International Space Station
Thermal Control Group (TCG)
Thermal Control System

All Expedition Flights

Mission Operations Directorate
Operations Division

September 7, 2000

These procedures are available electronically on the SODF Homepage at http://fitproc.jsc.nasa.gov
INTERNATIONAL SPACE STATION
THERMAL CONTROL GROUP (TCG)
THERMAL CONTROL SYSTEM
ALL EXPEDITION FLIGHTS

September 7, 2000

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

## Thermal Control Group (TCG)

### Thermal Control System

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ACTIVATION AND CHECKOUT PROCEDURES
NOTE
In order to activate all flex hose heaters, this procedure is nominally performed twice sequentially.

1. **POWERING ON LOOP A(B) FLEX HOSE HEATERS**

PCS

P6: TCS: LoopA(B) Line Heater Icon (select either icon)

[LoopA(B) Line Heater Commands]

‘Z1 Flex Hose Htr’

sel RPCM Z13B(4B) B RPC 07

RPCM Z13B(4B) B RPC 07

‘RPC Position’

**cmd** – Close

√RPC Position – Cl
This Page Intentionally Blank
1. POWERING OFF LOOP A(B) FLEX HOSE HEATERS

PCS

P6: TCS: LoopA(B) Line Heater Icon (select either icon)

LoopA(B) Line Heater Commands

‘Z1 Flex Hose Htr’

sel RPCM Z13B(4B) B RPC 07

RPCM Z13B(4B) B RPC 07

‘RPC Position’

cmd – Open

√RPC Position – Op
1. **VERIFYING IFHX SOFTWARE CONFIGURATION**

**NOTE**

The IFHX Control Processing is not redundant in the Node1 MDMs. When the Node1 MDMs are in their nominal operational state, N1-1 is in secondary and controls the LTL IFHX Control Processing, and N1-2 is in primary and controls the MTL IFHX Control Processing. When N1-1 has transitioned to primary, the MTL IFHX Control Processing is no longer available, and the LTL IFHX Control Processing must be executed from a different section in the display.

<table>
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<td>LTL(MTL) IFHX Additional Commands</td>
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If verifying the LTL IFHX

- ‘LTL IFHX NH3’
- ‘Secondary NCS’
- √IFHX Cntl Processing – Ena

If verifying the MTL IFHX

- ‘MTL IFHX NH3’
- ‘Primary NCS’
- √IFHX Cntl Processing – Ena

- ‘Isol Vlv’
- √Op Posn Ind Avail – Ena
- √Cl Posn Ind Avail – Ena

- ‘Byp Vlv’
- √Flothru Posn Ind Avail – Ena
- √Byp Posn Ind Avail – Ena
- √Flothu Precond Ck – Ena

- ‘Isol Vlv’
- √Cl Precond Ck – Ena

- ‘LTL(MTL) IFHX’
- √NH3 Faild Precond Ck Rejection Counter: 0

- ‘LoopA(B) PFCS’
- √PmpA Conv Speed: 0 rpm (± 975 rpm)
- √PmpB Conv Speed: 0 rpm (± 975 rpm)
1.201 LAB IFHX ACTIVATION AND CHECKOUT
(TCS/4A - ALL/FIN) Page 2 of 4 pages

sel LTL(MTL) IFHX Commands

<table>
<thead>
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<tr>
<td>√ Byp Vlv Cntl Avail – Ena</td>
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<tr>
<td>√ Undtemp Resp – Ena</td>
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‘Isol Vlv (SDO Card)’

√ RPC Posn – Cl

‘Byp Vlv (SDO Card)’

√ RPC Posn – Cl

‘LTL(MTL) IFHX NH3’

Verify Isol Vlv Open – X
Verify Byp Vlv Byp – X

2. INHIBITING NCS IFHX UNDETEMP FDIR

PCS

LAB: TCS: LTL(MTL) IFHX

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<tr>
<td>cmd Undtemp Resp – Inh</td>
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√ Undtemp Resp – Inh

sel LTL(MTL) IFHX Additional Commands

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<tbody>
<tr>
<td>cmd Byp Vlv Flothru Precond Ck – Inh</td>
<td>Execute</td>
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√ Byp Vlv Flothru Precond Ck – Inh
CAUTION

1. IFHX valve position must be verified before position commands can be issued. If the valve position is indeterminate, driving the valve in the direction opposite of its last direction of motion can potentially result in damage to the valve seal. If the valve position is indeterminate, √MCC-H.

2. Once commanded, if the valve does not reach the commanded position, the operator is allowed to issue the same position command up to three additional times. If the desired position is still not reached, √MCC-H.

3. COMMANDING BYPASS VALVE TO FLOTHRU

PCS
LAB: TCS: LTL(MTL) IFHX
LTL(MTL) IFHX Commands
‘LTL(MTL) IFHX NH3’

If Byp Vlv – Flothru/Byp ≠ blank
   cmd Byp Vlv – Flothru  Execute

   √Byp Vlv Flothru – X

4. COMMANDING BYPASS VALVE TO BYPASS

PCS
LAB: TCS: LTL(MTL) IFHX
LTL(MTL) IFHX Commands
‘LTL(MTL) IFHX NH3’

   cmd Byp Vlv – Byp  Execute

   √Byp Vlv Byp – X

5. REENABLE FLOTHRU PRECONDITION CHECK FDIR SOFTWARE

PCS
LAB: TCS: LTL(MTL) IFHX: LTL(MTL) IFHX Additional Commands
LTL(MTL) IFHX Additional Commands
‘LTL(MTL) IFHX NH3’

   cmd Byp Vlv Flothru Precond Ck – Ena  Execute

   √Byp Vlv Flothru Precond Ck – Ena

6. COMMANDING ISOLATION/RELIEF VALVE TO CLOSE

PCS
LAB: TCS: LTL(MTL) IFHX
LTL(MTL) IFHX Commands
‘LTL(MTL) IFHX NH3’

If Isol Vlv – Open/Close ≠ blank
   cmd Isol Vlv – Close  Execute

   √Isol Vlv Close – X
7. **COMMANDING ISOLATION/RELIEF VALVE TO OPEN**

PCS

<table>
<thead>
<tr>
<th>LAB: TCS: LTL(MTL) IFHX</th>
</tr>
</thead>
<tbody>
<tr>
<td>LTL(MTL) IFHX Commands</td>
</tr>
<tr>
<td>‘LTL(MTL) IFHX NH3’</td>
</tr>
</tbody>
</table>

**cmd** Isol Vlv – Open  **Execute**

√Isol Vlv Open – X

8. **COMMANDING ISOLATION/RELIEF VALVE TO CLOSE**

PCS

<table>
<thead>
<tr>
<th>LAB: TCS: LTL(MTL) IFHX</th>
</tr>
</thead>
<tbody>
<tr>
<td>LTL(MTL) IFHX Commands</td>
</tr>
<tr>
<td>‘LTL(MTL) IFHX NH3’</td>
</tr>
</tbody>
</table>

**cmd** Isol Vlv – Close  **Execute**

√Isol Vlv Close – X
1. PROVIDING POWER TO THERMOSTAT FOR LAB SHELL HEATER 1
PCS LAB: TCS: IATCS Details: LAB Shell Heater Control: Lab Shell Htr1:
RPCM LA2B E RPC 14
RPCM LA2B E RPC 14

**cmd** RPC Position – Close

Verify – CI

2. PROVIDING POWER TO THERMOSTAT FOR LAB SHELL HEATER 2
PCS LAB: TCS: IATCS Details: LAB Shell Heater Control: Lab Shell Htr2:
RPCM LA2B B RPC 12
RPCM LA2B B RPC 12

**cmd** RPC Position – Close

Verify – CI

3. PROVIDING POWER TO THERMOSTAT FOR LAB SHELL HEATER 3
PCS LAB: TCS: IATCS Details: LAB Shell Heater Control: Lab Shell Htr3:
RPCM LA2B B RPC 10
RPCM LA2B B RPC 10

**cmd** RPC Position – Close

Verify – CI

4. PROVIDING POWER TO THERMOSTAT FOR LAB SHELL HEATER 4
PCS LAB: TCS: IATCS Details: LAB Shell Heater Control: Lab Shell Htr4:
RPCM LA1B E RPC 06
RPCM LA1B E RPC 06

**cmd** RPC Position – Close

Verify – CI

5. PROVIDING POWER TO THERMOSTAT FOR LAB SHELL HEATER 5
PCS LAB: TCS: IATCS Details: LAB Shell Heater Control: Lab Shell Htr5:
RPCM LA1B E RPC 07
RPCM LA1B E RPC 07

**cmd** RPC Position – Close

Verify – CI
6. PROVIDING POWER TO THERMOSTAT FOR LAB SHELL HEATER 6

PCS LAB: TCS: IATCS Details: LAB Shell Heater Control: Lab Shell Htr6:
RPCM LA1B H RPC 05
RPCM LA1B H RPC 05

**cmd** RPC Position – Close

Verify – Cl
NOMINAL PROCEDURES
NOTE
1. The PVCU contains an algorithm that automatically performs this check when the FCV position exceeds a user defined tolerance (default of 2 deg). If possible, perform this procedure at the beginning of insolation periods to minimize IFHX freeze protection FDIR actions and radiator freezing.

2. An “X” will appear in all the Line Htr Cntl Inh Arm status fields when any Line Htr Inh command is armed.

1. **INHIBITING LINE HEATER CONTROL**

PCS
P6: TCS: LoopA(B) Line Heater (select either icon)

<table>
<thead>
<tr>
<th>LoopA(B) Line Heater Commands</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘EETCS LoopA(B) PFCS’</td>
</tr>
<tr>
<td>‘Line Htr Cntl’</td>
</tr>
</tbody>
</table>

**cmd Inhibit Htr1/Htr2 – Arm (√ – X)**
**cmd Inhibit Htr1/Htr2 – Inh Htr1/Htr2**

√Line Htr Cntl – Inh
√Inhibited Line Htr – Both

‘Ln Htr1’

√RPC Posn – Op

‘Ln Htr2’

√RPC Posn – Op

2. **INHIBITING ALGORITHMS IN THE BACKUP MDM**

PCS
P6: TCS: LoopA(B) PFCS: LoopA(B) Bkup PVCU Commands

<table>
<thead>
<tr>
<th>LoopA(B) Bkup PVCU Commands</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘Bkup PVCU EETCS LoopA(B)’</td>
</tr>
<tr>
<td>‘PFCS FCV Cntl’</td>
</tr>
</tbody>
</table>

**cmd Inhibit – Arm**
**cmd Inhibit – Inh**

√PFCS FCV Cntl – Inh

‘PFCS Ln Htr Cntl’

**cmd Inhibit Htr1/Htr2 – Arm**
**cmd Inhibit Htr1/Htr2 – Inh**

√PFCS Ln Htr Cntl – Inh
3. **INHIBITING FCV CONTROL SOFTWARE ALGORITHM**

PCS

P6: TCS: LoopA(B) PFCS

LoopA(B) PFCS Nominal Commands

‘EETCS LoopA(B) PFCS’

---

**CAUTION**

When FCV Control is inhibited, the EETCS loop temperature setpoint will no longer be controlled. The Lab IATCS may overheat in 1.5 hours while in dual loop mode. This procedure should be expedited to prevent overheating IATCS equipment.

‘FCV Cntl’

**cmd** Inhibit – Arm (√ – X)

**cmd** Inhibit – Inh

√FCV Cntl – Inh

4. **RESETTING THE FCV POSITION**

PCS

P6: TCS: LoopA(B) PFCS

LoopA(B) PFCS Nominal Commands

‘EETCS LoopA(B) PFCS’

Record current FCV Posn: ______ Deg

---

**NOTE**

A Normalized position is calculated by dividing the current FCV position reading in angular degrees by 90 degrees, which is the nominal range of motion for the valve. The operator can use up to three significant digits to express the FCV Normalized Position.

Calculate FCV Normalized Position: ______ \((\text{FCV Posn})/(90^\circ)\)

input FCV Set Init Posn – FCV Normalized Position

**cmd** FCV Set Init Posn – Set

5. **ENABLING FCV CONTROL SOFTWARE ALGORITHM**

PCS

P6: TCS: LoopA(B) PFCS

LoopA(B) PFCS Nominal Commands

‘EETCS LoopA(B) PFCS’

---

**NOTE**

The FCV position has now been manually reset. Once FCV Control is enabled in the primary PVCU MDM, loop temperature control begins and heat transfer across the IFHX is reestablished. The FCV must be in the Full Bypass position prior to enabling FCV Control.
input FCV Posn: 0.0 (0 – Full Bypass position)

**cmd** Set

√FCV Posn: 0 ± 5.3 Deg

‘FCV Cntl’

**cmd** Enable – Arm (√ – X)
**cmd** Enable – Ena

√FCV Cntl – Ena

### 6. ENABLING LINE HEATER CONTROL

**PCS**

P6: TCS: LoopA(B) Line Heater (select either icon)

- LoopA(B) Line Heater Commands
- ‘EETCS LoopA(B) PFCS’
- ‘Line Htr Cntl’

**cmd** Enable – Arm (√ – X)
**cmd** Enable – Ena

**NOTE**
When Line Heater Control is enabled, ignore the Inhibited Line Heater telemetry field. It does not update based on the Line Htr Cntl Ena command.

√Line Htr Cntl – Ena

### 7. ENABLING ALGORITHMS IN THE BACKUP MDM

**PCS**

P6: TCS: LoopA(B) PFCS: LoopA(B) Bkup PVCU Commands

- LoopA(B) Bkup PVCU Commands
- ‘Bkup PVCU EETCS LoopA(B)’
- ‘PFCS FCV Cntl’

**cmd** Enable – Arm
**cmd** Enable – Ena

√PFCS FCV Cntl – Ena

‘PFCS Ln Htr Cntl’

**cmd** Enable – Arm
**cmd** Enable – Ena

√PFCS Ln Htr Cntl – Ena
1. **INHIBITING FCV CONTROL ALGORITHMS**

PCS P6: TCS: LoopA PFCS

LoopA PFCS Nominal Commands

‘EETCS LoopA PFCS’

---

**CAUTION**

When FCV Control is inhibited, the EETCS loop temperature setpoint will no longer be controlled. Placing the FCV in the Full Bypass position prevents most heat exchange. The Lab IATCS may overheat in 1.5 hours. This procedure should be expedited to prevent overheating IATCS equipment.

‘FCV Cntl’

**cmd** Inhibit – Arm (✓ – X)

**cmd** Inhibit – Inh

✓FCV Cntl – Inh

input FCV Posn: 0.0 (0.0 = 0 Deg – Full Bypass position)

**cmd** Set

✓FCV Posn: 0 ± 5.3 Deg (Full Bypass position)

sel LoopA Bkup PVCU Commands

---

LoopA Bkup PVCU Commands

‘Bkup PVCU EETCS LoopA’

‘PFCS FCV Cntl’

**cmd** Inhibit – Arm

**cmd** Inhibit – Inh

✓PFCS FCV Cntl – Inh

2. **SELECTING THE APPROPRIATE TEMPERATURE SENSOR FOR LOOP CONTROL**

PCS P6: TCS: LoopA PFCS: LoopA PFCS Nominal Additional Commands

LoopA PFCS Nominal Additional Commands

‘EETCS LoopA PFCS’

‘Sel Out Temp1(2)(Temp1/Temp2) Cntl’

**cmd** Temp1(2)(Temp1/Temp2) Cntl
3. RECONFIGURING FCV CONTROL ALGORITHM

PCS

P6: TCS: LoopA PFCS

LoopA PFCS Nominal Commands
‘EETCS LoopA PFCS’
‘FCV Cntl’

**cmd** Enable – Arm (√ – X)

**cmd** Enable – Ena

√FCV Cntl – Ena

**NOTE**
Once FCV Control is enabled in the primary PVCU MDM, loop temperature control begins and heat transfer across the IFHX is reestablished.

sel LoopA Bkup PVCU Commands

LoopA Bkup PVCU Commands
‘Bkup PVCU EETCS LoopA’
‘PFCS FCV Cntl’

**cmd** Enable – Arm

**cmd** Enable – Ena

√PFCS FCV Cntl – Ena
1. **CONFIGURING LINE HEATER CONTROL ALGORITHM**

   **NOTE**
   An “X” will appear in all the Line Htr Cntl Inh Arm status fields when any Line Htr Inh command is armed.

   **PCS**
   P6: TCS: LoopA(B) Line Heater (select either heater icon)
   ‘EETCS LoopA(B) PFCS’
   ‘Line Htr Cntl’

   **cmd** Inhibit Htr1/Htr2 – Arm (√ – X)
   **cmd** Inhibit Htr1/Htr2 – Inh Htr1/Htr2

   √/Line Htr Cntl – Inh
   √/Inhibited Line Htr – Both
   √/Line Htr Cmd Ck – Ena

   **CAUTION**
   RPCs associated with LoopA(B) Line Heaters must be opened prior to PFCS pump shutdown on the affected loop. Deactivating the Line Heaters eliminates the risk of plumbing insulation overheating/breakdown and/or localized NH3 boiling in the affected loops with stagnant conditions.

   ‘Ln Htr1’

   √RPC Posn – Op
   ‘Ln Htr2’

   √RPC Posn – Op

   sel LoopA(B) Bkup PVCU Commands

   **LoopA(B) Bkup PVCU Commands**
   ‘Bkup PVCU EETCS LoopA(B)’
   ‘PFCS FCV Cntl’

   **cmd** Inhibit – Arm
   **cmd** Inhibit – Inh

   √PFCS FCV Cntl – Inh

   ‘PFCS Ln Htr Cntl’

   **cmd** Inhibit Htr1/Htr2 – Arm
   **cmd** Inhibit Htr1/Htr2 – Inh

   √PFCS Ln Htr Cntl – Inh
2.104 EETCS LOOPA(B) PFCS PUMP SWITTOVER - MANUAL
(TCS/4A - ALL/FIN) Page 2 of 5 pages

2. COMMANDING PUMP [X] OFF AND VERIFYING OFF

<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>When FCV Control is inhibited, the EETCS loop temperature setpoint will no longer be controlled. Placing the FCV in the Full Bypass position prevents most heat exchange. The Lab ITCS may overheat in 1.5 hours. This procedure should be expedited to prevent overheating ITCS equipment.</td>
</tr>
</tbody>
</table>

PCS P6: TCS: LoopA(B) PFCS

LoopA(B) PFCS Nominal Commands

‘EETCS LoopA(B) PFCS’
‘FCV Cntl’

**cmd** Inhibit – Arm (√ – X)

**cmd** Inhibit – Inh

√FCV Cntl – Inh

input FCV Position: 0.0 (0.0 = normalized angle for Full Bypass flow)

**cmd** Set

√FCV Posn: 0 ± 5.3 Deg (Full Bypass flow position)

<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal analysis (performed using warm conditions and environment) indicates that the PFCS cannot remain powered for longer than 30 minutes without a pump running.</td>
</tr>
</tbody>
</table>

√MCC-H for additional capabilities

**cmd** Pump [X] – Off (where [X] = A or B, whichever pump is active)

√Pump [X] – Off

Verify Pump [X] Spd: 0 ± 975 rpm

Record Pump [X] Off: ______ / ______:______:______ GMT
3. COMMANDING PUMP [Y] ON AND VERIFYING ON

PCS

EETCS Startup Pressure vs Temperature

Start up Pressure: __________ kPa

Verify the following parameters are within range:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Lower Limit</th>
<th>Upper Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>In Press</td>
<td>Startup Pressure</td>
<td>1,800 kPa</td>
</tr>
<tr>
<td>Out Fltrd Lwr Temp</td>
<td>-42.8° C</td>
<td>10° C</td>
</tr>
</tbody>
</table>

**********************************************************************
If In Press or Out Fltrd Lwr Temp are out of range, \( \sqrt{MCC-H} \).
**********************************************************************
LoopA(B) PFCS Nominal Commands

‘EETCS LoopA(B) PFCS’

cmd Pump [Y] – On  where [Y] = B(A), whichever pump was not active at the start of executing this procedure

√Pump [Y] – On

Record Pump [Y] On: _____ /_____:_____:_____ GMT

P6: TCS

‘EETCS Overview’

Verify the following parameters read within the specified ranges. Allow 60 seconds for parameters to reach nominal values.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Lower Limit</th>
<th>Upper Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accum Fltrd Avg Qty</td>
<td>36.1 %</td>
<td>68.9 %</td>
</tr>
<tr>
<td>Flow Rate</td>
<td>772 kg/hr</td>
<td>1,100 kg/hr</td>
</tr>
<tr>
<td>Pump [Y] Spd</td>
<td>12605 rpm</td>
<td>14555 rpm</td>
</tr>
</tbody>
</table>

4. RECONFIGURING LINE HEATER CONTROL ALGORITHM

‘EETCS LoopA(B) PFCS’

‘Line Htr Cntl’

cmd Enable – Arm (√ – X)

cmd Enable – Ena

√Line Htr Cntl – Ena

√Line Htr Cmd Ck – Ena

sel LoopA(B) PFCS Nominal Commands

‘FCV Cntl’

cmd Enable – Arm (√ – X)

cmd Enable – Ena
√FCV Cntl – Ena

sel LoopA(B) Bkup PVCU Commands

[LoopA(B) Bkup PVCU Commands]
‘Bkup PVCU EETCS LoopA(B)’
‘PFCS FCV Cntl’

**cmd** Enable – Arm
**cmd** Enable – Ena

√PFCS FCV Cntl – Ena

‘PFCS Ln Htr Cntl’

**cmd** Enable – Arm
**cmd** Enable – Ena

√PFCS Ln Htr Cntl – Ena
If executing prior to Lab activation, do not perform step 1.

1. **HEAT LOAD REDUCTION AND RECONFIGURATION**
   Perform [4.214 LAB MANUAL HEAT LOAD REDUCTION AND RECONFIGURATION], all (SODF: TCS: CORRECTIVE: IATCS), then:

2. **CONFIGURING LINE HEATER CONTROL ALGORITHM**
   PCS P6: TCS: LoopA(B) Line Heater (select either heater icon)
   [LoopA(B) Line Heater Commands]
   ‘EETCS LoopA(B) PFCS’
   ‘Line Htr Cntl’

   **NOTE**
   An “X” will appear in all the Line Htr Cntl Inh Arm status fields when any Line Htr Inh command is armed.

   **cmd** Inhibit Htr1/Htr2 – Arm (√ – X)
   **cmd** Inhibit Htr1/Htr2 – Inh Htr1/Htr2

   √Line Htr Cntl – Inh
   √Inhibited Line Htr – Both
   √Line Htr Cmd Ck – Ena

   **CAUTION**
   RPCs associated with LoopA(B) Line Heaters must be opened prior to PFCS pump shutdown on the affected loop. Deactivating the Line Heaters eliminates the risk of plumbing insulation overheating/breakdown and/or localized NH3 boiling in the affected loops with stagnant conditions.

   ‘Ln Htr1’
   √RPC Posn – Op

   ‘Ln Htr2’
   √RPC Posn – Op

   sel LoopA(B) Bkup PVCU Commands

   [LoopA(B) Bkup PVCU Commands]
   ‘Bkup PVCU EETCS LoopA(B)’
   ‘PFCS FCV Cntl’

   **cmd** Inhibit – Arm
   **cmd** Inhibit – Inh

   √PFCS FCV Cntl – Inh
‘PFCS Ln Htr Cntl’

**cmd** Inhibit Htr1/Htr2 – Arm

**cmd** Inhibit Htr1/Htr2 – Inh

√PFCS Ln Htr Cntl – Inh

### 3. POWERING OFF LOOP A(B) PUMPS

**PCS**

P6: TCS: Loop A(B) PFCS

| Loop A(B) PFCS Nominal Commands
| ---
| ‘EETCS Loop A(B) PFCS’
| ‘FCV Cntl’

**cmd** Inhibit – Arm (√ – X)

**cmd** Inhibit – Inh

√FCV Cntl – Inh

input FCV Posn: 0.0 (0.0 – Full Bypass position)

**cmd** Set

√FCV Posn: 0 ± 5.3 Deg (Full Bypass flow)

**NOTE**

Only the active pump needs to be commanded off. The active pump is defined as the pump with a speed > 12000 rpm.

**CAUTION**

Thermal analysis (performed using warm conditions and environment) indicates that the PFCS cannot remain powered for longer than 30 minutes without a pump running.

√**MCC-H** for additional capabilities

**cmd** Pump [X] – Off where [X] = A(B), whichever pump is active

√Pump A,B – Off

Verify Pump A,B Spd: 0 ± 975 rpm

Record Pump [X] Off: _____ / _____:____:_____ GMT (where [X] = A(B), whichever pump was commanded off)
4. **INHIBITING THE EETCS PFCS RT FDIR**

PCS

P6: C&DH: Primary PVCU MDM (select the MDM identified as primary)

| Primary PVCU MDM |

 sel UB PVB 24-1(2): RT Status

<table>
<thead>
<tr>
<th>UB PVB 24 1(2) RT Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘09 PFCS 4B(2B) (SPA)’</td>
</tr>
<tr>
<td>‘RT FDIR Status’</td>
</tr>
</tbody>
</table>

**cmd** Inhibit FDIR

**cmd** Inhibit FDIR **Execute**

√RT FDIR Status – Inh

5. **POWERING OFF LOOPA(B) PFCS**

PCS

P6: TCS: LoopA(B) PFCS: RPCM 4B(2B) A RPC 04

| RPCM 4B(2B) A RPC 04 |

**CAUTION**

| 1. The following Warning messages may be generated when the PFCS is turned off: |
| ‘EEATCS LoopA(B) PFCS Loss of Comm - P6’ |
| ‘EEATCS LoopA(B) PFCS ORU Failure - P6’ |

| 2. All EETCS LoopA(B) data (except the EETCS LoopA(B) Out Line Fltrd Temp) are invalid after powering off the PFCS. |

**cmd** RPC Position – Open

√RPC Position – Op

P6: TCS

**P6: EETCS Overview**

‘EETCS PFCS Loop A(B)’

Verify Integ Counter – <not incrementing>
This Page Intentionally Blank
1. INHIBITING FCV CONTROL ALGORITHMS

CAUTION

When FCV Control is inhibited, the EETCS loop temperature setpoint will no longer be controlled. Placing the FCV in the Full Bypass position prevents most heat exchange. The Lab IATCS may overheat in 1.5 hours. This procedure should be expedited to prevent overheating IATCS equipment.

‘FCV Cntl’

`cmd` Inhibit – Arm (✓ − X)

`cmd` Inhibit – Inh

√FCV Cntl – Inh

input FCV Posn: 0.0 (0.0 = 0 Deg – Full Bypass)

`cmd` Set

√FCV Posn: 0 ± 5.3 Deg (Full Bypass flow position)

sel LoopB Bkup PVCU Commands

2. SELECTING THE APPROPRIATE TEMPERATURE SENSOR FOR LOOP CONTROL

CAUTION

When FCV Control is inhibited, the EETCS loop temperature setpoint will no longer be controlled. Placing the FCV in the Full Bypass position prevents most heat exchange. The Lab IATCS may overheat in 1.5 hours. This procedure should be expedited to prevent overheating IATCS equipment.

‘FCV Cntl’

`cmd` Inhibit – Arm (✓ − X)

`cmd` Inhibit – Inh

√FCV Cntl – Inh

input FCV Posn: 0.0 (0.0 = 0 Deg – Full Bypass)

`cmd` Set

√FCV Posn: 0 ± 5.3 Deg (Full Bypass flow position)

sel LoopB Bkup PVCU Commands

Bkup PVCU EETCS LoopB

‘PFCS FCV Cntl’

`cmd` Inhibit – Arm

`cmd` Inhibit – Inh

√PFCS FCV Cntl – Inh

2. SELECTING THE APPROPRIATE TEMPERATURE SENSOR FOR LOOP CONTROL

PCS

P6: TCS: LoopB PFCS: LoopB PFCS Nominal Additional Commands

`cmd` Temp 1(2)(Temp 1/Temp 2) Cntl
3. RECONFIGURING FCV CONTROL ALGORITHM

PCS P6: TCS: LoopB PFCS
LoopB PFCS Nominal Commands
‘EETCS LoopB PFCS’
‘FCV Cntl’

\textbf{cmd} Enable – Arm (√ – X)
\textbf{cmd} Enable – Ena

√FCV Cntl – Ena

\begin{center}
\textbf{NOTE}
Once FCV Control is enabled in the primary PVCU MDM, loop temperature control begins and heat transfer across the IFHX is reestablished.
\end{center}

sel LoopB Bkup PVCU Commands

LoopB Bkup PVCU Commands
‘Bkup PVCU EETCS LoopB’
‘PFCS FCV Cntl’

\textbf{cmd} Enable – Arm
\textbf{cmd} Enable – Ena

√PFCS FCV Cntl – Ena
1. **CONFIRMING RADIATOR IS READY FOR DEPLOYMENT**

**WARNING**

If deployment takes place during an EVA, ensure no EVA activities are being held within 3 meters of the radiator to avoid potential injury to EVA crew member.

**CAUTION**

Pressure in both loops should be less than 1,724 kPa in order to avoid damaging the radiator during deployment.

PCS

P6: TCS

P6: EETCS Overview

‘EETCS PFCS Loop A(B)’

Verify Out Press < 1,724 kPa

2. **VERIFYING RADIATOR ALGORITHM STATUS**

PCS

P6: TCS: TTCR(STCR)

TTCR(STCR) Commands

‘EETCS Loop A(B) TTCR(STCR)’

√ Config Fail FDIR – Ena
√ Auto Time Out FDIR – Ena

‘Auto Off’

**cmd** Inhibit – Arm (√ – X)
**cmd** Inhibit – Inh

√ Auto Off – Inh

3. **MOTOR POWER-ON, STATUS VERIFICATION AND ACCUMULATOR READINGS**

PCS

P6: TCS: TTCR(STCR)

TTCR(STCR) Commands

‘EETCS Loop A(B) TTCR(STCR)’

**cmd** Motor Power On – Arm (√ – X)
**cmd** Motor Power On – On

Verify Motor Power Cmd Stat – On
Verify Deployed – <blank>
Verify Retracted – X
Verify Overcurrent Trip – <blank>

‘EETCS LoopA TTCR(STCR)’

Record Accum Qty: _____ % (lower section of display)
2.107 EETCS RADIATOR DEPLOY
(TCS/4A - ALL/FIN) Page 2 of 5 pages

‘EETCS LoopB TT(CR(STCR)’

Record Accum Qty: _____% (lower section of display)

P6: TCS: Loop A PFCS
   [LoopA PFCS Nominal Commands]
   ‘EETCS Loop A PFCS’ (midsection of display)

Record Accum Qty 1: _____%

Record Accum Qty 2: _____%

P6: TCS: Loop B PFCS
   [LoopB PFCS Nominal Commands]
   ‘EETCS Loop B PFCS’ (midsection of display)

Record Accum Qty 1: _____%

Record Accum Qty 2: _____%

CAUTION
Station should be placed in free drift in order to avoid damaging the radiator during deployment.

4. CONFIGURING STATION TO FREE DRIFT
Perform as appropriate.

Either perform {HANDOVER ATTITUDE CONTROL RS THRUSTERS TO ORBITER}, steps 2, 3 (SODF: JNT OPS: MATED OPERATIONS), then:

or

C3(A6) DAP: FREE
Orbiter ⇒ ISS, MCC-H, “Orbiter is in Free Drift.”
### 5. STARTING RADIATOR DEPLOYMENT AND MONITOR STATUS

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The Auto-off function is inhibited because the deploy motor needs to run for one additional minute after the Deploy Indicator becomes active in order to ensure the cables are at the proper tension.</td>
</tr>
<tr>
<td>2. The Auto Time Out FDIR resides in the firmware controller and protects the drive motor from continued operation after a loss of communication with the PVCA or the PVCA fails to command the motor off. The Auto Time Out FDIR will command the motor to stop, power it off, and set the Timeout Indicator after 13 minutes if deploy conditions are not met.</td>
</tr>
<tr>
<td>3. The Config Fail FDIR resides in the PVCU and will command the motor to stop after 15 minutes if deploy conditions are not met.</td>
</tr>
<tr>
<td>4. Accumulator quantity sensor data may fluctuate due to radiator motion.</td>
</tr>
</tbody>
</table>

Crew should set an event timer upon execution of the deploy command and when the Deploy Indicator becomes active.

```
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
If one of the following parameters becomes true
  Trip Ind
  Overcurrent Trip
  Timeout Ind

* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
```

**PCS P6: TCS: TTCR(STCR)**

**TTCR(STCR) Commands**

‘EETCS Loop A(B) TTCR(STCR)’

- `cmd Deploy – Arm (√ – X)`
- `cmd Deploy – Deploy`

Start event timer and record time: GMT ______ /________________.
Monitor and verify the following parameters during operation.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Stowed</th>
<th>Transition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drive Stat</td>
<td>Stop</td>
<td>Run</td>
</tr>
<tr>
<td>Motor Power Cmd Stat</td>
<td>On</td>
<td>On</td>
</tr>
<tr>
<td>Deployed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Retracted</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Trip Ind</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overcurrent Trip</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Timeout Ind</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Record time when Deployed Indicator transitions to “X”:
GMT ___/________________.

After the Deployed Indicator has been set to “X” for 60 seconds, send the following commands
‘Drive Stat’

\[ \text{cmd} \text{ Stop} – \text{Arm (} \checkmark – \text{X}) \]
\[ \text{cmd} \text{ Stop} \]
\[ \checkmark \text{Drive Stat} – \text{Stop} \]

‘Motor Power’

\[ \text{cmd} \text{ Off} – \text{Arm (} \checkmark – \text{X}) \]
\[ \text{cmd} \text{ Off} – \text{Off} \]
\[ \checkmark \text{Motor Power Cmd Stat} – \text{Off} \]

**NOTE**
The ISS should be transitioned back to active attitude control after the radiator motor has been turned off.

### 6. RESUMING ATTITUDE CONTROL
Perform as appropriate.

Either perform *(HANDOVER ATTITUDE CONTROL ORBITER TO RS THRUSTERS)*, steps 2, 4, 5 (SODF: JNT OPS: MATED OPERATIONS), then:

or

C3(A6) DAP: INRTL

When rates are damped
DAP: AUTO
7. CONCLUDING RADIATOR OPERATIONS

PCS

P6: TCS: TTCR(STCR)

TTCR(STCR) Commands

‘EETCS LoopA TTCR(STCR)’

Record Accum Qty: _____% (lower section of display)

‘EETCS LoopB TTCR(STCR)’

Record Accum Qty: _____% (lower section of display)

‘Auto Off’

\textbf{cmd} Enable – Arm (√ – X)

\textbf{cmd} Enable – Ena

√Auto Off – Ena

P6: TCS: Loop A PFCS

LoopA PFCS Nominal Commands

‘EETCS Loop A PFCS’ (midsection of display)

Record Accum Qty 1: _____%

Record Accum Qty 2: _____%

P6: TCS: Loop B PFCS

LoopB PFCS Nominal Commands

‘EETCS Loop B PFCS’ (midsection of display)

Record Accum Qty 1: _____%

Record Accum Qty 2: _____%

Notify \textbf{MCC-H} that procedure is complete.
NOTE

1. In order for the retract algorithm to function, this procedure transitions the PVCA channel mode to Fully Commanded (FC). This mode does not allow certain EPS and TCS control algorithms to operate autonomously as they do in the other channel modes. Operators should ensure that this procedure has been coordinated with all MCC-H positions and with MCC-M.

2. Temperature control of the associated EETCS loop will be lost when the PVCA channel is transitioned to FC mode. Operators should ensure that internal and external thermal control loops have been configured to accommodate this operation.

1. CONFRMING RADIATOR IS READY FOR RETRACT

WARNING
If retraction takes place during an EVA, ensure no EVA activities are being held within 3 meters of the radiator to avoid potential injury to EVA crewmember.

CAUTION
Pressure in both loops should be less than 1724 kPa in order to avoid damaging the radiator during retraction.

PCS

P6: TCS
P6: EETCS Overview
‘EETCS PFCS Loop A(B)’

Verify Out Press < 1724 kPa

2. VERIFYING RADIATOR ALGORITHM STATUS

PCS

P6: TCS: TTCR(STCR)
TTCR(STCR) Commands
‘EETCS Loop A(B) TTCR(STCR)’

√ Config Fail FDIR – Ena
√ Auto Time Out FDIR – Ena
√ Auto Off – Ena

3. MOTOR POWER-ON, STATUS VERIFICATION, AND ACCUMULATOR READINGS

PCS

P6: TCS: TTCR(STCR)
TTCR(STCR) Commands
‘EETCS Loop A(B) TTCR(STCR)’

cmd Motor Power On – Arm (√ – X)
cmd Motor Power On – On
Verify Motor Power Cmd Stat – On
Verify Deployed – X
Verify Retracted – <blank>
Verify Overcurrent Trip – <blank>

‘EETCS LoopA TTCR(STCR)’ (lower section of display)

Record Accum Qty: _____%

‘EETCS LoopB TTCR(STCR)’ (lower section of display)

Record Accum Qty: _____%

P6: TCS: Loop A PFCS

LoopA PFCS Nominal Commands
‘EETCS Loop A PFCS’ (midsection of display)

Record Accum Qty 1: _____%

Record Accum Qty 2: _____%

P6: TCS: Loop B PFCS

LoopB PFCS Nominal Commands
‘EETCS Loop B PFCS’ (midsection of display)

Record Accum Qty 1: _____%

Record Accum Qty 2: _____%

4. TRANSITIONING PSN TO FULLY COMMANDED MODE

NOTE
Mode transition should be performed for the power channel which is associated with the radiator being transitioned. The Trailing Thermal Control Radiator (TTCR) is controlled by the Loop A PFCS which is associated with power channel 4B. The Starboard Thermal Control Radiator (STCR) is controlled by the Loop B PFCS which is associated with power channel 2B.

Perform {PVCA POWER SOURCE NODE TRANSITION TO FULLY COMMANDED MODE}, all (SODF: TBD), then:

CAUTION
Station should be placed in free drift in order to avoid damaging the radiator during retraction.

5. CONFIGURING STATION TO FREE DRIFT
Perform as appropriate.
Either perform \{HANDOVER ATTITUDE CONTROL RS THRUSTERS TO ORBITER\}, steps 2, 3 (SODF: JNT OPS: MATED OPS), then:

or

C3(A6) DAP: FREE
Orbiter $\Rightarrow$ ISS, MCC-H, “Orbiter is in Free Drift.”

6. STARTING RADIATOR RETRACTION AND MONITOR STATUS

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Auto-off function should automatically shutdown drive motor after full retraction if conditions are nominal.</td>
</tr>
<tr>
<td>2. The Auto Time Out FDIR resides in the firmware controller and protects the drive motor from continued operation after a loss of communication with the PVCA or the PVCA fails to command the motor off. The Auto Time Out FDIR will command the motor to stop, power it off, and set the Timeout Indicator after 13 minutes if the retract conditions are not met.</td>
</tr>
<tr>
<td>3. The Config Fail FDIR function resides in the PVCU and will command the motor to stop after 15 minutes if retract conditions are not met.</td>
</tr>
<tr>
<td>4. Accumulator quantity sensor data may fluctuate due to the radiator motion.</td>
</tr>
</tbody>
</table>

Crew should set an event timer upon execution of the retract command.

***********************************************************************
If one of the following parameters becomes true
Trip Ind
Overcurrent Trip
Timeout Ind
Perform \{3.109  EETCS RADIATOR DEPLOY/RETRACT FAILURE\}, all (SODF: TCS: MALFUNCTION: EETCS).
***********************************************************************

PCS P6: TCS: TTCR(STCR)

TTCR(STCR) Commands
‘EETCS Loop A(B) TTCR(STCR)’
‘Drive Stat’

**cmd** Retract – Arm (√ – X)
**cmd** Retract – Retract

Start event timer and record time: GMT ___/_____________.
Monitor and verify the following parameters during operation.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Deployed</th>
<th>Transition</th>
<th>Retracted (after 10 minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drive Stat</td>
<td>Stop</td>
<td>Run</td>
<td>Stop</td>
</tr>
<tr>
<td>Motor Power Cmd</td>
<td>On</td>
<td>On</td>
<td>Off</td>
</tr>
<tr>
<td>Deployed</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Retracted</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Trip Ind</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overcurrent Trip</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Timeout Ind</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Record time when either Drive Stat transitions to ‘Stop’ or Motor Power Cmd Stat transitions to ‘Off’: GMT ____/______________.

NOTE
The ISS should be transitioned back to active attitude control when either the Drive Stat transitions to ‘Stop’ or the Motor Power Cmd Stat transitions to ‘Off’.

7. RESUMING ATTITUDE CONTROL
Perform as appropriate.

Either perform [HANDOVER ATTITUDE CONTROL ORBITER TO RS THRUSTERS], steps 2, 4, 5 (SODF: JNT OPS: MATED OPS), then:

or

C3(A6)  DAP: INRTL

When rates are damped
  DAP: AUTO

8. COMPLETING RADIATOR OPERATIONS

PCS
P6: TCS: TTCR(STCR)

TTCR(STCR) Commands
  ‘EETCS LoopA TTCR(STCR)’

Record Accum Qty: _____% (lower section of display)

  ‘EETCS LoopB TTCR(STCR)’

Record Accum Qty: _____% (lower section of display)

P6: TCS: Loop A PFCS

[LoopA PFCS Nominal Commands]
  ‘EETCS Loop A PFCS’ (midsection of display)
2.108  EETCS RADIATOR RETRACT
(TCS/4A - ALL/FIN)  Page 5 of 5 pages

Record Accum Qty 1: _____%

Record Accum Qty 2: _____%

P6: TCS: Loop B PFCS

LoopB PFCS Nominal Commands
‘EETCS Loop B PFCS’ (midsection of display)

Record Accum Qty 1: _____%

Record Accum Qty 2: _____%

9.  RETURNING PSN TO NON-SOLAR TRACKING MODE

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mode transition should be performed for the power channel which is associated with the radiator being transitioned. The TTCR is controlled by the Loop A PFCS which is associated with power channel 4B. The STCR is controlled by the Loop B PFCS which is associated with power channel 2B.</td>
</tr>
</tbody>
</table>

Perform (PVCA POWER SOURCE NODE TRANSITION TO NON-SOLAR TRACKING MODE), all (SODF: TBD), then:

Notify MCC that procedure is completed.
NOTE
This procedure configures the EETCS after a PVCU transition. It assumes that all closed loop control and FDIR algorithms are in their default states. Commands are sent only to those algorithms that need their state changed. This procedure also assumes that any critical EETCS PPLs have been loaded into the PVCU EEPROM.

Perform only those steps referenced in the appropriate PVCU MDM STATE TRANSITION procedure.

1. CONFIGURING EETCS LOOP A CLOSED LOOP CONTROL AND FDIR ALGORITHMS IN THE BACKUP PVCU MDM

PCS
P6: TCS: Loop A PFCS: Loop A Bkup PVCU Commands

Loop A Bkup PVCU Commands
‘Bkup PVCU EETCS Loop A’
‘PFCS FCV Cntl’

**cmd** Enable – Arm
**cmd** Enable – Ena

√PFCS FCV Cntl – Ena
√PFCS Pmp Deadhead FDIR – Ena
√PFCS Pump Switch FDIR – Ena
√PFCS Min Out Temp FDIR – Ena

‘PFCS Ln Htr Cntl’

**cmd** Enable – Arm
**cmd** Enable – Ena

√PFCS Ln Htr Cntl – Ena
√PFCS Ln Htr Cmd Ck – Ena
√PFCS Inval Data FDIR – Ena

sel LoopA Bkup PVCU Additional Commands

LoopA Bkup PVCU Additional Commands
‘Bkup PVCU EETCS Loop A’

√Invalid Data/Max Ln Temp FDIR – Inh
√PFCS Auto FCV Recal – Inh
√PFCS FCV Temp Recal FDIR – Inh

‘PFCS Max Out Temp FDIR’

**cmd** Enable – Arm
**cmd** Enable – Ena
2.109 EETCS RECONFIGURATION FOLLOWING PVCU TRANSITION
(TCS/4A - ALL/FIN) Page 2 of 5 pages

√PFCS Max Out Temp FDIR – Ena
√PFCS Min In Temp FDIR – Ena
√PFCS TTCR Config Fail FDIR – Ena

2. CONFIGURING EETCS LOOP B CLOSED LOOP CONTROL AND FDIR ALGORITHMS IN THE BACKUP PVCU MDM

PCS P6: TCS: Loop B PFCS: Loop B Bkup PVCU Commands

<table>
<thead>
<tr>
<th>Loop B Bkup PVCU Commands</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘Bkup PVCU EETCS Loop B’</td>
</tr>
<tr>
<td>‘PFCS FCV Cntl’</td>
</tr>
<tr>
<td>cmd Enable – Arm</td>
</tr>
<tr>
<td>cmd Enable – Ena</td>
</tr>
<tr>
<td>√PFCS FCV Cntl – Ena</td>
</tr>
<tr>
<td>√PFCS Pmp Deadhead FDIR – Ena</td>
</tr>
<tr>
<td>√PFCS Pump Switch FDIR – Ena</td>
</tr>
<tr>
<td>√PFCS Min Out Temp FDIR – Ena</td>
</tr>
</tbody>
</table>

| ‘PFCS Ln Htr Cntl’ |
| cmd Enable – Arm |
| cmd Enable – Ena |
|√PFCS Ln Htr Cntl – Ena |
|√PFCS Ln Htr Cmd Ck – Ena |
|√PFCS Inval Data FDIR – Ena |

<table>
<thead>
<tr>
<th>sel LoopB Bkup PVCU Additional Commands</th>
</tr>
</thead>
<tbody>
<tr>
<td>LoopB Bkup PVCU Additional Commands</td>
</tr>
<tr>
<td>‘Bkup PVCU EETCS Loop B’</td>
</tr>
<tr>
<td>√Invalid Data/Max Ln Temp FDIR – Inh</td>
</tr>
<tr>
<td>√PFCS Auto FCV Recal – Inh</td>
</tr>
<tr>
<td>√PFCS FCV Temp Recal FDIR – Inh</td>
</tr>
</tbody>
</table>

| ‘PFCS Max Out Temp FDIR’ |
| cmd Enable – Arm |
| cmd Enable – Ena |
|√PFCS Max Out Temp FDIR – Ena |
|√PFCS Min In Temp FDIR – Ena |
|√PFCS STCR Config Fail FDIR – Ena |
3. **CONFIGURING EETCS FCV FOR PVCU MDM SWITCHOVER**

PCS P6: TCS: Loop A PFCS: Loop A Bkup PVCU Commands

<table>
<thead>
<tr>
<th>Loop A Bkup PVCU Commands</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘Bkup PVCU EETCS Loop A’</td>
</tr>
<tr>
<td>‘PFCS FCV Cntl’</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>cmd</th>
<th>Inhibit – Arm</th>
</tr>
</thead>
<tbody>
<tr>
<td>cmd</td>
<td>Inhibit – Inh</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>√PFCS FCV Cntl – Inh</th>
</tr>
</thead>
</table>

PCS P6: TCS: Loop B PFCS: Loop B Bkup PVCU Commands

<table>
<thead>
<tr>
<th>Loop B Bkup PVCU Commands</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘Bkup PVCU EETCS Loop B’</td>
</tr>
<tr>
<td>‘PFCS FCV Cntl’</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>cmd</th>
<th>Inhibit – Arm</th>
</tr>
</thead>
<tbody>
<tr>
<td>cmd</td>
<td>Inhibit – Inh</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>√PFCS FCV Cntl – Inh</th>
</tr>
</thead>
</table>

PCS P6: TCS: Loop A PFCS

<table>
<thead>
<tr>
<th>Loop A PFCS Nominal Commands</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘EETCS Loop A PFCS’</td>
</tr>
</tbody>
</table>

**NOTE**

When FCV Control is inhibited in the Primary PVCU MDM and the FCV commanded to 0 Deg (Full Bypass), heat is no longer being removed from the Lab IATCS. IATCS component may overheat within 1.5 hours. Expedite the remaining PVCU transition steps to reestablish IATCS cooling.

‘FCV Cntl’

<table>
<thead>
<tr>
<th>cmd</th>
<th>Inhibit – Arm (✓ – X)</th>
</tr>
</thead>
<tbody>
<tr>
<td>cmd</td>
<td>Inhibit – Inh</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>√FCV Cntl – Inh</th>
</tr>
</thead>
</table>

‘FCV Posn’

input FCV Posn: 0.0 (0.0 – Full Bypass position)

<table>
<thead>
<tr>
<th>cmd</th>
<th>Set</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>√FCV Posn: 0 ± 5.3 Deg</th>
</tr>
</thead>
</table>
P6: TCS: Loop B PFCS

Loop B PFCS Nominal Commands
‘EETCS Loop B PFCS’
‘FCV Cntl’

**cmd Inhibit – Arm (√ – X)**

**cmd Inhibit – Inh**

√FCV Cntl – Inh

‘FCV Posn’

input FCV Posn: 0.0 (0.0 – Full Bypass position)

**cmd Set**

√FCV Posn: 0 ± 5.3 Deg

4. **CONFIGURING EETCS FOR NEW PRIMARY PVCU MDM**

PCS

P6: TCS: Loop A PFCS: Loop A Bkup PVCU Commands

Loop A Bkup PVCU Commands
‘Bkup PVCU EETCS Loop A’
‘PFCS FCV Cntl’

**cmd Enable – Arm**

**cmd Enable – Ena**

√PFCS FCV Cntl – Ena

P6: TCS: Loop B PFCS: Loop B Bkup PVCU Commands

Loop B Bkup PVCU Commands
‘Bkup PVCU EETCS Loop B’
‘PFCS FCV Cntl’

**cmd Enable – Arm**

**cmd Enable – Ena**

√PFCS FCV Cntl – Ena

P6: TCS: Loop A PFCS

Loop A PFCS Nominal Commands
‘EETCS Loop A PFCS’

**NOTE**

When FCV Control is reenabled in the primary PVCU MDM, then cooling to the IATCS is reestablished.

‘FCV Posn’
2.109 EETCS RECONFIGURATION FOLLOWING PVCU TRANSITION
(TCS/4A - ALL/FIN)  Page 5 of 5 pages

input FCV Position: 0.0 (0.0 – Full Bypass position)

**cmd** Set

√FCV Posn: 0 ± 5.3 Deg

‘FCV Cntl’

**cmd** Enable – Arm (√ – X)
**cmd** Enable – Ena

√FCV Cntl – Ena

P6: TCS: Loop B PFCS

<table>
<thead>
<tr>
<th>Loop B PFCS Nominal Commands</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘EETCS Loop B PFCS’</td>
</tr>
<tr>
<td>‘FCV Posn’</td>
</tr>
</tbody>
</table>

input FCV Posn: 0.0 (0.0 – Full Bypass position)

**cmd** Set

√FCV Posn: 0 ± 5.3 Deg

‘FCV Cntl’

**cmd** Enable – Arm (√ – X)
**cmd** Enable – Ena

√FCV Cntl – Ena
NOTE

1. If this procedure is used to change the Setpoint of the MTL or MTL REGEN TWMV, do not perform steps 1, 2, and 4.

2. If elevating the Setpoint of the MTL or MTL REGEN TWMV, expect the following possible C&W messages
   'Lab MTL TWMV Overtemp - LAB'
   'Lab Regen HX TWMV Overtemp - LAB'

3. If this procedure is performed from MCC-H, steps 2 and 4 can only be performed from the ODIN Console Position.

4. LTL, MTL, and MTL REGEN Setpoint Min/Max acceptable range: 2.2° C to 21.1° C. If the new Setpoint is outside of this range, the command will be rejected.

5. If the LTL will be operated at > 6.6° C for an extended period of time, consideration will be given to uplinking new limits associated with the events inhibited in step 2 and reenabling those events to give the crew and MCC-H adequate C&W monitoring capability of the LTL and associated equipment.

6. Operating the LTL at the required elevated temperature Setpoint necessary for Lab Activation and Checkout, may result in activating the LAB1P6/S6 CCAA Overtemp Caution Event if the air outlet temperature of the CCAA exceeds 29.4° C.

1. DETERMINING TWMV SETPOINT REQUIRED TO BE CHANGED
   If required to raise LTL Setpoint < 6.6° C starting from a nominal Setpoint of 4.4° C, perform step 3.

   If required to raise LTL Setpoint > 6.6° C, perform steps 2 --- 4.

   If required to lower LTL Setpoint < 6.6° C to return to nominal temperature range and all previously inhibited events associated with LTL Overtemp are required to be reenabled, perform steps 3 and 4.

2. INHIBITING LTL TWMV EVENTS
   PCS
   C&W SUMM
   'EVENT CODE TOOLS'
   sel INHIBIT

   INHIBIT ANNUNCIATION OF INACTIVE EVENT
2.201 LAB IATCS SETPOINT CHANGE
(TCS/5A - ALL/FIN)  Page 2 of 2 pages

Enter EVENT CODE [X] where [X] = 6084 6418 6407 6426 6213

cmd Arm
cmd Execute

Repeat

3. CHANGING CLC SETPOINT

PCS
LAB: TCS: LTL (MTL) (MTL REGEN) TWMV ICON
LTL (MTL) (MTL REGEN) TWMV COMMANDS
‘[X] TWMV’ where [X] = LTL (MTL) (MTL REGEN)
‘Temp Setpt’

input new setpoint

cmd Set – Execute

√ Temp Setpt = new Setpoint

4. ENABLING LTL TWMV EVENTS

PCS
C&W SUMM
‘EVENT CODE TOOLS’

sel ENABLE

ENABLE ANNUNCIATION OF INACTIVE EVENT

Enter EVENT CODE [X] where [X] = 6084 6418 6407 6426 6213

cmd Arm
cmd Execute

Repeat
1. **CHECKING MCC-H FOR NEW SFCA SETPOINT**
   SFCA Setpoint – _____ kPa

2. **VERIFYING SFCA CONFIGURATION**

   PCS
   LAB: TCS: LTL(MTL) SFCA
   LTL(MTL) SFCA Commands
   ‘LTL(MTL) SFCA’

   Verify Software – Started
   Verify CLC – Ena

3. **CHANGING SETPOINT**

   PCS
   LAB: TCS: LTL(MTL) SFCA
   LTL(MTL) SFCA Commands
   ‘LTL(MTL) SFCA’
   ‘Mod Vlv dP Setpt’

   input Set – ‘New Setpoint’ kPa

   **cmd** Set – Set

   √Mod Vlv dP Setpt – ‘New Setpoint’ kPa

   **NOTE**
   ‘New Setpoint’ is the value received from **MCC-H** in step 1.
1. **VERIFYING RPC POSITIONS AND RT STATUS**

   PCS

   LAB: TCS: IATCS Details: LAB Act TCS RPC Commands
   LAB Act TCS RPC Commands

   Verify positions of all (17) RPCs – Cl

   LAB: TCS: IATCS Details
   IATCS Details

   Verify LTL PPA RT Status – Ena
   Verify MTL PPA RT Status – Ena

2. **BEGINNING MODE TRANSITION**

   PCS

   LAB: TCS: Software
   Software Commands
   ‘IATCS’
   ‘Mode’

   **cmd** Dual – Arm

   √Arm Status – Dual Armed

   **cmd** Dual – Dual

   Expect: Caution ‘Lab LTL SFCA Uncontrolled DP - LAB’
   Expect: Caution ‘Lab MTL SFCA Uncontrolled DP - LAB’
If any of the alarms listed in the table are enunciated, the IATCS software may not complete the transition to Dual. The software will take the action specified in the table below.

