JSC-48536

International Space Station Robotics Group Robotics Book - Generic

All Expedition Flights

Mission Operations Directorate
Operations Division

22 DEC 04

Do not use until after X2R4 uplink.

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United Space Alliance

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JSC-48536

INTERNATIONAL SPACE STATION
ROBOTICS GROUP
ROBOTICS BOOK - GENERIC

22 DEC 04

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Rob Gen U297
Rob Gen U298A
Rob Gen U299
Rob Gen U301
Rob Gen U304
Rob Gen U305A
Rob Gen U306A
Rob Gen U307
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Rob Gen U313
Rob Gen U321
Rob Gen U322
Rob Gen U324
Rob Gen U325A
Rob Gen U326A
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Rob Gen U338A
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Uplinked Messages (or Approved Flight Notes) replaced by this revision, remove from Book:

None

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6.101 DISPLAY AND CONTROL PANEL CHECKOUT

1. CUP(LAB) RWS STATUS CHECK

PCS MSS: RWS

√'LAS5(LAP5) CEU Mode' – Backup

****

* If LAS5(LAP5) CEU Mode – Active
* | For currently Active RWS, perform {6.123 BACKUP
* | ROBOTIC WORKSTATION CUP(LAB) DESIGNATION},
* | all (SODF: RBT GEN: NOMINAL), then:

****

2. PANEL/INST LIGHTING

> NOTE
>
> Hold switches and pushbuttons until the talkback indication appears. Release after 5 seconds if no talkback appears.

MSS: LAS5(LAP5) DCP: Cupola(Lab) DCP Status

DCP 'PANEL/INST LIGHTING'	PCS 'PANEL/INST LIGHTING'
sel LAMP TEST Verify all DCP lights are on.	Verify dial at LAMP TEST.
sel OFF Verify all DCP lights are off.	Verify dial at OFF.
sel first tick mark Verify DCP lighting present.	Verify dial at first tick mark.
sel second tick mark Verify increase in DCP lighting.	Verify dial at second tick mark.
sel third tick mark Verify increase in DCP lighting.	Verify dial at third tick mark.
sel fourth tick mark Verify increase in DCP lighting.	Verify dial at fourth tick mark.
sel fifth tick mark Verify increase in DCP lighting.	Verify dial at fifth tick mark.
sel sixth tick mark Verify increase in DCP lighting.	Verify dial at sixth tick mark.
sel BRT Verify increase in DCP lighting.	Verify dial at BRIGHT.

DCP Position PANEL/INST LIGHTING rotary switch for desired brightness.

3. DCP DIAGNOSTICS

PCS Verify ‘Osc Period’ 1: 625 to 714
Verify ‘Osc Period’ 2: 625 to 714

Verify ‘Voltage’ ‘Reference’ +4.9: +4.8 to +4.9
Verify ‘Voltage’ ‘Reference’ -4.9: -4.9 to -4.8
Verify ‘Voltage’ ‘Reference’ 0.0: -0.1 to +0.1

Verify ‘Voltage’ ‘Rail’ +5: 4.7 to 5.5
Verify ‘Voltage’ ‘Rail’ +15: 13.9 to 16.0
Verify ‘Voltage’ ‘Rail’ -15: -16.0 to -13.9

Verify ‘Voltage’ ‘Osc’ 1: -39.4 to -33.2
Verify ‘Voltage’ ‘Osc’ 2: -39.4 to -33.2

Verify ‘Voltage’ ‘Trackball’ +5: 4.6 to 5.4

4. DCP CAMERA COMMAND CHECKOUT
‘CAMERA COMMAND’

Verify no checkmarks are present in any field.

DCP ‘CAMERA COMMAND’	PCS ‘CAMERA COMMAND’
RATE → HIGH	Verify RATE HIGH – √
RATE → LOW	Verify RATE LOW – √
FOCUS → FAR	Verify FOCUS FAR – √
FOCUS → NEAR	Verify FOCUS NEAR – √
ZOOM → IN	Verify ZOOM IN – √
ZOOM → OUT	Verify ZOOM OUT – √
IRIS → OPEN	Verify IRIS OPEN – √
IRIS → CLOSE	Verify IRIS CLOSE – √
TILT → UP	Verify TILT UP – √
TILT → DOWN	Verify TILT DOWN – √
PAN → LEFT	Verify PAN LEFT – √
PAN → RIGHT	Verify PAN RIGHT – √

DCP **cmd** IRIS – AUTO

PCS Verify ‘IRIS’ AUTO – √

5. MONITOR SELECT CHECKOUT

‘MONITOR SELECT’

Verify no checkmarks are present in any field.

DCP ‘MONITOR SELECT’	PCS ‘MONITOR SELECT’
cmd MON 1 Verify MON 1 – ☐	Verify MON 1 – √ Lt
cmd MON 2 Verify MON 2 – ☐	Verify MON 2 – √ Lt
cmd MON 3 Verify MON 3 – ☐	Verify MON 3 – √ Lt

6. MULTIPLEX UNIT CHECKOUT

PCS ‘MULTIPLEX UNIT’

Verify no checkmarks are present in any field.

DCP ‘MULTIPLEX UNIT’	PCS ‘MULTIPLEX UNIT’
cmd MUX A LEFT Verify MUX A LEFT – ☐	Verify MUX A LEFT – √ Lt
cmd MUX A RIGHT Verify MUX A RIGHT – ☐	Verify MUX A RIGHT – √ Lt
cmd MUX B LEFT Verify MUX B LEFT – ☐	Verify MUX B LEFT – √ Lt
cmd MUX B RIGHT Verify MUX B RIGHT – ☐	Verify MUX B RIGHT – √ Lt

7. CAMERA SELECT CHECKOUT

NOTE

1. To prevent camera routing commands from being sent, a different monitor is selected after each camera select pushbutton is pressed. Failure to do this may cause the DCP to become unresponsive for a few minutes.

2. The CAMERA SELECT pushbuttons should be held down until instructed to release.

PCS ‘CAMERA SELECT’

Verify no checkmarks are present in any field.

DCP ‘CAMERA SELECT’

cmd [X] where [X] = 0 1 2 3 4 5 6 7 8 9

Verify [X] – illuminated while pressed

PCS ‘CAMERA SELECT’

‘[X]’

Verify [X] – √
Verity [X] – Lt

Release [X]

DCP ‘MONITOR SELECT’

Select a different monitor.

Repeat

8. JOINT SELECT CHECKOUT

DCP ‘JOINT SELECT’	PCS ‘JOINT SELECT’
sel SPDM BODY	Verify dial at SPDM BODY.
sel SHOULDER ROLL	Verify dial at SHOULDER ROLL.
sel SHOULDER YAW	Verify dial at SHOULDER YAW.
sel SHOULDER PITCH	Verify dial at SHOULDER PITCH.
sel ELBOW PITCH	Verify dial at ELBOW PITCH.
sel WRIST PITCH	Verify dial at WRIST PITCH.
sel WRIST YAW	Verify dial at WRIST YAW.
sel WRIST ROLL	Verify dial at WRIST ROLL.

9. BRAKES SWITCH CHECKOUT

PCS ‘BRAKES’

Verify no checkmarks are present in any field.

DCP ‘BRAKES’	PCS ‘BRAKES’
SPDM ARM 1 → ON	Verify SPDM ARM 1 ON – √√
SPDM ARM 1 → OFF	Verify SPDM ARM 1 OFF – √√
SPDM ARM 2 → ON	Verify SPDM ARM 2 ON – √√
SPDM ARM 2 → OFF	Verify SPDM ARM 2 OFF – √√
SPDM BODY → ON	Verify SPDM BODY ON – √√
SPDM BODY → OFF	Verify SPDM BODY OFF – √√
SSRMS → ON	Verify SSRMS ON – √√
SSRMS → OFF	Verify SSRMS OFF – √√

10. AUTO SEQUENCE SWITCH CHECKOUT

PCS ‘AUTO SEQ’

Verify no checkmarks are present in any field.

DCP ‘AUTO SEQ’	PCS ‘AUTO SEQ’
→ PROC	Verify AUTO SEQ PROCEED – √√
→ PAUSE	Verify AUTO SEQ PAUSE – √√

11. SPDM TORQUE DRIVE SWITCH CHECKOUT

PCS ‘SPDM TORQUE DRIVE’

Verify no checkmarks are present in any field.

DCP ‘SPDM TORQUE DRIVE’	PCS ‘SPDM TORQUE DRIVE’
DIRECTION → CW	Verify DIRECTION CW – √√
DIRECTION → CCW	Verify DIRECTION CCW – √√
POSITION → EXTEND	Verify POSITION EXTEND – √√
POSITION → RETRACT	Verify POSITION RETRACT – √√

12. SAFING SWITCH CHECKOUT

PCS Verify ‘SAFING’ SAFE – no checkmarks are present

DCP SAFING → SAFE

PCS Verify ‘SAFING’ SAFE – √√

13. PARTIAL E-STOP CHECKOUT

PCS ‘STOP’

Verify no checkmarks are present.

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6.102 HAND CONTROLLER (THC AND RHC) DIAGNOSTIC

(RBT GEN/ULF1 - ALL/FIN)   Page 1 of 3 pages

1. RWS STATUS CHECK

PCS   MSS: RWS

√'LAS5(LAP5) CEU Mode' – Backup

****
* If LAS5(LAP5) CEU Mode – Active
* | For currently Active RWS, perform {6.123 BACKUP
* | ROBOTIC WORKSTATION CUP(LAB) DESIGNATION},
* | all (SODF: RBT GEN: NOMINAL), then:
****

2. POWER SUPPLY DIAGNOSTICS

MSS: LAS5(LAP5) HCs: Cupola(Lab) HC Status

Verify 'Supply Voltage' 'A' +12:   11.16 to 12.84
Verify 'Supply Voltage' 'A' -12: -12.84 to -11.16

'B'

Verify 'Supply Voltage' 'B' +12:   11.16 to 12.84
Verify 'Supply Voltage' 'B' -12: -12.84 to -11.16

3. THC DIAGNOSTICS

'THC'

Verify 'THC' X-Axis,Y-Axis,Z-Axis: 0.0 ± 0.3
0.0 ± 0.3

THC	Deflect slowly to hardstops	PCS	'THC' Verify smooth increase and decrease of values with corresponding THC deflection. Verify maximum and minimum range. Deflect hand controllers slowly enough to see voltage incrementing.
	+X (in)	X-Axis:	3.3 to 4.7 -4.7 to -3.3
	-X (out)	X-Axis:	-4.7 to -3.3 3.3 to 4.7
	+Y (right)	Y-Axis:	3.3 to 4.7 -4.7 to -3.3
	-Y (left)	Y-Axis:	-4.7 to -3.3 3.3 to 4.7
	+Z (down)	Z-Axis:	3.3 to 4.7 -4.7 to -3.3
	-Z (up)	Z-Axis:	-4.7 to -3.3 3.3 to 4.7

4. RHC DIAGNOSTICS

‘RHC’

Verify ‘RHC’ Pitch-Axis,Yaw-Axis,Roll-Axis: 0.0 ± 0.3
0.0 ± 0.3

RHC	Deflect slowly to hardstops	PCS	‘RHC’ Verify smooth increase and decrease of values with corresponding RHC deflection. Verify maximum and minimum range. Deflect hand controllers slowly enough to see voltage incrementing.
	+Pitch	Pitch-Axis:	3.7 to 4.7 -4.7 to -3.7
	-Pitch	Pitch-Axis:	-4.7 to -3.7 3.7 to 4.7
	+Yaw	Yaw-Axis:	3.7 to 4.7 -4.7 to -3.7
	-Yaw	Yaw-Axis:	-4.7 to -3.7 3.7 to 4.7
	+Roll	Roll-Axis:	3.6 to 4.7 -4.7 to -3.6
	-Roll	Roll-Axis	-4.7 to -3.6 3.6 to 4.7

RHC √Rate – COARSE

‘Coarse/Vern’

PCS Verify ‘Coarse/Vern’ Coarse – √
√

RHC RATE → VERNIER

PCS Verify ‘Vern’ – √
√

	‘Rate Hold’
	If ‘Rate Hold’ Rate Hold – √ √
RHC	Press Rate Hold.
PCS	Verify Rate Hold – ☐
RHC	Press Rate Hold.
PCS	Verify Rate Hold – √ √
	If ‘Rate Hold’ Rate Hold – ☐
RHC	Press Rate Hold.
PCS	Verify Rate Hold – √ √
RHC	Press Rate Hold.
PCS	Verify Rate Hold – ☐
RHC	Press and hold release trigger.
PCS	Verify Release – √ √
RHC	Release release trigger.
PCS	Verify Release – ☐
RHC	Press and hold capture trigger.
PCS	Verify Capture – √ √
RHC	Release capture trigger.
PCS	Verify Capture – ☐

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6.112 ROBOTIC WORKSTATION CUP(LAB) EXTERNAL RACK RELOCATION

(RBT GEN/X2R4 - ALL/FIN) Page 1 of 2 pages

1. POWERING DOWN RWS & PCS

   Perform {6.334 MSS POWERDOWN FROM OPERATIONAL TO KEEP-ALIVE}, step 4 (SODF: RBT GEN: NOMINAL), then:

   Perform {6.114 LAB(CUP) RWS UOP BYPASS CABLE RECONFIGURATION}, step 1 (SODF: RBT GEN: NOMINAL), then:

2. DISCONNECTING RWS CABLES

   NOTE
   Only cables routed from the external RWS rack to the internal rack must be disconnected. Do not disconnect cabling exclusive to external rack.

   At Rack Interface Panel, disconnect
   - J53 ←|→ W1193-P1(W1293-P1)
   - J54 ←|→ W1193-P2(W1293-P2)
   - J55 ←|→ W1193-P3(W1293-P3)

   At UOP, disconnect
   - J3 ←|→ W1192-P3(W1292-P3)
   - J4 ←|→ US DC Power and 1553 Cable 8′ (UOP to power supply and 760)

   Secure loose cables to External Rack with Velcro Ties.

3. RELOCATING EXTERNAL RACK

   If relocating to/from Cupola environment
   - Unlock and unlatch lower handrail U-clamps (two) from mounting rail.
   - Lift Rack until all U-clamps (four) are clear of mounting rail.
   - Relocate External Rack to desired location.

   NOTE
   U-clamp rotation necessary for Cupola rail clearance.

   Rotate right-side lower U-clamp assembly 180 degrees.

   NOTE
   All U-clamps (four) must be lowered so that simultaneous rail alignment is made.

   Lower External Rack onto mounting rails.
   Latch and lock lower handrail U-clamps (two) onto mounting rail.

   If relocating within US Lab environment
   - Release seat track locks (four) on Rack Adapter.
   - Relocate External Rack and Rack Adapter to desired location.
   - Place Rack Adapter against Lab Rack and relatch seat track locks (four).

6.112 ROBOTIC WORKSTATION CUP(LAB) EXTERNAL RACK RELOCATION

4. CONNECTING RWS CABLES

At Rack Interface Panel, connect

J53 →|← W1193-P1(W1293-P1) (RS-422/ Discrete lines)
J54 →|← W1193-P2(W1293-P2) (Video)
J55 →|← W1193-P3(W1293-P3) (Scar)

At UOP, connect

J3 →|← W1192-P3(W1292-P3)
J4 →|← US DC Power and 1553 Cable 8′ (UOP to power supply and 760)

6.113 CUP(LAB) ARTIFICIAL VISION UNIT (AVU) HARD DISK DRIVE (HDD) CHANGEOUT

(RBT GEN/ULF1 - ALL/FIN 1) Page 1 of 1 page

1. EXTERNAL RACK RELOCATION

   Perform {6.112 ROBOTIC WORKSTATION CUP(LAB) EXTERNAL RACK RELOCATION}, steps 1 to 3 (SODF: RBT GEN: NOMINAL), then:

2. AVU HARD DRIVE REMOVAL

   LAS5 (LAP5) Open access panel and secure.

   AVU Loosen thumbscrews on AVU HDD.

   Remove AVU HDD.

   Notify **MCC-H** of serial number on HDD removed.

   Stow AVU HDD.

3. AVU HARD DRIVE INSTALLATION

   Notify **MCC-H** of serial number on HDD being installed.

   AVU Install new AVU HDD.

   Tighten thumbscrews.

   LAS5 (LAP5) Close access panel and secure.

4. EXTERNAL RACK RELOCATION

   Go to {6.112 ROBOTIC WORKSTATION CUP(LAB) EXTERNAL RACK RELOCATION}, steps 3 and 4 (SODF: RBT GEN: NOMINAL).

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6.114 LAB(CUP) RWS UOP BYPASS CABLE RECONFIGURATION

(RBT GEN/E10 - ALL/FIN) Page 1 of 2 pages

OBJECTIVE:

Reconfigure the Lab (or Cupola) RWS UOP Bypass Cable by demating (or mating) the DCP leg of the bypass cable. This procedure will allow the DCP to be powered down while still providing power to the PCS located on the RWS workstation.

NOTE

1. The following assumption can be made:
   CEU is powered OFF (to prevent loss of comm between CEU and DCP).

2. Entire time between removing power and reapplying power is less than 1 hr (to prevent the PCS battery from depleting when power is removed for more than 1 hr).

LOCATION:

MSS Avionics Rack 2(1), LAB1P5(LAB1S5)

DURATION:

10 minutes

PARTS:

None

MATERIALS:

Kapton Tape (for demate)
Velcro Tie Wraps (for demate)

TOOLS REQUIRED:

None

REFERENCED PROCEDURE(S):

None

1. DCP POWERDOWN/CABLE DEMATE

WARNING

Failure to remove power and apply close inhibit could result in electrical shock hazard.

1.1 Open and Close – Inhibit LAP51A4A-A(LAS52A3B-A) RPC 18

LAB: EPS: LAB1P5(LAB1S5): RPCM LAP51A4A(RPCM LAS52A3B): ‘RPC’ 18

RPCM_LAP51A4A_A_RPC_18(RPCM_LAS52A3B_A_RPC_18)

cmd ‘RPC Position’ Open (Verify – Op)
cmd ‘Close Cmd’ Inhibit (Verify – Inh)

1.2 DCP J1 ←|→ P1 (UOP PWR BYPASS 1J00137-1)

1.3 Install tethered protective cap on P1 (UOP PWR BYPASS 1J00137-1).
Cover DCP J1 (Kapton Tape).

1.4 Secure DCP leg of bypass cable to DC P/S leg of bypass cable (Velcro Tie Wraps).

1.5

CAUTION
The 760XD laptop main battery must indicate a minimum of 50% state of charge prior to turning on the laptop. A charge less than 50% can cause damage to the USOS 120VDC power supply due to excessive current draw.

If laptop battery state of charge is below 50%, let the battery charge before turning on the laptop.

1.6 Close – Enable and Close LAP51A4A-A(LAS52A3B-A) RPC 18

LAB: EPS: LAB1P5(LAB1S5): RPCM LAP51A4A(RPCM LAS52A3B): ‘RPC’ 18
RPCM_LAP51A4A_A_RPC_18(RPCM_LAS52A3B_A_RPC_18)

cmd ‘Close Cmd’ Enable (Verify – Ena)
cmd ‘RPC Position’ Close (Verify – Cl)

2. CABLE MATE/DCP POWERUP

WARNING
Failure to remove power and apply close inhibit could result in electrical shock hazard.

2.1 Perform step 1.1 to Open and Close – Inhibit LAP51A4A-A(LAS52A3B-A) RPC 18.

2.2 Detach Velcro securing DCP leg of bypass cable to DC P/S leg of bypass cable.

2.3 Uncap P1 (UOP PWR BYPASS 1J00137-1)
Remove Kapton Tape from DCP J1.

2.4 DCP J1 →|← P1 (UOP PWR BYPASS 1J00137-1)

2.5 Perform steps 1.5 and 1.6 to Close – Enable and Close LAP51A4A-A(LAS52A3B-A) RPC 18.

6.123 BACKUP ROBOTIC WORKSTATION CUP(LAB) DESIGNATION

(RBT GEN/R2 - ALL/FIN) Page 1 of 1 page

BACKUP ROBOTIC WORKSTATION CUP(LAB) DESIGNATION

PCS MSS: LAS5(LAP5) CEU Mode: $\boxed{\text{CEU Mode}}$

cmd Active CEU – Backup (Verify previously Active RWS is Backup)

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6.201 MT PRE-TRANSLATION IMCA CHECKOUT

(RBT GEN/ULF1 - ALL/FIN 2) Page 1 of 5 pages

NOTE
The IMCA takes approximately 6 seconds to complete self-tests once power is applied.

1. SETUP

PCS MSS: MT: MT Mode: MT Mode

√'MT Process State' – Disabled

input MT Position

Refer to Table 1.

Table 1. MT Positions

Location	MT Position
WS9	3672.8
WS1	2169.2
WS2	1653.5
WS3	795.0
WS4	287.0
Launch Site	-254.0
WS5	-525.8
WS6	-795.0
WS7	-1653.5
WS8	-2169.2
WS10	-3672.8

cmd Load New MT Position **Execute**
cmd Initiate MT Process **Execute**

Verify 'SEPS Process State' – Initiated
Verify 'IMCA Process State' – Initiated
Verify 'MT Process State' – Initiated

MSS: MT: Mobile_Transporter

Verify 'MT Position Data Valid' – √

NOTE

1. When I/O is enabled to the IMCAs, expect the following twenty Robotics Advisory messages:
   ‘**R9Z - MSS MT LTU 1 IMCA 1,2 Comm or Device Fail**’
   ‘**R9Z - MSS MT LTU 2 IMCA 1,2 Comm or Device Fail**’
   ‘**R9Z - MSS MT LTU 3 IMCA 1,2 Comm or Device Fail**’
   ‘**R9Z - MSS MT LTU 4 IMCA 1,2 Comm or Device Fail**’
   ‘**R9Z - MSS MT ED IMCA 1,2 Comm or Device Fail**’
   ‘**R9Z - MSS MT TD IMCA 1,2 Comm or Device Fail**’
   ‘**R9Z - MSS MT UMA 1 IMCA 1,2 Comm or Device Fail**’
   ‘**R9Z - MSS MT UMA 2 IMCA 1,2 Comm or Device Fail**’
   ‘**R9Z - MSS MT TUS 1 IMCA 1,2 Comm or Device Fail**’
   ‘**R9Z - MSS MT TUS 2 IMCA 1,2 Comm or Device Fail**’

2. MT IMCA RT FDIR remains inhibited at all times to avoid channel switching caused by nominal IMCA power removal. This also suppresses some of the nuisance RT Comm Fail C&W messages.

2. IMCA RT I/O ENABLE
MSS: MT: ‘MT’ ‘Amp 1’ MT LB A: RT Status:
LB MT 1 RT Status

cmd ‘RT Status’ ‘00 LTU 1P’ Enable **Execute** (Verify – Ena)
cmd ‘RT Status’ ‘01 LTU 2P’ Enable **Execute** (Verify – Ena)
cmd ‘RT Status’ ‘02 LTU 3P’ Enable **Execute** (Verify – Ena)
cmd ‘RT Status’ ‘03 LTU 1S’ Enable **Execute** (Verify – Ena)
cmd ‘RT Status’ ‘04 LTU 4P’ Enable **Execute** (Verify – Ena)
cmd ‘RT Status’ ‘05 LTU 3S’ Enable **Execute** (Verify – Ena)
cmd ‘RT Status’ ‘06 LTU 2S’ Enable **Execute** (Verify – Ena)
cmd ‘RT Status’ ‘07 LTU 4S’ Enable **Execute** (Verify – Ena)
cmd ‘RT Status’ ‘08 ED P’ Enable **Execute** (Verify – Ena)
cmd ‘RT Status’ ‘09 TD P’ Enable **Execute** (Verify – Ena)
cmd ‘RT Status’ ‘11 ED S’ Enable **Execute** (Verify – Ena)

sel RT Status Cont. RT#16-25

LB MT 1 RT Status Cont

cmd ‘RT Status’ ‘14 TD S’ Enable **Execute** (Verify – Ena)
cmd ‘RT Status’ ‘16 TUS 1S’ Enable **Execute** (Verify – Ena)
cmd ‘RT Status’ ‘17 TUS 2P’ Enable **Execute** (Verify – Ena)
cmd ‘RT Status’ ‘18 TUS 2S’ Enable **Execute** (Verify – Ena)
cmd ‘RT Status’ ‘19 UMA 1P’ Enable **Execute** (Verify – Ena)
cmd ‘RT Status’ ‘20 UMA 1S’ Enable **Execute** (Verify – Ena)
cmd ‘RT Status’ ‘21 UMA 2P’ Enable **Execute** (Verify – Ena)
cmd ‘RT Status’ ‘22 UMA 2S’ Enable **Execute** (Verify – Ena)
cmd ‘RT Status’ ‘24 TUS 1P’ Enable **Execute** (Verify – Ena)

3. MT SOFTWARE MODE TO STANDBY

MSS: MT: MT Mode: MT Mode

If ‘MT Software Mode’ – Idle
cmd Standby **Execute** (Verify – Standby)

4. IMCA POWER APPLICATION

sel RPC [X] where [X] = 3A-F 4B-F 3A-E 4B-E

MSS: MT: Power: ‘RPCM S0-[X]’ 1: RPCM S0[X] RPC 01

cmd ‘RPC Position’ – Close (Verify – Cl)

Repeat

sel RPC [X] where [X] = 7 2 10 9 5 1 4 11

MSS: MT: Power: ‘MT’ ‘RPCM MT-4B’ [X]: RPCM MT4B A RPC [X]

cmd ‘RPC Position’ – Close (Verify – Cl)

MSS: MT: Power: ‘MT’ ‘RPCM MT-3A’ [X]: RPCM MT3A A RPC [X]

cmd ‘RPC Position’ – Close (Verify – Cl)

Repeat

5. IMCA POWER VERIFICATION

MSS: MT: IMCA Data Stale State: MT IMCA Data Stale State

Verify ‘TUS1’ to ‘TUS2’ ‘IMCA’ ‘A’ ‘Status Measurements’ – blank
Verify ‘TUS1’ to ‘TUS2’ ‘IMCA’ ‘B’ ‘Status Measurements’ – blank
Verify ‘UMA1’ to ‘UMA2’ ‘IMCA’ ‘A’ ‘Status Measurements’ – blank
Verify ‘UMA1’ to ‘UMA2’ ‘IMCA’ ‘B’ ‘Status Measurements’ – blank
Verify ‘LTU1’ to ‘LTU4’ ‘IMCA’ ‘A’ ‘Status Measurements’ – blank
Verify ‘LTU1’ to ‘LTU4’ ‘IMCA’ ‘B’ ‘Status Measurements’ – blank
Verify ‘TD’ ‘IMCA’ ‘A’ ‘Status Measurements’ – blank
Verify ‘TD’ ‘IMCA’ ‘B’ ‘Status Measurements’ – blank
Verify ‘ED’ ‘IMCA’ ‘A’ ‘Status Measurements’ – blank
Verify ‘ED’ ‘IMCA’ ‘B’ ‘Status Measurements’ – blank

MSS: MT: Power: MT Power

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Verify ‘TUS1’ ‘RPCM S0-3A-F’ ‘Mode’ – Standby
Verify ‘TUS1’ ‘RPCM S0-3A-F’ ‘Fault’ – blank
Verify ‘TUS1’ ‘RPCM S0-4B-F’ ‘Mode’ – Standby
Verify ‘TUS1’ ‘RPCM S0-4B-F’ ‘Fault’ – blank
Verify ‘TUS2’ ‘RPCM S0-3A-E’ ‘Mode’ – Standby
Verify ‘TUS2’ ‘RPCM S0-3A-E’ ‘Fault’ – blank
Verify ‘TUS2’ ‘RPCM S0-4B-E’ ‘Mode’ – Standby
Verify ‘TUS2’ ‘RPCM S0-4B-E’ ‘Fault’ – blank

Verify ‘MT’ ‘RPCM MT-4B’ ‘UMA1’ to ‘UMA2’ ‘Mode’ – Standby
Verify ‘MT’ ‘RPCM MT-4B’ ‘UMA1’ to ‘UMA2’ ‘Fault’ – blank
Verify ‘MT’ ‘RPCM MT-3A’ ‘UMA1’ to ‘UMA2’ ‘Mode’ – Standby
Verify ‘MT’ ‘RPCM MT-3A’ ‘UMA1’ to ‘UMA2’ ‘Fault’ – blank
Verify ‘MT’ ‘RPCM MT-4B’ ‘LTU1’ to ‘LTU4’ ‘Mode’ – Standby
Verify ‘MT’ ‘RPCM MT-4B’ ‘LTU1’ to ‘LTU4’ ‘Fault’ – blank
Verify ‘MT’ ‘RPCM MT-3A’ ‘LTU1’ to ‘LTU4’ ‘Mode’ – Standby
Verify ‘MT’ ‘RPCM MT-3A’ ‘LTU1’ to ‘LTU4’ ‘Fault’ – blank
Verify ‘MT’ ‘RPCM MT-4B’ ‘TD’ ‘Mode’ – Standby
Verify ‘MT’ ‘RPCM MT-4B’ ‘TD’ ‘Fault’ – blank
Verify ‘MT’ ‘RPCM MT-3A’ ‘TD’ ‘Mode’ – Standby
Verify ‘MT’ ‘RPCM MT-3A’ ‘TD’ ‘Fault’ – blank
Verify ‘MT’ ‘RPCM MT-4B’ ‘ED’ ‘Mode’ – Standby
Verify ‘MT’ ‘RPCM MT-4B’ ‘ED’ ‘Fault’ – blank
Verify ‘MT’ ‘RPCM MT-3A’ ‘ED’ ‘Mode’ – Standby
Verify ‘MT’ ‘RPCM MT-3A’ ‘ED’ ‘Fault’ – blank

6. IMCA POWER REMOVAL

sel RPC [X] where [X] = 3A-F | 4B-F | 3A-E | 4B-E

MSS: MT: Power: ‘RPCM S0-[X]’ 1: RPCM S0[X] RPC 01

cmd ‘RPC Position’ – Open (Verify – Op)

Repeat

sel RPC [X] where [X] = 7 | 2 | 10 | 9 | 5 | 1 | 4 | 11

MSS: MT: Power: ‘MT’ ‘RPCM MT-4B’ [X]: RPCM MT4B A RPC [X]

cmd ‘RPC Position’ – Open (Verify – Op)

MSS: MT: Power: ‘MT’ ‘RPCM MT-3A’ [X]: RPCM MT3A A RPC [X]

cmd ‘RPC Position’ – Open (Verify – Op)

Repeat

7. MT SOFTWARE SHUTDOWN

MSS: MT: MT Mode: MT Mode

cmd Idle **Execute** (Verify ‘MT Software Mode’ – Idle)
cmd Disable MT Process **Execute** (Verify ‘MT Process State’ – Disabled)

8. IMCA RT I/O INHIBIT

MSS: MT: ‘MT’ ‘Amp 1’ MT LB A: RT Status: LB MT 1 RT Status

cmd ‘RT Status’ ‘00 LTU 1P’ Inhibit **Execute** (Verify – Inh)
cmd ‘RT Status’ ‘01 LTU 2P’ Inhibit **Execute** (Verify – Inh)
cmd ‘RT Status’ ‘02 LTU 3P’ Inhibit **Execute** (Verify – Inh)
cmd ‘RT Status’ ‘03 LTU 1S’ Inhibit **Execute** (Verify – Inh)
cmd ‘RT Status’ ‘04 LTU 4P’ Inhibit **Execute** (Verify – Inh)
cmd ‘RT Status’ ‘05 LTU 3S’ Inhibit **Execute** (Verify – Inh)
cmd ‘RT Status’ ‘06 LTU 2S’ Inhibit **Execute** (Verify – Inh)
cmd ‘RT Status’ ‘07 LTU 4S’ Inhibit **Execute** (Verify – Inh)
cmd ‘RT Status’ ‘08 ED P’ Inhibit **Execute** (Verify – Inh)
cmd ‘RT Status’ ‘09 TD P’ Inhibit **Execute** (Verify – Inh)
cmd ‘RT Status’ ‘11 ED S’ Inhibit **Execute** (Verify – Inh)

sel RT Status Cont. RT#16-25

LB MT 1 RT Status Cont

cmd ‘RT Status’ ‘14 TD S’ Inhibit **Execute** (Verify – Inh)
cmd ‘RT Status’ ‘16 TUS 1S’ Inhibit **Execute** (Verify – Inh)
cmd ‘RT Status’ ‘17 TUS 2P’ Inhibit **Execute** (Verify – Inh)
cmd ‘RT Status’ ‘18 TUS 2S’ Inhibit **Execute** (Verify – Inh)
cmd ‘RT Status’ ‘19 UMA 1P’ Inhibit **Execute** (Verify – Inh)
cmd ‘RT Status’ ‘20 UMA 1S’ Inhibit **Execute** (Verify – Inh)
cmd ‘RT Status’ ‘21 UMA 2P’ Inhibit **Execute** (Verify – Inh)
cmd ‘RT Status’ ‘22 UMA 2S’ Inhibit **Execute** (Verify – Inh)
cmd ‘RT Status’ ‘24 TUS 1P’ Inhibit **Execute** (Verify – Inh)

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6.210 MT GENERIC AUTO TRANSLATION USING STRING A(B) IMCAS
(RBT GEN/X2R4 - ALL/FIN) Page 1 of 12 pages

NOTE

1. IMCAs take approximately 6 seconds to complete self-tests once power is applied.

2. MT IMCA RT FDIR is enabled to the TUS IMCAs during the translation (step 17). This allows the software in the EXT MDM to halt MT motion in the case of a TUS IMCA failure. Enabling TUS IMCA FDIR only during the translation limits annunciation of nuisance IMCA Comm Fail Robotics advisories and MT Local Bus channel switching. The nuisance messages and channel switching only occur when all of the following are true: IO and FDIR are enabled, EXT MDM detects RPC closed, and EXT MDM detects loss of comm with the IMCA (SCR 28581).

1. IMCA RT I/O ENABLE

PCS MSS: MT: Auto Translate: MT Auto Translate

Verify 'SEPS Process State' – Initiated
Verify 'IMCA Process State' – Initiated

MSS: MT: 'MT' 'Amp1' MT LB A: RT Status: LB MT 1 RT Status

cmd 'RT Status' '00 LTU 1P' Enable **Execute** (Verify – Ena)
cmd 'RT Status' '01 LTU 2P' Enable **Execute** (Verify – Ena)
cmd 'RT Status' '02 LTU 3P' Enable **Execute** (Verify – Ena)
cmd 'RT Status' '03 LTU 1S' Enable **Execute** (Verify – Ena)
cmd 'RT Status' '04 LTU 4P' Enable **Execute** (Verify – Ena)
cmd 'RT Status' '05 LTU 3S' Enable **Execute** (Verify – Ena)
cmd 'RT Status' '06 LTU 2S' Enable **Execute** (Verify – Ena)
cmd 'RT Status' '07 LTU 4S' Enable **Execute** (Verify – Ena)
cmd 'RT Status' '08 ED P' Enable **Execute** (Verify – Ena)
cmd 'RT Status' '09 TD P' Enable **Execute** (Verify – Ena)
cmd 'RT Status' '11 ED S' Enable **Execute** (Verify – Ena)

sel RT Status Cont. RT#16-25

LB MT 1 RT Status Cont

cmd 'RT Status' '14 TD S' Enable **Execute** (Verify – Ena)
cmd 'RT Status' '16 TUS 1S' Enable **Execute** (Verify – Ena)
cmd 'RT Status' '17 TUS 2P' Enable **Execute** (Verify – Ena)
cmd 'RT Status' '18 TUS 2S' Enable **Execute** (Verify – Ena)
cmd 'RT Status' '19 UMA 1P' Enable **Execute** (Verify – Ena)
cmd 'RT Status' '20 UMA 1S' Enable **Execute** (Verify – Ena)
cmd 'RT Status' '21 UMA 2P' Enable **Execute** (Verify – Ena)
cmd 'RT Status' '22 UMA 2S' Enable **Execute** (Verify – Ena)
cmd 'RT Status' '24 TUS 1P' Enable **Execute** (Verify – Ena)

2. MT ORU TEMPERATURE VERIFICATION

CAUTION

Damage or reduced lifetime to MT components may result if the startup temperatures within this step are equal to or higher than the value shown. The IMCAs should not exceed 71.4 deg C in operation.

2.1 Non-IMCA Temperature Verification

MSS: MT: Thermal: MT Thermal

Verify ‘TUS1’ to ‘TUS2’ ‘Gearbox’ (two) < 47.8 deg C
Verify ‘MT’ ‘RPCM MT-4B’ ‘RPCM Bracket Temp’ < 48.9 deg C
Verify ‘MT’ ‘RPCM MT-3A’ ‘RPCM Bracket Temp’ < 48.9 deg C

2.2 IMCA Power Application

sel RPCM [X] where [X] = 3A-F 4B-F 3A-E 4B-E

MSS: MT: Power: ‘RPCM S0-[X]’ 1: RPCM S0[X] RPC 01

cmd ‘RPC Position’ – Close (Verify – Cl)

Repeat

sel RPC [X] where [X] = 7 2 10 9 5 1 4 11

MSS: MT: Power: ‘MT’ ‘RPCM MT-4B’ [X]: RPCM MT4B A RPC [X]

cmd ‘RPC Position’ – Close (Verify – Cl)

MSS: MT: Power: ‘MT’ ‘RPCM MT-3A’ [X]: RPCM MT3A A RPC [X]

cmd ‘RPC Position’ – Close (Verify – Cl)

Repeat

2.3 <u>IMCA Power Verification</u>
MSS: MT: IMCA Data Stale State: MT IMCA Data Stale State

Verify ‘Status Measurements’ ‘TUS1’ to ‘TUS2’ ‘IMCA’ ‘A’ (two) – blank
Verify ‘Status Measurements’ ‘TUS1’ to ‘TUS2’ ‘IMCA’ ‘B’ (two) – blank
Verify ‘Status Measurements’ ‘UMA1’ to ‘UMA2’ ‘IMCA’ ‘A’ (two) – blank
Verify ‘Status Measurements’ ‘UMA1’ to ‘UMA2’ ‘IMCA’ ‘B’ (two) – blank
Verify ‘Status Measurements’ ‘LTU1’ to ‘LTU4’ ‘IMCA’ ‘A’ (four) – blank
Verify ‘Status Measurements’ ‘LTU1’ to ‘LTU4’ ‘IMCA’ ‘B’ (four) – blank
Verify ‘Status Measurements’ ‘TD’ ‘IMCA’ ‘A’ – blank
Verify ‘Status Measurements’ ‘TD’ ‘IMCA’ ‘B’ – blank
Verify ‘Status Measurements’ ‘ED’ ‘IMCA’ ‘A’ – blank
Verify ‘Status Measurements’ ‘ED’ ‘IMCA’ ‘B’ – blank

MSS: MT: Power: MT Power

Verify ‘TUS1’ ‘RPCM S0-3A-F’ ‘Mode’ – Standby
Verify ‘TUS1’ ‘RPCM S0-3A-F’ ‘Fault’ – blank
Verify ‘TUS1’ ‘RPCM S0-4B-F’ ‘Mode’ – Standby
Verify ‘TUS1’ ‘RPCM S0-4B-F’ ‘Fault’ – blank
Verify ‘TUS2’ ‘RPCM S0-3A-E’ ‘Mode’ – Standby
Verify ‘TUS2’ ‘RPCM S0-3A-E’ ‘Fault’ – blank
Verify ‘TUS2’ ‘RPCM S0-4B-E’ ‘Mode’ – Standby
Verify ‘TUS2’ ‘RPCM S0-4B-E’ ‘Fault’ – blank

Verify ‘MT’ ‘RPCM MT-4B’ ‘UMA1’ to ‘UMA2’ ‘Mode’ (two) – Standby
Verify ‘MT’ ‘RPCM MT-4B’ ‘UMA1’ to ‘UMA2’ ‘Fault’ (two) – blank
Verify ‘MT’ ‘RPCM MT-3A’ ‘UMA1’ to ‘UMA2’ ‘Mode’ (two) – Standby
Verify ‘MT’ ‘RPCM MT-3A’ ‘UMA1’ to ‘UMA2’ ‘Fault’ (two) – blank
Verify ‘MT’ ‘RPCM MT-4B’ ‘LTU1’ to ‘LTU4’ ‘Mode’ (four) – Standby
Verify ‘MT’ ‘RPCM MT-4B’ ‘LTU1’ to ‘LTU4’ ‘Fault’ (four) – blank
Verify ‘MT’ ‘RPCM MT-3A’ ‘LTU1’ to ‘LTU4’ ‘Mode’ (four) – Standby
Verify ‘MT’ ‘RPCM MT-3A’ ‘LTU1’ to ‘LTU4’ ‘Fault’ (four) – blank
Verify ‘MT’ ‘RPCM MT-4B’ ‘TD’ ‘Mode’ – Standby
Verify ‘MT’ ‘RPCM MT-4B’ ‘TD’ ‘Fault’ – blank
Verify ‘MT’ ‘RPCM MT-3A’ ‘TD’ ‘Mode’ – Standby
Verify ‘MT’ ‘RPCM MT-3A’ ‘TD’ ‘Fault’ – blank
Verify ‘MT’ ‘RPCM MT-4B’ ‘ED’ ‘Mode’ – Standby
Verify ‘MT’ ‘RPCM MT-4B’ ‘ED’ ‘Fault’ – blank
Verify ‘MT’ ‘RPCM MT-3A’ ‘ED’ ‘Mode’ – Standby
Verify ‘MT’ ‘RPCM MT-3A’ ‘ED’ ‘Fault’ – blank

2.4 IMCA Temperature Verification

MSS: MT: Thermal: MT Thermal

Verify 'TUS1' 'S0-3A-F IMCA' < 49.4 deg C
Verify 'TUS1' 'S0-4B-F IMCA' < 49.4 deg C
Verify 'TUS2' 'S0-3A-E IMCA' < 49.4 deg C
Verify 'TUS2' 'S0-4B-E IMCA' < 49.4 deg C

Verify 'MT' 'RPCM MT-4B' 'LTU1' to 'LTU4' (four) < 60.0 deg C
Verify 'MT' 'RPCM MT-3A' 'LTU1' to 'LTU4' (four) < 60.0 deg C
Verify 'MT' 'RPCM MT-4B' 'UMA1' to 'UMA2' (two) < 57.8 deg C
(< 51.1 deg C when translating from another segment to WS4)
Verify 'MT' 'RPCM MT-3A' 'UMA1' to 'UMA2' (two) < 57.8 deg C
(< 51.1 deg C when translating from another segment to WS4)
Verify 'MT' 'RPCM MT-4B' 'TD1' < 50.0 deg C
Verify 'MT' 'RPCM MT-3A' 'TD2' < 50.0 deg C
Verify 'MT' 'RPCM MT-4B' 'ED1' < 58.9 deg C
Verify 'MT' 'RPCM MT-3A' 'ED2' < 58.9 deg C

2.5 IMCA Power Removal

sel RPCM [X] where [X] = 3A-F 4B-F 3A-E 4B-E

MSS: MT: Power: 'RPCM S0-[X]' 1: RPCM S0[X] RPC 01

cmd 'RPC Position' – Open (Verify – Op)

Repeat

sel RPC [X] where [X] = 7 2 10 9 5 1 4 11

MSS: MT: Power: 'MT' 'RPCM MT-4B' [X]: RPCM MT4B A RPC [X]

cmd 'RPC Position' – Open (Verify – Op)

MSS: MT: Power: 'MT' 'RPCM MT-3A' [X]: RPCM MT3A A RPC [X]

cmd 'RPC Position' – Open (Verify – Op)

Repeat

3. VERIFYING STATION CONFIGURED FOR MT TRANSLATION

Verify any payloads or SSRMS attached to the MBS positioned within the translation corridor.
Verify translation path is clear of obstacles.

4. MT AUTOSAFING ENABLED VERIFICATION

MSS: MT: Auto Safing: MT Autosafing

√‘MT Autosafing State’ – ENA

5. MT POSITION CHECK

MSS: MT: MT Mode: MT Mode

√‘MT Process State’ – Disabled

MSS: MT: Mobile Transporter

√‘MT Position’ – Matches value shown in Table 1 to within ±12 cm

Table 1. MT Positions

Location	MT Position (cm)
WS9	3672.8
WS1	2169.2
WS2	1653.5
WS3	795.0
WS4	287.0
Launch Site	-254.0
WS5	-525.8
WS6	-795.0
WS7	-1653.5
WS8	-2169.2
WS10	-3672.8

6. MT SOFTWARE PROCESS INITIATION AND MODE TO AUTO

MSS: MT: Auto Translate: MT Auto Translate

cmd Initiate MT Process **Execute** (Verify ‘MT Process State’ – Initiated)
cmd Mode MT to Standby **Execute** (Verify ‘MT Software Mode’ – Standby)
cmd Mode MT to Auto **Execute** (Verify ‘MT Software Mode’ – Auto)

7. HARDWARE CONFIGURATION SELECTION

NOTE

If HW Config C1 selected, apply power to only RPCM MT-4B IMCAs in following procedures. Likewise, if HW Config C2 selected, apply power to only RPCM MT-3A IMCAs.

√**MCC-H** for MT Hardware Configuration Selection

cmd ‘HW Config’ 1(2) **Execute** (Verify – C1(C2))

8. MBS/SSRMS POWER REMOVAL

MSS: LAS5 CEU Mode: CEU Mode

√'Cupola (LAS5)' or 'Lab (LAP5)' – Active

If SSRMS attached to MBS
  MSS: MBS: MBS

  √'MCU' – Operational

  For both strings
    Perform {6.434 SSRMS POWERDOWN TO OFF ON BOTH STRINGS}, all (SODF: RBT GEN: NOMINAL), then:

  For Operational string
    Perform {6.334 MSS POWERDOWN FROM OPERATIONAL TO KEEP-ALIVE}, step 3 (SODF: RBT GEN: NOMINAL), then:

NOTE
Expect '**R1E - MSS Active OCS MBS Prime(Redun) MCU SRT Comm Fail**' Caution and Warning messages (SCR 17730).

MSS: MBS: MCU: MCU

cmd 'Prime' Off (Verify – Off) (30 s max)
cmd 'Redundant' Off (Verify – Off) (30 s max)

Record GMT.
Inform **MCC-H** at next opportunity.

√Utility Port power is off for Current Worksite by examining the appropriate RPCM in Table 2

Table 2. Current Worksite Utility Port Power

Utility Port	Service	
	Primary	Secondary
1	RPCM S3-4B-F	RPCM S3-3A-F
2	RPCM S1-4B-E	RPCM S1-3A-E
3	RPCM S1-4B-F	RPCM S1-3A-F
4	RPCM S0-4B-A	RPCM S0-3A-A
5	RPCM S0-4B-B	RPCM S0-3A-B
6	RPCM P1-4B-F	RPCM P1-3A-F
7	RPCM P1-4B-E	RPCM P1-3A-E
8	RPCM P3-4B-F	RPCM P3-3A-F
9	RPCM S4-3A-B	RPCM S4-1A-B
10	RPCM P4-4A-B	RPCM P4-2A-B

9. UMA IMCA POWER APPLICATION AND VERIFICATION

9.1 UMA IMCA Power Application

sel RPC [X] where [X] = 7 2

MSS: MT: Power: ‘MT’ ‘RPCM MT-4B(3A)’ [X]: RPCM MT4B(3A) A RPC [X]

cmd ‘RPC Position’ – Close (Verify – Cl)

Repeat

9.2 UMA IMCA Power Verification

MSS: MT: IMCA Data Stale State: MT IMCA Data Stale State

Verify ‘Status Measurements’ ‘UMA1’ to ‘UMA2’ ‘IMCA’ ‘A(B)’ (two) – blank

MSS: MT: Power: MT Power

Verify ‘MT’ ‘RPCM MT-4B(3A)’ ‘UMA1’ to ‘UMA2’ ‘Mode’ (two) – Standby
Verify ‘MT’ ‘RPCM MT-4B(3A)’ ‘UMA1’ to ‘UMA2’ ‘Fault’ (two) – blank

10. UMA DEMATE PREPARATION

MSS: MT: Auto Translate: MT Auto Translate

Verify ‘Prepare to Demate UMAs’ – Ready

cmd Prepare to Demate UMAs **Execute** (Verify – Complete)

11. THRUSTER INHIBIT

If ISS/orbiter mated

MSS: MT: Thruster: Thruster Controls for MSS Ops

cmd ‘Desat Request’ Inhibit (Verify – Inh)

√‘Auto Att Control Handover to RS’ – Inh

If ISS not mated to orbiter, √**MCC-H** for proper thruster configuration before proceeding.

12. UMA DEMATE EXECUTION

MSS: MT: Auto Translate: MT Auto Translate

Verify ‘Demate UMAs’ – Ready

cmd Demate UMAs **Execute** (Verify – Complete)

13. LTU AND TD IMCA POWER APPLICATION AND VERIFICATION

13.1 LTU and TD IMCA Power Application

sel RPC [X] where [X] = 10 | 9 | 5 | 1 | 4

MSS: MT: Power: ‘MT’ ‘RPCM MT-4B(3A)’ [X]:
RPCM MT4B(3A) A RPC [X]

cmd ‘RPC Position’ – Close (Verify – Cl)

Repeat

13.2 LTU and TD IMCA Power Verification

MSS: MT: IMCA Data Stale State: MT IMCA Data Stale State

Verify ‘Status Measurements’ ‘LTU1’ to ‘LTU4’ ‘IMCA’ ‘A(B)’ (four) – blank
Verify ‘Status Measurements’ ‘TD’ ‘IMCA’ ‘A(B)’ – blank

MSS: MT: Power: MT Power

Verify ‘MT’ ‘RPCM MT-4B(3A)’ ‘LTU1’ to ‘LTU4’ ‘Mode’ (four) – Standby
Verify ‘MT’ ‘RPCM MT-4B(3A)’ ‘LTU1’ to ‘LTU4’ ‘Fault’ (four) – blank

Verify ‘MT’ ‘RPCM MT-4B(3A)’ ‘TD’ ‘Mode’ – Standby
Verify ‘MT’ ‘RPCM MT-4B(3A)’ ‘TD’ ‘Fault’ – blank

14. PREPARING TD IMCA

MSS: MT: Auto Translate: MT Auto Translate

Verify ‘Ready TD’ – Ready

cmd Ready TD **Execute** (Verify – Complete)

15. MT TRANSLATION PREPARATION

Verify ‘Prepare to Translate’ – Ready

cmd Prepare to Translate **Execute**

When motion is complete (~ 7.5 minutes), verify the following:

sel RPC [X] where [X] = 10 | 9 | 5 | 1 | 11

MSS: MT: Power: ‘MT’ ‘RPCM MT-4B(3A)’ [X]:
RPCM MT4B(3A) A RPC [X]

Verify ‘RPC Position’ – Op

Repeat

16. TUS IMCA RT FDIR ENABLE

MSS: MT: ‘MT’ ‘Amp1’ MT LB A: RT Status: RT Status Cont. RT#16-25
LB MT 1 RT Status Cont

If HW Config C1 selected in step 7
cmd ‘RT FDIR Status’ ‘24 TUS 1P’ Enable FDIR **Execute** (Verify – Ena)
cmd ‘RT FDIR Status’ ‘17 TUS 2P’ Enable FDIR **Execute** (Verify – Ena)

If HW Config C2 selected in step 7
cmd ‘RT FDIR Status’ ‘16 TUS 1S’ Enable FDIR **Execute** (Verify – Ena)
cmd ‘RT FDIR Status’ ‘18 TUS 2S’ Enable FDIR **Execute** (Verify – Ena)

17. MT TRANSLATION AND LATCH/MATE EXECUTION

NOTE
Pause function only available during the following:
Translate Phase 1 portion of Translate Inboard of SARJ.
Translate Phase 1 and Translate Phase 3 portion of Translate across SARJ.

If Current and Destination Worksite ≤ 8
MSS: MT: Auto Translate: Translate Inboard of SARJ:
MT Translate Inboard of SARJ

Verify ‘Event in progress’ – Ready

sel ‘Current Worksite’ – as desired
sel ‘Destination Worksite’ – as desired
sel ‘Payload Mass’ – as desired

cmd Translate Inboard of SARJ **Execute**

If Current or Destination Worksite ≥ 9
MSS: MT: Auto Translate: Translate across SARJ:
MT Translate across SARJ

Verify ‘Event in progress’ – Ready

sel ‘Current Worksite’ – as desired
sel ‘Destination Worksite’ – as desired

cmd Translate across SARJ **Execute**

MSS: MT: Mobile Transporter

Verify ‘Destination WS’ – as chosen
Verify ‘MT Position’ – changing
Verify ‘MT Velocity’: -3.0 to 3.0
Verify MT bug is moving from Current to Destination Worksite.

NOTE

Because FDIR is Enabled to the TUS IMCAs, expect the following messages to annunciate and return to Norm twice: once during the IMCA Built In Test (communication is interrupted for several seconds during the BIT) and again when power is removed (SPN 3265).

If HW Config C1 is selected:
  R9Z - MSS MT TUS 1 IMCA 1 Comm or Device Fail
  R9Z - MSS MT TUS 2 IMCA 1 Comm or Device Fail
If HW Config C2 is selected:
  R9Z - MSS MT TUS 1 IMCA 2 Comm or Device Fail
  R9Z - MSS MT TUS 2 IMCA 2 Comm or Device Fail

MSS: MT: Auto Translate: Translate Inboard of SARJ (Translate across SARJ):
MT Translate Inboard of SARJ (MT Translate across SARJ)

Verify ‘Event in progress’ – Complete

18. THRUSTER ENABLE

If ISS/orbiter mated

MSS: MT: Thruster: Thruster Controls for MSS Ops

cmd ‘Desat Request’ Enable (Verify – Ena)

If ISS not mated to orbiter, √**MCC-H** for proper thruster configuration.

19. TUS AND MT IMCA POWER REMOVAL VERIFICATION

19.1 TUS IMCA Power Removal Verification

sel RPC [X] where [X] = 3A-F 4B-F 3A-E 4B-E

MSS: MT: Power: ‘RPCM S0-[X]’ 1: RPCM S0[X] RPC 01

Verify ‘RPC Position’ – Op

Repeat

19.2 MT IMCA Power Removal Verification

sel RPC [X] where [X] = 7 2 10 9 5 1 4 11

MSS: MT: Power: ‘MT’ ‘RPCM MT-4B(3A)’ [X]:
RPCM MT4B(3A) A RPC [X]

Verify ‘RPC Position’ – Op

Repeat

20. MT SOFTWARE SHUTDOWN

MSS: MT: Auto Translate: MT Auto Translate

cmd Mode MT to Standby **Execute** (Verify 'MT Software Mode' – Standby)
cmd Mode MT to Idle **Execute** (Verify 'MT Software Mode' – Idle)
cmd Disable MT Process **Execute** (Verify 'MT Process State' – Disabled)

21. MT POSITION RESET

MSS: MT: MT Mode: MT Mode

input 'MT Position' per Table 3

Table 3. MT Positions

Location	MT Position (cm)
WS9	3672.8
WS1	2169.2
WS2	1653.5
WS3	795.0
WS4	287.0
Launch Site	-254.0
WS5	-525.8
WS6	-795.0
WS7	-1653.5
WS8	-2169.2
WS10	-3672.8

cmd Load New MT Position **Execute**
cmd Initiate MT Process **Execute** (Verify 'MT Process State' – Initiated)

MSS: MT: Mobile Transporter

Verify 'MT Position Data Valid' – √

MSS: MT: MT Mode: MT Mode

cmd Disable MT Process **Execute** (Verify 'MT Process State' – Disabled)

22. MSS POWERUP

Inform **MCC-H**, go for MBS Powerup (and SSRMS Powerup if based on MBS).

23. IMCA RT I/O AND FDIR INHIBIT

MSS: MT: ‘MT’ ‘Amp1’ MT LB A: RT Status: LB MT 1 RT Status

cmd ‘RT Status’ ‘00 LTU 1P’ Inhibit **Execute** (Verify – Inh)
cmd ‘RT Status’ ‘01 LTU 2P’ Inhibit **Execute** (Verify – Inh)
cmd ‘RT Status’ ‘02 LTU 3P’ Inhibit **Execute** (Verify – Inh)
cmd ‘RT Status’ ‘03 LTU 1S’ Inhibit **Execute** (Verify – Inh)
cmd ‘RT Status’ ‘04 LTU 4P’ Inhibit **Execute** (Verify – Inh)
cmd ‘RT Status’ ‘05 LTU 3S’ Inhibit **Execute** (Verify – Inh)
cmd ‘RT Status’ ‘06 LTU 2S’ Inhibit **Execute** (Verify – Inh)
cmd ‘RT Status’ ‘07 LTU 4S’ Inhibit **Execute** (Verify – Inh)
cmd ‘RT Status’ ‘08 ED P’ Inhibit **Execute** (Verify – Inh)
cmd ‘RT Status’ ‘09 TD P’ Inhibit **Execute** (Verify – Inh)
cmd ‘RT Status’ ‘11 ED S’ Inhibit **Execute** (Verify – Inh)

sel RT Status Cont. RT#16-25

LB MT 1 RT Status Cont

If HW Config C1 selected in step 7
- **cmd** ‘RT FDIR Status’ ‘24 TUS 1P’ Inhibit FDIR **Execute** (Verify – Inh)
- **cmd** ‘RT FDIR Status’ ‘17 TUS 2P’ Inhibit FDIR **Execute** (Verify – Inh)

If HW Config C2 selected in step 7
- **cmd** ‘RT FDIR Status’ ‘16 TUS 1S’ Inhibit FDIR **Execute** (Verify – Inh)
- **cmd** ‘RT FDIR Status’ ‘18 TUS 2S’ Inhibit FDIR **Execute** (Verify – Inh)

cmd ‘RT Status’ ‘14 TD S’ Inhibit **Execute** (Verify – Inh)
cmd ‘RT Status’ ‘16 TUS 1S’ Inhibit **Execute** (Verify – Inh)
cmd ‘RT Status’ ‘17 TUS 2P’ Inhibit **Execute** (Verify – Inh)
cmd ‘RT Status’ ‘18 TUS 2S’ Inhibit **Execute** (Verify – Inh)
cmd ‘RT Status’ ‘19 UMA 1P’ Inhibit **Execute** (Verify – Inh)
cmd ‘RT Status’ ‘20 UMA 1S’ Inhibit **Execute** (Verify – Inh)
cmd ‘RT Status’ ‘21 UMA 2P’ Inhibit **Execute** (Verify – Inh)
cmd ‘RT Status’ ‘22 UMA 2S’ Inhibit **Execute** (Verify – Inh)
cmd ‘RT Status’ ‘24 TUS 1P’ Inhibit **Execute** (Verify – Inh)

6.311 MBS POA DIAGNOSTICS

(RBT GEN/X2R4 - ALL/FIN 2/SPN) Page 1 of 1 page

1. SETUP

PCS MSS: MBS: MBS

√'MBS Safing' – Safed

Verify 'POA' Loaded – blank

2. DIAGNOSTICS

MSS: MBS: Diagnostic: MBS Diagnostics

cmd 'Diagnostics' Test POA

> NOTE
> The operator may cancel the current test by Safing (SPN 2467).

MSS: MBS: Discrete Log: MSS Discrete Log

Verify '**Diagnostic Test: MBS POA … Test Passed**' (eleven) (SCR 30060).

If any tests fail, record which tests fail.

DCP SAFING → SAFE (Verify – ON) (SCR 21456, 23261)

3. CHECKPOINT DATA UPDATE

PCS MSS: SSRMS: Checkpoint Data: Checkpoint Data

cmd Checkpoint Current Data (SCR 23238)

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6.321 MBS POA CHECKOUT

(RBT GEN/E9 - ALL/FIN 2/SPN) Page 1 of 2 pages

> NOTE
> The MBS POA must be unloaded before performing a POA checkout or calibration.

1. POA SETUP FOR CAPTURE

PCS MSS: MBS: POA: POA

√'POA Mechanisms' – Calibrated

****
* If POA Mechanisms – Not Calibrated
* | Perform {6.322 MBS POA CALIBRATION}, all (SODF: RBT
* | GEN: NOMINAL), then:
****

√'Setup' – Yes

****
* If Setup – No
* | Perform {6.323 POA SETUP FOR CAPTURE}, all
* | (SODF: RBT GEN: NOMINAL), then:
****

2. SLOW POA CHECKOUT

> NOTE
> POA commands will work only with SLOW speed (SPN 2909, 3162).

cmd Checkout ► Slow (Verify 'Speed' – Slow)

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

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

> NOTE
> Once the trigger is hot, only safing or trigger commands should be sent to the Robotics equipment. If a configure change is required, including routing MSS cameras, safe the system to exit POA operations (SPN 1892, 3160).

cmd Confirm (Verify RHC Trigger Hot Icon)

Verify POA Mode – Checkout POA

RHC TRIGGER → press (momentarily)

6.321 MBS POA CHECKOUT

(RBT GEN/E9 - ALL/FIN 2/SPN) Page 2 of 2 pages

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

6.322 MBS POA CALIBRATION

I

(RBT GEN/X2R4 - ALL/FIN 2/SPN) Page 1 of 1 page

NOTE

1. The POA must be unloaded.

2. A Calibrate command may be aborted by a ‘**MBS POA LEU Mtr Velocity Runaway**’ Robotics Advisory message and the MSS safed if one of the three POA mechanisms was initially located at the hardstop position. If safing occurs, cancel safing and restart this procedure from the beginning (SCR 20379).

PCS MSS: MBS: MBS

√‘MBS Safing’ – Not Safed

MSS: MBS: POA: POA

cmd ‘POA Mechanisms’ – Calibrate

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, PCS commands should not be sent to Robotics equipment. If a configuration change is required, safe the system to exit POA operations.

cmd Confirm (Verify Trigger Hot Icon)

NOTE

1. Apply safing to stop mechanism motion (SCR 23262, 28433).

2. Calibration might take up to 5 minutes 40 seconds to complete.

RHC TRIGGER → press (momentarily)

PCS Verify ‘Snare’ Open – blue
Verify ‘Carriage’ Extend – blue
Verify ‘Latch’ Unlatch – blue
Verify ‘POA Mechanisms’ – Calibrated
Verify ‘Load Cell’ – Calibrated
Verify ‘Motors’ – Inh (340 s max)

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6.323 MBS POA SETUP FOR CAPTURE

I

(RBT GEN/E10 - ALL/FIN 2/SPN) Page 1 of 1 page

NOTE

1. The POA must be unloaded and calibrated.

2. If no POA response is observed within 70 seconds of a command being issued, safe and reattempt (SCR 19378).

PCS MSS: MBS: POA: POA

cmd Capture ► Setup ► Slow (Verify ‘Speed’ – Slow) (SCR 23242)

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

CAUTION

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

NOTE

Once the trigger is hot, PCS commands should not be sent to Robotics equipment. If a configuration change is required, safe the system to exit POA operations.

cmd Confirm (Verify RHC Trigger Hot Icon)

NOTE

Apply safing to stop mechanism motion (SCR 23262, 14662).

RHC TRIGGER → press (momentarily)

PCS Verify ‘Snare’ Open – blue
Verify ‘Carriage’ Extend – blue
Verify ‘Latch’ Unlatch – blue
Verify ‘Motors’ – Inh (340 s max)

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6.325 MBS POA AUTOMATIC RELEASE

(RBT GEN/E10 - ALL/FIN 2/SPN) Page 1 of 3 pages

> NOTE
> If no POA response is observed within 70 seconds of a command being issued, safe and reattempt (SCR 19378).

1. POA CALIBRATION STATUS VERIFICATION

PCS MSS: MBS: POA: POA

If POA Mechanisms – Not Calibrated

Go to {8.212 POA MANUAL RELEASE WITH UNCALIBRATED POA}, all (SODF: RBT GEN: CORRECTIVE).

2. POA CARRIAGE RIGIDIZATION

MSS: MBS: MBS

√ 'MSS Safing' - Not Safed

MSS: MBS: POA: POA

If 'Latch' Latch – blue and 'Carriage' Tension < 2891 N

cmd Rigidize ► Slow (Verify Speed – Slow) (SCR 23242)

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

> NOTE
> 1. Once the trigger is hot, PCS commands should not be sent to Robotics equipment.
> 2. If a configuration change is required, safe the system to exit POA operations.

cmd Confirm (Verify RHC Trigger Hot icon)

> NOTE
> Apply safing to stop mechanism motion (SCR 23262, 28433).

RHC TRIGGER → press (momentarily)

PCS Verify Tension > 2891 N (90 s max)

3. POA FILE CONFIGURATION

MSS: MBS: MBS

√POA Payload – as required

4. SSRMS SETUP
   Configure camera and overlays as required.

   MSS: SSRMS: SSRMS

   √Loaded FOR – as required

   Verify Loaded Parameters – √

   √Display – as required
   √Command – Internal>FOR
   √Vernier

DCP   BRAKES SSRMS → OFF (Verify OFF)

PCS   Enter Mode – Manual (Verify Manual – blue)

5. INHIBIT STATION THRUSTERS
   MSS: SSRMS: Thrusters: Thruster Controls for MSS Ops

   cmd 'Desat Request' – Inhibit (Verify Inh)

6. SLOW RELEASE

   NOTE
   POA Automatic Release should be run with slow speed. (SCR 23242)

   MSS: MBS: POA: 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 three seconds prior to receiving a Trigger Hot icon status on the PCS.

   NOTE
   1. Once the trigger is hot, PCS commands should not be sent to Robotics equipment.

   2. If a configuration change is required, safe the system to exit POA operations.

   cmd Confirm (Verify RHC Trigger Hot icon)

NOTE
Apply safing to stop mechanism motion (SCR 23262, 28433).

RHC TRIGGER → press (momentarily)

If POA was mated

PCS Verify ‘Umbilical’ Demate – blue (10 s max)

If POA was latched

Verify ‘Latch’ Unlatch – blue [65 s(13 s) max]

Verify ‘Carriage’ Derigidize – blue [90 s(18 s) max]
Verify ‘Snare’ Open – blue [12 s(3 s) max]

THC Back off from POA until grapple fixture pin is clear.

PCS Verify ‘Carriage’ Extend – blue [90 s(18 s) max]

7. ENABLE STATION THRUSTERS

MSS: SSRMS: Thrusters: Thruster Controls for MSS Ops

cmd ‘Desat Request’ – Enable (Verify Ena)

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6.327 MBS POA SEMI-MANUAL RELEASE

(RBT GEN/E10 - ALL/FIN 2/SPN) Page 1 of 3 pages

> NOTE
> If no POA response is observed within 70 seconds of a command being issued, safe and reattempt (SCR 19378).

1. POA CALIBRATION STATUS VERIFICATION

PCS MSS: MBS: POA: POA

If POA Mechanisms – Not Calibrated

Go to {8.212 POA MANUAL RELEASE WITH UNCALIBRATED POA}, all (SODF: RBT GEN: CORRECTIVE).

2. POA CARRIAGE RIGIDIZATION

MSS: MBS: MBS

√'MSS Safing' – Not Safed

MSS: MBS: POA: POA

If 'Latch' Latch – blue and 'Carriage' Tension < 2891 N

cmd Rigidize ► Slow (Verify Speed – Slow) (SCR 23242)

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

> NOTE
> 1. Once the trigger is hot, PCS commands should not be sent to Robotics equipment.
>
> 2. If a configuration change is required, safe the system to exit POA operations.

cmd Confirm (Verify RHC Trigger Hot icon)

> NOTE
> Apply safing to stop mechanism motion (SCR 23262, 28433).

RHC TRIGGER → press (momentarily)

PCS Verify Tension >2891 N (90 s max)

3. POA FILE CONFIGURATION

MSS: MBS: MBS

√POA Payload – as required

4. SSRMS SETUP

Configure camera and overlays, as required.

MSS: SSRMS: SSRMS

√Loaded FOR – as required

Verify Loaded Parameters – √

√Display – as required
√Command – Internal>FOR
√Vernier

DCP BRAKES SSRMS → OFF (Verify OFF)

PCS Enter Mode – Manual (Verify Manual – blue)

5. INHIBITING STATION THRUSTERS

MSS: SSRMS: Thrusters: Thruster Controls for MSS Ops

cmd ‘Desat Request’ – Inhibit (Verify Inh)

6. SLOW RELEASE (SCR 23242)

> NOTE
> POA Semi-manual Release should be run with slow speed unless otherwise specified.

MSS: MBS: POA: POA

PCS **cmd** Release ► Semi-Manual ► Slow (Verify Speed – Slow)

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

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

> NOTE
> 1. Once the trigger is hot, PCS commands should not be sent to Robotics equipment.
>
> 2. If a configuration change is required, safe the system to exit POA operations.

cmd Confirm (Verify RHC Trigger Hot icon)

> NOTE
> Apply safing to stop mechanism motion (SCR 23262, 28433).

If ‘Umbilical’ Mate – blue
RHC TRIGGER → press (hold until ‘Latch’ Demate – blue) (10 s max)

6.327 MBS POA SEMI-MANUAL RELEASE

(RBT GEN/E10 - ALL/FIN 2/SPN) Page 3 of 3 pages

PCS If ‘Latch’ Latch – blue
RHC TRIGGER → press (hold until ‘Latch’ Unlatch – blue) [65 s(13 s) max]

TRIGGER → press (hold until ‘Carriage’ Derigidize – blue) [90 s(18 s) max]

TRIGGER → press (hold until ‘Snare’ Open – blue) [12 s(3 s) max]

THC Back off from POA until grapple fixture pin is clear.

RHC TRIGGER → press (hold until ‘Carriage’ Extend – blue) [90 s(18 s) max]

7. ENABLING STATION THRUSTERS

PCS MSS: SSRMS: Thrusters: Thruster Controls for MSS Ops

cmd ‘Desat Request’ – Enable (Verify Ena)

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6.331 MBS POWERUP FROM OFF TO KEEP-ALIVE ON BOTH STRINGS

(RBT/UF2 - ALL/FIN) Page 1 of 1 page

NOTE

1. All power statuses on the MBS page, except for ‘MT UOP’, ‘Pwr 1’, and ‘Pwr 2’, do not reflect the current hardware status when MBS is not Operational. No telemetry is available when MBS is in the Keep-Alive state.

2. The MT position shown on the Mobile Transporter PCS display must match the actual position of the MT for the MBS Keep-Alive Command to be accepted and succeed.

1. TRANSITION MBS PRIME STRING FROM OFF TO KEEP-ALIVE

   MSS: MBS: MCU: MCU

   cmd ‘Prime’ Keep-Alive (Verify Keep-Alive) (30 s max)

2. TRANSITION MBS REDUNDANT STRING FROM OFF TO KEEP-ALIVE
   cmd ‘Redundant’ Keep-Alive (Verify Keep-Alive) (30 s max)

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6.332 MSS POWERUP FROM KEEP-ALIVE TO OPERATIONAL

I

(RBT GEN/X2R4 - ALL/FIN/SCR) Page 1 of 6 pages

1. ROBOTIC WORKSTATION CUP(LAB) POWERUP
Perform {6.114 LAB(CUP) RWS UOP BYPASS CABLE RECONFIGURATION}, step 2 (SODF: RBT GEN: NOMINAL), then:

> NOTE
> The Firmware Start, Start WHS, VGS 1, 2 and 3 and OCS fields will show stale data until a Frame Count is acquired at the end of step 1.2 (SCR 11448).

1.1 CEU Initialization

PCS MSS: LAS5(LAP5) Initialize: LAS5(LAP5) Initialization

cmd ‘B. CEU’ Close (Verify – √)

Wait 60 seconds for POST to complete.

1.2 Comm Enable

> NOTE
> CEU-1/CEU-2 I/O will always be displayed as Enabled even when the CEU RT I/O is Inhibited. Use ‘Frame Count’ increments to verify I/O Enabled (SCR 16057).

cmd ‘C. CB Ext 2(1) Bus comm’ Enable

Verify ‘Frame Count’ increments.
Verify ‘Firmware Start’ – √

1.3 WHS Download

> NOTE
> The Set File and Set Address commands must be sent within 180 seconds of each other.

cmd ‘D. Download WHS’ Set File
cmd ‘D. Download WHS’ Set Address

Wait 1.5 minutes for download to complete.

1.4 WHS Startup
cmd ‘E. Start WHS’ Start (Verify – √)

```
****************************************
*  If Start not √
*  |   Wait 1 minute.
*  |
*  |   cmd Start (Verify Start – √)
****************************************
```

DCP If PANEL/INST LIGHTING – OFF
PANEL/INST LIGHTING → Desired background light intensity

1.5 FDIR Enable

PCS **cmd** 'F. FDIR' Enable (Verify – √)

1.6 VGS and OCS Download

> NOTE
> 1. Download of VGS and OCS should take approximately 4 to 7.5 minutes to complete.
>
> 2. An '**R9Z - MSS CUP(LAB) OCS WHS Cmd Sequence Err**' Robotics Advisory message may be annunciated (SCR 19996).

cmd 'G. Set RWS location' – Cupola(Lab)

Verify VGS 1 – √
Verify VGS 2 – √
Verify VGS 3 – √
Verify OCS – √
Verify CEU Mode: Backup – √

DCP Verify RWS STATUS BACKUP – ☐

MON 1,2,3 Verify monitor number appears and is flashing in upper left-hand corner.

1.7 First and Second CVIU Initialization

PCS **cmd** 'H. Power CVIU4(12)' Close (Verify – √)
cmd 'I. Power CVIU5(2)' Close (Verify – √)

1.8 Third CVIU Initialization

If VTR or an orbiter video view is required
  cmd 'J. Power CVIU6(3)' Close (Verify – √)

2. ACTIVE ROBOTIC WORKSTATION CUP(LAB) DESIGNATION

> NOTE
> Video overlay data from the Active RWS will not be available on a Backup RWS unless the Backup RWS is powered up before the other RWS is made Active. If two RWSs are to be used for MSS operations and video overlay data is to be shared, both RWSs must be in Backup before one is made Active.

PCS MSS: LAS5(LAP5) CEU Mode: $\boxed{\text{CEU Mode}}$

If alternate RWS is Active
│ **cmd** Active CEU – Backup (Verify alternate RWS is Backup)

cmd Cupola(Lab) – Active (Verify Cupola(Lab) – Active)

3. MBS POWERUP TO OPERATIONAL

NOTE

1. A warmup period in Keep-Alive will be required if the MBS has been unpowered for over 30 minutes. This is to ensure the MBS is within thermal limits.

2. The alternate MBS string must not be in Operational.

3. The operator can follow the transition to Operational by looking at the MSS Discrete Log.

4. The transition from Keep-Alive to Operational can be stopped at any time by issuing a Safing command.

5. If the alternate string is Off while the MBS is operational, expect the following Robotics Advisory messages:
   ‘**R2O - MBS CRPCM … Cat-2 Transmit Msg Err**’ (SCR 21744)
   ‘**R2O - MBS CRPCM … Cat-2 Receive Msg Err**’ (SCR 21744)

6. If the SSRMS is in Keep-Alive and is based off an MBS PDGF, expect the following Robotics Advisory message for each string that is in Keep-Alive:
   ‘**R2O - MBS CRPCM … Output Voltage … Stat Err**’

PCS MSS: MBS: MCU: MCU

cmd ‘Prime’(‘Redundant’) Operational (Verify Systems State – Operational) (~3 min)

4. SSRMS POWERUP TO OPERATIONAL

NOTE

A warmup period in Keep-Alive will be required if the SSRMS has been unpowered for over 30 minutes. This is to ensure that the SSRMS is within thermal limits.

4.1 Transition Prime(Redundant) String to Off

PCS MSS: SSRMS: Power: SSRMS Power

If SSRMS based on MBS PDGF and ‘SSRMS’ Prime(Redundant) not Off

NOTE

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

2. Expect the ‘**R1E - MSS Active OCS SSRMS Prime(Redun) ACU SRT Comm Fail**’ Robotics Advisory message (SCR 17730).

3. If the SSRMS is based on an MBS PDGF, expect the following Robotics Advisory message to go to Norm for the commanded SSRMS string that was in Keep-Alive:
‘**R2O - MBS CRPCM … Output Voltage … Stat Err**’

cmd ‘SSRMS’ Prime(Redundant) – Off (Verify – Off)

4.2 Transition Prime(Redundant) String to Keep-Alive
If ‘SSRMS’ Prime(Redundant) – Off

NOTE

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

MSS: SSRMS: Power: SSRMS Power

cmd ‘SSRMS’ Prime(Redundant) – Keep-Alive (Verify Keep-Alive)

4.3 Transition Redundant(Prime) String to Off
If ‘SSRMS’ Redundant(Prime) not Off

NOTE

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

2. Expect the ‘**R1E - MSS Active OCS SSRMS Prime(Redun) ACU SRT Comm Fail**’ Robotics Advisory message (SCR 17730).

3. If the SSRMS is based on an MBS PDGF, expect the following Robotics Advisory message to go to Norm for the commanded SSRMS string that was in Keep-Alive:
‘**R2O - MBS CRPCM … Output Voltage … Stat Err**’

MSS: SSRMS: Power: SSRMS Power

cmd ‘SSRMS’ Redundant(Prime) – Off (Verify – Off)

4.4 Transition Prime(Redundant) String to Operational

NOTE

1. The transition from Keep-Alive to Operational can be stopped at any time by commanding SAFING on the DCP.

2. The operator can follow the transition to Operational by looking at the MSS discrete log.

3. If Tip LEE is mated to a PDGF connected to ISS Ground, expect '**R3L - SSRMS Pwr Flags Fail**' Robotics Advisory message (SCR 19019).

4. While the SSRMS transitions from Keep-Alive to Operational, the following 17 LEE inhibit errors will go to Norm approximately 10 seconds after they are raised:
'**R9B - SSRMS LEE … Inh Err**'

cmd 'SSRMS' Prime(Redundant) – Operational

Verify 'Systems State' – Operational (~6 minutes)

5. MSS VIDEO COMPONENTS POWERUP

5.1 Video Distribution Units Powerup

PCS MSS: MBS: VDU1: [MSS VDUs]

sel [X] where [X] = [MBS 1] [MBS 2]

√'Primary','Redundant' Keep-Alive

Repeat

NOTE

Expect '**R6F - MBS… PFM Carrier On Video 1 Err**' Robotics Advisory message as each VDU is powered on. Message may toggle in and out of alarm until video is routed to the defined VDU (SCR 24376).

sel '[X]' as required where [X] = [Base LEE] [Base Elbow] [Tip Elbow] [Tip Lee] [MSB 1] [MSB 2] [POA]

cmd '[X]' On (Verify – On)

Repeat

5.2 Cameras Powerup
MSS: MBS: MBS Central Camera icon: MBS Camera

sel [X] as required where [X] = B-Elb 22 T-Elb 24 LEE 25
MBS 37 POA 32

cmd ‘Power’ On (Verify – On)

Repeat

5.3 Lights Powerup
MSS: MBS: MBS Central Light icon: MSS Lights

sel [X] as required where [X] = Base Elbow Tip Elbow Tip LEE
MBS POA

cmd [X] On (Verify – On)

Repeat

6.334 MSS POWERDOWN FROM OPERATIONAL TO KEEP-ALIVE

(RBT GEN/X2R4 - ALL/FIN 2/SCR) Page 1 of 3 pages

1. MSS VIDEO COMPONENTS POWERDOWN

1.1 MSS Video Derouting

MSS: MBS: Video: Video Routing

If the MSS Video System is On, perform {6.617 MSS VIDEO DEROUTING}, all (SODF: RBT GEN: NOMINAL), then:

1.2 Lights Powerdown

PCS MSS: MBS: MBS central light icon: MSS Lights

If [X] – On where [X] = Base Elbow | Tip Elbow | Tip LEE | MBS | POA

cmd Keep-Alive (Verify Keep-Alive)

Repeat

1.3 Cameras Powerdown

MSS: MBS: MBS central camera icon: MBS Camera

sel [X] where [X] = B-Elb 22 | T-Elb 24 | LEE 25 | MBS 37 | POA 32

If ‘Power’ – On

NOTE

Expect ‘**R6B – SSRMS Base (Tip)(MBS) LEE(POA) VDU TVC (PTU) On Off Err**’ Robotics Advisory message after Tip LEE Camera or POA Camera is commanded to Keep-Alive. Message should return to Norm (SCR 22814).

cmd ‘Power’ Keep-Alive (Verify Keep-Alive)

Repeat

1.4 Video Distribution Units Powerdown

MSS: MBS: VDU1: MSS VDUs

If [X] – On where [X] = Base LEE | Base Elbow | Tip Elbow | Tip ELee | POA

cmd Keep-Alive (Verify Keep-Alive)

Repeat

If [X] – On where [X] = MBS 1 MBS 2

cmd 'Primary'('Redundant') Keep-Alive (Verify Keep-Alive)

Repeat

2. SSRMS POWERDOWN FROM OPERATIONAL TO KEEP-ALIVE

2.1 Setup

PCS MSS: SSRMS: SSRMS

√'SSRMS Safing' – Safed

2.2 Transition Prime(Redundant) String From Operational to Keep-Alive

NOTE

Expect '**R1E - CUP(LAB) RWS CEU PLB(MLB) ACU Cmd Resp Sync Msg Err**' Robotics Advisory message when transitioning from Operational to Keep-Alive (SCR 31294).

MSS: SSRMS: Power: SSRMS Power

cmd 'SSRMS' Prime(Redundant) – Keep-Alive (Verify – Keep-Alive) (~30 sec)

2.3 Transition Redundant(Prime) String From Off to Keep-Alive

If SSRMS is based on MBS

MSS: MBS: MCU: MCU 'Redundant(Prime)'

√'Redundant(Prime)' – Keep-Alive

MSS: SSRMS: Power: SSRMS Power

cmd 'SSRMS' Redundant(Prime) – Keep-Alive (Verify – Keep-Alive) (~30 sec)

3. MBS POWERDOWN FROM OPERATIONAL TO KEEP-ALIVE

3.1 Setup

PCS MSS: MBS: MBS

√'MBS Safing' – Safed

MSS: MBS: POA Power: POA Power

If the POA is Operational

Perform {6.343 MBS POA POWERDOWN FROM OPERATIONAL TO KEEP-ALIVE ON PRIME(REDUNDANT) STRING}, all (SODF: RBT GEN: NOMINAL), then:

3.2 <u>Transition MBS Prime(Redundant) String From Operational to Keep-Alive</u>

MSS: MBS: MCU: $\boxed{\text{MCU}}$ ‘Prime (Redundant)’

√‘Redundant(Prime)’ – Keep-Alive

cmd ‘Keep-Alive’ (Verify – ‘Keep-Alive’) (30 s max)

4. <u>ROBOTIC WORKSTATION CUP(LAB) POWERDOWN</u>

4.1 <u>CUP(LAB) CEU Designation as Backup</u>

PCS MSS: LAS5(LAP5) CEU Mode: $\boxed{\text{CEU Mode}}$

cmd Active CEU – Backup (Verify previously Active RWS is Backup)

4.2 <u>CUP(LAB) RWS Powerdown</u>

MSS: LAS5(LAP5) Pwr Dn: $\boxed{\text{LAS5(LAP5) Power Down}}$

cmd ‘C. CVIU 5(2)’ Open (Verify – √)
cmd ‘D. CVIU 4(12)’ Open (Verify – √)

Verify ‘E. AVU’ Off – √

cmd ‘F. FDIR’ Inhibit (Verify – √)
cmd ‘G. CB Ext 2(1) Bus Comm’ Inhibit

Verify Frame Count stops incrementing (SPN 494).

cmd ‘H. CEU’ Open (Verify – √)

5. <u>ROBOTIC WORKSTATION CUP(LAB) DCP POWERDOWN</u>

Go to {6.114 LAB(cUP) RWS UOP BYPASS CABLE RECONFIGURATION}, step 1 (SODF: RBT GEN: NOMINAL).

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6.335 MBS POWERDOWN TO OFF ON PRIME(REDUNDANT) STRING

(RBT GEN/X2R4 - ALL/FIN 1/SCR) Page 1 of 2 pages

> NOTE
> The MT position shown on the Mobile Transporter PCS display must match the actual position of the MT for the MBS Powerdown Command to be accepted and succeed.

1. SETUP

PCS MSS: MBS: MBS

If the MBS is Operational
√'MBS Safing' – Safed, then:

MSS: MBS: POA P/L Power: POA Payload Power

√'Prime'('Redundant') – Off

MSS: MBS: MCAS P/L Power: MCAS Payload Power

√'Prime'('Redundant') – Off

MSS: MBS: EVA1(2): EVA Power

√'EVA' 1(2) – Off

MSS: MBS: Video: Video Routing

If SSRMS is not OFF on MBS String being powered OFF
Perform {6.434 SSRMS POWERDOWN TO OFF ON BOTH STRINGS}, steps 1 to 3, as required (SODF: RBT GEN: NOMINAL), then:

If Keep-Alive string of the MBS is being powered OFF while the MBS is Operational:

> NOTE
> Expect the following Robotics Advisory messages:
> '**R2O - MBS CRPCM … Cat-2 Transmit Msg Err**' (SCR 21744)
> '**R2O - MBS CRPCM … Cat-2 Receive Msg Err**' (SCR 21744)

√**MCC** has verified VDUs are receiving power from Operational MBS String (SCR 24292)

If Operational string of the MBS is being powered OFF
If the MBS Video System is On
Perform {6.617 MSS VIDEO DEROUTING}, all (SODF: RBT GEN: NOMINAL), then:

MSS: MBS: POA Power: POA Power

~

If the POA is Operational

Perform {6.343 MBS POA POWERDOWN FROM OPERATIONAL TO KEEP-ALIVE ON PRIME(REDUNDANT) STRING}, all (SODF: RBT GEN: NOMINAL), then:

2. TRANSITION MBS PRIME(REDUNDANT) STRING TO OFF

NOTE

Expect ‘**R1E - MSS Active OCS MBS Prime(Redun) MCU SRT Comm Fail**’ Caution and Warning messages (SCR 17730).

MSS: MBS: MCU: MCU

cmd ‘Prime’(‘Redundant’) Off (Verify – Off) (30 s max)

6.341 MBS POA POWERUP FROM OFF TO KEEP ALIVE ON BOTH STRINGS

(RBT GEN/UF2 - ALL/FIN) Page 1 of 1 page

1. MBS POA POWERUP FROM OFF TO KEEP-ALIVE ON PRIME STRING

PCS MSS: MBS: POA Power: POA Power

Verify 'Redundant' – not Operational

cmd 'Prime' Keep-Alive (Verify Keep-Alive) (30 s max)

2. MBS POA POWERUP FROM OFF TO KEEP-ALIVE ON REDUNDANT STRING

PCS MSS: MBS: POA Power: POA Power
Verify 'Prime' – not Operational

cmd 'Redundant' Keep-Alive (Verify Keep-Alive) (30 s max)

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6.342 MBS POA POWERUP TO OPERATIONAL ON PRIME(REDUNDANT) STRING

(RBT GEN/X2R4 - ALL/FIN 2/SPN) Page 1 of 1 page

1. SETUP

PCS MSS: MBS: MCU: MCU

Verify ‘Prime’(‘Redundant’) – Operational

MSS: MBS: MBS

√‘MBS Safing ’ – Safed

2. TRANSITION REDUNDANT(PRIME) TO OFF

MSS: MBS: POA Power: POA Power

If ‘Redundant’(‘Prime’) – not Off
cmd ‘Redundant’(‘Prime’) Off (Verify Off) (30 s max)

3. TRANSITION PRIME(REDUNDANT) STRING TO KEEP-ALIVE

MSS: MBS: POA Power: POA Power

If ‘Prime’(‘Redundant’) – Off
cmd ‘Prime’(‘Redundant’) Keep-Alive (Verify Keep-Alive) (30 s max)

4. TRANSITION PRIME(REDUNDANT) STRING TO OPERATIONAL

MSS: MBS: Latch: MCAS Latch

Verify Active MBS IMCA – None

NOTE

1. The transition from Keep-Alive to Operational can be stopped at anytime by commanding SAFING on the DCP.
2. If the transition is not complete in 2.5 minutes, apply SAFING on the DCP to stop transition (SCR 22619).
3. If the transition is interrupted by Operator Safing or by a system failure, the MBS string will have to be commanded to Operational again before the POA transition can be reattempted.
4. The operator can follow the transition to Operational by looking at the MSS discrete log.

MSS: MBS: POA Power: POA Power

cmd ‘Prime’(‘Redundant’) Operational (Verify Operational) (SCR 22616)

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6.343 MBS POA POWERDOWN FROM OPERATIONAL TO KEEP-ALIVE ON PRIME(REDUNDANT) STRING

(RBT GEN/E10 - ALL/FIN 1/SPN) Page 1 of 1 page

1. SETUP

PCS MSS: MBS: MBS

√'MBS Safing' – Safed

2. TRANSITION MBS POA PRIME(REDUNDANT) STRING FROM OPERATIONAL TO KEEP-ALIVE

If the transition is interrupted by Operator Safing or by a system failure
√**MCC**.

MSS: MBS: POA Power: POA Power

cmd 'Prime'('Redundant') – Keep-Alive (Verify – Keep-Alive)
(30 s max)

MSS: Discrete Log: MSS Discrete Log

Verify a '**LEU_Shutdown_Failed**' or '**Unit_Failed_On**' discrete message has not been annunciated (SPNs 1798, 1881).

```
**************************************************************************************
*  If 'Prime'('Redundant') – 'LEU_Shutdown_Failed' or  'Unit_Failed_On'
*  |  discrete message has been annunciated
*  |    cmd 'Prime'('Redundant') – Off (Verify – Off)
*  |    cmd 'Prime'('Redundant') – Keep-Alive (Verify – Keep-Alive)
*  |      (SCR 23231)
**************************************************************************************
```

3. TRANSITION MBS POA REDUNDANT(PRIME) STRING FROM OFF TO KEEP-ALIVE

MSS: MBS: MCU: MCU

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

MSS: MBS: POA Power: POA Power

cmd 'Redundant'('Prime') – Keep-Alive (Verify – Keep-Alive)
(30 s max)

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6.344 MBS POA POWERDOWN TO OFF ON BOTH STRINGS

(RBT GEN/X2R4 - ALL/FIN) Page 1 of 1 page

NOTE
The MBS POA should not be left with both strings in the Off state for extended periods due to thermal constraints.

1. SETUP

PCS MSS: MBS: MBS

√‘MBS Safing’ – Safed
√MCU – Operational

2. TRANSITION MBS POA PRIME STRING TO OFF

MSS: MBS: POA Power: POA Power

If ‘Prime’ not Off
cmd ‘Prime’ Off (Verify Off) (30 s max)

3. TRANSITION MBS POA REDUNDANT STRING TO OFF

MSS: MBS: POA Power: POA Power

If ‘Redundant’ not Off
cmd ‘Redundant’ Off (Verify Off) (30 s max)

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6.351 MBS MCAS LATCH CHECKOUT CLOSE

(RBT GEN/X2R4 - ALL/FIN 2/SPN) Page 1 of 3 pages

NOTE
Expect sporadic '**R4H - MBS MCU MCAS Latch Cat-2 Cksum Fail**' Robotics Advisory messages (SCR 22667).

1. POWER ON PRIME(REDUNDANT) MCAS LATCH IMCA

PCS MSS: MBS: POA Power: POA Power

√'Prime' – Off (Keep-Alive)
√'Redundant' – Off (Keep-Alive)

MSS: MBS: MBS

√'MBS Safing' – Not Safed

MSS: MBS: Latch: MCAS Latch

Verify 'Active MBS IMCA' – None
Verify 'Power' – Off

MSS: MBS: Latch: Power: MCAS Latch IMCA Power

cmd Enable (Verify √)
cmd Confirm (Verify √)
cmd On (Verify √)

MSS: MBS: Latch: MCAS Latch

Verify 'Active MBS IMCA' – MCAS Latch
Verify 'Mode' – Standby (6 seconds)

2. VERIFY POST TESTS
MSS: MBS: Latch: Commands ► BIT: MCAS Latch POST and BIT

Verify all – blank

3. SETUP
Configure cameras and overlays as required.

4. INITIALIZE MCAS LATCH IMCA WITH SAFING INITFRAME
MSS: MBS: Latch: MCAS Latch

Verify 'Latch' Closed – blank
Verify 'Latch' Open – √

MSS: MBS: Latch: Commands ► Checkout:
MCAS Latch Checkout Commands

cmd Safing Initframe

MSS: MBS: Latch: MCAS Latch

Verify 'Command Response' Initframe Received – √
Verify 'Command Response' Parameter Checksum Failed – blank

MSS: MBS: Latch: Commands ► Checkout:
MCAS Latch Checkout Commands
Initframe Details:
MBS IMCA Initframe Details

Verify 'Limits' Position Change – High: 0 Rev

5. MODE IMCA TO ON
MSS: MBS: Latch: Commands ► Checkout:
MCAS Latch Checkout Commands

cmd On

MSS: MBS: Latch: MCAS Latch

Verify Mode – On

6. CHECKOUT CLOSE
MSS: MBS: Latch: Commands ► Checkout:
MCAS Latch Checkout Commands

cmd Close

MSS: MBS: Latch: MCAS Latch

Verify 'Command Response' Parameter Checksum Failed – blank

MSS: MBS: Latch: Commands ► Checkout:
MCAS Latch Checkout Commands
Initframe Details:
MBS IMCA Initframe Details

Verify 'Limits' Position Change – High: 3110 Rev (± 2)

NOTE

1. For MSS: MBS: Latch: MCAS Latch 'Motor Status', expect large fluctuations in values for Acceleration and Current. The data is unreliable.
2. The Actuate command will initiate full opening of the MCAS Latch Mechanism.
3. To pause IMCA motion, mode IMCA back to On.

MSS: MBS: Latch: Commands ► Checkout:
MCAS Latch Checkout Commands

cmd Actuate

MSS: MBS: Latch: MCAS Latch

Verify 'Mode' – Enabled
Verify 'Motor Status' Position – incrementing

Verify 'Mode' – On (~7 minutes)
Verify 'Motor Status' Position: 3110 Rev (± 2)

Verify 'Latch' Closed – √
Verify 'Latch' Open – blank

7. MODE IMCA TO STANDBY
MSS: MBS: Latch: Commands ► Checkout:
MCAS Latch Checkout Commands

cmd Standby

MSS: MBS: Latch: MCAS Latch

Verify 'Mode' – Standby

8. POWER OFF PRIME(REDUNDANT) MCAS LATCH IMCA
MSS: MBS: LATCH: MCAS Latch

Verify 'Active MBS IMCA' – MCAS Latch
Verify 'Power' – On
Verify 'Mode' – Standby

MSS: MBS: Latch: Power: MCAS Latch IMCA Power

cmd Off (Verify Off – √)

MSS: MBS: Latch: MCAS Latch

Verify 'Active MBS IMCA' – None
Verify 'Power' – Off

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6.352 MBS MCAS LATCH CHECKOUT OPEN

(RBT GEN/X2R4 - ALL/FIN 2/SPN) Page 1 of 3 pages

NOTE
Expect sporadic '**R4H - MBS MCU MCAS Latch Cat-2 Cksum Fail**' Robotics Advisory messages (SCR 22667).

1. POWER ON PRIME(REDUNDANT) MCAS LATCH IMCA

PCS MSS: MBS: POA Power: POA Power

√'Prime' – Off (Keep-Alive)
√'Redundant' – Off (Keep-Alive)

MSS: MBS: MBS

√'MBS Safing' – Not Safed

MSS: MBS: Latch: MCAS Latch

Verify 'Active MBS IMCA' – None
Verify 'Power' – Off

MSS: MBS: Latch: Power: MCAS Latch IMCA Power

cmd Enable (Verify – √)
cmd Confirm (Verify – √)
cmd On (Verify – √)

MSS: MBS: Latch: MCAS Latch

Verify 'Active MBS IMCA' – MCAS Latch
Verify 'Power' – On
Verify 'Mode' – Standby (6 seconds)

2. VERIFY POST TESTS

MSS: MBS: Latch: Commands ► BIT: MCAS Latch POST and BIT

Verify all – blank

3. SETUP

Configure cameras and overlays as required.

4. INITIALIZE MCAS LATCH IMCA WITH SAFING INITFRAME

MSS: MBS: Latch: MCAS Latch

Verify 'Latch' Closed – √
Verify 'Latch' Open – blank

MSS: MBS: Latch: Commands ► Checkout:
MCAS Latch Checkout Commands

cmd Safing Initframe

MSS: MBS: Latch: MCAS Latch

Verify 'Command Response' Initframe Received – √
Verify 'Command Response' Parameter Checksum Failed – blank

MSS: MBS: Latch: Commands ► Checkout: Initframe Details:
MBS IMCA Initframe Details

Verify 'Limits' 'Position Change – High': 0 Rev

5. MODE IMCA TO ON
MSS: MBS: Latch: Commands ► Checkout:
MCAS Latch Checkout Commands

cmd On

MSS: MBS: Latch: MCAS Latch

Verify 'Mode' – On

6. CHECKOUT OPEN
MSS: MBS: Latch: Commands ► Checkout:
MCAS Latch Checkout Commands

cmd Open

MSS: MBS: Latch: MCAS Latch

Verify 'Command Response' Parameter Checksum Failed – blank

MSS: MBS: Latch: Commands ► Checkout: Initframe Details:
MBS IMCA Initframe Details

Verify 'Limits' 'Position Change – High': -3110 Rev (± 2)

NOTE

1. For MSS: MBS: Latch: MCAS Latch 'Motor Status', expect large fluctuations in values for Acceleration and Current. The data is unreliable.

2. The Actuate command will initiate full opening of the MCAS Latch Mechanism.

3. To pause IMCA motion, mode IMCA back to On.

MSS: MBS: Latch: Commands ► Checkout:
MCAS Latch Checkout Commands

cmd Actuate

MSS: MBS: Latch: MCAS Latch

Verify ‘Mode’ – Enabled
Verify ‘Motor Status’ Position – decrementing

Verify ‘Mode’ – On (~7 minutes)
Verify ‘Motor Status’ Position: -3110 Rev (± 2)

Verify ‘Latch’ Closed – blank
Verify ‘Latch’ Open – √

7. MODE IMCA TO STANDBY

MSS: MBS: Latch: Commands ► Checkout:
MCAS Latch Checkout Commands

cmd Standby

MSS: MBS: Latch: MCAS Latch

Verify ‘Mode’ – Standby

8. POWER OFF PRIME(REDUNDANT) MCAS LATCH IMCA

MSS: MBS: Latch: MCAS Latch

Verify ‘Active MBS IMCA’ – MCAS Latch
Verify ‘Power’ – On
Verify ‘Mode’ – Standby

MSS: MBS: Latch: Power: MCAS Latch IMCA Power

cmd Off (Verify Off – √)

MSS: MBS: Latch: MCAS Latch

Verify ‘Active MBS IMCA’ – None
Verify ‘Power’ – Off

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6.353 MBS MCAS LATCH CAPTURE

(RBT GEN/X2R4 - ALL/FIN 2/SPN) Page 1 of 5 pages

NOTE
Expect sporadic ‘**R4H - MBS MCU MCAS Latch Cat-2 Cksum Fail**’ Robotics Advisory messages (SCR 22667).

1. POWER ON PRIME(REDUNDANT) MCAS LATCH IMCA

PCS MSS: MBS: POA Power: POA Power

√‘Prime’ – Off (Keep-Alive)
√‘Redundant’ – Off (Keep-Alive)

MSS: MBS: MBS

√‘MBS Safing’ – Not Safed

MSS: MBS: Latch: MCAS Latch

Verify ‘Active MBS IMCA’ – None
Verify ‘Power’ – Off

MSS: MBS: Latch: Power: MCAS Latch IMCA Power

cmd Enable (Verify √)
cmd Confirm (Verify √)
cmd On (Verify √)

MSS: MBS: Latch: MCAS Latch

Verify ‘Active MBS IMCA’ – MCAS Latch
Verify Mode – Standby (6 seconds)

2. VERIFY POST TESTS

MSS: MBS: Latch: Commands ► BIT: MCAS Latch POST and BIT

Verify all – blank

3. SETUP

NOTE
At this point, the payload must be seated in the MCAS V-Guides and grappled by SSRMS.

Configure cameras and overlays as required.

Verify RTL 1 – √
Verify RTL 2 – √
Verify RTL 3 – √

4. INITIALIZE MCAS LATCH IMCA WITH SAFING INITFRAME

MSS: MBS: Latch: MCAS Latch

Verify ‘Latch’ Closed – blank
Verify ‘Latch’ Open – √

MSS: MBS: Latch: Commands ► Close: MCAS Latch Close Commands

cmd Safing Initframe

MSS: MBS: Latch: MCAS Latch

Verify ‘Command Response’ Initframe Received – √
Verify ‘Command Response’ Parameter Checksum Failed – blank

MSS: MBS: Latch: Commands ► Close:
MCAS Latch Close Commands
Initframe Details:
MBS IMCA Initframe Details

Verify ‘Limits’ Position Change – High: 0 Rev

5. MODE IMCA TO ON

MSS: MBS: Latch: Commands ► Close: MCAS Latch Close Commands

cmd On

MSS: MBS: Latch: MCAS Latch

Verify Mode – On

6. PHASE ONE CAPTURE

MSS: MBS: Latch: Commands ► Close: MCAS Latch Close Commands

cmd First Phase

MSS: MBS: Latch: MCAS Latch

Verify ‘Command Response’ Parameter Checksum Failed – blank

MSS: MBS: Latch: Commands ► Close:
MCAS Latch Close Commands
Initframe Details:
MBS IMCA Initframe Details

Verify ‘Limits’ Position Change – High: 1100 Rev (± 2)

NOTE

1. For MSS: MBS: Latch: MCAS Latch ‘Motor Status’, expect large fluctuations in values for Shaft Speed, Acceleration, and Current. The data is unreliable.
2. The Actuate command will initiate partial closing of the MCAS Latch Mechanism.
3. To pause IMCA motion, mode the IMCA back to On.

MSS: MBS: Latch: Commands ► Close: MCAS Latch Close Commands

cmd Actuate

MSS: MBS: Latch: MCAS Latch

Verify ‘Mode’ – Enabled
Verify ‘Motor Status’ Position – incrementing

Verify ‘Mode’ – On (~2 minutes, 30 seconds)
Verify ‘Motor Status’ Position: 1100 Rev (± 2)

Verify ‘Latch’ Closed – blank
Verify ‘Latch’ Open – blank

7. SSRMS CONFIGURATION

PCS MSS: SSRMS: Limp: SSRMS Limp

cmd All Limp (Verify Limp – blue)

MSS: SSRMS: SSRMS

Verify all joints – Limped

8. PHASE TWO CAPTURE

MSS: MBS: Latch: Commands ► Close: MCAS Latch Close Commands

cmd Second Phase

MSS: MBS: Latch: MCAS Latch

Verify ‘Command Response’ Parameter Checksum failed – blank

MSS: MBS: Latch: Commands ► Close:
MCAS Latch Close Commands
Initframe Details:
MBS IMCA Initframe Details

Verify ‘Limits’ Position Change – High: 1650 Rev (± 2)

NOTE

1. For MSS: MBS: Latch: MCAS Latch 'Motor Status', expect large fluctuations in values for Acceleration and Current. The data is unreliable.
2. The Actuate command will initiate partial closing of the MCAS Latch Mechanism.
3. To pause IMCA motion, mode IMCA back to On.

MSS: MBS: Latch: Commands ► Close: MCAS Latch Close Commands

cmd Actuate

MSS: MBS: Latch: MCAS Latch

Verify 'Mode' – Enabled
Verify 'Motor Status' Position – incrementing

Verify 'Mode' – On (~1 minute, 15 seconds)
Verify 'Motor Status' Position: 1650 Rev (± 2)

Verify 'Latch' Closed – blank
Verify 'Latch' Open – blank

9. PHASE THREE CAPTURE
MSS: MBS: Latch: Commands ► Close: MCAS Latch Close Commands

cmd Third Phase

MSS: MBS: Latch: MCAS Latch

Verify 'Command Response' Parameter Checksum Failed – blank

MSS: MBS: Latch: Commands ► Close:
MCAS Latch Close Commands
Initframe Details:
MBS IMCA Initframe Details

Verify 'Limits' Position Change – High: 3110 Rev (± 2)

NOTE

1. For MBS: MCAS Latch: MCAS Latch 'Motor Status', expect large fluctuations in values for Acceleration and Current. The data is unreliable.
2. The Actuate command will initiate full closing of the MCAS Latch Mechanism.
3. To pause IMCA motion, mode IMCA back to On.

MSS: MBS: Latch: Commands ► Close: MCAS Latch Close Commands

cmd Actuate

MSS: MBS: Latch: MCAS Latch

Verify ‘Mode’ – Enabled
Verify ‘Motor Status’ Position – incrementing

Verify ‘Mode’ – On (~3 minutes, 20 seconds)
Verify ‘Motor Status’ Position: 3110 Rev (± 2)

Verify ‘Latch’ Closed – √
Verify ‘Latch’ Open – blank

10. MODE IMCA TO STANDBY

MSS: MBS: Latch: Commands ► Close: MCAS Latch Close Commands

cmd Standby

MSS: MBS: Latch: MCAS Latch

Verify ‘Mode’ – Standby

11. SSRMS CONFIGURATION

PCS MSS: SSRMS: Limp: SSRMS Limp

cmd None Limp (Verify Standby – blue)

12. POWER OFF PRIME(REDUNDANT) MCAS LATCH IMCA

MSS: MBS: Latch: MCAS Latch

Verify ‘Active MBS IMCA’ – MCAS Latch
Verify ‘Power’ – On
Verify ‘Mode’ – Standby

MSS: MBS: Latch: Power: MCAS Latch IMCA Power

cmd Off (Verify Off – √)

MSS: MBS: Latch: MCAS Latch

Verify ‘Active MBS IMCA’ – None
Verify ‘Power’ – Off

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6.354 MBS MCAS LATCH RELEASE

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NOTE
Expect sporadic '**R4H - MBS MCU MCAS Latch Cat-2 Cksum Fail**' Robotics Advisory messages (SCR 22667).

1. POWER ON PRIME(REDUNDANT) MCAS LATCH IMCA

PCS MSS: MBS: POA Power: POA Power

√'Prime' – Off (Keep-Alive)
√'Redundant' – Off (Keep-Alive)

MSS: MBS: MBS

√'MBS Safing' – Not Safed

MSS: MBS: Latch: MCAS Latch

Verify 'Active' MBS IMCA – None
Verify 'Power' – Off

MSS: MBS: Latch: Power: MCAS Latch IMCA Power

cmd Enable (Verify √)
cmd Confirm (Verify √)
cmd On (Verify √)

MSS: MBS: Latch: MCAS Latch

Verify 'Active MBS IMCA' – MCAS Latch
Verify 'Mode' – Standby (6 seconds)

2. VERIFY POST TESTS

MSS: MBS: Latch: Commands ► BIT: MCAS Latch POST and BIT

Verify all – blank

3. SETUP

Configure cameras and overlays as required.

4. SSRMS CONFIGURATION

PCS MSS: SSRMS: Limp: SSRMS Limp

cmd All Limp (Verify Limp – blue)

MSS: SSRMS: SSRMS

Verify All Joints – Limped

Wait 30 seconds.

MSS: SSRMS: Limp: SSRMS Limp

cmd None Limp (Verify Standby – blue)

5. INITIALIZE MCAS LATCH IMCA WITH SAFING INITFRAME

MSS: MBS: Latch: MCAS Latch

Verify ‘Latch’ Closed – √
Verify ‘Latch’ Open – blank

MSS: MBS: Latch: Commands ► Open: MCAS Latch Open Commands

cmd Safing Initframe

MSS: MBS: Latch: MCAS Latch

Verify ‘Command Response’ Initframe Received – √
Verify ‘Command Response’ Parameter Checksum Failed – blank

MSS: MBS: Latch: Commands ► Open:
MCAS Latch Open Commands
Initframe Details:
MBS IMCA Initframe Details

Verify ‘Limits’ Position Change – High: 0 Rev

6. MODE IMCA TO ON

MSS: MBS: Latch: Commands ► Open: MCAS Latch Open Commands

cmd On

MSS: MBS: Latch: MCAS Latch

Verify ‘Mode’ – On

7. FULLY OPEN MCAS LATCH

MSS: MBS: Latch: Commands ► Open: MCAS Latch Open Commands

cmd Fully Open

MSS: MBS: Latch: MCAS Latch

Verify ‘Command Response’ Parameter Checksum Failed – blank

MSS: MBS: Latch: Commands ► Open:
MCAS Latch Open Commands
Initframe Details:
MBS IMCA Initframe Details

Verify ‘Limits’ Position Change – High: -3110 Rev (± 2)

NOTE

1. For MSS: MBS: Latch: MCAS Latch 'Motor Status', expect large fluctuations in values for Acceleration and Current. The data is unreliable.

2. The Actuate command will initiate full opening of the MCAS Latch Mechanism.

3. To pause IMCA motion, mode IMCA back to On.

MSS: MBS: Latch: Commands ► Open: MCAS Latch Open Commands

cmd Actuate

MSS: MBS: Latch: MCAS Latch

Verify 'Mode' – Enabled
Verify 'Motor Status' Position – decrementing

Verify 'Mode' – On (~7 minutes)
Verify 'Motor Status' Position: -3110 Rev (± 2)

Verify 'Latch' Closed – blank
Verify 'Latch' Open – √

8. MODE IMCA TO STANDBY

MSS: MBS: Latch: Commands ► Open: MCAS Latch Open Commands

cmd Standby

MSS: MBS: Latch: MCAS Latch

Verify Mode – Standby

9. POWER OFF PRIME(REDUNDANT) MCAS LATCH IMCA

MSS: MBS: Latch: MCAS Latch

Verify 'Active MBS IMCA' – MCAS Latch
Verify 'Power' – On
Verify 'Mode' – Standby

MSS: MBS: Latch: Power: MCAS Latch IMCA Power

cmd Off (Verify Off – √)

MSS: MBS: Latch: MCAS Latch

Verify 'Active MBS IMCA' – None
Verify 'Power' – Off

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6.360 MBS MCAS UMA MATE

(RBT GEN/X2R4 - ALL/FIN 2) Page 1 of 4 pages

NOTE

1. Only one MBS mechanism (MCAS UMA, MTCL, POA or MCAS Latch) can be Operational at one time.

2. Expect sporadic ‘**R4H - MBS MCU MCAS UMA Cat-2 Cksum Fail**’ Robotics Advisory messages (SPN 1910).

3. A sporadic ‘**R4H - MBS MCU MCAS Abnormal Stop Cond**’ Robotics Advisory message may be raised when a new IMCA init frame is loaded. This message may be ignored unless it is raised immediately following the end of the IMCA trajectory (SCR 28923).

1. SETUP

PCS MSS: MBS: POA Power: POA Power

Verify ‘Prime’ – Keep-Alive(Off)
Verify ‘Redundant’ – Keep-Alive(Off)

MSS: MBS: UMA: MCAS UMA

Verify ‘Active MBS IMCA’ – None

2. CANCEL MBS SAFING

MSS: MBS: MBS Safing: MBS Safing

cmd Remove (Verify Not Safed)

3. POWER ON MCAS UMA IMCA

MSS: MBS: UMA: Power: MCAS UMA IMCA Power

cmd Enable (Verify – √)
cmd Confirm (Verify – √)
cmd On (Verify – √)

MSS: MBS: UMA: MCAS UMA

Verify ‘Power’ – On (6 seconds)

4. VERIFY POST AND BIT TESTS

MSS: MBS: UMA: Commands ► BIT: MCAS UMA Post and BIT

Verify all – blank

5. INITIALIZE MCAS UMA IMCA WITH SAFING INITFRAME

MSS: MBS: UMA: MCAS UMA

Verify ‘Mated’ – blank
Verify ‘Demated’ – √

MSS: MBS: UMA: Commands ► Mate: MCAS UMA Mate Commands

cmd Safing Initframe

MSS: MBS: UMA: MCAS UMA
‘Command Response’

Verify ‘Initframe Received’ – √
Verify ‘Parameter Checksum Failed’ – blank

MSS: MBS: UMA: Command ► Mate: Initframe Details:
MBS IMCA Initframe Details

Verify ‘Limits’ ‘Position Change – High’: 0

MSS: MBS: UMA: Commands ► Mate: MCAS UMA Mate Commands

cmd On

MSS: MBS: UMA: MCAS UMA

Verify ‘Mode’ – On

6. THRUSTERS INHIBIT

If ISS/orbiter mated

MSS: SSRMS: Thrusters: Thruster Controls for MSS Ops

cmd ‘Desat Request’ Inhibit (Verify – Inh)

√‘Auto Att Control Handover to RS’ – Inh

If ISS not mated to orbiter, √**MCC-H** for proper thruster configuration before proceeding.

7. FIRST STAGE MATE

MSS: MBS: UMA: Commands ► Mate: MCAS UMA Mate Commands

cmd First Phase

MSS: MBS: UMA: MCAS UMA

Verify ‘Command Response’ ‘Parameter Checksum Failed’ – blank

MSS: MBS: UMA: Commands ► Mate: Initframe Details:
MBS IMCA Initframe Details

Verify ‘Limits’ ‘Position Change – High’: -450

NOTE

For MSS: MBS: UMA: MCAS UMA 'Motor Status', expect large fluctuations in values for Acceleration and Current. The data is unreliable.

MSS: MBS: UMA: Commands ► Mate: MCAS UMA Mate Commands

cmd Actuate

MSS: MBS: UMA: MCAS UMA

Verify 'Mode' – Enabled
Verify 'Motor Status' 'Position' – decrementing

Verify 'Mode' – On (~1 minute)
Verify 'Motor Status' 'Position': -450 ± 2

Verify 'Mated' – blank
Verify 'Demated' – blank

8. SECOND STAGE MATE

MSS: MBS: UMA: Commands ► Mate: MCAS UMA Mate Commands

cmd Second Phase

MSS: MBS: UMA: MCAS UMA

Verify 'Command Response' 'Parameter Checksum Failed' – blank

MSS: MBS: UMA: Commands ► Mate: Initframe Details:
MBS IMCA Initframe Details

Verify 'Limits' 'Position Change – High': -516

NOTE

1. For MSS: MBS: UMA: MCAS UMA 'Motor Status', expect large fluctuations in values for Acceleration and Current. The data is unreliable.

2. A timing problem between the MCU and IMCA may cause the MBS to safe and remove power from the UMA IMCAS after the mated microswitch is tripped. The following messages will be raised for one cycle:
   '**R2O – MBS MCU UMA Inadvertent Pwr On**'
   '**R2P – MSS OCS MBS Prime(Redun) MCU SRT Inh Fail**'
   '**R4H – MBS MCU UMA Stop Cond Err**'

   The state of the mated microswitch can be verified by canceling safing and applying power to the UMA IMCA.

MSS: MBS: UMA: Commands ► Mate: MCAS UMA Mate Commands

cmd Actuate

MSS: MBS: UMA: MCAS UMA

Verify ‘Mode’ – Enabled
Verify ‘Motor Status’ ‘Position’ – decrementing

Verify ‘Mode’ – On (~35 seconds)
Verify ‘Latch Status’ – Switch 1
Verify ‘Motor Status’ ‘Position’: -505 ± 5

Verify ‘Mated’ – √
Verify ‘Demated’ – blank

9. MODE IMCA TO STANDBY

MSS: MBS: UMA: Commands ► Mate: MCAS UMA Mate Commands

cmd Standby

MSS: MBS: UMA: MCAS UMA

Verify ‘Mode’ – Standby

10. IMCA POWER REMOVAL

MSS: MBS: UMA: Power: MCAS UMA IMCA Power

cmd Off (Verify – √)

11. THRUSTERS ENABLE

If ISS/orbiter mated

> MSS: SSRMS: Thrusters: Thruster Controls for MSS Ops
>
> **cmd** ‘Desat Request’ Enable (Verify – Ena)

If ISS not mated to orbiter, √**MCC-H** for proper thruster configuration.

6.361 MBS MCAS UMA DEMATE

(RBT GEN/X2R4 - ALL/FIN 2/SPN) Page 1 of 5 pages

NOTE

1. Only one MBS mechanism (MCAS UMA, MTCL, POA or MCAS Latch) can be Operational at one time.
2. Expect sporadic '**R4H - MBS MCU MCAS UMA Cat-2 Cksum Fail**' Robotics Advisory messages (SCR 22667).
3. A sporadic '**R4H - MBS MCU MCAS Abnormal Stop Cond**' Robotics Advisory message may be raised when a new IMCA init frame is loaded. This message may be ignored unless it is raised immediately following the end of the IMCA trajectory (SPN 3302).

1. SETUP

PCS MSS: MBS: POA Power: POA Power

Verify 'Prime' – Keep-Alive(Off)
Verify 'Redundant' – Keep-Alive(Off)

MSS: MBS: UMA: MCAS UMA

Verify 'Active MBS IMCA' – None

2. CANCEL MBS SAFING

MSS: MBS: MBS Safing: MBS Safing

cmd Remove (Verify Not Safed)

3. POWER ON MCAS UMA IMCA

MSS: MBS: UMA: Power: MCAS UMA IMCA Power

cmd Enable (Verify – √)
cmd Confirm (Verify – √)
cmd On (Verify – √)

MSS: MBS: UMA: MCAS UMA

Verify 'Power' – On (6 seconds)

4. VERIFY POST AND BIT TESTS

MSS: MBS: UMA: Commands ▶ BIT: MCAS UMA Post and BIT

Verify all – blank

5. INITIALIZE MCAS UMA IMCA WITH SAFING INITFRAME

MSS: MBS: UMA: MCAS UMA

Verify ‘Mated’ – √
Verify ‘Demated’ – blank

MSS: MBS: UMA: Commands ▶ Demate: MCAS UMA Demate Commands

cmd Safing Initframe

MSS: MBS: UMA: MCAS UMA
‘Command Response’

Verify ‘Initframe Received’ – √
Verify ‘Parameter Checksum Failed’ – blank

MSS: MBS: UMA: Commands ▶ Demate: Initframe Details:
MBS IMCA Initframe Details

Verify ‘Limits’ ‘Position Change – High’: 0

MSS: MBS: UMA: Commands ▶ Demate: MCAS UMA Demate Commands

cmd On

MSS: MBS: UMA: MCAS UMA

Verify ‘Mode’ – On

6. THRUSTERS INHIBIT

If ISS/orbiter mated

> MSS: SSRMS: Thrusters: Thruster Controls for MSS Ops
>
> **cmd** ‘Desat Request’ Inhibit (Verify – Inh)
>
> √‘Auto Att Control Handover to RS’ – Inh

If ISS not mated to orbiter, √**MCC-H** for proper thruster configuration before proceeding.

7. FIRST STAGE DEMATE

MSS: MBS: UMA: Commands ▶ Demate: MCAS UMA Demate Commands

cmd First Phase

MSS: MBS: UMA: MCAS UMA

Verify ‘Command Response’ ‘Parameter Checksum Failed’ – blank

MSS: MBS: UMA: Commands ▶ Demate: Initframe Details:
MBS IMCA Initframe Details

Verify ‘Limits’ ‘Position Change – High’: 450

NOTE
For MSS: MBS: UMA: MCAS UMA ‘Motor Status’, expect large fluctuations in values for Acceleration and Current. The data is unreliable.

MSS: MBS: UMA: Commands ▶ Demate: MCAS UMA Demate Commands

cmd Actuate
MSS: MBS: UMA: MCAS UMA

Verify ‘Mode’ – Enabled
Verify ‘Motor Status’ ‘Position’ – incrementing

Verify ‘Mode’ – On (~1 minute)
Verify ‘Motor Status’ ‘Position’: 450 ± 2

Verify ‘Mated’ – blank
Verify ‘Demated’ – blank

8. SECOND STAGE DEMATE
MSS: MBS: UMA: Commands ▶ Demate: MCAS UMA Demate Commands

cmd Second Phase

MSS: MBS: UMA: MCAS UMA

Verify ‘Command Response’ ‘Parameter Checksum Failed’ – blank

MSS: MBS: UMA: Commands ▶ Demate: Initframe Details:
MBS IMCA Initframe Details

Verify ‘Limits’ ‘Position Change – High’: 516

NOTE

1. For MSS: MBS: UMA: MCAS UMA 'Motor Status', expect large fluctuations in values for Acceleration and Current. The data is unreliable.

2. A timing problem between the MCU and IMCA may cause the MBS to safe and remove power from the UMA IMCAS after the demated microswitch is tripped. The following messages will be raised for one cycle:
   '**R2O – MBS MCU UMA Inadvertent Pwr On**'
   '**R2P – MSS OCS MBS Prime(Redun) MCU SRT Inh Fail**'
   '**R4H – MBS MCU UMA Stop Cond Err**'

   The state of the demated microswitch can be verified by canceling safing, and applying power to the UMA IMCA.

MSS: MBS: UMA: Commands ▶ Demate: MCAS UMA Demate Commands

cmd Actuate

MSS: MBS: UMA: MCAS UMA

Verify 'Mode' – Enabled
Verify 'Motor Status' 'Position'– incrementing

Verify 'Mode' – On (~35 seconds)
Verify 'Latch Status' – Switch 2

Verify 'Motor Status' 'Position': 505 ± 5

Verify 'Mated' – blank
Verify 'Demated' – √

9. MODE IMCA TO STANDBY

MSS: MBS: UMA: Commands ▶ Demate: MCAS UMA Demate Commands

cmd Standby

MSS: MBS: UMA: MCAS UMA

Verify 'Mode' – Standby

10. IMCA POWER REMOVAL

MSS: MBS: UMA: Power: MCAS UMA IMCA Power

cmd Off (Verify – √)

11. THRUSTERS ENABLE

If ISS/orbiter mated

MSS: SSRMS: Thrusters: Thruster Controls for MSS Ops

cmd ‘Desat Request’ Enable (Verify – Ena)

If ISS not mated to orbiter, √**MCC-H** for proper thruster configuration.

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6.401 SSRMS JOINT BRAKE TEST

(RBT GEN/X2R4 - ALL/FIN 1/SPN) Page 1 of 1 page

1. SETUP

PCS MSS: SSRMS: SSRMS

√'SSRMS Safing' – Safed
√Coarse

2. DIAGNOSTICS

> NOTE
>
> If this procedure is called as part of a nominal checkout, all joints should be selected as part of diagnostics. If this procedure is called from a malfunction procedure, only the joint(s) specified in the malfunction procedure should be selected.

MSS: SSRMS: Diagnostic: SSRMS Diagnostics

sel 'Joints' SR,SY,SP,EP,WP,WY,WR – as required

√'Joint Brakes' Stop on Error button is deselected

cmd Brake Test

MSS: SSRMS: Discrete Log: MSS Discrete Log

Verify test status messages (four per joint selected) – Passed
(SCR 19062)

MSS: CW Summ Robotics: Caution & Warning Summary

If any Robotics Advisories were annunciated during the diagnostics
DCP SAFING → SAFE (Verify ON) (SCR 23261)

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6.402 SSRMS JOINT ELECTRONICS UNIT DIAGNOSTICS

(RBT GEN/E10 - ALL/FIN 1/SPN) Page 1 of 1 page

1. SETUP

PCS MSS: SSRMS: SSRMS

√'SSRMS Safing' – Safed
√Coarse

2. DIAGNOSTICS

> NOTE
> If this procedure is called as part of a nominal checkout, all joints should be selected as part of diagnostics. If this procedure is called from a malfunction procedure, only the joint(s) specified in the malfunction procedure should be selected.

MSS: SSRMS: Diagnostic: SSRMS Diagnostics

sel 'Joints' SR,SY,SP,EP,WP,WY,WR – as required

> NOTE
> The operator may cancel the current test by Safing (SCR 19015).

cmd 'Unit' – Test Units

MSS: SSRMS: Discrete Log: MSS Discrete Log

> NOTE
> The '**Errors in Diagnostic Test**' message may not show the correct value (SCR 19062).

Verify '**Diagnostic Test:… Passed**' (five per joint selected) (SCR 19062)

MSS: CW Summ Robotics: Caution & Warning Summary

If any Robotics advisories were annunciated during the diagnostics

DCP SAFING → SAFE (Verify ON) (SCR 23261)

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6.403 SSRMS LEE DIAGNOSTICS

(RBT GEN/X2R4 - ALL/FIN 2/SPN) Page 1 of 1 page

1. SETUP

PCS MSS: SSRMS: SSRMS

√'SSRMS Safing' – Safed

Verify Unloaded Parameters – √

2. DIAGNOSTICS

MSS: SSRMS: Diagnostic: SSRMS Diagnostics

sel 'Tip LEE' LEE

NOTE

The operator may cancel the current test by Safing (SCR 19015).

cmd 'Unit' Test Units

MSS: SSRMS: Discrete Log: MSS Discrete Log

NOTE

The '**Errors in Diagnostic Test**' message may not show the correct value (SCR 19062).

Verify '**Diagnostic Test: SSRMS Tip LEE … Test Passed**' (twelve)

If any tests fail, record which tests fail.

MSS: CW Summ Robotics: Caution & Warning Summary

If any Robotics Advisories were annunciated during the diagnostics

DCP SAFING → SAFE (Verify – On) (SCR 23261)

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6.417 SSRMS BASE PDGF PRE-LAUNCH CHECKOUT

(RBT GEN/E10 - ALL/FIN/SPN) Page 1 of 4 pages

NOTE

1. This procedure can be performed from the ground.

2. This procedure assumes the MSS is configured as follows:
   LAB(CUP) RWS active
   MSS is safed
   All MSS Trunklines derouted
   If either the new or current SSRMS base is on the MBS, the MBS must be operational on one string and KA on the other.

3. At the end of this procedure, the MSS will be configured as follows:
   SSRMS KA on both strings on original base end
   If the new SSRMS base is an MBS PDGF, MBS is operational on alternate string.

1. SSRMS POWERDOWN TO OFF ON BOTH STRINGS

PCS MSS: SSRMS: Power: SSRMS Power

NOTE

1. Expect the following Robotics Advisories when the SSRMS is commanded to OFF when based on an ISS PDGF:
   ‘**R1E - MSS Active OCS SSRMS Prime(Redun) ACU SRT Comm Fail**’
   Messages will return to Norm (SCR 17730).

2. The SSRMS should not be left with both strings Off for extended periods due to thermal constraints.

If ‘Prime’ – Keep-Alive or Operational
  cmd ‘SSRMS’ ‘Prime’ Off (Verify – Off)

If ‘Redundant’ – Keep-Alive or Operational
  cmd ‘SSRMS’ ‘Redundant’ Off (Verify – Off)

2. BASE CHANGE

MSS: SSRMS: Base LEE: Base

cmd A(B)

MSS: SSRMS: SSRMS

Verify Base LEE – A(B)
Verify ‘PDGF’ – as required

3. SSRMS POWERUP TO KEEP-ALIVE ON BOTH STRINGS

MSS: SSRMS: Power: SSRMS Power

cmd ‘SSRMS’ ‘Prime’ Keep-Alive (Verify – Keep-Alive)
cmd ‘SSRMS’ ‘Redundant’ Keep-Alive (Verify – Keep-Alive)

4. MBS POWERUP ON ALTERNATE STRING

If the SSRMS is based on the MBS

MSS: MBS: MCU: MCU

cmd ‘Prime(Redundant)’ – Keep-Alive (Verify – Keep-Alive)
cmd ‘Redundant(Prime)’ – Operational (Verify ‘Systems State’ – Operational)

5. MSS(PDGF) LB CHECKOUT

NOTE

In this step, use PDGF if the SSRMS is based on an ISS PDGF. Use MSS if the SSRMS is based on an MBS PDGF.

MSS: LAS5(LAP5) Bus Config: LAS5(LAP5) CEU Bus Configuration

cmd ‘Local Bus’ ‘MSS(PDGF)’ B (Verify – B)
cmd ‘Local Bus’ ‘MSS(PDGF)’ A (Verify – A)

6. SSRMS POWERUP TO OPERATIONAL

NOTE

1. SSRMS transition from Keep-Alive to Operational will require at least 6 minutes to complete. The time is contingent on file transfer activity from the C&C MDM.
2. Expect the following Robotics Advisory when the SSRMS is commanded to OFF when based on an ISS PDGF:
   ‘**R1E - MSS Active OCS SSRMS Prime(Redun) ACU SRT Comm Fail**’
   Messages will return to Norm (SCR 17730).
3. Expect ‘**R3L - SSRMS Pwr Flags Fail**’ Robotics Advisory message when SSRMS becomes operational (SCR 19019).

MSS: SSRMS: Power: SSRMS Power

cmd ‘SSRMS’ ‘Redundant(Prime)’ Off (Verify – Off)
cmd ‘SSRMS’ ‘Prime(Redundant)’ Operational (Verify ‘Systems State’ – Operational)

7. SSRMS VIDEO COMPONENTS POWERUP

7.1 SSRMS Video Distribution Units Powerup

MSS: SSRMS: Base LEE VDU icon: SSRMS VDUs

‘[X]’ where [X] = Base LEE | Base Elbow | Tip Elbow | Tip LEE

NOTE

Expect ‘**R6F - … PFM Carrier on Video … Err**’ message. Messages will be intermittent until video is routed on the specified channel (SCR 24376).

cmd On (Verify – On)

Repeat

7.2 Cameras Powerup

MSS: SSRMS: [X] Camera icon: SSRMS Camera

'[X]' where [X] = Base Elbow | Tip Elbow | Tip LEE

cmd 'Power' On (Verify – On)

Repeat

8. VIDEO ROUTING TEST

Perform the following SSRMS video routes.

SOURCE	DESTINATION
SSRMS Tip LEE	Mon 1
SSRMS Tip Elbow	Mon 2
SSRMS Base Elbow	Mon 3

9. SSRMS POWERDOWN TO OFF

9.1 Derouting MSS Video

MSS: Video: Trunkline Usage: Trunkline Usage 'MSS Trunklines'

sel MSS Trunkline [X]

where [X] = 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9

MSS Trunkline [X]

Note all destinations with "√".

MSS: Video: Video Overview: Video Overview

Repeat the following for all destinations noted.

sel Destination icon

[Destination name]

cmd 'Deroute Video Signal' Deroute

Repeat

9.2 SSRMS Powerdown to OFF

NOTE

1. Expect the following Robotics Advisories when the SSRMS is commanded to OFF when based on and ISS PDGF:
   ‘**R1E - MSS Active OCS SSRMS Prime(Redun) ACU SRT Comm Fail**’
   Messages will return to Norm (SCR 17730).

2. The SSRMS should not be left with both strings Off for extended periods due to thermal constraints.

MSS: SSRMS: Power: SSRMS Power

If ‘Prime’ – Keep-Alive or Operational
cmd ‘SSRMS’ ‘Prime’ Off (Verify – Off)

If ‘Redundant’ – Keep-Alive or Operational
cmd ‘SSRMS’ ‘Redundant’ Off (Verify – Off)

10. BASE CHANGE

MSS: SSRMS: Base LEE: Base

cmd A(B) (Verify Base LEE – A(B))

MSS: SSRMS: SSRMS

Verify ‘PDGF’ – as required

11. SSRMS POWERUP TO KEEP-ALIVE ON BOTH STRINGS

MSS: SSRMS: Power: SSRMS Power

cmd ‘SSRMS’ ‘Prime’ Keep-Alive (Verify – Keep-Alive)
cmd ‘SSRMS’ ‘Redundant’ Keep-Alive (Verify – Keep-Alive)

6.421 LEE CALIBRATION

(RBT GEN/E9 - ALL/FIN 2/SPN) Page 1 of 1 page

NOTE

1. The SSRMS must be unloaded.

2. A Calibrate command may be aborted by a ‘**SSRMS LEE LEU Mtr Velocity Runaway**’ Robotics Advisory message, and the MSS Safed if one of the three LEE mechanisms was initially located at the hardstop position. If Safing occurs, cancel Safing and restart this procedure from the beginning (SCR 20379).

PCS MSS: SSRMS: Tip LEE: SSRMS Tip LEE

cmd ‘LEE Mechanism’ – Calibrate

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, PCS commands should not be sent to Robotics equipment. If a configuration change is required, safe the system to exit LEE operations.

cmd Confirm (Verify Trigger Hot Icon)

NOTE

1. Apply safing to stop mechanism motion (SCR 23262, 28433).

2. Calibration might take up to 5 minutes, 40 seconds to complete.

RHC TRIGGER → press (momentarily)

PCS
Verify ‘Snare’ Open – blue
Verify ‘Carriage’ Extend – blue
Verify ‘Latch’ Unlatch – blue
Verify ‘LEE Mechanisms’ – Calibrated
Verify ‘Load Cell’ – Calibrated
Verify ‘Motors’ – Inh (340 s max)

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NOTE
The SSRMS must be unloaded to perform a LEE Checkout.

1. SETUP

DCP √BRAKES SSRMS ON – ☐

If SSRMS wrist configuration is not

WP	WY
-20.0	-170.0

Note current wrist configuration.

WP	WY

DCP BRAKES SSRMS → OFF (Verify OFF)

PCS MSS: SSRMS: SSRMS

√Vernier

input Mode – Single (Verify Single – 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 Maneuver to the following wrist configuration.

WP	WY
-20.0	-170.0

DCP BRAKES SSRMS → ON (Verify ON)

NOTE
1. The LEE mechanisms are now visible through the Tip Elbow camera.
2. If no LEE response is observed within 70 seconds of a command being issued, safe and reattempt (SPN 2045).

2. LEE SETUP FOR CAPTURE

PCS MSS: SSRMS: Tip LEE: SSRMS Tip LEE

√‘LEE Mechanisms’ – Calibrated

****
* If LEE Mechanisms – Not Calibrated
* | Perform {6.421 LEE CALIBRATION}, all (SODF: RBT GEN:
* | NOMINAL), then:
****

√'Setup' – Yes

****
* If 'Setup' – No
* | Perform {6.428 LEE SETUP FOR CAPTURE},
* | all (SODF: RBT GEN: NOMINAL), then:
****

3. SLOW(FAST) LEE CHECKOUT

NOTE
Checkout should be run with slow speed unless otherwise specified.

cmd Checkout ▶ Slow(Fast) (Verify 'Speed' – Slow(Fast))

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, PCS commands should not be sent to Robotics equipment. If a configuration change is required, safe the system to exit LEE operations.

cmd Confirm (Verify RHC Trigger Hot icon)

NOTE
Apply safing to stop mechanism motion (SPN 1892, 3160).

RHC TRIGGER → press (momentarily)

6.422 LEE CHECKOUT

(RBT GEN/E8 - ALL/FIN 2/SPN)

PCS	Verify ‘Snare’ Close	– blue (12 s(3 s) max)
	Verify ‘Carriage’ Retract	– blue (90 s(18 s)max)
	Verify ‘Latch’ Latch	– blue (65 s(13 s)max)
	Verify ‘Umbilical’ Mate	– blue (10 s max)
	Verify ‘Umbilical’ Demate	– blue (10 s max)
	Verify ‘Latch’ Unlatch	– blue (65 s(13 s) max)
	Verify ‘Carriage’ Derigidize	– blue (90 s(18 s) max)
	Verify ‘Snare’ Open	– blue (12 s(3 s) max)
	Verify ‘Carriage’ Extend	– blue (90 s(18 s) max)

4. RECONFIGURE WRIST

If wrist joints were reconfigured for the checkout

DCP BRAKES SSRMS → OFF (Verify OFF)

PCS MSS: SSRMS: SSRMS

√Vernier

input Mode – Single (Verify Single – 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 Maneuver back to original wrist configuration as recorded in step 1.

DCP BRAKES SSRMS → ON (Verify ON)

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6.423 AUTOMATIC CAPTURE

(RBT GEN/X2R4 - ALL/FIN 3/SPN) Page 1 of 3 pages

1. SETUP

PCS MSS: SSRMS: Tip LEE: SSRMS Tip LEE

√LEE Mechanisms – Calibrated

****
* If LEE Mechanisms – Not Calibrated
* | Perform {6.421 LEE CALIBRATION}, all
* | (SODF: RBT GEN: NOMINAL), then:
****

√Setup – Yes

****
* If Setup – No
* | Perform {6.428 LEE SETUP FOR CAPTURE},
* | all (SODF: RBT GEN: NOMINAL), then:
****

Prior to beginning payload capture, review {SSRMS LEE CUE CARD}, all (SODF: RBT GEN: REFERENCE}, then:

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

Configure cameras and overlays for grapple.

MSS: SSRMS: SSRMS

√Manual – blue
√Vernier

2. SLOW(FAST) CAPTURE COMMANDS

NOTE
Automatic Capture should be run with slow speed unless otherwise specified.

MSS: SSRMS: Tip LEE: SSRMS Tip LEE

cmd Capture ▶ Automatic ▶ Slow(Fast), Limp

Verify Speed – Slow(Fast)
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

3. GRAPPLE MANEUVER

RHC/THC Maneuver to within grapple envelope.

4. GRAPPLE

RHC TRIGGER → press (momentarily)

PCS Verify 'Snare' Close, Capture (two) – blue (12 s(3 s) max)

****
* If 'Snare' Capture – not blue
* | Perform {8.111 LEE MISCAPTURE}, all
* | (SODF: RBT GEN: CORRECTIVE), then:
* | If top choice performed >>
****

If capturing a PDGF
| Verify Capture to Latch – Yes (SCR 19282)

If capturing an FRGF
Verify Capture to Latch – No (SCR 19282)

Verify 'Carriage' Tension ~5500 N (90 s(24 s) max)
Verify 'Carriage' Retract – blue

If capturing an FRGF >>

Verify 'Latch' Latch – blue (65 s(13 s) max)

5. MATE UMBILICALS

If mating of the umbilicals is required

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. DERIGIDIZE CARRIAGE

If derigidization of the carriage is not required >>

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

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

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Derigidize

RHC TRIGGER → press (momentarily) (SCR 19064)

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

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6.424 AUTOMATIC RELEASE

(RBT GEN/E9 - ALL/FIN 4/SPN) Page 1 of 2 pages

1. VERIFY LEE CALIBRATION STATUS

PCS MSS: SSRMS: Tip LEE: SSRMS Tip LEE

If LEE Mechanisms – Not Calibrated

> Go to {8.103 MANUAL RELEASE WITH UNCALIBRATED LEE}, all (SODF: RBT GEN: CORRECTIVE).

2. ENTER MODE

DCP √BRAKES SSRMS OFF – ☐

PCS MSS: SSRMS: Limp: SSRMS Limp

cmd All Limp (Verify Limp – blue)

MSS: SSRMS: SSRMS

Verify All Joints – Limped

Wait 30 seconds.

MSS: SSRMS: Limp: SSRMS Limp

cmd None Limp (Verify Standby – blue)

Enter Mode – Manual (Verify blue)

√Vernier

3. RIGIDIZE CARRIAGE

PCS MSS: SSRMS: Tip LEE: SSRMS Tip LEE

If 'Latch' Latch – blue and 'Carriage' Tension < 2891 N

> **cmd** 'Carriage' Rigidize ▶ Slow (Verify Speed – Slow)
>
> Verify '**Confirm or Terminate**' prompt.
>
> **CAUTION**
>
> Due to end-to-end system latency, the RHC Trigger is hot up to 3 seconds prior to receiving a Trigger Hot icon status on the PCS.
>
> NOTE
>
> Once the trigger is hot, only safing or trigger commands should be sent to the Robotics equipment. If a configuration change is required, including routing MSS cameras, safe the system to exit LEE operations (SCR 23262, 14662).
>
> **cmd** Confirm (Verify RHC Trigger Hot icon)
>
> Verify LEE Mode – Rigidize
>
> RHC TRIGGER → press (momentarily) (SCR 19064)
>
> PCS Verify 'Carriage' Tension ~5500 N (~8 s, 90 s max)
> Verify 'Carriage' Retract – blue

4. SLOW(FAST) RELEASE

NOTE
Automatic Release should be run with slow speed unless otherwise specified.

PCS **cmd** Release ▶ Automatic ▶ Slow(Fast) (Verify Speed – Slow(Fast))

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

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

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

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Auto Release

RHC TRIGGER → press (momentarily)

PCS Verify ‘Umbilical’ Demate – blue (10 s max)
Verify ‘Latch’ Unlatch – blue (65 s(13 s) max)
Verify ‘Carriage’ Derigidize – blue (90 s(24 s) max)
Verify ‘Snare’ Open – blue (12 s(3 s) max)

THC Back off from grapple fixture until clear of pin.

PCS Verify ‘Carriage’ Extend – blue (90 s(24 s) max)

6.425 SEMI-MANUAL CAPTURE

(RBT GEN/X2R4 - ALL/FIN 3/SPN) Page 1 of 3 pages

1. SETUP

PCS MSS: SSRMS: Tip LEE: SSRMS Tip LEE

√LEE Mechanisms – Calibrated

****

* If LEE Mechanisms – Not Calibrated
* | Perform {6.421 LEE CALIBRATION}, all
* | (SODF: RBT GEN: NOMINAL), then:

****

√Setup – Yes

****

* If Setup – No
* | Perform {6.428 LEE SETUP FOR CAPTURE},
* | all (SODF: RBT GEN: NOMINAL), then:

****

Prior to beginning payload capture, review {SSRMS LEE CUE CARD}, all (SODF: RBT GEN: REFERENCE}, then:

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

Configure cameras and overlays for grapple.

MSS: SSRMS: SSRMS

√Manual – blue
√Vernier

2. SLOW(FAST) CAPTURE COMMANDS

NOTE
Semi-manual Capture should be run with slow speed, unless otherwise specified.

MSS: SSRMS: Tip LEE: SSRMS Tip LEE

cmd Capture ▶ Semi-manual ▶ Slow(Fast), Limp

Verify Speed – Slow(Fast)
Verify ‘**Confirm or Terminate**’ prompt.

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

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

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Semi-manual Capture

3. GRAPPLE MANEUVER

RHC/ THC Maneuver to within grapple envelope.

4. GRAPPLE

RHC TRIGGER → press (hold until ‘Snare’ Brakes – On) (12 s(3 s) max)

PCS Verify ‘Snare’ Close, Capture (two) – blue

****
* If ‘Snare’ Capture – not blue
* Perform {8.111 LEE MISCAPTURE}, all
* (SODF: RBT GEN: CORRECTIVE), then:
* If top choice performed >>
****

If capturing a PDGF
Verify Capture to Latch – Yes (SCR 19282)

If capturing an FRGF
Verify Capture to Latch – No (SCR 19282)

RHC TRIGGER → press (hold until ’Carriage’ Brakes – On) (90 s(24 s) max)

PCS Verify ‘Carriage’ Tension ~5500 N (90 s(24 s) max)
Verify ‘Carriage’ Retract – blue

If capturing an FRGF >>

RHC TRIGGER → press (hold until ‘Latch’ Brakes – On) (65 s(13 s) max)

PCS Verify ‘Latch’ Latch – blue

5. MATE UMBILICALS

If mating of the umbilicals is required

PCS | **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. DERIGIDIZE CARRIAGE

If derigidization of the carriage is not required >>

cmd ‘Carriage’ Derigidize ▶ Slow (Verify Speed – Slow)

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

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Derigidize

RHC TRIGGER → press (momentarily) (SCR 19064)

PCS Verify ‘Carriage’ Derigidize – blue (90 s max)

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6.426 SEMI-MANUAL RELEASE

(RBT GEN/E9 - ALL/FIN 4/SPN) Page 1 of 3 pages

1. VERIFY LEE CALIBRATION STATUS

PCS MSS: SSRMS: Tip LEE: SSRMS Tip LEE

If LEE Mechanisms – Not Calibrated

> Go to {8.103 MANUAL RELEASE WITH UNCALIBRATED LEE}, all (SODF: RBT GEN: CORRECTIVE).

2. ENTER MODE

DCP √BRAKES SSRMS OFF – ☐

PCS MSS: SSRMS: Limp: SSRMS Limp

cmd All Limp (Verify Limp – blue)

MSS: SSRMS: SSRMS

Verify All Joints – Limped

Wait 30 seconds.

MSS: SSRMS: Limp: SSRMS Limp

cmd None Limp (Verify Standby – blue)

Enter Mode – Manual (Verify blue)

√Vernier

3. RIGIDIZE CARRIAGE

PCS MSS: SSRMS: Tip LEE: SSRMS Tip LEE

If ‘Latch’ Latch – blue and ‘Carriage’ Tension < 2891 N

> **cmd** ‘Carriage’ Rigidize ▶ Slow (Verify Speed – Slow)
>
> Verify ‘**Confirm or Terminate**’ prompt.
>
> **CAUTION**
>
> Due to end-to-end system latency, the RHC Trigger is hot up to 3 seconds prior to receiving a Trigger Hot icon status on the PCS.
>
> NOTE
>
> Once the trigger is hot, only safing or trigger commands should be sent to the Robotics equipment. If a configuration change is required, including routing MSS cameras, safe the system to exit LEE operations (SCR 23262, 14662).

