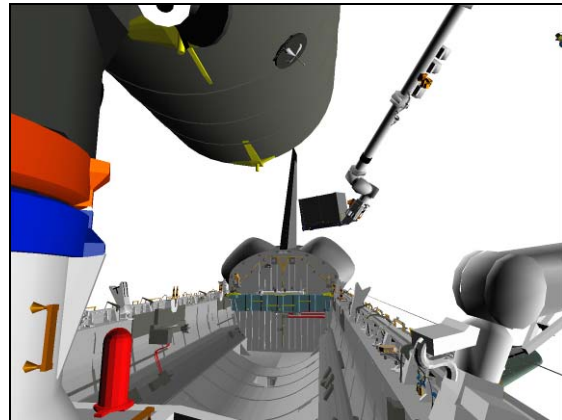


Figure 28.- Payload Bay Port Clear (71: Camera A: -5, +10).

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14. ATA LMC APPROACH MANEUVER

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+130, +30)	71(MON2): Camera A (-5, +10)	03: S1 Lower Outboard (+60, +30)	SRMS Elbow (-135, +40)	OBSS ITVC (+140, -60)

NOTE

1. ATA ► Orbiter Aft Bulkhead, closest approach 86 cm (34 in), OBSS ITVC.
2. ATA ► MPM, closest approach 79 cm (31 in), Camera A.
3. ATA ► LMC, decreases to 130 cm (51 in), Camera A.

RHC RATE → VERNIER (Verify Vernier on PCS)

PCS MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

THC/
RHC Maneuver ATA to ATA LMC Approach position (within 5 cm/1 deg).
Expect +Z motion (THC Down).

Locked	SR	SY	SP	EP	WP	WY	WR
	+146.1	-22.8	-14.7	56.9	-154.3	-171.2	-110.4
	X	Y	Z	Pitch	Yaw	Roll	
	-3135	-250	-1200	-171.4	64.2	162.7	
FOR	Loaded – ATA Mnvr Cntr, SSRMS, SR Held						
Disp	ISS>ISSACS						

Notify EVA: “At LMC Approach position, ready for GCA to ATA release position.”

15. ATA RELEASE POSITION GCA MANEUVER

On EVA GO, maneuver to ATA release position:

NOTE

1. ATA ► Orbiter Aft Bulkhead, closest approach 86 cm (34 in), OBSS ITVC.
2. ATA ► LMC, decreases to 71 cm (28 in), Camera A.
3. Base Boom ► MPLM, decreases to 102 cm (40 in), SRMS Elbow.

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THC/
RHC Maneuver ATA, per EVA GCA, to ATA Release position.
Expect +Y or +Z motion (THC Right/Down).

Locked						
SR	SY	SP	EP	WP	WY	WR
+146.1	-19.8	-4.3	+57.1	-164.5	-170.0	-107.6
X	Y	Z	Pitch	Yaw	Roll	
-3135	-22	-1150	-171.5	+64.3	+162.7	
FOR	Loaded – ATA Mnvr Cntr, SSRMS, SR Held					
Disp	ISS>OBAS					

PCS MSS: SSRMS:

Enter Mode – Standby (Verify blue)

Notify EVA: “In standby mode, setting up for ATA release.”

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

16. OLD ATA RELEASE AND BACKOFF

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+130, +30)	25: Tip LEE (Zoomed out)	71(MON2): Camera A (-5, +10)	SRMS Elbow (-135, +40)	OBSS ITVC (+140, -60)

NOTE

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

MSS: SSRMS:

Set ‘Scale’ ‘Vernier’ Rate Scale: As Desired

√Vernier

16.1 SETUP FOR ATA RELEASE

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

On EVA GO, ready for ATA release:

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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

MSS: SSRMS:

Verify Active Effector – SSRMS Tip LEE

16.2 SSRMS RELEASE AND BACKOFF

NOTE

Base boom ► MPLM, 93 cm (37 in) and increases, SRMS Elbow.

Notify EVA of Trigger Pull.

RHC TRIGGER → Press (momentarily)

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

Notify EVA when beginning backoff maneuver and when clear of the grapple pin.

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THC/
RHC

Maneuver to ATA Backoff position (within 10 cm/5 deg).
Expect -X motion (THC Out).

Locked						
SR	SY	SP	EP	WP	WY	WR
+146.1	-17.9	-22.3	+78.2	-167.2	-169.3	-105.8
X	Y	Z	Pitch	Yaw	Roll	
-2985	-240	-1341	-117.8	+33.0	+119.7	
FOR	Unloaded – LEE Tip, SR Held					
Disp	ISS>OBAS					

PCS

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

MSS: SSRMS:

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

Notify EVA: SSRMS is clear of the ATA.

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

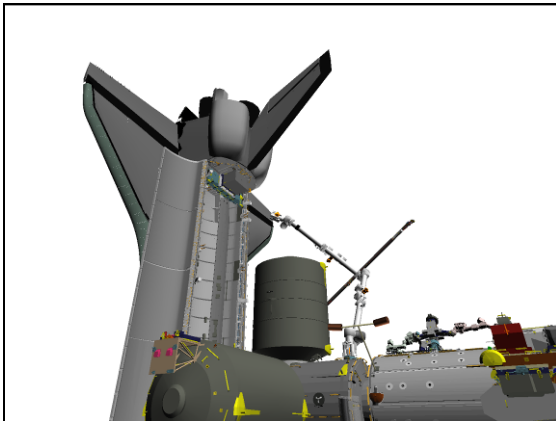


Figure 29.- ATA Backoff
(03: S1 Lower Outboard: +60, +30).

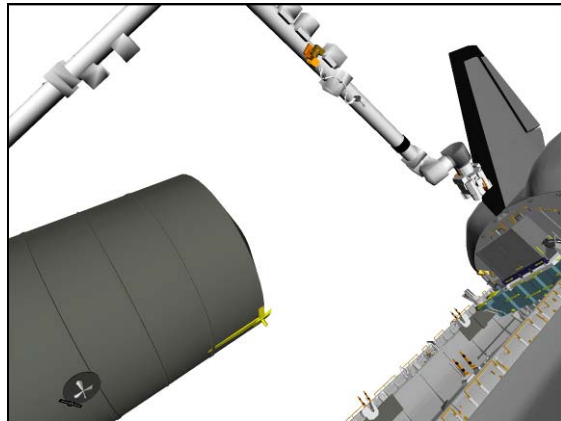


Figure 30.- ATA Backoff
(SRMS Elbow: -135, +40).

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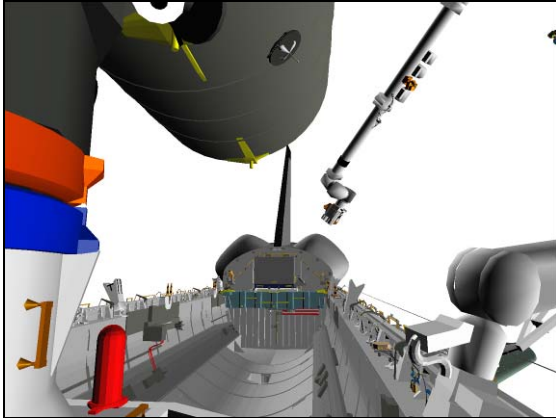


Figure 31.- ATA Backoff
(71: Camera A: -5, +10).

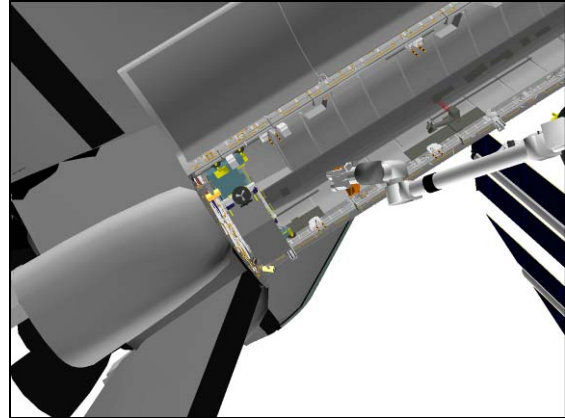


Figure 32.- ATA Backoff
(OBSS ITVC: +140, -60).

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1. SETUP

NOTE

Have shuttle crew route Camera C to MON 1 with a pan/tilt of +25, +20.

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+130,+30)	24: Tip Elbow (-5, +5)	03: S1 Lower Outboard (+55, +30)	Camera C (+25, +20)	OBSS ITVC (+100, -70)

PCS MSS: SSRMS:

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

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

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

Verify SSRMS at ATA Backoff position (within 10 cm/5 deg).

SR	SY	SP	EP	WP	WY	WR
+146.1	-17.9	-22.3	+78.2	-167.2	-169.3	-105.8
X	Y	Z	Pitch	Yaw	Roll	
+1395	-243	+1897	-26.8	+33.1	+119.9	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>ISSACS					

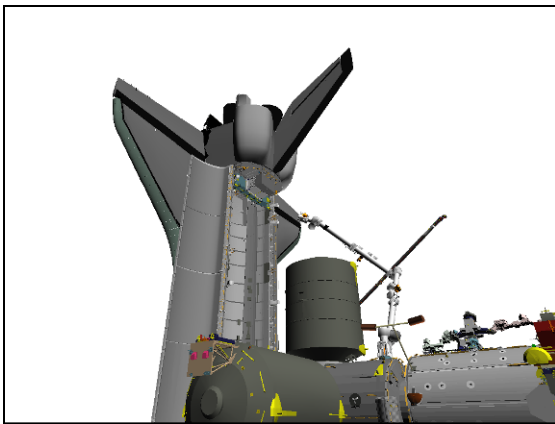


Figure 1.- ATA Backoff
(03: S1 Lower Outboard: +55, +30).

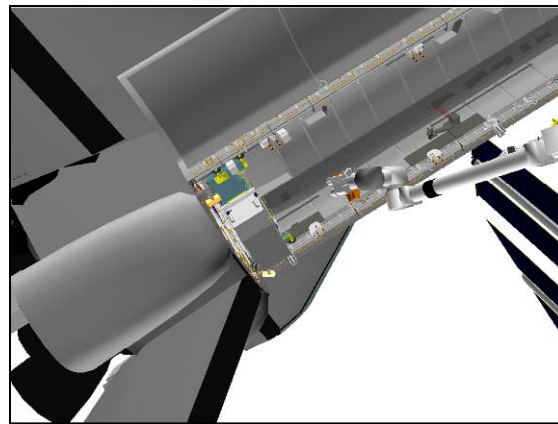


Figure 2.- ATA Backoff
(OBSS ITVC: +140, -60).

DCP BRAKES SSRMS → OFF (Verify OFF)

RHC RATE → COARSE (Verify Coarse on PCS)

2. LWAPA INTERMEDIATE JOINT OCAS

PCS MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

pick File ► Menu 1 ► Menu 2

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

SR	SY	SP	EP	WP	WY	WR
+60.0	+120.0	-95.0	+77.0	-140.0	-100.0	-40.0

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)	+146.1	-17.9	-22.3	+78.2	-167.2	-169.3	-105.8
TGT	+60.0	+120.0	-95.0	+77.0	-140.0	-100.0	-40.0
ERR	+86.1	-137.9	+72.7	+1.2	-27.2	-69.3	-65.8

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
+60.0	+120.0	-95.0	+77.0	-140.0	-100.0	-40.0

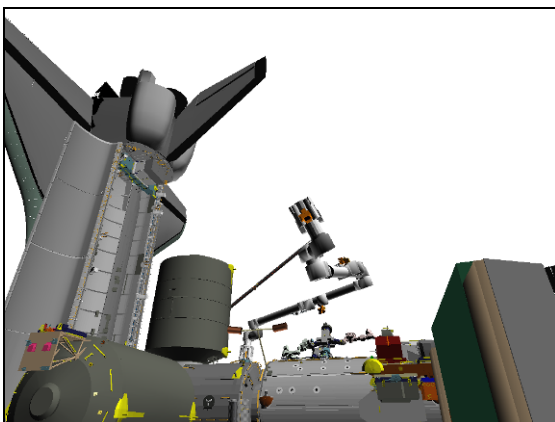


Figure 3.- LWAPA Intermediate
 (03: S1 Lower Outboard: +75, +30).

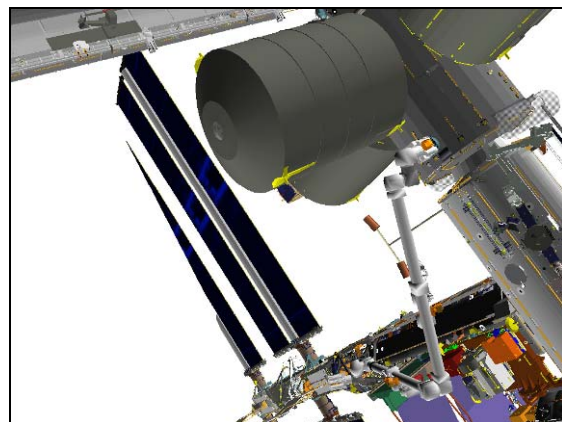


Figure 4.- LWAPA Intermediate
 (OBSS ITVC: +100, -70).

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3. LWAPA APPROACH JOINT OCAS

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+110, +10)	24: Tip Elbow (-5, +5)	03: S1 Lower Outboard (+75, +30)	Camera C (+25, +20)	OBSS ITVC (+100, -70)

NOTE

SP joint ► MPLM decreases to 36 cm (14 in), OBSS ITVC, P1 Lower Outboard.

RHC RATE → VERNIER (Verify Vernier on PCS)

SSRMS Joint OCAS

pick File ► Menu 1 ► Menu 2

Verify 'Joint Angles' 'Destination' for LWAPA Approach position.

SR	SY	SP	EP	WP	WY	WR
+4.7	+153.3	-111.6	+76.8	-126.1	-45.6	+24.0

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)	+60.0	+120.0	-95.0	+77.0	-140.0	-100.0	-40.0
TGT	+4.7	+153.3	-111.6	+76.8	-126.1	-45.6	+24.0
ERR	+55.3	-33.3	+16.6	+0.2	-13.9	-54.4	-64.0

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 LWAPA Approach position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+4.7	+153.3	-111.6	+76.8	-126.1	-45.6	+24.0
X	Y	Z	Pitch	Yaw	Roll	
+1000	+1200	+950	-71.2	+6.0	+107.8	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>ISSACS					

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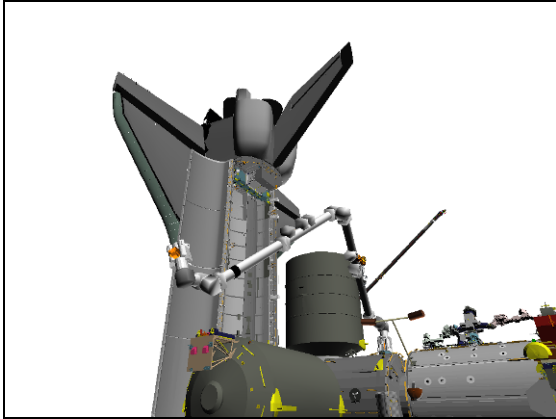


Figure 5.- LWAPA Approach
(03: S1 Lower Outboard: +55, +30).

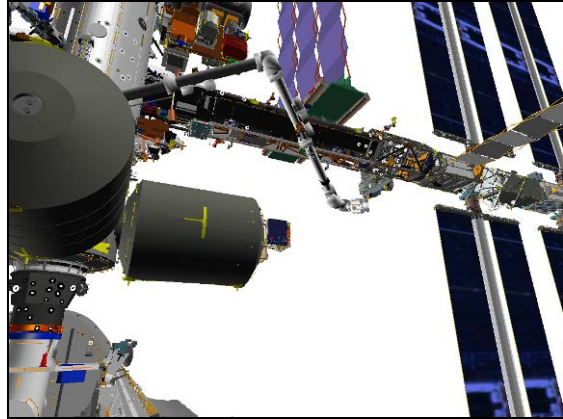


Figure 6.- LWAPA Approach
(72: Camera C: +25, +20).

4. APFR INSTALL MANEUVER

NOTE

Have shuttle crew route Camera C to MON 1 with a pan/tilt of +25, +20.

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+110,+10) Focal Length: 30 mm	24: Tip Elbow (+5, +10)	03: S1 Lower Outboard (+55, +15)	Camera C (+25, +20)	OBSS ITVC (+100, -70)

NOTE

WY Joint ► Columbus Cargo Platform decreases to 43 cm (17 in), Tip Elbow.

MSS: SSRMS: SSRMS

Enter Mode – Manual (Verify blue)

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

cmd Shoulder Yaw (Verify SY – Locked)

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THC/
RHC

Maneuver to APFR Install Intermediate position (within 5 cm/1 deg).
Expect -Z (THC Up).

	Locked					
SR	SY	SP	EP	WP	WY	WR
+9.7	+153.3	-98.1	+73.2	-138.2	-47.0	+17.7
X	Y	Z	Pitch	Yaw	Roll	
+1000	+1200	+750	-71.2	+6.0	+107.8	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>ISSACS					

Notify EVA: “Ready for GCA to APFR Install position.”

PCS

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

On EVA GO, maneuver to APFR install position:

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

THC/
RHC

Maneuver, per EVA GCA, to APFR Install.
Expect -Y (THC Left).

	Locked					
SR	SY	SP	EP	WP	WY	WR
+10.4	+153.3	-103.8	+89.8	-149.5	-47.2	+17.0
X	Y	Z	Pitch	Yaw	Roll	
+1000	+1060	+750	-71.2	+6.0	+107.8	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>ISSACS					

PCS

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

Notify EVA: “In standby. GO to install APFR.”

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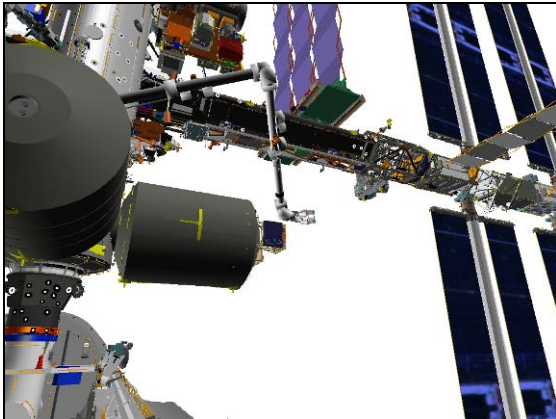


Figure 7.- APFR Install
(72: Camera C: +25, +20).

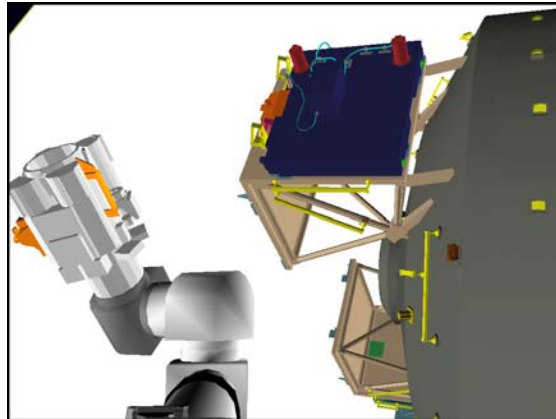


Figure 8.- APFR Install
(24: Tip Elbow: +5, +10).

5. SETUP FOR EVA INGRESS

Change Unloaded Parameters ► EVA ► Chest 12/NN/F/6 SYH
Verify 'Unloaded Parameters' (two) – Chest 12/NN/F/6, SY Held

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

Expected APFR Install position.

SR	SY	SP	EP	WP	WY	WR
+10.4	+153.3	-103.8	+89.8	-149.5	-47.2	+17.0
X	Y	Z	Pitch	Yaw	Roll	
+1053	+935	+901	+105.2	-78.0	-93.8	
FOR	Unloaded – Chest 12/NN/F/6, SY Held					
Disp	ISS>ISSACS					

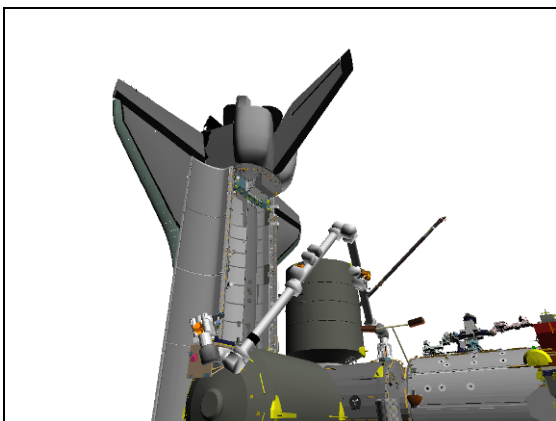


Figure 9.- APFR Install Position
(03: S1 Lower Outboard: +55, +30).