<table>
<thead>
<tr>
<th>Message</th>
<th>Software Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caution: 'Lab LTL PPA Pump</td>
<td>FDIR will configure to Single MT. Go to {2.205 LAB IATCS TRANSITION TO SINGLE MT</td>
</tr>
<tr>
<td>Failure - LAB'</td>
<td>(AUTO)}, steps 3, 4 (SODF: TCS: NOMINAL: IATCS).</td>
</tr>
<tr>
<td>Caution: 'Lab MTL PPA Pump</td>
<td>FDIR will configure to Single LT. Go to {2.204 LAB IATCS TRANSITION TO SINGLE LT</td>
</tr>
<tr>
<td>Failure - LAB'</td>
<td>(AUTO)}, steps 3, 4 (SODF: TCS: NOMINAL: IATCS).</td>
</tr>
<tr>
<td>Caution: 'Lab LTL SFCA Shutoff</td>
<td>FDIR will configure to Single MT. Go to {2.205 LAB IATCS TRANSITION TO SINGLE MT</td>
</tr>
<tr>
<td>Valve Failure - LAB'</td>
<td>(AUTO)}, steps 3, 4 (SODF: TCS: NOMINAL: IATCS).</td>
</tr>
<tr>
<td>Caution: 'Lab MTL SFCA Shutoff</td>
<td>FDIR will configure to Single LT. Go to {2.204 LAB IATCS TRANSITION TO SINGLE LT</td>
</tr>
<tr>
<td>Valve Failure - LAB'</td>
<td>(AUTO)}, steps 3, 4 (SODF: TCS: NOMINAL: IATCS).</td>
</tr>
<tr>
<td>Caution: 'Lab LCA Valve 1</td>
<td>FDIR will configure to Single MT. Go to {2.205 LAB IATCS TRANSITION TO SINGLE MT</td>
</tr>
<tr>
<td>Failure - LAB'</td>
<td>(AUTO)}, steps 3, 4 (SODF: TCS: NOMINAL: IATCS).</td>
</tr>
<tr>
<td>Caution: 'Lab LCA Valve 2</td>
<td>FDIR will configure to Single MT. Go to {2.205 LAB IATCS TRANSITION TO SINGLE MT</td>
</tr>
<tr>
<td>Failure - LAB'</td>
<td>(AUTO)}, steps 3, 4 (SODF: TCS: NOMINAL: IATCS).</td>
</tr>
</tbody>
</table>

3. **VERIFYING MODE TRANSITION**

   **LAB: TCS**
   
<table>
<thead>
<tr>
<th>Lab: IATCS Overview</th>
</tr>
</thead>
<tbody>
<tr>
<td>'Status'</td>
</tr>
<tr>
<td>'IATCS'</td>
</tr>
</tbody>
</table>

   Wait 3 minutes.

   Verify Status – Oper
   Verify Mode – Dual
4. **SETTING ACCUMULATOR LEAK LIMITS**

PCS

LAB: TCS

- Lab: IATCS Overview
- ‘PPA’

Record LTL Avg Accum Qty: __________ %

Record MTL Avg Accum Qty: __________ %

LAB: TCS: Software: Software Additional Commands

- Software Additional Commands
- ‘Leak Recovery IATCS’

**cmd** Set Normal Leak Limits – Set
2.203 LAB IATCS TRANSITION TO DUAL (AUTO)
(TCS/5A - ALL/FIN) Page 4 of 4 pages

NOTE
1. Data in Table 1 can be verified on the Lab: IATCS Overview and IATCS Details displays.
2. Table 1 is included for reference only.

Table 1. IATCS Dual Mode Operational Values
Procedure Verification Table: Lab IATCS Transition to Dual (Auto)

<table>
<thead>
<tr>
<th>IATCS Details Display</th>
<th>LTL</th>
<th>MTL</th>
</tr>
</thead>
<tbody>
<tr>
<td>TWMV Software</td>
<td>Started</td>
<td>Started</td>
</tr>
<tr>
<td>CLC</td>
<td>Ena</td>
<td>Ena</td>
</tr>
<tr>
<td>Regen TWMV Software</td>
<td>Started</td>
<td></td>
</tr>
<tr>
<td>Posn</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLC</td>
<td></td>
<td>Inh</td>
</tr>
<tr>
<td>SFCA Software</td>
<td>Started</td>
<td>Started</td>
</tr>
<tr>
<td>CLC</td>
<td>Ena</td>
<td>Ena</td>
</tr>
<tr>
<td>SOV Posn</td>
<td>Open</td>
<td>Open</td>
</tr>
<tr>
<td>PPA Software</td>
<td>Started</td>
<td>Started</td>
</tr>
</tbody>
</table>

Lab: IATCS Overview

‘LCA’

<table>
<thead>
<tr>
<th>Vlv1 Posn</th>
<th>Dual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vlv2 Posn</td>
<td>Dual</td>
</tr>
</tbody>
</table>

‘Status’

<table>
<thead>
<tr>
<th>IATCS Status</th>
<th>Oper</th>
</tr>
</thead>
<tbody>
<tr>
<td>IATCS Mode</td>
<td>Dual</td>
</tr>
<tr>
<td>Fail Rcvry Status</td>
<td>Ena</td>
</tr>
<tr>
<td>Leak Rcvry Status</td>
<td>Ena</td>
</tr>
<tr>
<td>LTL Leak Rcvry Status</td>
<td>Ena</td>
</tr>
<tr>
<td>MTL Leak Rcvry Status</td>
<td>Ena</td>
</tr>
</tbody>
</table>

‘PPA’

| Pmp In Press (kPa)   | 172 ± 48 | 172 ± 48 |
| Pmp dP (kPa)         | 207 ± 34 | 290 ± 34 |
| HR Flow (kg/hr)      | 1361 ± 136 | 1361 ± 136 |
| Pmp Spd (rpm)        | 15,880 ± 1,250 | 17,200 ± 1,250 |

‘SFCA’

| Mod Vlv dP (kPa) | 76 ± 7 | 76 ± 7 |
1. **VERIFYING RPC POSITIONS AND RT STATUS**

**PCS**

LAB: TCS: IATCS Details: LAB Act TCS RPC Commands

LAB Act TCS RPC Commands

Verify positions of all (17) RPCs – Cl

LAB: TCS: IATCS Details

IATCS Details

Verify LTL PPA RT Status – Ena
Verify MTL PPA RT Status – Ena

2. **BEGINNING MODE TRANSITION**

**PCS**

LAB: TCS: Software

Software Commands

‘IATCS’

‘Mode’

**cmd** Sngl LT – Arm

√Arm Status – Sngl LT Armed

**cmd** Sngl LT – Sngl LT

Expect: Caution ‘Lab LTL SFCA Uncontrolled DP - LAB’
Expect: Caution ‘Lab MTL SFCA Uncontrolled DP - LAB’
If any of the alarms listed in the table are enunciated, the IATCS software may not complete the transition to Single LT. The software will take the action specified in the table below.

<table>
<thead>
<tr>
<th>Message</th>
<th>Software Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caution: ‘Lab LTL PPA Pump Failure - LAB’</td>
<td>FDIR will configure to Single MT. Go to 2.205 LAB IATCS TRANSITION TO SINGLE MT (AUTO), steps 3, 4 (SODF: TCS: NOMINAL: IATCS).</td>
</tr>
<tr>
<td>Caution: ‘Lab LTL SFCA Shutoff Valve Failure - LAB’</td>
<td>FDIR will configure to Single MT. Go to 2.205 LAB IATCS TRANSITION TO SINGLE MT (AUTO), steps 3, 4 (SODF: TCS: NOMINAL: IATCS).</td>
</tr>
<tr>
<td>Caution: ‘Lab MTL PPA Pump Failure - LAB’</td>
<td>No action required. Software will continue transition to Single LT.</td>
</tr>
<tr>
<td>Caution: ‘Lab MTL PPA Pump Shutdown Command Failed - LAB’</td>
<td>No action required. Software will continue transition to Single LT.</td>
</tr>
<tr>
<td>Caution: ‘Lab MTL SFCA Shutoff Valve Failure - LAB’</td>
<td>Refer to off-nominal steps below.</td>
</tr>
<tr>
<td>Caution: ‘Lab LCA Valve 1 Failure - LAB’</td>
<td>No action required. Software will continue transition to Single LT.</td>
</tr>
<tr>
<td>Caution: ‘Lab LCA Valve 2 Failure - LAB’</td>
<td>No action required. Software will continue transition to Single LT.</td>
</tr>
</tbody>
</table>

****************************************************************************************************

If Caution: ‘Lab MTL SFCA Shutoff Valve Failure - LAB’ is received, then

Expect Warning: ‘Lab IATCS Mode Unknown - LAB’

**CAUTION**

The LTL and/or MTL may not be receiving cooling in this situation. The steps contained within this starred block should be performed within 30 minutes in order to protect critical avionics.

LAB: TCS
Lab: IATCS Overview
‘LCA’
√Vlv1 Position – Dual
√Vlv2 Position – Dual

Open front panel on Rack LABS6 by lifting the panel latches (two) and swinging the panel door open.

Verify that Pump Inlet Shutoff Handle is in the Open position.

Close front panel by swinging the panel closed and engaging the panel latches (two).
LAB: TCS: MTL PPA

MTL PPA Commands

'MTL PPA'

‘Pump Software’

**cmd** Startup – Startup

Square Pump Software – Started

‘Set Pump Speed’

input Arm:  17200 rpm

**cmd** Arm – Arm

input Set:  17200 rpm

**cmd** Set – Set

LAB: TCS

Lab: IATCS Overview

‘SFCA’

√LTL SOV Position – Open

LAB: TCS: LTL PPA

LTL PPA Commands

‘LTL PPA’

√Pump Software – Started

‘Set Pump Speed’

input Arm:  15880 rpm

**cmd** Arm – Arm

input Set:  15880 rpm

**cmd** Set – Set

LAB: TCS

Lab: IATCS Overview

‘PPA’

Verify LTL Pmp Spd:  15880 ± 1250 rpm
Verify MTL Pmp Spd:  17200 ± 1250 rpm
LAB: TCS: LTL SFCA
[LTL SFCA Commands]
‘LTL SFCA’

**cmd** CLC – Ena

√CLC – Ena

LAB: TCS: MTL SFCA
[MTL SFCA Commands]
‘MTL SFCA’

**cmd** CLC – Ena

√CLC – Ena

LAB: TCS: MTL TWMV Icon
[MTL TWMV Commands]
‘MTL TWMV’

**cmd** CLC – Ena **Execute**

√CLC – Ena

LAB: TCS: Regen TWMV Icon
[MTL Regen TWMV Commands]
‘MTL Regen TWMV’

**cmd** CLC – Inh **Execute**

√CLC – Inh

**cmd** Posn – Byp **Execute**

√Posn – Byp

**NOTE**
The IATCS is now functioning in a Dual mode. However, the IATCS mode will be ‘Xtion Sngl LT’. As long as the TCS software thinks that the IATCS is in this mode, certain FDIR (especially LRITCS) will not work properly. **MCC-H** may need to inhibit LRITCS and other FDIR.

Exit procedure.

****************************************************************************************************
3. **VERIFYING MODE TRANSITION**
   
   **LAB: TCS**
   
   [Lab: IATCS Overview]
   
   ‘Status’
   
   ‘IATCS’
   
   Wait 3 minutes.
   
   Verify Status – Oper
   
   Verify Mode – Sngl LT
   
4. **CONFIGURING LCA VALVE 2 TO DUAL POSITION**
   
   **PCS**
   
   [LAB: TCS: LCA Icon]
   
   [LCA Commands]
   
   ‘LCA’
   
   √Vlv1 Posn – Sngl
   
   If Vlv2 Posn – Sngl then
   
   **cmd** Vlv2 Posn – Dual **Execute**
   
   √Vlv2 Posn – Dual
NOTE
1. Data in Table 1 can be verified on the Lab: IATCS Overview and IATCS Details displays.
2. Table 1 is included for reference only.
3. Cautions received during the transition may affect valve positions listed in Table 1.

Table 1. IATCS Single LT Mode Operational Values

<table>
<thead>
<tr>
<th>Procedure Verification Table: Lab IATCS Transition to Single LT (Auto)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IATCS Details Display</strong></td>
</tr>
<tr>
<td>LTL</td>
</tr>
<tr>
<td>TWMV Software</td>
</tr>
<tr>
<td>Posn</td>
</tr>
<tr>
<td>CLC</td>
</tr>
<tr>
<td>Regen TWMV Software</td>
</tr>
<tr>
<td>CLC</td>
</tr>
<tr>
<td>SFCA Software</td>
</tr>
<tr>
<td>CLC</td>
</tr>
<tr>
<td>SOV Posn</td>
</tr>
<tr>
<td>PPA Software</td>
</tr>
</tbody>
</table>

Lab: IATCS Overview

<table>
<thead>
<tr>
<th><strong>LCA</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Vlv1 Posn</td>
</tr>
<tr>
<td>Vlv2 Posn</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Status</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>IATCS Status</td>
</tr>
<tr>
<td>IATCS Mode</td>
</tr>
<tr>
<td>Fail Rcvry Status</td>
</tr>
<tr>
<td>Leak Rcvry Status</td>
</tr>
<tr>
<td>LTL Leak Rcvry Status</td>
</tr>
<tr>
<td>MTL Leak Rcvry Status</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>PPA</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pmp In Press (kPa)</td>
</tr>
<tr>
<td>dP (kPa)</td>
</tr>
<tr>
<td>HR Flow (kg/hr)</td>
</tr>
<tr>
<td>Pmp Spd (rpm)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>SFCA</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mod Vlv dP (kPa)</td>
</tr>
</tbody>
</table>
1. **VERIFYING RPC POSITIONS AND RT STATUS**

   PCS
   LAB: TCS: IATCS Details: LAB Act TCS RPC Commands
   LAB: TCS: IATCS Details
   IATCS Details

   Verify positions of all (17) RPCs – Cl

   LAB: TCS: IATCS Details
   IATCS Details

   Verify LTL RT PPA Status – Ena
   Verify MTL RT PPA Status – Ena

2. **BEGINNING MODE TRANSITION**

   PCS
   LAB: TCS: Software
   Software Commands
   ‘IATCS’
   ‘Mode’

   **cmd** Sngl MT – Arm

   √Arm Status – Sngl MT Armed

   **cmd** Sngl MT – Sngl MT

   Expect: Caution ‘Lab LTL SFCA Uncontrolled DP - LAB’
   Expect: Caution ‘Lab MTL SFCA Uncontrolled DP - LAB’
If any of the alarms listed in the table are enunciated, the IATCS software may not complete the transition to Single MT. The software will take the action specified in the following table.

<table>
<thead>
<tr>
<th>Message</th>
<th>Software Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caution: ‘Lab MTL PPA Pump Failure - LAB’</td>
<td>FDIR will configure to Single LT. Go to 2.204  LAB IATCS TRANSITION TO SINGLE LT (AUTO), steps 3 --- 4 (SODF: TCS: NOMINAL: IATCS).</td>
</tr>
<tr>
<td>Caution: ‘Lab MTL SFCA Shutoff Valve Failure - LAB’</td>
<td>FDIR will configure to Single LT. Go to 2.204  LAB IATCS TRANSITION TO SINGLE LT (AUTO), steps 3 --- 4 (SODF: TCS: NOMINAL: IATCS).</td>
</tr>
<tr>
<td>Caution: ‘Lab LTL PPA Pump Failure - LAB’</td>
<td>No action required. Software will continue transition to Single MT.</td>
</tr>
<tr>
<td>Caution: ‘Lab LTL PPA Pump Shutdown Command Failed - LAB’</td>
<td>No action required. Software will continue transition to Single MT.</td>
</tr>
<tr>
<td>Caution: ‘Lab LTL SFCA Shutoff Valve Failure - LAB’</td>
<td>See the following off-nominal steps.</td>
</tr>
<tr>
<td>Caution: ‘Lab LCA Valve 1 Failure - LAB’</td>
<td>No action required. Software will continue transition to Single MT.</td>
</tr>
<tr>
<td>Caution: ‘Lab LCA Valve 2 Failure - LAB’</td>
<td>No action required. Software will continue transition to Single MT.</td>
</tr>
</tbody>
</table>
If Caution: ‘Lab LTL SFCA Shutoff Valve Failure - LAB’ is received
Expect Warning: ‘Lab IATCS Mode Unknown - LAB’

**CAUTION**

The LTL and/or MTL may not be receiving cooling in this situation. The steps contained within this off-nominal situation should be performed within 30 minutes in order to protect critical avionics.

LAB: TCS
Lab: IATCS Overview
‘LCA’

√Vlv1 Position – Dual
√Vlv2 Position – Dual

Open front panel on Rack LABP6 by lifting the panel latches (two) and swinging the panel door open.

Verify that Pump Inlet Shutoff Handle is in the Open position.

Close front panel by swinging the panel closed and engaging the panel latches (two).

LAB: TCS: LTL PPA
LTL PPA Commands
‘LTL PPA’
‘Pump Software’

cmd Startup – Startup

√Pump Software – Started
‘Set Pump Speed’
input Arm: 15880 rpm

cmd Arm – Arm
input Set: 15880 rpm

cmd Set – Set

LAB: TCS
Lab: IATCS Overview
‘SFCA’

√MTL SOV Position – Open
LAB: TCS: MTL PPA

MTL PPA Commands

'MTL PPA'

Pump Software – Started

'Set Pump Speed'

input Arm: 17200 rpm

cmd Arm – Arm

input Set: 17200 rpm

cmd Set – Set

LAB: TCS

Lab: IATCS Overview

'PPA'

Verify LTL Pmp Spd: 15880 ± 1250 rpm
Verify MTL Pmp Spd: 17200 ± 1250 rpm

LAB: TCS: LTL SFCA

LTL SFCA Commands

'LTL SFCA'

cmd CLC – Ena

√CLC – Ena

LAB: TCS: MTL SFCA

MTL SFCA Commands

'MTL SFCA'

cmd CLC – Ena

√CLC – Ena

LAB: TCS: MTL TWMV Icon

MTL TWMV Commands

'MTL TWMV'

cmd CLC – Ena Execute

√CLC – Ena
LAB: TCS: Regen TWMV Icon

MTL Regen TWMV Commands

'MTL Regen TWMV'

**cmd** CLC – Inh  **Execute**

√CLC – Inh

**cmd** Posn – Byp

√Posn – Byp

---

**CAUTION**

The IATCS is now functioning in Dual mode. However, the IATCS mode will be ‘Xtion Sngl MT’. As long as the software thinks that the IATCS is in this mode, certain FDIR (especially LRITCS) will not work properly. **MCC-H** may need to inhibit LRITCS and other FDIR.

---

Exit procedure.

*******************************************************

3. **VERIFYING MODE TRANSITION**

LAB: TCS

Lab: IATCS Overview

‘Status’

‘IATCS’

Wait 3 minutes.

Verify Status – Oper
Verify Mode – Sngl MT

4. **CONFIGURING LCA VALVE 2 TO DUAL POSITION**

PCS

LAB: TCS: LCA Icon

LCA Commands

‘LCA’

√Vlv1 Posn – Sngl

If Vlv2 Posn – Sngl then

**cmd** Vlv2 Posn – Dual  **Execute**

√Vlv2 Posn – Dual
### 2.205 LAB IATCS TRANSITION TO SINGLE MT (AUTO)
(TCS/5A - ALL/FIN) Page 6 of 6 pages

#### NOTE
1. Data in Table 1 can be verified on the Lab: IATCS Overview and IATCS Details displays.
2. Table 1 is included for reference only.
3. Cautions received during the transition may affect valve positions listed in Table 1.

#### Table 1. IATCS Single MT Mode Operational Values

<table>
<thead>
<tr>
<th>Procedure Verification Table: Lab IATCS Transition to Single MT (Auto)</th>
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<tbody>
<tr>
<td><strong>IATCS Details Display</strong></td>
</tr>
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<td>LTL</td>
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<tr>
<td>CLC</td>
</tr>
<tr>
<td>Regen TWMV Software</td>
</tr>
<tr>
<td>SFCA Software</td>
</tr>
<tr>
<td>SFCA CLC</td>
</tr>
<tr>
<td>SOV Posn</td>
</tr>
<tr>
<td>PPA Software</td>
</tr>
<tr>
<td><strong>Lab: IATCS Overview</strong></td>
</tr>
<tr>
<td>‘LCA’</td>
</tr>
<tr>
<td>Vlv1 Posn</td>
</tr>
<tr>
<td>Vlv2 Posn</td>
</tr>
<tr>
<td>‘Status’</td>
</tr>
<tr>
<td>IATCS Status</td>
</tr>
<tr>
<td>IATCS Mode</td>
</tr>
<tr>
<td>Fail Rcvry Status</td>
</tr>
<tr>
<td>Leak Rcvry Status</td>
</tr>
<tr>
<td>LTL Leak Rcvry Status</td>
</tr>
<tr>
<td>MTL Leak Rcvry Status</td>
</tr>
<tr>
<td>‘PPA’</td>
</tr>
<tr>
<td>LTL</td>
</tr>
<tr>
<td>Pmp In Press (kPa)</td>
</tr>
<tr>
<td>Pmp dP (kPa)</td>
</tr>
<tr>
<td>HR Flow (kg/hr)</td>
</tr>
<tr>
<td>Pmp Spd (rpm)</td>
</tr>
<tr>
<td>‘SFCA’</td>
</tr>
<tr>
<td>Mod Vlv dP (kPa)</td>
</tr>
</tbody>
</table>

08 AUG 00

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2484.doc
1. **INHIBITING NODE 1 HEATERS 1 -- 6 WITH TWO SENSORS**

PCS

Node 1: TCS
‘Node 1’

sel Htr Availability

Node1Htr16avail

**NOTE**

Node 1 Heaters with two sensors must be inhibited to prevent the Temp Snsr Disagree advisory from being generated.

‘Htr[X]’ where [X] = 1A 3A 5A 6A

1B 3B 5B 6B

**cmd** Availability – Inhibit

√Availability – Inh

Repeat

2. **INHIBITING NODE 1 HEATERS 7A AND 7B**

PCS

Node 1: TCS
‘Node 1’

sel Htr Availability

sel Node1 Htrs7-9 Availability

Node1Htr79avail

‘Htr[X]’ where [X] = 7A 7B

**cmd** Availability – Inhibit

√Availability – Inh

Repeat

3. **MODIFYING INCREMENT SETPOINTS FOR PMA1 TEMPERATURE SENSORS**

PCS

Node 1: TCS
‘PMA1’

sel Htr Availability

sel PMA1 HtrA(B) Setpoints

PMA1 HtrA(B) Setpoints
NOTE
1. PMA1 Heaters 2A and 4B are not active and do not appear on the PCS Node 1 TCS display.

2. Heater setpoint commanding is nominally performed by MCC-H. When performed by the onboard crew, the PCS displays will be used to send the commands.

3. The following steps provide display navigation for the onboard crew using a PCS.

\[\text{\textquoteleft}Htr[X]\text{\textquoteright} \text{ where } [X] = \begin{array}{c} 1A \\ 3A \\ 4A \\ 5A \\ 1B \\ 2B \\ 3B \\ 5B \end{array}\]

sel Change Setpoint

PMA1 Htr[X] Setpoint

NOTE
Specific values to be entered in the template command below for each PMA1 Temperature Sensor are provided in Table 1. Values are provided for each of the five items in the template: Upper Setpoint, Failure Upper Limit, Lower Setpoint, Failure Lower Limit, and Cyclic Load Delta.

input Failure Upper Limit
    Upper Setpoint
    Lower Setpoint
    Failure Lower Limit
    Cyclic Load Delta

\textbf{cmd} Execute Change

Node 1: TCS
‘PMA1’

sel Htr Availability
sel PMA1 HtrA(B) Setpoints

PMA1 HtrA(B) Setpoints

NOTE
The specific values to be verified in the step below are provided in Table 1.

√Failure Upper Limit
√Upper Setpoint
√Lower Setpoint
√Failure Lower Limit
√Cyclic Load Delta

Repeat
4. **MODIFYING SETPOINTS FOR NODE 1 TEMPERATURE SENSORS**

PCS

Node 1: TCS

‘Node 1’

sel Htr Availability
sel Node1 HtrA(B) Setpoints

NOTE

1. Heater setpoint commanding is nominally performed by MCC-H.

2. The following steps provide display navigation for the onboard crew using a PCS.

If heater setpoint commanding is performed by the onboard crew, the PCS displays will be used to send the commands.
The following steps provide display navigation for the onboard crew using a PCS.
2.301 NODE 1/PMA 1 HEATER CONFIGURATION FOR NOMINAL OPS
(TCS/4A - ALL/FIN) Page 4 of 7 pages

‘Htr[X]’ where [X] = 1A 2A 3A 4A 5A 6A 7A 8A 9A
1B 2B 3B 4B 5B 6B 7B 8B 9B

NOTE
1. As depicted on the PCS NODE 1 TCS display, certain Node 1 Heaters have two temperature sensors (Heaters 1A, 1B, 3A, 3B, 5A, 5B, 6A, 6B, 7A, and 7B). For these heaters, setpoints for both temperature sensors must be changed. Values for both sensors are provided in Table 1.

2. Specific values to be entered in the template command below for each Node 1 Temperature Sensor are provided in Table 1. Values are provided for each of the five items in the template: Upper Setpoint, Failure Upper Limit, Lower Setpoint, Failure Lower Limit, and Cyclic Load Delta.

3. SPN 303 (PR 13700) documents a problem with the Node 1 HtrB Setpoints display for 4A. The 7B Snsr1 and Snsr2 setpoint telemetry fields use the PUIs for Htr7A. To view the correct setpoints for Node 1 Htr7B Snsr1 and Snsr2, the user should select the Node 1 Htr7 button. This problem is fixed on the e5A displays onwards.

sel Chng Setpt

Node1 HtrA(B) Setpoint

input Failure Upper Limit
Upper Setpoint
Lower Setpoint
Failure Lower Limit
Cyclic Load Delta

cmd Execute Change

Node 1: TCS
‘Node1’

sel Htr Availability
sel Node1 HtrA(B) Setpoints

Node1 HtrA(B) Setpoints

NOTE
The specific values to be verified in the following steps are provided in Table 1.

√Failure Upper Limit
√Upper Setpoint
√Lower Setpoint
√Failure Lower Limit
√Cyclic Load Delta

Repeat
5. **PMA1 B HEATERS ENABLE TO OPERATE**

PCS

Node 1: TCS

‘PMA1’

sel Htr Availability

![PMA1 HtrAvailability]

‘Htr[X]’ where [X] = 1B 2B 3B 5B

.cmd Availability – Ena Operate

√Availability – Ena Opr

Repeat

6. **NODE 1 B HEATERS 1 ENABLE TO OPERATE**

PCS

Node 1: TCS

‘Node 1’

sel Htr Availability

![Node1 Htr16avail]

NOTE

The operator must select the Node 1 Htr7-9 Availability commands from the Node 1 Htr16avail command page to reach the availability commands for Node 1 Heaters 7 --- 9.

‘Htr[X]’ where [X] = 1B 2B 3B 4B 5B 6B 7B 8B 9B

.cmd Availability – Ena Operate

√Availability – Ena Opr

Repeat
7. **PMA1 A HEATERS ENABLE TO BACKUP**

PCS

Node 1: TCS

‘PMA1’

sel Htr Availability

```
PMA1 HtrAvailability
```

‘Htr[X]A’ where [X] = 1A 3A 4A 5A

- cmd Availability – Ena Backup
- √Availability – Ena BU

Repeat

8. **NODE1 A HEATERS ENABLE TO BACKUP**

PCS

Node 1: TCS

‘Node 1’

sel Htr Availability

```
Node1 Htr16avail
```

**NOTE**

The operator must select the Node 1 Htr7-9 Availability commands from the Node 1 Htr16avail command page to reach the availability commands for Node 1 Heaters 7 --- 9.

‘Htr[X]A’ where [X] = 1A 2A 3A 4A 5A 6A 7A 8A 9A

- cmd Availability – Ena Backup
- √Availability – Ena BU

Repeat
### Table 1. PMA1/Node 1 Heater Configuration for Nominal Operations

#### PMA1 Heaters - All Temperatures in °C

<table>
<thead>
<tr>
<th>Heater (Sensor)</th>
<th>Availability</th>
<th>Failure Upper Limit</th>
<th>Upper Setpoint</th>
<th>Lower Setpoint</th>
<th>Failure Lower Limit</th>
<th>Cyclic Load Delta</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A (Sensor)</td>
<td>Enable BU</td>
<td>36.7</td>
<td>23.9</td>
<td>21.2</td>
<td>17.2</td>
<td>5.6</td>
</tr>
<tr>
<td>1B (Sensor)</td>
<td>Enable Opr</td>
<td>36.7</td>
<td>23.9</td>
<td>21.2</td>
<td>17.2</td>
<td>5.6</td>
</tr>
<tr>
<td>2B (Sensor)</td>
<td>Enable Opr</td>
<td>36.7</td>
<td>23.9</td>
<td>21.2</td>
<td>17.2</td>
<td>5.6</td>
</tr>
<tr>
<td>3A (Sensor)</td>
<td>Enable BU</td>
<td>36.7</td>
<td>23.9</td>
<td>21.2</td>
<td>17.2</td>
<td>5.6</td>
</tr>
<tr>
<td>3B (Sensor)</td>
<td>Enable Opr</td>
<td>36.7</td>
<td>23.9</td>
<td>21.2</td>
<td>17.2</td>
<td>5.6</td>
</tr>
<tr>
<td>4A (Sensor)</td>
<td>Enable BU</td>
<td>36.7</td>
<td>23.9</td>
<td>21.2</td>
<td>17.2</td>
<td>5.6</td>
</tr>
<tr>
<td>5A (Sensor)</td>
<td>Enable BU</td>
<td>36.7</td>
<td>23.9</td>
<td>21.2</td>
<td>17.2</td>
<td>5.6</td>
</tr>
<tr>
<td>5B (Sensor)</td>
<td>Enable Opr</td>
<td>36.7</td>
<td>23.9</td>
<td>21.2</td>
<td>17.2</td>
<td>5.6</td>
</tr>
</tbody>
</table>

#### Node 1 Heaters - All Temperatures in °C

<table>
<thead>
<tr>
<th>Heater (Sensor)</th>
<th>Availability</th>
<th>Failure Upper Limit</th>
<th>Upper Setpoint</th>
<th>Lower Setpoint</th>
<th>Failure Lower Limit</th>
<th>Cyclic Load Delta</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A (Snsr 1)</td>
<td>Enable BU</td>
<td>35.6</td>
<td>29.7</td>
<td>26.1</td>
<td>20.6</td>
<td>1.7</td>
</tr>
<tr>
<td>1A (Snsr 2)</td>
<td></td>
<td>35.6</td>
<td>29.7</td>
<td>26.1</td>
<td>20.6</td>
<td>1.7</td>
</tr>
<tr>
<td>1B (Snsr 1)</td>
<td>Enable Opr</td>
<td>35.6</td>
<td>32.7</td>
<td>26.1</td>
<td>20.6</td>
<td>1.7</td>
</tr>
<tr>
<td>1B (Snsr 2)</td>
<td></td>
<td>35.6</td>
<td>32.7</td>
<td>26.1</td>
<td>20.6</td>
<td>1.7</td>
</tr>
<tr>
<td>2A (Sensor)</td>
<td>Enable BU</td>
<td>35.6</td>
<td>26.1</td>
<td>23.3</td>
<td>17.8</td>
<td>1.7</td>
</tr>
<tr>
<td>2B (Sensor)</td>
<td>Enable Opr</td>
<td>35.6</td>
<td>26.1</td>
<td>23.3</td>
<td>17.8</td>
<td>1.7</td>
</tr>
<tr>
<td>3A (Snsr 1)</td>
<td>Enable BU</td>
<td>35.6</td>
<td>27.5</td>
<td>22.7</td>
<td>17.2</td>
<td>1.7</td>
</tr>
<tr>
<td>3A (Snsr 2)</td>
<td></td>
<td>35.6</td>
<td>27.5</td>
<td>22.7</td>
<td>17.2</td>
<td>1.7</td>
</tr>
<tr>
<td>3B (Snsr 1)</td>
<td>Enable Opr</td>
<td>35.6</td>
<td>25.1</td>
<td>22.7</td>
<td>17.2</td>
<td>1.7</td>
</tr>
<tr>
<td>3B (Snsr 2)</td>
<td></td>
<td>35.6</td>
<td>25.1</td>
<td>22.7</td>
<td>17.2</td>
<td>1.7</td>
</tr>
<tr>
<td>4A (Sensor)</td>
<td>Enable BU</td>
<td>35.6</td>
<td>25.5</td>
<td>22.7</td>
<td>17.2</td>
<td>1.7</td>
</tr>
<tr>
<td>4B (Sensor)</td>
<td>Enable Opr</td>
<td>35.6</td>
<td>25.5</td>
<td>22.7</td>
<td>17.2</td>
<td>1.7</td>
</tr>
<tr>
<td>5A (Snsr 1)</td>
<td>Enable BU</td>
<td>35.6</td>
<td>26.2</td>
<td>23.8</td>
<td>18.3</td>
<td>1.7</td>
</tr>
<tr>
<td>5A (Snsr 2)</td>
<td></td>
<td>35.6</td>
<td>26.2</td>
<td>23.8</td>
<td>18.3</td>
<td>1.7</td>
</tr>
<tr>
<td>5B (Snsr 1)</td>
<td>Enable Opr</td>
<td>35.6</td>
<td>26.2</td>
<td>23.8</td>
<td>18.3</td>
<td>1.7</td>
</tr>
<tr>
<td>5B (Snsr 2)</td>
<td></td>
<td>35.6</td>
<td>26.2</td>
<td>23.8</td>
<td>18.3</td>
<td>1.7</td>
</tr>
<tr>
<td>6A (Snsr 1)</td>
<td>Enable BU</td>
<td>35.6</td>
<td>26.8</td>
<td>24.4</td>
<td>18.9</td>
<td>1.7</td>
</tr>
<tr>
<td>6A (Snsr 2)</td>
<td></td>
<td>35.6</td>
<td>26.8</td>
<td>24.4</td>
<td>18.9</td>
<td>1.7</td>
</tr>
<tr>
<td>6B (Snsr 1)</td>
<td>Enable Opr</td>
<td>35.6</td>
<td>26.8</td>
<td>24.4</td>
<td>18.9</td>
<td>1.7</td>
</tr>
<tr>
<td>6B (Snsr 2)</td>
<td></td>
<td>35.6</td>
<td>26.8</td>
<td>24.4</td>
<td>18.9</td>
<td>1.7</td>
</tr>
<tr>
<td>7A (Snsr 1)</td>
<td>Enable BU</td>
<td>35.6</td>
<td>28.5</td>
<td>22.7</td>
<td>17.2</td>
<td>1.7</td>
</tr>
<tr>
<td>7A (Snsr 2)</td>
<td></td>
<td>35.6</td>
<td>28.5</td>
<td>22.7</td>
<td>17.2</td>
<td>1.7</td>
</tr>
<tr>
<td>7B (Snsr 1)</td>
<td>Enable Opr</td>
<td>35.6</td>
<td>26.3</td>
<td>22.7</td>
<td>17.2</td>
<td>1.7</td>
</tr>
<tr>
<td>7B (Snsr 2)</td>
<td></td>
<td>35.6</td>
<td>26.3</td>
<td>22.7</td>
<td>17.2</td>
<td>1.7</td>
</tr>
<tr>
<td>8A (Sensor)</td>
<td>Enable BU</td>
<td>35.6</td>
<td>24.9</td>
<td>22.2</td>
<td>16.7</td>
<td>1.7</td>
</tr>
<tr>
<td>8B (Sensor)</td>
<td>Enable Opr</td>
<td>35.6</td>
<td>24.9</td>
<td>22.2</td>
<td>16.7</td>
<td>1.7</td>
</tr>
<tr>
<td>9A (Sensor)</td>
<td>Enable BU</td>
<td>35.6</td>
<td>25.5</td>
<td>22.7</td>
<td>17.2</td>
<td>1.7</td>
</tr>
<tr>
<td>9B (Sensor)</td>
<td>Enable Opr</td>
<td>35.6</td>
<td>25.5</td>
<td>22.7</td>
<td>17.2</td>
<td>1.7</td>
</tr>
</tbody>
</table>
1. **VERIFYING ALL NODE AND PMA 1 SHELL HEATERS ARE INHIBITED**

**NOTE**

1. PMA 1 Heaters 2A and 4B are not active and do not appear on the CDDT and PCS NODE 1 TCS display.

2. NODE1Htr79Avail display can be accessed from the NODE1Htr16Avail CDDT and PCS display page.

3. The Node Htr 7B setpoints on the Node1 HtrB Setpoints CDDT and PCS display are incorrect due to an identified mapping problem. The Node 1 Htr 7B setpoints should be accessed from the Node 1 Htr 7 page. The Node 1 Htr 7 page can be accessed as follows:

   PCS  Node 1: TCS: Htr Availability: Node1 Htr 7-9 Availability:
   Node1 Htr 7
   Node 1 Htr7

**2. DETERMINING IF ANY SHELL HEATER SETPOINTS NEED TO BE CHANGED**

Using the values in Table 1, check the upper and lower setpoints, failure upper and lower limits, and cyclic load delta, for all Node 1 and PMA 1 Heaters.

Check both A and B Heaters for all zones on Node 1 and PMA 1.

For a heater with two sensors, check setpoints, limits, and deltas for both sensors.

Display navigation is specified below.

**PCS**

Node 1: TCS

Node 1: TCS

‘Node 1’

√[X]A Htr Availability – Inh where [X] = 1 --- 9

√[X]B Htr Availability – Inh where [X] = 1 --- 9

‘PMA1’

√[X]A Htr Availability – Inh where [X] = 1 2 3 4

√[X]B Htr Availability – Inh where [X] = 1 2 3 5
2.302 NODE 1/PMA 1 PRE-WARMUP HEATER RECONFIGURATION
(TCS/4A - ALL/FIN) Page 2 of 5 pages

sel Node 1 HtrA(B) Setpoints or PMA 1 HtrA(B) Setpoints

| Node 1 HtrA(B) Setpoints | PMA1 HtrA(B) Setpoints |

If all Node 1 and PMA 1 heater setpoints match the values listed in Table 1, skip steps 3 and 4. >>

If Node A(B) Heaters do not match Table 1 values, perform step 3.
If PMA 1 A(B) Heaters do not match Table 1 values, perform step 4.

3. MODIFYING SETPOINTS FOR NODE 1 HEATER TEMP SENSORS

Modify Node 1 setpoints to the values in Table 1 per the following example (for Node 1 Htr 1A sensor 1).

PCS

| Node 1: TCS |
| Node 1: TCS |
| ‘Node 1’ |

sel Htr Availability

| Node1 Htr16avail |

sel Node 1 HtrA Setpoints

| Node1 HtrA Setpoints |

sel Htr1A Snsr1 – Chng Setpt

| Node1 Htr1A SNSR1 Setpoint |

NOTE

1. Specific values to be entered in the template command below for each temperature sensor are provided in Table 1 - PMA 1/ Node 1 Heater Configuration.

2. Values are provided for each of the five items in the template. Upper Setpoint, Failure Upper Limit, Lower Setpoint, Failure Lower Limit, Cyclic Load Delta

3. The setpoints provided in Table 1 are based on a 10°C (50°F) calculated Node 1 dewpoint.

4. If the dewpoint in Node 1 is lower or higher than 10°C, the heater setpoints should be lowered or raised accordingly to reduce heater power usage or prevent condensation in the Node.
2.302 NODE 1/PMA 1 PRE-WARMUP HEATER RECONFIGURATION

(TCS/4A - ALL/FIN) Page 3 of 5 pages

input Failure Upper Limit, deg C: 40  
  Upper Setpoint, deg C: 24  
  Lower Setpoint, deg C: 21  
  Failure Lower Limit, deg C: -17  
  Cyclic Load Delta, deg C: 5

**cmd** Execute Change

<table>
<thead>
<tr>
<th>Node 1 HtrA Setpoints</th>
</tr>
</thead>
<tbody>
<tr>
<td>√ Htr1A Snsr1 Failure Upper Limit, deg C: 40</td>
</tr>
<tr>
<td>√ Upper Setpoint, deg C: 24</td>
</tr>
<tr>
<td>√ Lower Setpoint, deg C: 21</td>
</tr>
<tr>
<td>√ Failure Lower Limit, deg C: -17</td>
</tr>
<tr>
<td>√ Cyclic Load Delta, deg C: 5</td>
</tr>
</tbody>
</table>

4. **MODIFYING SETPOINTS FOR PMA 1 HEATER TEMP SENSORS**

Modify PMA 1 setpoints to the values in Table 1 per the following example (for PMA 1 Htr1A).

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>PMA 1 Heater 2A and 4B are not active and do not appear on the PCS Node 1 TCS display.</td>
</tr>
</tbody>
</table>

PCS

<table>
<thead>
<tr>
<th>Node 1: TCS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Node 1: TCS</td>
</tr>
<tr>
<td>‘PMA 1’</td>
</tr>
</tbody>
</table>

sel Htr Availability

| PMA1 HtrAvailability |

sel PMA 1 HtrA Setpoints

| PMA1 HtrA Setpoints |

sel Htr1A – Change Setpoint

| PMA1 Htr1A Setpoint |
NOTE

1. Specific values to be entered in the template command below for each temperature sensor are provided in Table 1 PMA 1/Node 1 Heater Configuration.

2. Values are provided for each of the five items in the template.
   - Upper Setpoint
   - Failure Upper Limit
   - Lower Setpoint
   - Failure Lower Limit
   - Cyclic Load Delta

3. The setpoints provided in Table 1 are based on a 10° C (50° F) calculated Node 1 dewpoint.

4. If the dewpoint in Node 1 is lower or higher than 10° C, the heater setpoints should be lowered or raised accordingly to reduce heater power usage or prevent condensation in the Node.

input Failure Upper Limit, deg C: 40
    Upper Setpoint, deg C: 24
    Lower Setpoint, deg C: 21
    Failure Lower Limit, deg C: -17
    Cyclic Load Delta, degC: 5

```

     PMA1 HtrA Setpoints

√Htr1A Failure Upper Limit, deg C: 40
 √Upper Setpoint, deg C: 24
 √Lower Setpoint, deg C: 21
 √Failure Lower Limit, deg C: -17
 √Cyclic Load Delta, deg C: 5
```
### Table 1. PMA 1/Node 1 Heater Configuration

**PMA 1 Heaters - All Temperatures in °C(°F)**

<table>
<thead>
<tr>
<th>Heater</th>
<th>Availability</th>
<th>Failure Upper Limit</th>
<th>Upper Setpoint</th>
<th>Lower Setpoint</th>
<th>Failure Lower Limit</th>
<th>Cyclic Load Delta</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A Inhibit</td>
<td>40(104)</td>
<td>24(75.2)</td>
<td>21(69.8)</td>
<td>-17(1.4)</td>
<td>5(9)</td>
<td></td>
</tr>
<tr>
<td>1B Inhibit</td>
<td>40(104)</td>
<td>24(75.2)</td>
<td>21(69.8)</td>
<td>-17(1.4)</td>
<td>5(9)</td>
<td></td>
</tr>
<tr>
<td>2B Inhibit</td>
<td>40(104)</td>
<td>24(75.2)</td>
<td>21(69.8)</td>
<td>-17(1.4)</td>
<td>5(9)</td>
<td></td>
</tr>
<tr>
<td>3A Inhibit</td>
<td>40(104)</td>
<td>24(75.2)</td>
<td>21(69.8)</td>
<td>-17(1.4)</td>
<td>5(9)</td>
<td></td>
</tr>
<tr>
<td>3B Inhibit</td>
<td>40(104)</td>
<td>24(75.2)</td>
<td>21(69.8)</td>
<td>-17(1.4)</td>
<td>5(9)</td>
<td></td>
</tr>
<tr>
<td>4A Inhibit</td>
<td>40(104)</td>
<td>24(75.2)</td>
<td>21(69.8)</td>
<td>-17(1.4)</td>
<td>5(9)</td>
<td></td>
</tr>
<tr>
<td>5A Inhibit</td>
<td>40(104)</td>
<td>24(75.2)</td>
<td>21(69.8)</td>
<td>-17(1.4)</td>
<td>5(9)</td>
<td></td>
</tr>
<tr>
<td>5B Inhibit</td>
<td>40(104)</td>
<td>24(75.2)</td>
<td>21(69.8)</td>
<td>-17(1.4)</td>
<td>5(9)</td>
<td></td>
</tr>
</tbody>
</table>

**Node 1 Heaters - All Temperatures in °C(°F)**

<table>
<thead>
<tr>
<th>Heater (Sensor)</th>
<th>Availability</th>
<th>Failure Upper Limit</th>
<th>Upper Setpoint</th>
<th>Lower Setpoint</th>
<th>Failure Lower Limit</th>
<th>Cyclic Load Delta</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A (Snsr 1) Inhibit</td>
<td>40(104)</td>
<td>24(75.2)</td>
<td>21(69.8)</td>
<td>-17(1.4)</td>
<td>5(9)</td>
<td></td>
</tr>
<tr>
<td>1A (Snsr 2) Inhibit</td>
<td>40(104)</td>
<td>24(75.2)</td>
<td>21(69.8)</td>
<td>-17(1.4)</td>
<td>5(9)</td>
<td></td>
</tr>
<tr>
<td>1B (Snsr 1) Inhibit</td>
<td>40(104)</td>
<td>28(82.4)</td>
<td>21(69.8)</td>
<td>-17(1.4)</td>
<td>5(9)</td>
<td></td>
</tr>
<tr>
<td>1B (Snsr 2) Inhibit</td>
<td>40(104)</td>
<td>28(82.4)</td>
<td>21(69.8)</td>
<td>-17(1.4)</td>
<td>5(9)</td>
<td></td>
</tr>
<tr>
<td>2A Inhibit</td>
<td>40(104)</td>
<td>24(75.2)</td>
<td>21(69.8)</td>
<td>-17(1.4)</td>
<td>5(9)</td>
<td></td>
</tr>
<tr>
<td>2B Inhibit</td>
<td>40(104)</td>
<td>24(75.2)</td>
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<td>5(9)</td>
<td></td>
</tr>
<tr>
<td>3A (Snsr 1) Inhibit</td>
<td>40(104)</td>
<td>28(82.4)</td>
<td>21(69.8)</td>
<td>-17(1.4)</td>
<td>5(9)</td>
<td></td>
</tr>
<tr>
<td>3A (Snsr 2) Inhibit</td>
<td>40(104)</td>
<td>28(82.4)</td>
<td>21(69.8)</td>
<td>-17(1.4)</td>
<td>5(9)</td>
<td></td>
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<td>40(104)</td>
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</table>
1. DOCUMENTING HEATER POWER ALLOCATION FOR WARMUP OR MAINTENANCE

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
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<tbody>
<tr>
<td>1. The heater power allocation recorded in this step is the total power available for Node 1 and PMA 1 shell heaters.</td>
</tr>
<tr>
<td>2. PMA 1 Heaters 2A and 4B are not active and do not appear on the CDDT and PCS NODE 1 TCS display.</td>
</tr>
<tr>
<td>3. NODE1Htr79Avail display can be accessed from the NODE1Htr16Avail CDDT and PCS display page.</td>
</tr>
<tr>
<td>4. The Node Htr 7B setpoints on the Node1 HtrB Setpoints CDDT and PCS display are incorrect due to an identified mapping problem. The Node 1 Htr 7B setpoints should be accessed from the Node 1 Htr 7 page. The Node 1 Htr 7 page can be accessed as follows:</td>
</tr>
</tbody>
</table>

PCS Node 1: TCS: Htr Availability: Node1 Htr 7-9 Availability: Node1 Htr 7

√MCC for heater power allocation

Record Node 1 and PMA 1 total heater power allocation: ___________ W

2. NODE 1/PMA 1 SHELL HEATER PRIORITIZATION

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Node 1 and PMA 1 heaters are reconfigured at 4-hour intervals based on shell temperature and heater power allocation. The heaters may be reconfigured more frequently than every 4 hours if the heater power allocation changes. The heaters may be reconfigured less frequently during crew sleep periods or when not required.</td>
</tr>
<tr>
<td>2. While MCC-H is executing the procedure, additional margins will be applied to the shell temperature reading that may affect heater priority. These margins account for MDM errors, sensor errors, and sensor location.</td>
</tr>
<tr>
<td>3. While MCC-H is executing the procedure, Table 1 may be used, instead of Table 2, for maintenance operations to best condition the shell.</td>
</tr>
</tbody>
</table>

Record Node 1 and PMA 1 shell temperatures (use the lowest temperature if there are two temperature sensors) associated with each heater in Table 1 (or Table 2 during maintenance operations).

Rank the temperatures from coldest to warmest (i.e., coldest is ranked #1) in Table 1 (or Table 2 during maintenance operations).
In the rank order documented in Table 1 (or Table 2 during maintenance operations), select the group of heaters that can be operated within the heater power allocation recorded in step 1.

Record total power in Table 1 (or Table 2 during maintenance operations) for selected heaters.

If a given heater causes the total heater power to exceed the power allocation documented in step 1, then that heater should be skipped and the next heater in priority order should be compared to the power allocation.

3. **INHIBITING PMA 1 AND NODE 1 HEATERS NOT SELECTED FOR WARMUP OR MAINTENANCE**

   NOTE
   This step inhibits Node 1 and PMA 1 Shell Heaters which were used in the previous 4-hour period but were not selected for the next 4-hour period.

   If any PMA 1 or Node 1 Heater that did not meet the selection criteria in step 2 is Ena Opr, command the heater availability to inhibit per the following example (for PMA 1 Htr 1A).

   PCS  
   Node 1: TCS
   Node 1: TCS
   ‘PMA 1’

   sel Htr Availability

   PMA1 HtrAvailability

   cmd Htr1A – Inh

   √Availability – Inh

4. **ENABLING PMA 1 AND NODE 1 HEATERS SELECTED FOR WARMUP OR MAINTENANCE**

   NOTE
   This step enables Node 1 and PMA 1 Shell Heaters which were not used in the previous 4-hour period but were selected for the next 4-hour period.

   If any PMA 1 or Node 1 Heater selected in step 2 is Inh, command the heater availability to Ena Opr per the following example (for PMA 1 Htr 1A).

   PCS  
   Node 1: TCS
   Node 1: TCS
   ‘PMA 1’
sel Htr Availability

PMA1 HtrAvailability

cmd Htr1A – Ena Operate

√Availability – Ena Opr

Wait 4 hours, then repeat steps 1 --- 4 until all Node 1 and PMA 1 shell temperatures are ≥ the lower setpoints in Table 3.

Proceed to step 5 only after all PMA 1 and Node 1 shell temperatures are ≥ lower setpoint in Table 3.

5. REPEATING PREVIOUS STEPS FOR SHELL HEATER MAINTENANCE OPERATIONS

NOTE
This step should be executed only after all PMA 1 and Node 1 shell temperatures are ≥ the lower setpoints in Table 3. Table 2 is used for prioritizing heaters for heater maintenance operations.

Repeat steps 1 --- 4 every 4 hours or as required for shell heater maintenance operations.

NOTE
Table 2 should be used for the prioritization in step 2. The table indicates Node 1 and PMA 1 Shell Heaters that are utilized during maintenance operations.
Table 1. PMA 1/Node 1 Heater Prioritization for Shell Warmup

<table>
<thead>
<tr>
<th>Heater Name</th>
<th>Heater Power (Watts)</th>
<th>Temp (degC)</th>
<th>Rank</th>
<th>Temp (degC)</th>
<th>Rank</th>
<th>Temp (degC)</th>
<th>Rank</th>
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</thead>
<tbody>
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<td>PMA 1 HTR 1B</td>
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<td>PMA 1 HTR 2B</td>
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### Table 2. PMA 1/Node 1 Heater Prioritization for Shell Maintenance

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<th>Heater</th>
<th>Heater Power (Watts)</th>
<th>Temp (degC)</th>
<th>Rank</th>
<th>Temp (degC)</th>
<th>Rank</th>
<th>Temp (degC)</th>
<th>Rank</th>
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</table>
### Table 3. PMA 1/Node 1 Heater Configuration

#### PMA 1 Heaters - All Temperatures in °C(°F)

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<tr>
<th>Heater</th>
<th>Failure Upper Limit</th>
<th>Upper Setpoint</th>
<th>Lower Setpoint</th>
<th>Failure Lower Limit</th>
<th>Cyclic Load Delta</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A</td>
<td>40(104)</td>
<td>24(75.2)</td>
<td>21(69.8)</td>
<td>-17(1.4)</td>
<td>5(9)</td>
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<tr>
<td>1B</td>
<td>40(104)</td>
<td>24(75.2)</td>
<td>21(69.8)</td>
<td>-17(1.4)</td>
<td>5(9)</td>
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<tr>
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<td>40(104)</td>
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#### Node 1 Heaters - All Temperatures in °C(°F)

<table>
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<th>Failure Upper Limit</th>
<th>Upper Setpoint</th>
<th>Lower Setpoint</th>
<th>Failure Lower Limit</th>
<th>Cyclic Load Delta</th>
</tr>
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<tbody>
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<td>40(104)</td>
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<td>1A (Snsr 2)</td>
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</tr>
<tr>
<td>5A (Snsr 2)</td>
<td>40(104)</td>
<td>24(75.2)</td>
<td>21(69.8)</td>
<td>-17(1.4)</td>
<td>5(9)</td>
</tr>
<tr>
<td>5B (Snsr 1)</td>
<td>40(104)</td>
<td>24(75.2)</td>
<td>21(69.8)</td>
<td>-17(1.4)</td>
<td>5(9)</td>
</tr>
<tr>
<td>5B (Snsr 2)</td>
<td>40(104)</td>
<td>24(75.2)</td>
<td>21(69.8)</td>
<td>-17(1.4)</td>
<td>5(9)</td>
</tr>
<tr>
<td>6A (Snsr 1)</td>
<td>40(104)</td>
<td>24(75.2)</td>
<td>21(69.8)</td>
<td>-17(1.4)</td>
<td>5(9)</td>
</tr>
<tr>
<td>6A (Snsr 2)</td>
<td>40(104)</td>
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<td>21(69.8)</td>
<td>-17(1.4)</td>
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<td>6B (Snsr 1)</td>
<td>40(104)</td>
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<td>40(104)</td>
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<td>21(69.8)</td>
<td>-17(1.4)</td>
<td>5(9)</td>
</tr>
<tr>
<td>7A (Snsr 1)</td>
<td>40(104)</td>
<td>28(82.4)</td>
<td>21(69.8)</td>
<td>-17(1.4)</td>
<td>5(9)</td>
</tr>
<tr>
<td>7A (Snsr 2)</td>
<td>40(104)</td>
<td>28(82.4)</td>
<td>21(69.8)</td>
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<td>5(9)</td>
</tr>
<tr>
<td>9A (Snsr 1)</td>
<td>40(104)</td>
<td>24(75.2)</td>
<td>21(69.8)</td>
<td>-17(1.4)</td>
<td>5(9)</td>
</tr>
<tr>
<td>9B (Snsr 2)</td>
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<td>24(75.2)</td>
<td>21(69.8)</td>
<td>-17(1.4)</td>
<td>5(9)</td>
</tr>
</tbody>
</table>
1. DOCUMENTING PMA3 HEATER POWER ALLOCATION FOR WARMUP

**NOTE**
The heater power allocation recorded in this step is the total power available for PMA3 shell heaters.

√MCC-H for heater power allocation

Record heater power allocation here: __________ W

2. PMA3 SHELL HEATER PRIORITIZATION

**NOTE**
1. PMA3 heaters are reconfigured at 4-hour intervals based on shell temperature and heater power allocation. The heaters may be reconfigured more frequently than every 4 hours if the heater power allocation changes. The heaters may be reconfigured less frequently during crew sleep periods or when not required.