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Rigidize

RHC TRIGGER → press (momentarily) (SCR 19064)

PCS Verify ‘Carriage’ Tension ~5500 N (~8 s, 90 s max)
Verify ‘Carriage’ Retract – blue

4. SLOW(FAST) RELEASE

> NOTE
> Semi-manual Release should be run with slow speed unless otherwise specified.

cmd Release ▶ Semi-manual ▶ Slow(Fast) (Verify Speed – Slow(Fast))

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

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

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

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Semi-manual Release

If ‘Umbilical’ Mate – blue

RHC TRIGGER → press (hold until ’Latch’ Brakes – On) (10 s max)

PCS Verify ‘Umbilical’ Demate – blue

PCS If ‘Latch’ Latch – blue
RHC TRIGGER → press (hold until ‘Latch’ Brakes – On) (65 s(13 s) max)

PCS Verify ‘Latch’ Unlatch – blue

TRIGGER → press (hold until ‘Carriage’ Brakes – On) (90 s(24 s) max)

PCS Verify ‘Carriage’ Derigidize – blue

TRIGGER → press (hold until ‘Snare’ Brakes – On) (12 s(3 s) max)

6.426 SEMI-MANUAL RELEASE

(RBT GEN/E9 - ALL/FIN 4/SPN) Page 3 of 3 pages

PCS	Verify ‘Snare’ Open – blue
THC	Back off from grapple fixture until clear of pin.
RHC	TRIGGER → press (hold until ‘Carriage’ Brakes – On) (90 s(24 s) max)
PCS	Verify ‘Carriage’ Extend – blue

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6.427 FORCE MOMENT SENSOR (FMS) CALIBRATION

(RBT GEN/R2 - ALL/FIN) Page 1 of 1 page

> NOTE
>
> When performing an FMS calibration:
>
> 1. The SSRMS tip or grappled payload should not be in contact with the structure.
>
> 2. The SSRMS should be Safed, Braked, in Standby mode or in Position Hold.
>
> 3. Observed SSRMS dynamic oscillations should be negligible.

1. THRUSTER INHIBIT

PCS MSS: SSRMS: Thrusters: Thruster Controls for MSS Ops

cmd 'Desat Request' Inhibit (Verify Inh)

2. FMS CALIBRATION

MSS: SSRMS: Tip LEE: SSRMS Tip LEE

cmd 'FMS' Calibrate (Verify Calibrated)

3. THRUSTER ENABLE

MSS: SSRMS: Thrusters: Thruster Controls for MSS Ops

cmd 'Desat Request' Enable (Verify Ena)

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6.428 LEE SETUP FOR CAPTURE

(RBT GEN/E8 - ALL/FIN 2/SPN) Page 1 of 1 page

NOTE
The SSRMS must be unloaded.

PCS MSS: SSRMS: Tip LEE: SSRMS Tip LEE

If Setup – Yes >>

cmd Capture ▶ Setup ▶ 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 (SPN 1892, 3160).

cmd Confirm (Verify Trigger Hot icon)

Verfiy LEE Mode – Setup for Capture

RHC TRIGGER → press (momentarily)

PCS Verify ‘Snare’ Open – blue
Verify ‘Carriage’ Extend – blue
Verify ‘Latch’ Unlatch – blue
Verify Motors – Inh (340 s max)

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6.431 SSRMS POWERUP FROM OFF TO KEEP-ALIVE ON BOTH STRINGS I

(RBT GEN/X2R4 - ALL/FIN) Page 1 of 1 page

1. BASE LOCATION CHECK

PCS MSS: SSRMS: SSRMS

Verify ‘Base LEE’ Base LEE – as required
Verify ‘Base LEE’ PDGF – as required

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

2. TRANSITION PRIME STRING TO KEEP-ALIVE

MSS: SSRMS: Power: SSRMS Power

cmd ‘SSRMS’ Prime – Keep-Alive (Verify Keep-Alive)

3. TRANSITION REDUNDANT STRING TO KEEP-ALIVE

MSS: SSRMS: Power: SSRMS Power

cmd ‘SSRMS’ Redundant – Keep-Alive (Verify Keep-Alive)

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6.434 SSRMS POWERDOWN TO OFF ON BOTH STRINGS

(RBT GEN/X2R4 - ALL/FIN 1/SCR) Page 1 of 1 page

> NOTE
>
> The SSRMS should not be left with both strings in the Off state for extended periods due to thermal constraints.

1. SAFING STATUS CHECK

PCS MSS: SSRMS: Power: SSRMS Power

If ‘SSRMS’ Prime or Redundant – Operational

MSS: SSRMS: SSRMS

√’SSRMS Safing’ – Safed

2. TRANSITION PRIME STRING TO OFF

MSS: SSRMS: Power: SSRMS Power

If ‘SSRMS’ Prime not Off

> NOTE
>
> 1. It might take up to 30 seconds for the Off status indication to appear on the PCS.
> 2. Expect the ‘**R1E - MSS Active OCS SSRMS Prime ACU SRT Comm Fail**’ Robotics Advisory message (SCR 17730).
> 3. If the SSRMS is Operational, expect the ‘**R1E - CUP(LAB) RWS CEU PLB (MLB) ACU Cmd Resp Sync Msg Err**’ Robotics Advisory message (SCR 31294).

cmd ‘SSRMS’ Prime – Off (Verify – Off)

3. TRANSITION REDUNDANT STRING TO OFF

If ‘SSRMS’ Redundant not Off

> NOTE
>
> 1. It might take up to 30 seconds for the Off status indication to appear on the PCS.
> 2. Expect the ‘**R1E - MSS Active OCS SSRMS Redun ACU SRT Comm Fail**’ Robotics Advisory message (SCR 17730).
> 3. If the SSRMS is Operational, expect the ‘**R1E - CUP(LAB) RWS CEU PLB (MLB) ACU Cmd Resp Sync Msg Err**’ Robotics Advisory message (SCR 31294).

cmd ‘SSRMS’ Redundant – Off (Verify – Off)

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6.435 SSRMS OPERATING BASE CHANGE

(RBT GEN/R2 - ALL/FIN) Page 1 of 1 page

1. SSRMS POWER STATE CHECK

PCS MSS: SSRMS: Power: SSRMS Power

√Prime – Off
√Redundant – Off

2. BASE CHANGE

MSS: SSRMS: SSRMS

If Base LEE – A

MSS: SSRMS: Base LEE: Base

cmd B

MSS: SSRMS: SSRMS

Verify Base LEE – B

If Base LEE – B

MSS: SSRMS: Base LEE: Base

cmd A

MSS: SSRMS: SSRMS

Verify Base LEE – A

3. PDGF CHECK

Verify PDGF – as required

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6.604 CUP(LAB) ARTIFICIAL VISION UNIT (AVU) POWERUP

(RBT GEN/R2 - ALL/FIN)   Page 1 of 2 pages

1. VIDEO SETUP

DCP   'MONITOR SELECT'

cmd MON [X] where X = 1 | 2 | 3

Verify MON [X] – ☐

cmd 'CAMERA SELECT' 9,5

MON [X]   Verify Test Pattern.

Repeat

2. AVU POWERUP

LCDM   √Power On

PCS   MSS: LAS5(LAP5) AVU: LAS5(LAP5) AVU

cmd 'Power' On

NOTE
AVU bootup could take up to 4 minutes.

LCDM   Observe AVU bootup sequence.

3. CHECKING POWER STATUS

PCS   MSS: RWS

Verify 'LAS5'('LAP5') 'RPC3' – closed (blue)
Verify 'LAS5'('LAP5') 'Status from OCS' – On

4. SWITCHING LCDM MODE

LCDM
cmd MENU (Verify Brightness)
cmd UP (Verify Video Mode)
cmd SELECT (Verify RGB)
cmd UP (Verify COMPOSITE)
cmd SELECT

Verify AVU Systems Display appears.

NOTE
Where applicable, AVU Hotkeys are shown in the following manner: <hotkey>.

5. CHECKING AVU SYSTEM CONFIGURATION

LCDM/
MON1

International Space Station
Space Vision System

cmd OK <Alt-O> (window closes automatically in ~8 seconds)

‘Message’

Verify messages
- ‘**AVU: 1553 COMMUNICATION GROUND TELEMETRY RESTORED**’
- ‘**AVU: 1553 COMMUNICATION GROUND TELEMETRY SEND FAILED**’
- ‘**SYNC SIGNAL DETECTED ON VIDEO INPUT CHANNEL 2**’
- ‘**SYNC SIGNAL DETECTED ON VIDEO INPUT CHANNEL 1**’

NOTE
‘GMT EXTRACTION UNAVAILABLE, VID IN 1’ AVU system message may also appear in the AVU Message queue.

sel Clear All <Alt-L>
cmd Clear <Alt-L>

If new AVU hardware or software installed since last powerup

> Space Vision System
>
> **cmd** Advanced <Alt-A>
>
> sel Help <Alt-H> ▶ About SVS <A>
>
> International Space Station
> Space Vision System
>
> Verify ‘Software Version:’ as required.
> Verify ‘Systems Display Version:’ as required.
> Verify ‘Database File:’ - svs.dat
> Verify ‘Database ID:’ as required.
>
> **cmd** OK <Alt-O>
>
> sel View <Alt-V> ▶ Advisory Page <Alt-A>

6.607 CUP(LAB) ARTIFICIAL VISION UNIT (AVU) CHECKOUT WITH VTR 2(1)

(RBT GEN/R2 - ALL/FIN)   Page 1 of 5 pages

1. VIDEO SETUP

PCS   MSS: Video: SCU1: SCU1 Function: SCU1 Func

cmd ‘SCU Function Control’ ‘Split Screen Processor’ Inhibit (Verify Inhibit)
cmd ‘SCU Function Control’ ‘Time Base Correction’ Enable (Verify Enable)

> NOTE
> Messages may appear in the message queue on the AVU Systems display when changing video inputs to the AVU.

DCP   **cmd** ‘MONITOR SELECT’ MON1 (Verify ☐)
cmd ‘MULTIPLEX UNIT’ MUX A RIGHT (Verify ☐)
cmd ‘CAMERA SELECT’ 9,2(1)
cmd ‘MONITOR SELECT’ MON3 (Verify ☐)
cmd ‘CAMERA SELECT’ 9,3

2. VTR SETUP

Get AVU Checkout Videotape from storage location.

VTR2(1)   Unlock and open cassette door.
Insert videotape.
Close and lock cassette door.

√Local/Remote button – Remote

PCS   MSS: Video: VTR2(1): Video Tape Recorder 2(1)

Verify ‘Tape Status’ Cassette In – Detected

sel ‘VTR Control’ Mode
cmd PLAY (Verify ‘VTR Operation Mode’ Play)

MON3   Verify wiretray targets are visible.

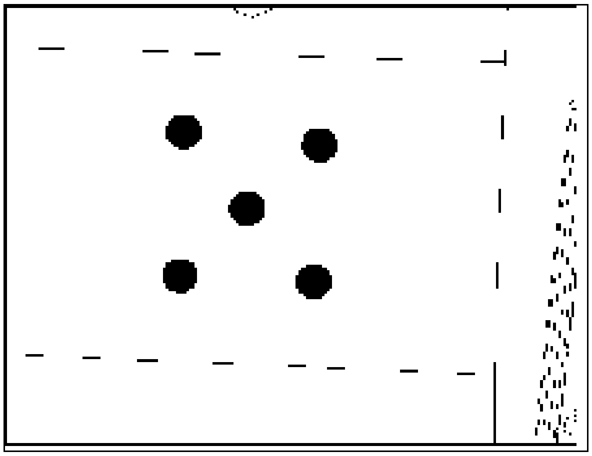

Figure 1.- Wiretray Targets.

NOTE

1. Where applicable, AVU Keyboard Hotkeys are shown in the following manner: <hotkey>.

2. If systems display disappears completely, triple-click the right button on the keyboard trackball or the bottom button on the AVU CCD to make the systems display appear on all outputs.

3. LOADING VIDEO ROUTING CHECKOUT SCRIPT FILE

NOTE
Perform step 3 using keyboard trackball only.

LCDM **cmd** Browse

sel/csvs/scripts/AVU/051_Routing_Checkout.act
cmd Load (script proceeds to ‘**12: READY (P)**’)

NOTE
Perform steps 4 to 11 using keyboard shortcuts only.

Required Operator Action

4. **cmd** Start <Alt-S> (script proceeds to ‘**22: VERIFY VIDEO CONFIG 1 (P)**’)

√Video configuration:

MON 1	MON 2	LCDM
VTR	Test pattern	Sys Disp

5. **cmd** Start <Alt-S> (script proceeds to ‘**33: VERIFY VIDEO CONFIG 2 (P)**’)

√Video configuration:

MON 1	MON 2	LCDM
Test Pattern	Sys Disp	VTR

MON2 6. **cmd** Start <Alt-S> (script proceeds to ‘**44: VERIFY VIDEO CONFIG 3 (P)**’)

√Video configuration:

MON 1	MON 2	LCDM
Sys Disp	VTR	Steer Disp

MON1 7. **cmd** Start <Alt-S> (script proceeds to ‘**55: VERIFY VIDEO CONFIG 4 (P)**’)

√Video configuration:

MON 1	MON 2	LCDM
Sys Disp	Steer Disp	Test pattern

8. **cmd** Start <Alt-S> (script proceeds to ‘**65: VERIFY VIDEO CONFIG 5 (P)**’)

√Video configuration:

MON 1	MON 2	LCDM
Enh Test pattern	VTR	Sys Disp

LCDM 9. **cmd** Start <Alt-S> (script proceeds to ‘**76: VERIFY VIDEO CONFIG 6 (P)**’)

√Video configuration:

MON 1	MON 2	LCDM
Enh VTR	VTR	Sys Disp

10. **cmd** Start <Alt-S> (script proceeds to ‘**85: VERIFY VIDEO CONFIG 7 (P)**’)

√Video configuration:

MON 1	MON 2	LCDM
Steer Disp	VTR	Sys Disp

11. **cmd** Start <Alt-S> (script proceeds to ‘**97: --------END--------**’)

12. LOADING AVU CHECKOUT SCRIPT FILE

NOTE
Perform steps 12 to 16 using AVU trackball only.

cmd Browse

sel/csvs/scripts/AVU/052_AVU_Checkout.act
cmd Load (script proceeds to ‘**22: READY (P)**’)

		Required Operator Action
LCDM MON1	13.	**cmd** Start <Alt-S> (script proceeds to ‘**33: CHECK PRESET WINDOWS (P)**’) Verify windows over targets (centered not required)
LCDM MON1	14.	**cmd** Start <Alt-S> (script proceeds to ‘**94: CHECK TRACKING WINDOWS (P)**’) ** * If script proceeds to ‘**78: ACQUIRE MANUALLY (P)**’ * Go to step 20. ** Verify ‘Window Tracking Status:’ is green for all ‘Task 1:’ windows. Verify windows tracking targets correctly.
LCDM	15.	**cmd** Start <Alt-S> (script proceeds to ‘**104: CHECK TASK 1 IN RUN (P)**’) Verify ‘Task 1:’ is in run (green).
LCDM	16.	**cmd** Start <Alt-S> (script proceeds to ‘**123: ------ END ------**’)

17. TESTING PATTERN ROUTING

NOTE
Messages may appear in the message queue on the AVU Systems Display when changing video inputs to the AVU.

DCP   **cmd** ‘MONITOR SELECT’ MON1 (Verify ☐)
cmd ‘CAMERA SELECT’ 9,5

18. VTR STOP

PCS   MSS: Video: VTR2(1): Mode: VTR2(1) Mode

cmd STOP (Verify ‘VTR Operation Mode’ Stop)
cmd Rewind (Verify ‘VTR Operation Mode’ Rewind)

When tape is fully rewound
  Verify ‘VTR Operation Mode’ – Unthread

VTR2(1)   Unlock and open cassette door.
Remove Videotape.
Close and lock cassette door.

√Local/Remote button – Remote

Return AVU Checkout Videotape to storage location.

19. SCU RECONFIGURATION

PCS MSS: Video: SCU1: SCU1 Function: | SCU1 Func |

cmd ‘SCU Function Control’ ‘Time Base Correction’ Inhibit (Verify Inhibit)
cmd ‘SCU Function Control’ ‘Split Screen Processor’ Enable (Verify Enable)

20. AVU MANUAL TARGET ACQUISITION

If manual target acquisition is required per step 14

LCDM **cmd** Advanced <Alt-A>

√‘Task:’ Cam B Aim – Enabled (blue) <F9>
√‘Task:’ Cam B Aim – Hold (white)

Cam B Aim: Tgt Acq: | Tgt Acq | <F3>

√‘TDH Mode:’ – None <Alt-D>

cmd ‘Tgt Acq’ Manual <Alt-M>

MON1(2) Acquire targets in order per picture.

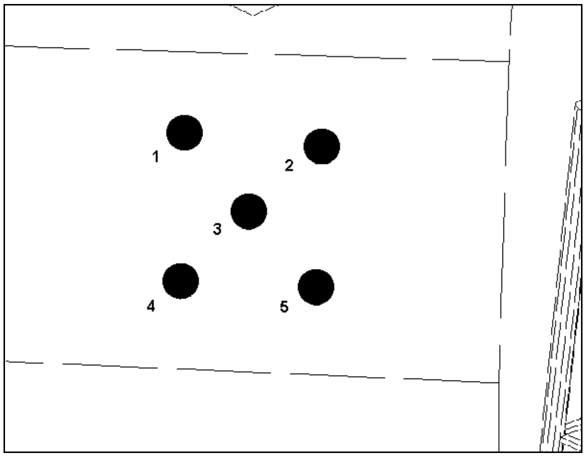

Figure 2.- Wiretray Target with Acquisition Order.

Exit acquisition mode (double-click button 3).

LCDM sel View <Alt-V> ▶ Advisory Page <Alt-A>

Perform step 14 again.

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6.608 CUP(LAB) ARTIFICIAL VISION UNIT (AVU) DATABASE LOAD

(RBT GEN/R2 - ALL/FIN 1)   Page 1 of 1 page

> NOTE
>
> Where applicable, AVU Keyboard Hotkeys are shown in the following manner: <hotkey>.

1. DATABASE LOAD

MON2 Verify Steering Display has yellow Hold symbol.

LCDM Space Vision System

cmd Advanced <Alt-A>

sel File <Alt-F> ▶ Load Database
cmd Don't Save

Database File Selector

sel file as required
cmd Load

2. DATABASE LOAD VERIFICATION

Space Vision System
'Db File:'

Verify file as previously selected.

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6.609 CUP(LAB) ARTIFICIAL VISION UNIT (AVU) POWERDOWN

(RBT GEN/R2 - ALL/FIN 1) Page 1 of 1 page

> NOTE
> Where applicable, AVU Keyboard Hotkeys are shown in the following manner: “hotkey”.

1. AVU SHUTDOWN

Verify system is in Hold.

LCDM

Space Vision System

cmd Advanced [Alt-A]

sel File [Alt-F] ▶ Exit
cmd Don’t Save
cmd Shutdown

AVU KYBD

In the QNX shell on the LCDM, input – phshutdown

cmd Enter

LCDM

Verify ‘**System may now be powered down**’ message appears.

2. SWITCH LCDM MODE

LCDM

cmd MENU (Verify Brightness)
cmd UP (Verify Video Mode)
cmd SELECT (Verify COMPOSITE)
cmd UP (Verify RGB)
cmd SELECT

3. AVU POWERDOWN

PCS

MSS: LAS5(LAP5) AVU: LAS5(LAP5) AVU

> NOTE
> Expect two ‘**R1E - MSS Active OCS AVU Comm Fail**’ Robotics Advisory messages after commanding AVU to Off. Both messages should return to Norm (SPN 1175).

cmd ‘Power’ Off

4. POWER STATUS

PCS

MSS: RWS

Verify ‘LAS5’(‘LAP5’) RPC3 – Open (gray)
Verify ‘LAS5’(‘LAP5’) Status from OCS – Off

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6.617 MSS VIDEO DEROUTING

(RBT GEN/ULF1 - ALL/FIN) Page 1 of 1 page

PCS MSS: Video: Trunkline Usage: Trunkline Usage
‘MSS Trunkline’

sel MSS Trunkline [X]

where [X] = 1 2 3 4 5 6 7 8 9

MSS Trunkline [X]

Note all destinations with “√.”

MSS: Video: Video Overview: Video Overview

Repeat the following for all destinations noted
sel Destination icon

[Destination name]

cmd ‘Deroute Video Signal’ Deroute

Repeat

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MALFUNCTION

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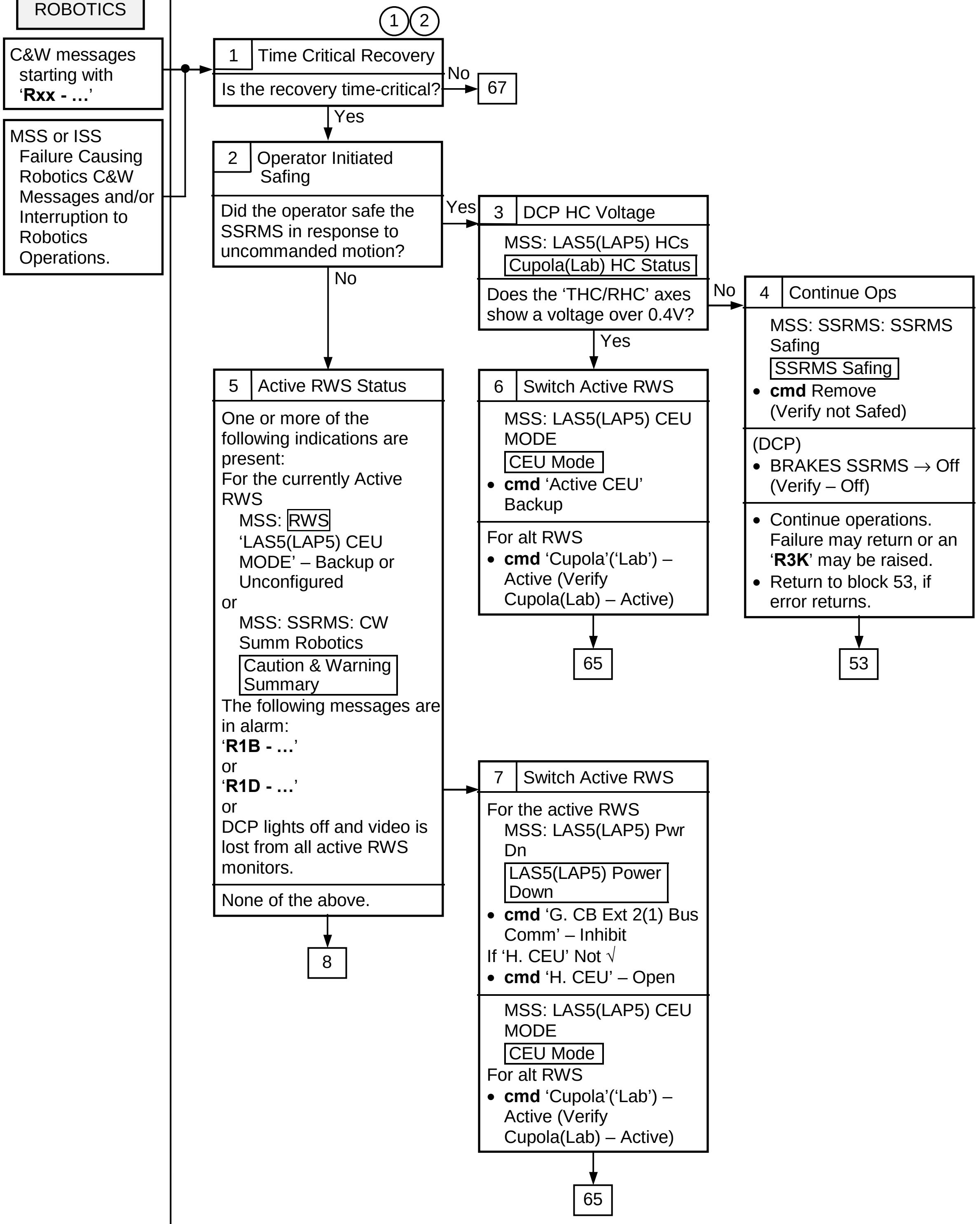
7.001 MSS FAILURE RESPONSE AND RECOVERY

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 1 of 26 pages

C&W
ROBOTICS



C&W messages starting with ‘**Rxx - …**’

MSS or ISS Failure Causing Robotics C&W Messages and/or Interruption to Robotics Operations.

1 Time Critical Recovery

Is the recovery time-critical?

2 Operator Initiated Safing

Did the operator safe the SSRMS in response to uncommanded motion?

3 DCP HC Voltage

MSS: LAS5(LAP5) HCs
Cupola(Lab) HC Status

Does the ‘THC/RHC’ axes show a voltage over 0.4V?

4 Continue Ops

MSS: SSRMS: SSRMS Safing
SSRMS Safing
- **cmd** Remove
(Verify not Safed)

(DCP)
- BRAKES SSRMS → Off
(Verify – Off)

- Continue operations. Failure may return or an ‘**R3K**’ may be raised.
- Return to block 53, if error returns.

5 Active RWS Status

One or more of the following indications are present:
For the currently Active RWS
MSS: RWS
‘LAS5(LAP5) CEU MODE’ – Backup or Unconfigured
or
MSS: SSRMS: CW Summ Robotics
Caution & Warning Summary
The following messages are in alarm:
‘**R1B - …**’
or
‘**R1D - …**’
or
DCP lights off and video is lost from all active RWS monitors.

None of the above.

6 Switch Active RWS

MSS: LAS5(LAP5) CEU MODE
CEU Mode
- **cmd** ‘Active CEU’ Backup

For alt RWS
- **cmd** ‘Cupola’(‘Lab’) – Active (Verify Cupola(Lab) – Active)

7 Switch Active RWS

For the active RWS
MSS: LAS5(LAP5) Pwr Dn
LAS5(LAP5) Power Down
- **cmd** ‘G. CB Ext 2(1) Bus Comm’ – Inhibit

If ‘H. CEU’ Not √
- **cmd** ‘H. CEU’ – Open

MSS: LAS5(LAP5) CEU MODE
CEU Mode
For alt RWS
- **cmd** ‘Cupola’(‘Lab’) – Active (Verify Cupola(Lab) – Active)

①
Unless otherwise indicated, all displays in the procedures are on the PCS.

②
Time-critical recovery is intended to regain MSS functionality (SSRMS motion capability) in situations where immediate operator response is required to ensure the safety of the crew, ISS, or a visiting vehicle. Time-critical recovery can be performed by the on-orbit crew without assistance from the ground.

Time-critical recovery steps do not account for MT, LEE or any MBS mechanism failures.

Time-critical recovery assumes the MSS is configured as follows:

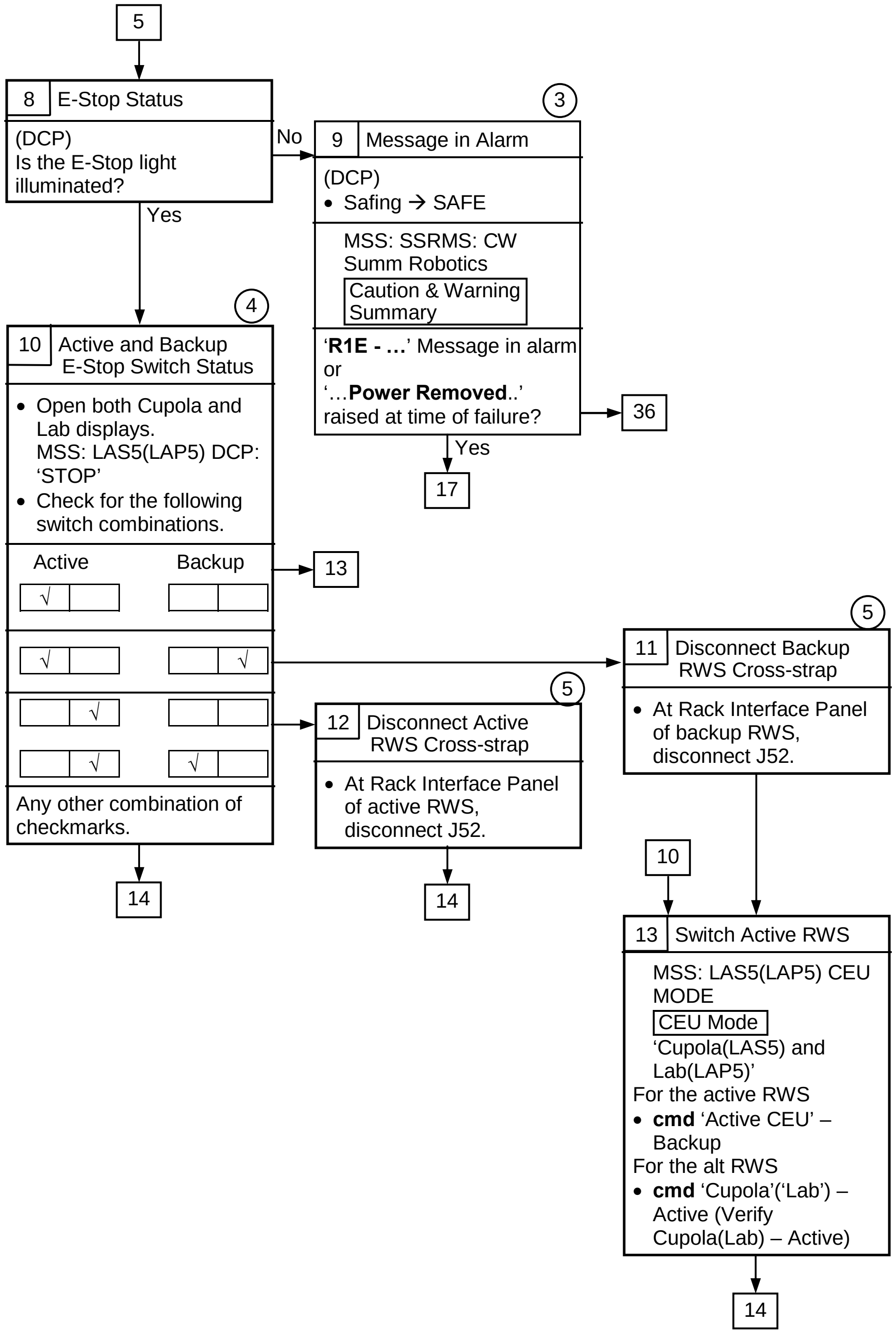
One RWS Backup

One RWS Active

SSRMS Operational with video system powered

MBS Operational on one string with video system powered, Keep-Alive on the other.

7.001 MSS FAILURE RESPONSE AND RECOVERY



8 E-Stop Status

(DCP)
Is the E-Stop light illuminated?

9 Message in Alarm

(DCP)
- Safing → SAFE

MSS: SSRMS: CW Summ Robotics
Caution & Warning Summary

‘**R1E - …**’ Message in alarm or ‘…**Power Removed**..’ raised at time of failure?

10 Active and Backup E-Stop Switch Status

- Open both Cupola and Lab displays.
  MSS: LAS5(LAP5) DCP: ‘STOP’
- Check for the following switch combinations.

Active		Backup	
√			
√			√
	√		
	√	√	

Any other combination of checkmarks.

11 Disconnect Backup RWS Cross-strap

- At Rack Interface Panel of backup RWS, disconnect J52.

12 Disconnect Active RWS Cross-strap

- At Rack Interface Panel of active RWS, disconnect J52.

13 Switch Active RWS

MSS: LAS5(LAP5) CEU MODE
CEU Mode
‘Cupola(LAS5) and Lab(LAP5)’

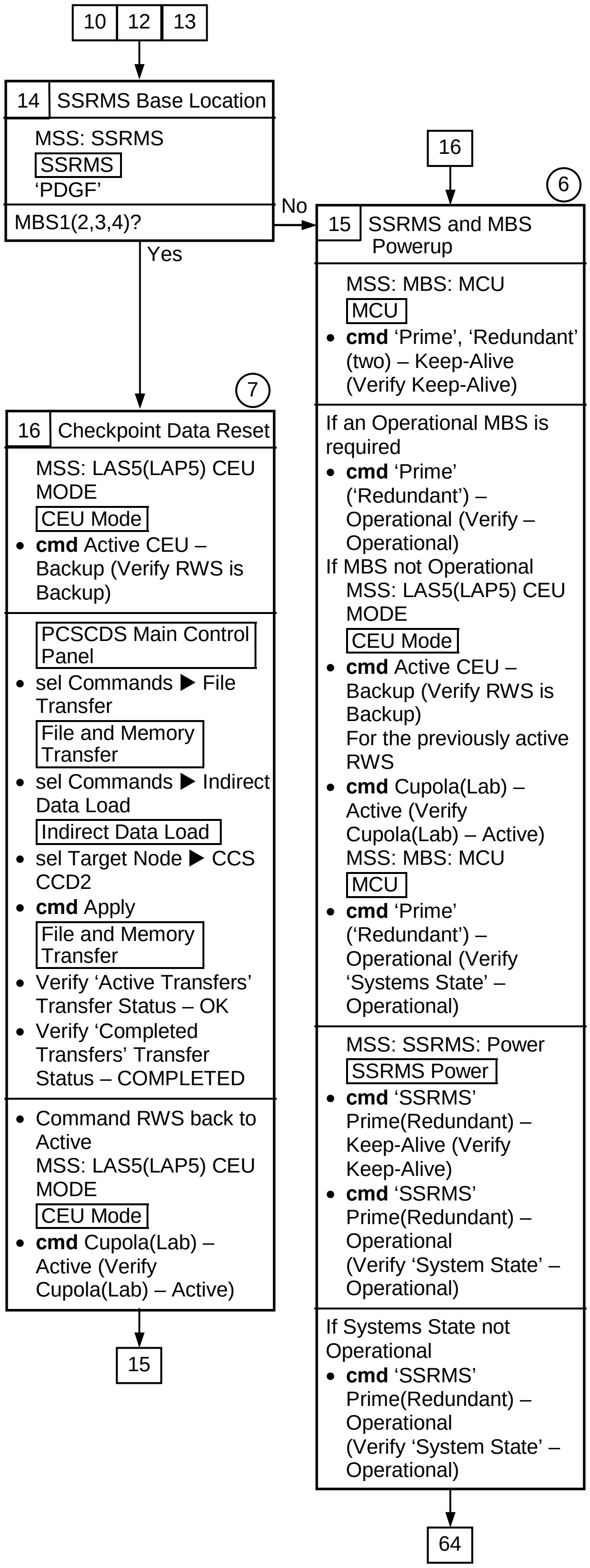
For the active RWS
- **cmd** ‘Active CEU’ – Backup

For the alt RWS
- **cmd** ‘Cupola’(‘Lab’) – Active (Verify Cupola(Lab) – Active)

③
SCR 22615, 23233, 19378, 21737

④
The E-Stop Reset command is not issued in this procedure to prevent removal of power in case of failed E-stop switch contact on either the Active or Backup RWS.

⑤
Cross-strap disconnect inhibits ability of backup RWS to safe system via backup RWS safing switch. E-stop still functional at failed RWS.



10 12 13

14 SSRMS Base Location

MSS: SSRMS
SSRMS
‘PDGF’

MBS1(2,3,4)?

Yes

No

16 Checkpoint Data Reset ⑦

MSS: LAS5(LAP5) CEU MODE
CEU Mode
- **cmd** Active CEU – Backup (Verify RWS is Backup)

PCSCDS Main Control Panel
- sel Commands ▶ File Transfer

File and Memory Transfer
- sel Commands ▶ Indirect Data Load

Indirect Data Load
- sel Target Node ▶ CCS CCD2
- **cmd** Apply

File and Memory Transfer
- Verify ‘Active Transfers’ Transfer Status – OK
- Verify ‘Completed Transfers’ Transfer Status – COMPLETED

- Command RWS back to Active

MSS: LAS5(LAP5) CEU MODE
CEU Mode
- **cmd** Cupola(Lab) – Active (Verify Cupola(Lab) – Active)

15

16

15 SSRMS and MBS Powerup ⑥

MSS: MBS: MCU
MCU
- **cmd** ‘Prime’, ‘Redundant’ (two) – Keep-Alive (Verify Keep-Alive)

If an Operational MBS is required
- **cmd** ‘Prime’ (‘Redundant’) – Operational (Verify – Operational)

If MBS not Operational
MSS: LAS5(LAP5) CEU MODE
CEU Mode
- **cmd** Active CEU – Backup (Verify RWS is Backup)

For the previously active RWS
- **cmd** Cupola(Lab) – Active (Verify Cupola(Lab) – Active)

MSS: MBS: MCU
MCU
- **cmd** ‘Prime’ (‘Redundant’) – Operational (Verify ‘Systems State’ – Operational)

MSS: SSRMS: Power
SSRMS Power
- **cmd** ‘SSRMS’ Prime(Redundant) – Keep-Alive (Verify Keep-Alive)
- **cmd** ‘SSRMS’ Prime(Redundant) – Operational (Verify ‘System State’ – Operational)

If Systems State not Operational
- **cmd** ‘SSRMS’ Prime(Redundant) – Operational (Verify ‘System State’ – Operational)

64

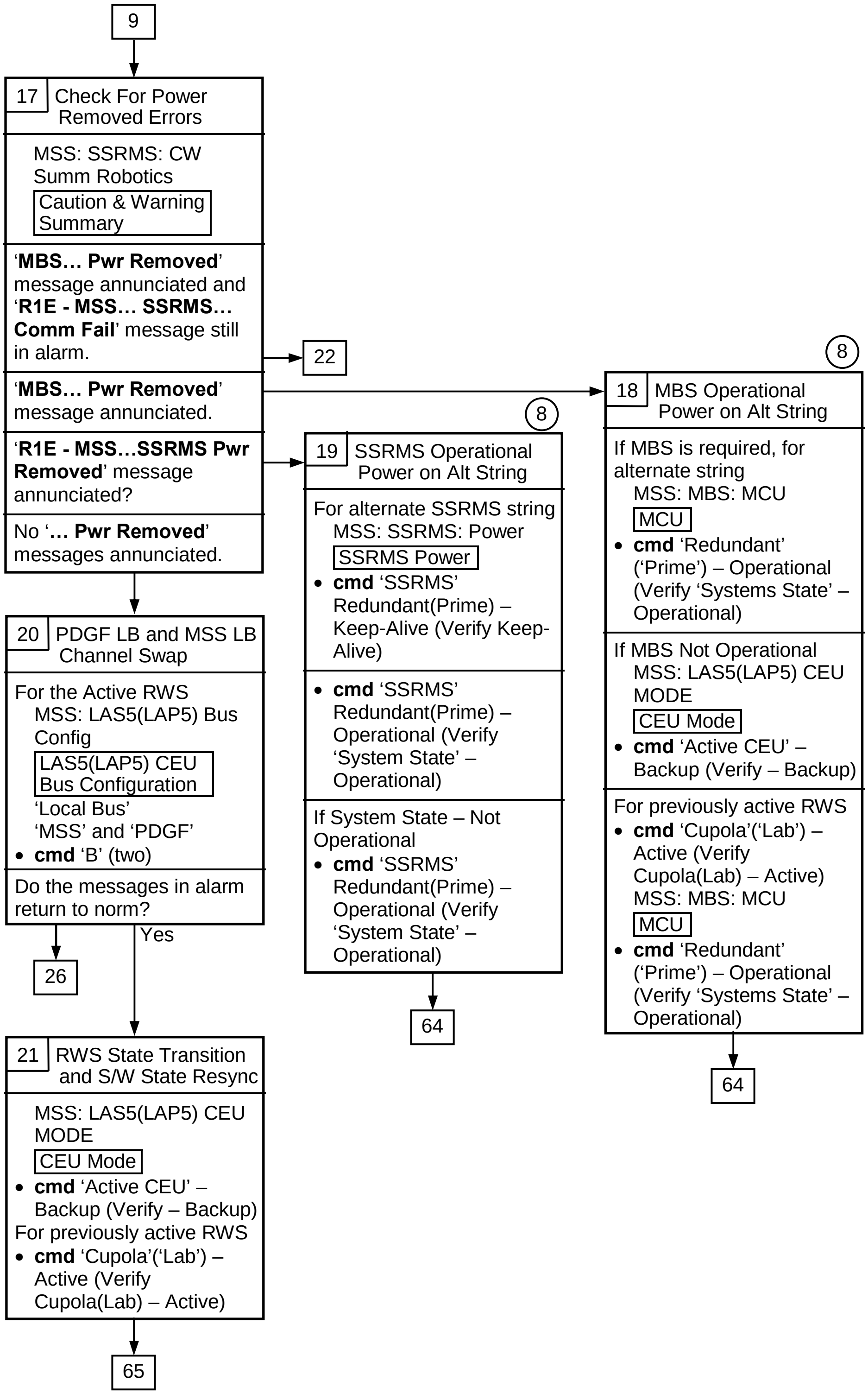
⑥
Power up the previously operational strings.

Due to a known SPN condition (SCR 20380), the MBS and SSRMS power to operational commands may not complete after the first attempt.

⑦
SCR 21749

7.001 MSS FAILURE RESPONSE AND RECOVERY

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 4 of 26 pages



17 Check For Power Removed Errors

MSS: SSRMS: CW Summ Robotics
Caution & Warning Summary

'**MBS… Pwr Removed**' message annunciated and '**R1E - MSS… SSRMS… Comm Fail**' message still in alarm.

'**MBS… Pwr Removed**' message annunciated.

'**R1E - MSS…SSRMS Pwr Removed**' message annunciated?

No '**… Pwr Removed**' messages annunciated.

20 PDGF LB and MSS LB Channel Swap

For the Active RWS
MSS: LAS5(LAP5) Bus Config
LAS5(LAP5) CEU Bus Configuration
'Local Bus'
'MSS' and 'PDGF'
- **cmd** 'B' (two)

Do the messages in alarm return to norm?

21 RWS State Transition and S/W State Resync

MSS: LAS5(LAP5) CEU MODE
CEU Mode
- **cmd** 'Active CEU' – Backup (Verify – Backup)

For previously active RWS
- **cmd** 'Cupola'('Lab') – Active (Verify Cupola(Lab) – Active)

19 SSRMS Operational Power on Alt String ⑧

For alternate SSRMS string
MSS: SSRMS: Power
SSRMS Power
- **cmd** 'SSRMS' Redundant(Prime) – Keep-Alive (Verify Keep-Alive)

- **cmd** 'SSRMS' Redundant(Prime) – Operational (Verify 'System State' – Operational)

If System State – Not Operational
- **cmd** 'SSRMS' Redundant(Prime) – Operational (Verify 'System State' – Operational)

18 MBS Operational Power on Alt String ⑧

If MBS is required, for alternate string
MSS: MBS: MCU
MCU
- **cmd** 'Redundant' ('Prime') – Operational (Verify 'Systems State' – Operational)

If MBS Not Operational
MSS: LAS5(LAP5) CEU MODE
CEU Mode
- **cmd** 'Active CEU' – Backup (Verify – Backup)

For previously active RWS
- **cmd** 'Cupola'('Lab') – Active (Verify Cupola(Lab) – Active)

MSS: MBS: MCU
MCU
- **cmd** 'Redundant' ('Prime') – Operational (Verify 'Systems State' – Operational)

⑧
Due to a known SPN condition (SCR 20380), the MBS and SSRMS power to operational commands may not complete after the first attempt.

7.001 MSS FAILURE RESPONSE AND RECOVERY

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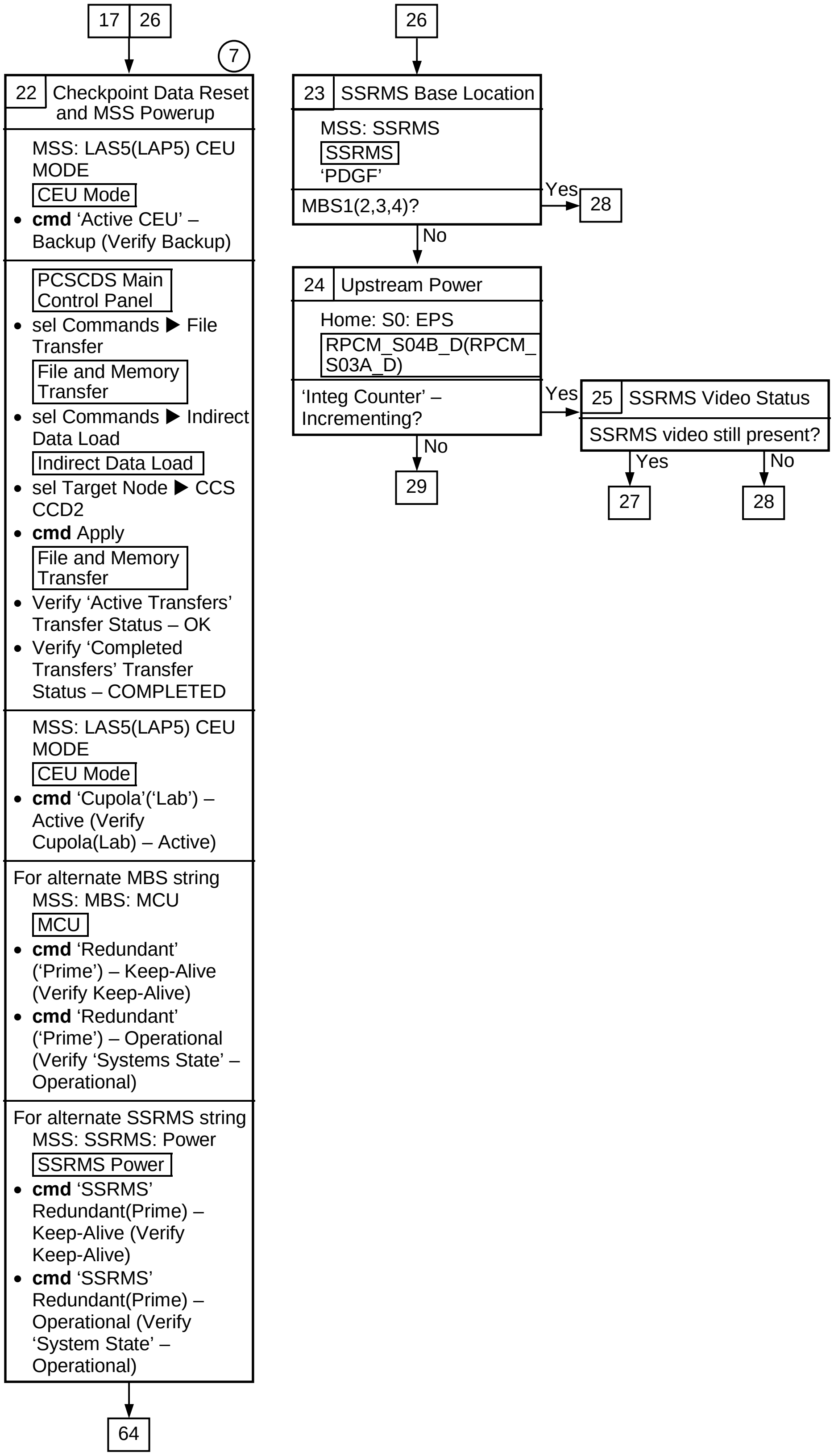

22 Checkpoint Data Reset and MSS Powerup

MSS: LAS5(LAP5) CEU MODE

CEU Mode

- **cmd** 'Active CEU' – Backup (Verify Backup)

PCSCDS Main Control Panel

- sel Commands ▶ File Transfer

File and Memory Transfer

- sel Commands ▶ Indirect Data Load

Indirect Data Load

- sel Target Node ▶ CCS CCD2
- **cmd** Apply

File and Memory Transfer

- Verify 'Active Transfers' Transfer Status – OK
- Verify 'Completed Transfers' Transfer Status – COMPLETED

MSS: LAS5(LAP5) CEU MODE

CEU Mode

- **cmd** 'Cupola'('Lab') – Active (Verify Cupola(Lab) – Active)

For alternate MBS string

MSS: MBS: MCU

MCU

- **cmd** 'Redundant' ('Prime') – Keep-Alive (Verify Keep-Alive)
- **cmd** 'Redundant' ('Prime') – Operational (Verify 'Systems State' – Operational)

For alternate SSRMS string

MSS: SSRMS: Power

SSRMS Power

- **cmd** 'SSRMS' Redundant(Prime) – Keep-Alive (Verify Keep-Alive)
- **cmd** 'SSRMS' Redundant(Prime) – Operational (Verify 'System State' – Operational)

23 SSRMS Base Location

MSS: SSRMS

SSRMS

'PDGF'

MBS1(2,3,4)?

24 Upstream Power

Home: S0: EPS

RPCM_S04B_D(RPCM_S03A_D)

'Integ Counter' – Incrementing?

25 SSRMS Video Status

SSRMS video still present?

⑦
SCR 21749

7.001 MSS FAILURE RESPONSE AND RECOVERY

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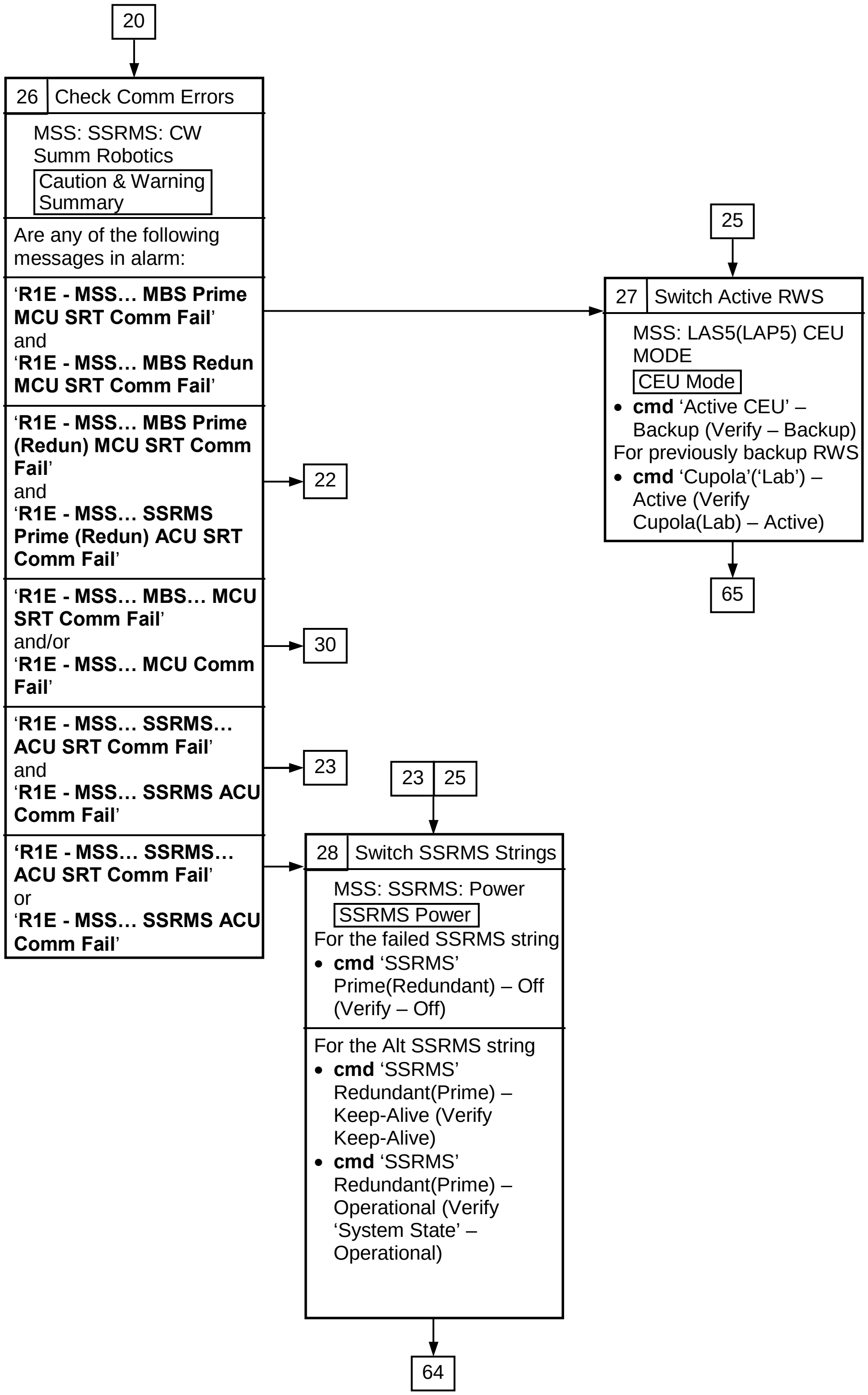


26 Check Comm Errors

MSS: SSRMS: CW Summ Robotics

Caution & Warning Summary

Are any of the following messages in alarm:

‘**R1E - MSS… MBS Prime MCU SRT Comm Fail**’ and ‘**R1E - MSS… MBS Redun MCU SRT Comm Fail**’

‘**R1E - MSS… MBS Prime (Redun) MCU SRT Comm Fail**’ and ‘**R1E - MSS… SSRMS Prime (Redun) ACU SRT Comm Fail**’

‘**R1E - MSS… MBS… MCU SRT Comm Fail**’ and/or ‘**R1E - MSS… MCU Comm Fail**’

‘**R1E - MSS… SSRMS… ACU SRT Comm Fail**’ and ‘**R1E - MSS… SSRMS ACU Comm Fail**’

‘R1E - MSS… SSRMS… ACU SRT Comm Fail’ or ‘**R1E - MSS… SSRMS ACU Comm Fail**’

27 Switch Active RWS

MSS: LAS5(LAP5) CEU MODE

CEU Mode

- **cmd** ‘Active CEU’ – Backup (Verify – Backup)

For previously backup RWS

- **cmd** ‘Cupola’(‘Lab’) – Active (Verify Cupola(Lab) – Active)

28 Switch SSRMS Strings

MSS: SSRMS: Power

SSRMS Power

For the failed SSRMS string

- **cmd** ‘SSRMS’ Prime(Redundant) – Off (Verify – Off)

For the Alt SSRMS string

- **cmd** ‘SSRMS’ Redundant(Prime) – Keep-Alive (Verify Keep-Alive)
- **cmd** ‘SSRMS’ Redundant(Prime) – Operational (Verify ‘System State’ – Operational)

24

29 Checkpoint Data Recovery and MSS Powerup on Alt String

MSS: MBS: MCU
MCU
- **cmd** ‘Prime’ – Off (Verify – Off)
- **cmd** ‘Redundant’ – Off (Verify – Off)

MSS: LAS5(LAP5) CEU MODE
CEU Mode
- **cmd** ‘Active CEU’ – Backup (Verify Backup)

PCSCDS Main Control Panel
- sel Commands ▶ File Transfer

File and Memory Transfer
- sel Commands ▶ Indirect Data Load

Indirect Data Load
- sel Target Node ▶ CCS CCD2
- **cmd** Apply

File and Memory Transfer
- Verify ‘Active Transfers’ Transfer Status – OK
- Verify ‘Completed Transfers’ Transfer Status – COMPLETED

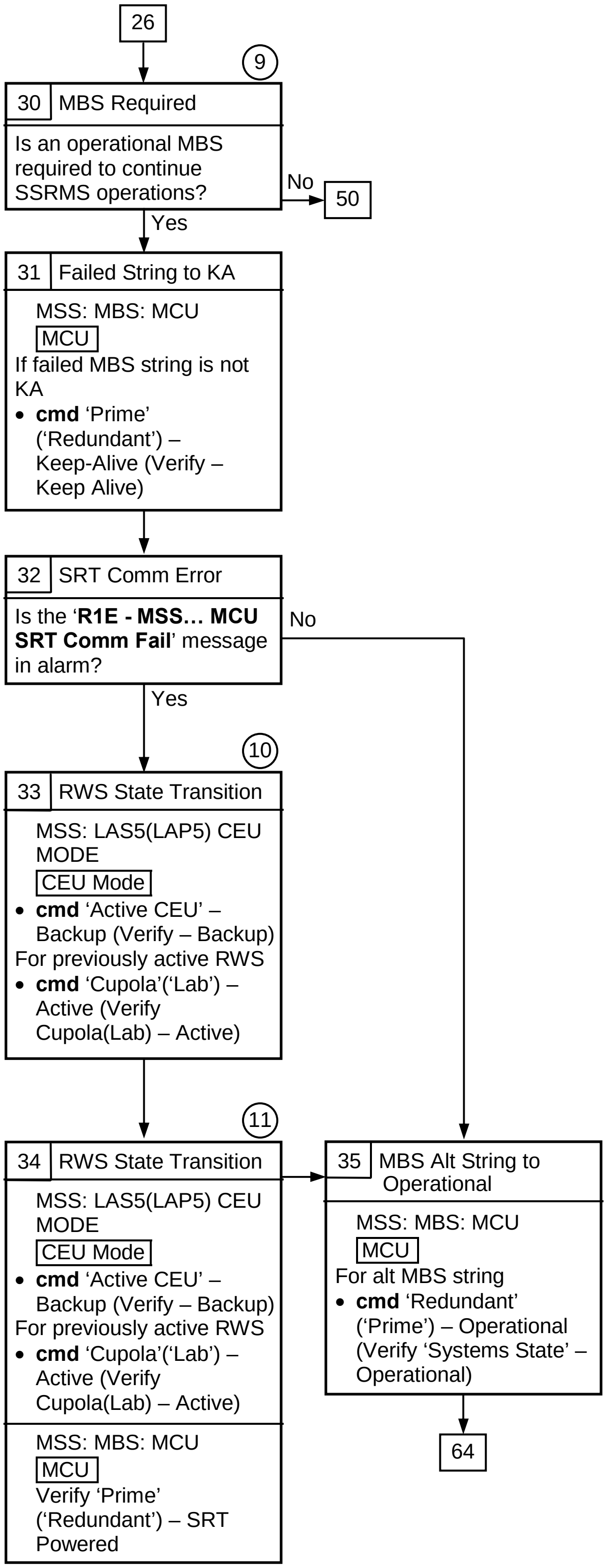
MSS: LAS5(LAP5) CEU MODE
CEU Mode
- **cmd** ‘Cupola’(‘Lab’) – Active (Verify Cupola(Lab) – Active)

MSS: MBS: MCU
MCU
- **cmd** ‘Prime’ – Keep-Alive (Verify Keep-Alive)
- **cmd** ‘Redundant’ – Keep-Alive (Verify Keep-Alive)

If Operational MBS is required
- **cmd** ‘Prime’ (‘Redundant’) – Operational (Verify ‘Systems State’ – Operational)

For alternate SSRMS string:
MSS: SSRMS: Power
SSRMS Power
- **cmd** ‘SSRMS’ Redundant(Prime) – Keep-Alive (Verify Keep-Alive)
- **cmd** ‘SSRMS’ Redundant(Prime) – Operational (Verify ‘System State’ – Operational)

64



⑨
An operational MBS is required to power the MBS Mast Camera and light, as well are route/deroute its view. An operational MBS is not required to control pan/tilt/zoom/focus if the Camera has already been routed.

⑩
Expect ‘**R1E - MSS... MCU SRT Comm Fail**’ to return into alarm and the MCU state to become SRT Powered.

⑪
The RWS state transition in the block is required even if it has been executed once already in block 33.

7.001 MSS FAILURE RESPONSE AND RECOVERY

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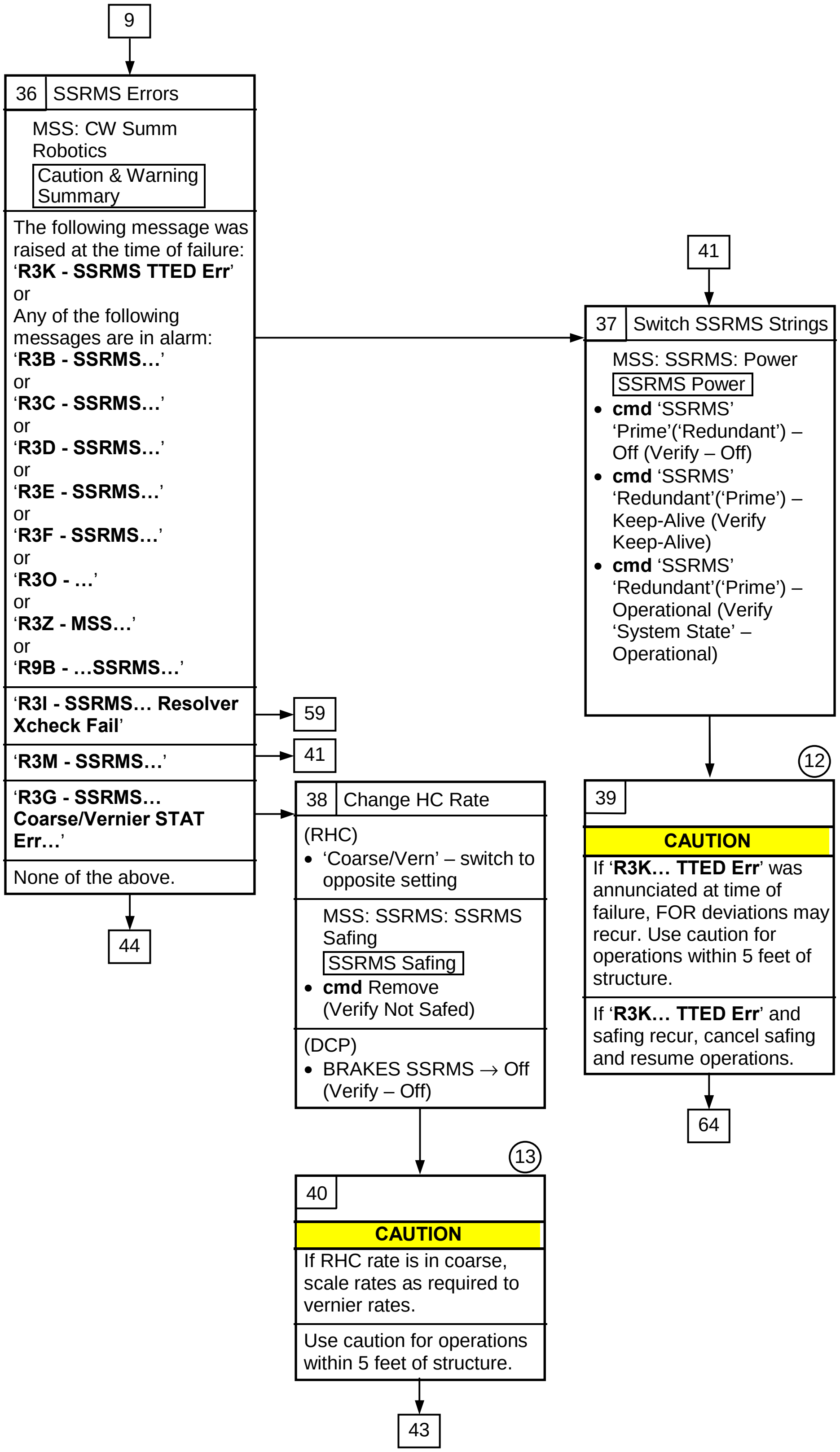


36 SSRMS Errors

MSS: CW Summ Robotics
Caution & Warning Summary

The following message was raised at the time of failure:
‘**R3K - SSRMS TTED Err**’
or
Any of the following messages are in alarm:
‘**R3B - SSRMS…**’
or
‘**R3C - SSRMS…**’
or
‘**R3D - SSRMS…**’
or
‘**R3E - SSRMS…**’
or
‘**R3F - SSRMS…**’
or
‘**R3O - …**’
or
‘**R3Z - MSS…**’
or
‘**R9B - …SSRMS…**’

‘**R3I - SSRMS… Resolver Xcheck Fail**’ → 59

‘**R3M - SSRMS…**’ → 41

‘**R3G - SSRMS… Coarse/Vernier STAT Err…**’

None of the above. → 44

37 Switch SSRMS Strings

MSS: SSRMS: Power
SSRMS Power

- **cmd** ‘SSRMS’ ‘Prime’(‘Redundant’) – Off (Verify – Off)
- **cmd** ‘SSRMS’ ‘Redundant’(‘Prime’) – Keep-Alive (Verify Keep-Alive)
- **cmd** ‘SSRMS’ ‘Redundant’(‘Prime’) – Operational (Verify ‘System State’ – Operational)

38 Change HC Rate

(RHC)
- ‘Coarse/Vern’ – switch to opposite setting

MSS: SSRMS: SSRMS Safing
SSRMS Safing
- **cmd** Remove (Verify Not Safed)

(DCP)
- BRAKES SSRMS → Off (Verify – Off)

39 ⑫

CAUTION

If ‘**R3K… TTED Err**’ was annunciated at time of failure, FOR deviations may recur. Use caution for operations within 5 feet of structure.

If ‘**R3K… TTED Err**’ and safing recur, cancel safing and resume operations.

40 ⑬

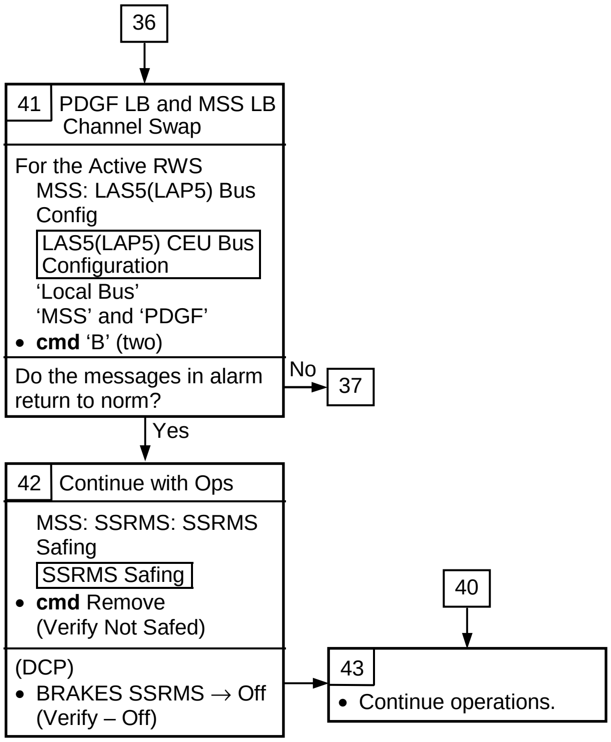
CAUTION

If RHC rate is in coarse, scale rates as required to vernier rates.

Use caution for operations within 5 feet of structure.

⑫
Sigle joint mode can be used to avoid R3K errors.

⑬
If failure is ‘**R3G - SSRMS ACU Coarse/Vernier Stat ERR**’ and RHC rate is in coarse, MSS powerdown or RWS state transition removes string functionality.
If failure is ‘**R3G - SSRMS SR (SY, SP, EP, WP, WY, WR) Coarse/Vernier Stat ERR**’ and RHC rate is in coarse, DJOPS is available to recover current string functionality in the case of a MSS Powerdown or RWS state transition.


36
41 PDGF LB and MSS LB Channel Swap
For the Active RWS
MSS: LAS5(LAP5) Bus Config
LAS5(LAP5) CEU Bus Configuration
'Local Bus'
'MSS' and 'PDGF'
• **cmd** 'B' (two)
Do the messages in alarm return to norm?
No
37
Yes
42 Continue with Ops
MSS: SSRMS: SSRMS Safing
SSRMS Safing
• **cmd** Remove
(Verify Not Safed)
(DCP)
• BRAKES SSRMS → Off
(Verify – Off)
40
43
• Continue operations.

7.001 MSS FAILURE RESPONSE AND RECOVERY

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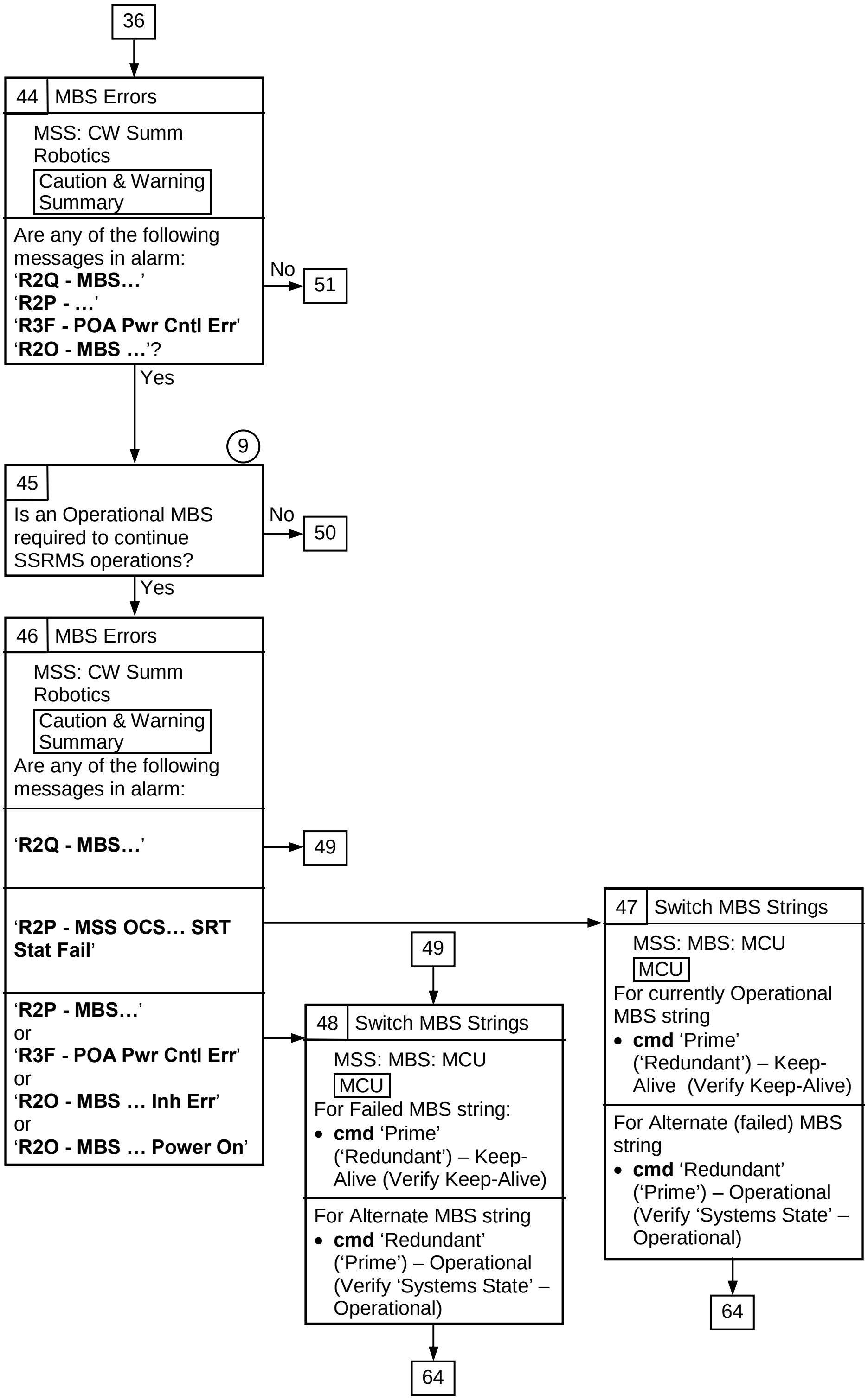

44 MBS Errors

MSS: CW Summ
Robotics
Caution & Warning Summary

Are any of the following messages in alarm:
‘**R2Q - MBS…**’
‘**R2P - …**’
‘**R3F - POA Pwr Cntl Err**’
‘**R2O - MBS …**’?

45 ⑨

Is an Operational MBS required to continue SSRMS operations?

46 MBS Errors

MSS: CW Summ
Robotics
Caution & Warning Summary

Are any of the following messages in alarm:

‘**R2Q - MBS…**’

‘**R2P - MSS OCS… SRT Stat Fail**’

‘**R2P - MBS…**’
or
‘**R3F - POA Pwr Cntl Err**’
or
‘**R2O - MBS … Inh Err**’
or
‘**R2O - MBS … Power On**’

47 Switch MBS Strings

MSS: MBS: MCU
MCU

For currently Operational MBS string
- **cmd** ‘Prime’ (‘Redundant’) – Keep-Alive (Verify Keep-Alive)

For Alternate (failed) MBS string
- **cmd** ‘Redundant’ (‘Prime’) – Operational (Verify ‘Systems State’ – Operational)

48 Switch MBS Strings

MSS: MBS: MCU
MCU

For Failed MBS string:
- **cmd** ‘Prime’ (‘Redundant’) – Keep-Alive (Verify Keep-Alive)

For Alternate MBS string
- **cmd** ‘Redundant’ (‘Prime’) – Operational (Verify ‘Systems State’ – Operational)

⑨ An operational MBS is required to power the MBS Mast Camera and light, as well are route/deroute its view. An operational MBS is not required to control pan/tilt/zoom/focus if the Camera has already been routed.

7.001 MSS FAILURE RESPONSE AND RECOVERY

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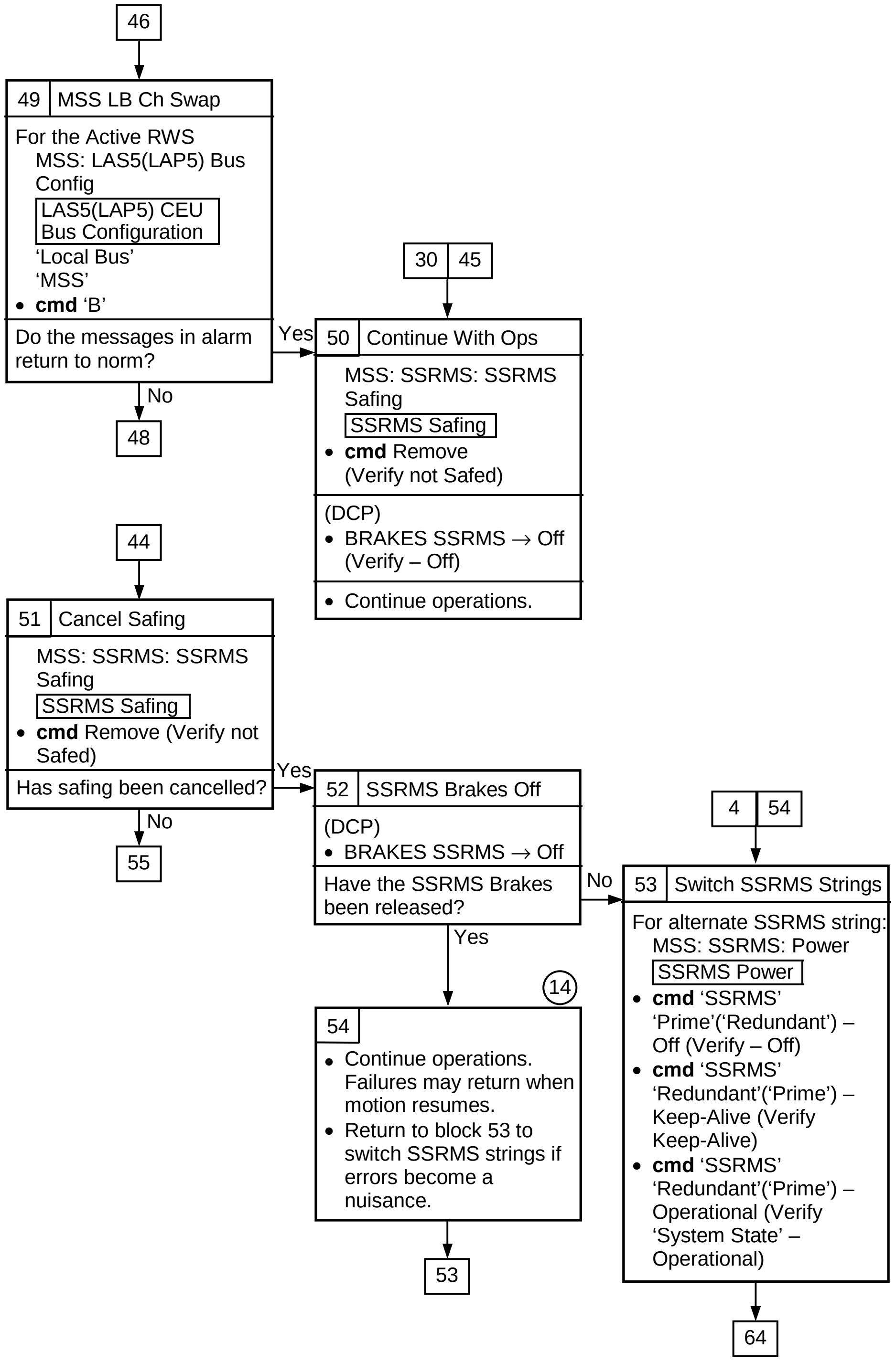


49 MSS LB Ch Swap

For the Active RWS
MSS: LAS5(LAP5) Bus Config
LAS5(LAP5) CEU Bus Configuration
‘Local Bus’
‘MSS’
- **cmd** ‘B’

Do the messages in alarm return to norm?

50 Continue With Ops

MSS: SSRMS: SSRMS Safing
SSRMS Safing
- **cmd** Remove (Verify not Safed)

(DCP)
- BRAKES SSRMS → Off (Verify – Off)

- Continue operations.

51 Cancel Safing

MSS: SSRMS: SSRMS Safing
SSRMS Safing
- **cmd** Remove (Verify not Safed)

Has safing been cancelled?

52 SSRMS Brakes Off

(DCP)
- BRAKES SSRMS → Off

Have the SSRMS Brakes been released?

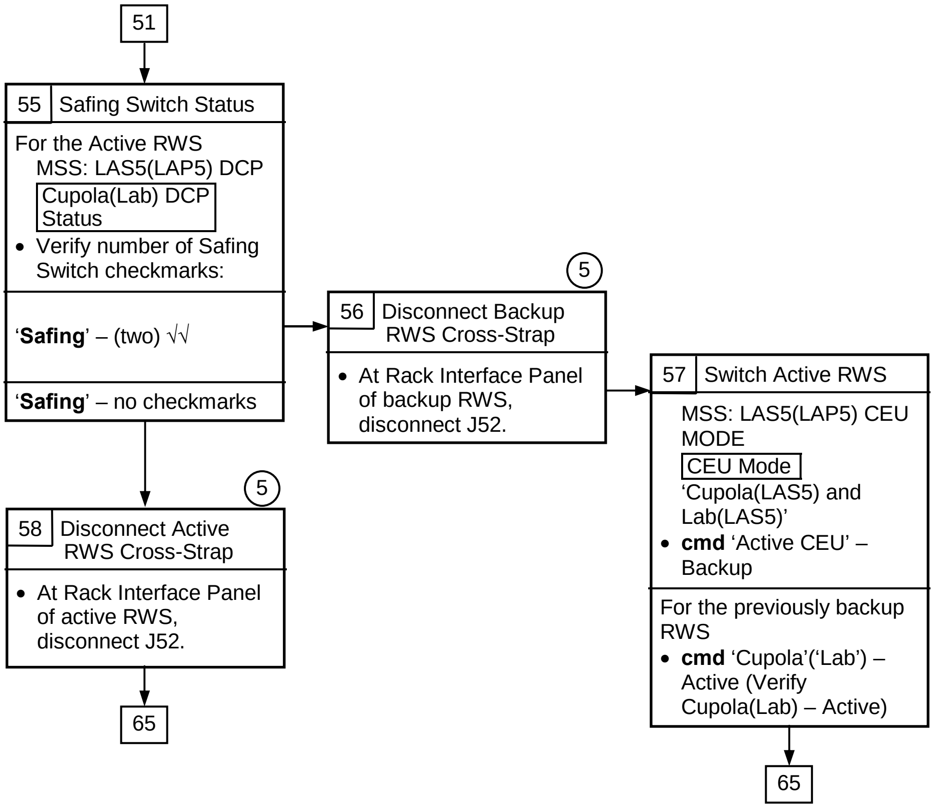
53 Switch SSRMS Strings

For alternate SSRMS string:
MSS: SSRMS: Power
SSRMS Power
- **cmd** ‘SSRMS’ ‘Prime’(‘Redundant’) – Off (Verify – Off)
- **cmd** ‘SSRMS’ ‘Redundant’(‘Prime’) – Keep-Alive (Verify Keep-Alive)
- **cmd** ‘SSRMS’ ‘Redundant’(‘Prime’) – Operational (Verify ‘System State’ – Operational)

54 ⑭

- Continue operations. Failures may return when motion resumes.
- Return to block 53 to switch SSRMS strings if errors become a nuisance.

⑭
If ‘**R3H - SSRMS Mtr Current Consistency Ck Fail**’ errors recur, changing the SSRMS rate setting on the RHC may reduce the likelihood of recurrence.



55 Safing Switch Status

For the Active RWS
MSS: LAS5(LAP5) DCP
Cupola(Lab) DCP Status
- Verify number of Safing Switch checkmarks:

'**Safing**' – (two) √√

'**Safing**' – no checkmarks

56 Disconnect Backup RWS Cross-Strap

- At Rack Interface Panel of backup RWS, disconnect J52.

57 Switch Active RWS

MSS: LAS5(LAP5) CEU MODE
CEU Mode
'Cupola(LAS5) and Lab(LAS5)'
- **cmd** 'Active CEU' – Backup

For the previously backup RWS
- **cmd** 'Cupola'('Lab') – Active (Verify Cupola(Lab) – Active)

58 Disconnect Active RWS Cross-Strap

- At Rack Interface Panel of active RWS, disconnect J52.

⑤
Cross-strap disconnect inhibits ability of backup RWS to safe system via backup RWS safing switch. E-stop still functional at failed RWS.

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36

59 Switch SSRMS Strings

MSS: SSRMS: Power
SSRMS Power

For the failed SSRMS string
- **cmd** ‘SSRMS’ ‘Prime’(‘Redundant’) – Off
  (Verify – Off)

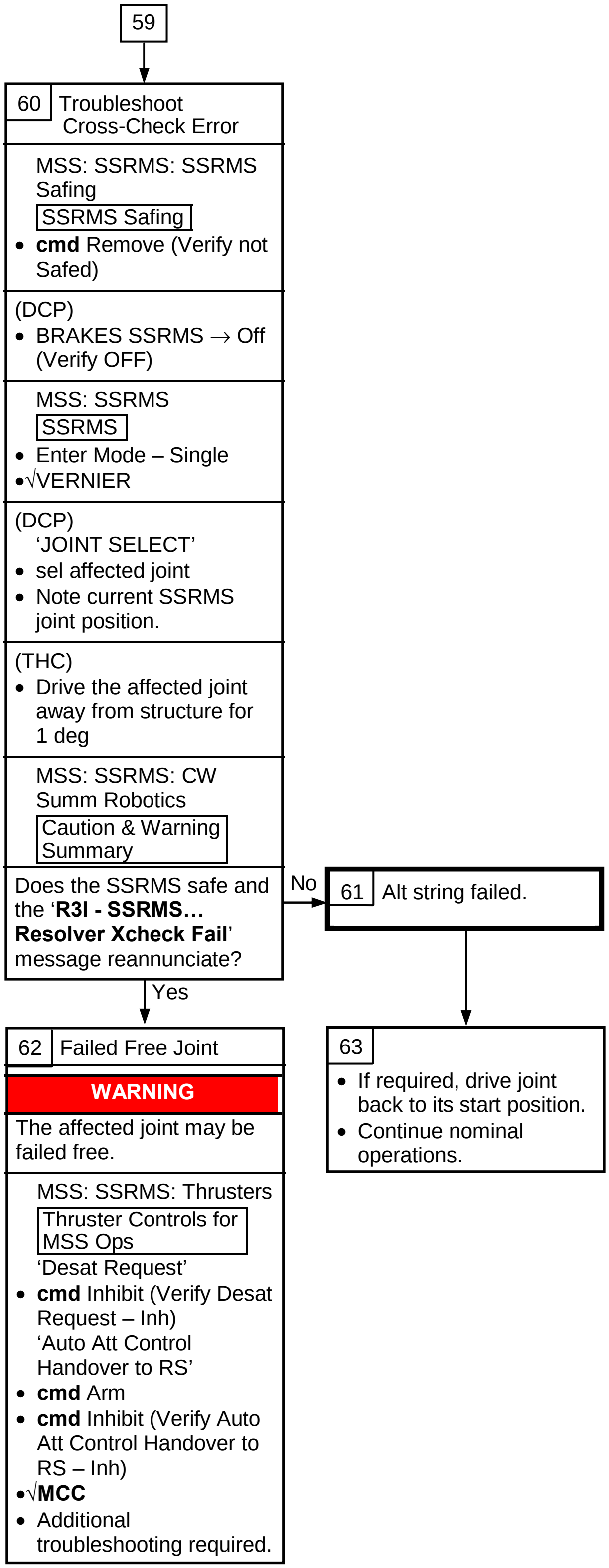
For the Alt SSRMS string
- **cmd** ‘SSRMS’ ‘Redundant’(‘Prime’) – Keep-Alive (Verify Keep-Alive)
- **cmd** ‘SSRMS’ ‘Redundant’(‘Prime’) – Operational (Verify ‘System State’ – Operational)

MSS: SSRMS: Base LEE VDU Icon
MSS VDUs
- Power up SSRMS VDUs as required.

MSS: SSRMS: Base Elbow Camera Icon
Base Elbow Camera
- Power up SSRMS cameras as required.
- **cmd** Color Bal – Metal on powered cameras

MSS: Video: Video Overview
Video Overview
- Repeat for all destinations to which an SSRMS camera is routed
- sel ‘Destination icon’
- **cmd** ‘Deroute Video Signal’ – Deroute

60



59

60 Troubleshoot Cross-Check Error

MSS: SSRMS: SSRMS Safing
SSRMS Safing
- **cmd** Remove (Verify not Safed)

(DCP)
- BRAKES SSRMS → Off (Verify OFF)

MSS: SSRMS
SSRMS
- Enter Mode – Single
- √VERNIER

(DCP)
'JOINT SELECT'
- sel affected joint
- Note current SSRMS joint position.

(THC)
- Drive the affected joint away from structure for 1 deg

MSS: SSRMS: CW Summ Robotics
Caution & Warning Summary

Does the SSRMS safe and the '**R3I - SSRMS… Resolver Xcheck Fail**' message reannunciate?

No → 61 Alt string failed.

Yes → 62 Failed Free Joint

WARNING

The affected joint may be failed free.

MSS: SSRMS: Thrusters
Thruster Controls for MSS Ops
'Desat Request'
- **cmd** Inhibit (Verify Desat Request – Inh)

'Auto Att Control Handover to RS'
- **cmd** Arm
- **cmd** Inhibit (Verify Auto Att Control Handover to RS – Inh)
- √**MCC**
- Additional troubleshooting required.

63
- If required, drive joint back to its start position.
- Continue nominal operations.

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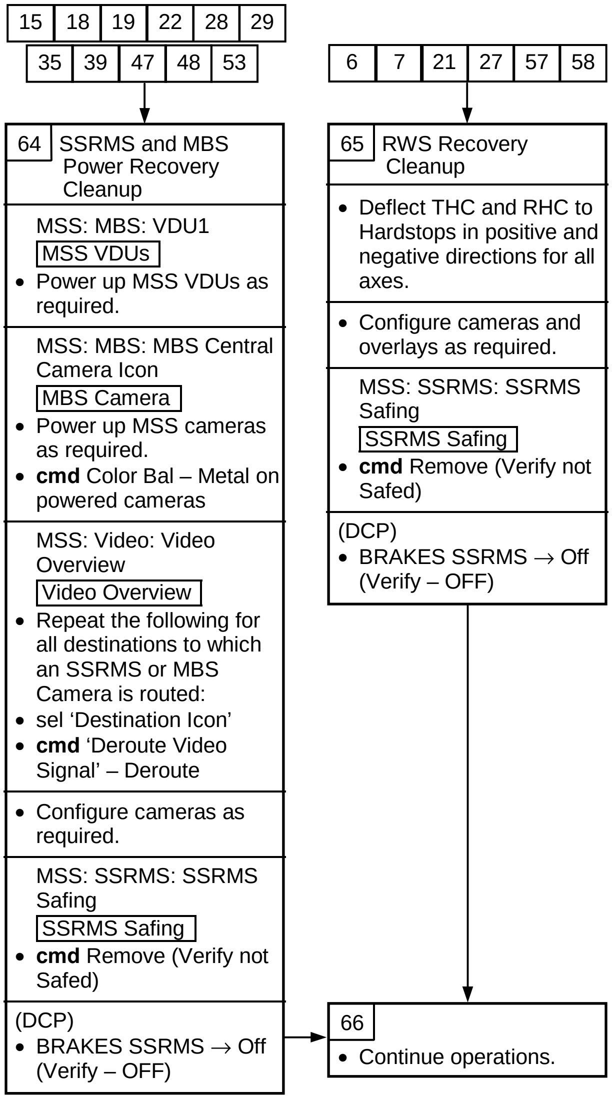

64 SSRMS and MBS Power Recovery Cleanup

MSS: MBS: VDU1
MSS VDUs
- Power up MSS VDUs as required.

MSS: MBS: MBS Central Camera Icon
MBS Camera
- Power up MSS cameras as required.
- **cmd** Color Bal – Metal on powered cameras

MSS: Video: Video Overview
Video Overview
- Repeat the following for all destinations to which an SSRMS or MBS Camera is routed:
- sel ‘Destination Icon’
- **cmd** ‘Deroute Video Signal’ – Deroute

- Configure cameras as required.

MSS: SSRMS: SSRMS Safing
SSRMS Safing
- **cmd** Remove (Verify not Safed)

(DCP)
- BRAKES SSRMS → Off (Verify – OFF)

65 RWS Recovery Cleanup

- Deflect THC and RHC to Hardstops in positive and negative directions for all axes.

- Configure cameras and overlays as required.

MSS: SSRMS: SSRMS Safing
SSRMS Safing
- **cmd** Remove (Verify not Safed)

(DCP)
- BRAKES SSRMS → Off (Verify – OFF)

66

- Continue operations.

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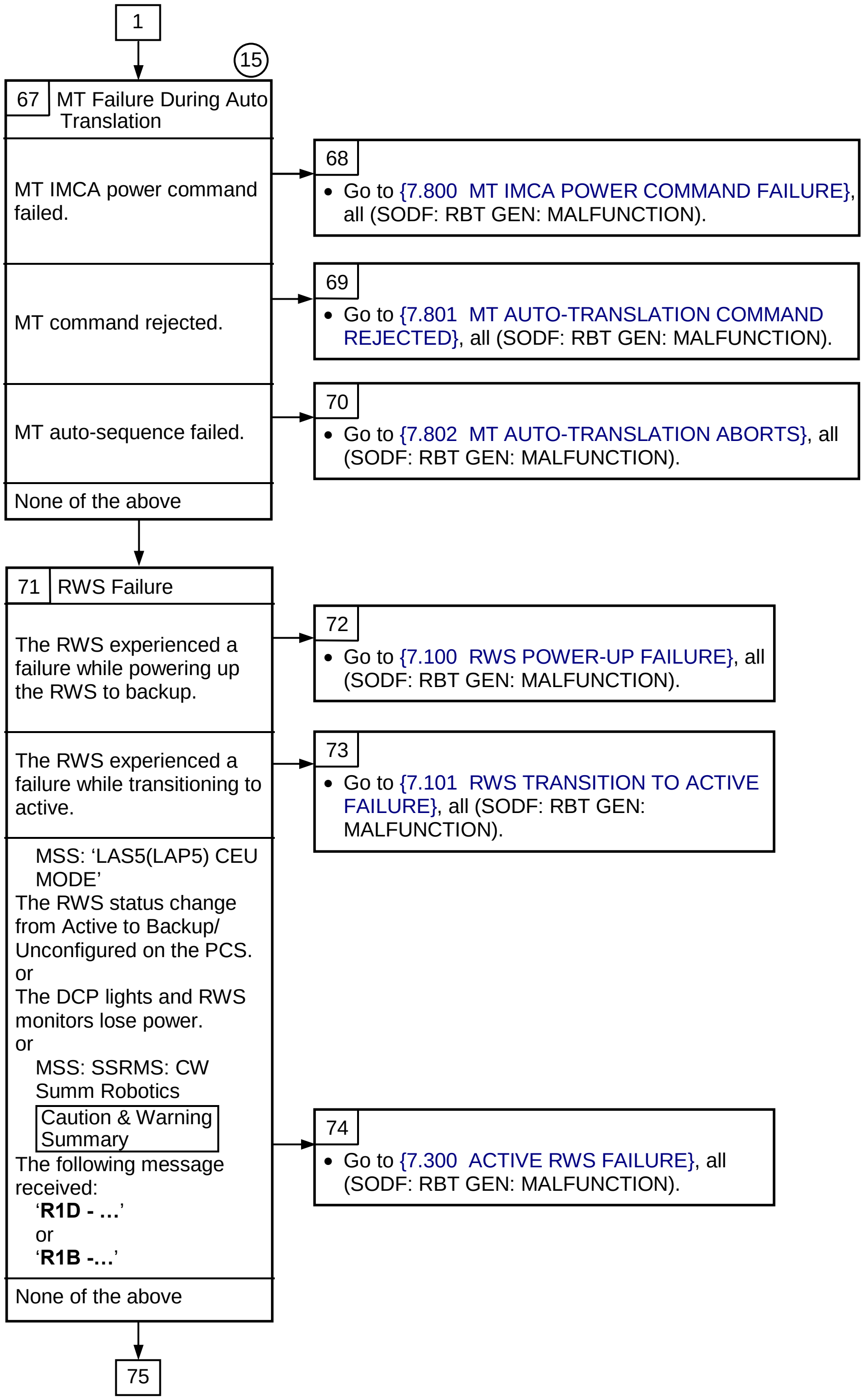

1

67 MT Failure During Auto Translation ⑮

- MT IMCA power command failed. → 68
- MT command rejected. → 69
- MT auto-sequence failed. → 70
- None of the above ↓

68
- Go to {7.800 MT IMCA POWER COMMAND FAILURE}, all (SODF: RBT GEN: MALFUNCTION).

69
- Go to {7.801 MT AUTO-TRANSLATION COMMAND REJECTED}, all (SODF: RBT GEN: MALFUNCTION).

70
- Go to {7.802 MT AUTO-TRANSLATION ABORTS}, all (SODF: RBT GEN: MALFUNCTION).

71 RWS Failure

- The RWS experienced a failure while powering up the RWS to backup. → 72
- The RWS experienced a failure while transitioning to active. → 73
- MSS: ‘LAS5(LAP5) CEU MODE’
  The RWS status change from Active to Backup/ Unconfigured on the PCS.
  or
  The DCP lights and RWS monitors lose power.
  or
  MSS: SSRMS: CW Summ Robotics
  Caution & Warning Summary
  The following message received:
  ‘**R1D - …**’
  or
  ‘**R1B -…**’ → 74
- None of the above ↓

72
- Go to {7.100 RWS POWER-UP FAILURE}, all (SODF: RBT GEN: MALFUNCTION).

73
- Go to {7.101 RWS TRANSITION TO ACTIVE FAILURE}, all (SODF: RBT GEN: MALFUNCTION).

74
- Go to {7.300 ACTIVE RWS FAILURE}, all (SODF: RBT GEN: MALFUNCTION).

75

⑮ Non time-critical recovery is lead by **MCC-H**. √**MCC-H** before executing procedures

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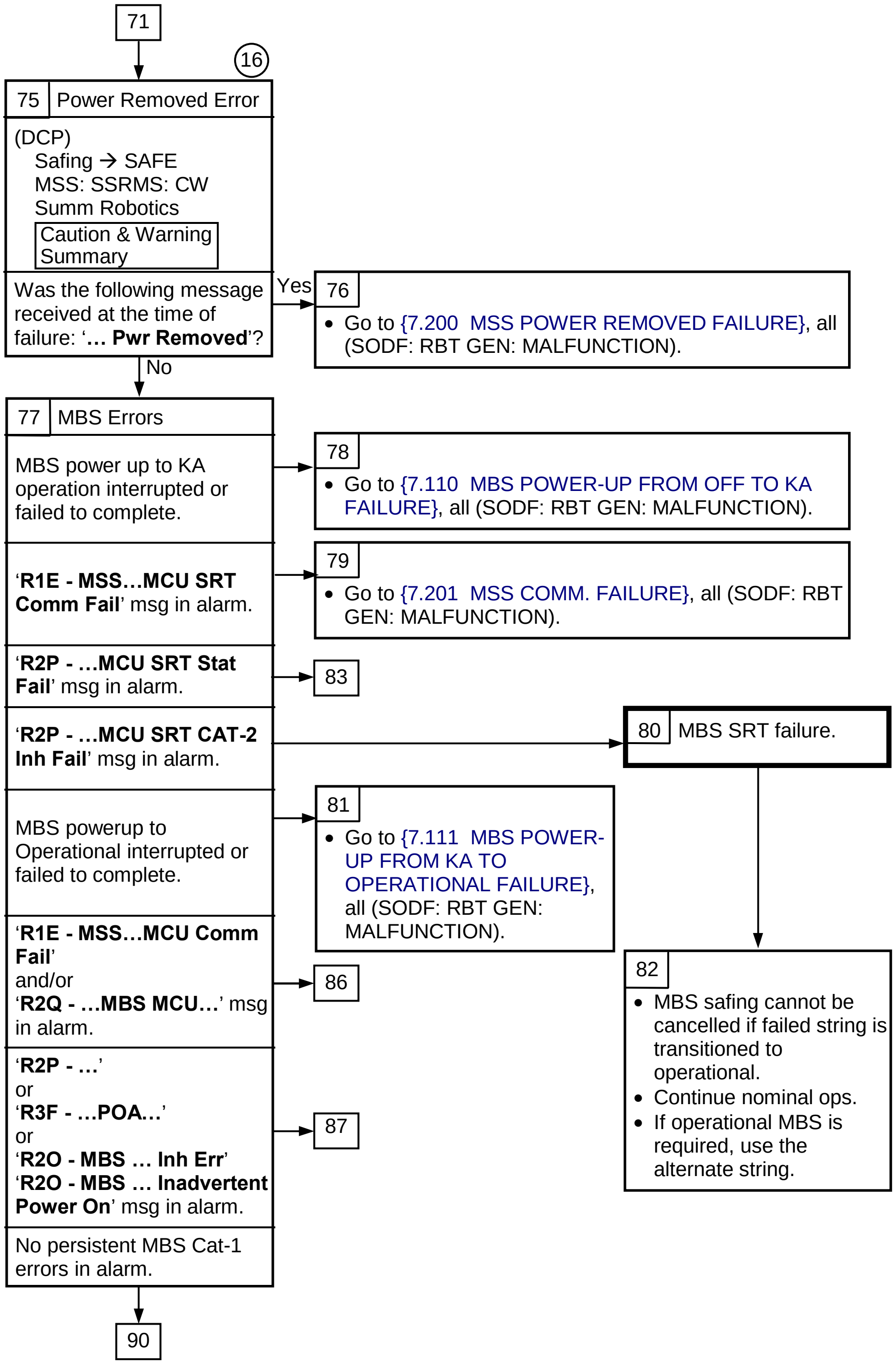


71

75 Power Removed Error ⑯

(DCP)
Safing → SAFE
MSS: SSRMS: CW
Summ Robotics
Caution & Warning Summary

Was the following message received at the time of failure: '**… Pwr Removed**'?

Yes → **76**

- Go to {7.200 MSS POWER REMOVED FAILURE}, all (SODF: RBT GEN: MALFUNCTION).

No ↓

77 MBS Errors

MBS power up to KA operation interrupted or failed to complete. → **78**

- Go to {7.110 MBS POWER-UP FROM OFF TO KA FAILURE}, all (SODF: RBT GEN: MALFUNCTION).

'**R1E - MSS…MCU SRT Comm Fail**' msg in alarm. → **79**

- Go to {7.201 MSS COMM. FAILURE}, all (SODF: RBT GEN: MALFUNCTION).

'**R2P - …MCU SRT Stat Fail**' msg in alarm. → 83

'**R2P - …MCU SRT CAT-2 Inh Fail**' msg in alarm. → **80** MBS SRT failure. → **82**

- MBS safing cannot be cancelled if failed string is transitioned to operational.
- Continue nominal ops.
- If operational MBS is required, use the alternate string.

MBS powerup to Operational interrupted or failed to complete. → **81**

- Go to {7.111 MBS POWER-UP FROM KA TO OPERATIONAL FAILURE}, all (SODF: RBT GEN: MALFUNCTION).

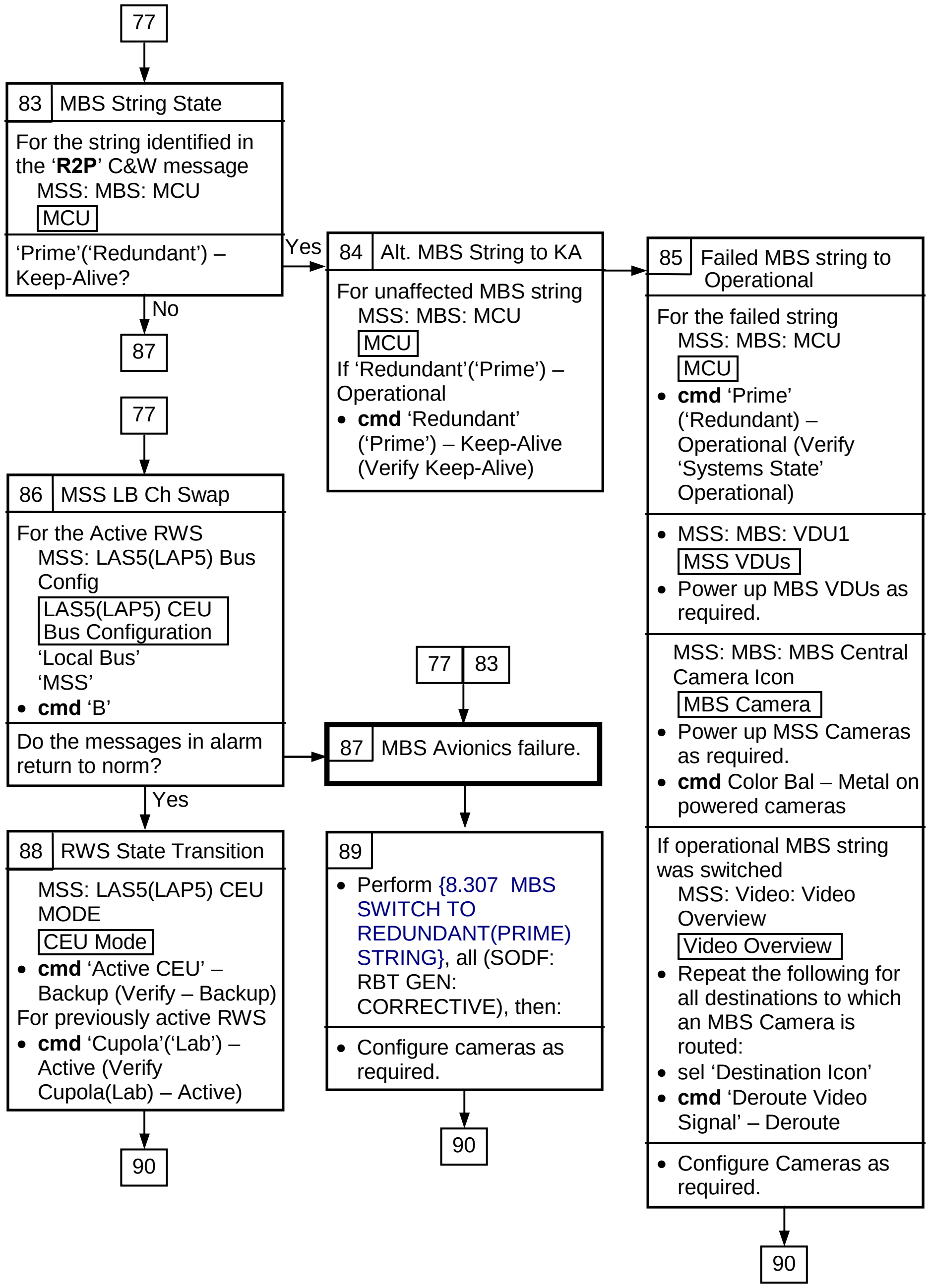
'**R1E - MSS…MCU Comm Fail**'
and/or
'**R2Q - …MBS MCU…**' msg in alarm. → 86

'**R2P - …**'
or
'**R3F - …POA…**'
or
'**R2O - MBS … Inh Err**'
'**R2O - MBS … Inadvertent Power On**' msg in alarm. → 87

No persistent MBS Cat-1 errors in alarm. → 90

⑯
SSRMS safing can be cancelled and SSRMS recovery operations can resume in the presence of an MBS CAT-1 error.

SCR 22615, 23233, 21737, 19378



83 MBS String State

For the string identified in the ‘**R2P**’ C&W message
MSS: MBS: MCU
MCU

‘Prime’(‘Redundant’) – Keep-Alive?

84 Alt. MBS String to KA

For unaffected MBS string
MSS: MBS: MCU
MCU
If ‘Redundant’(‘Prime’) – Operational
- **cmd** ‘Redundant’ (‘Prime’) – Keep-Alive (Verify Keep-Alive)

85 Failed MBS string to Operational

For the failed string
MSS: MBS: MCU
MCU
- **cmd** ‘Prime’ (‘Redundant) – Operational (Verify ‘Systems State’ Operational)

- MSS: MBS: VDU1
MSS VDUs
- Power up MBS VDUs as required.

MSS: MBS: MBS Central Camera Icon
MBS Camera
- Power up MSS Cameras as required.
- **cmd** Color Bal – Metal on powered cameras

If operational MBS string was switched
MSS: Video: Video Overview
Video Overview
- Repeat the following for all destinations to which an MBS Camera is routed:
- sel ‘Destination Icon’
- **cmd** ‘Deroute Video Signal’ – Deroute

- Configure Cameras as required.

86 MSS LB Ch Swap

For the Active RWS
MSS: LAS5(LAP5) Bus Config
LAS5(LAP5) CEU Bus Configuration
‘Local Bus’
‘MSS’
- **cmd** ‘B’

Do the messages in alarm return to norm?

87 MBS Avionics failure.

88 RWS State Transition

MSS: LAS5(LAP5) CEU MODE
CEU Mode
- **cmd** ‘Active CEU’ – Backup (Verify – Backup)

For previously active RWS
- **cmd** ‘Cupola’(‘Lab’) – Active (Verify Cupola(Lab) – Active)

89

- Perform {8.307 MBS SWITCH TO REDUNDANT(PRIME) STRING}, all (SODF: RBT GEN: CORRECTIVE), then:

- Configure cameras as required.

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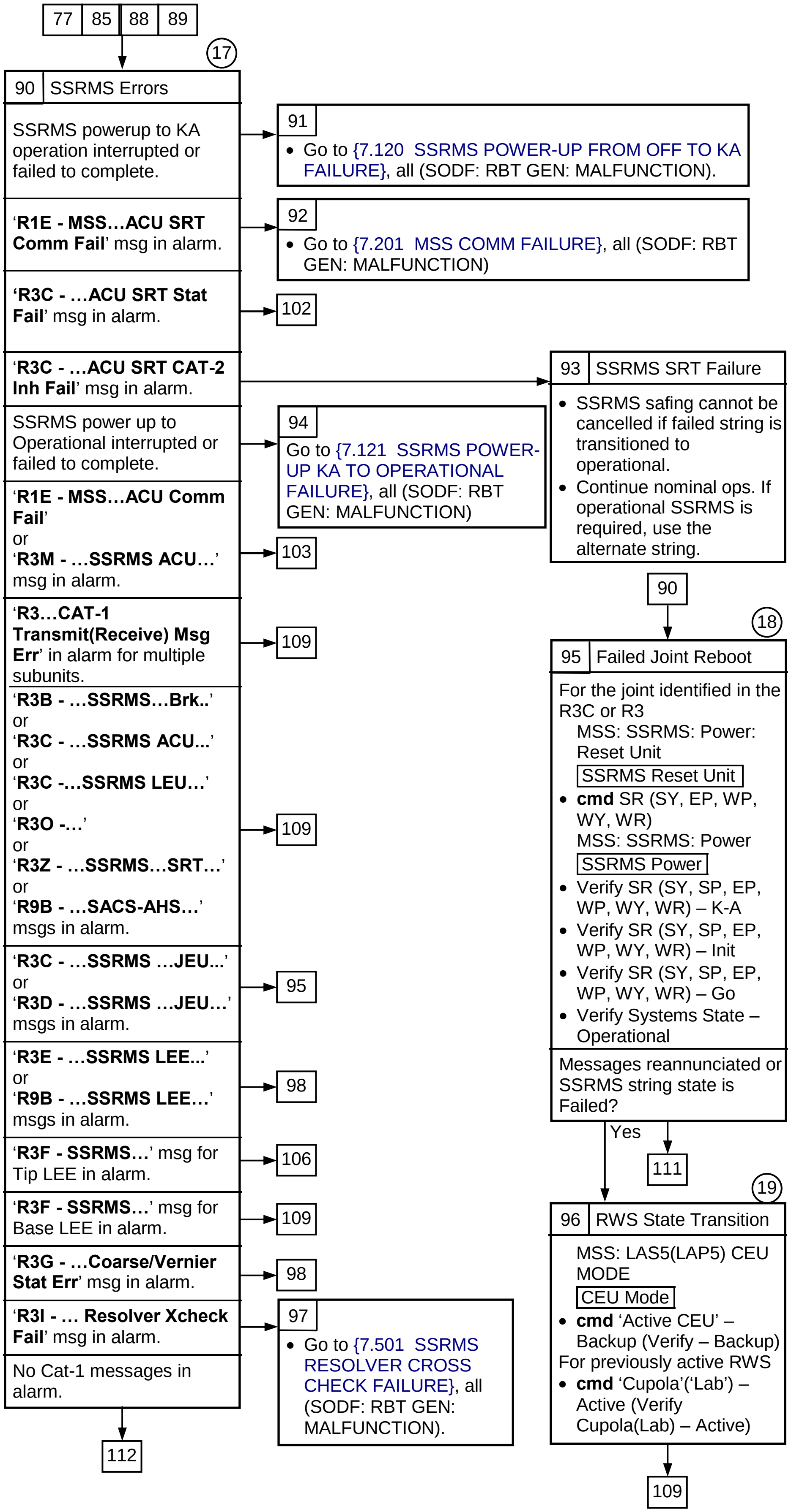

90 SSRMS Errors

- SSRMS powerup to KA operation interrupted or failed to complete. → 91
- ‘**R1E - MSS…ACU SRT Comm Fail**’ msg in alarm. → 92
- ‘**R3C - …ACU SRT Stat Fail**’ msg in alarm. → 102
- ‘**R3C - …ACU SRT CAT-2 Inh Fail**’ msg in alarm. → 93
- SSRMS power up to Operational interrupted or failed to complete. → 94
- ‘**R1E - MSS…ACU Comm Fail**’ or ‘**R3M - …SSRMS ACU…**’ msg in alarm. → 103
- ‘**R3…CAT-1 Transmit(Receive) Msg Err**’ in alarm for multiple subunits. → 109
- ‘**R3B - …SSRMS…Brk..**’ or ‘**R3C - …SSRMS ACU...**’ or ‘**R3C -…SSRMS LEU…**’ or ‘**R3O -…**’ or ‘**R3Z - …SSRMS…SRT…**’ or ‘**R9B - …SACS-AHS…**’ msgs in alarm. → 109
- ‘**R3C - …SSRMS …JEU...**’ or ‘**R3D - …SSRMS …JEU…**’ msgs in alarm. → 95
- ‘**R3E - …SSRMS LEE...**’ or ‘**R9B - …SSRMS LEE…**’ msgs in alarm. → 98
- ‘**R3F - SSRMS…**’ msg for Tip LEE in alarm. → 106
- ‘**R3F - SSRMS…**’ msg for Base LEE in alarm. → 109
- ‘**R3G - …Coarse/Vernier Stat Err**’ msg in alarm. → 98
- ‘**R3I - … Resolver Xcheck Fail**’ msg in alarm. → 97
- No Cat-1 messages in alarm. → 112

91

- Go to {7.120 SSRMS POWER-UP FROM OFF TO KA FAILURE}, all (SODF: RBT GEN: MALFUNCTION).

92

- Go to {7.201 MSS COMM FAILURE}, all (SODF: RBT GEN: MALFUNCTION)

93 SSRMS SRT Failure

- SSRMS safing cannot be cancelled if failed string is transitioned to operational.
- Continue nominal ops. If operational SSRMS is required, use the alternate string.

94

Go to {7.121 SSRMS POWER-UP KA TO OPERATIONAL FAILURE}, all (SODF: RBT GEN: MALFUNCTION)

90 → **95** Failed Joint Reboot ⑱

For the joint identified in the R3C or R3

MSS: SSRMS: Power: Reset Unit

SSRMS Reset Unit

- **cmd** SR (SY, EP, WP, WY, WR)

MSS: SSRMS: Power

SSRMS Power

- Verify SR (SY, SP, EP, WP, WY, WR) – K-A
- Verify SR (SY, SP, EP, WP, WY, WR) – Init
- Verify SR (SY, SP, EP, WP, WY, WR) – Go
- Verify Systems State – Operational

Messages reannunciated or SSRMS string state is Failed?

Yes → 96; → 111

96 RWS State Transition ⑲

MSS: LAS5(LAP5) CEU MODE

CEU Mode

- **cmd** ‘Active CEU’ – Backup (Verify – Backup)

For previously active RWS

- **cmd** ‘Cupola’(‘Lab’) – Active (Verify Cupola(Lab) – Active)

→ 109

97

- Go to {7.501 SSRMS RESOLVER CROSS CHECK FAILURE}, all (SODF: RBT GEN: MALFUNCTION).

⑰
If SSRMS is based on end A, Tip LEE is LEU2.

If SSRMS is based on end B, Tip LEE is LEU1.

⑱
If joint has previously failed on, reboot entire string per {8.106 SSRMS REBOOT PRIME (REDUNDANT) STRING}, all (SODF: RBT: GEN: CORRECTIVE)

⑲
SCR 28722

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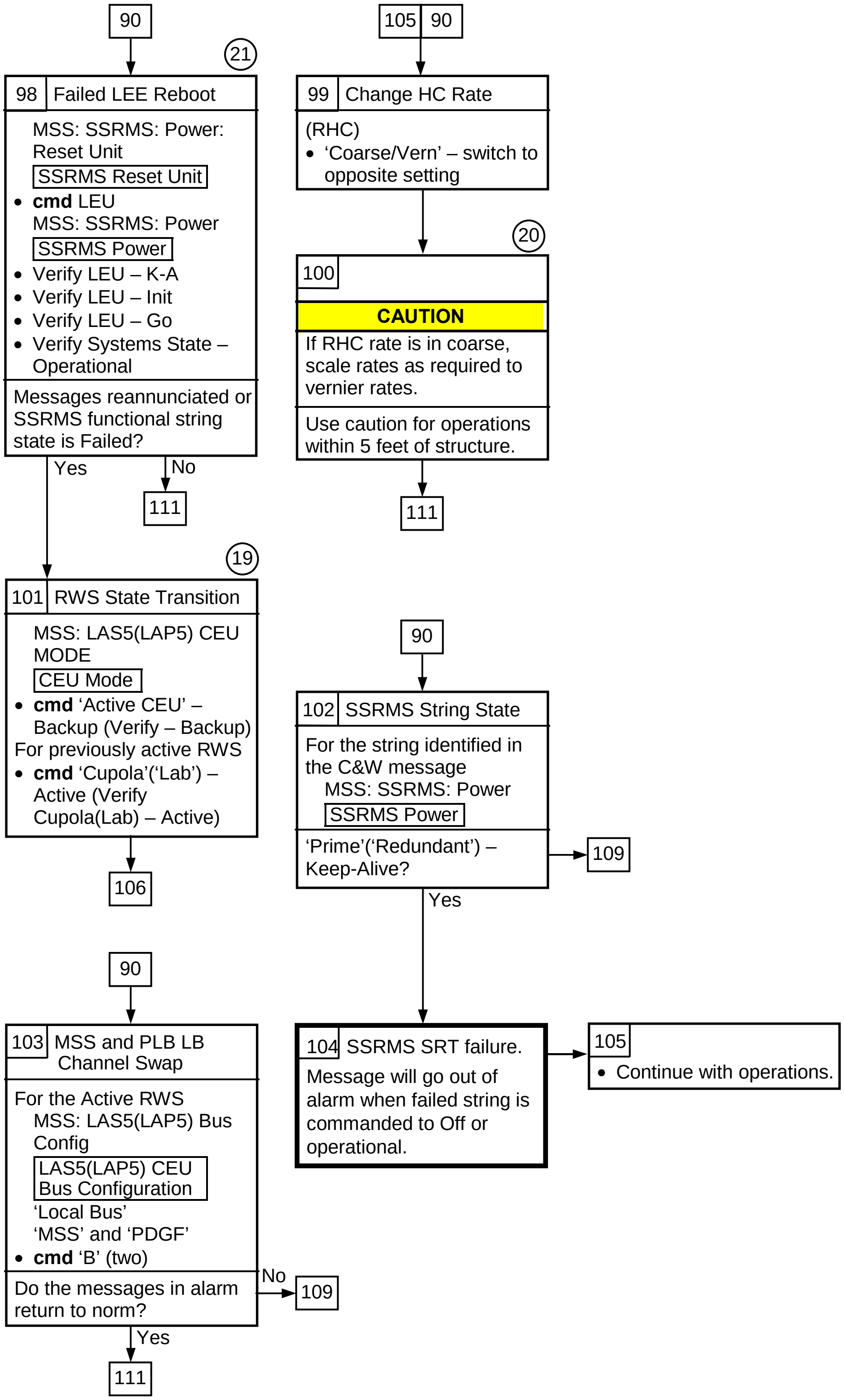

98 Failed LEE Reboot ⑳

MSS: SSRMS: Power: Reset Unit

SSRMS Reset Unit

- **cmd** LEU

MSS: SSRMS: Power

SSRMS Power

- Verify LEU – K-A
- Verify LEU – Init
- Verify LEU – Go
- Verify Systems State – Operational

Messages reannunciated or SSRMS functional string state is Failed?

99 Change HC Rate

(RHC)

- ‘Coarse/Vern’ – switch to opposite setting

100 ⑳

CAUTION

If RHC rate is in coarse, scale rates as required to vernier rates.

Use caution for operations within 5 feet of structure.

101 RWS State Transition ⑲

MSS: LAS5(LAP5) CEU MODE

CEU Mode

- **cmd** ‘Active CEU’ – Backup (Verify – Backup)

For previously active RWS

- **cmd** ‘Cupola’(‘Lab’) – Active (Verify Cupola(Lab) – Active)

102 SSRMS String State

For the string identified in the C&W message

MSS: SSRMS: Power

SSRMS Power

‘Prime’(‘Redundant’) – Keep-Alive?

103 MSS and PLB LB Channel Swap

For the Active RWS

MSS: LAS5(LAP5) Bus Config

LAS5(LAP5) CEU Bus Configuration

‘Local Bus’

‘MSS’ and ‘PDGF’

- **cmd** ‘B’ (two)

Do the messages in alarm return to norm?

104 SSRMS SRT failure.

Message will go out of alarm when failed string is commanded to Off or operational.

105

- Continue with operations.

⑲ SCR 28722

⑳ If failure is **‘R3G - SSRMS ACU Coarse/Vernier Stat ERR’** and RHC rate is in coarse, MSS powerdown or RWS state transition removes string functionality.

㉑ If LEE has previously failed on, reboot entire string per {8.106 SSRMS REBOOT PRIME (REDUNDANT) STRING}, all (SODF: RBT: GEN: CORRECTIVE

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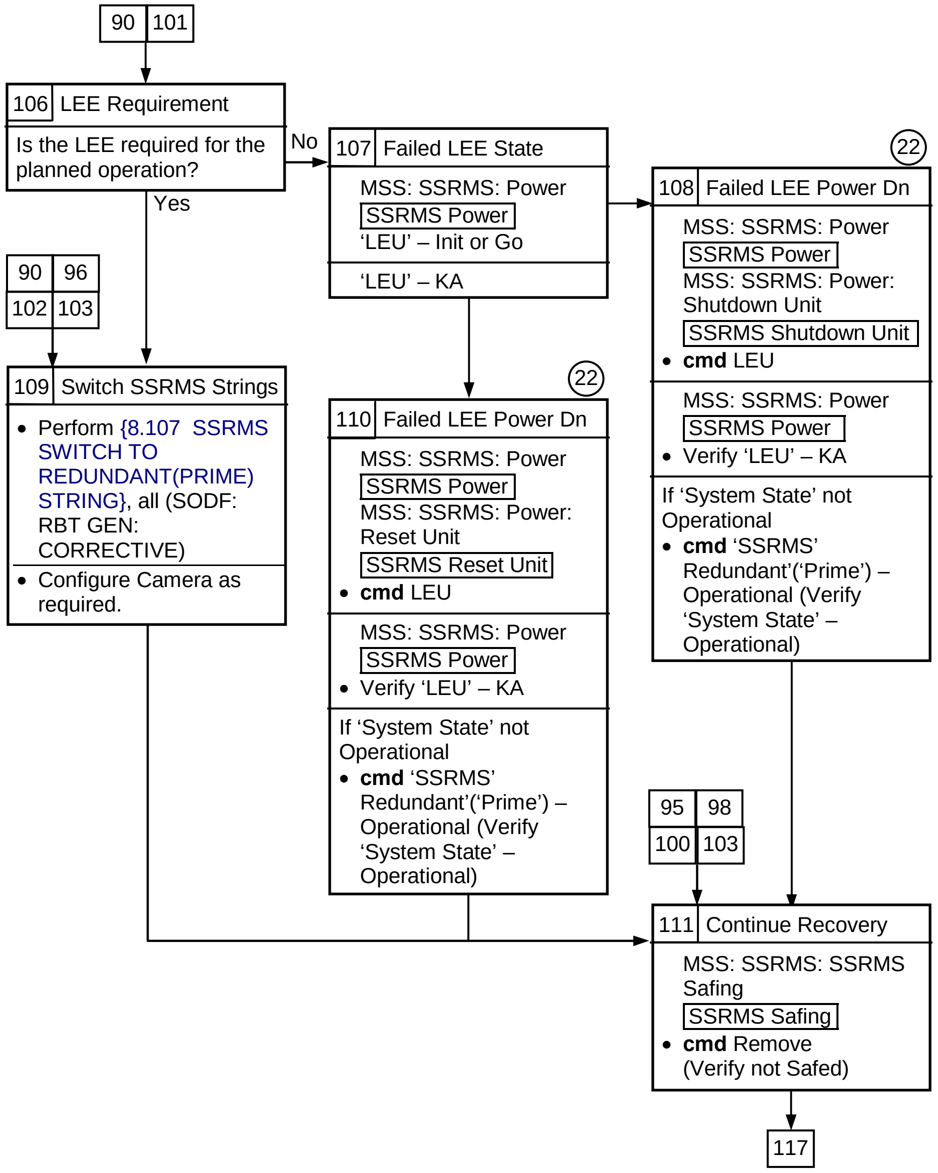
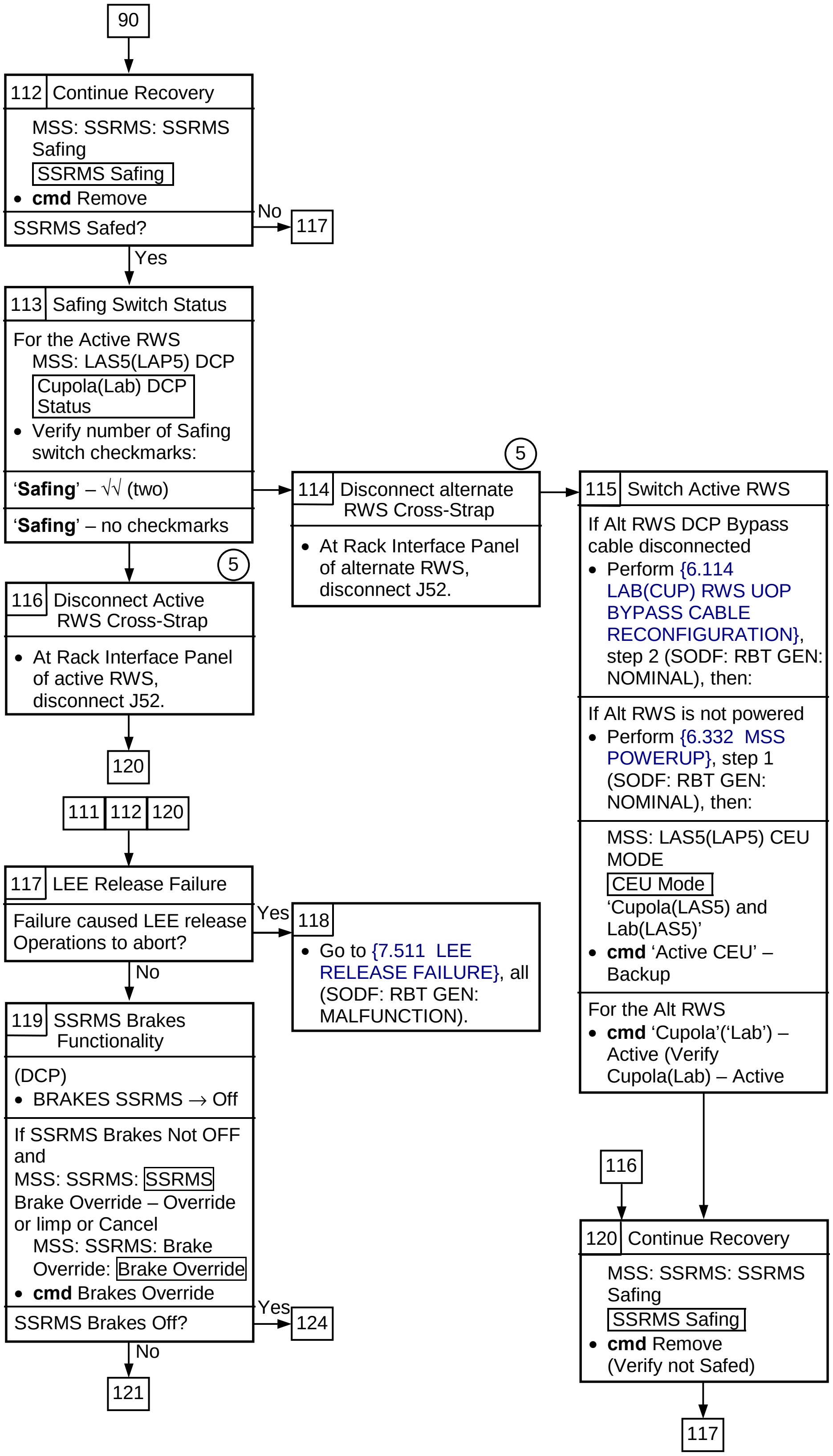
㉒
SCR 28418



7.001 MSS FAILURE RESPONSE AND RECOVERY



90

112 Continue Recovery

MSS: SSRMS: SSRMS Safing
SSRMS Safing
- **cmd** Remove

SSRMS Safed? No → 117; Yes ↓

113 Safing Switch Status

For the Active RWS
MSS: LAS5(LAP5) DCP
Cupola(Lab) DCP Status
- Verify number of Safing switch checkmarks:

'**Safing**' – √√ (two) → 114

'**Safing**' – no checkmarks ↓ 116

114 Disconnect alternate RWS Cross-Strap ⑤

- At Rack Interface Panel of alternate RWS, disconnect J52.

→ 115

115 Switch Active RWS

If Alt RWS DCP Bypass cable disconnected
- Perform {6.114 LAB(CUP) RWS UOP BYPASS CABLE RECONFIGURATION}, step 2 (SODF: RBT GEN: NOMINAL), then:

If Alt RWS is not powered
- Perform {6.332 MSS POWERUP}, step 1 (SODF: RBT GEN: NOMINAL), then:

MSS: LAS5(LAP5) CEU MODE
CEU Mode
'Cupola(LAS5) and Lab(LAS5)'
- **cmd** 'Active CEU' – Backup

For the Alt RWS
- **cmd** 'Cupola'('Lab') – Active (Verify Cupola(Lab) – Active

↓ 120

116 Disconnect Active RWS Cross-Strap ⑤

- At Rack Interface Panel of active RWS, disconnect J52.

↓ 120

111 | 112 | 120

117 LEE Release Failure

Failure caused LEE release Operations to abort? Yes → 118; No ↓ 119

118

- Go to {7.511 LEE RELEASE FAILURE}, all (SODF: RBT GEN: MALFUNCTION).

119 SSRMS Brakes Functionality

(DCP)
- BRAKES SSRMS → Off

If SSRMS Brakes Not OFF and
MSS: SSRMS: SSRMS Brake Override – Override or limp or Cancel
MSS: SSRMS: Brake Override: Brake Override
- **cmd** Brakes Override

SSRMS Brakes Off? Yes → 124; No ↓ 121

116

120 Continue Recovery

MSS: SSRMS: SSRMS Safing
SSRMS Safing
- **cmd** Remove (Verify not Safed)

↓ 117

⑤
Cross-strap disconnect inhibits ability of backup RWS to safe system via backup RWS safing switch.
E-stop still functional at failed RWS.

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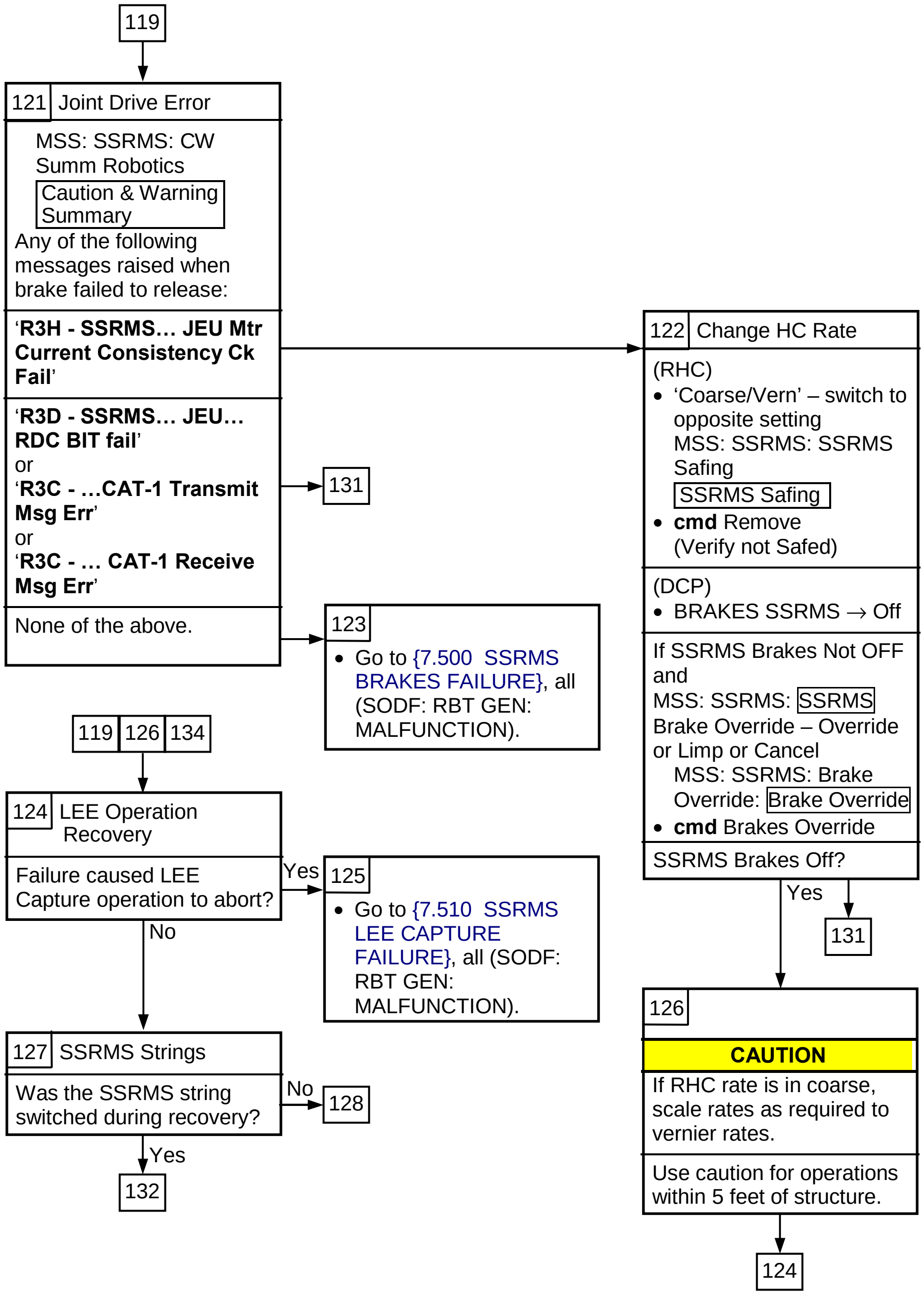

119

121 Joint Drive Error

MSS: SSRMS: CW
Summ Robotics
Caution & Warning Summary

Any of the following messages raised when brake failed to release:

- ‘**R3H - SSRMS… JEU Mtr Current Consistency Ck Fail**’ → 122
- ‘**R3D - SSRMS… JEU… RDC BIT fail**’ or ‘**R3C - …CAT-1 Transmit Msg Err**’ or ‘**R3C - … CAT-1 Receive Msg Err**’ → 131
- None of the above. → 123

122 Change HC Rate

(RHC)

- ‘Coarse/Vern’ – switch to opposite setting
  MSS: SSRMS: SSRMS Safing
  SSRMS Safing
- **cmd** Remove
  (Verify not Safed)

(DCP)

- BRAKES SSRMS → Off

If SSRMS Brakes Not OFF and
MSS: SSRMS: SSRMS Brake Override – Override or Limp or Cancel
MSS: SSRMS: Brake Override: Brake Override

- **cmd** Brakes Override

SSRMS Brakes Off?

Yes → 131

→ 126

123

- Go to {7.500 SSRMS BRAKES FAILURE}, all (SODF: RBT GEN: MALFUNCTION).

119 126 134

124 LEE Operation Recovery

Failure caused LEE Capture operation to abort?

Yes → 125

No → 127

125

- Go to {7.510 SSRMS LEE CAPTURE FAILURE}, all (SODF: RBT GEN: MALFUNCTION).

126

CAUTION

If RHC rate is in coarse, scale rates as required to vernier rates.

Use caution for operations within 5 feet of structure.

→ 124

127 SSRMS Strings

Was the SSRMS string switched during recovery?

No → 128

Yes → 132

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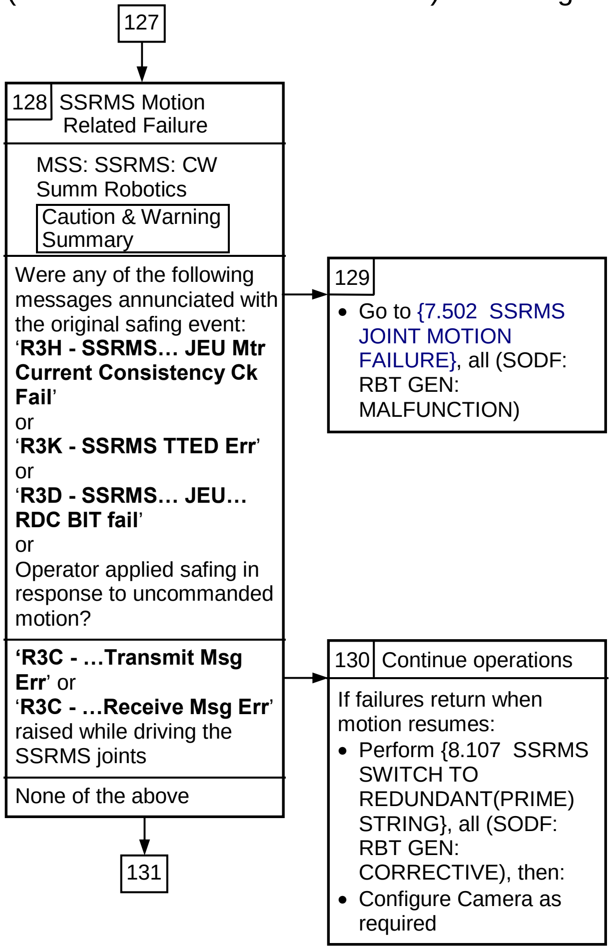

127

128 SSRMS Motion Related Failure

MSS: SSRMS: CW
Summ Robotics
Caution & Warning Summary

Were any of the following messages annunciated with the original safing event:
‘**R3H - SSRMS… JEU Mtr Current Consistency Ck Fail**’
or
‘**R3K - SSRMS TTED Err**’
or
‘**R3D - SSRMS… JEU… RDC BIT fail**’
or
Operator applied safing in response to uncommanded motion?

129

- Go to {7.502 SSRMS JOINT MOTION FAILURE}, all (SODF: RBT GEN: MALFUNCTION)

‘**R3C - …Transmit Msg Err**’ or
‘**R3C - …Receive Msg Err**’
raised while driving the SSRMS joints

130 Continue operations

If failures return when motion resumes:

- Perform {8.107 SSRMS SWITCH TO REDUNDANT(PRIME) STRING}, all (SODF: RBT GEN: CORRECTIVE), then:
- Configure Camera as required

None of the above

131

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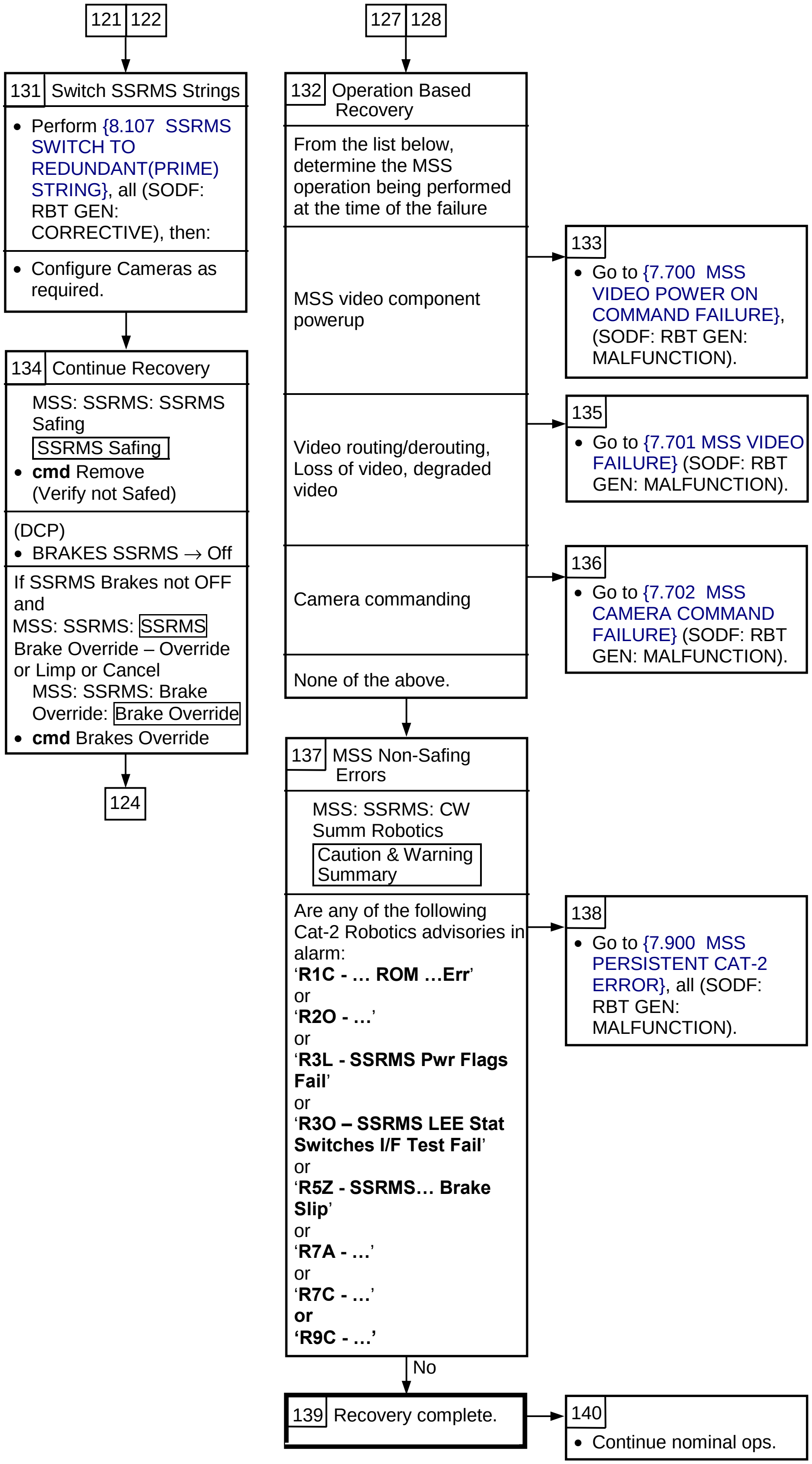


131 Switch SSRMS Strings

- Perform {8.107 SSRMS SWITCH TO REDUNDANT(PRIME) STRING}, all (SODF: RBT GEN: CORRECTIVE), then:
- Configure Cameras as required.

134 Continue Recovery

MSS: SSRMS: SSRMS Safing
SSRMS Safing

- **cmd** Remove (Verify not Safed)

(DCP)

- BRAKES SSRMS → Off

If SSRMS Brakes not OFF and
MSS: SSRMS: SSRMS Brake Override – Override or Limp or Cancel
MSS: SSRMS: Brake Override: Brake Override

- **cmd** Brakes Override

132 Operation Based Recovery

From the list below, determine the MSS operation being performed at the time of the failure

MSS video component powerup

Video routing/derouting, Loss of video, degraded video

Camera commanding

None of the above.

133

- Go to {7.700 MSS VIDEO POWER ON COMMAND FAILURE}, (SODF: RBT GEN: MALFUNCTION).

135

- Go to {7.701 MSS VIDEO FAILURE} (SODF: RBT GEN: MALFUNCTION).

136

- Go to {7.702 MSS CAMERA COMMAND FAILURE} (SODF: RBT GEN: MALFUNCTION).

137 MSS Non-Safing Errors

MSS: SSRMS: CW Summ Robotics
Caution & Warning Summary

Are any of the following Cat-2 Robotics advisories in alarm:
‘**R1C - … ROM …Err**’
or
‘**R2O - …**’
or
‘**R3L - SSRMS Pwr Flags Fail**’
or
‘**R3O – SSRMS LEE Stat Switches I/F Test Fail**’
or
‘**R5Z - SSRMS… Brake Slip**’
or
‘**R7A - …**’
or
‘**R7C - …**’
or
‘R9C - …’

138

- Go to {7.900 MSS PERSISTENT CAT-2 ERROR}, all (SODF: RBT GEN: MALFUNCTION).

139 Recovery complete.

140

- Continue nominal ops.

MSS

C&W
ROBOTICS

Robotics Workstation Failure While Performing Step 1 of 6.332 MSS Powerup or Step 2 of 6.114 LAB(CUP) RWS UOP Bypass Cable Reconfiguration

Nominal Config:

The DCP lighting switch is not in the OFF position.

The monitor brightness setting is not fully dimmed.