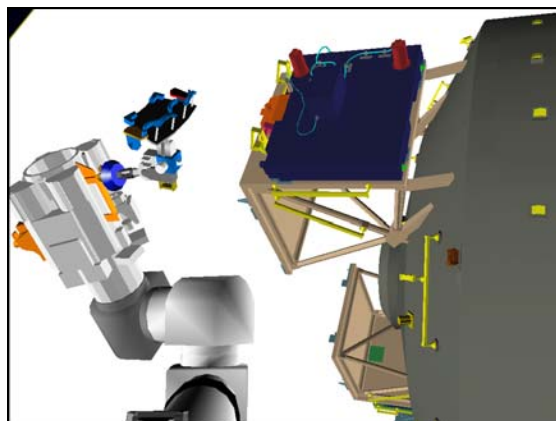


Figure 10.- APFR Install Position
(24: Tip Elbow: +5, +10).

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6. EVA INGRESS POSITION MANUEVER

On EVA GO, APFR Installed, maneuver to LWAPA Backoff position.

<u>NOTE</u>	
1.	APFR ► Columbus Cargo Platform decreases to 46 cm (18 in), Tip Elbow.
2.	WY ► Columbus Cargo Platform, 43 cm (17 in) and increases, Tip Elbow.
3.	Base Boom ► UHF Antenna, decreases to 97 cm (38 in), P1 Lower Outboard, OBSS ITVC.

PCS

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

THC/
RHC

Maneuver SSRMS to LWAPA Backoff position.
Expect +Y/-Z (THC Right/Up).

	Locked					
SR	SY	SP	EP	WP	WY	WR
+13.8	+153.3	-91.4	+77.7	-151.3	-48.0	+12.7
X	Y	Z	Pitch	Yaw	Roll	
+1053	+1000	+775	+105.2	-78.0	-93.8	
FOR	Unloaded – Chest 12/NN/F/6, SY Held					
Disp	ISS>ISSACS					

Notify EVA: “Ready for GCA to APFR Ingress position.”

THC/
RHC

Maneuver SSRMS, per EVA GCA, to APFR Ingress position.
Expect +X (THC In).

	Locked					
SR	SY	SP	EP	WP	WY	WR
+9.8	+153.3	91.3	+76.1	-148.0	-47.0	+17.7
X	Y	Z	Pitch	Yaw	Roll	
+1125	+1000	+775	+105.3	-78.0	-93.6	
FOR	Unloaded – Chest 12/NN/F/6, SY Held					
Disp	ISS>ISSACS					

DCP

BRAKES SSRMS → ON (Verify ON)

Give EVA GO to ingress the APFR.

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7. LWAPA REMOVAL

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+110,+10) Focal Length: 30 mm	24: Tip Elbow (-5, +10)	03: S1 Lower Outboard (+55, +15)	Camera C (+25, +20)	OBSS ITVC (+100, -70)

NOTE

1. Limit EVA body roll right (RHC tilt right) motion due to clearance concerns Base boom ≥ UHF Antenna, Wrist Cluster ► Columbus Cargo Platform.
2. Base Boom ► UHF antenna, decreases to 74 cm (29 in), P1 Lower Outboard, OBSS ITVC.
3. Wrist Cluster ► Columbus Cargo Platform, decreases to 69 cm (27 in), Tip Elbow.
4. SP Joint ► MPLM, decreases to 46 cm (18 in), P1 Lower Outboard, OBSS ITVC.
5. APFR ► Columbus Cargo Platform, decreases to 51 cm (20 in), Tip Elbow, Camera C.

On EVA GO, maneuver to LWAPA removal:

DCP BRAKES SSRMS → OFF (Verify OFF)

PCS MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

THC/
RHC Maneuver SSRMS, per EVA GCA, to LWAPA removal position. Expect -X/-Z (THC Out/Up).

	Locked					
SR	SY	SP	EP	WP	WY	WR
+12.7	+153.3	-87.2	+74.2	-151.6	-47.8	+14.0
X	Y	Z	Pitch	Yaw	Roll	
+1100	+1000	+725	+105.2	-78.0	-93.8	
FOR	Unloaded – Chest 12/NN/F/6, SY Held					
Disp	ISS>ISSACS					

DCP BRAKES SSRMS → ON (Verify ON)

Notify EVA: “Brakes on. GO for LWAPA removal.”

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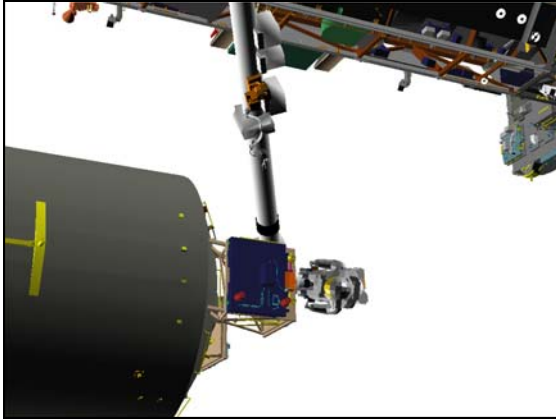


Figure 11.- LWAPA Removal
(72: Camera C: +25, +20).

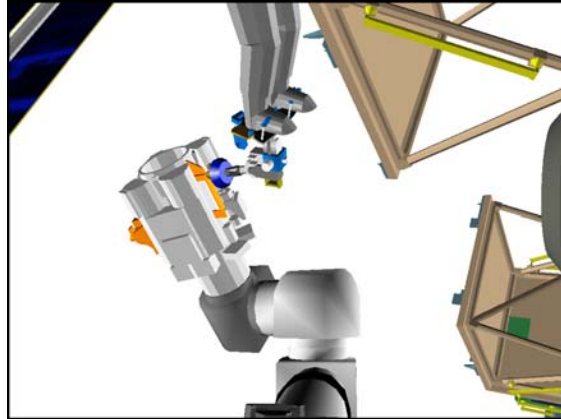


Figure 12.- LWAPA Removal
(24: Tip Elbow: -5, +10).

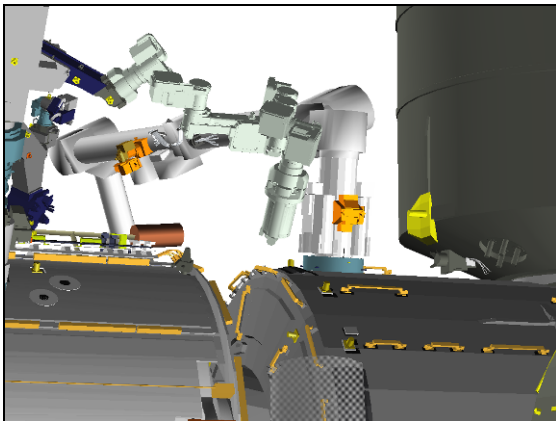


Figure 13.- LWAPA Removal
(09: P1 Lower Outboard: +110, +10, Focal Length: 30 mm).

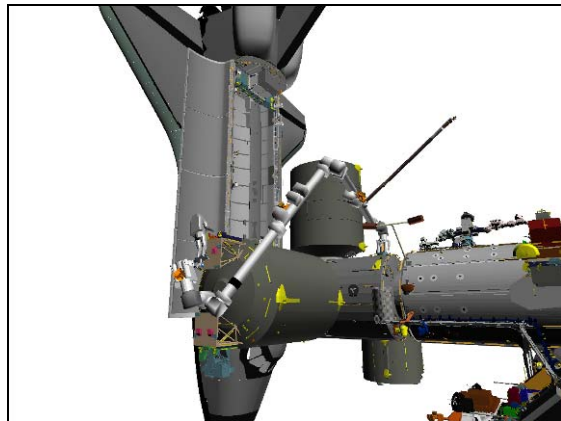


Figure 14.- LWAPA Removal
(03: S1 Lower Outboard: +55, +15).

8. LWAPA CLEARANCE MANEUVER

NOTE

1. Base Boom ► UHF antenna, 66 cm (26 in) closest approach, P1 Lower Outboard, OBSS ITVC.
2. Wrist Cluster ► Columbus Cargo Platform, 69 cm (27 in) and increases, Tip Elbow.
3. APFR ► Columbus Cargo Platform, 51 cm (20 in) and increases, Tip Elbow, Camera C.

On EVA GO, maneuver to LWAPA Clearance position:

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 EVA to LWAPA Clearance position (within 10 cm/2 deg).
Expect +Y then +Z motion (THC Right then Down).

LWAPA Removal 1: Y + 2: Z + LWAPA Clearance		Locked					
	SR	SY	SP	EP	WP	WY	WR
	+12.7	+153.3	-87.2	+74.2	-151.6	-47.8	+14.1
	X	Y	Z	Pitch	Yaw	Roll	
	+1100	+1000	+725	+105.2	-78.0	-93.8	
		+1050					
			+1100				
	+1100	+1050	+1100	+105.2	-78.0	-93.8	
	SR	SY	SP	EP	WP	WY	WR
	+2.4	+153.3	-112.7	+78.9	-126.2	-45.0	+26.7
FOR	Unloaded – Chest 12/NN/F/6, SY Held						
Disp	ISS>ISSACS						

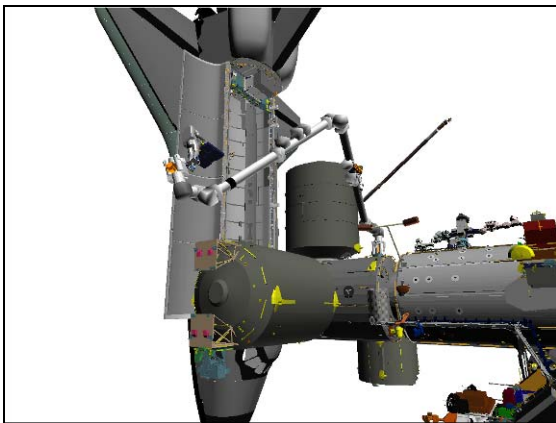


Figure 15.- LWAPA Clearance
(03: S1 Lower Outboard: +55, +15).

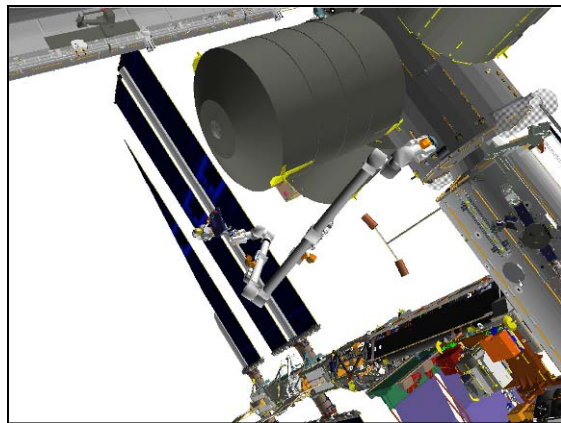


Figure 16.- LWAPA Clearance
(OBSS ITVC: +100, -70).

PCS

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

Change Unloaded Parameters ► EVA ► Chest 12/NN/F/6 SRH
Verify 'Unloaded Parameters' (two) – Chest 12/NN/F/6, SR Held

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

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

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9. MPLM CLEARANCE JOINT OCAS

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+130,+30) Zoomed Out	24: Tip Elbow (-5, +30)	03: S1 Lower Outboard (+55, +15)	Camera C (+25, +20)	OBSS ITVC (+100, -70)

MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

pick File ► Menu 1 ► Menu 2

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

SR	SY	SP	EP	WP	WY	WR
+60.0	+120.0	-95.0	+105.0	-140.0	-60.0	+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)	+2.4	+153.3	-112.7	+78.9	-126.2	-45.0	+26.7
TGT	+60.0	+120.0	-95.0	+105.0	-140.0	-60.0	+100.0
ERR	-57.6	+33.3	-17.7	-26.1	+13.8	+15.0	-73.3

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
+60.0	+120.0	-95.0	+105.0	-140.0	-60.0	+100.0

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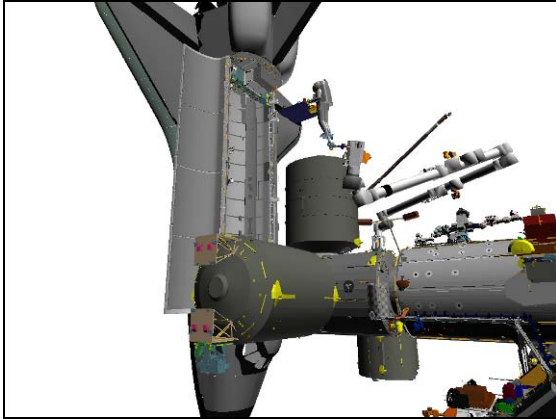


Figure 17.- MPLM Clearance
(03: S1 Lower Outboard: +55, +15).

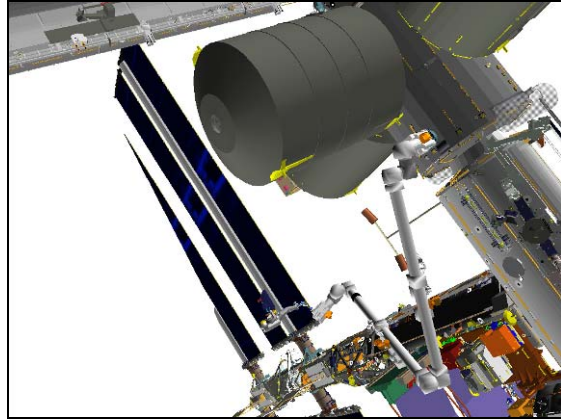


Figure 18.- MPLM Clearance
(OBSS ITVC: +100, -70).

10. PAYLOAD BAY APPROACH JOINT OCAS

NOTE

Have shuttle crew route SRMS Elbow to MON 1 with a pan/tilt of -130, +40 and route Camera C to DNLK (ISS Channel 72).

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+130,+30)	71(MON 2): Camera A (-5, +10)	03: S1 Lower Outboard (+55, +20)	SRMS Elbow (-135, +40)	OBSS ITVC (+140, -60)

NOTE

Expect Singularity warning when both the Shoulder Yaw and Wrist Yaw joints pass through +90/-90 degrees.

SSRMS Joint OCAS

pick File ► Menu 1 ► Menu 2

Verify 'Joint Angles' 'Destination' for Payload Bay Approach position.

SR	SY	SP	EP	WP	WY	WR
+130.2	+3.1	-23.3	+110.2	-176.5	-142.1	+190.3

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON

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

	SR	SY	SP	EP	WP	WY	WR
(current)	+60.0	+120.0	-95.0	+105.0	-140.0	-60.0	+100.0
TGT	+130.2	+3.1	-23.3	+110.2	-176.5	-142.1	+190.3
ERR	-70.2	+116.9	-71.7	-5.2	+36.5	+82.1	-90.3

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 Angles.

SR	SY	SP	EP	WP	WY	WR
+130.2	+3.1	-23.3	+110.2	-176.5	-142.1	+190.3

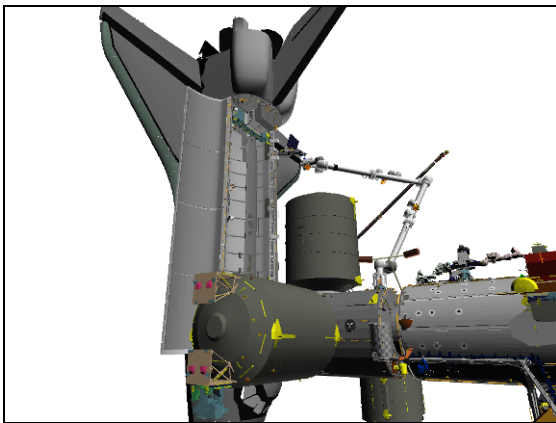


Figure 19.- Payload Bay Approach (03: S1 Lower Outboard: +55, +20).

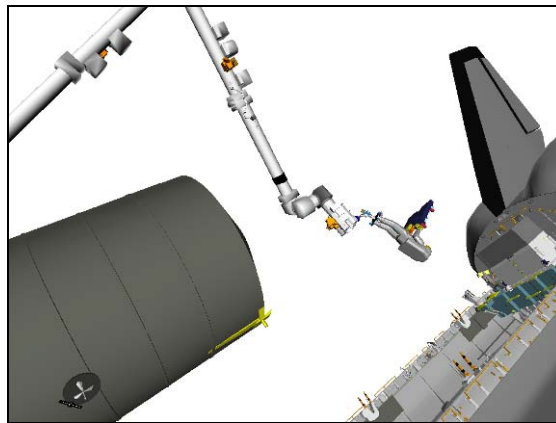


Figure 20.- Payload Bay Approach (SRMS Elbow: -135, +40).

11. LMC APPROACH MANEUVER

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

THC/
RHC

Maneuver to LMC Approach position (within 5 cm/1 deg).
Expect +Z (THC Down).

Locked						
SR	SY	SP	EP	WP	WY	WR
+130.2	-15.3	+3.1	+82.5	-189.0	-144.2	+167.4
X	Y	Z	Pitch	Yaw	Roll	
-2875	-33	-955	+159.0	-0.4	+1.9	
FOR	Unloaded – Chest 12/NN/F/6, SR Held					
Disp	ISS>OBAS					

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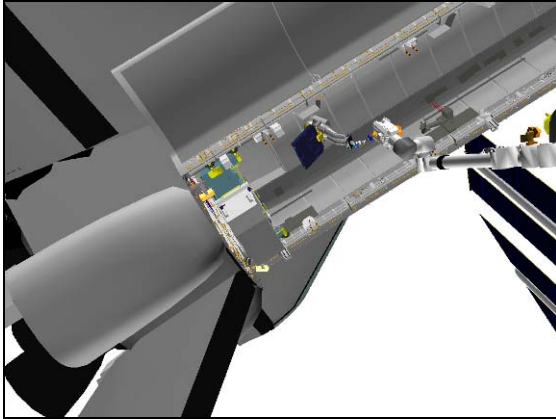


Figure 21.- LMC Approach
(OBSS ITVC: +140, -60).

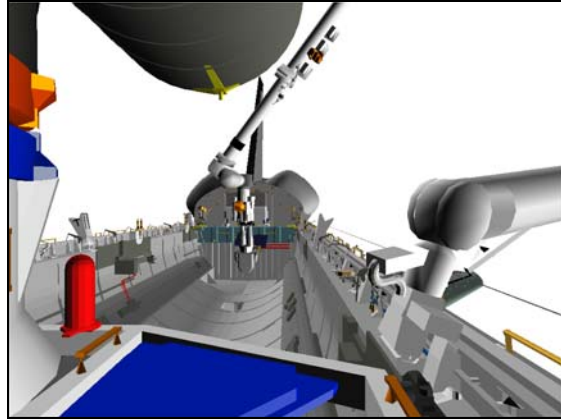


Figure 22.- LMC Approach
(71: Camera A: -5, +10).

12. LWAPA INSTALL POSITION MANEUVER

NOTE

1. To increase the clearance between the Base Boom and the MPLM: Command EVA body roll right (RHC tilt right). Note that axis of rotation is about the EVA chest.
2. Base Boom ► MPLM, decreases to 56 cm (22 in), SRMS Elbow camera.
3. APFR ► LMC, decreases to 81 cm (32 in), OBSS ITVC.

On EVA “GO”, maneuver to LWAPA Install position

THC/
RHC

Maneuver, per EVA GCA, to LWAPA Install position.
Expect -X (THC Out).

Locked						
SR	SY	SP	EP	WP	WY	WR
+130.2	-10.1	+10.4	+54.7	-164.8	-143.2	+173.8
X	Y	Z	Pitch	Yaw	Roll	
-3140	-33	-955	+159.0	-0.4	+1.9	
FOR	Unloaded – Chest 12/NN/F/6, SR Held					
Disp	ISS>OBAS					

DCP

BRAKES SSRMS → ON (Verify ON)

Give EVA GO: “Brakes On, ready to install LWAPA.”

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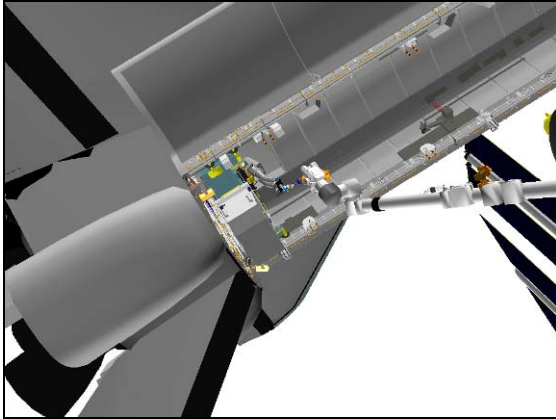


Figure 23.- LWAPA Install
(OBSS ITVC: +140, -60).