2. When MCC-H is executing the procedure, additional margins will be applied to the shell temperature reading, which may affect heater priority. These margins account for MDM errors, sensor errors, and sensor location.

Record PMA3 shell temperatures associated with each heater in Table 1.

First, rank the five B Heater’s shell temperatures from 1 --- 5 (1 being the coldest B Heater) in Table 1.

Second, rank the five A Heater’s shell temperatures from 6 --- 10 (6 being the coldest A Heater) in Table 1.

In Table 1, select the heaters that can be operated within the heater power allocation in step 2 by selecting the heaters in order of rank from coldest to warmest (lowest rank to greatest rank) from Table 1.

Record total power in Table 1 for selected heaters.

If a given heater will cause the total power to exceed the power allocation recorded in step 1, then that heater should be skipped and the next heater in rank should be compared to the power allocation.

3. INHIBITING HEATERS NOT SELECTED IN TABLE 1

Inhibit non-selected heaters from Table 1 per the following example (for PMA3 Heater 1B).

PCS

PMA3: TCS: Htr Availability

PMA3 HtrAvailability

*cmd* Htr 1B – Inhibit

√Htr 1B Availability – Inh
4. **POWERING ON SELECTED HEATERS**

Enable to Operate selected heaters from Table 1 per the following example (for PMA3 Heater 1B).

**PCS**

PMA3: TCS: Htr Availability

```plaintext
PMA3_HtrAvailability
```

**cmd** Htr 1B – Ena Operate

√ Htr 1B Availability – Ena Opr

Repeat steps 1 --- 4 every 4 hours until the coldest PMA3 shell temperature sensor is ≥ to the failure lower limit.

5. **CONFIGURING HEATERS FOR NOMINAL OPERATION**

**********************************************************

√MCC-H for heater power allocation to ensure that the following nominal heater reconfiguration does not exceed the power allocation

**********************************************************

**PCS**

PMA3: TCS: Htr Availability

```plaintext
PMA3_HtrAvailability
```

**cmd** Htr [X] B – Ena Opr  where [X] = 1 --- 5

**cmd** Htr [X] A – Ena BU  where [X] = 1 --- 5
### Table 1. Power for PMA3 Heaters

<table>
<thead>
<tr>
<th>Heater Name</th>
<th>Heater Power (W)</th>
<th>Temp (deg C)</th>
<th>Rank B (1 --- 5)</th>
<th>Total Heater Power (W)</th>
<th>Select Htr</th>
</tr>
</thead>
<tbody>
<tr>
<td>PMA3 HTR 1B</td>
<td>62.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PMA3 HTR 2B</td>
<td>60.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PMA3 HTR 3B</td>
<td>62.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PMA3 HTR 4B</td>
<td>62.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PMA3 HTR 5B</td>
<td>61.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PMA3 HTR 1A</td>
<td>61.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PMA3 HTR 2A</td>
<td>60.0</td>
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<tr>
<td>PMA3 HTR 3A</td>
<td>63.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PMA3 HTR 4A</td>
<td>63.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PMA3 HTR 5A</td>
<td>61.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Power Allocation: ____________W
Table 1. Power for PMA 3 Heaters (Cont)

<table>
<thead>
<tr>
<th>Heater Name</th>
<th>Heater Power (W)</th>
<th>Temp (deg C)</th>
<th>Rank B (1 --- 5)</th>
<th>Total Heater Power (W)</th>
<th>Select Htr</th>
</tr>
</thead>
<tbody>
<tr>
<td>PMA3 HTR 1B</td>
<td>62.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PMA3 HTR 2B</td>
<td>60.3</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PMA3 HTR 3B</td>
<td>62.9</td>
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<td></td>
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<tr>
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<td>60.0</td>
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</tr>
<tr>
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<td>63.4</td>
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</tr>
<tr>
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<td>63.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>PMA3 HTR 5A</td>
<td>61.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Power Allocation: _______________W
MALFUNCTION PROCEDURES
**TCS 3.101 EETCS LOOP A(B) PFCS FLUID LEAK CONDITION**

(Dec. 2000)

---

**Nominal Config:**
- P6: TCS: Loop A(B) PFCS
- PFCS: Loop A(B) PFCS FDIR Commands

**Leak Detection FDIR = Ena**

**Message is initiated if EETCS Loop A(B) PFCS Accum Fltrd Avg Qty < 10%**

**MCC-H** will assess the rate of the leak and the length of time before the pump(s) should be shut down. **MCC-H** will advise time and block number to reenter this procedure.

**The four accumulators monitored by the PFCS firmware are:**
- PFCS Accum Qty1
- PFCS Accum Qty2
- STCR Accum Qty
- TTCR Accum Qty

All four accumulator readings can be found using the following PCS navigation:
- P6: TCS: Loop A(B) PFCS
- Loop A(B) PFCS Details

**3. Loop A(B) is leaking.**

**4. Loop A(B) is leaking.**

**5. Message was either generated in error, or was caused by a transient.**

**6. Determine if Pump(s) are Shut Down**

**7. FDIR has commanded pump(s) Off to avoid pump damage. Line Heaters must now be deactivated.**

**8. FDIR has failed to shut down pump(s) in leaking loop. Pump(s) must be shut down in leaking loop to avoid pump activation.**

**9. Operating pump(s) in affected loop now shut down. Line heaters must also be shut down.**

---

29 AUG 00
Line heater patches contain a thermostat which should remove power from heater patches at elevated temperatures. However, no temperature or power insight is available to thermostats; therefore, heater RPC positions must be verified.

When the PFCS is powered off, all EETCS data on that loop becomes invalid, except the PFCS Out Ln Fltrd Temp.

Next step will likely be to address RPC failure.

With external coolant flow stopped, heat loads in the ITCS must be reduced to avoid overheating in ITCS components.
When enabled, the Max Out Temp FDIR will shut off the pumps and turn off both line heaters for the affected loop. Due to C&W reclassifications the Max Out Temp message is now a Caution; however, prior to CCS activation it appears as a Warning on the PCS and can be found in the Warning matrix.

If the Maximum Outlet Temp safing fails (pumps and/or line heaters cannot be commanded off) then the Maximum Outlet Temp Safing failed message is issued.

All displays in this procedure are on the PCS.

The line heaters contain thermostats which turn the line heaters off when temperature limits are exceeded; however, because there is no telemetry insight into the thermostats, it is necessary to check line heater RPC position.

User Notification

1. Confirming Maximum Outlet Temp FDIR was Successful
2. Checking Pump Speed
3. Checking Line Heater RPC Position
4. Commanding Pumps Off
5. Commanding PFCS Off
6. Commanding Line Htr1 RPC to Open
7. Commanding Line Htr2 RPC to Open

Nominal Config:
- FCV Cntl – Ena
- Line Htr Cntl – Ena
- EETCS Setpt PPL
- Ver ID – 1
- Line Htr Cmd Ck – Ena
- Max Out Temp FDIR – Ena
- FCV Temp Recal FDIR – Inh
- FCV Cntl algorithm controlling off both PFCS Out Temp sensors
- PSN Mode is not Fully Commanded
5 To continue troubleshooting, the PFCS must be turned back on in order to receive EETCS LoopA(B) data.

6 IFHX NH3 In Temp1 and IFHX NH3 In Temp2 may also be used to help determine the bias. These temperatures can be found on the EETCS Overview Display.

8 Removing power from the PFCS also removes power from the pumps. All EETCS LoopA(B) data is no longer updating.

9 Comparing Sensor Readings to Determine Bias
   - Compare data for PFCS Out Temp1, PFCS Out Temp2, and PFCS Out Ln Temp to determine which sensor reading is significantly different from the others.
   - PFCS Out Temp 1 indicates a bias
   - PFCS Out Temp 2 indicate a bias
   - No apparent biases

10 Removing PFCS Out Temp 1 from Sensor Selection Algorithm
   - To select Temp2 where X = A or B (the loop for which the procedure is being run), perform (2.102 EETCS LOOP A CONTROL OFF OF TEMP1(2)(TEMP1/TEMP2), all (SODF: TCS: NOMINAL: EETCS)) or (2.106 EETCS LOOP B CONTROL OFF OF TEMP1(2)(TEMP1/TEMP2), all (SODF: TCS: NOMINAL: EETCS)).

11 Removing PFCS Out Temp 2 from Sensor Selection Algorithm
   - To select Temp1 where X = A or B (the loop for which the procedure is being run), perform (2.102 EETCS LOOP A CONTROL OFF OF TEMP1(2)(TEMP1/TEMP2), all (SODF: TCS: NOMINAL: EETCS)) or (2.106 EETCS LOOP B CONTROL OFF OF TEMP1(2)(TEMP1/TEMP2), all (SODF: TCS: NOMINAL: EETCS)).

12 Comparing Sensor Readings Against Alarm Limit
   - PF6: TCS: LoopA(B) Details
     - LoopA(B) Details
     - EETCS LoopA(B)
   - No apparent biases

13 Transient temperature sensor reading. Neither sensor is above the failure limit.

14 Warning message caused by a biased sensor.

15 MCC-H for further details and data trending
When FCV Cntl is enabled, it generates an FCV Calc Setpt which is the position the PVCU believes the FCV needs to be at to maintain loop setpoint. The actual FCV Posn should closely match this value.

The FCV Calc Setpt is displayed as a normalized angle. To compare it against the FCV Posn, multiply the FCV Calc Setpt by 90 deg.

Comparing FCV Calc Setpt to FCV Posn

Checking FCV Position

Problem with FCV closed loop control. Either the control algorithm is working incorrectly, the FCV is not responding to commands or the PVCU commands are not executing properly.
### TCS 3.102 EETCS LOOP A(B) PFCS MAXIMUM OUTLET TEMP VIOLATION CONDITION

**Page 4 of 4 pages**

#### Checking Line Heater RPC Status

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>Was either Line Heater RPC opened via operator command?</td>
</tr>
</tbody>
</table>

- **Yes**: Continue to the next step.
- **No**: Go to the next step.

#### Checking Rad Rtn Temp

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>26</td>
<td>P6: TCS EETCS Overview 'EETCS PFCS Loop A(B)' Rad Rtn Temp &gt; 5°C?</td>
</tr>
</tbody>
</table>

- **Yes**: Proceed to step 27.
- **No**: Continue to the next step.

#### Inconsistent data.

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>29</td>
<td>Inhibited Line Htr Control in Backup PVCU</td>
</tr>
</tbody>
</table>

- **Yes**: Proceed to step 34.
- **No**: Go to the next step.

#### Placing Open Inhibit LoopB(A) PFCS RPC

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>37</td>
<td>P6: TCS Loop B(A) PFCS LoopB(A) PFCS (Nominal Commands) 'EETCS Loop B(A) PFCS' sel RPCM 2B(4B) A RPC04 RPCM 2B(4B) A RPC04 cmd Open Cmd – Inhibit</td>
</tr>
</tbody>
</table>

- **Yes**: Proceed to step 38.
- **No**: Go to the next step.

---

**Warm environment may be caused by station attitude. Attitude change may alleviate the warm condition.**

**An “X” will appear in all the Line Htr Cntl Inh Arm status fields when any Line Htr Inh command is armed.**

**MCC-H** may choose to perform **(EETCS LINE HEATER MANUAL CONTROL)**, all (SODF: TBD).

**An RPC Open command inhibit is placed on the remaining (opposite loop) PFCS RPC to prevent shutdown of the last remaining ammonia loop by the EPS Auto Load Shed capability.**

**MCC-H** will prepare and uplink a new version of the EPS Load Shed table which deletes auto powerdown of this PFCS. After this uplink is complete, the RPC Open Cmd Inhibit will be removed. Note that the RPC Open Command Inhibit disables one of three legs of IFHX Undertemp protection. If another leg of IFHX Freeze protection must be disabled in the near future, or the affected loop is recovered, the RPC Open Cmd Inhibit will be removed.
### 3.103 EETCS LOOP A(B) PFCS ORU FAILURE

(TCS/4A - ALL/FIN)

---

**1. Determine If PFCS Is Still Operating**

P6: TCS

- **P6:EETCS Overview**

  - EETCS PFCS LoopA(B)

  - Flow Rate > 772 kg/hr
  - Pump A or B Speed > 12000 rpm
  - Integ Counter – <incrementing>?

  - Yes: PFCS is still powered and pumps are running. However, there is no closed loop control of the outlet temperature. FCV and Line Heaters will remain in last commanded position. All data from the PFCS FWC is marked as invalid.

  - No: PFCS pumps are not running. No heat rejection provided to the Lab LTL(MTL) IFHX. ITCS loads may overheat in 1.5 hours.

**2. Verify Line Heater RPCs are Open**

P6: TCS: Loop A(B) Line Heater (Select either icon)

- **LoopA(B) Line Heater Commands**

  - EETCS LoopA(B) PFCS
    - ‘Ln Htr1’
    - RPC Posn – Op
    - ‘Ln Htr2’
    - RPC Posn – Op

**3. Perform PFCS FWC Reinit**

P6: TCS: Loop A(B) Firmware

- **LoopA(B) Firmware**

  - EETCS LoopA(B) PFCS
    - ‘FWC Reset’
    - cmd Arm
    - cmd Reset ‘RT Reset’
    - cmd RT Reset ‘Common Clear’
    - cmd Arm
    - cmd Common Clear

  - sel Clear Cmds: PV Assoc Data Clear

  - PV Assoc Data Clear
    - cmd Associated Data Clear Arm
    - cmd Associated Data Clear

  - Is ‘EETCS LoopA(B) PFCS ORU Failure - P6’ C&W message cleared?

**4. Verify EETCS Temperature Based FDIR Status**

- **P6: TCS: Loop A(B) PFCS LoopA(B) PFCS FDIR Commands**

  - LoopA(B) PFCS FDIR Commands
    - EETCS LoopA(B) PFCS
      - cmd Enable – Arm
      - cmd Enable – Ena
      - cmd Enable – X
      - cmd Enable – Ena

  - cmd Ena – Arm
  - cmd Ena – Ena
  - cmd Invaid Data/Max Ln Temp FDIR

**5. One of three legs for IFHX Freeze Protection are not functioning.**

**6. Perform PFCS FWC Reinit**

- **Inform MCC-H they are GO to perform {9.414 EETCS LOOP A(B) FCV MANUAL CONTROL}, (SODF: GND: TCS: CORRECTIVE).**

---

Notes:

- Failure message is generated by an ORU level error in a 1553 data bus transmission or if the time synchronization between the PFCS and PVCU exceeds the allowable tolerance.

Nominal Config:

- FCV Cntl – Ena
- Line Htr Cntl – Ena
- Line Htr Cmd Ck – Ena

**WARNING**

- **ALARM**

- ‘EEATCS LoopA(B) PFCS ORU Failure - P6’

- Nominal Config:
  - FCV Cntl – Ena
  - Line Htr Cntl – Ena
  - Line Htr Cmd Ck – Ena

- Failure message is generated by an ORU level error in a 1553 data bus transmission or if the time synchronization between the PFCS and PVCU exceeds the allowable tolerance.

---

**1. Determine If PFCS Is Still Operating**

P6: TCS

- **P6:EETCS Overview**

  - EETCS PFCS LoopA(B)

  - Flow Rate > 772 kg/hr
  - Pump A or B Speed > 12000 rpm
  - Integ Counter – <incrementing>?

  - Yes: PFCS is still powered and pumps are running. However, there is no closed loop control of the outlet temperature. FCV and Line Heaters will remain in last commanded position. All data from the PFCS FWC is marked as invalid.

  - No: PFCS pumps are not running. No heat rejection provided to the Lab LTL(MTL) IFHX. ITCS loads may overheat in 1.5 hours.

**2. Verify Line Heater RPCs are Open**

P6: TCS: Loop A(B) Line Heater (Select either icon)

- **LoopA(B) Line Heater Commands**

  - EETCS LoopA(B) PFCS
    - ‘Ln Htr1’
    - RPC Posn – Op
    - ‘Ln Htr2’
    - RPC Posn – Op

**3. Perform PFCS FWC Reinit**

P6: TCS: Loop A(B) Firmware

- **LoopA(B) Firmware**

  - EETCS LoopA(B) PFCS
    - ‘FWC Reset’
    - cmd Arm
    - cmd Reset ‘RT Reset’
    - cmd RT Reset ‘Common Clear’
    - cmd Arm
    - cmd Common Clear

  - sel Clear Cmds: PV Assoc Data Clear

  - PV Assoc Data Clear
    - cmd Associated Data Clear Arm
    - cmd Associated Data Clear

  - Is ‘EETCS LoopA(B) PFCS ORU Failure - P6’ C&W message cleared?

---

**1. There is no automatic FDIR response based on this failure.**

**2. The Freeze Protection leg which turns off the EETCS pumps will not function with invalid data. The FCV remains in its last commanded position. Depending on environmental conditions, the remaining two Freeze Protections legs could be initiated.**

**3. The FCV Manual Control procedure calls the EETCS Shutdown procedure if the loop temperature cannot be maintained. The shutdown procedure also reconfigures the ITCS loops. MCC-H will perform data dumps for additional troubleshooting.**

**4. If MCC-H is performing this procedure, then they may elect to perform a Commanded BIT and then data dump the results to help troubleshoot the failure. If MCC-H is unavailable, then continue with the procedure as written.**

---

16 AUG 00
3.103 EETCS LOOP A(B) PFCS ORU FAILURE
(TCS/4A - ALL/FIN)

9 Power Cycle PFCS
P6: TCS: Loop A(B)
PFCS: RPCM 4B(2B) A
RPC 04

- cmd RPC Position – Open
- RPC Position – Op
- Perform steps 1 -- 6,
  (4.106 EETCS LOOP A(B) RESTART), (SODF: TCS: CORRECTIVE: EETCS), then:

Is ‘EETCS Loop A(B) PFCS ORU Failure - P6’ C&W message cleared?

10 PFCS FW
reinitialization has cleared problem.

11 Restart the EETCS Loop

- Perform (4.106 EETCS LOOP A(B) RESTART)
  (SODF: TCS: CORRECTIVE: EETCS), steps 1 -- 5, then
  P6: TCS: Loop A(B)
  PFCS

LoopA(B) PFCS
Nominal Commands
EETCS LoopA(B) PFCS
- Record current FCV Posn = _______ Deg
- Calculate FCV Normalized Posn = _______ (= FCV Posn/90 Deg)
  ‘FCV Set Init Posn’
  input – FCV Normalized Angle
  cmd Set
  sel LoopA(B) PFCS
  Nominal Additional Commands

LoopA(B) PFCS
Nominal Additional Commands
EETCS LoopA(B) PFCS’ ‘FCV Set LOC Posn’
  input: 0.0
  cmd Arm
  cmd Set

12 Power cycle cleared problem and the EETCS can now be restarted.

13 Neither a warm reinit nor power cycle cleared problem.

14 Place Op Inh on the Other PFCS

Note that the navigation in this block is to the PFCS on the opposite loop.
P6: TCS: Loop B (A)
PFCS: RPCM 2B(4B) A
RPC 04

- cmd Open Cmd – Inh
- ‘Open Cmd – Inh

2.105 EETCS LOOP A(B) PFCS SHUTDOWN), steps 1, 4 (SODF: TCS: NOMINAL: EETCS)

5 MCC-H may perform data dumps of PFCS memory locations to try to isolate the failure. If needed, MCC-H will attempt additional warm reinit or power cycles.

6 A Normalized Position is calculated by dividing the current FCV Position reading in angular degrees by 90 degrees, which is the nominal range of motion for the valve.

7 The RPC Open Inhibit prevents the last operational PFCS from being shutdown in the event of a load shed. The Open Inhibit can be removed when a new version of the load shed table uplinked, power is recovered or another leg for freeze protection is lost.
The Pump Deadhead FDIR will attempt to command the pumps off and the Line Heater RPCs Open when the conditions are met. If safing is successful, the message 'EETCS LOOP A(B) PFCS PUMP DEADHEAD TRIP - P6' will be issued.

It is possible that multiple failures exist in the system. MCC-H will troubleshoot to determine if valve was erroneously closed or another problem resulted in it being closed. Opening line heater RPCs is considered part of the success criteria for deadhead safing FDIR; however, each of these line heaters has a thermostat which should protect the system from local overheating. Opening the RPCs is only taken as an additional precaution.
An RPC Open Command Inhibit is placed on the remaining PFCS RPC to prevent the last EETCS loop from being shutdown during an EPS Auto Load Shed. MCC-H will prepare and uplink a new version of the load shed table which prevents the shutdown of this PFCS. The RPC Open Command Inhibit will be removed at that time. Note that this disables one of three legs of IFHX freeze protection. If another leg is disabled, or the affected loop is recovered, this inhibit will be removed.

12 Commanding Affected Line Heater(s) RPCs to Open

On same display
• sel RPCM 4B(2B) A RPC 05(06)
• cmd RPC Position – Open

Is RPC Position – Open?

Yes

13 Troubleshooting RPC Problem

• Perform (3.203 RPC OPEN (CLOSE) FAILURE), all (SODF: EPS: MALFUNCTION: SECONDARY POWER SYSTEM), then:

14 Loop safing manually completed.

• Notify MCC-H that manual safing was required.

4

15

16 Determining if Flow Sensor has Failed

P6: TCS
P6: EETCS Overview
‘EETCS PFCS’

Is Loop A(B) Flow Rate = 0 ± 424 kg/hr?

Yes

17 Flow sensor is good and pump deadhead condition may actually exist.

No

18 Navigating to Opposite Loop PFCS and Inhibiting the RPC Open Command

P6: TCS: Loop B(A) PFCS
Loop B(A) PFCS Nominal Commands
‘EETCS LoopB(A) PFCS’
• sel RPCM 2B(4B) A RPC 04
• cmd Open Cmd – Inhibit
• √ Open Cmd – Inh

19 Flow sensor may have failed causing the alarm.

20 • MCC-H for confirmation of failed sensor

21 Inhibiting Pump Deadhead Algorithm

P6: TCS: Loop A(B) PFCS: Loop A(B) PFCS FDIR Commands
Loop A(B) PFCS FDIR Commands
‘Pmp Deadhead FDIR’
• cmd Inhibit – Arm
• cmd Inhibit – Inh
(√ – Inh)
• sel Loop A(B) Bkup PVCU Commands
Loop A(B) Bkup PVCU Commands
‘PFCS Pmp Deadhead FDIR’
• cmd Inhibit – Arm
• cmd Inhibit – Inh
(√ – Inh)

22 Reconfiguring IATCS

• Perform (4.214 LAB MANUAL HEAT LOAD REDUCTION AND RECONFIGURATION), all (SODF: TCS: CORRECTIVE: IATCS), then:
• MCC-H for further troubleshooting steps

24 AUG 00
3.105 EETCS LOOP A(B) PFCS PUMP X FAILURE
(TCS/4A - ALL/FIN)

1. Check for additional C&W
   1.1 CW Summ
   1.2 Caution & Warning Summary

   Warning - "EETCS Loop A(B) Pump Switchover Failed - P6?"
   Yes (2.801 EETCS LOOP A(B) PUMP SWITCHOVER FAILED CHECKLIST - WARN), all (SODF: EMER: WARNING: TCG)

   No

2. EETCS Loop A(B) PumpX degraded/failed.

3. Inhibit Pump Switch Algorithm
   P6: TCS: Loop A(B) PFCS: Loop(A(B) PFCS FDIR Commands
   LoopA(B) PFCS FDIR
   Commands
   ‘EETCS LoopA(B) PFCS (’Pump Switch FDIR’)
   • cmd Inhibit – Arm
   • cmd Inhibit – Inh
   • Pump Switch FDIR – Inh

4. Inhibit Pump Switch Algorithm in Backup MDM
   P6: TCS: Loop A(B) PFCS: LoopA(B) Bkup PVCU Commands
   LoopA(B) Bkup PVCU
   Commands
   ‘Bkup PVCU EETCS LoopA(B)’
   ‘PFCS Pump Switch FDIR’
   • cmd Inhibit – Arm
   • cmd Inhibit – Inh
   • PFCS Pump Switch FDIR – Inh

5. √ MCC-H for further action

All displays in this procedure are on the PCS.

The Pump Switch FDIR is inhibited to prevent the software from reactivating a failed pump in the event the new operating pump fails.

MCC-H will evaluate trend data on the failed pump to determine the extent of the pump failure (sensor bias, mechanical failure, etc.).
The PFCS FCS Temp Recal FDIR is nominally inhibited; and therefore, will not take recovery actions upon receiving this message. If temperatures continue to increase and the EATCS Loop A(B) PFCS Maximum Outlet Temp Violation Condition - P6 is enunciated, immediately perform step 102. EETCS Loop A(B) PFCS Maximum Outlet Temp Violation Condition - P6 is enunciated, immediately perform step 102.

All displays in this procedure are on the PCS.

PFCs Out Line Fltrd Temp, IFHX NH3 In Temp1 and IFHX NH3 In Temp2 may also be used to help determine the bias. These temperatures can be found on the EETCS Overview Display.

Caution condition will clear automatically once the Out Fltrd Lwr Temp drops below the 8.3 deg C limit for 5 minutes. No common or specific clear commands are necessary.

MCC-H for details on loop operation without use of affected line heater and possible RPC troubleshooting steps.
When FCV Cntl is enabled, it generates an FCV Calc Setpt which is the position the PVCU believes the FCV needs to be at to maintain loop setpoint. The actual FCV Posn should closely match this value.

The FCV Calc Setpt is displayed as a normalized angle. To compare it against the FCV Posn, multiply the FCV Calc Setpt by 90 deg.

Warm environment may be caused by station attitude. Attitude change may alleviate the warm condition.

Caution condition will clear automatically once the EEATCS Loop A(B) PFCS Out Fltrd Lwr Temp drops below the 8.3 deg C limit for 5 minutes. No common or specific clear commands are necessary.
This procedure assumes that PumpX has failed and that PumpY is the new primary pump.

Both pump speeds are at levels that should have passed the Command Response checks. One of the pumps may have taken longer than the Command Response timeframe to reach the necessary level. MCC-H will monitor pump performance.

With both pumps operating, it is possible that the check valve downstream of the parallel pumps could be "fluttering" between flow positions and causing the loop flow rate to be low. MCC-H will assess the impacts of operating with two pumps providing flow. As long as PFCS is providing the required flow rate to the IFHX, no immediate action is required.
Although PumpX has not been successfully commanded off, there is still some amount of cooling being provided to the Lab IATCS IFHX. MCC-H will evaluate whether or not to leave the EETCS in the current configuration or to attempt a power cycle of the PFCS.

The Pump Switch FDIR is inhibited to prevent the software from attempting to reactivate a failed pump in the event that the new primary pump fails.
The PFCS should not remain powered when no pumps are on. The PFCS electronics may overheat (no temperature insight for PFCS components). To be conservative, the PFCS is powered off.

Line Heater patches contain a thermostat which should remove power from heater patches at elevated temperatures. However, no temperature or power insight is available to thermostats. Therefore, Line Heater RPC positions must be verified.

After a thermal load shed (TLS) timer has started, the only way to prevent the TLS from occurring is to inhibit the TLS function and let the timer expire and return to its original value (default=300). A C&W message indicating that TLS was inhibited when timer expired may be available for CCS R2.

The Pump Switch FDIR is inhibited to prevent the software from attempting to reactivate a failed pump in the event that the new primary pump fails.
Firmware will move FCV to LOC position (Full Bypass FCV Posn = 0 deg).

All displays in this procedure are on the PCS.

Power Loss will cause static data to be displayed and valves will not move when commanded.

A static PFCS Integration Counter is evidence that LOC condition exists.

EETCS PFCS Max Out Temp FDIR occurs when the PFCS Out Ln Fltrd Temp reads 10 deg C. It will take the following actions: command the Pumps Off. Open the RPC’s for both Line Heaters.
An RPC Open command inhibit is placed on the remaining PFCS RPC to prevent shutdown of the last remaining ammonia loop by the EPS Auto Load Shed capability.

MCC-H will prepare and upload a new version of the EPS Load Shed table which deletes auto power down of this PFCS. After this upload is complete, the RPC Open Cmd Inhibit will be removed.

The RPC Open Command inhibit disables one of three legs of IFHX Undertemp protection. If another leg of IFHX Freeze protection must be disabled in the near future, or the affected loop is recovered, the RPC Open Cmd Inhibit will be removed.

Ground Troubleshoot:
Check for EPS failures.
Power Cycle PFCS EETCS Loop Restart.
An RPC Open command inhibit is placed on the remaining PFCS RPC to prevent shutdown of the last remaining ammonia loop by the EPS Auto Load Shed capability.

MCC-H will prepare and uplink a new version of the EPS Load Shed table which deletes auto power down of this PFCS. After this uplink is complete, the RPC Open Cmd Inhibit will be removed.

The RPC Open Command Inhibit disables one of three legs of IFHX Undertemp protection. If another leg of IFHX Freeze protection must be disabled in the near future, or the affected loop is recovered, the RPC Open Cmd Inhibit will be removed.

Since Out Line Fltr Temp is wired directly to PVCU LLA Card, it will not be affected by LOC and can be used to monitor Pump Out Temp.

Ensure that PFCS w/ stuck FCV Does Not Launch IFHX Freeze Protection FDIR. Commands to the PFCS will not work due to LOC condition, therefore the steps to Cmd Pump Off and Posn FCV should not be executed.

The Flow Control Valve Successfully transitioned to Full Bypass Posn (0 degrees).
All displays in this procedure are on the PCS.

By issuing these two commands, the error indicators generated by the firmware are cleared, allowing Deploy/Retract commands to be sent once again.

1. TCR Status
   P6: TCS: TTCR (STCR)
   TTCR (STCR) Commands
   'EETCS LoopA TTCR
   (LoopB STCR)'

2. Sailing the TCR
   Drive Stat = Stop
   or Motor Power Cmd Stat = Off?
   No

3. Checking for Advisory
   CW Summ
   (Turn Advisories On)
   Does the following Advisory exist?
   'EETCS Loop A(B) PVR
   Config Complete Salting
   Failed - P6'?

4. FDIR did not execute.

5. Checking Integrity of Cmd Path
   CW Summ
   (Turn Advisories On)
   Do either of these Advisories exist?
   'PFCS Command Response Failed' or
   'PFCS Not Receiving Commands'?
   No

6. Clearing Flag
   P6: TCS: Loop A(B)
   Firmware: Clear Cmds:
   PV Other CW Clear
   PV Other CW Clear
   Command
   'cmd' PVR Config Trip
   Clear – Arm
   'cmd' – Clear

7. FDIR did not execute.
   MCC-H for further troubleshooting
   No

8. Transient condition.
   Yes

9. If possible, perform a visual check for obstructions to radiator motion.
   Yes

10. Attitude is in Free Drift

Nominal Config:
   P6:TCS:TTCR
   (STCR)
   TTCR (STCR) Commands
   EETCS LoopA
   TTCR (LoopB
   STCR)'

TCR Config Fail
   FDIR = Ena
   TCR Auto Timeout
   FDIR = Ena
   TCR Auto Off = Ena
   TCR Status
   FDIR Actions
   (firmware):
   Overcurrent Trip
   (Event driven)
   TCR Power Off
   Auto Timeout
   (After 13 minutes
   w/o success)
   TCR Power Off
   TCR Stop

TCR Config Fail
   FDIR = Ena
   TCR Auto Timeout
   FDIR = Ena
   TCR Auto Off = Ena
   Attitude is in Free Drift

09 AUG 00
Mode Transition should be performed for the power channel, which is associated with the radiator being transitioned. The TTCR is controlled by Loop A PFCS, which is associated with power channel 4B. The STCR is controlled by Loop B PFCS, which is associated with power channel 2B.

If Attitude adjustment is necessary, perform adjustment before continuing with block 14 or 15. Radiator motor must be stopped during any attitude maneuver. Docking, undocking and reboost can be performed with a partially deployed/retracted radiator if necessary. The Station must be in Free Drift mode before attempting block 14 or 15.
Mode Transition should be performed for the power channel, which is associated with the radiator being transitioned. The TTCR is controlled by Loop A PFCS, which is associated with power channel 4B. The STCR is controlled by Loop B PFCS, which is associated with power channel 2B.

The EVA will likely include a visual check for obstructions. If the radiator looks to be fully deployed/retracted and the pulleys are in their hardstop position, then the problem was likely due to a sensor failure.
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All displays in this procedure are on the PCS.

A specific thermal load shed will be requested that is determined by the combination of entry conditions met. Table 1 lists all entry condition combinations and the resulting load shed response requests.
8 Load Shed FDIR has been inhibited.

9 Check MCC-H

10 A request for complete LTL and MTL thermal load sheds has been issued. If the software FDIR is enabled, all non-critical and critical heat loads on the LTL and MTL water loops will be unpowered.

11 Wait for Further C&W Messages

- C&W Summary
  - Wait until one of the following messages is received.
  - ‘Thermal Safing LTL Complete Load Shed Started’ and ‘Thermal Safing MTL Complete Load Shed Started’ messages received?
  - ‘Thermal Safing Load Shed Inhibited - LAB’ message received?

12 Load Shed FDIR has been inhibited.

13 Check MCC-H

- MCC-H for any further action required
A request for a partial LTL thermal load shed has been issued. If the software FDIR is enabled, non-critical heat loads on the LTL water loops will be unpowered.

A request for a partial MTL thermal load shed has been issued. If the software FDIR is enabled, non-critical heat loads on the MTL water loops will be unpowered.

Wait for Further C&W Messages

• Wait until one of the following messages is received.

Thermal Safing Load Shed Inhibited - LAB message received?

Thermal Safing MTL Partial Load Shed Started message received?

Thermal Safing LTL Partial Load Shed Started message received?

Non-critical heat loads have been shed from low temp internal water loop. Some functionality may be lost.

Check MCC-H

• MCC-H for possible thermal load shed recovery actions
A complete thermal load shed has executed. Currently no actively cooled equipment is receiving cooling. DDCU-TBD, C&C-TBD, INT-TBD, and TBD are still powered and will overheat if cooling is not restored.

Determine ITCS Functionality

C&W Summary

- Note the time 'Thermal Safing MTL Complete Load Shed Started' message was received.
- GMT: ____________

Determine ITCS Functionality

Lab: TCS: Thermal Load Reduction

- Thermal Load Reduction

**Entry Conditions**

- Determine if MTL ITCS functionality is still available.

IATCS MTL Shutdown Power Request – True and IATCS LTL Shutdown Power Request – True?

IATCS MTL Shutdown Power Request – True and IATCS LTL Shutdown Power Request – False?

Neither of the above conditions is met.

ITCS functionality is available, but heat rejection capability is lost. ITCS pumps should be used to avoid stagnant water in coldplates which will delay overheating of powered equipment.

MTL ITCS functionality has been lost. If cooling cannot be restored via on-orbit maintenance by the time noted in step TBD + TBD minutes, equipment should be powered down to avoid hardware damage.

ITCS functionality is available, but heat rejection capability is lost. ITCS pumps should be used to avoid stagnant water in coldplates which will delay overheating of powered equipment.

3.201 AUTOMATIC LTL(MTL) THERMAL LOAD SHED RESPONSE

(TCS/5A - ALL/FIN) Page 4 of 5 pages
### Table 1. Thermal Load Shed Entry Conditions and Associated Responses

<table>
<thead>
<tr>
<th>IATCS Mode</th>
<th>Entry Condition Telemetry</th>
<th>Response</th>
</tr>
</thead>
</table>
| Dual or Single LT or Single MT | EETCS Loop A Fail Ind – True  
EETCS Loop B Fail Ind – True | A  
IATCS MTL IFHX Byp/Isol – True  
IATCS MTL IFHX Byp/Isol – True |
| Dual LT Failed | EETCS Loop B Fail Ind – True  
IATCS MTL IFHX Byp/Isol – True |  
Dual MT Failed | EETCS Loop A Fail Ind – True  
IATCS MTL IFHX Byp/Isol – True |
| Dual | EETCS Loop A Fail Ind – True  
EETCS Loop B Fail Ind – True  
IATCS MTL IFHX Byp/Isol – True  
IATCS MTL IFHX Byp/Isol – True | B  
Single LT or Single MT | EETCS Loop A Fail Ind – True  
EETCS Loop B Fail Ind – True  
IATCS MTL IFHX Byp/Isol – True  
IATCS MTL IFHX Byp/Isol – True |
| Any IATCS Mode | IATCS LTL Shutdown Power Request – True  
IATCS MTL Shutdown Power Request – True | A  
IATCS LTL Shutdown Power Request – True  
IATCS MTL Shutdown Power Request – True | D  
IATCS MTL Shutdown Power Request – True | E |
3.202 LAB IATCS LEAK AUTO ISOLATION

(TCS/5A - ALL/FIN)

1. Determine System Status

- Lab IATCS Leak Isolation and Determination Failed
  Warning message issued?

- Lab LTL(MTL) Leak Auto Shutdown Warning message issued?

2. Leak isolation failed.
   all (SODF: EMER: WARNING PROCEDURES: TCG)

3. LTL(MTL) Loop is leaking.

4. LRITCS Auto shutdown is inhibited.
   (2.807 LAB LTL(MTL) LEAK SHUTDOWN INHIBITED - WARN),
   all (SODF: EMER: WARNING PROCEDURES: TCG)

5. Leak rate is too small for leak software to detect.

6. Determine Leaking Loop

- Lab: IATCS Overview
  IATCS Overview
  Lab: TCS
  LAB: IATCS Overview
  Status

- Is Lab LTL PPA Avg Accum Qty – decreasing or has LTL PPA Accum Qty Low Limit C&W been issued?

- Is Lab MTL PPA Avg Accum Qty – decreasing or has MTL PPA Accum Qty Low Limit C&W been issued?

7. LTL Loop is leaking.
   (3.206 LAB LTL LEAK SAFING), all (SODF: TCS: MALFUNCTION: IATCS)

8. MTL Loop is leaking.
   (3.219 LAB MTL LEAK SAFING), all (SODF: TCS: MALFUNCTION: IATCS)

9. Leak source indeterminate.

10. •√MCC-H for further Leak troubleshooting

All displays in this procedure are on the PCS.

Nominal Config:
LAB: TCS

IATCS Overview

Status
√IATCS Mode – Sngl
√Leak Rcvy – Ena
√LTL Leak Rcvy – Ena
√MTL Leak Rcvy – Ena

1 Determine System Status

‘Lab IATCS System Auto Isolation and Begin Leak Determination’

WARNING ALARM

‘Lab IATCS Leak Isolation and Determination Failed’ Warning message issued?

‘Lab LTL(MTL) Leak Auto Shutdown’ Warning message issued?

‘Lab LTL(MTL) Leak Auto Shutdown Inhibited’ Warning message issued?

All displays in this procedure are on the PCS.
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3.203 LAB IATCS LEAK ISOLATION FAILED
(TCS/5A - ALL/FIN)  Page 1 of 7 pages

All displays in this procedure are on the PCS.

2 FDIR has depressed the loop, but the SFCA shutoff valve failing closed has caused the loop to be isolated from its accumulator. If leak is in the same loop as the failed SFCA valve, the leak rate has not decreased in response to the accumulator venting.
3.203 LAB IATCS LEAK ISOLATION FAILED

(TCS/5A - ALL/FIN) Page 2 of 7 pages

2

6 Command LCA Valve

Lab: TCS: LCA Icon
LCA Commands
'LCA'
• cmd Vlv 1 Posn – Dual
Is LCA Vlv 1 Posn – Dual?
Yes

7 Command LCA Valve

Lab: TCS: LCA Icon
LCA Commands
'LCA'
• cmd Vlv 2 Posn – Dual
Is LCA Vlv 2 Posn – Dual?
No

8 Check Valve Position

• Rotate Rack LAP6 (Refer to {LAB LTL/CABIN AIR RACK ROTATE} (SODF: TBD)).
Is LCA Valve 1 in the "Isolated" Position?
Yes

9 Command LCA Valve

• Rotate Rack LAP6 (Refer to {LAB LTL/CABIN AIR RACK ROTATE} (SODF: TBD)).
Is LCA Valve 2 in the "Isolated" Position?
No

10 Manually Move LCA Valve 1

• Fold Out Handle on LCA Valve 1.
• Rotate Valve 1 clockwise from "Cross-Connected" to "Isolated."
• Fold In Handle on LCA Valve 1.
• Rotate Rack back to nominal installed position (Refer to {LAB LTL/CABIN AIR RACK ROTATE} (SODF: TBD)).
Did LCA Valve 1 Move?
No

11 Manually Move LCA Valve 2

• Rotate Rack LAP6 (Refer to {LAB LTL/CABIN AIR RACK ROTATE} (SODF: TBD)).
• Fold Out Handle on LCA Valve 2.
• Rotate Valve 2 clockwise from "Cross-Connected" to "Isolated."
• Leave Handle on LCA Valve 2 extended.
• Rotate Rack back to nominal installed position (Refer to {LAB LTL/CABIN AIR RACK ROTATE} (SODF: TBD)).
Did LCA Valve 2 Move?
Yes

12 Command LCA Valve

Lab: TCS: LCA Icon
LCA Commands
'LCA'
• cmd Vlv 1 Posn – Dual

13 Command LCA Valve

Lab: TCS: LCA Icon
LCA Commands
'LCA'
• cmd Vlv 2 Posn – Dual

Lab Rack LAP6 must be rotated out to access the LCA Valves.

When manually transitioning LCA Valve 2 from "Cross-Connected" to "Isolated," the valve handle cannot be reengaged into a stowed position. Leave the valve handle extended in this step.

Valve position must be commanded after a manual valve maneuver to synch up the software and hardware positions.

05 SEP 00

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TCS 3.203 LAB IATCS LEAK ISOLATION FAILED
(TCS/5A - ALL/FIN)  Page 3 of 7 pages

14 Check Valve Position
LAB: TCS: LTL SFCA
[MTL SFCA Commands]
LTL SFCA
• cmd Shutoff Vlv Posn – Open

LTL Shutoff Vlv Posn – Open?
Yes 27
No

16 Check Valve Position
• Open front panel on LABP6 rack by lifting the panel latches (two) and swinging the panel door open.

Is Pump Inlet Shutoff Handle in the Open position?
Yes 41
No

18 Manually Move LTL Shutoff Valve
• Pull Out LTL SFCA Pump Inlet Shutoff Handle.
• Turn Pump Inlet Shutoff Handle counterclockwise to the Open position.
• Push In LTL SFCA Header Pressure Valve Handle.
• Close front panel by swinging the panel closed and engaging the panel latches (two).

Did LTL SFCA Shutoff Valve Move?
Yes 26
No 20

15 Check Valve Position
LAB: TCS: MTL SFCA
[MTL SFCA Commands]
MTL SFCA
• cmd Shutoff Vlv Posn – Open

MTL Shutoff Vlv Posn – Open?
Yes 27
No

17 Check Valve Position
Open front panel on LABS6 Rack by lifting the panel latches (two) and swinging the panel door open.

Is Pump Inlet Shutoff Handle in the Open position?
Yes 41
No

19 Manually Move MTL Shutoff Valve
• Pull Out MTL SFCA Pump Inlet Shutoff Handle.
• Turn Pump Inlet Shutoff Handle counterclockwise to the Open position.
• Push In MTL SFCA Header Pressure Valve Handle.
• Close front panel by swinging the panel closed and engaging the panel latches (two).

Did MTL SFCA Shutoff Valve Move?
Yes
No 26
21
Shutoff valve is stuck closed, but leaking loop can still be determined by commanding the operational pump to a reduced speed and watching the loop's accumulator level.

- **20** Set MTL Pump Speed and Check Accumulator Qty
  - Lab: TCS: MTL PPA
  - MTL PPA Commands
    - 'MTL PPA'
      - Pump Software - Startup
        - When Pump Software - Started
          - input Set Pump Speed Arm: 11373 rpm
          - cmd Arm (√ – X)
          - input Set Pump Speed Set: 11373 rpm
          - cmd Set
            - Lab: IATCS Overview
              - 'PPA'
                - Verify MTL Pmp Spd: 11373 ± 1250 rpm
                - Record MTL Avg Accum Qty %
  - Is Lab MTL PPA Avg Accum Qty - <decreasing> at least 1 % within 5 minutes?
    - Yes
      - **23** Leak is on the MTL and the LTL PPA SOV is stuck closed. No ITCS cooling is currently available.
    - No
      - **21** Leak is on the LTL and the MTL PPA SOV is stuck closed. ITCS MTL cooling is currently available.
      - **32** Leak is on the MTL and the MTL PPA SOV is stuck closed. ITCS LTL cooling is currently available.

- **22** Leak is on the LTL and the LTL PPA SOV is stuck closed. ITCS MTL cooling is currently available.
  - Yes
  - No

- **24** Leak is on the LTL and the MTL PPA SOV is stuck closed. No ITCS cooling is currently available.
  - Yes
  - No

- **25** Leak is on the MTL and the MTL PPA SOV is stuck closed. ITCS LTL cooling is currently available.

- **26** Shutoff valve is stuck closed, but leaking loop can still be determined by commanding the operational pump to a reduced speed and watching the loop's accumulator level.

- **27** Leak is on the LTL and the LTL PPA SOV is stuck closed. No ITCS cooling is currently available.

- **28** Leak is on the MTL and the MTL PPA SOV is stuck closed. ITCS MTL cooling is currently available.

- **29** Leak is on the MTL and the MTL PPA SOV is stuck closed. ITCS LTL cooling is currently available.

- **30** Leak is on the MTL and the MTL PPA SOV is stuck closed. ITCS MTL cooling is currently available.

- **31** Leak is on the MTL and the MTL PPA SOV is stuck closed. ITCS LTL cooling is currently available.

- **32** Leak is on the MTL and the MTL PPA SOV is stuck closed. ITCS LTL cooling is currently available.

- **33** Leak is on the MTL and the MTL PPA SOV is stuck closed. ITCS LTL cooling is currently available.

- **34** Leak is on the MTL and the MTL PPA SOV is stuck closed. ITCS LTL cooling is currently available.

- **35** Leak is on the MTL and the MTL PPA SOV is stuck closed. ITCS LTL cooling is currently available.

- **36** Leak is on the MTL and the MTL PPA SOV is stuck closed. ITCS LTL cooling is currently available.

- **37** Leak is on the MTL and the MTL PPA SOV is stuck closed. ITCS LTL cooling is currently available.
### 3.203 LAB IATCS LEAK ISOLATION FAILED

(TCS/5A - ALL/FIN)  

---

**Command LTL(MTL) SFCA Shutoff Valve**

**LTL(MTL) SFCA Commands**

- **cmd** Shutoff Vlv Posn – Open

---

**Determine Leaking Loop**

- **Lab: IATCS Overview**
  - **IATCS Overview**
    - **PPA**

  **Is Lab LTL PPA Avg Accum Qty – <decreasing> at least 1 % within 5 minutes?**

  **Is Lab MTL PPA Avg Accum Qty – <decreasing> at least 1 % within 5 minutes?**

  **Neither Accumulator decreasing**

---

**Command ITCS Mode**

**Software Commands**

- **cmd** Dual – Arm
- **cmd** Dual – Dual

---

**Record Accumulator Qtys**

**Lab: IATCS Overview**

- **IATCS Overview**
  - **PPA**

  **Set Contingency Leak Limits**

  **Record LTL and MTL Avg Accum Qty.**

  **LTL**
  - Avg Accum Qty, LTL %
  - Lab: TCS Software Commands: Software Additional Commands
    - **cmd** Set Contingency Leak Limits – Set
    - Monitor for LTL or MTL ITCS Leak caution or warning messages.
    - Perform appropriate malfunction procedure if any messages are received.
Leak is un-isolatable. Lab must be shut down to avoid hardware damage.

Perform Lab Egress
- Egress the US LAB Module.

Shut down Lab
- Thermal Load Reduction
  - Manual Load Shed
  - cmd Partial LTL – Arm (√ – X)
  - cmd Partial LTL – Ena
  - Verify ‘Thermal Safing LTL Partial Load Shed Started’ Caution message received.
  - Wait 2 minutes.
  - cmd Complete LTL – Arm (√ – X)
  - cmd Complete LTL – Ena
  - Verify ‘Thermal Safing LTL Complete Load Shed Started’ Caution message received.
  - Wait 2 minutes.

Egress the US LAB Module.

Perform Leak Procedure
- Perform (3.206 LAB LTL LEAK SAFING), all (SODF: TCS: MALFUNCTION: IATCS)

Issue Mode Command
- cmd IATCS Mode Dual LTL Fail – Arm
- IATCS Mode Arm Status – Dual LTL Fail
- cmd IATCS Mode Dual LTL Fail – Dual LTL Fail
- IATCS Mode – Dual LTL Fail
- cmd IATCS Activation – Startup

Issue Mode Command
- cmd IATCS Mode Dual MT Fail – Arm
- IATCS Mode Arm Status – Dual MT Fail
- cmd IATCS Mode Dual MT Fail – Dual MT Fail
- IATCS Mode – Dual MT Fail
- cmd IATCS Activation – Startup

Perform Leak Procedure
- Perform (3.219 LAB MTL LEAK SAFING), all (SODF: TCS: MALFUNCTION: IATCS)

Issue Mode Command
- cmd IATCS Mode Dual MT Fail – Arm
- IATCS Mode Arm Status – Dual MT Fail
- cmd IATCS Mode Dual MT Fail – Dual MT Fail
- IATCS Mode – Dual MT Fail
- cmd IATCS Activation – Startup

On MCC-H GO
- CDH
- CDH Summary
- Is C&C-2 – Primary?
- Is C&C-1 – Primary?

Perform Leak Procedure
- Perform (3.219 LAB MTL LEAK SAFING), all (SODF: TCS: MALFUNCTION: IATCS)
41 SFCA Shutoff Valve
Position sensor has failed.
Valve is in a good
configuration for pump
start up.

42 LCA Valve Position
sensor has failed. Valve is
in a good configuration for
pump start up in Dual Loop
mode.

43 Spin Up Pumps
LAB: TCS: LTL PPA
LTL PPA Commands
'LTL PPA'
• Pump Software – Startup
When Pump Software –
Started
• input Set Pump Speed
Arm: 11373 rpm
• cmd Arm (√ – X)
• input Set Pump Speed
Set: 11373 rpm
• cmd Set
• Repeat this block for the
MTL Pump.

44 Set Accumulator Leak
Thresholds
Lab: IATCS Overview
IATCS Overview
‘PPA’
• Verify MTL and LTL Pmp
Spd: 11373 ± 1250 rpm
• Record LTL and MTL Avg
Accum Qty.
Avg Accum Qty,
LTL: %
Avg Accum Qty,
MTL: %
LAB: TCS: Software
Commands: Software
Additional Commands
Software Additional
Commands
• cmd Set Contingency
Leak Limits – Set

45 Leak Isolation
Procedure
• Perform (3.202 LAB
IATCS LEAK AUTO
ISOLATION), block 6
(SODF: TCS:
MALFUNCTION: IATCS)
There are no FDIR actions associated with this alarm.

Warning is close to occurring. Warning enables LRITCS to automatically switch to Dual Mode and set Contingency Leak Limits. Manually performing these actions (steps 4 and 5 of current procedure) in the event of a slower leak will result in less water being lost due to leakage.

LRITCS algorithm remains in Single Loop Mode until transition to Dual Loop Mode is complete.

1. Check Accumulator Quantities
   
   - If \((\text{LTL Avg Accum Qty} + \text{MTL Avg Accum Qty})/2) \leq 69\%\), execute steps 3 and 4.
   - Otherwise, restart from step 1.

2. Command to Dual Mode
   
   - Execute steps 3 and 4.

3. Wait for 'Lab IATCS System Auto Isolation and Begin Leak Determination - LAB' message to be issued.

4. Wait 2.5 minutes for transition to take effect.

5. Continue with next procedure.
Send Contingency Leak Limits Command

Contingency Leak Limits Command sets the LTL(MTL) PPA Accum Qty Low Limit = Current LTL(MTL) PPA Avg Accum Qty: 4 % and sets the LTL(MTL) Leak Rcvy Auto Shutdown Limit = Current LTL(MTL) PPA Avg Accum Qty: 7 %.

This step determines which loop is leaking and the leak rate.

Accumulator will reach the LTL(MTL) Leak Rcvy Auto Shutdown Limit (Warning) in no later than 60 minutes.

Monitor Leak Rate Over 10 Minutes

After 10 minutes, did LTL Avg Accum Qty decrease by 1 %?

After 10 minutes, did MTL Avg Accum Qty decrease by 1 %?

None of the above

MCC for any action

Command to Dual LT Failed Mode

Command to Dual MT Failed Mode

(3.206 LAB LTL LEAK SAFING), all (SODF: TCS: MALFUNCTION: IATCS)

(3.219 LAB MTL LEAK SAFING), all (SODF: TCS: MALFUNCTION: IATCS)
If both LTL Pump In Pressure and LTL Accum Qty are decreasing, then leak is real.

This step will determine whether the LTL Accumulator Quantity will reach the Leak Rcvy Auto Shutdown Limit within 2 hours.

1. Warning Messages
   - At any time during this procedure, if 'Lab LTL Leak Auto Shutdown' message is issued, perform (3.206 LAB LTL LEAK SAFING), all (SODF: TCS; MALFUNCTION: IATCS).

2. Inspecting Pump In-Pressure
   - Are both LTL Pmp In Press and LTL Accum Qty decreasing?

3. Sensor shift or loop maintenance has introduced air in the lines which is being removed by the Gas Trap.

4. MCC-H for action

5. Inspecting Accumulator Quantities

6. Leak is across Loop Crossover Assembly valve. No immediate action.

7. MCC-H

8. Monitoring LTL Accum Qty for up to 15 Minutes
   - Does LTL Accum Qty drop at a rate of 1 % per 15 minutes?

9. (3.205 LAB LTL LEAK SAFING), step 3 (SODF: TCS; MALFUNCTION: IATCS)
Quickly visually inspect all Utility Interface Panels, area around QDs, and inside rack doors (refer to Table 1 for applicable racks).

Is water visible?
- Yes
- No

Is leaking rack LAB1P6 (LTL)?
- Yes
- No

Shut Down Pump in LTL PPA

LAB: TCS: LTL PPA
LTL PPA Commands
- ‘Set Pump Speed’
  - set Arm: 0 rpm
  - cmd Arm – Arm (√ – X)
  - set Set: 0 rpm
  - cmd Set – Set

Disconnect Rack (Pull QDs) with Visible Water

On MCC-H GO
- Remove and restrain IUP Closeout.
- LOW TEMP COOLANT WATER RETURN ←|→ LOW TEMP TCS RET
- LOW TEMP COOLANT WATER SUPPLY ←|→ LOW TEMP TCS SUP

Is LTL Avg. Accum Qty still decreasing?
- Yes
- No

Leak is not isolated.

Leak is here.

Isolate and Powerdown Rack
- Go to applicable SSR procedure (refer to Table 2 for applicable SSR), all (SODF: TCS: CORRECTIVE: IATCS).
### TCS 3.205 LAB LTL LEAK ISOLATION

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16. **Reconnect Rack**
   - LOW TEMP COOLANT WATER RETURN →↓←
   - LOW TEMP TCS RETURN
   - LOW TEMP COOLANT WATER SUPPLY →↓←
   - LOW TEMP TCS SUPPLY
   - Replace UIP Closeout.