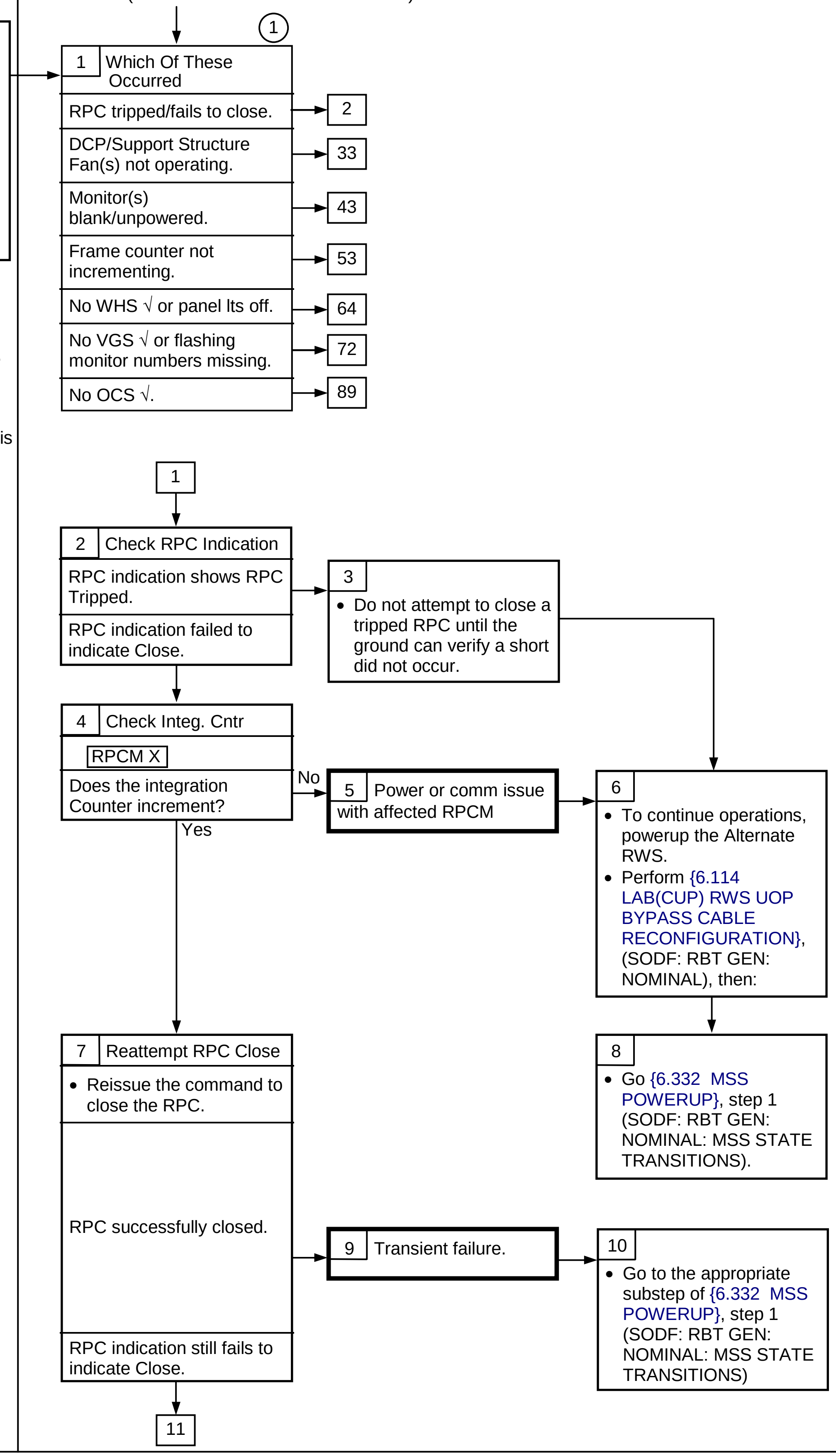
PMCU MDM configured for SEPS control.

Test Pattern routed to all monitors on affected RWS.

7.100 RWS POWER-UP FAILURE

(RBT GEN/X2R4 - ALL/FIN) Page 1 of 12 pages

{7.001 MSS FAILURE RESPONSE AND RECOVERY},
block 72 (SODF: RBT GEN: MALFUNCTION)



①

1 Which Of These Occurred

RPC tripped/fails to close. → 2

DCP/Support Structure Fan(s) not operating. → 33

Monitor(s) blank/unpowered. → 43

Frame counter not incrementing. → 53

No WHS √ or panel lts off. → 64

No VGS √ or flashing monitor numbers missing. → 72

No OCS √. → 89

1

2 Check RPC Indication

RPC indication shows RPC Tripped. → 3

RPC indication failed to indicate Close. → 4

3

- Do not attempt to close a tripped RPC until the ground can verify a short did not occur.

4 Check Integ. Cntr

RPCM X

Does the integration Counter increment?

No → 5

Yes → 7

5 Power or comm issue with affected RPCM

6

- To continue operations, powerup the Alternate RWS.
- Perform {6.114 LAB(CUP) RWS UOP BYPASS CABLE RECONFIGURATION}, (SODF: RBT GEN: NOMINAL), then:

8

- Go {6.332 MSS POWERUP}, step 1 (SODF: RBT GEN: NOMINAL: MSS STATE TRANSITIONS).

7 Reattempt RPC Close

- Reissue the command to close the RPC.

RPC successfully closed. → 9

RPC indication still fails to indicate Close. → 11

9 Transient failure.

10

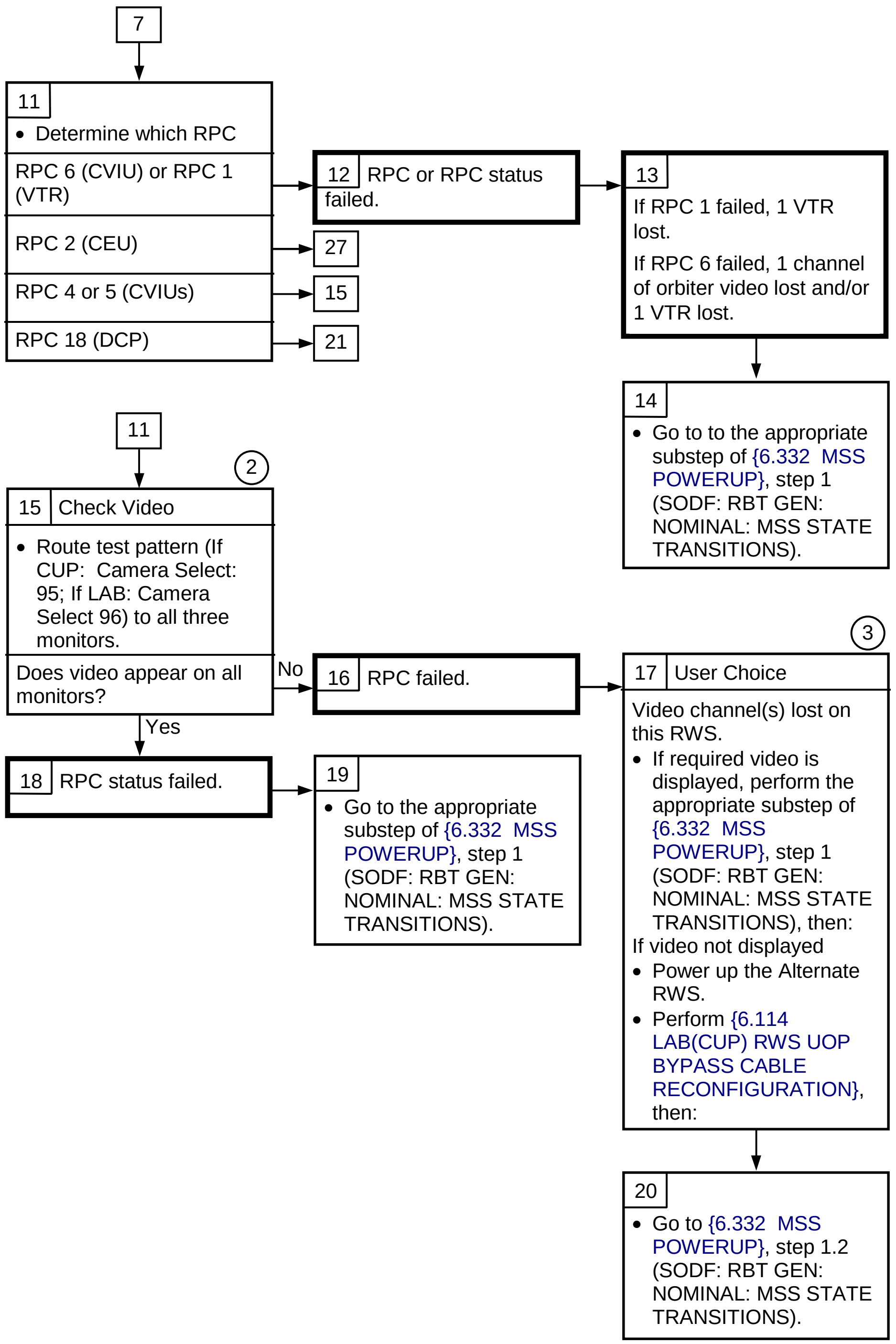
- Go to the appropriate substep of {6.332 MSS POWERUP}, step 1 (SODF: RBT GEN: NOMINAL: MSS STATE TRANSITIONS)

11

①
Unless otherwise indicated, all displays in this procedure are on the PCS.

7.100 RWS POWER-UP FAILURE

(RBT GEN/X2R4 - ALL/FIN) Page 2 of 12 pages



7

11
- Determine which RPC

RPC 6 (CVIU) or RPC 1 (VTR) → 12

RPC 2 (CEU) → 27

RPC 4 or 5 (CVIUs) → 15

RPC 18 (DCP) → 21

12 RPC or RPC status failed.

13 If RPC 1 failed, 1 VTR lost.

If RPC 6 failed, 1 channel of orbiter video lost and/or 1 VTR lost.

14
- Go to to the appropriate substep of {6.332 MSS POWERUP}, step 1 (SODF: RBT GEN: NOMINAL: MSS STATE TRANSITIONS).

11

15 Check Video ②
- Route test pattern (If CUP: Camera Select: 95; If LAB: Camera Select 96) to all three monitors.

Does video appear on all monitors?

No → 16

Yes → 18

16 RPC failed.

18 RPC status failed.

19
- Go to the appropriate substep of {6.332 MSS POWERUP}, step 1 (SODF: RBT GEN: NOMINAL: MSS STATE TRANSITIONS).

17 User Choice ③

Video channel(s) lost on this RWS.
- If required video is displayed, perform the appropriate substep of {6.332 MSS POWERUP}, step 1 (SODF: RBT GEN: NOMINAL: MSS STATE TRANSITIONS), then:

If video not displayed
- Power up the Alternate RWS.
- Perform {6.114 LAB(CUP) RWS UOP BYPASS CABLE RECONFIGURATION}, then:

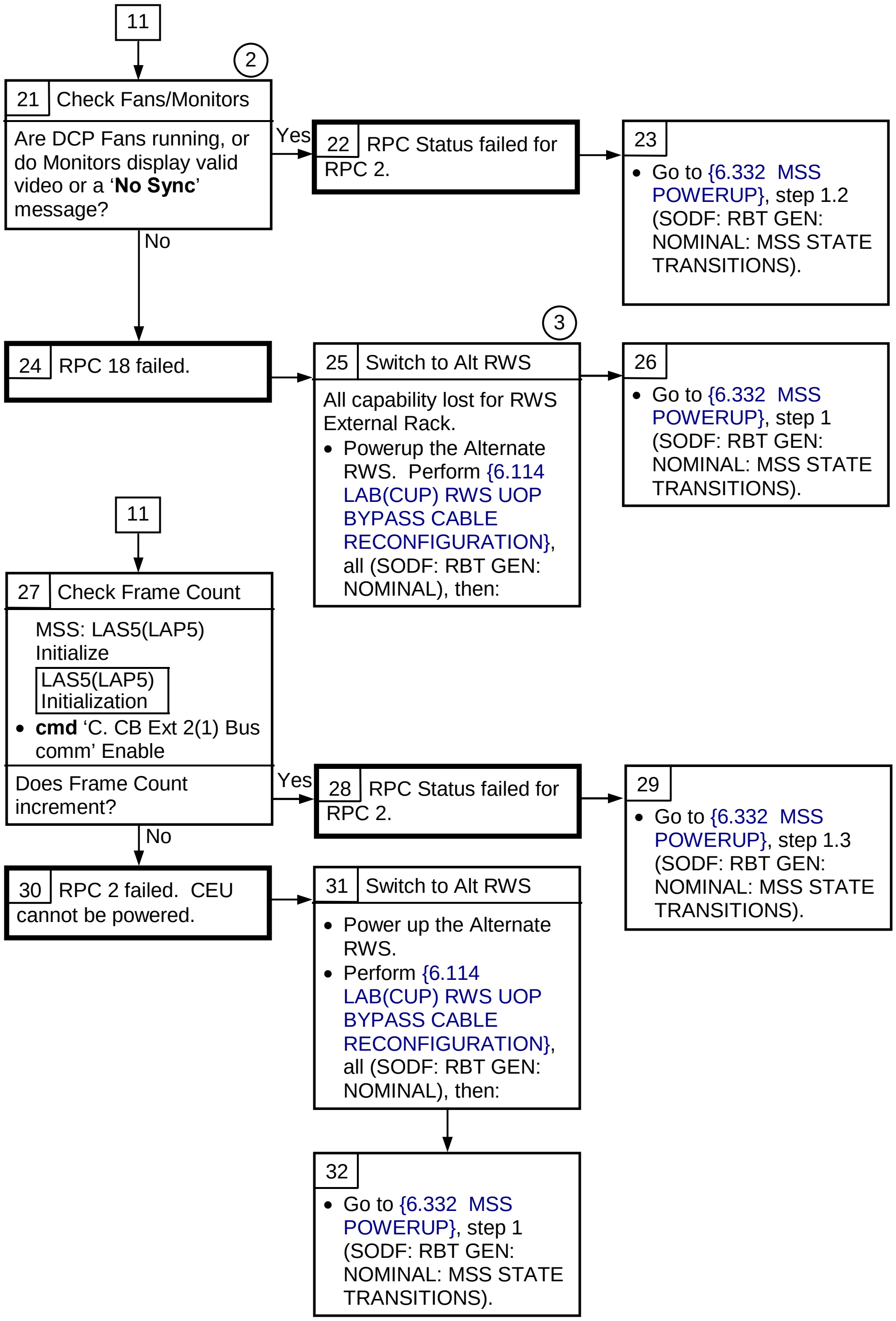
20
- Go to {6.332 MSS POWERUP}, step 1.2 (SODF: RBT GEN: NOMINAL: MSS STATE TRANSITIONS).

② This step can only be performed by onboard crew.

③ Ground will perform required steps for powerdown/cleanup.

7.100 RWS POWER-UP FAILURE

(RBT GEN/X2R4 - ALL/FIN) Page 3 of 12 pages



21 Check Fans/Monitors

Are DCP Fans running, or do Monitors display valid video or a '**No Sync**' message?

22 RPC Status failed for RPC 2.

23
- Go to {6.332 MSS POWERUP}, step 1.2 (SODF: RBT GEN: NOMINAL: MSS STATE TRANSITIONS).

24 RPC 18 failed.

25 Switch to Alt RWS

All capability lost for RWS External Rack.
- Powerup the Alternate RWS. Perform {6.114 LAB(CUP) RWS UOP BYPASS CABLE RECONFIGURATION}, all (SODF: RBT GEN: NOMINAL), then:

26
- Go to {6.332 MSS POWERUP}, step 1 (SODF: RBT GEN: NOMINAL: MSS STATE TRANSITIONS).

27 Check Frame Count

MSS: LAS5(LAP5) Initialize

LAS5(LAP5) Initialization
- **cmd** 'C. CB Ext 2(1) Bus comm' Enable

Does Frame Count increment?

28 RPC Status failed for RPC 2.

29
- Go to {6.332 MSS POWERUP}, step 1.3 (SODF: RBT GEN: NOMINAL: MSS STATE TRANSITIONS).

30 RPC 2 failed. CEU cannot be powered.

31 Switch to Alt RWS
- Power up the Alternate RWS.
- Perform {6.114 LAB(CUP) RWS UOP BYPASS CABLE RECONFIGURATION}, all (SODF: RBT GEN: NOMINAL), then:

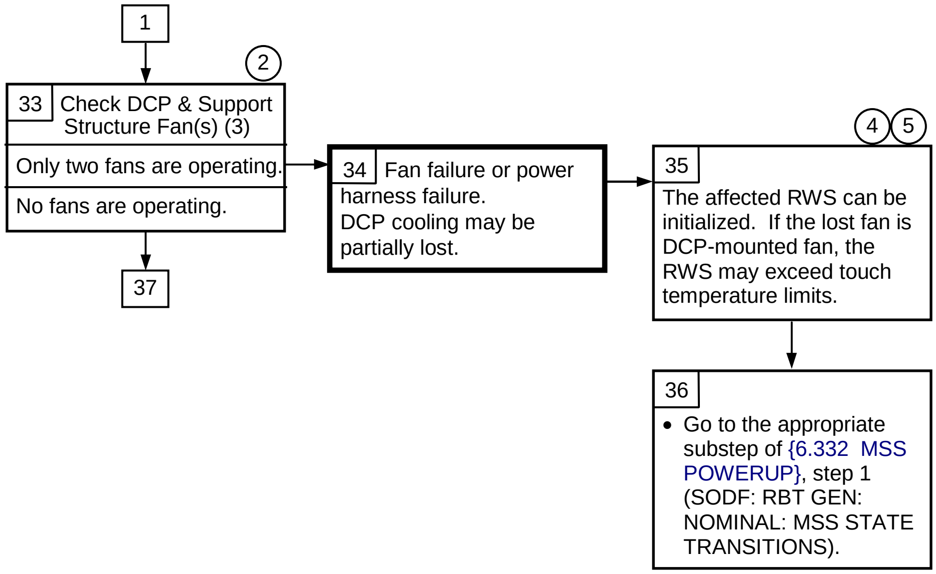
32
- Go to {6.332 MSS POWERUP}, step 1 (SODF: RBT GEN: NOMINAL: MSS STATE TRANSITIONS).

② This step can only be performed by onboard crew.

③ Ground will perform required steps for powerdown/cleanup.

7.100 RWS POWER-UP FAILURE

(RBT GEN/X2R4 - ALL/FIN) Page 4 of 12 pages



33 Check DCP & Support Structure Fan(s) (3)

Only two fans are operating.

No fans are operating.

34 Fan failure or power harness failure.
DCP cooling may be partially lost.

35 The affected RWS can be initialized. If the lost fan is DCP-mounted fan, the RWS may exceed touch temperature limits.

36
- Go to the appropriate substep of {6.332 MSS POWERUP}, step 1 (SODF: RBT GEN: NOMINAL: MSS STATE TRANSITIONS).

② This step can only be performed by onboard crew.

④ DCP touch temperature violation may occur. Analysis shows a potential overtemp of 2.6 deg with one fan failed.

⑤ The fan mounted underneath the PCS can be swapped out with a failed DCP fan to recover full DCP cooling.

7.100 RWS POWER-UP FAILURE

(RBT GEN/X2R4 - ALL/FIN) Page 5 of 12 pages

33

②

37 Powercycle DCP

- Prior to RPC opening, check if DCP Monitors are powered.

MSS: 'RPCM LAS5(LAP5)' 18

RPCM_LAS52A3B_A_RPC_18 (RPCM_LAP51A4A_A_RPC_18)

- **cmd** 'RPC Position' – Open (Verify – Op)

If monitors were unpowered prior to RPC opening

- **cmd** 'Close Cmd' – Inhibit (Verify – Inh)
- Check DCP J1, DCP J6, and UOP bypass cable connections (reference Figure 1), then:
- **cmd** 'Close Cmd' – Enable (Verify – Ena)
- **cmd** 'RPC Position' – Close (Verify – Cl)

Are monitors and fans powered?

No

38 DCP (power card or power harness) failure.

② ⑥

39 Switch to Alt RWS

- Power down this DCP, perform {6.334 MSS POWERDOWN}, step 5 (SODF: RBT GEN: NOMINAL: MSS STATE TRANSITIONS), then:

To disconnect the UOP bypass cable (DCP J1) for this RWS and connect it for the Alternate RWS,

- Perform {6.114 LAB(CUP) RWS UOP BYPASS CABLE RECONFIGURATION} (SODF: RBT GEN: NOMINAL), then:

42

- To power up Alternate RWS, go to {6.332 MSS POWERUP}, step 1 (SODF: RBT GEN: NOMINAL: MSS STATE TRANSITIONS).

Yes

40 Transient failure.

⑦

41

- Perform the appropriate substep of {6.332 MSS POWERUP}, step 1 (SODF: RBT GEN: NOMINAL: MSS STATE TRANSITIONS), then:
- Route test pattern (If CUP: Camera Select: 95; If LAB: Camera Select: 96) to all three monitors.

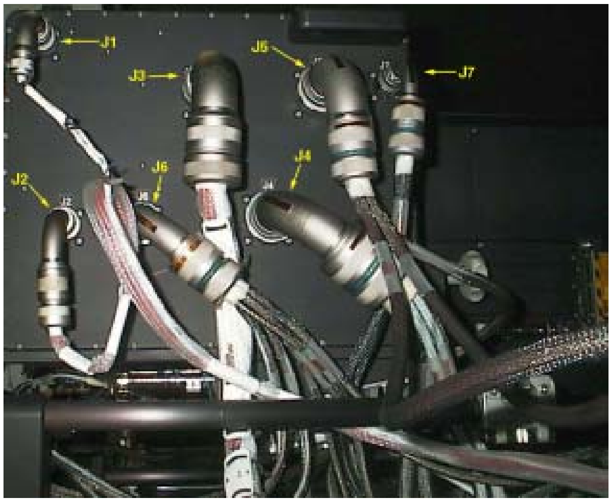


Figure 1. DCP Cables.

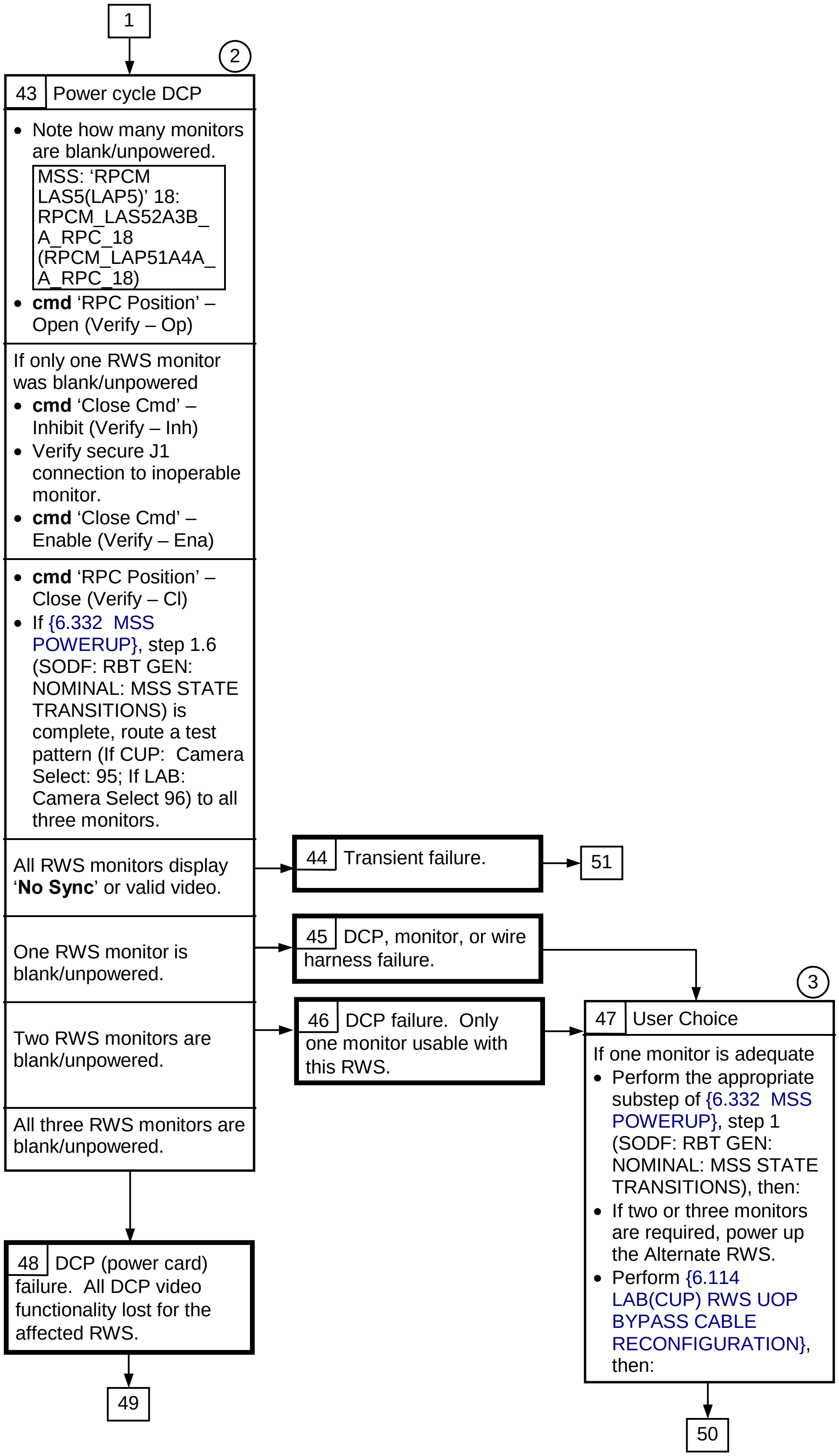
② This step can only be performed by onboard crew.

⑥ If monitors are powered, the affected RWS can be initialized, but the DCP will overheat.

⑦ Reroute video if necessary to clean up monitor view.

7.100 RWS POWER-UP FAILURE

(RBT GEN/X2R4 - ALL/FIN) Page 6 of 12 pages



43 Power cycle DCP

- Note how many monitors are blank/unpowered.

MSS: 'RPCM LAS5(LAP5)' 18: RPCM_LAS52A3B_A_RPC_18 (RPCM_LAP51A4A_A_RPC_18)

- **cmd** 'RPC Position' – Open (Verify – Op)

If only one RWS monitor was blank/unpowered

- **cmd** 'Close Cmd' – Inhibit (Verify – Inh)
- Verify secure J1 connection to inoperable monitor.
- **cmd** 'Close Cmd' – Enable (Verify – Ena)

- **cmd** 'RPC Position' – Close (Verify – Cl)
- If {6.332 MSS POWERUP}, step 1.6 (SODF: RBT GEN: NOMINAL: MSS STATE TRANSITIONS) is complete, route a test pattern (If CUP: Camera Select: 95; If LAB: Camera Select 96) to all three monitors.

All RWS monitors display '**No Sync**' or valid video. → 44 Transient failure. → 51

One RWS monitor is blank/unpowered. → 45 DCP, monitor, or wire harness failure. → 47

Two RWS monitors are blank/unpowered. → 46 DCP failure. Only one monitor usable with this RWS. → 47

All three RWS monitors are blank/unpowered. → 48 DCP (power card) failure. All DCP video functionality lost for the affected RWS. → 49

47 User Choice

If one monitor is adequate

- Perform the appropriate substep of {6.332 MSS POWERUP}, step 1 (SODF: RBT GEN: NOMINAL: MSS STATE TRANSITIONS), then:
- If two or three monitors are required, power up the Alternate RWS.
- Perform {6.114 LAB(CUP) RWS UOP BYPASS CABLE RECONFIGURATION}, then:

→ 50

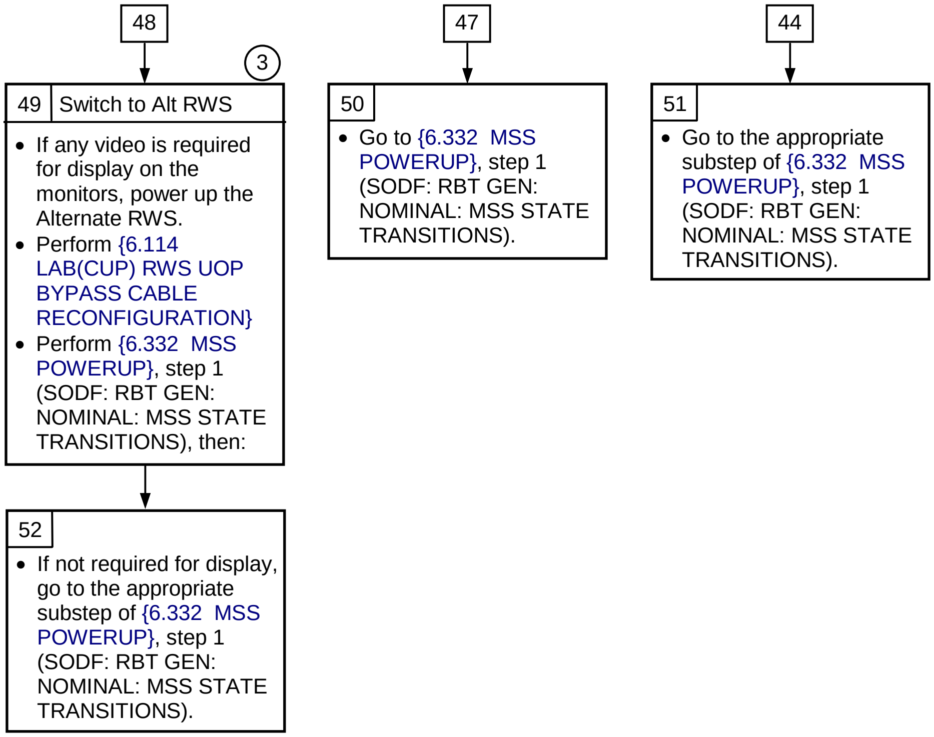
② This step can only be performed by onboard crew.

③ Ground will perform required steps for powerdown/cleanup.

MSS

7.100 RWS POWER-UP FAILURE

(RBT GEN/X2R4 - ALL/FIN) Page 7 of 12 pages



49 Switch to Alt RWS ③

- If any video is required for display on the monitors, power up the Alternate RWS.
- Perform {6.114 LAB(CUP) RWS UOP BYPASS CABLE RECONFIGURATION}
- Perform {6.332 MSS POWERUP}, step 1 (SODF: RBT GEN: NOMINAL: MSS STATE TRANSITIONS), then:

52

- If not required for display, go to the appropriate substep of {6.332 MSS POWERUP}, step 1 (SODF: RBT GEN: NOMINAL: MSS STATE TRANSITIONS).

50

- Go to {6.332 MSS POWERUP}, step 1 (SODF: RBT GEN: NOMINAL: MSS STATE TRANSITIONS).

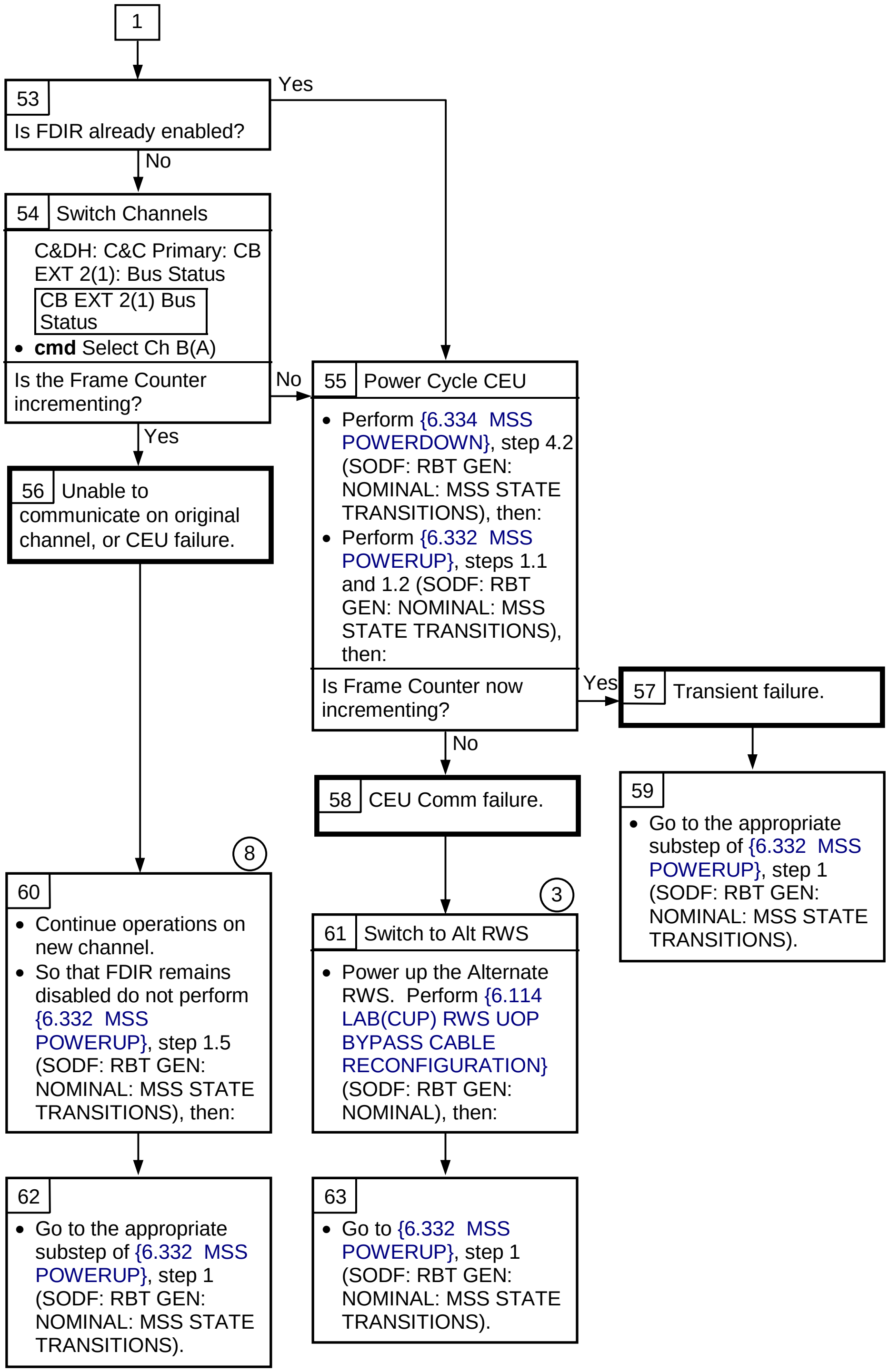
51

- Go to the appropriate substep of {6.332 MSS POWERUP}, step 1 (SODF: RBT GEN: NOMINAL: MSS STATE TRANSITIONS).

③ Ground will perform required steps for powerdown/cleanup.

7.100 RWS POWER-UP FAILURE

(RBT GEN/X2R4 - ALL/FIN) Page 8 of 12 pages



53 Is FDIR already enabled?

54 Switch Channels

C&DH: C&C Primary: CB EXT 2(1): Bus Status

CB EXT 2(1) Bus Status

- **cmd** Select Ch B(A)

Is the Frame Counter incrementing?

55 Power Cycle CEU

- Perform {6.334 MSS POWERDOWN}, step 4.2 (SODF: RBT GEN: NOMINAL: MSS STATE TRANSITIONS), then:
- Perform {6.332 MSS POWERUP}, steps 1.1 and 1.2 (SODF: RBT GEN: NOMINAL: MSS STATE TRANSITIONS), then:

Is Frame Counter now incrementing?

56 Unable to communicate on original channel, or CEU failure.

57 Transient failure.

58 CEU Comm failure.

59

- Go to the appropriate substep of {6.332 MSS POWERUP}, step 1 (SODF: RBT GEN: NOMINAL: MSS STATE TRANSITIONS).

60

- Continue operations on new channel.
- So that FDIR remains disabled do not perform {6.332 MSS POWERUP}, step 1.5 (SODF: RBT GEN: NOMINAL: MSS STATE TRANSITIONS), then:

61 Switch to Alt RWS

- Power up the Alternate RWS. Perform {6.114 LAB(CUP) RWS UOP BYPASS CABLE RECONFIGURATION} (SODF: RBT GEN: NOMINAL), then:

62

- Go to the appropriate substep of {6.332 MSS POWERUP}, step 1 (SODF: RBT GEN: NOMINAL: MSS STATE TRANSITIONS).

63

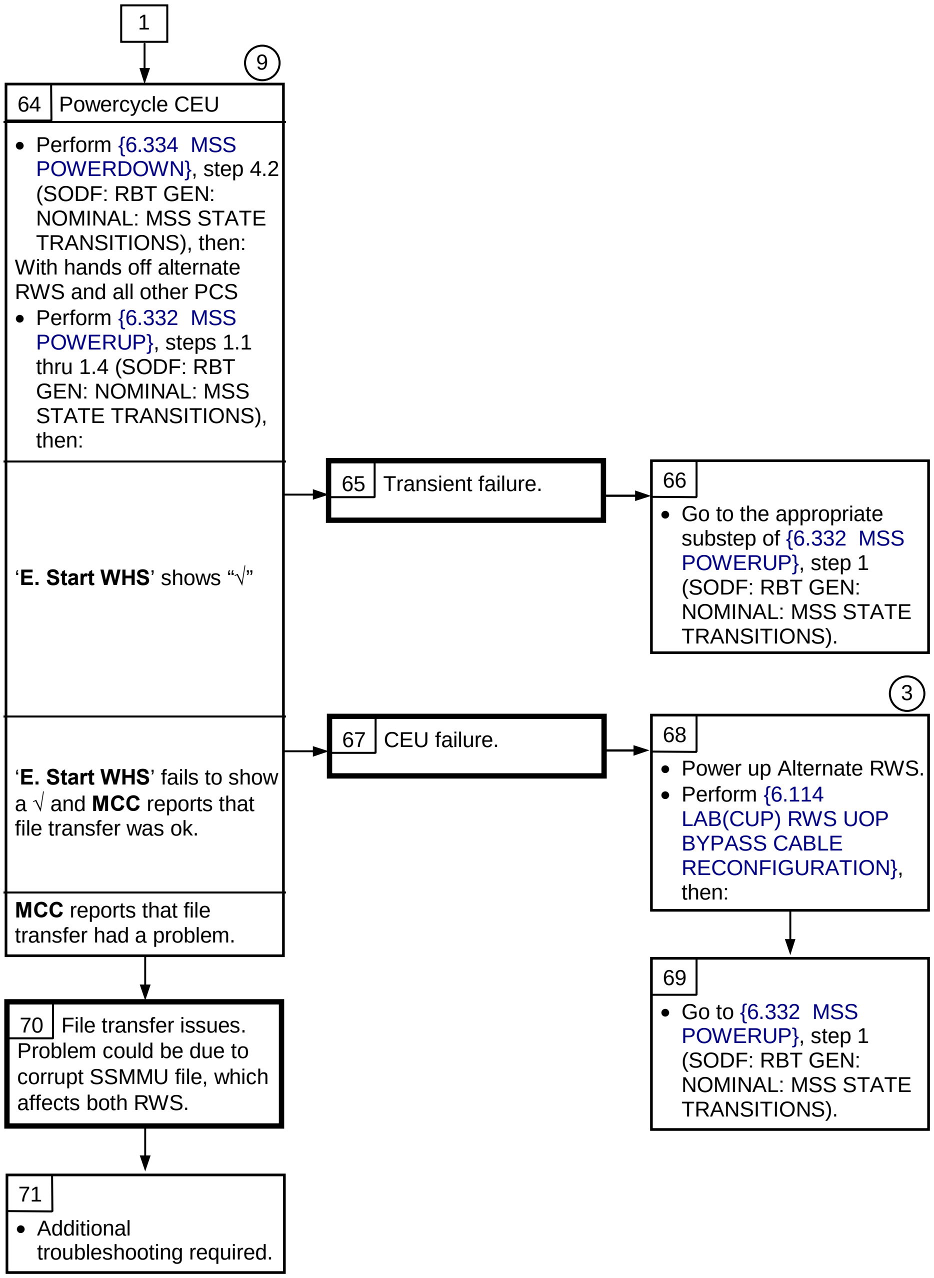
- Go to {6.332 MSS POWERUP}, step 1 (SODF: RBT GEN: NOMINAL: MSS STATE TRANSITIONS).

③ Ground will perform required steps for powerdown/cleanup.

⑧ A comm failure in any of the other RT's on CB-EXT1(2) may cause the C&C to swap back to the channel on which the CEU cannot communicate. If that occurs, the ground will to determine which of the two failed RTs are required.

7.100 RWS POWER-UP FAILURE

(RBT GEN/X2R4 - ALL/FIN) Page 9 of 12 pages



1

⑨

64 Powercycle CEU

- Perform {6.334 MSS POWERDOWN}, step 4.2 (SODF: RBT GEN: NOMINAL: MSS STATE TRANSITIONS), then:

With hands off alternate RWS and all other PCS

- Perform {6.332 MSS POWERUP}, steps 1.1 thru 1.4 (SODF: RBT GEN: NOMINAL: MSS STATE TRANSITIONS), then:

‘**E. Start WHS**’ shows “√”

65 Transient failure.

66

- Go to the appropriate substep of {6.332 MSS POWERUP}, step 1 (SODF: RBT GEN: NOMINAL: MSS STATE TRANSITIONS).

‘**E. Start WHS**’ fails to show a √ and **MCC** reports that file transfer was ok.

67 CEU failure.

③

68

- Power up Alternate RWS.
- Perform {6.114 LAB(CUP) RWS UOP BYPASS CABLE RECONFIGURATION}, then:

69

- Go to {6.332 MSS POWERUP}, step 1 (SODF: RBT GEN: NOMINAL: MSS STATE TRANSITIONS).

MCC reports that file transfer had a problem.

70 File transfer issues. Problem could be due to corrupt SSMMU file, which affects both RWS.

71

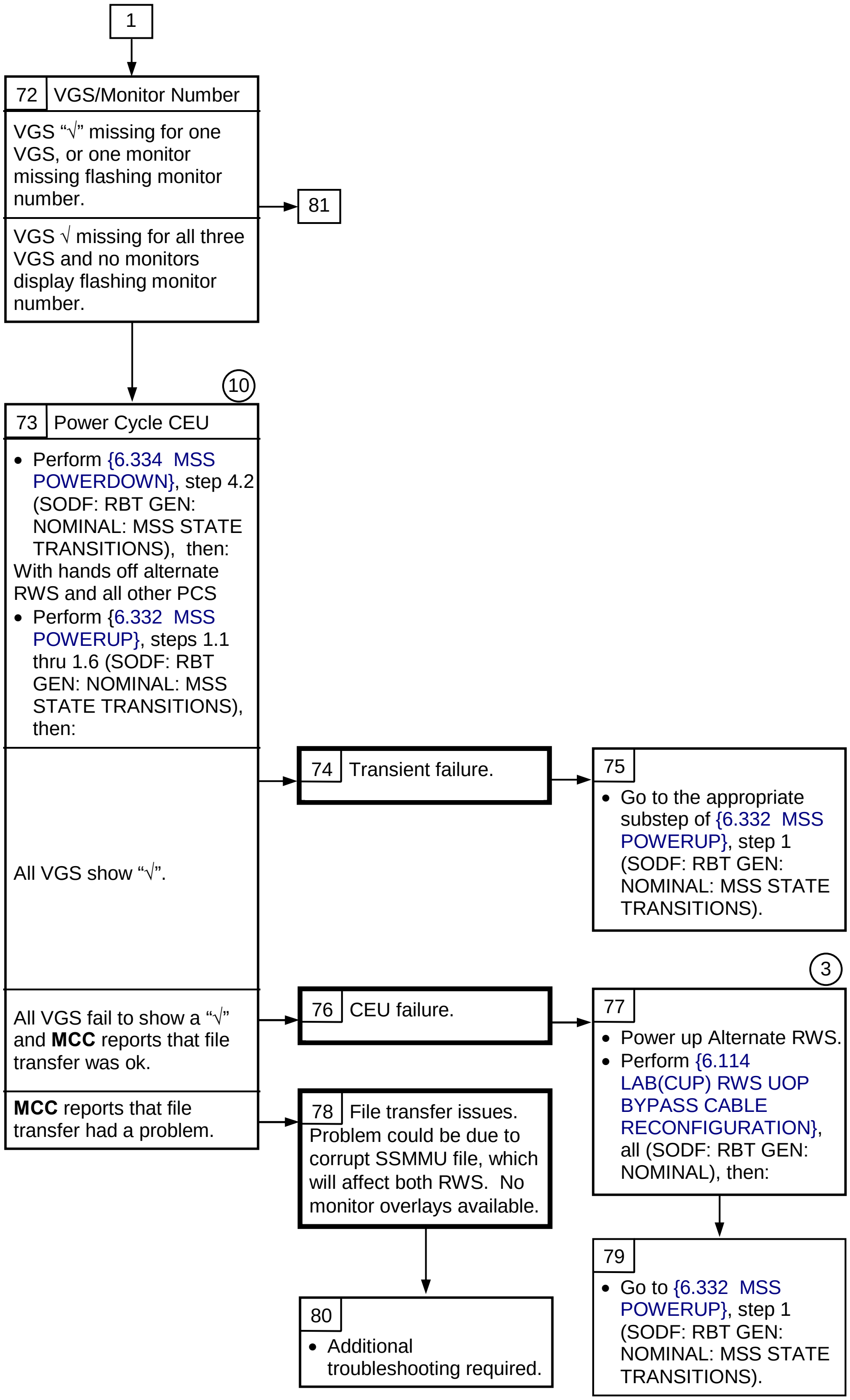
- Additional troubleshooting required.

③
Ground will perform required steps for powerdown/cleanup.

⑨
Ground must verify correct WHS file size and proper completion of file download.

7.100 RWS POWER-UP FAILURE

(RBT GEN/X2R4 - ALL/FIN) Page 10 of 12 pages



72 VGS/Monitor Number

VGS "√" missing for one VGS, or one monitor missing flashing monitor number. → 81

VGS √ missing for all three VGS and no monitors display flashing monitor number. → 73

73 Power Cycle CEU

- Perform {6.334 MSS POWERDOWN}, step 4.2 (SODF: RBT GEN: NOMINAL: MSS STATE TRANSITIONS), then:

With hands off alternate RWS and all other PCS

- Perform {6.332 MSS POWERUP}, steps 1.1 thru 1.6 (SODF: RBT GEN: NOMINAL: MSS STATE TRANSITIONS), then:

All VGS show "√". → 74

All VGS fail to show a "√" and **MCC** reports that file transfer was ok. → 76

MCC reports that file transfer had a problem. → 78

74 Transient failure. → 75

75

- Go to the appropriate substep of {6.332 MSS POWERUP}, step 1 (SODF: RBT GEN: NOMINAL: MSS STATE TRANSITIONS).

76 CEU failure. → 77

77

- Power up Alternate RWS.
- Perform {6.114 LAB(CUP) RWS UOP BYPASS CABLE RECONFIGURATION}, all (SODF: RBT GEN: NOMINAL), then:

79

- Go to {6.332 MSS POWERUP}, step 1 (SODF: RBT GEN: NOMINAL: MSS STATE TRANSITIONS).

78 File transfer issues. Problem could be due to corrupt SSMMU file, which will affect both RWS. No monitor overlays available.

80

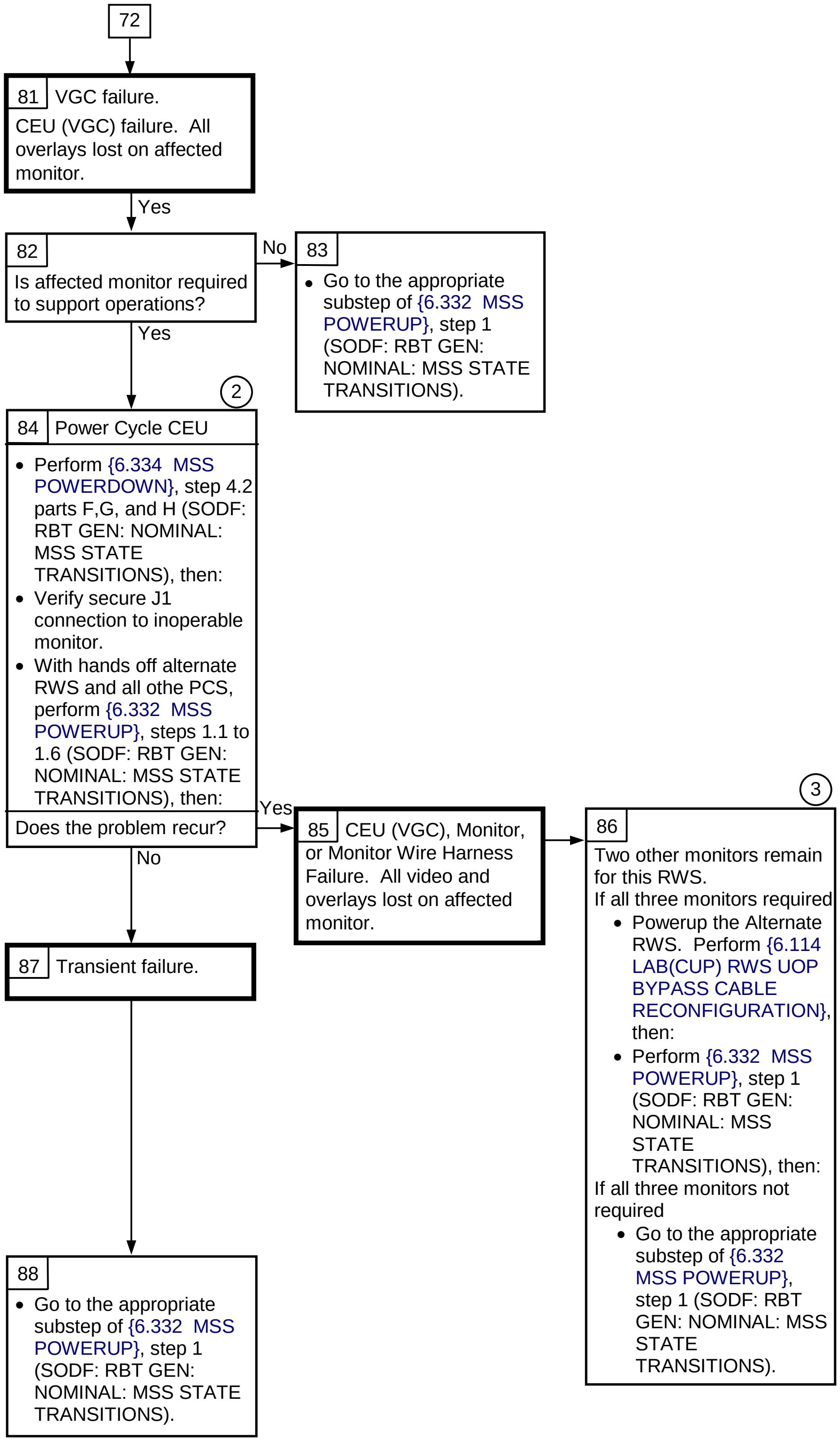
- Additional troubleshooting required.

③ Ground will perform required steps for powerdown/cleanup.

⑩ Ground must verify correct VGS file size and proper completion of file download.

7.100 RWS POWER-UP FAILURE

(RBT GEN/X2R4 - ALL/FIN) Page 11 of 12 pages



81 VGC failure.
CEU (VGC) failure. All overlays lost on affected monitor.

82
Is affected monitor required to support operations?

83
- Go to the appropriate substep of {6.332 MSS POWERUP}, step 1 (SODF: RBT GEN: NOMINAL: MSS STATE TRANSITIONS).

84 Power Cycle CEU
- Perform {6.334 MSS POWERDOWN}, step 4.2 parts F,G, and H (SODF: RBT GEN: NOMINAL: MSS STATE TRANSITIONS), then:
- Verify secure J1 connection to inoperable monitor.
- With hands off alternate RWS and all othe PCS, perform {6.332 MSS POWERUP}, steps 1.1 to 1.6 (SODF: RBT GEN: NOMINAL: MSS STATE TRANSITIONS), then:

Does the problem recur?

85 CEU (VGC), Monitor, or Monitor Wire Harness Failure. All video and overlays lost on affected monitor.

86
Two other monitors remain for this RWS.
If all three monitors required
- Powerup the Alternate RWS. Perform {6.114 LAB(CUP) RWS UOP BYPASS CABLE RECONFIGURATION}, then:
- Perform {6.332 MSS POWERUP}, step 1 (SODF: RBT GEN: NOMINAL: MSS STATE TRANSITIONS), then:

If all three monitors not required
- Go to the appropriate substep of {6.332 MSS POWERUP}, step 1 (SODF: RBT GEN: NOMINAL: MSS STATE TRANSITIONS).

87 Transient failure.

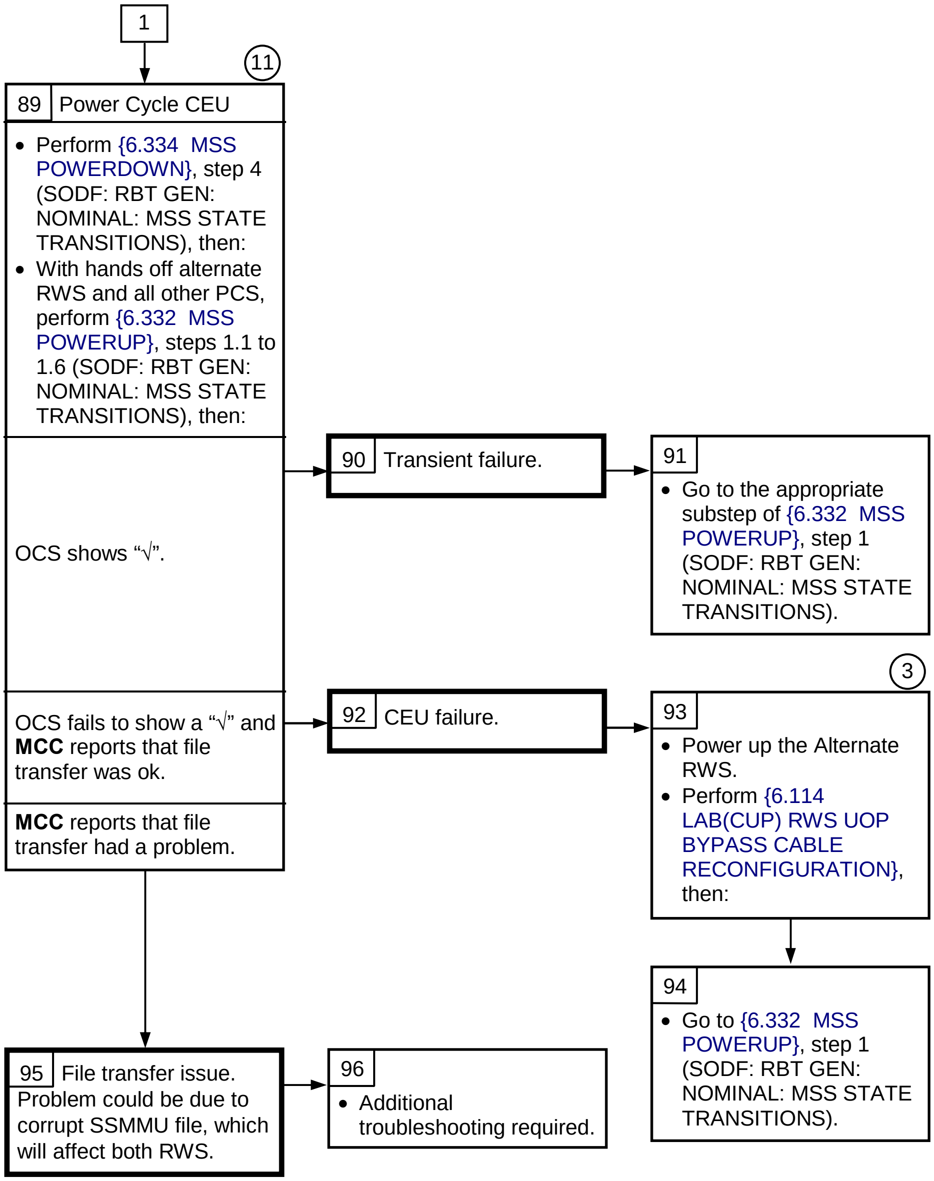
88
- Go to the appropriate substep of {6.332 MSS POWERUP}, step 1 (SODF: RBT GEN: NOMINAL: MSS STATE TRANSITIONS).

② This step can only be performed by onboard crew.

③ Ground will perform required steps for powerdown/cleanup.

7.100 RWS POWER-UP FAILURE

(RBT GEN/X2R4 - ALL/FIN) Page 12 of 12 pages



89 Power Cycle CEU

- Perform {6.334 MSS POWERDOWN}, step 4 (SODF: RBT GEN: NOMINAL: MSS STATE TRANSITIONS), then:
- With hands off alternate RWS and all other PCS, perform {6.332 MSS POWERUP}, steps 1.1 to 1.6 (SODF: RBT GEN: NOMINAL: MSS STATE TRANSITIONS), then:

OCS shows “√”.

OCS fails to show a “√” and **MCC** reports that file transfer was ok.

MCC reports that file transfer had a problem.

90 Transient failure.

91

- Go to the appropriate substep of {6.332 MSS POWERUP}, step 1 (SODF: RBT GEN: NOMINAL: MSS STATE TRANSITIONS).

92 CEU failure.

93

- Power up the Alternate RWS.
- Perform {6.114 LAB(CUP) RWS UOP BYPASS CABLE RECONFIGURATION}, then:

94

- Go to {6.332 MSS POWERUP}, step 1 (SODF: RBT GEN: NOMINAL: MSS STATE TRANSITIONS).

95 File transfer issue. Problem could be due to corrupt SSMMU file, which will affect both RWS.

96

- Additional troubleshooting required.

③
Ground will perform required steps for powerdown/cleanup.

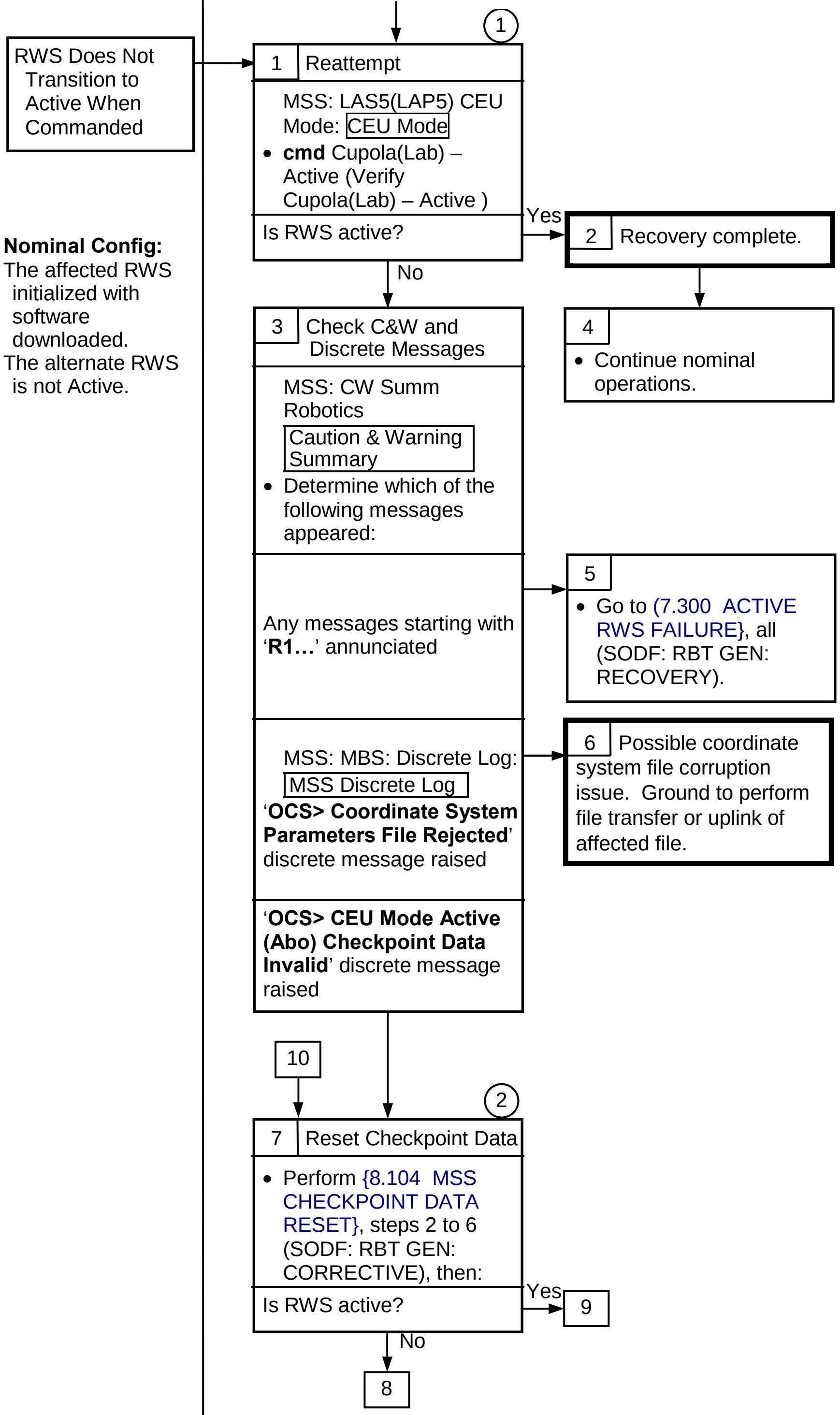
⑪
Ground must verify correct OCS file size and proper completion of file download.

C&W
ROBOTICS

7.101 RWS TRANSITION TO ACTIVE FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 1 of 2 pages

{7.001 MSS FAILURE RESPONSE AND RECOVERY}, block 73 (SODF: RBT GEN: MALFUNCTION)



RWS Does Not Transition to Active When Commanded

① 1 Reattempt

MSS: LAS5(LAP5) CEU Mode: CEU Mode

- **cmd** Cupola(Lab) – Active (Verify Cupola(Lab) – Active)

Is RWS active?

Yes → 2 Recovery complete.

4

- Continue nominal operations.

No → 3 Check C&W and Discrete Messages

MSS: CW Summ Robotics
Caution & Warning Summary

- Determine which of the following messages appeared:

Any messages starting with ‘**R1…**’ annunciated → 5

- Go to {7.300 ACTIVE RWS FAILURE}, all (SODF: RBT GEN: RECOVERY).

MSS: MBS: Discrete Log:
MSS Discrete Log
‘**OCS> Coordinate System Parameters File Rejected**’ discrete message raised → 6 Possible coordinate system file corruption issue. Ground to perform file transfer or uplink of affected file.

‘**OCS> CEU Mode Active (Abo) Checkpoint Data Invalid**’ discrete message raised

10

② 7 Reset Checkpoint Data

- Perform {8.104 MSS CHECKPOINT DATA RESET}, steps 2 to 6 (SODF: RBT GEN: CORRECTIVE), then:

Is RWS active?

Yes → 9

No → 8

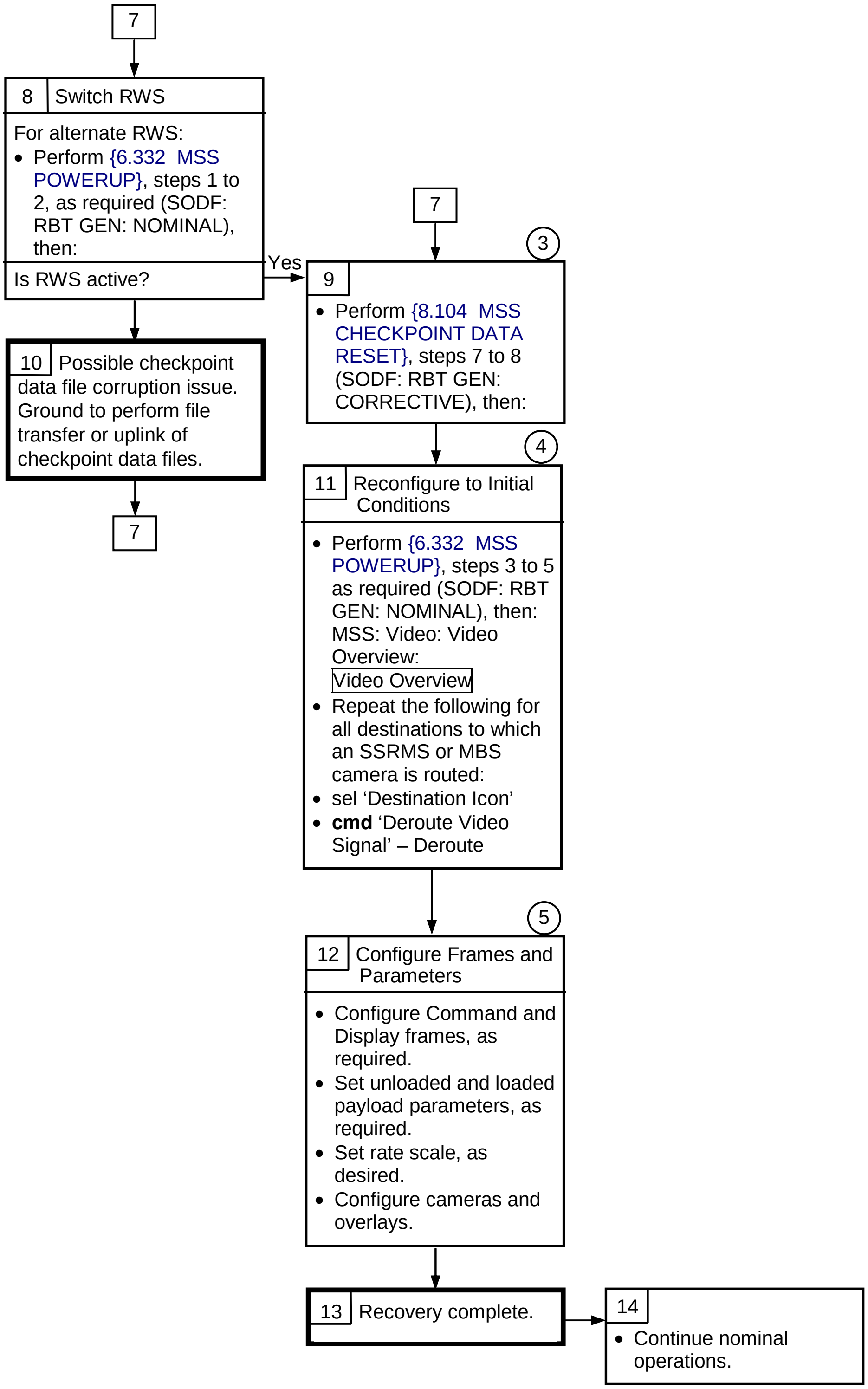
Nominal Config:
The affected RWS initialized with software downloaded.
The alternate RWS is not Active.

① Unless otherwise indicated, all displays in the procedure are on the PCS.

② SCR 24574

7.101 RWS TRANSITION TO ACTIVE FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 2 of 2 pages



8 Switch RWS

For alternate RWS:

- Perform {6.332 MSS POWERUP}, steps 1 to 2, as required (SODF: RBT GEN: NOMINAL), then:

Is RWS active?

9

- Perform {8.104 MSS CHECKPOINT DATA RESET}, steps 7 to 8 (SODF: RBT GEN: CORRECTIVE), then:

10 Possible checkpoint data file corruption issue. Ground to perform file transfer or uplink of checkpoint data files.

11 Reconfigure to Initial Conditions

- Perform {6.332 MSS POWERUP}, steps 3 to 5 as required (SODF: RBT GEN: NOMINAL), then:
  MSS: Video: Video Overview:
  Video Overview
- Repeat the following for all destinations to which an SSRMS or MBS camera is routed:
- sel ‘Destination Icon’
- **cmd** ‘Deroute Video Signal’ – Deroute

12 Configure Frames and Parameters

- Configure Command and Display frames, as required.
- Set unloaded and loaded payload parameters, as required.
- Set rate scale, as desired.
- Configure cameras and overlays.

13 Recovery complete.

14

- Continue nominal operations.

③ LEE and POA calibrations are lost. Use hard stops until calibrated.

④ Video deroutes are only required if video routes were in place at the time of the MSS powerdown.

⑤ The steps in this block can only be performed after the SSRMS has been powered up to Operational.

MBS

7.110 MBS POWER-UP FROM OFF TO KA FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 1 of 3 pages

① All displays in this procedure are on the PCS.

② An inability to provide power to both MBS strings indicates an EXT MDM (or lower tier Truss MDM) problem.

Nominal Config:
RWS powered and in Active state.

MT SSBAs powered.

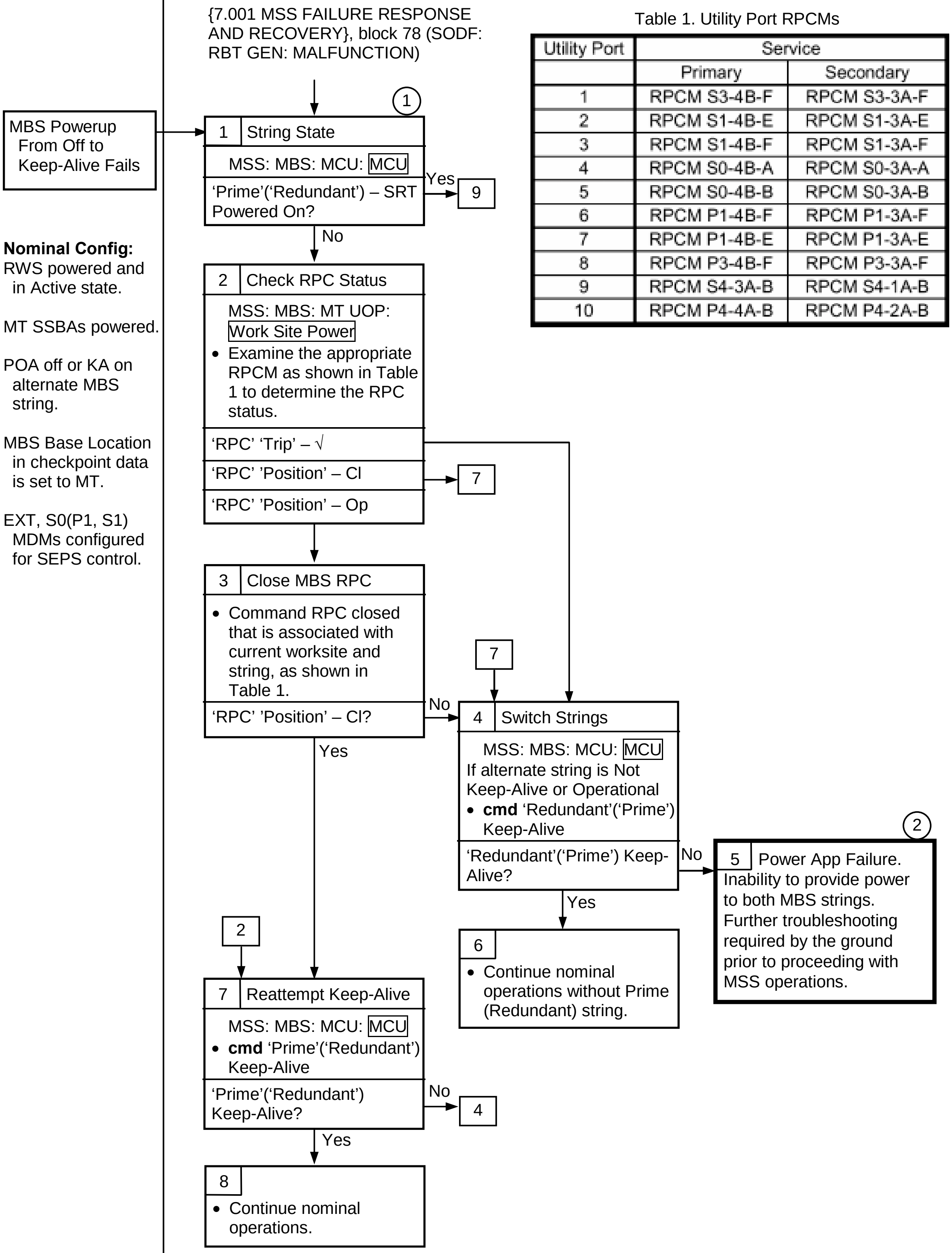
POA off or KA on alternate MBS string.

MBS Base Location in checkpoint data is set to MT.

EXT, S0(P1, S1) MDMs configured for SEPS control.

Table 1. Utility Port RPCMs

Utility Port	Service	
	Primary	Secondary
1	RPCM S3-4B-F	RPCM S3-3A-F
2	RPCM S1-4B-E	RPCM S1-3A-E
3	RPCM S1-4B-F	RPCM S1-3A-F
4	RPCM S0-4B-A	RPCM S0-3A-A
5	RPCM S0-4B-B	RPCM S0-3A-B
6	RPCM P1-4B-F	RPCM P1-3A-F
7	RPCM P1-4B-E	RPCM P1-3A-E
8	RPCM P3-4B-F	RPCM P3-3A-F
9	RPCM S4-3A-B	RPCM S4-1A-B
10	RPCM P4-4A-B	RPCM P4-2A-B



{7.001 MSS FAILURE RESPONSE AND RECOVERY}, block 78 (SODF: RBT GEN: MALFUNCTION)

MBS Powerup From Off to Keep-Alive Fails

1 String State ①
MSS: MBS: MCU: MCU
'Prime'('Redundant') – SRT Powered On?
Yes → 9
No ↓

2 Check RPC Status
MSS: MBS: MT UOP: Work Site Power
- Examine the appropriate RPCM as shown in Table 1 to determine the RPC status.

'RPC' 'Trip' – √ → 4
'RPC' 'Position' – Cl → 7
'RPC' 'Position' – Op ↓

3 Close MBS RPC
- Command RPC closed that is associated with current worksite and string, as shown in Table 1.

'RPC' 'Position' – Cl?
No → 4
Yes → 7

7 → 4 Switch Strings
MSS: MBS: MCU: MCU
If alternate string is Not Keep-Alive or Operational
- **cmd** 'Redundant'('Prime') Keep-Alive

'Redundant'('Prime') Keep-Alive?
No → 5
Yes → 6

5 Power App Failure. ②
Inability to provide power to both MBS strings. Further troubleshooting required by the ground prior to proceeding with MSS operations.

6
- Continue nominal operations without Prime (Redundant) string.

2 → 7 Reattempt Keep-Alive
MSS: MBS: MCU: MCU
- **cmd** 'Prime'('Redundant') Keep-Alive

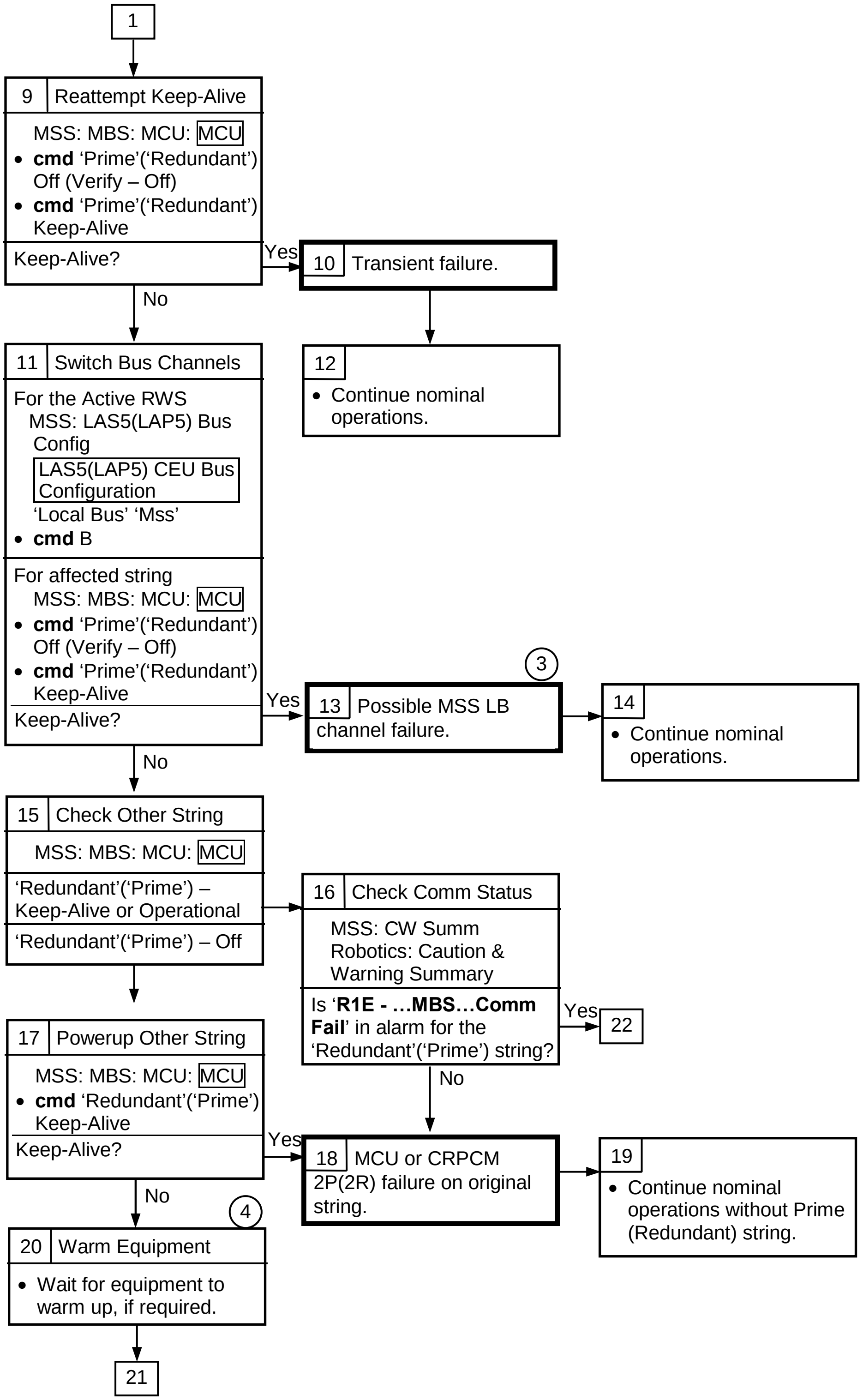
'Prime'('Redundant') Keep-Alive?
No → 4
Yes → 8

8
- Continue nominal operations.

MBS

7.110 MBS POWER-UP FROM OFF TO KA FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 2 of 3 pages



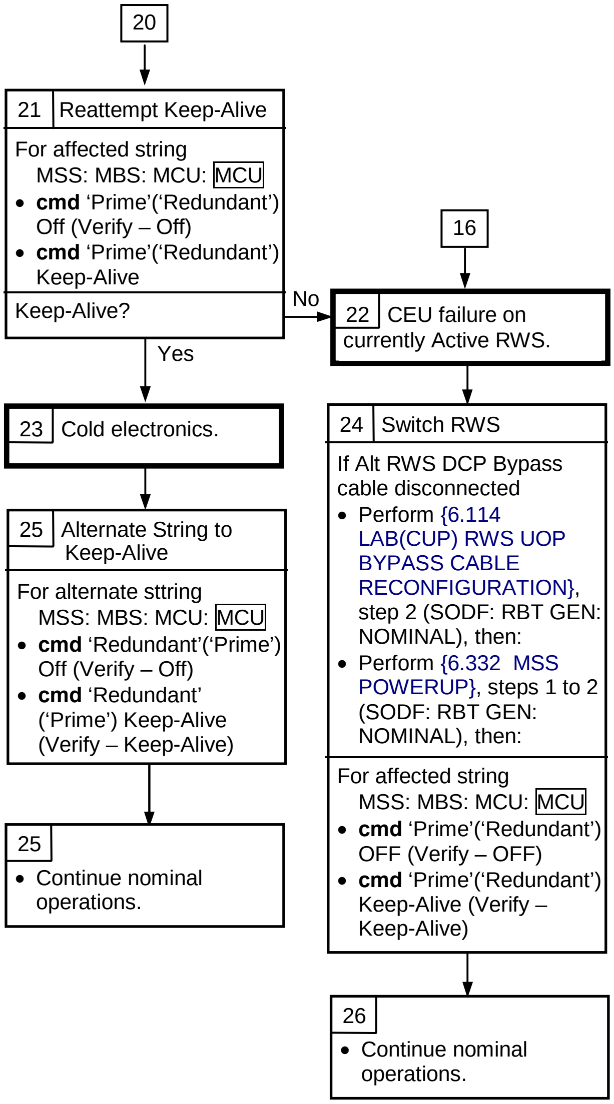
③ The communication bus between the RWS and MBS consists of 1553 converter cards in the CEU and MCU, and the 1553 cables in the wire harnesses. If any of these fail, at least one channel will be affected.

④ Ground can determine required length of wait time or whether it is required.

MBS

7.110 MBS POWER-UP FROM OFF TO KA FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 3 of 3 pages



21 Reattempt Keep-Alive

For affected string
MSS: MBS: MCU: MCU
- **cmd** ‘Prime’(‘Redundant’) Off (Verify – Off)
- **cmd** ‘Prime’(‘Redundant’) Keep-Alive

Keep-Alive?

22 CEU failure on currently Active RWS.

23 Cold electronics.

24 Switch RWS

If Alt RWS DCP Bypass cable disconnected
- Perform {6.114 LAB(CUP) RWS UOP BYPASS CABLE RECONFIGURATION}, step 2 (SODF: RBT GEN: NOMINAL), then:
- Perform {6.332 MSS POWERUP}, steps 1 to 2 (SODF: RBT GEN: NOMINAL), then:

For affected string
MSS: MBS: MCU: MCU
- **cmd** ‘Prime’(‘Redundant’) OFF (Verify – OFF)
- **cmd** ‘Prime’(‘Redundant’) Keep-Alive (Verify – Keep-Alive)

25 Alternate String to Keep-Alive

For alternate sttring
MSS: MBS: MCU: MCU
- **cmd** ‘Redundant’(‘Prime’) Off (Verify – Off)
- **cmd** ‘Redundant’ (‘Prime’) Keep-Alive (Verify – Keep-Alive)

25
- Continue nominal operations.

26
- Continue nominal operations.

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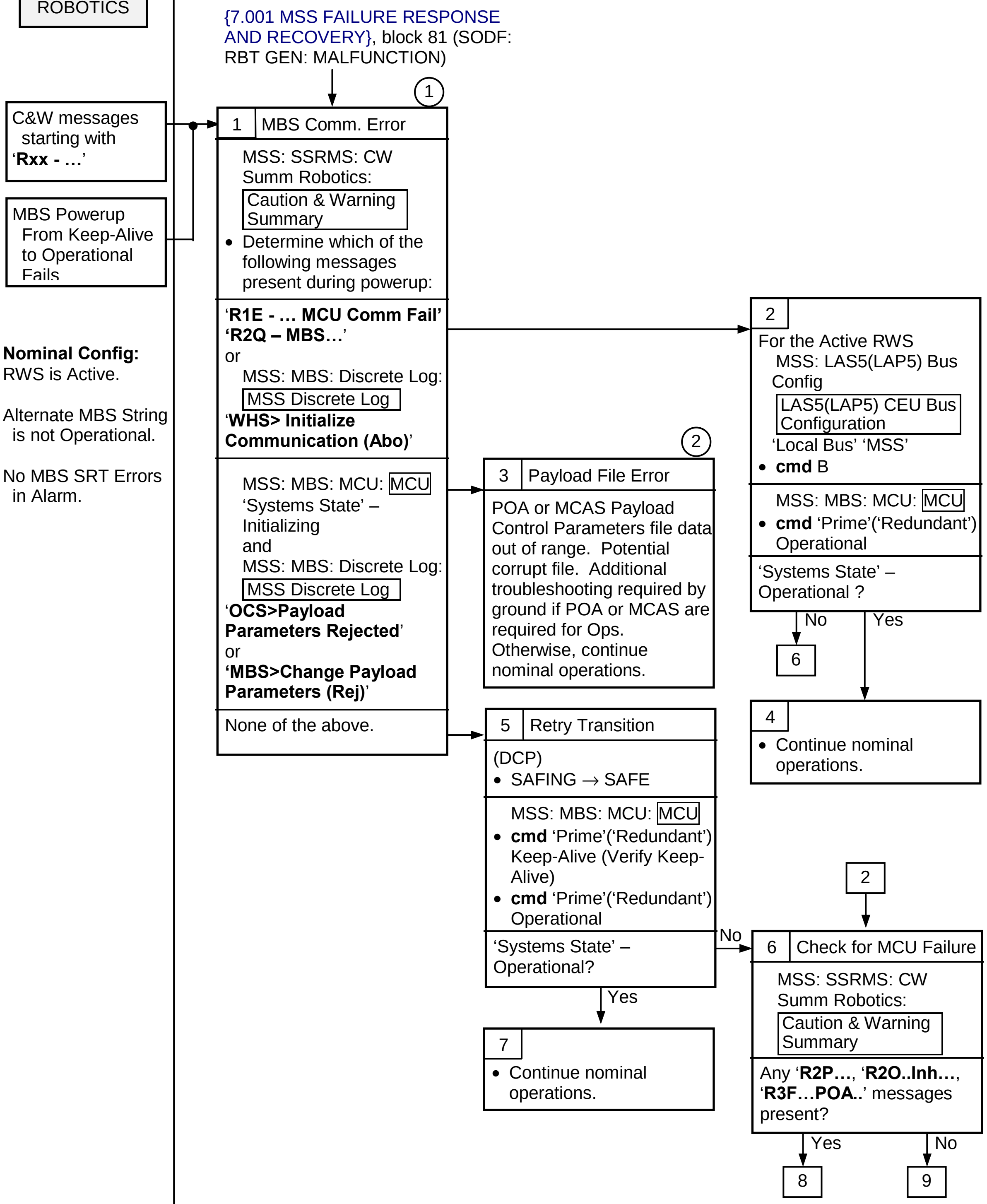
7.111 MBS POWER-UP FROM KA TO OPERATIONAL FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 1 of 2 pages



{7.001 MSS FAILURE RESPONSE AND RECOVERY}, block 81 (SODF: RBT GEN: MALFUNCTION)

C&W messages starting with '**Rxx - …**'

MBS Powerup From Keep-Alive to Operational Fails

1 MBS Comm. Error ①

MSS: SSRMS: CW Summ Robotics: Caution & Warning Summary

- Determine which of the following messages present during powerup:

'**R1E - … MCU Comm Fail**' '**R2Q – MBS…**' or MSS: MBS: Discrete Log: MSS Discrete Log '**WHS> Initialize Communication (Abo)**' → 2

MSS: MBS: MCU: MCU 'Systems State' – Initializing and MSS: MBS: Discrete Log: MSS Discrete Log '**OCS>Payload Parameters Rejected**' or '**MBS>Change Payload Parameters (Rej)**' → 3

None of the above. → 5

2 For the Active RWS

MSS: LAS5(LAP5) Bus Config LAS5(LAP5) CEU Bus Configuration 'Local Bus' 'MSS'

- **cmd** B

MSS: MBS: MCU: MCU

- **cmd** 'Prime'('Redundant') Operational

'Systems State' – Operational ?

No → 6; Yes → 4

3 Payload File Error ②

POA or MCAS Payload Control Parameters file data out of range. Potential corrupt file. Additional troubleshooting required by ground if POA or MCAS are required for Ops. Otherwise, continue nominal operations.

4

- Continue nominal operations.

5 Retry Transition

(DCP)

- SAFING → SAFE

MSS: MBS: MCU: MCU

- **cmd** 'Prime'('Redundant') Keep-Alive (Verify Keep-Alive)
- **cmd** 'Prime'('Redundant') Operational

'Systems State' – Operational?

No → 6; Yes → 7

6 Check for MCU Failure (from 2)

MSS: SSRMS: CW Summ Robotics: Caution & Warning Summary

Any '**R2P…**, '**R2O..Inh…**, '**R3F…POA..**' messages present?

Yes → 8; No → 9

7

- Continue nominal operations.

Nominal Config:
RWS is Active.

Alternate MBS String is not Operational.

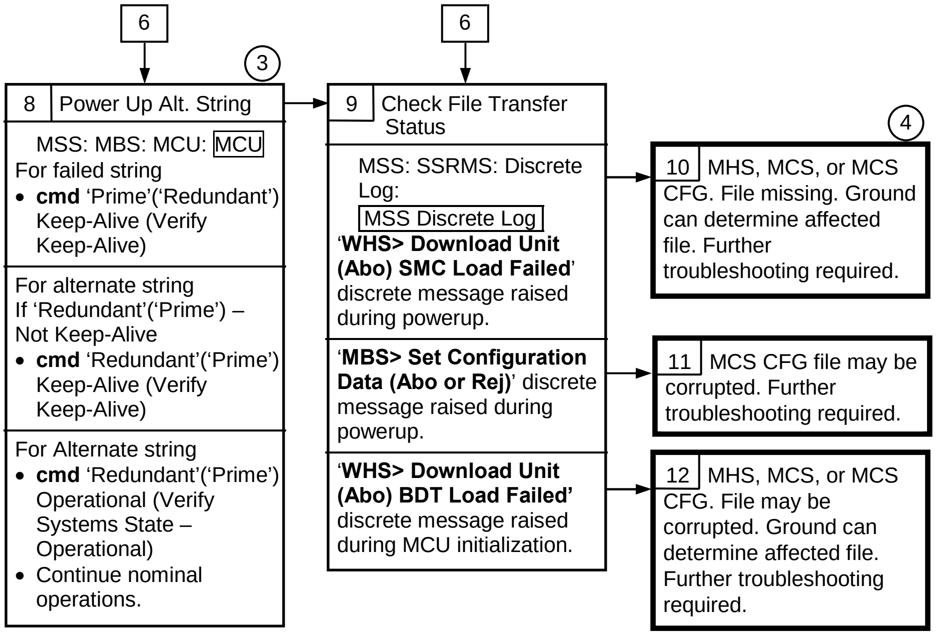
No MBS SRT Errors in Alarm.

① All displays in this procedure are on the PCS.

② Ground must uplink or transfer new file before reattempting Go to Operational command on either string.

7.111 MBS POWER-UP FROM KA TO OPERATIONAL FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 2 of 2 pages



8 Power Up Alt. String

MSS: MBS: MCU: MCU

For failed string

- **cmd** ‘Prime’(‘Redundant’) Keep-Alive (Verify Keep-Alive)

For alternate string

If ‘Redundant’(‘Prime’) – Not Keep-Alive

- **cmd** ‘Redundant’(‘Prime’) Keep-Alive (Verify Keep-Alive)

For Alternate string

- **cmd** ‘Redundant’(‘Prime’) Operational (Verify Systems State – Operational)
- Continue nominal operations.

9 Check File Transfer Status

MSS: SSRMS: Discrete Log: MSS Discrete Log

‘**WHS> Download Unit (Abo) SMC Load Failed**’ discrete message raised during powerup.

‘**MBS> Set Configuration Data (Abo or Rej)**’ discrete message raised during powerup.

‘**WHS> Download Unit (Abo) BDT Load Failed’** discrete message raised during MCU initialization.

10 MHS, MCS, or MCS CFG. File missing. Ground can determine affected file. Further troubleshooting required.

11 MCS CFG file may be corrupted. Further troubleshooting required.

12 MHS, MCS, or MCS CFG. File may be corrupted. Ground can determine affected file. Further troubleshooting required.

③ The Keep-Alive command may not successfully complete the first time it is issued (SCR 19993).

④ The ground can check for potentially corrupt MHS, MCS, or MCS CFG file.

MSS

C&W
ROBOTICS

7.120 SSRMS POWER-UP FROM OFF TO KA FAILURE

(RBT GEN/X2R4 - ALL/FIN)   Page 1 of 6 pages

C&W messages starting with ‘**Rxx - …**’

SSRMS Power-up From Off to Keep-Alive Fails

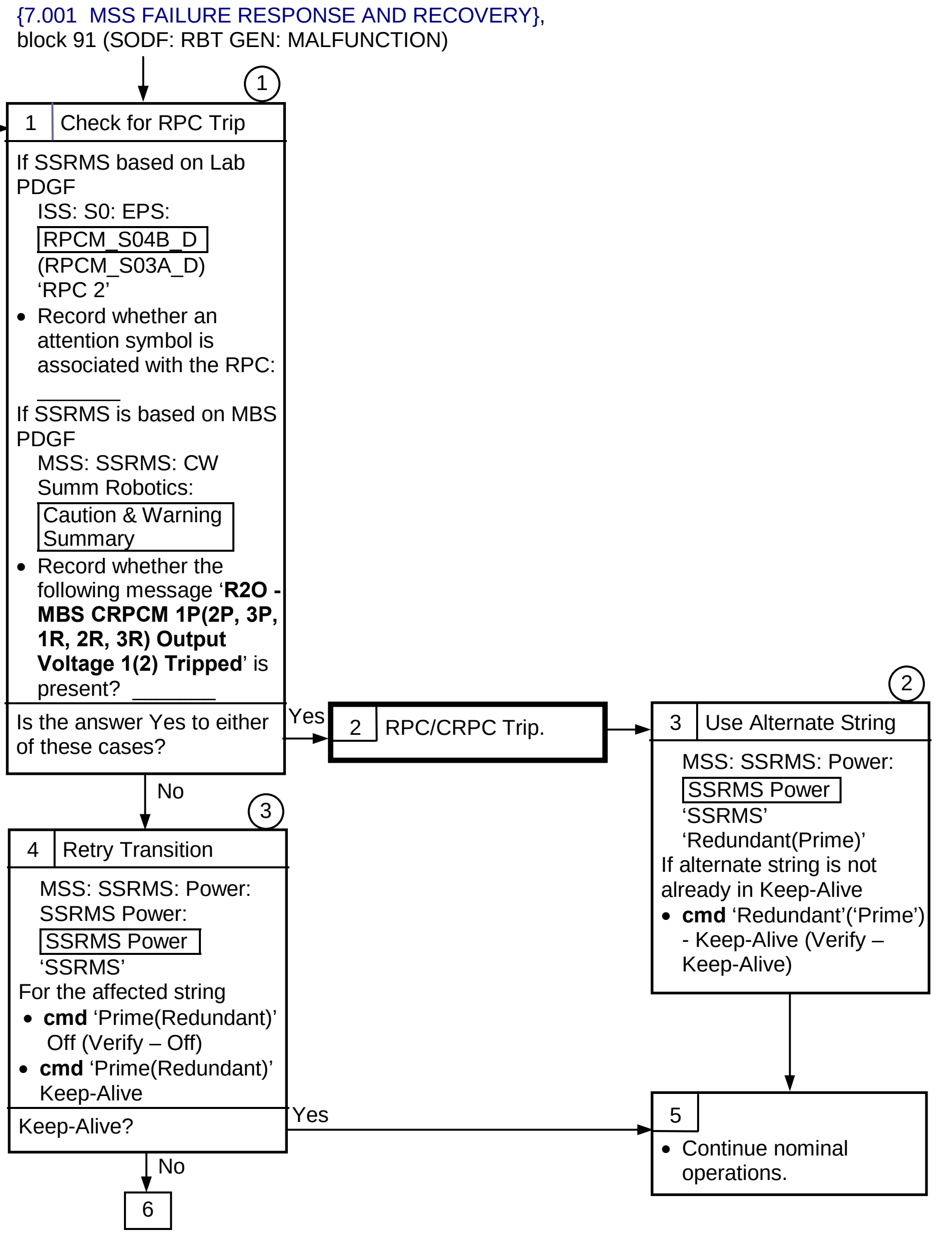
Nominal Config:
If SSRMS is based on MBS, MBS powered on both strings and Operational on one string with no MCU comm.

If SSRMS is based on ISS PDGF, EXT and S0 MDMs configured for SEPS control.

Alternate SSRMS string is not Operational.

RWS is Active.

{7.001 MSS FAILURE RESPONSE AND RECOVERY}, block 91 (SODF: RBT GEN: MALFUNCTION)



1 Check for RPC Trip ①

If SSRMS based on Lab PDGF
ISS: S0: EPS:
RPCM_S04B_D
(RPCM_S03A_D)
‘RPC 2’
- Record whether an attention symbol is associated with the RPC: ________

If SSRMS is based on MBS PDGF
MSS: SSRMS: CW Summ Robotics:
Caution & Warning Summary
- Record whether the following message ‘**R2O - MBS CRPCM 1P(2P, 3P, 1R, 2R, 3R) Output Voltage 1(2) Tripped**’ is present? ________

Is the answer Yes to either of these cases?

2 RPC/CRPC Trip.

3 Use Alternate String ②

MSS: SSRMS: Power:
SSRMS Power
‘SSRMS’
‘Redundant(Prime)’
If alternate string is not already in Keep-Alive
- **cmd** ‘Redundant’(‘Prime’) - Keep-Alive (Verify – Keep-Alive)

4 Retry Transition ③

MSS: SSRMS: Power:
SSRMS Power:
SSRMS Power
‘SSRMS’
For the affected string
- **cmd** ‘Prime(Redundant)’ Off (Verify – Off)
- **cmd** ‘Prime(Redundant)’ Keep-Alive

Keep-Alive?

5
- Continue nominal operations.

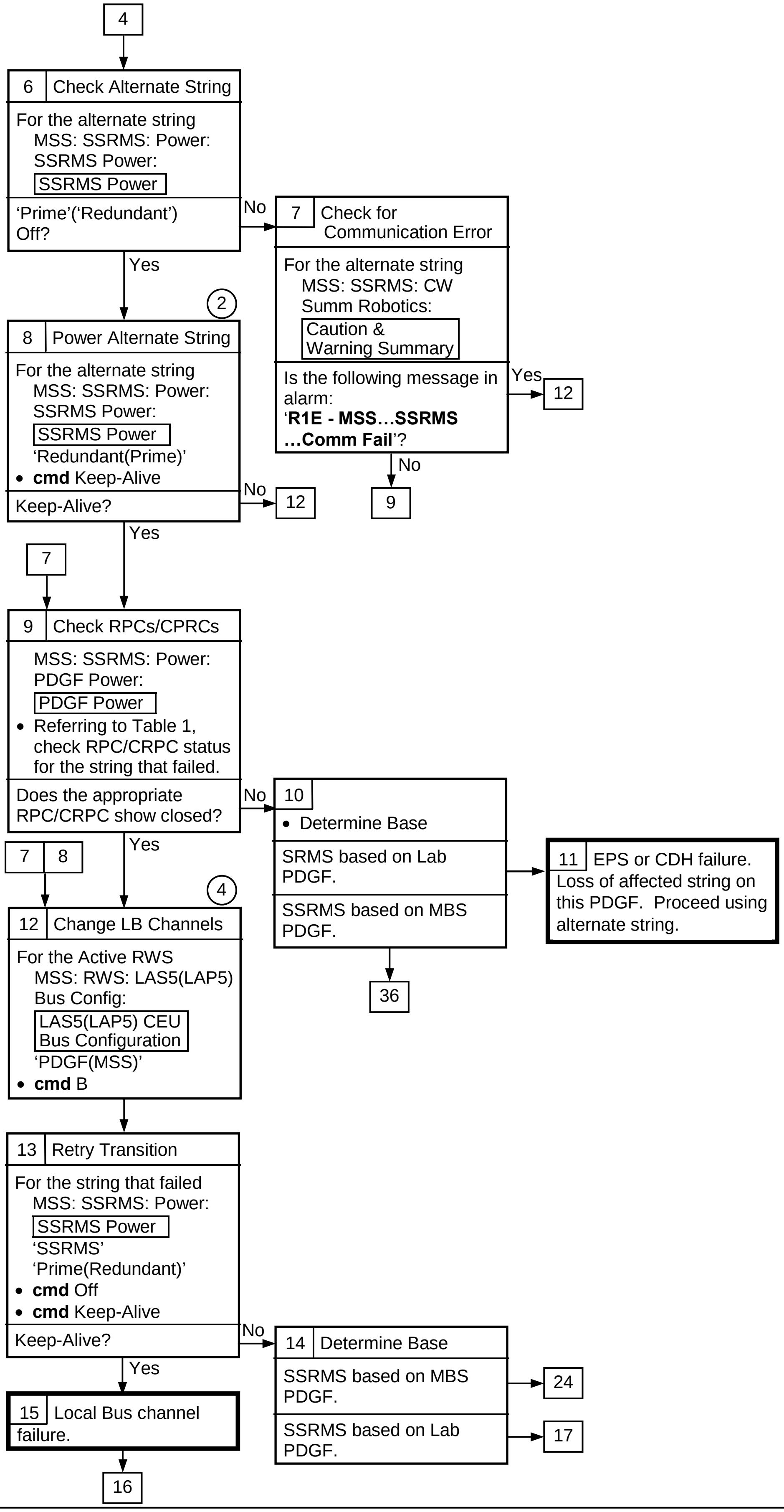
① Unless otherwise noted, all displays in this procedure are on the PCS.

② If both SSRMS strings have been powered Off for an extended period of time, refer to Flight Rule B12-104 for applicable warmup times prior to commanding string to Operational.

③ For some failure signatures it is possible that the 'Off' command will be rejected. If the command-rejected message is received, ignore it and press with the transition retry.

7.120 SSRMS POWER-UP FROM OFF TO KA FAILURE

(RBT GEN/X2R4 - ALL/FIN) Page 2 of 6 pages



4

6 Check Alternate String

For the alternate string
MSS: SSRMS: Power:
SSRMS Power:
SSRMS Power

'Prime'('Redundant') Off?

Yes → 8; No → 7

7 Check for Communication Error

For the alternate string
MSS: SSRMS: CW
Summ Robotics:
Caution & Warning Summary

Is the following message in alarm:
'**R1E - MSS…SSRMS …Comm Fail**'?

Yes → 12; No → 9

8 Power Alternate String ②

For the alternate string
MSS: SSRMS: Power:
SSRMS Power:
SSRMS Power
'Redundant(Prime)'
- **cmd** Keep-Alive

Keep-Alive?

Yes → 9; No → 12

7

9 Check RPCs/CPRCs

MSS: SSRMS: Power:
PDGF Power:
PDGF Power
- Referring to Table 1, check RPC/CRPC status for the string that failed.

Does the appropriate RPC/CRPC show closed?

Yes → 12; No → 10

10
- Determine Base

SRMS based on Lab PDGF. → 11

SSRMS based on MBS PDGF. → 11

36

11 EPS or CDH failure. Loss of affected string on this PDGF. Proceed using alternate string.

7 8

12 Change LB Channels ④

For the Active RWS
MSS: RWS: LAS5(LAP5)
Bus Config:
LAS5(LAP5) CEU Bus Configuration
'PDGF(MSS)'
- **cmd** B

13 Retry Transition

For the string that failed
MSS: SSRMS: Power:
SSRMS Power
'SSRMS'
'Prime(Redundant)'
- **cmd** Off
- **cmd** Keep-Alive

Keep-Alive?

Yes → 15; No → 14

14 Determine Base

SSRMS based on MBS PDGF. → 24

SSRMS based on Lab PDGF. → 17

15 Local Bus channel failure.

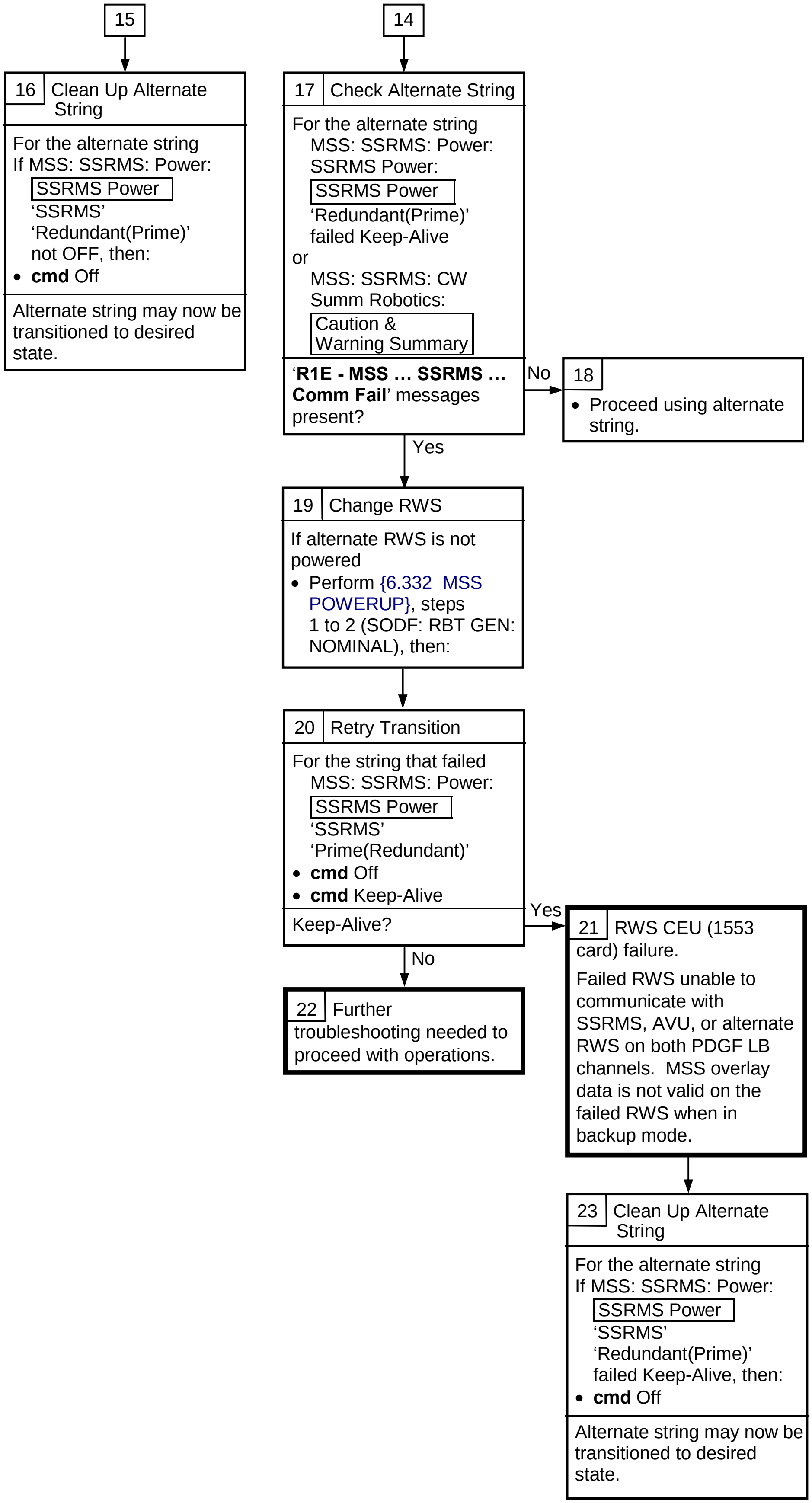
16

② If both SSRMS strings have been powered Off for an extended period of time, refer to Flight Rule B12-104 for applicable warmup times prior to commanding string to Operational.

④ PDGF LB if SSRMS is based on Lab PDGF, MSS LB if based on MBS PDGF.

7.120 SSRMS POWER-UP FROM OFF TO KA FAILURE

(RBT GEN/X2R4 - ALL/FIN) Page 3 of 6 pages



16 Clean Up Alternate String

For the alternate string
If MSS: SSRMS: Power:
SSRMS Power
'SSRMS'
'Redundant(Prime)'
not OFF, then:
- **cmd** Off

Alternate string may now be transitioned to desired state.

17 Check Alternate String

For the alternate string
MSS: SSRMS: Power:
SSRMS Power:
SSRMS Power
'Redundant(Prime)'
failed Keep-Alive
or
MSS: SSRMS: CW
Summ Robotics:
Caution & Warning Summary

'**R1E - MSS … SSRMS … Comm Fail**' messages present?

18
- Proceed using alternate string.

19 Change RWS

If alternate RWS is not powered
- Perform {6.332 MSS POWERUP}, steps 1 to 2 (SODF: RBT GEN: NOMINAL), then:

20 Retry Transition

For the string that failed
MSS: SSRMS: Power:
SSRMS Power
'SSRMS'
'Prime(Redundant)'
- **cmd** Off
- **cmd** Keep-Alive

Keep-Alive?

21 RWS CEU (1553 card) failure.

Failed RWS unable to communicate with SSRMS, AVU, or alternate RWS on both PDGF LB channels. MSS overlay data is not valid on the failed RWS when in backup mode.

22 Further troubleshooting needed to proceed with operations.

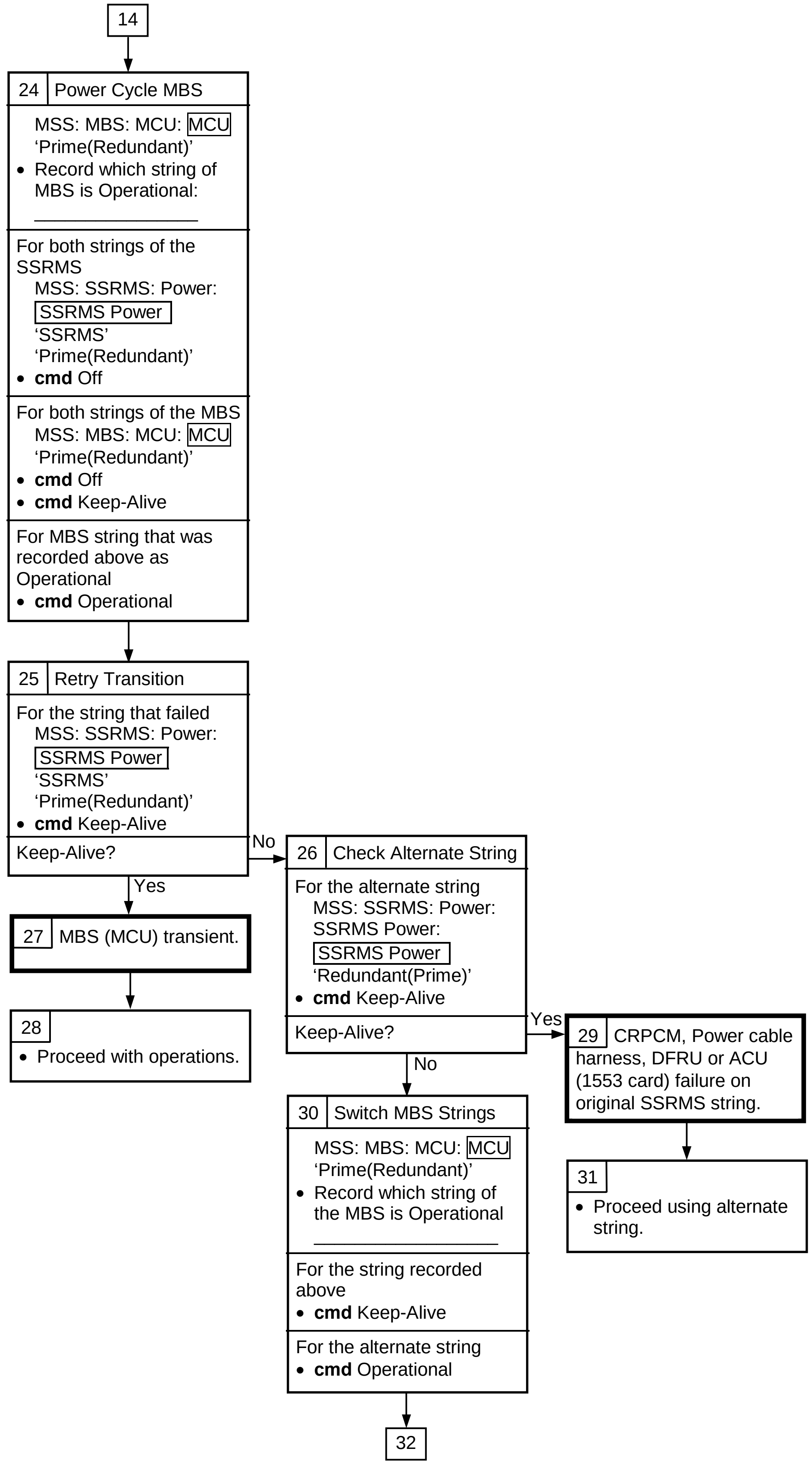
23 Clean Up Alternate String

For the alternate string
If MSS: SSRMS: Power:
SSRMS Power
'SSRMS'
'Redundant(Prime)'
failed Keep-Alive, then:
- **cmd** Off

Alternate string may now be transitioned to desired state.

7.120 SSRMS POWER-UP FROM OFF TO KA FAILURE

(RBT GEN/X2R4 - ALL/FIN) Page 4 of 6 pages



14

24 Power Cycle MBS

MSS: MBS: MCU: MCU
'Prime(Redundant)'
- Record which string of MBS is Operational:

____

For both strings of the SSRMS
MSS: SSRMS: Power:
SSRMS Power
'SSRMS'
'Prime(Redundant)'
- **cmd** Off

For both strings of the MBS
MSS: MBS: MCU: MCU
'Prime(Redundant)'
- **cmd** Off
- **cmd** Keep-Alive

For MBS string that was recorded above as Operational
- **cmd** Operational

25 Retry Transition

For the string that failed
MSS: SSRMS: Power:
SSRMS Power
'SSRMS'
'Prime(Redundant)'
- **cmd** Keep-Alive

Keep-Alive?

Yes → 27; No → 26

27 MBS (MCU) transient.

28
- Proceed with operations.

26 Check Alternate String

For the alternate string
MSS: SSRMS: Power:
SSRMS Power:
SSRMS Power
'Redundant(Prime)'
- **cmd** Keep-Alive

Keep-Alive?

Yes → 29; No → 30

29 CRPCM, Power cable harness, DFRU or ACU (1553 card) failure on original SSRMS string.

31
- Proceed using alternate string.

30 Switch MBS Strings

MSS: MBS: MCU: MCU
'Prime(Redundant)'
- Record which string of the MBS is Operational

____

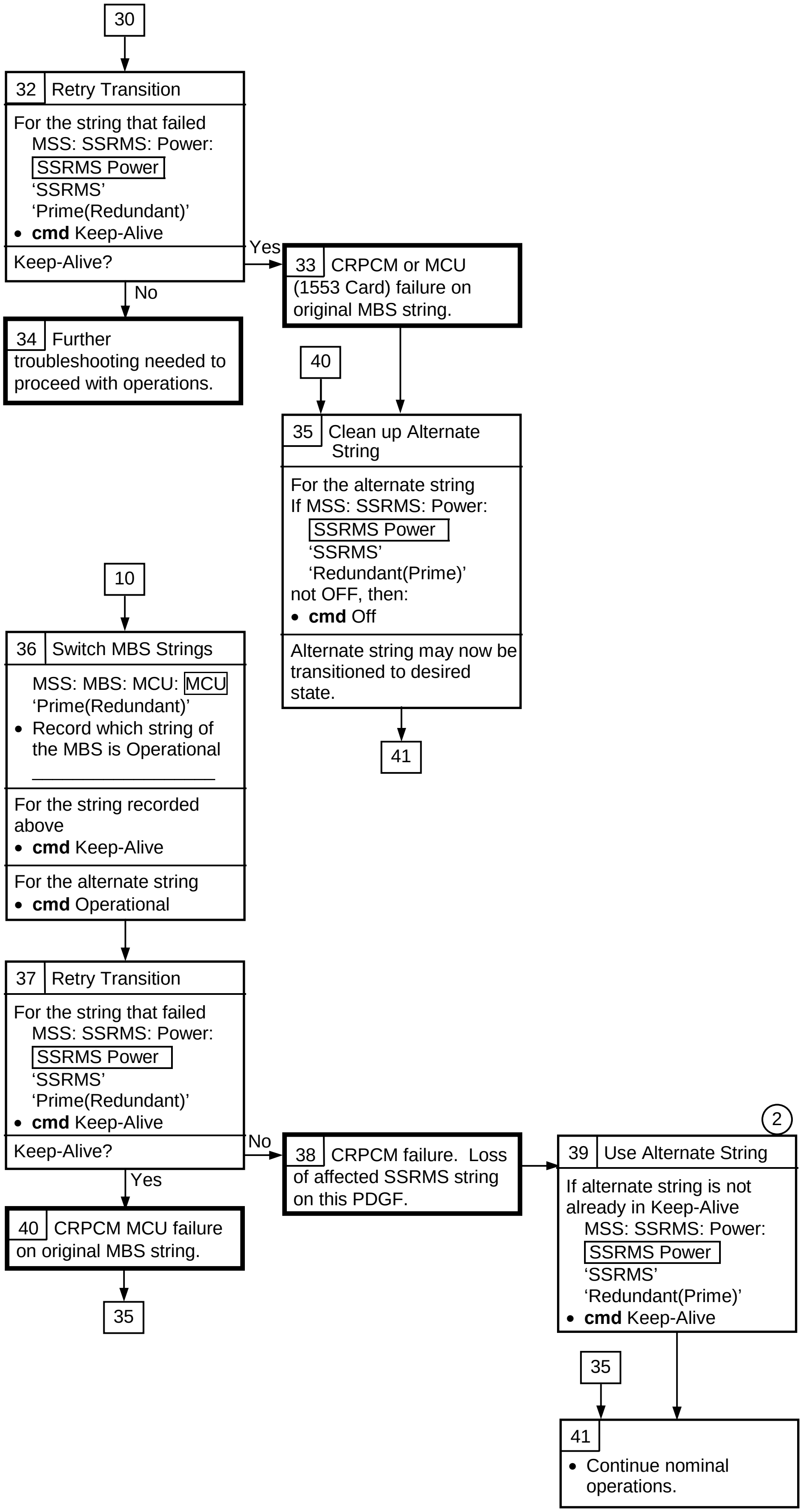
For the string recorded above
- **cmd** Keep-Alive

For the alternate string
- **cmd** Operational

32

7.120 SSRMS POWER-UP FROM OFF TO KA FAILURE

(RBT GEN/X2R4 - ALL/FIN) Page 5 of 6 pages



② If both SSRMS strings have been powered Off for an extended period of time, refer to Flight Rule B12-104 for applicable warm-up times prior to commanding string to Operational.

7.120 SSRMS POWER-UP FROM OFF TO KA FAILURE

(RBT GEN/X2R4 - ALL/FIN) Page 6 of 6 pages

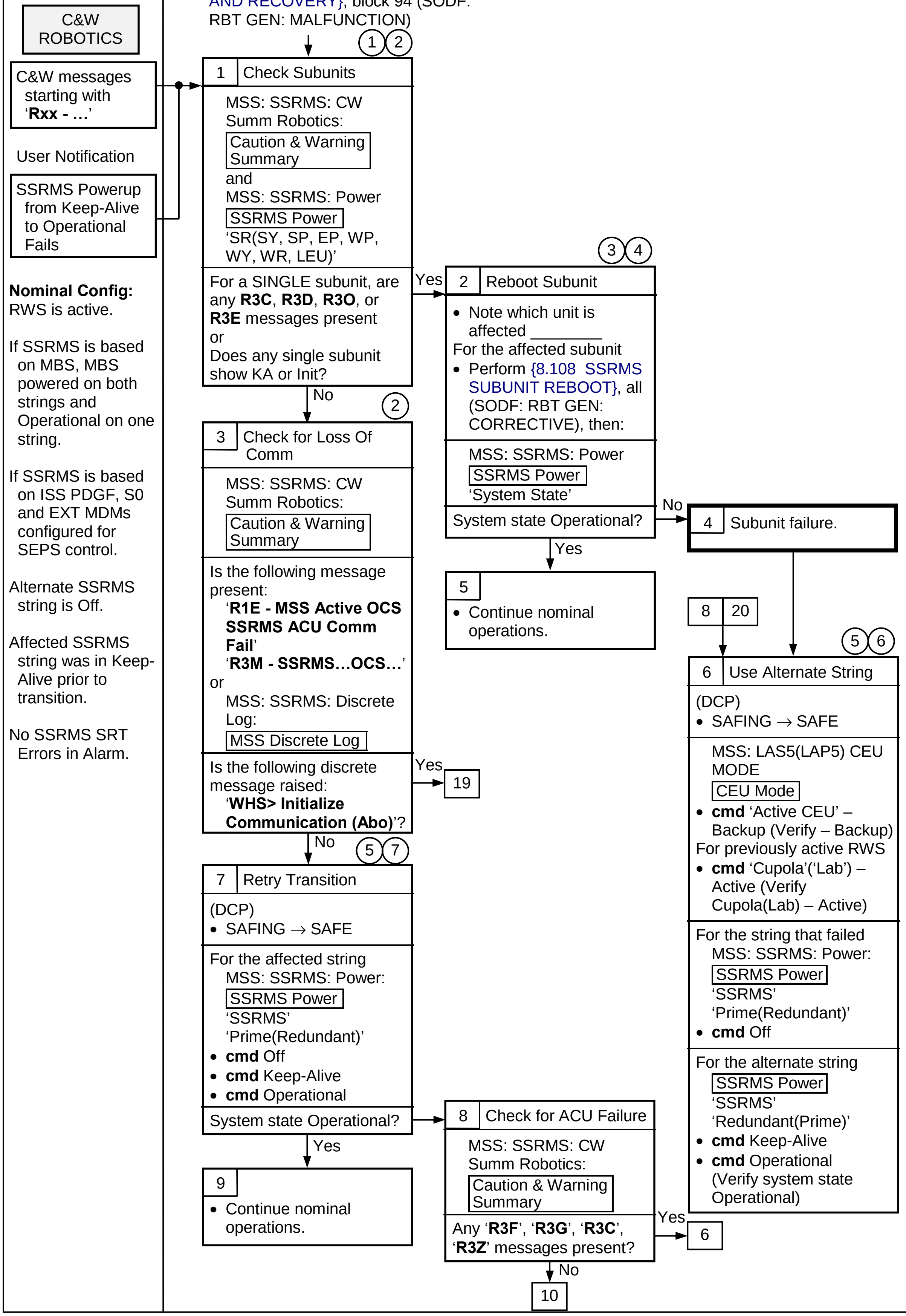
Table 1. RPC/CRPC Reference Data

Base Location	Lab PDGF	MBS PDGF 1	MBS PDGF 2	MBS PDGF 3	MBS PDGF 4
	‘S0 RPCs’	‘MBS CRPCs’	‘MBS CRPCs’	‘MBS CRPCs’	‘MBS CRPCs’
Prime	4B-D RPC 2	1P RPC 2	2P RPC 2	3P RPC 1	3P RPC 2
Redundant	3A-D RPC 2	1R RPC 2	2R RPC 2	3R RPC 1	3R RPC 2

7.121 SSRMS POWER-UP FROM KA TO OPERATIONAL FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 1 of 2 pages

{7.001 MSS FAILURE RESPONSE AND RECOVERY}, block 94 (SODF: RBT GEN: MALFUNCTION)



C&W ROBOTICS

C&W messages starting with ‘**Rxx - …**’

User Notification

SSRMS Powerup from Keep-Alive to Operational Fails

①②

1 Check Subunits

MSS: SSRMS: CW Summ Robotics: Caution & Warning Summary and MSS: SSRMS: Power SSRMS Power ‘SR(SY, SP, EP, WP, WY, WR, LEU)’

For a SINGLE subunit, are any **R3C**, **R3D**, **R3O**, or **R3E** messages present or Does any single subunit show KA or Init?

Yes → 2; No → 3 ②

③④

2 Reboot Subunit

- Note which unit is affected ________

For the affected subunit

- Perform {8.108 SSRMS SUBUNIT REBOOT}, all (SODF: RBT GEN: CORRECTIVE), then:

MSS: SSRMS: Power SSRMS Power ‘System State’

System state Operational?

Yes → 5; No → 4

3 Check for Loss Of Comm

MSS: SSRMS: CW Summ Robotics: Caution & Warning Summary

Is the following message present: ‘**R1E - MSS Active OCS SSRMS ACU Comm Fail**’ ‘**R3M - SSRMS…OCS…**’ or MSS: SSRMS: Discrete Log: MSS Discrete Log

Is the following discrete message raised: ‘**WHS> Initialize Communication (Abo)**’?

Yes → 19; No → 7 ⑤⑦

4 Subunit failure.

5

- Continue nominal operations.

8 20

⑤⑥

6 Use Alternate String

(DCP)

- SAFING → SAFE

MSS: LAS5(LAP5) CEU MODE CEU Mode

- **cmd** ‘Active CEU’ – Backup (Verify – Backup)

For previously active RWS

- **cmd** ‘Cupola’(‘Lab’) – Active (Verify Cupola(Lab) – Active)

For the string that failed

MSS: SSRMS: Power: SSRMS Power ‘SSRMS’ ‘Prime(Redundant)’

- **cmd** Off

For the alternate string

SSRMS Power ‘SSRMS’ ‘Redundant(Prime)’

- **cmd** Keep-Alive
- **cmd** Operational (Verify system state Operational)

7 Retry Transition

(DCP)

- SAFING → SAFE

For the affected string

MSS: SSRMS: Power: SSRMS Power ‘SSRMS’ ‘Prime(Redundant)’

- **cmd** Off
- **cmd** Keep-Alive
- **cmd** Operational

System state Operational?

Yes → 9; → 8

8 Check for ACU Failure

MSS: SSRMS: CW Summ Robotics: Caution & Warning Summary

Any ‘**R3F**’, ‘**R3G**’, ‘**R3C**’, ‘**R3Z**’ messages present?

Yes → 6; No → 10

9

- Continue nominal operations.

Nominal Config:
RWS is active.

If SSRMS is based on MBS, MBS powered on both strings and Operational on one string.

If SSRMS is based on ISS PDGF, S0 and EXT MDMs configured for SEPS control.

Alternate SSRMS string is Off.

Affected SSRMS string was in Keep-Alive prior to transition.

No SSRMS SRT Errors in Alarm.

① Unless otherwise indicated, all displays in this procedure are on the PCS.

② Only messages that may have come into alarm during the powerup sequence are of interest. The time hack noted in the log can be used to determine whether or not a message appeared within an appropriate timeframe. Messages may or may not persist in alarm.

③ SCR 21387.

④ Anticipated reset times are at least:
Joint: 2min, 9s
LEE: 2min, 22s

⑤ Operator must apply safing per SCR 22615.

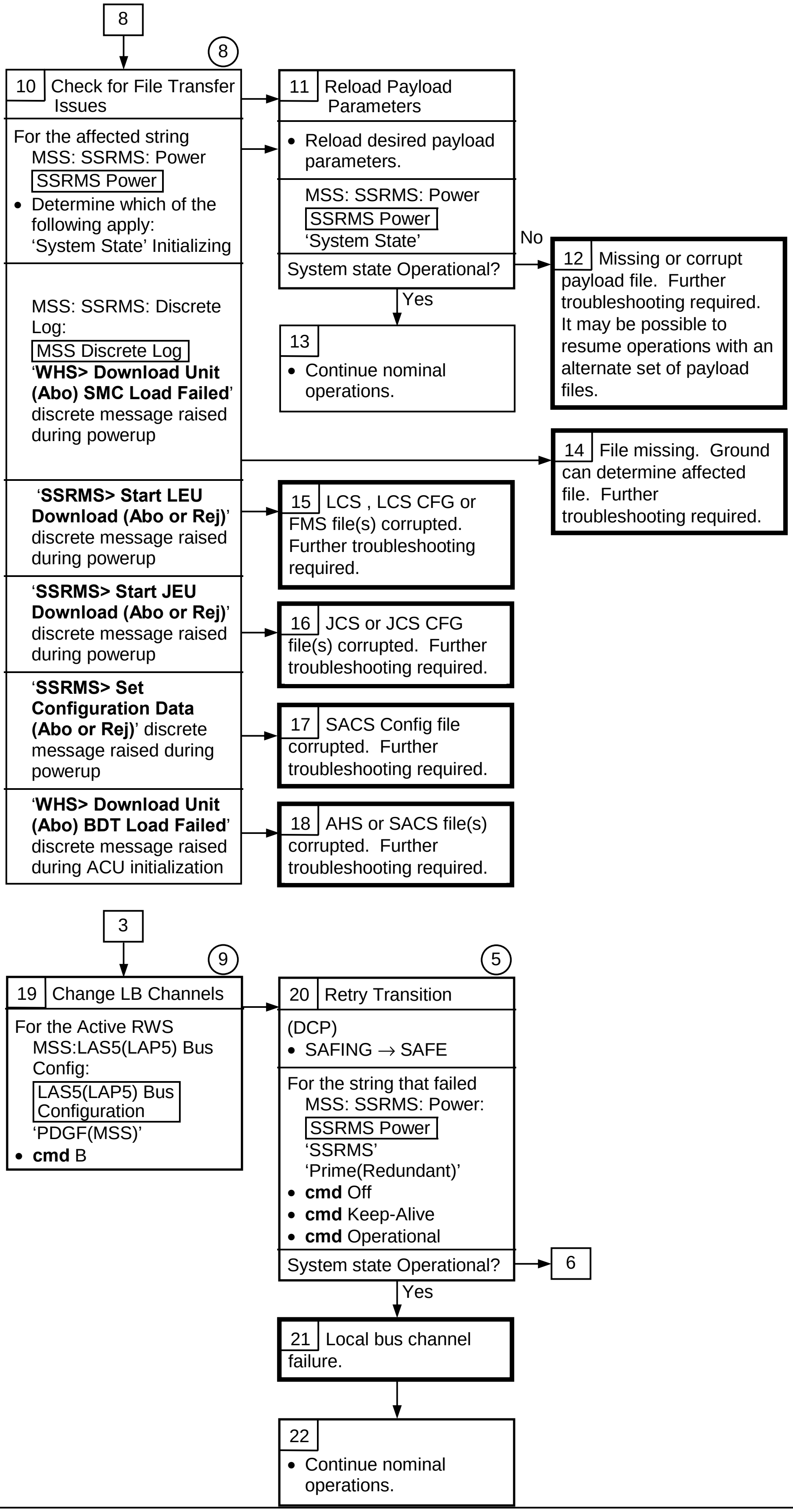
⑥ SCR 28722

⑦ SCR 25802

MSS

7.121 SSRMS POWER-UP FROM KA TO OPERATIONAL FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 2 of 2 pages



8

⑧ **10** Check for File Transfer Issues

For the affected string
MSS: SSRMS: Power
SSRMS Power
- Determine which of the following apply:
'System State' Initializing

MSS: SSRMS: Discrete Log:
MSS Discrete Log
'**WHS> Download Unit (Abo) SMC Load Failed**' discrete message raised during powerup

'**SSRMS> Start LEU Download (Abo or Rej)**' discrete message raised during powerup

'**SSRMS> Start JEU Download (Abo or Rej)**' discrete message raised during powerup

'**SSRMS> Set Configuration Data (Abo or Rej)**' discrete message raised during powerup

'**WHS> Download Unit (Abo) BDT Load Failed**' discrete message raised during ACU initialization

11 Reload Payload Parameters

- Reload desired payload parameters.

MSS: SSRMS: Power
SSRMS Power
'System State'

System state Operational?

No

12 Missing or corrupt payload file. Further troubleshooting required. It may be possible to resume operations with an alternate set of payload files.

Yes

13
- Continue nominal operations.

14 File missing. Ground can determine affected file. Further troubleshooting required.

15 LCS , LCS CFG or FMS file(s) corrupted. Further troubleshooting required.

16 JCS or JCS CFG file(s) corrupted. Further troubleshooting required.

17 SACS Config file corrupted. Further troubleshooting required.

18 AHS or SACS file(s) corrupted. Further troubleshooting required.

3

⑨ **19** Change LB Channels

For the Active RWS
MSS:LAS5(LAP5) Bus Config:
LAS5(LAP5) Bus Configuration
'PDGF(MSS)'
- **cmd** B

⑤ **20** Retry Transition

(DCP)
- SAFING → SAFE

For the string that failed
MSS: SSRMS: Power:
SSRMS Power
'SSRMS'
'Prime(Redundant)'
- **cmd** Off
- **cmd** Keep-Alive
- **cmd** Operational

System state Operational? → 6

Yes

21 Local bus channel failure.

22
- Continue nominal operations.

⑤
Operator must apply safing per SCR 22615.

⑧
The ground can check the ODIN File Transfer Status display to confirm the cause of the aborted file transfer.

⑨
PDGF LB if SSRMS is based on Lab PDGF, MSS LB if based on MBS PDGF.

7.200 MSS POWER REMOVED FAILURE

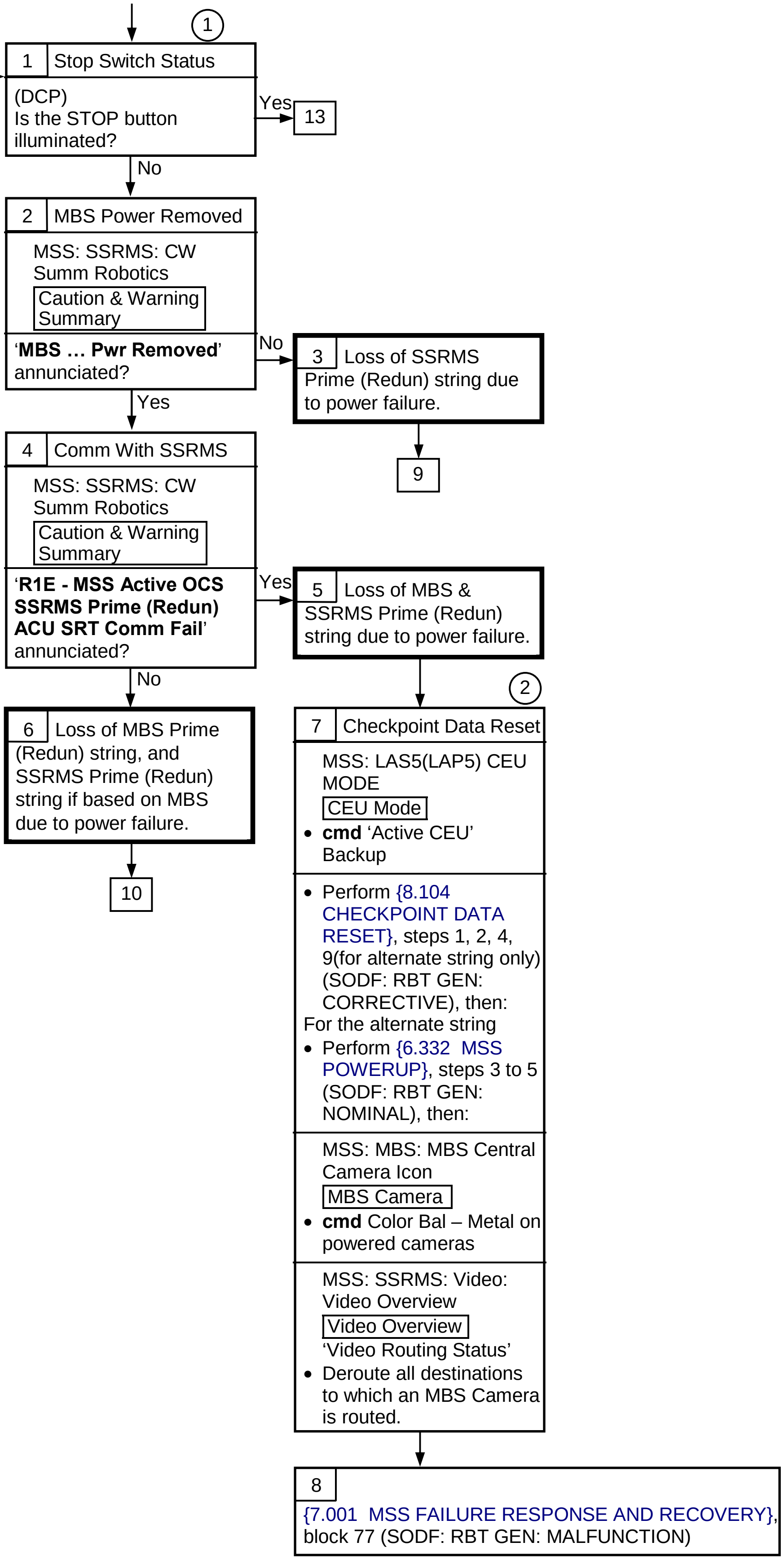
(RBT GEN/X2R4 - ALL/FIN/SPN) Page 1 of 5 pages

C&W ROBOTICS

C&W Messages with '… **MSS … Pwr Removed**' in the Text

Nominal Config:
RWS is active.

{7.001 MSS FAILURE RESPONSE AND RECOVERY}, block 76 (SODF: RBT GEN: MALFUNCTION)



① 1 Stop Switch Status
(DCP)
Is the STOP button illuminated?
Yes → 13
No → 2

2 MBS Power Removed
MSS: SSRMS: CW Summ Robotics
Caution & Warning Summary
'**MBS … Pwr Removed**' annunciated?
No → 3
Yes → 4

3 Loss of SSRMS Prime (Redun) string due to power failure.
→ 9

4 Comm With SSRMS
MSS: SSRMS: CW Summ Robotics
Caution & Warning Summary
'**R1E - MSS Active OCS SSRMS Prime (Redun) ACU SRT Comm Fail**' annunciated?
Yes → 5
No → 6

5 Loss of MBS & SSRMS Prime (Redun) string due to power failure.
→ 7

6 Loss of MBS Prime (Redun) string, and SSRMS Prime (Redun) string if based on MBS due to power failure.
→ 10

② 7 Checkpoint Data Reset

MSS: LAS5(LAP5) CEU MODE
CEU Mode
- **cmd** 'Active CEU' Backup

- Perform {8.104 CHECKPOINT DATA RESET}, steps 1, 2, 4, 9(for alternate string only) (SODF: RBT GEN: CORRECTIVE), then:

For the alternate string
- Perform {6.332 MSS POWERUP}, steps 3 to 5 (SODF: RBT GEN: NOMINAL), then:

MSS: MBS: MBS Central Camera Icon
MBS Camera
- **cmd** Color Bal – Metal on powered cameras

MSS: SSRMS: Video: Video Overview
Video Overview
'Video Routing Status'
- Deroute all destinations to which an MBS Camera is routed.

→ 8

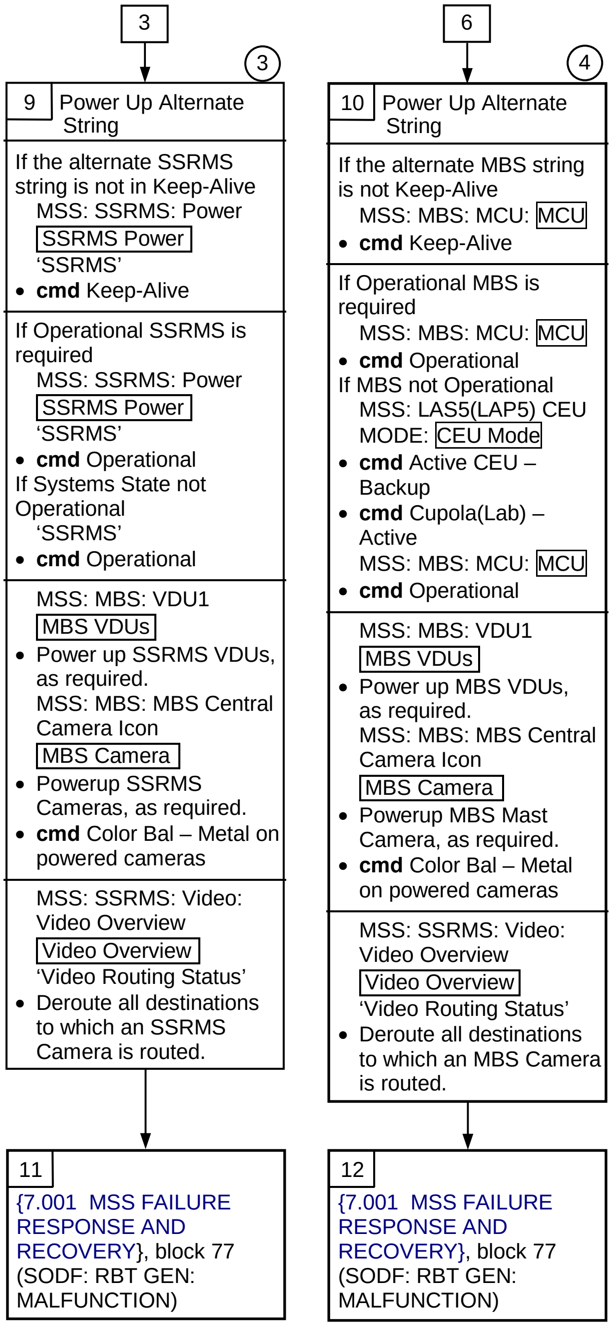
8 {7.001 MSS FAILURE RESPONSE AND RECOVERY}, block 77 (SODF: RBT GEN: MALFUNCTION)

①
Unless otherwise indicated, all displays in this procedure are on the PCS.

②
In place of the crew checkpoint procedure, ground should perform {8.270 GROUND MSS CHECKPOINT DATA RESET}, steps 2, 4, 6, 8 (GROUND HANDBOOK: ROBOTICS: NOMINAL) (SCR 21749).

7.200 MSS POWER REMOVED FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 2 of 5 pages



3

9 Power Up Alternate String ③

If the alternate SSRMS string is not in Keep-Alive
MSS: SSRMS: Power
SSRMS Power
'SSRMS'
- **cmd** Keep-Alive

If Operational SSRMS is required
MSS: SSRMS: Power
SSRMS Power
'SSRMS'
- **cmd** Operational

If Systems State not Operational
'SSRMS'
- **cmd** Operational

MSS: MBS: VDU1
MBS VDUs
- Power up SSRMS VDUs, as required.

MSS: MBS: MBS Central Camera Icon
MBS Camera
- Powerup SSRMS Cameras, as required.
- **cmd** Color Bal – Metal on powered cameras

MSS: SSRMS: Video: Video Overview
Video Overview
'Video Routing Status'
- Deroute all destinations to which an SSRMS Camera is routed.

11 {7.001 MSS FAILURE RESPONSE AND RECOVERY}, block 77 (SODF: RBT GEN: MALFUNCTION)

6

10 Power Up Alternate String ④

If the alternate MBS string is not Keep-Alive
MSS: MBS: MCU: MCU
- **cmd** Keep-Alive

If Operational MBS is required
MSS: MBS: MCU: MCU
- **cmd** Operational

If MBS not Operational
MSS: LAS5(LAP5) CEU MODE: CEU Mode
- **cmd** Active CEU – Backup
- **cmd** Cupola(Lab) – Active

MSS: MBS: MCU: MCU
- **cmd** Operational

MSS: MBS: VDU1
MBS VDUs
- Power up MBS VDUs, as required.

MSS: MBS: MBS Central Camera Icon
MBS Camera
- Powerup MBS Mast Camera, as required.
- **cmd** Color Bal – Metal on powered cameras

MSS: SSRMS: Video: Video Overview
Video Overview
'Video Routing Status'
- Deroute all destinations to which an MBS Camera is routed.

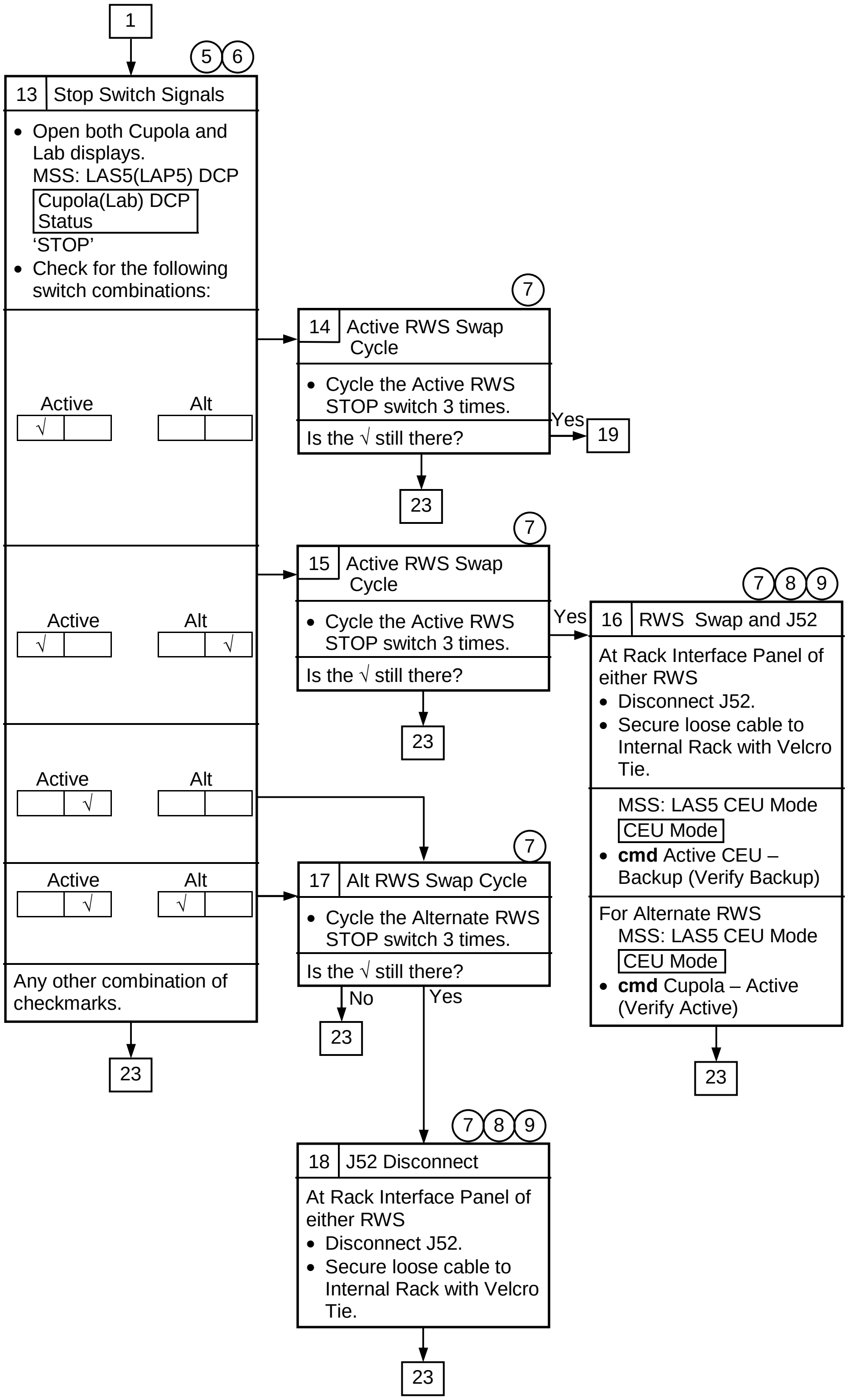
12 {7.001 MSS FAILURE RESPONSE AND RECOVERY}, block 77 (SODF: RBT GEN: MALFUNCTION)

③ If SSRMS had Safing removed when the Power Removal Failure occurred, then per SCR 20380, the first Go to Operational will fail, but a subsequent Go to Operational will work.