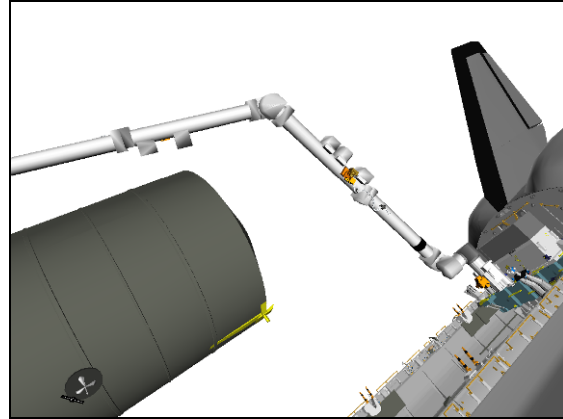


Figure 24.- LWAPA Install
(SRMS Elbow: -135, +40).

13. LMC CLEARANCE POSITION MANEUVER

On EVA GO, maneuver to LMC 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)

THC/
RHC Maneuver EVA to LMC Clearance position (within 10 cm/2 deg).
Expect +X/-Z (THC In/Up).

Locked						
SR	SY	SP	EP	WP	WY	WR
+130.2	+10.0	-32.3	+110.2	-162.1	-142.5	+199.1
X	Y	Z	Pitch	Yaw	Roll	
-2940	-33	-1500	+159.0	-0.4	+1.9	
FOR	Unloaded – Chest 12/NN/F/6, SR Held					
Disp	ISS>OBAS					

PCS MSS: SSRMS:

Enter Mode – Standby (Verify blue)

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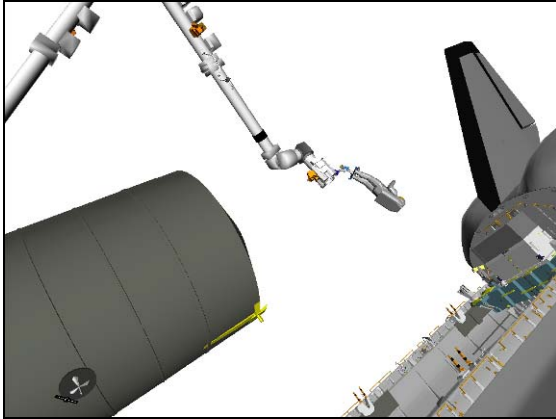


Figure 25.- LMC Clearance
(SRMS Elbow: -135, +40).

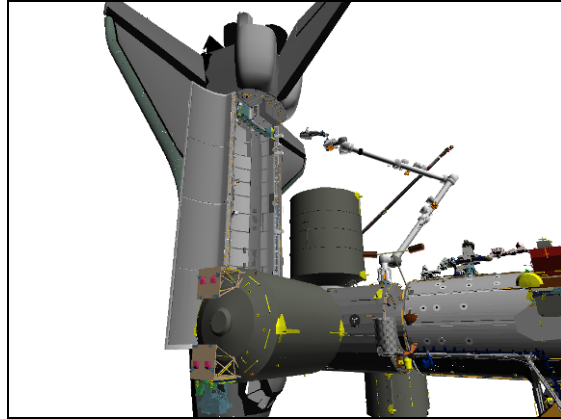


Figure 26.- LMC Clearance
(03 S1 Lower Outboard: +55, +20).

14. JEM CLEARANCE 1 JOINT OCAS

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+130,+30)	71(MON 2): Camera A (-5, +10) [24: Tip Elbow (-5, +10)]	03: S1 Lower Outboard (+55, +20)	SRMS Elbow (-135, +40)	OBSS ITVC (+140, -60)

Verify 'Unloaded Parameters' (two) – Chest 12/NN/F/6, SR Held

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

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

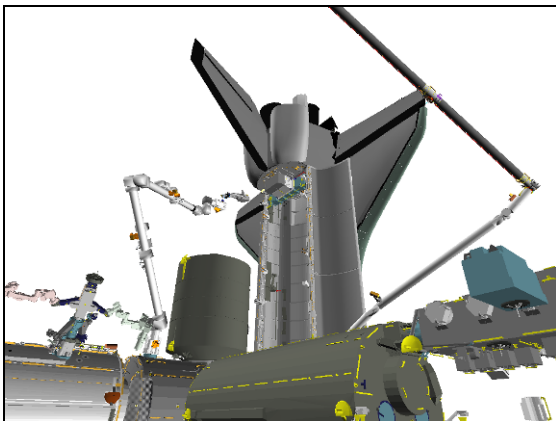


Figure 27.- LMC Clearance
(09: P1 Lower Outboard: +130, +30).

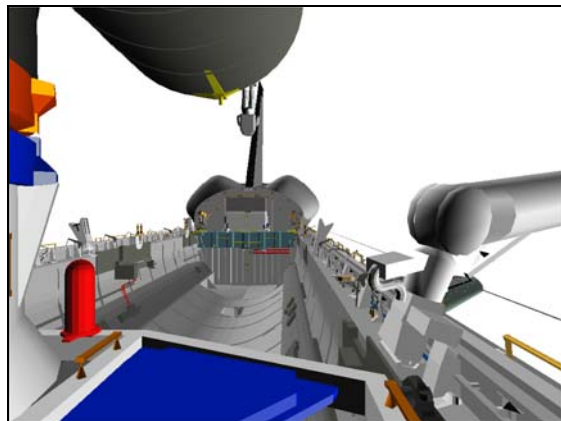


Figure 28.- LMC Clearance
(71: Camera A: -5, +10).

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MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

pick File ► Menu 1 ► Menu 2

Verify 'Joint Angles' 'Destination' for JEM Clearance 1 position.

SR	SY	SP	EP	WP	WY	WR
0.0	-5.0	-10.0	+80.0	-70.0	-80.0	+190.0

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)	+130.2	+3.4	-22.2	104.4	-171.6	-142.1	+190.7
TGT	0.0	-5.0	-10.0	+80.0	-70.0	-80.0	+190.0
ERR	+130.2	+8.4	-12.2	+24.4	-101.6	-62.1	+0.7

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
0.0	-5.0	-10.0	+80.0	-70.0	-80.0	+190.0

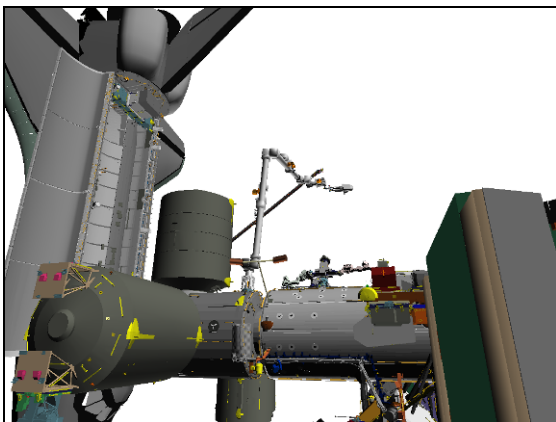


Figure 29.- JEM Clearance 1
(03: S1 Lower Outboard: +75, +20).

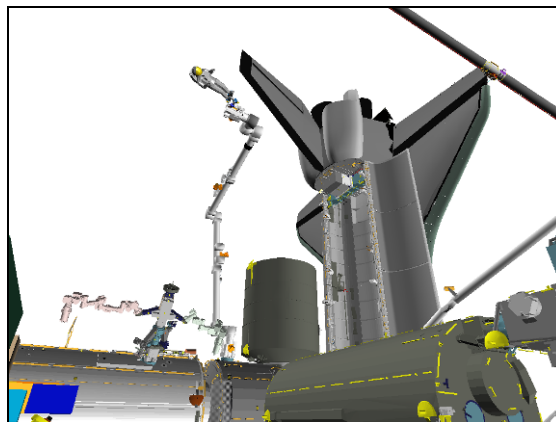


Figure 30.- JEM Clearance 1
(09: P1 Lower Outboard: +120, +30).

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15. JEM CLEARANCE 2 JOINT OCAS

NOTE

Have shuttle crew route Camera B to MON 2 (ISS Channel 71) with a pan/tilt of 0, +30. Adjust Camera C pan/tilt to +5, +30, zoomed out.

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+130,+30)	71(MON 2): Camera B (0, +30) [24: Tip Elbow (+15, +10)]	03: S1 Lower Outboard (+55, +20)	SRMS Elbow (+170, +40)	OBSS ITVC (+80, -65)

SSRMS Joint OCAS

pick File ► Menu 1 ► Menu 2

Verify 'Joint Angles' 'Destination' for JEM Clearance 2 position.

SR	SY	SP	EP	WP	WY	WR
0.0	-5.0	+50.0	+80.0	0.0	-120.0	+190.0

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)	0.0	-5.0	-10.0	+70.0	-70.0	-80.0	+190.0
TGT	0.0	-5.0	+50.0	+80.0	0.0	-120.0	+190.0
ERR	0.0	0.0	-60.0	-10.0	-70.0	+40.0	0.0

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

DCP AUTO SEQ → PROC

PCS MSS: SSRMS: SSRMS

Verify Posn Hold – orange

Verify Joint Angle values.

SR	SY	SP	EP	WP	WY	WR
0.0	-5.0	+50.0	+80.0	0.0	-120.0	+190.0

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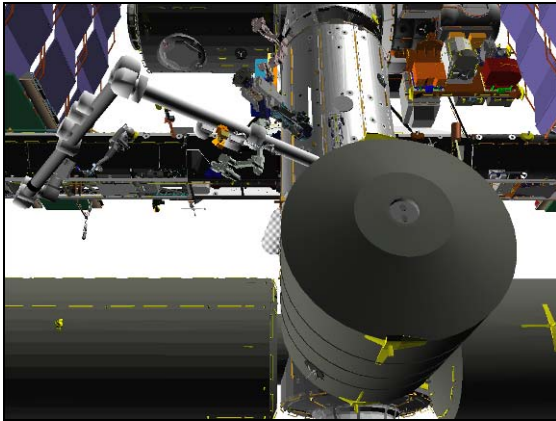


Figure 31.- JEM Clearance 2
(71: Camera B: 0, +30).

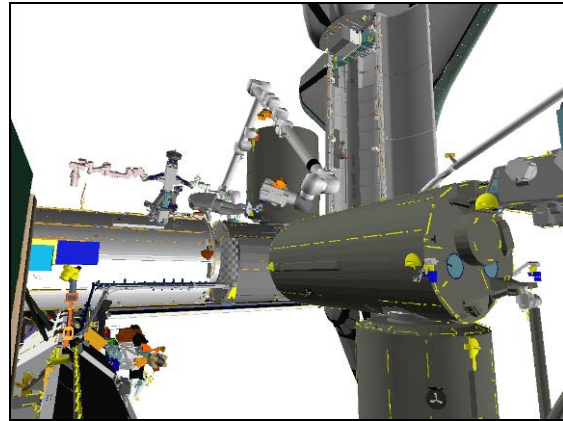


Figure 32.- JEM Clearance 2
(09: P1 Lower Outboard: +120, +10).

16. SPDM CLPA1 SETUP POSITION JOINT OCAS

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+120,+10)	71(MON 2): Camera B (0, +30) [24: Tip Elbow (+30, +25)]	07: P1 Lower Inboard (+170, +40)	SRMS Elbow (+170, +40)	OBSS ITVC (+80, -65)

NOTE

Base Boom ► SPDM Arm 2, decreases to 132 cm (52 in), OBSS ITVC.

SSRMS Joint OCAS

pick File ► Menu 1 ► Menu 2

Verify 'Joint Angles' 'Destination' for EP1 Setup position.

SR	SY	SP	EP	WP	WY	WR
+7.8	+35.9	+76.8	+107.2	-1.9	-142.2	+206.6

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)	0.0	-5.0	+50.0	+80.0	0.0	-80.0	+190.0
TGT	+7.8	+35.9	+76.8	+107.2	-1.9	-142.2	+206.6
ERR	-7.8	-40.9	-26.8	-27.2	+1.9	+62.2	-16.6

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 CLPA 1 Setup position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+7.8	+35.9	+76.8	+107.2	-1.9	-142.2	+206.6
X	Y	Z	Pitch	Yaw	Roll	
+332	-477	+724	+152.7	+73.3	+21.5	
FOR	Unloaded – Chest 12/NN/F/6, SR Held					
Disp	ISS>ISSACS					

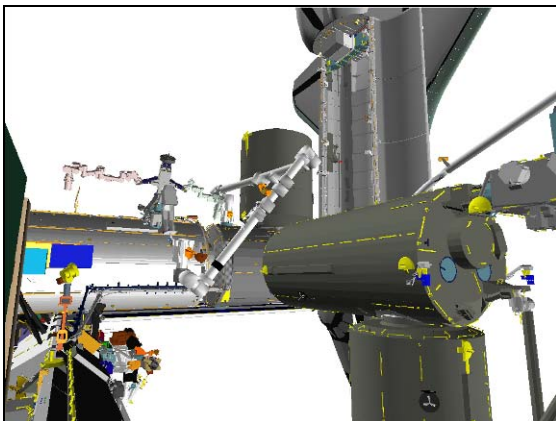


Figure 33.- CLPA 1 Setup
(09: P1 Lower Outboard: +120, +10).

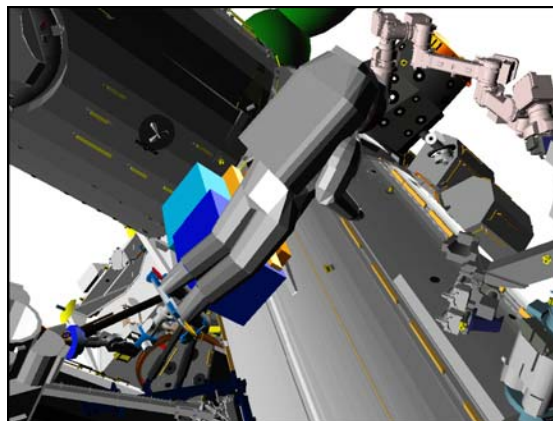


Figure 34.- CLPA 1 Setup
(24: Tip Elbow: +35, +25).

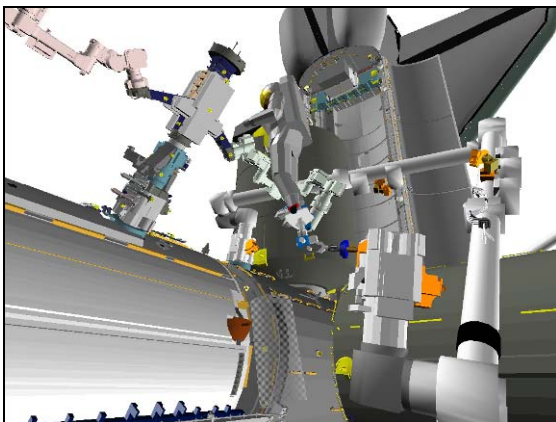


Figure 35.- CLPA 1 Setup
(07: P1 Lower Inboard: +145, +25).

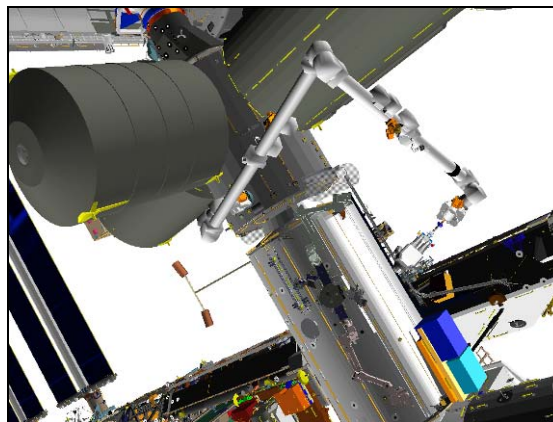


Figure 36.- CLPA 1 Setup
(OBSS ITVC: +80, -65).

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17. CLPA 1 INSTALL MANEUVER

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+120,+10)	24: Tip Elbow (+35, +25)	07: P1 Lower Inboard (+145, +25)	SRMS Elbow (+170, +40)	OBSS ITVC (+80, -65)

NOTE

1. Base Boom ► SPDM Arm 2, decreases to 140 cm (55 in), OBSS ITVC.
2. APFR ► LAB, decreases to 132 cm (52 in), P1 Lower Outboard.

PCS

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

On EVA GO: Maneuver to CLPA 1 Install position.

THC/
RHC

Maneuver, per EVA GCA, to CLPA 1 Install position.
Expect +X (THC In).

Locked	SR	SY	SP	EP	WP	WY	WR
	+7.8	+35.1	+81.4	+113.0	-12.2	-143.0	+206.6
	X	Y	Z	Pitch	Yaw	Roll	
	+301	-360	+708	+152.7	+73.3	+21.5	
FOR	Unloaded – Chest 12/NN/F/6, SR Held						
Disp	ISS>ISSACS						

DCP

BRAKES SSRMS → ON (Verify ON)

Notify EVA: “Brakes On. GO to install CLPA 1.”

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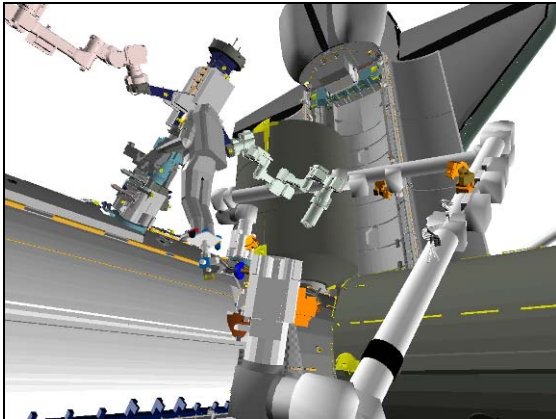


Figure 37.- CLPA 1 Install
(07: P1 Lower Inboard: +145, +25).

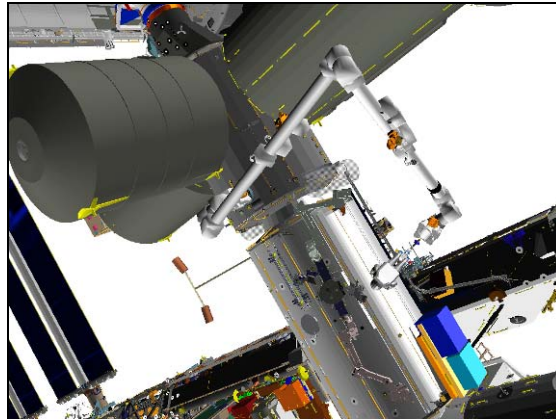


Figure 38.- CLPA 1 Install
(OBSS ITVC: +80, -65).

18. CLPA 1 BACKOFF MANEUVER

On EVA GO: Maneuver to CLPA 1 Setup 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 Maneuver EVA to CLPA 1 Setup position (within 5 cm/1 deg).
Expect -X (THC Out).

Locked						
SR	SY	SP	EP	WP	WY	WR
+7.8	+35.9	+76.8	+107.2	-1.9	-142.2	+206.6
X	Y	Z	Pitch	Yaw	Roll	
+332	-477	+724	+152.7	+73.3	+21.5	
FOR	Unloaded – Chest 12/NN/F/6, SR Held					
Disp	ISS>ISSACS					

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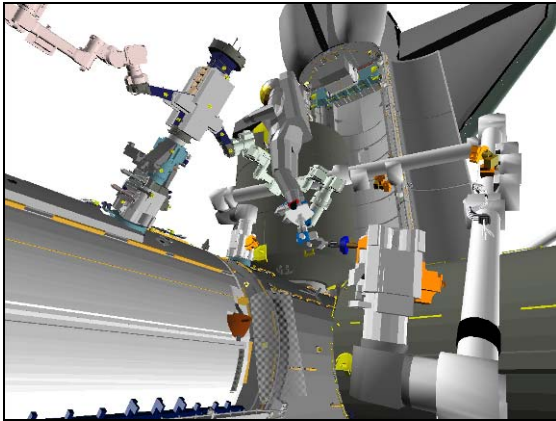


Figure 39.- CLPA 1 Setup
(07: P1 Lower Inboard: +145, +25).

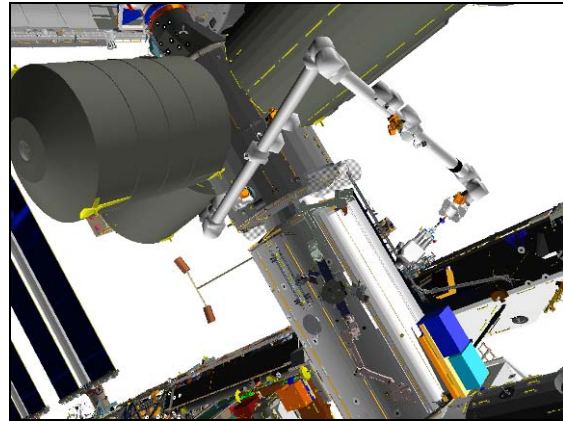


Figure 40.- CLPA 1 Setup
(OBSS ITVC: +80, -65).