17. **Shutdown LT Loop**
   - On MCC-H GO
     - LAB: TCS: Software
       - Software Commands
       - iATCS
         - cmd Mode Dual LT Fail – Arm
         - Mode Arm Status – Dual LT Fail
         - cmd Mode Dual LT Fail – Dual LT Fail
         - Mode – Dual LT Fail
     - LAB: TCS: LTL PPA: LTL NIA Commands
     - LTL NIA Commands
       - cmd LTL NIA Depress – Depress

18. **Go to and execute SSR procedures for all racks**
   - (refer to Tables 1,2), all (SODF: TCS: CORRECTIVE: IATCS).

19. **CAUTION**
   - CDRA must be shut down.
   - Coordinate with ECLS before continuing to next step.

20. • MCC-H

21. **Disconnect Rack**
   - LAB1S6 (Pull QDs)
   - On MCC-H GO
     - Remove and restrain UIP Closeout.
     - LOW TEMP COOLANT WATER RETURN ←↓→
       LT RET
     - LOW TEMP COOLANT WATER SUPPLY ←↓→
       LT SUP
   - Is LTL Avg. Accum Qty still decreasing?
     - Yes
     - No
   - 22. **Reconnect Rack**
     - LOW TEMP COOLANT WATER RETURN ←↓→
       LT RET
     - LOW TEMP COOLANT WATER SUPPLY ←↓→
       LT SUP
     - Replace UIP Closeout.

23. **Isolate and Powerdown Rack**
   - Go to applicable SSR procedure (refer to Table 2 for applicable SSR), all (SODF: TCS: CORRECTIVE: IATCS).
3.205 LAB LTL LEAK ISOLATION

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24 Disconnect Rack LAB1D6 (Pull QDs)

On MCC-H GO
- Remove and restrain IUP Closeout.
- LOW TEMP COOLANT WATER RETURN ←→ LOW TEMP TCS RETURN
- LOW TEMP COOLANT WATER SUPPLY ←→ LOW TEMP TCS SUPPLY

Is LTL Avg. Accum Qty still decreasing?  
No → 25 Isolate and Powerdown Rack
- Go to applicable SSR procedure (refer to Table 2 for applicable SSR), all (SODF: TCS: CORRECTIVE: IATCS).

Yes → 26 Reconnect Rack
- LOW TEMP COOLANT WATER RETURN →(←) LOW TEMP TCS RETURN
- LOW TEMP COOLANT WATER SUPPLY →(←) LOW TEMP TCS SUPPLY
- Replace IUP Closeout.

27 LAB1P6 (LTL)
Preconfiguration: Shut Down Pump in LTL PPA

LAB: TCS: LTL PPA
LTL PPA Commands
- ‘LTL PPA’
- ‘Set Pump Speed’
  - set Arm: 0 rpm
  - cmd Arm – Arm (√ – X)
  - set Set: 0 rpm
  - cmd Set – Set

28 Disconnect Rack LAB1P6 (Pull QDs)

On MCC-H GO
- Remove and restrain IUP Closeout.
- LOW TEMP COOLANT WATER RETURN ←→ LT RET
- LOW TEMP COOLANT WATER SUPPLY ←→ LT SUP

Is LTL Avg. Accum Qty still decreasing?  
No → 29 Restart Pump in LTL PPA
- Go to applicable SSR procedure (refer to Table 2 for applicable SSR), all (SODF: TCS: CORRECTIVE: IATCS).

Yes → 30 Isolate and Powerdown Rack
- Go to applicable SSR procedure (refer to Table 2 for applicable SSR), all (SODF: TCS: CORRECTIVE: IATCS).

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3.205 LAB LTL LEAK ISOLATION
(TCS/5A - ALL/FIN) Page 5 of 5 pages

Table 1. Rack Applicability for Specific Flights

<table>
<thead>
<tr>
<th>Flight 5A</th>
<th>LAB1S6, LAB1D6, LAB1P6</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2. SSR Applicability for Specific Racks

<table>
<thead>
<tr>
<th>Forward Endcone</th>
<th>[4.219 TCS SSR-1 LOSS OF COOLING IN FORWARD ENDCONE] (SODF: TCS: CORRECTIVE: IATCS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAB1D1</td>
<td>[4.221 TCS SSR-3 LOSS OF COOLING IN LAB1D1 (AVIONICS #2) RACK] (SODF: TCS: CORRECTIVE: IATCS)</td>
</tr>
<tr>
<td>LAB1P6</td>
<td>[4.222 TCS SSR-4 LOSS OF COOLING IN LAB1P6 (LTL TCS/CABIN AIR) RACK] (SODF: TCS: CORRECTIVE: IATCS)</td>
</tr>
<tr>
<td>LAB1S6</td>
<td>[4.223 TCS SSR-5A LOSS OF LTL COOLING IN LAB1S6 (MTL TCS/CABIN AIR) RACK] (SODF: TCS: CORRECTIVE: IATCS)</td>
</tr>
<tr>
<td>LAB1D5</td>
<td>[4.225 TCS SSR-6 LOSS OF COOLING IN LAB1D5 (AVIONICS #1) RACK] (SODF: TCS: CORRECTIVE: IATCS)</td>
</tr>
<tr>
<td>LAB1D6</td>
<td>[4.226 TCS SSR-7 LOSS OF LTL(MTL) COOLING IN LAB1D6 (AR) RACK] (SODF: TCS: CORRECTIVE: IATCS)</td>
</tr>
</tbody>
</table>

31 Leak is not isolated.

32 Reconnect Rack
- LOW TEMP COOLANT WATER RETURN → ⊕→
- LOW TEMP TCS RET
- LOW TEMP COOLANT WATER SUPPLY → ⊕→
- LOW TEMP TCS SUP
- Replace UIP Closeout.

33 Shutdown LT Loop
On MCC-H GO
LAB: TCS: Software
Software Commands
'IATCS'
- cmd Mode Dual LT Fail – Arm
- Mode Arm Status – Dual LT Fail
- cmd Mode Dual LT Fail – Dual LT Fail
- Mode – Dual LT Fail
LAB: TCS: LTL PPA: LTL NIA Commands
LTL NIA Commands
- cmd LTL NIA Depress – Depress

34 Go to and execute SSR procedures for all racks (refer to Tables 1,2), all
(SODF: TCS: CORRECTIVE: IATCS).
During the ITCS transition to Dual LT failed, new accumulator leak thresholds will be latched. This action will cause the ITCS leak Caution and Warning messages to Return to Normal. The messages may reoccur if the leak continues for an extended period. Do not stop working the procedure if the leak messages go in and out of alarm.

Disconnecting the leaking loop’s Gas Trap is required to ensure cabin air is not drawn overboard if the leak is to vacuum. MCC-H will provide instructions for isolating leak to vacuum.

US ECLS capability is lost due to the LT loop leak. RSOS ECLS capabilities should be utilized in this ITCS configuration. All Powered LTL equipment must be unpowered to prevent hardware damage.
C&W message is issued if LTL TWMV Out Temp > 8°C (46°F). No automatic FDIR response to this message.

All displays in this procedure are on the PCS.

In Dual (Sngl LT,MT) Loop Mode, the Overtemp condition will result in LTL TWMV CLC driving the valve to its full Flothru position in an attempt to decrease the LTL outlet temperature and maintain LTL setpoint.

Equipment in racks could be damaged at high temperatures; partial load shed may be required.

1. Checking for Transient Condition
   - LAB: TCS
   - LAB: IATCS Overview

2. Transient condition. LAB LTL TWMV Outlet Temperature has stabilized.

3. Checking LTL TWMV Position
   - LAB: TCS: LTL TWMV icon
   - LTL TWMV Commands

4. Inhibiting LTL TWMV CLC
   - LTL TWMV Commands
   - cmd CLC – Inh
   - \(\text{\textbullet}^\prime\) CLC – Inh

5. Commanding LTL TWMV to Flothru Position
   - LTL TWMV Commands
   - cmd Posn – Flothru
   - \(\text{\textbullet}^\prime\) Posn – Flothru

6. LTL TWMV is not responding to Commands or Valve is stuck.

7. LAB LTL TWMV is not responding to Commands or Valve is stuck.

8. \(\text{\textbullet}^\prime\) MCC-H for further instructions

9. LTL TWMV CLC problem. IATCS in a thermally stable configuration.
Equipment in racks could be damaged at high temperatures; partial load shed may be required.

Checking for Temperature Sensor Bias

| LAB: TCS
| LAB: IATCS Overview
| TWMV
| • Record LTL Out Temp, deg C ________
| • Record LTL H2O Out Temp, deg C ________

Is LTL TWMV Out Temp, deg C = LTL IFHX H2O Out Temp, deg C ± 3° C?

Yes

No

Checking IATCS Mode

| LAB: IATCS Overview
| ‘Status’

Is IATCS Mode – Dual?

Yes

No

IATCS Heat Loads exceed LTL Loop capability or EETCS Loop A PFCS Out temperature is high or possible obstruction in LTL IFHX. Powerdowns may be required.

Checking for Off-Nominal Pump Parameters

| LAB: IATCS Overview
| ‘PPA’
| • Record LTL Pmp dP, kPa ________
| • Record LTL HR Flow, kg/hr ________

Is LTL Pmp dP > 262 kPa and LTL HR Flow < 1292 kg/hr?

Yes

No

No obstruction exists in LTL IFHX.

(2.204 LAB IATCS TRANSITION TO SINGLE LT(AUTO)), all (SODF: TCS: NOMINAL: IATCS)
Bypassing LTL TWMV for a thermally stable configuration and in Single LT(MT) Loop Mode is only allowable during 5A timeframe because of low heat loads.

16 Possible obstruction exists in LTL IFHX.

17 Inhibiting LTL TWMV CLC

LAB: TCS: LTL TWMV icon
LTL TWMV Commands
• cmd CLC – Inh Execute
  • CLC – Inh

18 Commanding LTL TWMV Position

LAB: TCS: LTL TWMV icon
LTL TWMV Commands
• cmd Posn – Byp Execute
  • Posn – Byp

19 Checking For Off Nominal Pump Parameters

LAB: TCS
LAB: IATCS Overview
• Record LTL Pmp dP, kPa
• Record LTL HR Flow, kg/hr

Is LTL Pmp dP > 503 kPa and LTL HR Flow < 1225 kg/hr?

No

Yes

20 IATCS in a thermally stable configuration. No obstruction in LTL(MTL) IFHX.

21 Possible obstruction exists in LTL(MTL) IFHX.

22 Inhibiting LTL TWMV CLC

LAB: TCS: LTL TWMV icon
LTL TWMV Commands
• cmd CLC – Inh Execute
  • CLC – Inh

23 Commanding LTL TWMV Position

LTL TWMV Commands
• cmd Posn – Byp Execute
  • Posn – Byp
C&W message is issued if LTL TWMV Out Temp ≤ 2°C (35°F). No automatic FDIR response to this message.

All displays in this procedure are on the PCS.

In Dual (Sngl LT,MT) Loop Mode, the Undertemp condition will result in LTL TWMV CLC driving the valve to its full bypass position in an attempt to increase the outlet temperature and maintain LTL setpoint.
8 Checking IATCS Mode
LAB: TCS
LAB: IATCS Overview
'Status'
Is IATCS Mode – Dual (Dual MT Fail)?

9 Checking for Temp Sensor Bias
LAB: IATCS Overview
'TWMV'
- Record LTL Out Temp, deg C _____________
- 'PPA'
- Record LTL Out Temp, deg C _____________
Is LTL TWMV Out Temp, deg C = LTL PPA Out Temp, deg C ± 3° C?

10 Checking for Temp Sensor Bias
LAB: IATCS Overview
'TWMV'
- Record LTL Out Temp, deg C _____________
- Record MTL Out Temp, deg C _____________
Is LTL TWMV Out Temp, deg C = MTL TWMV Out Temp, deg C ± 3° C?

11 Temperature Sensor bias has occurred.

12 No additional action required. IATCS is configured correctly and temps should stabilize.

13 Inhibiting LTL TWMV CLC
LAB: TCS: LTL TWMV
icon
LTL TWMV Commands
'LTL TWMV'
• cmd CLC – Inh Execute
• CLC – Inh

14 MCC-H for further instructions and possible increase in LTL and/or MTL setpoints

15 Commanding LTL TWMV to Flothru Position
LTL TWMV Commands
'LTL TWMV'
• cmd Posn – Flothru Execute
• Posn – Flothru

16 Temperature Sensor bias has occurred.

17 Inhibiting LTL TWMV CLC
LAB: TCS: LTL TWMV
icon
LTL TWMV Commands
'LTL TWMV'
• cmd CLC – Inh Execute
• CLC – Inh

18 Reducing MTL TWMV Setpoint
LAB: TCS: MTL TWMV
icon
MTL TWMV Commands
'MTL TWMV'
• Input Temp Setpt: 4° C
• cmd Temp Setpt – Set Execute
• Temp Setpt: 4° C

19 Enabling MTL TWMV CLC
MTL TWMV Commands
'MTL TWMV'
• cmd CLC – Ena Execute
• CLC – Ena
Caution Alarm is generated when both In Temp Snsr1 and In Temp Snsr2 statuses are failed. Sensors are considered failed if two or more consecutive readings indicate that their temp is < Full Scale Low (-29°C) or their temp is > Full Scale High (34.7°C).

The Undertemp Response algorithm is inhibited to prevent erroneous data from either of the two failed sensors from triggering the FDIR. If Undertemp Response FDIR is not inhibited and an undertemp conditioned is detected, the IFHX Bypass valve would be commanded to the bypass position, resulting in a Thermal Load Shed condition.

The default state of the FDIR response associated with this failure is inhibited. Furthermore, there are no operator commands or telemetry to change or verify the current status of the FDIR. The enable/inhibit status of the FDIR can only be changed via PPL and verified via Data Dump. MCC-H will confirm that FDIR is inhibited.

The loss of In Temp Snsr insight results in the loss of only one of the three legs of freeze protection. Nominal operations should be continued.
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3.211 LAB LTL(MTL) PPA ACCUM QUANTITY SENSOR FAILURE

(TCS/5A - ALL/FIN) Page 1 of 2 pages

1 FDIR software performs automatic Mode Transition to Sngl MT(LT) when IATCS Mode = Dual and IATCS Status = Oper at time of failure.

1 Checking System Configuration

Lab: TCS
IATCS Overview 'Status'

Is IATCS Mode = Xtion Sngl MT(LT) and IATCS Status = Recon?

Yes

2 Automatic FDIR is reconfiguring IATCS Mode to Sngl MT(LT).

No

3 Confirming Mode Transition

Lab: TCS
IATCS Overview 'Status'

Is IATCS Mode = Sngl MT(LT) and IATCS Status = Oper?

Is IATCS Mode = Sngl LT(MT) and IATCS Status = Oper?

Neither of the above

4 Mode Transition Complete or System already in proper mode when failure occurred.

5 Automatic FDIR won’t occur. IATCS mode ≠ Dual when failure occurred.

6 Possible mode transition failure.

7 Checking for Transient Condition

C&W Log

Is 'Lab LTL(MTL) PPA Accum Qty Sensor Failure - Lab' C&W still in Alarm?

No

8 Possible transient condition.

Yes

9 • \text{MCC-H}

10 Performing Mode Transition

LTL Sensor failed?

MTL Sensor failed?

11 • Perform (2.204 LAB IATCS TRANSITION TO SINGLE LT (AUTO)), all (SODF: TCS: NOMINAL: IATCS), then:

12 • Perform (2.205 LAB IATCS TRANSITION TO SINGLE MT (AUTO)), all (SODF: TCS: NOMINAL: IATCS), then:

13 LTL(MTL) Accum Qty sensor is failed.

14 LTL(MTL) Accum Qty sensor is failed.

15 ☐
15 Confirming Mode Transition

After 2.5 minutes, is IATCS Mode = Sngl MT(LT) and IATCS Status = Oper?

16 Possible mode transition failure.

17 \*MCC-H

18 Checking for Transient Condition

Is ‘Lab LTL(MTL) PPA Accum Qty Sensor Failure - Lab’ C&W still in Alarm?

19 LTL(MTL) Accum Qty sensor is failed.

20 Possible transient condition.

21 \*MCC-H
3.214 LAB LTL(MTL) PPA OUTLET TEMP HIGH
(TCS/5A - ALL/FIN)  Page 1 of 2 pages

1. Checking for Transient Condition
   LAB: TCS
   LAB: IATCS Overview
   'PPA'
   Is LTL(MTL) Out Temp, deg C < 18°C, 65°F for LTL or 41°C, 105°F for MTL?
   Yes
   2. Transient condition. IATCS Temperatures have stabilized.
   No

2. Checking LAB IATCS Mode
   LAB: TCS
   LAB: IATCS Overview
   'Status'
   Is IATCS Mode – Sngl MT?
   No
   3. Checking LAB IATCS Mode
   LAB: TCS
   LAB: IATCS Overview
   'Status'
   Is IATCS Mode – Sngl LT?
   No
   4. Checking for C&W Message on Dormant LTL Pump
   C&W: Advisory Log
   Is 'LAB LTL PPA Pump Outlet Temp High' Caution?
   No
   5. Dormant pump (LTL) is at ambient temperature which is above LTL PPA Outlet Temp High limits or Sensor Bias. No action required.
   Yes
   6. On MCC-H GO
   • Perform (2.203 LAB IATCS TRANSITION TO DUAL (AUTO)), all (SODF: TCS: NOMINAL: IATCS), then:
   7. IATCS in a thermally stable configuration.
   8. Commanding MTL Regen TWMV Position to Bypass
   • Perform MTL Regen TWMV
   Commands
   MTL Regen TWMV
   • cmd Posn – Byp
   Execute
   • Posn – Byp
   Is Posn – Byp?
   No
   9. Commanding MTL Regen TWMV Position to Bypass
   • Perform MTL Regen TWMV
   Commands
   MTL Regen TWMV
   • cmd Posn – Byp
   Execute
   • Posn – Byp
   Is Posn – Byp?
   No
   10. MTL Regen TWMV is not responding to commands.
   Yes
   11. IATCS in a thermally stable configuration.
   12.

C&W message is issued if LTL(MTL) PPA Pump Outlet Temp ≥ 18°C, 65°F for LTL and 41°C, 105°F for MTL. Equipment in racks could be damaged at high temperatures. No automatic FDIR response to this message.

All displays in this procedure are on the PCS.

If TW MV Overtemp and/or Rack (X) Overtemp Cautions are received at any time either before or during this procedure, performing that respective procedure is higher priority.

In Sngl MT Loop Mode, the Non-Operating Pump (LTL Pump) will track ambient temperature.
Temperature sensor bias check is not accurate if in Sngl LT(MT) Loop Mode because of Regen HX TWMV or if LTL(MTL) IFHX is bypassed on IATCS side.

Transitioning to the opposite Single Loop Mode LT(MT) will shut down the current operating pump that is overheating. IATCS temperatures will stabilize.

Did MTL Regen TWMV position to Full Bypass successfully?

Yes

IATCS in a thermally stable configuration.

No

MTL Regen TWMV is stuck. Expect possible Rack Overtemps.

MCC-H for new MTL Setpoint

Did MTL Regen TWMV position to Full Bypass successfully?

Yes

IATCS in a thermally stable configuration.

No

MTL Regen TWMV is stuck. Expect possible Rack Overtemps.

MCC-H for new MTL Setpoint

Temperature sensor bias or pump performance degradation has occurred.

MCC-H for further instructions

Possible obstruction or IATCS is exceeding heat load capacity. Expect possible Rack Overtemps.

MCC-H for further instructions

On MCC-H GO

Go to [2.204 LAB IATCS TRANSITION TO SINGLE LT(AUTO)] or [2.205 LAB IATCS TRANSITION TO SINGLE MT(AUTO)], all (SODF: TCS: NOMINAL: IATCS).
A pump failure is caused by an PPA firmware controller fault, a pump commanding error, a firmware controller loss of comm or a pump out of speed tolerance fault. ITCS can perform nominally with only one pump in single loop mode.

1. Verify Pump Parameters
   - CW Summ
   - C&W Summary
   - Determine which message was received

2. LTL pump has failed. Automatic FDIR will attempt to transition ITCS to proper mode.

3. MTL pump has failed. Automatic FDIR will attempt to transition ITCS to proper mode.

4. Wait for Mode Xtion
   - Lab: TCS
   - IATCS Overview
   - 'Status'
   - Wait until IATCS Mode – Single MT or 'Lab IATCS Mode Unknown - LAB' message is annunciated.

5. Automatic FDIR has safed the system. No further action is required.

6. Automatic FDIR has failed to transition ITCS. Manual steps should be taken to restore cooling.

7. Continue nominal operations.
   - MCC-H for any further troubleshooting

8. Wait for Mode Xtion
   - Lab: TCS
   - IATCS Overview
   - 'Status'
   - Wait until IATCS Mode – Single LT or 'Lab IATCS Mode Unknown - LAB' message is annunciated.

9. Automatic FDIR has safed the system. No further action is required.

10. Continue nominal operations.
    - MCC-H for any further troubleshooting

11. Automatic FDIR has failed to transition ITCS. Manual steps should be taken to restore cooling.
A C&W message is issued if LTL(MTL) SFCA CLC is unable to maintain SFCA dP within SFCA dP setpoint tolerance. No automatic FDIR response to this message. Nominal LTL(MTL) SFCA dP = 76 kPa (11 psid).

All displays in this procedure are on the PCS.

During Mode transitions, OD connections, or Leak Isolation processes, SFCA Mod Vlv cannot open or close quickly enough, violating SFCA setpoint tolerance and triggering the 'Uncontrolled dP' message.

A C&W message is issued if SFCA dP > 131 kPa (19 psid). SFCA FDIR will reduce any operating pump's speed to 11,373 rpm to prevent SFCA dP sensor damage.

The maximum upper range reading of SFCA dP sensor is approximately 138 kPa (20 psid) and the sensor is damaged at approximately 386 kPa (56 psid). Pressure can reach 414 kPa (60 psid) or greater. SFCA FDIR will inhibit LTL(MTL) SFCA CLC and adjust LTL(MTL) SFCA Mod Vlv Spd: 0 volts.

Notes (cont)

A C&W message is issued if SFCA dP > 131 kPa (19 psid) and SFCA Overpress Protection is inhibited. No pump speed reduction can occur and the LTL(MTL) SFCA dP sensor may be damaged.

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### LAB LTL(MTL) SFCA FAILURE

#### (TCS/5A - ALL/FIN) Page 2 of 3 pages

**9** Comparing LTL(MTL) PPA Pump dP, HR Flow in Dual Mode

- Record LTL(MTL) Pmp dP, kPa
- Record LTL(MTL) HR Flow, kg/hr

Is LTL(MTL) Pmp dP > 241 kPa (324 kPa) and LTL(MTL) HR Flow < 1361 kg/hr?

**10** High Pmp dP and Low Flow Rate indicates possible restriction upstream of LTL(MTL) SFCA. Expect possible Rack Overtemp and/or Undertemp cautions. No immediate action required.

- **Yes**
- **No**

**11**
- **Yes**
- **No**

**12** Pump parameters are nominal.

**13** Manually Positioning LTL(MTL) SFCA Mod Vlv

- Perform OSO steps.
- Open Rack LAP6(LAS6) Door for LTL(MTL) SFCA access.
- Manually position LTL(MTL) SFCA Mod Vlv to 50 %.

Is manually positioning LTL(MTL) SFCA Mod Vlv to 50 % possible?

- **Yes**
- **No**

**14** LAB LTL(MTL) SFCA Mod Vlv stuck.

**15** Forcing All Flow through Racks by Disconnecting LTL(MTL) SFCA Bypass QD

On MCC-H GO

- Perform OSO steps.
- Open Rack LAP6(LAS6) Door for LTL(MTL) SFCA access.
- Disconnecting LTL(MTL) SFCA Bypass Leg QD.
16 Checking PPA Pump Speed on the Affected Loop

Is LTL(MTL) Pump Speed, 11373 rpm?

17 Checking IATCS Mode

Is IATCS Mode – Dual?

18 Increasing Operating Pump to Single Mode Speed

19 Increasing LTL, MTL PPA Pumps to Dual LTL, MTL Mode Speeds

20 IATCS in a thermally Stable configuration. Efficient amount of cooling is now flowing through racks.
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C&W message is issued if Sensor counts = -2048 (Off-Scale Low) or +2047 (Off-Scale High). LTL TWMV CLC is Inhibited.

All displays in this procedure on the PCS.

C&W message is issued if Sensor counts = -2048 (Off-Scale Low) or +2047 (Off-Scale High). MTL TWMV CLC is Inhibited.

C&W message is issued if Sensor counts = -2048 (Off-Scale Low) or +2047 (Off-Scale High). MTL Regen HX TWMV CLC is Inhibited.

No action required. IATCS in a thermally stable configuration. MTL Regen TWMV is controlling MTL setpoint. Avoid any future Dual Mode transitions without prior discussions.
Positioning MTL TWMV to a “half-way” position and enabling MTL Regen TWMV CLC in Dual Loop Mode will maintain MTL temperature setpoint for TBD loads.

1. Commanding LTL TWMV to Flothru Position
   - LAB: TCS: LTL TWMV icon
   - LTL TWMV Commands
     - cmd Posn – Flothru

2. Commanding MTL TWMV to Flothru Position
   - LAB: TCS: MTL TWMV icon
   - MTL TWMV Commands
     - MTL TWMV
       - cmd Posn – Flothru

3. IATCS in a thermally stable configuration.

4. Commanding LTL TWMV to Bypass Position
   - LAB: TCS: LTL TWMV icon
   - LTL TWMV Commands
     - cmd Posn – Byp

5. Commanding MTL TWMV Position
   - MTL TWMV Commands
     - MTL TWMV
       - Direct Vlv
         - input drive voltage: +1
         - input drive duration: 35

6. Reducing MTL TWMV Setpoint
   - LAB: TCS: MTL TWMV icon
   - MTL TWMV Commands
     - MTL TWMV
       - input Temp Setpt: 4°C

7. On MCC-H GO
   - Perform (2.203 LAB IATCS TRANSITION TO DUAL (AUTO), all (SODF: TCS: NOMINAL: IATCS).

8. IATCS is in a thermally stable configuration.

9. MCC-H for further instructions

10. Enabling MTL Regen TWMV CLC
    - LAB: TCS: Regen TWMV icon
    - MTL Regen TWMV Commands
      - MTL Regen TWMV
        - cmd CLC – Ena

11. Enabling MTL TWMV CLC
    - MTL TWMV Commands
      - MTL TWMV
        - cmd CLC – Ena

12. IATCS is in a thermally stable configuration. MTL temps should stabilize. MTL TWMV is now at half-way position. Regen TWMV is now controlling MTL setpoint.

13. Commanding LTL TWMV to Flothru Position
    - LAB: TCS: LTL TWMV icon
    - LTL TWMV Commands
      - cmd Posn – Flothru
    - Posn – Flothru

14. Commanding MTL TWMV to Flothru Position
    - LAB: TCS: MTL TWMV icon
    - MTL TWMV Commands
      - MTL TWMV
        - cmd Posn – Flothru
      - Posn – Flothru

15. IATCS is in a thermally stable configuration.

16. Commanding MTL TWMV to Flothru Position
    - LAB: TCS: MTL TWMV icon
    - MTL TWMV Commands
      - MTL TWMV
        - cmd Posn – Flothru
      - Posn – Flothru

17. MCC-H for further instructions

18. Reducing MTL TWMV Setpoint
    - LAB: TCS: MTL TWMV icon
    - MTL TWMV Commands
      - MTL TWMV
        - input Temp Setpt: 4°C
        - cmd Temp Setpt – Set

19. Enabling MTL Regen TWMV CLC
    - LAB: TCS: Regen TWMV icon
    - MTL Regen TWMV Commands
      - MTL Regen TWMV
        - cmd CLC – Ena

20. Enabling MTL TWMV CLC
    - MTL TWMV Commands
      - MTL TWMV
        - cmd CLC – Ena

21. IATCS is in a thermally stable configuration. MTL temps should stabilize. MTL TWMV is now at half-way position. Regen TWMV is now controlling MTL setpoint.

22. Enabling MTL TWMV CLC
    - MTL TWMV Commands
      - MTL TWMV
        - cmd CLC – Ena

23. IATCS is in a thermally stable configuration. MTL temps should stabilize. MTL TWMV is now at half-way position. Regen TWMV is now controlling MTL setpoint.

In Sngl LT Mode
LTL CLC – Ena
LTL Out Temp = 4°C (40°F)
MTL CLC – Inh
MTLHX Out Temp = 17°C (63°F)

In Sngl MT Mode
MTL CLC – Ena
MTLHX Out Temp = 17°C (63°F)

‘TWMV’
LTL CLC – Ena
LTL Out Temp = 4°C (40°F)

MTL CLC – Inh
If both MTL Pump In P and MTL Accum Qty are decreasing, then leak is real.

This step will determine whether the MTL Accumulator Quantity will reach the Leak Rcvy Auto Shutdown Limit within 2 hours.

1 Warning Messages
   - At any time during this procedure, if 'Lab MTL Leak Auto Shutdown' message is issued, perform [3.219 LAB MTL LEAK SAFING], all (SODF: TCS; MALFUNCTION: IATCS).

2 Inspecting Pump In-Pressure
   On MCC-H GO
   LAB: TCS
   Lab: IATCS Overview
   PPA
   Are both MTL Pmp In Press and MTL Accum Qty decreasing?

3 Sensor shift or loop maintenance has introduced air in the lines which is being removed by the Gas Trap.

4 •√MCC-H for action

5 Inspecting Accumulator Quantities
   On MCC-H GO
   LAB: TCS
   Lab: IATCS Overview
   PPA
   After 10 minutes, does LTL Avg Accum Qty drop while MTL Avg Accum Qty rise \([\text{LTL} + \text{MTL} \text{Accum Qty}/2 = \text{constant}]\)?

6 Leak is across Loop Crossover Assembly valve. No immediate action.

7 •√MCC-H

8 Monitoring MTL Accum Qty for up to 15 Minutes
   LAB: TCS
   Lab: IATCS Overview
   PPA
   LTL/MTL Avg Accum Qty, % ___/___ ___/___ ___/___ ___/___
   Does MTL Accum Qty drop at a rate of 1 % per 15 minutes?

9 (3.219 LAB MTL LEAK SAFING), step 4 (SODF: TCS; MALFUNCTION: IATCS)
Quickly visually inspect all Utility Interface Panels, area around QDs, and inside rack doors (see Table 1 for applicable racks).

Is water visible?
- Yes
- No

Is Rack LAB1S6 leaking?
- Yes
- No

Shut Down Pump in MTL PPA

LAB: TCS: MTL PPA
MTL PPA Commands
'MTL PPA'
'Set Pump Speed'
- set Arm – 0 rpm
- cmd Arm – Arm (√ – X)
- set Set – 0 rpm
- cmd Set – Set

CAUTION
Unhooking of racks will stop cooling to rack components which could lead to overheating in 30 minutes.

Disconnect Rack (Pull QDs) with Visible Water

On MCC-H GO
- Remove and restrain IUP Closeout.
- MOD TEMP COOLANT WATER RETURN ←→ MOD TEMP TCS RETURN
- MOD TEMP COOLANT WATER SUPPLY ←→ MOD TEMP TCS SUPPLY

Is MTL Avg. Accum Qty still decreasing?
- Yes
- No

Isolating and Powering Down Rack
- Confirm rack is disconnected.
- Go to applicable SSR procedure per Table 2.
**3.218 LAB MTL LEAK ISOLATION**

(TCS/5A - ALL/FIN) Page 3 of 6 pages

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**WARNING**

The following step will jumper the LAD1 rack avionics cooling to the LTL. If the LAD1 rack plumbing is the source of the ITCS leak, this step will feed the leak. If the LTL accumulator quantity begins rapidly decreasing or 'Lab LTL PPA Accum Qty Low - LAB' message is received, immediately perform \(3.219 \text{ LAB MTL LEAK SAFING}\), step 20 (SODF: TCS: MALFUNCTION: IATCS), then:

- **18** Jumper LAB1D1 to LTL through LAB1P1
  - Translate to LAB1D1, remove UIP Closeout, 1/4 turn fasteners (two).
  - Temporarily restrain UIP Closeout.
  - MOD TEMP COOLANT WATER RETURN \(\leftarrow\) TCS RETURN QD marked QP01
  - MOD TEMP COOLANT WATER SUPPLY \(\rightarrow\) TCS SUPPLY QD marked QP02
  - TCS Jumper \(\rightarrow\) TCS RETURN QD marked QP01
  - TCS Jumper \(\rightarrow\) TCS SUPPLY QD marked QP02
  - Translate to LAB1P1.
  - Remove UIP Closeout, 1/4 turn fasteners (two).
  - Temporary restrain UIP Closeout.
  - TCS Jumper \(\rightarrow\) TCS LOW RETURN
  - TCS Jumper \(\rightarrow\) TCS LOW SUPPLY
  - Wait 10 minutes.

LTL Avg Accum Qty decreasing?

- **19** Leak is here.
- **20** **WARNING**
  - The following step will jumper the Fwd Endcone avionics cooling to the LTL. If the Fwd Endcone plumbing is the source of the ITCS leak, this step will feed the leak. If the LTL accumulator quantity begins rapidly decreasing or 'Lab LTL PPA Accum Qty Low - LAB' message is received, immediately perform \(3.219 \text{ LAB MTL LEAK SAFING}\), step 16 (SODF: TCS: MALFUNCTION: IATCS), then:
  - **21** Isolating and Powering Down Rack
    - Confirm rack is disconnected.
    - Go to applicable SSR procedure per Table 2.

---

**21 AUG 00**

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3.218 LAB MTL LEAK ISOLATION
(TCS/5A - ALL/FIN) Page 4 of 6 pages

20  Jumper Forward Endcone to LTL

22  If required, remove Closeout Panel LAB1S0-01, 1/4 turn fasteners (twelve).
    Temporarily stow Closeout Panel LAB1S0-01.
    MOD TEMP COOLANT WATER RETURN ←→ TCS MOD RETURN
    MOD TEMP COOLANT WATER SUPPLY ←→ TCS MOD SUPPLY
    MOD TEMP COOLANT WATER RETURN ←→ TCS LOW RETURN
    MOD TEMP COOLANT WATER SUPPLY ←→ TCS LOW SUPPLY
    Wait 10 minutes.

Is LTL Avg. Accum Qty decreasing?

Yes
27  Leak is here.

No
25  Leak is not isolated.

23  Reconnecting Rack

24  CAUTION
    Unhooking of racks will stop cooling to rack components which could lead to overheating in 30 minutes.

9

28  Commanding to Dual MT Failed

LAB, TCS: Software Commands IATCS
  • cmd Mode Dual MT Fail – Arm
  •\cmd Mode Arm Status – Dual MT Fail
  • cmd Mode Dual MT Fail – Dual MT Fail
  •\cmd Mode – Dual MT Fail

Perform (4.220 TCS SSR-2 LOSS OF COOLING IN AFT ENDCONE), all (SODF: TCS: CORRECTIVE: IATCS), then:
Perform (4.224 TCS SSR-5B LOSS OF MTL COOLING IN LAB1S6 (MTL TCS/CABIN AIR) RACK), all (SODF: TCS: CORRECTIVE: IATCS), then:
Perform (4.225 TCS SSR-6 LOSS OF COOLING IN LAB1D5 (AVIONICS) RACK), all (SODF: TCS: CORRECTIVE: IATCS)
      • Confirm rack is disconnected.
      • Go to applicable SSR procedure per Table 2.

29  Isolating and Powering Down Rack

30  Leak is here.

31  Isolating and Powering Down Rack

32  Leak is here.

On MCC-H GO

• Disconnect Rack [X] where [X] = LAB1D6, LAB1D5, LAB1D1, Forward Endcone in this order.
• Remove and restrain IUP Closeout.
• MOD TEMP COOLANT WATER RETURN ←→ TCS MOD RETURN.
• MOD TEMP COOLANT WATER SUPPLY ←→ TCS MOD SUPPLY.
Have all racks listed in previous step been checked?

Yes

LAB1S6
Preconfiguration:
Shutting Down Pump in MTL PPA

LAB: TCS: MTL PPA
MTL PPA Commands
MTL PPA
‘Set Pump Speed’
• set Arm: 0 rpm
• cmd Arm – Arm (√ – X)
• set Set: 0 rpm
• cmd Set – Set

No

Disconnecting Rack LAB1S6
On MCC-H GO
• Remove and Restrain IUP Closeout.
• MOD TEMP COOLANT WATER RETURN ←→ MT RET.
• MOD TEMP COOLANT WATER SUPPLY ←→ MT SUP.

Is MTL Accum Qty still decreasing?

Yes

Restarting Pump in MTL PPA

LAB: TCS: MTL PPA
MTL PPA Commands
MTL PPA
‘Set Pump Speed’
• set Arm: 17,200 rpm
• cmd Arm – Arm (√ – X)
• set Set: 17,200 rpm
• cmd Set – Set

No

Leak is here.

Isolating and Powering Down Rack
• Confirm rack is disconnected.
• Go to applicable SSR procedure per Table 2.
### Table 1. Rack Applicability for Specific Flights

<table>
<thead>
<tr>
<th>Flight 5A</th>
<th>LAB1S6, LAB1D6, LAB1D5, LAB1D1, Forward Endcone</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 2. SSR Applicability for Specific Racks

<table>
<thead>
<tr>
<th>Rack Type</th>
<th>SSR Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forward Endcone</td>
<td>(4.219 TCS SSR-1 LOSS OF COOLING IN FORWARD ENDCONE) (SODF: TCS: CORRECTIVE: IATCS)</td>
</tr>
<tr>
<td>Aft Endcone</td>
<td>(4.220 TCS SSR-2 LOSS OF COOLING IN AFT ENDCONE) (SODF: TCS: CORRECTIVE: IATCS)</td>
</tr>
<tr>
<td>LAB1D1</td>
<td>(4.221 TCS SSR-3 LOSS OF COOLING IN LAB1D1 (AVIONICS #2) RACK) (SODF: TCS: CORRECTIVE: IATCS)</td>
</tr>
<tr>
<td>LAB1S6</td>
<td>(4.224 TCS SSR-5B LOSS OF MTL COOLING IN LAB1S6 (MTL TCS/CABIN AIR) RACK) (SODF: TCS: CORRECTIVE: IATCS)</td>
</tr>
<tr>
<td>LAB1D5</td>
<td>(4.225 TCS SSR-6 LOSS OF COOLING IN LAB1D5 (AVIONICS #1) RACK) (SODF: TCS: CORRECTIVE: IATCS)</td>
</tr>
<tr>
<td>LAB1D6</td>
<td>(4.226 TCS SSR-7 LOSS OF LTL(MTL) COOLING IN LAB1D6 (AR) RACK) (SODF: TCS: CORRECTIVE: IATCS)</td>
</tr>
</tbody>
</table>
C&W message is issued if MTL TWMV Out Temp > 19°C (67°F). No automatic FDIR response to this message.

All displays in this procedure are on the PCS.

Bypassing MTL TWMV for a thermally stable configuration and in Single LT(MT) is only allowable during 5A timeframe because of low heat loads.
Positioning MTL TWMV to a “half-way” position and Enabling MTL Regen TWMV CLC in Dual Loop Mode will maintain MTL temperature setpoint for TBD loads.

Equipment in racks could be damaged at high temperatures. Partial load shed may be required.

Transitioning to Single LT Mode will Inhibit MTL TWMV CLC and move it to Full Flothru Position. MTL Regen TWMV will assume MTL temperature control and LTL TWMV will assume LTL temperature control.
Bypassing MTL TWMV for a thermally stable configuration and in Single LT(MT) is only allowable during 5A timeframe because of low heat loads.

Transitioning to Single LT Mode will Inhibit MTL TWMV CLC and move it to Full Flothru Position. MTL Regen TWMV will assume MTL temperature control and LTL TWMV will assume LTL temperature control.
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C&W message is issued if MTL TWMV Out Temp ≤ 2°C (35°F). No automatic FDIR response to this message.

All displays in this procedure are on the PCS.

In Single Loop Mode, MTL TWMVs nominal position is Full Flothru.

LAB MTL TWMV UnderTemp

Nominal Config:
LAB: TCS
LAB: IATCS
Overview

‘Status’
IATCS Status – Oper
IATCS Mode = Dual,
Sngl LT(MT)
Fail Rcvry Status –
Ena
Leak Rcvry Status –
Ena
MTL Leak Rcvry
Status – Ena
LTL Leak Rcvry
Status – Ena
‘IFHX’
MTL NH3 Byp Vlv
Posn – Flothru
MTL NH3 Isol Vlv
Posn – Op

P6: TCS
P6: EETCS
Overview
EEATC PFCS
Loop A(B) Out Fltrd
Lwr Temp = 3.6°C (38.5°F)

If in Dual Mode
‘TWMV’
MTL CLC – Ena
MTL Out Temp =
17°C (63°F)
LTL CLC – Ena
LTL Out Temp =
4°C (40°F)

LAB: TCS: MTL TWMV
Regen TWMV icon

MTL TWMV Commands
‘MTL TWMV’
Posn – Byp

(Continued)
C&W message is issued if MTL TWMV Out Temp ≤ 14°C (57°F). No automatic FDIR response to this message.

In Dual Loop Mode, the Undertemp condition will result in MTL TWMV CLC driving the valve to its full bypass position in an attempt to increase the outlet temperature.

If in Sngl LT Mode LAB: TCS

MTL CLC – Inh
LTL CLC – Ena
LTL Out Temp = 4°C (40°F)
'Regen TWMV'

MTL CLC – Ena
MTL HX Out Temp = 17°C (63°F)

If in Sngl MT Mode, 'TWMV'

MTL CLC – Inh
LTL CLC – Ena
LTL Out Temp = 4°C (40°F)
'Regen TWMV'

MTL CLC – Ena
MTL HX Out Temp = 17°C (63°F)

3.221 LAB MTL TWMV UNDERTEMP
(TCS/5A - ALL/FIN)
13 Commanding MTL TWMV to Bypass Position

MTL TWMV Commands
• 'MTL TWMV'
• ^CLC – Inh
• cmd Posn – Byp
• Execute

Is MTL TWMV Posn – Byp?

Yes

14 Enabling MTL Regen TWMV CLC

LAB: TCS: Regen TWMV icon
MTL Regen TWMV Commands
• cmd CLC – Ena
• vCLC – Ena

No

16 LAB MTL TWMV is not responding to commands. No immediate action required.

18 Checking for Temperature Sensor Bias

LAB: TCS:
LAB: IATCS Overview
TWMV
• Record MTL Out Temp, deg C ___________ 'PPA'
• Record MTL Out Temp, deg C ___________

Is MTL TWMV Out Temp, deg C = MTL PPA Out Temp, deg C ± 3° C?

Yes

19 Temperature sensor bias has occurred.

No

17 IATCS is in a thermally stable configuration. MTL temperatures should stabilize. MTL TWMV is now at half-way position. Regen TWMV is now controlling MTL setpoint.

15 Commanding MTL TWMV Position

LAB: TCS: MTL TWMV icon
MTL TWMV Commands
• 'MTL TWMV' ‘Direct Vlv'
• input drive voltage: -1
• input drive duration: 35
• cmd Set – Set Execute

12

14 Enabling MTL Regen TWMV CLC

LAB: TCS: Regen TWMV icon
MTL Regen TWMV Commands
• cmd CLC – Ena
• vCLC – Ena

16 LAB MTL TWMV is not responding to commands. No immediate action required.

18 Checking for Temperature Sensor Bias

LAB: TCS:
LAB: IATCS Overview
TWMV
• Record MTL Out Temp, deg C ___________ 'PPA'
• Record MTL Out Temp, deg C ___________

Is MTL TWMV Out Temp, deg C = MTL PPA Out Temp, deg C ± 3° C?

Yes

19 Temperature sensor bias has occurred.

No

17 IATCS is in a thermally stable configuration. MTL temperatures should stabilize. MTL TWMV is now at half-way position. Regen TWMV is now controlling MTL setpoint.

21 No additional action required. IATCS is configured correctly and temperatures should stabilize. Condensation may form on MTL lines at this low temp. Expect MTL Regen TWMV Undertemp caution.

22 • MCC-H for further instructions and possible increase in MTL setpoint

20 Inhibiting MTL TWMV CLC

LAB: TCS: MTL TWMV icon
MTL TWMV Commands
• cmd CLC – Inh
• vCLC – Inh

14
One or several Rack Outlet Temperature Sensors may be overtemping. Refer to Table 1 for listing of sensors and ITCS loop connectivity.

If any SFCA or TWMV messages are enunciated while performing this procedure, stop and perform procedure associated with that message.

1. Check for Other Messages
   - C&W Summ
   - C&W Summ
   - If any messages associated with the SFCA or the TWMV for the effected loop have been or are generated during this procedure, stop immediately and perform the associated malfunction procedure.

2. Monitoring Rack Temperatures
   - Lab: TCS: Lab Rack Details
   - Lab Rack Details
   - Rack connected to LTL Lab Rack [X] Temp > 16.1°C
   - Rack connected to MTL Lab Rack [X] Temp > 32.2°C

3. Transient condition.
   - No
   - Yes
   - Continue Nominal Ops.

4. Quantifying Overtemps
   - Are multiple racks causing overtemp messages or above their nominal temperature range?
   - Yes
   - No
   - Overall ITCS water temperature is above nominal levels causing multiple rack overtemps. Problem could be TWMV, SFCA Mod valve, or system blockage.
   - MCC-H will need to look at water temperature and electronics input current trends to determine cause of overtemp.

5. Attempt to Increase Flow to System Racks
   - LTL
   - MTL
   - If MCC-H is unavailable and 30 minutes have elapsed or Rack Out Temp > 37.8°C since ‘Lab Rack [X] Overtemp - LAB’ message was issued.
     - Go to (LOSS OF RACK [X] SSR), all (SODF: TBD)

6. Shutting Down Rack (If Necessary)
   - If MCC-H is unavailable and 30 minutes have elapsed or Rack Out Temp > 37.8°C since ‘Lab Rack [X] Overtemp - LAB’ message was issued.
     - Go to (LOSS OF RACK [X] SSR), all (SODF: TBD)
### 3.222 LAB RACK OVERTEMP

(TCS/5A - ALL/FIN)

---

**11** Attempt to Increase Flow to System Racks

Lab: TCS: MTL SFCA

MTL SFCA Commands:
- input Mod Vlv dP Setpt
  Set: 117.2 kPa
- Mod Vlv dP Setpt: 117.2 kPa

**12** Monitor Rack Temperatures

Lab: TCS: Lab Rack Details

Lab Rack Details:
- MCC-H for further actions, if available
- Monitor Rack temperatures that were overtemping (temperatures should begin to decrease).
- If any Rack temperature stays above 43.3°C for over 10 minutes, perform associated Rack powerdown SSR.

---

### Table 1. System Rack ITCS Connectivity

<table>
<thead>
<tr>
<th>Flight Rack Activated</th>
<th>Rack Location [X]</th>
<th>ITCS Connectivity</th>
<th>Nominal Rack Outlet Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>5A</td>
<td>Fwd Endcone</td>
<td>MTL</td>
<td>Temp &lt; 29.4°C</td>
</tr>
<tr>
<td>5A</td>
<td>Aft Endcone</td>
<td>MTL</td>
<td>Temp &lt; 29.4°C</td>
</tr>
<tr>
<td>5A</td>
<td>LAB1D1</td>
<td>MTL</td>
<td>Temp &lt; 29.4°C</td>
</tr>
<tr>
<td>5A</td>
<td>LAB1D5</td>
<td>MTL</td>
<td>Temp &lt; 29.4°C</td>
</tr>
<tr>
<td>5A</td>
<td>LAB1D6</td>
<td>LTL</td>
<td>Temp &lt; 11.7°C</td>
</tr>
<tr>
<td>5A</td>
<td>LAB1P6</td>
<td>LTL</td>
<td>Temp &lt; 11.7°C</td>
</tr>
<tr>
<td>5A</td>
<td>LAB1S6</td>
<td>LTL</td>
<td>Temp &lt; 11.7°C</td>
</tr>
<tr>
<td>6A</td>
<td>LAB1D2</td>
<td>MTL</td>
<td>Temp &lt; 29.4°C</td>
</tr>
<tr>
<td>6A</td>
<td>LAB1D4</td>
<td>MTL</td>
<td>Temp &lt; 29.4°C</td>
</tr>
<tr>
<td>6A</td>
<td>LAB1O6</td>
<td>MTL</td>
<td>Temp &lt; 29.4°C</td>
</tr>
<tr>
<td>6A</td>
<td>LAB1P3</td>
<td>MTL</td>
<td>Temp &lt; 29.4°C</td>
</tr>
<tr>
<td>6A</td>
<td>LAB1P5</td>
<td>MTL</td>
<td>Temp &lt; 29.4°C</td>
</tr>
<tr>
<td>6A</td>
<td>LAB1S5</td>
<td>MTL</td>
<td>Temp &lt; 29.4°C</td>
</tr>
</tbody>
</table>
MCC-H will examine trend data to determine if the sensor is biased in such a way that uplinking a new calibration curve will correct the problem. If the sensor cannot be salvaged, MCC-H will provide instructions for ORU removal and replacement.
### Table 1. System Rack ITCS Connectivity

<table>
<thead>
<tr>
<th>Flight Rack Activated</th>
<th>Rack Location</th>
<th>ITCS Connectivity</th>
<th>Nominal Rack Outlet Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>5A</td>
<td>Fwd Endcone</td>
<td>MTL</td>
<td>Temp &lt; 29.4 deg C</td>
</tr>
<tr>
<td>5A</td>
<td>Aft Endcone</td>
<td>MTL</td>
<td>Temp &lt; 29.4 deg C</td>
</tr>
<tr>
<td>5A</td>
<td>LAB1D1</td>
<td>MTL</td>
<td>Temp &lt; 29.4 deg C</td>
</tr>
<tr>
<td>5A</td>
<td>LAB1D5</td>
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<tr>
<td>5A</td>
<td>LAB1D6</td>
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<td>Temp &lt; 11.7 deg C</td>
</tr>
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</tr>
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<td>LAB1D2</td>
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</tr>
<tr>
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<td>LAB1D4</td>
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</tr>
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<td>LAB1O6</td>
<td>MTL</td>
<td>Temp &lt; 29.4 deg C</td>
</tr>
<tr>
<td>6A</td>
<td>LAB1P3</td>
<td>MTL</td>
<td>Temp &lt; 29.4 deg C</td>
</tr>
<tr>
<td>6A</td>
<td>LAB1P5</td>
<td>MTL</td>
<td>Temp &lt; 29.4 deg C</td>
</tr>
<tr>
<td>6A</td>
<td>LAB1S5</td>
<td>MTL</td>
<td>Temp &lt; 29.4 deg C</td>
</tr>
</tbody>
</table>
**TCS 3.224 LAB REGEN HX TWMV OVERTEMP**

**Nominal Config:**
- LAB: TCS
- LAB: IATCS

**Overview 'Status'**
- IATCS Status – Oper
- IATCS Mode = Dual, Sngl LT(MT)
- Fail Rcvry Status – Ena
- Leak Rcvry Status – Ena
- MTL Leak Rcvry Status – Ena
- LTL Leak Rcvry Status – Ena

**Overview 'TWMV'**
- LTL CLC – Ena
- LTL Out Temp = 4° C (40° F)
- MTL CLC – Ena
- MTL Out Temp = 17° C (67° F)
- In Sngl MT Mode
- MTL CLC – Inh

**MTL Regen TWMV Commands**
- cmd Posn = Byp
- Execute

**Regen TWMV Commands**
- MTL Regen TWMV
- cmd Posn = Byp
- Execute

**C&W message is issued if MTL Regen TWMV Out Temp > 19° C (67° F). No automatic FDIR response to this message.**

**All displays in this procedure are on the PCS.**
9 Manually Positioning MTL Regen TWMV to Full Bypass Position
   • Perform OSO steps.
   • Remove Panel LAB1D7-02 for MTL Regen TWMV access.
   • Manually position MTL Regen TWMV Posn – Full Bypass.
   • TBD Label.

Did MTL Regen TWMV position to Full Bypass successfully?
   Yes
   12 IATCS is in a thermally stable configuration.

   No
   10 MTL Regen TWMV is stuck. Expect possible Rack Overtemps.

   11 • √ MCC-H for new MTL Setpoint

5

13 Checking for Temp Sensor Bias
   LAB: IATCS Overview
   ‘TWMV’
   • Record MTL Out Temp, deg C ____________
   ‘Regen TWMV’
   • Record HX Out Temp, deg C ____________

   Is MTL TWMV Out Temp, deg C = MTL Regen TWMV HX Out Temp, deg C ± 3°C?
   Yes

   No
   14 Temperature Sensor bias has occurred. No additional action required. LAB MTL TWMV is controlling MTL setpoint. MTL Regen TWMV unable to control temperature setpoint in Single Loop Mode.

   15 • √ MCC-H before any future loop transitions

16 Expect possible LAB MTL TWMV Overtemp Caution. No additional action required.

17 • √ MCC-H for further instructions
C&W message is issued if MTL Regen TWMV Out Temp ≤ 14° C (57° F). No automatic FDIR response to this message.

All displays in this procedure are on the PCS.

In Single Loop Mode, the Undertemp condition will result in MTL Regen TWMV CLC driving the valve to its full Flothru position in an attempt to increase the outlet temp.
3.225 LAB REGEN HX TWMV UNDERTEMP

(TCS/5A - ALL/FIN) Page 2 of 3 pages

10 Checking For Temperature Sensor Bias

LAB: TCS
LAB: IATCS Overview
TWMV
• Record MTL Out Temp, deg C ________
  ‘Regen TWMV’
• Record HX Out Temp, deg C ________

Is MTL TWMV Out Temp, deg C = MTL Regen TWMV HX Out Temp, deg C ± 3° C?

Yes 17

No

11 Temperature sensor bias has occurred.

12 Inhibiting MTL TWMV CLC

LAB: TCS: MTL TWMV icon
MTL TWMV Commands
• cmd CLC – Inh Execute

13 Commanding MTL TWMV to Bypass Position

MTL TWMV Commands
• cmd Posn – Byp Execute
  • Posn – Byp

14 Verifying Temperature Sensor Bias Location

LAB: TCS
LAB: IATCS Overview
TWMV
• Record MTL Out Temp, deg C ________
  ‘PPA’
• Record MTL Out Temp, deg C ________

Is MTL TWMV Out Temp, deg C = MTL PPA Out Temp, deg C ± 3° C?

No 15

Yes

15 MTL TWMV temperature sensor is biased.

16 MTL Regen TWMV temperature sensor is biased. No Action required. MTL Regen HX Out temp should not equal MTL PPA Out Temp, ± 3° C.

(2.204 LAB IATCS TRANSITION TO SINGLE LT (AUTO)), all (SODF: TCS: NOMINAL: IATCS)
In Dual Loop Mode, the Undertemp condition will result in MTL TWMV CLC driving the valve to its full bypass position in an attempt to increase the outlet temperature.

10 Verifying MTL TWMV Position
LAB: TCS: MTL TWMV icon
MTL TWMV Commands
'MTL TWMV'
Is Posn – Byp?

17 Inhibiting MTL TWMV CLC
MTL TWMV Commands
'MTL TWMV'
• cmd CLC – Inh
• \( CLC – \) Inh

19 Commanding MTL TWMV to Bypass Position
LAB: TCS: MTL TWMV icon
MTL TWMV Commands
'MTL TWMV'
• cmd Posn – Byp
• Posn – Byp
Is Posn – Byp?