④ If MBS had Safing removed when the Power Removal Failure occurred, then per SCR 20380, the first Go to Operational will fail, the operator must cycle the RWS to Backup and back to Active, and then a subsequent Go to Operational will work.

7.200 MSS POWER REMOVED FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 3 of 5 pages



13 Stop Switch Signals

- Open both Cupola and Lab displays.
  MSS: LAS5(LAP5) DCP
  Cupola(Lab) DCP Status
  'STOP'
- Check for the following switch combinations:

Any other combination of checkmarks.

14 Active RWS Swap Cycle

- Cycle the Active RWS STOP switch 3 times.

Is the √ still there?

15 Active RWS Swap Cycle

- Cycle the Active RWS STOP switch 3 times.

Is the √ still there?

16 RWS Swap and J52

At Rack Interface Panel of either RWS

- Disconnect J52.
- Secure loose cable to Internal Rack with Velcro Tie.

MSS: LAS5 CEU Mode
CEU Mode

- **cmd** Active CEU – Backup (Verify Backup)

For Alternate RWS
MSS: LAS5 CEU Mode
CEU Mode

- **cmd** Cupola – Active (Verify Active)

17 Alt RWS Swap Cycle

- Cycle the Alternate RWS STOP switch 3 times.

Is the √ still there?

18 J52 Disconnect

At Rack Interface Panel of either RWS

- Disconnect J52.
- Secure loose cable to Internal Rack with Velcro Tie.

⑤
The STOP counter will not be reset in this procedure, so once recovery is complete crew has lost the ability to command Estop. Ground will reset the STOP counter later as a cleanup step.

⑥
Safing cannot be cancelled on the Active RWS while it is detecting a STOP switch signal.

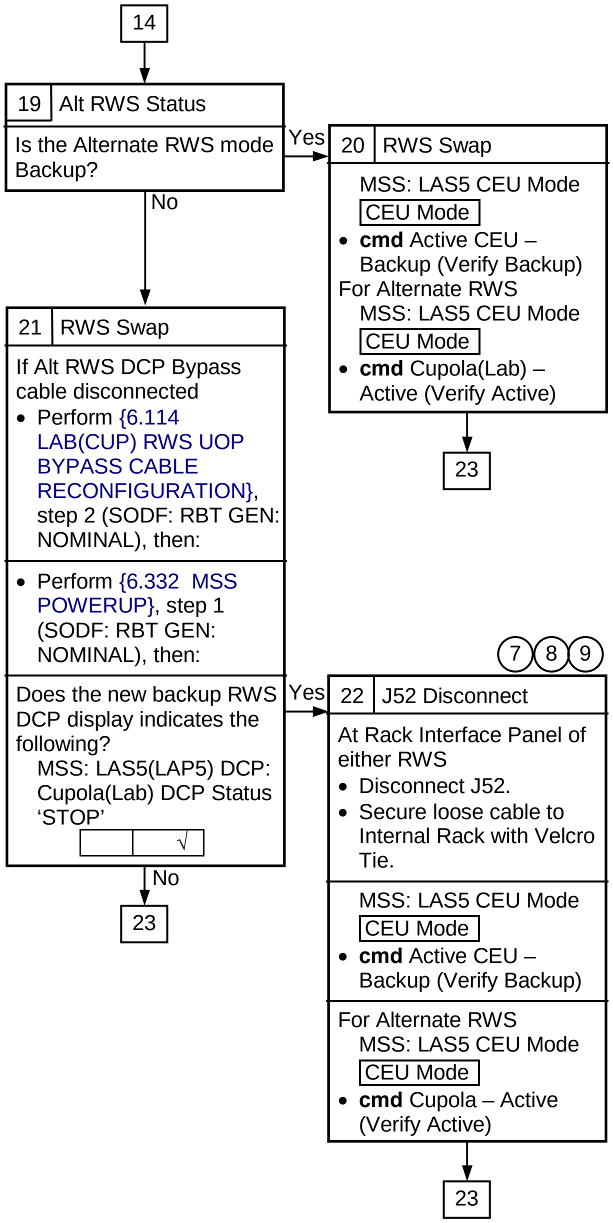
⑦
This step contains actions that can only be performed by the crew.

⑧
Per flight rule B2-1, crew may disconnect J52 with the RWS powered.

⑨
Once the J52 connector has been disconnected, the capability to Safe the MSS from the other RWS is lost.

7.200 MSS POWER REMOVED FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 4 of 5 pages



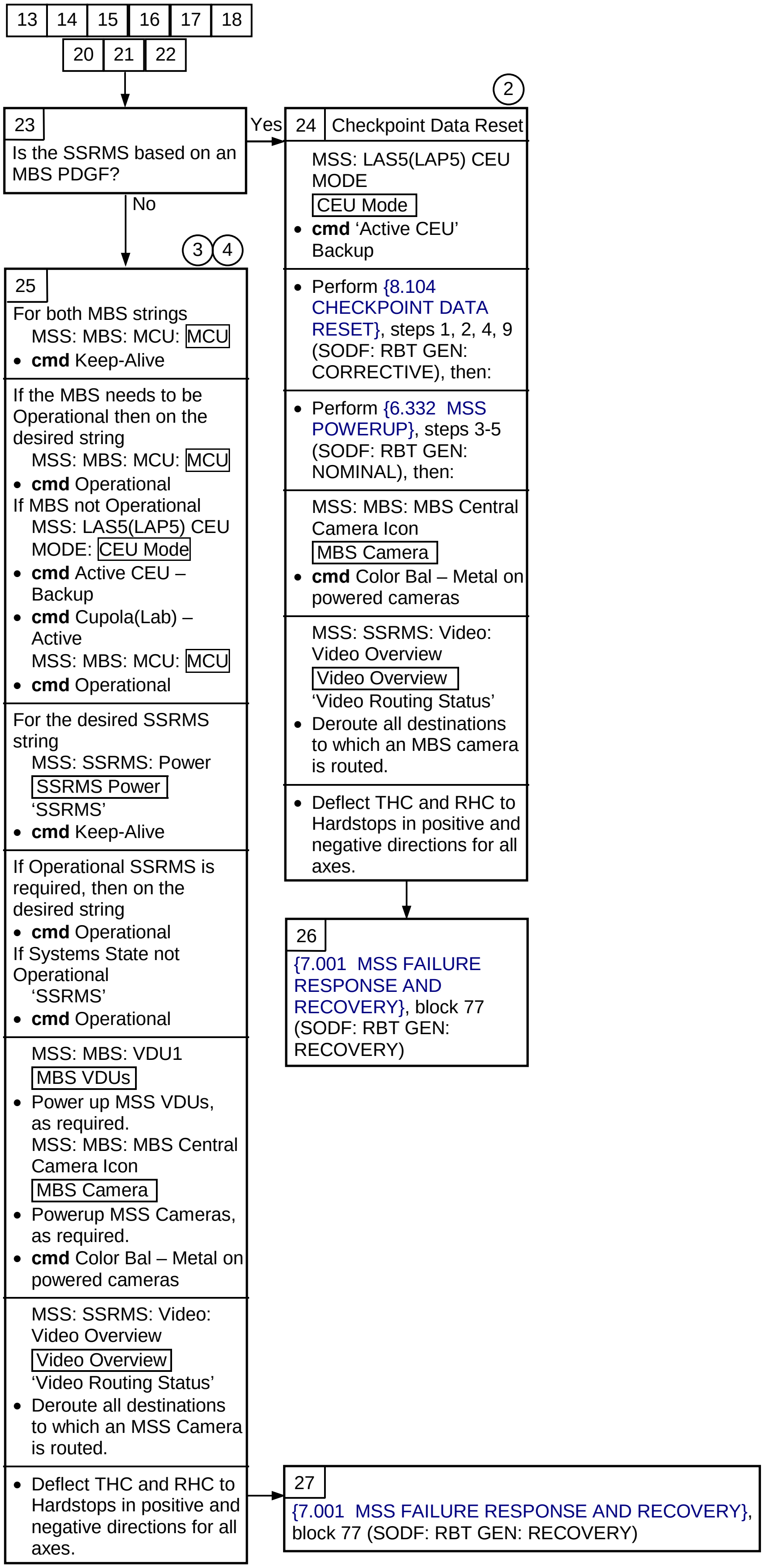
⑦
This step contains actions that can only be performed by the crew.

⑧
Per flight rule B2-1, crew may disconnect J52 with the RWS powered.

⑨
Once the J52 connector has been disconnected, the capability to Safe the MSS from the other RWS is lost.

7.200 MSS POWER REMOVED FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 5 of 5 pages



23
Is the SSRMS based on an MBS PDGF?

24 Checkpoint Data Reset

MSS: LAS5(LAP5) CEU MODE
CEU Mode
- **cmd** 'Active CEU' Backup

- Perform {8.104 CHECKPOINT DATA RESET}, steps 1, 2, 4, 9 (SODF: RBT GEN: CORRECTIVE), then:

- Perform {6.332 MSS POWERUP}, steps 3-5 (SODF: RBT GEN: NOMINAL), then:

MSS: MBS: MBS Central Camera Icon
MBS Camera
- **cmd** Color Bal – Metal on powered cameras

MSS: SSRMS: Video: Video Overview
Video Overview
'Video Routing Status'
- Deroute all destinations to which an MBS camera is routed.

- Deflect THC and RHC to Hardstops in positive and negative directions for all axes.

25
For both MBS strings
MSS: MBS: MCU: MCU
- **cmd** Keep-Alive

If the MBS needs to be Operational then on the desired string
MSS: MBS: MCU: MCU
- **cmd** Operational

If MBS not Operational
MSS: LAS5(LAP5) CEU MODE: CEU Mode
- **cmd** Active CEU – Backup
- **cmd** Cupola(Lab) – Active

MSS: MBS: MCU: MCU
- **cmd** Operational

For the desired SSRMS string
MSS: SSRMS: Power
SSRMS Power
'SSRMS'
- **cmd** Keep-Alive

If Operational SSRMS is required, then on the desired string
- **cmd** Operational

If Systems State not Operational
'SSRMS'
- **cmd** Operational

MSS: MBS: VDU1
MBS VDUs
- Power up MSS VDUs, as required.

MSS: MBS: MBS Central Camera Icon
MBS Camera
- Powerup MSS Cameras, as required.
- **cmd** Color Bal – Metal on powered cameras

MSS: SSRMS: Video: Video Overview
Video Overview
'Video Routing Status'
- Deroute all destinations to which an MSS Camera is routed.

- Deflect THC and RHC to Hardstops in positive and negative directions for all axes.

26
{7.001 MSS FAILURE RESPONSE AND RECOVERY}, block 77 (SODF: RBT GEN: RECOVERY)

27
{7.001 MSS FAILURE RESPONSE AND RECOVERY}, block 77 (SODF: RBT GEN: RECOVERY)

② In place of the crew checkpoint procedure, ground should perform {8.270 GROUND MSS CHECKPOINT DATA RESET}, steps 2, 4, 6, 8 (GROUND HANDBOOK: ROBOTICS: NOMINAL) (SCR 21749).

③ If SSRMS had Safing removed when the Power Removal Failure occurred, then per SCR 20380, the first Go to Operational will fail, but a subsequent Go to Operational will work.

④ If MBS had Safing removed when the Power Removal Failure occurred, then per SCR 20380, the first Go to Operational will fail, the operator must cycle the RWS to Backup and back to Active, and then a subsequent Go to Operational will work.

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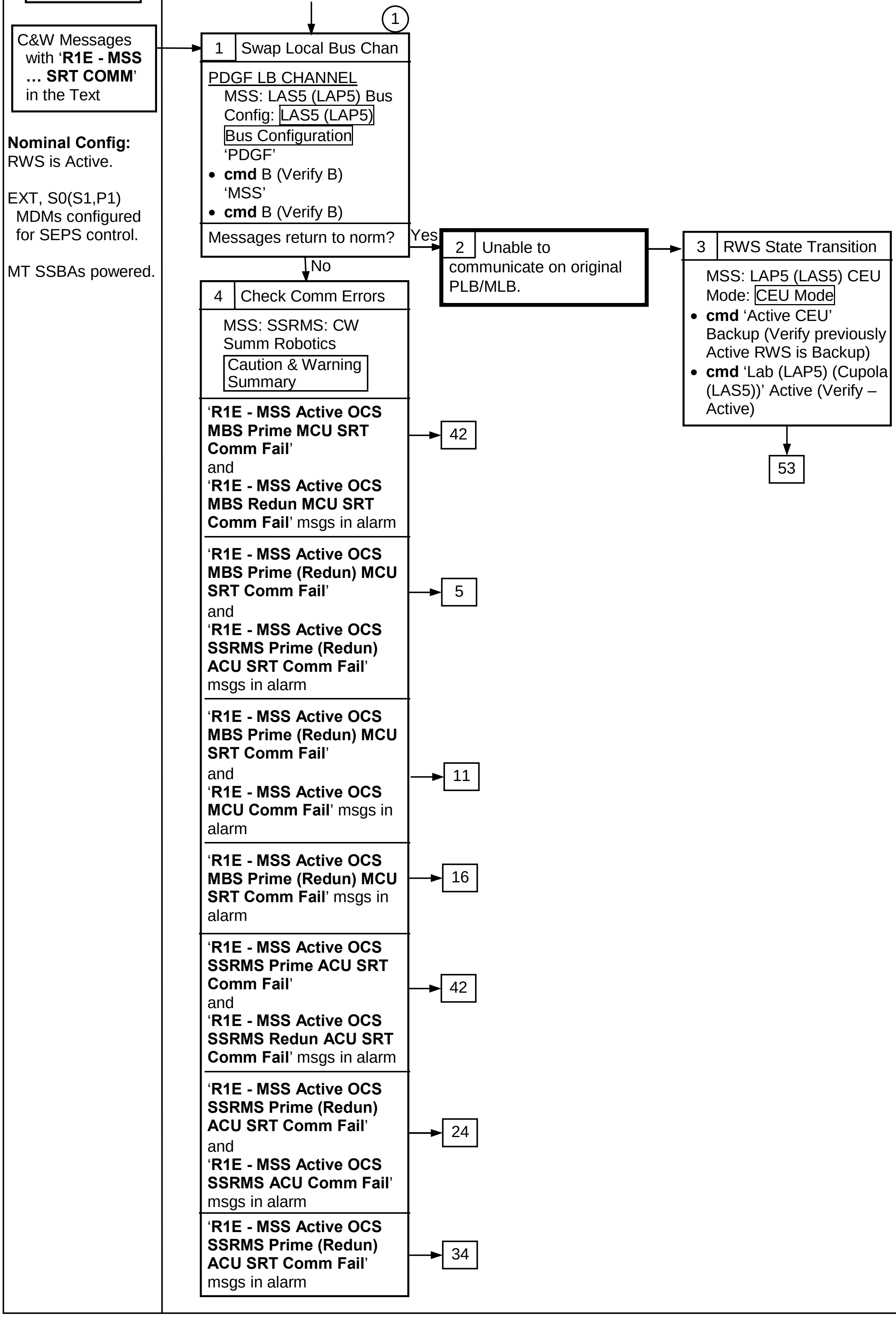
7.201 MSS COMM FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 1 of 8 pages

{7.001 MSS FAILURE RESPONSE AND RECOVERY}, block 78, and 92 (SODF: RBT GEN: MALFUNCTION).



C&W Messages with '**R1E - MSS … SRT COMM**' in the Text

Nominal Config:
RWS is Active.

EXT, S0(S1,P1) MDMs configured for SEPS control.

MT SSBAs powered.

① Unless otherwise noted, all displays in the procedures are on the PCS.

1 Swap Local Bus Chan ①

PDGF LB CHANNEL
MSS: LAS5 (LAP5) Bus Config: LAS5 (LAP5) Bus Configuration
'PDGF'
- **cmd** B (Verify B)

'MSS'
- **cmd** B (Verify B)

Messages return to norm? Yes → 2; No → 4

2 Unable to communicate on original PLB/MLB. → 3

3 RWS State Transition

MSS: LAP5 (LAS5) CEU Mode: CEU Mode
- **cmd** 'Active CEU' Backup (Verify previously Active RWS is Backup)
- **cmd** 'Lab (LAP5) (Cupola (LAS5))' Active (Verify – Active)

→ 53

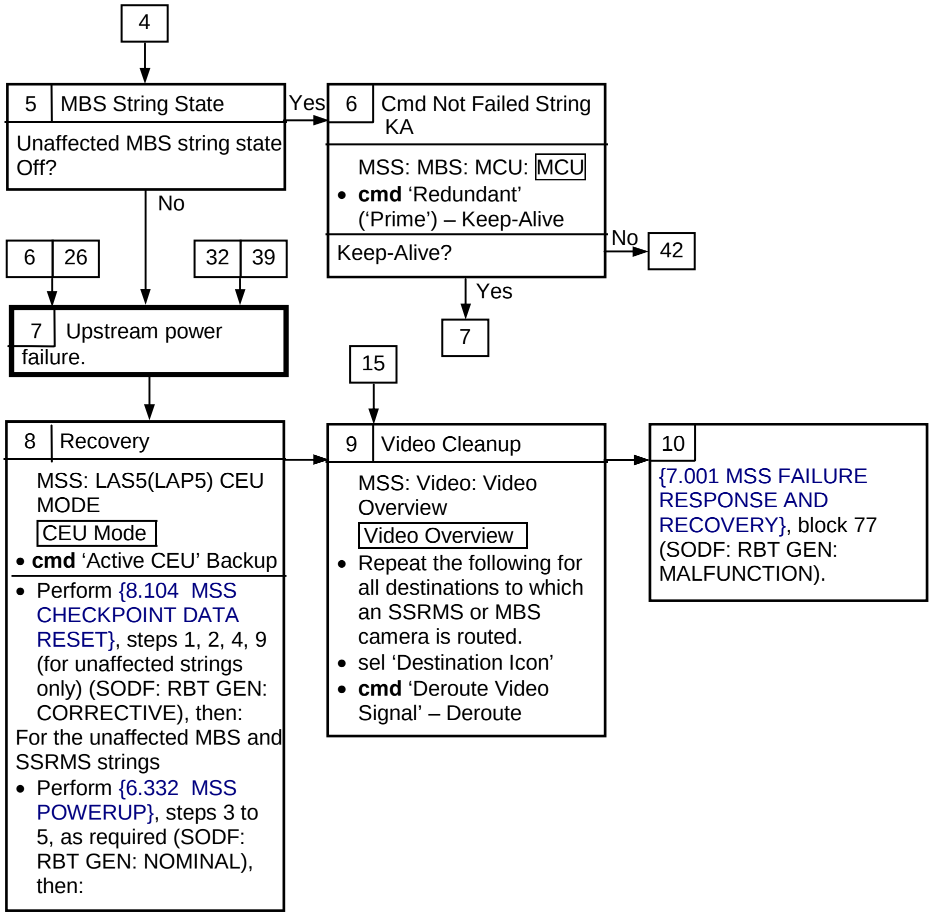
4 Check Comm Errors

MSS: SSRMS: CW Summ Robotics Caution & Warning Summary

'**R1E - MSS Active OCS MBS Prime MCU SRT Comm Fail**' and '**R1E - MSS Active OCS MBS Redun MCU SRT Comm Fail**' msgs in alarm	42
'**R1E - MSS Active OCS MBS Prime (Redun) MCU SRT Comm Fail**' and '**R1E - MSS Active OCS SSRMS Prime (Redun) ACU SRT Comm Fail**' msgs in alarm	5
'**R1E - MSS Active OCS MBS Prime (Redun) MCU SRT Comm Fail**' and '**R1E - MSS Active OCS MCU Comm Fail**' msgs in alarm	11
'**R1E - MSS Active OCS MBS Prime (Redun) MCU SRT Comm Fail**' msgs in alarm	16
'**R1E - MSS Active OCS SSRMS Prime ACU SRT Comm Fail**' and '**R1E - MSS Active OCS SSRMS Redun ACU SRT Comm Fail**' msgs in alarm	42
'**R1E - MSS Active OCS SSRMS Prime (Redun) ACU SRT Comm Fail**' and '**R1E - MSS Active OCS SSRMS ACU Comm Fail**' msgs in alarm	24
'**R1E - MSS Active OCS SSRMS Prime (Redun) ACU SRT Comm Fail**' msgs in alarm	34

7.201 MSS COMM FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 2 of 8 pages



5 MBS String State

Unaffected MBS string state Off?

6 Cmd Not Failed String KA

MSS: MBS: MCU: MCU

- **cmd** 'Redundant' ('Prime') – Keep-Alive

Keep-Alive?

7 Upstream power failure.

8 Recovery

MSS: LAS5(LAP5) CEU MODE

CEU Mode

- **cmd** 'Active CEU' Backup

- Perform {8.104 MSS CHECKPOINT DATA RESET}, steps 1, 2, 4, 9 (for unaffected strings only) (SODF: RBT GEN: CORRECTIVE), then:

For the unaffected MBS and SSRMS strings

- Perform {6.332 MSS POWERUP}, steps 3 to 5, as required (SODF: RBT GEN: NOMINAL), then:

9 Video Cleanup

MSS: Video: Video Overview

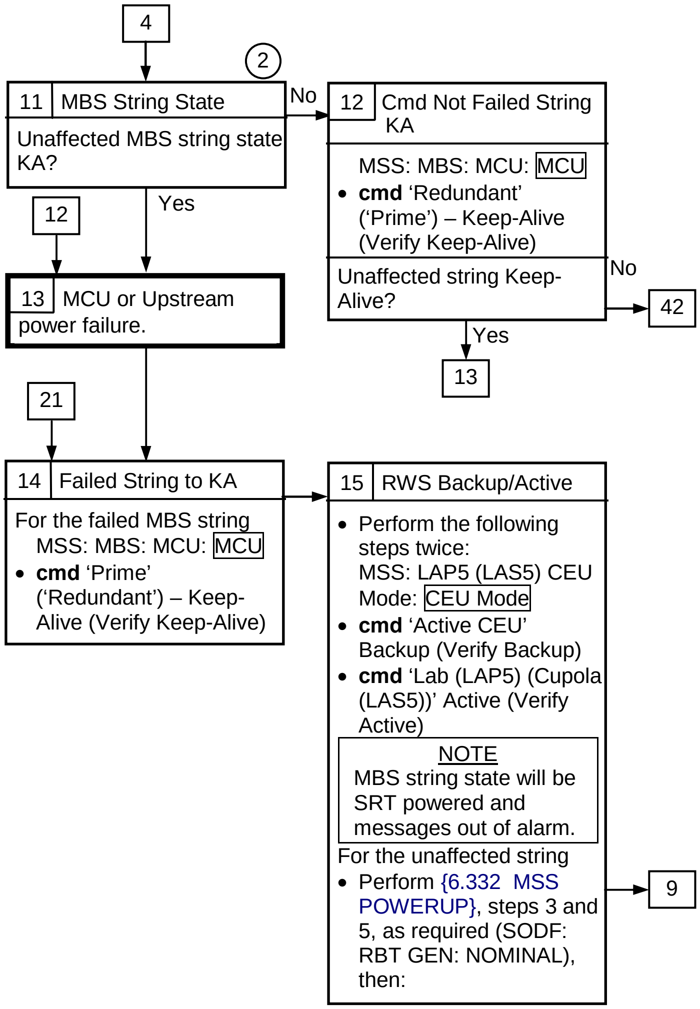
Video Overview

- Repeat the following for all destinations to which an SSRMS or MBS camera is routed.
- sel 'Destination Icon'
- **cmd** 'Deroute Video Signal' – Deroute

10 {7.001 MSS FAILURE RESPONSE AND RECOVERY}, block 77 (SODF: RBT GEN: MALFUNCTION).

7.201 MSS COMM FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 3 of 8 pages



11 MBS String State

Unaffected MBS string state KA?

12 Cmd Not Failed String KA

MSS: MBS: MCU: MCU

- **cmd** ‘Redundant’ (‘Prime’) – Keep-Alive (Verify Keep-Alive)

Unaffected string Keep-Alive?

13 MCU or Upstream power failure.

14 Failed String to KA

For the failed MBS string
MSS: MBS: MCU: MCU

- **cmd** ‘Prime’ (‘Redundant’) – Keep-Alive (Verify Keep-Alive)

15 RWS Backup/Active

- Perform the following steps twice:
  MSS: LAP5 (LAS5) CEU Mode: CEU Mode
- **cmd** ‘Active CEU’ Backup (Verify Backup)
- **cmd** ‘Lab (LAP5) (Cupola (LAS5))’ Active (Verify Active)

NOTE
MBS string state will be SRT powered and messages out of alarm.

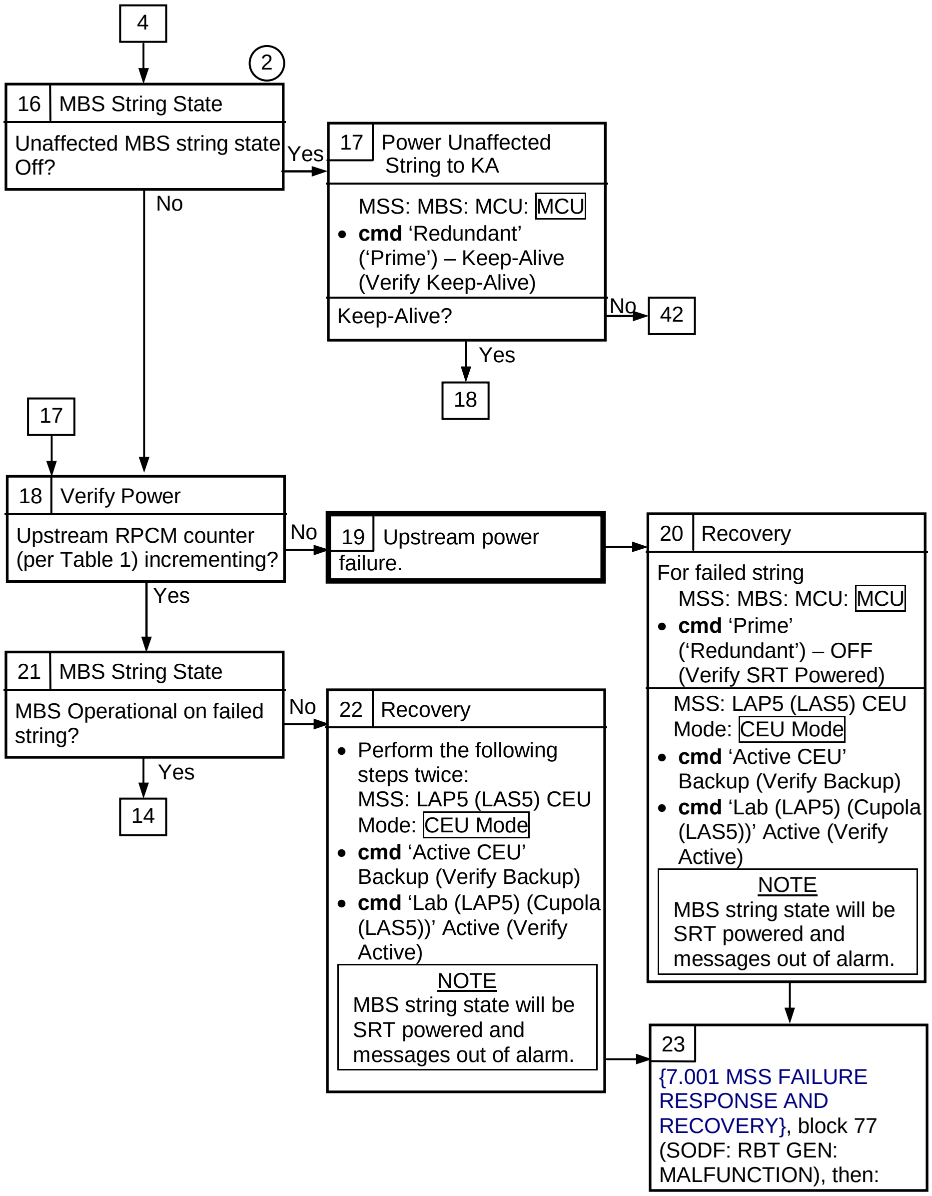
For the unaffected string

- Perform {6.332 MSS POWERUP}, steps 3 and 5, as required (SODF: RBT GEN: NOMINAL), then:

②
SSRMS safing can be cancelled and SSRMS recovery operations can resume in the presence of an MBS CAT-1 error.

7.201 MSS COMM FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 4 of 8 pages



16 MBS String State
Unaffected MBS string state Off?

17 Power Unaffected String to KA
MSS: MBS: MCU: MCU
- **cmd** ‘Redundant’ (‘Prime’) – Keep-Alive (Verify Keep-Alive)

Keep-Alive?

18 Verify Power
Upstream RPCM counter (per Table 1) incrementing?

19 Upstream power failure.

20 Recovery
For failed string
MSS: MBS: MCU: MCU
- **cmd** ‘Prime’ (‘Redundant’) – OFF (Verify SRT Powered)

MSS: LAP5 (LAS5) CEU Mode: CEU Mode
- **cmd** ‘Active CEU’ Backup (Verify Backup)
- **cmd** ‘Lab (LAP5) (Cupola (LAS5))’ Active (Verify Active)

NOTE
MBS string state will be SRT powered and messages out of alarm.

21 MBS String State
MBS Operational on failed string?

22 Recovery
- Perform the following steps twice:
  MSS: LAP5 (LAS5) CEU Mode: CEU Mode
- **cmd** ‘Active CEU’ Backup (Verify Backup)
- **cmd** ‘Lab (LAP5) (Cupola (LAS5))’ Active (Verify Active)

NOTE
MBS string state will be SRT powered and messages out of alarm.

23
{7.001 MSS FAILURE RESPONSE AND RECOVERY}, block 77 (SODF: RBT GEN: MALFUNCTION), then:

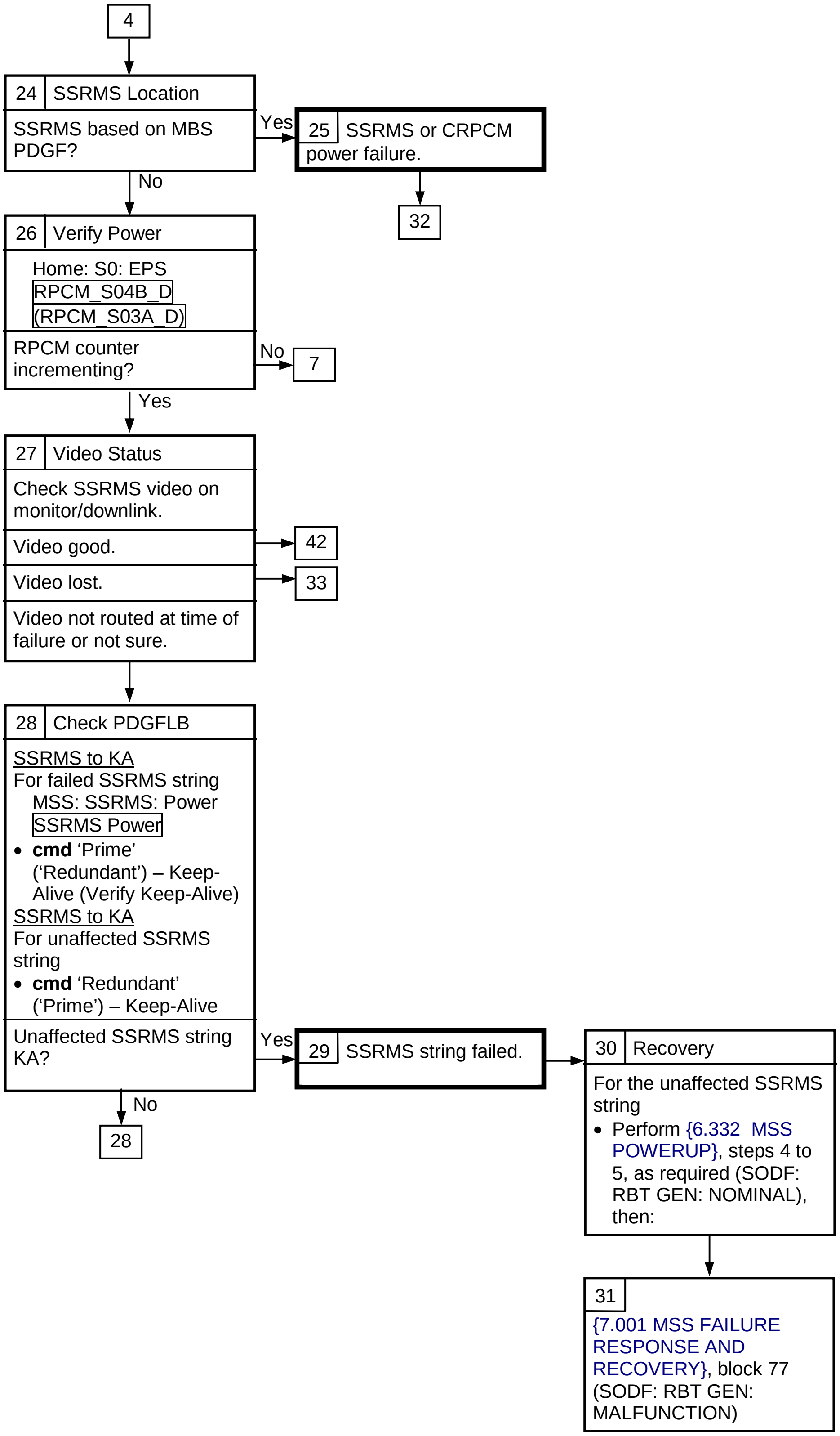
Table 1. Upstream RPCM Checks

MT Worksite	Prime	Redundant
1	RPCM S34B F	RPCM S33A F
2	RPCM S14B E	RPCM S13A E
3	RPCM S14B F	RPCM S13A F
4	RPCM S04B A	RPCM S03A A
5	RPCMS04B B	RPCM S03A B
6	RPCM P14B F	RPCM P13A F
7	RPCM P14B E	RPCM P13A E
8	RPCM P34B F	RPCM P33A F
9	RPCM S43A B	RPCM S41A B
10	RPCM P44A B	RPCM P42A B

② SSRMS safing can be cancelled and SSRMS recovery operations can resume in the presence of an MBS CAT-1 error.

7.201 MSS COMM FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 5 of 8 pages



24 SSRMS Location

SSRMS based on MBS PDGF?

25 SSRMS or CRPCM power failure.

26 Verify Power

Home: S0: EPS
RPCM_S04B_D
(RPCM_S03A_D)

RPCM counter incrementing?

27 Video Status

Check SSRMS video on monitor/downlink.

Video good.

Video lost.

Video not routed at time of failure or not sure.

28 Check PDGFLB

SSRMS to KA
For failed SSRMS string
MSS: SSRMS: Power
SSRMS Power

- **cmd** ‘Prime’ (‘Redundant’) – Keep-Alive (Verify Keep-Alive)

SSRMS to KA
For unaffected SSRMS string

- **cmd** ‘Redundant’ (‘Prime’) – Keep-Alive

Unaffected SSRMS string KA?

29 SSRMS string failed.

30 Recovery

For the unaffected SSRMS string

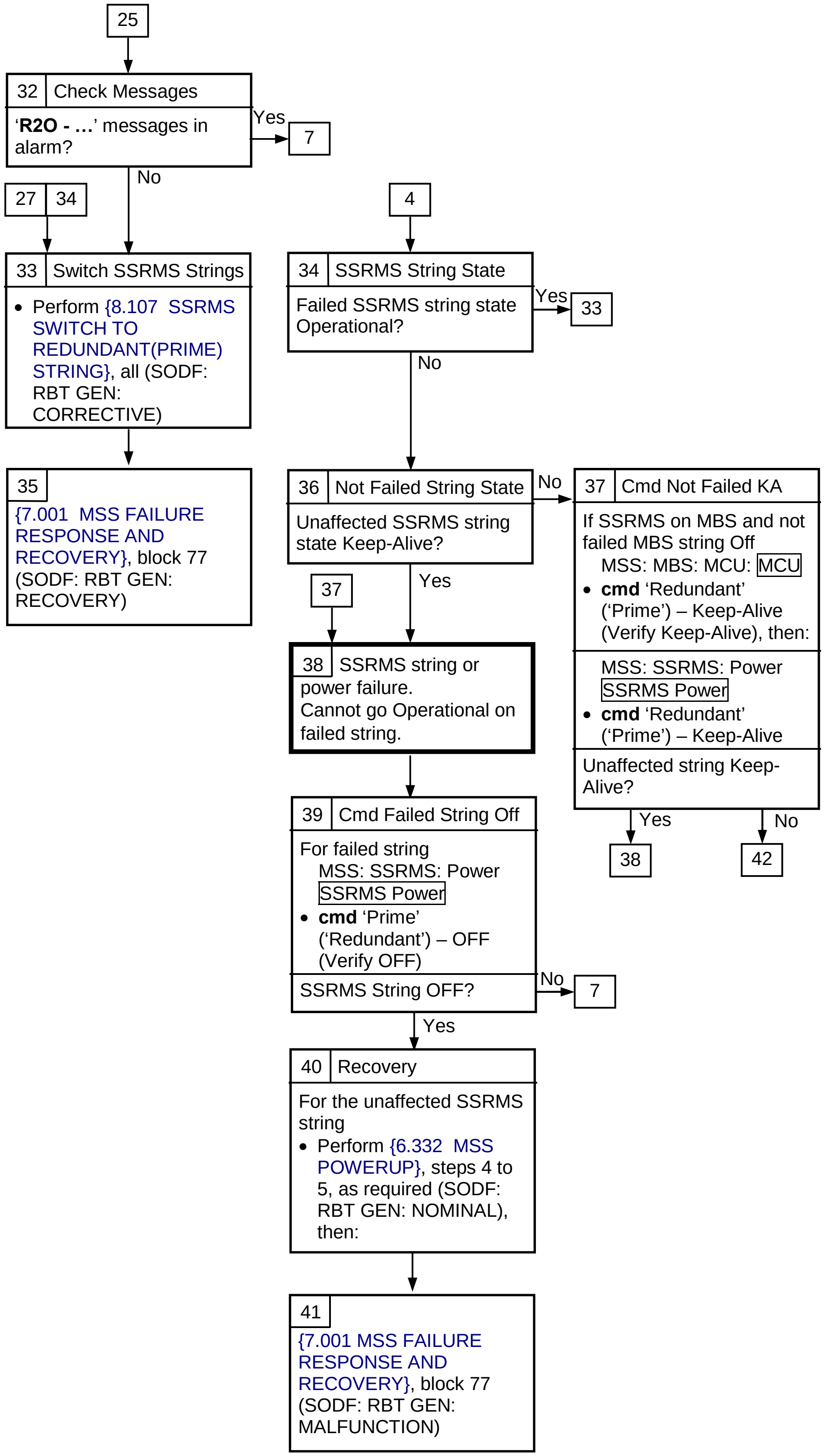
- Perform {6.332 MSS POWERUP}, steps 4 to 5, as required (SODF: RBT GEN: NOMINAL), then:

31

{7.001 MSS FAILURE RESPONSE AND RECOVERY}, block 77 (SODF: RBT GEN: MALFUNCTION)

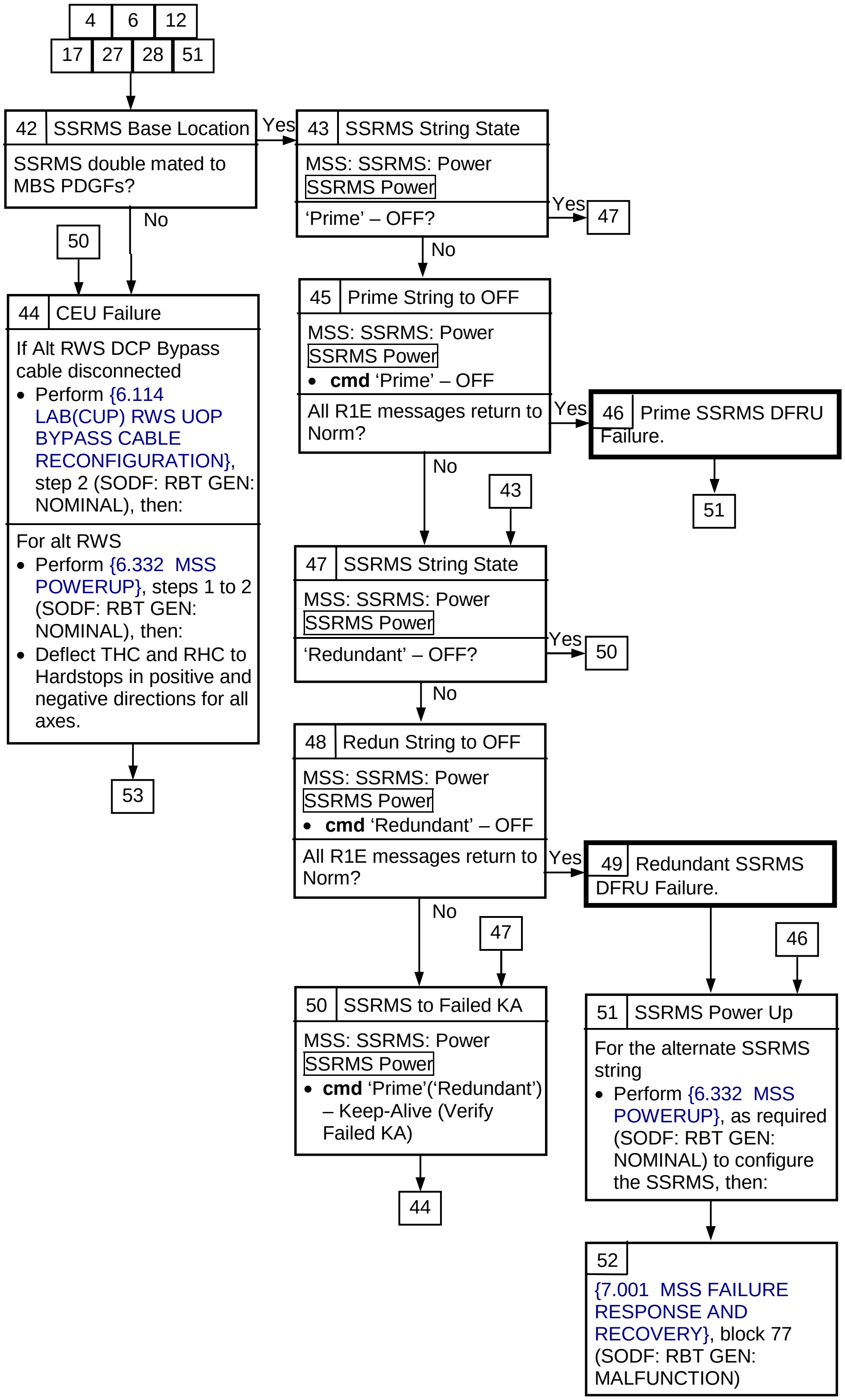
7.201 MSS COMM FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN)   Page 6 of 8 pages



7.201 MSS COMM FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 7 of 8 pages



42 SSRMS Base Location

SSRMS double mated to MBS PDGFs?

43 SSRMS String State

MSS: SSRMS: Power
SSRMS Power
'Prime' – OFF?

44 CEU Failure

If Alt RWS DCP Bypass cable disconnected

- Perform {6.114 LAB(CUP) RWS UOP BYPASS CABLE RECONFIGURATION}, step 2 (SODF: RBT GEN: NOMINAL), then:

For alt RWS

- Perform {6.332 MSS POWERUP}, steps 1 to 2 (SODF: RBT GEN: NOMINAL), then:
- Deflect THC and RHC to Hardstops in positive and negative directions for all axes.

45 Prime String to OFF

MSS: SSRMS: Power
SSRMS Power

- **cmd** 'Prime' – OFF

All R1E messages return to Norm?

46 Prime SSRMS DFRU Failure.

47 SSRMS String State

MSS: SSRMS: Power
SSRMS Power
'Redundant' – OFF?

48 Redun String to OFF

MSS: SSRMS: Power
SSRMS Power

- **cmd** 'Redundant' – OFF

All R1E messages return to Norm?

49 Redundant SSRMS DFRU Failure.

50 SSRMS to Failed KA

MSS: SSRMS: Power
SSRMS Power

- **cmd** 'Prime'('Redundant') – Keep-Alive (Verify Failed KA)

51 SSRMS Power Up

For the alternate SSRMS string

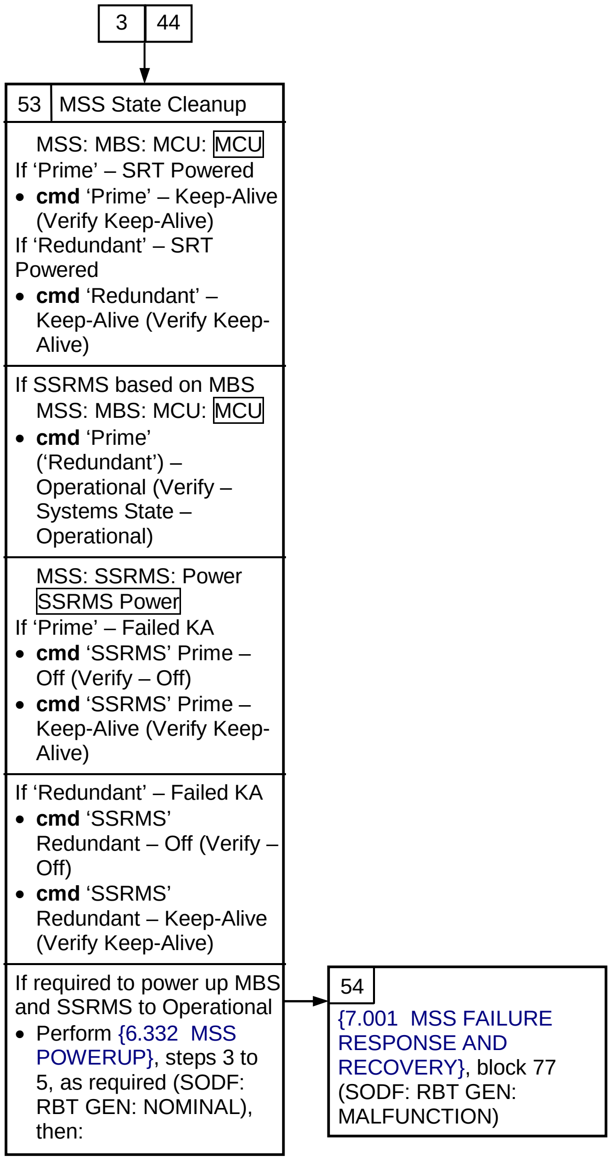
- Perform {6.332 MSS POWERUP}, as required (SODF: RBT GEN: NOMINAL) to configure the SSRMS, then:

52

{7.001 MSS FAILURE RESPONSE AND RECOVERY}, block 77 (SODF: RBT GEN: MALFUNCTION)

7.201 MSS COMM FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 8 of 8 pages



53 **MSS State Cleanup**

MSS: MBS: MCU: $\boxed{\text{MCU}}$

If ‘Prime’ – SRT Powered
- **cmd** ‘Prime’ – Keep-Alive (Verify Keep-Alive)

If ‘Redundant’ – SRT Powered
- **cmd** ‘Redundant’ – Keep-Alive (Verify Keep-Alive)

If SSRMS based on MBS

MSS: MBS: MCU: $\boxed{\text{MCU}}$
- **cmd** ‘Prime’ (‘Redundant’) – Operational (Verify – Systems State – Operational)

MSS: SSRMS: Power $\boxed{\text{SSRMS Power}}$

If ‘Prime’ – Failed KA
- **cmd** ‘SSRMS’ Prime – Off (Verify – Off)
- **cmd** ‘SSRMS’ Prime – Keep-Alive (Verify Keep-Alive)

If ‘Redundant’ – Failed KA
- **cmd** ‘SSRMS’ Redundant – Off (Verify – Off)
- **cmd** ‘SSRMS’ Redundant – Keep-Alive (Verify Keep-Alive)

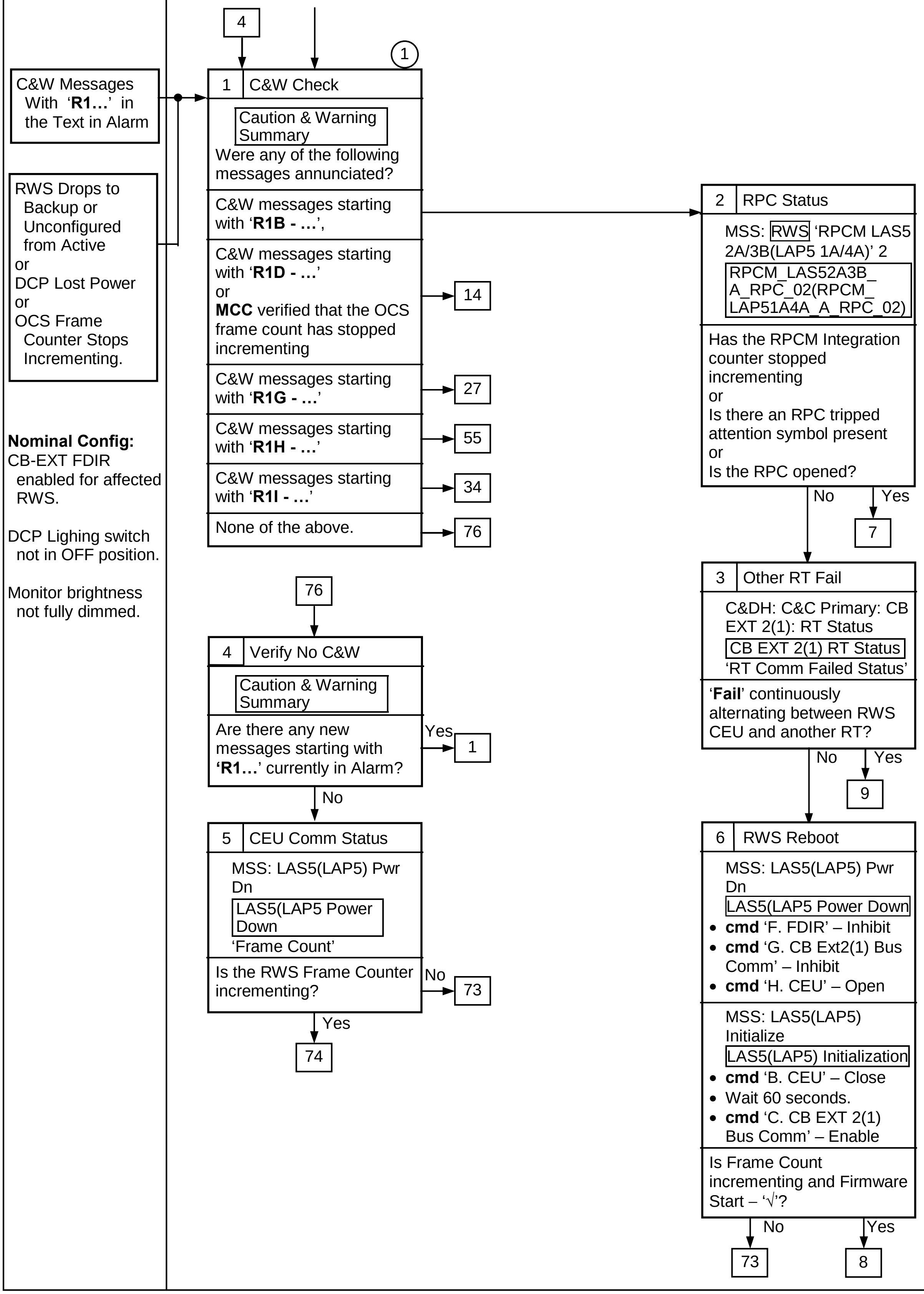
If required to power up MBS and SSRMS to Operational
- Perform {6.332 MSS POWERUP}, steps 3 to 5, as required (SODF: RBT GEN: NOMINAL), then:

54 {7.001 MSS FAILURE RESPONSE AND RECOVERY}, block 77 (SODF: RBT GEN: MALFUNCTION)

7.300 ACTIVE RWS FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 1 of 11 pages

{7.001 MSS FAILURE RESPONSE AND RECOVERY},
block 74 (SODF: RBT GEN: MALFUNCTION)
{7.101 RWS TRANSITION TO ACTIVE FAILURE},
block 5, (SODF:RBT: GEN: MALFUNCTION



C&W Messages With ‘**R1…**’ in the Text in Alarm

RWS Drops to Backup or Unconfigured from Active
or
DCP Lost Power
or
OCS Frame Counter Stops Incrementing.

1 C&W Check ①

Caution & Warning Summary

Were any of the following messages annunciated?

- C&W messages starting with ‘**R1B - …**’, → 2
- C&W messages starting with ‘**R1D - …**’ or **MCC** verified that the OCS frame count has stopped incrementing → 14
- C&W messages starting with ‘**R1G - …**’ → 27
- C&W messages starting with ‘**R1H - …**’ → 55
- C&W messages starting with ‘**R1I - …**’ → 34
- None of the above. → 76

2 RPC Status

MSS: RWS ‘RPCM LAS5 2A/3B(LAP5 1A/4A)’ 2
RPCM_LAS52A3B_A_RPC_02(RPCM_LAP51A4A_A_RPC_02)

Has the RPCM Integration counter stopped incrementing
or
Is there an RPC tripped attention symbol present
or
Is the RPC opened?

No → 3; Yes → 7

3 Other RT Fail

C&DH: C&C Primary: CB EXT 2(1): RT Status
CB EXT 2(1) RT Status
‘RT Comm Failed Status’

‘**Fail**’ continuously alternating between RWS CEU and another RT?

No → 6; Yes → 9

76 →

4 Verify No C&W

Caution & Warning Summary

Are there any new messages starting with **‘R1…**’ currently in Alarm?

Yes → 1; No → 5

5 CEU Comm Status

MSS: LAS5(LAP5) Pwr Dn
LAS5(LAP5 Power Down
‘Frame Count’

Is the RWS Frame Counter incrementing?

No → 73; Yes → 74

6 RWS Reboot

MSS: LAS5(LAP5) Pwr Dn
LAS5(LAP5 Power Down

- **cmd** ‘F. FDIR’ – Inhibit
- **cmd** ‘G. CB Ext2(1) Bus Comm’ – Inhibit
- **cmd** ‘H. CEU’ – Open

MSS: LAS5(LAP5) Initialize
LAS5(LAP5) Initialization

- **cmd** ‘B. CEU’ – Close
- Wait 60 seconds.
- **cmd** ‘C. CB EXT 2(1) Bus Comm’ – Enable

Is Frame Count incrementing and Firmware Start – ‘√’?

No → 73; Yes → 8

Nominal Config:
CB-EXT FDIR enabled for affected RWS.

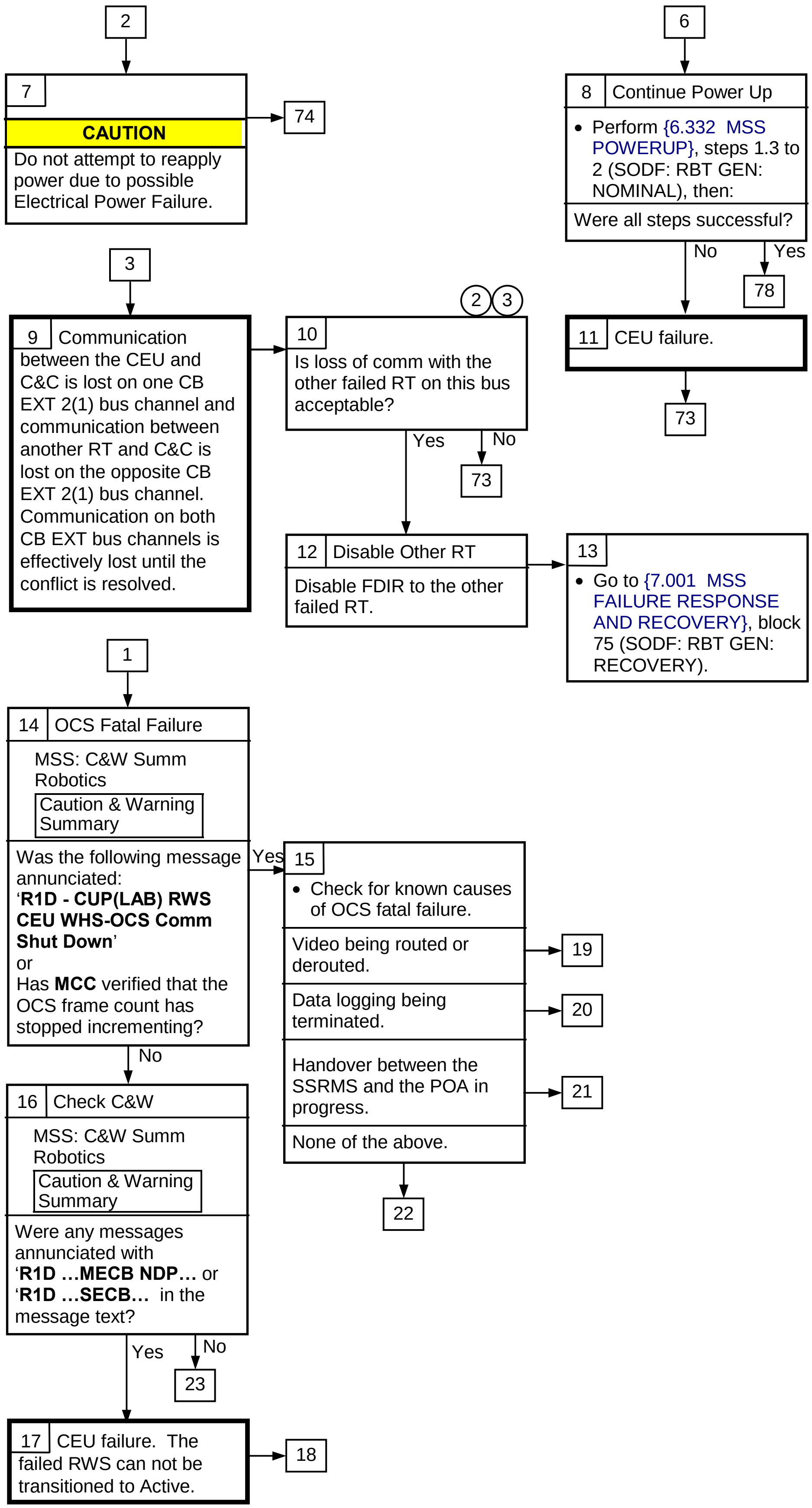
DCP Lighing switch not in OFF position.

Monitor brightness not fully dimmed.

① Unless otherwise indicated, all displays in this procedure are on the PCS.

7.300 ACTIVE RWS FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 2 of 11 pages



7 **CAUTION** Do not attempt to reapply power due to possible Electrical Power Failure.

8 Continue Power Up

- Perform {6.332 MSS POWERUP}, steps 1.3 to 2 (SODF: RBT GEN: NOMINAL), then:

Were all steps successful?

9 Communication between the CEU and C&C is lost on one CB EXT 2(1) bus channel and communication between another RT and C&C is lost on the opposite CB EXT 2(1) bus channel. Communication on both CB EXT bus channels is effectively lost until the conflict is resolved.

10 ② ③ Is loss of comm with the other failed RT on this bus acceptable?

11 CEU failure.

12 Disable Other RT

Disable FDIR to the other failed RT.

13

- Go to {7.001 MSS FAILURE RESPONSE AND RECOVERY}, block 75 (SODF: RBT GEN: RECOVERY).

14 OCS Fatal Failure

MSS: C&W Summ Robotics
Caution & Warning Summary

Was the following message annunciated:
'**R1D - CUP(LAB) RWS CEU WHS-OCS Comm Shut Down**'
or
Has **MCC** verified that the OCS frame count has stopped incrementing?

15

- Check for known causes of OCS fatal failure.

Video being routed or derouted.

Data logging being terminated.

Handover between the SSRMS and the POA in progress.

None of the above.

16 Check C&W

MSS: C&W Summ Robotics
Caution & Warning Summary

Were any messages annunciated with '**R1D …MECB NDP…** or '**R1D …SECB…** in the message text?

17 CEU failure. The failed RWS can not be transitioned to Active.

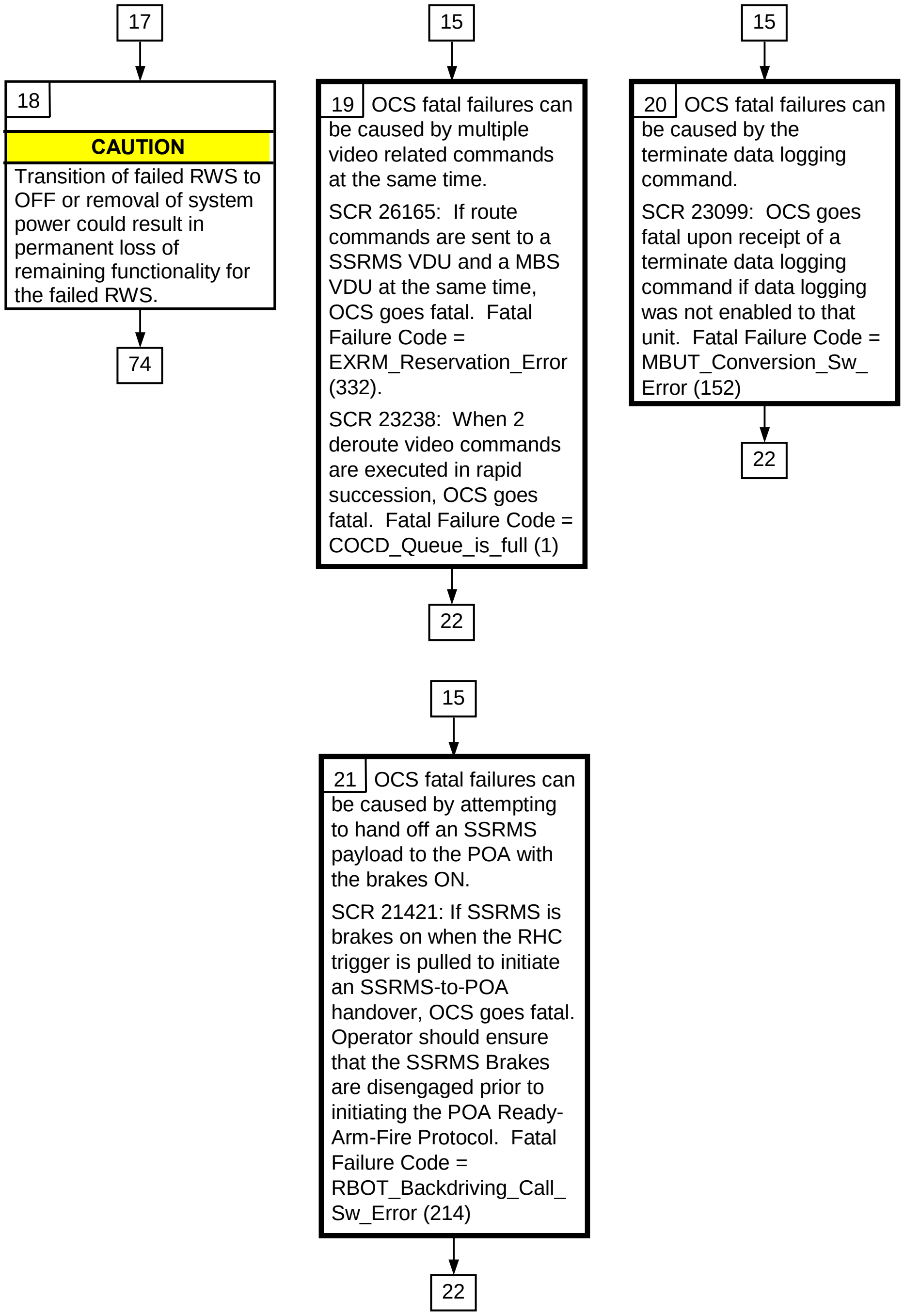
②
List of remote terminals on CB EXT 1:
13 LCA IMCA-1
22 RWS CEU-1
24 MDM EXT1
25 RPCM S0-1A-C
26 MDM PMCU1

List of remote terminals on CB EXT 2:
13 LCA IMCA-2
22 RWS CEU-2
24 MDM EXT2
25 RPCM S0-2B-C
26 MDM PMCU2

③
This step is ground only and requires coordination within the flight control team.

7.300 ACTIVE RWS FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 3 of 11 pages



18

CAUTION

Transition of failed RWS to OFF or removal of system power could result in permanent loss of remaining functionality for the failed RWS.

19 OCS fatal failures can be caused by multiple video related commands at the same time.

SCR 26165: If route commands are sent to a SSRMS VDU and a MBS VDU at the same time, OCS goes fatal. Fatal Failure Code = EXRM_Reservation_Error (332).

SCR 23238: When 2 deroute video commands are executed in rapid succession, OCS goes fatal. Fatal Failure Code = COCD_Queue_is_full (1)

20 OCS fatal failures can be caused by the terminate data logging command.

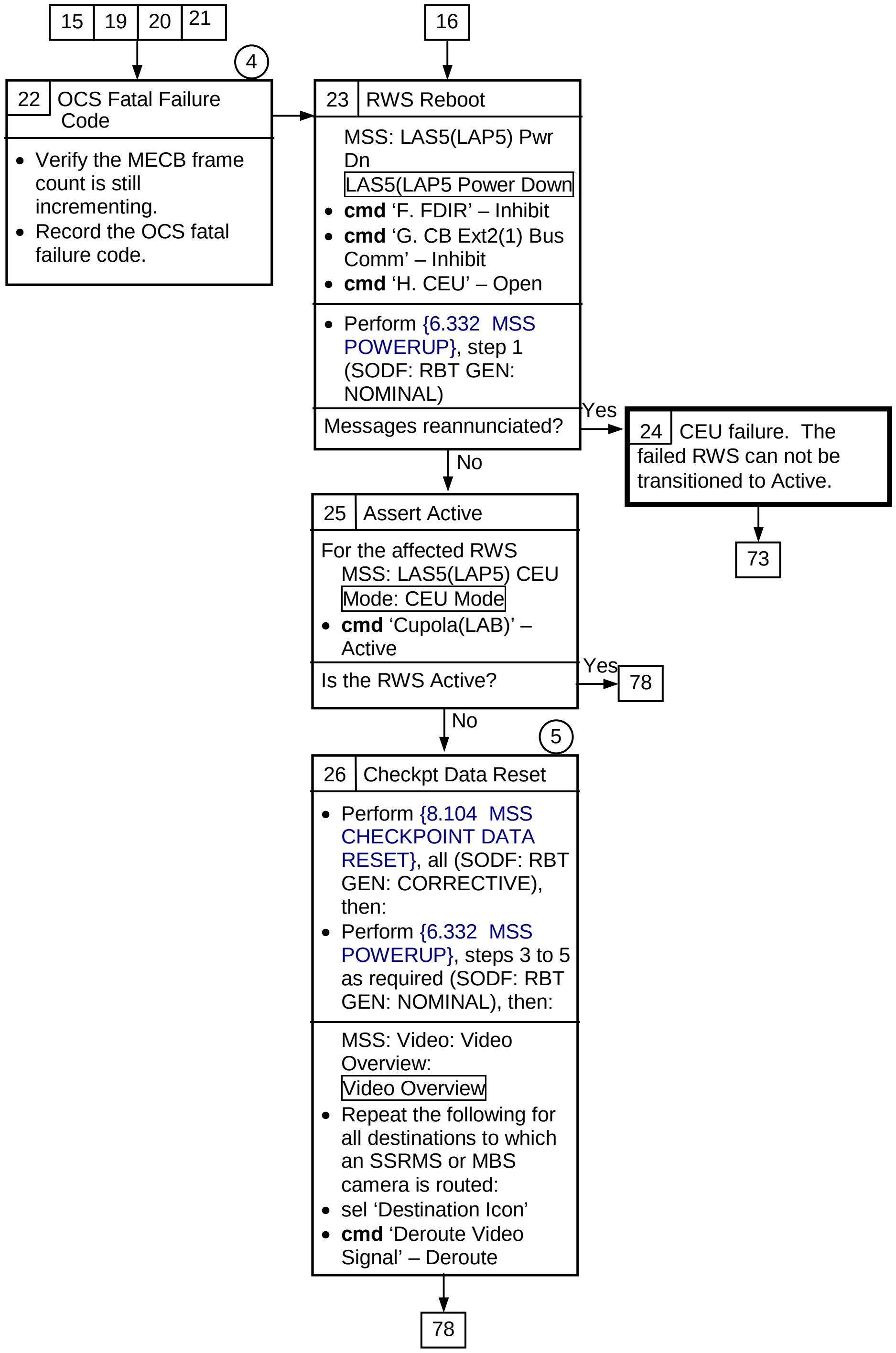
SCR 23099: OCS goes fatal upon receipt of a terminate data logging command if data logging was not enabled to that unit. Fatal Failure Code = MBUT_Conversion_Sw_Error (152)

21 OCS fatal failures can be caused by attempting to hand off an SSRMS payload to the POA with the brakes ON.

SCR 21421: If SSRMS is brakes on when the RHC trigger is pulled to initiate an SSRMS-to-POA handover, OCS goes fatal. Operator should ensure that the SSRMS Brakes are disengaged prior to initiating the POA Ready-Arm-Fire Protocol. Fatal Failure Code = RBOT_Backdriving_Call_Sw_Error (214)

7.300 ACTIVE RWS FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 4 of 11 pages



22 OCS Fatal Failure Code

- Verify the MECB frame count is still incrementing.
- Record the OCS fatal failure code.

23 RWS Reboot

MSS: LAS5(LAP5) Pwr Dn
LAS5(LAP5 Power Down

- **cmd** ‘F. FDIR’ – Inhibit
- **cmd** ‘G. CB Ext2(1) Bus Comm’ – Inhibit
- **cmd** ‘H. CEU’ – Open

- Perform {6.332 MSS POWERUP}, step 1 (SODF: RBT GEN: NOMINAL)

Messages reannunciated?

24 CEU failure. The failed RWS can not be transitioned to Active.

25 Assert Active

For the affected RWS
MSS: LAS5(LAP5) CEU
Mode: CEU Mode

- **cmd** ‘Cupola(LAB)’ – Active

Is the RWS Active?

26 Checkpt Data Reset

- Perform {8.104 MSS CHECKPOINT DATA RESET}, all (SODF: RBT GEN: CORRECTIVE), then:
- Perform {6.332 MSS POWERUP}, steps 3 to 5 as required (SODF: RBT GEN: NOMINAL), then:

MSS: Video: Video Overview:
Video Overview

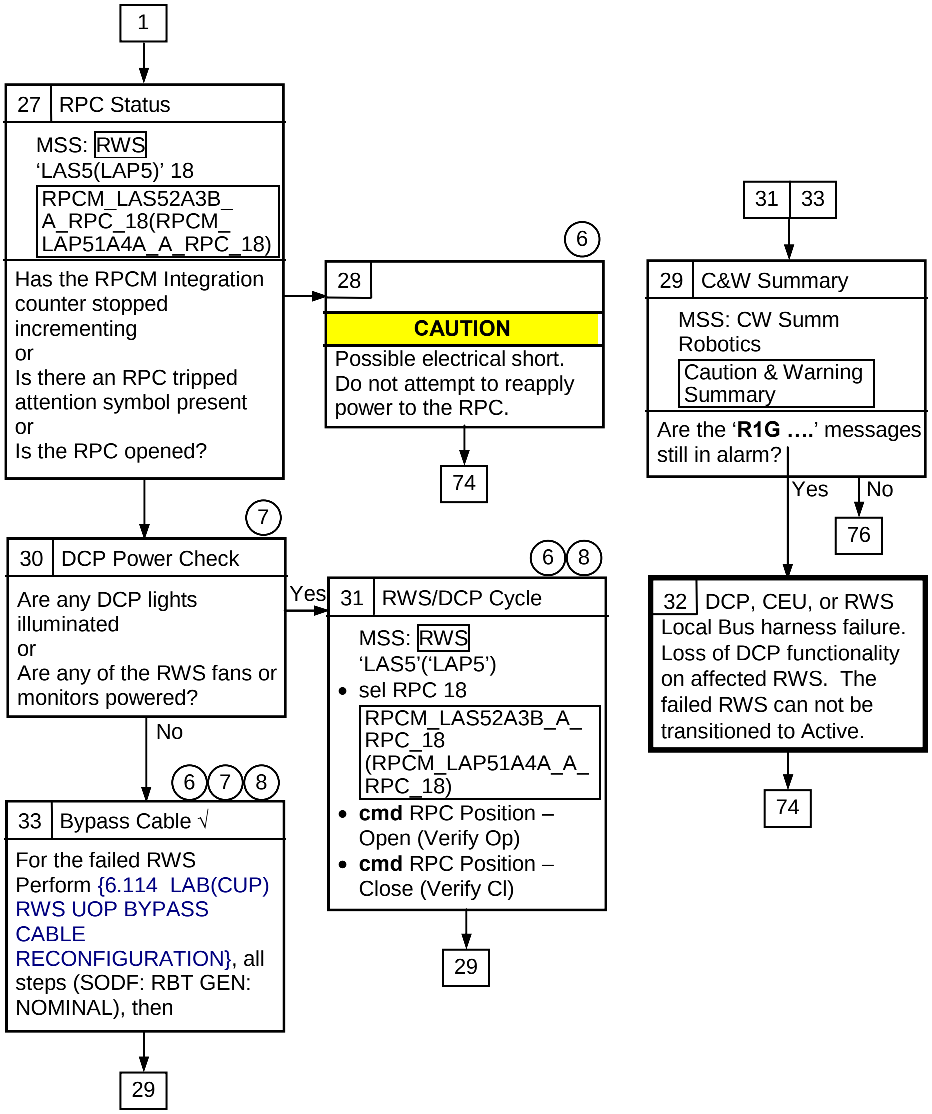
- Repeat the following for all destinations to which an SSRMS or MBS camera is routed:
- sel ‘Destination Icon’
- **cmd** ‘Deroute Video Signal’ – Deroute

④ The fatal failure code is only available in telemetry to the ground. Refer to SSP 50496 - OCS to RWS ICD PIRN 11 for the list of fatal failure codes.

⑤ SCR 24574, 28414

7.300 ACTIVE RWS FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 5 of 11 pages



27 RPC Status

MSS: RWS
'LAS5(LAP5)' 18
RPCM_LAS52A3B_A_RPC_18(RPCM_LAP51A4A_A_RPC_18)

Has the RPCM Integration counter stopped incrementing
or
Is there an RPC tripped attention symbol present
or
Is the RPC opened?

28

CAUTION

Possible electrical short. Do not attempt to reapply power to the RPC.

29 C&W Summary

MSS: CW Summ
Robotics
Caution & Warning Summary

Are the '**R1G ….**' messages still in alarm?

30 DCP Power Check

Are any DCP lights illuminated
or
Are any of the RWS fans or monitors powered?

31 RWS/DCP Cycle

MSS: RWS
'LAS5'('LAP5')

- sel RPC 18
  RPCM_LAS52A3B_A_RPC_18
  (RPCM_LAP51A4A_A_RPC_18)
- **cmd** RPC Position – Open (Verify Op)
- **cmd** RPC Position – Close (Verify Cl)

32 DCP, CEU, or RWS Local Bus harness failure. Loss of DCP functionality on affected RWS. The failed RWS can not be transitioned to Active.

33 Bypass Cable √

For the failed RWS
Perform {6.114 LAB(CUP) RWS UOP BYPASS CABLE RECONFIGURATION}, all steps (SODF: RBT GEN: NOMINAL), then

⑥
PCS at the failed RWS will be on battery power while the RPC is opened.

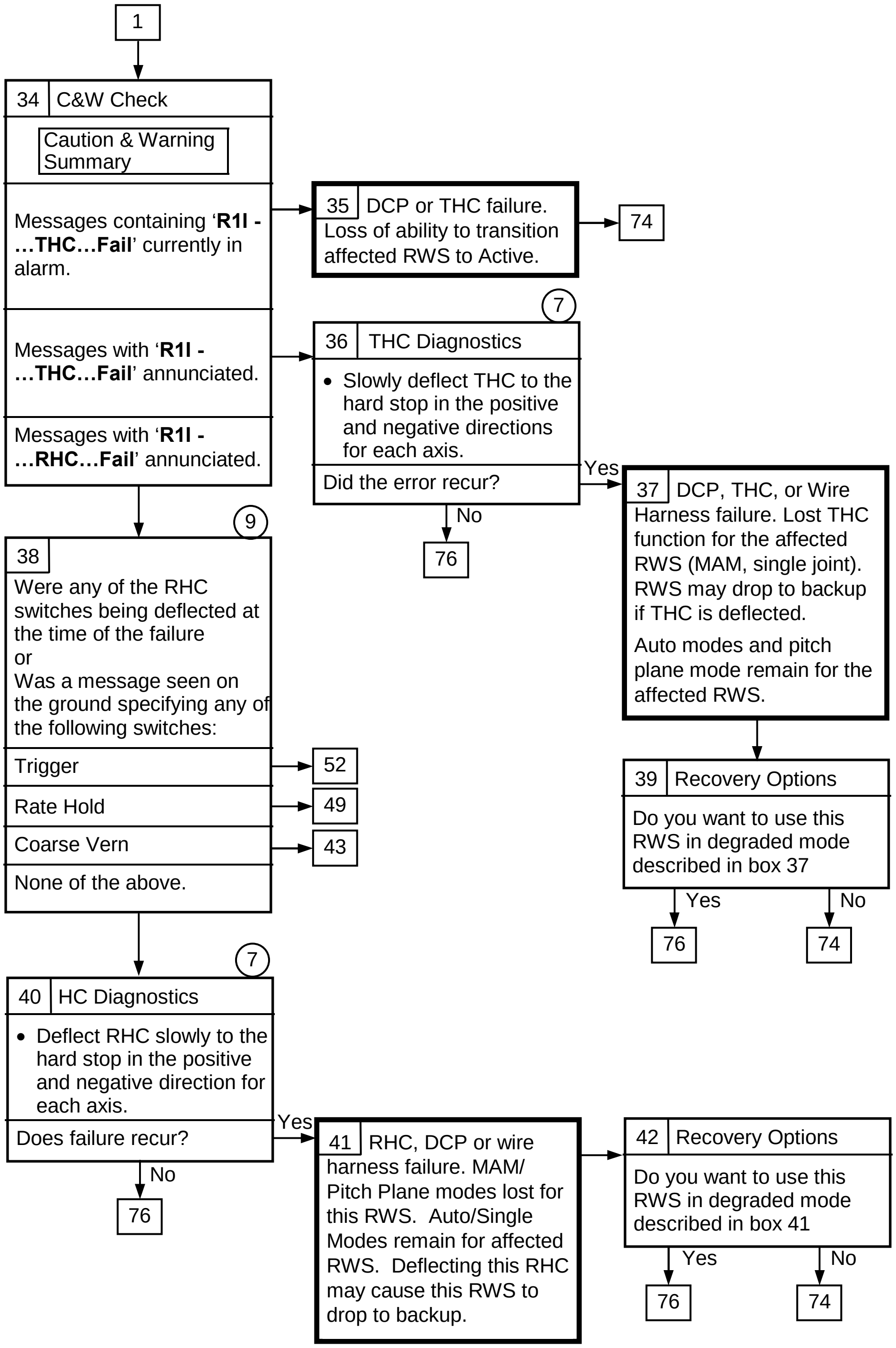
⑦
This step must be performed by the crew.

⑧
Expect '**R1G - …**', '**R1H**' and '**R1J**' messages to be annunciated when this block is executed. If the power cycle is successful, all messages should return to NORM when DCP power is reapplied.

Monitors may display anomalous video when power is reapplied to the DCP. Valid video can be recovered by routing a test pattern or another video view to each

7.300 ACTIVE RWS FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 6 of 11 pages



34 C&W Check

Caution & Warning Summary

Messages containing ‘**R1I - …THC…Fail**’ currently in alarm.

Messages with ‘**R1I - …THC…Fail**’ annunciated.

Messages with ‘**R1I - …RHC…Fail**’ annunciated.

35 DCP or THC failure. Loss of ability to transition affected RWS to Active.

36 THC Diagnostics

- Slowly deflect THC to the hard stop in the positive and negative directions for each axis.

Did the error recur?

37 DCP, THC, or Wire Harness failure. Lost THC function for the affected RWS (MAM, single joint). RWS may drop to backup if THC is deflected.

Auto modes and pitch plane mode remain for the affected RWS.

38 Were any of the RHC switches being deflected at the time of the failure or Was a message seen on the ground specifying any of the following switches:

Trigger

Rate Hold

Coarse Vern

None of the above.

39 Recovery Options

Do you want to use this RWS in degraded mode described in box 37

40 HC Diagnostics

- Deflect RHC slowly to the hard stop in the positive and negative direction for each axis.

Does failure recur?

41 RHC, DCP or wire harness failure. MAM/ Pitch Plane modes lost for this RWS. Auto/Single Modes remain for affected RWS. Deflecting this RHC may cause this RWS to drop to backup.

42 Recovery Options

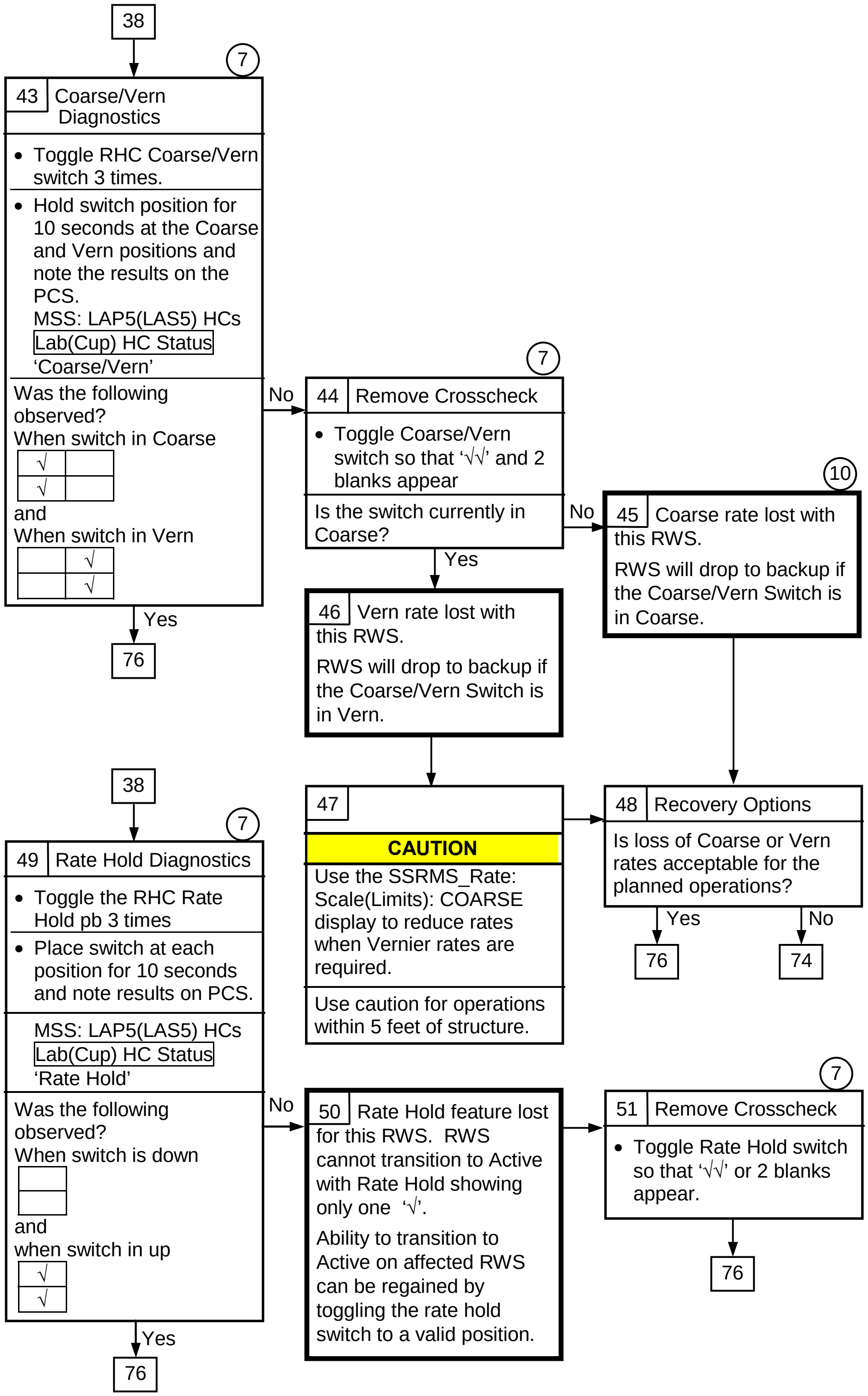
Do you want to use this RWS in degraded mode described in box 41

⑦ This step must be performed by the crew.

⑨ Cross check messages can be seen on the ground in the REM; however, due to timing considerations, these messages are not always seen. Persistent cross checks can also be identified on the PCS DCP display.

7.300 ACTIVE RWS FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 7 of 11 pages



43 Coarse/Vern Diagnostics

- Toggle RHC Coarse/Vern switch 3 times.
- Hold switch position for 10 seconds at the Coarse and Vern positions and note the results on the PCS.
  MSS: LAP5(LAS5) HCs
  Lab(Cup) HC Status
  'Coarse/Vern'

Was the following observed?
When switch in Coarse

√	
√	

and
When switch in Vern

	√
	√

44 Remove Crosscheck

- Toggle Coarse/Vern switch so that '√√' and 2 blanks appear

Is the switch currently in Coarse?

45 Coarse rate lost with this RWS.

RWS will drop to backup if the Coarse/Vern Switch is in Coarse.

46 Vern rate lost with this RWS.

RWS will drop to backup if the Coarse/Vern Switch is in Vern.

47

CAUTION

Use the SSRMS_Rate: Scale(Limits): COARSE display to reduce rates when Vernier rates are required.

Use caution for operations within 5 feet of structure.

48 Recovery Options

Is loss of Coarse or Vern rates acceptable for the planned operations?

49 Rate Hold Diagnostics

- Toggle the RHC Rate Hold pb 3 times
- Place switch at each position for 10 seconds and note results on PCS.

MSS: LAP5(LAS5) HCs
Lab(Cup) HC Status
'Rate Hold'

Was the following observed?
When switch is down

and
when switch in up

√
√

50 Rate Hold feature lost for this RWS. RWS cannot transition to Active with Rate Hold showing only one '√'.

Ability to transition to Active on affected RWS can be regained by toggling the rate hold switch to a valid position.

51 Remove Crosscheck

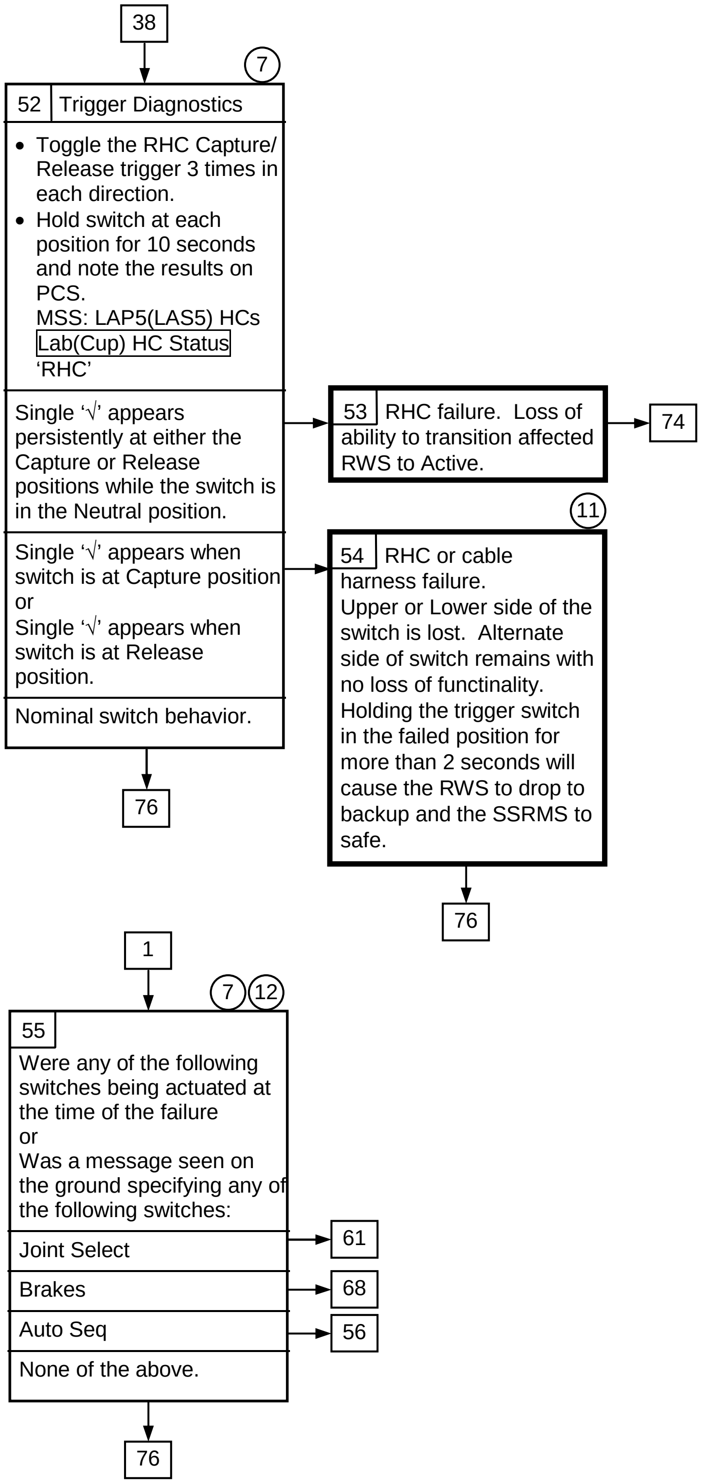
- Toggle Rate Hold switch so that '√√' or 2 blanks appear.

(7)
This step must be performed by the crew.

(10)
The SSRMS joint diagnostics may provide false fail without Coarse Rates include: Buck Regulator, Switch Motor Drive Switches, and Motor Windings tests.

7.300 ACTIVE RWS FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 8 of 11 pages



52 Trigger Diagnostics

- Toggle the RHC Capture/ Release trigger 3 times in each direction.
- Hold switch at each position for 10 seconds and note the results on PCS.
  MSS: LAP5(LAS5) HCs
  Lab(Cup) HC Status
  ‘RHC’

Single ‘√’ appears persistently at either the Capture or Release positions while the switch is in the Neutral position.

Single ‘√’ appears when switch is at Capture position
or
Single ‘√’ appears when switch is at Release position.

Nominal switch behavior.

53 RHC failure. Loss of ability to transition affected RWS to Active.

54 RHC or cable harness failure.
Upper or Lower side of the switch is lost. Alternate side of switch remains with no loss of functinality. Holding the trigger switch in the failed position for more than 2 seconds will cause the RWS to drop to backup and the SSRMS to safe.

55
Were any of the following switches being actuated at the time of the failure
or
Was a message seen on the ground specifying any of the following switches:

Joint Select

Brakes

Auto Seq

None of the above.

⑦
This step must be performed by the crew.

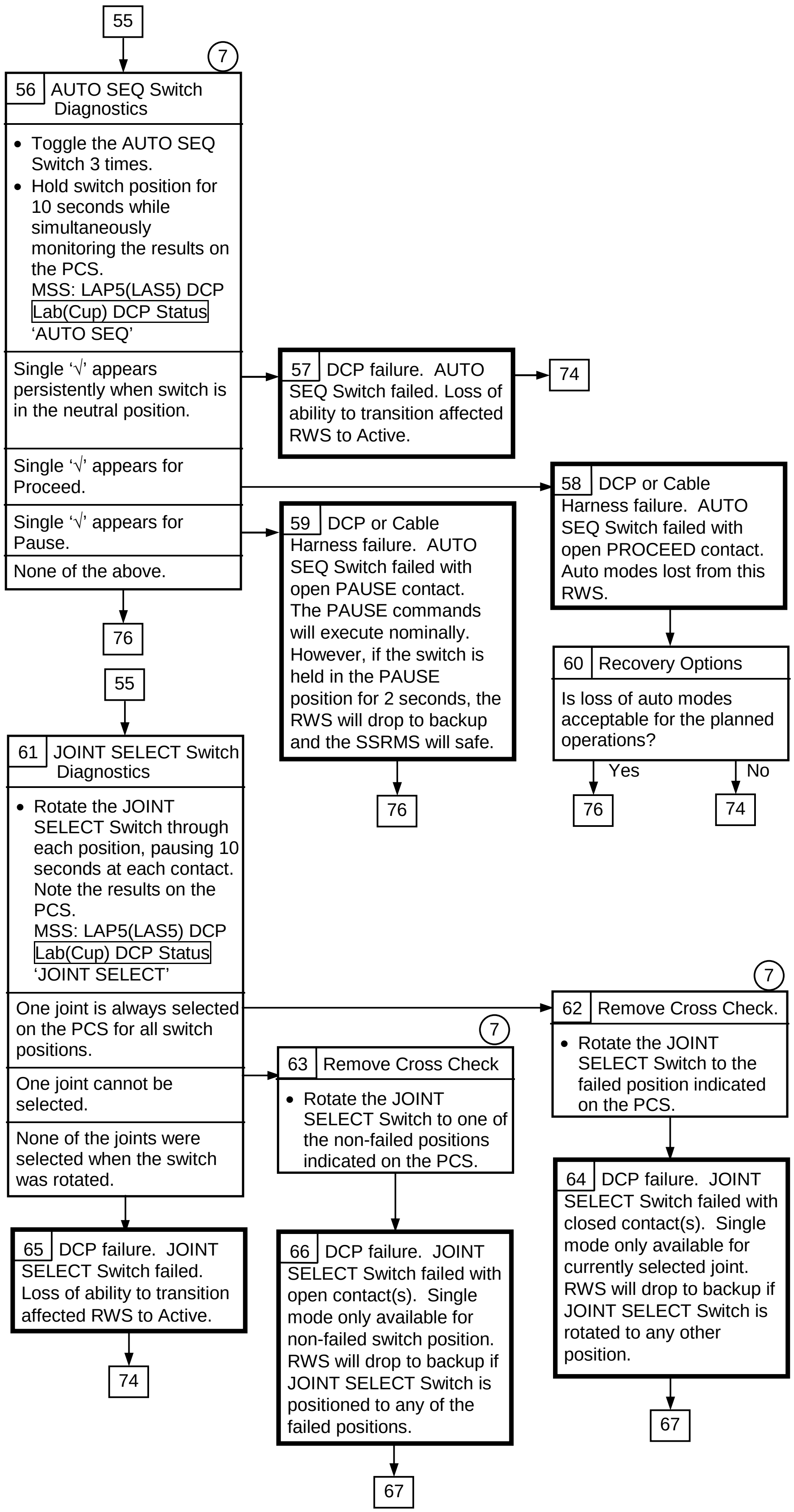
⑪
MSS software does not distinguish between the Lower and Upper side of the Capture/Release Trigger switch. The operator-defined action from the LEE page is executed whenever the trigger is moved from the neutral position regardless of direction.

⑫
Both on orbit and in simulations the RWS has dropped to backup when assertive DCP switch throws were not used.

MSS

7.300 ACTIVE RWS FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 9 of 11 pages



56 AUTO SEQ Switch Diagnostics ⑦

- Toggle the AUTO SEQ Switch 3 times.
- Hold switch position for 10 seconds while simultaneously monitoring the results on the PCS.
  MSS: LAP5(LAS5) DCP
  Lab(Cup) DCP Status
  'AUTO SEQ'

Single '√' appears persistently when switch is in the neutral position. → 57

Single '√' appears for Proceed. → 58

Single '√' appears for Pause. → 59

None of the above. → 76

57 DCP failure. AUTO SEQ Switch failed. Loss of ability to transition affected RWS to Active. → 74

58 DCP or Cable Harness failure. AUTO SEQ Switch failed with open PROCEED contact. Auto modes lost from this RWS. → 60

59 DCP or Cable Harness failure. AUTO SEQ Switch failed with open PAUSE contact. The PAUSE commands will execute nominally. However, if the switch is held in the PAUSE position for 2 seconds, the RWS will drop to backup and the SSRMS will safe. → 76

60 Recovery Options

Is loss of auto modes acceptable for the planned operations?

Yes → 76; No → 74

61 JOINT SELECT Switch Diagnostics

- Rotate the JOINT SELECT Switch through each position, pausing 10 seconds at each contact. Note the results on the PCS.
  MSS: LAP5(LAS5) DCP
  Lab(Cup) DCP Status
  'JOINT SELECT'

One joint is always selected on the PCS for all switch positions. → 62

One joint cannot be selected. → 63

None of the joints were selected when the switch was rotated. → 65

62 Remove Cross Check. ⑦

- Rotate the JOINT SELECT Switch to the failed position indicated on the PCS.

→ 64

63 Remove Cross Check ⑦

- Rotate the JOINT SELECT Switch to one of the non-failed positions indicated on the PCS.

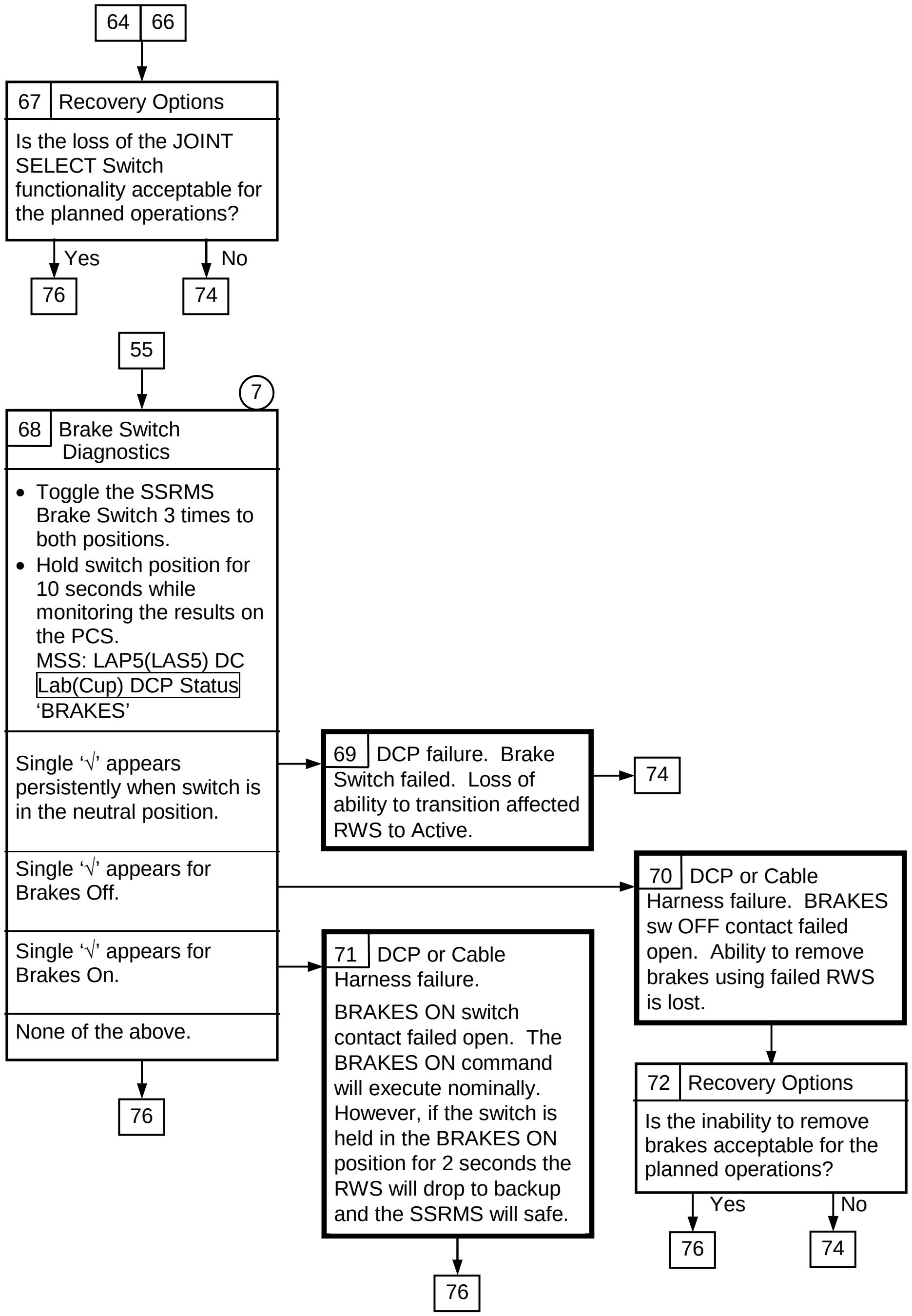
→ 66

64 DCP failure. JOINT SELECT Switch failed with closed contact(s). Single mode only available for currently selected joint. RWS will drop to backup if JOINT SELECT Switch is rotated to any other position. → 67

65 DCP failure. JOINT SELECT Switch failed. Loss of ability to transition affected RWS to Active. → 74

66 DCP failure. JOINT SELECT Switch failed with open contact(s). Single mode only available for non-failed switch position. RWS will drop to backup if JOINT SELECT Switch is positioned to any of the failed positions. → 67

⑦ This step must be performed by the crew.



67 Recovery Options

Is the loss of the JOINT SELECT Switch functionality acceptable for the planned operations?

68 Brake Switch Diagnostics

- Toggle the SSRMS Brake Switch 3 times to both positions.
- Hold switch position for 10 seconds while monitoring the results on the PCS.
  MSS: LAP5(LAS5) DC Lab(Cup) DCP Status
  'BRAKES'

Single '√' appears persistently when switch is in the neutral position.

Single '√' appears for Brakes Off.

Single '√' appears for Brakes On.

None of the above.

69 DCP failure. Brake Switch failed. Loss of ability to transition affected RWS to Active.

70 DCP or Cable Harness failure. BRAKES sw OFF contact failed open. Ability to remove brakes using failed RWS is lost.

71 DCP or Cable Harness failure.

BRAKES ON switch contact failed open. The BRAKES ON command will execute nominally. However, if the switch is held in the BRAKES ON position for 2 seconds the RWS will drop to backup and the SSRMS will safe.

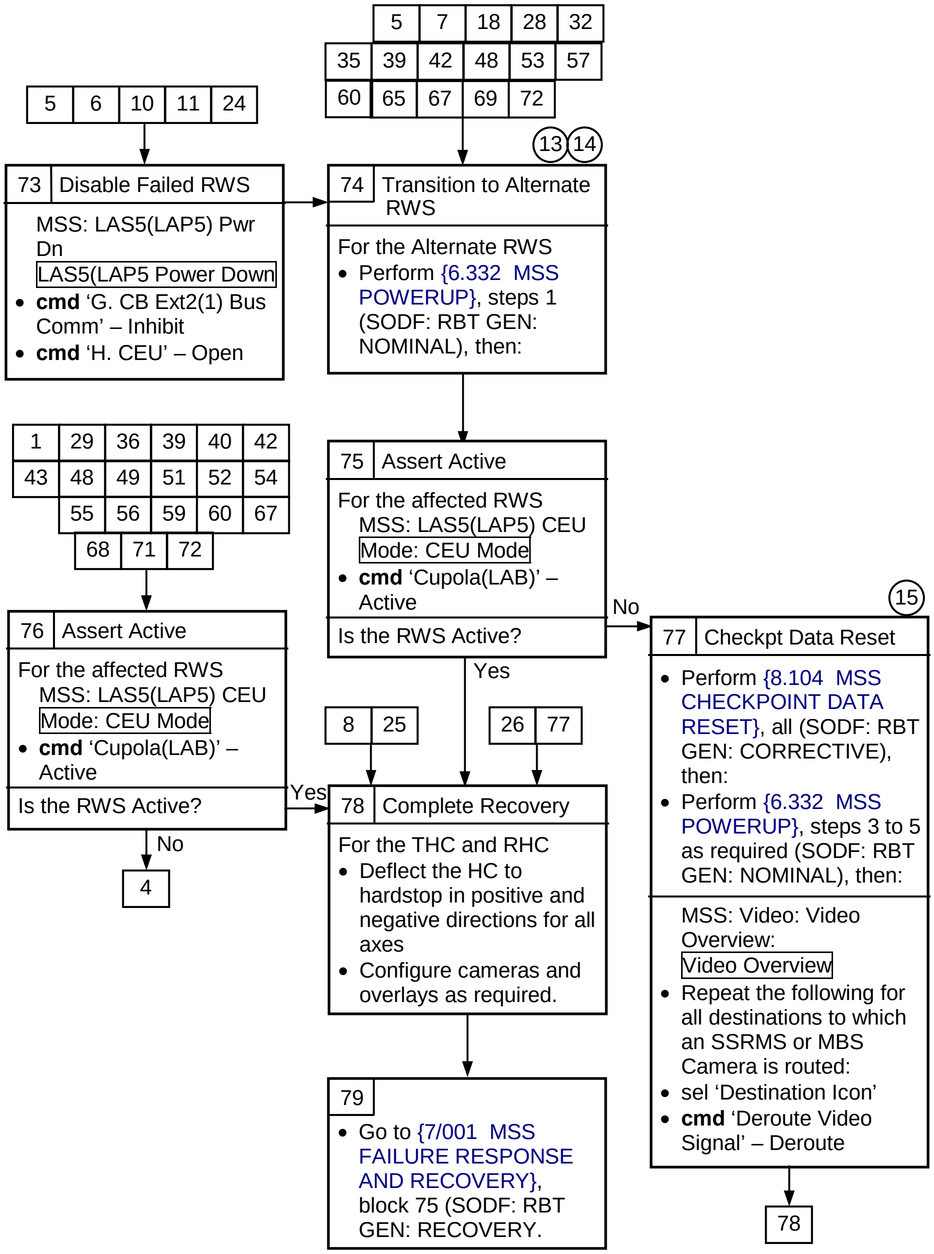
72 Recovery Options

Is the inability to remove brakes acceptable for the planned operations?

⑦
This step must be performed by the crew.

7.300 ACTIVE RWS FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 11 of 11 pages



73 Disable Failed RWS

MSS: LAS5(LAP5) Pwr Dn

LAS5(LAP5 Power Down

- **cmd** ‘G. CB Ext2(1) Bus Comm’ – Inhibit
- **cmd** ‘H. CEU’ – Open

74 Transition to Alternate RWS

For the Alternate RWS

- Perform {6.332 MSS POWERUP}, steps 1 (SODF: RBT GEN: NOMINAL), then:

75 Assert Active

For the affected RWS

MSS: LAS5(LAP5) CEU

Mode: CEU Mode

- **cmd** ‘Cupola(LAB)’ – Active

Is the RWS Active?

76 Assert Active

For the affected RWS

MSS: LAS5(LAP5) CEU

Mode: CEU Mode

- **cmd** ‘Cupola(LAB)’ – Active

Is the RWS Active?

77 Checkpt Data Reset

- Perform {8.104 MSS CHECKPOINT DATA RESET}, all (SODF: RBT GEN: CORRECTIVE), then:
- Perform {6.332 MSS POWERUP}, steps 3 to 5 as required (SODF: RBT GEN: NOMINAL), then:

MSS: Video: Video Overview:

Video Overview

- Repeat the following for all destinations to which an SSRMS or MBS Camera is routed:
- sel ‘Destination Icon’
- **cmd** ‘Deroute Video Signal’ – Deroute

78 Complete Recovery

For the THC and RHC

- Deflect the HC to hardstop in positive and negative directions for all axes
- Configure cameras and overlays as required.

79

- Go to {7/001 MSS FAILURE RESPONSE AND RECOVERY}, block 75 (SODF: RBT GEN: RECOVERY.

⑬
If failed workstation status remains in Backup in the CCS after power is removed, expect ‘**R1E - MSS Active OCS Other RWS Comm Fail**’ when powering up the alternate RWS.

⑭
Ground will perform required cleanup of the failed RWS.

⑮
SCR 24574, 28414

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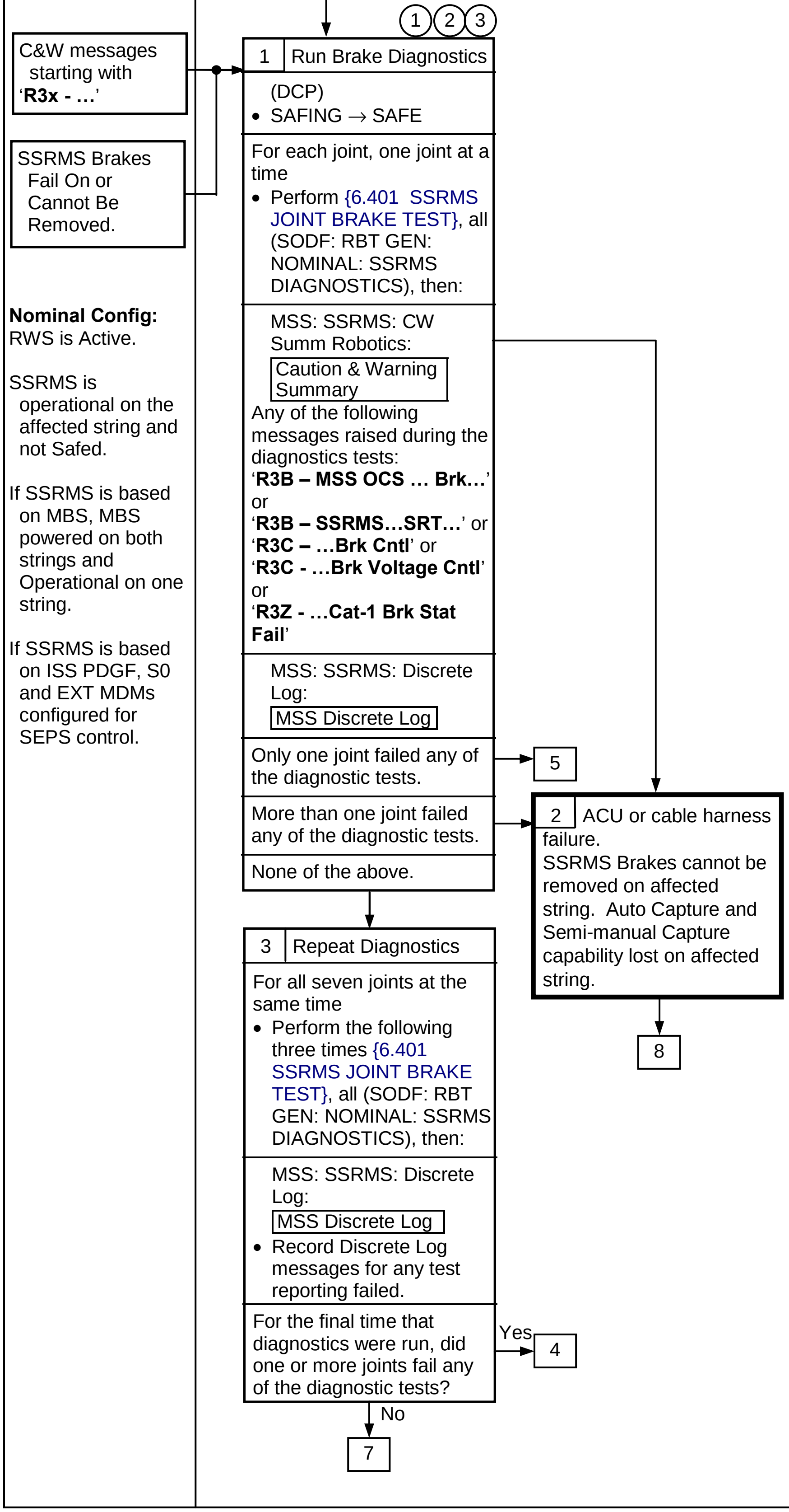
MSS

C&W ROBOTICS

7.500 SSRMS BRAKES FAILURE

(RBT GEN/X2R4 - ALL/FINI) Page 1 of 2 pages



{7.001 MSS FAILURE RESPONSE AND RECOVERY}, block 123 (SODF: RBT GEN: MALFUNCTION)

① ② ③

C&W messages starting with **'R3x - …'**

SSRMS Brakes Fail On or Cannot Be Removed.

1 Run Brake Diagnostics

(DCP)

- SAFING → SAFE

For each joint, one joint at a time

- Perform {6.401 SSRMS JOINT BRAKE TEST}, all (SODF: RBT GEN: NOMINAL: SSRMS DIAGNOSTICS), then:

MSS: SSRMS: CW Summ Robotics:

Caution & Warning Summary

Any of the following messages raised during the diagnostics tests:
'**R3B – MSS OCS … Brk…**' or
'**R3B – SSRMS…SRT…**' or
'**R3C – …Brk Cntl**' or
'**R3C - …Brk Voltage Cntl**' or
'**R3Z - …Cat-1 Brk Stat Fail**'

MSS: SSRMS: Discrete Log:

MSS Discrete Log

Only one joint failed any of the diagnostic tests. → 5

More than one joint failed any of the diagnostic tests. → 2

None of the above. → 3

2 ACU or cable harness failure.
SSRMS Brakes cannot be removed on affected string. Auto Capture and Semi-manual Capture capability lost on affected string.

→ 8

3 Repeat Diagnostics

For all seven joints at the same time

- Perform the following three times {6.401 SSRMS JOINT BRAKE TEST}, all (SODF: RBT GEN: NOMINAL: SSRMS DIAGNOSTICS), then:

MSS: SSRMS: Discrete Log:

MSS Discrete Log

- Record Discrete Log messages for any test reporting failed.

For the final time that diagnostics were run, did one or more joints fail any of the diagnostic tests?

Yes → 4

No → 7

Nominal Config:
RWS is Active.

SSRMS is operational on the affected string and not Safed.

If SSRMS is based on MBS, MBS powered on both strings and Operational on one string.

If SSRMS is based on ISS PDGF, S0 and EXT MDMs configured for SEPS control.

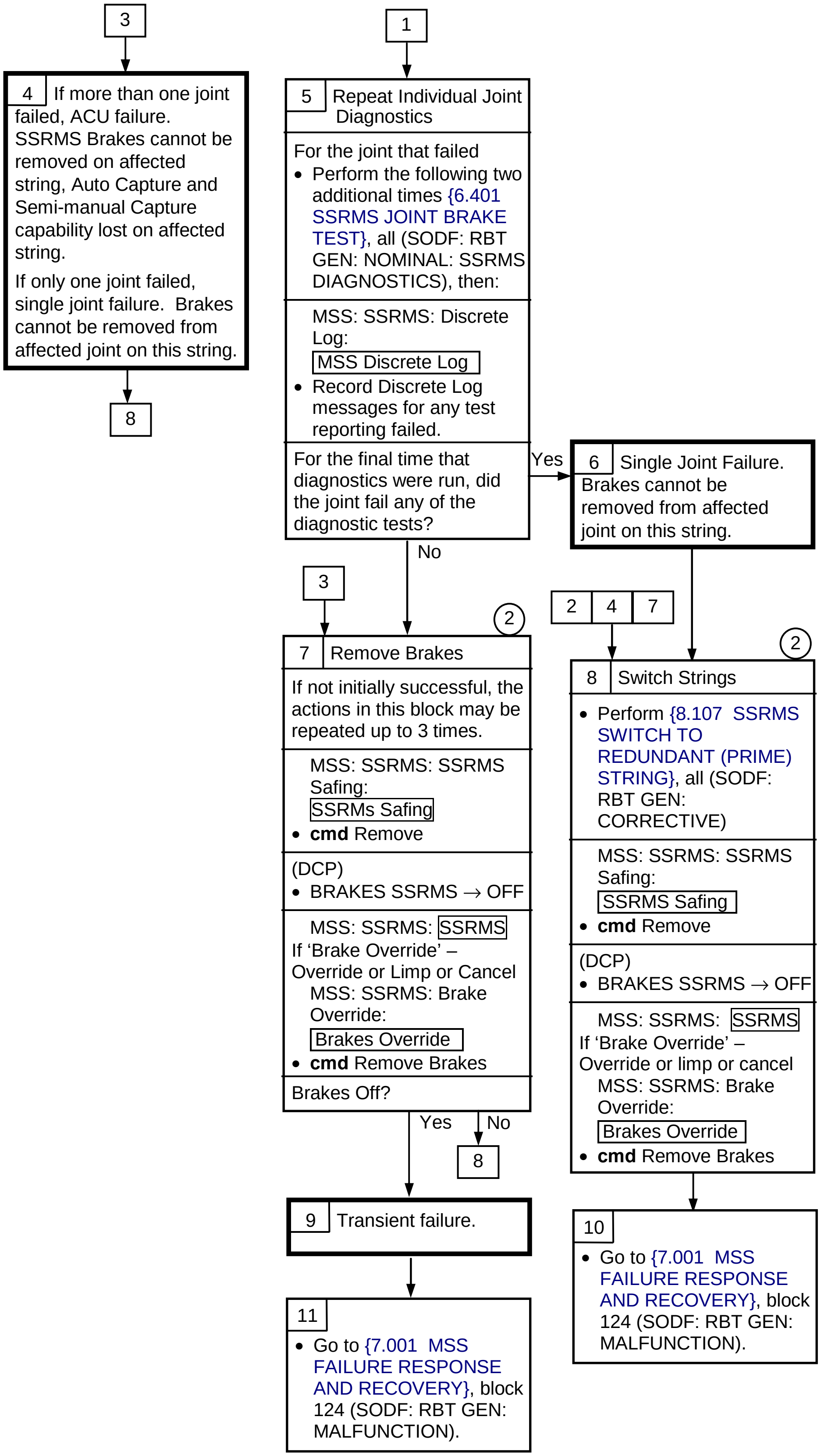
①
Unless otherwise indicated, all displays in this procedure are on the PCS.

②
This step requires DCP operator input and therefore can only be performed by onboard crew.

③
Time permitting, High Speed Data Log should be collected during all the diagnostics tests in this procedures.

7.500 SSRMS BRAKES FAILURE

(RBT GEN/X2R4 - ALL/FINI) Page 2 of 2 pages



4 If more than one joint failed, ACU failure. SSRMS Brakes cannot be removed on affected string, Auto Capture and Semi-manual Capture capability lost on affected string.

If only one joint failed, single joint failure. Brakes cannot be removed from affected joint on this string.

5 Repeat Individual Joint Diagnostics

For the joint that failed
- Perform the following two additional times {6.401 SSRMS JOINT BRAKE TEST}, all (SODF: RBT GEN: NOMINAL: SSRMS DIAGNOSTICS), then:

MSS: SSRMS: Discrete Log:
MSS Discrete Log
- Record Discrete Log messages for any test reporting failed.

For the final time that diagnostics were run, did the joint fail any of the diagnostic tests?

6 Single Joint Failure. Brakes cannot be removed from affected joint on this string.

7 Remove Brakes ②

If not initially successful, the actions in this block may be repeated up to 3 times.

MSS: SSRMS: SSRMS Safing:
SSRMs Safing
- **cmd** Remove

(DCP)
- BRAKES SSRMS → OFF

MSS: SSRMS: SSRMS
If ‘Brake Override’ – Override or Limp or Cancel
MSS: SSRMS: Brake Override:
Brakes Override
- **cmd** Remove Brakes

Brakes Off?

8 Switch Strings ②

- Perform {8.107 SSRMS SWITCH TO REDUNDANT (PRIME) STRING}, all (SODF: RBT GEN: CORRECTIVE)

MSS: SSRMS: SSRMS Safing:
SSRMS Safing
- **cmd** Remove

(DCP)
- BRAKES SSRMS → OFF

MSS: SSRMS: SSRMS
If ‘Brake Override’ – Override or limp or cancel
MSS: SSRMS: Brake Override:
Brakes Override
- **cmd** Remove Brakes

9 Transient failure.

10
- Go to {7.001 MSS FAILURE RESPONSE AND RECOVERY}, block 124 (SODF: RBT GEN: MALFUNCTION).

11
- Go to {7.001 MSS FAILURE RESPONSE AND RECOVERY}, block 124 (SODF: RBT GEN: MALFUNCTION).

② This step requires DCP operator input and therefore can only be performed by onboard crew.

7.501 SSRMS RESOLVER CROSS CHECK FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 1 of 5 pages

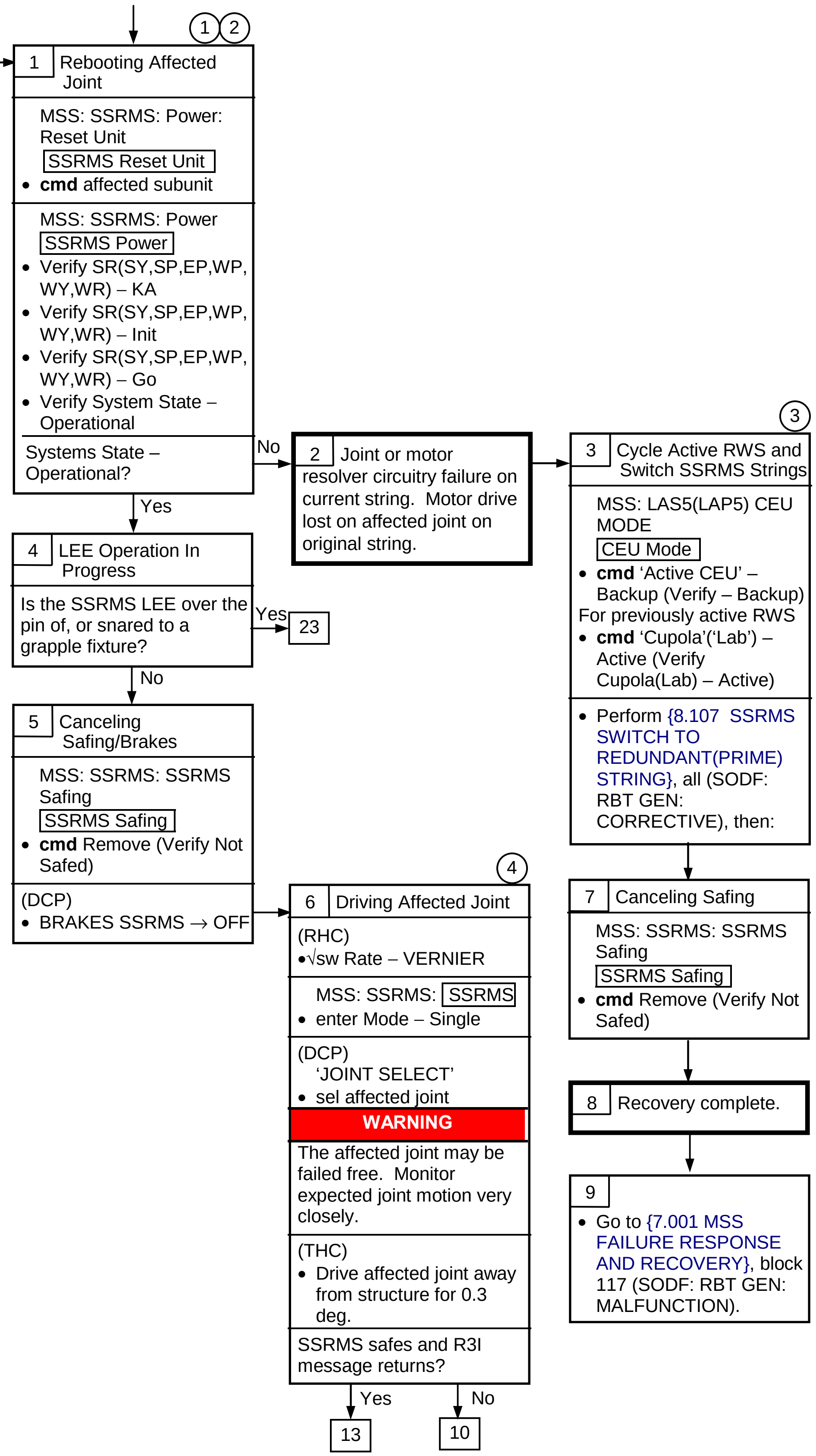
C&W Messages Starting with '**R3I - …**'

Nominal Config:
SSRMS is Operational on affected string and Safed.

If SSRMS is based on MBS, MBS powered on both strings and Operational on one string.

If SSRMS is based on ISS PDGF, S0 and EXT MDMs configured for SEPS control.

{7.001 MSS FAILURE RESPONSE AND RECOVERY}, block 97 (SODF: RBT GEN: RECOVERY)



1 Rebooting Affected Joint

MSS: SSRMS: Power: Reset Unit
SSRMS Reset Unit
- **cmd** affected subunit

MSS: SSRMS: Power
SSRMS Power
- Verify SR(SY,SP,EP,WP, WY,WR) – KA
- Verify SR(SY,SP,EP,WP, WY,WR) – Init
- Verify SR(SY,SP,EP,WP, WY,WR) – Go
- Verify System State – Operational

Systems State – Operational?

2 Joint or motor resolver circuitry failure on current string. Motor drive lost on affected joint on original string.

3 Cycle Active RWS and Switch SSRMS Strings

MSS: LAS5(LAP5) CEU MODE
CEU Mode
- **cmd** 'Active CEU' – Backup (Verify – Backup)

For previously active RWS
- **cmd** 'Cupola'('Lab') – Active (Verify Cupola(Lab) – Active)

- Perform {8.107 SSRMS SWITCH TO REDUNDANT(PRIME) STRING}, all (SODF: RBT GEN: CORRECTIVE), then:

4 LEE Operation In Progress

Is the SSRMS LEE over the pin of, or snared to a grapple fixture?

5 Canceling Safing/Brakes

MSS: SSRMS: SSRMS Safing
SSRMS Safing
- **cmd** Remove (Verify Not Safed)

(DCP)
- BRAKES SSRMS → OFF

6 Driving Affected Joint

(RHC)
- √sw Rate – VERNIER

MSS: SSRMS: SSRMS
- enter Mode – Single

(DCP)
'JOINT SELECT'
- sel affected joint

WARNING

The affected joint may be failed free. Monitor expected joint motion very closely.

(THC)
- Drive affected joint away from structure for 0.3 deg.

SSRMS safes and R3I message returns?

7 Canceling Safing

MSS: SSRMS: SSRMS Safing
SSRMS Safing
- **cmd** Remove (Verify Not Safed)

8 Recovery complete.

9
- Go to {7.001 MSS FAILURE RESPONSE AND RECOVERY}, block 117 (SODF: RBT GEN: MALFUNCTION).

① Unless otherwise indicated, all displays in this procedure are on the PCS.

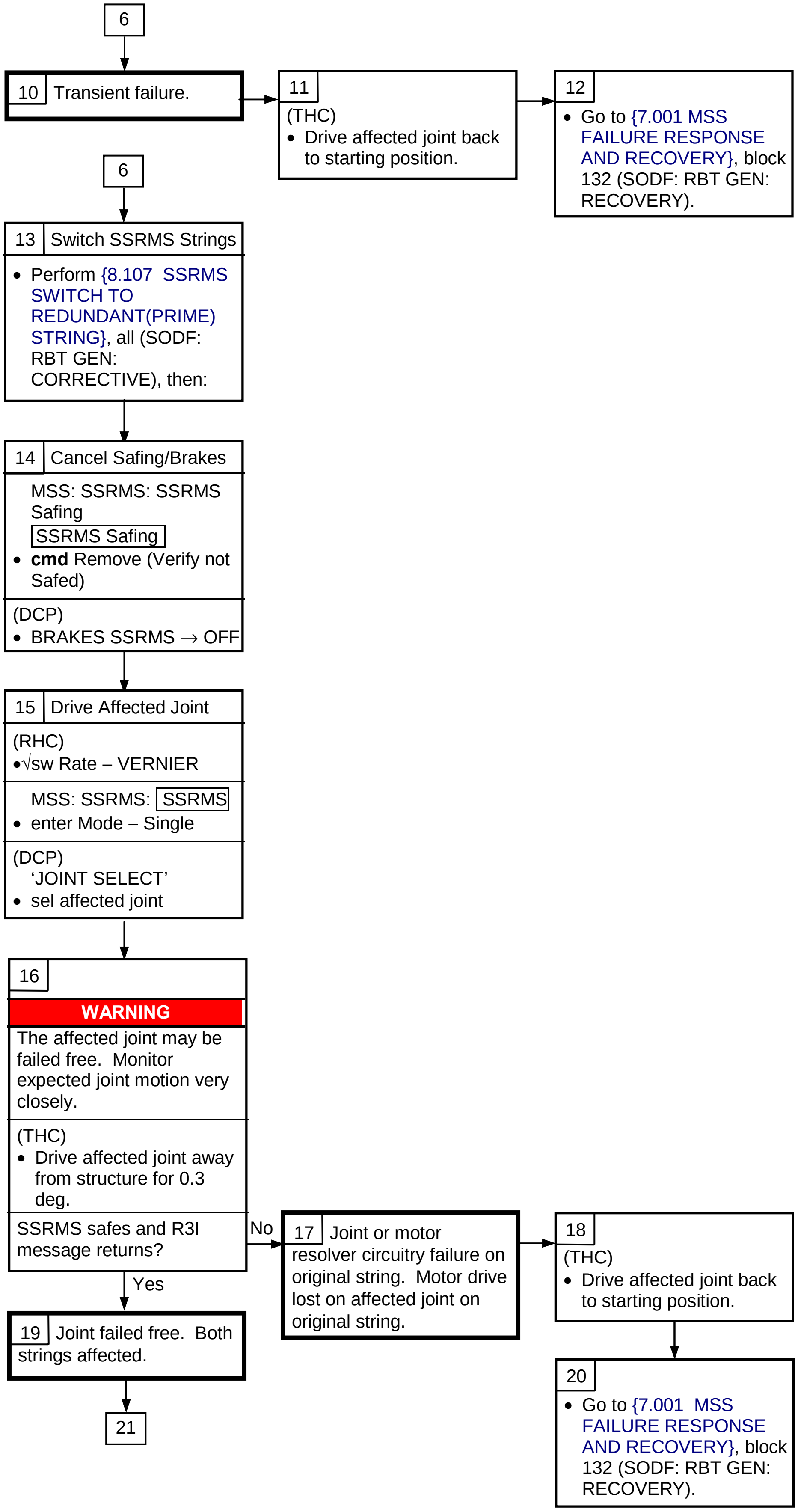
② JEU reboot is expected to take at least 2 minutes, 9 seconds.

③ SCR 28722

④ Driving other joints may be required to clear structure to allow the failed joint to be driven.

7.501 SSRMS RESOLVER CROSS CHECK FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 2 of 5 pages



6

10 Transient failure.

11
(THC)
- Drive affected joint back to starting position.

12
- Go to {7.001 MSS FAILURE RESPONSE AND RECOVERY}, block 132 (SODF: RBT GEN: RECOVERY).

6

13 Switch SSRMS Strings
- Perform {8.107 SSRMS SWITCH TO REDUNDANT(PRIME) STRING}, all (SODF: RBT GEN: CORRECTIVE), then:

14 Cancel Safing/Brakes

MSS: SSRMS: SSRMS Safing
SSRMS Safing
- **cmd** Remove (Verify not Safed)

(DCP)
- BRAKES SSRMS → OFF

15 Drive Affected Joint

(RHC)
- √sw Rate – VERNIER

MSS: SSRMS: SSRMS
- enter Mode – Single

(DCP)
'JOINT SELECT'
- sel affected joint

16

WARNING

The affected joint may be failed free. Monitor expected joint motion very closely.

(THC)
- Drive affected joint away from structure for 0.3 deg.

SSRMS safes and R3I message returns?

No

17 Joint or motor resolver circuitry failure on original string. Motor drive lost on affected joint on original string.

18
(THC)
- Drive affected joint back to starting position.

20
- Go to {7.001 MSS FAILURE RESPONSE AND RECOVERY}, block 132 (SODF: RBT GEN: RECOVERY).

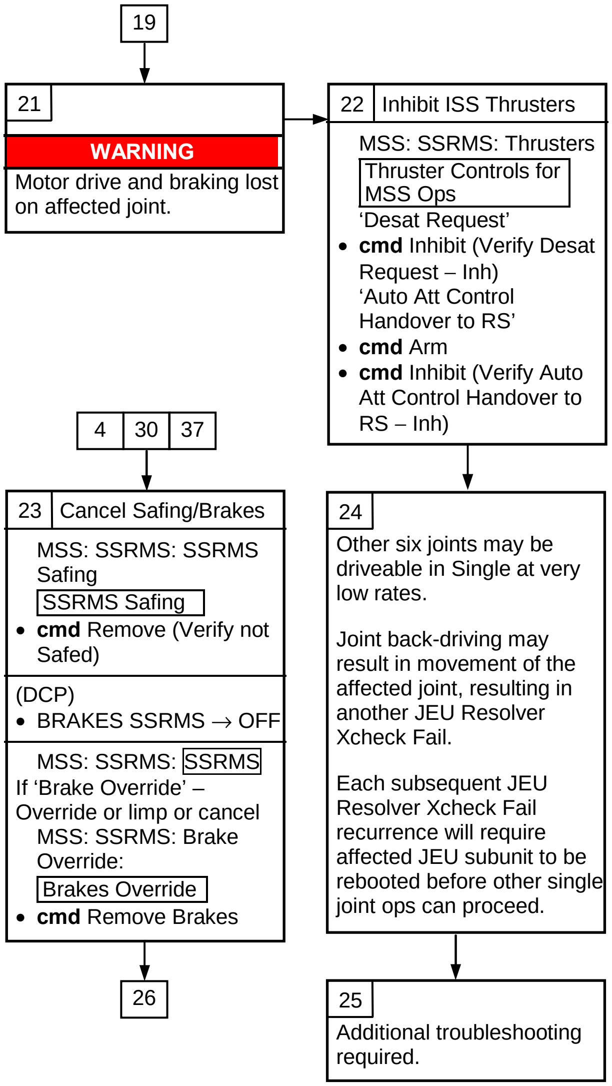
Yes

19 Joint failed free. Both strings affected.

21

7.501 SSRMS RESOLVER CROSS CHECK FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 3 of 5 pages



21

WARNING

Motor drive and braking lost on affected joint.

22 Inhibit ISS Thrusters

MSS: SSRMS: Thrusters

Thruster Controls for MSS Ops

'Desat Request'

- **cmd** Inhibit (Verify Desat Request – Inh)

'Auto Att Control Handover to RS'

- **cmd** Arm
- **cmd** Inhibit (Verify Auto Att Control Handover to RS – Inh)

23 Cancel Safing/Brakes

MSS: SSRMS: SSRMS Safing

SSRMS Safing

- **cmd** Remove (Verify not Safed)

(DCP)

- BRAKES SSRMS → OFF

MSS: SSRMS: SSRMS

If 'Brake Override' – Override or limp or cancel

MSS: SSRMS: Brake Override:

Brakes Override

- **cmd** Remove Brakes

24

Other six joints may be driveable in Single at very low rates.

Joint back-driving may result in movement of the affected joint, resulting in another JEU Resolver Xcheck Fail.

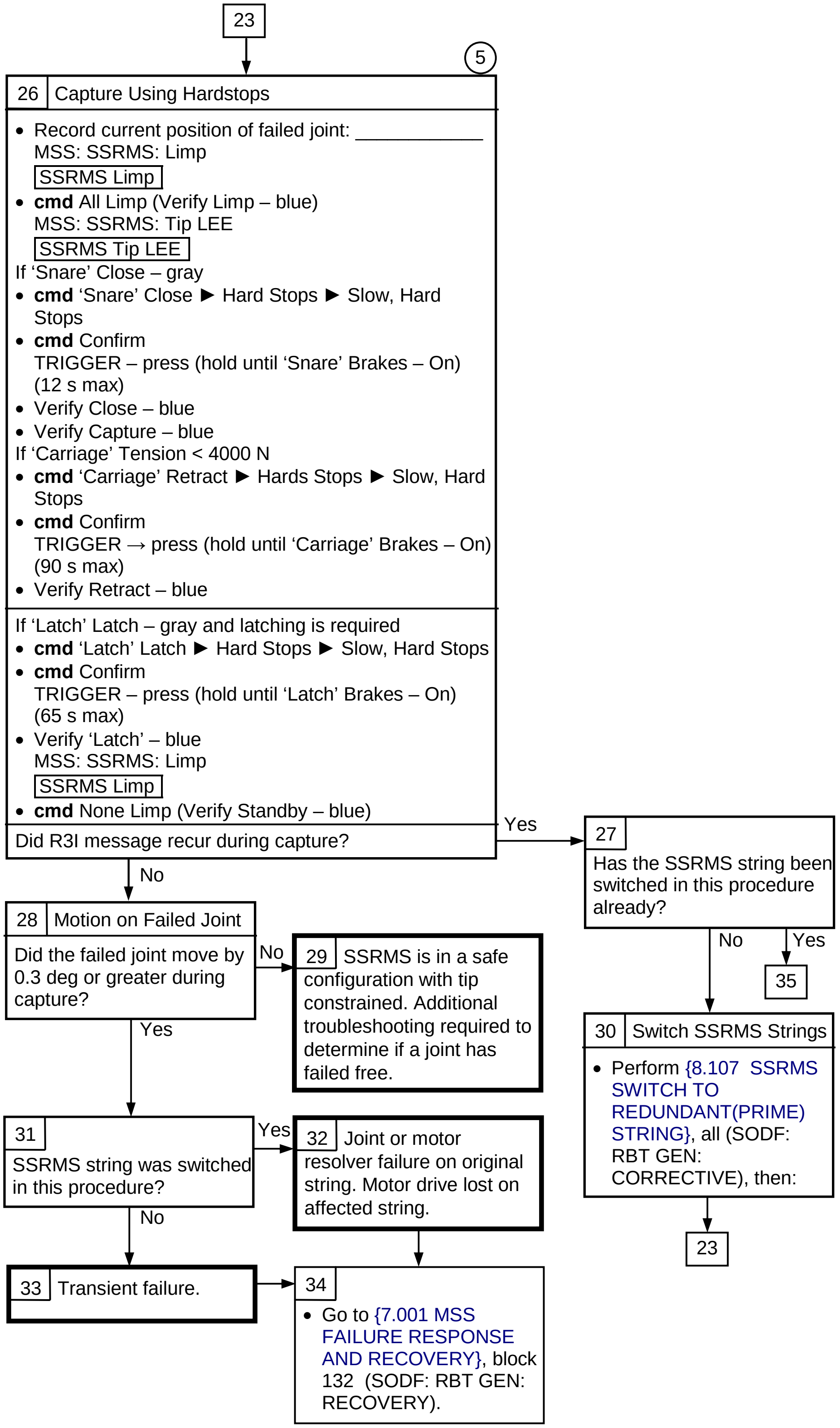
Each subsequent JEU Resolver Xcheck Fail recurrence will require affected JEU subunit to be rebooted before other single joint ops can proceed.

25

Additional troubleshooting required.

7.501 SSRMS RESOLVER CROSS CHECK FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 4 of 5 pages



26 Capture Using Hardstops

- Record current position of failed joint: ____________
  MSS: SSRMS: Limp
  SSRMS Limp
- **cmd** All Limp (Verify Limp – blue)
  MSS: SSRMS: Tip LEE
  SSRMS Tip LEE

If ‘Snare’ Close – gray

- **cmd** ‘Snare’ Close ▶ Hard Stops ▶ Slow, Hard Stops
- **cmd** Confirm
  TRIGGER – press (hold until ‘Snare’ Brakes – On) (12 s max)
- Verify Close – blue
- Verify Capture – blue

If ‘Carriage’ Tension < 4000 N

- **cmd** ‘Carriage’ Retract ▶ Hards Stops ▶ Slow, Hard Stops
- **cmd** Confirm
  TRIGGER → press (hold until ‘Carriage’ Brakes – On) (90 s max)
- Verify Retract – blue

If ‘Latch’ Latch – gray and latching is required

- **cmd** ‘Latch’ Latch ▶ Hard Stops ▶ Slow, Hard Stops
- **cmd** Confirm
  TRIGGER – press (hold until ‘Latch’ Brakes – On) (65 s max)
- Verify ‘Latch’ – blue
  MSS: SSRMS: Limp
  SSRMS Limp
- **cmd** None Limp (Verify Standby – blue)

Did R3I message recur during capture?

27 Has the SSRMS string been switched in this procedure already?

28 Motion on Failed Joint

Did the failed joint move by 0.3 deg or greater during capture?

29 SSRMS is in a safe configuration with tip constrained. Additional troubleshooting required to determine if a joint has failed free.

30 Switch SSRMS Strings

- Perform {8.107 SSRMS SWITCH TO REDUNDANT(PRIME) STRING}, all (SODF: RBT GEN: CORRECTIVE), then:

31 SSRMS string was switched in this procedure?

32 Joint or motor resolver failure on original string. Motor drive lost on affected string.

33 Transient failure.

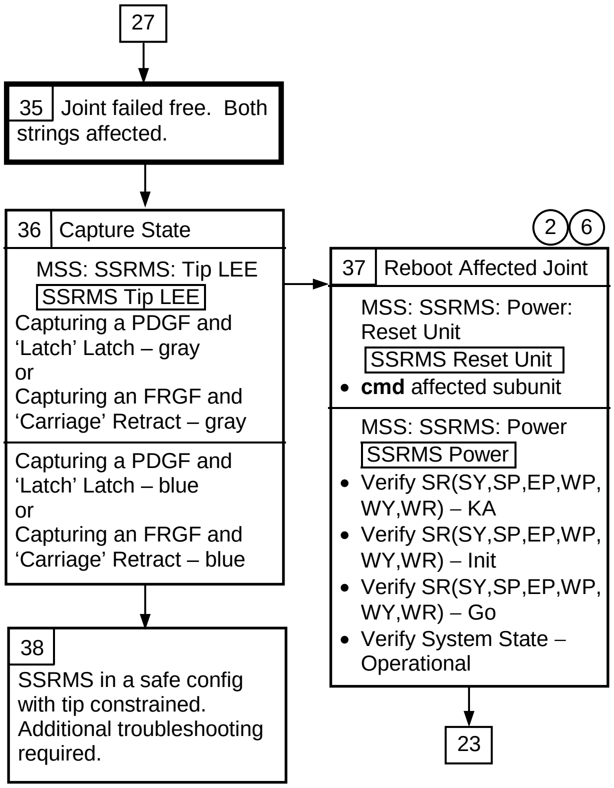
34

- Go to {7.001 MSS FAILURE RESPONSE AND RECOVERY}, block 132 (SODF: RBT GEN: RECOVERY).

⑤ If capturing a PDGF, driving the latches to hardstops will also mate the umbilical.

7.501 SSRMS RESOLVER CROSS CHECK FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 5 of 5 pages



35 Joint failed free. Both strings affected.

36 Capture State

MSS: SSRMS: Tip LEE

SSRMS Tip LEE

Capturing a PDGF and ‘Latch’ Latch – gray
or
Capturing an FRGF and ‘Carriage’ Retract – gray

Capturing a PDGF and ‘Latch’ Latch – blue
or
Capturing an FRGF and ‘Carriage’ Retract – blue

37 Reboot Affected Joint

MSS: SSRMS: Power: Reset Unit

SSRMS Reset Unit

- **cmd** affected subunit

MSS: SSRMS: Power

SSRMS Power

- Verify SR(SY,SP,EP,WP, WY,WR) – KA
- Verify SR(SY,SP,EP,WP, WY,WR) – Init
- Verify SR(SY,SP,EP,WP, WY,WR) – Go
- Verify System State – Operational

38

SSRMS in a safe config with tip constrained. Additional troubleshooting required.

② JEU reboot is expected to take at least 2 minutes 9 seconds.\

⑥ The path of blocks 23, 26, 27, 35, 36, and 37 should be repeated as required until capture is complete.