19. RECONFIGURE FOR EP1 BLANKET REMOVAL

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+120,+10)	24: Tip Elbow (+35, +35)	07: P1 Lower Inboard (+145, +25)	SRMS Elbow (+170, +40)	OBSS ITVC (+80, -65)

PCS MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

pick File ► Menu 1 ► Menu 2

Verify 'Joint Angles' 'Destination' for EP1 Setup position.

SR	SY	SP	EP	WP	WY	WR
+7.8	+42.6	+85.6	+105.3	+19.1	-140.6	+202.3

cmd Load (Verify Sequence Status – Confirm or Cancel)

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

	SR	SY	SP	EP	WP	WY	WR
(current)	+7.8	+35.9	+76.8	+107.2	-1.9	-142.2	+206.6
TGT	+7.8	+42.6	+85.6	+105.3	+19.1	-140.6	+202.3
ERR	0.0	-6.7	-8.8	+1.9	-21.0	-1.6	+4.3

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 EP1 Setup position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+7.8	+42.6	+85.6	+105.3	+19.1	-140.6	+202.3
X	Y	Z	Pitch	Yaw	Roll	
+320	-540	+750	-65.0	+75.0	-110.0	
FOR	Unloaded – Chest 12/NN/F/6, SR Held					
Disp	ISS>ISSACS					

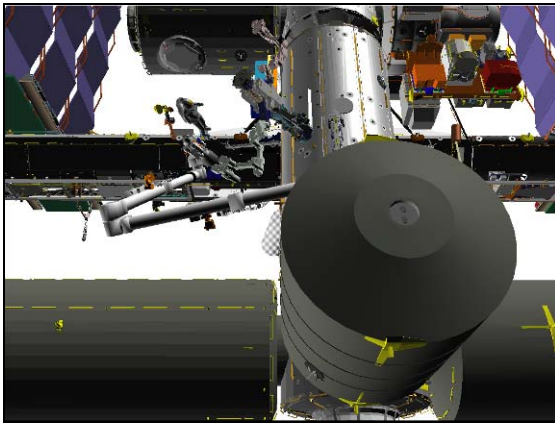


Figure 41.- EP1 Setup
(71: Camera B: 0, +30).

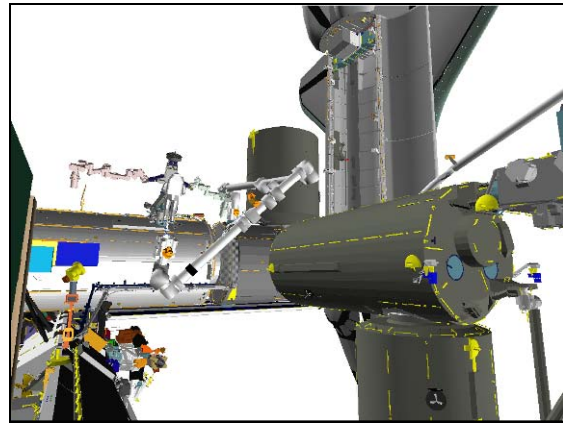


Figure 42.- EP1 Setup
(09: P1 Lower Outboard: +120, +10).

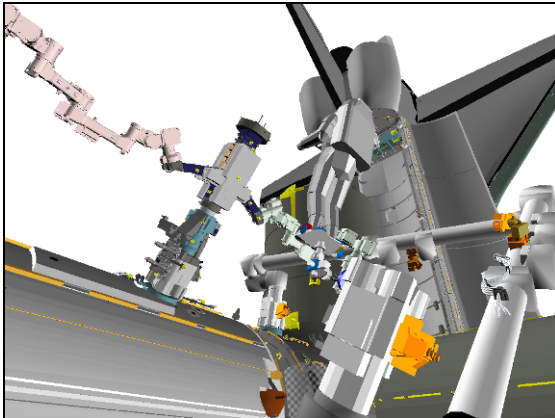


Figure 43.- EP1 Setup
(07: P1 Lower Inboard: +140, +35).

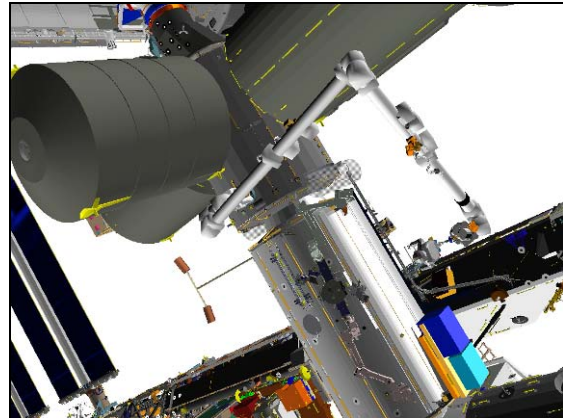


Figure 44.- EP1 Setup
(OBSS ITVC: +80, -65).

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20. EP1 BLANKET REMOVAL MANEUVER

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+120,+10)	24: Tip Elbow (+35, +25)	22: Base Elbow (+70, -20) [07: P1 Lower Inboard (+140, +35)]	SRMS Elbow (+170, +40)	OBSS ITVC (+80, -65)

NOTE

1. WY Joint ► LAB, decreases to 71 cm (28 in), Base Elbow.
2. APFR ► SPDM, decreases to 56 cm (22 in), OBSS ITVC.

√Vernier

MSS: SSRMS: SSRMS

Enter Mode – Manual (Verify blue)

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

cmd Shoulder Roll (Verify SR – Locked)

On EVA GO: Maneuver to EP1 Blanket Removal position:

THC/
RHC

Maneuver, per EVA GCA, to EP1 Blanket Removal.
Expect +X (THC In).

Locked	SR	SY	SP	EP	WP	WY	WR
	+7.8	+40.2	+86.6	+119.8	+2.7	-142.7	+200.7
	X	Y	Z	Pitch	Yaw	Roll	
	+341	-359	+794	-65.0	+75.0	-110.0	
FOR	Unloaded – Chest 12/NN/F/6, SR Held						
Disp	ISS>ISSACS						

DCP BRAKES SSRMS → ON (Verify ON)

Notify EVA: “Brakes On. GO to remove EP1 Blanket.”

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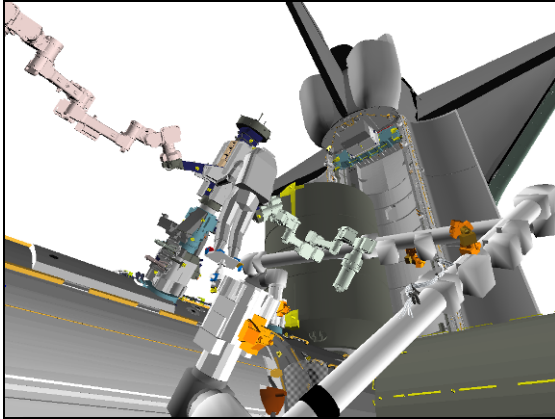


Figure 45.- EP1 Blanket Removal
(07: P1 Lower Inboard: +140, +35).

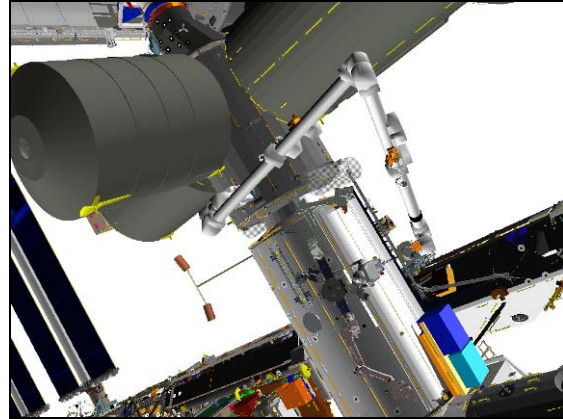


Figure 46.- EP1 Blanket Removal
(OBSS ITVC: +80, -65).

21. EP1 BACKOFF MANEUVER

On EVA GO: Maneuver to EP1 Setup 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 Maneuver EVA to EP1 Setup position (within 5 cm/1 deg).
Expect -X (THC Out).

Locked						
SR	SY	SP	EP	WP	WY	WR
+7.8	+42.6	+85.6	+105.3	+19.1	-140.6	+202.3
X	Y	Z	Pitch	Yaw	Roll	
+320	-540	+750	-65.0	+75.0	-110.0	
FOR	Unloaded – Chest 12/NN/F/6, SR Held					
Disp	ISS>ISSACS					

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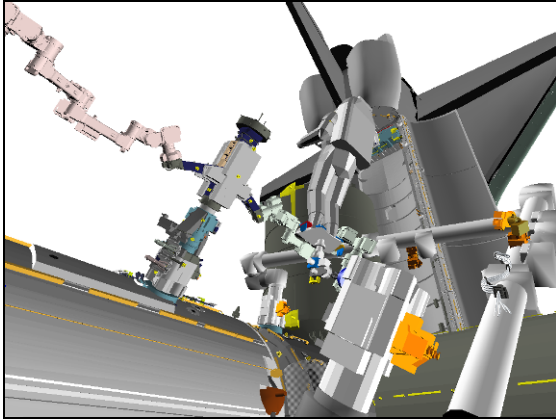


Figure 47.- EP1 Setup
(07: P1 Lower Inboard: +120, +10).

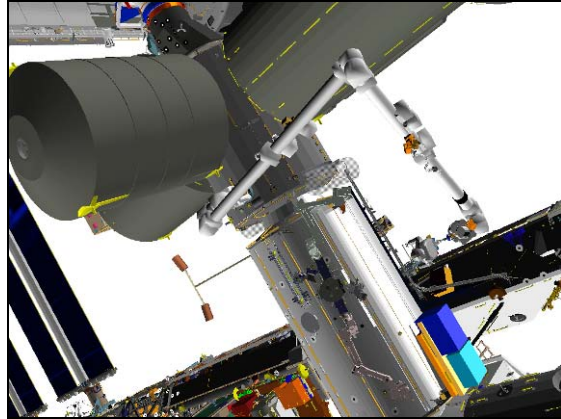


Figure 48.- EP1 Setup
(OBSS ITVC: +80, -65).

22. JEM CLEARANCE 2 JOINT OCAS

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+120,+10)	71(MON 2): Camera B (0, +30)	07: P1 Lower Inboard (+145, +25)	SRMS Elbow (+170, +40)	OBSS ITVC (+80, -65)

PCS MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

pick File ► Menu 1 ► Menu 2

Verify 'Joint Angles' 'Destination' for JEM Clearance 2 position.

SR	SY	SP	EP	WP	WY	WR
0.0	-5.0	+50.0	+80.0	0.0	-120.0	+190.0

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)	+7.8	+42.6	+85.6	+105.3	+19.1	-140.6	+202.3
TGT	0.0	-5.0	+50.0	+80.0	0.0	-120.0	+190.0
ERR	+7.8	+47.6	+35.6	+25.3	+19.1	-20.6	+12.3

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 Joint Angle values.

SR	SY	SP	EP	WP	WY	WR
0.0	-5.0	+50.0	+80.0	0.0	-120.0	+190.0

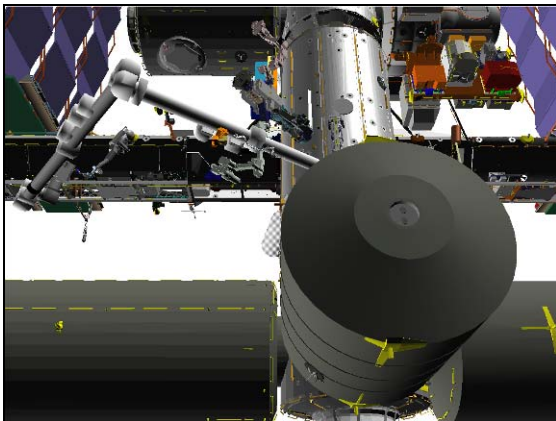


Figure 49.- JEM Clearance 2
(71: Camera B: 0, +30).

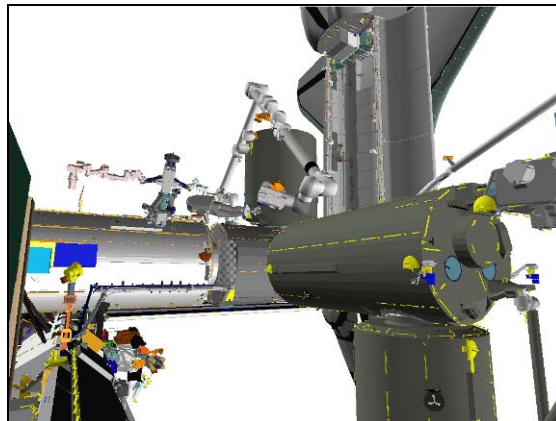


Figure 50.- JEM Clearance 2
(09: P1 Lower Outboard: +120, +10).

23. SPDM CLEARANCE JOINT OCAS

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+120,+10)	71(MON2): Camera B (0, +30)	03: S1 Lower Outboard (+75, +20)	SRMS Elbow (+170, +40)	OBSS ITVC (+80, -65)

pick File ► Menu 1 ► Menu 2

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

SR	SY	SP	EP	WP	WY	WR
+30.0	0.0	-50.0	+80.0	-50.0	-60.0	+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)	0.0	-5.0	+50.0	+80.0	0.0	-80.0	+190.0
TGT	+30.0	0.0	-50.0	+80.0	-50.0	-60.0	+100.0
ERR	-30.0	-5.0	+100.0	0.0	+50.0	-20.0	+90.0

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

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DCP AUTO SEQ → PROC

PCS MSS: SSRMS: SSRMS

Verify Posn Hold – orange

Verify Joint Angle values.

SR	SY	SP	EP	WP	WY	WR
+30.0	0.0	-50.0	+80.0	-50.0	-60.0	+100.0

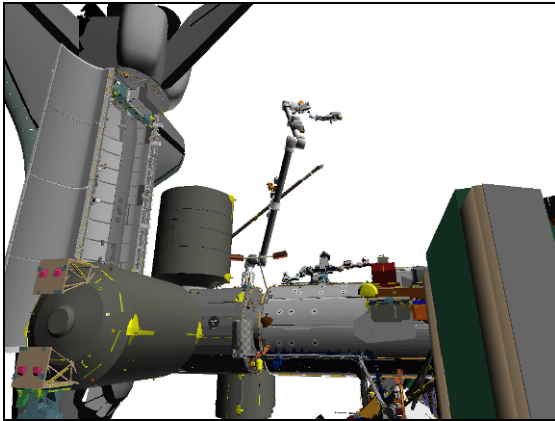


Figure 51.- SPDM Clearance
(03: S1 Lower Outboard: +75, +20).

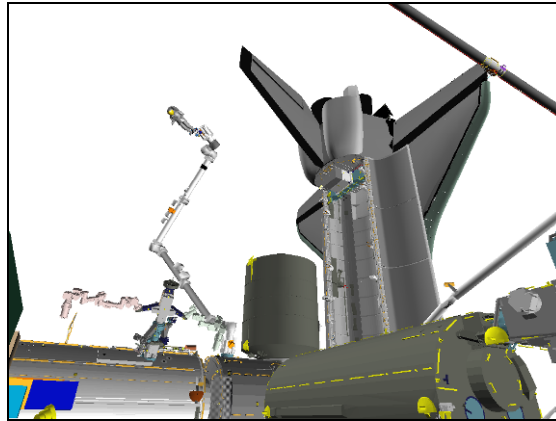


Figure 52.- SPDM Clearance
(09: P1 Lower Outboard: +120, +30).

24. LWAPA CLEARANCE JOINT OCAS

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+120,+30)	72(DNLK): Camera C (+25, +20)	03: S1 Lower Outboard (+75, +20)	SRMS Elbow (+170, +40)	OBSS ITVC (+80, -65)

NOTE

Base Boom ► UHF Antenna, 127 cm (50 in) closest approach, S1 Lower Outboard.

SSRMS Joint OCAS

pick File ► Menu 1 ► Menu 2

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

SR	SY	SP	EP	WP	WY	WR
+2.4	+153.3	-112.7	+78.9	-126.2	-45.0	+26.7

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)	+30.0	0.0	-50.0	+80.0	-50.0	-60.0	+100.0
TGT	+2.4	+153.3	-112.7	+78.9	-126.2	-45.0	+26.7
ERR	+27.6	-153.3	+62.7	+1.1	+76.2	-15.0	+73.3

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

DCP AUTO SEQ → PROC

PCS MSS: SSRMS:

Verify Posn Hold – orange

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

SR	SY	SP	EP	WP	WY	WR
+2.4	+153.3	-112.7	+78.9	-126.2	-45.0	+26.7
X	Y	Z	Pitch	Yaw	Roll	
+1100	+1050	+1100	+105.3	-78.0	-93.6	
FOR	Unloaded – Chest 12/NN/F/6, SR Held					
Disp	ISS>ISSACS					

MSS: SSRMS:

Enter Mode – Standby (Verify blue)

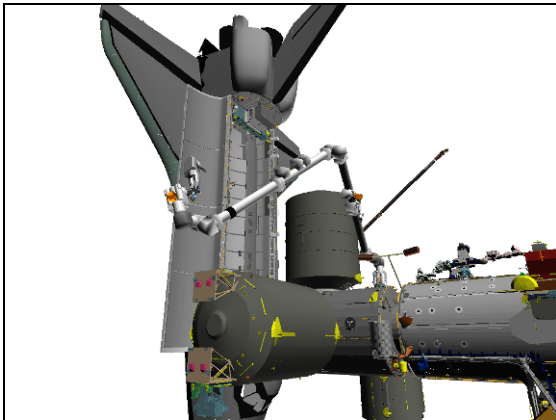


Figure 53.- LWAPA Clearance
(03: S1 Lower Outboard: +55, +20).

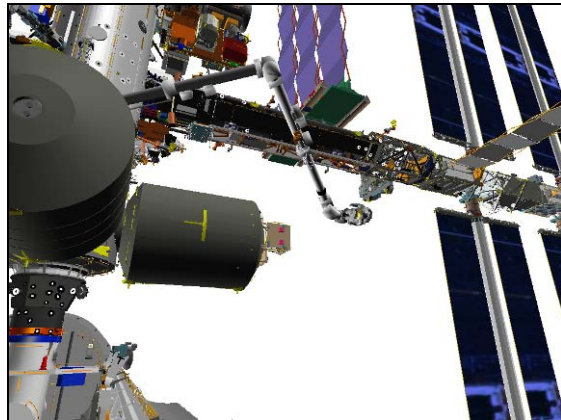


Figure 54.- LWAPA Clearance
(72: Camera C: +25, +20).

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25. COLUMBUS APPROACH MANEUVER

NOTE

Have shuttle crew route Camera C to MON 1 with a pan/tilt of +25, +20.

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+110,+10) Focal Length: 30 mm	24: Tip Elbow (+5, +10)	03: S1 Lower Outboard (+75, +20)	Camera C (+25, +20)	OBSS ITVC (+100, -70)

Change Unloaded Parameters ► EVA ► Chest 12/NN/F/6 SYH
Verify 'Unloaded Parameters' (two) – Chest 12/NN/F/6, SY Held

Verify Display – ISS>ISSACS

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

√Vernier

NOTE

Base Boom ► UHF Antenna, decreases to 86 cm (34 in) closest approach, S1 Lower Outboard.

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

THC/
RHC

Maneuver to Columbus Approach position (within 5 cm/1 deg).
Expect -Z (THC Up).

	Locked					
SR	SY	SP	EP	WP	WY	WR
+10.9	+153.3	-89.4	+70.5	-144.7	-47.3	+16.4
X	Y	Z	Pitch	Yaw	Roll	
+1100	+1050	+775	+105.3	-78.0	-93.6	
FOR	Unloaded – Chest 12/NN/F/6, SY Held					
Disp	ISS>ISSACS					

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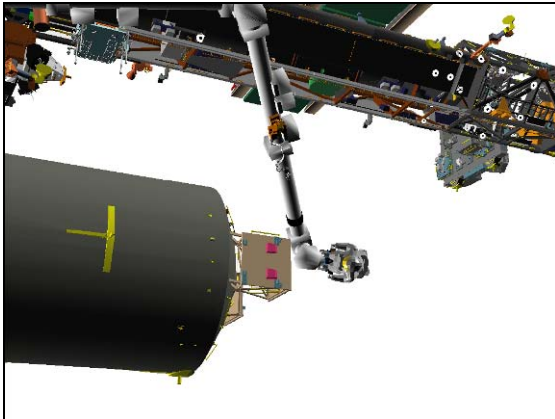


Figure 55.- Columbus Approach
(Camera C: +25, +20).