21 MTL TWMV command problem.

22 Commanding MTL TWMV Position
MTL TWMV Commands
'MTL TWMV'
'Direct Vlv'
• input drive voltage: -1
• input drive duration: 35
• cmd Set – Set

23 Enabling MTL Regen TWMV CLC
LAB: TCS: Regen TWMV icon
MTL Regen TWMV Commands
'MTL Regen TWMV'
• cmd CLC – Ena
• \( CLC – \) Ena

24 IATCS in a thermally stable configuration. MTL temperatures should stabilize. MTL TWMV is now at half-way position. Regen TWMV is now controlling MTL setpoint.
### THERMAL SAFING LTL(MTL) IFHX LEAK DETECTED

When Thermal Safing IFHX response is Ena:
- **IATCS Reconfig – Inh**
- **Auto LTL,MTL IFHX Reintegration – Inh**
- **LTL(MTL) IFHX Byp Vlv Posn – Byp**
- **LTL(MTL) IFHX Isol Vlv Posn – Isol**
- **LTL,MTL Partial Load Shed Counter initiated.**

A Partial Load Shed will occur within 12 minutes without user intervention.

#### MCC-H will determine the leak from trend data and plots. EETCS accumulator telemetry may not be useful in correlating to the leaking IFHX due to the great variants in thermal environment and the difference in volumes between the multiple EETCS accumulators and the single IATCS loop accumulator.

1. **Isolate Leak Location**
   - **MCC-H** will determine leaking IFHX.

2. **Is LTL NH3 IFHX Leaking?**
   - **Is LTL NH3 IFHX Leaking?**

3. **Verify IFHX Configuration**
   - **LAB: TCS**
     - **IATCS Overview**
       - **IFHX**
         - **LTL NH3 Byp Vlv Posn – Byp**
         - **LTL NH3 Isol Vlv Posn – Cl**
         - **MTL NH3 Isol Vlv Posn – Op**
         - **MTL NH3 Byp Vlv Posn – Flothru**

4. **Transition to Dual Mode**
   - **Expect possible message:**
     - **Thermal Safing MTL(LTL) IFHX Bypass/Isolation Failed/Inhibited**
     - **Software Commands**
       - **IATCS**
         - **cmd Mode Dual – Arm**
         - **Mode Dual – Arm**
         - **cmd Mode Dual – Dual**
         - **Wait 30 seconds.**
         - **Mode – Dual**

#### Additional Information:
- **Nominal Config:**
  - LA1(LA2 MDM Frame Counter – <incrementing>)
  - LA1(LA2 MDM Current State – Operational)
- **Thermal Safing Load Shed – Ena**
- **IFHX Reinteg – Inh**

Message triggered by LTL(MTL) Accum Qty > 90%
Both loops are contaminated with ammonium hydroxide; however, single loop operations shall continue to provide cooling to LAB critical avionics as long as possible, to avoid a complete LAB shutdown. The water loops will develop leaks when the ammonium hydroxide concentration > 8% across the Gas Trap membrane; or due to the high NH3 pressure. When this occurs, the LAB will.

Total IFHX Isolation on the ammonia side is not possible due to the presence of a bleed-line, which allows NH3 to trickle through until the pressure has stabilized ($\Delta P = 0$).

LTL loop is still active but no longer rejecting heat through the IFHX.
Total IFHX isolation on the ammonia side is not possible due to the presence of a bleed-line, which allows NH₃ to trickle through until the pressure has stabilized (ΔP = 0).

At the 5A Flight timeframe, the Partial Load Shed Table contains no commands.

Verify Partial Load Shed Execution
- Wait until following C&W messages are received:
  C&W Summary
  Warning: ‘Thermal Safing LTL Partial Load Shed Timer Started’
  Warning: ‘Thermal Safing MTL Partial Load Shed Timer Started’
  Caution: ‘Thermal Safing LTL Partial Load Shed Started’
  Caution: ‘Thermal Safing MTL Partial Load Shed Started’
- Wait TBD minutes.

Prepare LAB for Shutdown
- LAB; TCS: Thermal Load Reduction
  ‘Manual Load Shed’
  • cmd Complete LTL – Arm
  • Complete LTL Arm – X
  • cmd Complete LTL – Ena
  • Expect the following Warning message:
    ‘Thermal Safing Complete LTL Load Shed Timer Started’
  • Expect the following Caution message:
    ‘Thermal Safing Complete LTL Load Shed Started’
- Wait TBD minutes.
  ‘Manual Load Shed’
  • cmd Complete MTL – Arm
  • Complete MTL Arm – X
  • cmd Complete MTL – Ena
  • Expect the following Warning message:
    ‘Thermal Safing Complete MTL Load Shed Timer Started’
  • Expect the following Caution message:
    ‘Thermal Safing Complete MTL Load Shed Started’
  • Wait TBD minutes.

LAB Shutdown
- cmd DDCU 2B,4B – Off

MCC-H will consider the following options
- Vent NH₃ from affected IFHX to relieve pressure and minimize leakage (EVA).
- Schedule IFHX ORU replacement.

P6: TCS: LoopA PFCS
LoopA PFCS Nominal Commands
EETCS LoopA PFCS
• cmd PumpA – Off
• PumpA,B – Off
• Verify PumpA,B Spd: 0 ± 975 rpm

Minimize Leakage across LTL IFHX
PFCS must be powered on to monitor Accum Qty levels, as long as possible. Eventually it will have to be shut down to protect the PFCS (time running w/o coolant flowing).

If the MTL has been contaminated, MCC-H may request LAB Shutdown.

**CAUTION**
Once the Pump is shut off with a powered PFCS, the operator should record the higher of PFCS Out Temp1 or PFCS Out Temp2 as soon as possible. The PFCS can remain powered on for the length of time specified below, dependent on the temperature.

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Time Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>T &gt; 37°C</td>
<td>15 minutes</td>
</tr>
<tr>
<td>10°C &lt; T &lt; 37°C</td>
<td>1 hour</td>
</tr>
<tr>
<td>T &lt; 10°C</td>
<td>2 hours</td>
</tr>
</tbody>
</table>

**Execute LTL Thermal Load Shed**

LAB: TCS: Thermal Load Reduction

- **'Manual Load Shed'**
  - cmd Complete LTL – Arm
  - 'Complete LTL Arm – X
  - cmd Complete LTL – Ena
  - Expect the following Warning message: 'Thermal Safing Complete LTL Load Shed Timer Started'
  - Expect the following Caution message: 'Thermal Safing Complete LTL Load Shed Started'
  - Wait TBD minutes.

**Corrective Actions**
MCC-H will consider the following options

- Vent NH₃ from LTL IFHX to relieve pressure and minimize leakage (EVA).
- Schedule IFHX ORU replacement.
- Remove and stow female QDs from LTL water side and LoopA NH₃ IFHX inlets and outlets (EVA).
- For Loop A, go to (2.105 ETCS LOOP A(B) PFCS SHUTDOWN), all (SODF: TCS: NOMINAL: EETCS).

---

8

9

20 NH₃ leak across MTL IFHX.

21 NH₃ leak across LTL IFHX.

19 C&W Summary

Has message 'Thermal Safing MTL IFHX Leak Detected' been received?

Has message 'Thermal Safing LTL IFHX Leak Detected' been received?

18 Execute LTL Thermal Load Shed
At the 5A Flight timeframe, the Partial Load Shed Table contains no commands.

An Accumulator can hold more than 100% of water, and that makes it possible for a system average accumulator quantity to read above 90%.

FDIR counter has 12 minutes to execute the Partial Load shed. This block should only be performed if the Partial Load Shed has been executed. Recovery steps are provided in the called procedure.

Leak Response FDIR will be inhibited until MCC-H determines the magnitude/effect of the LCA, PPA SOV or Check valve leakage: or accumulator quantity bias.
MCC-H will consider performing LAB IATCS Accumulator Water Transfer procedure, as required, prior to executing this block.

In the case where Leak Response was inhibited upon entering this procedure and the cause determined to be a transient failure, MCC-H will consider re-enabling Leak Response after completion of this block.

Due to a software problem MCC-H must re-set the Load Shed Tables prior to enabling the Load Shed capability.
CORRECTIVE PROCEDURES
Line Heater closed loop control checks the FCV position before generating a Line Heater RPC close command. The Line Heater Command Check prevents the software from turning on line heaters if neither pump is running or a low flow condition exists. An advisory message will be issued if the line heater command fails the above mentioned validation checks.

### Nominal Config:

- Line Htr Cntl – Ena
- Line Htr Cmd Ck – Ena
- FCV Cntl – Ena
- Pump A(B) – On
- Pmp deadhead FDIR – Ena

### Current flow rate does not support heater operations.

- **MCC-H** for explanation of why pumps are off
- Clear Advisory Message

---

**MCC-H** may choose to perform a data dump to further analyze condition.
1. **DETERMINING CAUSE OF NON-TRIP DISCRETE FAILURE**

   PCS
   P6: TCS: LoopA(B) Firmware
   LoopA(B) Firmware
   ‘EETCS LoopA(B) PFCS’

   **CAUTION**

   Following a power on reset, the pump is no longer running and EETCS cooling capability is lost. The Lab IATCS may overheat in 1.5 hours while in dual loop mode. Steps 2 and 3 should be expedited to prevent overheating ITCS equipment.

   If Power On Reset Indicator = Occurred
   Perform steps 2 --- 16 only.

   sel TTCR(STCR) Commands

   **TTCR(STCR) Commands**
   ‘EETCS LoopA(B) TTCR(STCR)’

   If Timeout Ind = X
   Perform steps 17 --- 20 only.

2. **INHIBITING LINE HEATER CONTROL**

   PCS
   P6: TCS: LoopA(B) Line Heater (select either icon)
   LoopA(B) Line Heater Commands
   ‘EETCS LoopA(B) PFCS’
   ‘Line Htr Cntl’

   **NOTE**

   An “X” will appear in all the Line Htr Cntl Inh Arm status fields when any Line Htr Inh command is armed.

   **cmd** Inhibit Htr1/Htr2 – Arm (√ – X)
   **cmd** Inhibit Htr1/Htr2 – Inh Htr1/Htr2

   √ Line Htr Cntl – Inh
   √ Inhibited Line Htr – Both

   ‘Ln Htr1’

   √ RPC Posn – Op
   ‘Ln Htr2’

   √ RPC Posn – Op

   sel LoopA(B) Bkup PVCU Commands
4.102  EETCS LOOP A(B) NON-TRIP DISCRETE FAILURE
(TCS/4A - ALL/FIN) Page 2 of 10 pages

LoopA(B) Bkup PVCU Commands
‘Bkup PVCU EETCS LoopA(B)’
‘PFCS Ln Htr Cntl’

**cmd** Inhibit Htr1/Htr2 – Arm
**cmd** Inhibit Htr1/Htr2 – Inh

√PFCS Ln Htr Cntl – Inh

3.  TRANSITIONING LAB IATCS TO SINGLE LOOP MODE

4.  INHIBITING IFHX UNDERTEMP FDIR
PCS
P6: TCS: LTL(MTL) IFHX
LTL(MTL) IFHX Commands
‘LTL(MTL) IFHX NH3’

**cmd** Undtemp Resp – Inh  **Execute**
√Undtemp Resp – Inh

5.  INHIBITING FCV CONTROL SOFTWARE ALGORITHM
PCS
P6: TCS: Loop A(B) PFCS
LoopA(B) PFCS Nominal Commands
‘EETCS LoopA(B) PFCS’
‘FCV Cntl’

**cmd** Inhibit – Arm (√ – X)
**cmd** Inhibit – Inh

√FCV Cntl – Inh

sel LoopA(B) Bkup PVCU Commands

LoopA(B) Bkup PVCU Commands
‘Bkup PVCU EETCS LoopA(B)’
‘PFCS FCV Cntl’

**cmd** Inhibit – Arm
**cmd** Inhibit – Inh

√PFCS FCV Cntl – Inh

6.  INHIBITING EETCS MIN OUT TEMP FDIR
PCS
P6: TCS: Loop A(B) PFCS: LoopA(B) PFCS FDIR Commands
LoopA(B) PFCS FDIR Commands
‘EETCS LoopA(B) PFCS’
‘Min Out Temp FDIR’
4.102 EETCS LOOP A(B) NON-TRIP DISCRETE FAILURE
(TCS/4A - ALL/FIN) Page 3 of 10 pages

cmd Inhibit – Arm (√ – X)
cmd Inhibit – Inh

√Min Out Temp FDIR – Inh

sel LoopA(B) Bkup PVCU Commands

LoopA(B) Bkup PVCU Commands
‘Bkup PVCU EETCS LoopA(B)’
‘PFCS Min Out Temp FDIR’

cmd Inhibit – Arm
cmd Inhibit – Inh

√PFCS Min Out Temp FDIR – Inh

7. CLEARING POWER ON RESET INDICATION AND OTHER C&W LATCHES

PCS

P6: TCS: LoopA(B) Firmware

LoopA(B) Firmware
‘EETCS LoopA(B) PFCS’

cmd Common Clear – Arm (√ – X)
cmd Common Clear – Common Clear

√Power On Reset Indicator – Not Occurred

sel Clear Cmads: PV Cmd Response Clear

PV Cmd Response Clear
‘PFCS Command Response’

cmd Clear Arm
cmd Clear

P6: TCS: LoopA(B) PFCS: LoopA(B) Firmware: Clear Cmads: PV Assoc Data Clear

PV Assoc Data Clear

√MCC-H before sending the Associated Data Clear commands

The commands clear latched data in the PVCU MDM.
If there are other failures in the system, this command could erase valuable information.
If MCC-H is unavailable, skip the Associated Data Clear commands and proceed to the next step.
Inform MCC-H at the next opportunity.

cmd Associated Data Clear Arm
cmd Associated Data Clear
8. **RESETTING FCV POSITION**

PCS

P6: TCS: Loop A(B) PFCS

LoopA(B) PFCS Nominal Commands

‘EETCS LoopA(B) PFCS’

Record current FCV Posn: ______ Deg

**NOTE**

A Normalized Position is calculated by dividing the current FCV Position reading in angular degrees by 90°, which is the nominal range of motion for the valve.

Calculate FCV Normalized Position: ______ (FCV Position)/(90°)

input FCV Set Init Posn – Normalized Position

**cmd** FCV Set Init Posn – Set

input FCV Posn: 0.0 (Full Bypass position)

**cmd** FCV Posn – Set

Verify FCV Posn: 0 ± 5.3°

sel LoopA(B) PFCS Nominal Additional Commands

LoopA(B) PFCS Nominal Additional Commands

‘EETCS LoopA(B) PFCS’

input FCV Set LOC Posn: 0.0

**cmd** FCV Set LOC Posn – Arm

**cmd** FCV Set LOC Posn – Set

9. **RESTARTING PFCS PUMP**

PCS

P6: TCS

P6: EETCS Overview

‘EETCS PFCS LoopA(B)’

**NOTE**

This procedure assumes Pump B is the primary pump.

If previous failures or other factors (run time, etc.) require Pump A to be used, replace the Pump B callouts with Pump A in step 9.

**CAUTION**

If the LoopA(B) PFCS In Press is less than the calculated startup pressure do not start the pump. There is a potential for cavitation below this pressure.
Determine the startup pressure using the chart below where temperature is the Out Fltrd Lwr Temp in degrees Celsius.

EETCS Startup Pressure vs Temperature

![Graph showing EETCS Startup Pressure vs Temperature with pump startup allowed and not allowed regions.]

Startup Pressure = _________ kPa

Verify the following parameters are within range:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Lower Limit</th>
<th>Upper Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>In Press Startup Pressure</td>
<td></td>
<td>3034 kPa</td>
</tr>
<tr>
<td>Out Fltrd Lwr Temp</td>
<td>-42.8°C</td>
<td>10°C</td>
</tr>
</tbody>
</table>

If In Press or Out Fltrd Lwr Temp are out of range, √MCC-H.

sel Loop A(B) PFCS

LoopA(B) PFCS Nominal Commands
‘EETCS LoopA(B) PFCS’

cmd PumpB – On

√PumpB – On

Record PumpB On: _____/_____:/____:____ GMT

sel P6: TCS
Verify the following parameters read within the specified ranges. Allow 60 seconds for parameters to reach their nominal values.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Lower Limit</th>
<th>Upper Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accum Fltrd Avg Qty</td>
<td>36.1 %</td>
<td>68.9 %</td>
</tr>
<tr>
<td>Flow Rate</td>
<td>875 kg/hr</td>
<td>1100 kg/hr</td>
</tr>
<tr>
<td>PumpB Spd</td>
<td>12605 rpm</td>
<td>14555 rpm</td>
</tr>
</tbody>
</table>

### 10. ENABLING FCV CONTROL SOFTWARE ALGORITHM

**PCS**

P6: TCS: Loop A(B) PFCS

**LoopA(B) PFCS Nominal Commands**

- **‘EETCS LoopA(B) PFCS’**
  - **‘FCV Cntl’**
    - **cmd** Enable – Arm (√ – X)
    - **cmd** Enable – Ena

- **√FCV Cntl – Ena**

 sel LoopA(B) Bkup PVCU Commands

- **LoopA(B) Bkup PVCU Commands**
  - **‘Bkup PVCU EETCS LoopA(B)’**
  - **‘PFCS FCV Cntl’**
    - **cmd** Enable – Arm
    - **cmd** Enable – Ena

- **√PFCS FCV Cntl – Ena**

### 11. ENABLING LINE HEATER CONTROL

**PCS**

P6: TCS: Loop A(B) Line Heater (select either icon)

**LoopA(B) Line Heater Commands**

- **‘EETCS LoopA(B) PFCS’**
  - **‘Line Htr Cntl’**
    - **cmd** Enable – Arm (√ – X)
    - **cmd** Enable – Ena

- **√Line Htr Cntl – Ena**

**NOTE**

When Line Heater Control is enabled, ignore the Inhibited Line Htr telemetry field. It does not update based on the Line Htr Cntl Enable command.
sel LoopA(B) Bkup PVCU Commands

LoopA(B) Bkup PVCU Commands
'Bkup PVCU EETCS LoopA(B)'
'PFCS Ln Htr Cntl'

cmd Enable – Arm
cmd Enable – Ena

√PFCS Ln Htr Cntl – Ena

12. VERIFYING OUTLET FILTERED LOWER TEMP IS WITHIN SETPOINT LIMITS

PCS

P6: TCS
P6: EETCS Overview
‘EETCS PFCS LoopA(B)’

NOTE
Depending on the length of time the PFCS remained unpowered, the EETCS loop may take up to 2 hours to reach setpoint. Check MCC-H for a time estimate.

Verify Out Fltrd Lwr Temp: 3.6 ± 0.8°C

13. ENABLING IFHX UNDERTEMP FDIR

PCS

P6: TCS: LTL(MTL) IFHX
LTL(MTL) IFHX Commands
‘LTL(MTL) IFHX NH3’

cmd Undtemp Resp – Ena Execute

√Undtemp Resp – Ena

14. ENABLING EETCS MIN OUT TEMP FDIR

PCS

P6: TCS: Loop A(B) PFCS: LoopA(B) PFCS FDIR Commands
LoopA(B) PFCS FDIR Commands
‘EETCS LoopA(B) PFCS’
‘Min Out Temp FDIR’

cmd Enable – Arm (√ – X)
cmd Enable – Ena

√Min Out Temp FDIR – Ena

sel LoopA(B) Bkup PVCU Commands

LoopA(B) Bkup PVCU Commands
'Bkup PVCU EETCS LoopA(B)'
'PFCS Min Out Temp FDIR'
4.102 EETCS LOOP A(B) NON-TRIP DISCRETE FAILURE
(TCS/4A - ALL/FIN) Page 8 of 10 pages

cmd Enable – Arm
cmd Enable – Ena
√PFCS Min Out Temp FDIR – Ena

15. CONFIGURING IFHX VALVES FOR NORMAL OPERATIONS

PCS
P6: TCS: LTL(MTL) IFHX: LTL IFHX Additional Commands
LTL(MTL) IFHX Additional Commands
‘LTL(MTL) IFHX NH3’

√Byp Vlv Flothru Precond Ck – Ena
√Isol Vlv Cl Precond Ck – Ena

CAUTION
The IFHX Isol Valve must be commanded open prior to commanding the IFHX Bypass Valve to Flothru to prevent deadheading of the EETCS pump.

sel LTL(MTL) IFHX Commands

LTL(MTL)IFHX Commands
‘LTL(MTL) IFHX NH3’

cmd Isol Vlv – Open Execute
√Isol Vlv Open – X

cmd Byp Vlv – Flothru Execute
√Byp Vlv Flothru – X

16. TRANSITIONING LAB IATCS TO DUAL MODE (AUTO)
Perform {2.203 LAB IATCS TRANSITION TO DUAL (AUTO)}, all (SODF: TCS: NOMINAL: IATCS), then:

Notify MCC-H.

NOTE
MCC-H will coordinate a data dump to examine the BIT test results in CMN_MCD_BITSTAT data words.

17. INHIBITING TTCR(STCR) CONFIGURATION FAIL ALGORITHM

PCS
P6: TCS: TTCR(STCR)
TTCR(STCR) Commands
‘EETCS LoopA(B) TTCR(STCR)’
‘Config Fail FDIR’
4.102 EETCS LOOP A(B) NON-TRIP DISCRETE FAILURE
(TCS/4A - ALL/FIN) Page 9 of 10 pages

4.102 EETCS LOOP A(B) NON-TRIP DISCRETE FAILURE

**cmd** Inhibit – Arm (√ – X)
**cmd** Inhibit – Inh

√Config Fail FDIR – Inh

sel LoopA(B) Bkup PVCU Commands: LoopA(B) Bkup PVCU Additional Commands

LoopA(B) Bkup PVCU Additional Commands
‘Bkup PVCU EETCS LoopA(B)’
‘TTCR(STCR) Config Fail FDIR’

**cmd** Inhibit – Arm
**cmd** Inhibit – Inh

√TTCR(STCR) Config Fail FDIR – Inh

18. **PERFORMING EETCS RADIATOR DEPLOY/RETRACT FAILURE MALFUNCTION PROCEDURE**

19. **CHECKING TIMEOUT INDICATION HAS CLEARED**

PCS

TTCR(STCR) Commands
‘EETCS LoopA(B) TTCR(STCR)’

√Timeout Ind – blank

******************************************************
If Timeout Ind – X
   P6: TCS: TTCR(STCR)
      TTCR(STCR) Commands
      ‘EETCS LoopA(B) TTCR(STCR)’
      ‘Cmd Stat’

    **cmd** Stop – Arm (√ – X)
    **cmd** – Stop

    √Cmd Stat – Stop
    √Timeout Ind – blank
******************************************************

20. **ENABLING TTCR(STCR) CONFIGURATION FAIL ALGORITHM**

PCS

P6: TCS: TTCR(STCR)
TTCR(STCR) Commands
‘EETCS LoopA(B) TTCR(STCR)’
‘Config Fail FDIR’
4.102 EETCS LOOP A(B) NON-TRIP DISCRETE FAILURE
(TCS/4A - ALL/FIN) Page 10 of 10 pages

**cmd** Enable – Arm (√ – X)
**cmd** Enable – Ena

√Config Fail FDIR – Ena

sel LoopA(B) Bkup PVCU Commands: LoopA(B) Bkup PVCU Additional Commands

<table>
<thead>
<tr>
<th>LoopA(B) Bkup PVCU Additional Commands</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘Bkup PVCU EETCS LoopA(B)’</td>
</tr>
<tr>
<td>‘TTCR(STCR) Config Fail FDIR’</td>
</tr>
</tbody>
</table>

**cmd** Enable – Arm
**cmd** Enable – Ena

√TTCR(STCR) Config Fail FDIR – Ena
4.103 EETCS LOOP A(B) PFCS THERMAL DATA FILTER SENSOR FAILURE

(TCS/4A - ALL/FIN)

1. Compare Accumulator Sensor Readings
   P6: TCS: Loop A(B) PFCS: LoopA(B) Details
   "EETCS LoopA(B)"
   - Compare PFCS Accum Qty1, PFCS Accum Qty2, STCR Accum Qty, and TTCR Accum Qty to
determine which sensor is significantly different from the others.
   - PFCS Accum Qty1 indicates a bias.
   - PFCS Accum Qty2 indicates a bias.
   - STCR Accum Qty indicates a bias.
   - TTCR Accum Qty indicates a bias.
   - No apparent differences

2. Transient condition. Alarm should have cleared.
   - Continue nominal operations.

3. PFCS Accum Qty1 sensor invalid.
   - Remove PFCS Accum Qty1 from Leak FDIR Snsr Sel Algorithm
   
3. PFCS Accum Qty2 sensor invalid.
   - Remove PFCS Accum Qty2 from Leak FDIR Snsr Sel Algorithm

The Thermal Data Filter performs a weighted least squares algorithm to
determine the EETCS LoopA(B) PFCS Accum Fltrd Avg Qty. PFCS Accum Qty1, PFCS Accum Qty2, STCR Accum Qty, and TTCR Accum Qty are inputs to this algorithm. An invalid quantity measurement is rejected from the WLS algorithm and sets the Advisory message.

The message clears automatically when the invalid parameter returns within limits for two consecutive cycles. MCC-H may choose to perform a data dump to further analyze the condition.

The biased sensor must be removed from the Leak Detection FDIR to prevent the invalid measurement from being considered in the Leak Detection FDIR algorithm.
|   | 4.103 EETCS LOOP A(B) PFCS THERMAL DATA FILTER
SENSOR FAILURE (TCS/4A - ALL/FIN) |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The biased sensor must be removed from the Leak Detection FDIR to prevent the invalid measurement from being considered in the Leak Detection FDIR algorithm.</td>
</tr>
<tr>
<td>8</td>
<td>STCR Accum Qty sensor invalid.</td>
</tr>
<tr>
<td>9</td>
<td>TTCR Accum Qty sensor invalid.</td>
</tr>
<tr>
<td>10</td>
<td>Remove STCR Accum Qty from Leak FDIR Snsr Sel Algorithm</td>
</tr>
<tr>
<td>11</td>
<td>Remove TTCR Accum Qty from Leak FDIR Snsr Sel Algorithm</td>
</tr>
</tbody>
</table>
|   | P6: TCS: Loop A(B) PFCS: LoopA(B) PFCS FDIR Commands: LoopA(B) PFCS FDIR Additional Commands: 'EETCS LoopA(B) PFCS' 'Leak FDIR Snsr Sel'
|   | • pick TTCR Qty, Qty 1/2 |
|   | • cmd Arm (√ – X) |
|   | • cmd Sel |
|   | P6: TCS: Loop A(B) PFCS: LoopA(B) PFCS FDIR Commands: LoopA(B) PFCS FDIR Additional Commands: 'EETCS LoopA(B) PFCS' 'Leak FDIR Snsr Sel'
|   | • pick STCR Qty, Qty 1/2 |
|   | • cmd Arm (√ – X) |
|   | • cmd Sel |
1. **ACTIVATING PFCS/RADIATOR HEATERS**

PCS

**P6: TCS: Loop A(B) PFCS: LoopA(B) Line Heater Commands**

**LoopA(B) Line Heater Commands**

`EETCS LoopA(B) PFCS`

**NOTE**

1. RPCM 2B A RPC 07 provides power to the Loop A PFCS baseplate heater (100 W), TTCR heater 2 (282 W), and STCR heater 1 sets (282 W).

2. RPCM 4B A RPC 07 provides power to the Loop B PFCS baseplate heater (100 W), TTCR heater 1 (282 W), and STCR heater 2 (282 W).

3. Each 282 W TTCR and STCR heater set contains an 80 W deployment motor heater, a 40 W heater control unit heater, and a single 162 W heater that conditions the FQDC tube, flex hose patch, base tube, accumulator shroud, and torque panel tubes.

4. These heaters are thermostatically controlled and provide no corresponding temperature sensor insight.

If activating Loop A PFCS Baseplate Htr, STCR Htr 1, and TTCR Htr 2

`STCR Htr1 TTCR Htr2`

sel RPCM 2B A RPC 07

**RPCM 2B A RPC 07**

`RPC Position`

**cmd** RPC Position – Close (Verify – Cl)

If activating Loop B PFCS Baseplate Htr, STCR Htr 2, and TTCR Htr 1

`STCR Htr2 TTCR Htr1`

sel RPCM 4B A RPC 07

**RPCM 4B A RPC 07**

`RPC Position`

**cmd** RPC Position – Close (Verify – Cl)
1. **DEACTIVATING PFCS/RADIATOR HEATERS**

PCS P6: TCS: Loop A(B) PFCS: LoopA(B) Line Heater Commands

**NOTE**

1. RPCM 2B A RPC 07 provides power to the Loop A PFCS baseplate heater (100 W), TTCR heater set 2 (282 W), and STCR heater set 1 (282 W).

2. RPCM 4B A RPC 07 provides power to the Loop B PFCS baseplate heater (100 W), TTCR heater 1 (282 W), and STCR heater 2 (282 W).

3. Each 282 W TTCR and STCR heater set contains an 80 W deployment motor heater, a 40 W heater control unit heater, and a single 162 W heater that conditions the FQDC tube, flex hose patch, base tube, accumulator shroud, and torque panel tubes.

4. These heaters are thermostatically controlled and provide no corresponding temperature sensor insight.

If deactivating Loop A PFCS Baseplate Htr, STCR Htr 1, and TTCR Htr 2

`STCR Htr1 TTCR Htr2`

`sel RPCM 2B A RPC 07`

`RPCM 2B A RPC 07`

`RPC Position`

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

If deactivating Loop B PFCS Baseplate Htr, STCR Htr 2, and TTCR Htr 1

`STCR Htr2 TTCR Htr1`

`sel RPCM 4B A RPC 07`

`RPCM 4B A RPC 07`

`RPC Position`

`cmd` RPC Position – Open (Verify – Op)
4.106 EETCS LOOP A(B) RESTART
(TCS/4A - ALL/FIN) Page 1 of 15 pages

1. **VERIFYING THERMAL SAFING ALGORITHMS INHIBITED**

PCS LAB: TCS: Thermal Load Reduction

```
Thermal Load Reduction
```

- **cmd** Auto Thermal Load Shed Inhibit – Arm
  - **√** Auto Thermal Load Shed Inhibit – Arm
- **cmd** Auto Thermal Load Shed Inhibit – Inh
  - **√** Auto Thermal Load Shed – Inh
- **cmd** IATCS Reconfig Inhibit – Arm
  - **√** IATCS Reconfig Inhibit – Arm
- **cmd** IATCS Reconfig Inhibit – Inh
  - **√** IATCS Reconfig – Inh

**NOTE**
Expect possible Warning message *‘Thermal Safing IATCS Reintegration Action Inhibited’*.

```
sel IFHX Safing
```

- IFHX Safing
  - **√** LTL(MTL) IFHX Reinteg – Inh

**NOTE**
When the Bypass Valve is commanded to the Bypass position, expect following warning message:
*‘Thermal Safing [...] Load Shed Timer Started’*

When Thermal Load Shed Wait Timer reaches 0 expect the following warning:
*‘Thermal Safing Load Shed Inhibited - LAB’*
2. **VERIFYING IFHX VALVE POSITIONS**

**WARNING**

The IFHX Bypass Valve must be in the Bypass position and the Isol Valve should be in the Closed position prior to restart of the EETCS pump to prevent undertemperature of the IFHX core.

(E)PCS  
P6: TCS: LTL(MTL) IFHX  
LTL(MTL) IFHX Commands  
‘Isol Vlv (SDO Card)’

Verify RPC Position – Cl

‘Byp Vlv (SDO Card)’

Verify RPC Position – Cl

P6: TCS: LTL(MTL) IFHX: LTL(MTL) IFHX Additional Commands  
LTL(MTL) IFHX Additional Commands  
‘LTL(MTL) IFHX NH3’

√Byp Vlv Flothru Precond Ck – Ena  
√Isol Vlv Cl Precond Ck – Ena

sel LTL(MTL) IFHX Commands

Verify Bypass Valve position is either bypass or flow through.  
Verify Isolation Valve position is either opened or closed.

If valve position is indeterminate, verify position indicator availability.  
If position is available, without indication, contact MCC-H.

LTL(MTL) IFHX Commands  
‘LTL(MTL) IFHX NH3’

**CAUTION**

1. IFHX valve position must be verified before position commands can be issued.  
   If the valve position is indeterminate, driving the valve in the direction opposite of its last direction of motion can potentially result in damage to the valve seal.  
   If the valve position is indeterminate, √MCC-H.

2. Once commanded, if the valve does not reach the commanded position, the operator is allowed to issue the same position command up to three additional times.  
   If the desired position is still not reached, √MCC-H.
4.106 EETCS LOOP A(B) RESTART
(TCS/4A - ALL/FIN)  Page 3 of 15 pages

√Byp Vlv Cntl Avail – Ena

If Byp Vlv – Flothru/Byp ≠ blank
  cmd Byp Vlv – Byp Execute

√Byp Vlv Byp – X

√Isol Vlv Cntl Avail – Ena

If Isol Vlv – Open/Close ≠ blank
  cmd Isol Vlv – Close Execute

√Isol Vlv Close – X

***********************************************************************
If either the Bypass Valve or the Iso Relief Valve fail to move
to the desired position, verify the following before attempting
to command the valves again.

sel LTL(MTL) IFHX Additional Commands

LTL(MTL) IFHX Additional Commands
‘LTL(MTL) IFHX NH3’

√Byp Vlv Byp Posn Ind Avail – Ena
√Isol Vlv Cl Posn Ind Avail – Ena

If verifying LTL IFHX
  ‘LTL IFHX NH3’
  ‘Secondary NCS’

  √IFHX Cntl Processing – Ena

If verifying MTL IFHX
  ‘MTL IFHX NH3’
  ‘Primary NCS’

  √IFHX Cntl Processing – Ena

sel LTL(MTL) IFHX Commands

LTL(MTL) IFHX Commands
‘LTL(MTL) IFHX NH3’

cmd Byp Vlv – Byp Execute

√Byp Vlv Byp – X

cmd Isol Vlv – Close Execute

√Isol Vlv Close – X

***********************************************************************
4.106 EETCS LOOP A(B) RESTART

(TCS/4A - ALL/FIN) Page 4 of 15 pages

‘Isol Vlv (SDO Card)’

sel RPCM N1RS1 A RPC 06(RPCM N1RS2 C RPC 03)

**cmd** RPC Position – Op

√RPC Position – Op

3. **INHIBITING NCS IFHX UNDERTEMP FDIR**

(E)PCS

P6: TCS: LTL(MTL) IFHX

<table>
<thead>
<tr>
<th>LTL(MTL) IFHX Commands</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘LTL(MTL) IFHX NH3’</td>
</tr>
</tbody>
</table>

**cmd** Undtemp Resp – Inh  **Execute**

√Undtemp Resp – Inh

4. **VERIFYING EETCS SOFTWARE ALGORITHM STATES**

(E)PCS

P6: TCS: LoopA(B) PFCS

<table>
<thead>
<tr>
<th>LoopA(B) PFCS Nominal Commands</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘EETCS Loop A(B) PFCS’</td>
</tr>
</tbody>
</table>

√FCV Cntl – Inh

sel LoopA(B) Bkup PVCU Commands

<table>
<thead>
<tr>
<th>LoopA(B) Bkup PVCU Commands</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘Bkup PVCU EETCS LoopA(B)’</td>
</tr>
</tbody>
</table>

√PFCS FCV Cntl – Inh

**NOTE**

1. After completing step 4, the EETCS FDIR and Closed Loop Control algorithms within the software should be in the following configuration.

2. The table is provided for information only.
4.106 EETCS LOOP A(B) RESTART
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<table>
<thead>
<tr>
<th>Parameter</th>
<th>Display</th>
<th>State</th>
</tr>
</thead>
<tbody>
<tr>
<td>FCV Cntl</td>
<td>LoopA(B) PFCS Nominal Commands</td>
<td>Inh</td>
</tr>
<tr>
<td>Inval Data FDIR</td>
<td>LoopA(B) PFCS FDIR Commands</td>
<td>Ena</td>
</tr>
<tr>
<td>Min Out Temp FDIR</td>
<td>LoopA(B) PFCS FDIR Commands</td>
<td>Ena</td>
</tr>
<tr>
<td>Pump Deadhead FDIR</td>
<td>LoopA(B) PFCS FDIR Commands</td>
<td>Ena</td>
</tr>
<tr>
<td>Pump Switch FDIR</td>
<td>LoopA(B) PFCS FDIR Commands</td>
<td>Ena</td>
</tr>
<tr>
<td>Min In Temp FDIR</td>
<td>LoopA(B) PFCS FDIR Additional Commands</td>
<td>Ena</td>
</tr>
<tr>
<td>Max Out Temp FDIR</td>
<td>LoopA(B) PFCS FDIR Additional Commands</td>
<td>Ena</td>
</tr>
<tr>
<td>FCV Temp Recal FDIR</td>
<td>LoopA(B) PFCS FDIR Additional Commands</td>
<td>Inh</td>
</tr>
<tr>
<td>Auto FCV Recal</td>
<td>LoopA(B) PFCS Nominal Additional Commands</td>
<td>Inh</td>
</tr>
<tr>
<td>Invalid Data/Max Ln Temp FDIR</td>
<td>LoopA(B) PFCS FDIR Additional Commands</td>
<td>Inh</td>
</tr>
<tr>
<td>Line Htr Cntl</td>
<td>LoopA(B) Line Heater Commands</td>
<td>Ena</td>
</tr>
<tr>
<td>Line Htr Cmd Ck</td>
<td>LoopA(B) Line Heater Commands</td>
<td>Ena</td>
</tr>
</tbody>
</table>

5. **INHIBITING EETCS MIN OUT TEMP FDIR**

   (E)PCS P6: TCS: LoopA(B) PFCS: LoopA(B) PFCS FDIR Commands
   ‘EETCS LoopA(B) PFCS’
   ‘Min Out Temp FDIR’

   **cmd** Inhibit – Arm

   √Inhibit Arm – X

   **cmd** Inhibit – Inh

   √Min Out Temp FDIR – Inh

   sel LoopA(B) Bkup PVCU Commands

   ![LoopA(B) Bkup PVCU Commands]
   ‘Bkup PVCU EETCS Loop A(B)’

   **cmd** PFCS Min Out Temp FDIR Inh – Arm
   **cmd** PFCS Min Out Temp FDIR Inh – Inh

   √PFCS Min Out Temp FDIR – Inh

6. **POWERING ON LOOPA(B) PFCS**

   If required, perform step 6; if not, go to step 7.

   (E)PCS P6: TCS
   ![P6:EETCS Overview]

   If EETCS LoopA(B) PFCS Integ Counter – <incrementing>
   Go to step 7.
If EETCS LoopA(B) PFCS Integ Counter – <not incrementing>

P6: TCS: LoopA(B) PFCS: LoopA(B)PFCS FDIR Commands

‘EETCS LoopA(B) PFCS’

**cmd** Inval Data FDIR Inhibit – Arm

√ Inval Data FDIR Inhibit Arm – X

**cmd** Inval Data FDIR Inhibit – Inh

√ Inval Data FDIR – Inh

sel LoopA(B) Bkup PVCU Commands

‘Bkup PVCU EETCS LoopA(B)’

**cmd** PFCS Inval Data FDIR Inh – Arm
**cmd** PFCS Inval Data FDIR Inh – Inh

√ PFCS Inval Data FDIR – Inh

P6: TCS: LoopA(B) PFCS: RPCM 4B(2B) A RPC 04

RPCM 4B(2B) A RPC 04

---

**CAUTION**

Once the PFCS is powered on, the operator should record the higher of PFCS Out Temp1 or PFCS Out Temp2 as soon as possible (navigation provided below). The PFCS can remain powered on for the length of time specified below, dependent on the temperature.

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Time Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>T &gt; 37° C</td>
<td>15 minutes</td>
</tr>
<tr>
<td>10° C &lt; T &lt; 37° C</td>
<td>1 hour</td>
</tr>
<tr>
<td>T &lt; 10° C</td>
<td>2 hours</td>
</tr>
</tbody>
</table>

**cmd** RPC Position – Close

√ RPC Position – Cl

Record RPC closed: _____ / ______:______:______ GMT

P6: TCS: LoopA(B) Details

‘EETCS LoopA(B)’
Record the higher of PFCS Out Temp1 and PFCS Out Temp2. Compare this reading to the values in the Caution Block above to determine how long the PFCS can remain powered without an active pump.

PFCS Out Temp1 and PFCS Out Temp2: _______ deg C

P6: TCS
- P6:EETCS Overview
- ‘EETCS PFCS LoopA(B)’

Verify LoopA(B) PFCS Integ Counter – <incrementing>

---

**CAUTION**

Expect possible one or more of the following warning messages:
- ‘EETCS Loop A(B) PFCS Outlet Temp Low Violation P6’
- ‘EETCS LoopA(B) PFCS Maximum Outlet Temp Violation Condition P6’
- ‘EETCS LoopA(B) PFCS Min In Temp Violation Condition P6’
- ‘LAB LTL(MTL) IFHX NH3 In Temp Low - Bypass Attempt LAB’

---

(E)PCS
- P6: C&DH: Primary PVCU MDM (select the MDM identified as primary)
  - Primary PVCU MDM

sel UB PVB 24-1(2): RT Status

- UB PVB 24 1(2) RT Status
  - ‘09 PFCS 4B(2B) (SPA)’
  - ‘RT FDIR Status’

  **cmd** – Enable FDIR

  √ RT FDIR Status – Ena

Verify RT Failed Status – <blank>

---

6.1 Issuing Clear Commands to PFCS and PVCU

(E)PCS
- P6: TCS: LoopA(B) Firmware
  - LoopA(B) Firmware
  - ‘EETCS LoopA(B) PFCS’

  **cmd** Common Clear – Arm

  **cmd** Common Clear – Common Clear

sel Clear Cmds: PV Cmd Response Clear

- PV Cmd Response Clear
  - ‘PFCS Command Response Clear’
4.106 EETCS LOOP A(B) RESTART

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(cmd Arm
(cmd Clear

√MCC-H before sending the Associated Data Clear commands

The commands clear latched data in the PVCU MDM. If there are other failures in the system, this command could erase valuable information. If MCC-H is unavailable, skip the Associated Data Clear commands and proceed to the next set of commands. Inform MCC-H at the next opportunity.

P6: TCS: LoopA(B) PFCS: LoopA(B) Firmware: Clear Cmds: PV Assoc Data Clear

(cmd Associated Data Clear Arm
(cmd Associated Data Clear

6.2 Enabling Invalid Data FDIR

(E)PCS P6: TCS: LoopA(B) PFCS: LoopA(B)PFCS FDIR Commands

‘EETCS LoopA(B) PFCS’

(cmd Inval Data FDIR Enable – Arm
√Inval Data FDIR Enable Arm – X
(cmd Inval Data FDIR Enable – Ena
√Inval Data FDIR – Ena

sel LoopA(B) Bkup PVCU Commands

(cmd PFCS Inval Data FDIR Ena – Arm
(cmd PFCS Inval Data FDIR Ena – Ena

√PFCS Inval Data FDIR – Ena

7. SETTING FCV POSITION PARAMETERS

(E)PCS P6: TCS: LoopA(B) PFCS: LoopA(B) PFCS Nominal Additional Commands

‘EETCS LoopA(B) PFCS’

input FCV Set LOC Position: 0 (Full Bypass position)
**4.106 EETCS LOOP A(B) RESTART**

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**cmd** FCV Set LOC Position – Arm

√FCV Set LOC Posn Arm – X

**cmd** FCV Set LOC Position – Set

**NOTE**
When the software in the PFCS loses track of the actual FCV Position, the PFCS must be informed of the actual FCV Position. The PFCS will lose track of the FCV Position when power is removed from the PFCS. Some FDIR responses will shut off the PFCS by removing power.

(E)PCS P6: TCS: Loop A(B) PFCS

‘EETCS LoopA(B) PFCS’

Record current FCV Posn: ______ Deg

**NOTE**
A Normalized Position is calculated by dividing the current FCV Position reading in angular degrees by 90 degrees, which is the nominal range of motion for the valve.

Calculate FCV Normalized Posn: ______ (FCV Posn)/(90 Deg)

input FCV Set Init Posn – FCV Normalized Posn

**cmd** FCV Set Init Posn – Set

input FCV Posn: 0.0 (0.0 = normalized angle for Full Byp flow)

**cmd** Set

√FCV Posn: 0 ± 5.3 Deg (Full Bypass flow)

8. **ACTIVATING PUMP A(B) AND VERIFY PARAMETERS**

(E)PCS P6: TCS

‘EETCS LoopA(B) PFCS’

**CAUTION**
If the LoopA(B) PFCS In Press is less than the calculated startup pressure do not start the pump. There is a potential for activation below this pressure.
Determine the startup pressure using the chart below where temperature is the Out Fltrd Lwr Temp in degrees Celsius.

![EETCS Startup Pressure vs Temperature](chart.png)

Startup Pressure = __________ kPa

Verify the following parameters are within range:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Lower Limit</th>
<th>Upper Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>In Press Startup Pressure</td>
<td></td>
<td>1800 kPa</td>
</tr>
<tr>
<td>Out Fltrd Lwr Temp</td>
<td>-42.8°C</td>
<td>10°C</td>
</tr>
</tbody>
</table>

If In Press or Out Fltrd Lwr Temp are out of range, √MCC-H.

 sel LoopA(B) PFCS

LoopA(B) PFCS Nominal Commands

'EETCS LoopA(B) PFCS'

**NOTE**

This procedure uses Pump A as the nominal EETCS pump. Pump selection is dependent on excessive run-time or pump failure.

If Pump A has failed or is unavailable, Pump B can be used in its place.

cmd PumpA – On

√PumpA – On

Record PumpA On: _____/_____ : _____:_____ GMT
CAUTION

Expect possible one or more of the following warning messages:
- ‘EETCS Loop A(B) PFCS Outlet Temp Low Violation P6’
- ‘EETCS Loop A(B) PFCS Maximum Outlet Temp Violation Condition P6’
- ‘EETCS Loop A(B) PFCS Min In Temp Violation Condition P6’
- ‘LAB LTL(MTL) IFHX NH3 In Temp Low - Bypass Attempt LAB’

P6: TCS
P6:EETCS Overview
‘EETCS Loop A(B) PFCS’

Verify the following parameters read within the specified ranges. Allow 60 seconds for parameters to reach their nominal values.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Lower Limit</th>
<th>Upper Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accum Fltrd Avg Qty</td>
<td>36.1 %</td>
<td>68.9 %</td>
</tr>
<tr>
<td>Flow Rate</td>
<td>772 kg/hr</td>
<td>950 kg/hr</td>
</tr>
<tr>
<td>PumpA Spd</td>
<td>12605 rpm</td>
<td>14555 rpm</td>
</tr>
</tbody>
</table>

9. **ENABLING FCV AND LINE HEATER CONTROL**
(E)PCS
P6: TCS: Loop A(B) PFCS
- ‘EETCS Loop A(B) PFCS’

*cmd* FCV Cntl Enable – Arm

√FCV Cntl Arm – X

*cmd* FCV Cntl Enable – Ena

√FCV Cntl – Ena

sel Loop A(B) Line Heater Commands

- ‘EETCS Loop A(B) PFCS’
- ‘Line Htr Cntl’

**NOTE**
When Line Htr Cntl is enabled, ignore the Inhibited Line Heater telemetry field. It does not update based on the Line Htr Cntl Enable command.

*cmd* Enable – Arm (√X)

*cmd* Enable – Ena

√Line Htr Cntl – Ena
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sel LoopA(B) Bkup PVCU Commands

<table>
<thead>
<tr>
<th>LoopA(B) Bkup PVCU Commands</th>
<th>Bkup PVCU EETCS LoopA(B)</th>
</tr>
</thead>
</table>

`cmd` PFCS FCV Cntl Ena – Arm
`cmd` PFCS FCV Cntl Ena – Ena

√PFCS FCV Cntl – Ena

`cmd` PFCS Ln Htr Cntl Ena – Arm
`cmd` PFCS Ln Htr Cntl Ena – Ena

√PFCS Ln Htr Cntl – Ena

10. ENABLING REQUIRED EETCS FDIR ALGORITHMS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Display</th>
<th>State</th>
</tr>
</thead>
<tbody>
<tr>
<td>FCV Cntl</td>
<td>LoopA(B) PFCS Nominal Commands</td>
<td>Ena</td>
</tr>
<tr>
<td>Inval Data FDIR</td>
<td>LoopA(B) PFCS FDIR Commands</td>
<td>Ena</td>
</tr>
<tr>
<td>Min Out Temp FDIR</td>
<td>LoopA(B) PFCS FDIR Commands</td>
<td>Inh</td>
</tr>
<tr>
<td>Pmp Deadhead FDIR</td>
<td>LoopA(B) PFCS FDIR Commands</td>
<td>Ena</td>
</tr>
<tr>
<td>Pump Switch FDIR</td>
<td>LoopA(B) PFCS FDIR Commands</td>
<td>Ena</td>
</tr>
<tr>
<td>Min In Temp FDIR</td>
<td>LoopA(B) PFCS FDIR Additional Commands</td>
<td>Ena</td>
</tr>
<tr>
<td>Max Out Temp FDIR</td>
<td>LoopA(B) PFCS FDIR Additional Commands</td>
<td>Ena</td>
</tr>
<tr>
<td>FCV Temp Recal FDIR</td>
<td>LoopA(B) PFCS FDIR Additional Commands</td>
<td>Inh</td>
</tr>
<tr>
<td>Auto FCV Recal</td>
<td>LoopA(B) PFCS Nominal Additional Commands</td>
<td>Inh</td>
</tr>
<tr>
<td>Invalid Data/Max Ln Temp FDIR</td>
<td>LoopA(B) PFCS FDIR Additional Commands</td>
<td>Inh</td>
</tr>
<tr>
<td>Line Htr Cntl</td>
<td>LoopA(B) Line Heater Commands</td>
<td>Ena</td>
</tr>
<tr>
<td>Line Htr Cmd Ck</td>
<td>LoopA(B) Line Heater Commands</td>
<td>Ena</td>
</tr>
<tr>
<td>Integ Counter</td>
<td>EETCS Overview</td>
<td>&lt;incrementing&gt;</td>
</tr>
</tbody>
</table>

NOTE
1. After completing step 8, the EETCS FDIR and Closed Loop Control algorithms within the software should be in the following configuration.
2. The table is provided for information only.

When EETCS LoopA(B) Out Fltrd Lwr Temp or the Out Line Fltrd Temp temperatures < 1.2° C, it may take several hours for either of them to rise above 1.2° C.
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(E)PCS

P6: TCS: LoopA(B) PFCS: LoopA(B) PFCS FDIR Commands

LoopA(B) PFCS FDIR Commands

‘EETCS LoopA(B) PFCS’

Verify Out Fltrd Lwr Temp ≥ 1.2° C
Verify Out Ln Fltrd Temp ≥ 1.2° C

\text{cmd} \text{ Min Out Temp FDIR Enable – Arm}

√\text{Min Out Temp FDIR Enable Arm – X}

\text{cmd} \text{ Min Out Temp FDIR Enable – Ena}

√\text{Min Out Temp FDIR – Ena}

sel LoopA(B) Bkup PVCU Commands

LoopA(B) Bkup PVCU Commands

‘Bkup PVCU EETCS LoopA(B)

\text{cmd} \text{ PFCS Min Out Temp FDIR Ena – Arm}

\text{cmd} \text{ PFCS Min Out Temp FDIR Ena – Ena}

√\text{PFCS Min Out Temp FDIR – Ena}

11. REENABLING NCS IFHX UNDERTEMP FDIR

\textbf{NOTE}

When LTL IFHX NH3 In Temp 1 and 2 < 1.2° C, it may take several hours for both to rise above 1.2° C.

(E)PCS

P6: TCS: LTL(MTL) IFHX

LTL(MTL) IFHX Commands

‘LTL(MTL) IFHX’

Verify NH3 In Temp 1 ≥ 1.2° C
Verify NH3 In Temp 2 ≥ 1.2° C

\textbf{CAUTION}

The Undertemp Response algorithm should not be enabled until both NH3 In Temp 1 and NH3 In Temp 2 are greater than or equal to 1.2° C.

‘LTL(MTL) IFHX NH3’

\textbf{cmd} \text{ Undtemp Resp – Ena} \textbf{Execute}

√\text{Undtemp Resp – Ena}
12. CONFIGURING IFHX VALVES FOR NORMAL OPERATIONS

P6: TCS: LTL(MTL) IFHX: LTL(MTL) IFHX Additional Commands
‘LTL(MTL) IFHX Additional Commands’
‘LTL(MTL) IFHX NH3’

√Byp Vlv Flothru Precond Ck – Ena
√Isol Vlv Cl Precond Ck – Ena

CAUTION
The IFHX Isol valve must be commanded open prior to commanding the IFHX Bypass valve to Flothru to prevent deadheading of the EETCS pump.

sel LTL(MTL) IFHX Commands

LTL(MTL) IFHX Commands
‘Isol Vlv (SDO Card)’

sel RPCM N1RS1 A RPC 06(RPCM N1RS2 C RPC 03)

cmd RPC Position – Cl

√RPC Position – Cl

CAUTION
1. IFHX valve position must be verified before position commands can be issued. If the valve position is indeterminate, driving the valve in the direction opposite of its last direction of motion can potentially result in damage to the valve seal.

2. Once commanded, if the valve does not reach the commanded position, the operator is allowed to issue the same position command up to three additional times. If the desired position is still not reached, √MCC-H.

‘LTL(MTL) IFHX NH3’

√Isol Vlv Cntl Avail – Ena

If Isol Vlv – Open/Close ≠ blank

   cmd Isol Vlv – Open Execute

   √Isol Vlv Open – X
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√Byp Vlv Cntl Avail – Ena

If Byp Vlv – Flothru/Byp ≠ blank
  cmd Byp Vlv – Flothru  Execute

√Byp Vlv Flothru – X

NOTE
1. The following table is a summary of the configuration and expected ranges where the system should be operating.
2. After completing step 12, the IFHX Valves and NCS FDIR should be in the following configuration.
3. The table is provided for information only.

<table>
<thead>
<tr>
<th>Parameter Display State / Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>LTL(MTL) IFHX Undtemp Resp LAB IATCS Overview Enable</td>
</tr>
<tr>
<td>LTL(MTL) IFHX NH3 Isol Vlv Posn LAB IATCS Overview Open</td>
</tr>
<tr>
<td>LTL(MTL) IFHX NH3 Byp Vlv Posn LAB IATCS Overview Flothru</td>
</tr>
<tr>
<td>LTL(MTL) IFHX NH3 In Temp 1 LAB IATCS Overview ≥ 1.2°C</td>
</tr>
<tr>
<td>LTL(MTL) IFHX NH3 In Temp 2 LAB IATCS Overview ≥ 1.2°C</td>
</tr>
</tbody>
</table>

NOTE
MCC-H will perform the procedure necessary to reenable Thermal Load Shed.

13. ENABLING THERMAL SAFING ALGORITHMS

PCS
LAB: TCS: Thermal Load Reduction
  Thermal Load Reduction
  ‘Clear Load Shed C/Ws’

cmd Load Shed Timer/IATCS Reconfig – Clear C/W

Verify ‘Thermal Safing [. ] Load Shed Timer Started’ and ‘Thermal Safing IATCS Reconfig Action’ messages return to normal.