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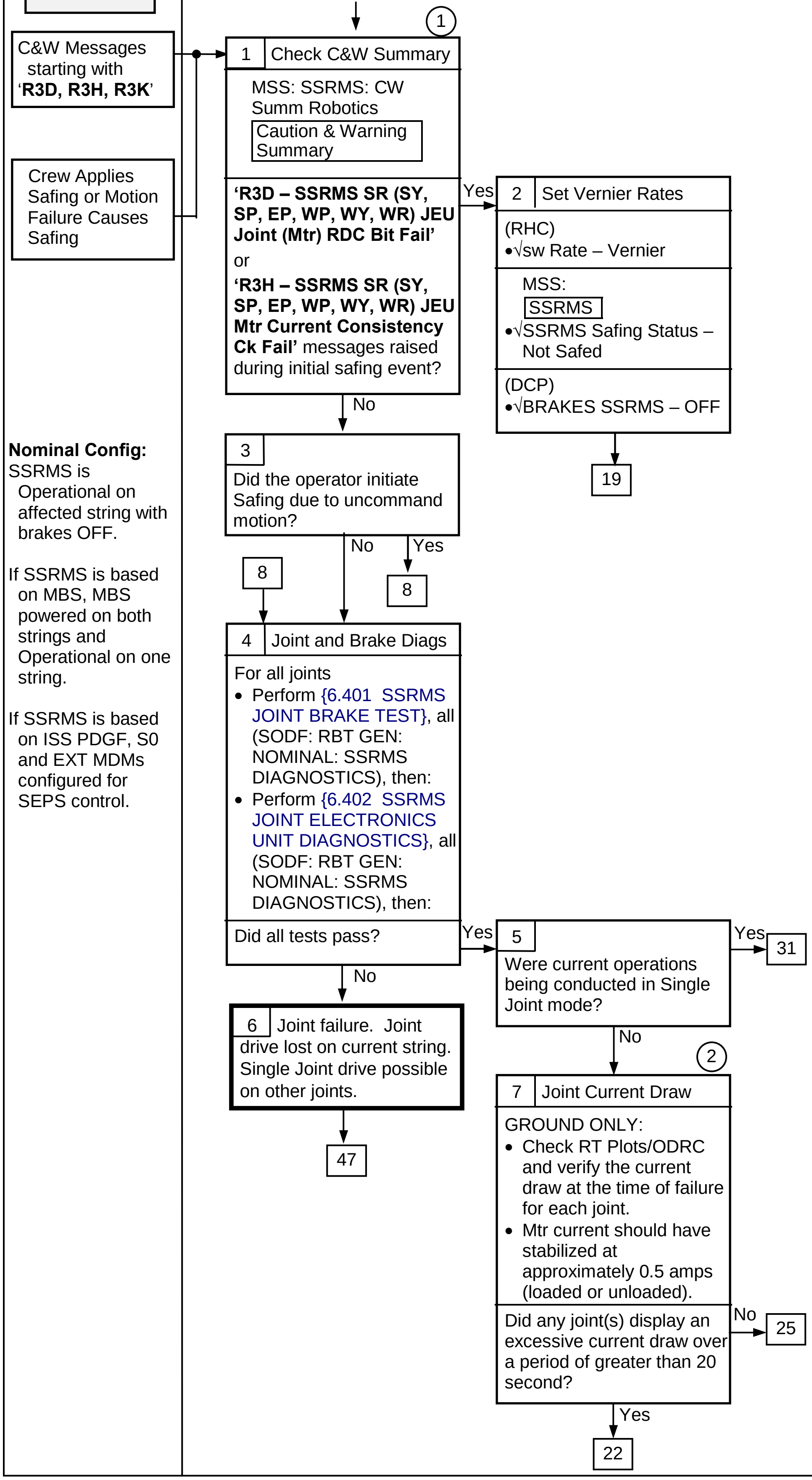
MSS

7.502 SSRMS JOINT MOTION FAILURE

(RBT GEN/X2R4 - ALL/FIN) Page 1 of 7 pages

C&W ROBOTICS

{7.001 MSS FAILURE RESPONSE AND RECOVERY}, block 129 (SODF: RBT GEN: MALFUNCTION)



C&W Messages starting with '**R3D, R3H, R3K**'

Crew Applies Safing or Motion Failure Causes Safing

1 Check C&W Summary ①

MSS: SSRMS: CW Summ Robotics

Caution & Warning Summary

'R3D – SSRMS SR (SY, SP, EP, WP, WY, WR) JEU Joint (Mtr) RDC Bit Fail' or **'R3H – SSRMS SR (SY, SP, EP, WP, WY, WR) JEU Mtr Current Consistency Ck Fail'** messages raised during initial safing event?

Yes → 2; No → 3

2 Set Vernier Rates

(RHC)

•√sw Rate – Vernier

MSS:

SSRMS

•√SSRMS Safing Status – Not Safed

(DCP)

•√BRAKES SSRMS – OFF

→ 19

3

Did the operator initiate Safing due to uncommand motion?

No → 4; Yes → 8

8 → 4

4 Joint and Brake Diags

For all joints

- Perform {6.401 SSRMS JOINT BRAKE TEST}, all (SODF: RBT GEN: NOMINAL: SSRMS DIAGNOSTICS), then:
- Perform {6.402 SSRMS JOINT ELECTRONICS UNIT DIAGNOSTICS}, all (SODF: RBT GEN: NOMINAL: SSRMS DIAGNOSTICS), then:

Did all tests pass?

Yes → 5; No → 6

5

Were current operations being conducted in Single Joint mode?

Yes → 31; No → 7

6 Joint failure. Joint drive lost on current string. Single Joint drive possible on other joints.

→ 47

7 Joint Current Draw ②

GROUND ONLY:

- Check RT Plots/ODRC and verify the current draw at the time of failure for each joint.
- Mtr current should have stabilized at approximately 0.5 amps (loaded or unloaded).

Did any joint(s) display an excessive current draw over a period of greater than 20 second?

No → 25; Yes → 22

Nominal Config:
SSRMS is Operational on affected string with brakes OFF.

If SSRMS is based on MBS, MBS powered on both strings and Operational on one string.

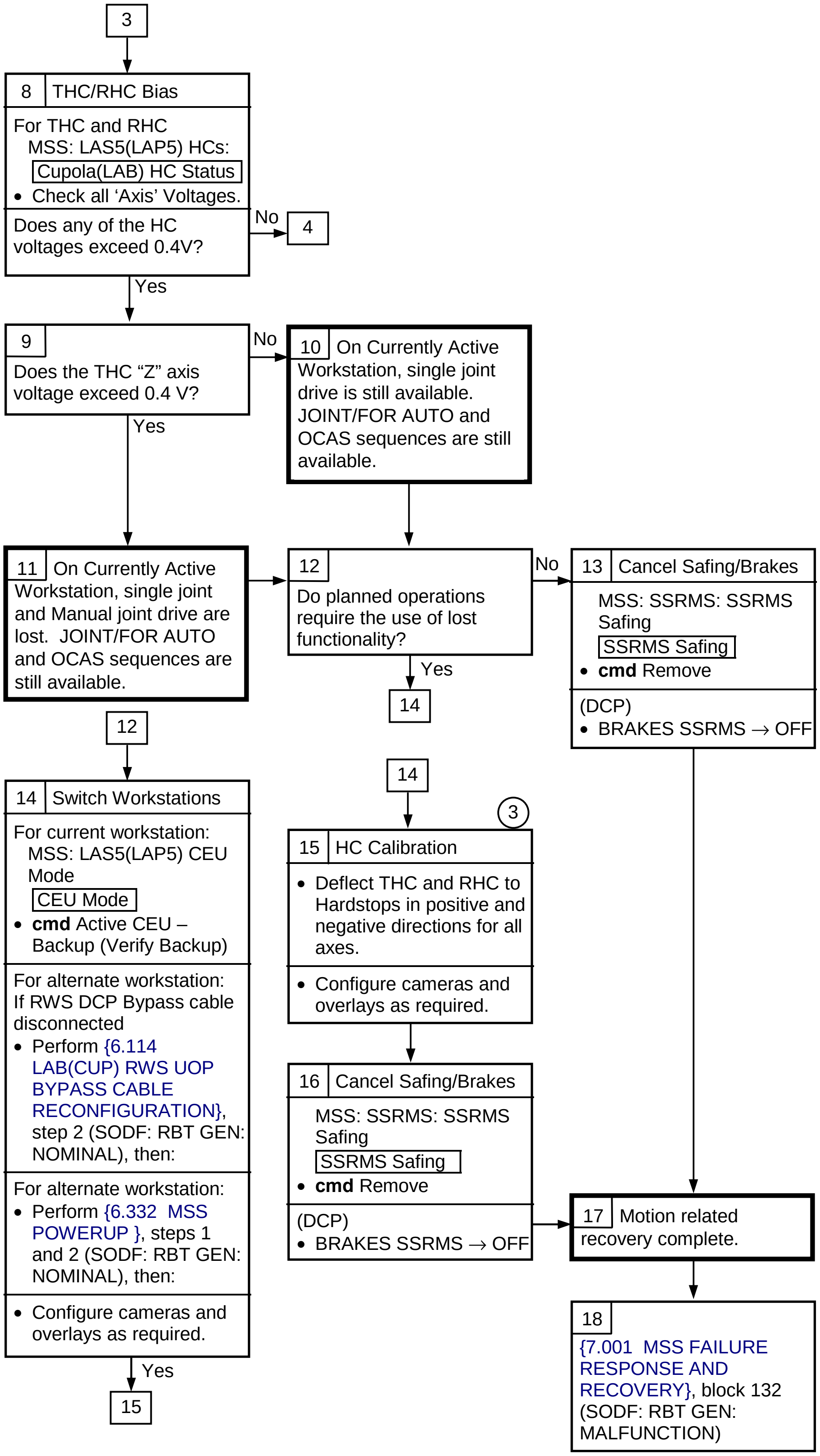
If SSRMS is based on ISS PDGF, S0 and EXT MDMs configured for SEPS control.

① Unless otherwise indicated, all displays in this procedure are on the PCS.

② This block contains steps to be carried out by Ground only.

7.502 SSRMS JOINT MOTION FAILURE

(RBT GEN/X2R4 - ALL/FIN) Page 2 of 7 pages



8 THC/RHC Bias

For THC and RHC
MSS: LAS5(LAP5) HCs:
Cupola(LAB) HC Status
- Check all ‘Axis’ Voltages.

Does any of the HC voltages exceed 0.4V?

9

Does the THC “Z” axis voltage exceed 0.4 V?

10 On Currently Active Workstation, single joint drive is still available. JOINT/FOR AUTO and OCAS sequences are still available.

11 On Currently Active Workstation, single joint and Manual joint drive are lost. JOINT/FOR AUTO and OCAS sequences are still available.

12

Do planned operations require the use of lost functionality?

13 Cancel Safing/Brakes

MSS: SSRMS: SSRMS Safing
SSRMS Safing
- **cmd** Remove

(DCP)
- BRAKES SSRMS → OFF

14 Switch Workstations

For current workstation:
MSS: LAS5(LAP5) CEU Mode
CEU Mode
- **cmd** Active CEU – Backup (Verify Backup)

For alternate workstation:
If RWS DCP Bypass cable disconnected
- Perform {6.114 LAB(CUP) RWS UOP BYPASS CABLE RECONFIGURATION}, step 2 (SODF: RBT GEN: NOMINAL), then:

For alternate workstation:
- Perform {6.332 MSS POWERUP }, steps 1 and 2 (SODF: RBT GEN: NOMINAL), then:

- Configure cameras and overlays as required.

15 HC Calibration

- Deflect THC and RHC to Hardstops in positive and negative directions for all axes.

- Configure cameras and overlays as required.

16 Cancel Safing/Brakes

MSS: SSRMS: SSRMS Safing
SSRMS Safing
- **cmd** Remove

(DCP)
- BRAKES SSRMS → OFF

17 Motion related recovery complete.

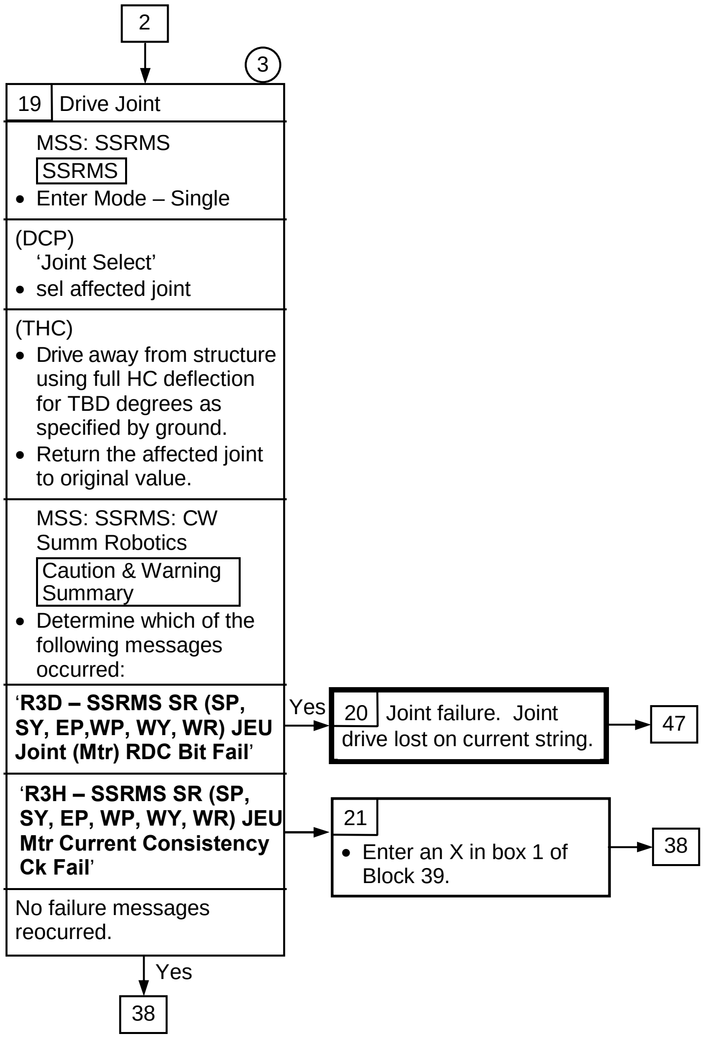
18

{7.001 MSS FAILURE RESPONSE AND RECOVERY}, block 132 (SODF: RBT GEN: MALFUNCTION)

③ This block contains steps to be carried out by crew only.

7.502 SSRMS JOINT MOTION FAILURE

(RBT GEN/X2R4 - ALL/FIN) Page 3 of 7 pages



19 Drive Joint

MSS: SSRMS

SSRMS

- Enter Mode – Single

(DCP)

‘Joint Select’

- sel affected joint

(THC)

- Drive away from structure using full HC deflection for TBD degrees as specified by ground.
- Return the affected joint to original value.

MSS: SSRMS: CW

Summ Robotics

Caution & Warning Summary

- Determine which of the following messages occurred:

‘**R3D – SSRMS SR (SP, SY, EP,WP, WY, WR) JEU Joint (Mtr) RDC Bit Fail**’

‘**R3H – SSRMS SR (SP, SY, EP, WP, WY, WR) JEU Mtr Current Consistency Ck Fail**’

No failure messages reocurred.

20 Joint failure. Joint drive lost on current string.

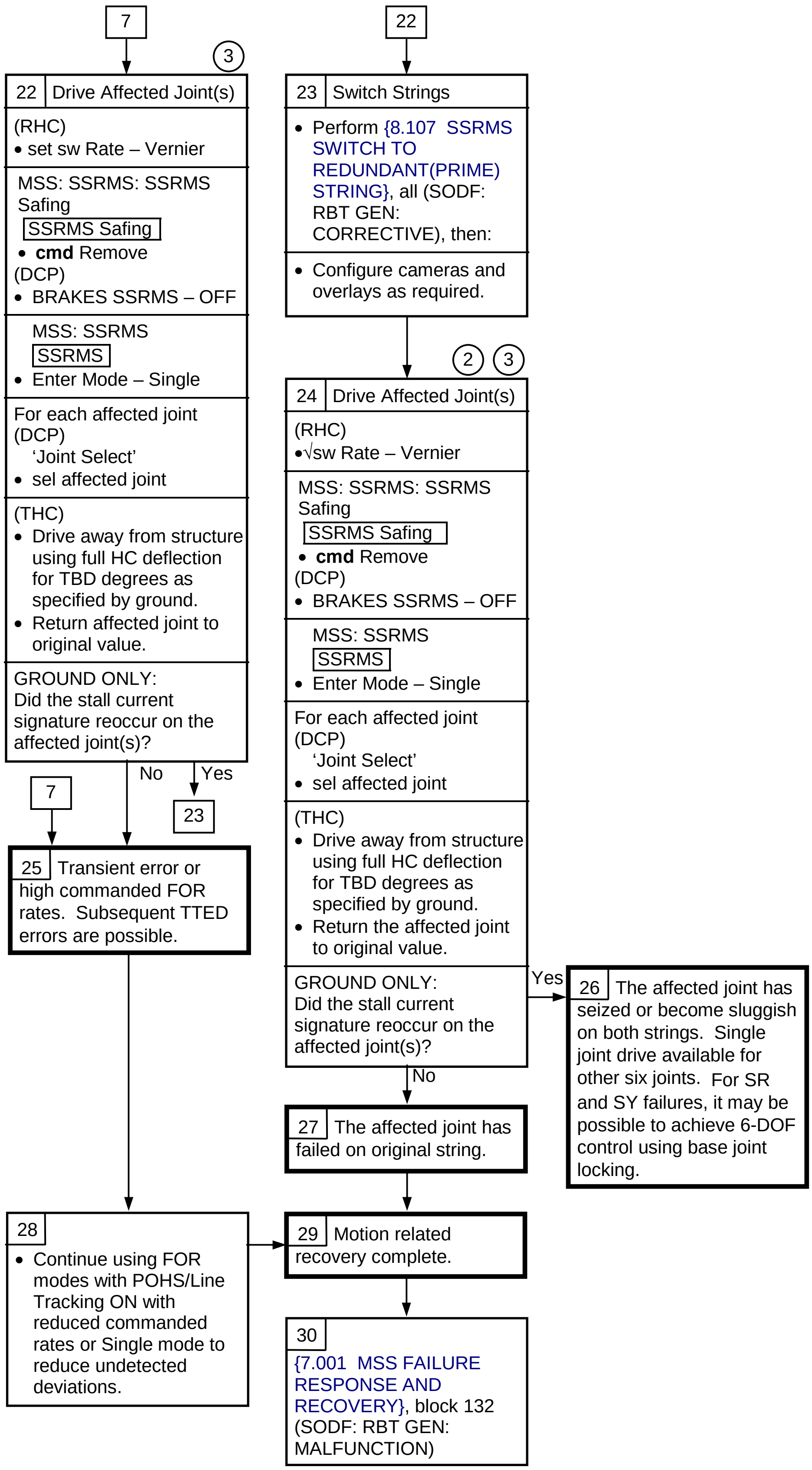
21

- Enter an X in box 1 of Block 39.

③

This block contains steps to be carried out by crew only.

The drive duration will be determined by the ground based on SSRMS clearances at the current config.



22 Drive Affected Joint(s)

(RHC)
- set sw Rate – Vernier

MSS: SSRMS: SSRMS Safing
SSRMS Safing
- **cmd** Remove

(DCP)
- BRAKES SSRMS – OFF

MSS: SSRMS
SSRMS
- Enter Mode – Single

For each affected joint
(DCP)
'Joint Select'
- sel affected joint

(THC)
- Drive away from structure using full HC deflection for TBD degrees as specified by ground.
- Return affected joint to original value.

GROUND ONLY:
Did the stall current signature reoccur on the affected joint(s)?

23 Switch Strings

- Perform {8.107 SSRMS SWITCH TO REDUNDANT(PRIME) STRING}, all (SODF: RBT GEN: CORRECTIVE), then:
- Configure cameras and overlays as required.

24 Drive Affected Joint(s)

(RHC)
- √sw Rate – Vernier

MSS: SSRMS: SSRMS Safing
SSRMS Safing
- **cmd** Remove

(DCP)
- BRAKES SSRMS – OFF

MSS: SSRMS
SSRMS
- Enter Mode – Single

For each affected joint
(DCP)
'Joint Select'
- sel affected joint

(THC)
- Drive away from structure using full HC deflection for TBD degrees as specified by ground.
- Return the affected joint to original value.

GROUND ONLY:
Did the stall current signature reoccur on the affected joint(s)?

25 Transient error or high commanded FOR rates. Subsequent TTED errors are possible.

26 The affected joint has seized or become sluggish on both strings. Single joint drive available for other six joints. For SR and SY failures, it may be possible to achieve 6-DOF control using base joint locking.

27 The affected joint has failed on original string.

28
- Continue using FOR modes with POHS/Line Tracking ON with reduced commanded rates or Single mode to reduce undetected deviations.

29 Motion related recovery complete.

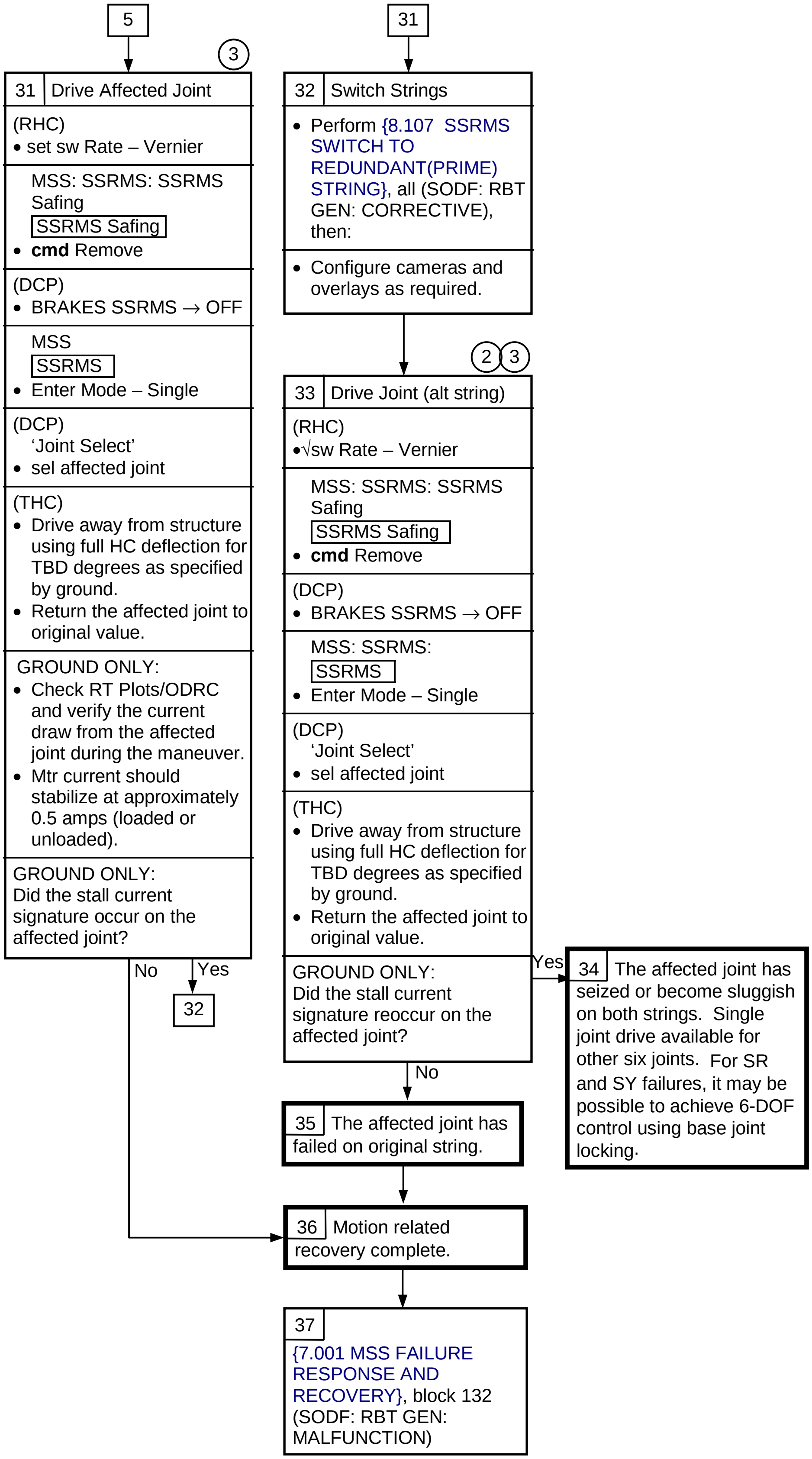
30 {7.001 MSS FAILURE RESPONSE AND RECOVERY}, block 132 (SODF: RBT GEN: MALFUNCTION)

④ This block contains steps to be carried out by Ground only

③ This block contains steps to be carried out by crew only.

7.502 SSRMS JOINT MOTION FAILURE

(RBT GEN/X2R4 - ALL/FIN) Page 5 of 7 pages



31 Drive Affected Joint

(RHC)
- set sw Rate – Vernier

MSS: SSRMS: SSRMS Safing
SSRMS Safing
- **cmd** Remove

(DCP)
- BRAKES SSRMS → OFF

MSS
SSRMS
- Enter Mode – Single

(DCP)
‘Joint Select’
- sel affected joint

(THC)
- Drive away from structure using full HC deflection for TBD degrees as specified by ground.
- Return the affected joint to original value.

GROUND ONLY:
- Check RT Plots/ODRC and verify the current draw from the affected joint during the maneuver.
- Mtr current should stabilize at approximately 0.5 amps (loaded or unloaded).

GROUND ONLY:
Did the stall current signature occur on the affected joint?

32 Switch Strings
- Perform {8.107 SSRMS SWITCH TO REDUNDANT(PRIME) STRING}, all (SODF: RBT GEN: CORRECTIVE), then:
- Configure cameras and overlays as required.

33 Drive Joint (alt string)

(RHC)
- √sw Rate – Vernier

MSS: SSRMS: SSRMS Safing
SSRMS Safing
- **cmd** Remove

(DCP)
- BRAKES SSRMS → OFF

MSS: SSRMS:
SSRMS
- Enter Mode – Single

(DCP)
‘Joint Select’
- sel affected joint

(THC)
- Drive away from structure using full HC deflection for TBD degrees as specified by ground.
- Return the affected joint to original value.

GROUND ONLY:
Did the stall current signature reoccur on the affected joint?

34 The affected joint has seized or become sluggish on both strings. Single joint drive available for other six joints. For SR and SY failures, it may be possible to achieve 6-DOF control using base joint locking.

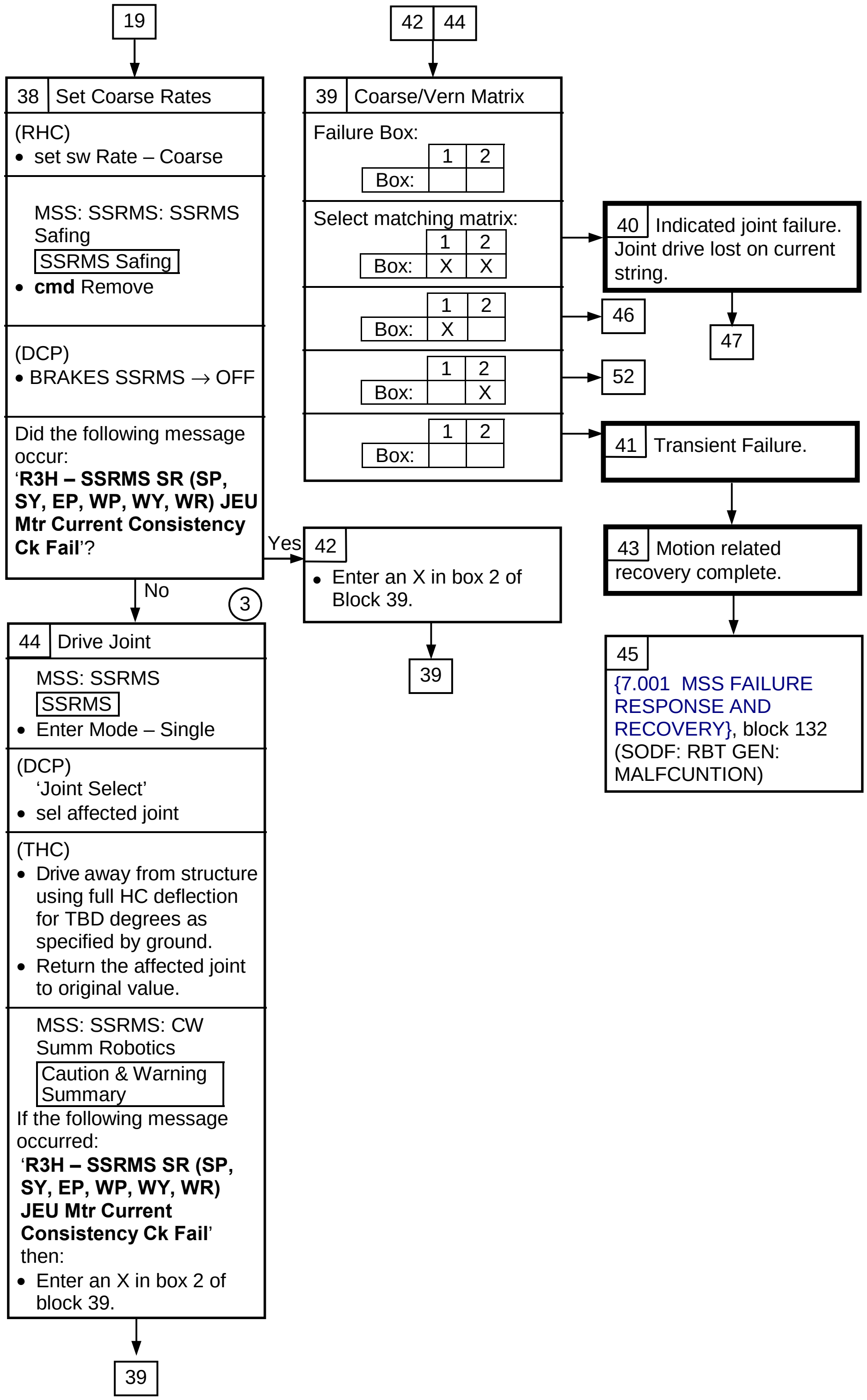
35 The affected joint has failed on original string.

36 Motion related recovery complete.

37 {7.001 MSS FAILURE RESPONSE AND RECOVERY}, block 132 (SODF: RBT GEN: MALFUNCTION)

⑤ This block contains steps to be carried out by Ground only

③ This block contains steps to be carried out by crew only.



19

38 Set Coarse Rates

(RHC)
- set sw Rate – Coarse

MSS: SSRMS: SSRMS Safing
SSRMS Safing
- **cmd** Remove

(DCP)
- BRAKES SSRMS → OFF

Did the following message occur:
‘**R3H – SSRMS SR (SP, SY, EP, WP, WY, WR) JEU Mtr Current Consistency Ck Fail**’?

Yes → 42; No → 44

③

44 Drive Joint

MSS: SSRMS
SSRMS
- Enter Mode – Single

(DCP)
‘Joint Select’
- sel affected joint

(THC)
- Drive away from structure using full HC deflection for TBD degrees as specified by ground.
- Return the affected joint to original value.

MSS: SSRMS: CW Summ Robotics
Caution & Warning Summary

If the following message occurred:
‘**R3H – SSRMS SR (SP, SY, EP, WP, WY, WR) JEU Mtr Current Consistency Ck Fail**’ then:
- Enter an X in box 2 of block 39.

→ 39

42 | 44

39 Coarse/Vern Matrix

Failure Box:

	1	2
Box:		

Select matching matrix:

	1	2
Box:	X	X

→ 40

	1	2
Box:	X	

→ 46

	1	2
Box:		X

→ 52

	1	2
Box:		

→ 41

42
- Enter an X in box 2 of Block 39.

→ 39

40 Indicated joint failure. Joint drive lost on current string.

→ 47

41 Transient Failure.

43 Motion related recovery complete.

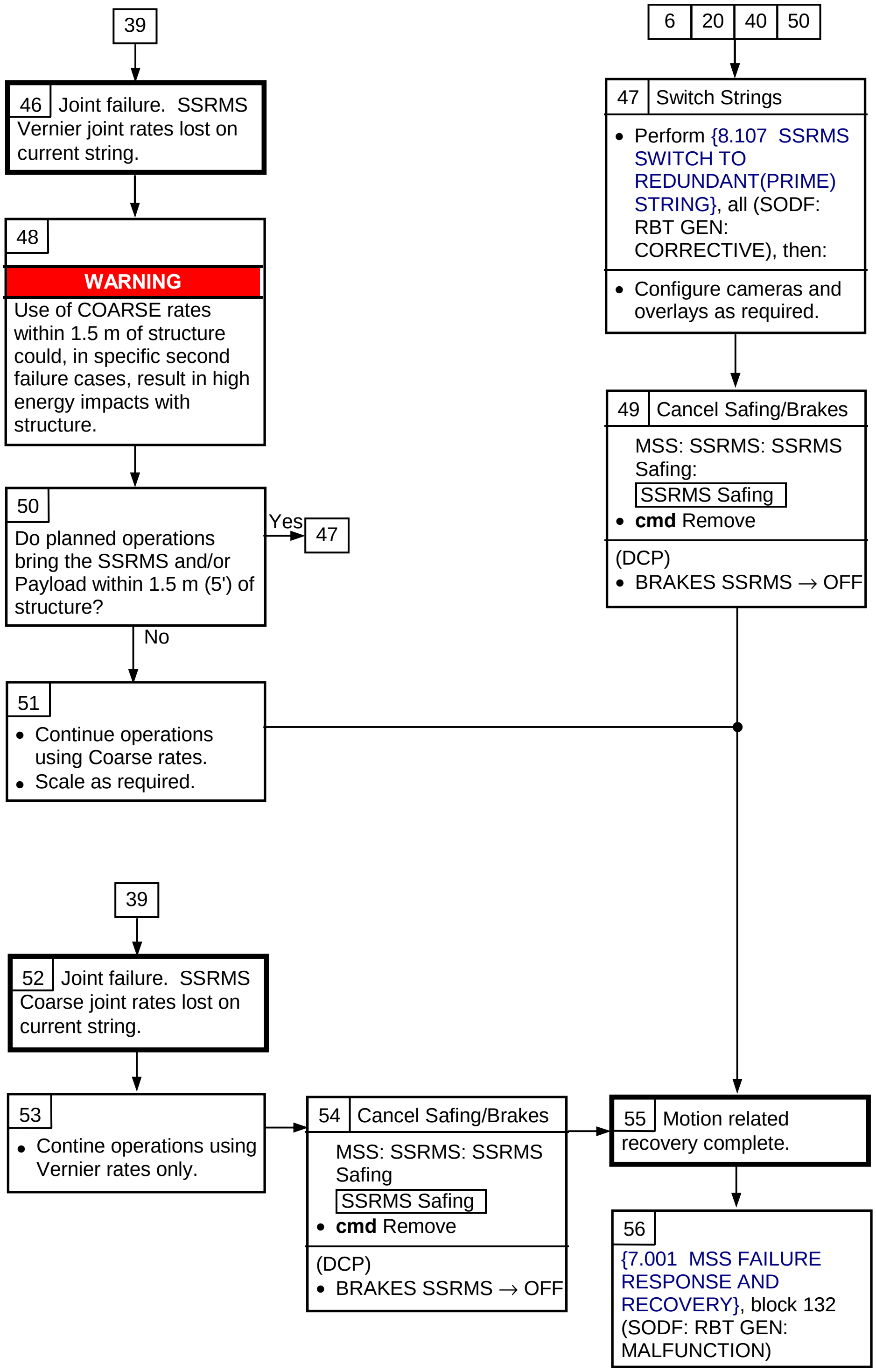
45 {7.001 MSS FAILURE RESPONSE AND RECOVERY}, block 132 (SODF: RBT GEN: MALFCUNTION)

③ This block contains steps to be carried out by crew only.

The drive duration will be determined by the ground based on SSRMS clearances at the current config.

7.502 SSRMS JOINT MOTION FAILURE

(RBT GEN/X2R4 - ALL/FIN) Page 7 of 7 pages



46 Joint failure. SSRMS Vernier joint rates lost on current string.

48

WARNING

Use of COARSE rates within 1.5 m of structure could, in specific second failure cases, result in high energy impacts with structure.

50 Do planned operations bring the SSRMS and/or Payload within 1.5 m (5') of structure?

51

- Continue operations using Coarse rates.
- Scale as required.

47 Switch Strings

- Perform {8.107 SSRMS SWITCH TO REDUNDANT(PRIME) STRING}, all (SODF: RBT GEN: CORRECTIVE), then:
- Configure cameras and overlays as required.

49 Cancel Safing/Brakes

MSS: SSRMS: SSRMS Safing:

SSRMS Safing

- **cmd** Remove

(DCP)

- BRAKES SSRMS → OFF

52 Joint failure. SSRMS Coarse joint rates lost on current string.

53

- Contine operations using Vernier rates only.

54 Cancel Safing/Brakes

MSS: SSRMS: SSRMS Safing

SSRMS Safing

- **cmd** Remove

(DCP)

- BRAKES SSRMS → OFF

55 Motion related recovery complete.

56 {7.001 MSS FAILURE RESPONSE AND RECOVERY}, block 132 (SODF: RBT GEN: MALFUNCTION)

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7.510 SSRMS LEE CAPTURE FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 1 of 18 pages

C&W ROBOTICS

C&W messages with ‘**Rxx-…**’ in the text

LEE Capture Does Not Complete.

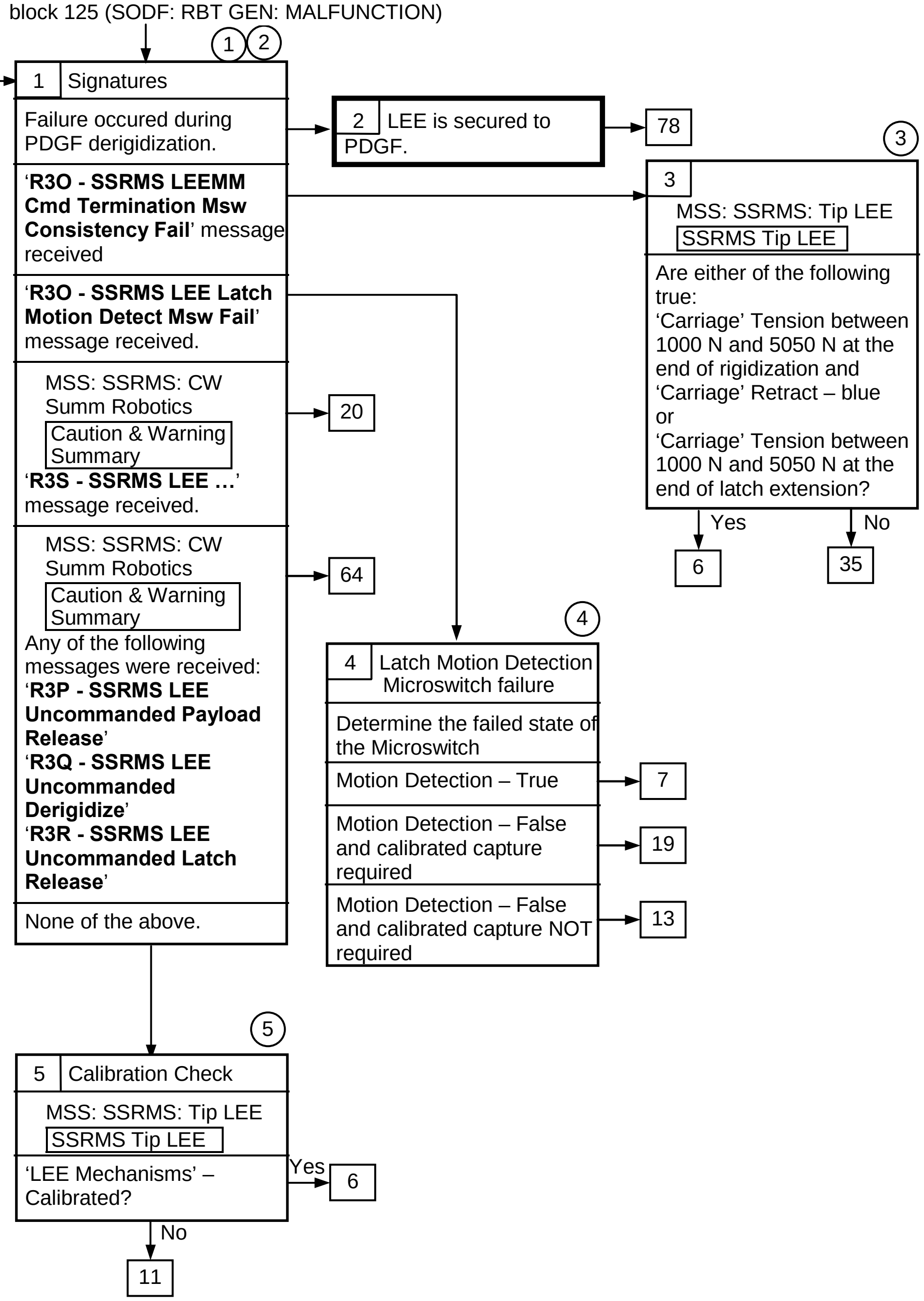
Nominal Config:
Active RWS.

SSRMS operational with brakes off.

If SSRMS is based on MBS, MBS powered on both strings and Operational on one string

If SSRMS is based on ISS PDGF, S0 and EXT MDMs configured for SEPS control

{7.001 MSS FAILURE RESPONSE AND RECOVERY},
block 125 (SODF: RBT GEN: MALFUNCTION)



① Unless otherwise indicated, all displays in the procedures are on the PCS.

② Throughout this procedure, MSS commands should not be issues while the trigger is hot. To change the configuration of the system, Safe to exit LEE operations (SCR 14662)

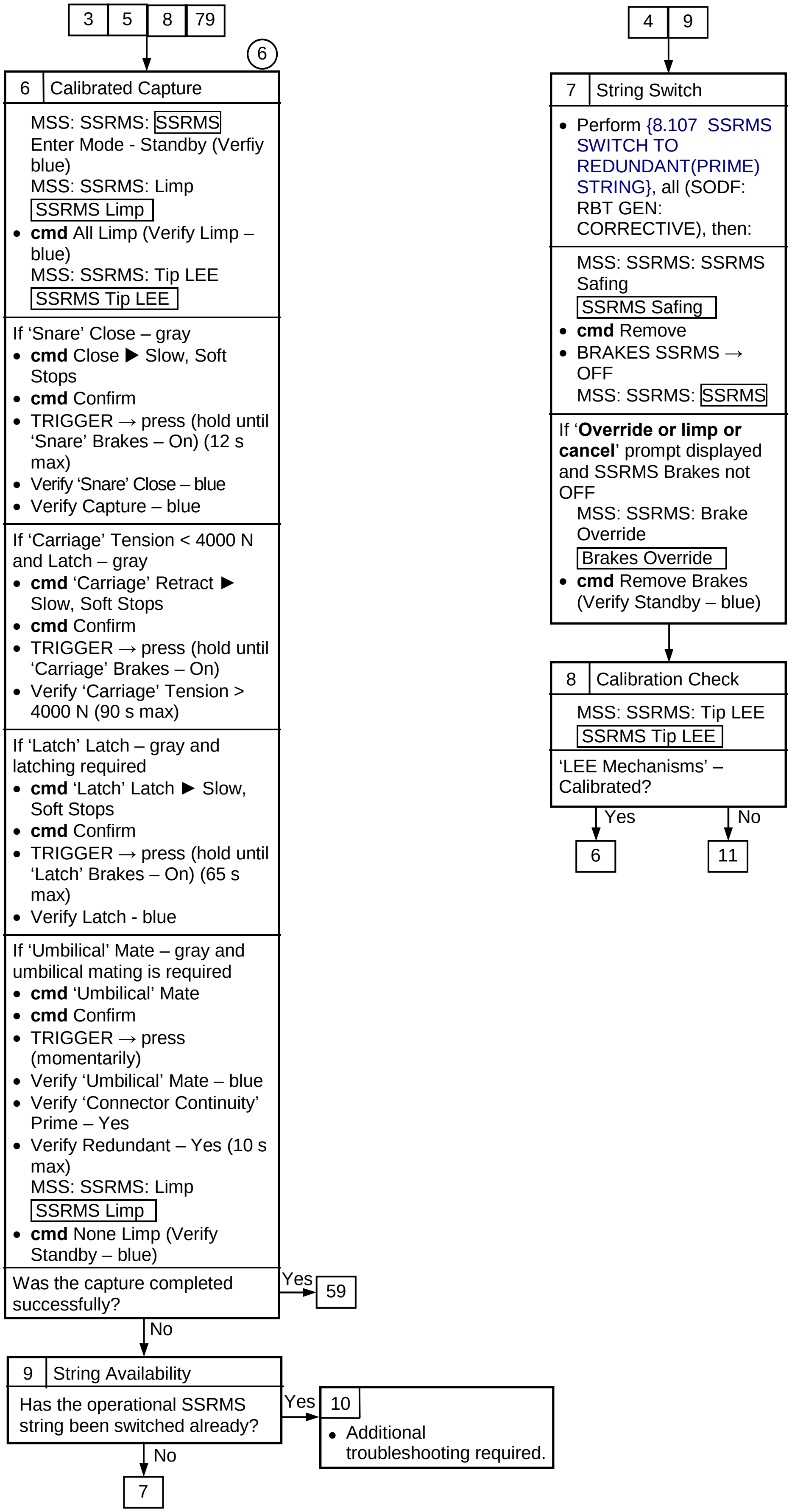
③ SCR 25421

④ Latch Motion Detection Microswitch status is only available on the ground.

⑤ If calibration is lost, completing the capture to hardstops will result in loss of uncommanded derigidization monitoring. Also, if mating is required, checkpoint data must be reset. This procedure gives steps to do so.

7.510 SSRMS LEE CAPTURE FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN)   Page 2 of 18 pages



3 | 5 | 8 | 79

⑥

6 Calibrated Capture

MSS: SSRMS: SSRMS
Enter Mode - Standby (Verfiy blue)
MSS: SSRMS: Limp
SSRMS Limp

- **cmd** All Limp (Verify Limp – blue)

MSS: SSRMS: Tip LEE
SSRMS Tip LEE

If ‘Snare’ Close – gray

- **cmd** Close ▶ Slow, Soft Stops
- **cmd** Confirm
- TRIGGER → press (hold until ‘Snare’ Brakes – On) (12 s max)
- Verify ‘Snare’ Close – blue
- Verify Capture – blue

If ‘Carriage’ Tension < 4000 N and Latch – gray

- **cmd** ‘Carriage’ Retract ▶ Slow, Soft Stops
- **cmd** Confirm
- TRIGGER → press (hold until ‘Carriage’ Brakes – On)
- Verify ‘Carriage’ Tension > 4000 N (90 s max)

If ‘Latch’ Latch – gray and latching required

- **cmd** ‘Latch’ Latch ▶ Slow, Soft Stops
- **cmd** Confirm
- TRIGGER → press (hold until ‘Latch’ Brakes – On) (65 s max)
- Verify Latch - blue

If ‘Umbilical’ Mate – gray and umbilical mating is required

- **cmd** ‘Umbilical’ Mate
- **cmd** Confirm
- TRIGGER → press (momentarily)
- Verify ‘Umbilical’ Mate – blue
- Verify ‘Connector Continuity’ Prime – Yes
- Verify Redundant – Yes (10 s max)

MSS: SSRMS: Limp
SSRMS Limp

- **cmd** None Limp (Verify Standby – blue)

Was the capture completed successfully?

Yes → 59

No ↓

9 String Availability

Has the operational SSRMS string been switched already?

Yes → 10

No → 7

10

- Additional troubleshooting required.

4 | 9

7 String Switch

- Perform {8.107 SSRMS SWITCH TO REDUNDANT(PRIME) STRING}, all (SODF: RBT GEN: CORRECTIVE), then:

MSS: SSRMS: SSRMS Safing
SSRMS Safing

- **cmd** Remove
- BRAKES SSRMS → OFF

MSS: SSRMS: SSRMS

If ‘**Override or limp or cancel**’ prompt displayed and SSRMS Brakes not OFF

MSS: SSRMS: Brake Override
Brakes Override

- **cmd** Remove Brakes (Verify Standby – blue)

8 Calibration Check

MSS: SSRMS: Tip LEE
SSRMS Tip LEE

‘LEE Mechanisms’ – Calibrated?

Yes → 6

No → 11

⑥
A locked joint will not be limped if SSRMS is in Manual mode when “All Limp” command is issued (SCR 29341).

7.510 SSRMS LEE CAPTURE FAILURE

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5 8

⑤

11 Calibration Requirement

Complete capture uncalibrated, instead of releasing and recalibrating?

16

Yes

4 12

⑥

13 Uncalibrated Capture

MSS: SSRMS: SSRMS
- Enter Mode - Standby (Verfiy blue)

MSS: SSRMS: Limp
SSRMS Limp
- **cmd** All Limp (Verify Limp – blue)

MSS: SSRMS: Tip LEE
SSRMS Tip LEE

If ‘Snare’ Close – gray
- **cmd** ‘Snare’ Close ► Hard Stops ► Slow, Hard Stops
- **cmd** Confirm
- TRIGGER → press (hold until ‘Snare’ Brakes – On) (12 s max)
- Verify Close – blue
- Verify Capture – blue

If ‘Carriage’ Tension < 4000 N
- **cmd** ‘Carriage’ Retract ► Hards Stops ► Slow, Hard Stops
- **cmd** Confirm
- TRIGGER → press (hold until ‘Carriage’ Brakes – On) (90 s max)
- Verify Carriage’ Tension > 4000 N

If ‘Latch’ Latch – gray and latching is required
- **cmd** ‘Latch’ Latch ► Hard Stops ► Slow, Hard Stops
- **cmd** Confirm
- TRIGGER → press (hold until ‘Latch’ Brakes – On) (65 s max)
- Verify ‘Latch’ – blue

MSS: SSRMS: Limp
SSRMS Limp
- **cmd** None Limp (Verify Standby – blue)

Was capture completed successfully?

Yes 55

No

14 String Availability

Has the operational SSRMS string been switched already?

Yes

15
- Additional troubleshooting required.

No

12

14

12 String Switch

- Perform {8.107 SSRMS SWITCH TO REDUNDANT(PRIME) STRING}, all (SODF: RBT GEN: CORRECTIVE), then:

MSS: SSRMS: SSRMS Safing
SSRMS Safing
- **cmd** Remove

- BRAKES SSRMS → OFF

MSS: SSRMS: SSRMS

If ‘**Override or limp or cancel**’ prompt displayed and Brakes Not OFF

MSS: SSRMS: Brake Override
Brakes Override
- **cmd** Remove Brakes (Verify Standby – blue)

13

⑤ If calibration is lost, completing the capture to hardstops will result in loss of uncommanded derigidization monitoring. Also, if mating is required, checkpoint data must be reset. This procedure gives steps to do so.

⑥ A locked joint will not be limped if SSRMS is in Manual mode when “All Limp” command is issued (SCR 29341).

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11 | 19

⑦ ⑧

16 Uncalibrated Release and Recalibration

MSS: SSRMS: Limp
SSRMS Limp
- **cmd** All Limp (Verify Limp – blue)

MSS: SSRMS: Tip LEE: SSRMS Tip LEE
If ‘Latch’ Unlatch – gray
- **cmd** ‘Latch’ Unlatch ► Hard Stops ► Slow, Hard Stops
- **cmd** Confirm
- TRIGGER → press (hold until ‘Latch’ Brakes – On) (65 s max)
- Verify ‘Latch’ Unlatch – blue

If Carriage Derigidize – gray
- **cmd** ‘Carriage’ Extend ► Hard Stops ► Slow, Hard Stops
- **cmd** Confirm
- TRIGGER → press (hold until Derigidize – blue) (20 s max)
- Verify Derigidize – blue
- **cmd** Terminate

If ‘Snare’ Open – gray
- **cmd** ‘Snare’ Open ► Hard Stops ► Slow, Hard Stops
- **cmd** Confirm
- TRIGGER → press (hold until ‘Snare’ Brakes – On) (12 s max)
- Verify ‘Snare’ Open – blue

If ‘Carriage’ Extend – gray
- **cmd** ‘Carriage’ Extend ► Hard Stops ► Slow, Hard Stops
- **cmd** Confirm
- TRIGGER → press (hold until ‘Carriage’ Brakes – On) (90 s max)
- Verify Extend – blue

MSS: SSRMS: Limp: SSRMS Limp
- **cmd** None Limp (Verify Standby – blue)

MSS: SSRMS: SSRMS
- Enter Mode – Manual (Verify Manual – blue)

MSS: SSRMS: Manual: Joint Lock
Joint Lock
- Lock the joint that was originally locked during the capture.
- Back off until clear of GF pin.

MSS: SSRMS: Tip LEE
SSRMS Tip LEE
- **cmd** ‘LEE Mechanism’ Calibrate
- **cmd** Confirm
- TRIGGER → press (momentarily)
- Verify ‘LEE Mechanisms’ – Calibrated (340 s max)

Were the steps completed successful?

Yes → 79

No → 17

⑦
A Calibrate command may be aborted by a ‘**SSRMS LEE LEU Mtr Velocity Runaway**’ Robotics Advisory message and the MSS safed if one of the three LEE mechanisms was initially located at the hardstop position. If safing occurs, cancel safing and command Calibrate again (SCR 20379).

⑧
When extending until derigidize – blue, the trigger must be released once the derigidize indication turns blue.

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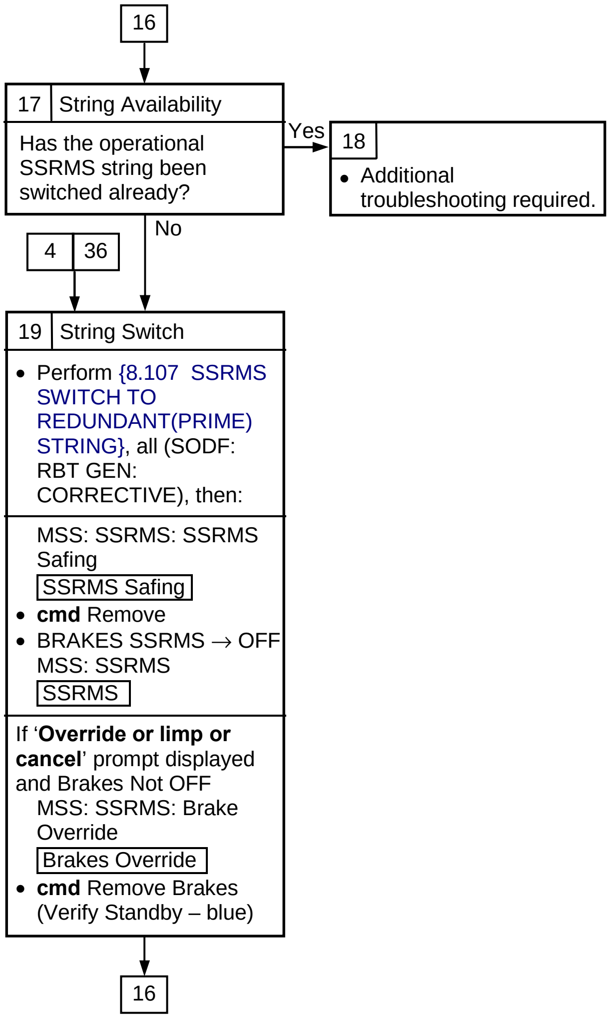


17 String Availability

Has the operational SSRMS string been switched already?

18

- Additional troubleshooting required.

19 String Switch

- Perform {8.107 SSRMS SWITCH TO REDUNDANT(PRIME) STRING}, all (SODF: RBT GEN: CORRECTIVE), then:

MSS: SSRMS: SSRMS Safing

SSRMS Safing

- **cmd** Remove
- BRAKES SSRMS → OFF

MSS: SSRMS

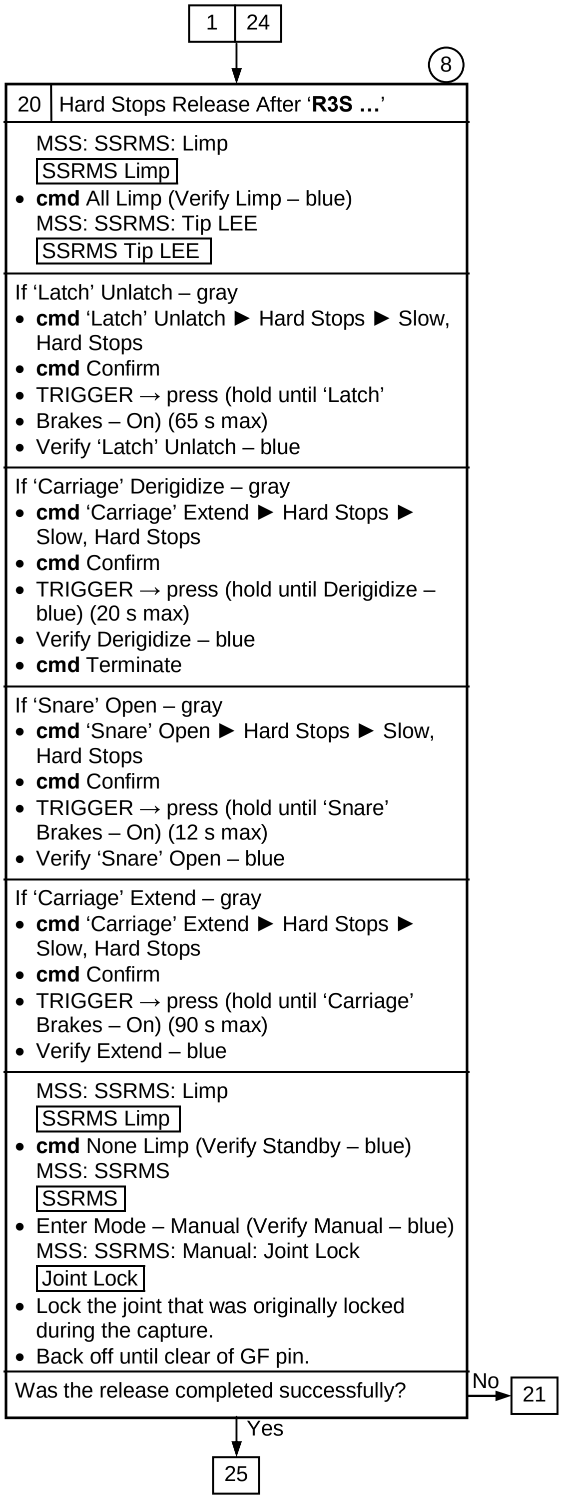
SSRMS

If ‘**Override or limp or cancel**’ prompt displayed and Brakes Not OFF

MSS: SSRMS: Brake Override

Brakes Override

- **cmd** Remove Brakes (Verify Standby – blue)



20 Hard Stops Release After ‘**R3S …**’

MSS: SSRMS: Limp
SSRMS Limp
- **cmd** All Limp (Verify Limp – blue)

MSS: SSRMS: Tip LEE
SSRMS Tip LEE

If ‘Latch’ Unlatch – gray
- **cmd** ‘Latch’ Unlatch ► Hard Stops ► Slow, Hard Stops
- **cmd** Confirm
- TRIGGER → press (hold until ‘Latch’
- Brakes – On) (65 s max)
- Verify ‘Latch’ Unlatch – blue

If ‘Carriage’ Derigidize – gray
- **cmd** ‘Carriage’ Extend ► Hard Stops ► Slow, Hard Stops
- **cmd** Confirm
- TRIGGER → press (hold until Derigidize – blue) (20 s max)
- Verify Derigidize – blue
- **cmd** Terminate

If ‘Snare’ Open – gray
- **cmd** ‘Snare’ Open ► Hard Stops ► Slow, Hard Stops
- **cmd** Confirm
- TRIGGER → press (hold until ‘Snare’ Brakes – On) (12 s max)
- Verify ‘Snare’ Open – blue

If ‘Carriage’ Extend – gray
- **cmd** ‘Carriage’ Extend ► Hard Stops ► Slow, Hard Stops
- **cmd** Confirm
- TRIGGER → press (hold until ‘Carriage’ Brakes – On) (90 s max)
- Verify Extend – blue

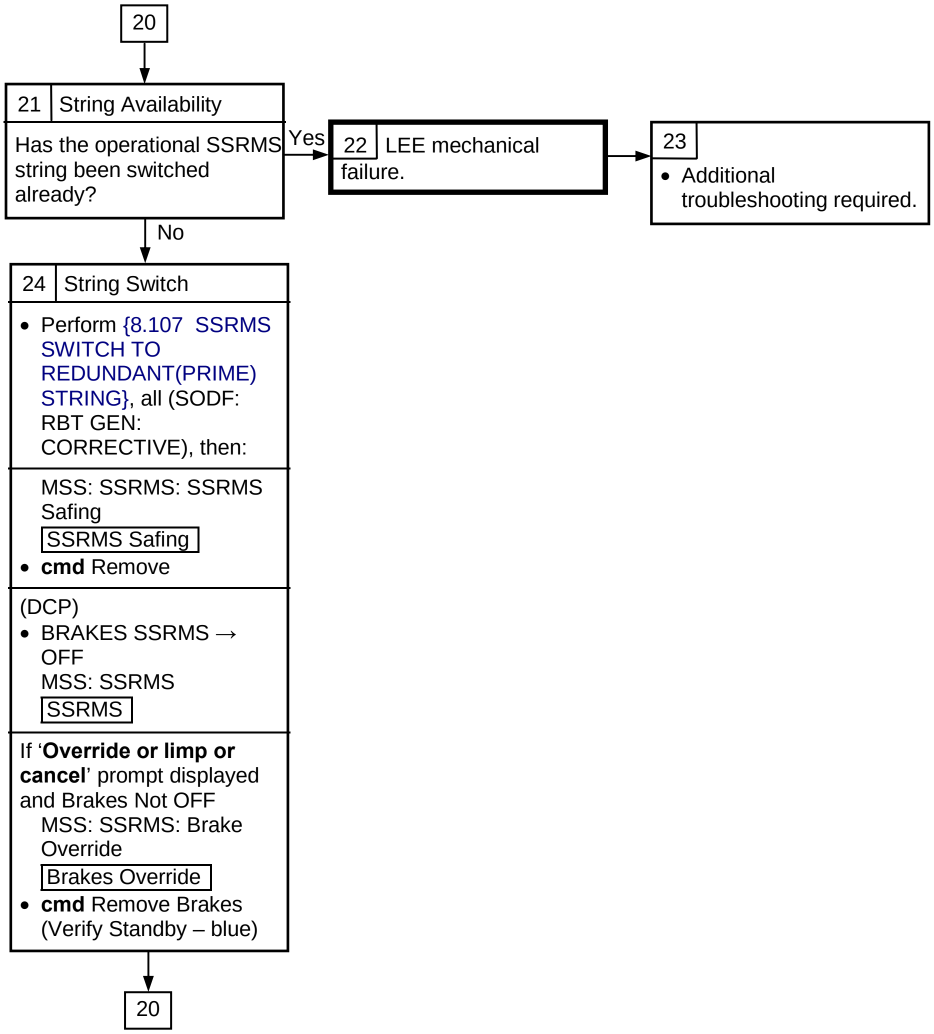
MSS: SSRMS: Limp
SSRMS Limp
- **cmd** None Limp (Verify Standby – blue)

MSS: SSRMS
SSRMS
- Enter Mode – Manual (Verify Manual – blue)

MSS: SSRMS: Manual: Joint Lock
Joint Lock
- Lock the joint that was originally locked during the capture.
- Back off until clear of GF pin.

Was the release completed successfully?

⑧ When extending until derigidize – blue, the trigger must be released once the derigidize indication turns blue.



21 String Availability

Has the operational SSRMS string been switched already?

22 LEE mechanical failure.

23

- Additional troubleshooting required.

24 String Switch

- Perform {8.107 SSRMS SWITCH TO REDUNDANT(PRIME) STRING}, all (SODF: RBT GEN: CORRECTIVE), then:

MSS: SSRMS: SSRMS Safing
SSRMS Safing
- **cmd** Remove

(DCP)
- BRAKES SSRMS → OFF

MSS: SSRMS
SSRMS

If ‘**Override or limp or cancel**’ prompt displayed and Brakes Not OFF

MSS: SSRMS: Brake Override
Brakes Override
- **cmd** Remove Brakes (Verify Standby – blue)

7.510 SSRMS LEE CAPTURE FAILURE

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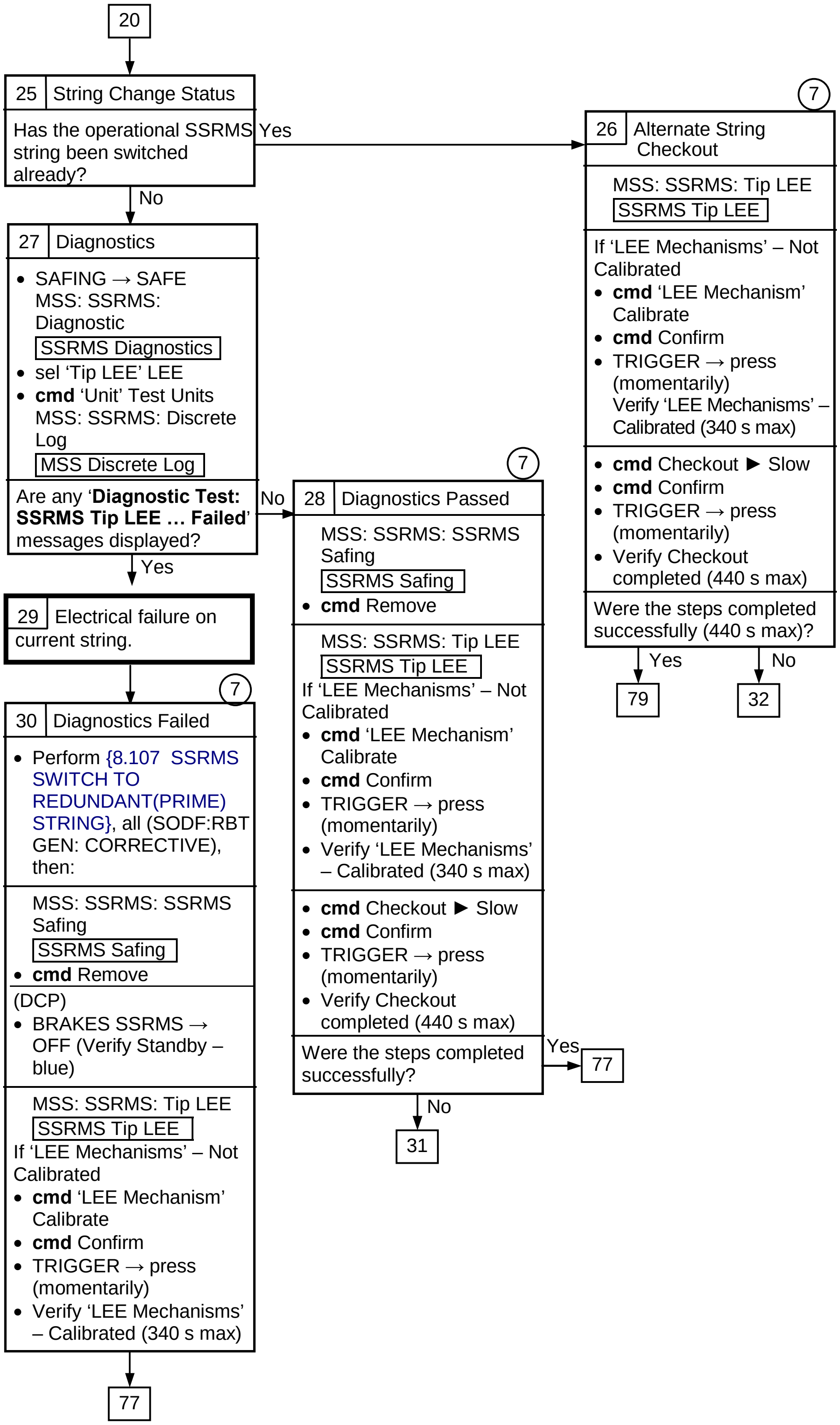


25 String Change Status

Has the operational SSRMS string been switched already?

26 Alternate String Checkout ⑦

MSS: SSRMS: Tip LEE

SSRMS Tip LEE

If 'LEE Mechanisms' – Not Calibrated

- **cmd** 'LEE Mechanism' Calibrate
- **cmd** Confirm
- TRIGGER → press (momentarily)
  Verify 'LEE Mechanisms' – Calibrated (340 s max)

- **cmd** Checkout ▶ Slow
- **cmd** Confirm
- TRIGGER → press (momentarily)
- Verify Checkout completed (440 s max)

Were the steps completed successfully (440 s max)?

27 Diagnostics

- SAFING → SAFE
  MSS: SSRMS: Diagnostic
  SSRMS Diagnostics
- sel 'Tip LEE' LEE
- **cmd** 'Unit' Test Units
  MSS: SSRMS: Discrete Log
  MSS Discrete Log

Are any '**Diagnostic Test: SSRMS Tip LEE … Failed**' messages displayed?

28 Diagnostics Passed ⑦

MSS: SSRMS: SSRMS Safing

SSRMS Safing

- **cmd** Remove

MSS: SSRMS: Tip LEE

SSRMS Tip LEE

If 'LEE Mechanisms' – Not Calibrated

- **cmd** 'LEE Mechanism' Calibrate
- **cmd** Confirm
- TRIGGER → press (momentarily)
- Verify 'LEE Mechanisms' – Calibrated (340 s max)

- **cmd** Checkout ▶ Slow
- **cmd** Confirm
- TRIGGER → press (momentarily)
- Verify Checkout completed (440 s max)

Were the steps completed successfully?

29 Electrical failure on current string.

30 Diagnostics Failed ⑦

- Perform {8.107 SSRMS SWITCH TO REDUNDANT(PRIME) STRING}, all (SODF:RBT GEN: CORRECTIVE), then:

MSS: SSRMS: SSRMS Safing

SSRMS Safing

- **cmd** Remove

(DCP)

- BRAKES SSRMS → OFF (Verify Standby – blue)

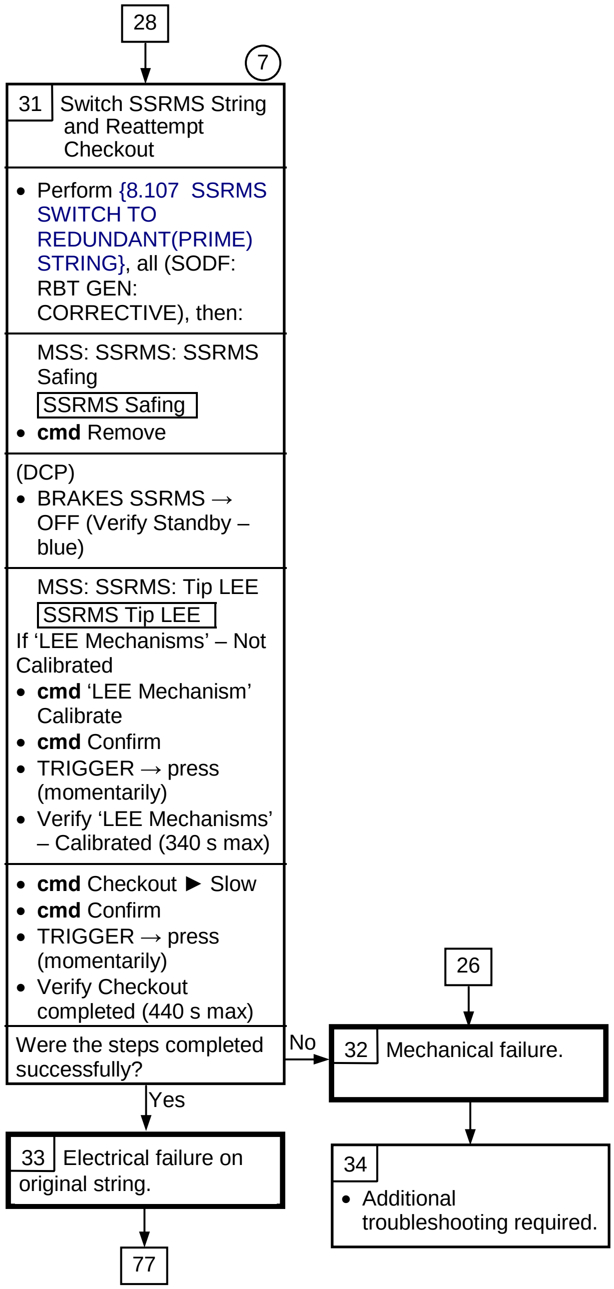
MSS: SSRMS: Tip LEE

SSRMS Tip LEE

If 'LEE Mechanisms' – Not Calibrated

- **cmd** 'LEE Mechanism' Calibrate
- **cmd** Confirm
- TRIGGER → press (momentarily)
- Verify 'LEE Mechanisms' – Calibrated (340 s max)

⑦ A Calibrate command may be aborted by a '**SSRMS LEE LEU Mtr Velocity Runaway**' Robotics Advisory message and the MSS safed if one of the three LEE mechanisms was initially located at the hardstop position. If safing occurs, cancel safing and command Calibrate again (SCR 20379).



31 Switch SSRMS String and Reattempt Checkout

- Perform {8.107 SSRMS SWITCH TO REDUNDANT(PRIME) STRING}, all (SODF: RBT GEN: CORRECTIVE), then:

MSS: SSRMS: SSRMS Safing
SSRMS Safing
- **cmd** Remove

(DCP)
- BRAKES SSRMS → OFF (Verify Standby – blue)

MSS: SSRMS: Tip LEE
SSRMS Tip LEE
If ‘LEE Mechanisms’ – Not Calibrated
- **cmd** ‘LEE Mechanism’ Calibrate
- **cmd** Confirm
- TRIGGER → press (momentarily)
- Verify ‘LEE Mechanisms’ – Calibrated (340 s max)

- **cmd** Checkout ► Slow
- **cmd** Confirm
- TRIGGER → press (momentarily)
- Verify Checkout completed (440 s max)

Were the steps completed successfully?

32 Mechanical failure.

33 Electrical failure on original string.

34
- Additional troubleshooting required.

⑦
A Calibrate command may be aborted by a ‘**SSRMS LEE LEU Mtr Velocity Runaway**’ Robotics Advisory message and the MSS safed if one of the three LEE mechanisms was initially located at the hardstop position. If safing occurs, cancel safing and command Calibrate again (SCR 20379).

7.510 SSRMS LEE CAPTURE FAILURE

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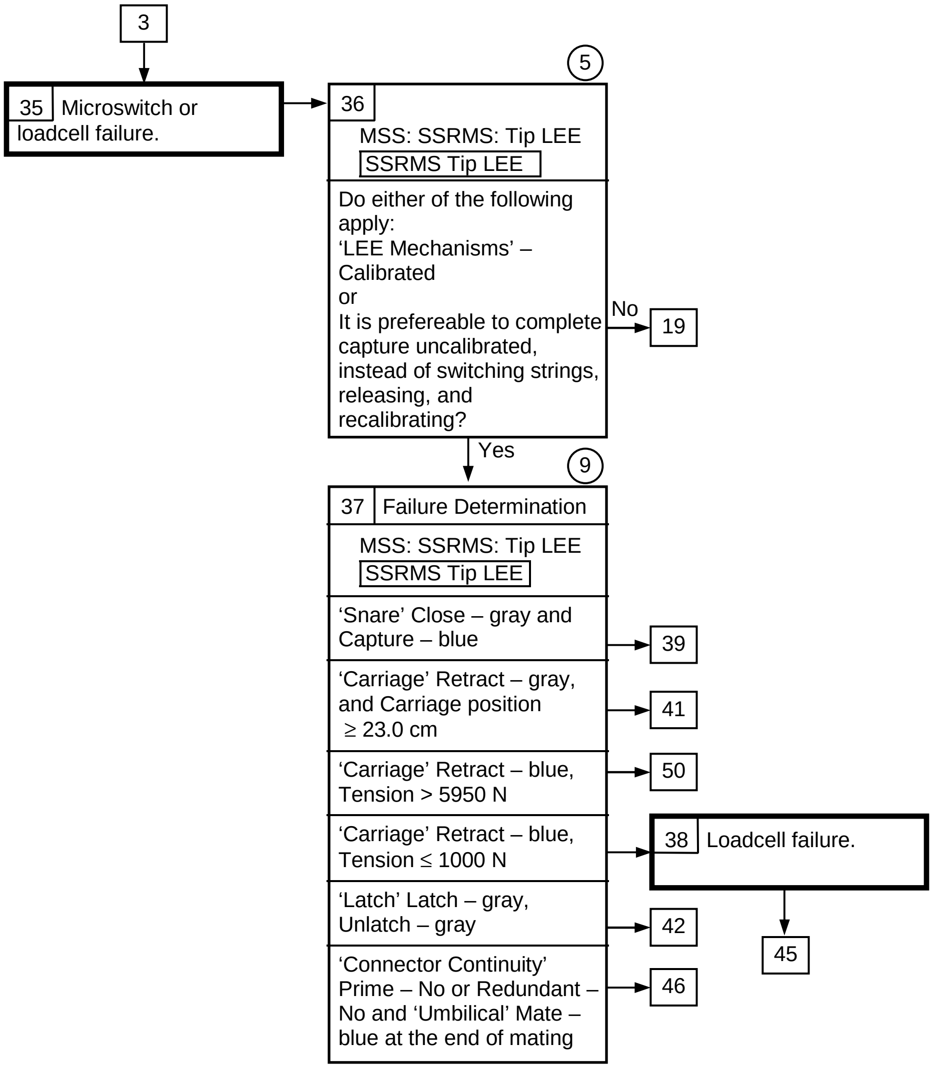

35 Microswitch or loadcell failure.

36 MSS: SSRMS: Tip LEE
SSRMS Tip LEE

Do either of the following apply:
'LEE Mechanisms' – Calibrated
or
It is prefereable to complete capture uncalibrated, instead of switching strings, releasing, and recalibrating?

37 Failure Determination

MSS: SSRMS: Tip LEE
SSRMS Tip LEE

'Snare' Close – gray and Capture – blue

'Carriage' Retract – gray, and Carriage position ≥ 23.0 cm

'Carriage' Retract – blue, Tension > 5950 N

'Carriage' Retract – blue, Tension ≤ 1000 N

'Latch' Latch – gray, Unlatch – gray

'Connector Continuity' Prime – No or Redundant – No and 'Umbilical' Mate – blue at the end of mating

38 Loadcell failure.

⑤ If calibration is lost, completing the capture to hardstops will result in loss of uncommanded derigidization monitoring. Also, if mating is required, checkpoint data must be reset.

⑨ The carriage position is only available on the ground.

7.510 SSRMS LEE CAPTURE FAILURE

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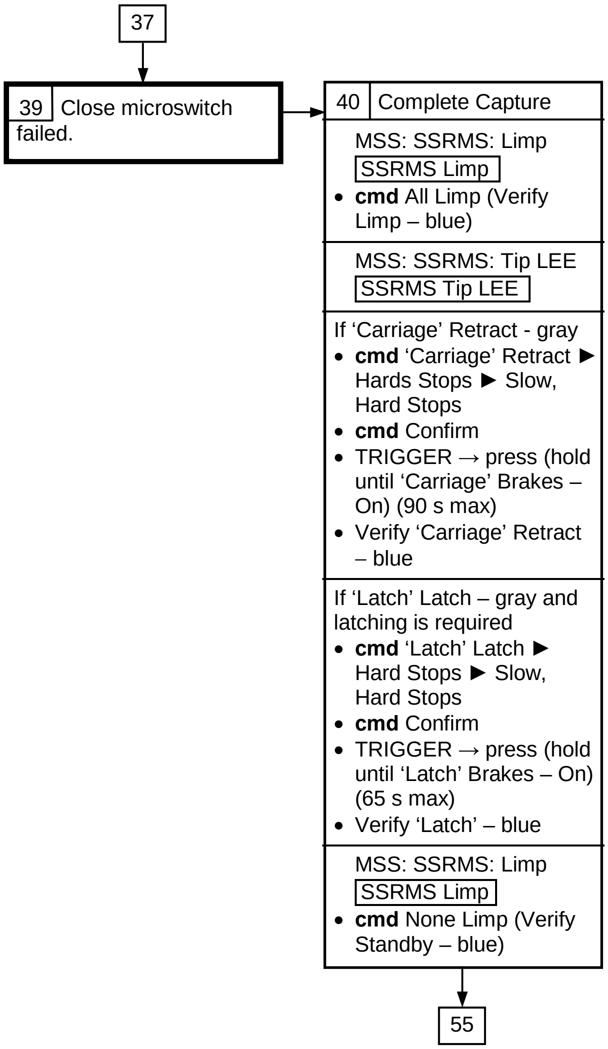

39 Close microswitch failed.

40 Complete Capture

MSS: SSRMS: Limp

SSRMS Limp

- **cmd** All Limp (Verify Limp – blue)

MSS: SSRMS: Tip LEE

SSRMS Tip LEE

If ‘Carriage’ Retract - gray

- **cmd** ‘Carriage’ Retract ► Hards Stops ► Slow, Hard Stops
- **cmd** Confirm
- TRIGGER → press (hold until ‘Carriage’ Brakes – On) (90 s max)
- Verify ‘Carriage’ Retract – blue

If ‘Latch’ Latch – gray and latching is required

- **cmd** ‘Latch’ Latch ► Hard Stops ► Slow, Hard Stops
- **cmd** Confirm
- TRIGGER → press (hold until ‘Latch’ Brakes – On) (65 s max)
- Verify ‘Latch’ – blue

MSS: SSRMS: Limp

SSRMS Limp

- **cmd** None Limp (Verify Standby – blue)

7.510 SSRMS LEE CAPTURE FAILURE

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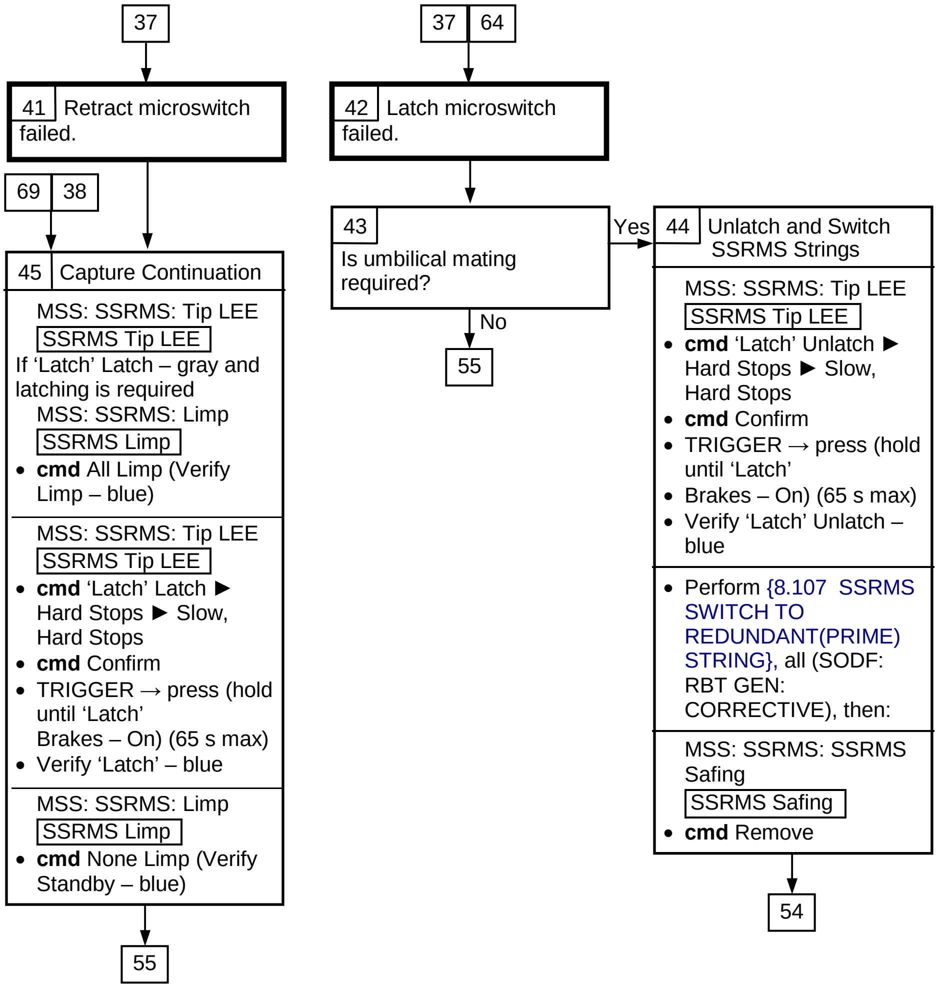


41 Retract microswitch failed.

42 Latch microswitch failed.

43 Is umbilical mating required?

44 Unlatch and Switch SSRMS Strings

MSS: SSRMS: Tip LEE

SSRMS Tip LEE

- **cmd** ‘Latch’ Unlatch ► Hard Stops ► Slow, Hard Stops
- **cmd** Confirm
- TRIGGER → press (hold until ‘Latch’
- Brakes – On) (65 s max)
- Verify ‘Latch’ Unlatch – blue

- Perform {8.107 SSRMS SWITCH TO REDUNDANT(PRIME) STRING}, all (SODF: RBT GEN: CORRECTIVE), then:

MSS: SSRMS: SSRMS Safing

SSRMS Safing

- **cmd** Remove

45 Capture Continuation

MSS: SSRMS: Tip LEE

SSRMS Tip LEE

If ‘Latch’ Latch – gray and latching is required

MSS: SSRMS: Limp

SSRMS Limp

- **cmd** All Limp (Verify Limp – blue)

MSS: SSRMS: Tip LEE

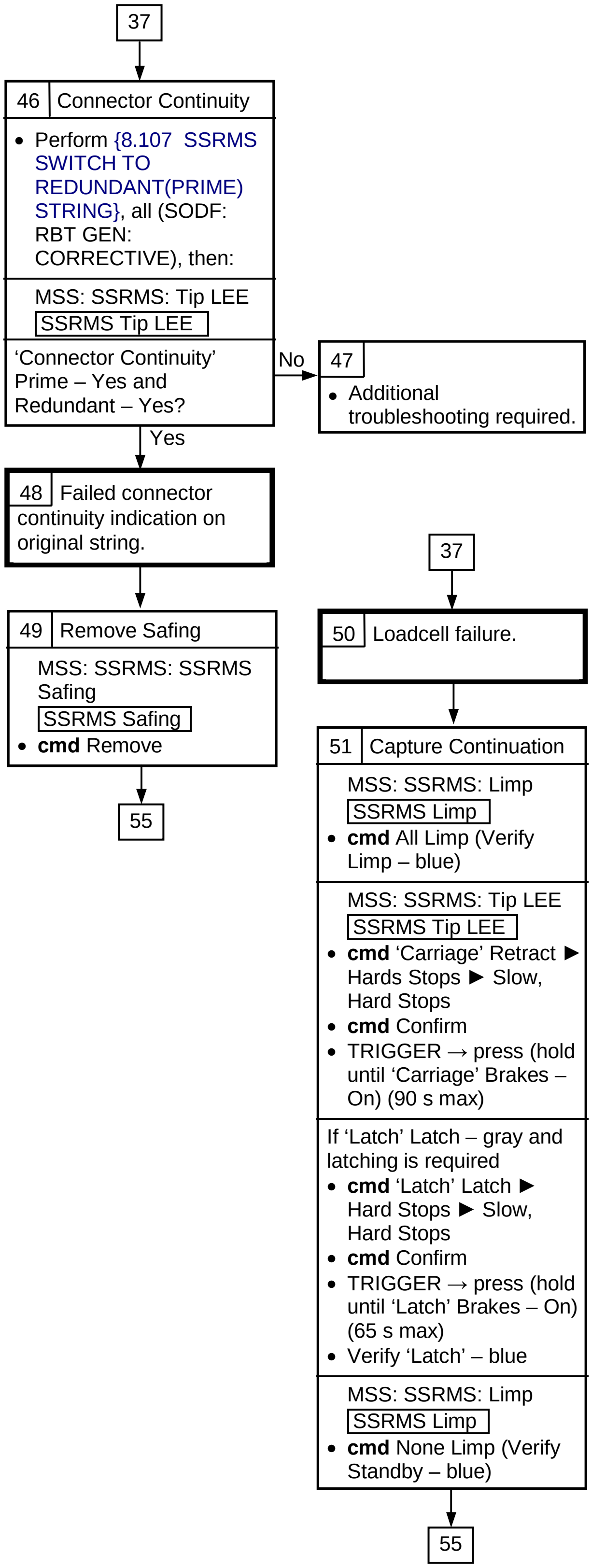
SSRMS Tip LEE

- **cmd** ‘Latch’ Latch ► Hard Stops ► Slow, Hard Stops
- **cmd** Confirm
- TRIGGER → press (hold until ‘Latch’ Brakes – On) (65 s max)
- Verify ‘Latch’ – blue

MSS: SSRMS: Limp

SSRMS Limp

- **cmd** None Limp (Verify Standby – blue)



37

46 Connector Continuity

- Perform {8.107 SSRMS SWITCH TO REDUNDANT(PRIME) STRING}, all (SODF: RBT GEN: CORRECTIVE), then:

MSS: SSRMS: Tip LEE
SSRMS Tip LEE

'Connector Continuity' Prime – Yes and Redundant – Yes?

No → 47

47

- Additional troubleshooting required.

Yes ↓

48 Failed connector continuity indication on original string.

49 Remove Safing

MSS: SSRMS: SSRMS Safing
SSRMS Safing
- **cmd** Remove

55

37

50 Loadcell failure.

51 Capture Continuation

MSS: SSRMS: Limp
SSRMS Limp
- **cmd** All Limp (Verify Limp – blue)

MSS: SSRMS: Tip LEE
SSRMS Tip LEE
- **cmd** 'Carriage' Retract ► Hards Stops ► Slow, Hard Stops
- **cmd** Confirm
- TRIGGER → press (hold until 'Carriage' Brakes – On) (90 s max)

If 'Latch' Latch – gray and latching is required
- **cmd** 'Latch' Latch ► Hard Stops ► Slow, Hard Stops
- **cmd** Confirm
- TRIGGER → press (hold until 'Latch' Brakes – On) (65 s max)
- Verify 'Latch' – blue

MSS: SSRMS: Limp
SSRMS Limp
- **cmd** None Limp (Verify Standby – blue)

55

7.510 SSRMS LEE CAPTURE FAILURE

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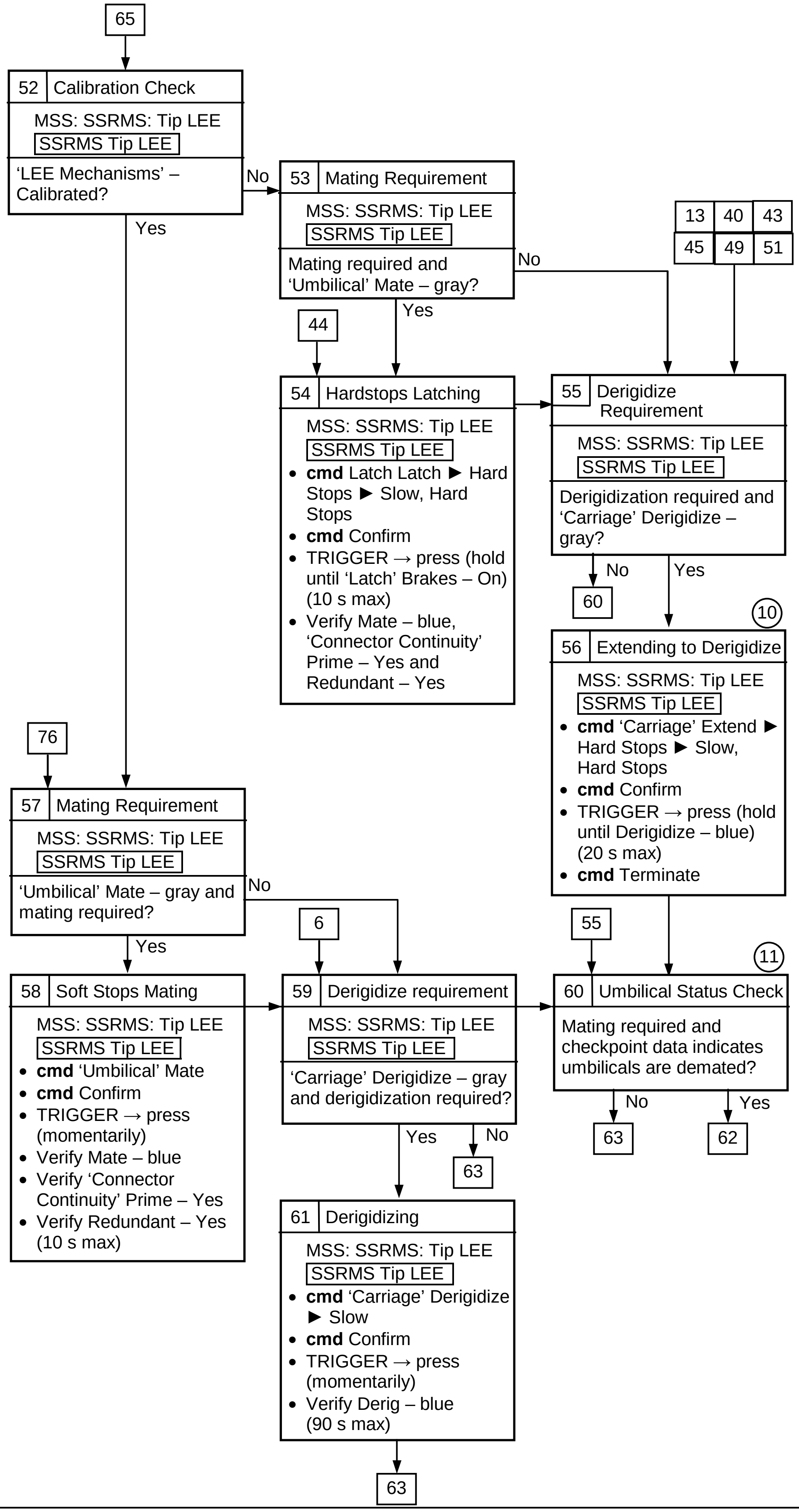
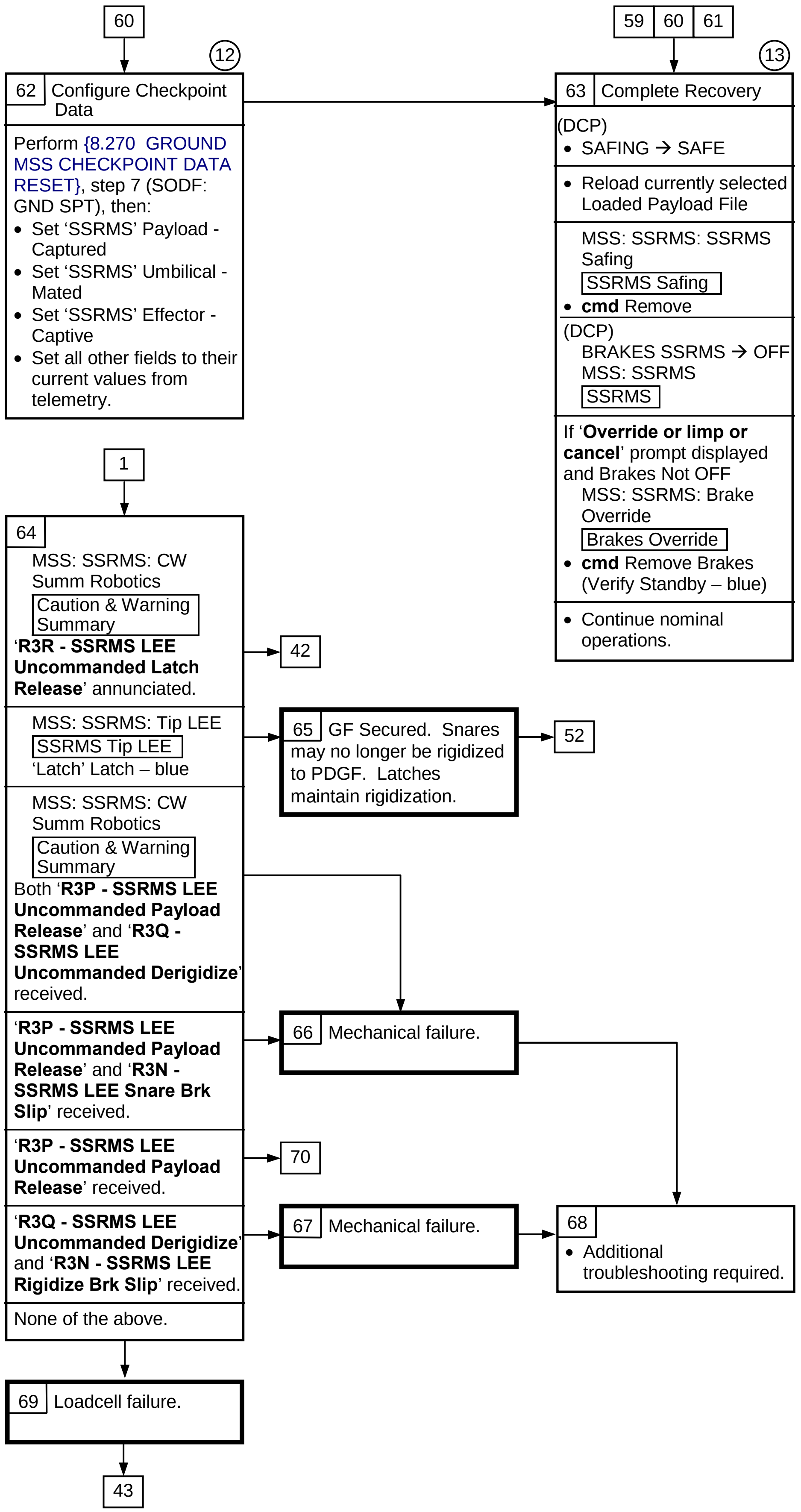


⑩ When extending until Derigidize - blue, the trigger must be released once the derigidize indication turns blue. Fully extending the carriage while the SSRMS is braked may cause hardware damage.

⑪ The UMB Status is only available on the ground.

7.510 SSRMS LEE CAPTURE FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN)



62 Configure Checkpoint Data ⑫

Perform {8.270 GROUND MSS CHECKPOINT DATA RESET}, step 7 (SODF: GND SPT), then:

- Set 'SSRMS' Payload - Captured
- Set 'SSRMS' Umbilical - Mated
- Set 'SSRMS' Effector - Captive
- Set all other fields to their current values from telemetry.

63 Complete Recovery ⑬

(DCP)
- SAFING → SAFE

- Reload currently selected Loaded Payload File

MSS: SSRMS: SSRMS Safing
SSRMS Safing
- **cmd** Remove

(DCP)
BRAKES SSRMS → OFF
MSS: SSRMS
SSRMS

If '**Override or limp or cancel**' prompt displayed and Brakes Not OFF
MSS: SSRMS: Brake Override
Brakes Override
- **cmd** Remove Brakes (Verify Standby – blue)

- Continue nominal operations.

64

MSS: SSRMS: CW Summ Robotics
Caution & Warning Summary
'**R3R - SSRMS LEE Uncommanded Latch Release**' annunciated.

MSS: SSRMS: Tip LEE
SSRMS Tip LEE
'Latch' Latch – blue

MSS: SSRMS: CW Summ Robotics
Caution & Warning Summary
Both '**R3P - SSRMS LEE Uncommanded Payload Release**' and '**R3Q - SSRMS LEE Uncommanded Derigidize**' received.

'**R3P - SSRMS LEE Uncommanded Payload Release**' and '**R3N - SSRMS LEE Snare Brk Slip**' received.

'**R3P - SSRMS LEE Uncommanded Payload Release**' received.

'**R3Q - SSRMS LEE Uncommanded Derigidize**' and '**R3N - SSRMS LEE Rigidize Brk Slip**' received.

None of the above.

65 GF Secured. Snares may no longer be rigidized to PDGF. Latches maintain rigidization.

66 Mechanical failure.

67 Mechanical failure.

68
- Additional troubleshooting required.

69 Loadcell failure.

⑫
This step is performed by the ground.

⑬
Cycling safing is required to enable Uncommanded derigidization detection in the software.
Reloading the loaded payload file is required to set the correct FOR in SACS for failed retract Microswitch scenarios.
If the brake override was issued in this block, it will be required for all subsequent brake release operations until the payload is released.

MSS

7.510 SSRMS LEE CAPTURE FAILURE

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64

70 Switch SSRMS Strings

- Perform {8.107 SSRMS SWITCH TO REDUNDANT(PRIME) STRING}, all (SODF:RBT GEN: CORRECTIVE), then:

MSS: SSRMS: SSRMS Safing

SSRMS Safing

- **cmd** Remove

(DCP)

- BRAKES SSRMS → OFF

MSS: SSRMS

SSRMS

If ‘**Override or limp or cancel**’ prompt displayed and Brakes Not OFF

MSS: SSRMS: Brake Override

Brakes Override

- **cmd** Remove Brakes (Verify Standby – blue)

71 Uncalibrated Release ⑧

MSS: SSRMS: Limp

SSRMS Limp

- **cmd** All Limp (Verify Limp – blue)

MSS: SSRMS: Tip LEE: SSRMS Tip LEE

If ‘Latch’ Unlatch – gray

- **cmd** ‘Latch’ Unlatch ► Hard Stops ► Slow, Hard Stops
- **cmd** Confirm
- TRIGGER → press (hold until ‘Latch’ Brakes – On) (65 s max)
- Verify ‘Latch’ Unlatch – blue

If Carriage Derigidize – gray

- **cmd** ‘Carriage’ Extend ► Hard Stops ► Slow, Hard Stops
- **cmd** Confirm
- TRIGGER → press (hold until Derigidize – blue) (20 s max)
- Verify Derigidize – blue
- **cmd** Terminate

If ‘Snare’ Open – gray

- **cmd** ‘Snare’ Open ► Hard Stops ► Slow, Hard Stops
- **cmd** Confirm
- TRIGGER → press (hold until ‘Snare’ Brakes – On) (12 s max)
- Verify ‘Snare’ Open – blue

If ‘Carriage’ Extend – gray

- **cmd** ‘Carriage’ Extend ► Hard Stops ► Slow, Hard Stops
- **cmd** Confirm
- TRIGGER → press (hold until ‘Carriage’ Brakes – On) (90 s max)
- Verify Extend – blue

MSS: SSRMS: Limp: SSRMS Limp

- **cmd** None Limp (Verify Standby – blue)

MSS: SSRMS: SSRMS

- Enter Mode – Manual (Verify Manual – blue)

MSS: SSRMS: Manual: Joint Lock

Joint Lock

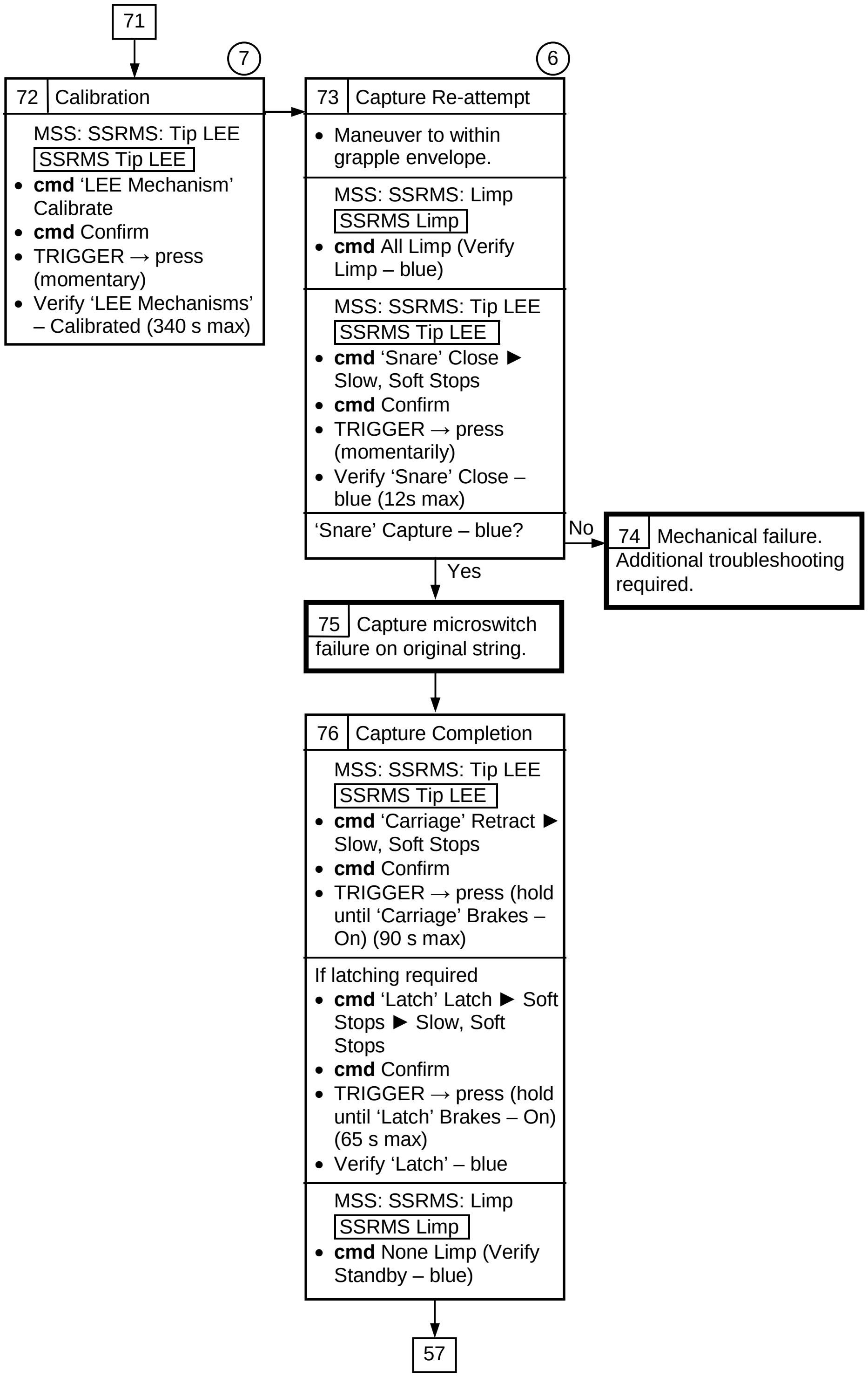
- Lock the joint that was originally locked during the capture.
- Back off until clear of GF pin.

72

⑧ When extending until derigidize – blue, the trigger must be released once the derigidize indication turns blue.

7.510 SSRMS LEE CAPTURE FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 17 of 18 pages



71

72 Calibration ⑦

MSS: SSRMS: Tip LEE

SSRMS Tip LEE

- **cmd** ‘LEE Mechanism’ Calibrate
- **cmd** Confirm
- TRIGGER → press (momentary)
- Verify ‘LEE Mechanisms’ – Calibrated (340 s max)

73 Capture Re-attempt ⑥

- Maneuver to within grapple envelope.

MSS: SSRMS: Limp

SSRMS Limp

- **cmd** All Limp (Verify Limp – blue)

MSS: SSRMS: Tip LEE

SSRMS Tip LEE

- **cmd** ‘Snare’ Close ► Slow, Soft Stops
- **cmd** Confirm
- TRIGGER → press (momentarily)
- Verify ‘Snare’ Close – blue (12s max)

‘Snare’ Capture – blue?

No

74 Mechanical failure. Additional troubleshooting required.

Yes

75 Capture microswitch failure on original string.

76 Capture Completion

MSS: SSRMS: Tip LEE

SSRMS Tip LEE

- **cmd** ‘Carriage’ Retract ► Slow, Soft Stops
- **cmd** Confirm
- TRIGGER → press (hold until ‘Carriage’ Brakes – On) (90 s max)

If latching required

- **cmd** ‘Latch’ Latch ► Soft Stops ► Slow, Soft Stops
- **cmd** Confirm
- TRIGGER → press (hold until ‘Latch’ Brakes – On) (65 s max)
- Verify ‘Latch’ – blue

MSS: SSRMS: Limp

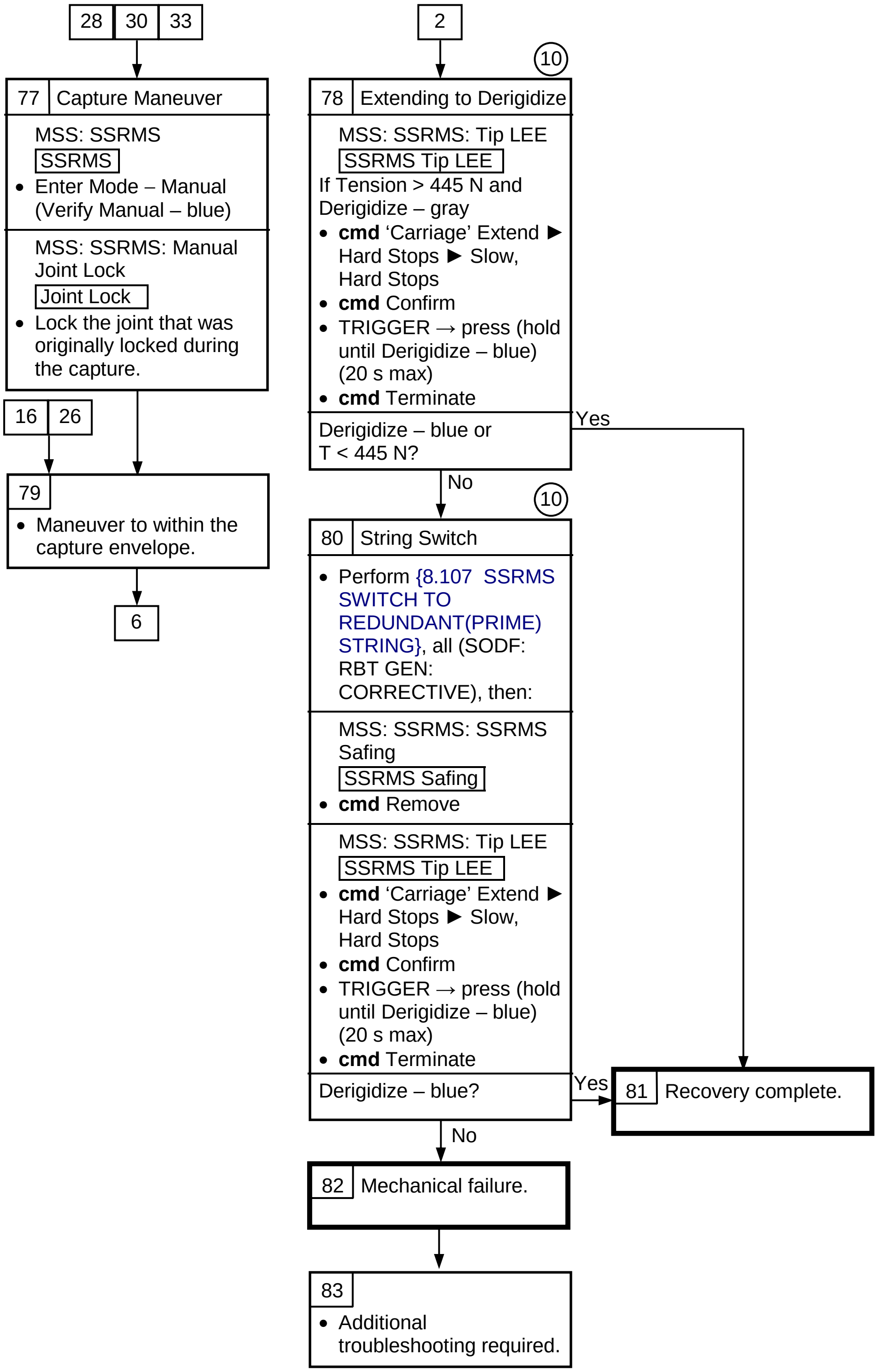
SSRMS Limp

- **cmd** None Limp (Verify Standby – blue)

57

⑥ A locked joint will not be limped if SSRMS is in Manual mode when “All Limp” command is issued (SCR 29314).

⑦ A Calibrate command may be aborted by a ‘**SSRMS LEE LEU Mtr Velocity Runaway**’ Robotics Advisory message and the MSS safed if one of the three LEE mechanisms was initially located at the hardstop position. If safing occurs, cancel safing and command Calibrate again (SCR 20379).



77 Capture Maneuver

MSS: SSRMS
SSRMS
- Enter Mode – Manual (Verify Manual – blue)

MSS: SSRMS: Manual Joint Lock
Joint Lock
- Lock the joint that was originally locked during the capture.

78 Extending to Derigidize ⑩

MSS: SSRMS: Tip LEE
SSRMS Tip LEE
If Tension > 445 N and Derigidize – gray
- **cmd** ‘Carriage’ Extend ► Hard Stops ► Slow, Hard Stops
- **cmd** Confirm
- TRIGGER → press (hold until Derigidize – blue) (20 s max)
- **cmd** Terminate

Derigidize – blue or T < 445 N?

79
- Maneuver to within the capture envelope.

80 String Switch ⑩
- Perform {8.107 SSRMS SWITCH TO REDUNDANT(PRIME) STRING}, all (SODF: RBT GEN: CORRECTIVE), then:

MSS: SSRMS: SSRMS Safing
SSRMS Safing
- **cmd** Remove

MSS: SSRMS: Tip LEE
SSRMS Tip LEE
- **cmd** ‘Carriage’ Extend ► Hard Stops ► Slow, Hard Stops
- **cmd** Confirm
- TRIGGER → press (hold until Derigidize – blue) (20 s max)
- **cmd** Terminate

Derigidize – blue?

81 Recovery complete.

82 Mechanical failure.

83
- Additional troubleshooting required.

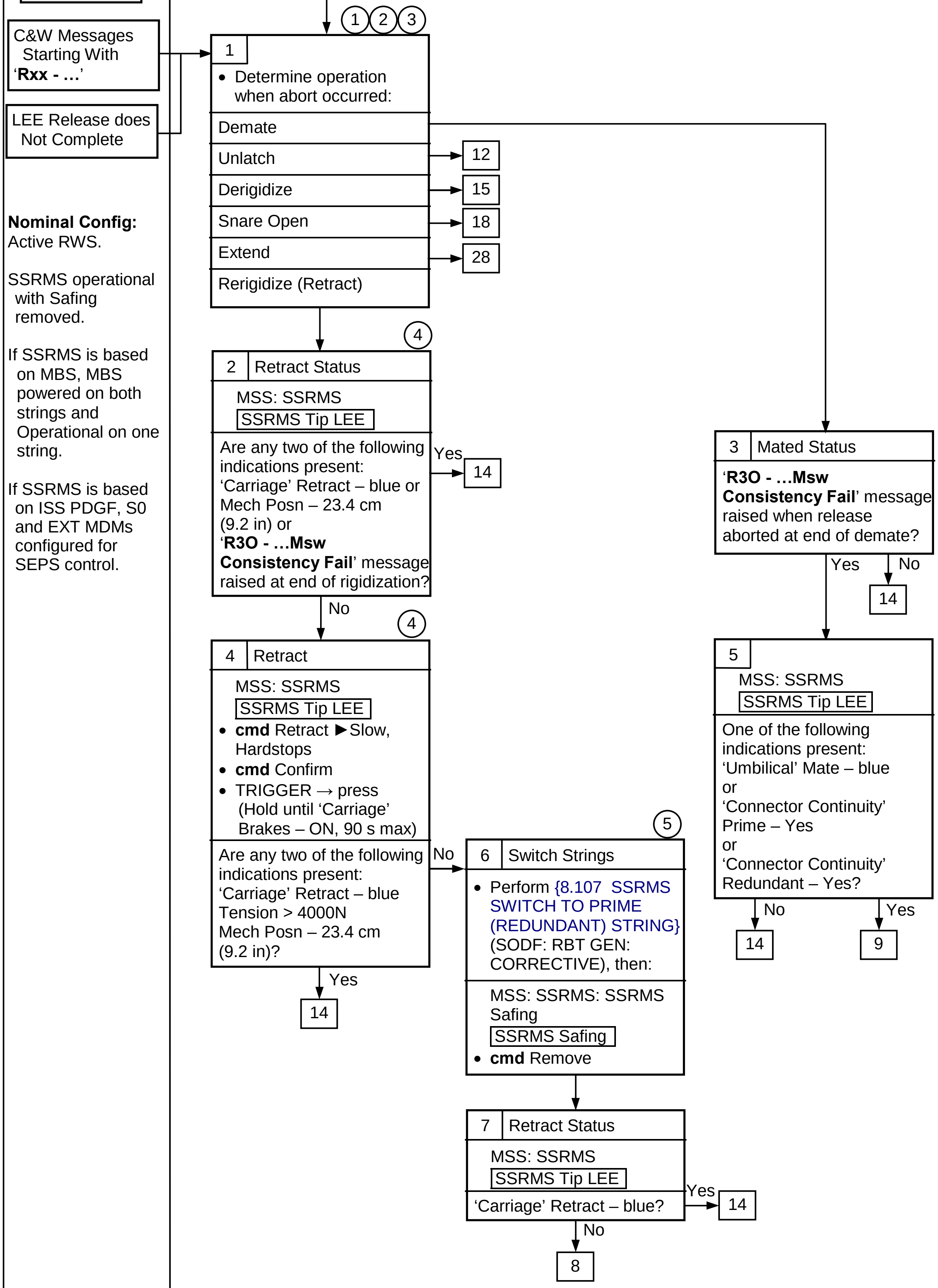
⑩
When extending until Derigidize - blue, the trigger must be released once the derigidize indication turns blue. Fully extending the carriage while the SSRMS is braked may cause hardware damage.

C&W
ROBOTICS

7.511 SSRMS LEE RELEASE FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 1 of 5 pages

{7.001 MSS FAILURE RESPONSE AND RECOVERY}, block 118 (SODF: RBT GEN: MALFUNCTION)



C&W Messages Starting With '**Rxx - …**'

LEE Release does Not Complete

①②③

1
- Determine operation when abort occurred:

Demate	3
Unlatch	12
Derigidize	15
Snare Open	18
Extend	28
Rerigidize (Retract)	2

2 Retract Status ④

MSS: SSRMS
SSRMS Tip LEE

Are any two of the following indications present:
'Carriage' Retract – blue or
Mech Posn – 23.4 cm (9.2 in) or
'**R3O - …Msw Consistency Fail**' message raised at end of rigidization?

Yes → 14
No → 4

3 Mated Status

'**R3O - …Msw Consistency Fail**' message raised when release aborted at end of demate?

Yes → 5
No → 14

4 Retract ④

MSS: SSRMS
SSRMS Tip LEE
- **cmd** Retract ►Slow, Hardstops
- **cmd** Confirm
- TRIGGER → press (Hold until 'Carriage' Brakes – ON, 90 s max)

Are any two of the following indications present:
'Carriage' Retract – blue
Tension > 4000N
Mech Posn – 23.4 cm (9.2 in)?

Yes → 14
No → 6

5

MSS: SSRMS
SSRMS Tip LEE

One of the following indications present:
'Umbilical' Mate – blue
or
'Connector Continuity' Prime – Yes
or
'Connector Continuity' Redundant – Yes?

No → 14
Yes → 9

6 Switch Strings ⑤
- Perform {8.107 SSRMS SWITCH TO PRIME (REDUNDANT) STRING} (SODF: RBT GEN: CORRECTIVE), then:

MSS: SSRMS: SSRMS Safing
SSRMS Safing
- **cmd** Remove

7 Retract Status

MSS: SSRMS
SSRMS Tip LEE

'Carriage' Retract – blue?

Yes → 14
No → 8

Nominal Config:
Active RWS.

SSRMS operational with Safing removed.

If SSRMS is based on MBS, MBS powered on both strings and Operational on one string.

If SSRMS is based on ISS PDGF, S0 and EXT MDMs configured for SEPS control.

① Unless otherwise noted, all displays are on PCS.

② This table can be used by Ground for reference on LEE mechanism positions.

MECH	POSN
Retract	23.4cm
Demate	12.5cm
Unlatch	0
Derig	20.6cm
Open	0
Extend	-0.076cm

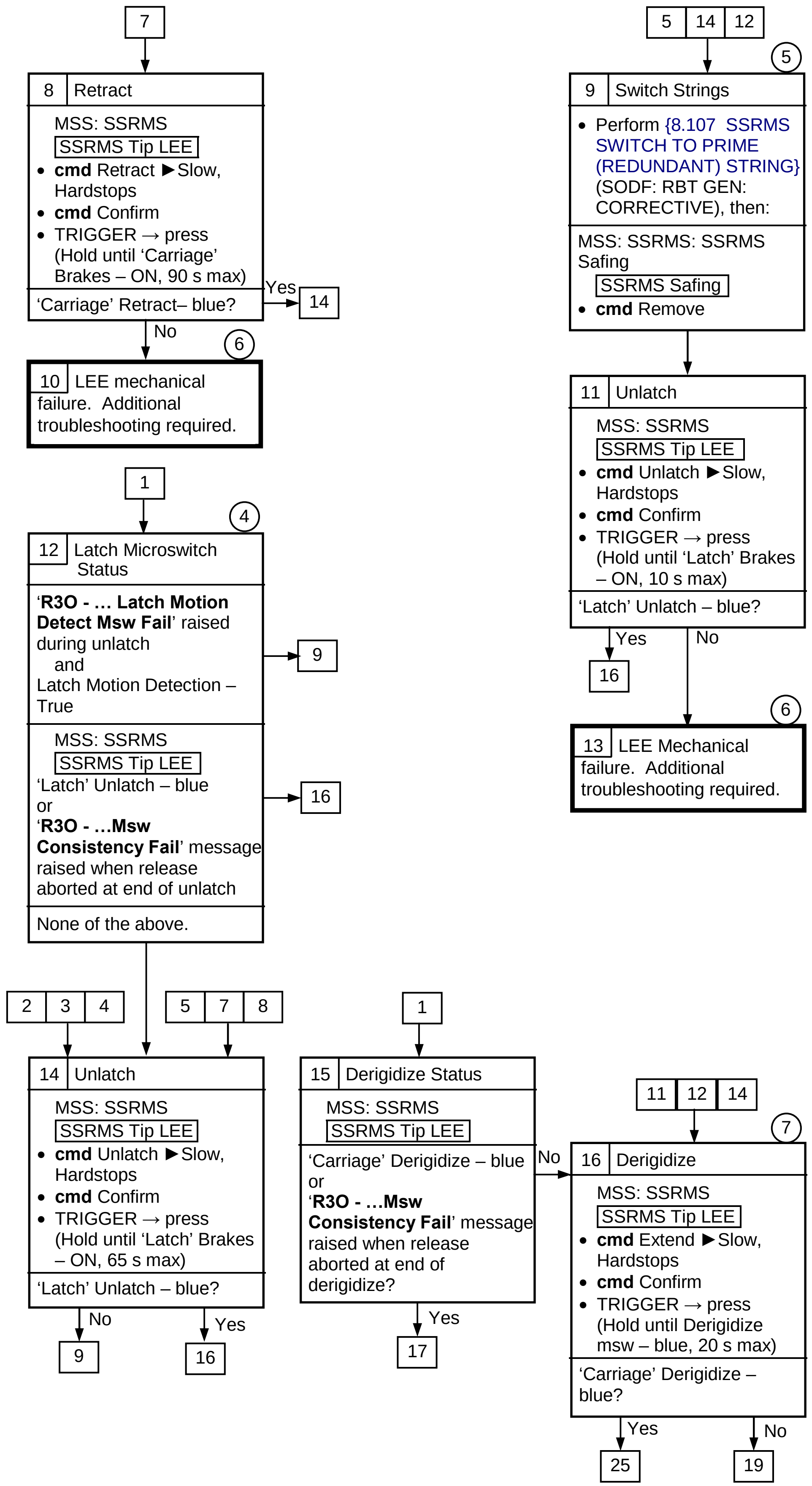
③ Throughout this procedure, MSS commands should not be issues while the trigger is hot. To change the configuration of the system, Safe to exit LEE operations (SCR 14662).

④ This block contains some ground only telemetry verification.

⑤ Do not switch strings if previously switched within this recovery procedure, or switched within a previously run recovery procedure.

7.511 SSRMS LEE RELEASE FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 2 of 5 pages



8 Retract

MSS: SSRMS

SSRMS Tip LEE

- **cmd** Retract ►Slow, Hardstops
- **cmd** Confirm
- TRIGGER → press (Hold until ‘Carriage’ Brakes – ON, 90 s max)

‘Carriage’ Retract– blue?

10 LEE mechanical failure. Additional troubleshooting required.

12 Latch Microswitch Status

‘**R3O - … Latch Motion Detect Msw Fail**’ raised during unlatch and Latch Motion Detection – True

MSS: SSRMS

SSRMS Tip LEE

‘Latch’ Unlatch – blue or ‘**R3O - …Msw Consistency Fail**’ message raised when release aborted at end of unlatch

None of the above.

9 Switch Strings

- Perform {8.107 SSRMS SWITCH TO PRIME (REDUNDANT) STRING} (SODF: RBT GEN: CORRECTIVE), then:

MSS: SSRMS: SSRMS Safing

SSRMS Safing

- **cmd** Remove

11 Unlatch

MSS: SSRMS

SSRMS Tip LEE

- **cmd** Unlatch ►Slow, Hardstops
- **cmd** Confirm
- TRIGGER → press (Hold until ‘Latch’ Brakes – ON, 10 s max)

‘Latch’ Unlatch – blue?

13 LEE Mechanical failure. Additional troubleshooting required.

14 Unlatch

MSS: SSRMS

SSRMS Tip LEE

- **cmd** Unlatch ►Slow, Hardstops
- **cmd** Confirm
- TRIGGER → press (Hold until ‘Latch’ Brakes – ON, 65 s max)

‘Latch’ Unlatch – blue?

15 Derigidize Status

MSS: SSRMS

SSRMS Tip LEE

‘Carriage’ Derigidize – blue or ‘**R3O - …Msw Consistency Fail**’ message raised when release aborted at end of derigidize?

16 Derigidize

MSS: SSRMS

SSRMS Tip LEE

- **cmd** Extend ►Slow, Hardstops
- **cmd** Confirm
- TRIGGER → press (Hold until Derigidize msw – blue, 20 s max)

‘Carriage’ Derigidize – blue?

④ This block contains some Ground only telemetry verification.

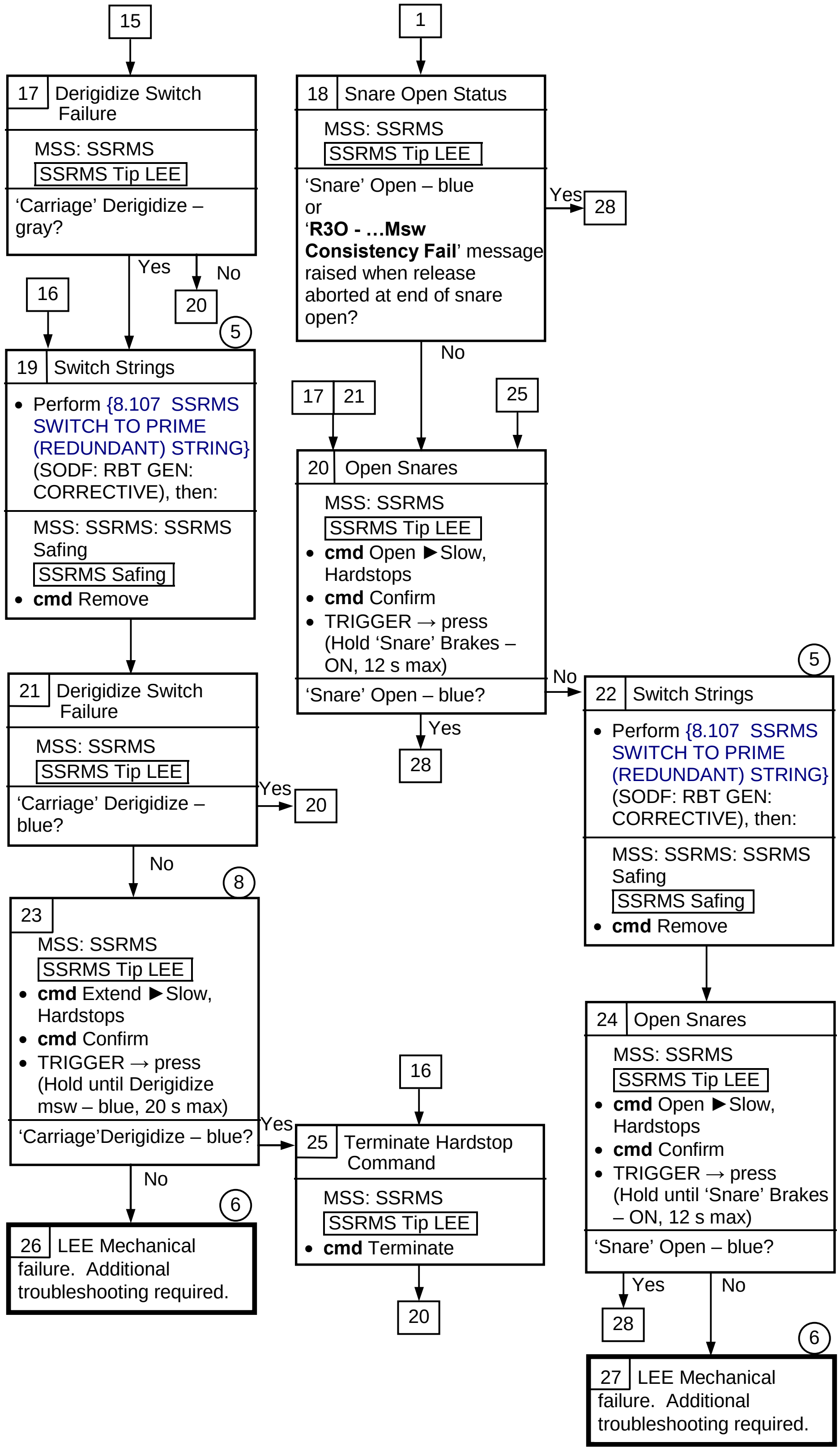
⑤ Do not switch strings if previously switched within this recovery procedure, or switched within a previously run recovery procedure.

⑥ EVA workaround to release the Grapple Fixture pin may be possible.

⑦ When extending until Derigidize – blue, the trigger must be released once the Derigidize indication turns blue.

7.511 SSRMS LEE RELEASE FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 3 of 5 pages



17 Derigidize Switch Failure

MSS: SSRMS
SSRMS Tip LEE

‘Carriage’ Derigidize – gray?

18 Snare Open Status

MSS: SSRMS
SSRMS Tip LEE

‘Snare’ Open – blue or ‘**R3O - …Msw Consistency Fail**’ message raised when release aborted at end of snare open?

19 Switch Strings

- Perform {8.107 SSRMS SWITCH TO PRIME (REDUNDANT) STRING} (SODF: RBT GEN: CORRECTIVE), then:

MSS: SSRMS: SSRMS Safing
SSRMS Safing

- **cmd** Remove

20 Open Snares

MSS: SSRMS
SSRMS Tip LEE

- **cmd** Open ▶Slow, Hardstops
- **cmd** Confirm
- TRIGGER → press (Hold ‘Snare’ Brakes – ON, 12 s max)

‘Snare’ Open – blue?

21 Derigidize Switch Failure

MSS: SSRMS
SSRMS Tip LEE

‘Carriage’ Derigidize – blue?

22 Switch Strings

- Perform {8.107 SSRMS SWITCH TO PRIME (REDUNDANT) STRING} (SODF: RBT GEN: CORRECTIVE), then:

MSS: SSRMS: SSRMS Safing
SSRMS Safing

- **cmd** Remove

23

MSS: SSRMS
SSRMS Tip LEE

- **cmd** Extend ▶Slow, Hardstops
- **cmd** Confirm
- TRIGGER → press (Hold until Derigidize msw – blue, 20 s max)

‘Carriage’Derigidize – blue?

24 Open Snares

MSS: SSRMS
SSRMS Tip LEE

- **cmd** Open ▶Slow, Hardstops
- **cmd** Confirm
- TRIGGER → press (Hold until ‘Snare’ Brakes – ON, 12 s max)

‘Snare’ Open – blue?

25 Terminate Hardstop Command

MSS: SSRMS
SSRMS Tip LEE

- **cmd** Terminate

26 LEE Mechanical failure. Additional troubleshooting required.

27 LEE Mechanical failure. Additional troubleshooting required.

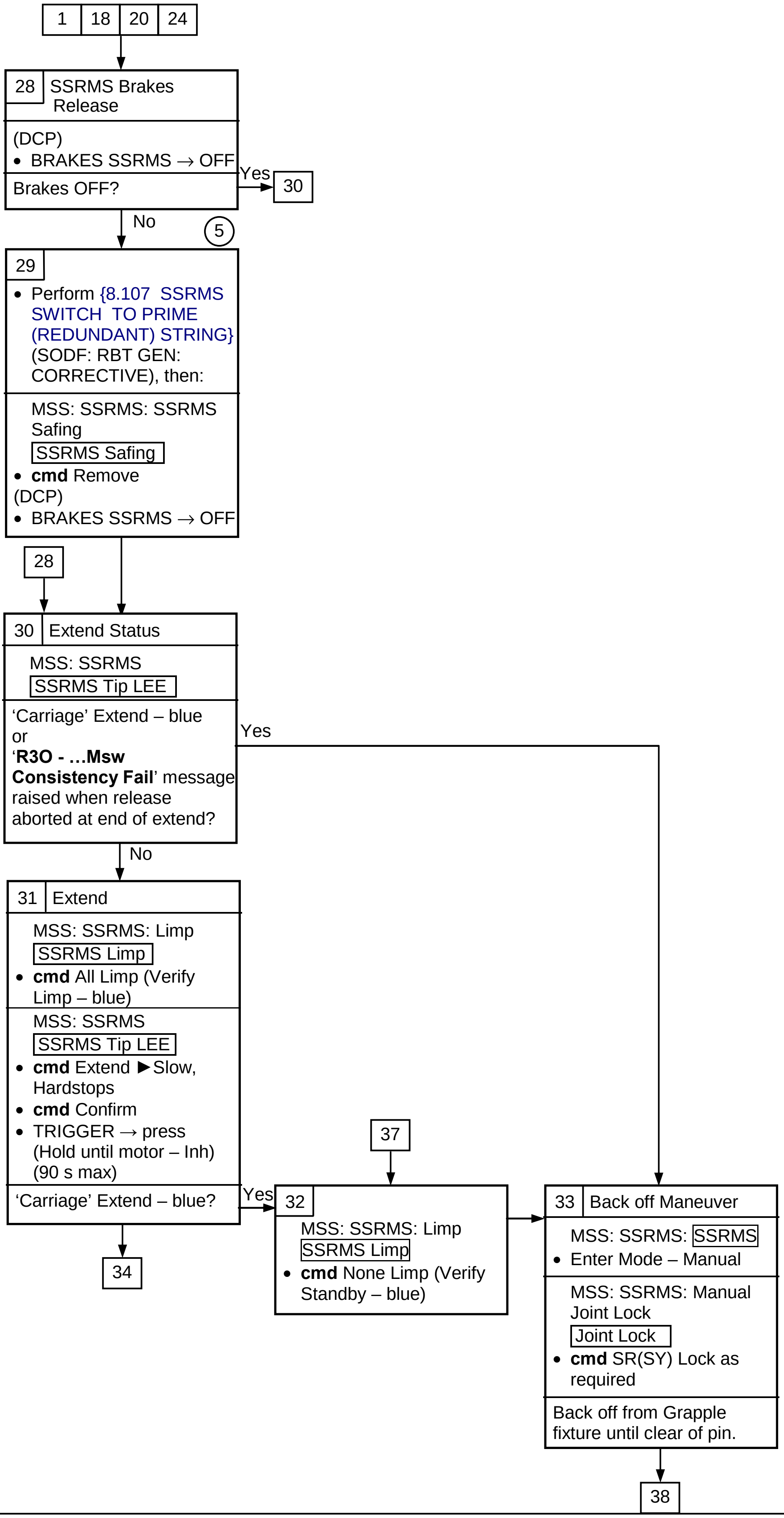
⑤ Do not switch strings if previously switched within this recovery procedure, or switched within a previously run recovery procedure.

⑥ EVA workaround to release the Grapple Fixture pin may be possible.

⑧ When extending until Derigidize – blue, the trigger must be released once the derigidize indication turns blue. Fully extending the Carriage while the SSRMS is braking may cause hardware damage.

7.511 SSRMS LEE RELEASE FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 4 of 5 pages



28 SSRMS Brakes Release

(DCP)

- BRAKES SSRMS → OFF

Brakes OFF?

29

- Perform {8.107 SSRMS SWITCH TO PRIME (REDUNDANT) STRING} (SODF: RBT GEN: CORRECTIVE), then:

MSS: SSRMS: SSRMS Safing

SSRMS Safing

- **cmd** Remove

(DCP)

- BRAKES SSRMS → OFF

30 Extend Status

MSS: SSRMS

SSRMS Tip LEE

‘Carriage’ Extend – blue or ‘**R3O - …Msw Consistency Fail**’ message raised when release aborted at end of extend?

31 Extend

MSS: SSRMS: Limp

SSRMS Limp

- **cmd** All Limp (Verify Limp – blue)

MSS: SSRMS

SSRMS Tip LEE

- **cmd** Extend ►Slow, Hardstops
- **cmd** Confirm
- TRIGGER → press (Hold until motor – Inh) (90 s max)

‘Carriage’ Extend – blue?

32

MSS: SSRMS: Limp

SSRMS Limp

- **cmd** None Limp (Verify Standby – blue)

33 Back off Maneuver

MSS: SSRMS: SSRMS

- Enter Mode – Manual

MSS: SSRMS: Manual Joint Lock

Joint Lock

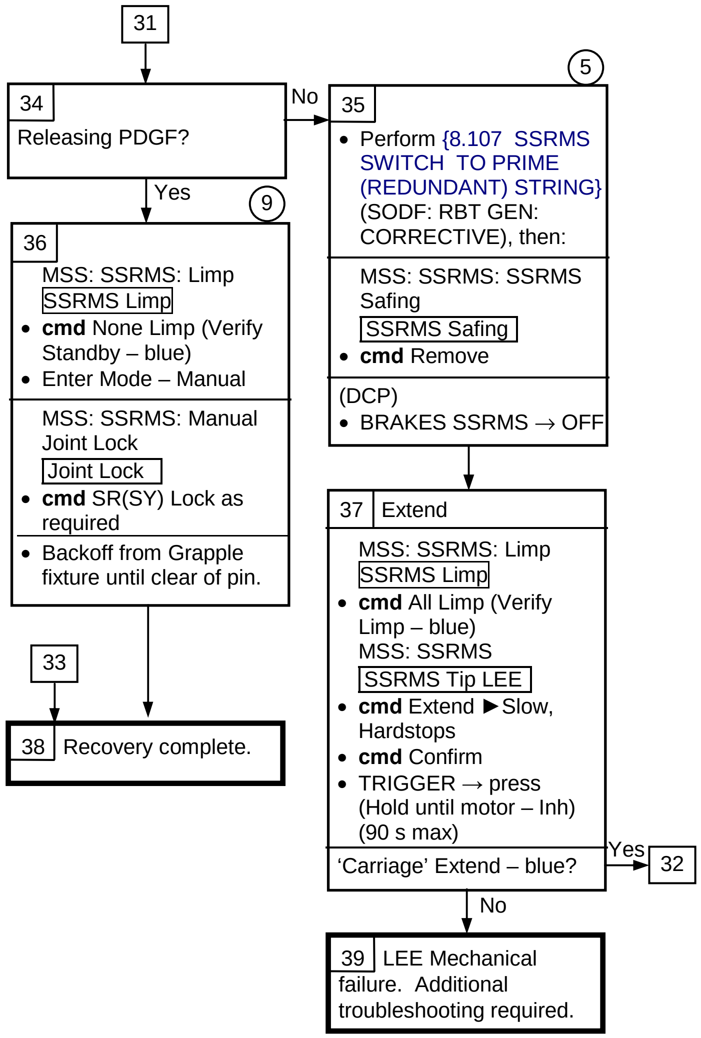
- **cmd** SR(SY) Lock as required

Back off from Grapple fixture until clear of pin.

⑤
Do not switch strings if previously switched within this recovery procedure, or switched within a previously run recovery procedure.

7.511 SSRMS LEE RELEASE FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 5 of 5 pages



⑤
Do not switch strings if previously switched within this recovery procedure, or switched within a previously run recovery procedure.

⑨
Release may be sticky.

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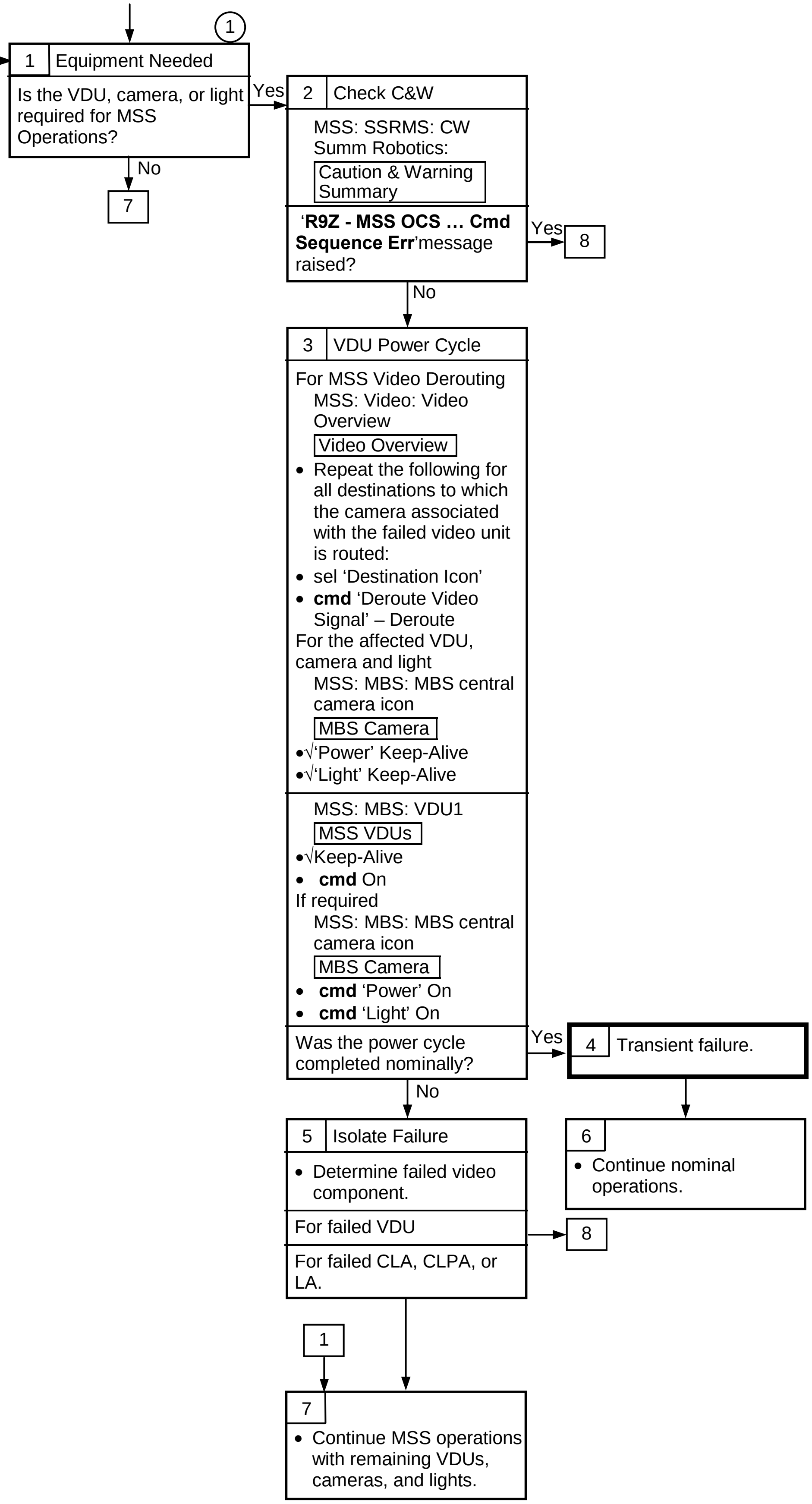
7.700 MSS VIDEO POWER ON COMMAND FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 1 of 2 pages

{7.001 MSS FAILURE RESPONSE AND RECOVERY}, block 133 (SODF: RBT GEN: MALFUNCTION)

Unsuccessful Power On of an MSS Video Unit



1 Equipment Needed ①

Is the VDU, camera, or light required for MSS Operations?

Yes → 2; No → 7

2 Check C&W

MSS: SSRMS: CW Summ Robotics:

Caution & Warning Summary

'**R9Z - MSS OCS … Cmd Sequence Err**'message raised?

Yes → 8; No → 3

3 VDU Power Cycle

For MSS Video Derouting

MSS: Video: Video Overview

Video Overview

- Repeat the following for all destinations to which the camera associated with the failed video unit is routed:
- sel 'Destination Icon'
- **cmd** 'Deroute Video Signal' – Deroute

For the affected VDU, camera and light

MSS: MBS: MBS central camera icon

MBS Camera

- √'Power' Keep-Alive
- √'Light' Keep-Alive

MSS: MBS: VDU1

MSS VDUs

- √Keep-Alive
- **cmd** On

If required

MSS: MBS: MBS central camera icon

MBS Camera

- **cmd** 'Power' On
- **cmd** 'Light' On

Was the power cycle completed nominally?

Yes → 4; No → 5

4 Transient failure.

6

- Continue nominal operations.

5 Isolate Failure

- Determine failed video component.

For failed VDU → 8

For failed CLA, CLPA, or LA. → 7

1 → 7

7

- Continue MSS operations with remaining VDUs, cameras, and lights.

Nominal Config:
RWS is Active.

Affected element is Operational.