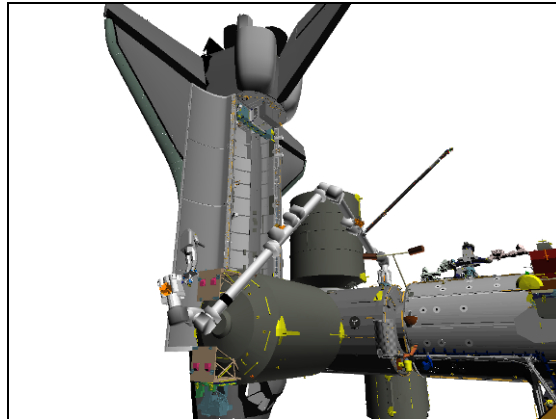


Figure 56.- Columbus Approach
(03: S1 Lower Outboard: +75, +20).

26. APFR EGRESS MANEUVER

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+110,+10) Focal Length: 30 mm	24: Tip Elbow (+5, +10)	03: S1 Lower Outboard (+75, +20)	Camera C (+25, +20)	OBSS ITVC (+100, -70)

On EVA GO: Maneuver to APFR Egress position:

<u>NOTE</u>	
1. WY Joint ► Columbus Cargo Platform, decreases to 79 cm (31 in), Tip Elbow.	
2. APFR ► Columbus Cargo Platform, decreases to 43 cm (17 in), Tip Elbow.	
3. Base Boom ► UHF Antenna, 94 cm (37 in), P1 Lower Outboard.	

THC/
RHC

Maneuver to APFR Egress position.
Expect -Y (THC Left).

Locked						
SR	SY	SP	EP	WP	WY	WR
+11.2	+153.3	-91.3	+76.7	-149.1	-47.3	+16.0
X	Y	Z	Pitch	Yaw	Roll	
+1100	+1000	+775	+105.3	-78.0	-93.6	
FOR	Unloaded – Chest 12/NN/F/6, SY Held					
Disp	ISS>ISSACS					

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PCS MSS: SSRMS:

Enter Mode – Standby (Verify blue)

Notify EVA: “In standby mode, ready for APFR Egress.”

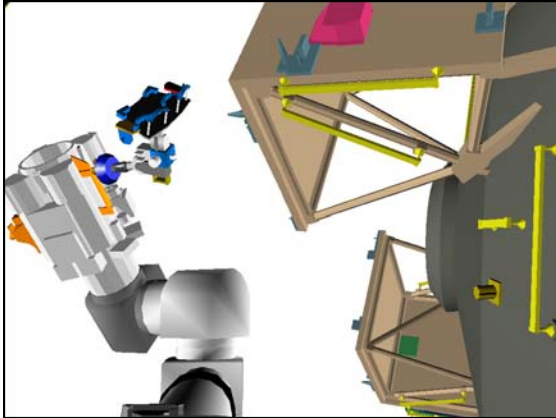


Figure 57.- APFR Egress
(24: Tip Elbow: +5, +10).

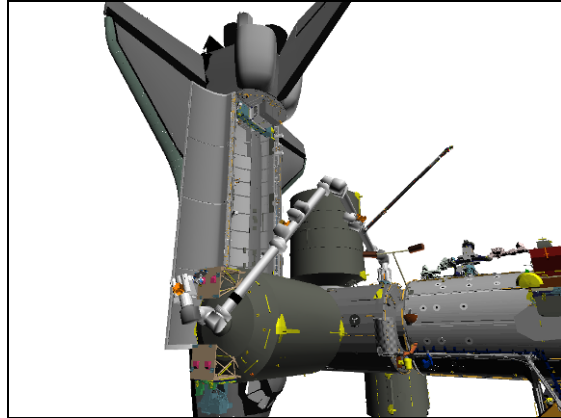


Figure 58.- APFR Egress
(03: S1 Lower Outboard: +70, +20).

27. APFR REMOVAL MANEUVER

On EVA GO: Maneuver to APFR Removal position:

NOTE

WY Joint ► Columbus Cargo Platform, decreases to 56 cm (22 in), Tip Elbow.

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

THC/
RHC

Maneuver, per EVA GCA, to APFR removal position.
Expect +Z (THC Down).

	Locked					
SR	SY	SP	EP	WP	WY	WR
+7.6	+153.3	-101.2	+81.4	-142.4	-46.4	+20.5
X	Y	Z	Pitch	Yaw	Roll	
+1100	+1000	+900	+105.3	-78.0	-93.6	
FOR	Unloaded – Chest 12/NN/F/6, SY Held					
Disp	ISS>ISSACS					

PCS MSS: SSRMS:

Enter Mode – Standby (Verify blue)

Notify EVA: “In standby mode, ready for APFR Removal.”

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28. COLUMBUS BACKOFF POSITION MANEUVER

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+110,+10)	24: Tip Elbow (+5, +10)	03: S1 Lower Outboard (+75, +20)	Camera C (+25, +20)	OBSS ITVC (+80, -65)

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

Verify Display – ISS>ISSACS

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

On EVA GO: APFR Removed and EVA clear of LEE, maneuver to Columbus Backoff position:

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

THC/
RHC

Maneuver SSRMS to Columbus Backoff position (within 10 cm/2 deg).
Expect +Y/+Z (THC Right/Down).

	Locked					
SR	SY	SP	EP	WP	WY	WR
+2.4	+153.3	-111.3	+75.7	-124.4	-44.9	+26.7
X	Y	Z	Pitch	Yaw	Roll	
+1048	+1200	+950	-71.2	+6.0	+107.8	
FOR	Unloaded – LEE Tip, SY Held					
Disp	ISS>ISSACS					

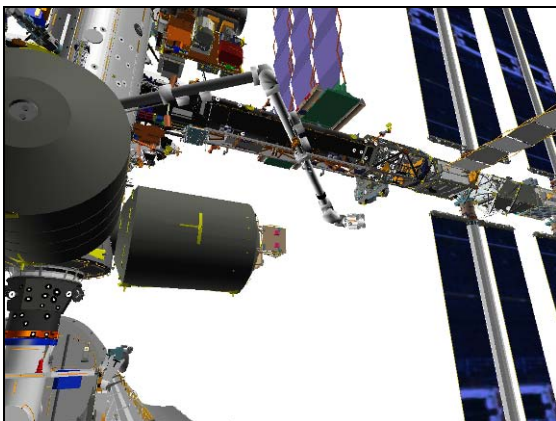


Figure 59.- Columbus Backoff
(Camera C: +25, +20).

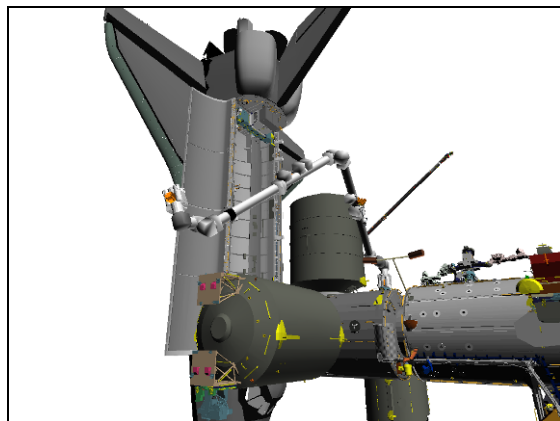


Figure 60.- Columbus Backoff
(03: S1 Lower Outboard: +75, +20).

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29. MPLM APPROACH JOINT OCAS

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
09: P1 Lower Outboard (+110,+20) Zoomed Out	24: Tip Elbow (+5, +10)	03: S1 Lower Outboard (+75, +20)	Camera C (+25, +20)	OBSS ITVC (+80, -65)

PCS MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

pick File ► Menu 1 ► Menu 2

Verify 'Joint Angles' 'Destination' for MPLM Approach position.

SR	SY	SP	EP	WP	WY	WR
+60.3	+151.3	-180.0	-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)	+4.6	+153.3	-111.6	+76.8	-126.0	-45.6	+23.9
TGT	+60.3	+151.3	-180.0	-109.2	-121.0	-5.8	+6.9
ERR	-55.7	+2.0	+68.4	+186.0	-5.0	-39.8	+17.0

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
+60.3	+151.3	-180.0	-109.2	-121.0	-5.8	+6.9



Figure 61.- MPLM Approach
(09: P1 Lower Outboard: +110, +20).

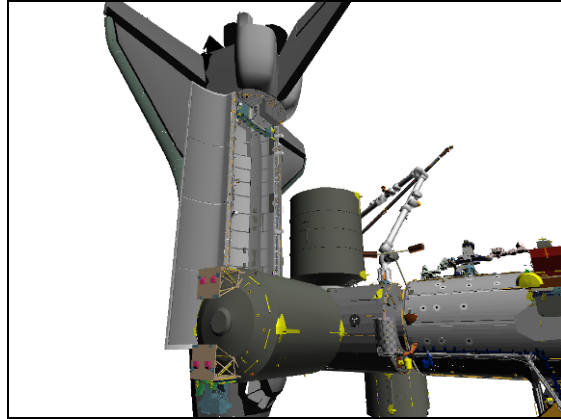


Figure 62.- MPLM Approach
(03: S1 Lower Outboard: +75, +20).

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)

CONTINGENCY

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2.400 WALK-OFF TO MBS PDGF 1

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1. HAND CONTROLLER CALIBRATION

1.1 Translational Hand Controller (THC) Calibration

THC

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

1.2 Rotational Hand Controller (RHC) Calibration

RHC

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

2. SETUP

Verify SRMS at MPLM Viewing position (within 5 cm/1 deg).

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	SSC 1 (MON 1)	SSC 2 (DTV)
03: S1 Lower Outboard (+70,+5)	22: Base Elbow (-90, -10) [24: Tip Elbow (-95, -10)]	09: P1 Lower Outboard (+110, +15)	Camera C (0, +30)	OBSS ITVC (+90, -70)

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

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

Change Display ► MBS ► PDGF 1 (Verify MBS>PDGF 1)

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

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

SR	SY	SP	EP	WP	WY	WR
+145.0	0.0	-5.0	-95.0	-40.0	0.0	+75.0
X	Y	Z	Pitch	Yaw	Roll	
+523	+1753	-188	+33.4	-28.8	-168.3	
FOR	Unloaded – LEE Tip, SR Held					
Disp	MBS>PDGF 1					

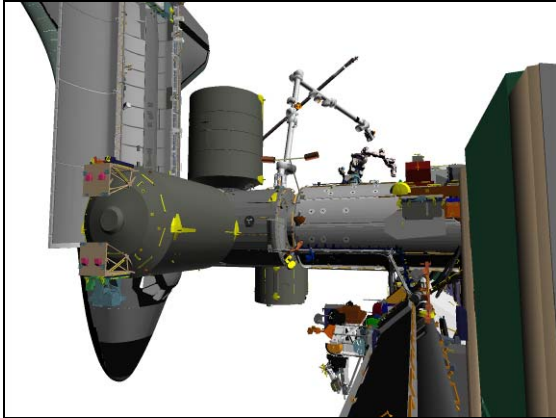


Figure 1.- JEM Clearance
 (03: S1 Lower Outboard: +70,+5).

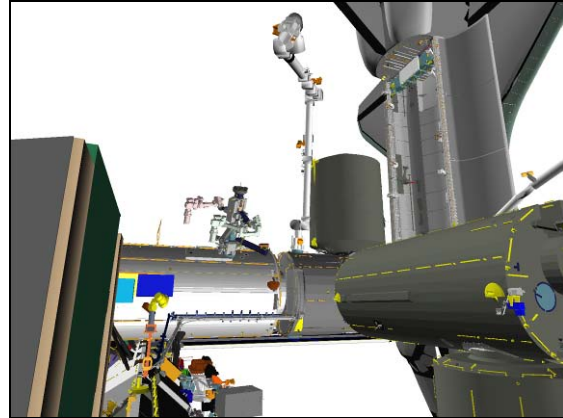


Figure 2.- JEM Clearance
 (09: P1 Lower Outboard: +110, +15).

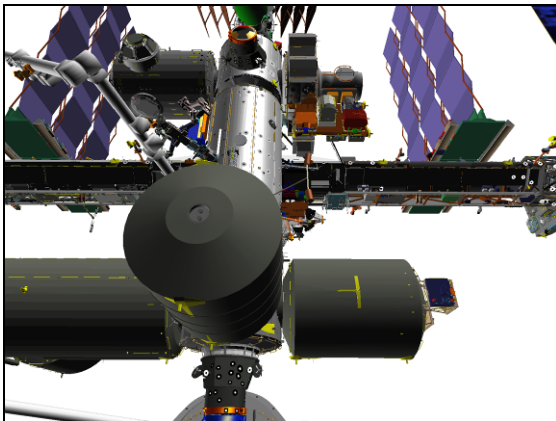


Figure 3.- JEM Clearance
 (Camera C: 0, +30).

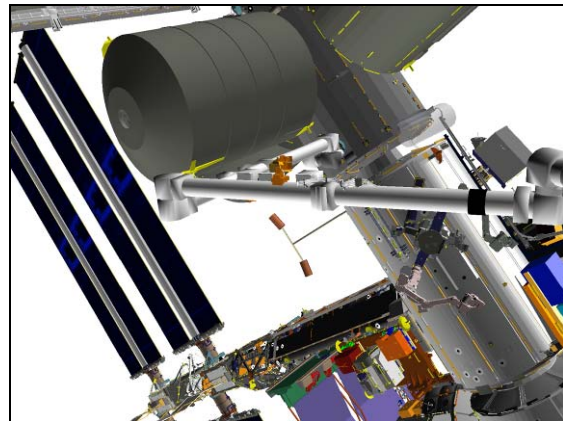


Figure 4.- JEM Clearance
 (OBSS ITVC: +90, -70).

3. WALK-OFF INTERMEDIATE JOINT OCAS

PCS MSS: SSRMS: MSS Safing:

cmd 'SSRMS' Remove (Verify Not Safed)

DCP BRAKES SSRMS → OFF (Verify OFF)

RHC RATE → VERNIER (Verify Vernier on PCS)

PCS MSS: SSRMS: Rate:

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

PCS MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

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pick File ► Menu 1 ► Menu 2

Verify 'Joint Angles' 'Destination' for Walk-off Intermediate position.

SR	SY	SP	EP	WP	WY	WR
0.0	0.0	-35.0	-100.0	-41.1	-30.0	+82.7

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON

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

	SR	SY	SP	EP	WP	WY	WR
(current)	+145.0	0.0	-5.0	-95.0	-40.0	0.0	+75.0
TGT	0.0	0.0	-35.0	-100.0	-41.1	-30.0	+82.7
ERR	+145.0	0.0	+30.0	+5.0	+1.1	+30.0	-7.7

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
0.0	0.0	-35.0	-100.0	-41.1	-30.0	+82.7

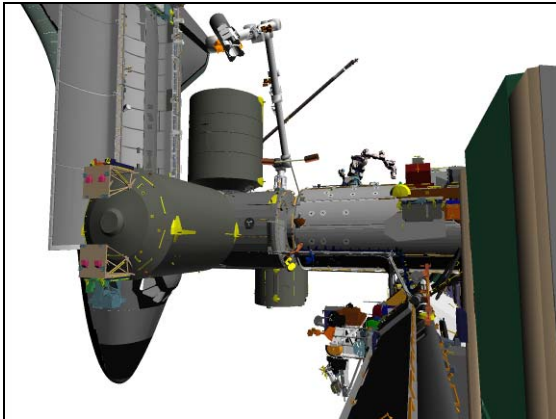


Figure 5.- Walk-off Intermediate
(03: S1 Lower Outboard: +70, +5).

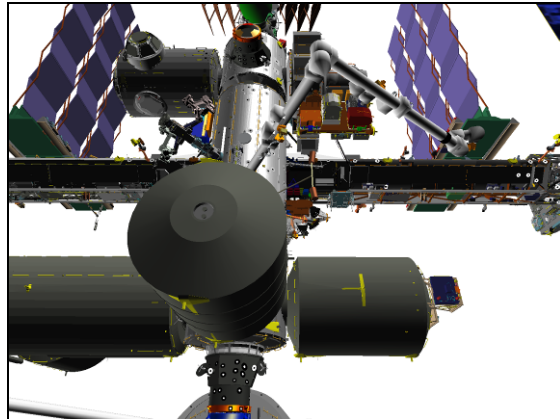


Figure 6.- Walk-off Intermediate
(Camera C: 0, +30).

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4. MBS 1 PRE-GRAPPLE JOINT OCAS

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
03: S1 Lower Outboard (+70,+5)	22: Base Elbow (-90, -10) [24: Tip Elbow (-90, -10)]	37: MBS Mast (+115,+15)	Camera C (0, +30)	OBSS ITVC (+90, -70)

SSRMS Joint OCAS

pick File ► Menu 1 ► Menu 2

Verify 'Joint Angles' 'Destination' for MBS1 Pre-Grapple position.

SR	SY	SP	EP	WP	WY	WR
-19.6	+12.3	-102.1	-107.8	-41.1	-30.0	+82.7

cmd Load (Verify Sequence Status – Confirm or Cancel)

MON

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

	SR	SY	SP	EP	WP	WY	WR
(current)	0.0	0.0	-35.0	-100.0	-41.1	-30.0	+82.7
TGT	-19.6	+12.3	-102.1	-107.8	-41.1	-30.0	+82.7
ERR	+19.6	-12.3	+67.1	+7.8	0.0	0.0	0.0

NOTE

1. Tip Boom ► Columbus, decrease to 73 cm (29 in), LSZ.
2. Tip Boom ► LSZ, decrease to 121 cm (48 in), MBS Mast.
3. Base Boom ► UHF antenna, decrease to 96 cm (38 in), LSZ.

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 MBS1 Pre-Grapple position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-19.6	+12.3	-102.1	-107.8	-41.1	-30.0	+82.7
X	Y	Z	Pitch	Yaw	Roll	
-150	0	0	0.0	0.0	0.0	
FOR	Unloaded – LEE Tip, SR Held					
Disp	MBS>PDGF 1					

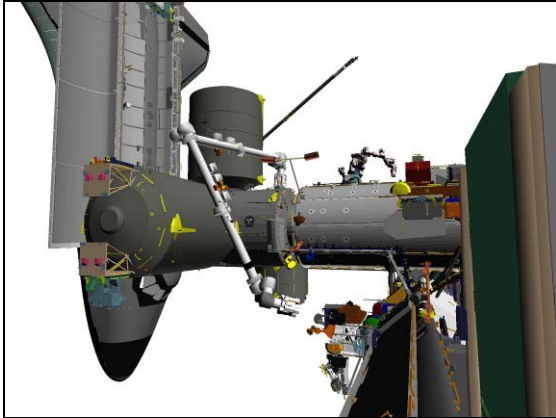


Figure 7.- MBS1 Pre-Grapple
 (03: S1 Lower Outboard: +70, +5).

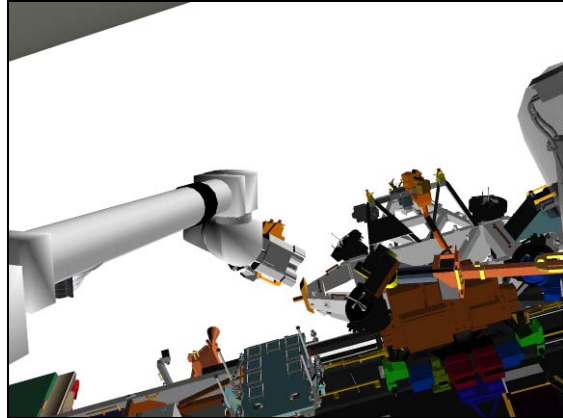


Figure 8.- MBS1 Pre-Grapple
 (22: Base Elbow: -90, -10).

5. MBS 1 GRAPPLE MANEUVER

5.1 Grapple Setup

Configure Cameras and overlays for grapple.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
03: S1 Lower Outboard (+70, -5) [37: MBS Mast (+140, -20)]	25: Tip LEE (Zoomed Out)	22: Base Elbow (-90, -10) [24: Tip Elbow (-105, -10)]	Camera C (0, -30)	OBSS ITVC (+90, -70)

NOTE

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

5.2 MBS PDGF1 Grapple Maneuver

√Vernier

MSS: SSRMS: Rate:

Set 'Scale' 'Vernier' Rate Scale: As Desired

NOTE

1. Tip Boom ► Columbus, 73 cm (29 in), LSZ.
2. Tip Boom ► LSZ, decreases to 68 cm (27 in), MBS Mast.
3. Base Boom ► UHF Antenna, decreases to 60 cm (24 in), LSZ.

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

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MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

RHC/
THC

Maneuver to within grapple envelope.