‘Load Shed Started’

cmd Partial LTL(MTL) – Clear C/W

Verify ‘Thermal Safing LTL Partial Load Shed Started’ message has returned to normal.
Verify LTL(MTL) Load Shed Wait Timer: 0
Verify IATCS LTL(MTL) IFHX Byp/Isol – blank
Verify IATCS LTL(MTL) Shutdown Power Request – blank

cmd IATCS Reconfig Enable – Ena

√IATCS Reconfig – Ena
**The Firmware memory will contain a message indicating the cause of the failure. MCC-H will perform the necessary data dump and further analysis and recovery.**

**In the event that MCC-H is unavailable to perform a data dump, the RT should be reset to reestablish the command path. When the RT Reset command is sent, the error message generated when the initial command was not received will be lost from firmware memory.**

**The failure message will be latched in the PVCU DRAM and has to be cleared via specific clear command.**

**To determine whether or not the RT Reset cleared the commanding problem, attempt to manually position the FCV position. If the FCV responds to the commands, the problem is fixed; otherwise, MCC should be contacted for further analysis.**
5 Command FCV
P6: TCS: Loop A(B) PFCS
LoopA(B) PFCS Nominal Commands
'EETCS LoopA(B) PFCS' 'FCV Posn'
• input FCV Posn = 0.0 (0.0 = 0 Deg - Full Bypass Flow)
• cmd Set

FCV Posn = 0 Deg?
>>> Yes
6 Problem fixed.

No

7 Unable to move FCV.
It will remain in current position.

8 Reenable FCV Control
P6: TCS: Loop A(B) PFCS
LoopA(B) PFCS Nominal Commands
'EETCS LoopA(B) PFCS' 'FCV Cntl'
• cmd Enable – Arm (√ – X)
• cmd Enable – Ena
• FCV Cntl – Ena

9 • Notify MCC-H for further troubleshooting

10
• Notify MCC-H of problem resolution.
The temperature reading tripping the advisory flag is possibly a sporadic temperature reading that could have been triggered by a transient temperature condition. This failure condition is cleared when the temperature returns within its limit for three consecutive readings (6 seconds).

An additional comparison can be made with the Interface Heat Exchanger Ammonia Inlet Temperatures for further indications of bias.

Select PFCS Out Temp 1 or 2 as the temperature to be used in the control function due to the bias of the other sensor.

If determination of which sensor is biased is difficult, MCC-H will perform predictions of the PFCS outlet temperature based on Radiator Return temperature, Radiator Bypass temperature and FCV position.
An additional comparison can be made with the Interface Heat Exchanger Ammonia Inlet Temperatures for further indications of bias.

If determination of which sensor is biased is difficult, MCC-H will perform predictions of the PFCS outlet temperature based on Radiator Return temperature, Radiator Bypass temperature and FCV position.

Biased sensor is no longer valid, and should be removed from sensor selection algorithm.

Only one PFCS Out Line Temperature Sensor is available through each PVCU. Losing the Out Line Temp Sensor removes one of three layers of IFHX freeze protection as well as one FDIR data input. A PVCU switch is required to regain PFCS Out Line Temps.
NOTE
This procedure is based on the following assumption:
The Nitrogen Interface Assembly is not available for use. The only failures in the Lab IATCS system that might be present are a failed open shutoff valve and a leaking PPA Check Valve.

1. **INHIBITING LEAK RECOVERY FDIR**

   PCS
   LAB: TCS: Software: Software Additional Commands
   | Software Additional Commands |
   | ‘Leak Recovery IATCS’ |
   | ‘Leak Rcvy’ |
   | ‘Auto Isolation’ |

   cmd
   Inhibit – Arm (√ – X)
   cmd
   Inhibit – Inh

   √Auto Isolation – Inh

   ‘LTL Leak Rcvy’
   ‘Auto Shutdown’

   cmd
   Inhibit – Arm (√ – X)
   cmd
   Inhibit – Inh

   √Auto Shutdown – Inh

   ‘MTL Leak Rcvy’
   ‘Auto Shutdown’

   cmd
   Inhibit – Arm (√ – X)
   cmd
   Inhibit – Inh

   √Auto Shutdown – Inh

2. **INHIBITING IFHX LEAK RESPONSE FDIR**

   PCS
   LAB: TCS: Thermal Load Reduction: IFHX Safing
   | IFHX Safing |
   | ‘LTL IFHX Leak Resp’ |

   cmd
   Inhibit – Arm (√ – X)
   cmd
   Inhibit – Inh

   √LTL IFHX Leak Resp – Inh

   ‘MTL IFHX Leak Resp’

   cmd
   Inhibit – Arm (√ – X)
   cmd
   Inhibit – Inh

   √MTL IFHX Leak Resp – Inh
3. **INHIBITING FAILURE RECOVERY FDIR**

**NOTE**

While the Failure Recovery FDIR is inhibited, any cautions indicating an IATCS Pump/Valve failure will probably be followed by a Warning: ‘LAB IATCS Failure with Fail Rcvy Inhibited - Lab’ message. In this case, it will mostly likely be due to a pump failure.

**********************************************************
If Warning: ‘LAB IATCS Failure with Fail Rcvy Inhibited - Lab’ message occurs anywhere in this procedure, \MCC-H for further action.
**********************************************************

PCS

LAB: TCS: Software

Software Commands

‘IATCS’
‘Fail Rcvy’

**cmd** Inhibit – Arm (√ – X)

**cmd** Inhibit – Inh

√Fail Rcvy – Inh

4. **SWITCHING ACTIVE PUMPS WITH MODE TRANSITION**

**NOTE**

Turning on the pump with excess water and turning off the underfull pump will allow water to be transferred in a controlled manner. The inactive pump will have a lower pressure following the Mode transition, allowing water to be transferred from the active pump’s PPA Accumulator.

If MTL PPA Accumulator has excess water and IATCS Mode ≠ Sngl MT, perform {2.205 LAB IATCS TRANSITION TO SINGLE MT (AUTO)}, steps 1,4,5,8 (SODF: TCS: NOMINAL: IATCS), then:

If LTL PPA Accumulator has excess water and IATCS Mode ≠ Sngl LT, perform {2.204 LAB IATCS TRANSITION TO SINGLE LT (AUTO)}, steps 1,4,5,8 (SODF: TCS: NOMINAL: IATCS), then:

5. **DETERMINING MODE CONFIGURATION**

If IATCS Mode – Sngl LT,
Perform steps 6 --- 9 for the MTL and LABS6.

If IATCS Mode – Sngl MT,
Perform steps 6 --- 9 for the LTL and LABP6.
6. **VERIFYING TARGET ACCUMULATOR QUANTITY**

√MCC-H for accumulator quantity target

Record target LTL(MTL) Avg Accum Qty: ______ %

7. **ACCESSING THE SOV FOR THE LTL(MTL) PUMP**

Open front panel on Rack LABP6(LABS6) by lifting the panel latches (two) and swinging the panel door open.

Pull Out LTL(MTL) SFCA Pump Inlet Shutoff Knob (SOV).

8. **ADJUSTING THE SOV FOR THE LTL(MTL) PUMP**

**NOTE**

The SFCA Pump Inlet Shutoff Knob should not be held open for more than 2 seconds at a time.

Turn the LTL(MTL) SFCA Pump Inlet Shutoff Knob counterclockwise to the Open position for 1 second so that water begins flowing from the LTL(MTL) PPA Accumulator.

Close LTL(MTL) PPA Accumulator again.

**NOTE**

This step allows water from the active PPA Accumulator to flow into the inactive PPA until the active PPA Accumulator is brought down to an acceptable quantity.

9. **CHECKING ACCUMULATOR QUANTITY**

Wait 10 seconds to allow accumulator quantities to come to an equilibrium.

PCS Lab: TCS

Lab IATCS Overview

‘PPA’

Record LTL(MTL) Avg Accum Qty: ______ %

If LTL(MTL) Avg Accum Qty is within 5% of target LTL(MTL) Avg Accum Qty

Push in LTL(MTL) SFCA Pump Inlet Shutoff Knob.

Close front panel by swinging the panel closed and engaging the panel latches (two).

If LTL (MTL) Avg Accum Qty is not within 5% of target LTL(MTL) Avg Accum Qty

Repeat steps 8 and 9.
10. **ENABLING FAILURE RECOVERY FDIR**

PCS

LAB: TCS: Software

[Software Commands]

‘IATCS’

‘Fail Rcvy’

**cmd** Enable – Ena

√Fail Rcvy – Ena

11. **ENABLING LEAK RECOVERY FDIR**

PCS

LAB: TCS: Software: Software Additional Commands

[Software Additional Commands]

‘Leak Recovery IATCS’

‘Leak Rcvy’

‘Auto Isolation’

**cmd** Enable – Ena

√Auto Isolation – Ena

‘LTL Leak Rcvy’

‘Auto Shutdown’

**cmd** Enable – Ena

√Auto Shutdown – Ena

‘MTL Leak Rcvy’

‘Auto Shutdown’

**cmd** Enable – Ena

√Auto Shutdown – Ena

12. **ENABLING IFHX LEAK RESPONSE FDIR**

PCS

LAB: TCS: Thermal Load Reduction: IFHX Safing

[IFHX Safing]

‘LTL IFHX Leak Resp’

‘Enable’

**cmd** Enable – Ena

√LTL IFHX Leak Resp – Ena

‘MTL IFHX Leak Resp’

‘Enable’

**cmd** Enable – Ena

√MTL IFHX Leak Resp – Ena
13. **LOOP MODE CONFIGURATION**
   If an IATCS Loop Mode transition was performed in step 4, √MCC-H for final Loop configuration.
NOTE
Steps 1 --- 5 of this procedure place the IATCS into a proper configuration following a failure of the LA 1 MDM. Steps 6 --- 10 reconfigure the IATCS to a nominal Dual mode once the LA 1 MDM has returned to an operational state.

1. VERIFICATION OF IATCS SYSTEM

PCS
LAB: TCS
Lab: IATCS Overview
‘Status’

If Mode – Single LT
Verify LTL PPA Pmp Spd: 18900 ± 1250 rpm
Verify MTL Regen TWMV HX Out Temp: 17.2 ± 2 deg C

If Mode – Single MT
Verify MTL PPA Pmp Spd: 18900 ± 1250 rpm
Verify MTL Regen TWMV HX Out Temp: 17.2 ± 2 deg C

If Mode – Dual
Verify LTL PPA Pmp Spd: 15880 ± 1250 rpm
Verify MTL PPA Pmp Spd: 17200 ± 1250 rpm
Verify MTL TWMV Out Temp: 17.2 ± 2 deg C

NOTE
If the LA 1 MDM is expected to be down for an extended period of time (i.e., hard failed), then MCC-H may consider either performing a manual transition of the IATCS to Single MT (if not already in Single MT) or jumpering an RFCA to gain additional loop insight.

2. CONFIGURATION OF PMA2 HEATERS

NOTE
If the PMA2 Heaters are currently being used then the PMA2 B String Heaters will be placed into an Override On status since temperature insight will be lost due to the LA 1 MDM failure. Manual cycling between Ovrd On and Ovrd Off may be required to preclude 45.6°C (114°F) touch temp violations.
4.202 LAB IATCS RECONFIGURATION FOR LA 1 MDM FAILURE

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If CLC – Ena

    **cmd** Inhibit – Arm (√ – X)
    **cmd** Inhibit – Inh

Verify CLC – Inh

PMA2: TCS

<table>
<thead>
<tr>
<th>PMA2:TCS</th>
</tr>
</thead>
</table>

    sel Htr[X] Icon   where [X] = 1B 2B 3B 4B 5B

    **PMA2 Htr [X]**

    ‘PMA2 Htr[X] Status’

    **cmd** Override On – Ovrd On

Verify Status – Ovrd On

Repeat

3. CONFIGURATION OF LAB WINDOW HEATER

**NOTE**

Lab Window Heater temperature insight and software control will be lost due to LA 1 MDM failure. The heater will be off and the Lab window shutter will need to be closed.

Close Lab window shutter.

4. CONFIGURATION OF MTL IFHX HEATERS

**NOTE**

MTL IFHX Heaters will be inhibited because the insight to the temp sensors will be lost when the LA 1 MDM failed. The three legs of freeze protection for the MTL IFHX are still available since those algorithms do not use these sensors. If MTL flow through the IFHX were to be stopped then the IFHX heaters may need to be commanded to Ovrd On.

PCS LAB: TCS: MTL IFHX: MTL IFHX Heater Commands

<table>
<thead>
<tr>
<th>MTL IFHX Heater Commands</th>
</tr>
</thead>
</table>

    ‘MTL IFHX’

    ‘Htr Sys’

    **cmd** CLC – Inh

Verify CLC – Inh
5. SENSORS LOST DUE TO LA 1 FAILURE

**NOTE**

1. During the time that LA 1 MDM is in a non-operational state, the following rack out temps will not be available: LAB1P3, LAB1P5, LAB1P6, LAB1D1 and Fwd E/C.

2. During the time that LA 1 MDM is in a non-operational state the following Rack Flow Control Assemblies (RFCAs) will not be available: LAB1S1, LAB1S2, LAB1S3, LAB1P1, LAB1D3 and NODE1 LTL.

3. During the time that LA 1 MDM is in a non-operational state the PMA2 APAS temperatures will not be available.

4. During the time that LA 1 MDM is in a non-operational state the LTL TWMV, SFCA, PPA and NIA will not have valid telemetry.

6. Steps 6 --- 10 are to be performed separate from steps 1 --- 5.

6. STARTUP OF LTL COMPONENT SOFTWARE

<table>
<thead>
<tr>
<th>PCS</th>
<th>LAB: TCS: LTL SFCA</th>
</tr>
</thead>
<tbody>
<tr>
<td>LTL SFCA Commands</td>
<td>‘LTL SFCA’ ‘Software’</td>
</tr>
</tbody>
</table>

**cmd** Startup – Startup

Verify Software – Started

<table>
<thead>
<tr>
<th>LAB: TCS: LTL TWMV Icon</th>
<th>LTL TWMV Commands</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘LTL TWMV’</td>
<td></td>
</tr>
</tbody>
</table>

**cmd** Software Startup – Startup **Execute**

Verify Software – Started

**cmd** CLC – Ena **Execute**

Verify CLC – Ena

7. TRANSITIONING OF IATCS TO DUAL MODE

**NOTE**

This step is to be performed, even if the IATCS mode is already Dual, in order to properly configure all IATCS valves.

Perform [2.203 LAB IATCS TRANSITION TO DUAL (AUTO)], all (SODF: TCS: NOMINAL: IATCS), then:
8. **RECOVERY OF PMA2 SHELL HEATERS**
   If step 3 was fully performed (i.e., CLC – Ena at beginning of step 3)
   
   **PCS**
   
   PMA2: TCS
   
   `PMA2:TCS`
   
   sel Htr[X] Icon where [X] = 1B 2B 3B 4B 5B
   
   `PMA2 Htr [X]`
   
   ‘PMA2 Htr[X] Status’
   
   `cmd` CLC – Ena
   
   Verify Status – On or Off
   
   Repeat

9. **RECOVERY OF LAB WINDOW HEATER**
   Open Lab window shutter.
   
   **PCS**
   
   LAB: TCS: IATCS Details: LAB Window Heater Commands
   
   `LAB Window Heater Commands`
   
   ‘LAB Window Heater’
   
   RPC Posn – CI
   
   ‘Software’
   
   `cmd` Startup – Startup
   
   Verify Software – Started
   
   ‘CLC’
   
   `cmd` CLC – Ena
   
   Verify CLC – Ena

10. **RECOVERY OF MTL IFHX HEATERS**
    
    **PCS**
    
    LAB: TCS: MTL IFHX: MTL IFHX Heater Commands
    
    `MTL IFHX Heater Commands`
    
    ‘MTL IFHX’
    
    ‘Htr Sys’
    
    `cmd` CLC – Ena
    
    Verify CLC – Ena
4.203 LAB IATCS RECONFIGURATION FOR LA 2 MDM FAILURE
(TCS/5A - ALL/FIN) Page 1 of 3 pages

NOTE
Steps 1 --- 3 of this procedure places the IATCS into a proper configuration following a failure of the LA 2 MDM. Steps 4 --- 6 reconfigure the IATCS to a nominal Dual mode once the LA 2 MDM has returned to an operational state.

1. VERIFICATION OF IATCS SYSTEM

PCS
LAB: TCS
Lab:IATCS Overview
‘Status’

If Mode – Single LT
    Verify LTL PPA Pmp Spd: 18900 ± 1250 rpm
    Verify LTL TWMV Out Temp: 4 ± 2 deg C

If Mode – Single MT
    Verify MTL PPA Pmp Spd: 18900 ± 1250 rpm
    Verify LTL TWMV Out Temp: 4 ± 2 deg C

If Mode – Dual
    Verify LTL PPA Pmp Spd: 15880 ± 1250 rpm
    Verify MTL PPA Pmp Spd: 17200 ± 1250 rpm
    Verify LTL TWMV Out Temp: 4 ± 2 deg C

NOTE
If the LA 2 MDM is expected to be down for an extended period of time (i.e., hard failed), then MCC-H may consider either performing a manual transition of the IATCS to Single LT (if not already in Single LT) or jumpering an RFCA to gain additional loop insight.

2. CONFIGURATION OF LTL IFHX HEATERS

NOTE
LTL IFHX Heaters will be inhibited because the insight to the temp sensors will be lost when the LA 2 MDM is transitioned. The three legs of freeze protection for the LTL IFHX are still available since those algorithms do not use these sensors. If LTL flow through the IFHX were to be stopped then the IFHX Heaters may need to be commanded to Ovrd On.

PCS
LAB: TCS: LTL IFHX: LTL IFHX Heater Commands
LTL IFHX Heater Commands
‘LTL IFHX’
‘Htr Sys’

cmd CLC – Inh

Verify CLC – Inh
3. SENSORS LOST DUE TO LA 2 FAILURE

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
</table>
1. During the time that LA 2 MDM is in a non-operational state, the following rack out temps will not be available: LAB1O6 and LAB1S6.

2. During the time that LA 2 MDM is in a non-operational state, the following Rack Flow Control Assemblies (RFCAs) will not be available: LAB1O1, LAB1O2, LAB1O3, LAB1O4 and LAB1O5.

3. During the time that LA 2 MDM is in a non-operational state, the telemetry for the MTL TWMV, Regen TWMV, SFCA, PPA and NIA will be invalid.

4. Steps 4 --- 6 are to be performed separate from steps 1 --- 3.

4. STARTUP OF MTL COMPONENT SOFTWARE

**PCS**

LAB: TCS: MTL SFCA

<table>
<thead>
<tr>
<th>MTL SFCA Commands</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘MTL SFCA’</td>
</tr>
<tr>
<td>‘Software’</td>
</tr>
</tbody>
</table>

**cmd** Startup – Startup

Verify Software – Started

LAB: TCS: MTL TWMV Icon

<table>
<thead>
<tr>
<th>MTL TWMV Commands</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘MTL TWMV’</td>
</tr>
</tbody>
</table>

**cmd** Software Startup – Startup **Execute**

Verify Software – Started

LAB: TCS: Regen TWMV Icon

<table>
<thead>
<tr>
<th>MTL Regen TWMV Commands</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘MTL Regen TWMV’</td>
</tr>
</tbody>
</table>

**cmd** Software Startup – Startup **Execute**

Verify Software – Started
5. **TRANSITIONING IATCS TO DUAL MODE**

**NOTE**
This step is to be performed, even if the IATCS mode is already Dual, in order to properly configure all IATCS valves.

Perform [2.203 LAB IATCS TRANSITION TO DUAL (AUTO)], all (SODF: TCS: NOMINAL: IATCS), then:

6. **RECOVERY OF LTL IFHX HEATERS**

PCS

LAB: TCS: LTL IFHX: LTL IFHX Heater Commands

LTL IFHX Heater Commands

‘LTL IFHX’
‘Htr Sys’

**cmd** CLC – Ena

Verify CLC – Ena
NOTE
Steps 1 --- 8 of this procedure places the IATCS into a proper configuration to handle an LA 1 MDM transition to a non-operational state. Steps 9 --- 13 reconfigure the IATCS to do a nominal Dual mode once the LA 1 MDM has returned to an operational state.

1. TRANSITIONING IATCS TO SINGLE MT

PCS

LAB: TCS

Lab: IATCS Overview

‘Status’

If Mode ≠ Sngl MT then

Perform [2.205 LAB IATCS TRANSITION TO SINGLE MT (AUTO)], steps 1 --- 3 (SODF: TCS: NOMINAL: IATCS), then:

2. CONFIGURATION OF LCA VALVES

PCS

LAB: TCS: LCA Icon

[ LCA Commands ]

‘LCA’

**cmd Vlv2 Posn – Sngl** Execute

Verify Vlv2 Posn – Sngl

**cmd Vlv1 Posn – Dual** Execute

Verify Vlv1 Posn – Dual

3. VERIFYING SYSTEM STABILIZATION

PCS

LAB: TCS

Lab: IATCS Overview

NOTE

It may take up to 5 minutes for the IATCS to reach a steady state configuration in order to check the following parameters. Any planned ORU powerdowns (heat load reductions) for the LA 1 MDM transition should be performed prior to continuing with this step. The purpose of this wait time is to allow the LTL TWMV to reach a steady-state position prior to inhibiting it.

Wait up to 5 minutes.

Verify LTL TWMV Out Temp: 4 ± 1.5 deg C
Verify MTL Regen TWMV HX Out Temp: 17 ± 1.5 deg C
4. INHIBITING LTL TWMV

NOTE
If IATCS heat loads (especially LTL) change during the time while LA 1 MDM is in a non-operational mode, then it may be possible to receive a ‘Lab Regen HX TWMV Undertemp - LAB’ caution message. In this scenario reconfiguration of the LTL IFHX NH3 Valves and/or the MTL TWMV may be necessary.

PCS
LAB: TCS: LTL TWMV Icon
LTL TWMV Commands
‘LTL TWMV’

cmd CLC – Inh Execute
Verify CLC – Inh

5. CONFIGURATION OF PMA2 HEATERS

NOTE
If the PMA2 Heaters are currently being used, then the PMA2 B String Heaters will be placed into an Override On status since temperature insight will be lost during the LA 1 MDM transition. Manual cycling between Ovrd On and Ovrd Off may be required to preclude 45.6°C (114°F) touch temperature violations.

PCS
PMA2: TCS: PMA2 Heater Control
PMA2: TCS
PMA2 Heater Control
‘CLC’

If CLC – Ena

cmd Inhibit – Arm (√ – X)
cmd Inhibit – Inh

Verify CLC – Inh

PMA2: TCS
PMA2: TCS
sel Htr[X] Icon where [X] = 1B 2B 3B 4B 5B

[PMA2 Htr[X]]
‘PMA2 Htr[X] Status’

cmd Override On – Ovrd On
Verify Status – Ovrd On
Repeat
6. CONFIGURATION OF LAB WINDOW HEATER

**NOTE**
Lab window heater temperature insight and software control will be lost during the LA 1 MDM transition. The heater will be turned off and the Lab window shutter will need to be closed.

**PCS**
LAB: TCS: IATCS Details: LAB Window Heater Commands
LAB Window Heater Commands
‘LAB Window Heater’

**cmd** CLC – Inh

Verify CLC – Inh

Close Lab window shutter.

7. CONFIGURATION OF MTL IFHX HEATERS

**NOTE**
MTL IFHX Heaters will be inhibited because the insight to the temp sensors will be lost when the LA 1 MDM is transitioned. The three legs of freeze protection for the MTL IFHX are still available since those algorithms do not use these sensors. If MTL flow through the IFHX were to be stopped, then the IFHX may need to be commanded to Ovrd On.

**PCS**
LAB: TCS: MTL IFHX: MTL IFHX Heater Commands
MTL IFHX Heater Commands
‘MTL IFHX’
‘Htr Sys’

**cmd** CLC – Inh

Verify CLC – Inh
8. SENSORS LOST DUE TO LA 1 TRANSITION
The IATCS is now configured properly for a transition of LA 1 MDM to Diagnostic or Power Off.

NOTE
1. During the time that LA 1 MDM is in a non-operational state, the following rack out temperatures will not be available: LAB1P3, LAB1P5, LAB1P6, LAB1D1 and Fwd E/C.

2. During the time that LA 1 MDM is in a non-operational state, the following Rack Flow Control Assemblies (RFCAs) will not be available: LAB1S1, LAB1S2, LAB1S3, LAB1P1, LAB1D3 and NODE1 LTL.

3. During the time that LA 1 MDM is in a non-operational state, the PMA2 APAS temperatures will not be available.

4. During the time that LA 1 MDM is in a non-operational state, the telemetry for the LTL TWMV, SFCA, PPA and NIA will be invalid.

5. Steps 9 --- 13 are to be performed separate from steps 1 --- 8.

9. STARTUP OF LTL COMPONENT SOFTWARE

PCS
LAB: TCS: LTL SFCA
LTL SFCA Commands
‘LTL SFCA’
‘Software’

cmd Startup – Startup
Verify Software – Started

LAB: TCS: LTL TWMV Icon
LTL TWMV Commands
‘LTL TWMV’

cmd Software Startup – Startup Execute
Verify Software – Started

cmd CLC – Ena Execute
Verify CLC – Ena
10. **TRANSITIONING IATCS TO DUAL MODE**

Perform \{2.203 LAB IATCS TRANSITION TO DUAL (AUTO)\}, all (SODF: TCS: NOMINAL: IATCS), then:

11. **RECOVERY OF PMA2 SHELL HEATERS**

If step 5 was fully performed (i.e., CLC – Ena at beginning of step 3)

```
PCS
PMA2: TCS
PMA2: TCS

sel Htr[X] Icon where [X] = 1B 2B 3B 4B 5B

PMA2 Htr [X]
‘PMA2 Htr[X] Status’

**cmd** CLC – Ena

Verify Status – On or Off
```

12. **RECOVERY OF LAB WINDOW HEATER**

Open Lab window shutter.

```
PCS
LAB: TCS: IATCS Details: LAB Window Heater Commands
LAB Window Heater Commands
‘LAB Window Heater’

✓Software – Started

**cmd** CLC – Ena

Verify CLC – Ena
```

13. **RECOVERY OF MTL IFHX HEATERS**

```
PCS
LAB: TCS: MTL IFHX: MTL IFHX Heater Commands
MTL IFHX Heater Commands
‘MTL IFHX’
‘Htr Sys’

**cmd** CLC – Ena

Verify CLC – Ena
```
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Steps 1 --- 6 of this procedure place the IATCS into a proper configuration to handle an LA 2 MDM transition to a non-operational state. Steps 7 --- 9 reconfigure the IATCS do a nominal Dual mode once the LA 2 MDM has returned to an operational state.

1. **TRANSITIONING IATCS TO SINGLE LT**

PCS

LAB: TCS

Lab: IATCS Overview

‘Status’

If Mode ≠ Sngl MT

Perform {2.204 LAB IATCS TRANSITION TO SINGLE LT (AUTO)}, steps 1 --- 3 (SODF: TCS: NOMINAL: IATCS), then:

2. **CONFIGURING LCA VALVES**

PCS

LAB: TCS: LCA Icon

‘LCA Commands’

√Vlv1 Posn – Sngl

√Vlv2 Posn – Dual

3. **VERIFYING SYSTEM STABILIZATION**

PCS

LAB: TCS

Lab: IATCS Overview

**NOTE**

It may take up to 5 minutes for the IATCS to reach a steady state configuration in order to check the parameters below. Any planned ORU powerdowns (heat load reductions) for the LA 1 MDM Transition should be performed prior to continuing with this step. The purpose of this wait time is to allow the Regen TWMV to reach a steady-state position prior to inhibiting it.

Wait up to 5 minutes.

Verify LTL TWMV Out Temp: 4 ± 1.5 deg C

Verify MTL Regen TWMV HX Out Temp: 17 ± 1.5 deg C
4. INHIBITING REGEN TWMV

**NOTE**
If IATCS Heat Loads (especially LTL) change during the time while LA 2 MDM is in a non-operational mode, then it may be possible to undertemp the water coming out of the Regen HX and condense water on the MTL lines. In this scenario, reconfiguration of the MTL IFHX NH3 valves and/or the LTL TWMV may be necessary.

PCS
- LAB: TCS: Regen TWMV Icon
  
  MTL Regen TWMV Commands
  
  ‘MTL Regen TWMV’

  **cmd** CLC – Inh  **Execute**

  Verify CLC – Inh

5. CONFIGURING LTL IFHX HEATERS

**NOTE**
LTL IFHX Heaters will be inhibited because the insight to the temp sensors will be lost when the LA 2 MDM is transitioned. The three legs of freeze protection for the LTL IFHX are still available since those algorithms do not use these sensors. If LTL flow through the IFHX were to be stopped then the IFHX may need commanded to Ovrd On.

PCS
- LAB: TCS: LTL IFHX: LTL IFHX Heater Commands
  
  LTL IFHX Heater Commands
  
  ‘LTL IFHX’
  
  ‘Htr Sys’

  **cmd** CLC – Inh

  Verify CLC – Inh
6. SENSORS LOST DUE TO LA 2 TRANSITION

The IATCS is now configured properly for a transition of LA 2 MDM to Diagnostic or Power Off.

**NOTE**

1. During the time that LA 2 MDM is in a non-operational state, the following rack out temps will not be available: LAB1O6 and LAB1S6.

2. During the time that LA 2 MDM is in a non-operational state, the following Rack Flow Control Assemblies (RFCAs) will not be available: LAB1O1, LAB1O2, LAB1O3, LAB1O4 and LAB1O5.

3. During the time that LA 2 MDM is in a non-operational state, the telemetry from the MTL TWMV, Regen TMWV, SFCA, PPA and NIA will be invalid.

4. Steps 7 --- 9 are to be performed separate from steps 1 --- 6.

7. STARTUP OF MTL COMPONENT SOFTWARE

**PCS**

LAB: TCS: MTL SFCA

**MTL SFCA Commands**

`'MTL SFCA'`

`'Software'`

**cmd** Startup – Startup

Verify Software – Started

LAB: TCS: MTL TWMV Icon

**MTL TWMV Commands**

`'MTL TWMV'`

`'Software'`

**cmd** Startup – Startup **Execute**

Verify Software – Started

LAB: TCS: Regen TWMV Icon

**MTL Regen TWMV Commands**

`'MTL Regen TWMV'`

`'Software'`

**cmd** Startup – Startup **Execute**

Verify Software – Started
8. **TRANSITIONING IATCS TO DUAL MODE**
Perform \(2.203\) **LAB IATCS TRANSITION TO DUAL (AUTO)**, all (SODF: TCS: NOMINAL: IATCS), then:

9. **RECOVERY OF LTL IFHX HEATERS**
PCS LAB: TCS: LTL IFHX: LTL IFHX Heater Commands

<table>
<thead>
<tr>
<th>LTL IFHX Heater Commands</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘LTL IFHX’</td>
</tr>
<tr>
<td>‘Htr Sys’</td>
</tr>
</tbody>
</table>

**cmd** CLC – Ena

Verify CLC – Ena
1. **VERIFYING FAILURE RECOVERY FDIR INHIBIT**

   **NOTE**
   While the Failure Recovery FDIR is inhibited, any cautions indicating an IATCS Pump/Valve failure will probably be followed by a Warning: *LAB IATCS Failure with Fail Rcvy Inhibited - Lab* message. No action will need to be taken for this message.

   **PCS**
   LAB: TCS: Software
   | Software Commands |
   | ‘IATCS’ |
   | √ Fail Rcvy – Inh |

2. **VERIFYING LEAK RECOVERY FDIR INHIBIT**

   **PCS**
   LAB: TCS: Software: Software Additional Commands
   | Software Additional Commands |
   | ‘Leak Recovery IATCS’ |
   | ‘Leak Rcvy’ |
   | √ Auto Isolation – Inh |
   | ‘LTL Leak Rcvy’ |
   | √ Auto Shutdown – Inh |
   | ‘MTL Leak Rcvy’ |
   | √ Auto Shutdown – Inh |

3. **VERIFYING LTL RPCS ARE CLOSED**

   **PCS**
   Task: 5A: LAB Act TCS RPC Commands
   | LAB Act TCS RPC Commands |
   | ‘LTL’ |
   | ‘RPCM LA1B_D’ |
   | √ RPC 3 - LAP6 RPC Posn – Cl |
   | ‘RPCM LAP61B_A’ |
   | √ RPC 5 - LTL SFCA SOV RPC Posn – Cl |
   | √ RPC 6 - LTL SFCA Mod Vlv RPC Posn – Cl |
   | √ RPC 7 - LTL NIA Vent Vlv RPC Posn – Cl |
   | √ RPC 8 - LTL NIA Isol Vlv RPC Posn – Cl |
   | √ RPC 18 - LTL PPA RPC Posn – Cl |
   | ‘RPCM LA1B_F’ |
   | √ RPC 4 - LTL TWMV RPC Posn – Cl |
   | √ RPC 15 - LCA Vlv1 RPC Posn – Cl |
4. VERIFYING LCA CONFIGURATION DUAL

PCS
LAB: TCS: LCA Icon
LCA Commands
‘LCA’

√Vlv1 Posn – Dual
√Vlv2 Posn – Dual

5. STARTUP OF LTL PUMP SOFTWARE

PCS
LAB: TCS: LTL PPA
LTL PPA Commands
‘LTL PPA’
‘Pump Software’

cmd Startup – Startup

√Pump Software – Started

‘LTL PPA Firmware’
Verify Mode – Operational

6. STARTING SFCA/OPENING SFCA MODULATION VALVE

PCS
LAB: TCS: LTL SFCA
LTL SFCA Commands
‘LTL SFCA’
‘Software’

√Software – Started
√CLC – Inh

<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>The SFCA Modulating Valve must be commanded open to prevent dP sensor damage when starting a pump or increasing a pump speed.</td>
</tr>
</tbody>
</table>

‘Mod Vlv’

input Direct Vlv drive voltage: -5 Volts
duration: 17 seconds

cmd Direct Vlv – Set
7. OPENING LTL SFCA SHUTOFF VALVE

LAB: TCS: LTL SFCA

LTL SFCA Commands

‘LTL SFCA’
‘Shutoff Vlv Posn’

**cmd** Open – Open

Verify Shutoff Vlv Posn – Open

*******************************************************************************

If Shutoff Vlv Posn ≠ Open

Expect Caution: ‘Lab LTL SFCA Shutoff Valve Failure - LAB’
Open front panel on Rack LABP6 by lifting the panel latches (two) and swinging the panel door open.
Pull out LTL SFCA Pump Inlet Shutoff Handle.
Turn Pump Inlet Shutoff Handle to the Open position.
Push in LTL SFCA Pump Inlet Shutoff Handle.
Close front panel by swinging the panel closed and engaging the panel latches (two).

NOTE
The following is required to inform the IATCS software of the SFCA Shutoff Valve position change. Caution will clear if command is successful.

**cmd** Open – Open

Verify Shutoff Vlv Posn – Open

*******************************************************************************

**********************************************************************

If Shutoff Vlv Posn ≠ Open (after previous off-nominal steps)

NOTE

If Shutoff Vlv Posn ≠ Open, then there is no way to inform the IATCS software of the valve position change. Therefore, Automatic FDIR functions must remain inhibited. Caution will not clear.

Perform steps 8 --- 10, then exit this procedure.

*******************************************************************************

8. INITIALIZING/ENABLING LTL TWMV

PCS

LAB: TCS: LTL TWMV Icon

LTL TWMV Commands

‘LTL TWMV’
‘Software’

√Software – Started
9. **SETTING LTL PUMP TO 100 % SPEED/REENABLING SFCA CLC**

**LTL PPA Commands**

- Input Set Pump Speed Arm: 15880 rpm

**LTL SFCA Commands**

- Input Set Pump Speed Set: 15880 rpm

Wait 30 seconds.

Verify LTL Pmp dP: 207 ± 34 kPa
Verify LTL HR Flow: 1361 ± 136 kg/hr
Verify LTL Pmp Spd: 15880 ± 1250 rpm
10. **CONFIGURING IFHX VALVES**

<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. IFHX valve position must be verified before position commands can be issued. If the valve position is indeterminate, driving the valve in the direction opposite of its last direction of motion can potentially result in damage to the valve seal. If the valve position is indeterminate, √MCC-H.</td>
</tr>
<tr>
<td>2. Once commanded, if the valve does not reach the commanded position, the operator is allowed to issue the same position command up to three additional times. If the desired position is still not reached, √MCC-H.</td>
</tr>
</tbody>
</table>

PCS LAB: TCS: LTL IFHX

- **LTL IFHX Commands**
- ‘LTL IFHX NH3’
- ‘Isol Vlv’

If Isol Vlv – Open/Close ≠ blank
- √Open – X

- ‘Byp Vlv’

If Isol Vlv – Open/Close ≠ blank
- √Floothru – X

11. **CHANGING SOFTWARE MODE TO DUAL**

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do not execute steps 14 --- 17 if the second off-nominal situation in step 7 was performed.</td>
</tr>
</tbody>
</table>

PCS LAB: TCS: Software

- **Software Commands**
- ‘IATCS’
- ‘Mode’

**cmd** Dual – Arm

√Arm Status – Dual Armed

**cmd** Dual – Dual

Wait 3 minutes.

Verify Mode – Dual
12. **SETTING ACCUMULATOR LEAK LIMITS**

   **PCS**
   **LAB: TCS**
   **Lab: IATCS Overview**
   ‘PPA’

   Record LTL Avg Accum Qty: _________ %

   Record MTL Avg Accum Qty: _________ %

   **LAB: TCS: Software: Software Additional Commands**
   **Software Additional Commands**
   ‘Leak Recovery IATCS’

   **cmd** Set Normal Leak Limits – Set

13. **ENABLING FAILURE RECOVERY FDIR**

   **PCS**
   **LAB: TCS: Software**
   **Software Commands**
   ‘IATCS’
   ‘Fail Rcvy’

   **cmd** Enable – Ena

   √ Fail Rcvy – Ena

14. **ENABLING LEAK RECOVERY FDIR**

   **PCS**
   **LAB: TCS: Software: Software Additional Commands**
   **Software Additional Commands**
   ‘Leak Recovery IATCS’
   ‘Leak Rcvy’
   ‘Auto Isolation’

   **cmd** Enable – Ena

   √ Auto Isolation – Ena

   ‘LTL Leak Rcvy’
   ‘Auto Shutdown’

   **cmd** Enable – Ena

   √ Auto Shutdown – Ena

   ‘MTL Leak Rcvy’
   ‘Auto Shutdown’

   **cmd** Enable – Ena

   √ Auto Shutdown – Ena
1. **VERIFYING FAILURE RECOVERY FDIR INHIBIT**

   **NOTE**
   While the Failure Recovery FDIR is inhibited, any cautions indicating an IATCS Pump/Valve failure will probably be followed by a Warning: ‘**LAB IATCS Failure with Fail Rcvy Inhibited - Lab**’ message. No action will need to be taken for this message.

   **PCS**
   LAB: TCS: Software
   | Software Commands | ‘IATCS’ |
   |                  |        |
   |                  |        |
   √ Fail Rcvy – Inh

2. **VERIFYING LEAK RECOVERY FDIR INHIBIT**

   **PCS**
   LAB: TCS: Software: Software Additional Commands
   | Software Additional Commands | ‘Leak Recovery IATCS’ |
   |                               | ‘Leak Rcvy’ |
   |                               |        |
   |                               |        |
   |                               |        |
   √ Auto Isolation – Inh
   ‘LTL Leak Rcvy’
   √ Auto Shutdown – Inh
   ‘MTL Leak Rcvy’
   √ Auto Shutdown – Inh

3. **APPLYING POWER TO LAS6 (MTL) TCS EQUIPMENT**

   **PCS**
   Task: 5A: LAB Act TCS RPC Commands
   | LAB Act TCS RPC Commands | ‘MTL’ |
   |                           | ‘RPCM LA2_B_F’ |
   |                           | ‘RPC 1 - LAS6 RPC’ |
   | cmd Close (Verify Posn – Cl) |
   | ‘RPCM LAS62B_A’ |
   | ‘RPC 5 - MTL SFCA SOV RPC’ |
   cmd Close (Verify Posn – Cl)
   ‘RPC 6 - MTL SFCA Mod Vlv RPC’
   cmd Close (Verify Posn – Cl)
4. APPLYING POWER TO AFT END CONE (MTL) TCS EQUIPMENT

PCS Task: 5A: LAB Act TCS RPC Commands

‘RPCM LA2B_G’
‘RPC 2 - MTL TWMV RPC’
‘RPC 1 - MTL Regen TWMV RPC’
‘RPCM LA2B_E’
‘RPC 2 - LCA Vlv2 RPC’

cmd Close (Verify Posn – Cl)

5. VERIFYING LCA CONFIGURATION DUAL

PCS LAB: TCS: LCA Icon

‘LCA’

√Vlv1 Posn – Dual
√Vlv2 Posn – Dual

6. BEGINNING MTL MANUAL STARTUP

PCS LAB: TCS: MTL PPA

‘MTL PPA’
‘Pump Software’

cmd Startup – Startup

√Pump Software – Started

‘MTL PPA Firmware’

√Mode – Operational
7. **STARTING SFCA/OPENING SFCA MODULATION VALVE**

PCS

LAB: TCS: MTL SFCA

**MTL SFCA Commands**

‘MTL SFCA’

‘Software’

√Software – Started

√CLC – Inh

---

**CAUTION**

The SFCA Modulating Valve must be commanded open to prevent dP sensor damage when starting a pump or increasing a pump speed.

‘Mod Vlv’

input Direct Vlv drive voltage: -5 Volts
duration: 17 seconds

**cmd** Direct Vlv – Set

---

8. **OPENING MTL SFCA SHUTOFF VALVE**

LAB: TCS: MTL SFCA

**MTL SFCA Commands**

‘MTL SFCA’

‘Shutoff Vlv Posn’

**cmd** Open – Open

Verify Shutoff Vlv Posn – Open

***********************************************************************

If Shutoff Vlv Posn ≠ Open

Expect Caution: ‘**Lab MTL SFCA Shutoff Valve Failure - LAB**’

Open front panel on rack LABS6 by lifting the panel latches (two) and swinging the panel door open.

Pull out MTL SFCA Pump Inlet Shutoff Handle.

Turn Pump Inlet Shutoff Handle ☐ to the Open position.

Push in MTL SFCA Pump Inlet Shutoff Handle.

Close front panel by swinging the panel closed and engaging the panel latches (two).

**NOTE**

The following is required to inform the IATCS software of the SFCA Shutoff Valve position change. Caution will clear if command is successful.

**cmd** Open – Open

Verify Shutoff Vlv Posn – Open

***********************************************************************
4.207 LAB IATCS TRANSITION FROM DUAL MT FAILED TO DUAL - MANUAL
(TCS/5A - ALL/FIN) Page 4 of 7 pages

************************************************************************
If Shutoff Vlv Posn ≠ Open (after previous off-nominal step)

NOTE
If Shutoff Vlv Posn ≠ Open, then there is no way to inform the IATCS software of the valve position change. Therefore, Automatic FDIR functions must remain inhibited. Caution will not clear.

Perform steps 9 --- 13, then exit this procedure.
************************************************************************

9. INITIALIZING MTL REGEN TWMV
PCS
LAB: TCS: Regen TWMV Icon
MTL Regen TWMV Commands
‘MTL Regen TWMV’
‘Software’

cmd Startup – Startup Execute

✓Software – Startup

‘CLC’

✓CLC – Inh

‘Posn’

✓Posn – Byp

10. INITIALIZING/ENABLING MTL TWMV
PCS
LAB: TCS: MTL TWMV Icon
MTL TWMV Commands
‘MTL TWMV’
‘Software’

cmd Startup – Startup Execute

✓Software – Started

‘CLC’

cmd Ena Execute

✓CLC – Ena
11. **SETTING MTL PUMP TO FULL SPEED/REENABLING SFCA CLC**

**PCS**

**LAB: TCS: MTL PPA**

**MTL PPA Commands**

‘MTL PPA’

**input Set Pump Speed Arm:** 17200 rpm

**cmd** Set Pump Speed Arm – Arm (√ – X)

**input Set Pump Speed Set:** 17200 rpm

**cmd** Set Pump Speed Set – Set

**LAB: TCS: MTL SFCA**

**MTL SFCA Commands**

‘MTL SFCA’

**cmd** CLC – Ena

√CLC – Ena

Wait 30 seconds.

**LAB: TCS**

**Lab: IATCS Overview**

‘PPA’

Verify MTL Pmp dP: 290 ± 34 kPa
Verify MTL HR Flow: 1361 ± 136 kg/hr
Verify MTL Pmp Spd: 17200 ± 1250 rpm

12. **CONFIGURING IFHX VALVES**

[CAUTION]

1. IFHX valve position must be verified before position commands can be issued. If the valve position is indeterminate, driving the valve in the direction opposite of its last direction of motion can potentially result in damage to the valve seal. If the valve position is indeterminate, \( \text{✓ MCC-H} \).

2. Once commanded, if the valve does not reach the commanded position, the operator is allowed to issue the same position command up to three additional times. If the desired position is still not reached, \( \text{✓ MCC-H} \).

**PCS**

**LAB: TCS: MTL IFHX**

**MTL IFHX Commands**

‘LTL IFHX NH3’

‘Isol Vlv’
If Isol Vlv – Open/Close ≠ blank
   √Open – X

   ‘Byp Vlv’

If Byp Vlv – Flothru/Byp ≠ blank
   √Flothru – X

13. **ADJUSTING LTL SETPOINT**

PCS

LAB: TCS: LTL TWMV Icon

LTL TWMV Commands

‘LTL TWMV’

input Temp Setpt: 4 deg C

cmd Temp Setpt – Set

Wait 3 minutes.

Verify Cntl Temp: 4 ± 1.5 deg C

14. **CHANGING SOFTWARE MODE TO DUAL**

NOTE
Do not execute steps 14 --- 17 if the second off-nominal situation in step 8 was performed.

PCS

LAB: TCS: Software

Software Commands

‘IATCS’

‘Mode’

   cmd Dual – Arm

   √Arm Status – Dual Armed

   cmd Dual – Dual

   Wait 2 minutes.

   Verify Mode – Dual
15. SETTING ACCUMULATOR LEAK LIMITS

PCS

LAB: TCS

Lab: IATCS Overview

‘PPA’

Record LTL Avg Accum Qty: _________ %

Record MTL Avg Accum Qty: _________ %

LAB: TCS: Software: Software Additional Commands

Software Additional Commands

‘Leak Recovery IATCS’

**cmd** Set Normal Leak Limits – Set

16. ENABLING FAILURE RECOVERY FDIR

PCS

LAB: TCS: Software

‘Software Commands’

‘IATCS’

‘Fail Rcvy’

**cmd** Enable – Ena

√ Fail Rcvy – Ena

17. ENABLING LEAK RECOVERY FDIR

PCS

LAB: TCS: Software: Software Additional Commands

Software Additional Commands

‘Leak Recovery IATCS’

‘Leak Rcvy’

‘Auto Isolation’

**cmd** Enable – Ena

√ Auto Isolation – Ena

‘LTL Leak Rcvy’

‘Auto Shutdown’

**cmd** Enable – Ena

√ Auto Shutdown – Ena

‘MTL Leak Rcvy’

‘Auto Shutdown’

**cmd** Enable – Ena

√ Auto Shutdown – Ena
1. **INHIBITING FAILURE RECOVERY FDIR**

   **NOTE**
   While the Failure Recovery FDIR is inhibited, any cautions indicating an IATCS Pump/Valve failure will probably be followed by a Warning: ‘LAB IATCS Failure with Fail Rcvy Inhibited - Lab’ message. No action will need to be taken for this message.

   PCS  
   LAB: TCS: Software  
   Software Commands  
   ‘IATCS’  
   ‘Fail Rcvy’

   **cmd** Inhibit – Arm (√ – X)
   **cmd** Inhibit – Inh

   √Fail Rcvy – Inh

2. **RECONFIGURING MTL REGEN TWMV**

   PCS  
   LAB: TCS: Regen TWMV Icon  
   MTL Regen TWMV Commands  
   ‘MTL Regen TWMV’

   **cmd** CLC – Ena **Execute**

   √CLC – Ena

3. **INHIBITING LTL/MTL SFCA CLOSED LOOP CONTROL**

   PCS  
   LAB: TCS: LTL SFCA  
   LTL SFCA Commands  
   ‘LTL SFCA’

   **cmd** CLC – Inh

   √CLC – Inh

   LAB: TCS: MTL SFCA  
   MTL SFCA Commands  
   ‘MTL SFCA’

   **cmd** CLC – Inh

   √CLC – Inh
4. SETTING LTL PUMP TO REDUCED SPEED

NOTE

If the pump is left at full speed, then it is not possible to manually move an LCA Valve.

PCS

LAB: TCS: LTL PPA

LTL PPA Commands

‘LTL PPA’

input Set Pump Speed Arm:  11373 rpm

**cmd** Set Pump Speed Arm – Arm (\( \sqrt{X} \))

input Set Pump Speed Set:  11373 rpm

**cmd** Set Pump Speed Set – Set

LAB: TCS

Lab: IATCS Overview

‘PPA’

Verify LTL Pmp dP:  103 ± 34 kPa

Verify LTL HR Flow:  726 ± 91 kg/hr

Verify LTL Pmp Spd:  11373 ± 1250 rpm

5. OPENING LTL SFCA MODULATING VALVE

CAUTION

The SFCA Modulating Valve must be commanded open to prevent dP sensor damage when starting a pump or increasing a pump speed.

PCS

LAB: TCS: LTL SFCA

LTL SFCA Commands

‘Mod Vlv’

input Direct Vlv drive voltage:  -5 Volts

duration:  17 seconds

**cmd** Direct Vlv – Set

LAB: TCS

Lab: IATCS Overview

‘SFCA’

Verify LTL Mod Vlv dP:  0 ± 7 kPa
**4.208 LAB IATCS TRANSITION FROM DUAL TO SINGLE LT - MANUAL**

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********************************************************************
If LTL Mod Vlv dP > 7 kPa
Open front panel on Rack LABP6 by lifting the panel
latches (two) and swinging the panel door open.
Pull out LTL SFCA Header Pressure Valve Handle.
Turn Header Pressure Handle → to the Open position.
Push in LTL SFCA Header Pressure Valve Handle.
Close front panel by swinging the panel closed and
engaging the panel latches (two).
********************************************************************

6. **STOPPING MTL PUMP**

**CAUTION**
After stopping the MTL Pump, equipment connected to
the MTL will no longer be receiving cooling. Steps 7, 8
must be completed within 30 minutes in order to keep
DDCUs, C&C MDMs, and other critical avionics
operational.

PCS

LAB: TCS: MTL PPA
MTL PPA Commands
‘MTL PPA’

input Set Pump Speed Arm: 0 rpm

**cmd** Set Pump Speed Arm – Arm (√ – X)

input Set Pump Speed Set: 0 rpm

**cmd** Set Pump Speed Set – Set

Verify LR Flow: 0 ± 50 kg/hr

LAB: TCS

Lab: IATCS Overview
‘PPA’

Verify MTL Pmp dP: 0 ± 34 kPa
Verify MTL Pmp Spd: 0 ± 54 rpm

7. **CLOSING MTL SFCA SHUTOFF VALVE**

PCS

LAB: TCS: MTL SFCA
MTL SFCA Commands
‘MTL SFCA’
‘Shutoff Vlv Posn’

**cmd** Close – Arm (√ – X)
**cmd** Close – Close

√Shutoff Vlv Posn – Close
If Shutoff Vlv Posn ≠ Close
Expect Caution: ‘Lab MTL SFCA Shutoff Valve Failure - LAB’
Open front panel on Rack LABS6 by lifting the panel latches (two) and swinging the panel door open.
Pull out MTL SFCA Pump Inlet Shutoff Handle.
Turn Pump Inlet Shutoff Handle to the Close position.
Push in MTL SFCA Pump Inlet Shutoff Handle.
Close front panel by swinging the panel closed and engaging the panel latches (two).

NOTE
The following is required to inform the IATCS software of the SFCA Shutoff Valve position change. Caution will clear if command is successful.

**cmd** Close – Arm (√ – X)
**cmd** Close – Close

Verify Shutoff Vlv Posn – Close
If Shutoff Vlv Posn ≠ Close (after previous off-nominal steps)

NOTE

If Shutoff Vlv Posn ≠ Close, then there is no way to inform the IATCS software of the valve position change. Therefore, Automatic FDIR functions must be inhibited. Caution will not clear.

LAB: TCS: Thermal Load Reduction

- Thermal Load Reduction
  - ‘Auto Thermal Load Shed’

  cmd Inhibit – Arm (√ – X)
  cmd Inhibit – Inh

  √Auto Thermal Load Shed – Inh

- ‘IATCS Reconfig’

  cmd Inhibit – Arm (√ – X)
  cmd Inhibit – Inh

  √IATCS Reconfig – Inh

LAB: TCS: Software: Software Additional Commands

- Software Additional Commands
  - ‘Leak Recovery IATCS’
  - ‘Leak Rcvy’
  - ‘Auto Isolation’

  cmd Inhibit – Arm (√ – X)
  cmd Inhibit – Inh

  √Auto Isolation – Inh

  - ‘LTL Leak Rcvy’
  - ‘Auto Shutdown’

  cmd Inhibit – Arm (√ – X)
  cmd Inhibit – Inh

  √Auto Shutdown – Inh

  - ‘MTL Leak Rcvy’
  - ‘Auto Shutdown’

  cmd Inhibit – Arm (√ – X)
  cmd Inhibit – Inh

  √Auto Shutdown – Inh

Perform steps 8 --- 12, then exit this procedure.

***********************************************************************
8. Configuring LCA Valves

**NOTE**
Only one LCA Valve is needed to be in Single for IATCS to be in Single Loop mode. Both LCA Valves are required to be in Dual for the IATCS to be in Dual Loop mode.

PCS
LAB: TCS: LCA Icon

LCA Commands

‘LCA’

√Vlv 2 Posn – Dual

**cmd** Vlv 1 Posn – Sngl Execute

√Vlv 1 Posn – Sngl

If Vlv 1 Posn ≠ Sngl

**cmd** Vlv 2 Posn – Sngl Execute

√Vlv 2 Posn – Sngl

******************************************************************************

If Vlv 1 Posn ≠ Sngl and Vlv2 Posn ≠ Sngl

Expect Caution: ‘Lab LCA Valve 1 Failure - LAB’

Expect Caution: ‘Lab LCA Valve 2 Failure - LAB’

Rotate Rack LABP6 (refer to [LAB LTL(MTL)/CABIN AIR RACK ROTATE], all (SODF: TBD)).

TBD OSO steps to remove panel.

Fold out Handle on LCA Valve 1.

Rotate Valve 1 \(\sim\) from Dual to Single.

Fold in Handle on LCA Valve 1.

**NOTE**
The following is required to inform the IATCS software of the LCA Valve 1 position change.

Caution will clear if command is successful.

**cmd** Vlv 1 Posn – Sngl Execute

√Vlv 1 Posn – Sngl

******************************************************************************
If Vlv 1 Posn ≠ Sngl (after previous off-nominal steps)

NOTE

If the Vlv 1 Posn ≠ Sngl, then there is no way to inform the IATCS software of the valve position change. Therefore, Automatic FDIR functions must be inhibited. Caution will not clear.