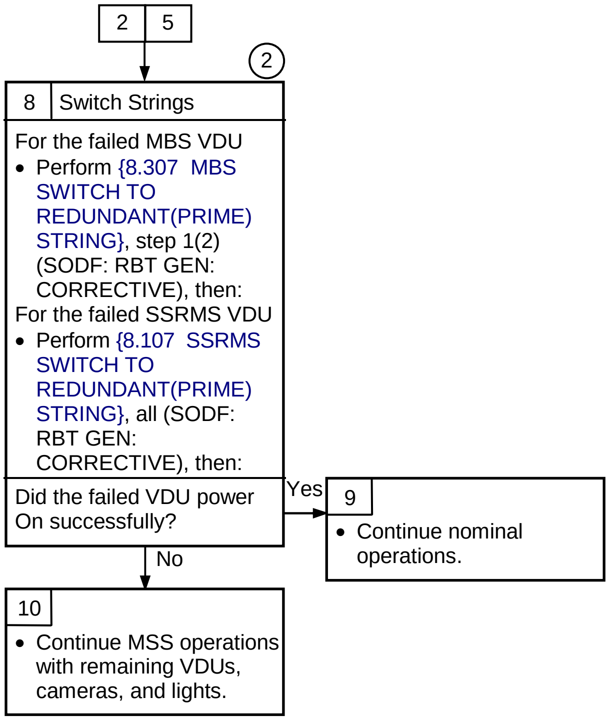
If SSRMS is based on MBS, MBS powered on both strings and Operational on one string.

S0(S1,P1) and EXT MDMs configured for SEPS control.

① Unless otherwise noted, all displays in this procedure are on PCS.

7.700 MSS VIDEO POWER ON COMMAND FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 2 of 2 pages



8 Switch Strings

For the failed MBS VDU
- Perform {8.307 MBS SWITCH TO REDUNDANT(PRIME) STRING}, step 1(2) (SODF: RBT GEN: CORRECTIVE), then:

For the failed SSRMS VDU
- Perform {8.107 SSRMS SWITCH TO REDUNDANT(PRIME) STRING}, all (SODF: RBT GEN: CORRECTIVE), then:

Did the failed VDU power On successfully?

9
- Continue nominal operations.

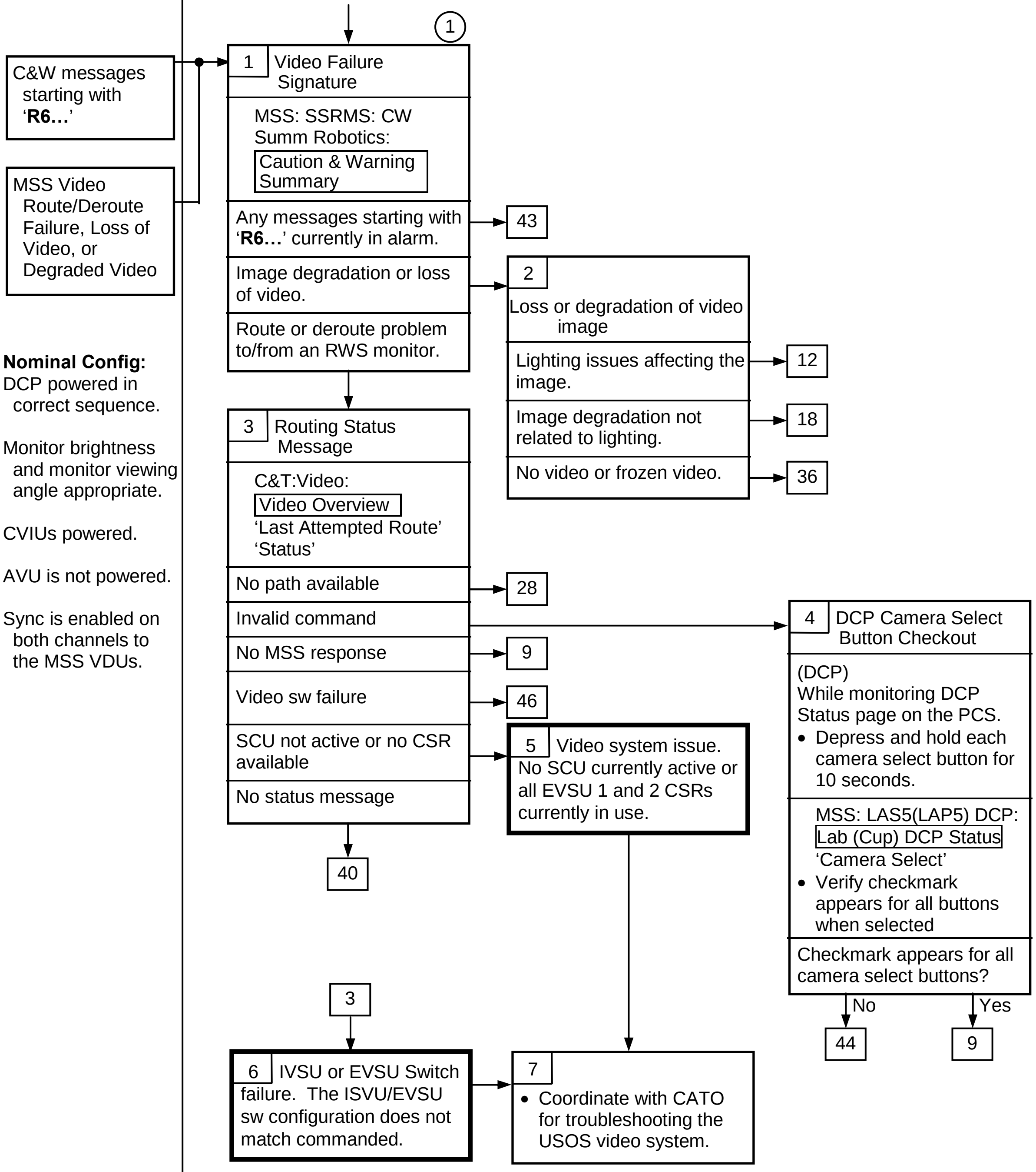
10
- Continue MSS operations with remaining VDUs, cameras, and lights.

② Per SCR 20130, for SSRMS VDUs, rebooting the SSRMS may clear the problem.

7.701 MSS VIDEO FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 1 of 8 pages

{7.001 MSS FAILURE RESPONSE AND RECOVERY}, block 135 (SODF: RBT GEN: MALFUNCTION)



C&W messages starting with '**R6…**'

MSS Video Route/Deroute Failure, Loss of Video, or Degraded Video

1 Video Failure Signature ①

MSS: SSRMS: CW Summ Robotics: Caution & Warning Summary

- Any messages starting with '**R6…**' currently in alarm. → 43
- Image degradation or loss of video. → 2
- Route or deroute problem to/from an RWS monitor. → 3

2 Loss or degradation of video image

- Lighting issues affecting the image. → 12
- Image degradation not related to lighting. → 18
- No video or frozen video. → 36

3 Routing Status Message

C&T:Video: Video Overview 'Last Attempted Route' 'Status'

- No path available → 28
- Invalid command → 4
- No MSS response → 9
- Video sw failure → 46
- SCU not active or no CSR available → 5
- No status message → 40

4 DCP Camera Select Button Checkout

(DCP) While monitoring DCP Status page on the PCS.
- Depress and hold each camera select button for 10 seconds.

MSS: LAS5(LAP5) DCP: Lab (Cup) DCP Status 'Camera Select'
- Verify checkmark appears for all buttons when selected

Checkmark appears for all camera select buttons?

No → 44

Yes → 9

5 Video system issue. No SCU currently active or all EVSU 1 and 2 CSRs currently in use. → 7

3 → 6

6 IVSU or EVSU Switch failure. The ISVU/EVSU sw configuration does not match commanded. → 7

7
- Coordinate with CATO for troubleshooting the USOS video system.

Nominal Config:
DCP powered in correct sequence.

Monitor brightness and monitor viewing angle appropriate.

CVIUs powered.

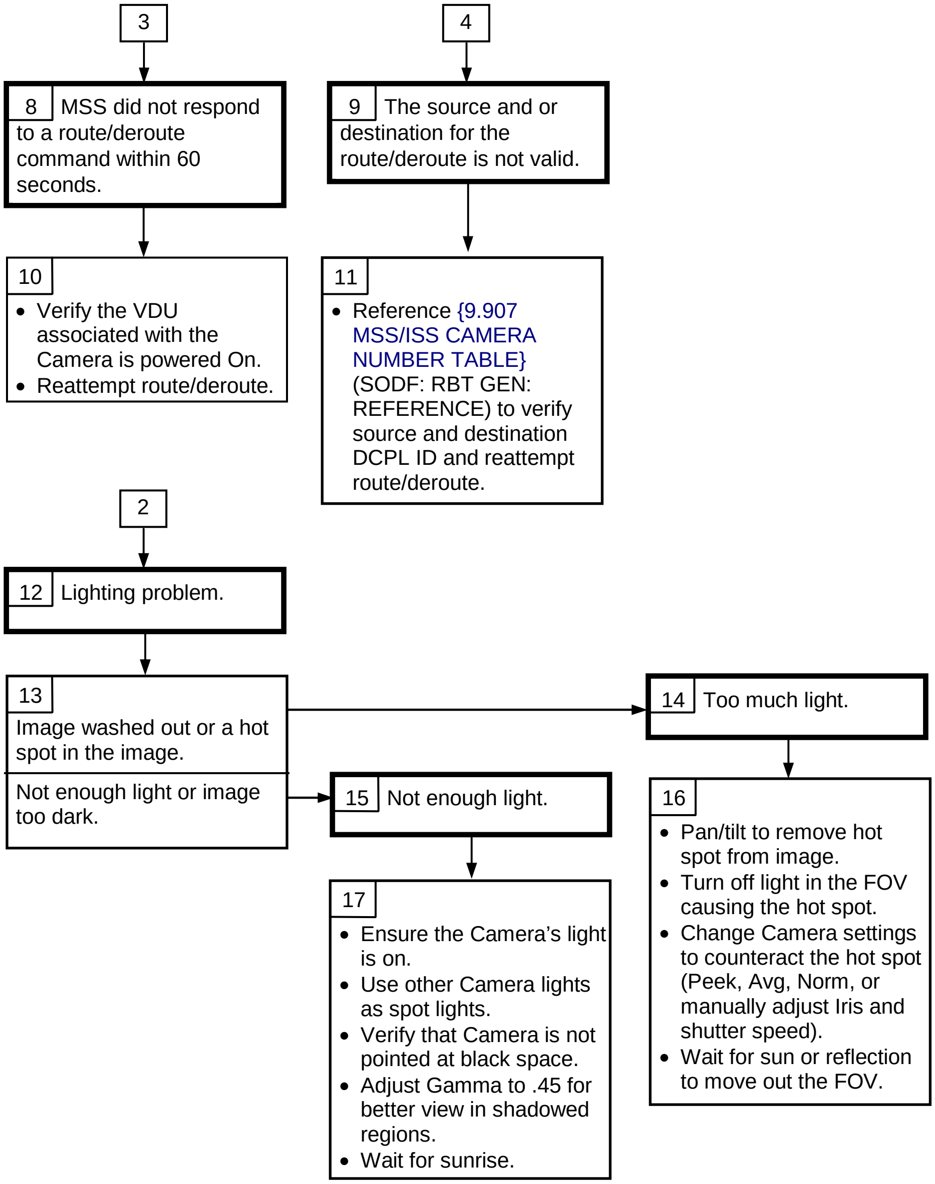
AVU is not powered.

Sync is enabled on both channels to the MSS VDUs.

① Unless otherwise indicated all displays in this procedure are on the PCS.

7.701 MSS VIDEO FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 2 of 8 pages



8 MSS did not respond to a route/deroute command within 60 seconds.

10
- Verify the VDU associated with the Camera is powered On.
- Reattempt route/deroute.

9 The source and or destination for the route/deroute is not valid.

11
- Reference {9.907 MSS/ISS CAMERA NUMBER TABLE} (SODF: RBT GEN: REFERENCE) to verify source and destination DCPL ID and reattempt route/deroute.

12 Lighting problem.

13

Image washed out or a hot spot in the image.

Not enough light or image too dark.

14 Too much light.

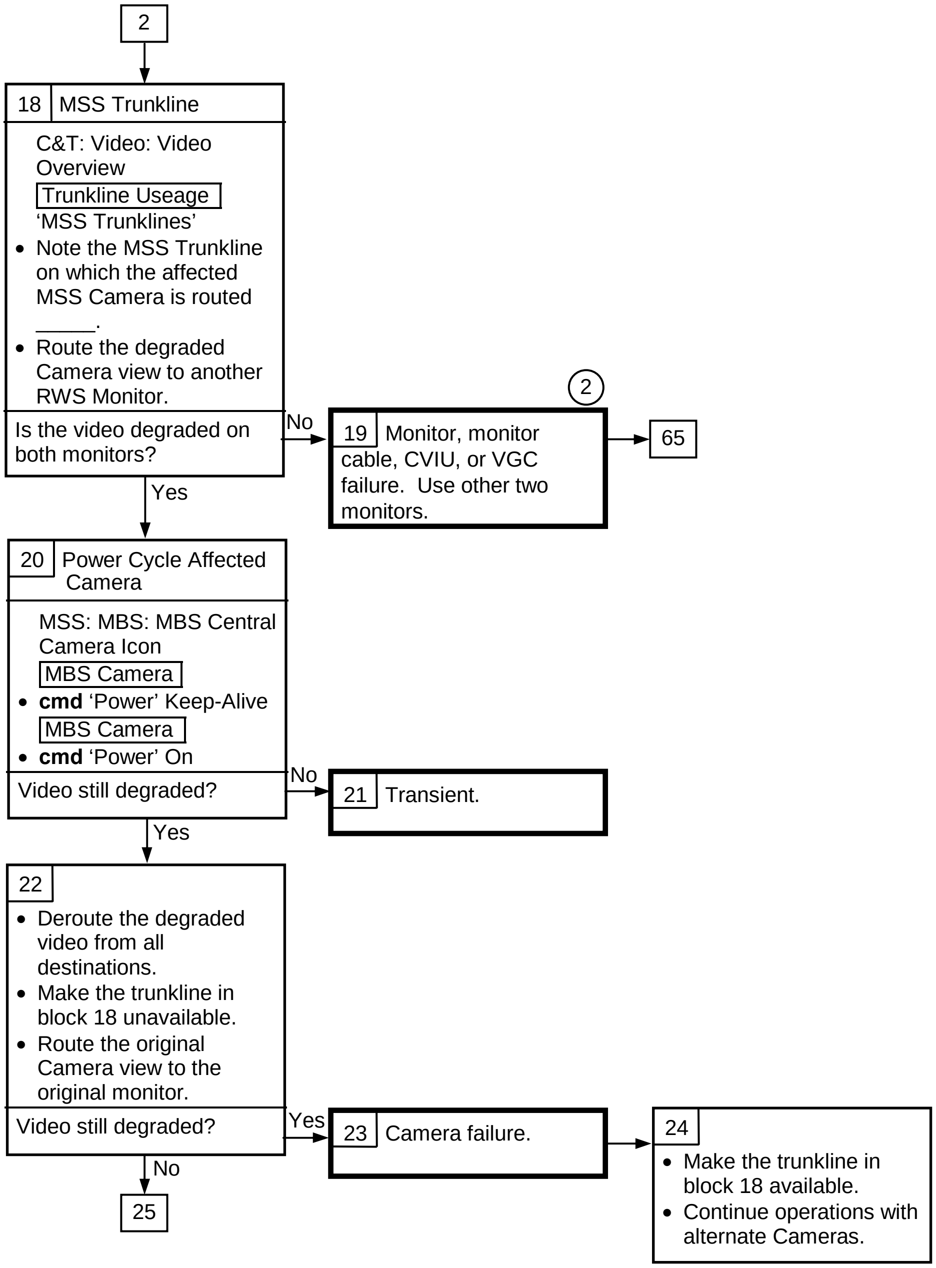
16
- Pan/tilt to remove hot spot from image.
- Turn off light in the FOV causing the hot spot.
- Change Camera settings to counteract the hot spot (Peek, Avg, Norm, or manually adjust Iris and shutter speed).
- Wait for sun or reflection to move out the FOV.

15 Not enough light.

17
- Ensure the Camera’s light is on.
- Use other Camera lights as spot lights.
- Verify that Camera is not pointed at black space.
- Adjust Gamma to .45 for better view in shadowed regions.
- Wait for sunrise.

7.701 MSS VIDEO FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 3 of 8 pages



18 MSS Trunkline

C&T: Video: Video Overview
Trunkline Useage
'MSS Trunklines'
- Note the MSS Trunkline on which the affected MSS Camera is routed _____.
- Route the degraded Camera view to another RWS Monitor.

Is the video degraded on both monitors?

19 Monitor, monitor cable, CVIU, or VGC failure. Use other two monitors. ②

20 Power Cycle Affected Camera

MSS: MBS: MBS Central Camera Icon
MBS Camera
- **cmd** 'Power' Keep-Alive

MBS Camera
- **cmd** 'Power' On

Video still degraded?

21 Transient.

22
- Deroute the degraded video from all destinations.
- Make the trunkline in block 18 unavailable.
- Route the original Camera view to the original monitor.

Video still degraded?

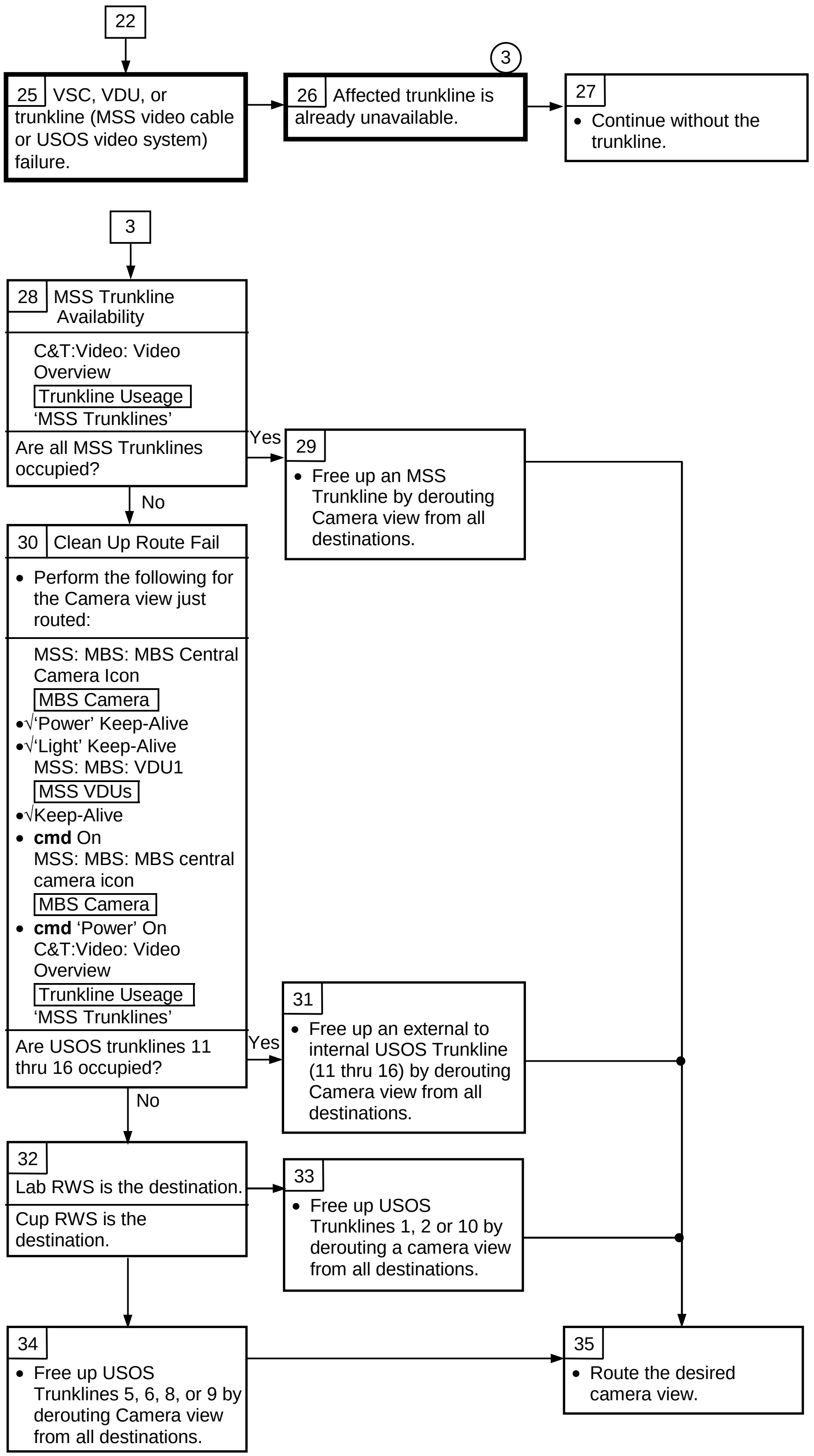
23 Camera failure.

24
- Make the trunkline in block 18 available.
- Continue operations with alternate Cameras.

② Power cycling the monitor or RWS may recover the monitor or VGC failure.

7.701 MSS VIDEO FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 4 of 8 pages



25 VSC, VDU, or trunkline (MSS video cable or USOS video system) failure.

26 Affected trunkline is already unavailable.

27
- Continue without the trunkline.

28 MSS Trunkline Availability

C&T:Video: Video Overview
Trunkline Useage
‘MSS Trunklines’

Are all MSS Trunklines occupied?

29
- Free up an MSS Trunkline by derouting Camera view from all destinations.

30 Clean Up Route Fail
- Perform the following for the Camera view just routed:

MSS: MBS: MBS Central Camera Icon
MBS Camera
•√‘Power’ Keep-Alive
•√‘Light’ Keep-Alive
MSS: MBS: VDU1
MSS VDUs
•√Keep-Alive
- **cmd** On
MSS: MBS: MBS central camera icon
MBS Camera
- **cmd** ‘Power’ On
C&T:Video: Video Overview
Trunkline Useage
‘MSS Trunklines’

Are USOS trunklines 11 thru 16 occupied?

31
- Free up an external to internal USOS Trunkline (11 thru 16) by derouting Camera view from all destinations.

32
Lab RWS is the destination.

Cup RWS is the destination.

33
- Free up USOS Trunklines 1, 2 or 10 by derouting a camera view from all destinations.

34
- Free up USOS Trunklines 5, 6, 8, or 9 by derouting Camera view from all destinations.

35
- Route the desired camera view.

③ Power the affected VDU to Keep-Alive may recover the trunkline for upstrream cameras.

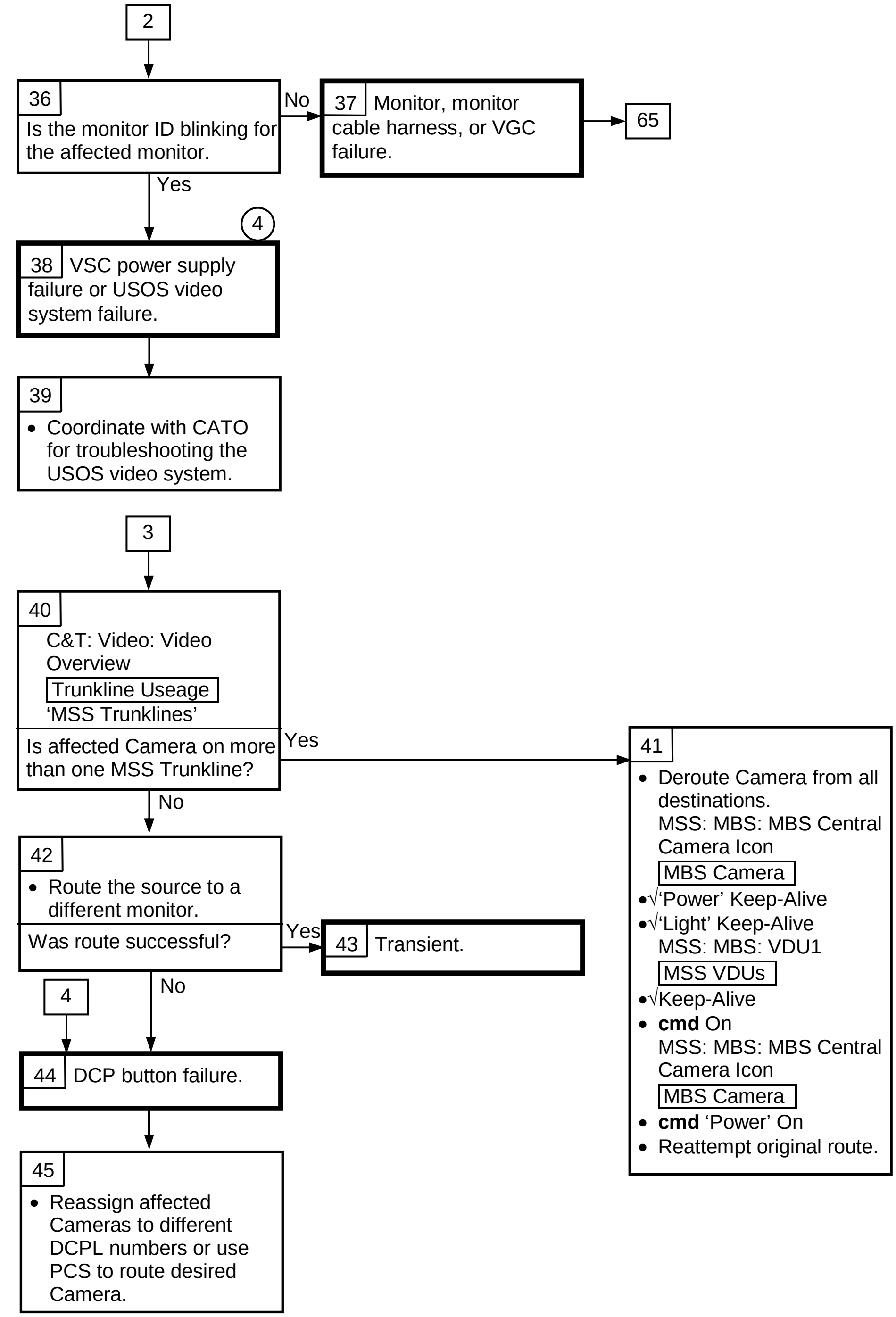
7.701 MSS VIDEO FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 5 of 8 pages

Table 1.

Base = Lab DGF				Base = MBS PDGF 1 or 2				Base = MBS PDGF 3 or 4			
Camera	MSS T/L	→	EVSU	Camera	MSS T/L	→	EVSU	Camera	MSS T/L	→	EVSU
SSRMS Cameras	1	→	EVSU 3	SSRMS Cameras	4	→	EVSU 1	SSRMS Cameras	5	→	EVSU 1
	2	→	EVSU 2		6	→	EVSU 2		7	→	EVSU 2
	3	→	EVSU 1		9	→	EVSU 3		8	→	EVSU 3
MBS Camera	5	→	EVSU 1	MBS Camera	5	→	EVSU 1	MBS Camera	9	→	EVSU 3

④ VSC failure may affect multiple MSS Trunklines.



2

36 Is the monitor ID blinking for the affected monitor?

No → 37 Monitor, monitor cable harness, or VGC failure. → 65

Yes ↓ ④

38 VSC power supply failure or USOS video system failure.

39
- Coordinate with CATO for troubleshooting the USOS video system.

3

40
C&T: Video: Video Overview
Trunkline Useage
'MSS Trunklines'

Is affected Camera on more than one MSS Trunkline?

Yes → 41
- Deroute Camera from all destinations.
MSS: MBS: MBS Central Camera Icon
MBS Camera
- √'Power' Keep-Alive
- √'Light' Keep-Alive
MSS: MBS: VDU1
MSS VDUs
- √Keep-Alive
- **cmd** On
MSS: MBS: MBS Central Camera Icon
MBS Camera
- **cmd** 'Power' On
- Reattempt original route.

No ↓

42
- Route the source to a different monitor.

Was route successful?

Yes → 43 Transient.

No ↓ 4

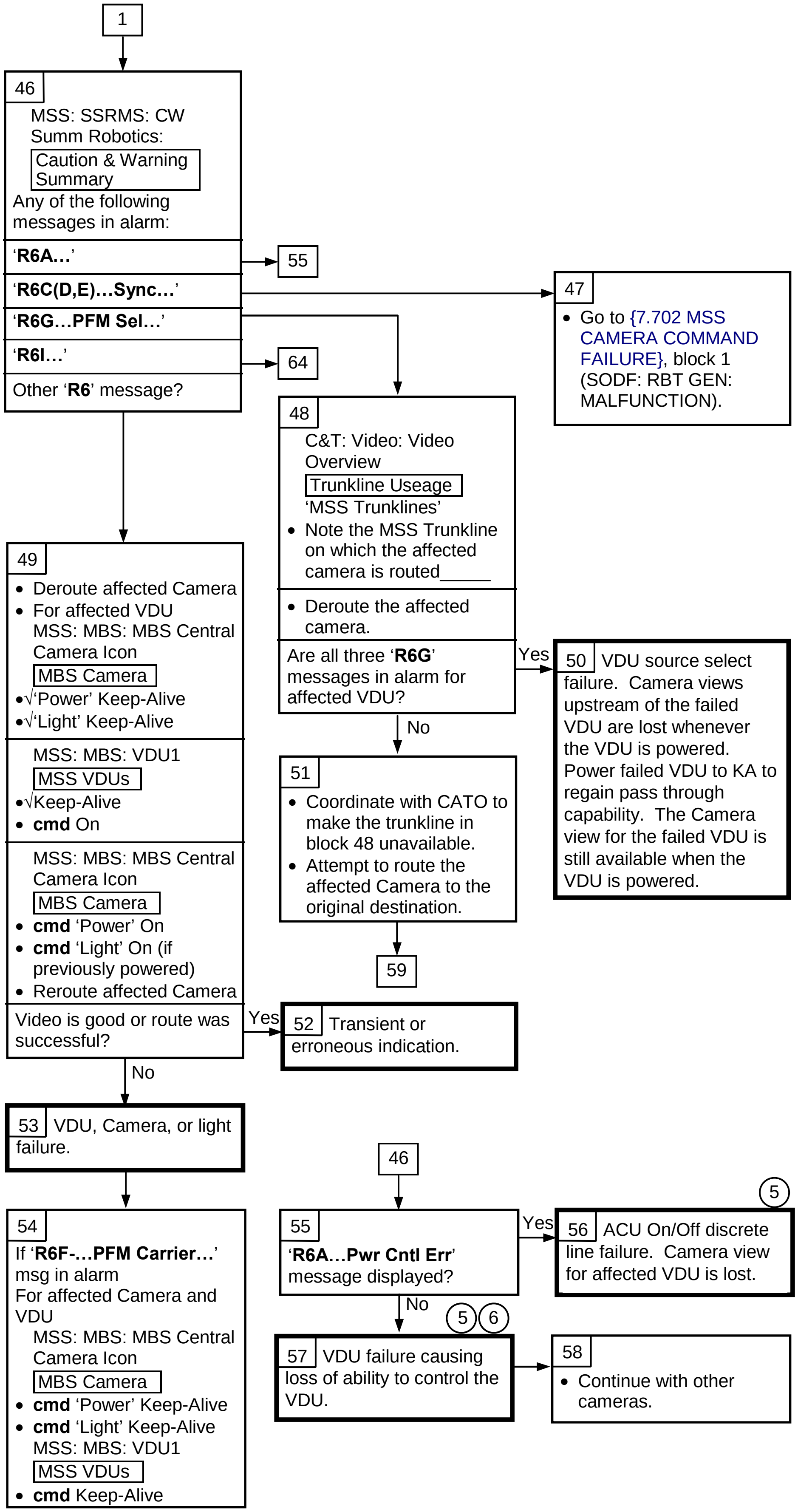
44 DCP button failure.

45
- Reassign affected Cameras to different DCPL numbers or use PCS to route desired Camera.

7.701 MSS VIDEO FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 6 of 8 pages

9



1

46 MSS: SSRMS: CW
Summ Robotics:
Caution & Warning Summary
Any of the following messages in alarm:
- ‘**R6A…**’ → 55
- ‘**R6C(D,E)…Sync…**’ → 47
- ‘**R6G…PFM Sel…**’ → 48
- ‘**R6I…**’ → 64
- Other ‘**R6**’ message? → 49

47
- Go to {7.702 MSS CAMERA COMMAND FAILURE}, block 1 (SODF: RBT GEN: MALFUNCTION).

48 C&T: Video: Video Overview
Trunkline Useage
‘MSS Trunklines’
- Note the MSS Trunkline on which the affected camera is routed_____
- Deroute the affected camera.

Are all three ‘**R6G**’ messages in alarm for affected VDU?
Yes → 50; No → 51

49
- Deroute affected Camera
- For affected VDU
MSS: MBS: MBS Central Camera Icon
MBS Camera
- √‘Power’ Keep-Alive
- √‘Light’ Keep-Alive

MSS: MBS: VDU1
MSS VDUs
- √Keep-Alive
- **cmd** On

MSS: MBS: MBS Central Camera Icon
MBS Camera
- **cmd** ‘Power’ On
- **cmd** ‘Light’ On (if previously powered)
- Reroute affected Camera

Video is good or route was successful?
Yes → 52; No → 53

50 VDU source select failure. Camera views upstream of the failed VDU are lost whenever the VDU is powered. Power failed VDU to KA to regain pass through capability. The Camera view for the failed VDU is still available when the VDU is powered.

51
- Coordinate with CATO to make the trunkline in block 48 unavailable.
- Attempt to route the affected Camera to the original destination.

→ 59

52 Transient or erroneous indication.

53 VDU, Camera, or light failure.

54 If ‘**R6F-…PFM Carrier…**’ msg in alarm
For affected Camera and VDU
MSS: MBS: MBS Central Camera Icon
MBS Camera
- **cmd** ‘Power’ Keep-Alive
- **cmd** ‘Light’ Keep-Alive
MSS: MBS: VDU1
MSS VDUs
- **cmd** Keep-Alive

46

55 ‘**R6A…Pwr Cntl Err**’ message displayed?
Yes → 56; No → 57

56 ⑤ ACU On/Off discrete line failure. Camera view for affected VDU is lost.

57 ⑤ ⑥ VDU failure causing loss of ability to control the VDU.

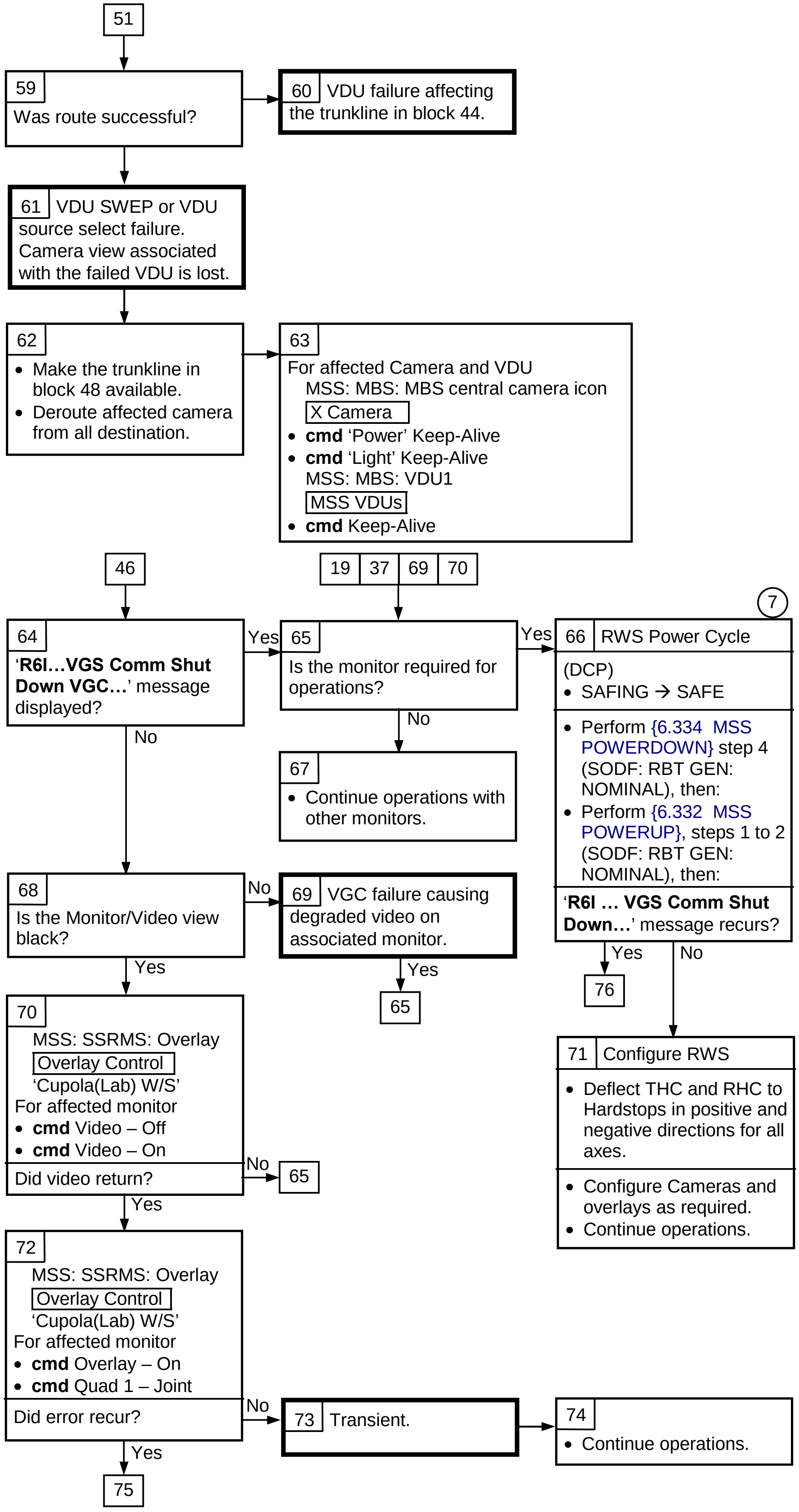
58
- Continue with other cameras.

⑤ Switching SSRMS/MBS/POA strings or forcing the VDU to the alternate power source may recover the VDU.

⑥ The Camera view may remain and will still be controllable but will permanently occupy the current MSS trunkline until power is removed from the VDU.

7.701 MSS VIDEO FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 7 of 8 pages



51 → 59

59 Was route successful? → 60; ↓ 61

60 VDU failure affecting the trunkline in block 44.

61 VDU SWEP or VDU source select failure. Camera view associated with the failed VDU is lost. → 62

62
- Make the trunkline in block 48 available.
- Deroute affected camera from all destination.

→ 63

63 For affected Camera and VDU
MSS: MBS: MBS central camera icon
X Camera
- **cmd** ‘Power’ Keep-Alive
- **cmd** ‘Light’ Keep-Alive

MSS: MBS: VDU1
MSS VDUs
- **cmd** Keep-Alive

46 → 64

64 ‘**R6I…VGS Comm Shut Down VGC…**’ message displayed? Yes → 65; No → 68

19, 37, 69, 70 → 65

65 Is the monitor required for operations? Yes → 66; No → 67

66 RWS Power Cycle ⑦
(DCP)
- SAFING → SAFE

- Perform {6.334 MSS POWERDOWN} step 4 (SODF: RBT GEN: NOMINAL), then:
- Perform {6.332 MSS POWERUP}, steps 1 to 2 (SODF: RBT GEN: NOMINAL), then:

‘**R6I … VGS Comm Shut Down…**’ message recurs? Yes → 76; No → 71

67
- Continue operations with other monitors.

68 Is the Monitor/Video view black? No → 69; Yes → 70

69 VGC failure causing degraded video on associated monitor. Yes → 65

70 MSS: SSRMS: Overlay
Overlay Control
‘Cupola(Lab) W/S’
For affected monitor
- **cmd** Video – Off
- **cmd** Video – On

Did video return? No → 65; Yes → 72

71 Configure RWS
- Deflect THC and RHC to Hardstops in positive and negative directions for all axes.

- Configure Cameras and overlays as required.
- Continue operations.

72 MSS: SSRMS: Overlay
Overlay Control
‘Cupola(Lab) W/S’
For affected monitor
- **cmd** Overlay – On
- **cmd** Quad 1 – Joint

Did error recur? No → 73; Yes → 75

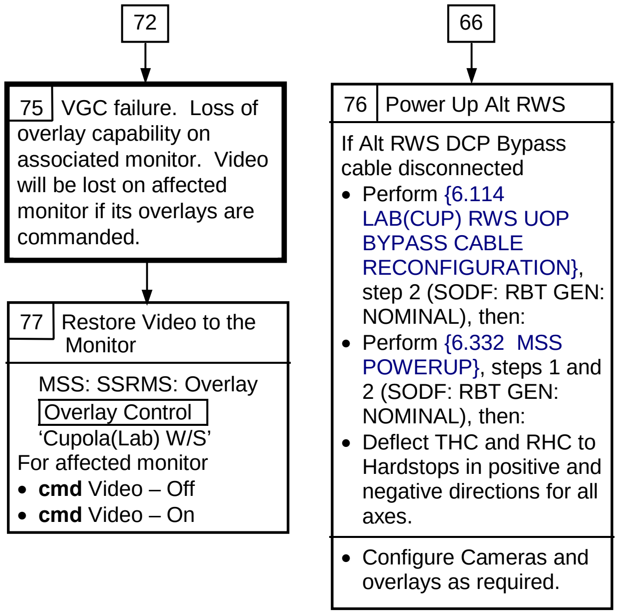
73 Transient. → 74

74
- Continue operations.

⑦ The ground can perform the following if desired:
Perform {8.260 MSS POWERDOWN}, steps 5 to 6.4 (SODF: GND: RBT: NOMINAL)
Perform {8.250 MSS POWERUP}, steps 1.2 to 2 (SODF: GND: RBT: NOMINAL)

7.701 MSS VIDEO FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 8 of 8 pages



75 VGC failure. Loss of overlay capability on associated monitor. Video will be lost on affected monitor if its overlays are commanded.

77 Restore Video to the Monitor

MSS: SSRMS: Overlay
Overlay Control
'Cupola(Lab) W/S'

For affected monitor

- **cmd** Video – Off
- **cmd** Video – On

76 Power Up Alt RWS

If Alt RWS DCP Bypass cable disconnected

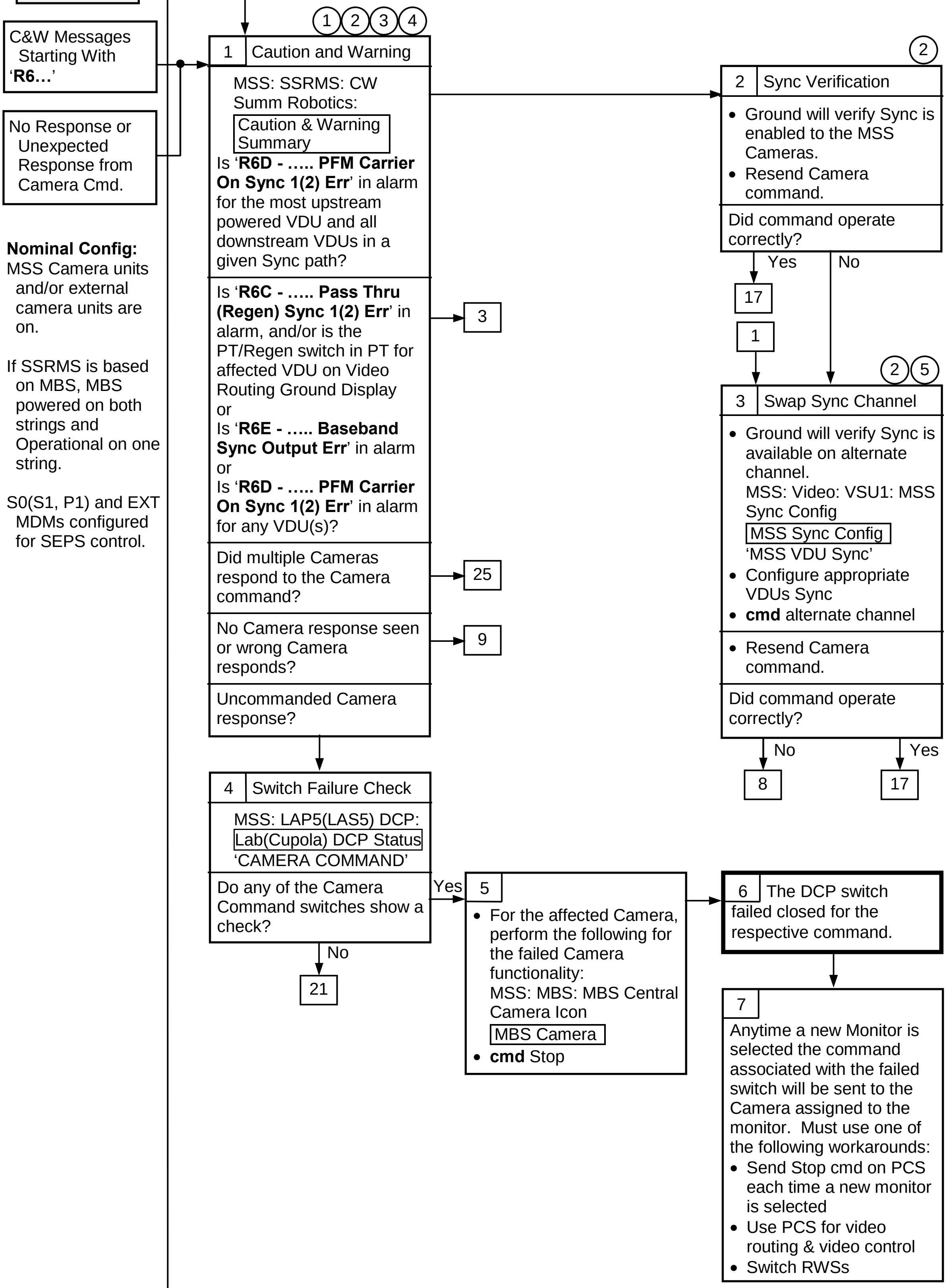
- Perform {6.114 LAB(CUP) RWS UOP BYPASS CABLE RECONFIGURATION}, step 2 (SODF: RBT GEN: NOMINAL), then:
- Perform {6.332 MSS POWERUP}, steps 1 and 2 (SODF: RBT GEN: NOMINAL), then:
- Deflect THC and RHC to Hardstops in positive and negative directions for all axes.

- Configure Cameras and overlays as required.

7.702 MSS CAMERA COMMAND FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 1 of 8 pages

{7.701 MSS VIDEO FAILURE}, block 47 (SODF: RBT GEN: MALFUNCTION)
{7.001 MSS FAILURE RESPONSE AND RECOVERY}, block 136 (SODF: RBT GEN: MALFUNCTION)



C&W ROBOTICS

C&W Messages Starting With ‘**R6…**’

No Response or Unexpected Response from Camera Cmd.

Nominal Config:
MSS Camera units and/or external camera units are on.

If SSRMS is based on MBS, MBS powered on both strings and Operational on one string.

S0(S1, P1) and EXT MDMs configured for SEPS control.

① ② ③ ④

1 Caution and Warning

MSS: SSRMS: CW
Summ Robotics:
Caution & Warning Summary

Is ‘**R6D - ….. PFM Carrier On Sync 1(2) Err**’ in alarm for the most upstream powered VDU and all downstream VDUs in a given Sync path? 2

Is ‘**R6C - ….. Pass Thru (Regen) Sync 1(2) Err**’ in alarm, and/or is the PT/Regen switch in PT for affected VDU on Video Routing Ground Display
or
Is ‘**R6E - ….. Baseband Sync Output Err**’ in alarm
or
Is ‘**R6D - ….. PFM Carrier On Sync 1(2) Err**’ in alarm for any VDU(s)? 3

Did multiple Cameras respond to the Camera command? 25

No Camera response seen or wrong Camera responds? 9

Uncommanded Camera response? 4

②

2 Sync Verification

- Ground will verify Sync is enabled to the MSS Cameras.
- Resend Camera command.

Did command operate correctly?

Yes 17 1
No 3

② ⑤

3 Swap Sync Channel

- Ground will verify Sync is available on alternate channel.
  MSS: Video: VSU1: MSS Sync Config
  MSS Sync Config
  ‘MSS VDU Sync’
- Configure appropriate VDUs Sync
- **cmd** alternate channel
- Resend Camera command.

Did command operate correctly?

No 8
Yes 17

4 Switch Failure Check

MSS: LAP5(LAS5) DCP:
Lab(Cupola) DCP Status
‘CAMERA COMMAND’

Do any of the Camera Command switches show a check?

Yes 5
No 21

5

- For the affected Camera, perform the following for the failed Camera functionality:
  MSS: MBS: MBS Central Camera Icon
  MBS Camera
- **cmd** Stop

6 The DCP switch failed closed for the respective command.

7

Anytime a new Monitor is selected the command associated with the failed switch will be sent to the Camera assigned to the monitor. Must use one of the following workarounds:

- Send Stop cmd on PCS each time a new monitor is selected
- Use PCS for video routing & video control
- Switch RWSs

① Unless otherwise indicated, all displays in this procedure are on the PCS.

② This block contains some Ground-only telemetry verification.

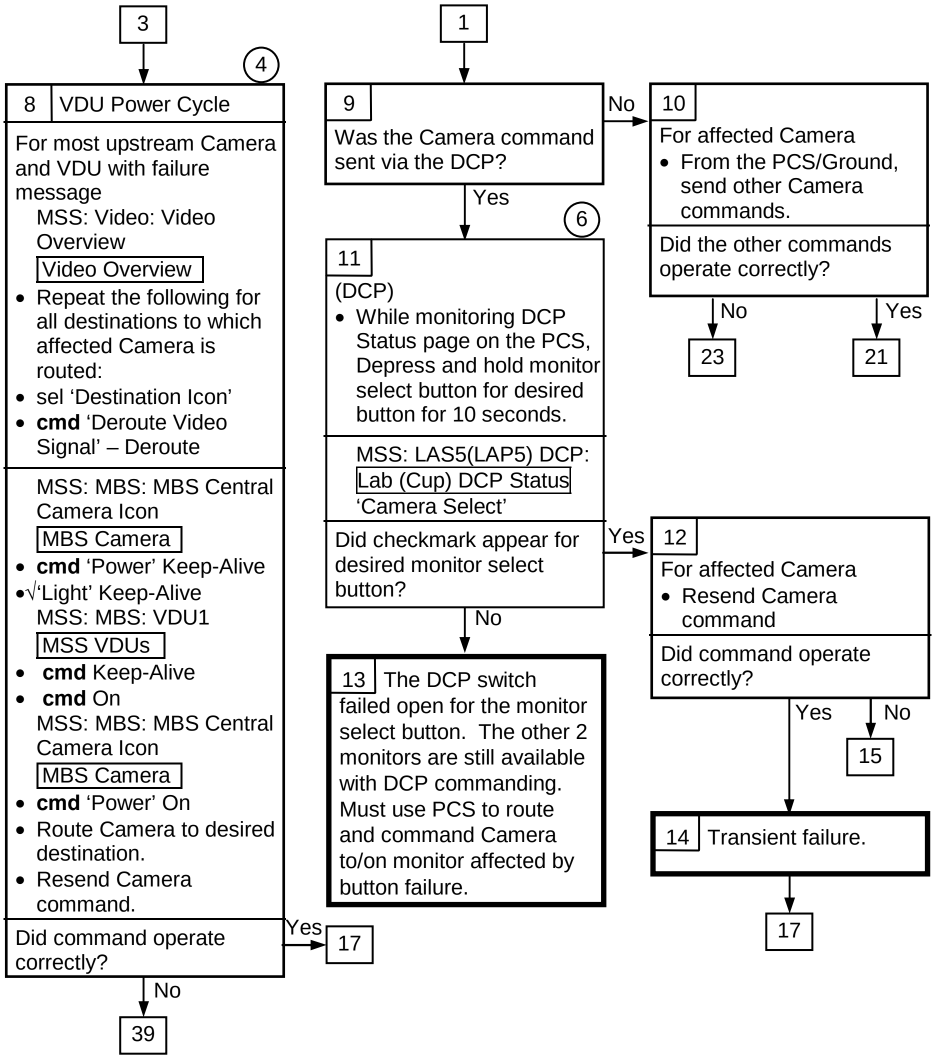
③ OCS will only annunciate the ‘**R6C - ….. Pass Thru (Regen) Sync 1(2) Err**’ when a SWEP is issued.

④ Reference figures 1 and 2 for description of upstream/ downstream, and Sync path.

⑤ Do not command MBS and SSRMS VDUs to switch Sync channels with the same command. Due to SCR 26165 this will cause an OCS Fatal Failure.

7.702 MSS CAMERA COMMAND FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 2 of 8 pages



8 VDU Power Cycle

For most upstream Camera and VDU with failure message

MSS: Video: Video Overview

Video Overview

- Repeat the following for all destinations to which affected Camera is routed:
- sel 'Destination Icon'
- **cmd** 'Deroute Video Signal' – Deroute

MSS: MBS: MBS Central Camera Icon

MBS Camera

- **cmd** 'Power' Keep-Alive
- √'Light' Keep-Alive

MSS: MBS: VDU1

MSS VDUs

- **cmd** Keep-Alive
- **cmd** On

MSS: MBS: MBS Central Camera Icon

MBS Camera

- **cmd** 'Power' On
- Route Camera to desired destination.
- Resend Camera command.

Did command operate correctly?

9

Was the Camera command sent via the DCP?

10

For affected Camera

- From the PCS/Ground, send other Camera commands.

Did the other commands operate correctly?

11

(DCP)

- While monitoring DCP Status page on the PCS, Depress and hold monitor select button for desired button for 10 seconds.

MSS: LAS5(LAP5) DCP: Lab (Cup) DCP Status 'Camera Select'

Did checkmark appear for desired monitor select button?

12

For affected Camera

- Resend Camera command

Did command operate correctly?

13 The DCP switch failed open for the monitor select button. The other 2 monitors are still available with DCP commanding. Must use PCS to route and command Camera to/on monitor affected by button failure.

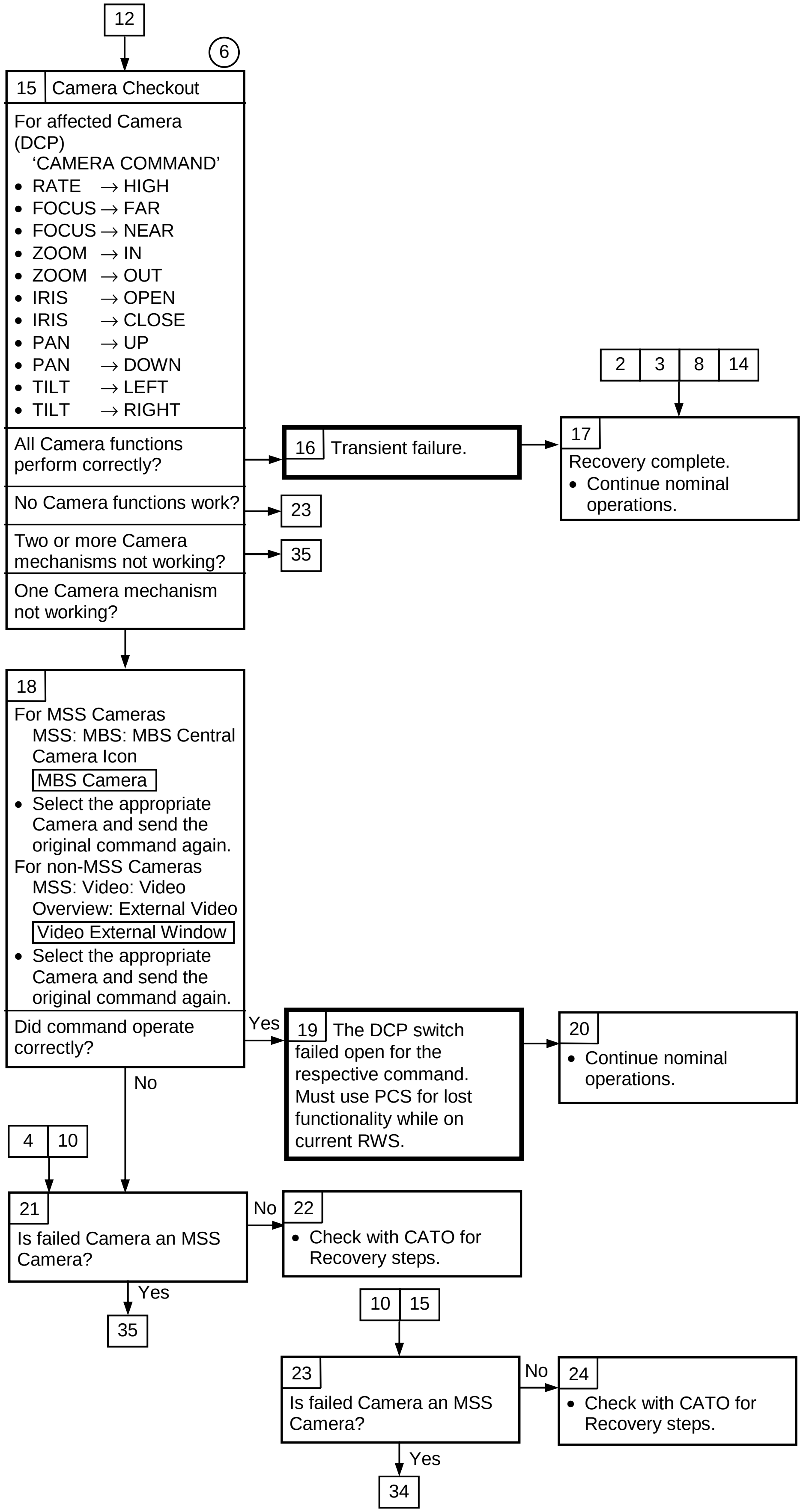
14 Transient failure.

④ Reference figures 1 and 2 for description of upstream/ downstream, and Sync path.

⑥ This block contains crew-only steps.

7.702 MSS CAMERA COMMAND FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 3 of 8 pages



15 Camera Checkout

For affected Camera (DCP)
'CAMERA COMMAND'
- RATE → HIGH
- FOCUS → FAR
- FOCUS → NEAR
- ZOOM → IN
- ZOOM → OUT
- IRIS → OPEN
- IRIS → CLOSE
- PAN → UP
- PAN → DOWN
- TILT → LEFT
- TILT → RIGHT

All Camera functions perform correctly?

No Camera functions work?

Two or more Camera mechanisms not working?

One Camera mechanism not working?

16 Transient failure.

17 Recovery complete.
- Continue nominal operations.

18
For MSS Cameras
MSS: MBS: MBS Central Camera Icon
MBS Camera
- Select the appropriate Camera and send the original command again.

For non-MSS Cameras
MSS: Video: Video Overview: External Video
Video External Window
- Select the appropriate Camera and send the original command again.

Did command operate correctly?

19 The DCP switch failed open for the respective command. Must use PCS for lost functionality while on current RWS.

20
- Continue nominal operations.

21 Is failed Camera an MSS Camera?

22
- Check with CATO for Recovery steps.

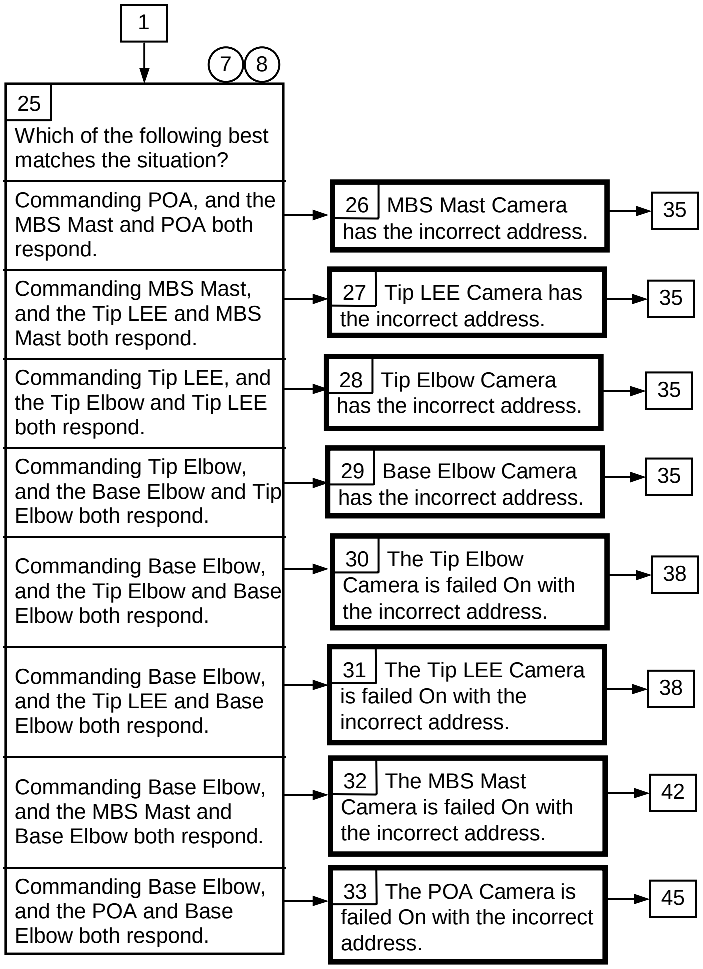
23 Is failed Camera an MSS Camera?

24
- Check with CATO for Recovery steps.

⑥ This block contains crew-only steps.

7.702 MSS CAMERA COMMAND FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 4 of 8 pages

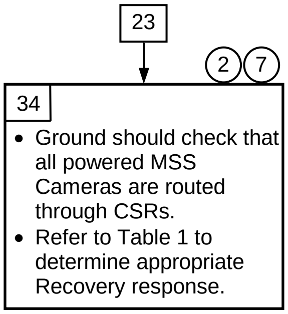


⑦ This logic assumes the MSS Cameras were powered in the following order: Base Elbow, Tip Elbow, Tip LEE, MBS Mast, POA.

⑧ Ground can also use Table 1 for an alternative method to determine appropriate recovery response.

7.702 MSS CAMERA COMMAND FAILURE

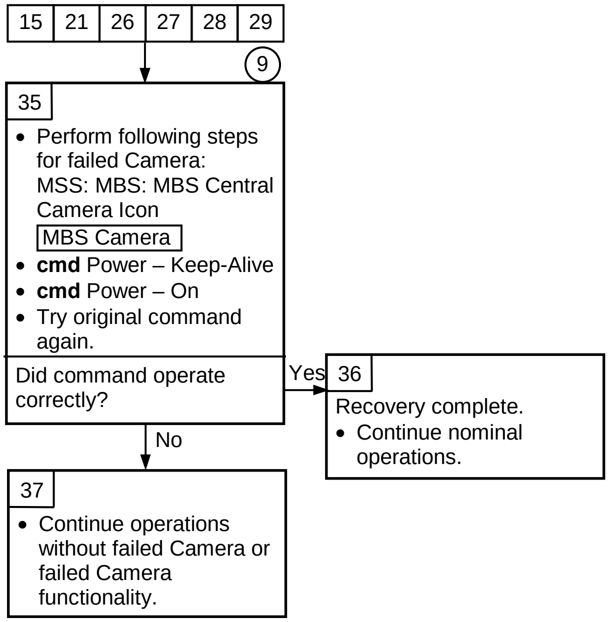
(RBT GEN/X2R4 - ALL/FIN/SPN) Page 5 of 8 pages



- Ground should check that all powered MSS Cameras are routed through CSRs.
- Refer to Table 1 to determine appropriate Recovery response.

Table 1. Recovery Response to Camera Failure

Affected Camera Routed to CSR	Camera ID Shown on CSR	Recovery Block
Base Elbow	Tip Elbow	34
Tip Elbow	Base Elbow	37
Tip Elbow	Tip LEE	34
Tip LEE	Base Elbow	37
Tip LEE	MBS Mast	34
MBS Mast	Base Elbow	41
MBS Mast	POA	34
POA	Base Elbow	44
None of the above (Camera ID shown on the CSR is the same as the affected Camera or no Camera ID shown)		34



35
- Perform following steps for failed Camera:
  MSS: MBS: MBS Central Camera Icon
  MBS Camera
- **cmd** Power – Keep-Alive
- **cmd** Power – On
- Try original command again.

Did command operate correctly?

36
Recovery complete.
- Continue nominal operations.

37
- Continue operations without failed Camera or failed Camera functionality.

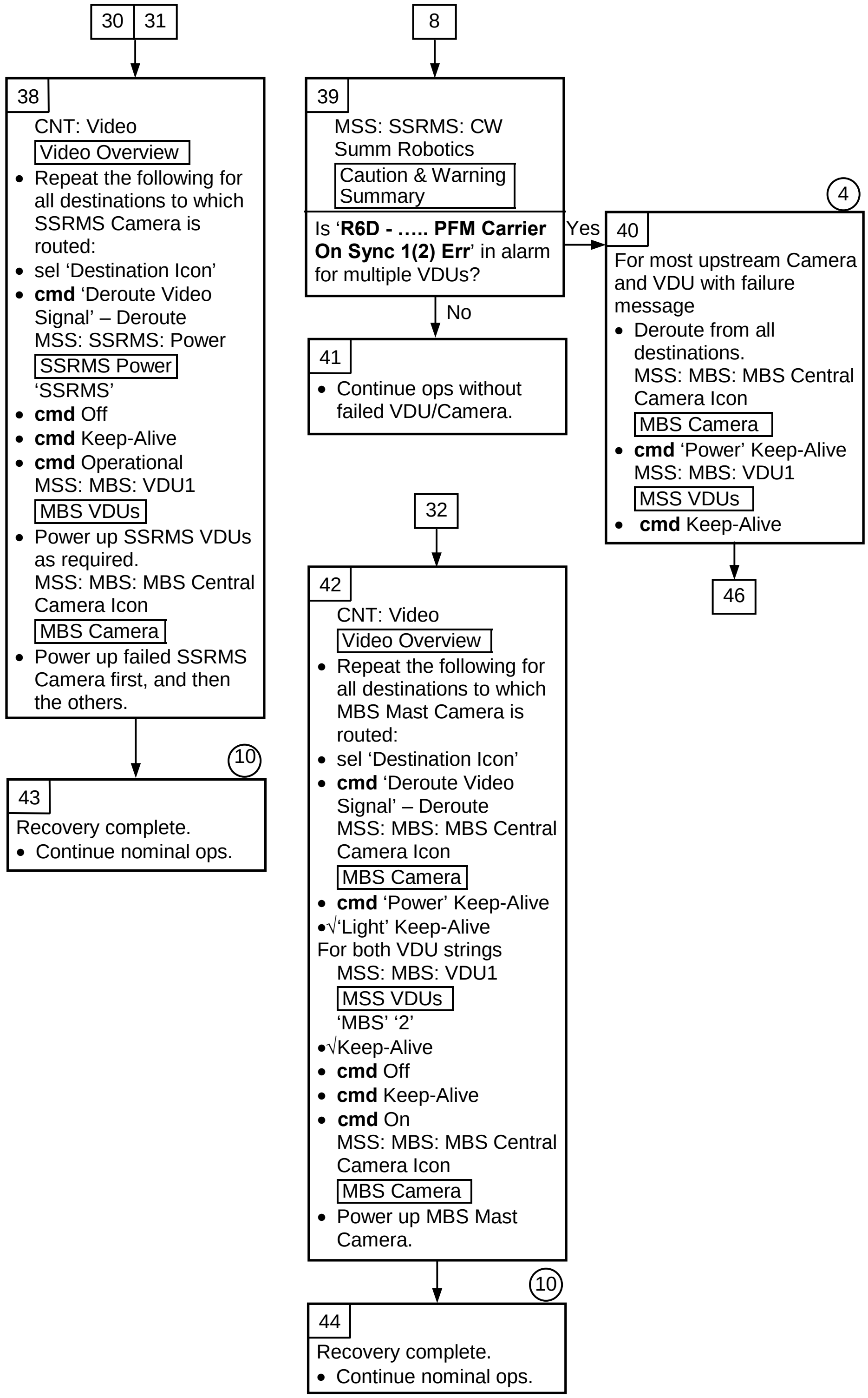
②
This block contains some Ground-only telemetry verification.

⑦
This logic assumes the MSS Cameras were powered in the following order: Base Elbow, Tip Elbow, Tip LEE, MBS Mast, POA.

⑨
Power cycling the failed camera will reset camera functions to default settings.

7.702 MSS CAMERA COMMAND FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 6 of 8 pages



38
CNT: Video
Video Overview
- Repeat the following for all destinations to which SSRMS Camera is routed:
- sel 'Destination Icon'
- **cmd** 'Deroute Video Signal' – Deroute
  MSS: SSRMS: Power
  SSRMS Power
  'SSRMS'
- **cmd** Off
- **cmd** Keep-Alive
- **cmd** Operational
  MSS: MBS: VDU1
  MBS VDUs
- Power up SSRMS VDUs as required.
  MSS: MBS: MBS Central Camera Icon
  MBS Camera
- Power up failed SSRMS Camera first, and then the others.

43
Recovery complete.
- Continue nominal ops.

39
MSS: SSRMS: CW
Summ Robotics
Caution & Warning Summary

Is '**R6D - ….. PFM Carrier On Sync 1(2) Err**' in alarm for multiple VDUs?

41
- Continue ops without failed VDU/Camera.

40
For most upstream Camera and VDU with failure message
- Deroute from all destinations.
  MSS: MBS: MBS Central Camera Icon
  MBS Camera
- **cmd** 'Power' Keep-Alive
  MSS: MBS: VDU1
  MSS VDUs
- **cmd** Keep-Alive

42
CNT: Video
Video Overview
- Repeat the following for all destinations to which MBS Mast Camera is routed:
- sel 'Destination Icon'
- **cmd** 'Deroute Video Signal' – Deroute
  MSS: MBS: MBS Central Camera Icon
  MBS Camera
- **cmd** 'Power' Keep-Alive
- √'Light' Keep-Alive

For both VDU strings
MSS: MBS: VDU1
MSS VDUs
'MBS' '2'
- √Keep-Alive
- **cmd** Off
- **cmd** Keep-Alive
- **cmd** On
  MSS: MBS: MBS Central Camera Icon
  MBS Camera
- Power up MBS Mast Camera.

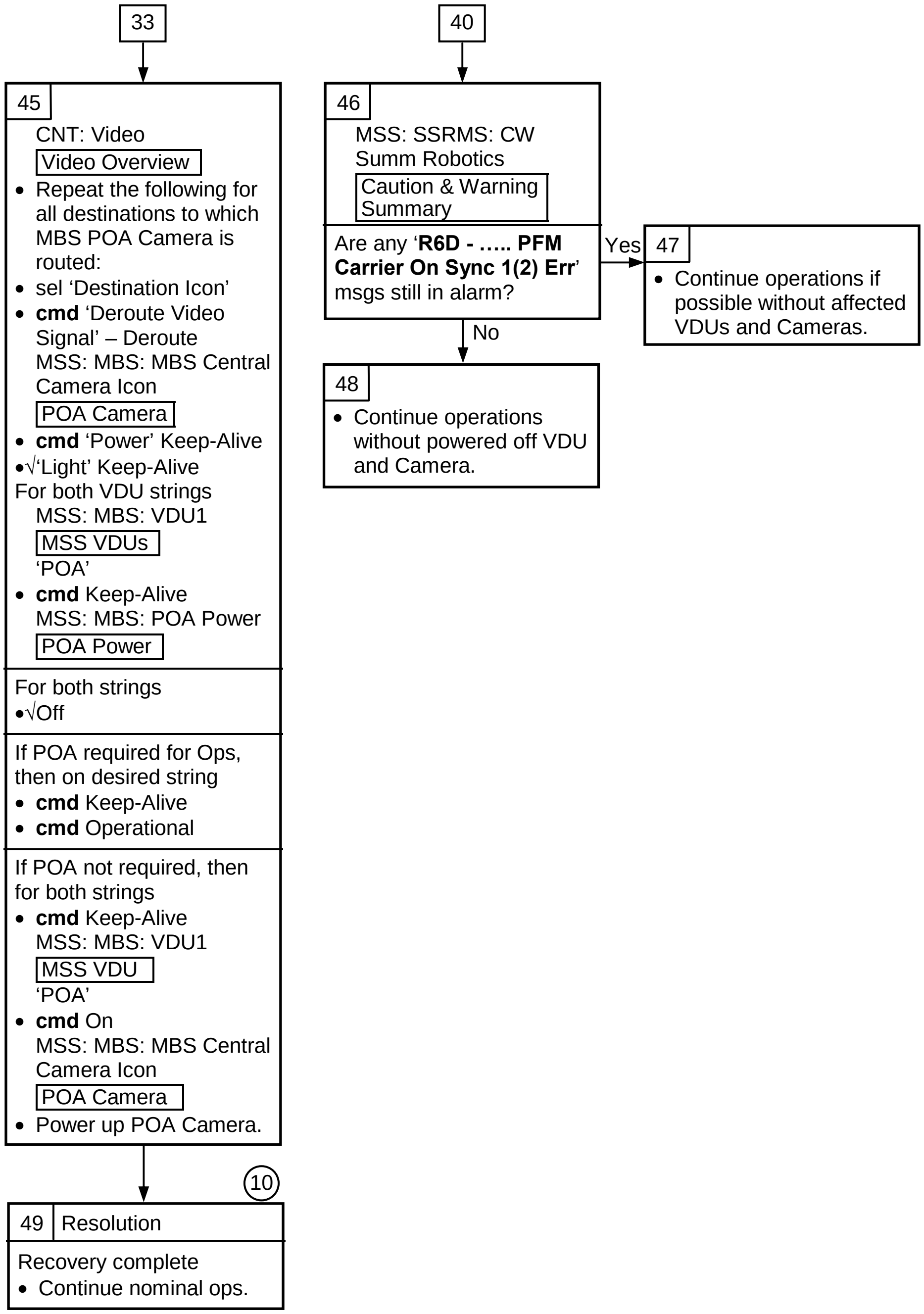
44
Recovery complete.
- Continue nominal ops.

④
Reference figures 1 and 2 for description of upstream/ downstream, and Sync path.

⑩
In the future the failed Camera must always be powered first to ensure it receives the correct Camera address.

7.702 MSS CAMERA COMMAND FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 7 of 8 pages



45

CNT: Video

Video Overview

- Repeat the following for all destinations to which MBS POA Camera is routed:
- sel ‘Destination Icon’
- **cmd** ‘Deroute Video Signal’ – Deroute

MSS: MBS: MBS Central Camera Icon

POA Camera

- **cmd** ‘Power’ Keep-Alive
- √‘Light’ Keep-Alive

For both VDU strings

MSS: MBS: VDU1

MSS VDUs

‘POA’

- **cmd** Keep-Alive

MSS: MBS: POA Power

POA Power

For both strings

- √Off

If POA required for Ops, then on desired string

- **cmd** Keep-Alive
- **cmd** Operational

If POA not required, then for both strings

- **cmd** Keep-Alive

MSS: MBS: VDU1

MSS VDU

‘POA’

- **cmd** On

MSS: MBS: MBS Central Camera Icon

POA Camera

- Power up POA Camera.

46

MSS: SSRMS: CW Summ Robotics

Caution & Warning Summary

Are any ‘**R6D - ….. PFM Carrier On Sync 1(2) Err**’ msgs still in alarm?

47

- Continue operations if possible without affected VDUs and Cameras.

48

- Continue operations without powered off VDU and Camera.

49 Resolution

Recovery complete

- Continue nominal ops.

⑩ In the future the failed Camera must always be powered first to ensure it receives the correct Camera address.

7.702 MSS CAMERA COMMAND FAILURE

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 8 of 8 pages

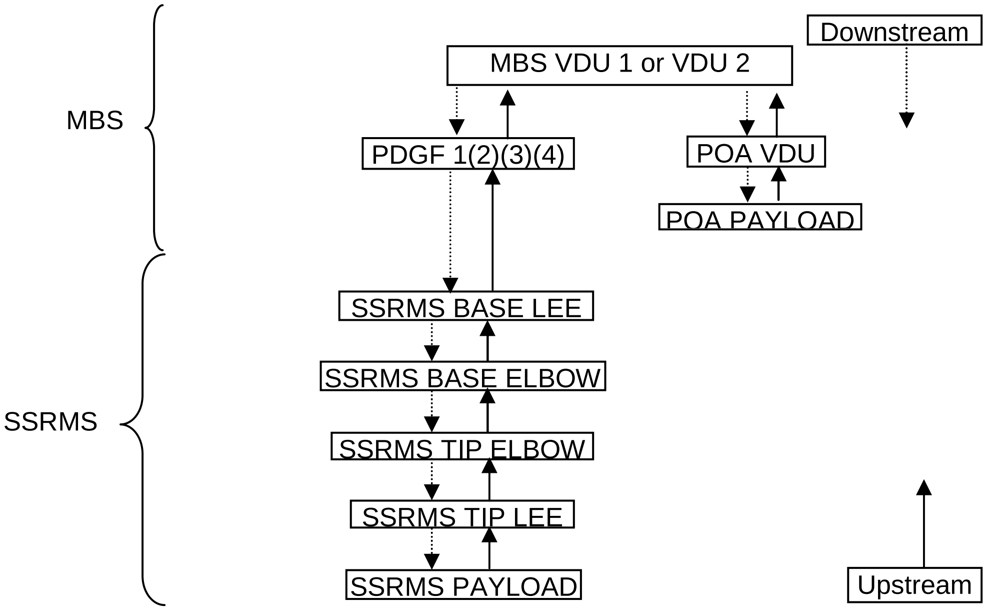
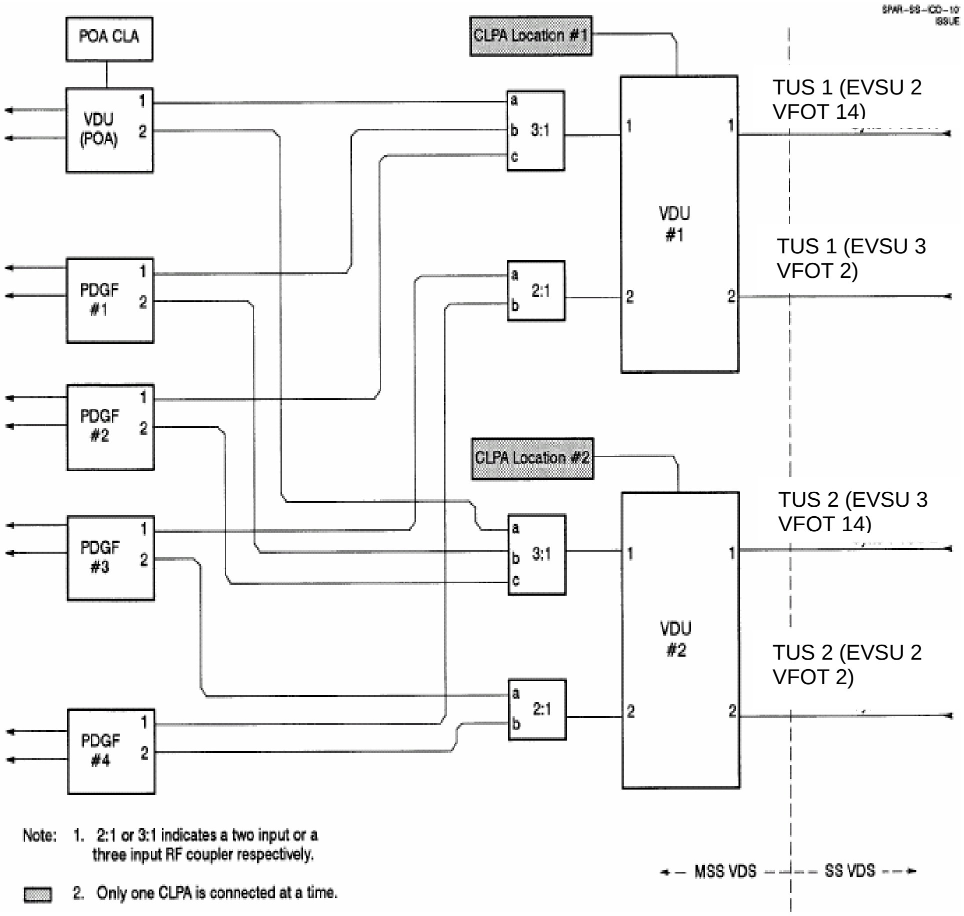


Figure 1.- Downstream vs. Upstream.



Note: 1. 2:1 or 3:1 indicates a two input or a three input RF coupler respectively.

▨ 2. Only one CLPA is connected at a time.

Figure 2.- MSS Sync Flow Diagram.

7.900 MSS PERSISTENT CAT-2 ERROR

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 1 of 16 pages

C&W
ROBOTICS

C&W messages starting with '**Rxx - …**

Persistent MSS Cat-2 C&W Message is in Alarm.

Nominal Config:

R1C: affected unit is powered and ready for operations

R2O: MBS is operational on one string, keep-alive on the other

R3L: SSRMS is operational

R5Z: SSRMS is operational with brakes on

R7A: SSRMS(MBS) is operational

R7C: S0 MDM PTCS is enabled, heaters are in closed loop mode

R9C: SSRMS is transitioning from Keep-Alive to Operational

R3O: SSRMS is Operational

EXT, S0(S1, P1) MDMs configured for SEPS Control

{7.001 MSS FAILURE RESPONSE AND RECOVERY}, block 138 (SODF: RBT GEN: MALFUNCTION)

①

1 Message Identification

MSS: MBS: CW Summ Robotics
Caution & Warning Summary

- Identify the Cat-2 message received.

'**R2O - MBS CRPCM …**'	5
'**R3L - SSRMS Pwr Flags Fail**'	92
'**R5Z - SSRMS SR(SY, SP, EP, WP, WY, WR) Brk Slip**'	101
'**R7A - SSRMS(MBS) Temp Out of Limits**'	106
'**R7C - TUS Temp Out of Limits**'	114
'R9C - MSS OCS SSRMS SR(SY,SP,EP,WP,WY,WR) Joint Init Posn Err'	128
'R3O - SSRMS LEE Stat Switches I/F Test Fail'	131
'**R1C - …OCS(ACU, MCU, JEU, LEU) ROM…**'	2

2 ROM Checksum Failed

CAUTION

For SSRMS failures, transition to off or KA or removal of power will result in permanent loss of the SSRMS string until the failed ACU, JEU, or LEU is replaced.

For POA failures, transition of the POA to off or KA or transition of the MBS to off or keep-alive or removal of power will result in permanent loss of the POA on that MBS string until the failed LEU is replaced.

For MBS (non-POA) failures, transition to off or KA or removal of power will result in permanent loss of the MBS string until the failed MCU is replaced.

For RWS failures, transition from Active or Backup to off will result in permanent loss of the RWS until the failed CEU is replaced.

3 Recovery complete.

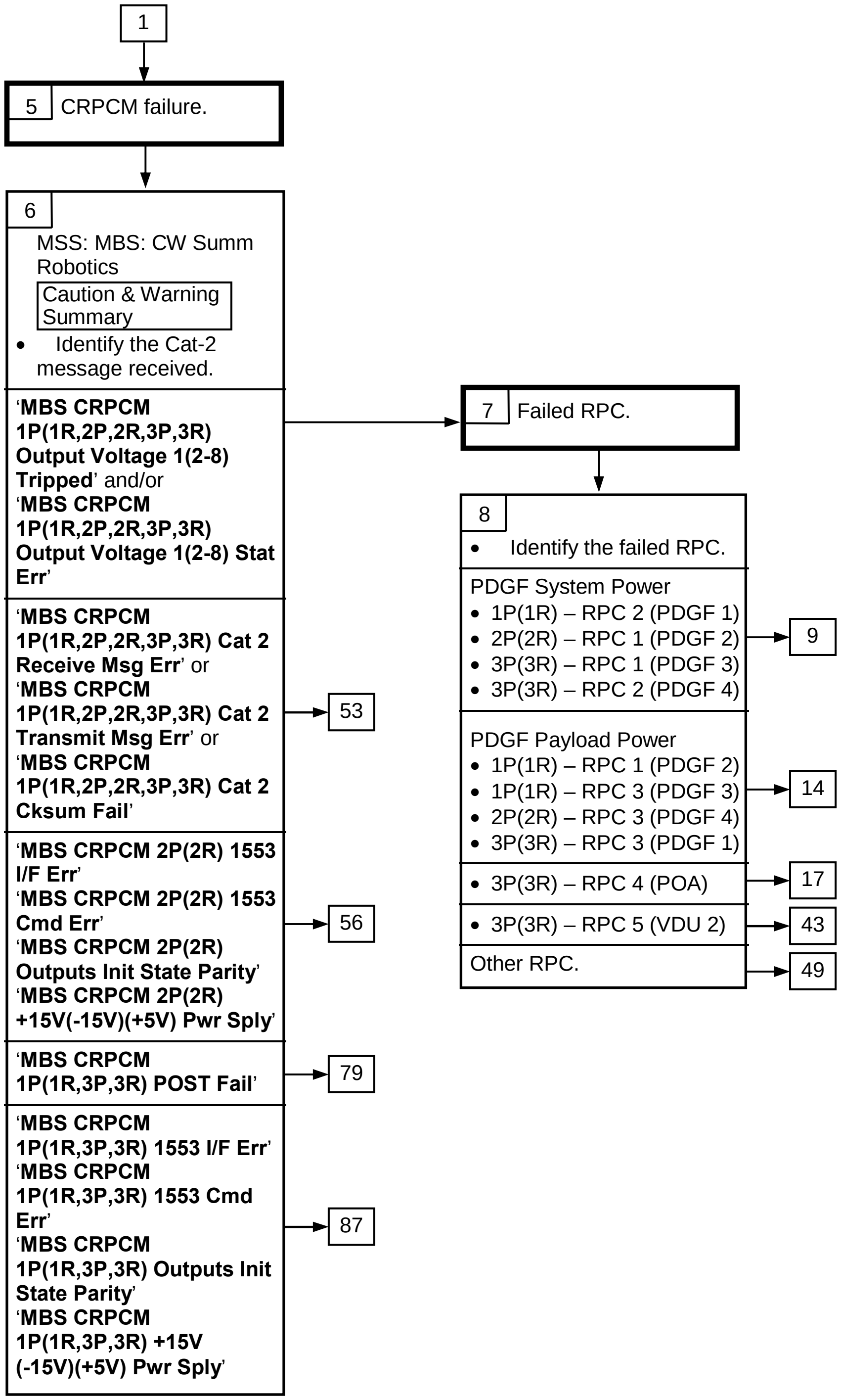
4

- Continue nominal operations.

① Unless otherwise indicated, all displays in this procedure are on the PCS.

7.900 MSS PERSISTENT CAT-2 ERROR

(RBT GEN/X2R4 - ALL/FIN/SPN)   Page 2 of 16 pages



1

5 CRPCM failure.

6
MSS: MBS: CW Summ Robotics
Caution & Warning Summary
- Identify the Cat-2 message received.

‘**MBS CRPCM 1P(1R,2P,2R,3P,3R) Output Voltage 1(2-8) Tripped**’ and/or ‘**MBS CRPCM 1P(1R,2P,2R,3P,3R) Output Voltage 1(2-8) Stat Err**’ → 7

‘**MBS CRPCM 1P(1R,2P,2R,3P,3R) Cat 2 Receive Msg Err**’ or ‘**MBS CRPCM 1P(1R,2P,2R,3P,3R) Cat 2 Transmit Msg Err**’ or ‘**MBS CRPCM 1P(1R,2P,2R,3P,3R) Cat 2 Cksum Fail**’ → 53

‘**MBS CRPCM 2P(2R) 1553 I/F Err**’
‘**MBS CRPCM 2P(2R) 1553 Cmd Err**’
‘**MBS CRPCM 2P(2R) Outputs Init State Parity**’
‘**MBS CRPCM 2P(2R) +15V(-15V)(+5V) Pwr Sply**’ → 56

‘**MBS CRPCM 1P(1R,3P,3R) POST Fail**’ → 79

‘**MBS CRPCM 1P(1R,3P,3R) 1553 I/F Err**’
‘**MBS CRPCM 1P(1R,3P,3R) 1553 Cmd Err**’
‘**MBS CRPCM 1P(1R,3P,3R) Outputs Init State Parity**’
‘**MBS CRPCM 1P(1R,3P,3R) +15V (-15V)(+5V) Pwr Sply**’ → 87

7 Failed RPC.

8
- Identify the failed RPC.

PDGF System Power
- 1P(1R) – RPC 2 (PDGF 1)
- 2P(2R) – RPC 1 (PDGF 2)
- 3P(3R) – RPC 1 (PDGF 3)
- 3P(3R) – RPC 2 (PDGF 4)

→ 9

PDGF Payload Power
- 1P(1R) – RPC 1 (PDGF 2)
- 1P(1R) – RPC 3 (PDGF 3)
- 2P(2R) – RPC 3 (PDGF 4)
- 3P(3R) – RPC 3 (PDGF 1)

→ 14

- 3P(3R) – RPC 4 (POA) → 17

- 3P(3R) – RPC 5 (VDU 2) → 43

Other RPC. → 49

7.900 MSS PERSISTENT CAT-2 ERROR

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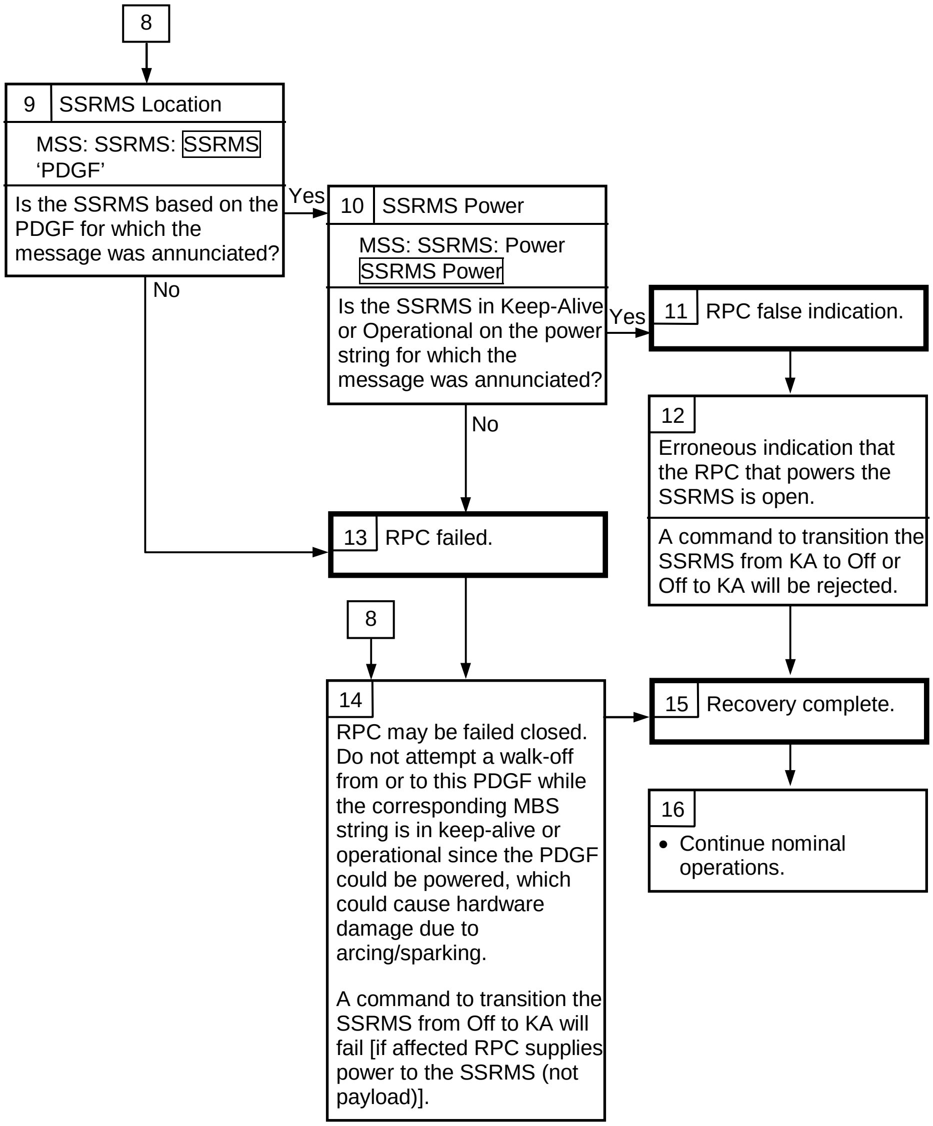


9 SSRMS Location

MSS: SSRMS: SSRMS ‘PDGF’

Is the SSRMS based on the PDGF for which the message was annunciated?

10 SSRMS Power

MSS: SSRMS: Power SSRMS Power

Is the SSRMS in Keep-Alive or Operational on the power string for which the message was annunciated?

11 RPC false indication.

12 Erroneous indication that the RPC that powers the SSRMS is open.

A command to transition the SSRMS from KA to Off or Off to KA will be rejected.

13 RPC failed.

14 RPC may be failed closed. Do not attempt a walk-off from or to this PDGF while the corresponding MBS string is in keep-alive or operational since the PDGF could be powered, which could cause hardware damage due to arcing/sparking.

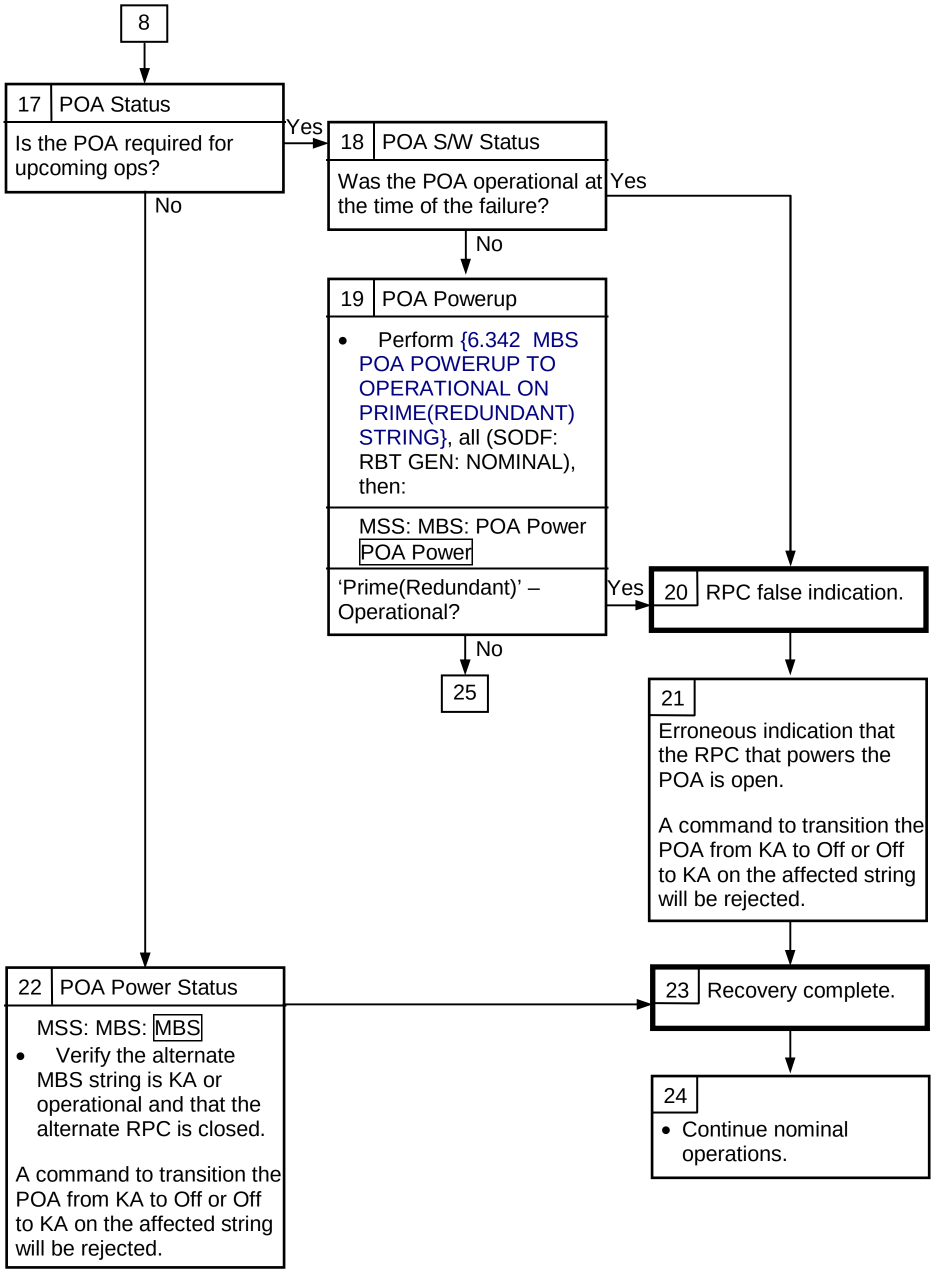
A command to transition the SSRMS from Off to KA will fail [if affected RPC supplies power to the SSRMS (not payload)].

15 Recovery complete.

16
- Continue nominal operations.

7.900 MSS PERSISTENT CAT-2 ERROR

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 4 of 16 pages



17 POA Status

Is the POA required for upcoming ops?

18 POA S/W Status

Was the POA operational at the time of the failure?

19 POA Powerup

- Perform {6.342 MBS POA POWERUP TO OPERATIONAL ON PRIME(REDUNDANT) STRING}, all (SODF: RBT GEN: NOMINAL), then:

MSS: MBS: POA Power POA Power

'Prime(Redundant)' – Operational?

20 RPC false indication.

21

Erroneous indication that the RPC that powers the POA is open.

A command to transition the POA from KA to Off or Off to KA on the affected string will be rejected.

22 POA Power Status

MSS: MBS: MBS

- Verify the alternate MBS string is KA or operational and that the alternate RPC is closed.

A command to transition the POA from KA to Off or Off to KA on the affected string will be rejected.

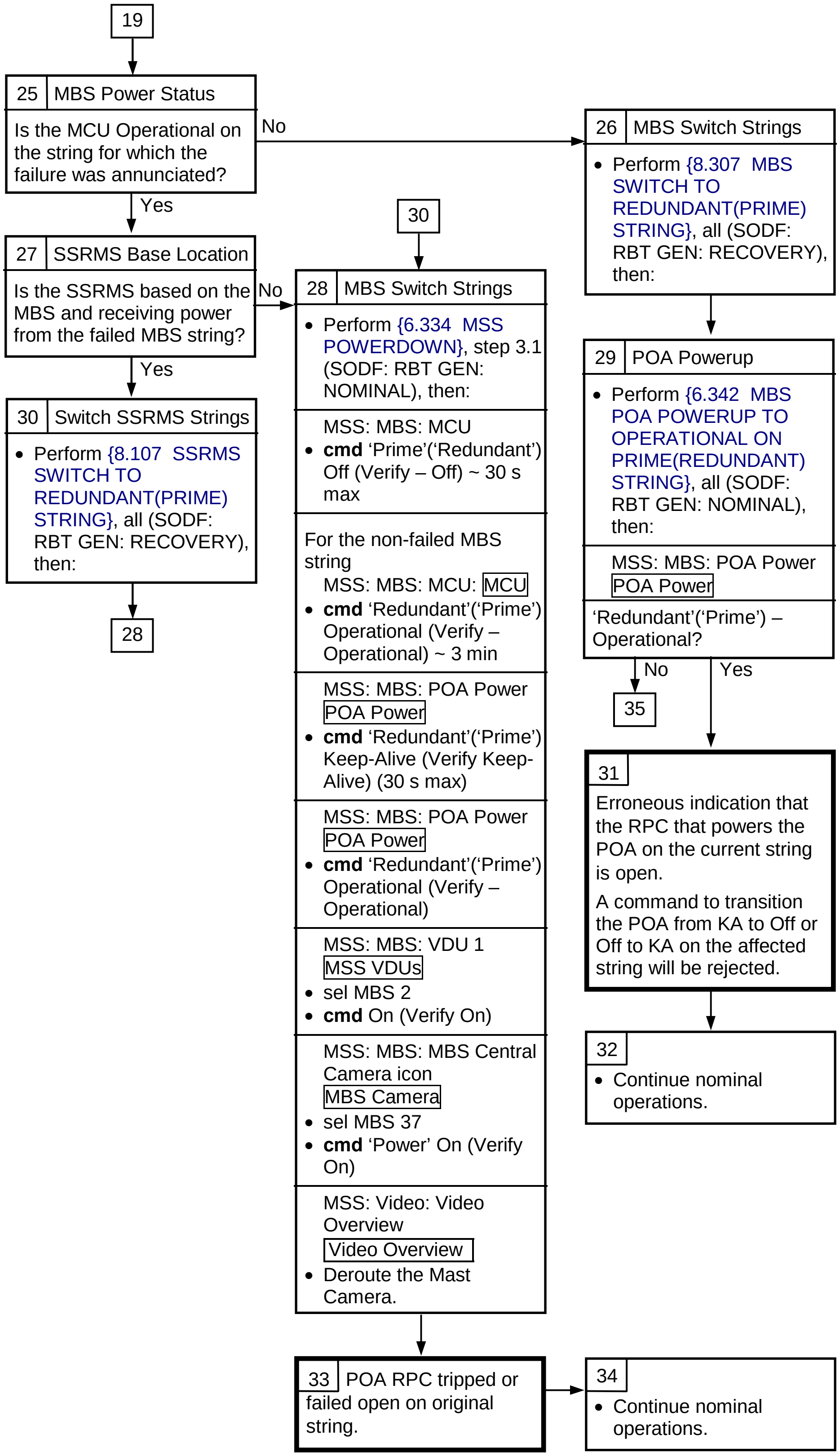
23 Recovery complete.

24

- Continue nominal operations.

7.900 MSS PERSISTENT CAT-2 ERROR

(RBT GEN/X2R4 - ALL/FIN/SPN)   Page 5 of 16 pages



25 MBS Power Status

Is the MCU Operational on the string for which the failure was annunciated?

26 MBS Switch Strings

- Perform {8.307 MBS SWITCH TO REDUNDANT(PRIME) STRING}, all (SODF: RBT GEN: RECOVERY), then:

27 SSRMS Base Location

Is the SSRMS based on the MBS and receiving power from the failed MBS string?

28 MBS Switch Strings

- Perform {6.334 MSS POWERDOWN}, step 3.1 (SODF: RBT GEN: NOMINAL), then:

MSS: MBS: MCU

- **cmd** 'Prime'('Redundant') Off (Verify – Off) ~ 30 s max

For the non-failed MBS string

MSS: MBS: MCU: MCU

- **cmd** 'Redundant'('Prime') Operational (Verify – Operational) ~ 3 min

MSS: MBS: POA Power

POA Power

- **cmd** 'Redundant'('Prime') Keep-Alive (Verify Keep-Alive) (30 s max)

MSS: MBS: POA Power

POA Power

- **cmd** 'Redundant'('Prime') Operational (Verify – Operational)

MSS: MBS: VDU 1

MSS VDUs

- sel MBS 2
- **cmd** On (Verify On)

MSS: MBS: MBS Central Camera icon

MBS Camera

- sel MBS 37
- **cmd** 'Power' On (Verify On)

MSS: Video: Video Overview

Video Overview

- Deroute the Mast Camera.

29 POA Powerup

- Perform {6.342 MBS POA POWERUP TO OPERATIONAL ON PRIME(REDUNDANT) STRING}, all (SODF: RBT GEN: NOMINAL), then:

MSS: MBS: POA Power

POA Power

'Redundant'('Prime') – Operational?

30 Switch SSRMS Strings

- Perform {8.107 SSRMS SWITCH TO REDUNDANT(PRIME) STRING}, all (SODF: RBT GEN: RECOVERY), then:

31

Erroneous indication that the RPC that powers the POA on the current string is open.

A command to transition the POA from KA to Off or Off to KA on the affected string will be rejected.

32

- Continue nominal operations.

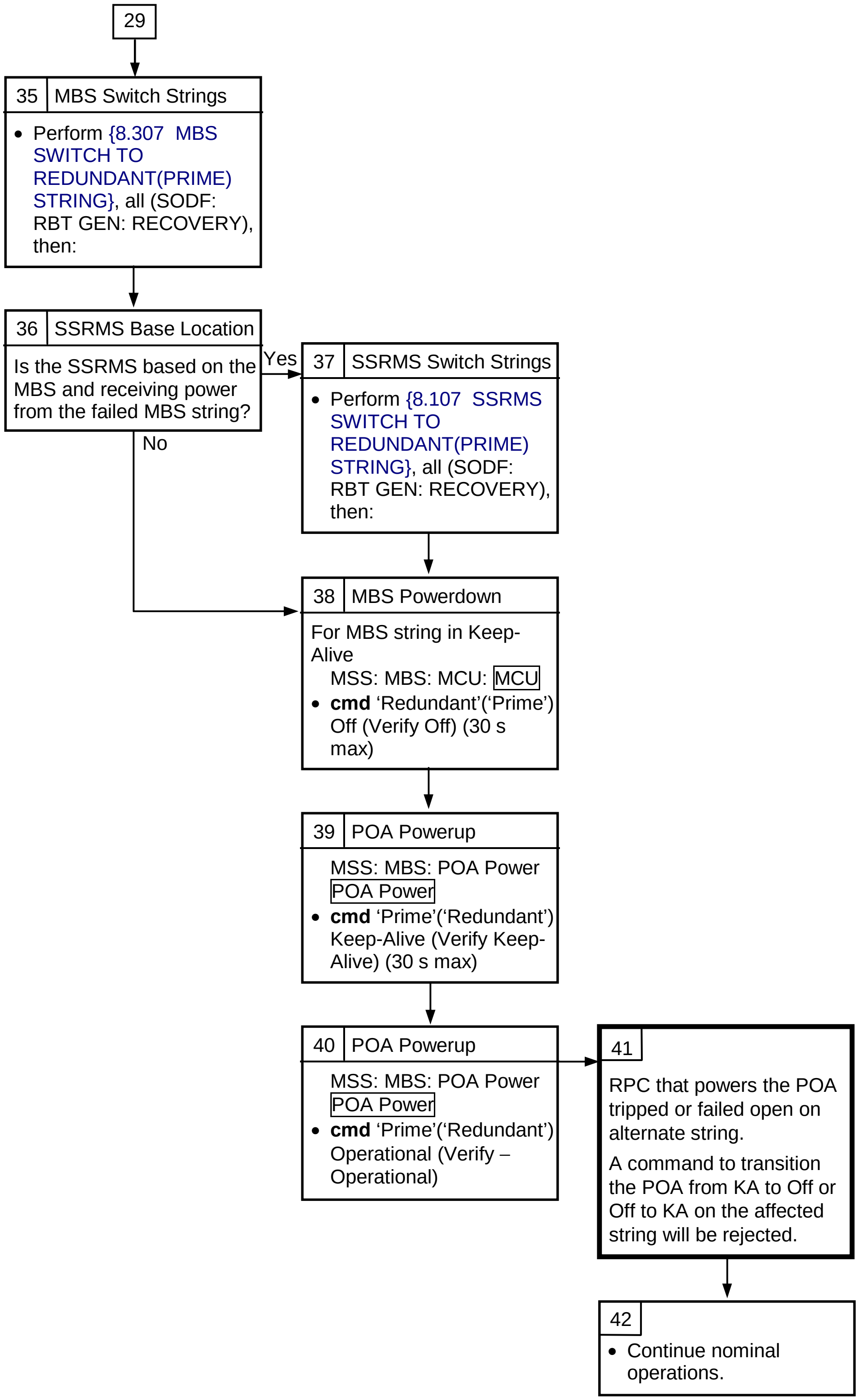
33 POA RPC tripped or failed open on original string.

34

- Continue nominal operations.

7.900 MSS PERSISTENT CAT-2 ERROR

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 6 of 16 pages



35 MBS Switch Strings

- Perform {8.307 MBS SWITCH TO REDUNDANT(PRIME) STRING}, all (SODF: RBT GEN: RECOVERY), then:

36 SSRMS Base Location

Is the SSRMS based on the MBS and receiving power from the failed MBS string?

37 SSRMS Switch Strings

- Perform {8.107 SSRMS SWITCH TO REDUNDANT(PRIME) STRING}, all (SODF: RBT GEN: RECOVERY), then:

38 MBS Powerdown

For MBS string in Keep-Alive

MSS: MBS: MCU: MCU

- **cmd** ‘Redundant’(‘Prime’) Off (Verify Off) (30 s max)

39 POA Powerup

MSS: MBS: POA Power POA Power

- **cmd** ‘Prime’(‘Redundant’) Keep-Alive (Verify Keep-Alive) (30 s max)

40 POA Powerup

MSS: MBS: POA Power POA Power

- **cmd** ‘Prime’(‘Redundant’) Operational (Verify – Operational)

41

RPC that powers the POA tripped or failed open on alternate string.

A command to transition the POA from KA to Off or Off to KA on the affected string will be rejected.

42

- Continue nominal operations.

7.900 MSS PERSISTENT CAT-2 ERROR

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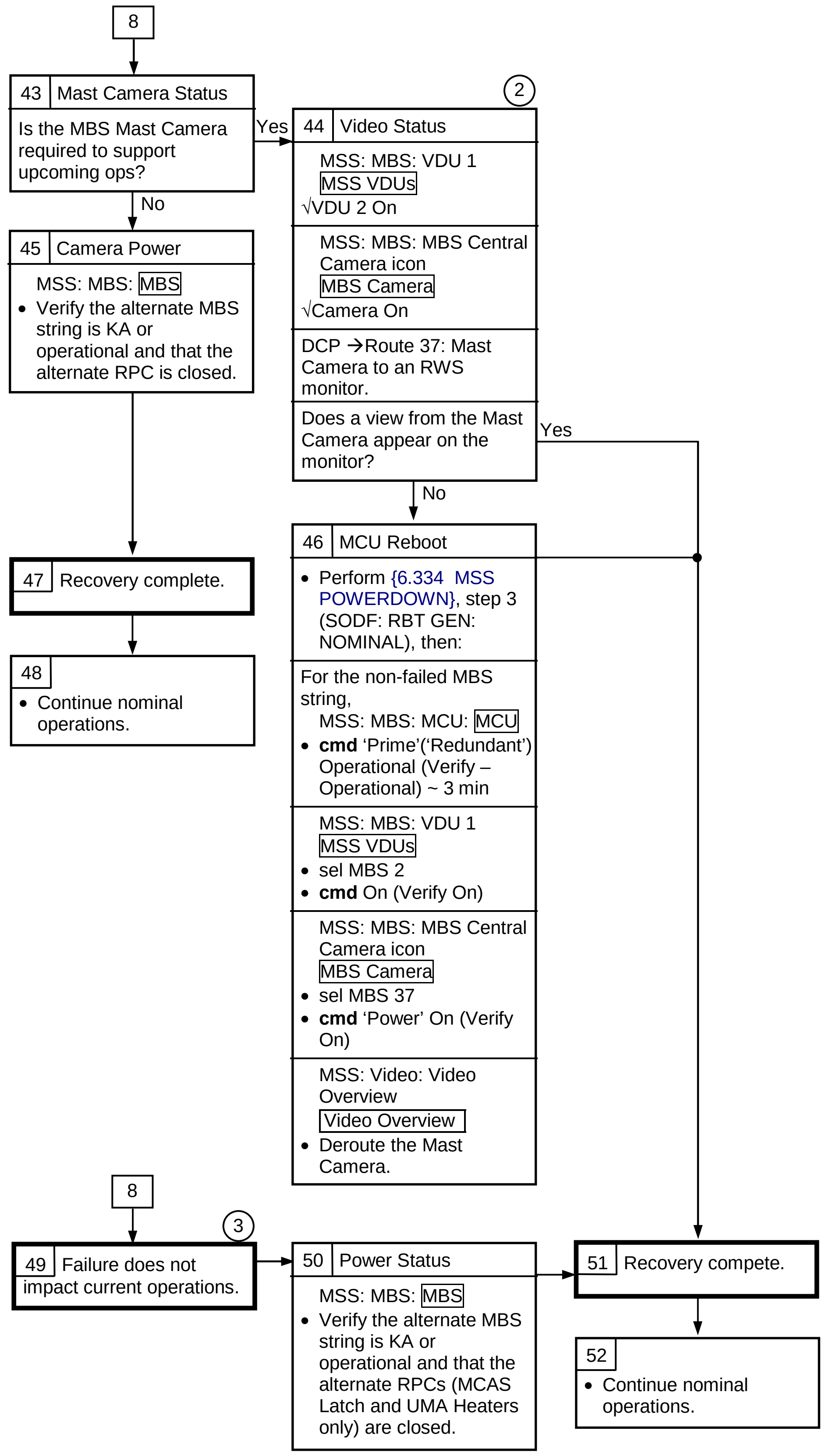

8

43 Mast Camera Status

Is the MBS Mast Camera required to support upcoming ops?

Yes → 44; No → 45

44 Video Status ②

MSS: MBS: VDU 1
MSS VDUs
√VDU 2 On

MSS: MBS: MBS Central Camera icon
MBS Camera
√Camera On

DCP →Route 37: Mast Camera to an RWS monitor.

Does a view from the Mast Camera appear on the monitor?

Yes → 51; No → 46

45 Camera Power

MSS: MBS: MBS
- Verify the alternate MBS string is KA or operational and that the alternate RPC is closed.

46 MCU Reboot

- Perform {6.334 MSS POWERDOWN}, step 3 (SODF: RBT GEN: NOMINAL), then:

For the non-failed MBS string,
MSS: MBS: MCU: MCU
- **cmd** ‘Prime’(‘Redundant’) Operational (Verify – Operational) ~ 3 min

MSS: MBS: VDU 1
MSS VDUs
- sel MBS 2
- **cmd** On (Verify On)

MSS: MBS: MBS Central Camera icon
MBS Camera
- sel MBS 37
- **cmd** ‘Power’ On (Verify On)

MSS: Video: Video Overview
Video Overview
- Deroute the Mast Camera.

47 Recovery complete.

48
- Continue nominal operations.

8

49 Failure does not impact current operations. ③

50 Power Status

MSS: MBS: MBS
- Verify the alternate MBS string is KA or operational and that the alternate RPCs (MCAS Latch and UMA Heaters only) are closed.

51 Recovery compete.

52
- Continue nominal operations.

② If KU AOS, **MCC** can downlink view to ground instead.

③ If ‘MBS CRPCM 1P(1R,2P,2R,3P, 3R) Output Voltage 8 Stat Err’ is annunciated for the alternate string, it will not be possible to cancel safing when the alternate string is commanded to operational (SCR 23241).

7.900 MSS PERSISTENT CAT-2 ERROR

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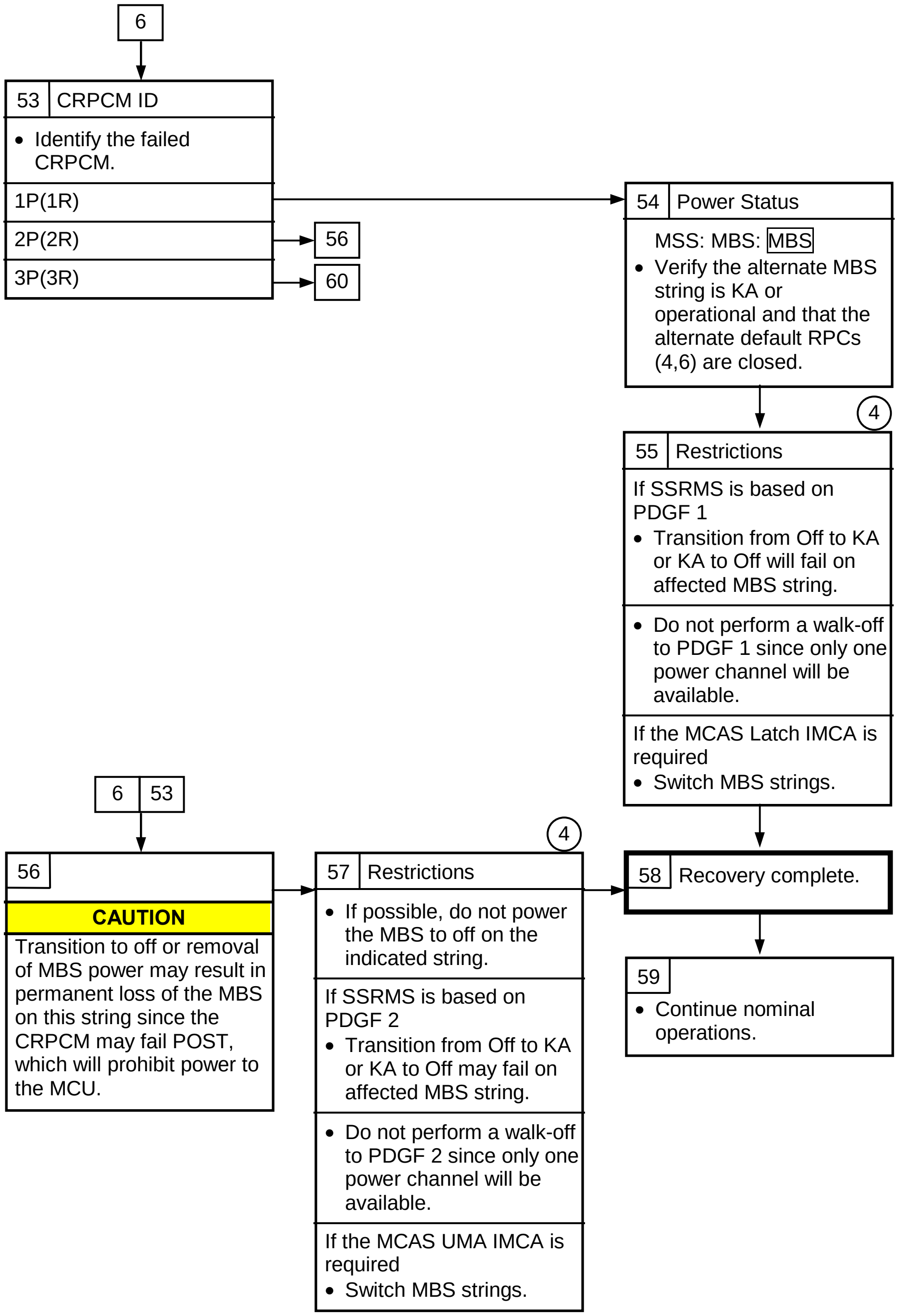

53 CRPCM ID

- Identify the failed CRPCM.

1P(1R) → 54

2P(2R) → 56

3P(3R) → 60

54 Power Status

MSS: MBS: MBS

- Verify the alternate MBS string is KA or operational and that the alternate default RPCs (4,6) are closed.

55 Restrictions ④

If SSRMS is based on PDGF 1

- Transition from Off to KA or KA to Off will fail on affected MBS string.

- Do not perform a walk-off to PDGF 1 since only one power channel will be available.

If the MCAS Latch IMCA is required

- Switch MBS strings.

56

CAUTION

Transition to off or removal of MBS power may result in permanent loss of the MBS on this string since the CRPCM may fail POST, which will prohibit power to the MCU.

57 Restrictions ④

- If possible, do not power the MBS to off on the indicated string.

If SSRMS is based on PDGF 2

- Transition from Off to KA or KA to Off may fail on affected MBS string.

- Do not perform a walk-off to PDGF 2 since only one power channel will be available.

If the MCAS UMA IMCA is required

- Switch MBS strings.

58 Recovery complete.

59

- Continue nominal operations.

④
For a loss of comm with the CRPCM, switching MBS strings may restore full functionality (except for MCAS or POA ops).

7.900 MSS PERSISTENT CAT-2 ERROR

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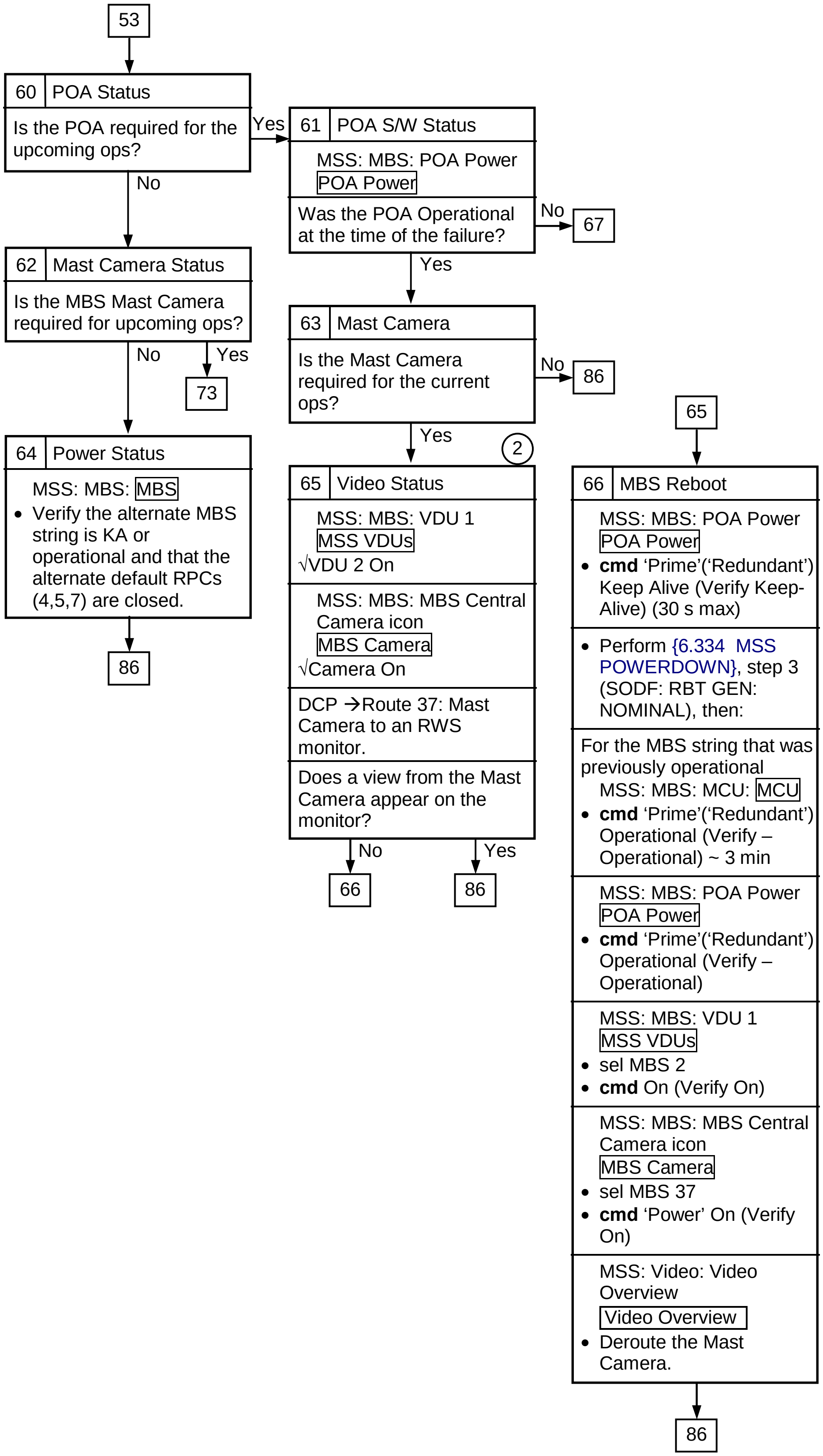
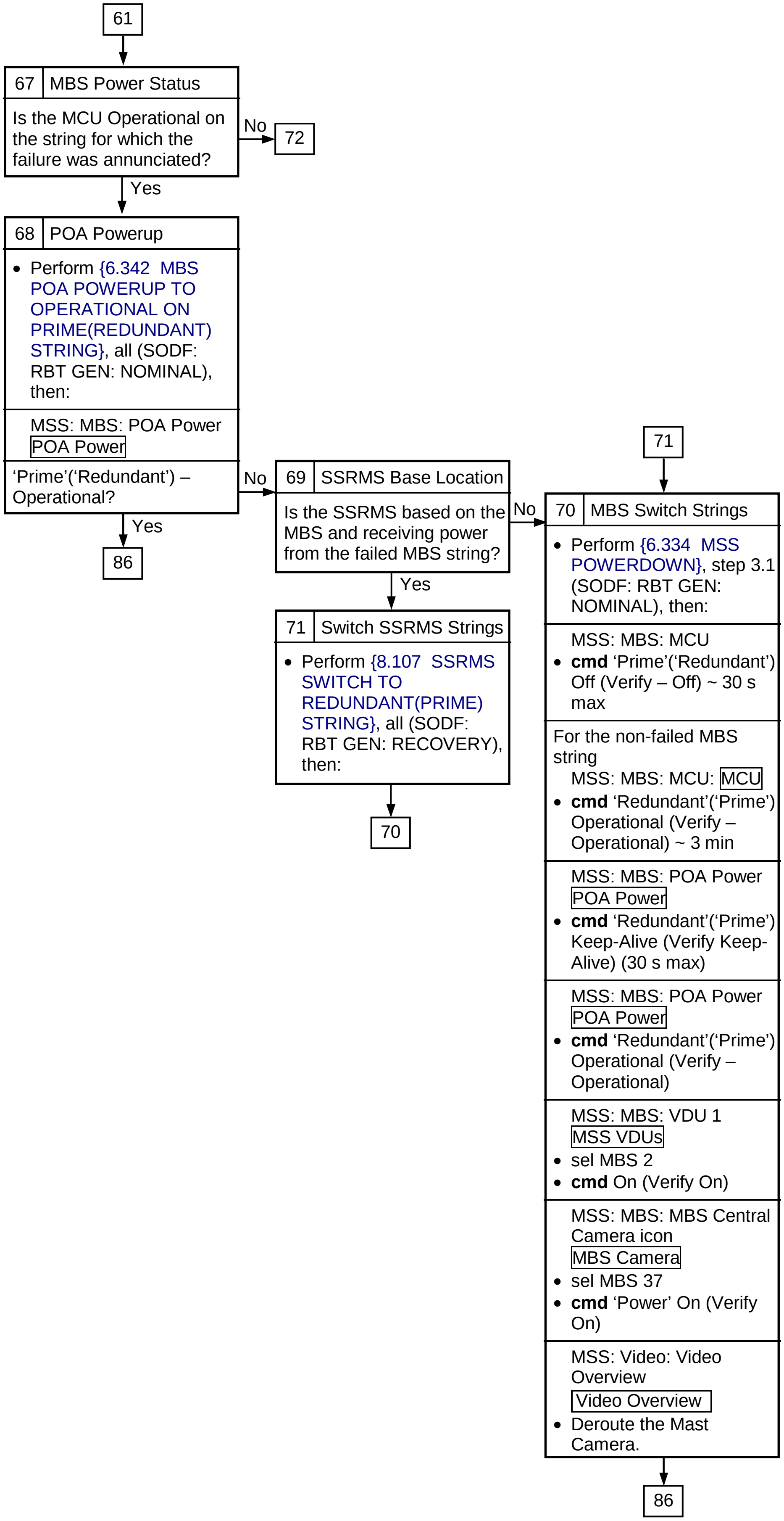


② If KU AOS, **MCC** can downlink view to ground instead.

7.900 MSS PERSISTENT CAT-2 ERROR

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 10 of 16 pages



67 MBS Power Status

Is the MCU Operational on the string for which the failure was annunciated?

68 POA Powerup

- Perform {6.342 MBS POA POWERUP TO OPERATIONAL ON PRIME(REDUNDANT) STRING}, all (SODF: RBT GEN: NOMINAL), then:

MSS: MBS: POA Power
POA Power

'Prime'('Redundant') – Operational?

69 SSRMS Base Location

Is the SSRMS based on the MBS and receiving power from the failed MBS string?

71 Switch SSRMS Strings

- Perform {8.107 SSRMS SWITCH TO REDUNDANT(PRIME) STRING}, all (SODF: RBT GEN: RECOVERY), then:

70 MBS Switch Strings

- Perform {6.334 MSS POWERDOWN}, step 3.1 (SODF: RBT GEN: NOMINAL), then:

MSS: MBS: MCU
- **cmd** 'Prime'('Redundant') Off (Verify – Off) ~ 30 s max

For the non-failed MBS string

MSS: MBS: MCU: MCU
- **cmd** 'Redundant'('Prime') Operational (Verify – Operational) ~ 3 min

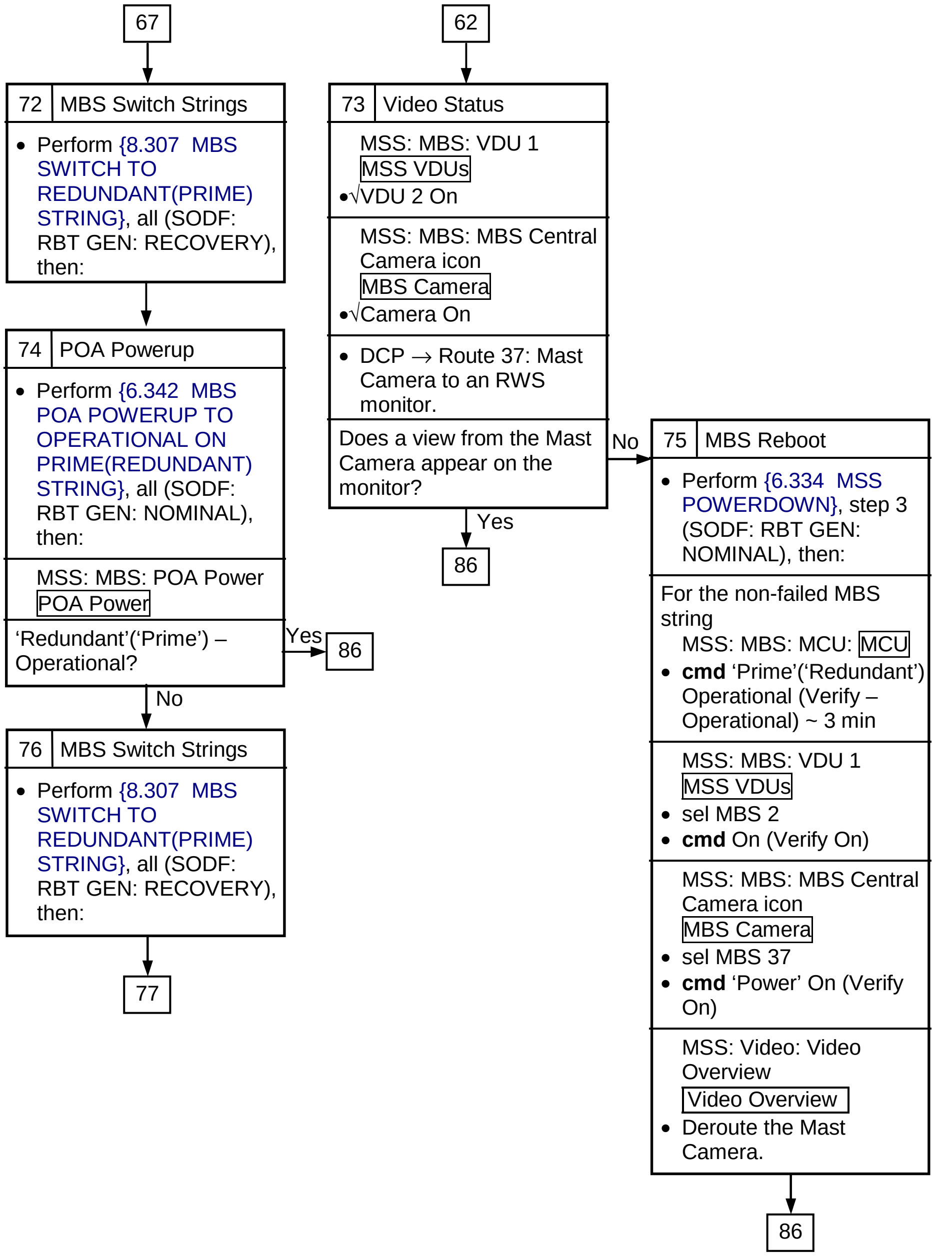
MSS: MBS: POA Power
POA Power
- **cmd** 'Redundant'('Prime') Keep-Alive (Verify Keep-Alive) (30 s max)

MSS: MBS: POA Power
POA Power
- **cmd** 'Redundant'('Prime') Operational (Verify – Operational)

MSS: MBS: VDU 1
MSS VDUs
- sel MBS 2
- **cmd** On (Verify On)

MSS: MBS: MBS Central Camera icon
MBS Camera
- sel MBS 37
- **cmd** 'Power' On (Verify On)

MSS: Video: Video Overview
Video Overview
- Deroute the Mast Camera.



72 MBS Switch Strings

- Perform {8.307 MBS SWITCH TO REDUNDANT(PRIME) STRING}, all (SODF: RBT GEN: RECOVERY), then:

74 POA Powerup

- Perform {6.342 MBS POA POWERUP TO OPERATIONAL ON PRIME(REDUNDANT) STRING}, all (SODF: RBT GEN: NOMINAL), then:

MSS: MBS: POA Power
POA Power

'Redundant'('Prime') – Operational?

76 MBS Switch Strings

- Perform {8.307 MBS SWITCH TO REDUNDANT(PRIME) STRING}, all (SODF: RBT GEN: RECOVERY), then:

73 Video Status

MSS: MBS: VDU 1
MSS VDUs
- √VDU 2 On

MSS: MBS: MBS Central Camera icon
MBS Camera
- √Camera On

- DCP → Route 37: Mast Camera to an RWS monitor.

Does a view from the Mast Camera appear on the monitor?

75 MBS Reboot

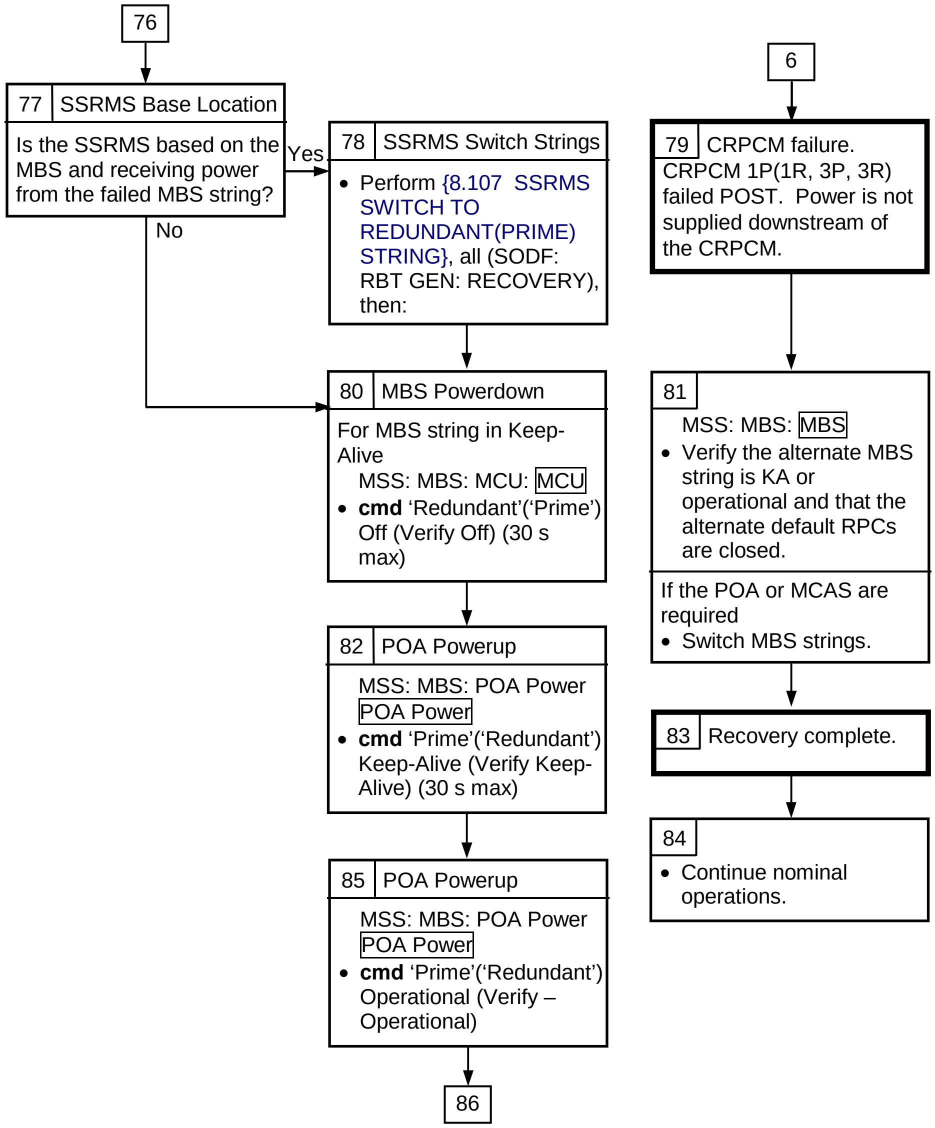
- Perform {6.334 MSS POWERDOWN}, step 3 (SODF: RBT GEN: NOMINAL), then:

For the non-failed MBS string
MSS: MBS: MCU: MCU
- **cmd** 'Prime'('Redundant') Operational (Verify – Operational) ~ 3 min

MSS: MBS: VDU 1
MSS VDUs
- sel MBS 2
- **cmd** On (Verify On)

MSS: MBS: MBS Central Camera icon
MBS Camera
- sel MBS 37
- **cmd** 'Power' On (Verify On)

MSS: Video: Video Overview
Video Overview
- Deroute the Mast Camera.



77 SSRMS Base Location

Is the SSRMS based on the MBS and receiving power from the failed MBS string?

78 SSRMS Switch Strings

- Perform {8.107 SSRMS SWITCH TO REDUNDANT(PRIME) STRING}, all (SODF: RBT GEN: RECOVERY), then:

79 CRPCM failure.

CRPCM 1P(1R, 3P, 3R) failed POST. Power is not supplied downstream of the CRPCM.

80 MBS Powerdown

For MBS string in Keep-Alive

MSS: MBS: MCU: MCU

- **cmd** ‘Redundant’(‘Prime’) Off (Verify Off) (30 s max)

81

MSS: MBS: MBS

- Verify the alternate MBS string is KA or operational and that the alternate default RPCs are closed.

If the POA or MCAS are required

- Switch MBS strings.

82 POA Powerup

MSS: MBS: POA Power POA Power

- **cmd** ‘Prime’(‘Redundant’) Keep-Alive (Verify Keep-Alive) (30 s max)

83 Recovery complete.

84

- Continue nominal operations.

85 POA Powerup

MSS: MBS: POA Power POA Power

- **cmd** ‘Prime’(‘Redundant’) Operational (Verify – Operational)

7.900 MSS PERSISTENT CAT-2 ERROR

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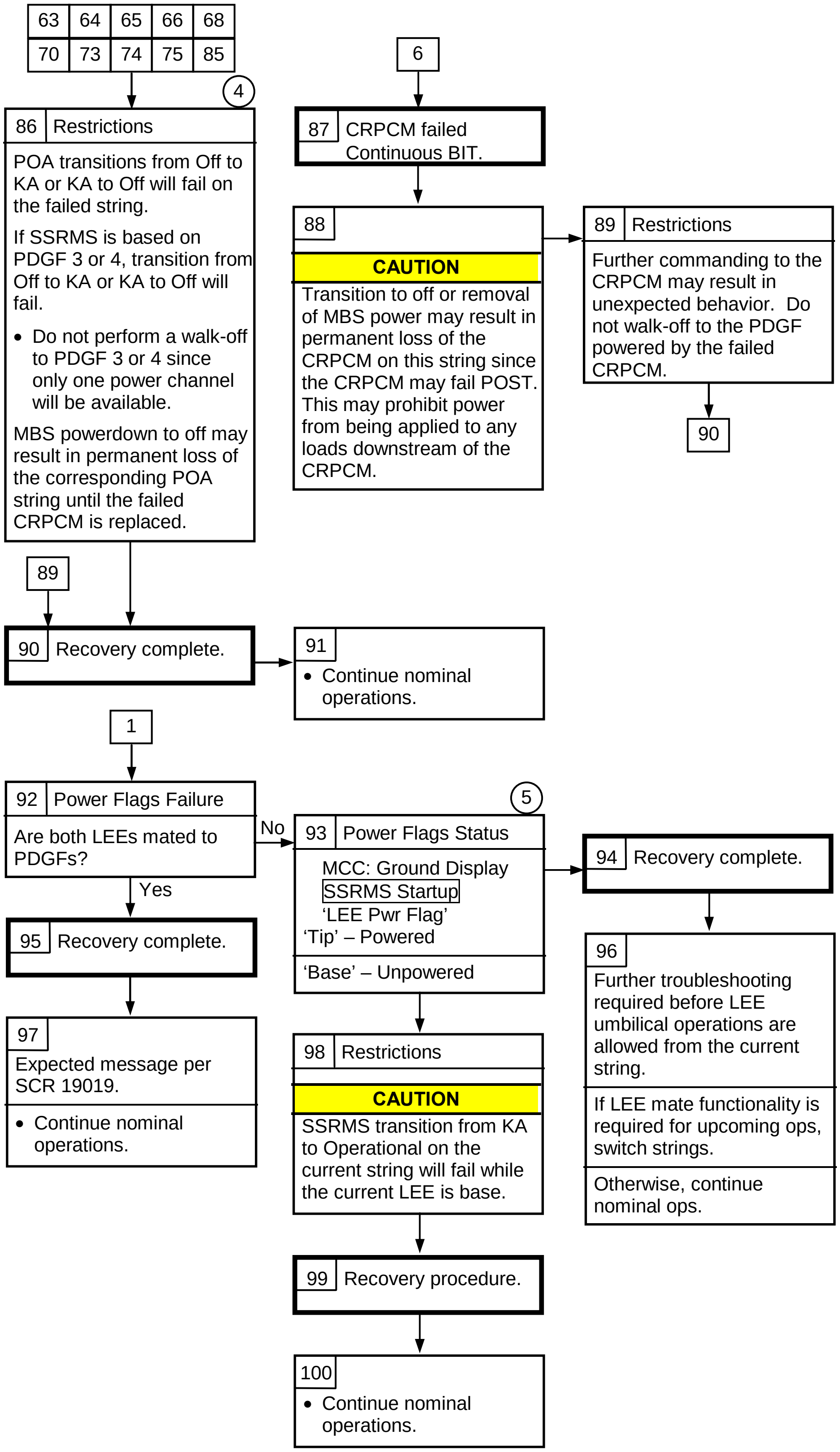


86 Restrictions

POA transitions from Off to KA or KA to Off will fail on the failed string.

If SSRMS is based on PDGF 3 or 4, transition from Off to KA or KA to Off will fail.

- Do not perform a walk-off to PDGF 3 or 4 since only one power channel will be available.

MBS powerdown to off may result in permanent loss of the corresponding POA string until the failed CRPCM is replaced.

87 CRPCM failed Continuous BIT.

88

CAUTION

Transition to off or removal of MBS power may result in permanent loss of the CRPCM on this string since the CRPCM may fail POST. This may prohibit power from being applied to any loads downstream of the CRPCM.

89 Restrictions

Further commanding to the CRPCM may result in unexpected behavior. Do not walk-off to the PDGF powered by the failed CRPCM.

90 Recovery complete.

91

- Continue nominal operations.

92 Power Flags Failure

Are both LEEs mated to PDGFs?

93 Power Flags Status

MCC: Ground Display
SSRMS Startup
'LEE Pwr Flag'
'Tip' – Powered

'Base' – Unpowered

94 Recovery complete.

95 Recovery complete.

96

Further troubleshooting required before LEE umbilical operations are allowed from the current string.

If LEE mate functionality is required for upcoming ops, switch strings.

Otherwise, continue nominal ops.

97

Expected message per SCR 19019.

- Continue nominal operations.

98 Restrictions

CAUTION

SSRMS transition from KA to Operational on the current string will fail while the current LEE is base.