PCS

5.3 PDGF Auto Capture

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

MSS: SSRMS:

Verify Active Effector – SSRMS Tip LEE

RHC

TRIGGER → Press (momentarily)

PCS

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

Verify Capture to Latch – Yes (SCR 19282)

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

Verify 'Carriage' Retract – blue

Verify 'Latch' Latch – blue (80s max)

5.4 Mating Umbilicals

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

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

NOTE

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

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cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Mate

RHC TRIGGER → Press (momentarily)

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

5.5 Grapple Cleanup

MSS: SSRMS:

Verify Loaded Parameters – √

Verify 'Loaded Parameters' (three) – MBS PDGF 1, SSRMS, SR Held

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

SR	SY	SP	EP	WP	WY	WR
-19.6	+17.1	-112.2	-106.2	-29.9	-28.3	+87.9
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded – MBS PDGF 1, SR Held					
Disp	MBS>PDGF 1					

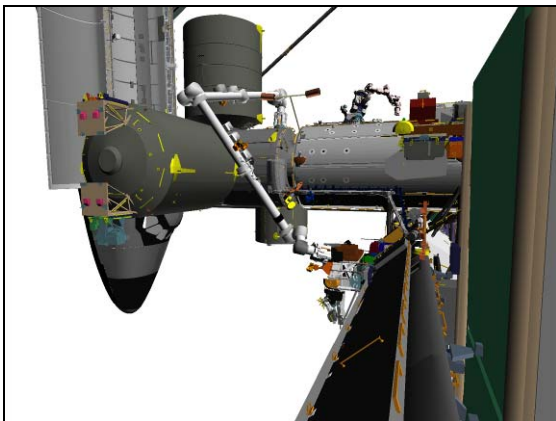


Figure 9.- MBS 1 Grapple
(03: S1 Lower Outboard: +70, -5).

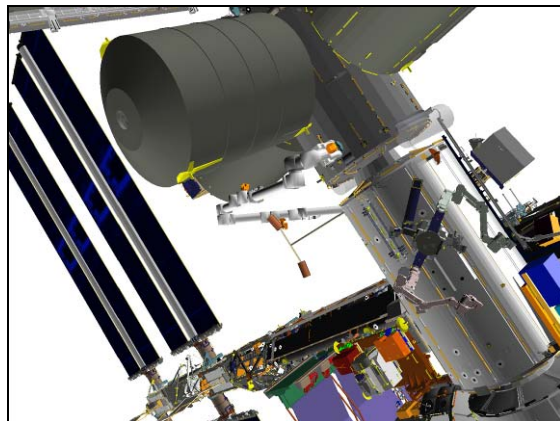


Figure 10.- MBS 1 Grapple
(OBSS ITVC: +90, -70).

5.6 MSS Safing

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 **MCC-H** GO for SSRMS Base Change.

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6. NODE 2 RELEASE

6.1 Release Setup

On **MCC-H GO**, SSRMS Base Change complete.

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
03: S1 Lower Outboard (+70, +5) [37: MBS Mast (+110, +20)]	25: Tip LEE (Zoomed Out)	24: Tip Elbow (-25, +10) [09: P1 Lower Outboard (+110, +15)]	Camera C (0, -30)	OBSS ITVC (+90, -70)

NOTE

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

PCS

MSS: SSRMS:

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

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

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

Verify Command – SSRMS>Internal

Expected Node 2 Grapple position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+87.9	+28.3	-29.9	-106.2	-112.2	-17.1	-19.6
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded – Node 2 PDGF, SR Held					
Disp	Node2>PDGF					

6.2 Removing SSRMS Safing

NOTE

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

MSS: SSRMS: MSS Safing:

cmd 'SSRMS' Remove (Verify Not Safed)

DCP

BRAKES SSRMS → OFF (Verify OFF)

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- 6.3 SSRMS Limp
- PCS MSS: SSRMS: Limp:
- cmd** All Limp (Verify Limp – blue)
- MSS: SSRMS:
- Verify all joints – Limped
- 6.4 Carriage Rigidize
- 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 'Carriage' Brakes – On (15 s max)
- 6.5 Auto Release
- Verify with **MCC-H** - Payload and PDGF power inhibits have been confirmed.
- 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
- MSS: SSRMS:
- Verify Active Effector – SSRMS Tip LEE
- RHC TRIGGER → Press (momentarily)

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PCS

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

6.6 SSRMS Backoff

MSS: SSRMS: Limp:

cmd None Limp (Verify Standby – blue)

MSS: SSRMS:

√Vernier

NOTE

1. Base Boom ► Columbus, increases to 116 cm (46 in), LSZ.
2. Base Boom ► LSZ, decreases to 55 cm (22 in), MBS Mast.
3. Tip Boom ► UHF, increases to 86 cm (34 in), LSZ.
4. Wrist ► MPLM, maintains 53 cm (21 in), TE/BE/03.

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

THC/
RHC

Maneuver SSRMS to Node 2 Back-off position (within 5 cm/1 deg).

	<input type="text" value="Locked"/>					
SR	SY	SP	EP	WP	WY	WR
+85.3	+28.3	-36.2	-92.0	-121.6	-14.9	-20.5
X	Y	Z	Pitch	Yaw	Roll	
-150	0	0	0.0	0.0	0.0	
FOR	Unloaded – LEE Tip, SY Held					
Disp	Node2>PDGF					

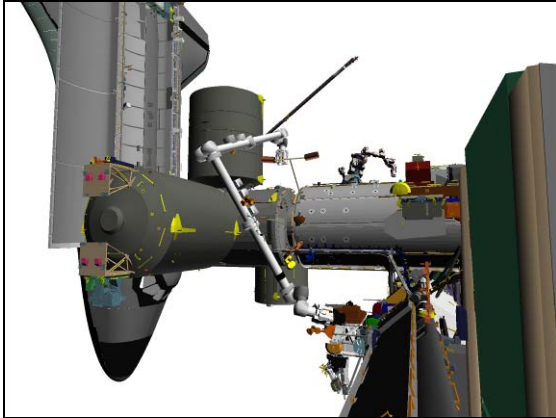


Figure 11.- Node 2 Backoff
 (03: S1 Lower Outboard: +70, +5).

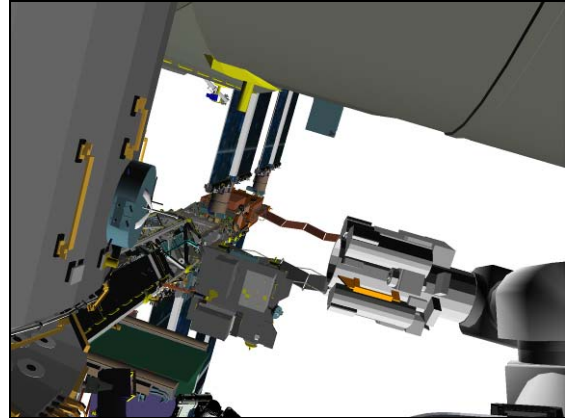


Figure 12.- Node 2 Backoff
 (24: Tip Elbow: -25, +10).

7. NODE 2 CLEARANCE FOR OCAS

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
03: S1 Lower Outboard (+60, +15)	13: LAB Stbd Zenith (-30, +40)	37: MBS Mast (+120, +20)	Camera C (+20, +30)	OBSS ITVC (+100, -65)

PCS

MSS: SSRMS:

Enter Mode – FOR OCAS (Verify blue)

MSS: SSRMS: SSRMS FOR OCAS: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

MSS: SSRMS: Rate:

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

pick File ► Menu 1 ► Menu 2

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

X	Y	Z	Pitch	Yaw	Roll
-400	0	+1150	+85.0	0.0	0.0

cmd Load (Verify Sequence Status – Confirm or Cancel)

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

	X	Y	Z	Pitch	Yaw	Roll
FOR	-150	0	0	0.0	0.0	0.0
TGT	-400	0	+1150	+85.0	0.0	0.0
ERR	+250	0	-1150	-85.0	0.0	0.0

NOTE

1. Base Boom ► LSZ, increase to 68 cm (27 in), MBS Mast.
2. Base Boom ► Columbus, closest approach 71 cm (28 in) then increases beyond 152 cm (60 in), LSZ.
3. Tip Boom ► UHF, increases beyond 152 cm (60 in), LSZ.
4. Wrist ► MPLM, increases beyond 152 cm (60 in), S1 Lower Outboard.

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

DCP AUTO SEQ → PROC

PCS MSS: SSRMS:

Verify Posn Hold – orange

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

SR	SY	SP	EP	WP	WY	WR
+50.3	+28.3	-19.3	-46.7	-123.5	-24.1	-19.0
X	Y	Z	Pitch	Yaw	Roll	
-400	0	+1150	+85.0	0.0	0.0	
FOR	Unloaded – LEE Tip, SY Held					
Disp	Node2>PDGF					

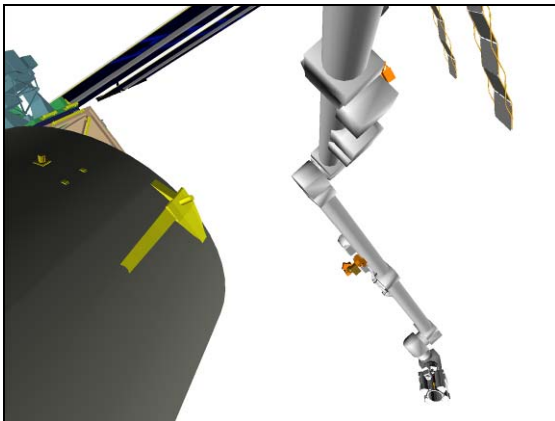


Figure 13.- Node 2 Clearance
(13: LAB Stbd Zenith: -30, +40).

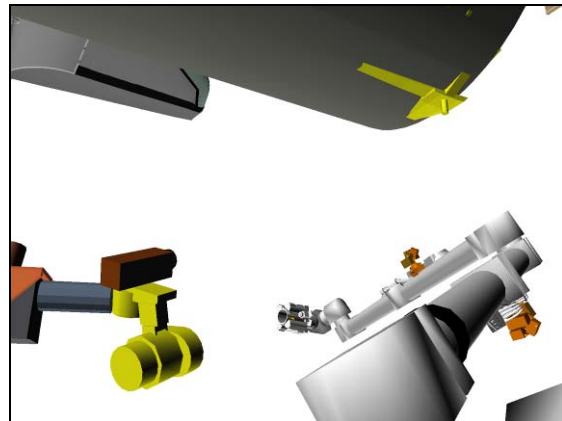


Figure 14.- Node 2 Clearance
(37: MBS Mast: +120, +20).

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8. ZENITH CLEARANCE JOINT OCAS

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
03: S1 Lower Outboard (+60, +15)	13: LAB Stbd Zenith (-30, +40)	37: MBS Mast (+120, +20)	Camera C (+20, +30)	OBSS ITVC (+100, -65)

MSS: SSRMS:

Enter Mode – Joint OCAS (Verify blue)

pick File ► Menu 1 ► Menu 2

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

SR	SY	SP	EP	WP	WY	WR
-63.0	+97.0	+15.0	-46.7	-123.5	-24.1	-19.0

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)	+50.3	+28.3	-19.3	-46.7	-123.5	-24.1	-19.0
TGT	-63.0	+97.0	+15.0	-46.7	-123.5	-24.1	-19.0
ERR	+113.3	-68.7	-34.3	0.0	0.0	0.0	0.0

NOTE

Base Boom ► LSZ, increase beyond 152 cm (60 in), MBS Mast.

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
-63.0	+97.0	+15.0	-46.7	-123.5	-24.1	-19.0

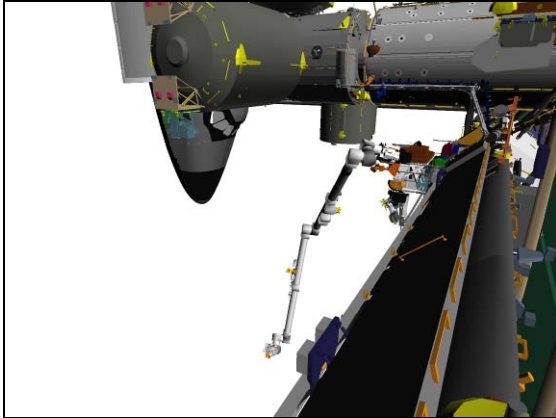


Figure 15.- Zenith Clearance
 (03: S1 Lower Outboard: +60, -20).

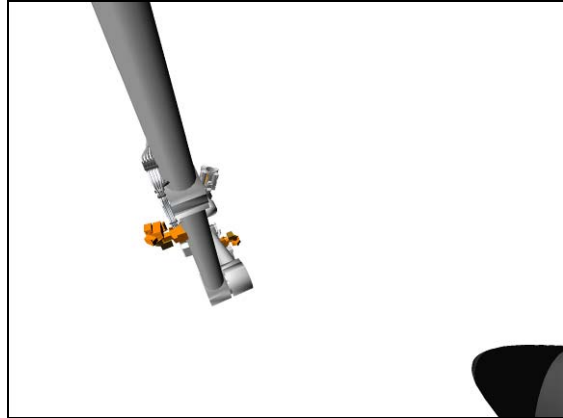


Figure 16.- Zenith Clearance
 (13: LAB Stbd Zenith: -150, +20).

9. OVERNIGHT PARK JOINT OCAS

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3
03: S1 Lower Outboard (+50, -25)	13: LAB Stbd Zenith (-160, +40)	22: Base Elbow (-90, -10) [37: MBS Mast (-130, +30)]

SSRMS Joint OCAS

pick File ► Menu 1 ► Menu 2

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

SR	SY	SP	EP	WP	WY	WR
-150.0	+115.0	-90.0	-99.9	-114.7	-1.0	+12.6

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)	-63.0	+97.0	+15.0	-46.7	-123.5	-24.1	-19.0
TGT	-150.0	+115.0	-90.0	-99.9	-114.7	-1.0	+12.6
ERR	+87.0	-18.0	+105.0	+53.2	-8.8	-23.1	-31.6

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

SR	SY	SP	EP	WP	WY	WR
-150.0	+115.0	-90.0	-99.9	-114.7	-1.0	+12.6
X	Y	Z	Pitch	Yaw	Roll	
+1305	-42	+918	+165.9	+18.1	+30.5	
FOR	Unloaded – LEE Tip, SY Held					
Disp	Node2>PDGF					

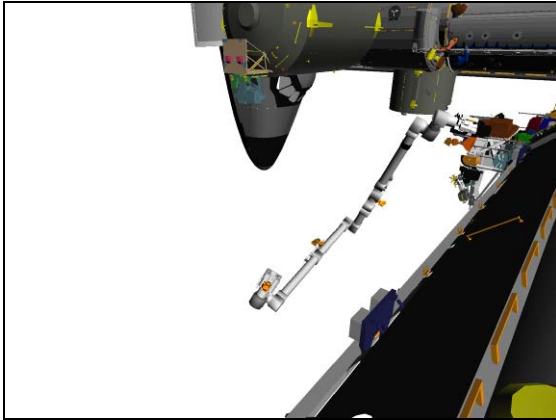


Figure 17.- Overnight Park
 (03: S1 Lower Outboard: +50, -25).

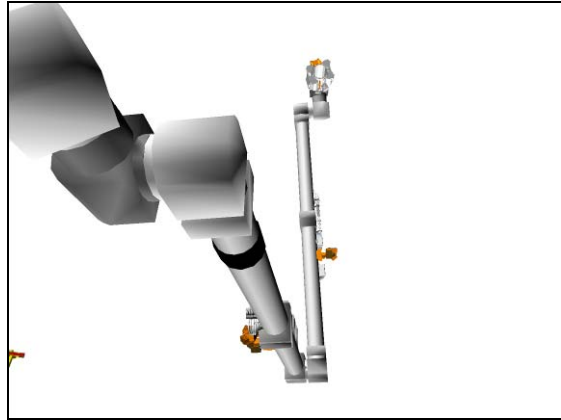


Figure 18.- Overnight Park
 (13: LAB Stbd Zenith: -160, +40).

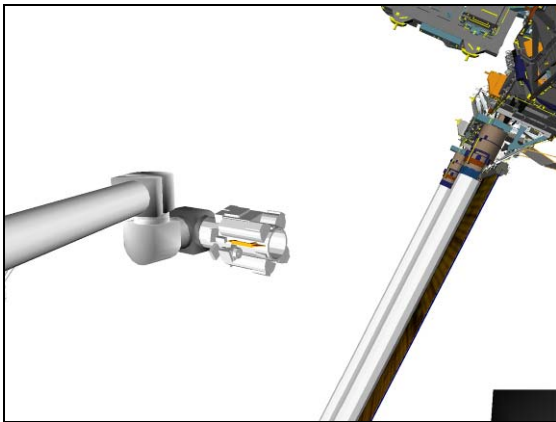


Figure 19.- Overnight Park
 (22: Base Elbow: -90, -10).

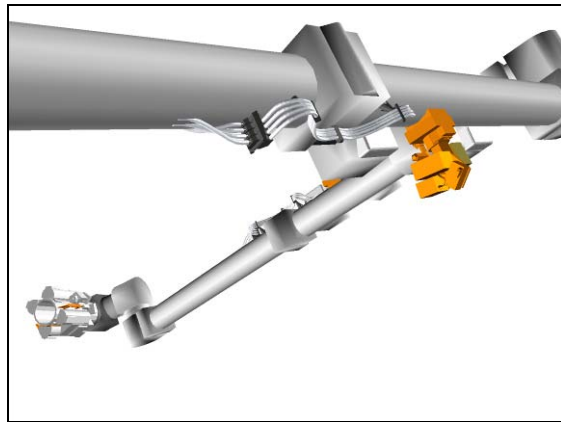


Figure 20.- Overnight Park
 (37: MBS Mast: -130, +30).

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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2.410 WALK-OFF TO NODE 2 PDGF

(RBT FS/19A/FIN/SPN) Page 1 of 12 pages

1. HAND CONTROLLER CALIBRATION

1.1 Translational Hand Controller (THC) Calibration

THC

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

1.2 Rotational Hand Controller (RHC) Calibration

RHC

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

2. SETUP

Verify SRMS 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	SSC 1 (MON 1)	SSC 2 (DTV)
03: S1 Lower Outboard (+70, -20)	22: Base Elbow (-90, -10)	09: P1 Lower Outboard (+100, -20)	Camera C (+10, +40)	OBSS ITVC (+90, -70)

PCS

MSS: SSRMS:

Change Loaded Parameters ► Walk Off ► Node 2 PDGF

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

Change Unloaded Parameters ► Unloaded ► LEE Tip SYH

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

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

Verify Command – SSRMS>Internal

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

SR	SY	SP	EP	WP	WY	WR
-150.0	+115.0	-90.0	-99.9	-114.7	-1.0	+12.6
X	Y	Z	Pitch	Yaw	Roll	
+1305	-42	+918	+165.9	+18.1	+30.5	
FOR	Unloaded – LEE Tip, SY Held					
Disp	Node2>PDGF					

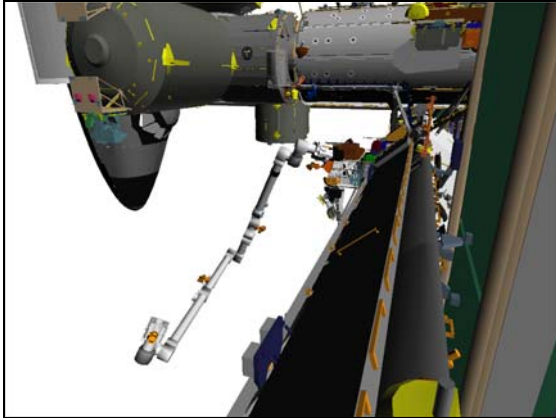


Figure 1.- Overnight Park
(03: S1 Lower Outboard: +70, -20).

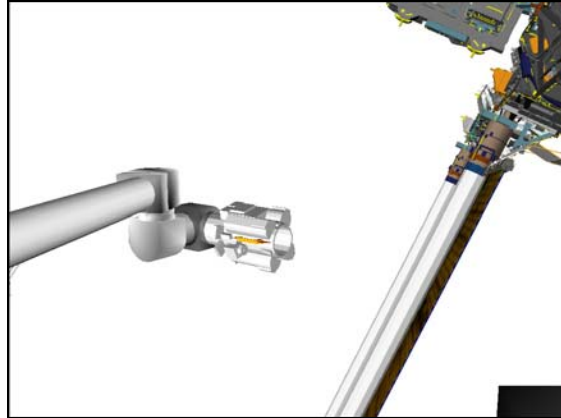


Figure 2.- Overnight Park
(22: Base Elbow: -90, -10).