LAB: TCS: Thermal Load Reduction

Thermal Load Reduction

‘Auto Thermal Load Shed’

**cmd** Inhibit – Arm (√ – X)

**cmd** Inhibit – Inh

√Auto Thermal Load Shed – Inh

‘IATCS Reconfig’

**cmd** Inhibit – Arm (√ – X)

**cmd** Inhibit – Inh

√IATCS Reconfig – Inh

LAB: TCS: Software: Software Additional Commands

Software Additional Commands

‘Leak Recovery IATCS’

‘Leak Rcvy’

‘Auto Isolation’

**cmd** Inhibit – Arm (√ – X)

**cmd** Inhibit – Inh

√Auto Isolation – Inh

‘LTL Leak Rcvy’

‘Auto Shutdown’

**cmd** Inhibit – Arm (√ – X)

**cmd** Inhibit – Inh

√Auto Shutdown – Inh

‘MTL Leak Rcvy’

‘Auto Shutdown’

**cmd** Inhibit – Arm (√ – X)

**cmd** Inhibit – Inh

√Auto Shutdown – Inh

Perform steps 9 --- 12, then exit this procedure.

***********************************************************************
9. **INHIBITING MTL TWMV CLOSED LOOP CONTROL**

PCS

LAB: TCS: MTL TWMV Icon

MTL TWMV Commands

‘MTL TWMV’

**cmd** CLC – Inh  **Execute**

**cmd** Posn – Flothru  **Execute**

√ CLC – Inh

√ Posn – Flothru

10. **SETTING LTL PUMP TO 100 % SPEED/REENABLING SFCA CLC**

PCS

LAB: TCS: LTL PPA

LTL PPA Commands

‘LTL PPA’

input Set Pump Speed Arm:  18900 rpm

**cmd** Set Pump Speed Arm – Arm (√ – X)

input Set Pump Speed Set:  18900 rpm

**cmd** Set Pump Speed Set – Set

*******************************************************************
If Rack LABP6 had been rotated in step 8
Perform (LAB LTL(MTL)/CABIN AIR RACK ROTATE),
steps TBD (SODF: TBD), then:
*******************************************************************

LAB: TCS: LTL SFCA

LTL SFCA Commands

‘LTL SFCA’

**cmd** CLC – Ena

√ CLC – Ena

Wait 30 seconds.

LAB: TCS

Lab: IATCS Overview

‘PPA’

Verify LTL Pmp dP:  448 ± 56 kPa
Verify LTL HR Flow:  1361 ± 136 kg/hr
Verify LTL Pmp Spd:  18900 ± 1250 rpm
11. **REENABLING MTL SFCA CLOSED LOOP CONTROL**

PCS

LAB: TCS: MTL SFCA

MTL SFCA Commands

‘MTL SFCA’

**cmd** CLC – Ena

√CLC – Ena

12. **SHUTDOWN OF MTL PUMP SOFTWARE**

PCS

LAB: TCS: MTL PPA

MTL PPA Commands

‘MTL PPA’

‘Pump Software’

**cmd** Shutdown – Arm (√ – X)

**cmd** Shutdown – Shutdown

√Pump Software – Shutdown

13. **CHANGING SOFTWARE MODE TO SINGLE LT**

**NOTE**

Do not execute steps 13, 14 if the second off-nominal situation in steps 7 or 8 was performed.

PCS

LAB: TCS: Software

Software Commands

‘IATCS’

‘Mode’

**cmd** Sngl LT – Arm

√Arm Status – Sngl LT Armed

**cmd** Sngl LT – Sngl LT

Wait 2 minutes.

Verify Mode – Sngl LT

14. **ENABLING FAILURE RECOVERY FDIR**

PCS

LAB: TCS: Software

Software Commands

‘IATCS’

‘Fail Rcvy’

**cmd** Enable – Ena

√Fail Rcvy – Ena
This Page Intentionally Blank
1. **INHIBITING FAILURE RECOVERY FDIR**

   **NOTE**
   While the Failure Recovery FDIR is inhibited, any cautions indicating an IATCS Pump/Valve failure will probably be followed by a Warning: ‘LAB IATCS Failure with Fail Rcvy Inhibited - Lab’ message. No action will need to be taken for this message.

   PCS
   LAB: TCS: Software
   Software Commands
   ‘IATCS’
   ‘Fail Rcvy’

   **cmd** Inhibit – Arm (√ – X)
   **cmd** Inhibit – Inh
   √Fail Rcvy – Inh

2. **ENABLING MTL REGEN TWMV**

   PCS
   LAB: TCS: Regen TWMV Icon
   MTL Regen TWMV Commands
   ‘MTL Regen TWMV’

   **cmd** CLC – Ena **Execute**
   √CLC – Ena

3. **INHIBITING LTL/MTL SFCA CLOSED LOOP CONTROL**

   PCS
   LAB: TCS: LTL SFCA
   LTL SFCA Commands
   ‘LTL SFCA’

   **cmd** CLC – Inh
   √CLC – Inh

   LAB: TCS: MTL SFCA
   MTL SFCA Commands
   ‘MTL SFCA’

   **cmd** CLC – Inh
   √CLC – Inh
4. **SETTING MTL PUMP TO REDUCED SPEED**

**NOTE**
If the pump is left at full speed, then it is not possible to manually move an LCA Valve.

**PCS**

LAB: TCS: MTL PPA

<table>
<thead>
<tr>
<th>MTL PPA Commands</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘MTL PPA’</td>
</tr>
</tbody>
</table>

input Set Pump Speed Arm: 11373 rpm

**cmd** Set Pump Speed Arm – Arm (√ – X)

input Set Pump Speed Set: 11373 rpm

**cmd** Set Pump Speed Set – Set

**LAB: TCS**

<table>
<thead>
<tr>
<th>Lab: IATCS Overview</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘PPA’</td>
</tr>
</tbody>
</table>

Verify MTL Pmp dP: 138 ± 34 kPa
Verify MTL HR Flow: 907 ± 91 kg/hr
Verify MTL Pmp Spd: 11373 ± 1250 rpm

5. **OPENING MTL SFCA MODULATING VALVE**

**CAUTION**
The SFCA Modulating Valve must be commanded open to prevent dP sensor damage when increasing a pump speed or starting a pump.

**PCS**

LAB: TCS: MTL SFCA

<table>
<thead>
<tr>
<th>MTL SFCA Commands</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘Mod Vlv’</td>
</tr>
</tbody>
</table>

input Direct Vlv drive voltage: -5 Volts
duration: 17 seconds

**cmd** Direct Vlv – Set

**LAB: TCS**

<table>
<thead>
<tr>
<th>Lab: IATCS Overview</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘SFCA’</td>
</tr>
</tbody>
</table>

Verify MTL Mod Vlv dP: 0 ± 7 kPa
If MTL Mod Vlv dP > 7 kPa
Open front panel on Rack LABS6 by lifting the panel latches (two) and swinging the panel door open.
Pull out MTL SFCA Header Pressure Valve Handle.
Turn Header Pressure Handle "" to the Open position.
Push in MTL SFCA Header Pressure Valve Handle.
Close front panel by swinging the panel closed and engaging the panel latches (two).

6. STOPPING LTL PUMP

**CAUTION**

After stopping the LTL Pump, equipment connected to the LTL will no longer be receiving cooling. Steps 7, 8 must be completed within 30 minutes in order to keep the CDRA fan and other equipment operational.

**PCS**

LAB: TCS: LTL PPA

<table>
<thead>
<tr>
<th>LTL PPA Commands</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘LTL PPA’</td>
</tr>
</tbody>
</table>

input Set Pump Speed Arm: 0 rpm

**cmd** Set Pump Speed Arm – Arm (√ – X)

input Set Pump Speed Set: 0 rpm

**cmd** Set Pump Speed Set – Set

Verify LR Flow: 0 ± 50 kg/hr

**LAB: TCS**

<table>
<thead>
<tr>
<th>Lab: IATCS Overview</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘PPA’</td>
</tr>
</tbody>
</table>

Verify LTL Pmp dP: 0 ± 34 kPa
Verify LTL Pmp Spd: 0 ± 54 rpm

7. CLOSING LTL SFCA SHUTOFF VALVE

**PCS**

LAB: TCS: LTL SFCA

<table>
<thead>
<tr>
<th>LTL SFCA Commands</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘LTL SFCA’</td>
</tr>
<tr>
<td>‘Shutoff Vlv Posn’</td>
</tr>
</tbody>
</table>

**cmd** Close – Arm (√ – X)

**cmd** Close – Close

√Shutoff Vlv Posn – Close
If Shutoff Vlv Posn ≠ Close

Expect Caution: ‘Lab LTL SFCA Shutoff Valve Failure - LAB’

Open front panel on Rack LABP6 by lifting the panel latches (two) and swinging the panel door open.

Pull out LTL SFCA Pump Inlet Shutoff Handle.

Turn Pump Inlet Shutoff Handle $\sim$ to the Close position.

Push in LTL SFCA Pump Inlet Shutoff Handle.

Close front panel by swinging the panel closed and engaging the panel latches (two).

NOTE

The following is required to inform the IATCS software of the SFCA Shutoff Valve position change. Caution will clear if command is successful.

cmd Close – Arm (√ – X)
cmd Close – Close

Verify Shutoff Vlv Posn – Close
If Shutoff Vlv Posn ≠ Close (after previous off-nominal steps)

**NOTE**
If Shutoff Vlv Posn ≠ Close, then there is no way to inform the IATCS software of the valve position change. Therefore, Automatic FDIR functions must be inhibited. Caution will not clear.

LAB: TCS: Thermal Load Reduction
- **Thermal Load Reduction**
- ‘Auto Thermal Load Shed’

  *cmd* Inhibit – Arm (√ – X)
  *cmd* Inhibit – Inh

  √Auto Thermal Load Shed – Inh

  ‘IATCS Reconfig’

  *cmd* Inhibit – Arm (√ – X)
  *cmd* Inhibit – Inh

  √IATCS Reconfig – Inh

LAB: TCS: Software: Software Additional Commands
- **Software Additional Commands**
- ‘Leak Recovery IATCS’
- ‘Leak Rcvy’
- ‘Auto Isolation’

  *cmd* Inhibit – Arm (√ – X)
  *cmd* Inhibit – Inh

  √Auto Isolation – Inh

- ‘LTL Leak Rcvy’
- ‘Auto Shutdown’

  *cmd* Inhibit – Arm (√ – X)
  *cmd* Inhibit – Inh

  √Auto Shutdown – Inh

- ‘MTL Leak Rcvy’
- ‘Auto Shutdown’

  *cmd* Inhibit – Arm (√ – X)
  *cmd* Inhibit – Inh

  √Auto Shutdown – Inh

Perform steps 8 --- 12, then exit this procedure.

*******************************************************
8. CONFIGURING LCA VALVES

NOTE
Only one LCA Valve is needed to be in Single for the IATCS to be in Single Loop mode. Both LCA Valves are required to be in Dual for the IATCS to be in Dual Loop mode.

PCS
LAB: TCS: LCA Icon
LCA Commands
‘LCA’

√Vlv 2 Posn – Dual

**cmds** Vlv 1 Posn – Sngl  **Execute**

√Vlv 1 Posn – Sngl

If Vlv 1 Posn ≠ Sngl

**cmds** Vlv 2 Posn – Sngl  **Execute**

√Vlv 2 Posn – Sngl

*******************************************************************************

If Vlv 1 Posn ≠ Sngl and Vlv2 Posn ≠ Sngl

Expect Caution: ‘Lab LCA Valve 1 Failure - LAB’

Expect Caution: ‘Lab LCA Valve 2 Failure - LAB’

Rotate Rack LAP6 (refer to {LAB LTL(MTL)/CABIN AIR RACK ROTATE} (SODF: TBD)).

TBD OSO steps to remove panel.

Fold out Handle on LCA Valve 1.

Rotate Valve 1 \(\nearrow\) from Dual to Single.

Fold in Handle on LCA Valve 1.

NOTE

The following is required to inform the IATCS software of the LCA Valve 1 position change. Caution will clear if command is successful.

**cmds** Vlv 1 Posn – Sngl  **Execute**

√Vlv 1 Posn – Sngl

*******************************************************************************
If Vlv 1 Posn ≠ Sngl (after previous off-nominal steps)

**NOTE**
If the Vlv 1 Posn ≠ Sngl, then there is no way to inform the IATCS software of the valve position change. Therefore, Automatic FDIR functions must be inhibited. Caution will not clear.

LAB: TCS: Thermal Load Reduction

[Thermal Load Reduction]

‘Auto Thermal Load Shed’

**cmd** Inhibit – Arm (\(\sqrt{X}\))

**cmd** Inhibit – Inh

\(\sqrt{X}\)Auto Thermal Load Shed – Inh

‘IATCS Reconfig’

**cmd** Inhibit – Arm (\(\sqrt{X}\))

**cmd** Inhibit – Inh

\(\sqrt{X}\)IATCS Reconfig – Inh

LAB: TCS: Software: Software Additional Commands

[Software Additional Commands]

‘Leak Recovery IATCS’

‘Leak Rcvy’

‘Auto Isolation’

**cmd** Inhibit – Arm (\(\sqrt{X}\))

**cmd** Inhibit – Inh

\(\sqrt{X}\)Auto Isolation – Inh

‘LTL Leak Rcvy’

‘Auto Shutdown’

**cmd** Inhibit – Arm (\(\sqrt{X}\))

**cmd** Inhibit – Inh

\(\sqrt{X}\)Auto Shutdown – Inh

‘MTL Leak Rcvy’

‘Auto Shutdown’

**cmd** Inhibit – Arm (\(\sqrt{X}\))

**cmd** Inhibit – Inh

\(\sqrt{X}\)Auto Shutdown – Inh

Perform steps 9 --- 12, then exit this procedure.

***********************************************************************
9. **INHIBITING MTL TWMV CLOSED LOOP CONTROL**

PCS

LAB: TCS: MTL TWMV Icon

MTL TWMV Commands

‘MTL TWMV’

<table>
<thead>
<tr>
<th>cmd</th>
<th>CLC – Inh</th>
<th>Execute</th>
</tr>
</thead>
</table>

| cmd | Posn – Flothru | Execute |

√CLC – Inh

√Posn – Flothru

10. **SETTING MTL PUMP TO 100 % SPEED/REENABLING SFCA CLC**

PCS

LAB: TCS: MTL PPA

MTL PPA Commands

‘MTL PPA’

input Set Pump Speed Arm: 18900 rpm

| cmd | Set Pump Speed Arm – Arm (√ – X) |

input Set Pump Speed Set: 18900 rpm

| cmd | Set Pump Speed Set – Set |

LAB: TCS: MTL SFCA

MTL SFCA Commands

‘MTL SFCA’

| cmd | CLC – Ena |

√CLC – Ena

******************************************************************************

If Rack LABP6 had been rotated in step 8
Perform [LAB LTL(MTL)/CABIN AIR RACK ROTATE],
steps TBD (SODF: TBD), then:

******************************************************************************

Wait 30 seconds.

LAB: TCS

Lab: IATCS Overview

‘PPA’

Verify MTL Pmp dP: 448 ± 56 kPa
Verify MTL HR Flow: 1361 ± 136 kg/hr
Verify MTL Pmp Spd: 18900 ± 1250 rpm
11. REENABLING LTL SFCA CLOSED LOOP CONTROL

LAB: TCS: LTL SFCA
LTL SFCA Commands
‘LTL SFCA’

\textbf{cmd} CLC – Ena

√CLC – Ena

12. SHUTDOWN OF LTL PUMP SOFTWARE

LAB: TCS: LTL PPA
LTL PPA Commands
‘LTL PPA’
‘Pump Software’

\textbf{cmd} Shutdown – Arm (√ – X)
\textbf{cmd} Shutdown – Shutdown

√Pump Software – Shutdown

13. CHANGING SOFTWARE MODE TO SINGLE MT

\begin{quote}
\textbf{NOTE}
Do not execute steps 13, 14 if the second off-nominal situation in steps 7 or 8 was performed.
\end{quote}

LAB: TCS: Software
Software Commands
‘IATCS’
‘Mode’

\textbf{cmd} Sngl MT – Arm

√Arm Status – Sngl MT Armed

\textbf{cmd} Sngl MT – Sngl MT

Wait 2 minutes.

Verify Mode – Sngl MT

14. ENABLING FAILURE RECOVERY FDIR

LAB: TCS: Software
Software Commands
‘IATCS’
‘Fail Rcvy’

\textbf{cmd} Enable – Ena

√Fail Rcvy – Ena
This Page Intentionally Blank
1. **INHIBITING FAILURE RECOVERY FDIR**

**PCS**

LAB: TCS: Software

- Software Commands
- 'IATCS'
- 'Fail Rcvy'

**cmd** Inhibit – Arm (√ – X)

**cmd** Inhibit – Inh

√Fail Rcvy – Inh

2. **INHIBITING SFCA CLOSED LOOP CONTROL**

**PCS**

LAB: TCS: MTL SFCA

- MTL SFCA Commands
- 'MTL SFCA'

**cmd** CLC – Inh

√CLC – Inh

LAB: TCS: LTL SFCA

- LTL SFCA Commands
- 'LTL SFCA'

**cmd** CLC – Inh

√CLC – Inh

3. **SETTING LTL PUMP SPEED TO REDUCED SPEED**

**NOTE**

If the pump is left at full speed, then it is not possible to manually move an LCA Valve.

**PCS**

LAB: TCS: LTL PPA

- LTL PPA Commands
- 'LTL PPA'

**cmd** Set Pump Speed Arm – Arm (√ – X)

input Set Pump Speed Arm: 11373 rpm

**cmd** Set Pump Speed Set – Set

input Set Pump Speed Set: 11373 rpm
Verify LTL Pmp dP:  172 ± 34 kPa
Verify LTL HR Flow:  726 ± 91 kg/hr
Verify LTL Pmp Spd:  11373 ± 1250 rpm

4. STARTUP OF MTL PPA PUMP SOFTWARE

PCS
LAB: TCS: MTL PPA
MTL PPA Commands
'MTL PPA'

\textbf{cmd} Pump Software Startup – Startup

√Pump Software – Started

Verify MTL PPA Firmware Mode – Operational

5. VERIFYING MTL PUMP IS SHUTDOWN

PCS
LAB: TCS: MTL PPA
MTL PPA Commands
'MTL PPA'

LAB: TCS
Lab: IATCS Overview
'PPA'

Verify LR Flow:  0 ± 91 kg/hr

Verify MTL Pmp dP:  0 ± 21 kPa
Verify MTL Pmp Spd:  0 ± 54 rpm

6. OPENING MTL SFCA MODULATING VALVE

\textbf{CAUTION}
The SFCA Modulating Valve must be commanded open to prevent dP sensor damage when increasing a pump speed or starting a pump.

PCS
LAB: TCS: MTL SFCA
MTL SFCA Commands
'Mod Vlv'

input Direct Vlv drive voltage:  -5 Volts
duration:  17 seconds

\textbf{cmd} Direct Vlv – Set

LAB: TCS
Lab: IATCS Overview
'SFCA'

Verify MTL Mod Vlv dP:  0 ± 7 kPa
If MTL Mod Vlv dP > 7 kPa
Open front panel on Rack LABS6 by lifting the panel latches (two) and swinging the panel door open.
Pull out MTL SFCA Header Pressure Valve Handle.
Turn Header Pressure Handle \( \wedge \) to the Open position.
Push in MTL SFCA Header Pressure Valve Handle.
Close front panel by swinging the panel closed and engaging the panel latches (two).

7. **VERIFYING LTL TWMV CLOSED LOOP CONTROL ENABLED**

   PCS
   LAB: TCS
   Lab: IATCS Overview
   ‘TWMV’
   √LTL TWMV CLC – Ena

8. **CONFIGURING LCA VALVES**

   **CAUTION**
   When both LCA Valves are in the Dual position, equipment connected to the MTL will no longer be receiving cooling. Steps 9 --- 11 must be completed within 30 minutes of changing the LCA Valve 1 to the Dual position in order to keep DDCUs, C&C MDMs, and other critical avionics operational.

   **NOTE**
   Only one LCA Valve is needed to be in Single for the IATCS to be in Single Loop mode. Both LCA Valves are required to be in Dual for the IATCS to be in Dual Loop mode.

   PCS
   LAB: TCS: LCA Icon
   LCA Commands
   ‘LCA’
   √Vlv 2 Posn – Dual
   **cmd** Vlv 1 Posn – Dual **Execute**
   √Vlv 1 Posn – Dual
If Vlv 1 Posn ≠ Dual
  Expect Caution: ‘Lab LCA Valve 1 Failure - LAB’
  Rotate Rack LABP6 (refer to [LAB LTL (MTL)/CABIN AIR
  RACK ROTATE] (SODF: TBD)).
  TBD OSO steps to remove panel.
  Fold out Handle on LCA Valve 1.
  Rotate Valve 1 $\leftarrow$ from Single to Dual.
  Fold in Handle on LCA Valve 1.

NOTE
The following is required to inform the IATCS
software of the LCA Valve 1 position change.
Caution will clear if command is successful.

**cmd Vlv 1 Posn – Dual  Execute**

$\sqrt{Vlv \text{ 1 Posn – Dual}}$

************************************************************************
If Vlv 1 Posn ≠ Dual (after previous off-nominal steps)

NOTE
If the Vlv 1 Posn ≠ Dual, then there is no way to inform the IATCS software of the valve position change. Therefore, Automatic FDIR functions must be inhibited. Caution will not clear.

LAB: TCS: Thermal Load Reduction

Thermal Load Reduction
‘Auto Thermal Load Shed’

• cmd Inhibit – Arm (√ – X)
• cmd Inhibit – Inh

√Auto Thermal Load Shed – Inh

‘IATCS Reconfig’

• cmd Inhibit – Arm (√ – X)
• cmd Inhibit – Inh

√IATCS Reconfig – Inh

LAB: TCS: Software: Software Additional Commands

Software Additional Commands
‘Leak Recovery IATCS’
‘Leak Rcvy’
‘Auto Isolation’

• cmd Inhibit – Arm (√ – X)
• cmd Inhibit – Inh

√Auto Isolation – Inh

‘LTL Leak Rcvy’
‘Auto Shutdown’

• cmd Inhibit – Arm (√ – X)
• cmd Inhibit – Inh

√Auto Shutdown – Inh

‘MTL Leak Rcvy’
‘Auto Shutdown’

• cmd Inhibit – Arm (√ – X)
• cmd Inhibit – Inh

√Auto Shutdown – Inh

Perform steps 9 --- 13, then exit this procedure.

************************************************************************
9. OPENING MTL SFCA SHUTOFF VALVE

LAB: TCS: MTL SFCA

MTL SFCA Commands

‘MTL SFCA’

‘Shutoff Vlv Posn’

**cmd** Open – Open

Verify Shutoff Vlv Posn – Open

********************************************************************************

If Shutoff Vlv Posn ≠ Open

Expect Caution: ‘**Lab MTL SFCA Shutoff Valve Failure - LAB**’

Open front panel on Rack LABS6 by lifting the panel latches (two) and swinging the panel door open.

Pull out MTL SFCA Pump Inlet Shutoff Handle.

Turn Pump Inlet Shutoff Handle \(\wedge\) to the Open position.

Push in MTL SFCA Pump Inlet Shutoff Handle.

Close front panel by swinging the panel closed and engaging the panel latches (two).

NOTE

The following is required to inform the IATCS software of the SFCA Shutoff Valve position change. Caution will clear if command is successful.

**cmd** Open – Open

Verify Shutoff Vlv Posn – Open

********************************************************************************
If Shutoff Vlv Posn ≠ Open (after previous off-nominal steps)

NOTE
If Shutoff Vlv Posn ≠ Open, then there is no way to inform the IATCS software of the valve position change. Therefore, Automatic FDIR functions must be inhibited. Caution will not clear.

LAB: TCS: Thermal Load Reduction

Thermal Load Reduction

‘Auto Thermal Load Shed’

\texttt{cmd} Inhibit – Arm (\checkmark – X)
\texttt{cmd} Inhibit – Inh

√Auto Thermal Load Shed – Inh

‘IATCS Reconfig’

\texttt{cmd} Inhibit – Arm (\checkmark – X)
\texttt{cmd} Inhibit – Inh

√IATCS Reconfig – Inh

LAB: TCS: Software: Software Additional Commands

Software Additional Commands

‘Leak Recovery IATCS’
‘Leak Rcvy’
‘Auto Isolation’

\texttt{cmd} Inhibit – Arm (\checkmark – X)
\texttt{cmd} Inhibit – Inh

√Auto Isolation – Inh

‘LTL Leak Rcvy’
‘Auto Shutdown’

\texttt{cmd} Inhibit – Arm (\checkmark – X)
\texttt{cmd} Inhibit – Inh

√Auto Shutdown – Inh

‘MTL Leak Rcvy’
‘Auto Shutdown’

\texttt{cmd} Inhibit – Arm (\checkmark – X)
\texttt{cmd} Inhibit – Inh

√Auto Shutdown – Inh

Perform steps 10 --- 13, then exit this procedure.

************************************************************************
10. **RECONFIGURING MTL TWMV**

**PCS**

LAB: TCS: MTL TWMV Icon

<table>
<thead>
<tr>
<th>MTL TWMV Commands</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘MTL TWMV’</td>
</tr>
</tbody>
</table>

**cmd** CLC – Ena **Execute**

√CLC – Ena

LAB: TCS: Regen TWMV Icon

<table>
<thead>
<tr>
<th>MTL Regen TWMV Commands</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘MTL Regen TWMV’</td>
</tr>
</tbody>
</table>

**cmd** CLC – Inh **Execute**

√CLC – Inh

**cmd** Posn – Byp **Execute**

√Posn – Byp

11. **SETTING MTL PUMP TO FULL SPEED/RE-ENABLING SFCA CLC**

**PCS**

LAB: TCS

<table>
<thead>
<tr>
<th>Lab: IATCS Overview</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘SFCA’</td>
</tr>
</tbody>
</table>

Verify MTL Mod Vlv dP: 0 ± 7 KPa

LAB: TCS: MTL PPA

<table>
<thead>
<tr>
<th>MTL PPA Commands</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘MTL PPA’</td>
</tr>
</tbody>
</table>

input Set Pump Speed Arm: 17200 rpm

**cmd** Set Pump Speed Arm – Arm (√ – X)

input Set Pump Speed Set: 17200 rpm

**cmd** Set Pump Speed Set – Set

********************************************************************
If Rack LABP6 had been rotated in step 8
Perform (LAB LTL(MTL)/CABIN AIR RACK ROTATE),
steps TBD (SODF: TBD), then:
********************************************************************
LAB: TCS: MTL SFCA

MTL SFCA Commands

'MTL SFCA'

cmd CLC – Ena

√CLC – Ena

Wait 30 seconds.

LAB: TCS

Lab: IATCS Overview

'PPA'

Verify MTL Pmp dP: 290 ± 34 kPa
Verify MTL HR Flow: 1361 ± 136 kg/hr
Verify MTL Pmp Spd: 17200 ± 1250 rpm

12. OPENING LTL SFCA MODULATING VALVE

CAUTION

The SFCA Modulating Valve must be commanded open to prevent dP sensor damage when starting a pump or increasing a pump speed.

LAB: TCS: LTL SFCA

LTL SFCA Commands

'Mod Vlv'

input Direct Vlv drive voltage: -5 Volts
duration: 17 seconds

cmd Direct Vlv – Set

LAB: TCS

Lab: IATCS Overview

'SFCA'

Verify LTL Mod Vlv dP: 0 ± 7 kPa
13. **SETTING LTL PUMP TO FULL DUAL SPEED/REENABLING SFCA CLC**

**PCS**

**LAB: TCS: LTL PPA**

**LTL PPA Commands**

`LTL PPA`

input Set Pump Speed Arm: 15880 rpm

**cmd** Set Pump Speed Arm – Arm (√ – X)

input Set Pump Speed Set: 15880 rpm

**cmd** Set Pump Speed Set – Set

**LAB: TCS: LTL SFCA**

**LTL SFCA Commands**

`LTL SFCA`

**cmd** CLC – Ena

√CLC – Ena

Wait 30 seconds.

**LAB: TCS**

[Lab: IATCS Overview]

`PPA`

Verify LTL Pmp dP: 207 ± 34 kPa
Verify LTL HR Flow: 1361 ± 136 kg/hr
Verify LTL Pmp Spd: 15880 ± 1250 rpm
14. **SETTING SOFTWARE MODE TO DUAL**

**NOTE**
Do not execute steps 14 ---16 if the second off-nominal situation in steps 8 or 9 was performed.

**PCS**

LAB: TCS: Software

- Software Commands
  - ‘IATCS’
  - ‘Mode’

**cmd** Dual – Arm

√Arm Status – Dual Armed

**cmd** Dual – Dual

Wait 3 minutes.

Verify Mode – Dual

15. **SETTING ACCUMULATOR LEAK LIMITS**

**PCS**

LAB: TCS

- Lab: IATCS Overview
  - ‘PPA’

Record LTL Avg Accum Qty: __________ %

Record MTL Avg Accum Qty: __________ %

LAB: TCS: Software: Software Additional Commands

<table>
<thead>
<tr>
<th>Software Additional Commands</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘Leak Recovery IATCS’</td>
</tr>
</tbody>
</table>

**cmd** Set Normal Leak Limits – Set

16. **ENABLING FAILURE RECOVERY FDIR**

**PCS**

LAB: TCS: Software

- Software Commands
  - ‘IATCS’
  - ‘Fail Rcvy’

**cmd** Enable – Ena

√Fail Rcvy – Ena
1. **INHIBITING FAILURE RECOVERY FDIR**

   **NOTE**
   While the Failure Recovery FDIR is inhibited, any cautions indicating an IATCS Pump/Valve failure will probably be followed by a Warning: ‘LAB IATCS Failure with Fail Rcvy Inhibited - Lab’ message. No action will need to be taken for this message.

   **PCS**
   ```
   LAB: TCS: Software
   Software Commands
   ‘IATCS’
   ‘Fail Rcvy’
   ```
   
   **cmd** Inhibit – Arm (√ – X)
   **cmd** Inhibit – Inh

   √Fail Rcvy – Inh

2. **STARTUP OF MTL PPA PUMP SOFTWARE**

   **PCS**
   ```
   LAB: TCS: MTL PPA
   MTL PPA Commands
   ‘MTL PPA’
   ```
   
   **cmd** Pump Software Startup – Startup

   √Pump Software – Started

   Verify MTL PPA Firmware Mode – Operational

3. **INHIBITING LTL/MTL SFCA CLOSED LOOP CONTROL**

   **PCS**
   ```
   LAB: TCS: LTL SFCA
   LTL SFCA Commands
   ‘LTL SFCA’
   ```
   
   **cmd** CLC – Inh

   √CLC – Inh

   ```
   LAB: TCS: MTL SFCA
   MTL SFCA Commands
   ‘MTL SFCA’
   ```
   
   **cmd** CLC – Inh

   √CLC – Inh
4. **SETTING LTL PUMP TO 0 RPM (0 % SPEED)**

<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>The single loop is no longer receiving cooling after completing this step. Steps 5 --- 8 must be completed within 30 minutes or critical MDMs, DDCUs, and other flight avionics will be lost.</td>
</tr>
</tbody>
</table>

**PCS**

<table>
<thead>
<tr>
<th>LAB: TCS: LTL PPA</th>
</tr>
</thead>
<tbody>
<tr>
<td>LTL PPA Commands</td>
</tr>
<tr>
<td>‘LTL PPA’</td>
</tr>
</tbody>
</table>

Input Set Pump Speed Arm: 0 rpm

**cmd** Set Pump Speed Arm – Arm (√ – X)

Input Set Pump Speed Set: 0 rpm

**cmd** Set Pump Speed Set – Set

Verify LR Flow: 0 ± 50 kg/hr

**LAB: TCS**

<table>
<thead>
<tr>
<th>Lab: IATCS Overview</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘PPA’</td>
</tr>
</tbody>
</table>

Verify LTL Pmp dP: 0 ± 34 kPa
Verify LTL Pmp Spd: 0 ± 54 rpm

5. **CLOSING LTL SFCA SHUTOFF VALVE**

**PCS**

<table>
<thead>
<tr>
<th>LAB: TCS: LTL SFCA</th>
</tr>
</thead>
<tbody>
<tr>
<td>LTL SFCA Commands</td>
</tr>
<tr>
<td>‘LTL SFCA’</td>
</tr>
<tr>
<td>‘Shutoff Vlv Posn’</td>
</tr>
</tbody>
</table>

**cmd** Close – Arm (√ – X)

**cmd** Close

√Shutoff Vlv Posn – Close
If Shutoff Vlv Posn ≠ Close
Expect Caution: ‘Lab LTL SFCA Shutoff Valve Failure - LAB’
Open front panel on Rack LABP6 by lifting the panel latches (two)
and swinging the panel door open.
Pull out LTL SFCA Pump Inlet Shutoff Handle.
Turn Pump Inlet Shutoff Handle ∨ to the Close position.
Push in LTL SFCA Pump Inlet Shutoff Handle.
Close front panel by swinging the panel closed and engaging the
panel latches (two).

NOTE
The following is required to inform the IATCS software
of the SFCA Shutoff Valve position change. Caution
will clear if command is successful.

**cmd** Close – Arm (√ – X)
**cmd** Close – Close

Verify Shutoff Vlv Posn – Close

*******************************************************************************
If Shutoff Vlv Posn ≠ Close (after previous off-nominal steps)

**NOTE**
If Shutoff Vlv Posn ≠ Close, then there is no way to inform the IATCS software of the valve position change. Therefore, Automatic FDIR functions must be inhibited. Caution will not clear.

LAB: TCS: Thermal Load Reduction

[Thermal Load Reduction]

‘Auto Thermal Load Shed’

**cmd Inhibit – Arm (√ – X)**

**cmd Inhibit – Inh**

√Auto Thermal Load Shed – Inh

‘IATCS Reconfig’

**cmd Inhibit – Arm (√ – X)**

**cmd Inhibit – Inh**

√IATCS Reconfig – Inh

LAB: TCS: Software: Software Additional Commands

[Software Additional Commands]

‘Leak Recovery IATCS’

‘Leak Rcvy’

‘Auto Isolation’

**cmd Inhibit – Arm (√ – X)**

**cmd Inhibit – Inh**

√Auto Isolation – Inh

‘LTL Leak Rcvy’

‘Auto Shutdown’

**cmd Inhibit – Arm (√ – X)**

**cmd Inhibit – Inh**

√Auto Shutdown – Inh

‘MTL Leak Rcvy’

‘Auto Shutdown’

**cmd Inhibit – Arm (√ – X)**

**cmd Inhibit – Inh**

√Auto Shutdown – Inh

Perform steps 6 --- 12, then exit this procedure.

************************************************************************
6. OPENING MTL SFCA SHUTOFF VALVE
   LAB: TCS: MTL SFCA
   MTL SFCA Commands
   ‘MTL SFCA’
   ‘Shutoff Vlv Posn’

   cmd Open – Open

   Verify Shutoff Vlv Posn – Open

   ***********************************************************************
   If Shutoff Vlv Posn ≠ Open
   Expect Caution: ‘Lab MTL SFCA Shutoff Valve Failure - LAB’
   Open front panel on Rack LABS6 by lifting the panel latches (two)
   and swinging the panel door open.
   Pull out MTL SFCA Pump Inlet Shutoff Handle.
   Turn Pump Inlet Shutoff Handle to the Open position.
   Push in MTL SFCA Pump Inlet Shutoff Handle.
   Close front panel by swinging the panel closed and engaging the
   panel latches (two).

   NOTE
   The following is required to inform the IATCS software
   of the SFCA Shutoff Valve position change. Caution
   will clear if command is successful.

   cmd Open – Open

   Verify Shutoff Vlv Posn – Open

   ***********************************************************************
If Shutoff Vlv Posn ≠ Open (after previous off-nominal steps)

NOTE
If Shutoff Vlv Posn ≠ Open, then there is no way to inform the IATCS software of the valve position change. Therefore, Automatic FDIR functions must be inhibited. Caution will not clear.

LAB: TCS: Thermal Load Reduction

‘Auto Thermal Load Shed’

**cmd** Inhibit – Arm (√ – X)
**cmd** Inhibit – Inh

√Auto Thermal Load Shed – Inh

‘IATCS Reconfig’

**cmd** Inhibit – Arm (√ – X)
**cmd** Inhibit – Inh

√IATCS Reconfig – Inh

LAB: TCS: Software: Software Additional Commands

‘Leak Recovery IATCS’
‘Leak Rcvy’
‘Auto Isolation’

**cmd** Inhibit – Arm (√ – X)
**cmd** Inhibit – Inh

√Auto Isolation – Inh

‘LTL Leak Rcvy’
‘Auto Shutdown’

**cmd** Inhibit – Arm (√ – X)
**cmd** Inhibit – Inh

√Auto Shutdown – Inh

‘MTL Leak Rcvy’
‘Auto Shutdown’

**cmd** Inhibit – Arm (√ – X)
**cmd** Inhibit – Inh

√Auto Shutdown – Inh

Perform steps 7 --- 12, then exit this procedure.

************************************************************************
7. OPENING MTL SFCA MODULATING VALVE

**CAUTION**

The SFCA Modulating Valve must be commanded open to prevent dP sensor damage when changing pump speeds.

PCS

LAB: TCS: MTL SFCA

MTL SFCA Commands

‘Mod Vlv’

input Direct Vlv drive voltage: -5 Volts

duration: 17 seconds

**cmd** Direct Vlv – Set

LAB: TCS

Lab: IATCS Overview

‘SFCA’

Verify MTL Mod Vlv dP: 0 ± 7 kPa

*********************************************************************

If MTL Mod Vlv dP > 7 kPa

Open front panel on Rack LABS6 by lifting the panel latches (two) and swinging the panel door open.

Pull out MTL SFCA Header Pressure Valve Handle.

Turn Header Pressure Handle ◄ to the Open position.

Push in MTL SFCA Header Pressure Valve Handle.

Close front panel by swinging the panel closed and engaging the panel latches (two).

*********************************************************************

8. OPENING LTL SFCA MODULATING VALVE

**CAUTION**

The SFCA Modulating Valve must be commanded open to prevent dP sensor damage when starting a pump or increasing a pump speed.

PCS

LAB: TCS: LTL SFCA

LTL SFCA Commands

‘Mod Vlv’

input Direct Vlv drive voltage: -5 Volts

duration: 17 seconds

**cmd** Direct Vlv – Set
4.211 LAB IATCS TRANSITION FROM SINGLE LT TO SINGLE MT - MANUAL
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LAB: TCS
Lab: IATCS Overview
‘SFCA’

Verify LTL Mod Vlv dP: 0 ± 7 kPa

******************************************************************************
If LTL Mod Vlv dP > 7 kPa
  Open front panel on Rack LABP6 by lifting the panel latches (two) and swinging the panel door open.
  Pull out LTL SFCA Header Pressure Valve Handle.
  Turn Header Pressure Handle → to the Open position.
  Push in LTL SFCA Header Pressure Valve Handle.
  Close front panel by swinging the panel closed and engaging the panel latches (two).
******************************************************************************

9. SETTING MTL PUMP TO FULL SPEED

PCS
LAB: TCS: MTL PPA
MTL PPA Commands
‘MTL PPA’

input Set Pump Speed Arm: 18900 rpm

**cmd** Set Pump Speed Arm – Arm (√ – X)

input Set Pump Speed Set: 18900 rpm

**cmd** Set Pump Speed Set – Set

Wait 30 seconds.

LAB: TCS
Lab: IATCS Overview
‘PPA’

Verify MTL Pmp dP: 448 ± 56 kPa
Verify MTL HR Flow: 1361 ± 136 kg/hr
Verify MTL Pmp Spd: 18900 ± 1250 rpm

10. SHUTDOWN OF LTL PPA PUMP SOFTWARE

PCS
LAB: TCS: LTL PPA
LTL PPA Commands
‘LTL PPA’
‘Pump Software’

**cmd** Shutdown – Arm (√ – X)
**cmd** Shutdown – Shutdown

√Pump Software – Shutdown
11. **VERIFYING CONFIGURATION OF LCA VALVES**

PCS

LAB: TCS: LCA Icon

LCA Commands

‘LCA’

\(\sqrt{Vlv1 \text{ Posn} – \text{Sngl}}\)

\(\sqrt{Vlv2 \text{ Posn} – \text{Dual}}\)

12. **REENABLELING LTL/MTL SFCA CLOSED LOOP CONTROL**

PCS

LAB: TCS: LTL SFCA

LTL SFCA Commands

‘LTL SFCA’

**cmd** CLC – Ena

\(\sqrt{\text{CLC – Ena}}\)

LAB: TCS: MTL SFCA

MTL SFCA Commands

‘MTL SFCA’

**cmd** CLC – Ena

\(\sqrt{\text{CLC – Ena}}\)

13. **CHANGING SOFTWARE MODE TO SINGLE MT**

**NOTE**

Do not execute steps 13, 14 if the second off-nominal situation in steps 5 or 6 was performed.

PCS

LAB: TCS: Software

Software Commands

‘IATCS’

‘Mode’

**cmd** Sngl MT – Arm

\(\sqrt{\text{Arm Status – Sngl MT Armed}}\)

**cmd** Sngl MT – Sngl MT

Wait 3 minutes.

Verify Mode – Sngl MT
14. **ENABLING FAILURE RECOVERY FDIR**

PCS

LAB: TCS: Software

Software Commands

‘IATCS’

‘Fail Rcvy’

**cmd** Enable – Ena

√Fail Rcvy – Ena
1. **INHIBITING FAILURE RECOVERY FDIR**

   **NOTE**
   While the Failure Recovery FDIR is inhibited, any cautions indicating an IATCS Pump/Valve Failure will probably be followed by a Warning: ‘**LAB IATCS Failure with Fail Rcvy Inhibited - Lab**’ message. No action will need to be taken for this message.

   PCS
   
   LAB: TCS: Software
   Software Commands
   ‘IATCS’
   ‘Fail Rcvy’

   cmd Inhibit – Arm (√ – X)
   cmd Inhibit – Inh

   √Fail Rcvy – Inh

2. **INHIBITING SFCA CLOSED LOOP CONTROL**

   PCS
   
   LAB: TCS: LTL SFCA
   LTL SFCA Commands
   ‘LTL SFCA’

   cmd CLC – Inh

   √CLC – Inh

   LAB: TCS: MTL SFCA
   MTL SFCA Commands
   ‘MTL SFCA’

   cmd CLC – Inh

   √CLC – Inh

3. **SETTING MTL PUMP SPEED TO REDUCED SPEED**

   **NOTE**
   If the pump is left at full speed, then it is not possible to manually move an LCA valve.

   PCS
   
   LAB: TCS: MTL PPA
   MTL PPA Commands
   ‘MTL PPA’

   input Set Pump Speed Arm: 11373 rpm

   cmd Set Pump Speed Arm – Arm (√ – X)

   input Set Pump Speed Set: 11373 rpm

   cmd Set Pump Speed Set – Set
LAB: TCS
Lab: IATCS Overview
‘PPA’

Verify MTL Pmp dP: 172 ± 34 kPa
Verify MTL HR Flow: 726 ± 91 kg/hr
Verify MTL Pmp Spd: 11373 ± 1250 rpm

4. STARTUP OF LTL PPA PUMP SOFTWARE

PCS
LAB: TCS: LTL PPA
LTL PPA Commands
‘LTL PPA’

\textbf{cmd} Pump Software Startup – Startup

√ Pump Software – Started

Verify LTL PPA Firmware Mode – Operational

5. VERIFYING LTL PUMP IS SHUTDOWN

PCS
LAB: TCS: LTL PPA
LTL PPA Commands
‘LTL PPA’

Verify LTL LR Flow: 0 ± 91 kg/hr

LAB: TCS
Lab: IATCS Overview
‘PPA’

Verify LTL Pmp dP: 0 ± 21 kPa
Verify LTL Pmp Spd: 0 ± 54 rpm

6. OPENING LTL SFCA MODULATING VALVE

\textbf{CAUTION}

The SFCA Modulating Valve must be commanded open to prevent dP sensor damage when starting a pump or increasing a pump speed.

PCS
LAB: TCS: LTL SFCA
LTL SFCA Commands
‘Mod Vlv’

input Direct Vlv drive voltage: -5 Volts
duration: 17 seconds

\textbf{cmd} Direct Vlv – Set
LAB: TCS
Lab: IATCS Overview
'SFCA'

Verify LTL Mod Vlv dP: 0 ± 7 kPa

*********************************************************************
If LTL Mod Vlv dP > 7 kPa
Open front panel on Rack LABP6 by lifting the panel latches (two) and swinging the panel door open.
Pull out LTL SFCA Header Pressure Valve Handle.
Turn Header Pressure Handle \(\leftarrow\) to the Open position.
Push in LTL SFCA Header Pressure Valve Handle.
Close front panel by swinging the panel closed and engaging the panel latches (two).
*********************************************************************

7. RECONFIGURING MTL TWMV CLOSED LOOP CONTROL

CAUTION
MTL CLC must be enabled prior to configuring the LCA Valves in order to prevent condensation on the MTL water lines.

PCS LAB: TCS: MTL TWMV Icon
MTL TWMV Commands
'MTL TWMV'

cmd CLC – Ena Execute

√ CLC – Ena

8. CONFIGURING LCA VALVES

CAUTION
When both LCA Valves are in the Dual position, equipment connected to the LTL will no longer be receiving cooling. Steps 9, 10 must be expedited. If a problem occurs while executing these steps, perform CDRA Shutdown.

NOTE
Only one LCA Valve is needed to be in Single for the IATCS to be in Single Loop mode. Both LCA Valves are required to be in Dual for the IATCS to be in Dual Loop mode.

PCS LAB: TCS: LCA
LCA Commands
' LCA'
√Vlv 2 Posn – Dual

**cmd** Vlv 1 Posn – Dual **Execute**

√Vlv 1 Posn – Dual

*******************************************************************************
If Vlv 1 Posn ≠ Dual
Expect Caution: ‘Lab LCA Valve 1 Failure - LAB’
Rotate Rack LABP6 (refer to {LAB LTL(MTL)/CABIN AIR RACK 
ROTATE} (SODF: TBD)).
TBD OSO Steps to remove panel.
Fold out Handle on LCA Valve 1.
Rotate Valve 1 from Single to Dual.
Fold in Handle on LCA Valve 1.

**NOTE**
The following is required to inform the IATCS software of the LCA Valve 1 position change.
Caution will clear if command is successful.

**cmd** Vlv 1 Posn – Dual **Execute**

√Vlv 1 Posn – Dual

*******************************************************************************
If Vlv 1 Posn ≠ Dual (after previous off-nominal steps)

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>If the Vlv 1 Posn ≠ Dual, then there is no way to inform the IATCS software of the valve position change. Therefore, Automatic FDIR functions must be inhibited. Caution will not clear.</td>
</tr>
</tbody>
</table>

LAB: TCS: Thermal Load Reduction

- Thermal Load Reduction
  - ‘Auto Thermal Load Shed’

  **cmd** Inhibit – Arm (√ – X)
  **cmd** Inhibit – Inh

  √Auto Thermal Load Shed – Inh

  ‘IATCS Reconfig’

  **cmd** Inhibit – Arm (√ – X)
  **cmd** Inhibit – Inh

  √IATCS Reconfig – Inh

LAB: TCS: Software: Software Additional Commands

- Software Additional Commands
  - ‘Leak Recovery IATCS’
  - ‘Leak Rcvy’
  - ‘Auto Isolation’

  **cmd** Inhibit – Arm (√ – X)
  **cmd** Inhibit – Inh

  √Auto Isolation – Inh

  ‘LTL Leak Rcvy’
  ‘Auto Shutdown’

  **cmd** Inhibit – Arm (√ – X)
  **cmd** Inhibit – Inh

  √Auto Shutdown – Inh

  ‘MTL Leak Rcvy’
  ‘Auto Shutdown’

  **cmd** Inhibit – Arm (√ – X)
  **cmd** Inhibit – Inh

  √Auto Shutdown – Inh

Perform steps 9 --- 14, then exit this procedure.
9. OPENING LTL SFCA SHUTOFF VALVE

LAB: TCS: LTL SFCA

LTL SFCA Commands

‘LTL SFCA’
‘Shutoff Vlv Posn’

**cmd** Open – Open

Verify Shutoff Vlv Posn – Open

********************************************************************************

If Shutoff Vlv Posn ≠ Open

Expect Caution: ‘**Lab LTL SFCA Shutoff Valve Failure - LAB**’

Open front panel on Rack LABP6 by lifting the panel latches (two) and swinging the panel door open.

Pull out LTL SFCA Pump Inlet Shutoff Handle.

Turn Pump Inlet Shutoff Handle \(^\downarrow\) to the Open position.

Push in LTL SFCA Pump Inlet Shutoff Handle.

Close front panel by swinging the panel closed and engaging the panel latches (two).

**NOTE**

The following is required to inform the IATCS software of the SFCA Shutoff Valve position change. Caution will clear if commands is successful.

**cmd** Open – Open

Verify Shutoff Vlv Posn – Open

********************************************************************************
If Shutoff Vlv Posn ≠ Open (after previous off-nominal steps)

**NOTE**

If Shutoff Vlv Posn ≠ Open, then there is no way to inform the IATCS software of the valve position change. Therefore, Automatic FDIR functions must be inhibited. Caution will not clear.

LAB: TCS: Thermal Load Reduction

[Thermal Load Reduction]

‘Auto Thermal Load Shed’

*cmd* Inhibit – Arm (√ – X)

*cmd* Inhibit – Inh

√Auto Thermal Load Shed – Inh

‘IATCS Reconfig’

*cmd* Inhibit – Arm (√ – X)

*cmd* Inhibit – Inh

√IATCS Reconfig – Inh

LAB: TCS: Software: Software Additional Commands

[Software Additional Commands]

‘Leak Recovery IATCS’

‘Leak Rcvy’

‘Auto Isolation’

*cmd* Inhibit – Arm (√ – X)

*cmd* Inhibit – Inh

√Auto Isolation – Inh

‘LTL Leak Rcvy’

‘Auto Shutdown’

*cmd* Inhibit – Arm (√ – X)

*cmd* Inhibit – Inh

√Auto Shutdown – Inh

‘MTL Leak Rcvy’

‘Auto Shutdown’

*cmd* Inhibit – Arm (√ – X)

*cmd* Inhibit – Inh

√Auto Shutdown – Inh

Perform steps 10 --- 14, then exit this procedure.

************************************************************************************
10. SETTING LTL PUMP TO FULL SPEED/REENABLING SFCA CLC

PCS

LAB: TCS
Lab: IATCS Overview
'SFCA'

Verify LTL Mod Vlv dP: 0 ± 7 kPa

LAB: TCS: LTL PPA
LTL PPA Commands
'LTL PPA'

input Set Pump Speed Arm: 15880 rpm

**cmd** Set Pump Speed Arm – Arm (√ – X)

input Set Pump Speed Set: 15880 rpm

**cmd** Set Pump Speed Set – Set

**********************************************************************
If Rack LABP6 had been rotated in step 8
Perform {LAB LTL (MTL)/CABIN AIR RACK ROTATE},
steps TBD (SODF: TBD)), then:
**********************************************************************

LAB: TCS: LTL SFCA
LTL SFCA Commands
'LTL SFCA'

**cmd** CLC – Ena

√CLC – Ena

Wait 30 seconds.

LAB: TCS
Lab: IATCS Overview
'PPA'

Verify LTL Pmp dP: 207 ± 34 kPa
Verify LTL HR Flow: 1361 ± 136 kg/hr
Verify LTL Pmp Spd: 15880 ± 1250 rpm
11. OPENING MTL SFCA MODULATING VALVE

**CAUTION**
The SFCA Modulating Valve must be commanded open to prevent dP sensor damage when increasing a pump speed or starting a pump.

Verify MTL Mod Vlv dP: 0 ± 7 kPa

If MTL Mod Vlv dP > 7 kPa
- Open front panel on Rack LABS6 by lifting the panel latches (two) and swinging the panel door open.
- Pull out MTL SFCA Header Pressure Valve Handle.
- Turn Header Pressure Handle \( \wedge \) to the Open position.
- Push in MTL SFCA Header Pressure Valve Handle.
- Close front panel by swinging the panel closed and engaging the panel latches (two).

12. SETTING MTL PUMP TO FULL DUAL SPEED/REENABLING SFCA CLC

input Set Pump Speed Arm: 17200 rpm

**cmd** Set Pump Speed Arm – Arm (\( \sqrt{} \) – X)

input Set Pump Speed Set: 17200 rpm

**cmd** Set Pump Speed Set – Set
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\[\sqrt{CLC} \rightarrow Ena\]

Wait 30 seconds.

LAB: TCS
<table>
<thead>
<tr>
<th>Lab: IATCS Overview</th>
</tr>
</thead>
<tbody>
<tr>
<td>'PPA'</td>
</tr>
</tbody>
</table>

Verify MTL Pmp dP: 290 ± 34 kPa
Verify MTL HR Flow: 1361 ± 136 kg/hr
Verify MTL Pmp Spd: 17200 ± 1250 rpm

13. RECONFIGURING MTL REGEN TWMV

PCS
<table>
<thead>
<tr>
<th>LAB: TCS: Regen TWMV Icon</th>
</tr>
</thead>
<tbody>
<tr>
<td>'MTL Regen TWMV Commands'</td>
</tr>
<tr>
<td>'MTL Regen TWMV'</td>
</tr>
</tbody>
</table>

**cmd** CLC – Inh  **Execute**

\[\sqrt{CLC} \rightarrow Inh\]

**cmd** Posn – Byp  **Execute**

\[\sqrt{Posn} \rightarrow Byp\]

14. VERIFYING LTL TWMV CLOSED LOOP CONTROL ENABLED

PCS
<table>
<thead>
<tr>
<th>LAB: TCS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lab: IATCS Overview</td>
</tr>
<tr>
<td>'TWMV'</td>
</tr>
</tbody>
</table>

\[\sqrt{LTL TWMV CLC} \rightarrow Ena\]

15. SETTING SOFTWARE MODE TO DUAL

**NOTE**
Do not execute steps 15 --- 17 if the second off-nominal situation in steps 8 or 9 was performed.

PCS
<table>
<thead>
<tr>
<th>LAB: TCS: Software</th>
</tr>
</thead>
<tbody>
<tr>
<td>Software Commands</td>
</tr>
<tr>
<td>'IATCS'</td>
</tr>
<tr>
<td>'Mode'</td>
</tr>
</tbody>
</table>

**cmd** Dual – Arm

\[\sqrt{Arm Status} \rightarrow Dual Armed\]

**cmd** Dual – Dual

Wait 2 minutes.

Verify Mode – Dual
16. **SETTING ACCUMULATOR LEAK LIMITS**

**PCS**

LAB: TCS

Lab: IATCS Overview

‘PPA’

Record LTL Avg Accum Qty: __________ %

Record MTL Avg Accum Qty: __________ %

LAB: TCS: Software: Software Additional Commands

Software Additional Commands

‘Leak Recovery IATCS’

cmd Set Normal Leak Limits – Set

17. **ENABLING FAILURE RECOVERY FDIR**

**PCS**

LAB: TCS: Software

Software Commands

‘IATCS’

‘Fail Rcvy’

cmd Enable – Ena

√Fail Rcvy – Ena
1. **INHIBITING FAILURE RECOVERY FDIR**

   **NOTE**
   
   While the Failure Recovery FDIR is inhibited, any cautions indicating an IATCS Pump/Valve failure will probably be followed by a Warning: ‘LAB IATCS Failure with Fail Rcvy Inhibited - Lab’ message. No action will need to be taken for this message.