99 Recovery procedure.

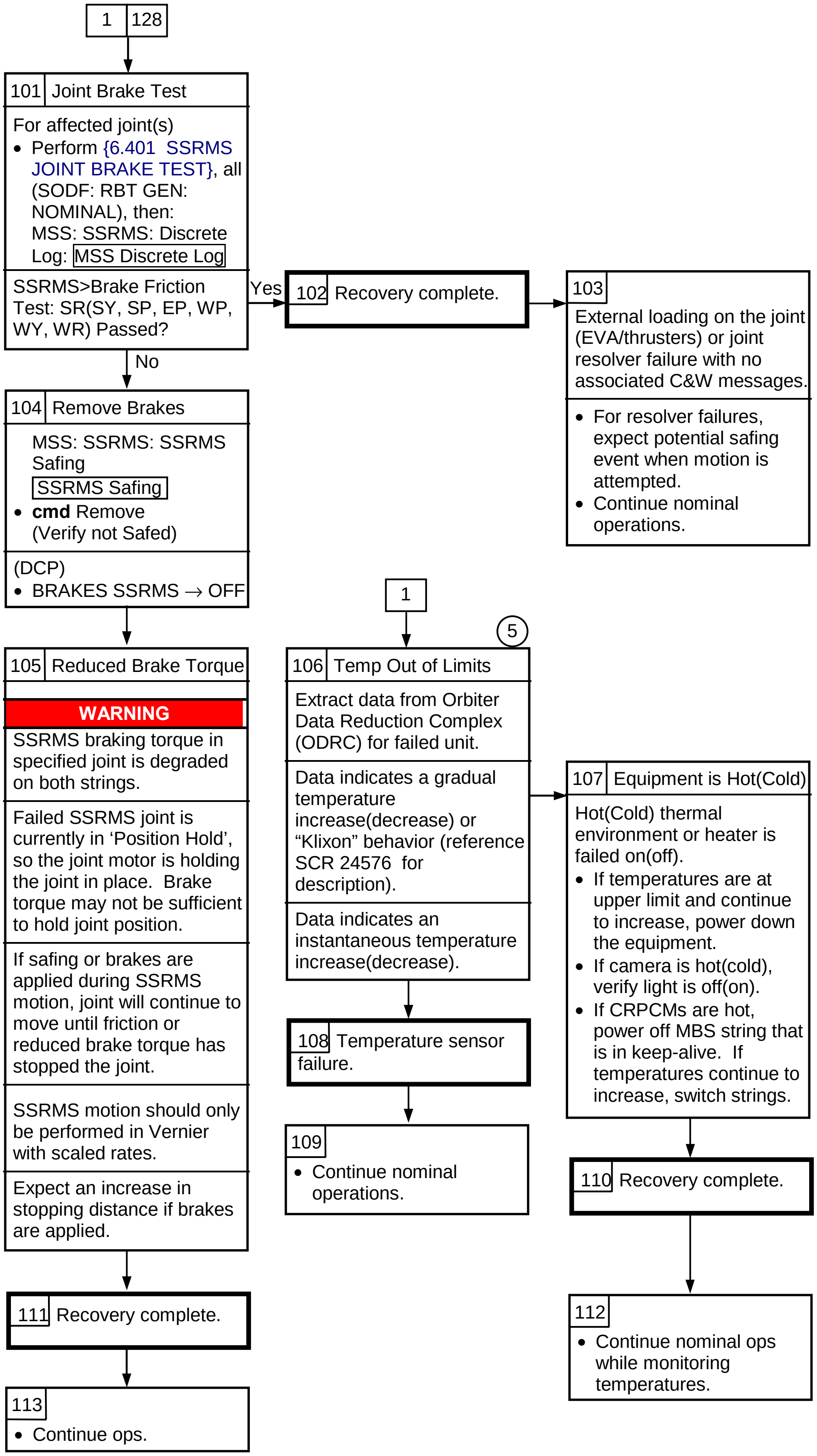
100

- Continue nominal operations.

④ For a loss of comm with the CRPCM, switching MBS strings may restore full functionality (except for MCAS or POA ops).

⑤ This block is ground only.

7.900 MSS PERSISTENT CAT-2 ERROR



101 Joint Brake Test

For affected joint(s)

- Perform {6.401 SSRMS JOINT BRAKE TEST}, all (SODF: RBT GEN: NOMINAL), then: MSS: SSRMS: Discrete Log: MSS Discrete Log

SSRMS>Brake Friction Test: SR(SY, SP, EP, WP, WY, WR) Passed?

102 Recovery complete.

103

External loading on the joint (EVA/thrusters) or joint resolver failure with no associated C&W messages.

- For resolver failures, expect potential safing event when motion is attempted.
- Continue nominal operations.

104 Remove Brakes

MSS: SSRMS: SSRMS Safing

SSRMS Safing

- **cmd** Remove (Verify not Safed)

(DCP)

- BRAKES SSRMS → OFF

105 Reduced Brake Torque

WARNING

SSRMS braking torque in specified joint is degraded on both strings.

Failed SSRMS joint is currently in 'Position Hold', so the joint motor is holding the joint in place. Brake torque may not be sufficient to hold joint position.

If safing or brakes are applied during SSRMS motion, joint will continue to move until friction or reduced brake torque has stopped the joint.

SSRMS motion should only be performed in Vernier with scaled rates.

Expect an increase in stopping distance if brakes are applied.

106 Temp Out of Limits

Extract data from Orbiter Data Reduction Complex (ODRC) for failed unit.

Data indicates a gradual temperature increase(decrease) or "Klixon" behavior (reference SCR 24576 for description).

Data indicates an instantaneous temperature increase(decrease).

107 Equipment is Hot(Cold)

Hot(Cold) thermal environment or heater is failed on(off).

- If temperatures are at upper limit and continue to increase, power down the equipment.
- If camera is hot(cold), verify light is off(on).
- If CRPCMs are hot, power off MBS string that is in keep-alive. If temperatures continue to increase, switch strings.

108 Temperature sensor failure.

109

- Continue nominal operations.

110 Recovery complete.

111 Recovery complete.

112

- Continue nominal ops while monitoring temperatures.

113

- Continue ops.

⑤ This block is ground only.

7.900 MSS PERSISTENT CAT-2 ERROR

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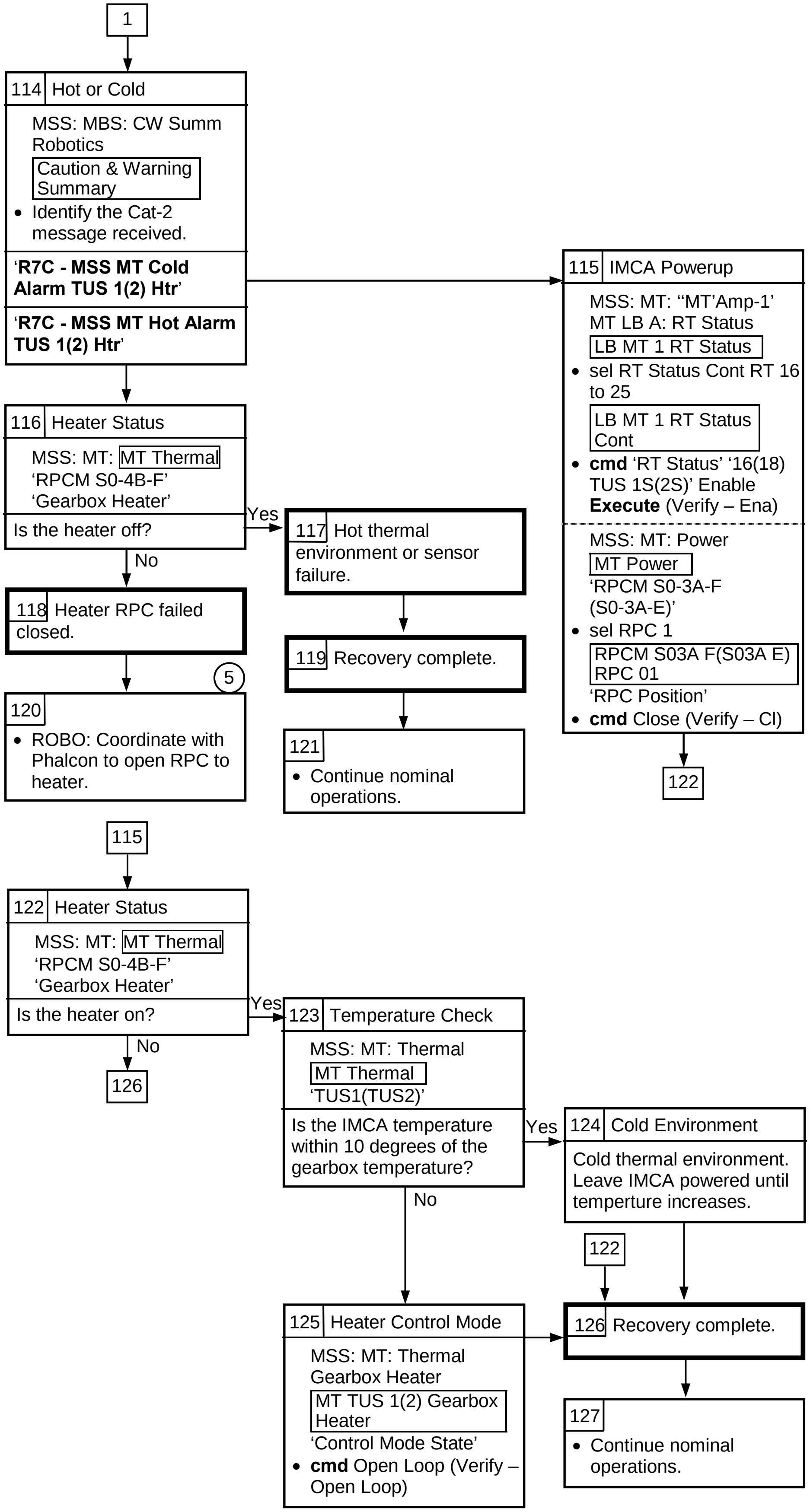

1

114 Hot or Cold

MSS: MBS: CW Summ Robotics

Caution & Warning Summary

- Identify the Cat-2 message received.

'**R7C - MSS MT Cold Alarm TUS 1(2) Htr**' → 115

'**R7C - MSS MT Hot Alarm TUS 1(2) Htr**' → 116

115 IMCA Powerup

MSS: MT: "MT'Amp-1'

MT LB A: RT Status

LB MT 1 RT Status

- sel RT Status Cont RT 16 to 25

LB MT 1 RT Status Cont

- **cmd** 'RT Status' '16(18) TUS 1S(2S)' Enable **Execute** (Verify – Ena)

MSS: MT: Power

MT Power

'RPCM S0-3A-F (S0-3A-E)'

- sel RPC 1

RPCM S03A F(S03A E) RPC 01

'RPC Position'

- **cmd** Close (Verify – Cl)

122

116 Heater Status

MSS: MT: MT Thermal

'RPCM S0-4B-F'

'Gearbox Heater'

Is the heater off?

Yes → 117; No → 118

117 Hot thermal environment or sensor failure.

118 Heater RPC failed closed.

119 Recovery complete.

120 ⑤

- ROBO: Coordinate with Phalcon to open RPC to heater.

121

- Continue nominal operations.

115

122 Heater Status

MSS: MT: MT Thermal

'RPCM S0-4B-F'

'Gearbox Heater'

Is the heater on?

Yes → 123; No → 126

123 Temperature Check

MSS: MT: Thermal

MT Thermal

'TUS1(TUS2)'

Is the IMCA temperature within 10 degrees of the gearbox temperature?

Yes → 124; No → 125

124 Cold Environment

Cold thermal environment. Leave IMCA powered until temperture increases.

122

125 Heater Control Mode

MSS: MT: Thermal Gearbox Heater

MT TUS 1(2) Gearbox Heater

'Control Mode State'

- **cmd** Open Loop (Verify – Open Loop)

126 Recovery complete.

127

- Continue nominal operations.

⑤ This block is ground only.

7.900 MSS PERSISTENT CAT-2 ERROR

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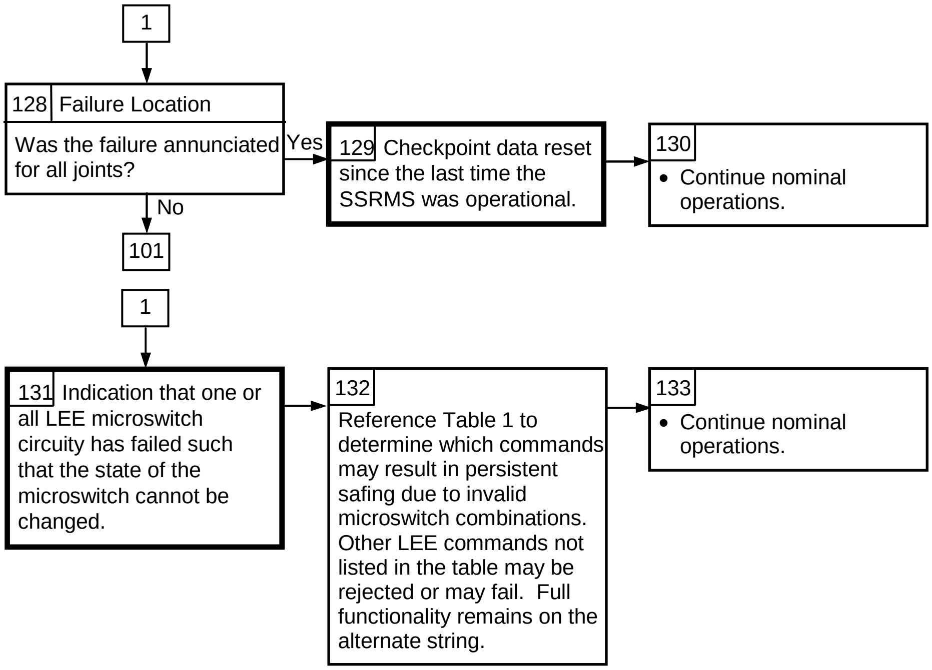

Table 1: LEE Commands that will result in Persistent safing

Microswitch	Permanent Indication	Action that will safe the SSRMS
Open	Open	Snare is captured or closed
Close	Close	Snare is opened
Capture	Capture	Snare is opened
Extend	Extend	Carriage is rigidized or retracted
Retract	Retract	Carriage is derigidized or extended
Derigidize	Derigidize	Carriage is retracted
	Not Derigidize	Carriage is extended
Disengage-Demated	Disengaged-Demated	Latches are engaged, umbilicals are mated, Latch motion is detected, Prime or Redundant Loopbacks are achieved
Engaged-Demated	Engaged-Demated	Latches are disengaged or Latch motion is detected
Engaged-Mated	Engaged-Mated	Latches are disengaged, Umbilicals are demated, or Latch motion is detected
	Not Engaged-Mated	Either prime or redundant loopback is acquired
Motion Detection	Motion Detection	Latches are driven to any microswitch when not already tripping any microswitch before motion
Prime Loopback	Prime Loopback	Latches are disengaged, Latch motion is detected, or Umbilicals are demated
Redundant Loopback	Redundant Loopback	Latches are disengaged, Latch motion is detected, or Umbilicals are demated

CORRECTIVE

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8.101 MANUAL CAPTURE WITH CALIBRATED LEE

(RBT GEN/X2R4 - ALL/FIN 3/SPN) Page 1 of 4 pages

1. SETUP

PCS MSS: SSRMS: Tip LEE: SSRMS Tip LEE

√LEE Mechanisms – Calibrated

****
* If LEE Mechanisms – Not Calibrated
* | Perform {6.421 LEE CALIBRATION}, all
* | (SODF: RBT GEN: NOMINAL), then:
****

√Setup – Yes

****
* If Setup – No
* | Perform {6.428 LEE SETUP FOR CAPTURE},
* | all (SODF: RBT GEN: NOMINAL), then:
****

Prior to beginning payload capture, review {SSRMS LEE CUE CARD}, all (SODF: RBT GEN: REFERENCE), then:

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

Configure cameras and overlays for grapple.

MSS: SSRMS: SSRMS

√Manual – blue
√Vernier

2. GRAPPLE MANEUVER

RHC/THC Maneuver to within grapple envelope.

3. LIMP SSRMS

MSS: SSRMS: Limp: SSRMS Limp

cmd All Limp (Verify Limp – blue)

PCS MSS: SSRMS: SSRMS

Verify all joints – Limped

4. CLOSE SNARES

PCS MSS: SSRMS: Tip LEE: SSRMS Tip LEE

cmd ‘Snare’ Close ▶ Slow, Soft Stops

Verify Speed – Slow
Verify Stops – Soft
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 – Close Snares

RHC TRIGGER → press (hold until ’Snare’ Brakes – On) (12 s(3 s) max)

PCS Verify ‘Snare’ Close, Capture (two) – blue

5. RETRACT CARRIAGE

PCS MSS: SSRMS: Tip LEE: SSRMS Tip LEE

cmd ‘Carriage’ Retract ▶ Slow, Soft Stops

Verify Speed – Slow
Verify Stops – Soft
Verify ‘**Confirm or Terminate**’ prompt.

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Retract Carriage

RHC TRIGGER → press (hold until ‘Carriage’ Brakes – On) (90 s(24 s) max)

PCS Verify ‘Carriage’ Retract – blue
Verify ‘Carriage’ Tension > 4003 N

6. LATCH

If grapple fixture is an FRGF or latching is not required, go to step 8.

MSS: SSRMS: Tip LEE: SSRMS Tip LEE

cmd ‘Latch’ Latch ▶ Slow, Soft Stops

Verify Speed – Slow
Verify Stops – Soft
Verify ‘**Confirm or Terminate**’ prompt.

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Latch

RHC TRIGGER → press (hold until 'Latch' Brakes – On) (65 s(13 s) max)

Verify 'Latch' Latch – blue

7. MATE UMBILICALS

If mating of the umbilicals is required

PCS MSS: SSRMS: Tip LEE: SSRMS Tip LEE

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

> NOTE
> Expect '**R3L - SSRMS Pwr Flags Fail**' Robotics Advisory message when mating 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

8. DELIMP SSRMS

PCS MSS: SSRMS: Limp: SSRMS Limp

cmd None Limp (Verify Standby – blue)

9. SSRMS DEADSTART CALIBRATION

> NOTE
> 1. This step should only be performed if uncommanded Derig detection is required for the planned operations.
>
> 2. Expect the following message when safing is commanded:
> '**R3Z - MSS OCS SSRMS Prime(Redun) ACU SRT Cat-1 Brk Stat Fail**' (SCR 17495)
> All messages should return to Norm.

DCP SAFING → SAFE (Verify Safed)

PCS MSS: SSRMS: SSRMS Safing: SSRMS Safing

cmd Remove (Verify Not Safed)

DCP SSRMS BRAKES → OFF (Verify OFF)

10. DERIGIDIZE CARRIAGE
If derigidization of the carriage is not required >>

PCS MSS: SSRMS: Tip LEE: SSRMS Tip LEE

cmd ‘Carriage’ Derigidize ▶ Slow (Verify Speed – Slow)

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

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Derigidize

RHC TRIGGER → press (momentarily) (SCR 19064)

PCS Verify ‘Carriage’ Derigidize – blue (90 s max)

8.102 MANUAL RELEASE WITH CALIBRATED LEE

I

(RBT GEN/E9 - ALL/FIN 4/SPN) Page 1 of 4 pages

1. VERIFY LEE CALIBRATION STATUS

PCS MSS: SSRMS: Tip LEE: SSRMS Tip LEE

If LEE Mechanisms – Not Calibrated
Go to {8.103 MANUAL RELEASE WITH UNCALIBRATED LEE}, all (SODF: RBT GEN: CORRECTIVE).

2. RIGIDIZE CARRIAGE

MSS: SSRMS: Tip LEE: SSRMS Tip LEE

If ‘Latch’ Latch – blue and ‘Carriage’ Tension < 2891 N

cmd ‘Carriage’ Rigidize ▶ Slow (Verify Speed – Slow)

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

CAUTION

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

NOTE

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

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Rigidize

RHC TRIGGER → press (momentarily) (SCR 19064)

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

3. LIMP SSRMS AND ENTER MODE

PCS MSS: SSRMS: Limp: SSRMS Limp

cmd All Limp (Verify Limp – blue)

MSS: SSRMS: SSRMS

Verify All Joints – Limped

Wait 30 seconds.

MSS: SSRMS: Limp: SSRMS Limp

cmd None Limp (Verify Standby – blue)

Enter Mode – Manual (Verify blue)

√Vernier

4. DEMATE UMBILICALS

DCP √BRAKES OFF – ☐

PCS MSS: SSRMS: Tip LEE: SSRMS Tip LEE

If ‘Umbilical’ Mate – blue

cmd ‘Umbilical’ Demate (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 – Demate

RHC TRIGGER → press (momentarily)

PCS Verify ‘Umbilical’ Demate – blue (10 s max)

5. UNLATCH

PCS MSS: SSRMS: Tip LEE: SSRMS Tip LEE

If ‘Latch’ Latch – blue

cmd ‘Latch’ Unlatch ▶ Slow, Soft Stops

Verify Speed – Slow
Verify Stops – Soft
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 – Unlatch

RHC TRIGGER → press (hold until 'Latch' Brakes – On) (65 s max)

Verify 'Latch' Unlatch – blue

6. DERIGIDIZE CARRIAGE

MSS: SSRMS: Tip LEE: SSRMS Tip LEE

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

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

CAUTION

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

NOTE

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

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Derigidize

RHC TRIGGER → press (momentarily) (SCR 19064)

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

7. OPEN SNARES

PCS MSS: SSRMS: Tip LEE: SSRMS Tip LEE

cmd 'Snare' Open ▶ Slow, Soft Stops

Verify Speed – Slow
Verify Stops – Soft
Verify '**Confirm or Terminate**' prompt.

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Open Snares

RHC TRIGGER → press (hold until 'Snare' Brakes – On) (12 s max)

Verify 'Snare' Open – blue

THC Back off from grapple fixture until clear of pin.

8. EXTEND CARRIAGE

MSS: SSRMS: Tip LEE: SSRMS Tip LEE

cmd ‘Carriage’ Extend ▶ Slow, Soft Stops

Verify Speed – Slow
Verify Stops – Soft
Verify ‘**Confirm or Terminate**’ prompt.

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Extend Carriage

RHC TRIGGER → press (hold until ’Carriage’ Brakes – On) (90 s max)

Verify ‘Carriage’ Extend – blue

8.103 MANUAL RELEASE WITH UNCALIBRATED LEE

(RBT GEN/E9 - ALL/FIN 4/SPN) Page 1 of 3 pages

1. RETRACT CARRIAGE

PCS MSS: SSRMS: Tip LEE: SSRMS Tip LEE

If 'Latch' Latch – blue and 'Carriage' Retract – gray

cmd 'Carriage' Retract ▶ Hard Stops ▶ Slow, Hard Stops

Verify Speed – Slow
Verify Stops – Hard
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 (SPN 1892, 3160).

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Retract Carriage

RHC TRIGGER → press (hold until 'Carriage' Brakes – On) (90 s max)

Verify 'Carriage' Retract – blue

2. LIMP SSRMS AND ENTER MODE

PCS MSS: SSRMS: Limp: SSRMS Limp

cmd All Limp (Verify Limp – blue)

MSS: SSRMS: SSRMS

Verify All Joints – Limped

Wait 30 seconds.

MSS: SSRMS: Limp: SSRMS Limp

cmd None Limp (Verify Standby – blue)

Enter Mode – Manual (Verify blue)

√Vernier

3. DEMATE AND UNLATCH

If ‘Latch’ Latch – blue

cmd ‘Latch’ Unlatch ▶ Hard Stops ▶ Slow, Hard Stops

Verify Speed – Slow
Verify Stops – Hard
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 (SPN 1892, 3160).

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Unlatch

RHC TRIGGER → press (hold until ’Latch’ Brakes – On) (65 s max)

Verify ‘Latch’ Unlatch – blue

4. DERIGIDIZE CARRIAGE

MSS: SSRMS: Tip LEE: SSRMS Tip LEE

cmd ‘Carriage’ Extend ▶ Hard Stops ▶ Slow, Hard Stops

Verify Speed – Slow
Verify Stops – Hard
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 (SPN 1892, 3160).

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Extend Carriage

8.103 MANUAL RELEASE WITH UNCALIBRATED LEE

(RBT GEN/E9 - ALL/FIN 4/SPN) Page 3 of 3 pages

> **CAUTION**
>
> The trigger must be released once the Derigidize indication turns blue. Failure to do so will cause the carriage to hit the grapple fixture cams, possibly causing hardware damage.

RHC TRIGGER → press (hold until ‘Carriage’ Derigidize – blue) (90 s max)

PCS **cmd** Terminate

5. OPEN SNARES

PCS MSS: SSRMS: Tip LEE: SSRMS Tip LEE

cmd ‘Snare’ Open ▶ Hard Stops ▶ Slow, Hard Stops

Verify Speed – Slow
Verify Stops – Hard
Verify ‘**Confirm or Terminate**’ prompt.

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Open Snares

RHC TRIGGER → press (hold until ’Snare’ Brakes – On) (12 s max)

PCS Verify ‘Snare’ Open – blue

THC Back off from grapple fixture until clear of pin.

6. EXTEND CARRIAGE

PCS MSS: SSRMS: Tip LEE: SSRMS Tip LEE

cmd ‘Carriage’ Extend ▶ Hard Stops ▶ Slow, Hard Stops

Verify Speed – Slow
Verify Stops – Hard
Verify ‘**Confirm or Terminate**’ prompt.

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Extend Carriage

RHC TRIGGER → press (hold until ’Carriage’ Brakes – On) (90 s max)

Verify ‘Carriage’ Extend – blue

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8.104 MSS CHECKPOINT DATA RESET

(RBT GEN/X2R4 - ALL/FIN/SPN) Page 1 of 5 pages

NOTE
This procedure was created for SPN 956.

1. CHECKING FOR ACTIVE RWS

If either RWS is Active, for Active RWS

PCS MSS: LAP5(LAS5) Initialize: LAP5(LAS5) Initialization

Verify 'Frame Count' incrementing

MSS: SSRMS: Checkpoint Data: Checkpoint Data

cmd Checkpoint Current Data >>

2. MSS CYCLIC CHECKPOINT DATA LOAD

PCS If PCSCDS Main Control Panel is an icon, restore the 'cds_ui' icon.

PCSCDS Main Control Panel

sel Commands ▶ File Transfer

File and Memory Transfer

sel Commands ▶ Indirect Data Load

Indirect Data Load

sel Target Node ▶ CCS CCD2

NOTE
Opening displays or initiating other file transfers on this or any other PCS during the MSS Event Driven Checkpoint Data load could cause the load to fail.

cmd Apply

File and Memory Transfer

Verify 'Active Transfers' Transfer Status – OK

NOTE
This file load could take up to 2 minutes. The progress of the file load can be determined by selecting the entry in the Active Transfers window and then selecting Status. An entry will appear in the window at the bottom of the display with the current status.

Verify 'Completed Transfers' Transfer Status – COMPLETED

3. MSS EVENT DRIVEN CHECKPOINT DATA LOAD

Indirect Data Load

sel Target Node ▶ CCS EDCD3

> NOTE
> Opening displays or initiating other file transfers on this or any other PCS during the MSS Event Driven Checkpoint Data load could cause the load to fail.

cmd Apply

File and Memory Transfer

Verify ‘Active Transfers’ Transfer Status – OK

> NOTE
> This file load could take up to 2 minutes. The progress of the file load can be determined by selecting the entry in the Active Transfers window and then selecting Status. An entry will appear in the window at the bottom of the display with the current status.

Verify ‘Completed Transfers’ Transfer Status – COMPLETED

sel Commands ▶ Close

Verify Shutdown

sel Yes

4. VERIFY CYCLIC CHECKPOINT DATA LOAD

MSS: SSRMS: SSRMS

Verify SSRMS Joint and FOR configuration.

SR	SY	SP	EP	WP	WY	WR
0.0	0.0	0.0	0.0	0.0	0.0	0.0
X	Y	Z	Pitch	Yaw	Roll	
0.0	0.0	0.0	0.0	0.0	0.0	

5. VERIFY EVENT DRIVEN CHECKPOINT DATA LOAD

> NOTE
> The following values may not reflect the current system configuration but are used to confirm a successful event driven checkpoint data load. These values will be updated in step 7 with the actual system configuration.

Verify ‘Base LEE’ – B
Verify ‘PDGF’ – LAB

6. RWS POWERUP

If neither LAB nor Cupola RWS is initialized
  Perform {6.332 MSS POWERUP}, step 1 (SODF: RBT GEN: NOMINAL), then:

7. SET CURRENT CHECKPOINT DATA

PCS MSS: LAP5 CEU Mode: CEU Mode

cmd 'Cupola (LAS5)' ('Lab (LAP5)') Active (Verify – Active)

> NOTE
> SSRMS/MBS data referenced in this step may be incorrect on the PCS. The selection should reflect the actual state of the system. If the actual state of the system is unknown, √**MCC**.

MSS: SSRMS: Checkpoint Data: Checkpoint Data

Enter 'SSRMS' 'Payload' per Table 1.

Table 1. SSRMS/POA Payload Selection

Description	Payload
Snares are open or closed with no capture indication.	Released
If GF is PDGF Snares are closed with capture indication but not latched (may be rigidized). If GF is FRGF or RSGF Snares are closed with capture indication but not rigidized.	Captive
If GF is PDGF Snares are closed with capture indication, rigidized, and latched. If GF is FRGF or RSGF Snares are closed with capture indication and rigidized.	Captured

Enter 'SSRMS' 'Umbilical' per Table 2.

Table 2. SSRMS/POA/MCAS Umbilical Selection

Description	Umbilical
Umbilical is not mated to a payload.	Demated
Umbilical is mated to a payload.	Mated

Enter ‘SSRMS’ ‘Effector’ per Table 3.

Table 3. SSRMS/POA Effector Selection

Description	Effector
Effector is Setup for capture (snares open, carriage extended, latches retracted).	Setup
Effector is neither Setup nor Captive.	Intermediate
Snares are closed with a capture indication.	Captive

Enter ‘SSRMS’ ‘Calibration’ – Not Calibrated
Enter ‘SSRMS’ ‘Base Location’.
Enter ‘SSRMS’ ‘Operating Base’.

Enter ‘POA’ ‘Payload’ per Table 1.
Enter ‘POA’ ‘Umbilical’ per Table 2.
Enter ‘POA’ ‘Effector’ per Table 3.
Enter ‘POA’ ‘Calibration’ – Not Calibrated

Enter ‘MCAS’ ‘Payload’ per Table 4.

Table 4. MCAS Payload Selection

Description	Payload
MCAS Latch is open.	Released
MCAS Latch is closed.	Captured

Enter ‘MCAS’ ‘Umbilical’ per Table 2.

input ‘SSRMS Joint Positions’ (seven) – 0

input ‘Dead Start’ ‘SSRMS’ (eight) – 0
input ‘Dead Start’ ‘POA’ (eight) – 0

cmd Configure Checkpoint Data

8. MSS POWERDOWN

DCP **cmd** STOP (Verify – ☐)

9. SSRMS AND MBS POWERUP

MSS: MBS: MCU: MCU

NOTE
All power statuses on the MBS page, except for ‘MT UOP’, ‘Pwr 1’, and ‘Pwr 2’, do not reflect the current hardware status when MBS is in the Keep-Alive state.

cmd ‘Prime’, ‘Redundant’ (two) – Keep-Alive (Verify – Keep-Alive) (30 s max)

NOTE

1. The operator can follow the transition to Operational by looking at the MSS discrete log.

2. The transition from Keep-Alive to Operational can be stopped at anytime by commanding SAFING on the DCP.

cmd 'Prime'('Redundant') – Operational

Verify Systems State – Operational) (~3 min)

MSS: SSRMS: Power: SSRMS Power

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

NOTE

When the SSRMS is next taken to Operational, expect the following Robotics Advisory messages:
'**R9C - MSS OCS SSRMS SR Joint Init Posn Err**'
'**R9C - MSS OCS SSRMS SY Joint Init Posn Err**'
'**R9C - MSS OCS SSRMS SP Joint Init Posn Err**'
'**R9C - MSS OCS SSRMS EP Joint Init Posn Err**'
'**R9C - MSS OCS SSRMS WP Joint Init Posn Err**'
'**R9C - MSS OCS SSRMS WY Joint Init Posn Err**'
'**R9C - MSS OCS SSRMS WR Joint Init Posn Err**'

10. E-STOP RESET

MSS: RWS: Reset: E-Stop Reset

cmd Yes

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8.106 SSRMS REBOOT PRIME(REDUNDANT) STRING

(RBT GEN/X2R4 - ALL/FIN 2/SPN) Page 1 of 2 pages

1. SAFING STATUS CHECK

PCS MSS: SSRMS: SSRMS

√'SSRMS Safing' – Safed

2. TRANSITION PRIME(REDUNDANT) STRING TO OFF

NOTE

1. It might take up to 30 seconds for the Off status indication to appear on the PCS.
2. Expect the '**R1E - MSS Active OCS SSRMS Prime(Redun) ACU SRT Comm Fail**' Robotics Advisory message (SCR 17730).
3. If the SSRMS is Operational, expect the '**R1E - CUP(LAB) RWS CEU PLB (MLB) ACU Cmd Resp Sync Msg Err**' Robotics Advisory message (SCR 31294).

PCS MSS: SSRMS: Power: SSRMS Power

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

3. TRANSITION PRIME(REDUNDANT) STRING TO KEEP-ALIVE

NOTE

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

PCS MSS: SSRMS: Power: SSRMS Power

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

4. TRANSITION PRIME(REDUNDANT) STRING TO OPERATIONAL

NOTE

1. SSRMS transition from Keep-Alive to Operational will require at least 6 minutes to complete. The time is contingent on file transfer activity from the C&C MDM.
2. The transition from Keep-Alive to Operational can be stopped at any time by issuing a safing command.
3. If Tip LEE is mated to a PDGF connected to ISS Ground, expect '**R3L - SSRMS Pwr Flags Fail**' Robotics Advisory message (SCR 19019).
4. While the SSRMS transitions from Keep-Alive to Operational, 17 LEE inhibit errors will go to Norm approximately 10 seconds after they are raised:
   '**R9B - SSRMS LEE … Inh Err**'

MSS: SSRMS: Power: SSRMS Power

cmd ‘SSRMS’ Prime(Redundant) – Operational

Verify Systems State – Operational

5. VIDEO SYSTEM POWERUP

NOTE

Expect ‘**R6F - SSRMS… PFM Carrier On Video …Err**’ Robotics Advisory message as each VDU is powered on. Message may toggle in and out of alarm until video is routed to the defined VDU (SCR 24376).

PCS MSS: SSRMS: Base LEE VDU: MSS VDUs

sel ‘[X]’ as required where [X] = Base LEE Base Elbow Tip Elbow Tip LEE

cmd ‘[X]’ On (Verify – On)

Repeat

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

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

cmd ‘Power’ On (Verify – On)

Repeat

6. SSRMS VIDEO DEROUTING

MSS:Video: Video Routing

Repeat the following for all destinations to which an SSRMS Camera is routed:

sel ‘Destination Icon’

cmd ‘Deroute Video Signal’ – Deroute

8.107 SSRMS SWITCH TO REDUNDANT(PRIME) STRING

(RBT GEN/X2R4 - ALL/FIN 2/SCR) Page 1 of 3 pages

1. SAFING STATUS CHECK

PCS MSS: SSRMS: SSRMS

√'SSRMS Safing' – Safed

2. TRANSITION PRIME(REDUNDANT) STRING TO OFF

NOTE

1. It might take up to 30 seconds for the Off status indication to appear on the PCS.
2. Expect the '**R1E - MSS Active OCS SSRMS Prime(Redun) ACU SRT Comm Fail**' Robotics Advisory message (SCR 17730).
3. If the SSRMS is Operational, expect the '**R1E - CUP(LAB) RWS CEU PLB (MLB) ACU Cmd Resp Sync Msg Err**' Robotics Advisory message (SCR 31294).
4. If based on an MBS PDGF, expect the following Robotics Advisory message to go to Norm for each SSRMS string that was in Keep-Alive:
   '**R2O - MBS CRPCM … Output Voltage … Stat Err**'

MSS: SSRMS: Power: SSRMS Power

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

3. TRANSITION ALTERNATE STRING TO KEEP-ALIVE

NOTE

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

MSS: SSRMS: Power: SSRMS Power

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

4. TRANSITION ALTERNATE STRING TO OPERATIONAL

NOTE

1. SSRMS transition from Keep-Alive to Operational will require at least 6 minutes to complete. The time is contingent on file transfer activity from the C&C MDM.
2. The transition from Keep-Alive to Operational can be stopped at any time by issuing a safing command.
3. If Tip LEE is mated to a PDGF, expect '**R3L - SSRMS Pwr Flags Fail**' Robotics Advisory message (SCR 19019).
4. While the SSRMS transitions from Keep-Alive to Operational, the following 17 LEE inhibit errors will go to Norm approximately 10 seconds after they are raised:
   '**R9B - SSRMS LEE … Inh Err**'

MSS: SSRMS: Power: SSRMS Power

cmd 'SSRMS' Redundant(Prime) – Operational

Verify 'Systems State' – Operational

5. VIDEO SYSTEM POWERUP

NOTE

Expect '**R6F - SSRMS… PFM Carrier On Video …Err**' Robotics Advisory message as each VDU is powered on. Message may toggle in and out of alarm until video is routed to the defined VDU (SCR 24376).

PCS MSS: SSRMS: Base LEE VDU: MSS VDUs

'[X]' as required where [X] = Base LEE | Base Elbow | Tip Elbow | Tip LEE

cmd '[X]' On (Verify – On)

Repeat

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

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

cmd 'Power' On (Verify – On)

Repeat

6. SSRMS VIDEO DEROUTING

MSS: Video: Video Routing

Repeat the following for all destinations to which an SSRMS Camera is routed:

sel ‘Destination Icon’

cmd ‘Deroute Video Signal’ – Deroute

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8.108 SSRMS SUBUNIT REBOOT

(RBT GEN/R3 - ALL/FIN 3/SPN) Page 1 of 1 page

> NOTE
>
> When rebooting the LEU and if the Tip LEE is mated to a PDGF connected to ISS Ground, expect '**R3L - SSRMS Pwr Flags Fail**' Robotics Advisory message (SCR 19019).

PCS MSS: SSRMS: SSRMS

√SSRMS Safing – Safed

MSS: SSRMS: Power: Reset Unit: SSRMS Reset Unit

cmd SR(SY,SP,EP,WP,WY,WR,LEU)

MSS: SSRMS: Power: SSRMS Power

Verify SR(SY,SP,EP,WP,WY,WR,LEU) – K-A
Verify SR(SY,SP,EP,WP,WY,WR,LEU) – Init
Verify SR(SY,SP,EP,WP,WY,WR,LEU) – Go (~2 minutes, 9 seconds for a JEU and ~2 minutes, 22 seconds for the LEU)

If 'SSRMS' Prime(Redundant) – Failed
  cmd 'SSRMS' Prime(Redundant) – Operational

Verify Systems State – Initializing
Verify Systems State – Operational

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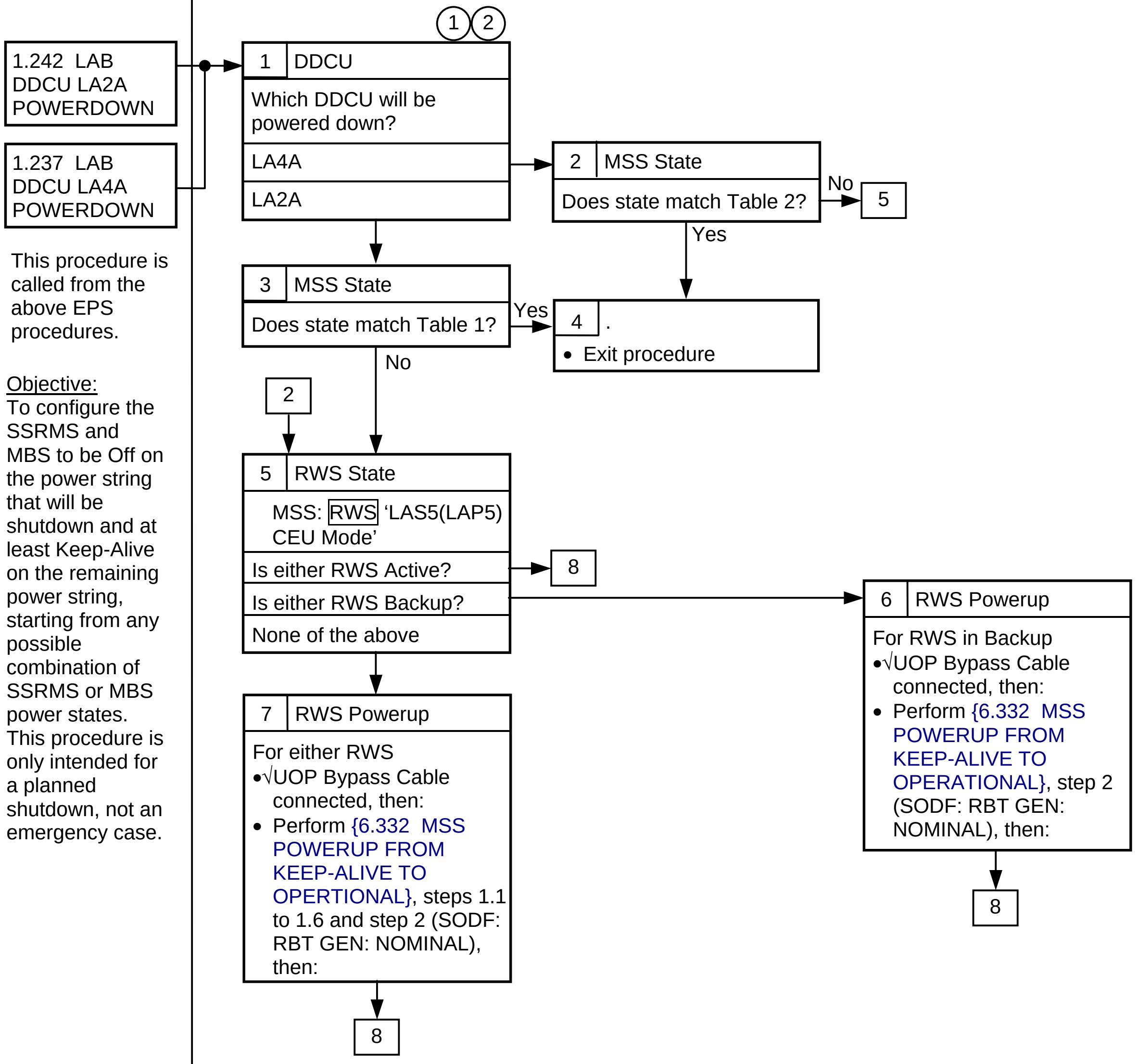
8.109 DDCU POWERDOWN MSS POWER CONFIGURATION

(RBT GEN/X2R4 - 12A/FIN) Page 1 of 4 pages



This procedure is called from the above EPS procedures.

Objective:
To configure the SSRMS and MBS to be Off on the power string that will be shutdown and at least Keep-Alive on the remaining power string, starting from any possible combination of SSRMS or MBS power states. This procedure is only intended for a planned shutdown, not an emergency case.

Table 1. LA2A DDCU Powerdown

Element	String	State	PCS Path
MBS	Prime	Keep-Alive or Operational	MSS: MBS: MCU: MCU 'Prime'
MBS	Redundant	Off	MSS: MBS: MCU: MCU 'Redundant'
SSRMS	Prime	Keep-Alive or Operational	MSS: SSRMS: Power: SSRMS Power 'SSRMS' 'Prime'
SSRMS	Redundant	Off	MSS: SSRMS: Power: SSRMS Power 'SSRMS' 'Redundant'

Table 2. LA4A DDCU Powerdown

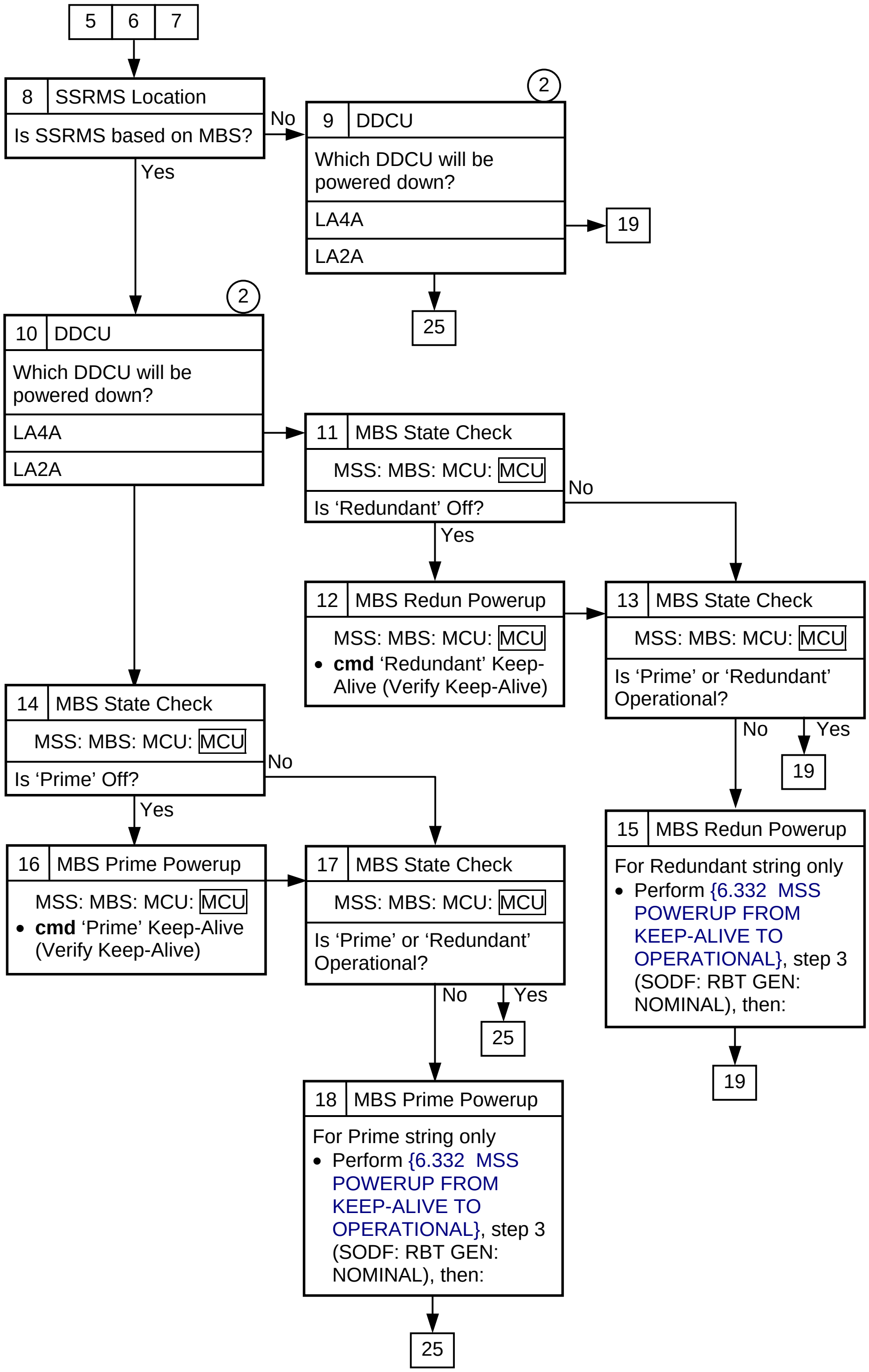
Element	String	State	PCS Path
MBS	Prime	Off	MSS: MBS: MCU: MCU 'Prime'
MBS	Redundant	Keep-Alive or Operational	MSS: MBS: MCU: MCU 'Redundant'
SSRMS	Prime	Off	MSS: SSRMS: Power: SSRMS Power 'SSRMS' 'Prime'
SSRMS	Redundant	Keep-Alive or Operational	MSS: SSRMS: Power: SSRMS Power 'SSRMS' 'Redundant'

① All display in this procedure are on the PCS.

② Prior to the ISS Power Reconfiguration at 12A, the RWS, MBS and SSRMS receive power from DDCUs LA2A and LA4A. After the 12A Power Reconfiguration, the RWS continues to receive power from DDCUs LA2A and LA4A, but the MBS and SSRMS receive power from DDCUs P13A and S14B.

8.109 DDCU POWERDOWN MSS POWER CONFIGURATION

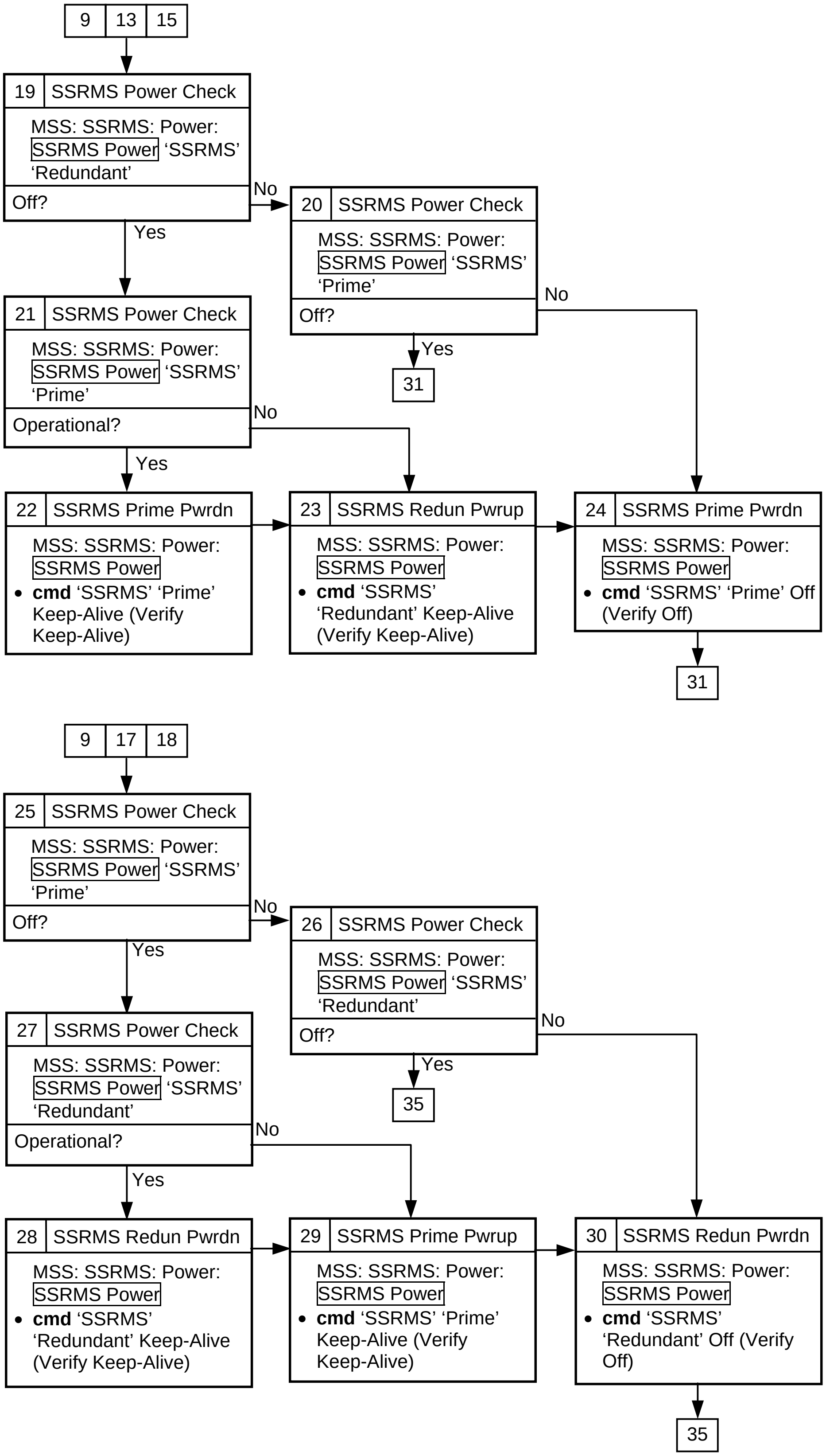
(RBT GEN/X2R4 - 12A/FIN) Page 2 of 4 pages



② Prior to the ISS Power Reconfiguration at 12A, the RWS, MBS and SSRMS receive power from DDCUs LA2A and LA4A. After the 12A Power Reconfiguration, the RWS continues to receive power from DDCUs LA2A and LA4A, but the MBS and SSRMS receive power from DDCUs P13A and S14B.

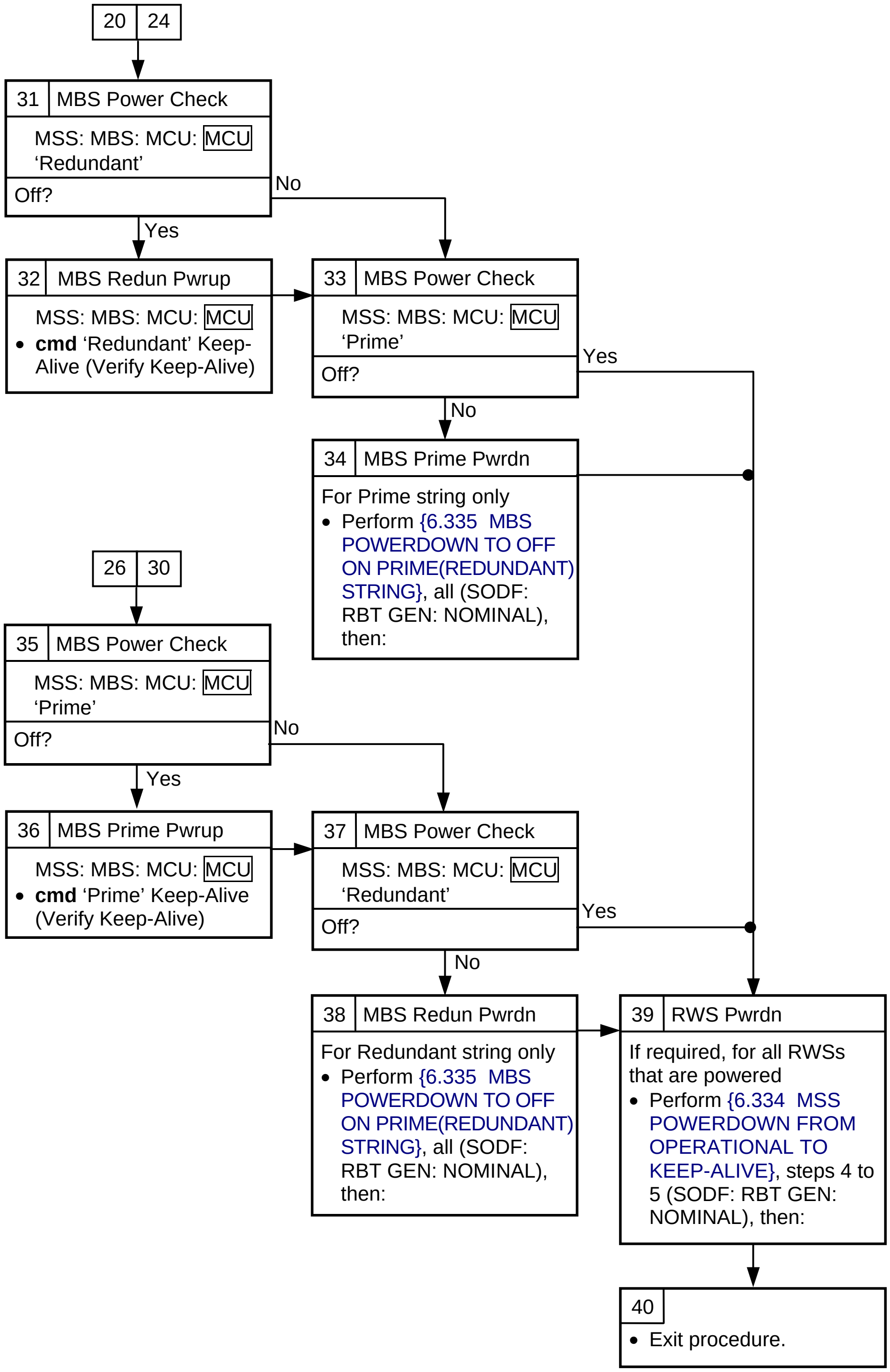
8.109 DDCU POWERDOWN MSS POWER CONFIGURATION

(RBT GEN/X2R4 - 12A/FIN) Page 3 of 4 pages



8.109 DDCU POWERDOWN MSS POWER CONFIGURATION

(RBT GEN/X2R4 - 12A/FIN) Page 4 of 4 pages



31 MBS Power Check

MSS: MBS: MCU: MCU ‘Redundant’

Off?

32 MBS Redun Pwrup

MSS: MBS: MCU: MCU

- **cmd** ‘Redundant’ Keep-Alive (Verify Keep-Alive)

33 MBS Power Check

MSS: MBS: MCU: MCU ‘Prime’

Off?

34 MBS Prime Pwrdn

For Prime string only

- Perform {6.335 MBS POWERDOWN TO OFF ON PRIME(REDUNDANT) STRING}, all (SODF: RBT GEN: NOMINAL), then:

35 MBS Power Check

MSS: MBS: MCU: MCU ‘Prime’

Off?

36 MBS Prime Pwrup

MSS: MBS: MCU: MCU

- **cmd** ‘Prime’ Keep-Alive (Verify Keep-Alive)

37 MBS Power Check

MSS: MBS: MCU: MCU ‘Redundant’

Off?

38 MBS Redun Pwrdn

For Redundant string only

- Perform {6.335 MBS POWERDOWN TO OFF ON PRIME(REDUNDANT) STRING}, all (SODF: RBT GEN: NOMINAL), then:

39 RWS Pwrdn

If required, for all RWSs that are powered

- Perform {6.334 MSS POWERDOWN FROM OPERATIONAL TO KEEP-ALIVE}, steps 4 to 5 (SODF: RBT GEN: NOMINAL), then:

40

- Exit procedure.

8.110 MANUAL CAPTURE WITH UNCALIBRATED LEE

I

(RBT GEN/E9 - ALL/FIN 3/SPN) Page 1 of 3 pages

1. SETUP

Prior to beginning payload capture, review {SSRMS LEE CUE CARD}, all (SODF: RBT GEN: REFERENCE), then:

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

Configure cameras and overlays for grapple.

PCS MSS: SSRMS: SSRMS

√Manual – blue
√Vernier

2. GRAPPLE MANEUVER

RHC/ THC Maneuver to within grapple envelope.

3. LIMP SSRMS

MSS: SSRMS: Limp: SSRMS Limp

cmd All Limp (Verify Limp – blue)

PCS MSS: SSRMS: SSRMS

Verify all joints – Limped

4. CLOSE SNARES

MSS: SSRMS: Tip LEE: SSRMS Tip LEE

cmd ‘Snare’ Close ▶ Hard Stops ▶ Slow, Hard Stops

Verify Speed – Slow
Verify Stops – Hard
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 (SPN 1892, 3160).

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Close Snares

RHC TRIGGER → press (hold until ’Snare’ Brakes – On) (12 s max)

8.110 MANUAL CAPTURE WITH UNCALIBRATED LEE

(RBT GEN/E9 - ALL/FIN 3/SPN) Page 2 of 3 pages

PCS Verify ‘Snare’ Close, Capture (two) – blue

5. RETRACT CARRIAGE

MSS: SSRMS: Tip LEE: SSRMS Tip LEE

cmd ‘Carriage’ Retract ▶ Hard Stops ▶ Slow, Hard Stops

Verify Speed – Slow
Verify Stops – Hard
Verify ‘**Confirm or Terminate**’ prompt.

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Retract Carriage

RHC TRIGGER → press (hold until ’Carriage’ Brakes – On) (90 s max)

PCS Verify ‘Carriage’ Retract – blue

6. LATCH

If grapple fixture is an FRGF or latching is not required, go to step 8.

MSS: SSRMS: Tip LEE: SSRMS Tip LEE

cmd ‘Latch’ Latch ▶ Hard Stops ▶ Slow, Hard Stops

Verify Speed – Slow
Verify Stops – Hard
Verify ‘**Confirm or Terminate**’ prompt.

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Latch

RHC TRIGGER → press (hold until ‘Latch’ Latch – blue) (65 s max)

cmd Terminate

7. MATE UMBILICALS

If mating of the umbilicals is required

MSS: SSRMS: Tip LEE: SSRMS Tip LEE

cmd ‘Latch’ Latch ▶ Hard Stops ▶ Slow, Hard Stops

Verify Speed – Slow
Verify Stops – Hard
Verify ‘**Confirm or Terminate**’ prompt.

NOTE
Expect **'R3L - SSRMS Pwr Flags Fail'** Robotics Advisory message when mating is complete (SPN 2599).

cmd Confirm (Verify RHC Trigger Hot icon)
Verify LEE Mode – Latch

RHC TRIGGER → press (hold until 'Latch' Brakes – On) (65 s max)

Verify 'Umbilical' Mate – blue
Verify 'Connector Continuity' Prime, Redundant (two) – Yes

8. DELIMP SSRMS
MSS: SSRMS: Limp: SSRMS Limp

cmd None Limp (Verify Standby – blue)

9. DERIGIDIZE CARRIAGE
If derigidization of the carriage is not required >>

MSS: SSRMS: Tip LEE: SSRMS Tip LEE

cmd 'Carriage' Extend ▶ Hard Stops ▶ Slow, Hard Stops

Verify Speed – Slow
Verify Stops – Hard
Verify '**Confirm or Terminate**' prompt.

cmd Confirm (Verify RHC Trigger Hot icon)

Verify LEE Mode – Extend Carriage

CAUTION
The trigger must be released once the derigidize indication turns blue. Failure to do so will cause the carriage to hit the grapple fixture cams, possibly causing hardware damage.

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

cmd Terminate

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8.111 LEE MISCAPTURE

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(RBT GEN/X2R4 - ALL/FIN 1) Page 1 of 2 pages

RECOVERY

If LEE visually confirmed far enough over the grapple pin for a good capture

> NOTE
>
> Expect the following message when Safing is commanded:
> ‘**R3Z - MSS OCS SSRMS Prime(Redun) ACU SRT Cat-1 Brk Stat Fail**’ (SCR 17495)
> Message should return to Norm.

DCP	SAFING → SAFE (Verify ON)
PCS	MSS: SSRMS: SSRMS Safing: SSRMS Safing
	cmd Remove (Verify Not Safed)
DCP	BRAKES SSRMS → OFF (Verify OFF)

> **CAUTION**
>
> In the case of a failed capture microswitch, the payload parameter state will not update to Loaded following the successful grapple. Differences in FOR and translation/rotation rates may be apparent and trajectory redesign may be required before proceeding with loaded operations.

Go to {8.101 MANUAL CAPTURE WITH CALIBRATED LEE}, steps 3 and 5 to 10 (SODF: RBT GEN: CORRECTIVE).

If no visual confirmation after attempting an Auto Capture

RHC	TRIGGER → press (momentarily)
PCS	Verify Setup – Yes
RHC/ THC	Maneuver to within grapple envelope.
RHC	TRIGGER → press (momentarily)
PCS	Verify ‘Snare’ Close, Capture (two) – blue (12 s(3 s) max)

8.111 LEE MISCAPTURE

(RBT GEN/X2R4 - ALL/FIN 1) Page 2 of 2 pages

If no visual confirmation, and after attempting a Semi-Manual Capture

RHC TRIGGER → press (momentarily)

PCS Verify Setup – Yes

RHC/THC Maneuver to within grapple envelope.

Go to {6.425 SEMI-MANUAL CAPTURE }, steps 4 to 6 (SODF: RBT GEN: NOMINAL).

If no visual confirmation, and after attempting a Manual Capture

PCS MSS: SSRMS: Tip LEE: SSRMS Tip LEE

cmd Capture ▶ Setup ▶ Slow (Verify Speed – Slow)

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

cmd Confirm (Verify Trigger Hot icon)

Verfiy LEE Mode – Setup for Capture

RHC TRIGGER → press (momentarily)

PCS Verify Setup – Yes

Go to {8.101 MANUAL CAPTURE WITH CALIBRATED LEE}, steps 2 to 10 (SODF: RBT GEN: CORRECTIVE).

8.112 SSRMS CAPTURE ABORT RECOVERY

(RBT GEN/X2R4 - ALL/FIN) Page 1 of 3 pages

NOTE

1. This procedure can be executed if an SSRMS automatic LEE capture sequence aborts due to one of the following:
   Loadcell tension at the end of rigidization is below 5055 N.

   Loadcell tension at the end of latching is below 5055 N.

   Loadcell tension at the end of rigidization is nominal, but the retract microswitch is not tripped.

2. The minimum loadcell tension for proper latch engagement/disengagement is 4003 N.

1. LEE DEADSTART CALIBRATION

PCS MSS: SSRMS: SSRMS Safing: SSRMS Safing

cmd Remove (Verify Not Safed)

MSS: SSRMS: Tip LEE: SSRMS Tip LEE

Verify LEE Mechanisms, Load Cell (two) – Calibrated

2. LIMP SSRMS

NOTE

1. The caution ‘**R3Q – SSRMS LEE Uncommanded Derigidize**’ may be raised when the SSRMS joints are limped and/or when the latches are driven (tension drops below 4003 N).

2. In this step, the brakes will not be released until the override command is issued.

DCP BRAKES SSRMS → OFF

PCS MSS: SSRMS: SSRMS

Verify Brake Override – True

MSS: SSRMS: Brake Override: Brakes Override

cmd Remove Brakes and Limping

MSS: SSRMS: SSRMS

Verify Limp – blue
Verify All Joints – Limp

3. RETRACT CARRIAGE

MSS: SSRMS: Tip LEE: SSRMS Tip LEE

cmd ‘Carriage’ Retract ▶ Soft Stops ▶ Slow, Soft Stops

Verify Speed – Slow
Verify Stops – Soft
Verify ‘**Confirm or Terminate**’ prompt.

8.112 SSRMS CAPTURE ABORT RECOVERY
(RBT GEN/X2R4 - ALL/FIN) Page 2 of 3 pages

> **CAUTION**
>
> Due to end-to-end system latency, the RHC Trigger is hot up to three 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 – Retract Carriage

RHC TRIGGER → press (hold until ‘Carriage’ Brakes – On) (90 s max)

PCS Verify ‘Carriage’ Tension > 4003 N
Retract – blue

4. EXTEND LATCH

If capturing a PDGF

> PCS MSS: SSRMS: Tip LEE: SSRMS Tip LEE
>
> Verify ‘Capture to Latch’ – Yes
>
> If Unlatch – gray
>
>> **cmd** ‘Latch’ Unlatch ▶ Slow, Soft Stops (Verify Speed – Slow)
>>
>> Verify Stops – soft
>> Verify ‘**Confirm or Terminate**’ prompt.
>>
>> **cmd** Confirm (Verify RHC Trigger Hot Icon)
>>
>> Verify LEE Mode – Unlatch
>>
>> RHC TRIGGER → press (hold until ’Latch’ Brakes – On) (65 s max)
>>
>> PCS Verify ‘Latch’ Unlatch – blue
>
> **cmd** ‘Latch’ Latch ▶ Slow, Soft Stops (Verify Speed – Slow)
>
> Verify ‘**Confirm or Terminate**’ prompt.
>
> **cmd** Confirm (Verify RHC Trigger Hot Icon)
>
> Verify LEE Mode – Latch
>
> RHC TRIGGER → press (hold until ’Latch’ Brakes – On) (65 s max)
>
> PCS Verify ‘Latch’ Latch – blue

5. MATE UMBILICAL
   If umbilical mating is required
   cmd 'Umbilical' Mate (Verify '**Confirm or Terminate**' prompt)
   cmd Confirm (Verify RHC Trigger Hot Icon)

   Verify LEE Mode – Mate

RHC TRIGGER → press (momentarily)

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

6. DERIGIDIZE CARRIAGE
   If carriage derigidization is required
   cmd 'Carriage' Derigidize ▶ Slow (Verify 'Speed' – Slow)

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

   cmd Confirm (Verify RHC Trigger Hot Icon)

   Verify 'LEE Mode' – Derigidize

RHC TRIGGER → press (momentarily) (SCR 19064)

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

7. DELIMP SSRMS
   MSS: SSRMS: Limp SSRMS Limp

   cmd None Limp

   MSS: SSRMS: SSRMS

   Verify Standby – blue

8. SSRMS DEADSTART CALIBRATION

NOTE
This step should only be performed if uncommanded Derig detection is required for the planned operations.

DCP SAFING → SAFE (Verify ON)

PCS MSS: SSRMS: SSRMS Safing: SSRMS Safing

cmd Remove (Verify Not Safed)

DCP SSRMS BRAKES → OFF (Verify OFF)

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8.201 MT MANUAL UMA MSW ACQUISITION

(RBT GEN/ULF1 - ALL/FIN 1) Page 1 of 7 pages

NOTE

1. The IMCA automatically returns to On mode after the programmed trajectory has completed.

2. A pause command can be issued by commanding the IMCA to On mode on the following page
   MSS: MT: Manual Translate: MT Manual Translate
   'IMCA Commands'

3. The IMCA takes approximately 6 seconds to complete self-tests once power is applied.

1. UMA IMCA RT I/O ENABLE

PCS MSS: MT: 'MT' 'Amp1' MT LB A: RT Status: RT Status Cont.
RT#16-25: LB MT 1 RT Status Cont

cmd 'RT Status' '19 UMA 1P' Enable **Execute** (Verify – Ena)
cmd 'RT Status' '20 UMA 1S' Enable **Execute** (Verify – Ena)
cmd 'RT Status' '21 UMA 2P' Enable **Execute** (Verify – Ena)
cmd 'RT Status' '22 UMA 2S' Enable **Execute** (Verify – Ena)

2. MT SOFTWARE PROCESS INITIATION

CAUTION

If, at any time during this procedure, a UMA IMCA temperature reaches or surpasses 60.0° C, power off that IMCA.

MSS: MT: MT Mode: MT Mode

If 'MT Process State' – Disabled
  cmd Initiate MT Process **Execute**

Verify 'SEPS Process State' – Initiated
Verify 'IMCA Process State' – Initiated
Verify 'MT Process State' – Initiated

If 'MT Software Mode' – Idle or Auto
  cmd Standby **Execute** (Verify – Standby)

If 'MT Software Mode' – Standby
  cmd Manual **Execute** (Verify – Manual)

3. UMA MICROSWITCH VERIFICATION

3.1 MT Power Verification

MSS: MT: Power: MT Power

Verify 'TUS1' 'RPCM S0-4B-F' 17 – Cl
Verify 'MT' 'RPCM MT-4B' 13,14 (two) – Cl
Verify 'TUS2' 'RPCM S0-3A-E' 18 – Cl
Verify 'MT' 'RPCM MT-3A' 13,14 (two) – Cl

3.2 UMA IMCA Power Application

sel RPC[X] where [X] = 7 2

MSS: MT: Power: 'MT' 'RPCM MT-4B' [X]: RPCM MT4B A RPC [X]

cmd 'RPC Position' Close (Verify – Cl)

MSS: MT: Power: 'MT' 'RPCM MT-3A' [X]: RPCM MT3A A RPC [X]

cmd 'RPC Position' Close (Verify – Cl)

Repeat

MSS: MT: IMCA Data Stale State: MT IMCA Data Stale State

Verify 'Status Measurements' 'UMA1' to 'UMA2' 'IMCA' 'A' (two) – blank
Verify 'Status Measurements' 'UMA1' to 'UMA2' 'IMCA' 'B' (two) – blank

MSS: MT: Power: MT Power

Verify 'MT' 'RPCM MT-4B' 'UMA1' to 'UMA2' 'Mode' (two) – Standby
Verify 'MT' 'RPCM MT-4B' 'UMA1' to 'UMA2' 'Fault' (two) – blank
Verify 'MT' 'RPCM MT-3A' 'UMA1' to 'UMA2' 'Mode' (two) – Standby
Verify 'MT' 'RPCM MT-3A' 'UMA1' to 'UMA2' 'Fault' (two) – blank

3.3 UMA Microswitch State Examination
MSS: MT: UMA1: MT UMA Manual Operations

Record State:
'UMA1' 'State' 'IMCA A' 'Mat' _______
'UMA1' 'State' 'IMCA A' 'Dmt' _______
'UMA1' 'State' 'IMCA B' 'Mat' _______
'UMA1' 'State' 'IMCA B' 'Dmt' _______
'UMA2' 'State' 'IMCA A' 'Mat' _______
'UMA2' 'State' 'IMCA A' 'Dmt' _______
'UMA2' 'State' 'IMCA B' 'Mat' _______
'UMA2' 'State' 'IMCA B' 'Dmt' _______

****
* If ‘UMA1’ ‘State’ ‘IMCA A’ ‘Mat’ and ‘UMA1’ ‘State’ ‘IMCA B’ ‘Mat’
* – blank
*
* √**MCC**
*
* If ‘UMA2’ ‘State’ ‘IMCA A’ ‘Mat’ and ‘UMA2’ ‘State’ ‘IMCA B’ ‘Mat’
* – blank
*
* √**MCC**
*
* If any ‘State’ ‘Dmt’ √
*
* √**MCC**
****

4. MBS/SSRMS POWERDOWN

CAUTION

The Mobile Servicing Center UMA Utility Port pass through power must be turned off at the current worksite prior to UMA motion to avoid possible arcing/sparking and damage to the hardware.

Verify Utility Port power is off for Current Worksite and Service by examining the appropriate RPCM(s) in Table 1.

√**MCC** if RPC is closed for UMA which will be commanded

Table 1. Worksite Utility Port Power

Worksite	Service	
	Primary (UMA1)	Secondary (UMA2)
1	RPCM S3-4B-F	RPCM S3-3A-F
2	RPCM S1-4B-E	RPCM S1-3A-E
3	RPCM S1-4B-F	RPCM S1-3A-F
4	RPCM S0-4B-A	RPCM S0-3A-A
5	RPCM S0-4B-B	RPCM S0-3A-B
6	RPCM P1-4B-F	RPCM P1-3A-F
7	RPCM P1-4B-E	RPCM P1-3A-E
8	RPCM P3-4B-F	RPCM P3-3A-F
9	RPCM S4-3A-B	RPCM S4-1A-B
10	RPCM P4-4A-B	RPCM P4-2A-B

5. UMA ACTIVATION

5.1 IMCA Commanding Selection

MSS: MT: Manual Translate: HW Config Manual: MT HW Config Manual

If ‘UMA1’ ‘State’ ‘IMCA A’ ‘Mat’ recorded in step 3.3 – blank
sel ‘UMA1’ ‘IMCA Selection’ – CMD IMCA A

If ‘UMA1’ ‘State’ ‘IMCA B’ ‘Mat’ recorded in step 3.3 – blank
sel ‘UMA1’ ‘IMCA Selection’ – CMD IMCA B

If ‘UMA2’ ‘State’ ‘IMCA A’ ‘Mat’ recorded in step 3.3 – blank
sel ‘UMA2’ ‘IMCA Selection’ – CMD IMCA A

If ‘UMA2’ ‘State’ ‘IMCA B’ ‘Mat’ recorded in step 3.3 – blank
sel ‘UMA2’ ‘IMCA Selection’ – CMD IMCA B

cmd Load HW Config

Verify ‘UMA1’ ‘State’ – matches selection
Verify ‘UMA2’ ‘State’ – matches selection
Verify all others – none

5.2 Safing Init Frame Selection
MSS: MT: Manual Translate: Init Frame Config:
MT Init Frame Config

input ‘UMA’ ‘Init Frame’ – 2

cmd Load Init Frame Config (Verify ‘UMA’ ‘State’: 2)

√all others: 0

5.3 IMCA Initialization
MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ Initialize **Execute**

MSS: MT: IMCA Cmd State: MT IMCA Cmd State

If UMA1 IMCA selected in IMCA Commanding Selection
Verify ‘Initialize’ ‘UMA1’ ‘IMCA’ ‘A(B)’ – √

If UMA2 IMCA selected in IMCA Commanding Selection
Verify ‘Initialize’ ‘UMA2’ ‘IMCA’ ‘A(B)’– √

5.4 IMCA Mode to On
MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ On **Execute**

MSS: MT: Manual Translate: UMA: MT UMA Manual Operations

If UMA1 IMCA selected in IMCA Commanding Selection
Verify ‘UMA1’ ‘IMCA A(B)’ ‘Mode’ – On

If UMA2 IMCA selected in IMCA Commanding Selection
Verify ‘UMA2’ ‘IMCA A(B)’ ‘Mode’ – On

5.5 Initialization Frame Selection

MSS: MT: Manual Translate: Init Frame Config: MT Init Frame Config

input ‘UMA’ ‘Init Frame’ – 5

cmd Load Init Frame Config (Verify ‘UMA’ ‘State’: 5)

√all others: 0

5.6 IMCA Initialization

MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ Initialize **Execute**

MSS: MT: IMCA Cmd State: MT IMCA Cmd State

If UMA1 IMCA selected in IMCA Commanding Selection
Verify ‘Initialize’ ‘UMA1’ ‘IMCA’ ‘A(B)’– √

If UMA2 IMCA selected in IMCA Commanding Selection
Verify ‘Initialize’ ‘UMA2’ ‘IMCA’ ‘A(B)’– √

5.7 IMCA Movement Initiation

Verify IMCA motion using the following page
MSS: MT: Manual Translate: UMA: MT UMA Manual Operations

CAUTION

Moding the IMCA to On, if it is still enabled after 30 seconds, will avoid possible damage to the hardstops.

MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ Actuate **Execute**

MSS: MT: Manual Translate: UMA: MT UMA Manual Operations

If UMA1 IMCA selected in IMCA Commanding Selection
- Verify ‘UMA1’ ‘IMCA A(B)’ ‘Mode’ – Enabled
- Verify ‘UMA1’ ‘IMCA A(B)’ ‘Mode’ – On
- Verify ‘UMA1’ ‘IMCA A(B)’ ‘State’ ‘Mat’ – √

If UMA2 IMCA selected in IMCA Commanding Selection
- Verify ‘UMA2’ ‘IMCA A(B)’ ‘Mode’ – Enabled
- Verify ‘UMA2’ ‘IMCA A(B)’ ‘Mode’ – On
- Verify ‘UMA2’ ‘IMCA A(B)’ ‘State’ ‘Mat’ – √

6. IMCA MODE TO STANDBY

MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ Standby **Execute**

MSS: MT: Manual Translate: UMA: MT UMA Manual Operations

If UMA1 IMCA selected in IMCA Commanding Selection
- Verify ‘UMA1’ ‘IMCA A(B)’ ‘Mode’ – Standby

If UMA2 IMCA selected in IMCA Commanding Selection
- Verify ‘UMA2’ ‘IMCA A(B)’ ‘Mode’ – Standby

7. IMCA BIT INITIATION

MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ BIT Initiate **Execute**

MSS: MT: IMCA Cmd State: MT IMCA Cmd State

If UMA1 IMCA selected in IMCA Commanding Selection
- Verify ‘BIT Initiate’ ‘UMA1’ ‘IMCA’ ‘A(B)’– √

If UMA2 IMCA selected in IMCA Commanding Selection
- Verify ‘BIT Initiate’ ‘UMA2’ ‘IMCA’ ‘A(B)’– √

8. UMA IMCAs POWER REMOVAL

sel RPC[X] where [X] = 7 2

MSS: MT: Power: ‘MT’ ‘RPCM MT-4B’ [X]: RPCM MT4B A RPC [X]

cmd ‘RPC Position’ Open (Verify – Op)

MSS: MT: Power: ‘MT’ ‘RPCM MT-3A’ [X]: RPCM MT3A A RPC [X]

cmd ‘RPC Position’ Open (Verify – Op)

Repeat

Inform **MCC**, “Go for MSS Powerup.”

9. MT SOFTWARE SHUTDOWN

MSS: MT: MT Mode: | MT Mode |

cmd Standby **Execute** (Verify – Standby)
cmd Idle **Execute** (Verify – Idle)
cmd Disable MT Process **Execute** (Verify – Disabled)

10. UMA IMCA RT I/O INHIBIT

MSS: MT: ‘MT’ ‘Amp1’ MT LB A: RT Status: RT Status Cont.
RT#16-25: | LB MT 1 RT Status Cont |

cmd ‘RT Status’ ‘19 UMA 1P’ Inhibit **Execute** (Verify – Inh)
cmd ‘RT Status’ ‘20 UMA 1S’ Inhibit **Execute** (Verify – Inh)
cmd ‘RT Status’ ‘21 UMA 2P’ Inhibit **Execute** (Verify – Inh)
cmd ‘RT Status’ ‘22 UMA 2S’ Inhibit **Execute** (Verify – Inh)

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8.202 MT MANUAL UMA MATE

(RBT GEN/E7 - ALL/FIN 1/SPN) Page 1 of 6 pages

NOTE

1. The IMCA automatically returns to On mode after the programmed trajectory has completed.

2. A pause command can be issued by commanding the IMCA to On mode on the following page
   MSS: MT: Manual Translate: MT Manual Translate
   'IMCA Commands'

3. The IMCA takes approximately 6 seconds to complete self-tests once power is applied.

1. UMA IMCA RT I/O ENABLE

PCS MSS: MT: 'MT' 'Amp1' MT LB A: RT Status:
RT Status Cont. RT#16-25
LB MT 1 RT Status Cont

cmd 'RT Status' '19 UMA 1P' Enable **Execute** (Verify – Ena)
cmd 'RT Status' '20 UMA 1S' Enable **Execute** (Verify – Ena)
cmd 'RT Status' '21 UMA 2P' Enable **Execute** (Verify – Ena)
cmd 'RT Status' '22 UMA 2S' Enable **Execute** (Verify – Ena)

2. MT SOFTWARE PROCESS INITIATION

MSS: MT: MT Mode: MT Mode

If 'MT Process State' – Disabled

cmd Initiate MT Process **Execute**

Verify 'SEPS Process State' – Initiated
Verify 'IMCA Process State' – Initiated
Verify 'MT Process State' – Initiated

If 'MT Software Mode' – Idle or Auto

cmd Standby **Execute** (Verify – Standby)

If 'MT Software Mode' – Standby

cmd Manual **Execute** (Verify – Manual)

3. TUS POWER VERIFICATION

MSS: MT: Power: MT Power

Verify 'TUS1' 'RPCM S0-4B-F' 17 – Cl
Verify 'TUS2' 'RPCM S0-3A-E' 18 – Cl
Verify 'MT' 'RPCM MT-4B' 13,14(two) – Cl
Verify 'MT' 'RPCM MT-3A' 13,14(two) – Cl

4. UMA IMCA POWER APPLICATION

NOTE
The IMCA takes approximately 6 seconds to complete self-tests once power is applied.

MSS: MT: Power: 'MT' 'RPCM MT-4B(3A)' 7:
RPCM MT4B(3A) A RPC 07

Verify 'RPC Position' – Op

cmd 'RPC Position' Close (Verify – Cl)

MSS: MT: Power: 'MT' 'RPCM MT-4B(3A)' 2:
RPCM MT4B(3A) A RPC 02

Verify 'RPC Position' – Op

cmd 'RPC Position' Close (Verify – Cl)

MSS: MT: IMCA Data Stale State: MT IMCA Data Stale State

Verify 'UMA1' to 'UMA2' 'A(B)' 'Status Measurements' – blank

MSS: MT: Power: MT Power

Verify 'MT' 'RPCM MT-4B(3A)' 'UMA1' to 'UMA2' 'Mode' – Standby
Verify 'MT' 'RPCM MT-4B(3A)' 'UMA1' to 'UMA2' 'Fault' – blank

5. IMCA COMMANDING SELECTION

MSS: MT: Manual Translate: HW Config Manual: MT HW Config Manual

pick 'IMCA Selection' 'UMA1' – CMD IMCA A(B)
'UMA2' – CMD IMCA A(B)
all others – None

cmd Load HW Config

Verify 'UMA1' to 'UMA2' 'State' – CMD IMCA A(B)
Verify 'State' all others – None

MSS: MT: Manual Translate: UMA: MT UMA Manual Operations

Verify 'UMA1' to 'UMA2' 'IMCA A(B)' 'State' 'Dmt' – √

6. UMA MATE PHASE 1

6.1 Initialization Frame Selection

MSS: MT: Init Frame: MT Init Frame Config

input 'Init Frame' 'UMA' – 2
all others – 0

cmd Load Init Frame Config

Verify 'State' 'UMA': 2
Verify 'State' all others: 0

6.2 IMCA Initialization

MSS: MT: Manual Translate: MT Manual Translate

cmd 'IMCA Commands' Initialize **Execute**

MSS: MT: IMCA Cmd State: MT IMCA Cmd State

Verify 'UMA1' to 'UMA 2' 'IMCA A(B)' 'Initialize' – √

6.3 Mode IMCA to On

MSS: MT: Manual Translate: MT Manual Translate

cmd 'IMCA Commands' On **Execute**

MSS: MT: Manual Translate: UMA: MT UMA Manual Operations

Verify 'UMA1' to 'UMA2' 'IMCA A(B)' 'Mode' – On

6.4 Initialization Frame Selection

MSS: MT: Init Frame: MT Init Frame Config

input 'Init Frame' 'UMA' – 4
all others – 0

cmd Load Init Frame Config

Verify 'State' 'UMA': 4
Verify 'State' all others: 0

6.5 IMCA Initialization

MSS: MT: Manual Translate: MT Manual Translate

cmd 'IMCA Commands' Initialize **Execute**

MSS: MT: IMCA Cmd State: MT IMCA Cmd State

Verify 'UMA1' to 'UMA 2' 'IMCA A(B)' 'Initialize' – √

6.6 Thruster Inhibit

If ISS/orbiter mated

MSS: MT: Thruster: Thruster Controls for MSS Ops

cmd 'Desat Request' Inhibit (Verify – Inh)

√'Auto Att Control Handover to RS' – Inh

If ISS not mated to orbiter, √**MCC-H** for proper thruster configuration before proceeding.

6.7 IMCA Movement Initiation

CAUTION
To avoid damage to the hardstop, mode the IMCA to On if still Enabled after 67 seconds.

Verify IMCA motion using the following page
MSS: MT: Manual Translate: UMA:
MT UMA Manual Operations

MSS: MT: Manual Translate: MT Manual Translate

cmd 'IMCA Commands' Actuate **Execute**

MSS: MT: Manual Translate: UMA: MT UMA Manual Operations

Verify 'UMA1' to 'UMA2' 'IMCA A(B)' 'Mode' – Enable
Verify 'UMA1' to 'UMA2' 'IMCA A(B)' 'State' 'Mat' and 'Dmt' – blank
Verify 'UMA1' to 'UMA2' 'IMCA A(B)' 'Position' – decreasing
Verify 'UMA1' to 'UMA2' 'IMCA A(B)' 'Shaft Spd' ≤ 415 rpm
Verify 'UMA1' to 'UMA2' 'IMCA A(B)' 'Mode' – On

7. UMA MATE PHASE 2

7.1 Initialization Frame Selection

MSS: MT: Init Frame: MT Init Frame Config

input 'Init Frame' 'UMA' – 5
all others – 0

cmd Load Init Frame Config

Verify 'State' 'UMA': 5
Verify 'State' all others: 0

7.2 IMCA Initialization

MSS: MT: Manual Translate: MT Manual Translate

cmd 'IMCA Commands' Initialize **Execute**

MSS: MT: IMCA Cmd State: MT IMCA Cmd State

Verify ‘UMA1’ to ‘UMA 2’ ‘IMCA A(B)’ ‘Initialize’ – √

7.3 IMCA Movement Initiation

CAUTION
To avoid damage to the hardstop, mode the IMCA to On if still Enabled after 40 seconds.

Verify IMCA motion using the following page
MSS: MT: Manual Translate: UMA:
MT UMA Manual Operations

MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ Actuate **Execute**

MSS: MT: Manual Translate: UMA: MT UMA Manual Operations

Verify ‘UMA1’ to ‘UMA2’ ‘IMCA A(B)’ ‘Mode’ – Enable
Verify ‘UMA1’ to ‘UMA2’ ‘IMCA A(B)’ ‘State’ ‘Mat’ and ‘Dmt’ – blank
Verify ‘UMA1’ to ‘UMA2’ ‘IMCA A(B)’ ‘Position’ – decreasing
Verify ‘UMA1’ to ‘UMA2’ ‘IMCA A(B)’ ‘Shaft Spd’ ≤ 100 rpm

Verify ‘UMA1’ to ‘UMA2’ ‘IMCA A(B)’ ‘Mode’ – On
Verify ‘UMA1’ to ‘UMA2’ ‘IMCA A(B)’ ‘State’ ‘Mat’ – √

8. THRUSTER ENABLE

If ISS/orbiter mated
MSS: MT: Thruster: Thruster Controls for MSS Ops

cmd ‘Desat Request’ Enable (Verify – Ena)

If ISS not mated to orbiter, √**MCC-H** for proper thruster configuration.

9. COMMANDING IMCA TO STANDBY

MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ Standby **Execute**

MSS: MT: Manual Translate: UMA: MT UMA Manual Operations

Verify ‘UMA1’ to ‘UMA2’ ‘IMCA A(B)’ ‘Mode’ – Standby

10. UMA IMCA POWER REMOVAL

MSS: MT: Power: ‘MT’ ‘RPCM MT-4B(3A)’ 7:
RPCM MT4B(3A) A RPC 07

cmd ‘RPC Position’ Open (Verify – Op)

MSS: MT: Power: ‘MT’ ‘RPCM MT-4B(3A)’ 2:
RPCM MT4B(3A) A RPC 02

cmd ‘RPC Position’ Open (Verify – Op)

11. MT SOFTWARE SHUTDOWN

MSS: MT: MT Mode: MT Mode

cmd Standby **Execute** (Verify – Standby)
cmd Idle **Execute** (Verify – Idle)
cmd Disable MT Process **Execute** (Verify – Disabled)

12. UMA IMCA RT I/O INHIBIT

MSS: MT: ‘MT’ ‘Amp1’ MT LB A: RT Status:
RT Status Cont. RT#16-25
LB MT 1 RT Status Cont

cmd ‘RT Status’ ‘19 UMA 1P’ Inhibit **Execute** (Verify – Inh)
cmd ‘RT Status’ ‘20 UMA 1S’ Inhibit **Execute** (Verify – Inh)
cmd ‘RT Status’ ‘21 UMA 2P’ Inhibit **Execute** (Verify – Inh)
cmd ‘RT Status’ ‘22 UMA 2S’ Inhibit **Execute** (Verify – Inh)

8.204 MT MANUAL LTU LATCH (ED DISENGAGE)

(RBT GEN/ULF1 - ALL/FIN 2) Page 1 of 15 pages

NOTE

1. The IMCA automatically returns to On mode after the programmed trajectory has completed.

2. A pause command can be issued by commanding the IMCA to On mode on the following page:
   MSS: MT: Manual Translate: MT Manual Translate
   ‘IMCA Commands’

3. The IMCA takes approximately 6 seconds to complete self-tests once power is applied.

4. When I/O is enabled to the IMCAs, expect the following twenty Robotics Advisory messages:
   ‘**R9Z - MSS MT LTU 1 IMCA 1,2 Comm or Device Fail**’
   ‘**R9Z - MSS MT LTU 2 IMCA 1,2 Comm or Device Fail**’
   ‘**R9Z - MSS MT LTU 3 IMCA 1,2 Comm or Device Fail**’
   ‘**R9Z - MSS MT LTU 4 IMCA 1,2 Comm or Device Fail**’
   ‘**R9Z - MSS MT ED IMCA 1,2 Comm or Device Fail**’
   ‘**R9Z - MSS MT TD IMCA 1,2 Comm or Device Fail**’
   ‘**R9Z - MSS MT UMA 1 IMCA 1,2 Comm or Device Fail**’
   ‘**R9Z - MSS MT UMA 2 IMCA 1,2 Comm or Device Fail**’
   ‘**R9Z - MSS MT TUS 1 IMCA 1,2 Comm or Device Fail**’
   ‘**R9Z - MSS MT TUS 2 IMCA 1,2 Comm or Device Fail**’

5. MT IMCA RT FDIR remains inhibited at all times to avoid channel switching caused by nominal IMCA power removal. This also suppresses some of the nuisance RT Comm Fail C&W messages.

6. The ‘LTU2’ ‘IMCA B’ ‘Mode’ field is incorrect on
   MSS: MT: Manual Translate: LTU ED:
   MT LTU ED Manual Operations

   The mode of this IMCA must be verified on
   MSS: MT: Power: MT Power

1. IMCA RT I/O ENABLE

If MT IMCAs I/O not Enabled

MSS: MT: ‘MT’ ‘Amp 1’ MT LB A: RT Status:
LB MT 1 RT Status ‘RT Status’

cmd ‘00 LTU 1P’ Enable **Execute** (Verify – Ena)
cmd ‘01 LTU 2P’ Enable **Execute** (Verify – Ena)
cmd ‘02 LTU 3P’ Enable **Execute** (Verify – Ena)
cmd ‘03 LTU 1S’ Enable **Execute** (Verify – Ena)
cmd ‘04 LTU 4P’ Enable **Execute** (Verify – Ena)
cmd ‘05 LTU 3S’ Enable **Execute** (Verify – Ena)
cmd ‘06 LTU 2S’ Enable **Execute** (Verify – Ena)
cmd ‘07 LTU 4S’ Enable **Execute** (Verify – Ena)
cmd ‘08 ED P’ Enable **Execute** (Verify – Ena)

cmd ‘09 TD P’ Enable **Execute** (Verify – Ena)
cmd ‘11 ED S’ Enable **Execute** (Verify – Ena)

sel RT Status Continued RT#16-25

LB MT 1 RT Status Cont ‘RT Status’

cmd ‘14 TD S’ Enable **Execute** (Verify – Ena)
cmd ‘16 TUS 1S’ Enable **Execute** (Verify – Ena)
cmd ‘17 TUS 2P’ Enable **Execute** (Verify – Ena)
cmd ‘18 TUS 2S’ Enable **Execute** (Verify – Ena)
cmd ‘19 UMA 1P’ Enable **Execute** (Verify – Ena)
cmd ‘20 UMA 1S’ Enable **Execute** (Verify – Ena)
cmd ‘21 UMA 2P’ Enable **Execute** (Verify – Ena)
cmd ‘22 UMA 2S’ Enable **Execute** (Verify – Ena)
cmd ‘24 TUS 1P’ Enable **Execute** (Verify – Ena)

2. MT SOFTWARE PROCESS INITIATION

PCS MSS: MT: MT Mode: MT Mode

If ‘MT Process State’ – Disabled
cmd Initiate MT Process **Execute**

Verify ‘SEPS Process State’ – Initiated
Verify ‘IMCA Process State’ – Initiated
Verify ‘MT Process State’ – Initiated

If ‘MT Software Mode’ – Idle or Auto
cmd Standby **Execute** (Verify – Standby)

If ‘MT Software Mode’ – Standby
cmd Manual **Execute** (Verify – Manual)

3. TUS POWER VERIFICATION

MSS: MT: Power: MT Power

Verify ‘TUS 1’ ‘RPCM S0-4B-F’ 17 – Cl
Verify ‘MT’ ‘RPCM MT-4B’ 13,14 (two) – Cl
Verify ‘TUS 2’ ‘RPCM S0-3A-E’ 18 – Cl
Verify ‘MT’ ‘RPCM MT-3A’ 13,14 (two) – Cl

4. LTU IMCAs POWER APPLICATION

PCS MSS: MT: Manual Translate: TUS TD: MT TUS TD Manual Operations

Verify ‘TD1(2)’ ‘Worksite sw’ ‘Stbd’ – √
Verify ‘TD1(2)’ ‘Worksite sw’ ‘Port’ – √

sel RPC [X] where [X] = 10 | 9 | 5 | 1

MSS: MT: Power: ‘MT’ ‘RPCM MT-4B(3A)’ [X]:
RPCM MT 4B(3A) A RPC[X]

cmd ‘RPC Position’ – Close (Verify – Cl)

Repeat

MSS: MT: Power: MT Power

Verify ‘MT’ ‘RPCM MT-4B(3A)’ ‘LTU1’ to ‘LTU4’ ‘Mode’ (four) – Standby
Verify ‘MT’ ‘RPCM MT-4B(3A)’ ‘LTU1’ to ‘LTU4’ ‘Fault’ (four) – blank

MSS: MT: IMCA Data Stale State: MT IMCA Data Stale State

Verify ‘LTU1’ to ‘LTU4’ ‘IMCA’ ‘A(B)’ ‘Status Measurements’ (four) – blank

5. LTU LATCH PHASE 1

5.1 LTU IMCA Commanding Selection

MSS: MT: Manual Translate: HW Config Manual:
MT HW Config Manual

√‘LTU1’ to ‘LTU4’ ‘IMCA Selection’ (four) – CMD IMCA A(B)
√all others – none

cmd Load HW Config

Verify ‘LTU1’ to ‘LTU4’ ‘State’ (four) – CMD IMCA A(B)

Verify all others – none

MSS: MT: Manual Translate: LTU ED:
MT LTU ED Manual Operations

Verify ‘LTU1’ to ‘LTU4’ ‘IMCA A(B)’ ‘State’ ‘Rel’ (four) – √

5.2 LTU Initialization Frame Selection

MSS: MT: Init Frame: MT Init Frame Config

input ‘Init Frame’ ‘LTU’ – 2
all others – 0

cmd Load Init Frame Config (Verify ‘LTU’ ‘State’: 2)

Verify all others: 0

5.3 LTU IMCA Initialization
MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ Initialize **Execute**

MSS: MT: IMCA Cmd State: MT IMCA Cmd State

Verify ‘LTU1’ to ‘LTU4’ ‘IMCA’ ‘A(B)’ ‘Initialize’ (four) – √

5.4 Moding LTU IMCAs to On
MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ On **Execute**

MSS: MT: Manual Translate: LTU ED: MT LTU ED Manual Operations

Verify ‘LTU1’ to ‘LTU4’ ‘Mode’ ‘IMCA A(B)’ (four) – On

5.5 LTU Initialization Frame Selection
MSS: MT: Init Frame: MT Init Frame Config

input ‘Init Frame’ ‘LTU’ – 9
all others – 0

cmd Load Init Frame Config (Verify ‘LTU’ ‘State’: 9)

Verify all others: 0

NOTE
Initialization frame 9 commands phase 1 latch of the LTUs.

5.6 LTU IMCA Initialization
MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ Initialize **Execute**

MSS: MT: IMCA Cmd State: MT IMCA Cmd State

Verify ‘LTU1’ to ‘LTU4’ ‘IMCA’ ‘A(B)’ ‘Initialize’ (four) – √

5.7 LTU IMCA Movement Initiation

CAUTION
Mode IMCA to On if it is still Enabled after 100 seconds.

MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ Actuate **Execute**

MSS: MT: Manual Translate: LTU ED: MT LTU ED Manual Operations

Verify 'LTU1' to 'LTU4' 'IMCA A(B)' 'Mode' (four) – Enabled
Verify 'LTU1' to 'LTU4' 'IMCA A(B)' 'Position' (four) – decreasing
Verify 'LTU1' to 'LTU4' 'IMCA A(B)' 'Shaft Spd' (four) ≤ 10 rpm

After motion complete
Verify 'LTU1' to 'LTU4' 'IMCA A(B)' 'Mode' (four) – On

MSS: MT: Manual Translate: MT Manual Translate

cmd 'IMCA Commands' Standby **Execute**

MSS: MT: Manual Translate: LTU ED: MT LTU ED Manual Operations

Verify Standby 'LTU1' to 'LTU4' 'IMCA A(B)' 'Mode' (four) – Standby

6. LTU LATCH PHASE 2A

6.1 LTU IMCA Commanding Selection

MSS: MT: Manual Translate: HW Config Manual:
MT HW Config Manual

sel 'LTU3' to 'LTU4' 'IMCA Selection' (two) – CMD IMCA A(B)
sel all others – none

cmd Load HW Config

Verify 'LTU3' to 'LTU4' 'State' (two) – CMD IMCA A(B)

Verify all others – none

6.2 LTU Initialization Frame Selection

MSS: MT: Init Frame: MT Init Frame Config

input 'Init Frame' 'LTU' – 1 3
all others – 0

cmd Load Init Frame Config (Verify 'LTU' 'State': 13)

Verify all others: 0

NOTE
Initialization frame 13 commands phase 2A latching of the LTUs.

6.3 LTU IMCA Initialization
MSS: MT: Manual Translate: MT Manual Translate

cmd 'IMCA Commands' Initialize **Execute**

MSS: MT: IMCA Cmd State: MT IMCA Cmd State

Verify Initialize 'LTU3' to 'LTU4' 'IMCA' 'A(B)' 'Initialize' (two) – √

6.4 Moding LTU IMCAs to On
MSS: MT: Manual Translate: MT Manual Translate

cmd 'IMCA Commands' On **Execute**

MSS: MT: Manual Translate: LTU ED: MT LTU ED Manual Operations

Verify 'LTU3' to 'LTU4' 'IMCA A(B)' 'Mode' (two) – On

6.5 LTU IMCA Movement Initiation

CAUTION

Mode IMCA to On if it is still Enabled after 120 seconds.

MSS: MT: Manual Translate: MT Manual Translate

cmd 'IMCA Commands' Actuate **Execute**

MSS: MT: Manual Translate: LTU ED: MT LTU ED Manual Operations

Verify 'LTU3' to 'LTU4' 'IMCA A(B)' 'Mode' (two) – Enabled
Verify 'LTU3' to 'LTU4' 'IMCA A(B)' 'Position' (two) – increasing
Verify 'LTU3' to 'LTU4' 'IMCA A(B)' 'Shaft Spd' (two) ≤ 48.21 rpm

After motion complete
Verify 'LTU3' to 'LTU4' 'IMCA A(B)' 'Mode' (two) – On

7. LTU LATCH PHASE 2B
7.1 LTU IMCA Commanding Selection
MSS: MT: Manual Translate: HW Config Manual:
MT HW Config Manual

sel 'LTU1' to 'LTU2' 'IMCA Selection' (two) – CMD IMCA A(B)
sel all others – none

cmd Load HW Config

Verify ‘LTU1’ to ‘LTU2’ ‘State’ (two) – CMD IMCA A(B)

Verify all others – none

7.2 LTU Initialization Frame Selection

MSS: MT: Init Frame: MT Init Frame Config

input ‘Init Frame’ ‘LTU’ – 1 0
all others – 0

cmd Load Init Frame Config (Verify ‘LTU’ ‘State’: 10)

Verify all others: 0

NOTE
Initialization frame 10 commands phase 2B latching of the LTUs.

7.3 LTU IMCA Initialization

MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ Initialize **Execute**

MSS: MT: IMCA Cmd State: MT IMCA Cmd State

Verify ‘LTU1’ to ‘LTU2’ ‘IMCA’ ‘A(B)’ ‘Initialize’ (two) – √

7.4 Moding LTU IMCAs to On

MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ On **Execute**

MSS: MT: Manual Translate: LTU ED: MT LTU ED Manual Operations

Verify ‘LTU1’ to ‘LTU2’ ‘IMCA A(B)’ ‘Mode’ (two) – On

7.5 LTU IMCA Movement Initiation

CAUTION
Mode IMCA to On if it is still Enabled after 110 seconds.

MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ Actuate **Execute**

MSS: MT: Manual Translate: LTU ED: MT LTU ED Manual Operations

Verify ‘LTU1’ to ‘LTU2’ ‘IMCA A(B)’ ‘Mode’ (two) – Enabled
Verify ‘LTU1’ to ‘LTU2’ ‘IMCA A(B)’ ‘Position’ (two) – increasing
Verify ‘LTU1’ to ‘LTU2’ ‘IMCA A(B)’ ‘Shaft Spd’ (two) ≤ 48.21 rpm

After motion complete
Verify ‘LTU1’ to ‘LTU2’ ‘IMCA A(B)’ ‘Mode’ – On

8. TD GAIN CHANGE

8.1 TD IMCA Commanding Selection
MSS: MT: Manual Translate: HW Config Manual:
MT HW Config Manual

sel ‘TD’ ‘IMCA Selection’ – CMD IMCA A(B)
sel all others – none

cmd Load HW Config (Verify ‘TD’ ‘State’ – CMD IMCA A(B))

Verify all others – none

8.2 TD Initialization Frame Selection
MSS: MT: Init Frame: MT Init Frame Config

input ‘Init Frame’ ‘TD’ – 2 6 0
all others – 0

cmd Load Init Frame Config (Verify ‘TD’ ‘State’: 260)

Verify all others: 0

NOTE
Initialization frame 260 changes the gain of the TD.

8.3 TD IMCA Initialization
MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ Initialize **Execute**

MSS: MT: IMCA Cmd State: MT IMCA Cmd State

Verify ‘TD’ ‘IMCA’ ‘A(B)’ ‘Initialize’ – √

9. ED DISENGAGEMENT

9.1 ED IMCAs Power Application

> NOTE
>
> If the ED Changeover procedure was performed on the redundant IMCA string due to the failed primary IMCA string, the redundant IMCA string should be powered on or vice versa.

MSS: MT: Power: ‘RPCM MT-4B(3A)’ 11:
RPCM MT4B(3A) A RPC 11

cmd ‘RPC Position’ – Close (Verify – Cl)

MSS: MT: Power: MT Power

Verify ‘MT’ ‘RPCM MT-4B(3A)’ ‘ED’ ‘Mode’ – Standby
Verify ‘MT’ ‘RPCM MT-4B(3A)’ ‘ED’ ‘Fault’ – blank

MSS: MT: IMCA Data Stale State: MT IMCA Data Stale State

Verify ‘ED’ ‘IMCA’ ‘A(B)’ ‘Status Measurements’ – blank

9.2 ED IMCA Commanding Selection

MSS: MT: Manual Translate: HW Config Manual:
MT HW Config Manual

sel ‘ED’ ‘IMCA Selection’ – CMD IMCA A(B)
sel all others – none

cmd Load HW Config (Verify ‘ED’ ‘State’ – CMD IMCA A(B))

Verify all others – none

9.3 ED Initialization Frame Selection

MSS: MT: Init Frame: MT Init Frame Config

input ‘Init Frame’ ‘ED’ – 2
all others – 0

cmd Load Init Frame Config (Verify ‘ED’ ‘State’: 2)

Verify all others: 0

9.4 ED IMCA Initialization

MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ Initialize **Execute**

MSS: MT IMCA Cmd State: MT IMCA Cmd State

Verify ‘ED’ ‘IMCA’ ‘A(B)’ ‘Initialize’ – √

9.5 Moding ED IMCA to On
MSS: MT: Manual Translate: MT Manual Translate

cmd 'IMCA Commands' On **Execute**

MSS: MT: Manual Translate: LTU ED: MT LTU ED Manual Operations

Verify 'ED1(2)' 'IMCA A(B)' 'Mode' – On

9.6 ED Initialization Frame Selection

NOTE
Initialization frame 4 commands disengagement of the ED.

If Manual LDU Drive changeover has been performed
Use ED Changeover Disengage Frame 8 to disengage the ED.

MSS: MT: Init Frame: MT Init Frame Config

input 'Init Frame' 'ED' – 4(8)
all others – 0

cmd Load Init Frame Config (Verify 'ED' 'State': 4(8))

Verify all others: 0

9.7 ED IMCA Initialization
MSS: MT: Manual Translate: MT Manual Translate

cmd 'IMCA Commands' Initialize **Execute**

MSS: MT IMCA Cmd State: MT IMCA Cmd State

Verify 'ED' 'IMCA' 'A(B)' 'Initialize' – √

9.8 ED IMCA Movement Initiation

CAUTION
Mode IMCA to On if it is still Enabled after 60 seconds.

MSS: MT: Manual Translate: MT Manual Translate

cmd 'IMCA Commands' Actuate **Execute**

MSS: MT: Manual Translate: LTU ED: MT LTU ED Manual Operations

Verify 'ED1(2)' 'IMCA A(B)' 'Mode' – Enabled
Verify 'ED1(2)' 'IMCA A(B)' 'Position' – increasing(decreasing)
Verify 'ED1(2)' 'IMCA A(B)' 'Shaft Spd' ≤ 37 (24) rpm

After motion is complete

Verify 'ED1(2)' 'IMCA A(B)' 'Switch States' 'Engaged'	– blank
Verify 'ED1(2)' 'IMCA A(B)' 'Switch States' 'Disengage Trigger'	– √
Verify 'ED1(2)' 'IMCA A(B)' 'Switch States' 'Disengage Verify'	– √
Verify 'ED1(2)' 'IMCA A(B)' 'Switch States' 'Alt Disengage'	– √
Verify 'ED1(2)' 'IMCA A(B)' 'Mode'	– On

9.9 Commanding ED IMCA to Standby

MSS: MT: Manual Translate: MT Manual Translate

cmd 'IMCA Commands' Standby **Execute**

MSS: MT: Manual Translate: LTU ED: MT LTU ED Manual Operations

Verify 'ED1(2)' 'IMCA A(B)' 'Mode' – Standby

9.10 ED IMCAs Power Removal
MSS: MT: Power: 'RPCM MT-4B(3A)' 11: RPCM MT4B(3A) A RPC 11

cmd 'RPC Position' – Open (Verify – Op)

10. TD POWER OFF

10.1 TD IMCA Commanding Selection
MSS: MT: Manual Translate: HW Config Manual:
MT HW Config Manual

sel 'TD' 'IMCA Selection' – CMD IMCA A(B)
sel all others – none

cmd Load HW Config (Verify 'TD' 'State' – CMD IMCA A(B))

Verify all others – none

10.2 Commanding TD IMCA to Standby
MSS: MT: Manual Translate: MT Manual Translate

cmd 'IMCA Commands' Standby **Execute**

MSS: MT: Manual Translate: TUS TD: MT TUS TD Manual Operations

Verify 'TD1(2)' 'IMCA A(B)' 'Mode' – Standby

10.3 TD IMCAs Power Removal
MSS: MT: Power: 'RPCM MT-4B(3A)' 4:
RPCM MT4B(3A) A RPC 4

cmd 'RPC Position' – Open (Verify – Op)

11. LTU LATCH PHASE 3A

11.1 LTU IMCA Commanding Selection
MSS: MT: Manual Translate: HW Config Manual:
MT HW Config Manual

sel 'LTU3' to 'LTU4' 'IMCA Selection' (two) – CMD IMCA A(B)
sel all others – none

cmd Load HW Config

Verify 'LTU3' to 'LTU4' 'State' (two) – CMD IMCA A(B)

Verify all others – none

11.2 LTU Initialization Frame Selection
MSS: MT: Init Frame: MT Init Frame Config

input 'Init Frame' 'LTU' – 1 4
all others – 0

cmd Load Init Frame Config (Verify 'LTU' 'State': 14)

Verify all others: 0

NOTE
Initialization frame 14 commands phase 3A latch of the LTUs.

11.3 LTU IMCA Initialization
MSS: MT: Manual Translate: MT Manual Translate

cmd 'IMCA Commands' Initialize **Execute**

MSS: MT: IMCA Cmd State: MT IMCA Cmd State

Verify 'LTU3' to 'LTU4' 'IMCA' 'A(B)' 'Initialize' (two) – √

11.4 LTU IMCA Movement Initiation

CAUTION
Mode IMCA to On if it is still Enabled after 70 seconds.

MSS: MT: Manual Translate: MT Manual Translate

cmd 'IMCA Commands' Actuate **Execute**

MSS: MT: Manual Translate: LTU ED:
MT LTU ED Manual Operations

Verify ‘LTU3’ to ‘LTU4’ ‘IMCA A(B)’ ‘Mode’ (two) – Enabled
Verify ‘LTU3’ to ‘LTU4’ ‘IMCA A(B)’ ‘Position’ (two) – increasing
Verify ‘LTU3’ to ‘LTU4’ ‘IMCA A(B)’ ‘Shaft Spd’ (two) ≤ 48.21 rpm

After motion is complete
Verify ‘LTU3’ to ‘LTU4’ ‘IMCA A(B)’ ‘Mode’ (two) – On

12. LTU LATCH PHASE 3B

12.1 LTU IMCA Commanding Selection

MSS: MT: Manual Translate: HW Config Manual:
MT HW Config Manual

sel ‘LTU1’ to ‘LTU2’ ‘IMCA Selection’ (two) – CMD IMCA A(B)
sel all others – none

cmd Load HW Config

Verify ‘LTU1’ to ‘LTU2’ ‘State’ (two) – CMD IMCA A(B)

Verify all others – none

12.2 LTU Initialization Frame Selection

MSS: MT: Init Frame: MT Init Frame Config

input ‘Init Frame’ ‘LTU’ – 1 1
all others – 0

cmd Load Init Frame Config (Verify ‘LTU’ ‘State’: 11)

Verify all others: 0

NOTE
Initialization frame 11 commands phase 3B latch of the LTUs.

12.3 LTU IMCA Initialization

MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ Initialize **Execute**

MSS: MT: IMCA Cmd State: MT IMCA Cmd State

Verify ‘LTU1’ to ‘LTU2’ ‘IMCA’ ‘A(B)’ ‘Initialize’ (two) – √

12.4 LTU IMCA Movement Initiation

CAUTION
Mode IMCA to On if it is still Enabled after 80 seconds.

MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ Actuate **Execute**

MSS: MT: Manual Translate: LTU ED:
MT LTU ED Manual Operations

Verify ‘LTU1’ to ‘LTU2’ ‘IMCA A(B)’ ‘Mode’ (two) – Enabled
Verify ‘LTU1’ to ‘LTU2’ ‘IMCA A(B)’ ‘Position’ (two) – increasing
Verify ‘LTU1’ to ‘LTU2’ ‘IMCA A(B)’ ‘Shaft Spd’ (two) ≤ 48.21 rpm

After motion complete
Verify ‘LTU1’ to ‘LTU2’ ‘IMCA A(B)’ ‘Mode’ (two) – On

13. LTU LATCH PHASE 4

13.1 LTU IMCA Commanding Selection

MSS: MT: Manual Translate: HW Config Manual:
MT HW Config Manual

sel ‘LTU1’ to ‘LTU4’ ‘IMCA Selection’ (four) – CMD IMCA A(B)
sel all others – none

cmd Load HW Config

Verify ‘LTU1’ to ‘LTU4’ ‘State’ (four)– CMD IMCA A(B)

Verify all others – none

13.2 LTU Initialization Frame Selection

MSS: MT: Init Frame: MT Init Frame Config

input ‘Init Frame’ ‘LTU’ – 1 2
all others – 0

cmd Load Init Frame Config (Verify ‘LTU’ ‘State’: 12)

Verify all others: 0

> NOTE
> Initialization frame 12 commands phase 4 latch of the LTUs.

13.3 LTU IMCA Initialization

MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ Initialize **Execute**

MSS: MT: IMCA Cmd State: MT IMCA Cmd State

Verify ‘LTU1’ to ‘LTU4’ ‘IMCA’ ‘A(B)’ ‘Initialize’ (four) – √

13.4 LTU IMCA Movement Initiation

CAUTION
Mode IMCA to On if it is still Enabled after 80 seconds.

MSS: MT: Manual Translate: MT Manual Translate

cmd 'IMCA Commands' Actuate **Execute**

MSS: MT: Manual Translate: LTU ED:
MT LTU ED Manual Operations

Verify 'LTU1' to 'LTU4' 'IMCA A(B)' 'Mode' (four) – Enabled
Verify 'LTU1' to 'LTU4' 'IMCA A(B)' 'Position' (four) – increasing
Verify 'LTU1' to 'LTU4' 'IMCA A(B)' 'Shaft Spd' (four) ≤ 48.21 rpm

After motion complete
Verify 'LTU1' to 'LTU4' 'IMCA A(B)' 'Mode' (four) – On
Verify 'LTU1' to 'LTU4' 'IMCA A(B)' 'State' 'Lat' (four) – √

14. LTU IMCAs POWERDOWN

14.1 Commanding LTU IMCAs to Standby

MSS: MT: Manual Translate: MT Manual Translate

cmd 'IMCA Commands' Standby **Execute**

MSS: MT: Manual Translate: LTU ED:
MT LTU ED Manual Operations

Verify 'LTU1' to 'LTU4' 'IMCA A(B)' 'Mode' (four) – Standby

14.2 LTU IMCAs Power Removal

sel RPC [X] where [X] = 10 | 9 | 5 | 1

MSS: MT: Power: 'MT' 'RPCM MT-4B' [X]:
RPCM MT 4B(3A) A RPC[X]

cmd 'RPC Position' – Open (Verify – Op)

Repeat

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8.205 MT MANUAL LTU UNLATCH (ED ENGAGE)

(RBT GEN/ULF1 - ALL/FIN 2) Page 1 of 10 pages

NOTE

1. The IMCA automatically returns to On mode after the programmed trajectory has completed.

2. A pause command can be issued by commanding the IMCA to On mode on the following page:
   MSS: MT: Manual Translate: MT Manual Translate
   ‘IMCA Commands’

3. The IMCA takes approximately 6 seconds to complete self-tests once power is applied.

4. When I/O is enabled to the IMCAs, expect the following Robotics Advisory messages:
   ‘**R9Z - MSS MT LTU 1 IMCA 1,2 Comm or Device Fail**’
   ‘**R9Z - MSS MT LTU 2 IMCA 1,2 Comm or Device Fail**’
   ‘**R9Z - MSS MT LTU 3 IMCA 1,2 Comm or Device Fail**’
   ‘**R9Z - MSS MT LTU 4 IMCA 1,2 Comm or Device Fail**’
   ‘**R9Z - MSS MT ED IMCA 1,2 Comm or Device Fail**’
   ‘**R9Z - MSS MT TD IMCA 1,2 Comm or Device Fail**’
   ‘**R9Z - MSS MT UMA 1 IMCA 1,2 Comm or Device Fail**’
   ‘**R9Z - MSS MT UMA 2 IMCA 1,2 Comm or Device Fail**’
   ‘**R9Z - MSS MT TUS 1 IMCA 1,2 Comm or Device Fail**’
   ‘**R9Z - MSS MT TUS 2 IMCA 1,2 Comm or Device Fail**’

5. MT IMCA RT FDIR remains inhibited at all times to avoid channel switching caused by nominal IMCA power removal. This also suppresses some of the nuisance RT Comm Fail C&W messages.

6. The ‘LTU2’ ‘IMCA B’ ‘Mode’ field is incorrect on
   MSS: MT: Manual Translate: LTU ED:
   MT LTU ED Manual Operations
   The mode of this IMCA must be verified on MSS: MT: Power:
   MT Power (SPN 2422)

1. IMCA RT I/O ENABLE

If MT IMCAs I/O not Enable

MSS: MT: ‘MT’ ‘Amp 1’ MT LB A: RT Status:
LB MT 1 RT Status
‘RT Status’

cmd ‘00 LTU 1P’ Enable **Execute** (Verify – Ena)
cmd ‘01 LTU 2P’ Enable **Execute** (Verify – Ena)
cmd ‘02 LTU 3P’ Enable **Execute** (Verify – Ena)
cmd ‘03 LTU 1S’ Enable **Execute** (Verify – Ena)
cmd ‘04 LTU 4P’ Enable **Execute** (Verify – Ena)
cmd ‘05 LTU 3S’ Enable **Execute** (Verify – Ena)
cmd ‘06 LTU 2S’ Enable **Execute** (Verify – Ena)
cmd ‘07 LTU 4S’ Enable **Execute** (Verify – Ena)
cmd ‘08 ED P’ Enable **Execute** (Verify – Ena)
cmd ‘09 TD P’ Enable **Execute** (Verify – Ena)

cmd ‘11 ED S’ Enable **Execute** (Verify – Ena)

sel RT Status Continued RT#16-25

LB MT 1 RT Status Cont ‘RT Status’

cmd ‘14 TD S’ Enable **Execute** (Verify – Ena)
cmd ‘16 TUS 1S’ Enable **Execute** (Verify – Ena)
cmd ‘17 TUS 2P’ Enable **Execute** (Verify – Ena)
cmd ‘18 TUS 2S’ Enable **Execute** (Verify – Ena)
cmd ‘19 UMA 1P’ Enable **Execute** (Verify – Ena)
cmd ‘20 UMA 1S’ Enable **Execute** (Verify – Ena)
cmd ‘21 UMA 2P’ Enable **Execute** (Verify – Ena)
cmd ‘22 UMA 2S’ Enable **Execute** (Verify – Ena)
cmd ‘24 TUS 1P’ Enable **Execute** (Verify – Ena)

2. MT SOFTWARE PROCESS INITIATION

PCS MSS: MT: MT Mode: MT Mode

If ‘MT Process State’ – Disabled
cmd Initiate MT Process **Execute**

Verify ‘SEPS Process State’ – Initiated
Verify ‘IMCA Process State’ – Initiated
Verify ‘MT Process State’ – Initiated

If ‘MT Software Mode’ – Idle or Auto
cmd Standby **Execute** (Verify – Standby)

If ‘MT Software Mode’ – Standby
cmd Manual **Execute** (Verify – Manual)

3. TUS POWER VERIFICATION

MSS: MT: Power: MT Power

Verify ‘TUS1’ ‘RPCM S0-4B-F’ 17 – Cl
Verify ‘MT’ ‘RPCM MT-4B’ 13,14 (two) – Cl
Verify ‘TUS2’ ‘RPCM S0-3A-E’ 18 – Cl
Verify ‘MT’ ‘RPCM MT-3A’ 13,14 (two) – Cl

4. TD IMCA POWER APPLICATION

MSS: MT: Power: ‘RPCM MT-4B(3A)’ 4: RPCM MT4B(3A) A RPC 04

cmd ‘RPC Position’ – Close (Verify – Cl)

MSS: MT: Power: MT Power
Verify ‘MT’ ‘RPCM MT-4B(3A)’ ‘TD’ ‘Mode’ – Standby
Verify ‘MT’ ‘RPCM MT-4B(3A)’ ‘TD’ ‘Fault’ – blank

MSS: MT: IMCA Data Stale State: MT IMCA Data Stale State

Verify 'TD' 'IMCA' 'A(B)' 'Status Measurements' – blank

5. TD POSITION HOLD

5.1 TD IMCA Commanding Selection

MSS: MT: Manual Translate: HW Config Manual: MT HW Config Manual

sel 'TD' 'IMCA Selection' – CMD IMCA A(B)
sel all others – none

cmd Load HW Config (Verify 'TD' 'State' – CMD IMCA A(B))

Verify all others – none

5.2 TD Initialization Frame Selection

MSS: MT: Init Frame: MT Init Frame Config

input 'Init Frame' 'TD' – 2
all others – 0

cmd Load Init Frame Config (Verify 'TD' 'State': 2)

Verify all others: 0

NOTE
Initialization frame 2 places the TD in position hold to prevent motion once the LTU is unlatched.

5.3 TD IMCA Initialization

MSS: MT: Manual Translate: MT Manual Translate

cmd 'IMCA Commands' Initialize **Execute**

MSS: MT: IMCA Cmd State: MT IMCA Cmd State

Verify 'TD' 'IMCA' 'A(B)' 'Initialize' – √

5.4 Moding TD IMCAs to On

MSS: MT: Manual Translate: MT Manual Translate

cmd 'IMCA Commands' On **Execute**

MSS: MT: Manual Translate: TUS TD: MT TUS TD Manual Operations

Verify 'TD1(2)' 'IMCA A(B)' 'Mode' – On

6. LTU UNLATCH PHASE 1

6.1 LTU IMCAs Power Application

sel RPC [X] where [X] = 10 | 9 | 5 | 1

MSS: MT: Power: ‘MT’ ‘RPCM MT-4B(3A)’ [X]: RPCM MT4B(3A) A RPC[X]

cmd ‘RPC Position’ – Close (Verify – Cl)

Repeat

MSS: MT: Power: MT Power

Verify ‘MT’ ‘RPCM MT-4B(3A)’ ‘LTU1’ to ‘LTU4’ ‘Mode’ (four) – Standby
Verify ‘MT’ ‘RPCM MT-4B(3A)’ ‘LTU1’ to ‘LTU4’ ‘Fault’ (four) – blank

MSS: MT: IMCA Data Stale State: MT IMCA Data Stale State

Verify ‘LTU1’ to ‘LTU4’ ‘IMCA’ ‘A(B)’ ‘Status Measurements’ (four) – blank

6.2 LTU IMCA Commanding Selection

MSS: MT: Manual Translate: HW Config Manual: MT HW Config Manual

sel ‘LTU1’ to ‘LTU4’ ‘IMCA Selection’ (four) – CMD IMCA A(B)
sel all others – none

cmd Load HW Config

Verify ‘LTU1’ to ‘LTU4’ ‘State’ (four) – CMD IMCA A(B)

Verify all others – none

6.3 LTU Initialization Frame Selection

MSS: MT: Init Frame: MT Init Frame Config

input ‘Init Frame’ ‘LTU’ – 2
all others – 0

cmd Load Init Frame Config (Verify ‘LTU’ ‘State’: 2)

Verify all others: 0

6.4 LTU IMCA Initialization

MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ Initialize **Execute**

MSS: MT: IMCA Cmd State: MT IMCA Cmd State

Verify ‘LTU1’ to ‘LTU4’ ‘IMCA’ ‘A(B)’ ‘Initialize’ (four) – √

6.5 Moding LTU IMCAs to On

MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ On **Execute**

MSS: MT: Manual Translate: LTU ED: MT LTU ED Manual Operations

Verify ‘LTU1’ to ‘LTU4’ ‘IMCA A(B)’ ‘Mode’ (four) – On

6.6 LTU Initialization Frame Selection

MSS: MT: Init Frame: MT Init Frame Config

input ‘Init Frame’ ‘LTU’ – 5
all others – 0

cmd Load Init Frame Config (Verify ‘LTU’ ‘State’: 5)

Verify all others: 0

NOTE
Initialization frame 5 commands phase 1 unlatching of the LTUs.

6.7 LTU IMCA Initialization

MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ Initialize **Execute**

MSS: MT: IMCA Cmd State: MT IMCA Cmd State

Verify ‘LTU1’ to ‘LTU4’ ‘IMCA’ ‘A(B)’ ‘Initialize’ (four) – √

6.8 LTU IMCA Movement Initiation

CAUTION
Mode IMCA to On if it is still Enabled after 110 seconds.

MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ Actuate **Execute**

MSS: MT: Manual Translate: LTU ED: MT LTU ED Manual Operations

Verify ‘LTU1’ to ‘LTU4’ ‘IMCA A(B)’ ‘Mode’ (four) – Enabled
Verify ‘LTU1’ to ‘LTU4’ ‘IMCA A(B)’ ‘Position’ (four) – decreasing
Verify ‘LTU1’ to ‘LTU4’ ‘IMCA A(B)’ ‘Shaft Spd’ (four) ≤ 48.21 rpm

After motion complete
Verify ‘LTU1’ to ‘LTU4’ ‘IMCA A(B)’ ‘Mode’ (four) – On

7. ED ENGAGEMENT

7.1 ED IMCA Power Application

MSS: MT: Power: ‘MT’ ‘RPCM MT-4B(3A)’ 11:
RPCM MT4B(3A) A RPC 11

cmd ‘RPC Position’ – Close (Verify – Cl)

MSS: MT: Power: MT Power

Verify ‘MT’ ‘RPCM MT-4B(3A)’ ‘ED’ ‘Mode’ – Standby
Verify ‘MT’ ‘RPCM MT-4B(3A)’ ‘ED’ ‘Fault’ – blank

MSS: MT: IMCA Data Stale State: MT IMCA Data Stale State

Verify ‘ED’ ‘IMCA’ ‘A(B)’ ‘Status Measurements’ – blank

MSS: MT: Manual Translate: LTU ED: MT LTU ED Manual Operations

Verify ‘ED1(2)’ ‘Switch States’ ‘Engaged’ – blank
Verify ‘ED1(2)’ ‘Switch States’ ‘Disengage Trigger’ – √
Verify ‘ED1(2)’ ‘Switch States’ ‘Disengage Verify’ – √
Verify ‘ED1(2)’ ‘Switch States’ ‘Alt Disengage’ – √

7.2 ED IMCA Commanding Selection

MSS: MT: Manual Translate: HW Config Manual: MT HW Config Manual

sel ‘ED’ ‘IMCA Selection’ – CMD IMCA A(B)
sel all others – none

cmd Load HW Config (Verify ‘ED’ ‘State’ – CMD IMCA A(B))

Verify all others – none

7.3 ED Initialization Frame Selection

MSS: MT: Init Frame: MT Init Frame Config

input ‘Init Frame’ ‘ED’ – 2
all others – 0

cmd Load Init Frame Config (Verify ‘ED’ ‘State’: 2)

Verify all others: 0

7.4 ED IMCA Initialization

MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ Initialize **Execute**

MSS: MT: IMCA Cmd State: MT IMCA Cmd State

Verify ‘ED’ ‘IMCA’ ‘A(B)’ ‘Initialize’ – √

7.5 Moding ED IMCAs to On

MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ On **Execute**

MSS: MT: Manual Translate: LTU ED: MT LTU ED Manual Operations

Verify ‘ED1(2)’ ‘IMCA A(B)’ ‘Mode’ – On

7.6 ED Initialization Frame Selection

MSS: MT: Init Frame: MT Init Frame Config

input ‘Init Frame’ ‘ED’ – 3
all others – 0

cmd Load Init Frame Config (Verify ‘ED’ ‘State’: 3)

Verify all others: 0

> NOTE
> Initialization Frame 3 commands the lowering of the TD wheel to the ITS Rail.

7.7 ED IMCA Initialization

MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ Initialize **Execute**

MSS: MT: IMCA Cmd State: MT IMCA Cmd State

Verify ‘ED’ ‘IMCA’ ‘A(B)’ ‘Initialize’ – √

7.8 ED IMCA Movement Initiation

> **CAUTION**
> Mode IMCA to On if it is still Enabled after 50 seconds.

MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ Actuate **Execute**

MSS: MT: Manual Translate: LTU ED: MT LTU ED Manual Operations

Verify ‘ED1(2)’ ‘IMCA A(B)’ ‘Mode’ – Enabled
Verify ‘ED1(2)’ ‘IMCA A(B)’ ‘Position’ – decreasing
Verify ‘ED1(2)’ ‘IMCA A(B)’ ‘Shaft Spd’ ≤ 48 rpm

After motion complete

Verify ‘ED1(2)’ ‘Switch States’ ‘Engaged’	– blank
Verify ‘ED1(2)’ ‘Switch States’ ‘Disengage Trigger’	– blank
Verify ‘ED1(2)’ ‘Switch States’ ‘Disengage Verify’	– blank
Verify ‘ED1(2)’ ‘Switch States’ ‘Alt Disengage’	– √
Verify ‘ED1(2)’ ‘IMCA A(B)’ ‘Mode’	– On

7.9 Commanding ED IMCA to Standby

MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ Standby **Execute**

MSS: MT: Manual Translate: LTU ED: MT LTU ED Manual Operations

Verify ‘ED1(2)’ ‘Mode’ – Standby

8. LTU UNLATCH PHASE 2

8.1 LTU IMCA Commanding Selection

MSS: MT: Manual Translate: HW Config Manual: MT HW Config Manual

sel ‘LTU1’ to ‘LTU4’ ‘IMCA Selection’ (four) – CMD IMCA A(B)
sel all others – none

cmd Load HW Config

Verify ‘LTU1’ to ‘LTU4’ ‘State’ (four) – CMD IMCA A(B)

Verify all others – none

8.2 LTU Initialization Frame Selection

MSS: MT: Init Frame: MT Init Frame Config

input ‘Init Frame’ ‘LTU’ – 6
all others – 0

cmd Load Init Frame Config (Verify ‘LTU’ ‘State’: 6)

Verify all others: 0

NOTE
Initialization frame 6 commands phase 2 unlatch of the LTUs.

8.3 LTU IMCA Initialization

MSS: MT: Manual Translate: MT Manual Translate

cmd 'IMCA Commands' Initialize **Execute**

MSS: MT: IMCA Cmd State: MT IMCA Cmd State

Verify 'LTU1' to 'LTU4' 'IMCA' 'A(B)' 'Initialize' (four) – √

8.4 LTU IMCA Movement Initiation

CAUTION
Mode IMCA to On if it is still Enabled after 150 seconds.

MSS: MT: Manual Translate: MT Manual Translate

cmd 'IMCA Commands' Actuate **Execute**

MSS: MT: Manual Translate: LTU ED: MT LTU ED Manual Operations

Verify 'LTU1' to 'LTU4' 'IMCA A(B)' 'Mode' (four) – Enabled
Verify 'LTU1' to 'LTU4' 'IMCA A(B)' 'Position' (four) – decreasing
Verify 'LTU1' to 'LTU4' 'IMCA A(B)' 'Shaft Spd' (four) ≤ 32.14 rpm

After motion complete
Verify 'ED1(2)' 'Switch States' 'Engaged' – √
Verify 'LTU1' to 'LTU4' 'IMCA A(B)' 'Mode' (four) – On
Verify 'LTU1' to 'LTU4' 'IMCA A(B)' 'State' 'Rel' (four) – √

8.5 Commanding LTU IMCAs to Standby

MSS: MT: Manual Translate: MT Manual Translate

cmd 'IMCA Commands' Standby **Execute**

MSS: MT: Manual Translate: LTU ED: MT LTU ED Manual Operations

Verify 'LTU1' to 'LTU4' 'IMCA A(B)' 'Mode' (four) – Standby

9. ED IMCA POWER REMOVAL

MSS: MT: Power: 'MT' 'RPCM MT-4B(3A)' 11:
RPCM MT4B(3A) A RPC 11

cmd 'RPC Position' – Open (Verify – Op)

10. LTU IMCAs POWER REMOVAL

sel RPC [X] where [X] = 10 9 5 1

MSS: MT: Power: ‘MT’ ‘RPCM MT-4B(3A)’ [X]:
RPCM MT 4B(3A) A RPC[X]

cmd ‘RPC Position’ – Open (Verify – Op)

Repeat

8.206 MT MANUAL LDU DRIVE CHANGEOVER

(RBT GEN/12A - ALL/FIN) Page 1 of 6 pages

NOTE

1. Procedure assumes failure occurred on the Prime string.
2. The IMCA automatically returns to On mode after the programmed trajectory has completed.
3. A pause command can be issued by commanding the IMCA to On mode on the following page:
   MSS: MT: Manual Translate: MT Manual Translate
   'IMCA Commands'
4. The IMCA takes approximately 6 seconds to complete self-tests once power is applied.

1. MT SOFTWARE PROCESS INITIATION

PCS MSS: MT: MT Mode: MT Mode

If MT Process State – Disabled
    cmd Initiate MT Process **Execute**

Verify 'SEPS Process State' – Initiated
Verify 'IMCA Process State' – Initiated
Verify 'MT Process State' – Initiated

If MT Software Mode – Idle or Auto
    cmd Standby **Execute** (Verify – Standby)

If MT Software Mode – Standby
    cmd Manual **Execute** (Verify – Manual)

2. TUS POWER VERIFICATION

MSS: MT: Power: MT Power

Verify 'TUS1' 'RPCM S0-4B-F' 17 – Cl
Verify 'MT' 'RPCM MT-4B' 13,14 (two) – Cl
Verify 'TUS2' 'RPCM S0-3A-E' 18 – Cl
Verify 'MT' 'RPCM MT-3A' 13,14 (two) – Cl

3. TD 1(2) IMCA POWER REMOVAL

MSS: MT: Power: 'MT' 'RPCM MT-4B(3A)' 4: RPCM MT4B(3A) A RPC 04

cmd RPC Position – Open (Verify – Op)

4. TD 2(1) IMCA POWER APPLICATION

MSS: MT: Power: 'MT' 'RPCM MT-3A(4B)' 4: RPCM MT3A(4B) A RPC 04

cmd RPC Position – Close (Verify – Cl)

5. TD 2(1) COMMANDING ON

5.1 IMCA Commanding Selection
MSS: MT: Manual Translate: HW Config Manual:
MT HW Config Manual

sel ‘TD’ ‘IMCA Selection’ – CMD IMCA B(A)

cmd Load HW Config (Verify ‘TD’ ‘State’ – CMD IMCA B(A))

Verify all others – none

5.2 Initialization Frame Selection
MSS: MT: Init Frame: MT Init Frame Config

input ‘Init Frame’ ‘TD’ – 2
all others – 0

cmd Load Init Frame Config (Verify ‘TD’ ‘State’: 2)

√all others: 0

5.3 IMCA Initialization
MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ Initialize **Execute**

MSS: MT: IMCA Cmd State: MT IMCA Cmd State

Verify ‘TD’ ‘IMCA’ ‘B(A)’ ‘Initialize’ – √

5.4 Mode TD IMCA to On
MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ On **Execute**

MSS: MT: Manual Translate: TUS TD: MT TUS TD Manual Operations

Verify ‘TD 2(1)’ ‘IMCA B(A)’ Mode – On

6. ED IMCA SETUP

PCS 6.1 ED IMCA Power Application
MSS: MT: Power: ‘MT’ ‘RPCM MT-3A(4B)’ 11:
RPCM MT3A(4B) A RPC 11

cmd RPC Position – Close (Verify – Cl)

6.2 IMCA Commanding Selection
MSS: MT: Manual Translate: HW Config Manual:
MT HW Config Manual

sel ‘ED’ ‘IMCA Selection’– CMD IMCA B(A)

cmd Load HW Config (Verify ‘ED’ ‘State’– CMD IMCA B(A))

√all others – none

MSS: MT: Manual Translate: LTU ED: MT LTU ED Manual Operations

Verify ‘ED 2(1)’ ‘Switch States’ ‘Engaged’ – blank
Verify ‘ED 2(1)’ ‘Switch States’ ‘Disengage Trigger’ – √
Verify ‘ED 2(1)’ ‘Switch States’ ‘Disengage Verify’ – √
Verify ‘ED 2(1)’ ‘Switch States’ ‘Center Cam Alt Disengage’ – blank

7. TD CHANGEOVER PART 1

7.1 Initialization Frame Selection
MSS: MT: Init Frame: MT Init Frame Config

input ‘Init Frame’ ‘ED’ – 2
all others – 0

cmd Load Init Frame Config (Verify ‘ED’ ‘State’: 2)

√all others: 0

7.2 IMCA Initialization
MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ Initialize **Execute**

MSS: MT: IMCA Cmd State: MT IMCA Cmd State

Verify ‘ED’ ‘IMCA’ ‘B(A)’ ‘Initialize’ – √

7.3 Mode ED IMCA to On
MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ On **Execute**

MSS: MT: Manual Translate: LTU ED: MT LTU ED Manual Operations

Verify ‘ED’ ‘IMCA B(A)’ ‘Mode’ – On

7.4 Initialization Frame Selection
MSS: MT: Init Frame: MT Init Frame Config

input ‘Init Frame’ ‘ED’ – 5
all others – 0

cmd Load Init Frame Config (Verify ‘ED’ ‘State’: 5)

√all others: 0

7.5 <u>IMCA Initialization</u>
MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ Initialize **Execute**

MSS: MT: IMCA Cmd State: MT IMCA Cmd State

Verify ‘ED’ ‘IMCA’ ‘B(A)’ ‘Initialize’ – √

7.6 <u>IMCA Movement Initiation</u>
Verify IMCA motion using the following page:
MSS: MT: Manual Translate: LTU ED:
MT LTU ED Manual Operations

CAUTION

Mode the IMCA to On if it is still Enabled after 60 seconds.

MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ Actuate **Execute**

MSS: MT: Manual Translate: LTU ED: MT LTU ED Manual Operations

Verify ‘ED 2(1)’ ‘IMCA B(A)’ ‘Mode’ – Enabled
Verify ‘ED 2(1)’ ‘IMCA B(A)’ ‘Position’ – increasing
Verify ‘ED 2(1)’ ‘IMCA B(A)’ ‘Shaft Spd’ ≤ 24 rpm

Verify ‘ED 2(1)’ ‘Switch States’ ‘Engaged’ – √
Verify ‘ED 2(1)’ ‘Switch States’ ‘Disengage Trigger’ – blank
Verify ‘ED 2(1)’ ‘Switch States’ ‘Disengage Verify’ – blank
Verify ‘ED 2(1)’ ‘Switch States’ ‘Center Cam Alt Disengage’ – blank
Verify ‘ED 2(1)’ ‘IMCA B(A)’ ‘Mode’ – On

8. <u>TD CHANGEOVER PART 2</u>

8.1 <u>Initialization Frame Selection</u>
MSS: MT: Init Frame: MT Init Frame Config

input ‘Init Frame’ ‘ED’ – <u>6</u>

cmd Load Init Frame Config (Verify ‘ED’ ‘State’: 6)

Verify all others: 0

8.2 <u>IMCA Initialization</u>
MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ Initialize **Execute**

MSS: MT: IMCA Cmd State: MT IMCA Cmd State

Verify ‘ED’ ‘IMCA’ ‘B(A)’ ‘Initialize’ – √

8.3 IMCA Movement Initiation

Verify IMCA motion using the following page:
MSS: MT: Manual Translate: LTU ED:
MT LTU ED Manual Operations

CAUTION

Mode the IMCA to On if it is still Enabled after 50 seconds.

MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ Actuate **Execute**

MSS: MT: Manual Translate: LTU ED: MT LTU ED Manual Operations

Verify ‘ED2(1)’ ‘IMCA B(A)’ ‘Mode’ – Enabled
Verify ‘ED2(1)’ ‘IMCA B(A)’ ‘Position’ – increasing
Verify ‘ED2(1)’ ‘IMCA B(A)’ ‘Shaft Spd’ ≤ 24 rpm

Verify ‘ED2(1)’ ‘Switch States’ ‘Engaged’ – √
Verify ‘ED2(1)’ ‘Switch States’ ‘Disengage Trigger’ – blank
Verify ‘ED2(1)’ ‘Switch States’ ‘Disengage Verify’ – blank
Verify ‘ED2(1)’ ‘Switch States’ ‘Center Cam Alt Disengage’ – √
Verify ‘ED2(1)’ ‘IMCA B(A)’ ‘Mode’ – On

9. TD CHANGEOVER PART 3

9.1 Initialization Frame Selection

MSS: MT: Init Frame: MT Init Frame Config

input ‘Init Frame’ ‘ED’ – 7
all others – 0

cmd Load Init Frame Config (Verify ‘ED’ ‘State’: 7)

Verify all others: 0

9.2 IMCA Initialization

MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ Initialize **Execute**

MSS: MT: IMCA Cmd State: MT IMCA Cmd State

Verify ‘ED’ ‘IMCA’ ‘B(A)’ ‘Initialize’ – √

9.3 IMCA Movement Initiation

Verify IMCA motion using the following page:
MSS: MT: Manual Translate: LTU ED:
MT LTU ED Manual Operations

CAUTION
Mode the IMCA to On if it is still Enabled after 50 seconds.

MSS: MT: Manual Translate: MT Manual Translate

cmd 'IMCA Commands' Actuate **Execute**

MSS: MT: Manual Translate: LTU ED: MT LTU ED Manual Operations

Verify 'ED 2(1)' 'IMCA B(A)' 'Mode' – Enabled
Verify 'ED 2(1)' 'IMCA B(A)' 'Position' – decreasing
Verify 'ED 2(1)' 'IMCA B(A)' 'Shaft Spd' ≤ 24 rpm

Verify 'ED 2(1)' 'Switch States' 'Engaged' – √
Verify 'ED 2(1)' 'Switch States' 'Disengage Trigger' – blank
Verify 'ED 2(1)' 'Switch States' 'Disengage Verify' – blank
Verify 'ED 2(1)' 'Switch States' 'Center Cam Alt Disengage' – √
Verify 'ED 2(1)' 'IMCA B(A)' 'Mode' – On

10. ED POWERDOWN

PCS 10.1 Command IMCA to Standby

MSS: MT: Manual Translate: MT Manual Translate

cmd 'IMCA Commands' Standby **Execute**

MSS: MT: Manual Translate: LTU ED:
MT LTU ED Manual Operations

Verify 'ED 2(1)' Mode – Standby

10.2 IMCAs Power Removal

MSS: MT: Power: 'MT' 'RPCM MT-3A(4B)' 11:
RPCM MT3A(4B) A RPC 11

cmd RPC Position – Open (Verify – Op)

8.208 MT MANUAL TUS INITIALIZATION

NOTE

1. The IMCA automatically returns to On mode after the programmed trajectory has completed.

2. A pause command can be issued by commanding the IMCA to On mode on the following page
   MSS: MT: Manual Translate: MT Manual Translate
   'IMCA Commands'

3. The IMCA takes approximately 6 seconds to complete self-tests once power is applied.

1. MT SOFTWARE PROCESS INITIATION

PCS MSS: MT: MT Mode: MT Mode

If 'MT Process State' – Disabled
  cmd Initiate MT Process **Execute**

  Verify 'SEPS Process State' – Initiated
  Verify 'IMCA Process State' – Initiated
  Verify 'MT Process State' – Initiated

If 'MT Software Mode' – Idle or Auto
  cmd Standby **Execute** (Verify – Standby)

If 'MT Software Mode' – Standby
  cmd Manual **Execute** (Verify – Manual)

2. TUS IMCAs POWER APPLICATION

NOTE
The IMCA takes approximately 6 seconds to complete self-tests once power is applied.