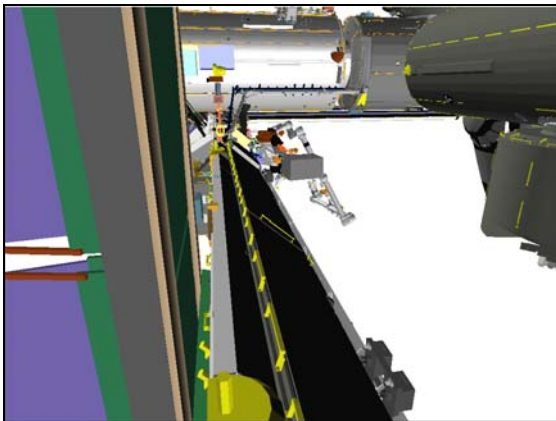


Figure 3.- Overnight Park
(09: P1 Lower Outboard: +100, -20).

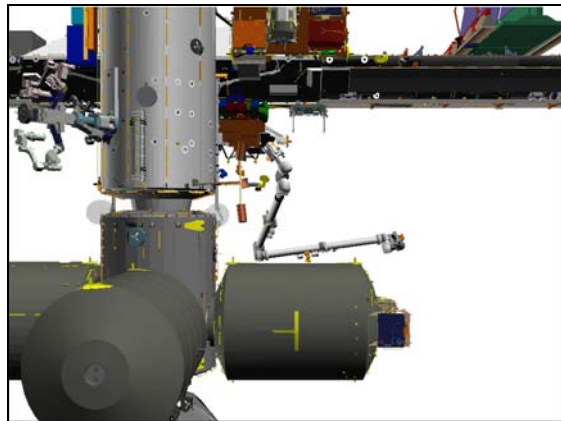


Figure 4.- Overnight Park
(ISS Nadir).

3. ZENITH CLEARANCE JOINT OCAS

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)

pick File ► Menu 1 ► Menu 2

2.410 WALK-OFF TO NODE 2 PDGF

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

SR	SY	SP	EP	WP	WY	WR
-63.0	+97.0	+15.0	-46.7	-123.3	-24.1	-18.8

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)	-150.0	+115.0	-90.0	-99.9	-114.7	-1.0	+12.6
TGT	-63.0	+97.0	+15.0	-46.7	-123.3	-24.1	-18.8
ERR	-87.0	+18.0	-105.0	-53.2	+8.6	+23.1	+31.4

PCS

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

DCP

AUTO SEQ → PROC

PCS

MSS: SSRMS:

Verify Posn Hold – orange

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

SR	SY	SP	EP	WP	WY	WR
-63.0	+97.0	+15.0	-46.7	-123.3	-24.1	-18.8
X	Y	Z	Pitch	Yaw	Roll	
+1857	-172	+275	-119.4	+6.2	-6.1	
FOR	Unloaded – LEE Tip, SY Held					
Disp	Node2>PDGF					

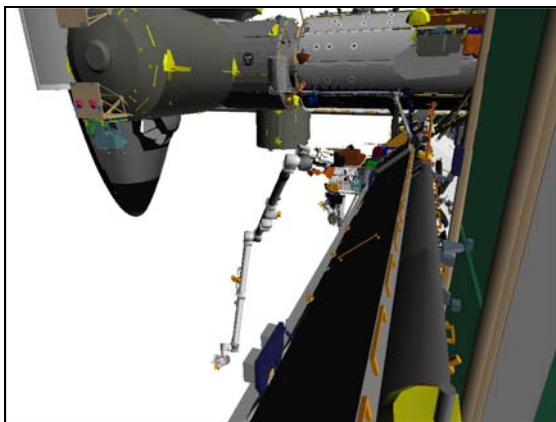


Figure 5.- Zenith Clearance
(03: S1 Lower Outboard: +70, -20).

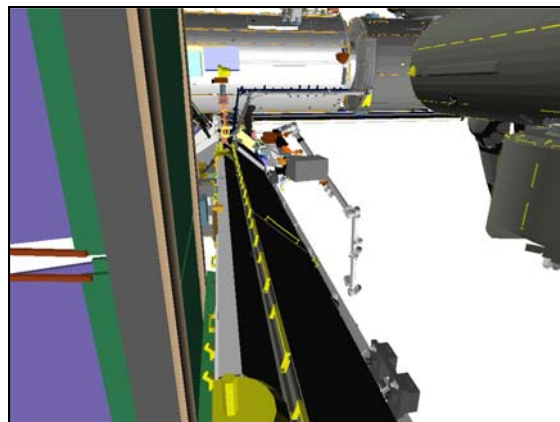


Figure 6.- Zenith Clearance
(09: P1 Lower Outboard: +100, -20).

2.410 WALK-OFF TO NODE 2 PDGF

(RBT FS/19A/FIN/SPN) Page 4 of 12 pages

4. NODE 2 APPROACH JOINT OCAS

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
03: S1 Lower Outboard (+70, -20)	22: Base Elbow (-140, -10)	09: P1 Lower Outboard (+100, -20)	Camera C (+10, +40)	OBSS ITVC (+90, -70)

pick File ► Menu 1 ► Menu 2

Verify 'Joint Angles' 'Destination' for Node 2 Approach position.

SR	SY	SP	EP	WP	WY	WR
+50.3	+28.3	-19.3	-46.7	-123.5	-24.1	-19.0

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)	-63.0	+97.0	+15.0	-46.7	-123.3	-24.1	-18.8
TGT	+50.3	+28.3	-19.3	-46.7	-123.5	-24.1	-19.0
ERR	-113.3	+68.7	+34.3	0.0	+0.2	0.0	+0.2

PCS

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

DCP

AUTO SEQ → PROC

PCS

MSS: SSRMS:

Verify Posn Hold – orange

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

SR	SY	SP	EP	WP	WY	WR
+50.3	+28.3	-19.3	-46.7	-123.5	-24.1	-19.0
X	Y	Z	Pitch	Yaw	Roll	
-400	0	+1150	+85.0	0.0	0.0	
FOR	Unloaded – LEE Tip, SY Held					
Disp	Node2>PDGF					

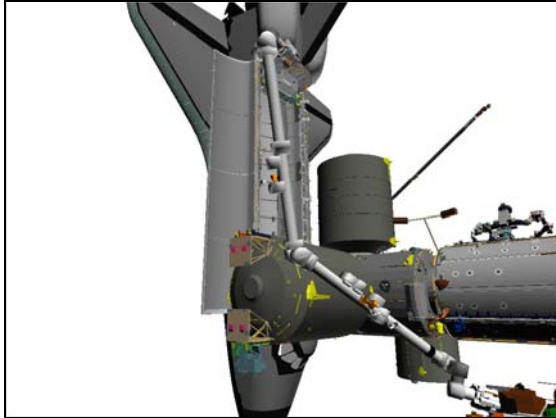


Figure 7.- Node 2 Approach
 (03: S1 Lower Outboard: +50, +15).

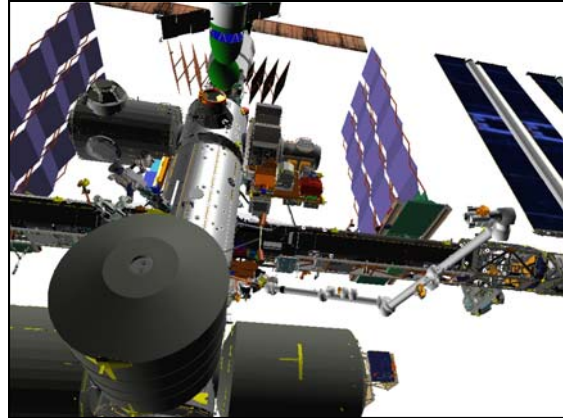


Figure 8.- Node 2 Approach
 (Camera C: +10, +40).

5. NODE 2 PDGF PRE-GRAPPLE FOR OCAS

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
03: S1 Lower Outboard (+50, +15)	22: Base Elbow (-140, -10)	37: MBS Mast (+120, +10)	Camera C (+10, +40)	OBSS ITVC (+90, -70)

NOTE

1. Tip Boom ► Columbus, minimum 71 cm (28 in), Camera C, MBS Mast.
2. Tip Boom ► MPLM, decreases to 53 cm (21 in), OBSS ITVC.
3. Tip Boom ► LSZ, decreases to 38 cm (17 in), MBS Mast. (note that this is a worst case clearance, dependant on the configuration of the LSZ Camera).

RHC RATE → VERNIER (Verify Vernier on PCS)

PCS MSS: SSRMS:

Enter Mode – FOR OCAS (Verify blue)

MSS: SSRMS: SSRMS FOR OCAS: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

2.410 WALK-OFF TO NODE 2 PDGF
 (RBT FS/19A/FIN/SPN) Page 6 of 12 pages

SSRMS FOR OCAS

pick File ► Menu 1 ► Menu 2

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

X	Y	Z	Pitch	Yaw	Roll
-150	0	0	0.0	0.0	0.0

cmd Load (Verify Sequence Status – Confirm or Cancel)

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

	X	Y	Z	Pitch	Yaw	Roll
FOR	-400	0	+1150	+85.0	0.0	0.0
TGT	-150	0	0	0.0	0.0	0.0
ERR	-250	0	+1150	+85.0	+0.0	+0.0

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

DCP AUTO SEQ → PROC

PCS MSS: SSRMS: SSRMS

Verify Posn Hold – orange

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

SR	SY	SP	EP	WP	WY	WR
+85.3	+28.3	-36.2	-92.0	-121.6	-14.9	-20.5
X	Y	Z	Pitch	Yaw	Roll	
-150	0	0	0.0	0.0	0.0	
FOR	Unloaded – LEE Tip, SY Held					
Disp	Node2>PDGF					

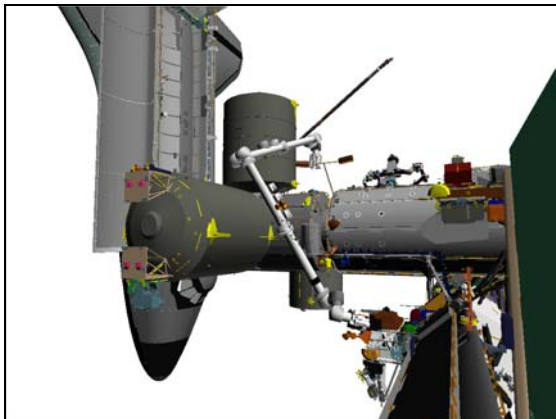


Figure 9.- Node 2 PDGF Pre-Grapple
 (03: S1 Lower Outboard: +65, +5).

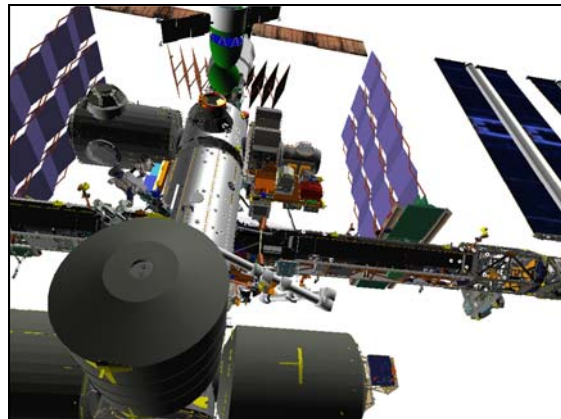


Figure 10.- Node 2 PDGF Pre-Grapple
 (Camera C: +10, +40).

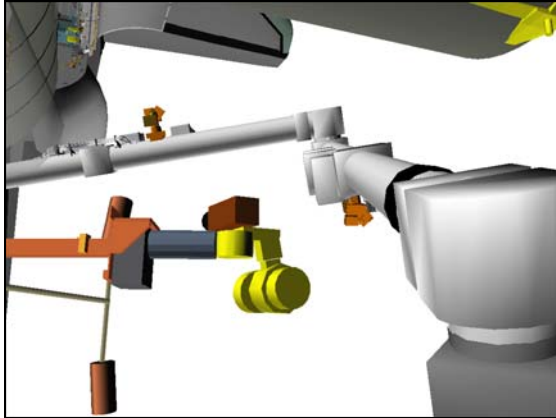


Figure 11.- Node 2 PDGF Pre-Grapple
 (37: MBS Mast: +110, +15).

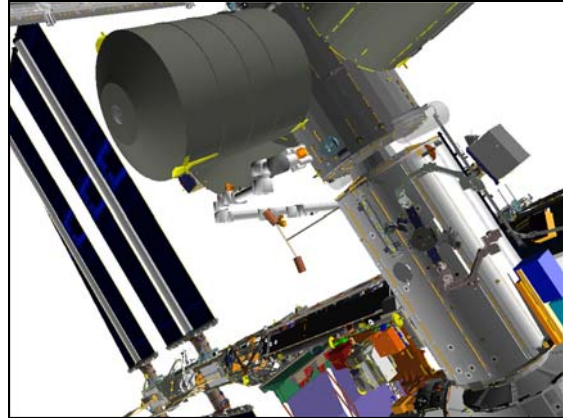


Figure 12.- Node 2 PDGF Pre-Grapple
 (72: OBSS ITVC: +90, -70).

6. NODE 2 PDGF GRAPPLE

6.1 Grapple Setup

Configure Cameras and overlays for grapple.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
37: MBS Mast (+140, +20)	25: Tip LEE (Zoomed Out)	24: Tip Elbow (-15, +5)	Camera C (+10, +40)	OBSS ITVC (+90, -70)

NOTE

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

6.2 Node 2 PDGF Grapple Maneuver

√Vernier

MSS: SSRMS: Rate:

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

NOTE

1. Base Boom ► Columbus, decreases to 79 cm (31 in), Camera C/MBS Mast.
2. Base Boom ► LSZ, 38 cm (17 in) and increases, MBS Mast.
3. LEE ► MPLM, maintains 53 cm (21 in), Tip Elbow.
4. Tip Boom ► UHF Antenna, 53 cm (21 in), OBSS ITVC.

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Yaw (Verify SY – Locked)

2.410 WALK-OFF TO NODE 2 PDGF

(RBT FS/19A/FIN/SPN) Page 8 of 12 pages

RHC/ Maneuver to within grapple envelope.
THC

PCS 6.3 PDGF Auto Capture
MSS: SSRMS: Tip LEE: SSRMS Tip LEE

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

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

CAUTION

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

NOTE

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

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Auto Capture

RHC TRIGGER → Press (momentarily)

PCS Verify 'Snare' Close, Capture (two) – blue (12 s max)
Verify Capture to Latch – Yes (SCR 19282)
Verify 'Carriage' Tension ~5500 N (90 s max)
Verify 'Carriage' Retract – blue
Verify 'Latch' Latch – blue (80s max)

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

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

NOTE

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

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Mate

RHC TRIGGER → Press (momentarily)

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

6.5 Grapple Cleanup

MSS: SSRMS: SSRMS

Verify Loaded Parameters – √
 Verify 'Loaded Parameters' (three) – Node2 PDGF, SSRMS, SR Held

Expected Node 2 PDGF Grapple position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
+87.9	+28.3	-29.9	-106.2	-112.2	-17.1	-19.6
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded – Node 2 PDGF, SSRMS, SR Held					
Disp	Node2>PDGF					

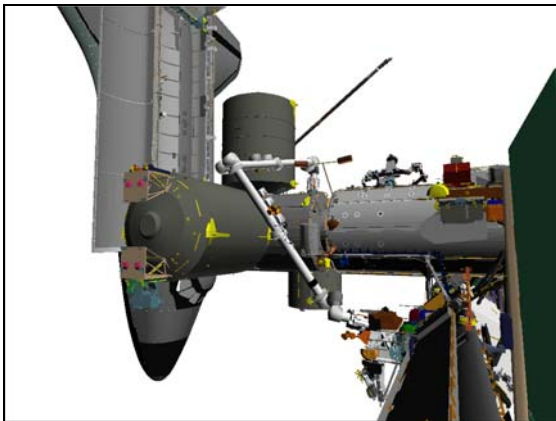


Figure 13.- Node 2 PDGF Grapple
 (03: S1 Lower Outboard: +65, +5).

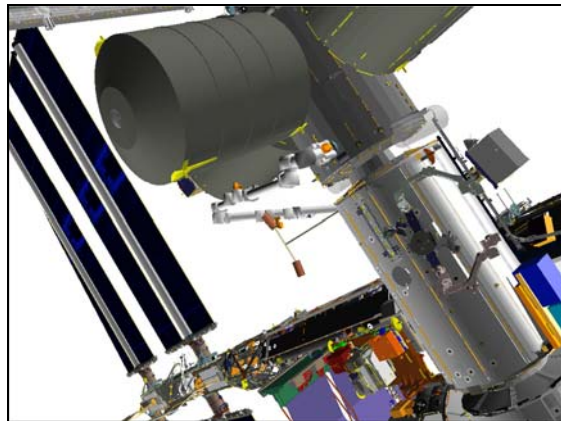


Figure 14.- Node 2 PDGF Grapple
 (OBSS ITVC: +90, -70).

6.6 MSS Safing and Brakes

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 **MCC-H GO** for SSRMS Base Change.

7. MBS PDGF 1 RELEASE

7.1 Release Setup

On **MCC-H GO**, SSRMS Base Change complete.

2.410 WALK-OFF TO NODE 2 PDGF

(RBT FS/19A/FIN/SPN) Page 10 of 12 pages

Configure Cameras and overlays as required.

Monitor 1	Monitor 2	Monitor 3	SSC 1 (MON 1)	SSC 2 (DTV)
37: MBS Mast (+120, +20)	25: Tip LEE (Zoomed Out)	24: Tip Elbow (-5, +5)	Camera C (+10, +40)	OBSS ITVC (+90, -70)

NOTE

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

Verify 'Loaded Parameters' (three) – MBS PDGF 1, SSRMS, SR Held

Change Unloaded Parameters ► Unloaded ► LEE Tip SRH

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

Change Display ► MBS ► PDGF 1 (Verify MBS>PDGF 1)

Verify Command – SSRMS>Internal

Expected MBS PDGF1 Grapple position (within 5 cm/1 deg).

SR	SY	SP	EP	WP	WY	WR
-19.6	+17.1	-112.2	-106.2	-29.9	-28.3	+87.9
X	Y	Z	Pitch	Yaw	Roll	
0	0	0	0.0	0.0	0.0	
FOR	Loaded – MBS PDGF 1, SSRMS, SR Held					
Disp	MBS>PDGF 1					

7.2 Removing SSRMS Safing and Brakes

PCS

MSS: SSRMS: MSS Safing:

cmd 'SSRMS' Remove (Verify Not Safed)

DCP

BRAKES SSRMS → OFF (Verify OFF)

7.3 SSRMS Limp

PCS

MSS: SSRMS: Limp:

cmd All Limp (Verify Limp – blue)

MSS: SSRMS:

Verify all joints – Limped

7.4 Auto Release

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

2.410 WALK-OFF TO NODE 2 PDGF

(RBT FS/19A/FIN/SPN) Page 11 of 12 pages

MSS: SSRMS: Tip LEE:

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

Verify 'Confirm or Terminate' prompt.

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Auto Release

RHC

TRIGGER → Press (momentarily)

PCS

Verify 'Umbilical' Demate – blue (10 s max)

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

Verify 'Carriage' Retract – gray (90 s max)

Verify 'Snare' Open – blue (12 s max)

Verify 'Carriage' Derigidize – blue

Verify 'Carriage' Extend – blue (90 s max)

7.5 SSRMS Backoff

MSS: SSRMS: Limp:

cmd None Limp (Verify Standby – blue)

MSS: SSRMS:

√Vernier

NOTE

1. Tip Boom ► Columbus, decreases to 71 cm (28 in), Camera C/MBS Mast.
2. Tip Boom ► LSZ, 48 cm (19 in) and increases, MBS Mast.
3. Base Boom ► UHF Antenna, 61 cm (24 in), OBSS ITVC.

MSS: SSRMS:

Enter Mode – Manual (Verify blue)

MSS: SSRMS: SSRMS Manual: Joint Lock:

cmd Shoulder Roll (Verify SR – Locked)

2.410 WALK-OFF TO NODE 2 PDGF

(RBT FS/19A/FIN/SPN) Page 12 of 12 pages

THC/
RHC

Maneuver to MBS PDGF 1 Backoff (ONP) position
(within 5 cm/1 deg).
Expect -X (THC Out).