   **PCS**
   
   LAB: TCS: Software
   
   Software Commands
   
   ‘IATCS’
   
   ‘Fail Rcvy’

   **cmd** Inhibit – Arm (√ – X)

   **cmd** Inhibit – Inh

   √Fail Rcvy – Inh

2. **STARTUP OF LTL PPA PUMP SOFTWARE**

   **PCS**
   
   LAB: TCS: LTL PPA
   
   LTL PPA Commands
   
   ‘LTL PPA’

   **cmd** Pump Software Startup – Startup

   √Pump Software – Started

   Verify LTL PPA Firmware Mode – Operational

3. **INHIBITING LTL/MTL SFCA CLOSED LOOP CONTROL**

   **PCS**
   
   LAB: TCS: LTL SFCA
   
   LTL SFCA Commands
   
   ‘LTL SFCA’

   **cmd** CLC – Inh

   √CLC – Inh

   LAB: TCS: MTL SFCA

   MTL SFCA Commands

   ‘MTL SFCA’

   **cmd** CLC – Inh

   √CLC – Inh
4. SETTING MTL PUMP TO 0 RPM (0 % SPEED)

CAUTION

The single loop is no longer receiving cooling after completing this step. Steps 5 --- 8 must be completed within 30 minutes or critical MDMs, DDCUs, and other flight avionics will be lost.

PCS

LAB: TCS: MTL PPA

MTL PPA Commands

`MTL PPA`

input Set Pump Speed Arm: 0 rpm

`cmd` Set Pump Speed Arm – Arm (√ – X)

input Set Pump Speed Set: 0 rpm

`cmd` Set Pump Speed Set – Set

Verify LR Flow: 0 ± 50 kg/hr

LAB: TCS

Lab: IATCS Overview

`PPA`

Verify MTL Pmp dP: 0 ± 34 kPa
Verify MTL Pmp Spd: 0 ± 54 rpm

5. CLOSING MTL SFCA SHUTOFF VALVE

PCS

LAB: TCS: MTL SFCA

MTL SFCA Commands

`MTL SFCA`

`Shutoff Vlv Posn`

`cmd` Close – Arm (√ – X)

`cmd` Close – Close

√Shutoff Vlv Posn – Close
If Shutoff Vlv Posn ≠ Close

Expect Caution: ‘Lab MTL SFCA Shutoff Valve Failure - LAB’

Open front panel on Rack LABS6 by lifting the panel latches (two) and swinging the panel door open.
Pull out MTL SFCA Pump Inlet Shutoff Handle.
Turn Pump Inlet Shutoff Handle to the Close position.
Push in MTL SFCA Pump Inlet Shutoff Handle.
Close front panel by swinging the panel closed and engaging the panel latches (two).

NOTE
The following is required to inform the IATCS software of the SFCA Shutoff Valve position change. Caution will clear if command is successful.

** cmd Close – Arm (√ – X)**
** cmd Close – Close **

Verify Shutoff Vlv Posn – Close

*******************************************************************************
If Shutoff Vlv Posn ≠ Close (after previous off-nominal steps)  

**NOTE**  
If Shutoff Vlv Posn ≠ Close, then there is no way to inform the IATCS software of the valve position change. Therefore, Automatic FDIR functions must be inhibited. Caution will not clear.

**LAB: TCS: Thermal Load Reduction**

<table>
<thead>
<tr>
<th>'Auto Thermal Load Shed'</th>
</tr>
</thead>
<tbody>
<tr>
<td>cmd Inhibit – Arm (√ – X)</td>
</tr>
<tr>
<td>cmd Inhibit – Inh</td>
</tr>
<tr>
<td>√Auto Thermal Load Shed – Inh</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>‘IATCS Reconfig’</th>
</tr>
</thead>
<tbody>
<tr>
<td>cmd Inhibit – Arm (√ – X)</td>
</tr>
<tr>
<td>cmd Inhibit – Inh</td>
</tr>
<tr>
<td>√IATCS Reconfig – Inh</td>
</tr>
</tbody>
</table>

**LAB: TCS: Software: Software Additional Commands**

<table>
<thead>
<tr>
<th>Software Additional Commands</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘Leak Recovery IATCS’</td>
</tr>
<tr>
<td>‘Leak Rcvy’</td>
</tr>
<tr>
<td>‘Auto Isolation’</td>
</tr>
</tbody>
</table>

| cmd Inhibit – Arm (√ – X) |
| cmd Inhibit – Inh |
| √Auto Isolation – Inh |

| ‘LTL Leak Rcvy’ |
| ‘Auto Shutdown’ |

| cmd Inhibit – Arm (√ – X)  |
| cmd Inhibit – Inh         |
| √Auto Shutdown – Inh      |

| ‘MTL Leak Rcvy’ |
| ‘Auto Shutdown’ |

| cmd Inhibit – Arm (√ – X)  |
| cmd Inhibit – Inh         |
| √Auto Shutdown – Inh      |

Perform steps 6 --- 12, then exit this procedure.

************************************************************************
6. OPENING LTL SFCA SHUTOFF VALVE
   LAB: TCS: LTL SFCA
   LTL SFCA Commands
   ‘LTL SFCA’
   ‘Shutoff Vlv Posn’

   **cmd** Open – Open

   Verify Shutoff Vlv Posn – Open

   ********************************************************************************
   If Shutoff Vlv Posn ≠ Open
   Expect Caution: ‘Lab LTL SFCA Shutoff Valve Failure - LAB’
   Open front panel on Rack LABP6 by lifting the panel latches (two) and swinging the panel door open.
   Pull out LTL SFCA Pump Inlet Shutoff Handle.
   Turn Pump Inlet Shutoff Handle → to the Open position.
   Push in LTL SFCA Pump Inlet Shutoff Handle.
   Close front panel by swinging the panel closed and engaging the panel latches (two).

   **NOTE**
   The following is required to inform the IATCS software of the SFCA Shutoff Valve position change. Caution will clear if command is successful.

   **cmd** Open – Open

   Verify Shutoff Vlv Posn – Open

   ********************************************************************************
If Shutoff Vlv Posn ≠ Open (after previous off-nominal steps)

NOTE
If Shutoff Vlv Posn ≠ Open, then there is no way to inform the IATCS software of the valve position change. Therefore, Automatic FDIR functions must be inhibited. Caution will not clear.

LAB: TCS: Thermal Load Reduction

Thermal Load Reduction
‘Auto Thermal Load Shed’

`cmd` Inhibit – Arm (√ – X)
`cmd` Inhibit – Inh

√Auto Thermal Load Shed – Inh

‘IATCS Reconfig’

`cmd` Inhibit – Arm (√ – X)
`cmd` Inhibit – Inh

√IATCS Reconfig – Inh

LAB: TCS: Software: Software Additional Commands

[Software Additional Commands]
‘Leak Recovery IATCS’
‘Leak Rcvy’
‘Auto Isolation’

`cmd` Inhibit – Arm (√ – X)
`cmd` Inhibit – Inh

√Auto Isolation – Inh

‘LTL Leak Rcvy’
‘Auto Shutdwn’

`cmd` Inhibit – Arm (√ – X)
`cmd` Inhibit – Inh

√Auto Shutdwn – Inh

‘MTL Leak Rcvy’
‘Auto Shutdwn’

`cmd` Inhibit – Arm (√ – X)
`cmd` Inhibit – Inh

√Auto Shutdwn – Inh

Perform steps 7 --- 12, then exit this procedure.

************************************************************************
7. OPENING LTL SFCA MODULATING VALVE

**CAUTION**
The SFCA Modulating Valve must be commanded open to prevent dP sensor damage when starting a pump or increasing a pump speed.

PCS

LAB: TCS: LTL SFCA

LTL SFCA Commands

`'Mod Vlv'`

input Direct Vlv drive voltage: -5 Volts
duration: 17 seconds

**cmd** Direct Vlv – Set

LAB: TCS

Lab: IATCS Overview

`'SFCA'`

Verify LTL Mod Vlv dP: 0 ± 7 kPa

*********************************************************************
If LTL Mod Vlv dP > 7 kPa
Open front panel on Rack LABP6 by lifting the panel latches (two) and swinging the panel door open.
Pull out LTL SFCA Header Pressure Valve Handle.
Turn Header Pressure Handle → to the Open position.
Push in LTL SFCA Header Pressure Valve Handle.
Close front panel by swinging the panel closed and engaging the panel latches (two).
*********************************************************************

8. OPENING MTL SFCA MODULATING VALVE

**CAUTION**
The SFCA Modulating Valve must be commanded open to prevent dP sensor damage when changing pump speeds.

PCS

LAB: TCS: MTL SFCA

MTL SFCA Commands

`'Mod Vlv'`

input Direct Vlv drive voltage: -5 Volts
duration: 17 seconds

**cmd** Direct Vlv – Set
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LAB: TCS

Lab: IATCS Overview
‘SFCA’

Verify MTL Mod Vlv dP: 0 ± 7 kPa

*****************************************************************************
If MTL Mod Vlv dP > 7 kPa
Open front panel on Rack LABS6 by lifting the panel latches (two) and swinging the panel door open.
Pull out MTL SFCA Header Pressure Valve Handle.
Turn Header Pressure Handle <\ to the Open position.
Push in MTL SFCA Header Pressure Valve Handle.
Close front panel by swinging the panel closed and engaging the panel latches (two).
*****************************************************************************

9. SETTING LTL PUMP TO 100 % SPEED

PCS

LAB: TCS: LTL PPA

LTL PPA Commands
‘LTL PPA’

input Set Pump Speed Arm: 18900 rpm

cmd Set Pump Speed Arm – Arm (√ – X)

input Set Pump Speed Set: 18900 rpm

cmd Set Pump Speed Set – Set

Wait 30 seconds.

LAB: TCS

Lab: IATCS Overview
‘PPA’

Verify LTL Pmp dP: 448 ± 56 kPa
Verify LTL HR Flow: 1361 ± 136 kg/hr
Verify LTL Pmp Spd: 18900 ± 1250 rpm

10. SHUTDOWN OF MTL PPA PUMP SOFTWARE

PCS

LAB: TCS: MTL PPA

MTL PPA Commands
‘MTL PPA’
‘Pump Software’

cmd Shutdown – Arm (√ – X)
cmd Shutdown – Shutdown

√Pump Software – Shutdown
11. **VERIFYING CONFIGURATION OF LCA VALVES**

PCS

LAB: TCS: LCA Icon

LCA Commands

‘LCA’

√Vlv1 Posn – Sngl

√Vlv2 Posn – Dual

12. **REENABLING LTL/MTL SFCA CLOSED LOOP CONTROL**

PCS

LAB: TCS: LTL SFCA

LTL SFCA Commands

‘LTL SFCA’

**cmd** CLC – Ena

√CLC – Ena

LAB: TCS: MTL SFCA

MTL SFCA Commands

‘MTL SFCA’

**cmd** CLC – Ena

√CLC – Ena

13. **CHANGING SOFTWARE MODE TO SINGLE LT**

**NOTE**

Do not execute steps 13 --- 15 if the second off-nominal situation in steps 5 or 6 was performed.

PCS

LAB: TCS: Software

Software Commands

‘IATCS’

‘Mode’

**cmd** Sngl LT – Arm

√Arm Status – Sngl LT Armed

**cmd** Sngl LT – Sngl LT

Wait 2 minutes.

Verify Mode – Sngl LT
14. **ENABLING FAILURE RECOVERY FDIR**

PCS

LAB: TCS: Software

Software Commands

‘IATCS’

‘Fail Rcvy’

**cmd** Enable – **Ena**

√Fail Rcvy – **Ena**
1. **TRANSITIONING FROM DUAL LOOP TO SINGLE LT MODE**

PCS

LAB: TCS

Lab: IATCS Overview

‘Status’

If IATCS MODE = DUAL

Perform \[2.204 \text{ LAB IATCS TRANSITION TO SINGLE LT (AUTO)}\],

all \(\text{SODF: TCS: NOMINAL: IATCS}\), then:

2. **REDUCING IATCS HEAT LOAD**

Based on expected radiator performance, no reduction in heat load is required during 5A stage operations.

**MCC-H** will monitor system data and perform any reconfigurations, if required.

3. **INHIBITING THERMAL LOAD SHED**

PCS

LAB: TCS: Thermal Load Reduction

[Thermal Load Reduction]

‘Auto Thermal Load Shed’

\textbf{cmd} Inhibit – Arm (√ – X)

\textbf{cmd} Inhibit – Inh

√Auto Thermal Load Shed – Inh

If EETCS LoopA cooling capability is being removed

Perform steps 4 and 5 for the Low Temperature Loop (LTL).

If EETCS LoopB cooling capability is being removed

Perform steps 4 and 5 for the Moderate Temperature Loop (MTL).

4. **VERIFYING INHIBIT OF IFHX REINTEGRATION**

PCS

LAB: TCS: Thermal Load Reduction: IFHX Safing

[IFHX Safing]

‘LTL (MTL) IFHX Reinteg’

√LTL (MTL) IFHX Reinteg – Inh
5. **COMMANDING LTL(MTL) IFHX VALVES TO BYP/CLOSE**

Expect annunciation of the following two Caution messages ‘Thermal Safing Partial LTL Load Shed Timer Started’ and ‘Thermal Safing Partial MTL Load Shed Timer Started’.

Following the expiration of the load shed timer, expect annunciation of ‘LTL(MTL) IFHX Reintegration Attempt Failed/Inhibited’ and ‘Thermal Safing Load Shed Inhibited - LAB’ Caution message.

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**CAUTION**

1. IFHX valve position must be verified before position commands can be issued. If the valve position is indeterminate, driving the valve in the direction opposite of its last direction of motion can potentially result in damage to the valve seal. If the valve position is indeterminate, √MCC-H.

2. Once commanded, if the valve does not reach the commanded position, the operator is allowed to issue the same position command up to three additional times. If the desired position is still not reached, √MCC-H.

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**PCS LAB: TCS: LTL (MTL) IFHX**

<table>
<thead>
<tr>
<th>LTL (MTL) IFHX Commands</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘LTL (MTL) IFHX NH3’</td>
</tr>
<tr>
<td>‘Byp Vlv’</td>
</tr>
</tbody>
</table>

√CNTL Avail – Ena

If Byp Vlv – Flothru/Byp ≠ blank
   cmd Byp – Execute (√ – X)

---

**CAUTION**

Do not command the IFHX Isol Valve to the Closed position unless the Bypass Valve has been verified to be in the Bypass position or the EETCS pump is shut down. If an EETCS pump is operating and the Bypass Valve is set to FLOTHRU, the PFCS pump will be deadheaded if the Isol Valve is commanded closed.

‘Isol Vlv’

√CNTL Avail – Ena

If Isol Vlv – Open/Close ≠ blank
   cmd Close – Execute (√ – X)
1. **RECOVERING CCAA**
   Perform \{2.501 CABIN TEMPERATURE CONTROL\}, all (SODF: ECLSS: NOMINAL: THC), then:

2. **RECOVERING CDRA**
   Perform \{1.301 ATMOSPHERE REVITALIZATION RACK ACTIVATION\}, step 6, Carbon Dioxide Removal Assembly (CDRA) Activation (SODF: ECLSS: ACTIVATION AND CHECKOUT: ARS), then:

   **NOTE**
   Table 1 includes all of the equipment in the Thermal Safing LTL Complete Load Shed Table (provided for reference).

**Table 1. LTL Complete Load Shed Table**

<table>
<thead>
<tr>
<th>Subsystem</th>
<th>Command</th>
<th>Load (W)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECLSS</td>
<td>CDRA Stop Arm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ECLSS</td>
<td>CDRA Stop Cfrm</td>
<td>118</td>
<td></td>
</tr>
<tr>
<td>ECLSS</td>
<td>LAB1P6 CCAA Standby</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ECLSS</td>
<td>LAB1S6 CCAA Standby</td>
<td>1626</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Total load reduced: 1744</td>
</tr>
</tbody>
</table>
This Page Intentionally Blank
1. **RECOVERY**
   No action required.
   LTL Partial Load Shed Table contains no commands.

   **NOTE**
   Table 1 includes all of the equipment in the Thermal Safing LTL Partial Load Shed Table (provided for reference).

<table>
<thead>
<tr>
<th>Subsystem</th>
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<th>Comments</th>
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<tr>
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<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>
1. **RECOVERY**

Perform **LOSS OF ATTITUDE CONTROL POWERDOWN & RECOVERY**, all recovery steps (SODF: TBD), then:

```
Table 1 includes all of the equipment in the Thermal Safing MTL Complete Load Shed Table (provided for reference).
```

### Table 1. MTL Complete Load Shed Table

<table>
<thead>
<tr>
<th>Subsystem</th>
<th>Command</th>
<th>Load (W)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECLSS/P/L</td>
<td>LAB VRS Shutdn</td>
<td></td>
<td>Shuts Vacuum relief valves.</td>
</tr>
<tr>
<td>ECLSS</td>
<td>MCA Shutdown Arm</td>
<td></td>
<td></td>
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<tr>
<td>ECLSS</td>
<td>MCA Shutdown</td>
<td></td>
<td></td>
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<tr>
<td>ECLSS</td>
<td>TCCS Shutdown Arm</td>
<td></td>
<td></td>
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<tr>
<td>ECLSS</td>
<td>TCCS Shutdown Cfrm</td>
<td>1200</td>
<td>Total MT Loads on AR Rack.</td>
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<tr>
<td>C&amp;DH/P/L</td>
<td>PL MDM Rcvy FDIR Inh Arm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C&amp;DH/P/L</td>
<td>PL MDM Rcvy FDIR Inh</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C&amp;DH/P/L</td>
<td>PL MDM Retry FDIR Inh Arm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C&amp;DH/P/L</td>
<td>PL MDM Rcvy FDIR Inh</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C&amp;DH/P/L</td>
<td>Auto PL Switch #1</td>
<td></td>
<td>Not powered on 5A</td>
</tr>
<tr>
<td>C&amp;DH/P/L</td>
<td>Auto PL Switch #2</td>
<td></td>
<td>Not powered on 5A</td>
</tr>
<tr>
<td>C&amp;DH/P/L</td>
<td>PL Ethernet Hub Gateway</td>
<td></td>
<td>Not powered on 5A</td>
</tr>
<tr>
<td>C&amp;DH/P/L</td>
<td>MDM-E PL 1</td>
<td>120</td>
<td>Not powered on 5A</td>
</tr>
<tr>
<td>C&amp;T</td>
<td>VSU: 3</td>
<td></td>
<td>Not powered on 5A</td>
</tr>
<tr>
<td>C&amp;T</td>
<td>CVIU: 8</td>
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<td>Not powered on 5A</td>
</tr>
<tr>
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<tr>
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<td>C&amp;T</td>
<td>CVIU: 1</td>
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<tr>
<td>C&amp;T</td>
<td>VSU: 2</td>
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<td>Not powered on 5A</td>
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<tr>
<td>C&amp;T</td>
<td>SCU: 2</td>
<td></td>
<td>Not powered on 5A</td>
</tr>
<tr>
<td>C&amp;T</td>
<td>SSSR: 2</td>
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<td>Not powered on 5A</td>
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<td>C&amp;T</td>
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<td>TCS</td>
<td>Fail Rcvy Inhibit Arm</td>
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<tr>
<td>TCS</td>
<td>Fail Rcvy Inhibit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TCS</td>
<td>LTA Htr 3A On (RPC Close)</td>
<td></td>
<td>Activation puts no load on Lab ITCS</td>
</tr>
<tr>
<td>TCS</td>
<td>LTA Htr 1A On (RPC Close)</td>
<td></td>
<td>Activation puts no load on Lab ITCS</td>
</tr>
<tr>
<td>TCS</td>
<td>LTA Htr 4A On (RPC Close)</td>
<td></td>
<td>Activation puts no load on Lab ITCS</td>
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### Table 1. Continued

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<th>Subsystem</th>
<th>Command Description</th>
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<th>Comments</th>
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<td>TCS</td>
<td>LTA Htr 2A On (RPC Close)</td>
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<tr>
<td>TCS</td>
<td>LTA Htr 3B On (RPC Close)</td>
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<td>Activation puts no load on Lab ITCS</td>
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<tr>
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<td>LTA Htr 4B On (RPC Close)</td>
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<td>TCS</td>
<td>LTA Htr 1B On (RPC Close)</td>
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<td>Activation puts no load on Lab ITCS</td>
</tr>
<tr>
<td>TCS</td>
<td>LTA Htr 2B On (RPC Close)</td>
<td></td>
<td>Activation puts no load on Lab ITCS</td>
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<td>TCS</td>
<td>PMA2 HTR INH Cmd</td>
<td></td>
<td>Reduces load on DDCU</td>
</tr>
<tr>
<td>TCS</td>
<td>LAB SHELL HEATER 4</td>
<td></td>
<td>Reduces load on DDCU</td>
</tr>
<tr>
<td>TCS</td>
<td>LAB SHELL HEATER 5</td>
<td></td>
<td>Reduces load on DDCU</td>
</tr>
<tr>
<td>TCS</td>
<td>LAB SHELL HEATER 6</td>
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<td>Reduces load on DDCU</td>
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<tr>
<td>TCS</td>
<td>LAB SHELL HEATER 3</td>
<td></td>
<td>Reduces load on DDCU</td>
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<tr>
<td>TCS</td>
<td>LAB SHELL HEATER 2</td>
<td></td>
<td>Reduces load on DDCU</td>
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<td>TCS</td>
<td>LAB SHELL HEATER 1</td>
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<td>Reduces load on DDCU</td>
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<td>MTL IFHX Htr Inhibit</td>
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<td>Reduces load on DDCU</td>
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<td>TCS</td>
<td>MTL Regen TWMV</td>
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<td>MTL SFCA Mod Valve</td>
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<td>MTL NIA Vent Valve</td>
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<td>Reduces load on DDCU</td>
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<tr>
<td>TCS</td>
<td>MTL NIA Intro Valve</td>
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<td>Reduces load on DDCU</td>
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<td>TCS</td>
<td>LTL SFCA S/O Valve</td>
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<td>Reduces load on DDCU</td>
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<td>TCS</td>
<td>LTL SFCA Mod Valve</td>
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<td>Reduces load on DDCU</td>
</tr>
<tr>
<td>TCS</td>
<td>LTL NIA Vent Valve</td>
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<td>Reduces load on DDCU</td>
</tr>
<tr>
<td>TCS</td>
<td>LTL NIA Intro Valve</td>
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<td>Reduces load on DDCU</td>
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<td>ECLSS</td>
<td>LAB1P6 CCAA Stop</td>
<td></td>
<td>Completion of Shutdown started in LTL Complete Table.</td>
</tr>
<tr>
<td>Subsystem</td>
<td>Command</td>
<td>Load (W)</td>
<td>Comments</td>
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<td>LAB1S6 CCAA Stop</td>
<td>Completion of Shutdown started in LTL Complete Table.</td>
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<td>ECLSS</td>
<td>AAA Shutdown</td>
<td>Completion of Shutdown</td>
<td></td>
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<td>SD Mon Inh</td>
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<td>EPS</td>
<td>EEL PS Lab 1B</td>
<td>Reduces load on DDCU</td>
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<tr>
<td>EPS</td>
<td>EEL PS Lab 1B</td>
<td>Reduces load on DDCU</td>
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<td>EPS</td>
<td>EEL PS Lab 1B2B</td>
<td>Reduces load on DDCU</td>
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<td>EPS</td>
<td>EEL PS Lab 1B2B</td>
<td>Reduces load on DDCU</td>
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<td>EPS</td>
<td>UOP 5</td>
<td>Reduces load on DDCU</td>
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<tr>
<td>EPS</td>
<td>UOP 6</td>
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<td>INT LIGHT LABOP6</td>
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<td>INT LIGHT LABOS1</td>
<td>Reduces load on DDCU</td>
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<td>Reduces load on DDCU</td>
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<td>EPS</td>
<td>INT LIGHT LABOP1</td>
<td>Reduces load on DDCU</td>
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<td>EPS</td>
<td>INT LIGHT LABOP3</td>
<td>Reduces load on DDCU</td>
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<td>EPS</td>
<td>INT LIGHT LABOP5</td>
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<td>EPS</td>
<td>INT LIGHT LABOP2</td>
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<td>EPS</td>
<td>INT LIGHT LABOP4</td>
<td>Reduces load on DDCU</td>
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<td>EPS</td>
<td>INT LIGHT LABOP6</td>
<td>Reduces load on DDCU</td>
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</tr>
<tr>
<td>ECLSS/P/L</td>
<td>Load Control Assy</td>
<td>Not powered on 5A</td>
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</tr>
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<td>ECLSS</td>
<td>IMV FAN</td>
<td>Reduces load on DDCU</td>
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</tr>
<tr>
<td>ECLSS</td>
<td>LAB1P6 CCAA Water Sep</td>
<td>Completion of Shutdown</td>
<td></td>
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<tr>
<td>ECLSS</td>
<td>LAB1P6 CCAA TCCV</td>
<td>Completion of Shutdown</td>
<td></td>
</tr>
<tr>
<td>ECLSS</td>
<td>LAB1P6 CCAA EIB</td>
<td>Completion of Shutdown</td>
<td></td>
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<td>ECLSS</td>
<td>LAB1P6 CCAA Fan</td>
<td>Completion of Shutdown</td>
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<tr>
<td>ECLSS</td>
<td>LAB1S6 CCAA Water Sep</td>
<td>Completion of Shutdown</td>
<td></td>
</tr>
<tr>
<td>ECLSS</td>
<td>LAB1S6 CCAA TCCV</td>
<td>Completion of Shutdown</td>
<td></td>
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<tr>
<td>ECLSS</td>
<td>LAB1S6 CCAA EIB</td>
<td>Completion of Shutdown</td>
<td></td>
</tr>
<tr>
<td>ECLSS</td>
<td>ARS RACK (LAB1D6)</td>
<td>Completion of Shutdown</td>
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</tr>
<tr>
<td>C&amp;DH</td>
<td>PMCU MDM Rcvy FDIR Inh Arm</td>
<td></td>
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<tr>
<td>C&amp;DH</td>
<td>PMCU MDM Rcvy FDIR Inh</td>
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<tr>
<td>C&amp;DH</td>
<td>PMCU MDM Retry FDIR Inh Arm</td>
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<tr>
<td>C&amp;DH</td>
<td>PMCU MDM Retry FDIR Inh</td>
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Table 1. Continued

<table>
<thead>
<tr>
<th>Subsystem</th>
<th>Command</th>
<th>Load (W)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>C&amp;DH</td>
<td>MDM-16 LA-1</td>
<td>120</td>
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<tr>
<td>C&amp;DH</td>
<td>MDM-16 LA-2</td>
<td>120</td>
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<td>MDM-16 LA-3</td>
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<td>C&amp;DH</td>
<td>MDM PMCU 1</td>
<td>129.5</td>
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<td>C&amp;DH</td>
<td>MDM PMCU 2</td>
<td>129.5</td>
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</tr>
</tbody>
</table>

Total heat loads reduced: 1809.5 W
1. **RECOVERY**

   No action required.

   MTL Partial Load Shed Table contains no commands.

   **NOTE**

   Table 1 includes all of the equipment in the Thermal Safing MTL Partial Load Shed Table (provided for reference).

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</tbody>
</table>
### ACTION

1. Verify status of Primary MDMs.
2. PCS C&DH
   - CDH SUMMARY

#### CDH SUMMARY

If GNC-1 MDM – Primary
- Perform [4.404 GNC MDM STATE TRANSITION D: TRANSITIONING BACKUP GNC MDM FROM STANDBY TO NORMAL AND TRANSITIONING PRIMARY GNC MDM FROM NORMAL TO STANDBY], all (SODF: C&DH: CORRECTIVE: MDM STATE TRANSITIONS TIER II), then:
  - Perform [4.403 GNC MDM STATE TRANSITION C: TRANSITIONING BACKUP GNC MDM FROM WAIT TO DIAGNOSTIC/OFF WHILE PRIMARY GNC MDM IS NORMAL], all (SODF: C&DH: CORRECTIVE: MDM STATE TRANSITIONS TIER II), then:

If C&C-1 MDM – Primary
- Perform [4.304 C&C MDM TRANSITION D: TRANSITIONING THE PRIMARY C&C TO STANDBY THE BACKUP C&C MDM TO PRIMARY, AND THE STANDBY C&C MDM TO BACKUP], all (SODF: C&DH: CORRECTIVE: MDM STATE TRANSITIONS TIER I)
  - Perform [4.303 C&C MDM TRANSITION C: TRANSITIONING ANY C&C MDM FROM STANDBY TO FAILED/DIAGNOSTIC/OFF], all (SODF: C&DH: CORRECTIVE: MDM STATE TRANSITIONS TIER I), then:

### EQUIP/FUNCTION LOST

(Continued)

### CREW INDICATION

C&W Messages:
- GNC MDM Transition: None
- C&C MDM Transition: None
- Backup CC MDM Fail - LAB (C)
- Backup CC MDM Fail - LAB (C)
- Backup INT MDM Fail - LAB (C)
- Backup INT MDM Fail - LAB (C)
- Backup PMCU MDM Fail - LAB (C)
- Backup PL MDM Fail - LAB (C)
- Backup GNC MDM Fail - LAB (C)

#### Spurious alarms:
- Primary CC Detected
  - Primary Node 1 MDM Failure - LAB (W)
  - Secondary Node 1 MDM Failure - LAB (C)
- Spurious PVCU MDM RT Fails
- PMCU MDM Transition:
  - Expect stale PMCU RT Tlm
- PL MDM Transition:
  - Expect stale APS, PEHG, and PL RT Tlm.

### NOTES

1. All equipment lost during this procedure is transitioned to off via procedure step callouts. Hardware damage could occur to powered equipment without cooling.
2. Powered MDMs will sustain hardware damage in 30 minutes without ITCS cooling.
3. Each MDM powered off during this procedure has a redundant box with identical functionality. No functions should be lost due to these power downs. After GNC-2, C&C-2, INT-2, PMCU-2, and PL-2 are in the primary state, power can be removed from GNC-1, C&C-1, INT-1, PMCU-1, PL-1.
If INT-1 MDM – Primary
   Perform \textit{4.408 INTERNAL MDM TRANSITION D: TRANSITIONING MDM 1(2) FROM STANDBY TO OPERATIONAL AND TRANSITIONING MDM 2(1) FROM OPERATIONAL TO STANDBY/DIAGNOSTIC/OFF}, all (SODF: C&DH: CORRECTIVE: MDM STATE TRANSITIONS TIER II), then:
   Perform \textit{4.407 INTERNAL MDM TRANSITION C: TRANSITIONING MDM 1(2) FROM STANDBY TO DIAGNOSTIC/OFF WHILE MDM 2(1) IS OPERATIONAL}, all (SODF: C&DH: CORRECTIVE: MDM STATE TRANSITIONS TIER II), then:

   \begin{verbatim}
   LAB: TCS: Software ‘IATCS’ ‘Mode’
   \textbf{cmd} Sngl MT – Arm
   √ Arm Status – Sngl MT Armed
   \textbf{cmd} Sngl MT – Sngl MT
   √ Mode – Sngl MT
   \textbf{cmd} Activation – Startup
   √ Activation – In Prog
   \end{verbatim}

(Continued)
<table>
<thead>
<tr>
<th>ACTION</th>
<th>EQUIP/FUNCTION LOST</th>
<th>CREW INDICATION</th>
<th>NOTES</th>
</tr>
</thead>
</table>
| If PMCU-1 MDM – Primary
Perform (4.415 PMCU MDM TRANSITION D: TRANSITIONING MDM 1(2) FROM WAIT TO OPERATIONAL AND TRANSITIONING MDM 2(1) FROM OPERATIONAL TO WAIT/DIAGNOSTIC/OFF), all (SODF: C&DH: CORRECTIVE: MDM STATE TRANSITIONS TIER II), then:

(4.414 PAYLOAD MDM TRANSITION C: TRANSITION PL MDM FROM OPERATIONAL TO STANDBY/DIAGNOSTIC/OFF), all (SODF: C&DH: CORRECTIVE: MDM STATE TRANSITIONS TIER II)

If PL-1 MDM – Primary
Perform (PAYLOAD MDM TRANSITION D) (SODF: TBD)

Perform (4.411 PAYLOAD MDM TRANSITION C: TRANSITION PL MDM FROM OPERATIONAL TO STANDBY/DIAGNOSTIC/OFF), all (SODF: C&DH: CORRECTIVE: MDM STATE TRANSITIONS TIER II), then:

If other conditions not primary, continue to next block.

Perform (4.503 LAB MDM TRANSITION C: TRANSITIONING LAB MDM FROM OPERATIONAL MIN OPS/STANDBY TO DIAGNOSTIC/OFF), all (SODF: C&DH: CORRECTIVE: MDM STATE TRANSITIONS TIER III), then:

(Continued) | All indications associated with the loss of DDCU LA1B are listed in the EPS SSR. | | 2 Powered MDMs will sustain hardware damage in 30 minutes without ITCS cooling.

3 Each MDM powered off during this procedure has a redundant box with identical functionality. No functions should be lost due to these power downs. After GNC-2, C&C-2, INT-2, PMCU-2, and PL-2 are in the primary state, power can be removed from GNC-1, C&C-1, INT-1, PMCU-1, PL-1. |
### 4.219 TCS SSR-1 LOSS OF COOLING IN FWD ENDCONE

#### (TCS/5A - ALL/FIN) Page 4 of 4 pages

<table>
<thead>
<tr>
<th>ACTION</th>
<th>EQUIP/FUNCTION LOST</th>
<th>CREW INDICATION</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAB: EPS: DDCU LA1B</td>
<td>DDCU LA1B and associated loads</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distribution: DDCU LA1B</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>icon: Converter icon</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DDCU LA1B</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Converter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>'Converter Off'</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>cmd Converter Off – Off</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Go to (EPS SSR LOSS OF DDCU 1B) steps</td>
<td></td>
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</tr>
<tr>
<td>TBD (SODF: TBD).</td>
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</tr>
</tbody>
</table>

#### PHYSICAL EFFECTS

4. DDCU 1B hardware damage will occur if DDCU is powered longer than 2 hours without cooling.

5. The LTL SFCA Modulating valve will remain in its last position when DDCU 1B is powered off.

25 AUG 00

358
# 4.220 TCS SSR-2 LOSS OF COOLING IN AFT ENDCONE

<table>
<thead>
<tr>
<th>ACTION</th>
<th>EQUIP/FUNCTION LOST</th>
<th>CREW INDICATION</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Verify status of Primary MDMs.</td>
<td>GNC-2 MDM</td>
<td>C&amp;W Messages:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C&amp;C-2 MDM</td>
<td>GNC MDM Transition: None</td>
</tr>
<tr>
<td>2</td>
<td>PCS C&amp;DH CDH SUMMARY</td>
<td>INT-2 MDM</td>
<td>C&amp;C MDM Transition:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PMCU-2 MDM</td>
<td>Backup CC MDM Transition to Primary - LAB (C)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PL-2 MDM</td>
<td>Backup CC MDM Fail - LAB (C)</td>
</tr>
<tr>
<td>4</td>
<td>If GNC-2 MDM – Primary</td>
<td></td>
<td>INT MDM Transition:</td>
</tr>
<tr>
<td></td>
<td>Perform (4.404 GNC MDM STATE TRANSITION D: TRANSITIONING BACKUP GNC MDM FROM STANDBY TO NORMAL AND TRANSITIONING PRIMARY GNC MDM FROM NORMAL TO STANDBY), all (SODF: C&amp;DH: CORRECTIVE: MDM STATE TRANSITIONS TIER II), then:</td>
<td></td>
<td>Expect stale LA MDM Tim, Node MDM Tim, and associated RT Tim.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Spurious alarms:</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Primary CC Detected Primary Node 1 MDM Failure - LAB (W)</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Primary CC Detected Secondary Node 1 MDM Failure - LAB (C)</td>
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<td></td>
<td></td>
<td></td>
<td>Spurious PVCU MDM RT Fails.</td>
</tr>
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<td></td>
<td>PMCU MDM Transition:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Expect stale PMCU RT Tim.</td>
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<td></td>
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<td></td>
<td>PL MDM Transition:</td>
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<tr>
<td></td>
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<td></td>
<td>Expect stale APS, PEHG, and PL RT Tim.</td>
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<td></td>
<td>Expect the following C&amp;W alarms due to MDM powerdowns:</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>Standby CC MDM Fail - LAB (C)</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Backup INT MDM Fail - LAB (C)</td>
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<td></td>
<td>Backup PMCU MDM Fail - LAB (C)</td>
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<td>Backup PL MDM Fail - LAB (C)</td>
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<td></td>
<td></td>
<td>Backup GNC MDM Fail - LAB (C)</td>
</tr>
<tr>
<td>3</td>
<td>If C&amp;C-2 MDM – Primary</td>
<td></td>
<td>C&amp;C MDM Transition:</td>
</tr>
<tr>
<td></td>
<td>Perform (4.403 GNC MDM STATE TRANSITION C: TRANSITIONING BACKUP GNC MDM FROM WAIT TO DIAGNOSTIC/OFF WHILE PRIMARY GNC MDM IS NORMAL), all (SODF: C&amp;DH: CORRECTIVE: MDM STATE TRANSITIONS TIER II), then:</td>
<td></td>
<td>Backup CC MDM Transition to Primary - LAB (C)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Backup CC MDM Fail - LAB (C)</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Backup INT MDM Fail - LAB (C)</td>
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<td></td>
<td>Backup PMCU MDM Fail - LAB (C)</td>
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<td></td>
<td>Backup PL MDM Fail - LAB (C)</td>
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<td></td>
<td></td>
<td></td>
<td>Backup GNC MDM Fail - LAB (C)</td>
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<td>~ (Continued)</td>
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<tr>
<td>ACTION</td>
<td>EQUIP/FUNCTION LOST</td>
<td>CREW INDICATION</td>
<td>NOTES</td>
</tr>
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<td>-----------------</td>
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</tr>
</tbody>
</table>
| If PL-2 MDM – Primary  
Perform {4.408 INT MDM TRANSITION D: TRANSITIONING MDM 1(2) FROM STANDBY TO OPERATIONAL AND TRANSITIONING MDM 2(1) FROM OPERATIONAL TO STANDBY/DIAGNOSTIC/OFF}, all (SODF: C&DH: CORRECTIVE: MDM STATE TRANSITIONS TIER II), then:  
Perform {4.407 INT MDM TRANSITION C: TRANSITIONING MDM 1(2) FROM STANDBY TO DIAGNOSTIC WHILE MDM 2(1) IS OPERATIONAL} (SODF: C&DH: CORRECTIVE: MDM STATE TRANSITIONS TIER II), then: | LA-2 MDM  
LA-3 MDM |  
Caution Messages: All indications associated with the loss of DDCU 2B are listed in the EPS SSR. | |
| (Continued) | (Continued) | | |
| If PMCU-2 MDM – Primary  
To transition LA-2 and LA-3 MDMs from Operational State to Off State, perform  
{4.503 LAB MDM TRANSITION C: TRANSITIONING LAB MDM FROM OPERATIONAL/MIN OPS/STANDBY TO DIAGNOSTIC OFF}, all (SODF: C&DH: CORRECTIVE: MDM STATE TRANSITIONS TIER III), then: | | | |
<table>
<thead>
<tr>
<th>ACTION</th>
<th>EQUIP/FUNCTION LOST</th>
<th>CREW INDICATION</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>cmd Converter Off – Off Go to [EPS SSR LOSS OF DDCU 2B], steps TBD (SODF: TBD)</td>
<td></td>
<td>5 DDCU 2B hardware damage will occur if DDCU is powered longer than 2 hours without cooling. 6 The MTL SFCA Modulating valve will remain in its last position when DDCU 2B is powered Off.</td>
</tr>
</tbody>
</table>
NOTES

1. Equipment that has lost cooling will be transitioned off throughout this procedure. Hardware damage could occur to powered equipment without cooling.

2. Each MDM powered off during this procedure has a redundant box with identical functionality. No functions should be lost due to these powerdowns. After C&C-2, INT-2, and PMCU-2 are in the primary state, power can be removed from C&C-1, INT-1, and PMCU-1.

3. Powered MDMs will sustain hardware damage in 30 minutes without ITCS cooling.
### ACTION

If PMCU-1 MDM – Primary

Perform {4.415 PMCU MDM STATE TRANSITION D: TRANSITIONING MDM 1(2) FROM WAIT TO OPERATIONAL AND TRANSITIONING MDM 2(1) FROM OPERATIONAL TO WAIT/DIAGNOSTIC OFF}, all (SODF: C&DH: CORRECTIVE: MDM STATE TRANSITIONS TIER II), then:

Perform {4.414 PMCU MDM TRANSITION C: TRANSITIONING MDM 1(2) FROM WAIT TO DIAGNOSTIC/OFF WHILE MDM 2(1) IS OPERATIONAL}, all (SODF: C&DH: CORRECTIVE: MDM STATE TRANSITIONS TIER II), then:

If PL-1 MDM – Primary

Perform (PAYLOAD MDM STATE TRANSITION D), all (SODF: TBD), then:

Perform {4.411 PAYLOAD MDM TRANSITION C: TRANSITION STANDBY TO DIAGNOSTIC/OFF}, all (SODF: C&DH: CORRECTIVE: MDM STATE TRANSITIONS TIER II), then:

If other conditions not Primary, continue to next block

---

### CREW INDICATION

EQUIP/FUNCTION LOST

### NOTES

(Continued)
### Action

**CAUTION**

S-Band A/G audio will be lost when AUIA-2 is powered down.

If required
- Perform **(1.203 EARLY COMM POWERUP POST LAB)**, all (SODF: C&T: ACTIVATION AND CHECKOUT: ECS), then:
- Perform **(EARLY COMM VIDEO CONFERENCE)**, all (SODF: TBD), then:

### Equipment/Function Lost

When this RPC is opened, power will be removed from RPCM LAD1-1B-A. The following equipment is lost:

- **C&T:**
  - ABC-1
  - AUIA-2
  - SCU-1
  - VSU-1
  - CVIU-1

### Crew Indication

**NOTES**

Early Comm video conference capability will be used for A/G voice.
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### ACTION

<p>| | | | |</p>
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<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>If CCAA in LAB1P6 operating, perform all steps below to shut down and remove power.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>If CCAA in LAB1P6 not operating, perform block 2 only.</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

**Stop CCAA.**

**PCS**

**LAB:** ECLSS: LAB1P6

**CCAA:** CCAA

**Commands**

**LAB1P6 CCAA Commands**

- **cmd** Stop
- √ CCAA State – EIB Off

**1**

**PCS EPS:** DDCU LA1B

**Distribution:** RPCM

**LA1B-D icon:** RPC 3 icon

**RPCM LA1B D RPC 03**

- **cmd** RPC Position – Open (Verify – Op)

- **Configure Low Temp Loop supply.**
- **Open CCAA Rack Closeout Panel.**

- **TCS Manual Flow Control Valve – Closed**
- **Close CCAA Rack Closeout Panel.**

<table>
<thead>
<tr>
<th></th>
<th><strong>EQUIP/FUNCTION LOST</strong></th>
<th></th>
<th><strong>CREW INDICATION</strong></th>
<th><strong>NOTES</strong></th>
</tr>
</thead>
</table>
| When this RPC is opened, power will be removed from LAP6-1B-A. The following equipment will be lost **ECLSS:**

- Cabin Air Water Separator Assembly
- CAA Electrical Interface Box
- TCCV Inlet Assembly Fan Group
- **TCS:**
  - SFCA
  - NIA
  - LTL PPA
- **EPS:** LAP6-1B-A |   |   | **1** Equipment that has lost cooling will be deenergized due to potential hardware damage to powered equipment without cooling. **2** ECLSS alternate CCAA in LAB1S6 will be available for use once IATCS Mode – Single MT. |   |   |

If desired, to activate alternate CCAA located in LAB1S6, go to (1.501 CCAA ACTIVATION), all (SODF: ECLSS: ACTIVATION AND CHECKOUT: THC).
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<table>
<thead>
<tr>
<th>ACTION</th>
<th>EQUIP/FUNCTION LOST</th>
<th>CREW INDICATION</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 If CCAA in LAB1S6 operating, perform all steps below to shut down and remove power.</td>
<td>ECLSS: Cabin Air Water Separator Assembly, CAA Electrical Interface Box TCCV, Inlet Fan Assembly Group</td>
<td></td>
<td>1 This procedure will stop the CCAA in LAB1S6, remove power, close the TCS Manual Flow Control Valve, and complete the shutdown of the CCAA.</td>
</tr>
<tr>
<td>2 If desired, to activate the alternate CCAA located in LAB1P6, go to {1.501 CCAA ACTIVATION}, all (SODF: ECLSS: ACTIVATION AND CHECKOUT: THC).</td>
<td></td>
<td>2 ECLSS alternate CCAA located in LAB1P6 should be available for use if required.</td>
<td></td>
</tr>
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</table>
### ACTION

<table>
<thead>
<tr>
<th>1</th>
<th><strong>CAUTION</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. ITCS Mode must be either in Single LT or Dual MT Failed.</td>
<td></td>
</tr>
<tr>
<td>2. If the ITCS Mode is Dual MT Failed, the Forward Endcone and LAB1D1 should be jumpered to the LT Loop prior to performing [3.219 LAB MTL LEAK SAFING), all (SODF: TCS: MALFUNCTION: IATCS).</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2</th>
<th>PCS LAB: EPS: DDCU LA2B</th>
</tr>
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<tbody>
<tr>
<td>Distribution: RPCM</td>
<td>LAS62B-A icon: RPCM</td>
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<tr>
<td>Details: RPC[X]</td>
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</tr>
<tr>
<td><strong>RPCM_LAS62B_A:</strong></td>
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</tr>
<tr>
<td><strong>RPC [X]</strong></td>
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</tr>
<tr>
<td>sel RPC [X] icon where</td>
<td></td>
</tr>
<tr>
<td>[X] = 04 05 06 07 18</td>
<td></td>
</tr>
<tr>
<td><strong>cmd</strong> RPC Position –</td>
<td></td>
</tr>
<tr>
<td>Open (Verify – Op)</td>
<td></td>
</tr>
<tr>
<td>Repeat</td>
<td></td>
</tr>
</tbody>
</table>

| 3 | If CCAA in LAB1S6 is operating, perform all steps below to shut down and remove power. |

| 4 | Perform [2.502 CCAA EMERGENCY STOP - WARN], all (SODF: EMER: WARNING PROCEDURES: ECG), then: |

| 5 | If desired, to activate the alternate CCAA located in LAB1P6, go to [1.501 CCAA ACTIVATION], all (SODF: ECLSS: ACTIVATION AND CHECKOUT: THC). |

### EQUIP/FUNCTION LOST

Opening these RPCs will result in the loss of the following equipment:

- **TCS**: MTL PPA SFCA NIA
- **ECLSS**: Cabin Air Water Separator Assembly CCAA Electrical Interface Box TCCV Inlet Fan Assembly Group

### CREW INDICATION

### NOTES

1. If the ITCS Mode is Dual MT Failed, jumping is required to restore cooling to DDCU-LA1B, LA-1 MDM, GNC-1 MDM, C&C-1 MDM, INT-1 MDM, P/L-1 MDM.

2. Potential damage will occur to MTL TCS powered equipment without cooling in LAB1S6.

3. This procedure will stop the CCAA in LAB1S6, remove power, close the TCS Manual Flow Control Valve, and complete the shutdown of the CCAA.

4. ECLSS alternate CCAA located in LAB1P6 should be available for use if required.
<table>
<thead>
<tr>
<th>ACTION</th>
<th>EQUIP/FUNCTION LOST</th>
<th>CREW INDICATION</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Verify status of Primary MDMs.</td>
<td></td>
<td>C&amp;C MDM Transition:</td>
<td></td>
</tr>
<tr>
<td>2 PCS C&amp;DH</td>
<td>C&amp;C-2 MDM</td>
<td>INT MDM to Primary - LAB (C)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>INT-2 MDM</td>
<td>Backup CC MDM Fail - LAB (C)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PMCU-2 MDM</td>
<td>INT MDM Transition:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Expect stale LA MDM Tlm, Node MDM Tlm, and associated RT Tlm.</td>
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<td></td>
<td></td>
<td>Spurious alarms:</td>
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<tr>
<td></td>
<td></td>
<td>Primary CC Detected</td>
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<td></td>
<td></td>
<td>Primary Node 1 MDM Failure - LAB (W)</td>
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<tr>
<td></td>
<td></td>
<td>Primary CC Detected</td>
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<tr>
<td></td>
<td></td>
<td>Secondary Node 1 MDM Failure - LAB (C)</td>
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<tr>
<td></td>
<td></td>
<td>Spurious PVCU MDM RT Fails</td>
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<td></td>
<td>PMCU MDM Transition:</td>
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<td></td>
<td></td>
<td>Expect Stale PMCU RT Tlm</td>
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<td></td>
<td>Expect the following C&amp;W alarms due to MDM powerdowns:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Standby CC MDM Fail - LAB (C)</td>
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<tr>
<td></td>
<td></td>
<td>Backup INT MDM Fail - LAB (C)</td>
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<td></td>
<td></td>
<td>Backup PMCU MDM Fail - LAB (C)</td>
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<tr>
<td></td>
<td></td>
<td>Equipment that has lost cooling will be transitioned off throughout this procedure. Hardware damage could occur to powered equipment without cooling.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Each MDM powered off during this procedure has a redundant box with identical functionality. No functions should be lost due to these powerdowns. After C&amp;C-1, INT-1, and PMCU-1 are in the primary state, power can be removed from C&amp;C-2, INT-2, and PMCU-2.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Powered MDMs will sustain hardware damage in 30 minutes without IATCS cooling.</td>
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<table>
<thead>
<tr>
<th>ACTION</th>
<th>EQUIP/FUNCTION LOST</th>
<th>CREW INDICATION</th>
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</tr>
</thead>
</table>
| If PMCU-2 MDM – Primary  
Perform [4.415 PMCU MDM STATE TRANSITION D: TRANSITIONING MDM 1(2) FROM WAIT TO OPERATIONAL AND TRANSITIONING MDM 2(1) FROM OPERATIONAL TO WAIT/DIAGNOSTIC/OFF], all (SODF: C&DH: CORRECTIVE: MDM STATE TRANSITIONS TIER II), then:  
Perform [4.414 PMCU MDM TRANSITION C: TRANSITIONING MDM 1(2) FROM WAIT TO DIAGNOSTIC/OFF WHILE MDM 2(1) IS OPERATIONAL], all (SODF: C&DH: CORRECTIVE: MDM STATE TRANSITIONS TIER II), then:  
If other conditions are not Primary, continue to next block  
RPCM LA2B C  
RPC 02  
RPCM LA1B  
H RPC 04  
If required, perform [1.203 EARLY COMM POWERUP POST LAB], all (SODF: C&T: ACTIVATION & CHECKOUT: ECS), then:  
Go to [EARLY COMM VIDEO CONFERENCE], all (SODF: TBD). | When this RPC is opened, power will be removed from RPCM LAD52B-A. The following equipment is lost:  
C&T:  
ABC-2  
IAC-2  
SCU-2  
VSU-2  
SSSR- XCVR A  
EPS:  
RPCM LAD52B-A  
When this RPC is opened, power will be removed from RPCM LAFWD-1B-H4. The following equipment is lost:  
C&T:  
ABC-2  
IAC-2  
SCU-2  
VSU-2  
SSSR XCVR A  
EPS:  
RPCM LAD52B-A  
When this RPC is opened, power will be removed from RPC LAFWD-1B-H4. The following equipment is lost:  
C&T:  
SSSR-XCVR B | | | |
| PCS LAB: EPS: DDCU LA2B  
Distribution: RPCM LA2B-C icon: RPC 2 icon  
**cmd** RPC Position – Open (Verify – Op)  
PCS LAB: EPS: DDCU LA1B  
Distribution: RPCM LA1B-H icon: RPC 4 icon  
**RPCM LA1B  
H RPC 04** | When this RPC is opened, power will be removed from RPCM LAD52B-A. The following equipment is lost:  
C&T:  
ABC-2  
IAC-2  
SCU-2  
VSU-2  
SSSR- XCVR A  
EPS:  
RPCM LAD52B-A  | | | |
### POWERING DOWN THE AR RACK

Go to [2.501 AR RACK EMERGENCY STOP - WARN], all (SODF: EMER: WARNING PROCEDURES: ECG)

<table>
<thead>
<tr>
<th>ACTION</th>
<th>EQUIP/FUNCTION LOST</th>
<th>CREW INDICATION</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ECLSS: CDRA TCCS MCA AAA AR Rack SD</td>
<td></td>
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<tr>
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</tbody>
</table>
1. INHIBITING CLOSED LOOP CONTROL FOR AFFECTED HEATER

Perform procedure for the appropriate heater according to the following example (for PMA1 Htr 1A).

NOTE

1. PMA1 Heaters 2A and 4B are not active and do not appear on the PCS NODE 1 TCS display.

2. Ena Opr or Ena Bu commands should not be performed from PCS or CDDT displays for PMA3 Heaters 1A, 1B, 2A, 2B, and 3A due to an identified PCS and CDDT mapping problem. Command Inventory (A MCC-H command application) should be used as the command interface for these commands.

3. All PMA3 Shell Heater Inhibit commands should be sent from the CDDT platform. Command Inventory Instantiated PMA3 Shell Heater Inhibit commands are broken. MCC-H may also use the Command Inventory PMA3 Heater Inhibit template to build/uplink these commands if available.

4. If performing the procedure for PMA3, the navigation will be from PMA3: TCS. PMA3 details pages should be accessed from the Htr Availability pages. The PMA3 Htr Icons on the PMA3: TCS page should not be used.

5. The RPC pages and commands have the incorrect load identified for RPCs belonging to PMA3 Heaters 2A through 5A and PMA3 Heaters 1B through 4B.

6. NODE1Htr79Avail display can be accessed from the NODE1Htr16Avail display page.

7. The Node Htr 7B setpoints on the Node1 HtrB Setpoints CDDT and PCS display are incorrect due to an identified mapping problem. The Node1 Htr 7B setpoints should be accessed from the Node1 Htr 7 page. The Node 1 Htr 7 page can be accessed as follows:

PCS Node 1: TCS: Htr Availability: Node 1 Htr 7-9 Availability:
Node1 Htr 7

NODE1 Htr7

PCS
Node 1: TCS
Node 1: TCS
‘PMA1’

sel Htr Availability

PMA1 HtrAvailability

cmd Htr1A – Inh

√Availability – Inh
2. **COMPARING SHELL TEMPERATURES TO LIMITS AND POWER HEATER ON/OFF**

   **NOTE**
   For Node 1 Heaters with two temperature sensors (Zones 1, 3, 5, 6, 7 A or B), each temperature reading should be compared to the limits for that specific sensor in order to decide whether to turn the heater on or off. If all temperature sensors in a zone have failed, then sensors in adjacent zones may be used.

Perform procedure for the appropriate heater according to the following example (for PMA1 Htr 1A).

**PCS**

Node 1: TCS

Node 1: TCS

‘PMA1’

sel PMA1 Htr 1A (icon)

PMA1 Htr1

‘PMA1 Htr1A’

If Temperature < Lower Setpoint

sel RPCM N1RS1 C RPC 01

RPCM N1RS1 C RPC 01

   **NOTE**
   If RPC is tripped or close command inhibited, √MCC-H for proper usage of the RPC before proceeding.

**cmd** RPC Position – Close

√RPC Position – Cl

If Temperature > Upper Setpoint

sel RPCM N1RS1 C RPC 01

RPCM N1RS1 C RPC 01

   **NOTE**
   If RPC is tripped or close command inhibited, √MCC-H for proper usage of the RPC before proceeding.

**cmd** RPC Position – Open

√RPC Position – Op

3. **REPEATING HEATER POWER ON/OFF CYCLES AS REQUIRED**

Repeat step 2, as required.