MSS: MT: Power
MT Power
'TUS1'

sel RPCM S0-3A-F

RPCM S03A_F

sel RPC 1

RPCM S03A_F_RPC_01

Verify 'RPC Position' – Op

MSS: MT: Power
MT Power
'TUS1'

sel RPCM S0-4B-F

RPCM S04B_F

sel RPC 1

RPCM S04B_F_RPC_01

Verify ‘RPC Position’ – Op

MSS: MT: Power
MT Power
‘TUS2’

sel RPCM S0-3A-E

RPCM S03A_E

sel RPC 1

RPCM S03A_E_RPC_01

Verify ‘RPC Position’ – Op

MSS: MT: Power
MT Power
‘TUS2’

sel RPCM S0-4B-E

RPCM S04B_E

sel RPC 1

RPCM S04B_E_RPC_01

Verify ‘RPC Position’ – Op

MSS: MT: Power
MT Power
‘TUS1’

sel RPCM S0-4B(3A)-F

RPCM S04B(3A)_F

sel RPC 1

RPCM S04B(3A)_F_RPC_01

cmd ‘RPC Position’ – Close (Verify – Cl)

MSS: MT: Power
MT Power
‘TUS2’

sel RPCM S0-4B(3A)-E

RPCM S04B(3A) E

sel RPC 1

RPCM S04B(3A) E RPC 01

cmd ‘RPC Position’ – Close (Verify – Cl)

MSS: MT: IMCA Data Stale State: MT IMCA Data Stale State

Verify Status Measurements ‘TUS1’ to ‘TUS2’ ‘IMCA A(B)’ (two) – blank

MSS: MT: Power: MT Power

Verify ‘TUS1’ ‘RPCM S0-4B(3A)-F’ Mode – Standby
Verify ‘TUS1’ ‘RPCM S0-4B(3A)-F’ Fault – blank
Verify ‘TUS2’ ‘RPCM S0-4B(3A)-E’ Mode – Standby
Verify ‘TUS2’ ‘RPCM S0-4B(3A)-E’ Fault – blank

3. IMCA COMMANDING SELECTION

MSS: MT: Manual Translate: HW Config Manual:
MT HW Config Manual

sel ‘TUS1’ to ‘TUS2’ ‘IMCA Selection’ (two) – CMD IMCA A(B)

cmd Load HW Config

Verify ‘TUS1’ to ‘TUS2’ ‘State’ (two) – CMD IMCA A(B)
Verify all others – none

4. TUS INITIALIZATION (PHASE 1)

4.1 TUS Initialization Frame Selection

MSS: MT: Manual Translate: Init Frame Config:
MT Init Frame Config

input ‘TUS Init Frame’ – 2

cmd Load Init Frame Config (Verify ‘TUS’ ‘State’: 2)

Verify ‘State’ all others – 0

4.2 TUS IMCA Initialization

MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ Initialize **Execute**

MSS: MT: IMCA Cmd State: MT IMCA Cmd State

Verify ‘TUS1’ to ‘TUS2’ ‘IMCA A(B)’ ‘Initialize’ (two) – √

4.3 Mode TUS IMCA to On

MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ On **Execute**

MSS: MT: Manual Translate: TUS TD: MT TUS TD Manual Operations

Verify ‘TUS1’ to ‘TUS2’ ‘IMCA A(B)’ ‘Mode’ (two)– On

4.4 TUS Initialization Frame Selection

MSS: MT: Manual Translate: Init Frame Config:
MT Init Frame Config

input ‘TUS Init Frame’ – 3

cmd Load Init Frame Config (Verify ‘TUS’ ‘State’: 3)

Verify ‘State’ all others: 0

4.5 TUS IMCA Initialization

MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ Initialize **Execute**

MSS: MT: IMCA Cmd State: MT IMCA Cmd State

Verify ‘TUS1’ to ‘TUS2’ ‘IMCA A(B)’ ‘Initialize’ (two) – √

4.6 TUS IMCA Movement Initiation

NOTE
Time for IMCA motion is ≤ 10 seconds.

Verify IMCA motion using the following page
MSS: MT: Manual Translate: TUS TD:
MT TUS TD Manual Operations

MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ Actuate **Execute**

MSS: MT: Manual Translate: TUS TD: MT TUS TD Manual Operations

Verify 'TUS1' to 'TUS2' 'IMCA A(B)' 'Mode' (two) – On
Verify 'TUS1' to 'TUS2' 'IMCA A(B)' 'Outer sw' 'Hi' to 'Lo' (four) – blank
Verify 'TUS1' to 'TUS2' 'IMCA A(B)' 'Inner sw' 'Hi' to 'Lo' (four) – blank

4.7 <u>Mode IMCA to Standby</u>
MSS: MT: Manual Translate: MT Manual Translate

cmd 'IMCA Commands' Standby **Execute**

MSS: MT: Manual Translate: TUS TD: MT TUS TD Manual Operations

Verify 'TUS1' to 'TUS2' 'IMCA A(B)' 'Mode' (two) – Standby

5. TUS INITIALIZATION (PHASE 2)

5.1 <u>TUS Initialization Frame Selection</u>
MSS: MT: Manual Translate: Init Frame Config: MT Init Frame Config

input 'TUS Init Frame' – <u>4</u>

cmd Load Init Frame Config (Verify 'TUS' 'State': 4)

Verify 'State' all others: 0

5.2 <u>TUS IMCA Initialization</u>
MSS: MT: Manual Translate: MT Manual Translate

cmd 'IMCA Commands' Initialize **Execute**

MSS: MT: IMCA Cmd State: MT IMCA Cmd State

Verify 'TUS1' to 'TUS2' 'IMCA A(B)' 'Initialize' (two) – √

5.3 <u>Mode TUS IMCA to On</u>
MSS: MT: Manual Translate: MT Manual Translate

cmd 'IMCA Commands' On **Execute**

MSS: MT: Manual Translate: TUS TD: MT TUS TD Manual Operations

Verify 'TUS1' to 'TUS2' 'IMCA A(B)' 'Mode' (two) – On

5.4 <u>IMCA Movement Initiation</u>

<u>NOTE</u>
Time for IMCA motion is ≤ 15 seconds.

Verify IMCA motion using the following page
MSS: MT: Manual Translate: TUS TD:
MT TUS TD Manual Operations

MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ Actuate **Execute**

MSS: MT: Manual Translate: TUS TD: MT TUS TD Manual Operations

Verify ‘TUS1’ to ‘TUS2’ ‘IMCA A(B)’ ‘Mode’ (two) – On
Verify ‘TUS1’ to ‘TUS2’ ‘IMCA A(B)’ ‘Outer sw’ ‘Hi’ – blank
Verify ‘TUS1’ to ‘TUS2’ ‘IMCA A(B)’ ‘Inner sw’ ‘Hi’ – blank
Verify ‘TUS1’ to ‘TUS2’ ‘IMCA A(B)’ ‘Outer sw’ ‘Lo’ – √
Verify ‘TUS1’ to ‘TUS2’ ‘IMCA A(B)’ ‘Inner sw’ ‘Lo’ – √

6. TUS INITIALIZATION (PHASE 3)

6.1 TUS Initialization Frame Selections

MSS: MT: Manual Translate: Init Frame Config:
MT Init Frame Config

input ‘TUS’ ‘Init Frame’ – 5

cmd Load Init Frame Config (Verify ‘TUS’ ‘State’: 5)

Verify ‘State’ all others: 0

6.2 TUS IMCA Initialization

MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ Initialize **Execute**

MSS: MT: IMCA Cmd State: MT IMCA Cmd State

Verify ‘TUS1’ to ‘TUS2’ ‘IMCA A(B)’ ‘Initialize’ (two) – √

6.3 TUS IMCA Movement Initialization

NOTE
Time for IMCA motion is ≤ 30 seconds.

Verify IMCA motion using the following page
MSS: MT: Manual Translate: TUS TD:
MT TUS TD Manual Operations

MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ Actuate **Execute**

MSS: MT: Manual Translate: TUS TD: MT TUS TD Manual Operations

Verify ‘TUS1’ to ‘TUS2’ ‘IMCA A(B)’ ‘Mode’ – On
Verify ‘TUS1’ to ‘TUS2’ ‘IMCA A(B)’ ‘Outer sw’ ‘Hi’ – √
Verify ‘TUS1’ to ‘TUS2’ ‘IMCA A(B)’ ‘Inner sw’ ‘Hi’ – √
Verify ‘TUS1’ to ‘TUS2’ ‘IMCA A(B)’ ‘Outer sw’ ‘Lo’ – blank
Verify ‘TUS1’ to ‘TUS2’ ‘IMCA A(B)’ ‘Inner sw’ ‘Lo’ – blank

7. TUS INITIALIZATION (PHASE 4)

7.1 TUS Initialization Frame Selection

MSS: MT: Init Frame: MT Init Frame Config

input 'TUS' 'Init Frame' – 6

cmd Load Init Frame Config (Verify 'TUS' 'State': 6)

Verify 'State' all others: 0

7.2 TUS IMCA Initialization

MSS: MT: Manual Translate: MT Manual Translate

cmd 'IMCA Commands' Initialize **Execute**

MSS: MT: IMCA Cmd State: MT IMCA Cmd State

Verify 'TUS1' to 'TUS2' 'IMCA A(B)' 'Initialize' (two) – √

7.3 TUS IMCA Movement Initiation

NOTE
Time for IMCA motion is ≤ 10 seconds.

Verify IMCA motion using the following page
MSS: MT: Manual Translate: TUS TD:
MT TUS TD Manual Operations

MSS: MT: Manual Translate: MT Manual Translate

cmd 'IMCA Commands' Actuate **Execute**

MSS: MT: Manual Translate: TUS TD: MT TUS TD Manual Operations

Verify 'TUS1' to 'TUS2' 'IMCA A(B)' 'Mode' (two) – On
Verify 'TUS1' to 'TUS2' 'IMCA A(B)' 'Outer sw' 'Hi' to 'Lo' (four) – blank
Verify 'TUS1' to 'TUS2' 'IMCA A(B)' 'Inner sw' 'Hi' to 'Lo' (four) – blank

NOTE
The 'Inner sw' 'Hi' microswitch may or may not be tripped at end of TUS Initialization Sequence. If tripped, it will be automatically cleaned up when TUS control is enabled.

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8.209 MT TUS CABLE CUT

(RBT GEN/ULF1 - ALL/FIN) Page 1 of 3 pages

1. VERIFICATION

PCS MSS: MT: MT Mode: MT Mode

Verify SEPS Process State – Initiated

MSS: MT: Power: MT Power

If failed cable – TUS1
√'TUS2' RPCM S0-3A-E RPC 18 – Cl
√'TUS1' RPCM S0-4B-F RPC 17 – Op

sel RPCM S0-4B-F RPC 17

cmd Close Cmd inhibit (Verify – Inh)

Go to step 2.

If failed cable – TUS2
√'TUS1' RPCM S0-4B-F RPC 17 – Cl
√'TUS2' RPCM S0-3A-E RPC 18 – Op

sel RPCM S0-3A-E RPC 18

cmd Close Cmd inhibit (Verify – Inh)

Go to step 3.

2. TUS1 CUT

2.1 TUS1 Cable Cutter Relay A Power
MSS: MT: TUS1 Cut: RPCM MT3A RPC 03:
RPCM MT3A A RPC 03

cmd 'RPC Position' – Close (Verify – Cl)

2.2 TUS1 Cable Cutter Relay B Power
MSS: MT: TUS1 Cut: RPCM MT3A RPC 06:
RPCM MT3A A RPC 06

cmd 'RPC Position' – Close (Verify – Cl)

2.3 TUS1 Cable Cut

CAUTION

The following step will sever the TUS1 Cable.

MSS: MT: TUS1 Cut: RPCM MT3A RPC 17:
RPCM MT3A A RPC 17

cmd 'RPC Position' – Close (Verify – Cl)

2.4 <u>TUS1 Cable Cutter Unpower</u>
cmd ‘RPC Position’ – Open (Verify – Op)

2.5 <u>TUS1 Cable Cutter Relay B Unpower</u>
MSS: MT: TUS1 Cut: RPCM MT3A RPC 06:
RPCM MT3A A RPC 06

cmd ‘RPC Position’ – Open (Verify – Op)

2.6 <u>TUS1 Cable Cutter Relay A Unpower</u>
MSS: MT: TUS1 Cut: RPCM MT3A RPC 03:
RPCM MT3A RPC 03

cmd ‘RPC Position’ – Open (Verify – Op) >>

3. <u>TUS2 CUT</u>

3.1 <u>TUS2 Cable Cutter Relay A Power</u>
MSS: MT: TUS2 Cut: RPCM MT4B RPC 03:
RPCM MT4B A RPC 03

cmd ‘RPC Position’ – Close (Verify – Cl)

3.2 <u>TUS2 Cable Cutter Relay B Power</u>
MSS: MT: TUS2 Cut: RPCM MT4B RPC 06:
RPCM MT4B A RPC 06

cmd ‘RPC Position’ – Close (Verify – Cl)

3.3 <u>TUS2 Cable Cut</u>

CAUTION

The following step will sever the TUS2 Cable.

MSS: MT: TUS2 Cut: RPCM MT4B RPC 17:
RPCM MT4B A RPC 17

cmd ‘RPC Position’ – Close (Verify – Cl)

3.4 <u>TUS2 Cable Cutter Unpower</u>
cmd ‘RPC Position’ – Open (Verify – Op)

3.5 <u>TUS2 Cable Cutter Relay B Unpower</u>
MSS: MT: TUS2 Cut: RPCM MT4B RPC 06:
RPCM MT4B A RPC 06

cmd ‘RPC Position’ – Open (Verify – Op)

3.6 TUS2 Cable Cutter Relay A Unpower
MSS: MT: TUS2 Cut: RPCM MT4B RPC 03:
RPCM MT4B A RPC 03

cmd ‘RPC Position’ – Open (Verify – Op)

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8.210 MT TRANSLATE TO NEAREST LOGICAL WORKSITE

NOTE

1. The IMCA automatically returns to On mode after the programmed trajectory has completed.

2. A pause command can be issued by commanding the IMCA to On mode on the following page:
   MSS: MT: Manual Translate: MT Manual Translate
   'IMCA Commands'

3. The IMCA takes approximately 6 seconds to complete self-tests once power is applied.

1. MT SOFTWARE PROCESS VERIFICATION

PCS MSS: MT: MT Mode: MT Mode

If 'MT Process State' – Disabled
 cmd Initiate MT Process **Execute**

Verify 'SEPS Process State' – Initiated
Verify 'IMCA Process State' – Initiated
Verify 'MT Process State' – Initiated

If 'MT Software Mode' – Idle or Auto
 cmd Standby **Execute** (Verify – Standby)

If 'MT Software Mode' – Standby
 cmd Manual **Execute** (Verify – Manual)

2. MT RPCM AND AMPLIFIER POWER VERIFICATION

MSS: MT: Power: MT Power

Verify 'TUS1' 'RPCM S0-4B-F' 17 – Cl
Verify 'MT' 'RPCM MT-4B' 13,14 – Cl

3. TD1(2) IMCA POWER VERIFICATION

MSS: MT: Power: 'MT' 'RPCM MT-4B(3A)' 4: RPCM MT4B(3A) RPC 4

√'RPC Position' – Cl

MSS: MT: Power: MT Power

MSS: MT: IMCA Data Stale State: MT IMCA Data Stale State

Verify 'Status Measurements' 'TD' 'IMCA' A(B) – blank

√'MT' 'RPCM MT-4B(3A)' 'TD Mode' – Standby

Verify 'MT' 'RPCM MT-4B(3A)' 'TD Fault' – blank

4. TD PHASE 2 SETUP

4.1 TD IMCA Commanding Selection

MSS: MT: Manual Translate HW Config Manual:
MT HW Config Manual

pick ‘TD’ ‘IMCA Selection’ – CMD IMCA A(B)
pick all others – none

cmd Load HW Config (Verify ‘State’ ‘TD’ – CMD IMCA A(B))

Verify all others – none

4.2 Loading Position Hold Init Frame

MSS: MT: Manual Translate: Init Frame Config: MT Init Frame Config

input ‘TD’ ‘Init Frame’ – 2
input all others – 0

cmd Load Init Frame Config (Verify ‘TD’ ‘State’: 2)

Verify all others: 0

4.3 TD IMCA Initialization

MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ Initialize **Execute**

MSS: MT: IMCA Cmd State: MT IMCA Cmd State

Verify ‘TD’ ‘IMCA’ A(B) ‘Initialize’– √

4.4 TD IMCA Mode to On

MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ On **Execute**

MSS: MT: Manual Translate: TUS TD: MT TUS TD Manual Operations

Verify ‘TD1(2)’ ‘IMCA’ A(B) Mode – On

4.5 TD Initialization Frame Selection

Table 1. Initialization Frame Selection

Nearest Logical Worksite Location	Init Frame
Starboard (+Y)	140
Port (-Y)	148

MSS: MT: Manual Translate: Init Frame Config: MT Init Frame Config

input ‘TD’ ‘Init Frame’ (Refer to Table 1)

cmd Load Init Frame Config (Verify ‘TD’ ‘State’, refer to Table 1)

Verify all others: 0

4.6 TD IMCA Initialization
MSS: MT: Manual Translate: $\boxed{\text{MT Manual Translate}}$

cmd ‘IMCA Commands’ Initialize **Execute**

MSS: MT: IMCA Cmd State: $\boxed{\text{MT IMCA Cmd State}}$

Verify ‘TD’ ‘IMCA’ A(B) ‘Initialize’– √

5. TUS IMCAs POWER VERIFICATION
MSS: MT: Power: ‘RPCM S0-4B(3A)-F’ 1: $\boxed{\text{RPCM S0-4B(3A)-F RPC 1}}$

√‘RPC Position’ – Cl

MSS: MT: Power: ‘RPCM S0-4B(3A)-E’ 1: $\boxed{\text{RPCM S0-4B(3A)-E RPC1}}$

√‘RPC Position’ – Cl

MSS: MT: Power: $\boxed{\text{MT Power}}$

MSS: MT: IMCA Data Stale State: $\boxed{\text{MT IMCA Data Stale State}}$

Verify ‘Status Measurements’ ‘TUS1’ to ‘TUS2’ ‘IMCA A(B)’ – blank

√‘TUS1’ ‘RPCM S0-4B(3A)-F’ ‘Mode’ – Standby
Verify ‘TUS1’ ‘RPCM S0-4B(3A)-F’ ‘Fault’ – blank

√‘TUS2’ ‘RPCM S0-4B(3A)-E’ ‘Mode’ – Standby
Verify ‘TUS2’ ‘RPCM S0-4B(3A)-E’ ‘Fault’ – blank

6. TUS CONTROL SETUP
6.1 TUS IMCA Commanding Selection
MSS: MT: Manual Translate: HW Config Manual:
$\boxed{\text{MT HW Config Manual}}$

pick ‘TUS1’ to ‘TUS2’ ‘IMCA Selection’ (two) – CMD IMCA A(B)
pick all others – none

cmd Load HW Config

Verify ‘TUS1’ ‘State’ – CMD IMCA A(B)
Verify ‘TUS2’ ‘State’ – CMD IMCA A(B)

Verify all others – none

6.2 Loading Safing Init Frame
MSS: MT: Manual Translate: Init Frame Config: $\boxed{\text{MT Init Frame Config}}$

input ‘TUS’ ‘Init Frame’ – 2
input all others – 0

cmd Load Init Frame Config (Verify ‘TUS’ ‘State’: 2)

Verify all others: 0

6.3 <u>TUS IMCA Initialization</u>
MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ Initialize **Execute**

MSS: MT: IMCA Cmd State: MT IMCA Cmd State

Verify ‘TUS1’ to ‘TUS2’ ‘IMCA’ A(B) ‘Initialize’ – √

6.4 <u>TUS IMCA Mode to On</u>
MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ On **Execute**

MSS: MT: Manual Translate: TUS TD: MT TUS TD Manual Operations

Verify ‘TUS1’ to ‘TUS2’ ‘IMCA’ A(B) Mode – On

6.5 <u>TUS Initialization Frame Selection</u>
MSS: MT: Manual Translate: Init Frame Config: MT Init Frame Config

input ‘TUS Init Frame’ – <u>8</u>

cmd Load Init Frame Config (Verify ‘TUS’ ‘State’: 8)

Verify all others: 0

6.6 <u>TUS IMCA Initialization</u>
MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ Initialize **Execute**

MSS: MT: IMCA Cmd State: MT IMCA Cmd State

Verify ‘TUS1’ to ‘TUS2’ ‘IMCA’ A(B) ‘Initialize’ – √

6.7 <u>TUS IMCA Movement Initiation</u>
Verify IMCA motion using the following page:
MSS: MT: Manual Translate: TUS TD:
MT TUS TD Manual Operations

MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ Actuate **Execute**

MSS: MT: Manual Translate: TUS TD: MT TUS TD Manual Operations

Verify ‘TUS1’ to ‘TUS2’ ‘IMCA’ A(B) ‘State’ – In Deadband
Verify ‘TUS1’ to ‘TUS2’ ‘IMCA’ A(B) ‘Mode’ – Enabled

7. TD PHASE 2 TRANSLATE TO NEAREST WORKSITE

7.1 TD IMCA Commanding Selection

MSS: MT: Manual Translate: HW Config Manual:
MT HW Config Manual

pick 'TD' 'IMCA Selection' – CMD IMCA A(B)
pick all others – none

cmd Load HW Config (Verify 'State' 'TD' – CMD IMCA A(B))

Verify all others – none

7.2 TD IMCA Movement Initiation

Verify IMCA motion using the following page:
MSS: MT: Manual Translate: TUS TD:
MT TUS TD Manual Operations

MSS: MT: Manual Translate: MT Manual Translate

cmd 'IMCA Commands' Actuate **Execute**

MSS: MT: Manual Translate: TUS TD: MT TUS TD Manual Operations

Verify 'TD'1(2) 'Mode' – Enabled
Verify 'TD'1(2) 'Position' – changing
Verify 'TD'1(2) 'Shaft Spd' ≤ 33 rpm (+ if motion to port, - if starboard)
Verify 'TD'1(2) 'Mode' – On

8. TD PHASE 3 TRANSLATE TO NEAREST WORKSITE

8.1 TD Initialization Frame Selection

Table 2. Initialization Frame Selection

Nearest Logical Worksite Location	Init Frame
Starboard (+Y)	197
Port (-Y)	205

MSS: MT: Manual Translate: Init Frame Config: MT Init Frame Config

input 'TD' 'Init Frame' (Refer to Table 2)
input all others – 0

cmd Load Init Frame Config (Verify 'TD' 'State', refer to Table 2)

Verify all others: 0

8.2 TD IMCA Initialization

MSS: MT: Manual Translate: MT Manual Translate

cmd 'IMCA Commands' Initialize **Execute**

MSS: MT: IMCA Cmd State: MT IMCA Cmd State

Verify 'TD' 'IMCA' A(B) 'Initialize' – √

8.3 TD IMCA Movement Initiation
Verify IMCA motion using the following page:
MSS: MT: Manual Translate: TUS TD:
MT TUS TD Manual Operations

MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ Actuate **Execute**

MSS: MT: Manual Translate: TUS TD: MT TUS TD Manual Operations

Verify ‘TD’1(2) ‘Mode’ – Enabled
Verify ‘TD’1(2) ‘Position’ – changing
Verify ‘TD’1(2) ‘Shaft Spd’ ≤ 9 rpm (+ if motion to port, - if starboard)

Verify ‘TD’1(2) ‘Mode’ – On
Verify ‘TD’1(2) ‘Worksite sw stbd’ – √
Verify ‘TD’1(2) ‘Worksite sw port’ – √

9. TUS SHUTDOWN

9.1 TUS IMCA Commanding Selection
MSS: MT: Manual Translate HW Config Manual:
MT HW Config Manual

pick ‘TUS1’ to ‘TUS2’ ‘IMCA Selection’ (two) – CMD IMCA A(B)
pick all others – none

cmd Load HW Config

Verify ‘TUS1’ to ‘TUS2’ ‘State’ (two) – CMD IMCA A(B)
Verify all others – none

9.2 TUS IMCA Mode to On
MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ On **Execute**

MSS: MT: Manual Translate: TUS TD: MT TUS TD Manual Operations

Verify ‘TUS1’ to ‘TUS2’ ‘IMCA A(B)’ ‘Mode’ – On

9.3 TUS IMCA Mode to Standby
MSS: MT: MT Translate: MT Manual Translate

cmd ‘IMCA Commands’ Standby **Execute**

MSS: MT: Manual Translate: TUS TD: MT TUS TD Manual Operations

Verify ‘TUS1’ to ‘TUS2’ ‘IMCA A(B)’ ‘Mode’ – Standby

9.4 <u>TUS IMCA BIT Initiation</u>
MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ BIT Initiate **Execute**

MSS: MT: IMCA Cmd State: MT IMCA Cmd State

Verify ‘TUS1’ to ‘TUS2’ ‘IMCA’ A(B) ‘BIT Initiate’ – √

9.5 <u>TUS IMCA Powerdown</u>
MSS: MT: Power: ‘RPCM S0-4B(3A)-F’ 1: RPCM S0-4B(3A)-F RPC 1

cmd ‘RPC Position’ – Open (Verify – Op)

MSS: MT: Power: ‘RPCM S0-4B(3A)-E’ 1: RPCM S0-4B(3A)-E RPC1

cmd ‘RPC Position’ – Open (Verify – Op)

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MT

CAUTION
ALARM

8.211 MT AUTOSEQUENCE FAILED RECOVERY

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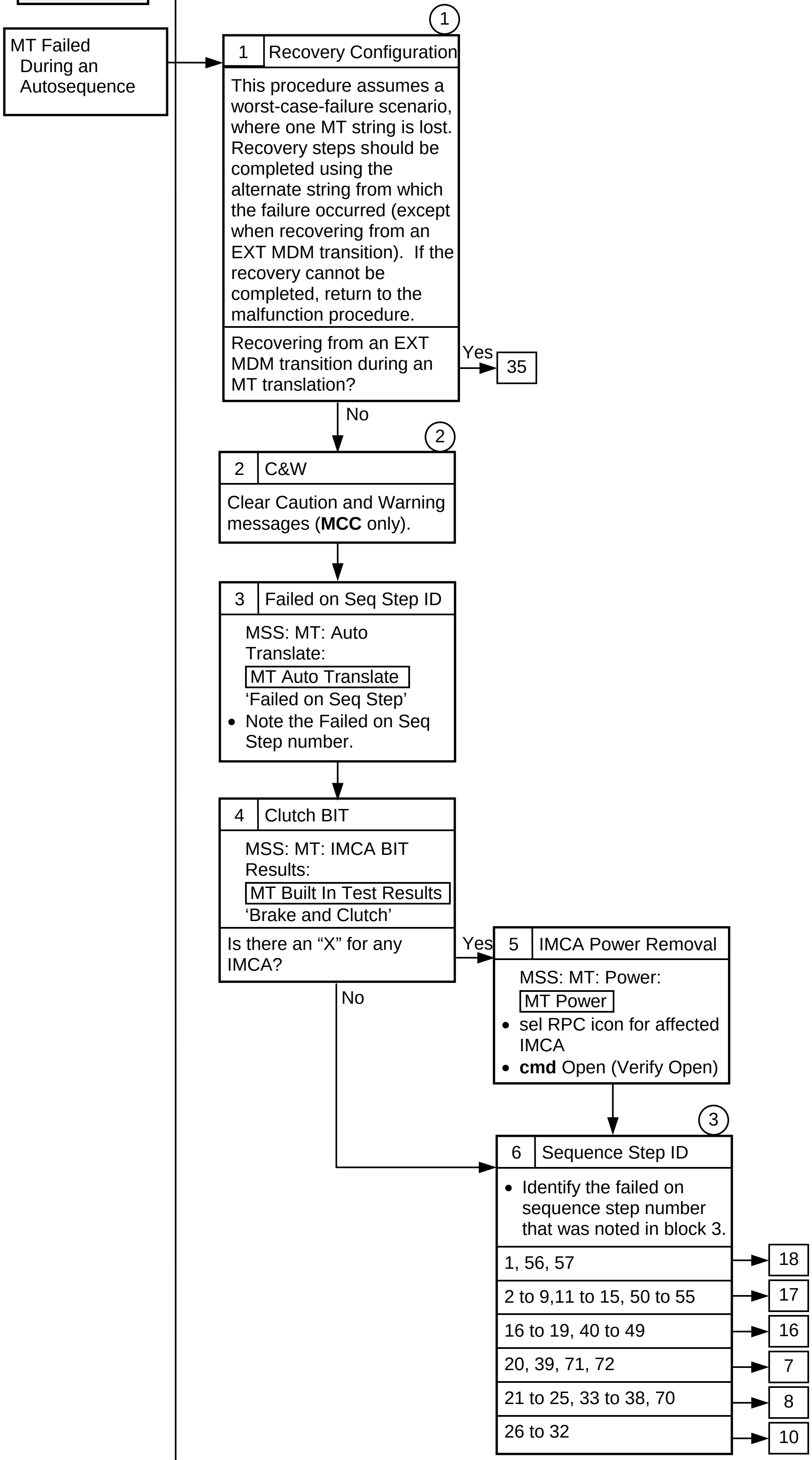

MT Failed During an Autosequence

① **1** Recovery Configuration

This procedure assumes a worst-case-failure scenario, where one MT string is lost. Recovery steps should be completed using the alternate string from which the failure occurred (except when recovering from an EXT MDM transition). If the recovery cannot be completed, return to the malfunction procedure.

Recovering from an EXT MDM transition during an MT translation?

Yes → 35

No ↓

② **2** C&W

Clear Caution and Warning messages (**MCC** only).

3 Failed on Seq Step ID

MSS: MT: Auto Translate:
MT Auto Translate
‘Failed on Seq Step’
- Note the Failed on Seq Step number.

4 Clutch BIT

MSS: MT: IMCA BIT Results:
MT Built In Test Results
‘Brake and Clutch’

Is there an “X” for any IMCA?

Yes → 5

No → 6

5 IMCA Power Removal

MSS: MT: Power:
MT Power
- sel RPC icon for affected IMCA
- **cmd** Open (Verify Open)

③ **6** Sequence Step ID

- Identify the failed on sequence step number that was noted in block 3.

1, 56, 57	18
2 to 9,11 to 15, 50 to 55	17
16 to 19, 40 to 49	16
20, 39, 71, 72	7
21 to 25, 33 to 38, 70	8
26 to 32	10

①
All displays in this procedure are on the PCS.

②
The command to clear the MT C&W is not available via the PCS. If **MCC** is not available, proceed to block 3.

CIPUI:
S0DD96IM1082K
Ops Name:
DSM_Clear_CWA_Data_MT.

③
Refer to Table 2 to identify the current MT configuration.

8.211 MT AUTOSEQUENCE FAILED RECOVERY

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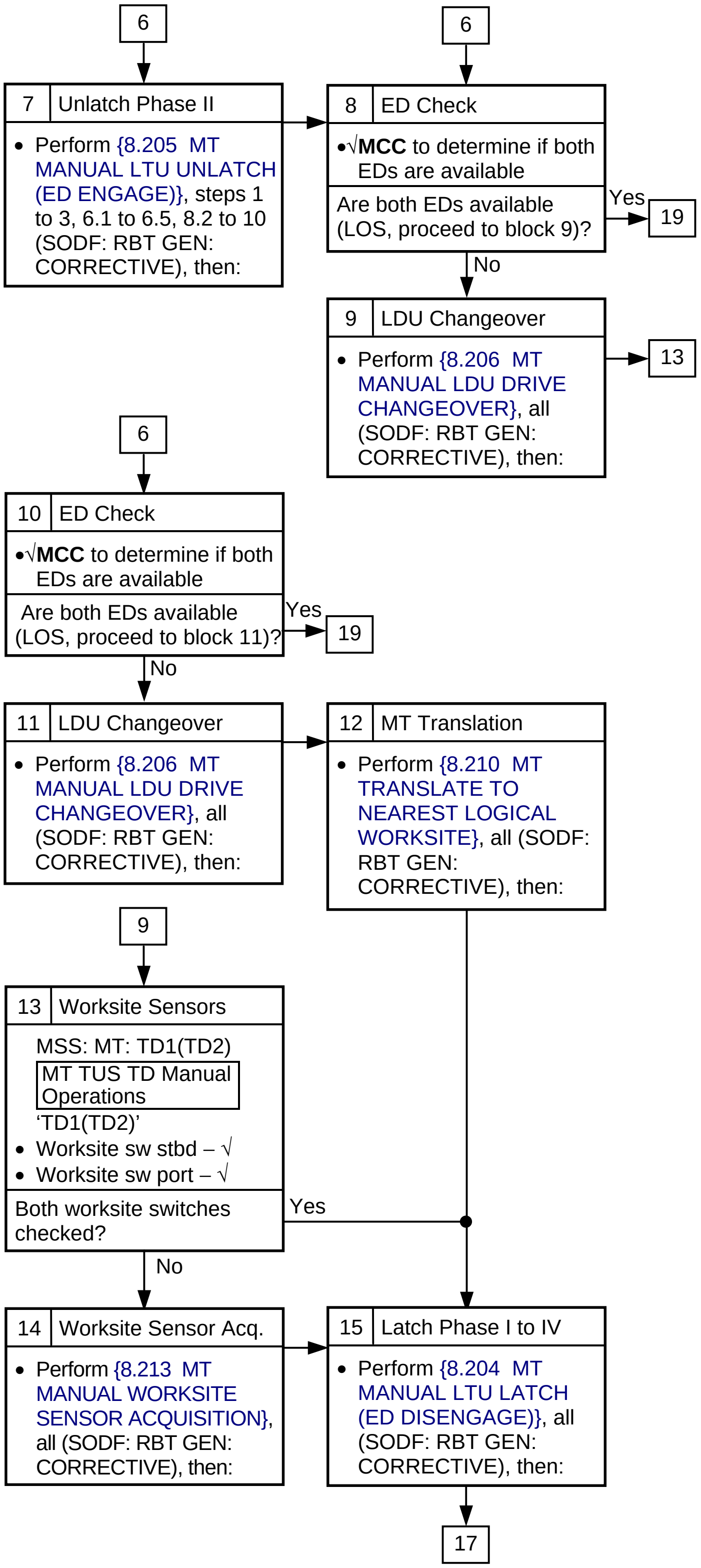


7 Unlatch Phase II

- Perform {8.205 MT MANUAL LTU UNLATCH (ED ENGAGE)}, steps 1 to 3, 6.1 to 6.5, 8.2 to 10 (SODF: RBT GEN: CORRECTIVE), then:

8 ED Check

- √**MCC** to determine if both EDs are available

Are both EDs available (LOS, proceed to block 9)?

9 LDU Changeover

- Perform {8.206 MT MANUAL LDU DRIVE CHANGEOVER}, all (SODF: RBT GEN: CORRECTIVE), then:

10 ED Check

- √**MCC** to determine if both EDs are available

Are both EDs available (LOS, proceed to block 11)?

11 LDU Changeover

- Perform {8.206 MT MANUAL LDU DRIVE CHANGEOVER}, all (SODF: RBT GEN: CORRECTIVE), then:

12 MT Translation

- Perform {8.210 MT TRANSLATE TO NEAREST LOGICAL WORKSITE}, all (SODF: RBT GEN: CORRECTIVE), then:

13 Worksite Sensors

MSS: MT: TD1(TD2)

MT TUS TD Manual Operations

'TD1(TD2)'

- Worksite sw stbd – √
- Worksite sw port – √

Both worksite switches checked?

14 Worksite Sensor Acq.

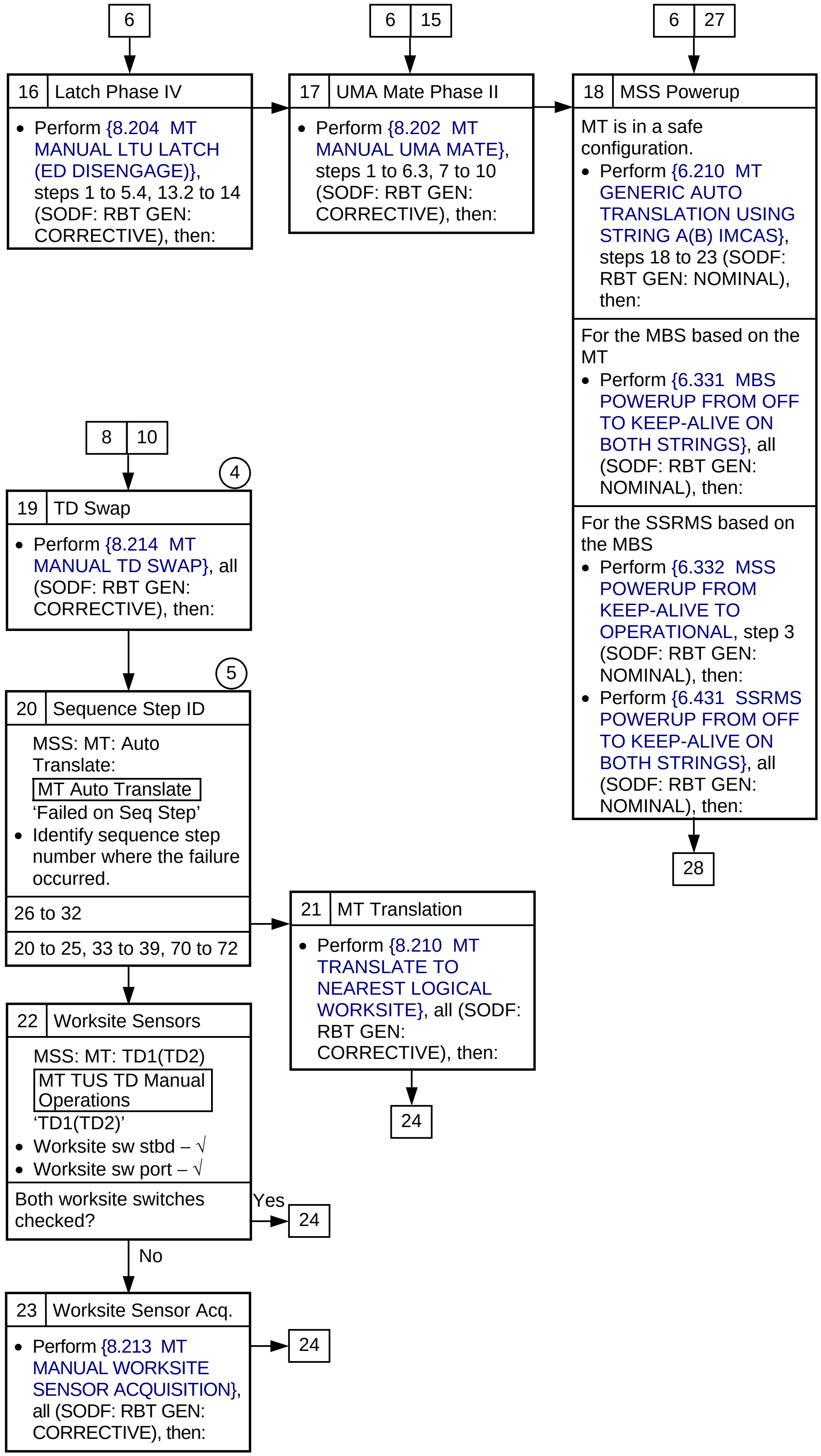
- Perform {8.213 MT MANUAL WORKSITE SENSOR ACQUISITION}, all (SODF: RBT GEN: CORRECTIVE), then:

15 Latch Phase I to IV

- Perform {8.204 MT MANUAL LTU LATCH (ED DISENGAGE)}, all (SODF: RBT GEN: CORRECTIVE), then:

8.211 MT AUTOSEQUENCE FAILED RECOVERY

(RBT GEN/X2R4 - ALL/FIN 3) Page 3 of 7 pages



16 Latch Phase IV

- Perform {8.204 MT MANUAL LTU LATCH (ED DISENGAGE)}, steps 1 to 5.4, 13.2 to 14 (SODF: RBT GEN: CORRECTIVE), then:

17 UMA Mate Phase II

- Perform {8.202 MT MANUAL UMA MATE}, steps 1 to 6.3, 7 to 10 (SODF: RBT GEN: CORRECTIVE), then:

18 MSS Powerup

MT is in a safe configuration.

- Perform {6.210 MT GENERIC AUTO TRANSLATION USING STRING A(B) IMCAS}, steps 18 to 23 (SODF: RBT GEN: NOMINAL), then:

For the MBS based on the MT

- Perform {6.331 MBS POWERUP FROM OFF TO KEEP-ALIVE ON BOTH STRINGS}, all (SODF: RBT GEN: NOMINAL), then:

For the SSRMS based on the MBS

- Perform {6.332 MSS POWERUP FROM KEEP-ALIVE TO OPERATIONAL, step 3 (SODF: RBT GEN: NOMINAL), then:
- Perform {6.431 SSRMS POWERUP FROM OFF TO KEEP-ALIVE ON BOTH STRINGS}, all (SODF: RBT GEN: NOMINAL), then:

19 TD Swap

- Perform {8.214 MT MANUAL TD SWAP}, all (SODF: RBT GEN: CORRECTIVE), then:

20 Sequence Step ID

MSS: MT: Auto Translate:
MT Auto Translate
'Failed on Seq Step'

- Identify sequence step number where the failure occurred.

26 to 32

20 to 25, 33 to 39, 70 to 72

21 MT Translation

- Perform {8.210 MT TRANSLATE TO NEAREST LOGICAL WORKSITE}, all (SODF: RBT GEN: CORRECTIVE), then:

22 Worksite Sensors

MSS: MT: TD1(TD2)
MT TUS TD Manual Operations
'TD1(TD2)'

- Worksite sw stbd – √
- Worksite sw port – √

Both worksite switches checked?

23 Worksite Sensor Acq.

- Perform {8.213 MT MANUAL WORKSITE SENSOR ACQUISITION}, all (SODF: RBT GEN: CORRECTIVE), then:

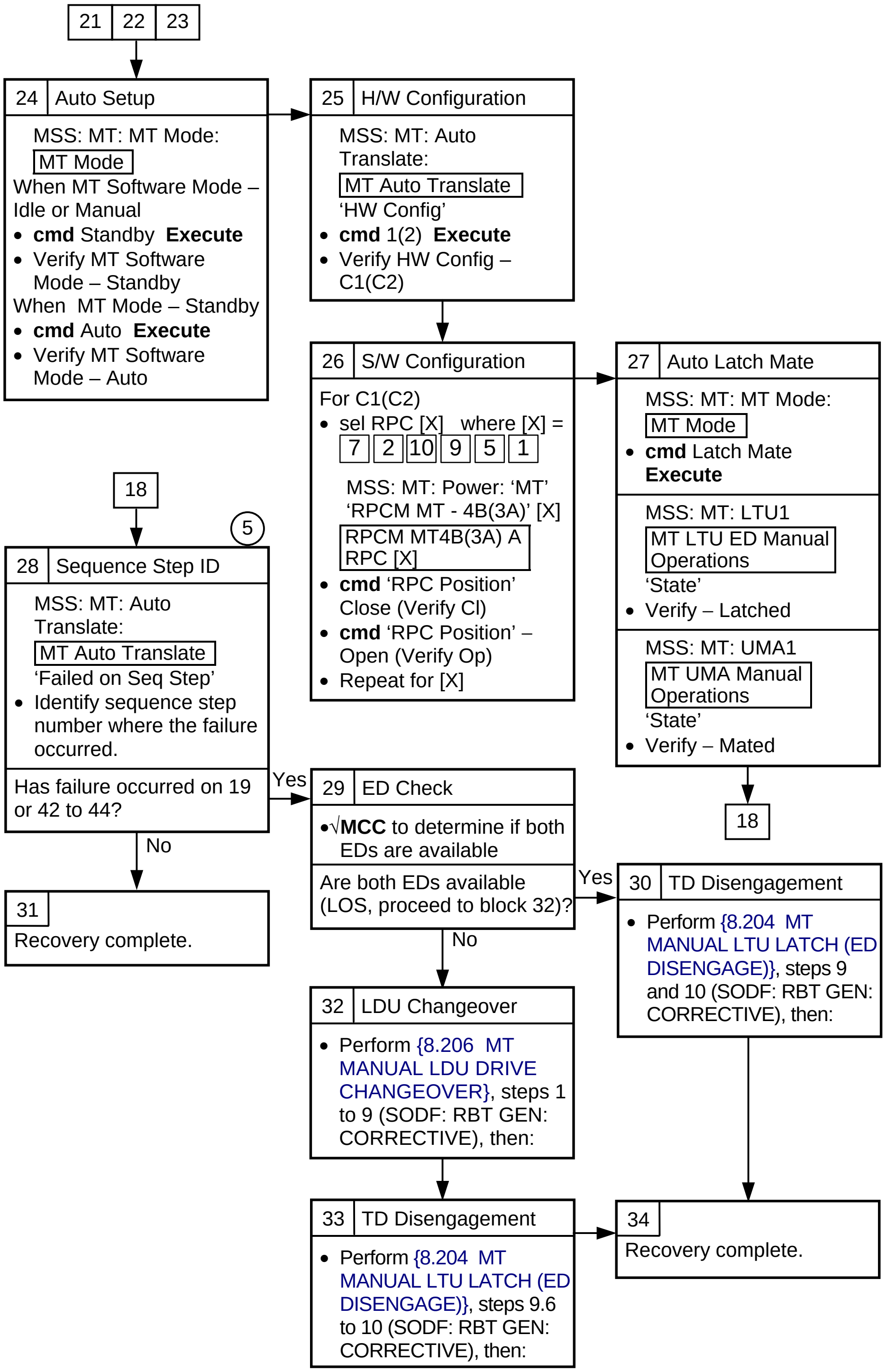
④
This note is for **MCC** use only. If the crew is performing this procedure, proceed with block 19.

If the ED and TD IMCAS on the original string are both healthy, the TD swap can be skipped, but this will require a mixed hardware configuration to be used in block 25. The MT translation in block 21, if required, can be completed using the TD on the original string.

⑤
This is the same Failed on Seq Step Number as in block 6.

8.211 MT AUTOSEQUENCE FAILED RECOVERY

(RBT GEN/X2R4 - ALL/FIN 3) Page 4 of 7 pages



24 Auto Setup

MSS: MT: MT Mode:
MT Mode

When MT Software Mode – Idle or Manual

- **cmd** Standby **Execute**
- Verify MT Software Mode – Standby

When MT Mode – Standby

- **cmd** Auto **Execute**
- Verify MT Software Mode – Auto

25 H/W Configuration

MSS: MT: Auto Translate:
MT Auto Translate
'HW Config'

- **cmd** 1(2) **Execute**
- Verify HW Config – C1(C2)

26 S/W Configuration

For C1(C2)

- sel RPC [X] where [X] = 7 2 10 9 5 1

MSS: MT: Power: 'MT'
'RPCM MT - 4B(3A)' [X]
RPCM MT4B(3A) A RPC [X]

- **cmd** 'RPC Position' Close (Verify Cl)
- **cmd** 'RPC Position' – Open (Verify Op)
- Repeat for [X]

27 Auto Latch Mate

MSS: MT: MT Mode:
MT Mode

- **cmd** Latch Mate **Execute**

MSS: MT: LTU1
MT LTU ED Manual Operations
'State'

- Verify – Latched

MSS: MT: UMA1
MT UMA Manual Operations
'State'

- Verify – Mated

28 Sequence Step ID ⑤

MSS: MT: Auto Translate:
MT Auto Translate
'Failed on Seq Step'

- Identify sequence step number where the failure occurred.

Has failure occurred on 19 or 42 to 44?

29 ED Check

- √**MCC** to determine if both EDs are available

Are both EDs available (LOS, proceed to block 32)?

30 TD Disengagement

- Perform {8.204 MT MANUAL LTU LATCH (ED DISENGAGE)}, steps 9 and 10 (SODF: RBT GEN: CORRECTIVE), then:

31

Recovery complete.

32 LDU Changeover

- Perform {8.206 MT MANUAL LDU DRIVE CHANGEOVER}, steps 1 to 9 (SODF: RBT GEN: CORRECTIVE), then:

33 TD Disengagement

- Perform {8.204 MT MANUAL LTU LATCH (ED DISENGAGE)}, steps 9.6 to 10 (SODF: RBT GEN: CORRECTIVE), then:

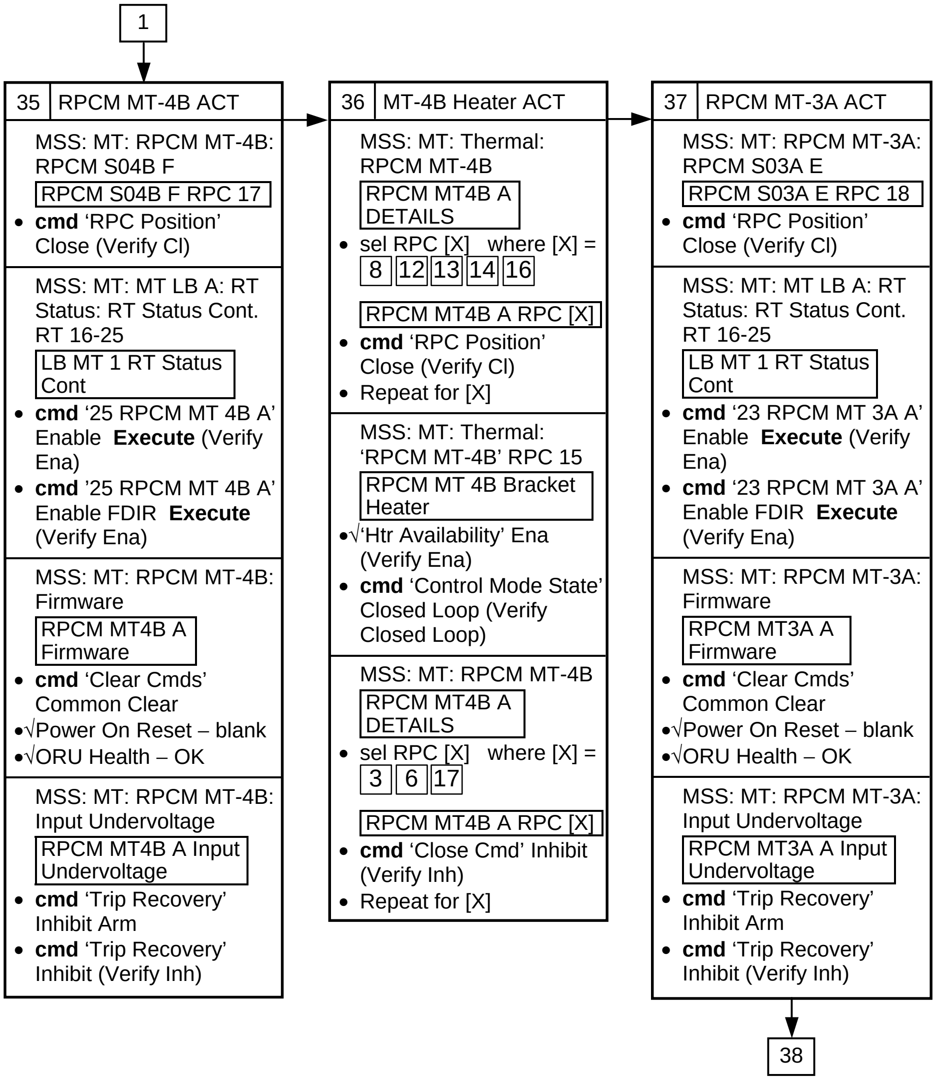
34

Recovery complete.

⑤ This is the same Failed on Seq Step Number as in block 6.

8.211 MT AUTOSEQUENCE FAILED RECOVERY

(RBT GEN/X2R4 - ALL/FIN 3) Page 5 of 7 pages



1

35 RPCM MT-4B ACT

MSS: MT: RPCM MT-4B: RPCM S04B F

RPCM S04B F RPC 17

- **cmd** ‘RPC Position’ Close (Verify Cl)

MSS: MT: MT LB A: RT Status: RT Status Cont. RT 16-25

LB MT 1 RT Status Cont

- **cmd** ‘25 RPCM MT 4B A’ Enable **Execute** (Verify Ena)
- **cmd** ’25 RPCM MT 4B A’ Enable FDIR **Execute** (Verify Ena)

MSS: MT: RPCM MT-4B: Firmware

RPCM MT4B A Firmware

- **cmd** ‘Clear Cmds’ Common Clear
- √Power On Reset – blank
- √ORU Health – OK

MSS: MT: RPCM MT-4B: Input Undervoltage

RPCM MT4B A Input Undervoltage

- **cmd** ‘Trip Recovery’ Inhibit Arm
- **cmd** ‘Trip Recovery’ Inhibit (Verify Inh)

36 MT-4B Heater ACT

MSS: MT: Thermal: RPCM MT-4B

RPCM MT4B A DETAILS

- sel RPC [X] where [X] = 8 12 13 14 16

RPCM MT4B A RPC [X]

- **cmd** ‘RPC Position’ Close (Verify Cl)
- Repeat for [X]

MSS: MT: Thermal: ‘RPCM MT-4B’ RPC 15

RPCM MT 4B Bracket Heater

- √‘Htr Availability’ Ena (Verify Ena)
- **cmd** ‘Control Mode State’ Closed Loop (Verify Closed Loop)

MSS: MT: RPCM MT-4B

RPCM MT4B A DETAILS

- sel RPC [X] where [X] = 3 6 17

RPCM MT4B A RPC [X]

- **cmd** ‘Close Cmd’ Inhibit (Verify Inh)
- Repeat for [X]

37 RPCM MT-3A ACT

MSS: MT: RPCM MT-3A: RPCM S03A E

RPCM S03A E RPC 18

- **cmd** ‘RPC Position’ Close (Verify Cl)

MSS: MT: MT LB A: RT Status: RT Status Cont. RT 16-25

LB MT 1 RT Status Cont

- **cmd** ‘23 RPCM MT 3A A’ Enable **Execute** (Verify Ena)
- **cmd** ‘23 RPCM MT 3A A’ Enable FDIR **Execute** (Verify Ena)

MSS: MT: RPCM MT-3A: Firmware

RPCM MT3A A Firmware

- **cmd** ‘Clear Cmds’ Common Clear
- √Power On Reset – blank
- √ORU Health – OK

MSS: MT: RPCM MT-3A: Input Undervoltage

RPCM MT3A A Input Undervoltage

- **cmd** ‘Trip Recovery’ Inhibit Arm
- **cmd** ‘Trip Recovery’ Inhibit (Verify Inh)

38

8.211 MT AUTOSEQUENCE FAILED RECOVERY

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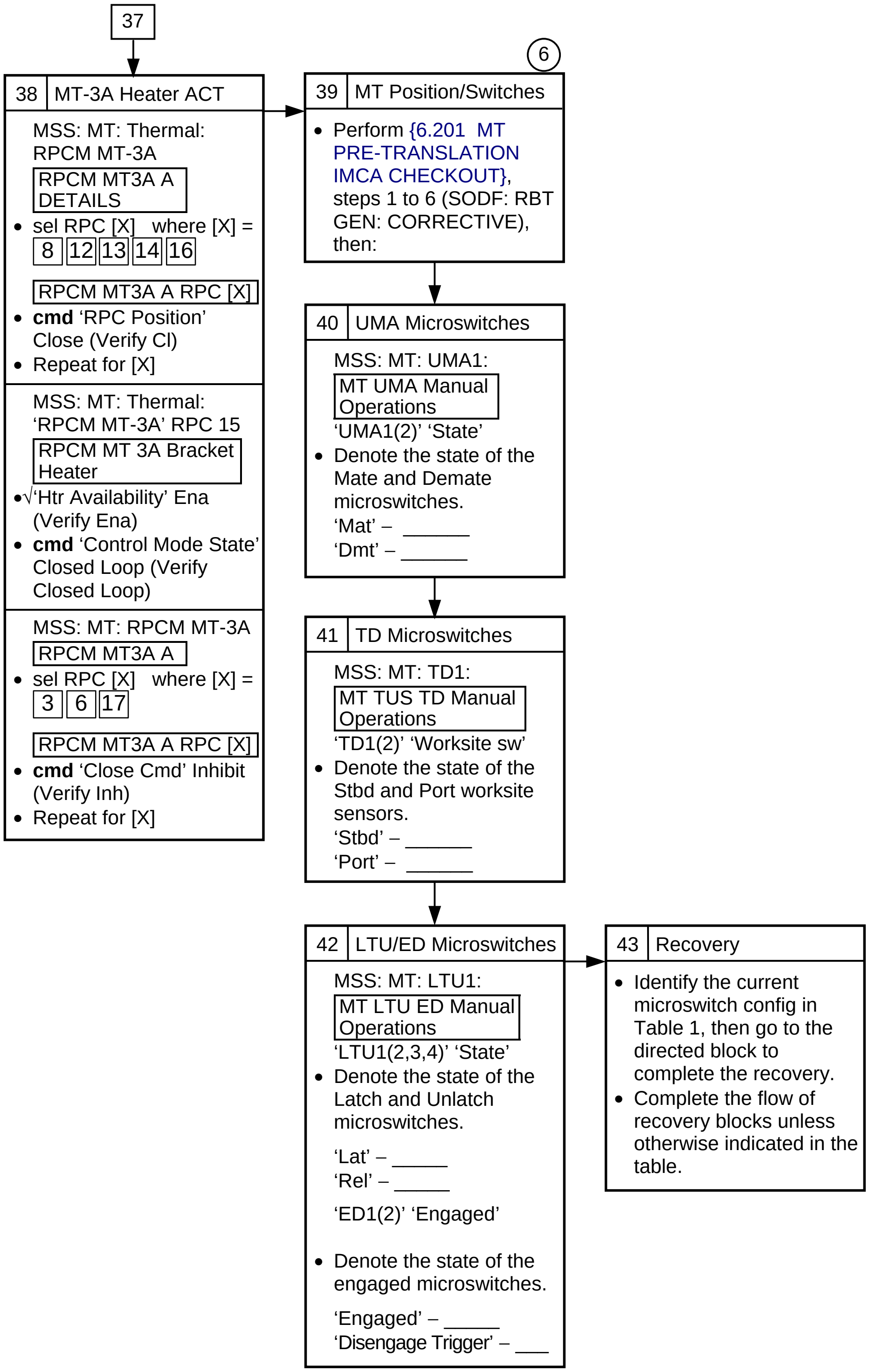

37

38 MT-3A Heater ACT

MSS: MT: Thermal: RPCM MT-3A

RPCM MT3A A DETAILS

- sel RPC [X] where [X] = 8 12 13 14 16

RPCM MT3A A RPC [X]

- **cmd** ‘RPC Position’ Close (Verify Cl)
- Repeat for [X]

MSS: MT: Thermal: ‘RPCM MT-3A’ RPC 15

RPCM MT 3A Bracket Heater

- √‘Htr Availability’ Ena (Verify Ena)
- **cmd** ‘Control Mode State’ Closed Loop (Verify Closed Loop)

MSS: MT: RPCM MT-3A

RPCM MT3A A

- sel RPC [X] where [X] = 3 6 17

RPCM MT3A A RPC [X]

- **cmd** ‘Close Cmd’ Inhibit (Verify Inh)
- Repeat for [X]

39 MT Position/Switches ⑥

- Perform {6.201 MT PRE-TRANSLATION IMCA CHECKOUT}, steps 1 to 6 (SODF: RBT GEN: CORRECTIVE), then:

40 UMA Microswitches

MSS: MT: UMA1:

MT UMA Manual Operations

‘UMA1(2)’ ‘State’

- Denote the state of the Mate and Demate microswitches.

‘Mat’ – ______

‘Dmt’ – ______

41 TD Microswitches

MSS: MT: TD1:

MT TUS TD Manual Operations

‘TD1(2)’ ‘Worksite sw’

- Denote the state of the Stbd and Port worksite sensors.

‘Stbd’ – ______

‘Port’ – ______

42 LTU/ED Microswitches

MSS: MT: LTU1:

MT LTU ED Manual Operations

‘LTU1(2,3,4)’ ‘State’

- Denote the state of the Latch and Unlatch microswitches.

‘Lat’ – _____

‘Rel’ – _____

‘ED1(2)’ ‘Engaged’

- Denote the state of the engaged microswitches.

‘Engaged’ – _____

‘Disengage Trigger’ – ___

43 Recovery

- Identify the current microswitch config in Table 1, then go to the directed block to complete the recovery.
- Complete the flow of recovery blocks unless otherwise indicated in the table.

⑥ The default state for the MT IMCAs following an EXT transition is to have FDIR and I/O enabled. Therefore, step 2 may not be required if ODIN's EXT MDM transition recovery script has not already disabled FDIR and I/O. Note that FDIR is nominally always disabled. Expect RT Fail messages for IMCAS until power is applied. Expect bus channel swapping until IMCA is powered or FDIR is inhibited.

8.211 MT AUTOSEQUENCE FAILED RECOVERY

(RBT GEN/X2R4 - ALL/FIN 3) Page 7 of 7 pages

Table 1. MDM Transition Recovery

Microswitch Configuration	Action	Go to Block:
UMAs demated, LTUs latched	Mate UMAs Phase II	17[1]
LTUs in intermediate state, EDs not engaged	Latch LTUs Phase IV	16[2]
LTUs in intermediate state, one ED engaged	Unlatch Phase II	7[1],[3],[4]
LTUs unlatched, worksite sensors are acquired	Latch/Mate	24[1],[4]
LTUs unlatched, worksite sensors are not acquired	Translate to nearest logical worksite	21[1],[4]

[1] Stop after completing block 18.

[2] If the ED is in an intermediate state, the answer for block 28 is ‘Yes’.

[3] After completing block 7, proceed to block 22.

[4] Skip block 26.

Table 2. MT Configuration based on Failed Sequence Step Number

Failed on Sequence Step Number	MT Configuration
1, 56, 57	UMAs are mated
2 to 9, 11 to 15, 50 to 55	LTUs are latched, UMAs are not mated
16 to 19, 40 to 49	LTUs in intermediate state, prizmoids are engaged, ED may be engaged
20, 39, 71, 72	LTUs in intermediate state, prizmoids are not engaged, ED is engaged
21 to 25, 33 to 38, 70	LTUs are unlatched, ED is engaged
26 to 32	MT is between worksites

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8.212 MT GENERIC MODIFY PREVIOUS INIT FRAME

(RBT GEN/ULF1 - ALL/FIN 1) Page 1 of 4 pages

1. RECORDING MECHANISM DATA
   Record mechanism(s) and IMCA to be commanded and Init Frame to be modified in Table 1.

Table 1. Recording Mechanism Data

Mechanism(s) to be commanded (ED, TD, LTU, UMA, or TUS?)	__________
IMCA to be commanded (A or B?)	__________
Init Frame to be modified	__________

2. RECORDING MODIFIED INIT FRAME PARAMETERS
   Record applicable Modified Init Frame parameters in Table 2.

NOTE
Table 2 is a complete list of all parameters for all mechanisms. Some parameters will not be available for all mechanisms.

Table 2. Recording Modified Init Frame Parameters

Item	Modified Init Frame Parameters	Value
1	‘Position Change’ ‘Stop On’	
2	‘Position Change’ ‘Limits’	________
3	‘Shaft Speed’ ‘Limits’	
4	‘Controller Temperature’ ‘Stop On’	________
5	‘Controller Temperature’ ‘Limits’	
6	‘Torque’ ‘Stop On’	________
7	‘Torque’ ‘Limits’	
8	‘Power’ Limits’	________
9	‘Accel/Decel Time’ ‘Limits’	________
10	‘Engaged’ (‘Vert Bogey Wheel Indicator’, ‘Unlatched’, ‘Demated’, ‘Deploy Emergency Stop’) ‘Stop On’	________
11	‘Disengage Trigger’ (‘Horiz Bogey Wheel Indicator’, ‘Latched’, ‘Mated’, ‘Retract Emergency Stop’) ‘Stop On’	________
12	‘Disengage Verify’ (‘+Y WS Sensor’, ‘Retract Tension Control’) ‘Stop On’	________
13	‘Center Cam Alt Disengage’ (‘-Y WS Sensor’, ‘Deploy Tension Control’) ‘Stop On’	________
14	‘Alt Disengage’ ‘Stop On’	________
15	‘Electrical Temperature’ ‘Stop On’	________
16	‘Rate Error’ ‘Stop On’	________
17	‘Enable Limit Switch Error Calculations’ ‘Clutch/Switch Settings’	________
18	‘Perform Overspeed/Reverse Speed Test’ ‘Clutch/Switch	________
19	‘Enable Clutch’ ‘Clutch/Switch Settings’	________
20	‘Enable Brake’ ‘Clutch/Switch Settings’	________

3. CHECKING MT SOFTWARE PROCESS AND MT MODE

PCS MSS: MT: MT Mode: MT Mode

√‘MT Process State’ – Initiated
√‘MT Software Mode’ – Manual

4. CHECKING POWER TO IMCAs

MSS: MT: Power: ‘MT’ ‘RPCM MT-4B(3A)’ [X]: RPCM MT 4B(3A) A RPC [X] (where [X] is the RPC numbers for all IMCAs to be commanded)

√‘RPC Position’ – Cl

5. SELECTING DESIRED IMCA WITH HARDWARE CONFIG

MSS: MT: Manual Translate: HW Config Manual: MT HW Config Manual

For all IMCAs to be commanded
sel Cmd IMCA A(B)

cmd Load HW Config (Verify – Cmd IMCA A(B) for all mechanisms to be commanded)

6. VERIFYING IMCA MODE ON

MSS: MT: Manual Translate: LTU ED (UMA, TUS TD): MT LTU ED (UMA, TUS TD) Manual Operations

If ‘IMCA A(B)’ ‘Mode’ – On for all mechanisms to be commanded
Go to step 10.

7. SENDING SAFING INIT FRAME TO SELECTED IMCAs

MSS: MT: Manual Translate: Init Frame Config: MT Init Frame Config

input for mechanism(s) to be commanded ‘Init Frame’ – 2

√all others: 0

cmd Load Init Frame Config

Verify ‘State’ – 2 for all mechanism(s) to be commanded
Verify ‘State’ all others – 0

8. INITIALIZING IMCAs

MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ Initialize **Execute**

MSS: MT: IMCA Cmd State: MT IMCA Cmd State

Verify ‘IMCA’ ‘A(B)’ ‘Initialize’ – √ for all mechanism(s) to be commanded

9. MODING IMCAs TO ON MODE

MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ On **Execute**

MSS: MT: Manual Translate: LTU ED (UMA, TUS TD):
MT LTU ED (UMA, TUS TD) Manual Operations

Verify ‘IMCA A(B)’ ‘Mode’ – On for all mechanism(s) to be commanded

10. SELECTING INIT FRAME TO BE MODIFIED

MSS: MT: Manual Translate: Init Frame Config:
MT Init Frame Config

input for all mechanism(s) to be commanded ‘Init Frame’ – per Table 1

cmd Load Init Frame Config

Verify ‘State’ – per Table 1 for all mechanism(s) to be commanded
Verify ‘State’ all others – 0

11. INITIALIZING IMCAs

MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ Initialize **Execute**

MSS: MT: IMCA Cmd State: MT IMCA Cmd State

Verify ‘IMCA’ ‘A(B)’ ‘Initialize’ – √ for all mechanism(s) to be commanded

12. MODIFYING INIT FRAME

MSS: MT: Manual Translate: Init Frame Config: IMCA Controller Parameters: ‘[X]’ IMCA A(B): [X] IMCA Modify Previous Init Frame:
MT [X] IMCA Modify Previous Init Frame
(where [X] is the mechanism name)

input Modified Values – per Table 2

cmd Load Modified Init Frame Parameters

13. SELECTING MODIFIED INIT FRAME

MSS: MT: Manual Translate: Init Frame Config:
MT Init Frame Config

input ‘[X]’ ‘Init Frame’ – 1 (where [X] is the mechanism(s) to be commanded)

cmd Load Init Frame Config

Verify ‘State’ – 1 for all mechanism(s) to be commanded
Verify ‘State’ all others – 0

14. INITIALIZING IMCAs

MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ Initialize **Execute**

MSS: MT: Manual Translate: Init Frame Config: IMCA Controller Parameters: ‘[X]’ IMCA A(B): MT [X] IMCA A(B) Controller Parameters

Verify all fields are correct per Table 2.

15. ACTUATING IMCA

NOTE

1. The IMCA automatically returns to On mode after the programmed trajectory has completed.

2. A pause command can be issued by commanding the IMCA to On mode.

3. Verify IMCA motion using the following page:
   MSS: MT: Manual Translate: UMA:
   MT UMA Manual Operations

MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ Actuate **Execute**

MSS: MT: Manual Translate: LTU ED (UMA, TUS TD):
MT LTU ED (UMA, TUS TD) Manual Operations

For all Mechanism(s) to be Commanded:
Verify ‘IMCA A(B)’ ‘Mode’ – Enabled
Verify ‘IMCA A(B)’ ‘Position’ – increasing or decreasing as expected
Verify ‘IMCA A(B)’ ‘Shaft Spd’ – as expected
Verify ‘IMCA A(B)’ ‘Mode’ – On

16. MODING IMCA BACK TO STANDBY

MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Command’ Standby **Execute**

MSS: MT: Manual Translate: LTU ED (UMA, TUS TD):
MT LTU ED (UMA, TUS TD) Manual Operations

Verify ‘IMCA A(B)’ ‘Mode’ – Standby for all mechanism(s) to be commanded

8.213 MT MANUAL WORKSITE SENSOR ACQUISITION

(RBT GEN/EXT R4 - ALL/FIN) Page 1 of 7 pages

NOTE

1. This procedure can be executed if a Port and/or Stbd WS sensor is not tripped when the MT is fully unlatched, but the MT is known to be within a few inches of the Worksite.

2. Initial Conditions:
   MT software in Auto mode
   MT demated and unlatched
   TD IMCA to be driven is powered and in On mode
   TUS IMCAs to be driven are powered and in On or Enabled mode

3. A pause command can be issued by commanding the IMCA to On mode on the following page:
   MSS: MT: Manual Translate: MT Manual Translate
   'IMCA Commands'

1. MT SOFTWARE MODE TO MANUAL

PCS MSS: MT: MT Mode: MT Mode

cmd Standby **Execute** (Verify 'MT Software Mode' – Standby)
cmd Manual **Execute** (Verify 'MT Software Mode' – Manual)

MSS: MT: Manual Translate: TUS TD: MT TUS TD Manual Operations

Verify 'TD1(2)' 'Mode' – On

If 'TUS1' to 'TUS2' 'IMCA A(B)' 'Mode' (two) – Enabled
Go to step 3.

Verify 'TUS1' to 'TUS2' 'IMCA A(B)' 'Mode' (two) – On

2. TUS CONTROL SETUP

2.1 TUS IMCA Commanding Selection
MSS: MT: Manual Translate: HW Config Manual:
MT HW Config Manual

sel 'TUS1' to 'TUS2' 'IMCA Selection' (two) – CMD IMCA A(B)

√'IMCA Selection' for all others – None

cmd Load HW Config

Verify 'TUS1' to 'TUS2' 'State' (two) – CMD IMCA A(B)
Verify 'State' for all others – None

2.2 TUS Initialization Frame Selection
MSS: MT: Manual Translate: Init Frame Config: MT Init Frame Config

input 'TUS' 'Init Frame' – 8

√all others: 0

cmd Load Init Frame Config (Verify 'TUS' 'State': 8)

Verify 'State' for all others: 0

2.3 TUS IMCA Initialization
MSS: MT: Manual Translate: MT Manual Translate

cmd 'IMCA Commands' Initialize **Execute**

MSS: MT: IMCA Cmd State: MT IMCA Cmd State

Verify 'TUS1' to 'TUS2' 'IMCA' 'A(B)' 'Initialize' (two) – √

2.4 TUS IMCA Movement Initiation
MSS: MT: Manual Translate: MT Manual Translate

cmd 'IMCA Commands' Actuate **Execute**

MSS: MT: Manual Translate: TUS TD: MT TUS TD Manual Operations

Verify 'TUS1' to 'TUS2' 'IMCA A(B)' 'Mode' (two) – Enabled

3. TD PART 1: MOTION AWAY FROM CURRENT WS

NOTE
This step will translate the MT in the direction of the lost worksite sensor for a distance of approximately 6 cm.

3.1 TD IMCA Commanding Selection
MSS: MT: Manual Translate: HW Config Manual:
MT HW Config Manual

sel 'TD' 'IMCA Selection' – CMD IMCA A(B)

√'IMCA Selection' for all others – None

cmd Load HW Config (Verify 'TD' 'State' – CMD IMCA A(B))

Verify 'State' for all others – None

3.2 TD Initial Position Check and/or Reset
MSS: MT: Manual Translate: TUS TD: MT TUS TD Manual Operations

If ‘TD1(2)’ ‘Position’ ≠ 0.0

3.2.1 Moding TD IMCA to Standby
MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ Standby **Execute**

MSS: MT: Manual Translate: TUS TD:
MT TUS TD Manual Operations

Verify ‘TD1(2)’ ‘Mode’ – Standby

3.2.2 TD Safing Initialization Frame Selection
MSS: MT: Manual Translate: Init Frame Config:
MT Init Frame Config

input ‘TD’ ‘Init Frame’ – 2

√all others: 0

cmd Load Init Frame Config (Verify ‘TD’ ‘State’: 2)

Verify ‘State’ for all others: 0

3.2.3 TD IMCA Initialization
MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ Initialize **Execute**

MSS: MT: IMCA Cmd State: MT IMCA Cmd State

Verify ‘TD’ ‘IMCA’ ‘A(B)’ ‘Initialize’ – √

3.2.4 Moding TD IMCA to On
MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ On **Execute**

MSS: MT: Manual Translate: TUS TD:
MT TUS TD Manual Operations

Verify ‘TD1(2)’ ‘Mode’ – On

3.3 <u>TD Initialization Frame Selection</u>

MSS: MT: Manual Translate: Init Frame Config: MT Init Frame Config

input ‘TD’ ‘Init Frame’ – <u>2</u> <u>0</u> <u>5</u>

√all others: 0

cmd Load Init Frame Config (Verify ‘TD’ ‘State’: 205)

Verify ‘State’ for all others: 0

3.4 <u>TD IMCA Initialization</u>

MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ Initialize **Execute**

MSS: MT: IMCA Cmd State: MT IMCA Cmd State

Verify ‘TD’ ‘IMCA’ ‘A(B)’ ‘Initialize’ – √

3.5 <u>TD Init Frame Modification</u>

MSS: MT: Manual Translate: Init Frame Config: IMCA Controller Parameters: ‘TD’ IMCA A(B): TD IMCA Modify Previous Init Frame: MT TD IMCA Modify Previous Init Frame

input Modified Values per Tables 1 and 2

Table 1. Modified Init Frame Stop On Parameters

	Stop On	Limits
Position Change	1	Per Table 2
Shaft Speed		8.1965
Controller Temperature	1	1360
Torque	0	1.1
Power		3733.7
Accel/Decel Time		8.55
Vert Bogey Wheel Indicator	0	
Horiz Bogey Wheel Indicator	0	
+Y WS Sensor	0	
-Y WS Sensor	0	
Electrical Temperature	1	
Rate Error	0	
		Clutch/ Switch Settings
Enable Limit Switch Error Calculation		0
Perform Overspeed/Reverse Speed Test		0
Enable Clutch		1
Enable Brake		1

NOTE
A positive Position Change will move the MT in the Port (-Y) direction and a negative Position Change will move the MT in the Starboard (+Y) direction.

Table 2. Modified Target Position

LOST WS MICRO-SWITCH	REV
Starboard (+Y)	-3
Port (-Y)	+3

cmd Load Modified Init Frame Parameters

3.6 TD Initialization Frame Selection

MSS: MT: Manual Translate: Init Frame Config: MT Init Frame Config

input 'TD' 'Init Frame' – 1

√all others: 0

cmd Load Init Frame Config (Verify 'TD' 'State': 1)

Verify 'State' for all others: 0

3.7 TD IMCA Initialization

MSS: MT: Manual Translate: MT Manual Translate

cmd 'IMCA Commands' Initialize **Execute**

MSS: MT: Manual Translate: Init Frame Config: IMCA Controller Parameters: 'TD' IMCA A(B):
MT TD IMCA A(B) Controller Parameters

Verify all fields are correct per Table 1 and 2.

3.8 TD Motion Initiation

MSS: MT: Manual Translate: MT Manual Translate

cmd 'IMCA Commands' Actuate **Execute**

MSS: MT: Manual Translate: TUS TD: MT TUS TD Manual Operations

Verify 'TD1(2)' 'Mode' – Enabled
Verify 'TD1(2)' 'Position' – changing but does not exceed +/- 3 Rev
Verify 'TD1(2)' 'Shaft Spd' ≤ 9 RPM (+ if motion to port, - if starboard)

Verify 'TD1(2)' 'Mode' – On
Verify 'TD1(2)' 'Worksite sw' 'Stbd' – blank
Verify 'TD1(2)' 'Worksite sw' 'Port' – blank

4. TD PART 2: WS SENSOR ACQUISITION

NOTE
This step will translate the MT to acquire both worksite sensors. Distance of travel will be approximately 6 cm.

4.1 TD Initialization Frame Selection

NOTE
The Initialization Frame 205 will move the MT in the Port (-Y) direction and the Initialization Frame 197 will move the MT in the Starboard (+Y) direction.

MSS: MT: Manual Translate: Init Frame Config: MT Init Frame Config

input ‘TD’ ‘Init Frame’ per Table 3

Table 3. Initialization Frame Selection

LOST WS MICRO-SWITCH	INIT FRAME
Starboard (+Y)	205
Port (-Y)	197

√all others: 0

cmd Load Init Frame Config (Verify ‘TD’ ‘State’ per Table 3)

Verify ‘State’ for all others: 0

4.2 TD IMCA Initialization

MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ Initialize **Execute**

MSS: MT: IMCA Cmd State: MT IMCA Cmd State

Verify ‘TD’ ‘IMCA’ ‘A(B)’ ‘Initialize’ – √

4.3 TD IMCA Movement Initiation

MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ Actuate **Execute**

MSS: MT: Manual Translate: TUS TD: MT TUS TD Manual Operations

Verify ‘TD1(2)’ ‘Mode’ – Enabled
Verify ‘TD1(2)’ ‘Position’ – changing
Verify ‘TD1(2)’ ‘Shaft Spd’ ≤ 9 RPM (+ if motion to port, - if starboard)

Verify ‘TD1(2)’ ‘Mode’ – On
Verify ‘TD1(2)’ ‘Worksite sw’ ‘Stbd’ – √
Verify ‘TD1(2)’ ‘Worksite sw’ ‘Port’ – √

5. MODING TUS IMCA TO ON

5.1 TUS IMCA Commanding Selection
MSS: MT: Manual Translate: HW Config Manual:
MT HW Config Manual

sel ‘TUS1’ to ‘TUS2’ ‘IMCA Selection’ (two) – CMD IMCA A(B)

√’IMCA Selection’ for all others – None

cmd Load HW Config

Verify ‘TUS1’ to ‘TUS2’ ‘State’ (two) – CMD IMCA A(B)
Verify ’State’ for all others – None

5.2 Moding TUS IMCA to On
MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ On **Execute**

MSS: MT: Manual Translate: TUS TD: MT TUS TD Manual Operations

Verify ‘TUS1’ to ‘TUS2’ ‘IMCA A(B)’ ‘Mode’ (two) – On

6. MODING MT SOFTWARE TO AUTO

MSS: MT: Auto Translate: MT Auto Translate

cmd Mode MT to Standby **Execute** (Verify ‘MT Software Mode’ – Standby)
cmd Mode MT to Auto **Execute** (Verify ‘MT Software Mode’ – Auto)
cmd ‘HW Config’ 1(2) **Execute** (Verify – C1(C2))

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8.214 MT MANUAL TD SWAP

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1 MT SOFTWARE PROCESS INITIATION

PCS MSS: MT: MT Mode: MT Mode

If 'MT Process State' – Disabled
  cmd Initiate MT Process **Execute**

Verify 'SEPS Process State' – Initiated
Verify 'IMCA Process State' – Initiated
Verify 'MT Process State' – Initiated

If 'MT Software Mode' – Idle or Auto
  cmd Standby **Execute** (Verify – Standby)

If 'MT Software Mode' – Standby
  cmd Manual **Execute** (Verify – Manual)

2. ALTERNATE TD IMCA POWER APPLICATION

MSS: MT: Power: 'RPCM MT-4B(3A)' 4: RPCM MT4B(3A) A RPC 04

cmd 'RPC Position' – Close (Verify – Cl)

MSS: MT: Power: MT Power

Verify 'MT' 'RPCM MT-4B(3A)' 'TD' 'Mode' – Standby
Verify 'MT' 'RPCM MT-4B(3A)' 'TD' 'Fault' – blank

MSS: MT: IMCA Data Stale State: MT IMCA Data Stale State

Verify 'TD' 'IMCA' 'A(B)' 'Status Measurements' – blank

3. ALTERNATE TD POSITION HOLD

3.1 TD IMCA Commanding Selection

MSS: MT: Manual Translate: HW Config Manual: MT HW Config Manual

sel 'TD' 'IMCA Selection' – CMD IMCA A(B)
sel all others – none

cmd Load HW Config (Verify 'TD' 'State' – CMD IMCA A(B))

Verify all others – none

3.2 TD Initialization Frame Selection

MSS: MT: Init Frame: MT Init Frame Config

input 'Init Frame' 'TD' – 2
all others – 0

cmd Load Init Frame Config (Verify 'TD' 'State': 2)

Verify all others: 0

3.3 <u>TD IMCA Initialization</u>
MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ Initialize **Execute**

MSS: MT: IMCA Cmd State: MT IMCA Cmd State

Verify ‘TD’ ‘IMCA’ ‘A(B)’ ‘Initialize’ – √

3.4 <u>Moding TD IMCA to On</u>
MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ On **Execute**

MSS: MT: Manual Translate: TUS TD: MT TUS TD Manual Operations

Verify ‘TD1(2)’ ‘IMCA A(B)’ ‘Mode’ – On

4. ALTERNATE ED ENGAGEMENT

4.1 <u>ED IMCA Power Application</u>
MSS: MT: Power: ‘MT’ ‘RPCM MT-4B(3A)’ 11:
RPCM MT4B(3A) A RPC 11

cmd ‘RPC Position’ – Close (Verify – Cl)

MSS: MT: Power: MT Power

Verify ‘MT’ ‘RPCM MT-4B(3A)’ ‘ED’ ‘Mode’ – Standby
Verify ‘MT’ ‘RPCM MT-4B(3A)’ ‘ED’ ‘Fault’ – blank

MSS: MT: IMCA Data Stale State: MT IMCA Data Stale State

Verify ‘ED’ ‘IMCA’ ‘A(B)’ ‘Status Measurements’ – blank

MSS: MT: Manual Translate: LTU ED: MT LTU ED Manual Operations

Verify ‘ED1(2)’ ‘Switch States’ ‘Engaged’ – blank
Verify ‘ED1(2)’ ‘Switch States’ ‘Disengage Trigger’ – √
Verify ‘ED1(2)’ ‘Switch States’ ‘Disengage Verify’ – √
Verify ‘ED1(2)’ ‘Switch States’ ‘Alt Disengage’ – blank

4.2 <u>ED IMCA Commanding Selection</u>
MSS: MT: Manual Translate: HW Config Manual: MT HW Config Manual

sel ‘ED’ ‘IMCA Selection’ – CMD IMCA A(B)
sel all others – none

cmd Load HW Config (Verify ‘ED’ ‘State’ – CMD IMCA A(B))

Verify all others – none

4.3 ED Initialization Frame Selection

MSS: MT: Init Frame: MT Init Frame Config

input ‘Init Frame’ ‘ED’ – 2
all others – 0

cmd Load Init Frame Config (Verify ‘ED’ ‘State’: 2)

Verify all others: 0

4.4 ED IMCA Initialization

MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ Initialize **Execute**

MSS: MT: IMCA Cmd State: MT IMCA Cmd State

Verify ‘ED’ ‘IMCA’ ‘A(B)’ ‘Initialize’ – √

4.5 Moding ED IMCA to On

MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ On **Execute**

MSS: MT: Manual Translate: LTU ED: MT LTU ED Manual Operations

Verify ‘ED1(2)’ ‘IMCA A(B)’ ‘Mode’ – On

4.6 ED Initialization Frame Selection

MSS: MT: Init Frame: MT Init Frame Config

input ‘Init Frame’ ‘ED’ – 3
all others – 0

cmd Load Init Frame Config (Verify ‘ED’ ‘State’: 3)

Verify all others: 0

NOTE

Initialization Frame 3 commands the lowering of the TD wheel to the ITS Rail.

4.7 ED IMCA Initialization

MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ Initialize **Execute**

MSS: MT: IMCA Cmd State: MT IMCA Cmd State

Verify ‘ED’ ‘IMCA’ ‘A(B)’ ‘Initialize’ – √

4.8 ED IMCA Movement Initiation

CAUTION
Mode IMCA to On if it is still Enabled after 50 seconds.

MSS: MT: Manual Translate: MT Manual Translate

cmd 'IMCA Commands' Actuate **Execute**

MSS: MT: Manual Translate: LTU ED: MT LTU ED Manual Operations

Verify 'ED1(2)' 'IMCA A(B)' 'Mode' – Enabled
Verify 'ED1(2)' 'IMCA A(B)' 'Position' – decreasing
Verify 'ED1(2)' 'IMCA A(B)' 'Shaft Spd' ≤ 48 rpm

After motion complete
Verify 'ED1(2)' 'Switch States' 'Engaged' – √
Verify 'ED1(2)' 'Switch States' 'Disengage Trigger' – blank
Verify 'ED1(2)' 'Switch States' 'Disengage Verify' – blank
Verify 'ED1(2)' 'Switch States' 'Alt Disengage' – blank
Verify 'ED1(2)' 'IMCA A(B)' 'Mode' – On

4.9 Commanding ED IMCA to Standby
MSS: MT: Manual Translate: MT Manual Translate

cmd 'IMCA Commands' Standby **Execute**

MSS: MT: Manual Translate: LTU ED: MT LTU ED Manual Operations

Verify 'ED1(2)' 'Mode' – Standby

4.10 ED IMCAs Power Removal
MSS: MT: Power: 'RPCM MT-4B(3A)' 11: RPCM MT4B(3A) A RPC 11

cmd 'RPC Position' – Open (Verify – Op)

5. PRIME ED DISENGAGEMENT

5.1 ED IMCAs Power Application
MSS: MT: Power: 'RPCM MT-4B(3A)' 11:
RPCM MT4B(3A) A RPC 11

cmd 'RPC Position' – Close (Verify – Cl)

MSS: MT: Power: MT Power

Verify 'MT' 'RPCM MT-4B(3A)' 'ED' 'Mode' – Standby
Verify 'MT' 'RPCM MT-4B(3A)' 'ED' 'Fault' – blank

MSS: MT: IMCA Data Stale State: MT IMCA Data Stale State

Verify 'ED' 'IMCA' 'A(B)' 'Status Measurements' – blank

5.2 ED IMCA Commanding Selection
MSS: MT: Manual Translate: HW Config Manual
MT HW Config Manual

sel ‘ED’ ‘IMCA Selection’ – CMD IMCA A(B)
sel all others – none

cmd Load HW Config (Verify ‘ED’ ‘State’ – CMD IMCA A(B))

Verify all others – none

5.3 ED Initialization Frame Selection
MSS: MT: Init Frame: MT Init Frame Config

input ‘Init Frame’ ‘ED’ – 2
all others – 0

cmd Load Init Frame Config (Verify ‘ED’ ‘State’: 2)

Verify all others: 0

5.4 ED IMCA Initialization
MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ Initialize **Execute**

MSS: MT IMCA Cmd State: MT IMCA Cmd State

Verify ‘ED’ ‘IMCA’ ‘A(B)’ ‘Initialize’ – √

5.5 Moding ED IMCA to On
MSS: MT: Manual Translate: MT Manual Translate

cmd ‘IMCA Commands’ On **Execute**

MSS: MT: Manual Translate: LTU ED: MT LTU ED Manual Operations

Verify ‘ED1(2)’ ‘IMCA A(B)’ ‘Mode’ – On

5.6 ED Initialization Frame Selection

NOTE
Initialization frame 4 commands disengagement of the ED.

MSS: MT: Init Frame: MT Init Frame Config

input ‘Init Frame’ ‘ED’ – 4
all others – 0

cmd Load Init Frame Config (Verify ‘ED’ ‘State’: 4)

Verify all others: 0

5.7 ED IMCA Initialization

MSS: MT: Manual Translate: MT Manual Translate

cmd 'IMCA Commands' Initialize **Execute**

MSS: MT IMCA Cmd State: MT IMCA Cmd State

Verify 'ED' 'IMCA' 'A(B)' 'Initialize' – √

5.8 ED IMCA Movement Initiation

CAUTION

Mode IMCA to On if it is still Enabled after 60 seconds.

MSS: MT: Manual Translate: MT Manual Translate

cmd 'IMCA Commands' Actuate **Execute**

MSS: MT: Manual Translate: LTU ED: MT LTU ED Manual Operations

Verify 'ED1(2)' 'IMCA A(B)' 'Mode' – Enabled
Verify 'ED1(2)' 'IMCA A(B)' 'Position' – increasing
Verify 'ED1(2)' 'IMCA A(B)' 'Shaft Spd' ≤ 37 rpm

After motion is complete

Verify 'ED1(2)' 'IMCA A(B)' 'Switch States' 'Engaged'	– blank
Verify 'ED1(2)' 'IMCA A(B)' 'Switch States' 'Disengage Trigger'	– √
Verify 'ED1(2)' 'IMCA A(B)' 'Switch States' 'Disengage Verify'	– √
Verify 'ED1(2)' 'IMCA A(B)' 'Switch States' 'Alt Disengage'	– blank
Verify 'ED1(2)' 'IMCA A(B)' 'Mode'	– On

5.9 Commanding ED IMCA to Standby

MSS: MT: Manual Translate: MT Manual Translate

cmd 'IMCA Commands' Standby **Execute**

MSS: MT: Manual Translate: LTU ED: MT LTU ED Manual Operations

Verify 'ED1(2)' 'IMCA A(B)' 'Mode' – Standby

5.10 ED IMCAs Power Removal

MSS: MT: Power: 'RPCM MT-4B(3A)' 11: RPCM MT4B(3A) A RPC 11

cmd 'RPC Position' – Open (Verify – Op)

6. PRIME TD POWER OFF

6.1 TD IMCA Commanding Selection

MSS: MT: Manual Translate: HW Config Manual:
MT HW Config Manual

sel initial 'TD' 'IMCA Selection' – CMD IMCA A(B)
sel all others – none

cmd Load HW Config (Verify 'TD' 'State' – CMD IMCA A(B))

Verify all others – none

6.2 Commanding TD IMCA to Standby
MSS: MT: Manual Translate: MT Manual Translate

cmd 'IMCA Commands' Standby **Execute**

MSS: MT: Manual Translate: TUS TD: MT TUS TD Manual Operations

Verify 'TD1(2)' 'IMCA A(B)' 'Mode' – Standby

6.3 TD IMCA Power Removal
MSS: MT: Power: 'RPCM MT-4B(3A)' 4:
RPCM MT4B(3A) A RPC 4

cmd 'RPC Position' – Open (Verify – Op)

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8.306 MBS REBOOT PRIME(REDUNDANT) STRING

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NOTE

POA must not be Operational.

1. SETUP

PCS MSS: MBS: MBS

√'MBS Safing' – Safed

2. TRANSITION MBS PRIME(REDUNDANT) STRING TO OFF

NOTE

1. If SSRMS is based on MBS, it must be Off on commanded string.

2. Expect the following Caution and Warning messages while performing the next command:
   '**R1E - MSS Active OCS MBS Prime(Redun) MCU SRT Comm Fail**'

PCS MSS: MBS: MCU: MCU

cmd 'Prime(Redundant)' Off (Verify – Off) (30 s max)

3. TRANSITION MBS PRIME(REDUNDANT) STRING FROM OFF TO KEEP-ALIVE

cmd '(Prime)Redundant' Keep-Alive (Verify – Keep-Alive) (30 s max)

4. TRANSITION MBS PRIME(REDUNDANT) STRING FROM KEEP-ALIVE TO OPERATIONAL

NOTE

1. The transition from Keep-Alive to Operational can be stopped at any time by issuing a safing command.

2. The MBS transition from Keep-Alive to Operational will require approximately 3 minutes. The time is contingent on file transfer activity from the C&C MDM.

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3. If the alternate string is Off while the MBS is Operational, expect the following Robotics Advisory messages:
   '**R2O - MSS MBS CRPCM 1R(1P) Cat-2 Transmit Msg Err**'
   '**R2O - MSS MBS CRPCM 2R(2P) Cat-2 Transmit Msg Err**'
   '**R2O - MSS MBS CRPCM 3R(3P) Cat-2 Transmit Msg Err**'
   '**R2O - MSS MBS CRPCM 1R(1P) Cat-2 Receive Msg Err**'
   '**R2O - MSS MBS CRPCM 2R(2P) Cat-2 Receive Msg Err**'
   '**R2O - MSS MBS CRPCM 3R(3P) Cat-2 Receive Msg Err**'
   (SCR 21744)

cmd 'Prime(Redundant)' Operational (Verify Systems State – Operational)

8.306 MBS REBOOT PRIME(REDUNDANT) STRING

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5. MBS VIDEO COMPONENTS POWERUP

PCS MSS: MBS: VDU1: MSS VDUs

sel '[X]' where [X] = MBS 1 MBS 2

√'Primary','Redundant' Keep-Alive

Repeat

NOTE
Expect '**R6F - MBS… PFM Carrier On Video 1 Err**' Robotics Advisory message as each VDU is powered on. Message may toggle in and out of alarm until video is routed to the defined VDU (SCR 24376).

sel '[X]' as required where [X] = MBS 1 MBS 2 POA

cmd On (Verify – On)

Repeat

MSS: MBS: MBS Central Camera icon: MBS Camera

sel [X] as required where [X] = MBS 37 POA 32

cmd 'Power' On (Verify – On)

Repeat

6. MBS VIDEO DEROUTING

MSS:Video: Video Routing

Repeat the following for all destinations to which an MBS Camera is routed:

sel 'Destination Icon'

cmd 'Deroute Video Signal' – Deroute

8.307 MBS SWITCH TO REDUNDANT(PRIME) STRING

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1. SETUP

PCS MSS: MBS: MBS

√'MBS Safing' – Safed

2. TRANSITION MBS PRIME (REDUNDANT) STRING FROM OPERATIONAL TO KEEP-ALIVE

MSS: MBS: MCU: MCU

cmd 'Prime(Redundant)' Keep-Alive (Verify – Keep-Alive) (30 s max)

3. TRANSITION MBS REDUNDANT(PRIME) STRING FROM OFF TO KEEP-ALIVE

If Redundant(Prime) – Off
cmd 'Redundant(Prime)' Keep-Alive (Verify – Keep-Alive) (30 s max)

4. TRANSITION MBS REDUNDANT(PRIME) STRING FROM KEEP-ALIVE TO OPERATIONAL

NOTE

1. The transition from Keep-Alive to Operational can be stopped at any time by issuing a Safing command.
2. If the SSRMS is in Keep-Alive and is based on an MBS PDGF, expect the following Robotics Advisory message for each string that is in Keep-Alive:
   '**R2O - MBS CRPCM … Output Voltage … Stat Err**'
3. The MBS transition from Keep-Alive to Operational will require approximately 3 minutes. The time is contingent on file transfer activity from the C&C MDM.

cmd 'Redundant(Prime)' Operational (Verify Systems State – Operational)

5. MBS VIDEO COMPONENTS POWERUP

PCS MSS: MBS: VDU1: MSS VDUs

sel '[X]' where [X] = MBS 1 | MBS 2

√'Primary','Redundant' Keep-Alive

Repeat

NOTE

Expect '**R6F - MBS… PFM Carrier On Video 1 Err**' Robotics Advisory message as each VDU is powered on. Message may toggle in and out of alarm until video is routed to the defined VDU (SCR 24376).

sel ‘[X]’ as required where [X] = MBS 1 | MBS 2 | POA

  cmd On (Verify – On)

Repeat

MSS: MBS: MBS Central Camera icon: MBS Camera

sel [X] as required where [X] = MBS 37 | POA 32

  cmd ‘Power’ On (Verify – On)

Repeat

6. MBS VIDEO DEROUTING

MSS:Video: Video Routing

Repeat the following for all destinations to which an MBS Camera is routed:

sel ‘Destination Icon’

cmd ‘Deroute Video Signal’ – Deroute

8.310 MBS POA REBOOT

(RBT GEN/X2R4 - ALL/FIN) Page 1 of 1 page

1. SETUP

PCS MSS: MBS: MBS

√'MBS Safing' – Safed

2. TRANSITION MBS PRIME(REDUNDANT) POA STRING TO KEEP-ALIVE

MSS: MBS: POA Power: POA Power

cmd 'Prime(Redundant)' Keep-Alive (Verify Keep-Alive) (30 s max)

3. TRANSITION MBS PRIME(REDUNDANT) POA STRING TO OPERATIONAL

NOTE

1. The transition from Keep-Alive to Operational can be stopped at any time by issuing a Safing command.
2. If the transition is not complete in 2.5 minutes, apply Safing on the DCP to stop transition (SCR 22619).
3. If the transition is interrupted by Operator Safing or by a system failure, the MBS string will have to be commanded to Operational again before the POA transition can be reattempted.
4. The MCU status on the MBS page will be incorrect during the POA transition.

MSS: MBS: POA Power: POA Power

cmd 'Prime(Redundant)' Operational (Verify Operational) (SCR 22616)

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8.311 MBS POA SWITCH TO REDUNDANT(PRIME) STRING

(RBT GEN/X2R4 - ALL/FIN) Page 1 of 3 pages

1. SETUP

PCS MSS: MBS: MBS

√‘MBS Safing’ – Safed

2. POA VDU POWERDOWN TO KEEP-ALIVE

PCS MSS: MBS: POA VDU: MSS VDUs

If ‘MBS’ ‘POA’ – On
    cmd ‘MBS’ ‘POA’ Keep-Alive (Verify Keep-Alive)

3. TRANSITION MBS PRIME(REDUNDANT) POA STRING FROM OPERATIONAL TO OFF

MSS: MBS: POA Power: POA Power

cmd ‘Prime(Redundant)’ Off (Verify – Off) (30 s max)

4. TRANSITION MBS REDUNDANT(PRIME) STRING FROM OFF TO KEEP-ALIVE

MSS: MBS: MCU: MCU

If Redundant (Prime) – Off
    cmd ‘Redundant(Prime)’ Keep-Alive (Verify Keep-Alive) (30 s max)

5. TRANSITION MBS PRIME(REDUNDANT) STRING FROM OPERATIONAL TO KEEP-ALIVE

MSS: MBS: MCU: MCU

cmd ‘Prime(Redundant)’ Keep-Alive (Verify Keep-Alive) (30 s max)

6. TRANSITION MBS REDUNDANT(PRIME) STRING FROM KEEP-ALIVE TO OPERATIONAL

NOTE

1. The transition from Keep-Alive to Operational can be stopped at any time by issuing a Safing command.
2. If the SSRMS is in Keep-Alive and is based off an MBS PDGF, expect the following Robotics Advisory message for each string that is in Keep-Alive:
    ‘**R2O - MBS CRPCM … Output Voltage … Stat Err**’

MSS: MBS: MCU: MCU

cmd ‘Redundant(Prime)’ Operational (Verify Operational)

7. TRANSITION MBS REDUNDANT(PRIME) POA STRING FROM KEEP-ALIVE TO OPERATIONAL

NOTE

1. The transition from Keep-Alive to Operational can be stopped at any time by issuing a Safing command.
2. If the transition is not complete in 2.5 minutes, apply Safing on the DCP to stop transition (SCR 22619).
3. If the transition is interrupted by Operator Safing or by a system failure, the MBS string will have to be commanded to Operational again before the POA transition can be reattempted.
4. The MCU status on the MBS page will be incorrect during the POA transition.

MSS: MBS: POA Power: [POA Power]

cmd ‘Redundant(Prime)’ Operational (Verify – Operational) (SCR 22616)

8. MBS VIDEO COMPONENTS POWERUP

PCS MSS: MBS: VDU1: [MSS VDUs]

sel ‘[X]’ where [X] = [MBS 1] [MBS 2]

√‘Primary’,‘Redundant’ Keep-Alive

Repeat

NOTE

Expect ‘**R6F - MBS… PFM Carrier On Video 1 Err**’ Robotics Advisory message as each VDU is powered on. Message may toggle in and out of alarm until video is routed to the defined VDU (SCR 24376).

sel ‘[X]’ as required where [X] = [MBS 1] [MBS 2] [POA]

cmd On (Verify – On)

Repeat

MSS: MBS: MBS Central Camera icon: [MBS Camera]

sel [X] as required where [X] = [MBS 37] [POA 32]

cmd ‘Power’ On (Verify – On)

Repeat

9. MBS VIDEO DEROUTING

MSS:Video: Video Routing

Repeat the following for all destinations to which an MBS Camera is routed:

sel ‘Destination Icon’

cmd ‘Deroute Video Signal’ – Deroute

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8.601 CUP(LAB) AVU LCDM CONFIGURATION AS MON 1(2)

(RBT GEN/9A - ALL/FIN) Page 1 of 1 page

1. VIDEO SETUP

DCP
cmd Monitor/Camera – 1/95
cmd Monitor/Camera – 2/95

2. AVU POWERUP

LCDM √Power On

PCS MSS: LAS5(LAP5) AVU: LAS5(LAP5) AVU

cmd ‘Power’ On

> NOTE
> AVU bootup could take up to 4 minutes.

MSS: RWS

Verify ‘LAS5’(‘LAP5’) ‘RPC3’ – closed (blue)
Verify ’LAS5’(‘LAP5’) ‘Status from OCS’ – On

3. LCDM MODE

> NOTE
> This step needs to be performed only if the LCDM mode was switched to RGB prior to powering the AVU down the last time.

LCDM
cmd MENU (Verify Brightness)
cmd UP (Verify Video Mode)
cmd SELECT (Verify RGB)
cmd UP (Verify Composite)
cmd SELECT

Verify AVU Systems Display appears.

4. AVU VIDEO OUTPUT ROUTING

> NOTE
> This step will remove the AVU Systems Display from all monitors. To regain it, triple click button 3.

cmd Advanced <Alt-A>

‘Vid Out’

pick ‘Out1:’ Raw Vid 1
pick ‘Out2:’ Raw Vid 2
pick ‘Out3:’ Raw Vid 1(2)

Verify Test Pattern appears on LCDM and MON 1(2).

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REFERENCE

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9.101 RWS PERIPHERALS CONFIGURATION 1

(RBT GEN/5A.1 - ALL/FIN 2) Page 1 of 5 pages

NOTE

1. Standard ISS LAB configuration has a single PCS dedicated to ISS Overhead and C&W. This is not the PCS located on the workstation for MSS operations.

2. The RWS UOP Bypass Cables provide power and data to the RWS PCS and the RWS DCP.

3. Some of the hardware, data cables and power cables may already be located on the RWS or on the Alternate RWS.

1. HARDWARE

   Retrieve the following hardware components:

   Laptop Stands (four PER RWS)
   AVU LCDM (one PER RWS) P/N 000681-05
   AVU Keyboard (one PER RWS) P/N 002247-01
   SSC (two per RWS)
   SSC-MCIU Card Assembly (one PER RWS) P/N 51140-2357-1

2. DATA CABLES

   Retrieve the following data cables:

   RS232 Y Cable (one PER RWS) P/N SED39124826-307
   Keyboard Cable (one PER RWS) P/N 000845-04
   LCDM Cable (one PER RWS) P/N 000783-05
   AVU-SSC MCIU Serial Cable (one PER RWS) P/N SED39126965-301
   AVU Quad Cable (one PER RWS) P/N 004397-01

3. POWER CABLES

   Retrieve the following Power Cables:

   For Cupola RWS configuration:
   STORAGE DEVICE PWR CABLE (UOP to MACE) P/N SEG46117493-301
   120VDC PEEK POWER CABLE, 20' P/N SEG33112596-303
   Three Additional Power cables (all three do not have to be the same type):
   POWER CABLE ASSEMBLY, PCS-UOP 120VDC P/N SEZ39129260-305 or 120VDC PEEK POWER CABLE, 20' P/N SEG33112596-303

   For Lab RWS configuration:
   120VDC PEEK POWER CABLE, 20' P/N SEG33112596-303
   Three Additional power cables (all three do not have to be the same type):
   POWER CABLE ASSEMBLY, PCS-UOP 120VDC P/N SEZ39129260-305 or 120VDC PEEK POWER CABLE, 20' P/N SEG33112596-303

4. SETTING UP
   Place Laptop Stands in Seat Tracks per the following diagram at operator preference to support MSS operations.
   Insert the PCMCIA Card of the SSC-MCIU Card Assembly into an available PCMCIA slot on RSAD/DOUG SSC.

5. AVU POWERDOWN

CAUTION
To avoid possible hardware damage, the AVU must be powered down prior to connecting peripherals.

For the AVU to which peripherals will be connected
MSS: RWS 'LAS5(LAP5)' 'AVU' 'Status from OCS'

If On
Perform {6.609 CUP(LAB) ARTIFICIAL VISION UNIT (AVU) POWERDOWN}, all (SODF: RBT GEN: NOMINAL), then:

6. RWS DATA CABLES
   Connect data cables as detailed in the following diagram.

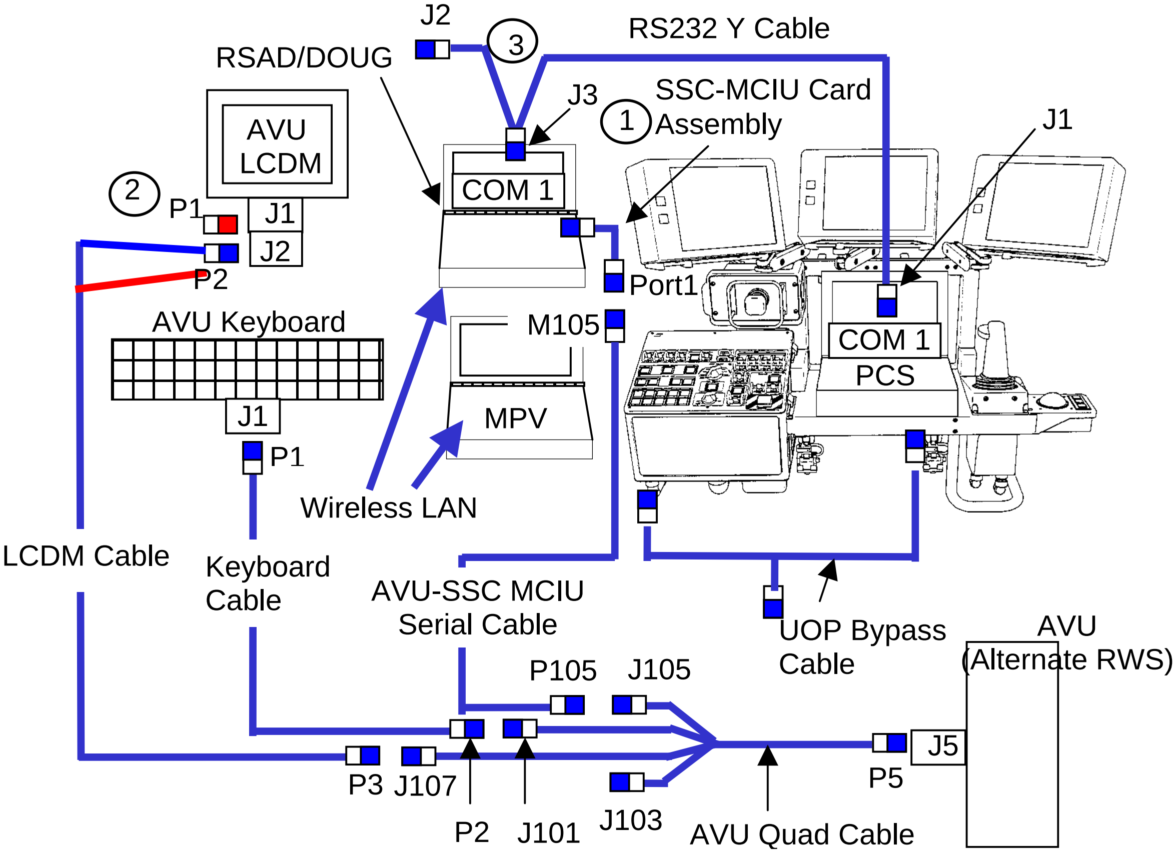

Figure 1.- RWS Data Cables.

Ops Name	Part Number
AVU LCDM	000681-05
Keyboard/trackball	002247-01
RS232 Y Cable	SED39124826-307
LCDM Cable	000783-05
Keyboard Cables	000845-04
AVU Quad Cable	004397-01
SSC-MCIU Card Assembly	51140-2357-1
AVU-SSC MCIU Serial Cable	SED39126965-301
UOP Bypass Cable	1J00138

NOTE

1. SSC-MCIU Card Assembly consists of the PCMCIA Card and attached cable. Insert PCMCIA Card of SSC-MCIU Card Assembly into RSAD/DOUG SSC.

2. LCDM Cable (“Y”) provides both data and power to LCDM. Connector design insures correct configuration.

3. Connect the J3 end of the “Y” cable to 9 pin port labeled COM 1 on back of RSAD/DOUG SSC and PCS. Do not connect anything to the J2 end of the “Y” cable. Deviations from this configuration may cause the PCS to fail to halt or application to terminate.

7. POWER CABLES
   Connect power cables as detailed in the following diagram.

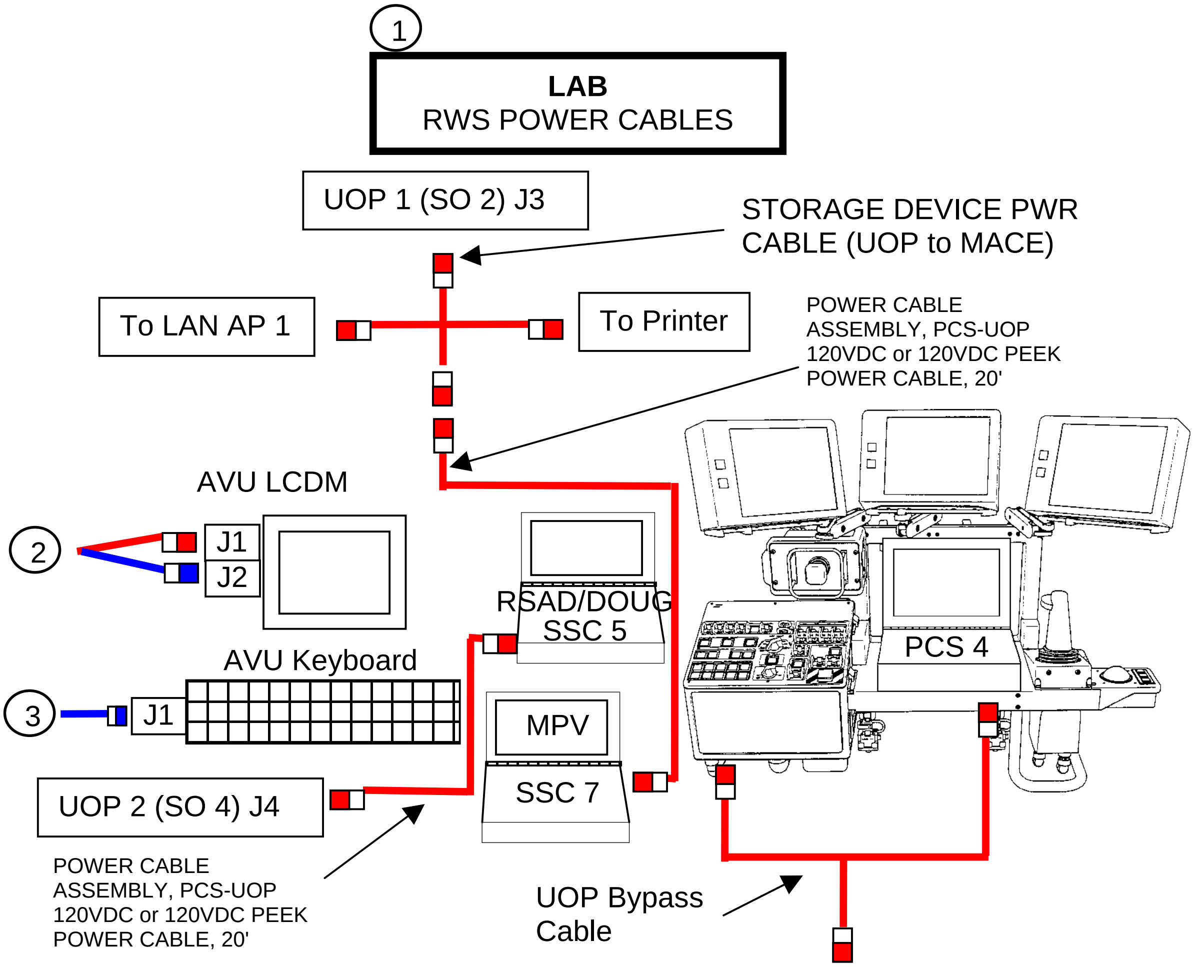

Figure 2.- Lab RWS Power Cables.

Ops Name	Part Number
STORAGE DEVICE PWR CABLE (UOP to MACE)	SEG46117493-301
UOP Bypass Cable	1J00137
120Vdc PEEK POWER CABLE, 20'	SEG33112596-303
POWER CABLE ASSEMBLY, PCS-UOP 120VDC	SEZ39129260-305

NOTE

1. To reduce clutter, these drawings do not show a “brick” on the power cables.

2. LCDM Cable (“Y”) provides both data and power to LCDM. Connector design insures correct configuration.

3. Keyboard is powered through data cable.

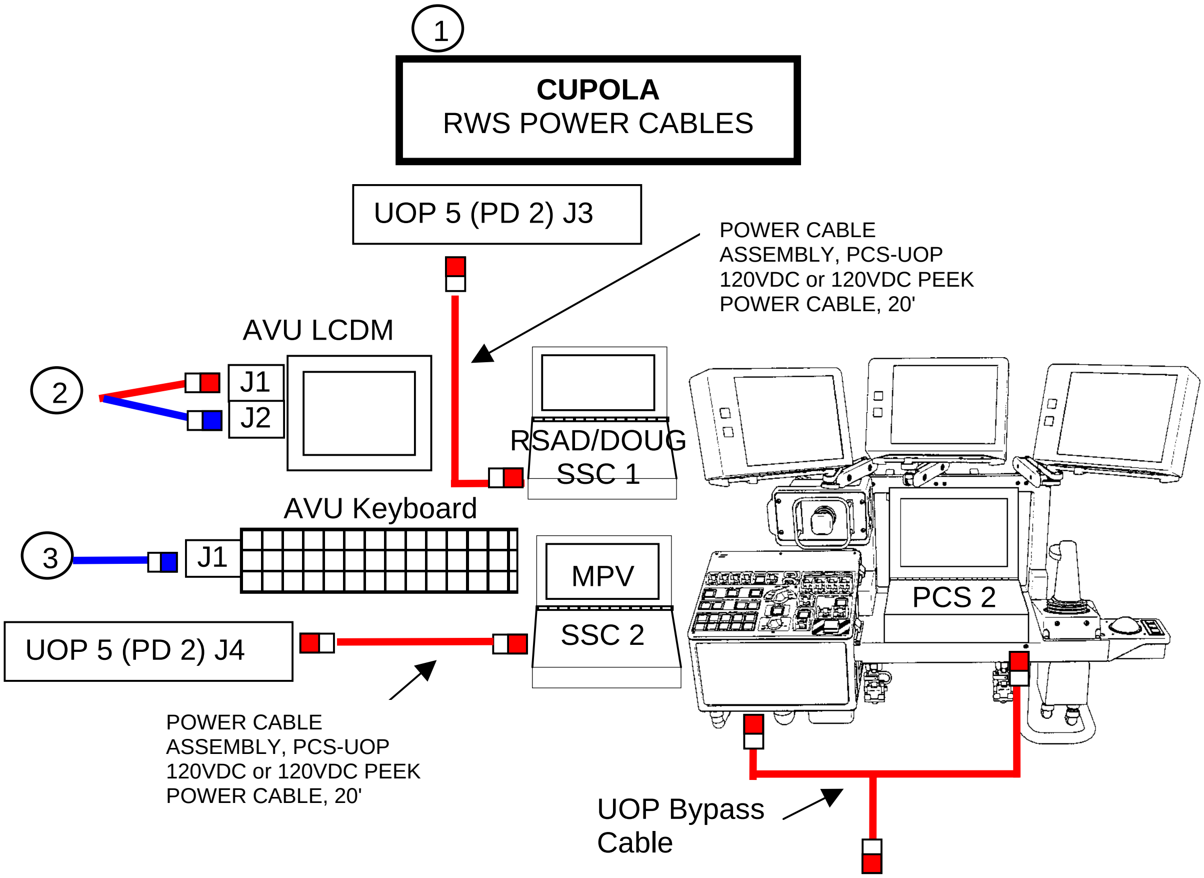

Figure 3.- Cupola RWS Power Cables.

Ops Name	Part Number
UOP Bypass Cable	1J00137
120Vdc PEEK POWER CABLE, 20'	SEG33112596-303
POWER CABLE ASSEMBLY, PCS-UOP 120VDC	SEZ39129260-305

NOTE

1. To reduce clutter, these drawings do not show a “brick” on the power cables.

2. LCDM Cable (“Y”) provides both data and power to LCDM. Connector design insures correct configuration.

3. Keyboard is powered through data cable.

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9.404 SSRMS SINGLE JOINT MNEMONICS

(RBT/6A - ALL/FIN) Page 1 of 2 pages

Joint rotation axes are illustrated, with circular arrows denoting positive rotation, and the dotted line is the initial position.

The diagram also illustrates the right hand rule: point thumb of right hand along positive direction of a vector, curling fingers around the vector's shaft. The fingers give the direction of positive rotation around the vector.

Given the joint rotation axes, the operator needs to determine the direction of positive/negative rotation for each joint. This is useful when commanding the SSRMS in Single Mode.

The following set of mnemonics use the right hand rule to help determine the direction of positive rotation for each joint:

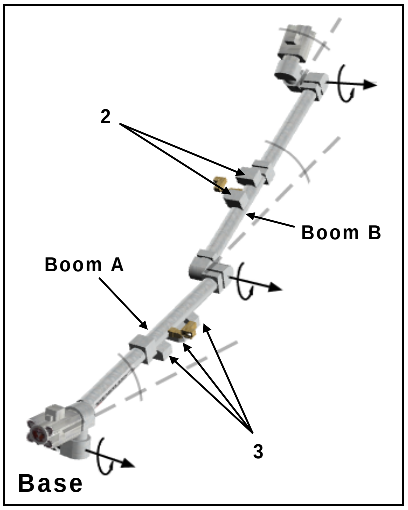


Figure 1.- Pitch Joint Mnemonics.

Pitch Joints (Mnemonic: 3 Trail, 2 Lead (3T2L)) - The three pitch joint axes (SP, EP & WP) are parallel and remain parallel for any arm configuration. Therefore, determine the positive direction for one of the three joints and infer the others. The fact that boom A has three electronics (the "3" on Figure 1), compared to boom B which has only two (the "2" on Figure 1), provides an easy landmark (i.e., 3 boxes vs. 2 boxes). These boxes are highlighted in gray in Figure 1. For positive pitch joint motion, the booms will always move so that the three boxes trail boom A while the two boxes lead boom B (3 Trail 2 Lead or 3T2L).

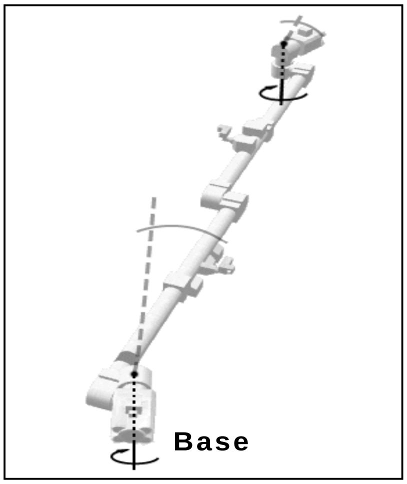


Figure 2.- Yaw Joint Mnemonics.

Yaw Joints (Mnemonic: Away from the LEE) - For the two yaw joints (SY & WY), to obtain the positive rotation direction, simply use the right-hand rule pointing the thumb along the yaw axis, away from the LEE (as seen in Figure 2).

9.404 SSRMS SINGLE JOINT MNEMONICS

(RBT/6A - ALL/FIN) Page 2 of 2 pages

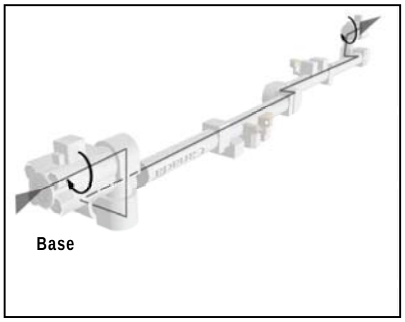
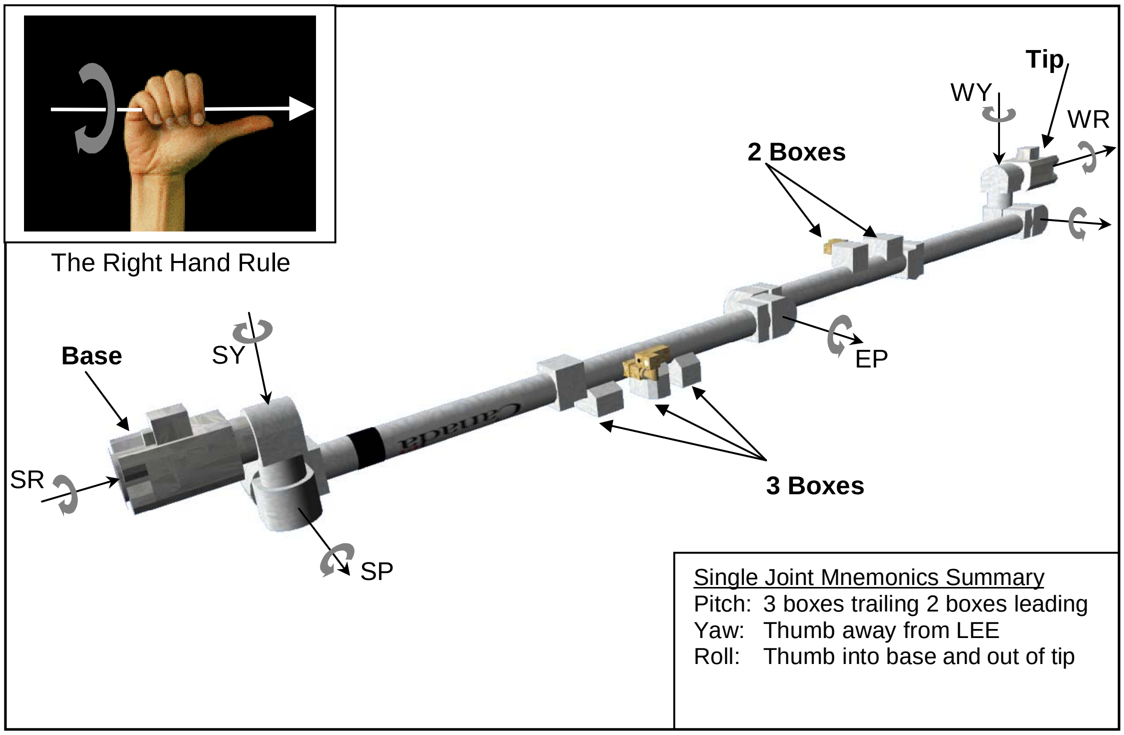


Figure 3.- Roll Joint Mnemonics.

<u>Roll Joints (Mnemonic: Power flow)</u> -
For the two roll joints (SR & WR), to obtain the positive rotation direction, also use the right hand-rule, pointing the thumb into the base LEE and out of the Tip LEE. As a memory aid, think of power flowing into the base LEE and out of the Tip LEE towards a payload (as shown in Figure 3).



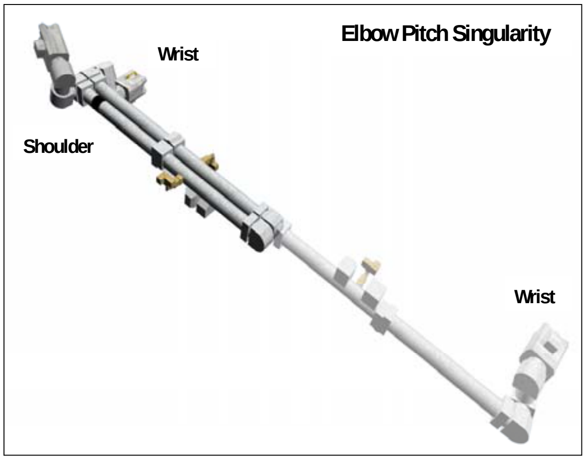
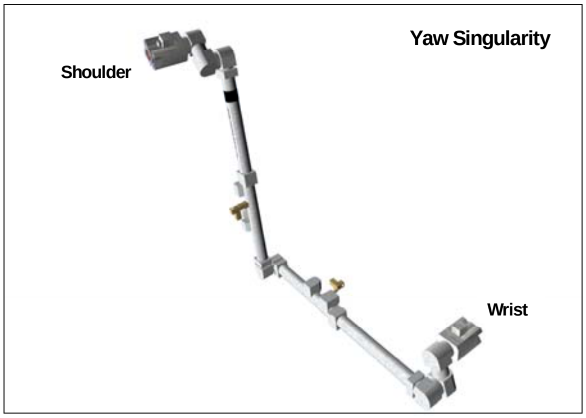
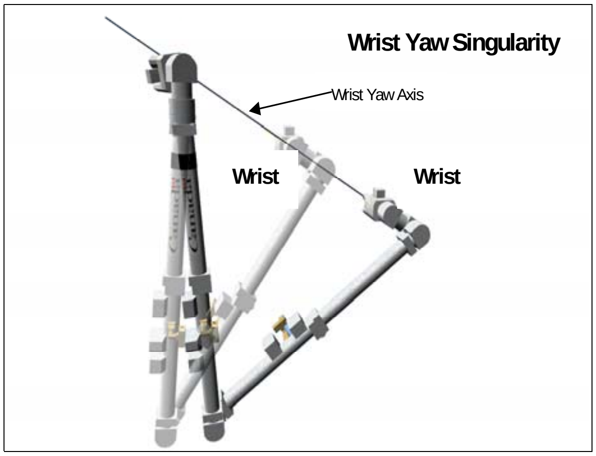
<u>Single Joint Mnemonics Summary</u>
Pitch: 3 boxes trailing 2 boxes leading
Yaw: Thumb away from LEE
Roll: Thumb into base and out of tip

Figure 4.- Single Joint Mnemonics.

9.405 SSRMS 7 JOINT SINGULARITY CUES

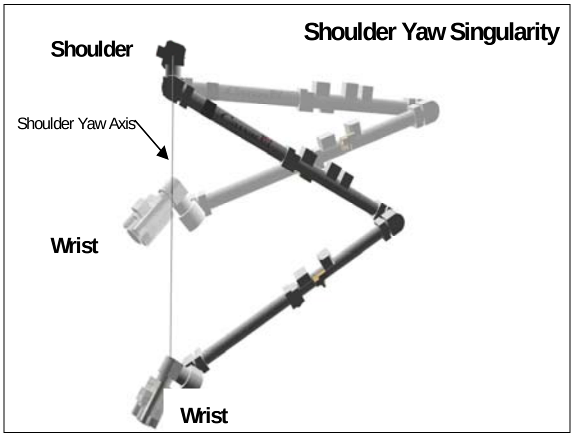
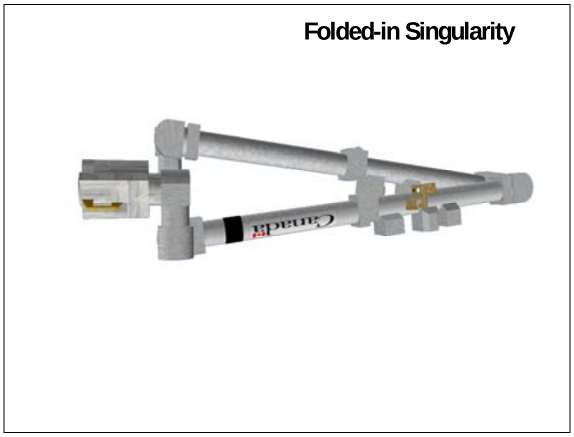
(RBT/6A - ALL/FIN) Page 1 of 2 pages

Table 1. Singularity Configuration Cues

Singularity Name And Description	Angles Conditions	Other Necessary Conditions	Lost DOFs
	EP = 0° or EP = ± 180°	None	Translation along the boom axis.
	WY and SY at ± 90° *	None	Translation perpendicular to the pitch plane becomes coupled with rotations.
	WY = ± 90° *	Wrist YAW axis** points toward the shoulder cluster.	Translation perpendicular to the pitch plane becomes coupled with rotations.

9.405 SSRMS 7 JOINT SINGULARITY CUES

(RBT/6A - ALL/FIN) Page 2 of 2 pages

Singularity Name And Description	Angles Conditions	Other Necessary Conditions	Lost DOFs
	SY = ± 90° [*]	Shoulder YAW axis[**] points toward the wrist cluster.	Translation perpendicular to the pitch plane.
	None	When looking at the arm with a line of sight perpendicular to the pitch plane, the SR-SY axis crossing point and the WR-WY axis crossing point appear colinear.	Translation perpendicular to the pitch plane.

[*] For these angles' conditions, values of ± 270° will also place the SSRMS in the associated singularity. However, ± 270° is also the soft stop limit of the SSRMS joints, and should be avoided.

[**] Positive or negative direction.

9.408 TIMING DATA FOR LEE OPERATIONS

(RBT GEN/12A - ALL/FIN 1) Page 1 of 1 page

Table 1. LEE/POA Timing Data

Mechanism	Fast Speed		Slow Speed	
	Nominal (seconds)	Maximum (seconds)	Nominal (seconds)	Maximum (seconds)
Snare	2	3	7	12
Rigidize	16	18	60	90
Latch	10	13	43	65
Mate	N/A	N/A	3	10

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9.409 NOMINAL ROBOTICS ADVISORIES

(RBT GEN/X2R4 - ALL/FIN 1) Page 1 of 2 pages

Table 1. Nominal Robotics C&W Advisories

Operation	Expected Messages	SCR
AVU Powerdown.	'**R1E - MSS Active OCS AVU Comm Fail**'	17439
MBS Operational and other string unpowered. (Messages occur for unpowered CRPCMs on unpowered string.)	'**R2O - MBS CRPCM (1P,2P,3P)(1R,2R,3R) Cat-2 Transmit Msg Err**' '**R2O - MBS CRPCM (1P,2P,3P)(1R,2R,3R) Cat-2 Receive Msg Err**'	21744
During safing event if OCS is commanding the SRT inhibits enabled	'**R3C - MSS OCS SSRMS Prime(Redun) ACU SRT Cat-1 Inh Fail**' '**R2P - MSS OCS MBS Prime(Redun) MCU SRT Inh Fail**'	23229
MBS operations, random annunciations of Cat-2 messages during IMCA operations.	'**R4H - MBS MCU MCAS UMA Cat-2 Cksum Fail**' '**R4H - MBS MCU MCAS Latch Cat-2 Cksum Fail**' '**R4H - MBS MCU MTCL Cat-2 Cksum Fail**'	22667
RWS Powerup after set RWS location command is sent.	'**R9Z - MSS CUP(LAB) OCS WHS Cmd Sequence Err**'	19996
LEE/POA Camera powered OFF. (Message will occur only for commanded VDU.)	'**R6B - SSRMS Base(Tip) LEE VDU TVC On Off Err**' '**R6B - MBS POA VDU TVC (PTU) On Off 1 Err**'	22814
VDU Sync on unselected channel	'**R6D - MBS POA VDU PFM Carrier On Sync 1(2) Err**' '**R6D - MBS VDU 1(2) PFM Carrier On Sync 1(2) Err**' '**R6D - SSRMS Base(Tip) LEE(Elbow) VDU PFM Carrier On Sync 1(2) Err**' '**R6F - SSRMS Base(Tip) LEE(Elbow) VDU PFM Carrier On Video 1(2)(3) Err**' '**R6F - MBS POA VDU PFM Carrier On Video 1(2)(3) Err**' '**R6F - MBS VDU 1(2) PFM Carrier On Video 1(2)(3) Err**'	24376
SSRMS commanded to operational with default cyclic checkpoint data (CCD) loaded into C&C. Note: Message will occur for each joint whose actual joint angle value is not zero.	'**R9C - MSS OCS SSRMS SR Joint Init Posn Err**' '**R9C - MSS OCS SSRMS SY Joint Init Posn Err**' '**R9C - MSS OCS SSRMS SP Joint Init Posn Err**' '**R9C - MSS OCS SSRMS EP Joint Init Posn Err**' '**R9C - MSS OCS SSRMS WP Joint Init Posn Err**' '**R9C - MSS OCS SSRMS WY Joint Init Posn Err**' '**R9C - MSS OCS SSRMS WR Joint Init Posn Err**'	24529
SSRMS is safed (system or operator initiated). If the alarm persists, this indicates a real failure.	'**R3Z - MSS OCS SSRMS Prime(Redun) ACU SRT Cat-1 Brk Stat Fail**'	17495

9.409 NOMINAL ROBOTICS ADVISORIES

(RBT GEN/X2R4 - ALL/FIN 1) Page 2 of 2 pages

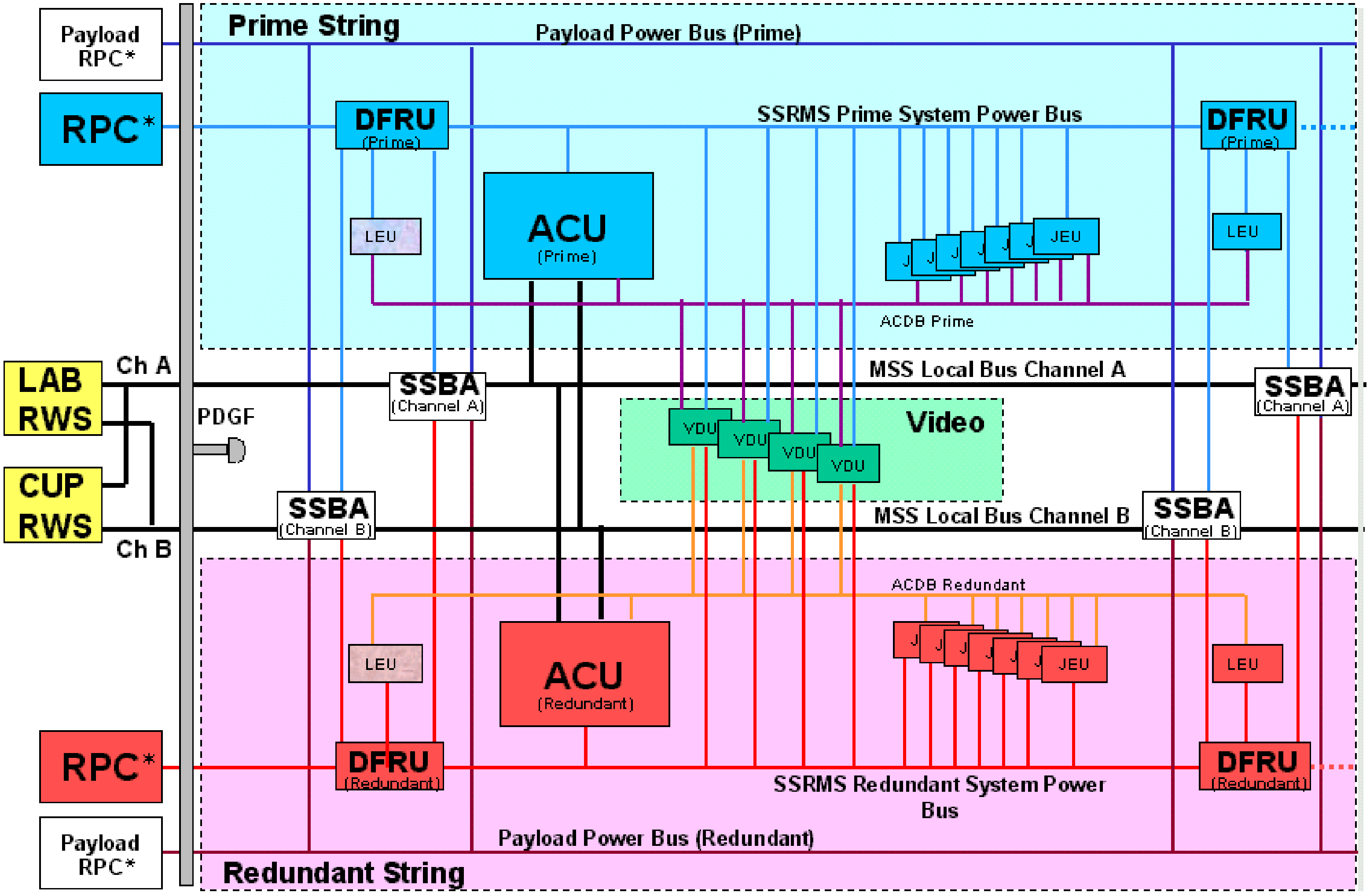
Table 1. Nominal Robotics C&W Advisories (Continued)

Operation	Expected Messages	SCR
Mating Tip LEE connectors to a PDGF which shares common ground with Base PDGF.	'**R3L - SSRMS Pwr Flags Fail**'	19019
Applying Brakes on SSRMS while trigger is hot	'**R3D - SSRMS SP(SR, SY, EP, WP, WR, WY) JCS State Err**'	14662
Comm dropout between CEU and ACU(MCU). Safing will occur.	'**R1E - MSS Active OCS SSRMS ACU Comm Fail**' '**R1E - MSS Active OCS MBS MCU Comm Fail**' '**R1E - LAB RWS CEU MLB ACU Cmd Resp Sync Msg Err**'	28151
Completion of an MCAS or MBS UMA demate operation.	'**R2P - MSS OCS MBS Prime(Redun) MCU SRT Inh Fail**' '**R4H - MBS MCU UMA Stop Cond Err**' '**R2O - MBS MCU UMA Inadvertent Pwr On**'	28152
MTCL, MCAS, or UMA IMCA transition to Standby after completing motion	'**R4H - MBS MCU MTCL(MCAS, UMA) Inadvertent Motion**' '**R2O - MBS MCU MTCL(MCAS, UMA) Inadvertent Pwr On**'	28780
Power removed from TUS IMCA while I/O is enabled	'**R9Z - MSS MT TUS 1(2) IMCA 1(2) Comm or Device Fail**' '**R9Z - Prime EXT MDM Detected RT Loss of Comm - Prime(Sec) TUS 1(2) - MT**'	28581
Loading an MCAS or MCAS UMA IMCA initialization frame	'**R4H - MBS MCU MCAS Abnormal Stop Cond**' '**R4H - MBS MCU UMA Abnormal Stop Cond**'	28923
SSRMS or MBS is commanded to OFF from KA or Operational. (Not always annunciated for the SSRMS when based on the MBS)	'**R1E - MSS Active OCS SSRMS Prime(Redun) ACU SRT Comm Fail**' '**R1E - MSS Active OCS MBS Prime(Redun) MCU SRT Comm Fail**'	17730
SSRMS powered down from Operational	'**R1E - CUP(LAB) RWS CEU PLB ACU Cmd Resp Sync Msg Err**'	

Table 2. Nominal Robotics Discrete Messages

Operation	Expected Messages	SCR
SSRMS is commanded to Operational or releasing brakes, while the rate hold button in the 'down' position.	'**SSRMS_Invalid_Rate_Hold_Selection**'	16091
Shutting down an SSRMS subunit for DJOPs	'**Invalid_Command_For_Current_Mode**'	28118

SSRMS Functional String



* RPC is SSRMS base dependent, including MT worksite location.

Figure 1.- SSRMS Electrical Components.

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9.907 MSS/ISS CAMERA NUMBER TABLE

(RBT GEN/E8 - ALL/FIN) Page 1 of 1 page

CAUTION

Routing video sources that do not exist may cause the Primary C&C to drop into Diagnostics Mode and lead to a C&C Transition. There is no concern for sources listed in this table.

Table 1. MSS/ISS Camera Number Title

Port	Video Source	Displayed Name	Address	
			Software ID	DCPL
2	S1 Upper Outboard	S1UPOB	2	02
3	S1 Lower Outboard	S1LOOB	4	03
4	S1 Upper Inboard	S1UPIB	7	04
5	S1 Lower Inboard	S1LOIB	8	05
6	P1 Upper Inboard	P1UPIB	11	06
7	P1 Lower Inboard	P1LOIB	14	07
8	P1 Upper Outboard	P1UPOB	16	08
9	P1 Lower Outboard	P1LOOB	19	09
12	Node 1 Zenith	NOD1UP	26	12
13	Lab Starboard/Zenith	LAB_S	28	13
	SSRMS Base LEE	BASE	40	21
	SSRMS Base Elbow	B_ELB	43	22
	SSRMS Tip Elbow	T_ELB	48	24
	SSRMS Tip LEE	LEE	51	25
	MBS POA	POA	32	32
	MBS Mast	MBS	37	37
	AVU1 Channel A	AVU1A	52	81
	AVU1 Channel B	AVU1B	53	82
	AVU2 Channel A	AVU2A	54	83
	AVU2 Channel B	AVU2B	55	84
	VTR1 PLAYBACK/Orbiter Channel 2*	VTR1	23	91
	VTR2 PLAYBACK/Orbiter Channel 1*	VTR2	24	92
	SCU 1 MUX Output	MUX1	3	93
	SCU 2 MUX Output	MUX2	12	94
	SCU 1 Test Pattern	TEST1	15	95
	SCU 2 Test Pattern	TEST2	20	96
	LAB Camcorder	LABCAM	68	
	Airlock Camcorder	AL_CAM	77	
	Node 1 Camcorder	N1_CAM	79	
* Video source dependent on VTR Bypass Cable routing.				

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TOP

HOOK VELCRO

HOOK VELCRO

SSRMS LEE CUE CARD (SSRMS IS LOADED AND LEE CAUTION IS ANNUNCIATED)

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1. STOP MOTION (RAMP OUT HC/PAUSE AUTO-SEQUENCE)

DCP Visually check for separation at the grapple interface.

2. CHECK LEE STATUS (PCS/MSS EFFECTOR OVERLAY)

PCS MSS: SSRMS: Tip LEE: SSRMS Tip LEE

Any of the following telemetry combinations indicate a secure payload:

(‘Snare’ Close – blue and ‘Carriage’ Tension > 4000 N)
or
(‘Snare’ Capture – blue and ‘Carriage’ Retract – blue)
or
‘Latch’ Latch – blue
or
‘Umbilical’ Mate – blue

If no separation is observed and telemetry indicates a secure payload >>

3. INHIBIT ATTITUDE CONTROL

If ISS in Attitude Control

PCS MSS: SSRMS: Thrusters: Thruster Controls for MSS Ops

cmd ‘Desat Request’ Inhibit (Verify Desat Request – Inh)

‘Auto Att Control Handover to RS’

cmd Arm
cmd Inhibit (Verify ‘Auto Att Control Handover to RS’ – Inh)

If shuttle in Attitude Control
Coordinate with shuttle crew members for DAP: FREE.

4. TERMINATE AUTO-SEQUENCE / ENTER STANDBY MODE

If Auto-sequence paused

PCS MSS: SSRMS: Joint(FOR) Auto(OCAS): SSRMS Joint(FOR) Auto(OCAS)

cmd Terminate (Verify Sequence Status – Waiting Destination)

Otherwise:
MSS: SSRMS: SSRMS

Enter Mode – Standby (Verify blue)

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(Continued on back)

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5. RETRACT CARRIAGE

If ‘Snare’ Capture – blue and (‘**R3N - SSRMS LEE Rigidize Brk Slip**’ and/or ‘**R3Q - SSRMS LEE Uncommanded Derigidize**’ Cautions were annunciated)

PCS MSS: SSRMS: Tip LEE: SSRMS Tip LEE

cmd ‘Carriage’ Retract ▶ Slow, Hard Stops (Verify ‘Stops’ – Hard)

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

cmd Confirm (Verify Hot Trigger icon)

RHC TRIGGER → press (hold until ‘Carriage’ Brakes – On) >>

WARNING

The following procedure will release the payload, and should not be performed unless the operator has determined that releasing is the safest course of action.

6. RELEASE PAYLOAD AND MANEUVER SSRMS CLEAR

Only perform this procedure if the crew has determined that releasing the payload is the safest course of action.

PCS MSS: SSRMS: SSRMS

√Command – Internal
√Vernier

Enter Mode – Manual (Verify blue)

√Base joint locked as required

MSS: SSRMS: Tip LEE: SSRMS Tip LEE

cmd ‘Snare’ Open ▶ Slow, Hard Stops (Verify Stops – Hard)

Verify ‘Confirm or Terminate’ Prompt

cmd Confirm (Verify Hot Trigger icon)

RHC TRIGGER → press (hold until ‘Snare’ Brakes – On)

THC/RHC Maneuver SSRMS to safe distance.

RBT - 1b/ALL/H