Locked						
SR	SY	SP	EP	WP	WY	WR
-19.6	+12.3	-102.1	-107.8	-41.1	-30.0	+82.7
X	Y	Z	Pitch	Yaw	Roll	
-150	0	0	0.0	0.0	0.0	
FOR	Unloaded – LEE Tip, SSRMS, SR Held					
Disp	MBS>PDGF 1					

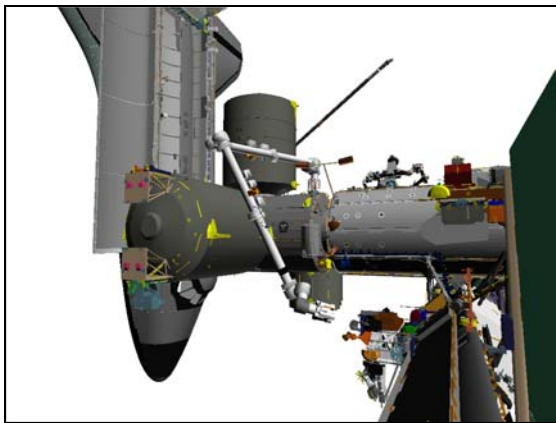


Figure 15.- MBS PDGF 1 Backoff (ONP)
(03: S1 Lower Outboard: +65, +5).

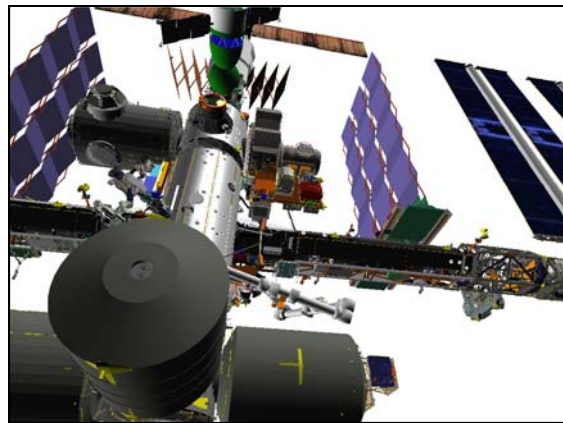


Figure 16.- MBS PDGF 1 Backoff (ONP)
(Camera C: +10, +40).

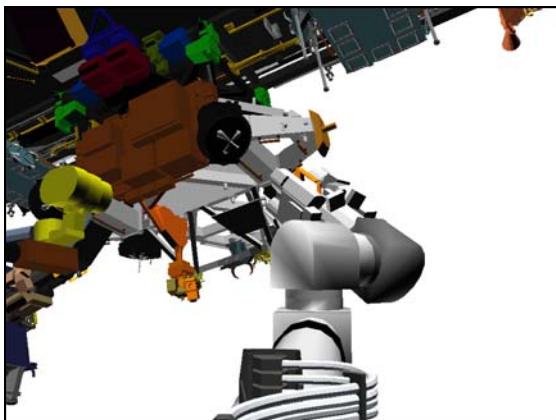


Figure 17.- MBS PDGF 1 Backoff (ONP)
(24: Tip Elbow -5, +5).

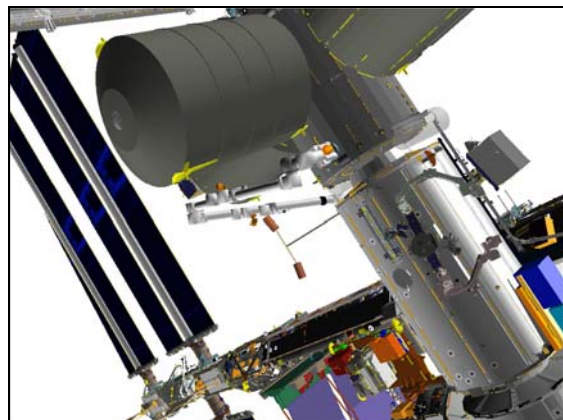


Figure 18.- MBS PDGF 1 Backoff (ONP)
(OBSS ITVC: +90, -70).

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)

19 NOV 09

2.666 CBM LATCH STALL RECOVERY

(RBT FS/19A/FIN)

Page 1 of 2 pages

1. SSRMS SAFING AND BRAKES STATUS

On CBM operator, "Go to perform 2.666 CBM LATCH STALL RECOVERY, all (SODF: RBT FS: CONTINGENCY PROCEDURES) 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/19A/FIN)

Page 2 of 2 pages

MSS: SSRMS: Limp:

cmd All Limp (Verify Limp – blue)

MSS: SSRMS:

Verify all joints – Limped

Give CBM operator, "GO to reattempt Second Stage Capture, SSRMS Mode to Limp complete."

REFERENCE

REFERENCE

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3.100 DISPLAY FRAME AND FOR REFERENCES

(RBT FS/19A/FIN)

Page 1 of 5 pages

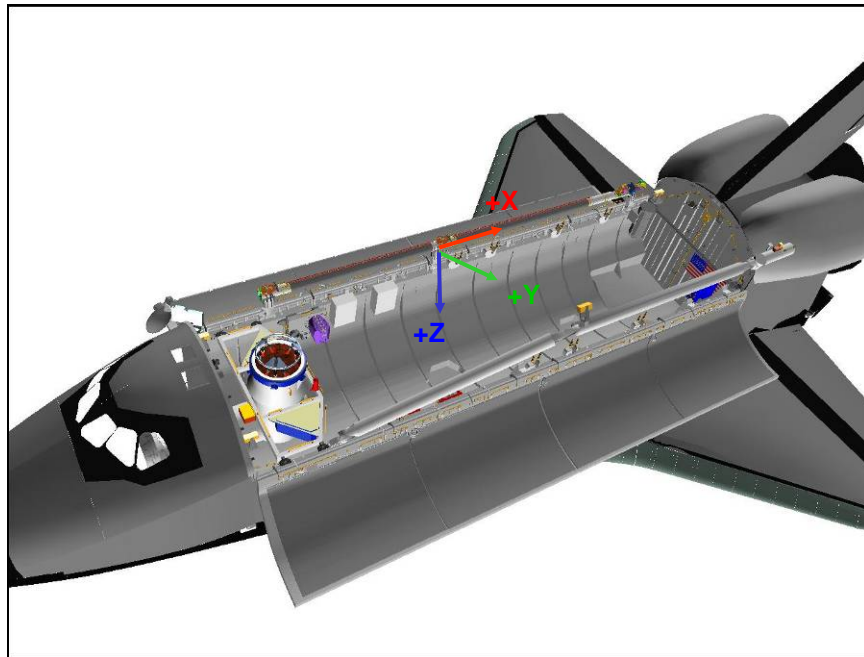


Figure 1.- OBSS Mid MPM FOR.

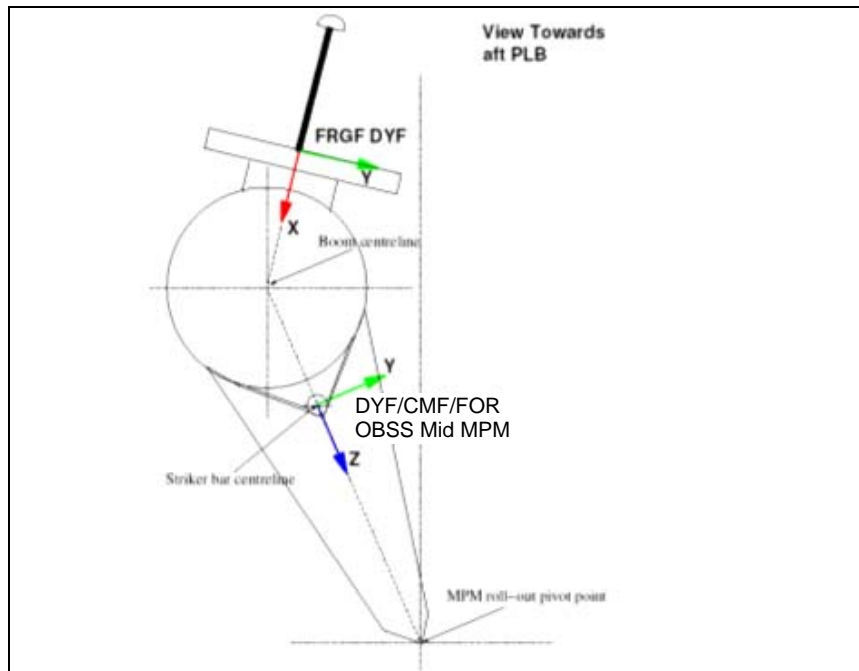


Figure 2.- OBSS Mid MPM Command Frame, Display Frame, and FOR.

Location:

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

3.100 DISPLAY FRAME AND FOR REFERENCES

(RBT FS/19A/FIN)

Page 2 of 5 pages

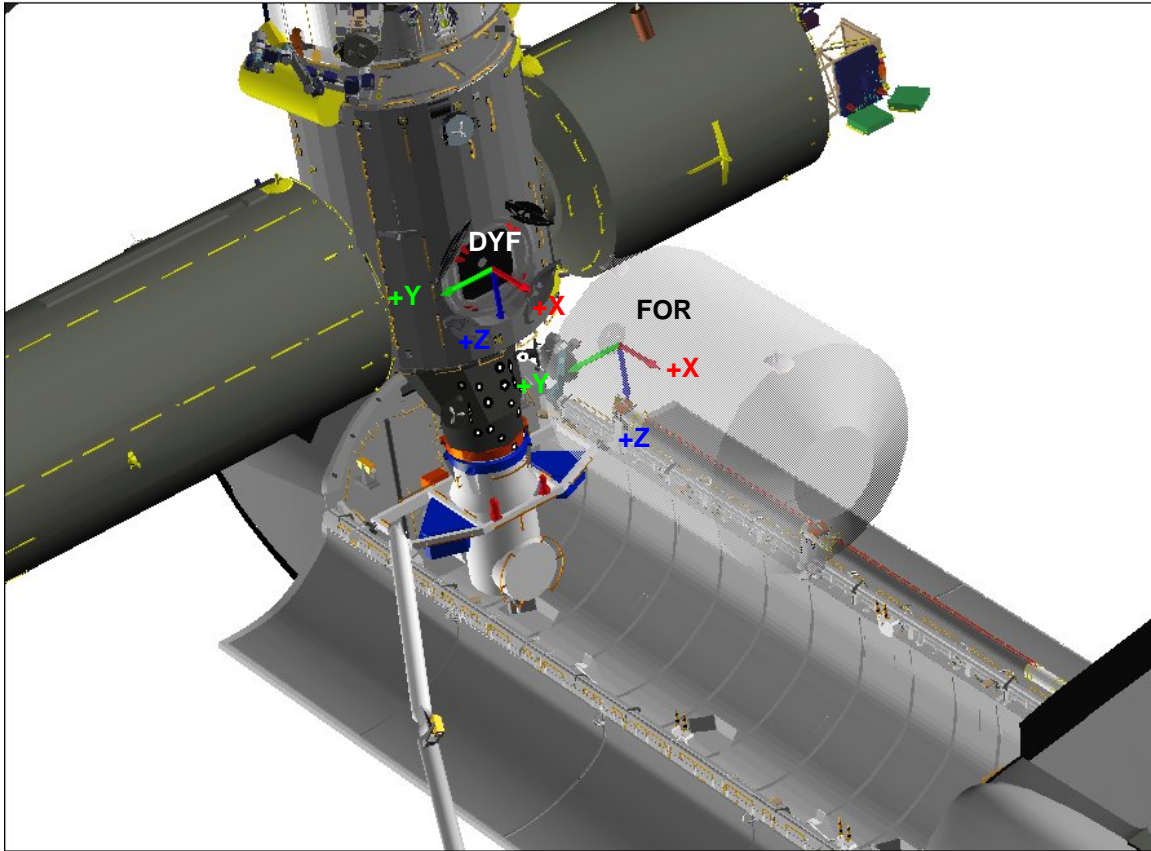


Figure 3.- MPLM Mate CBCS Display Frame and FOR.

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.

3.100 DISPLAY FRAME AND FOR REFERENCES

(RBT FS/19A/FIN)

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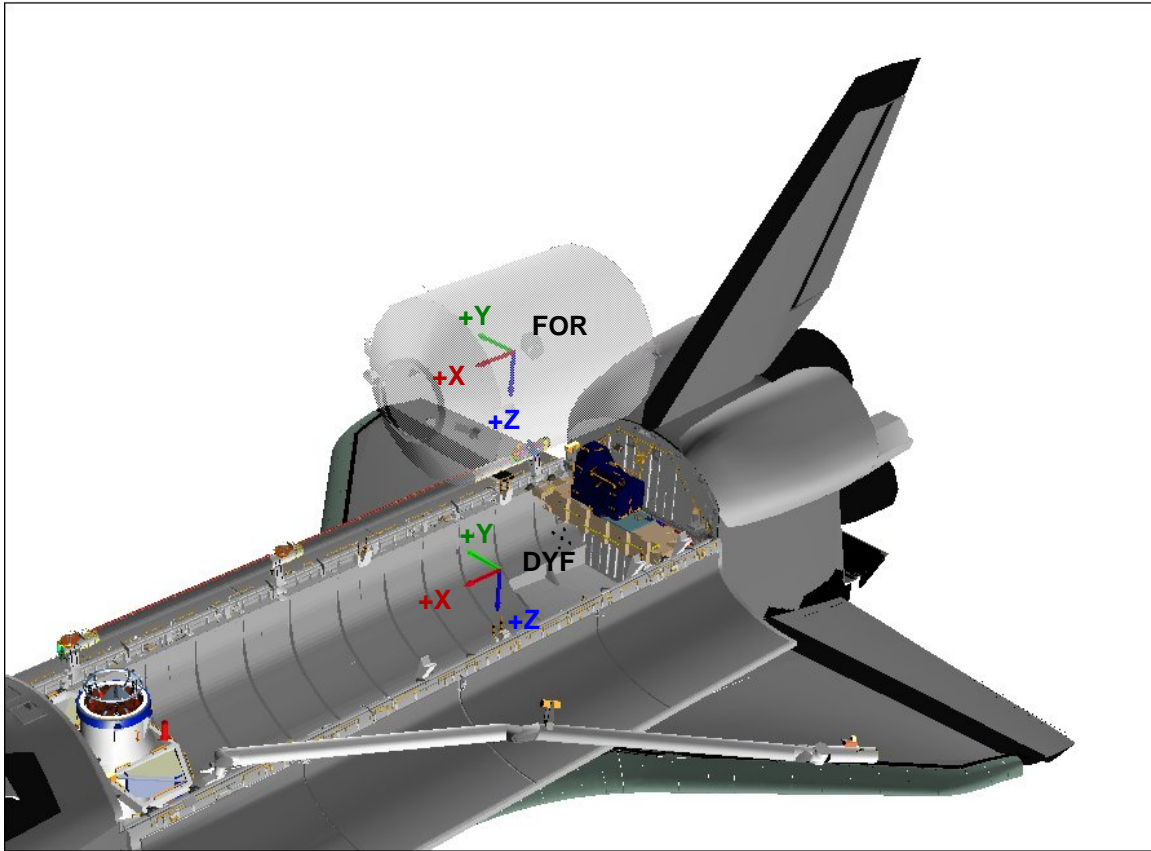


Figure 4.- MPLM Berth Display Frame and FOR.

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.

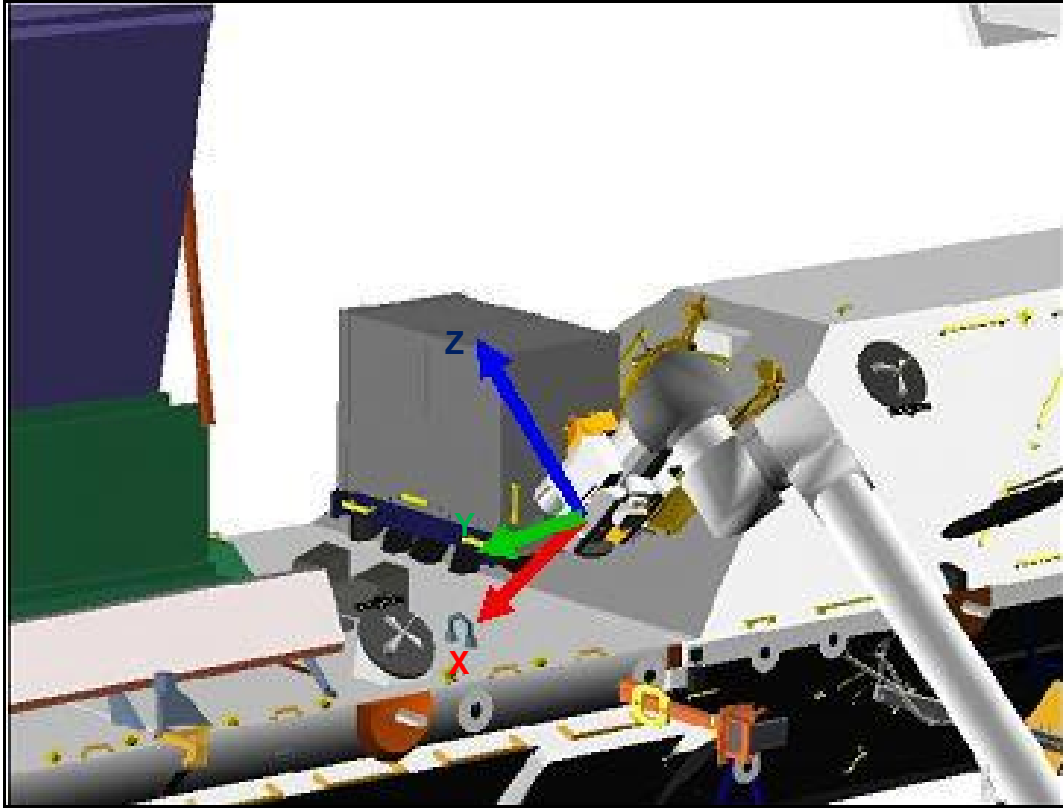


Figure 5. - ATA Mnvr FOR

Location: Located at the EEOCS origin. It also matches the ATA FGB2 GF origin.
Aligned such that it matches EEOCS when SSRMS TIP LEE is grappled to
ATA FGB2.

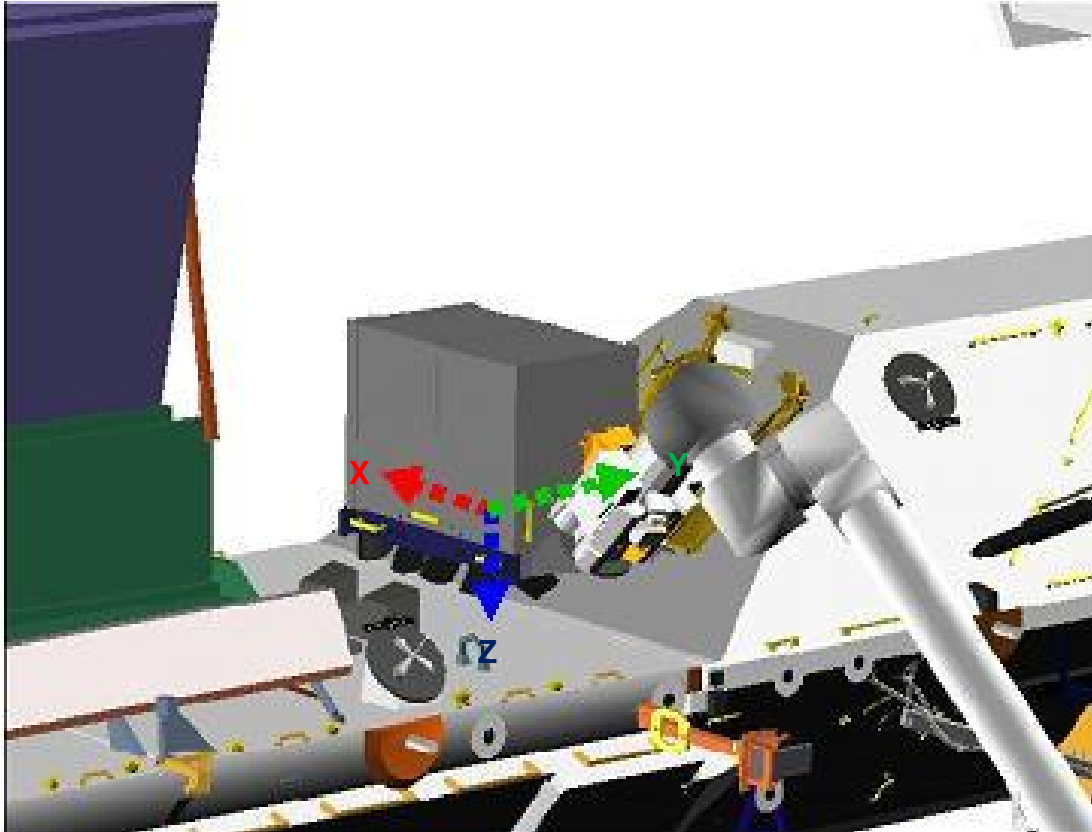


Figure 6. - ATA Mnvtr Cntr FOR

Location: Located at the Geometric center plane formed by the 4 attachment bolts for the ATA. Aligned with +Z into the truss and +X away from FGB2 when ATA is installed to the truss.

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