Calibrate FCI Nuclear Qualified FLT 93L Series Flex Switch at 242-A Evaporator

Tank Farm Maintenance Procedure

USQ # Routine Maintenance

<table>
<thead>
<tr>
<th>Rev-Mod</th>
<th>Release Date</th>
<th>Justification</th>
<th>Summary of Changes</th>
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<tbody>
<tr>
<td>B-1</td>
<td>05/18/2017</td>
<td>Maintenance Request</td>
<td>Added Step 5.1.1, 5.1.7, 5.2.4.3, 5.2.11, 5.2.11.3, 5.2.29, 5.6.24, 5.6.24.3, 5.6.31, 5.6.31.3 and miscellaneous alphabetical changes.</td>
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<tr>
<td>B-0</td>
<td>01/27/2016</td>
<td>Periodic Review</td>
<td>Added TSR Header, Add LCO 3.1 &amp; 3.2 to Scope. Add Limits Section 3.4. Rework Step 2.1.1. Changed last 3 Notes under 5.1 to Special Instructions. Rework 3rd bullet under 5.6.12.</td>
</tr>
<tr>
<td>A-7</td>
<td>11/10/2014</td>
<td>CHAMPS Removal</td>
<td>New records statement, CHAMPS Removal</td>
</tr>
<tr>
<td>A-6</td>
<td>09/30/2014</td>
<td>Maintenance Request</td>
<td>Added test port TP-CA1-20C to table 1 &amp; table 3. Added a “note” and steps 5.2.19, 5.2.25, 5.6.39, 5.6.47. Changed steps 5.1.12.2, 5.2.11, 5.2.15.1, 5.2.18, 5.2.24, 5.5.2, 5.6.38, 5.6.46, 5.9.2. Added ”/External Air Source” to Figure 6. Updated to current standards.</td>
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<tr>
<td>A-5</td>
<td>04/01/2014</td>
<td>Maintenance request</td>
<td>Moved Table 3 to Attachment 2. Moved Steps to improve procedure performance.</td>
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</tbody>
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1.0 PURPOSE AND SCOPE

1.1 Purpose

This procedure provides instructions for calibrating and performing maintenance on Fluid Components International Nuclear Qualified FLT 93L Series Flex Switch.

1.2 Scope

This procedure applies to Fluid Components International Nuclear Qualified FLT 93L Series Flex Switches configured for air flow in the 242-A Evaporator.

This procedure may only be performed when 242-A Evaporator is in SHUTDOWN mode.

This procedure provides maintenance of equipment that supports Evaporator DSA for LCO 3.1 and LCO 3.2.

2.0 INFORMATION

2.1 General Information

2.1.1 To maintain the integrity of the Safety Instrumented System (SIS), zero dependence between the performances of calibrations on redundant instruments must be maintained. To achieve this, the same personnel must not be used to perform calibrations on redundant instruments pairs. The calibrations also need to be separated by at least 1 minute. The specific instrumentation to which this applies is identified in the procedure steps.

3.0 PRECAUTIONS AND LIMITATIONS

3.1 Personnel Safety

3.1.1 An Energized Electrical Work Permit is not required when working energized parts that operate at less than 50 volts potential per DOE–0359, Hanford Site Electrical Safety Program.

The maximum voltage encountered when connecting and disconnecting from terminal strips is less than 50 VDC.

3.1.2 If working around live circuits, extreme caution should be used. Failure to follow electrical safety practices as outlined in DOE–0359, Hanford Site Electrical Safety Program could result in serious injury.

3.1.3 If a lock and tag is required during the performance of this procedure, comply with the DOE-0336, Hanford Site Lockout/Tagout Procedure.
3.1 Personnel Safety (Cont.)

3.1.4 Failure to use protective equipment when working on or near energized systems could result in serious injury. Job specific protective equipment requirements should be addressed during the pre-job brief and be in accordance with TFC-ESHQ-S_IS-C-02.

3.2 Equipment Safety

CAUTION – Removing/handling PC control board without using standard electrostatic discharge precautions can result in equipment damage.

3.3 Radiation and Contamination Control

Work in radiological areas will be performed using a radiological work permit following review and Risk Screening by Radiological Control per ALARA Work Planning procedure TFC-ESHQ-RP_RWP-C-03.

3.4 LIMITS

HNF-15279, 242-A Evaporator Technical Safety Requirements

LCO 3.1 – C-A-1-Vessel Flammable Gas Control System

LCO 3.2 – C-A-1 Vessel Waste High Level Control System

4.0 PREREQUISITES

4.1 Special Tools, Equipment and Supplies

The following supplies may be needed to perform this procedure:

- Three Digital Multi-meters (DMM)/Voltmeters
- 24 VDC Power supply
- Calibrated Mass Flow Meter (e.g. Sierra Instruments M100L-DD-2-0V1-PV2-V1-C1, ranged per Data Sheet)
- Dry cloth
- Damp cloth
- Other tools, equipment and supplies as identified by Shift Manager/OE/FWS/User.

4.2 Performance Documents

The following documents may be needed to perform this procedure:

- DOE-0336, Hanford Site Lockout/Tagout Procedure
- FCI Nuclear Qualified FLT 93L Series Flex Switch Manual, Doc 06EN003409.
4.3 Field Preparation

4.3.1 REQUEST Operations configure system to allow for performance of this procedure.

4.3.2 ENSURE lockout/tagout and overlocking requirements have been satisfied per DOE-0336, Hanford Site Lockout/Tagout Procedure.
5.0 PROEDURE

5.1 FLT 93L Series Flex Switch Calibration Setup

NOTE - Valves identified in Table 1 are located on the 5th floor of the condenser room.

- This procedure is written to perform the calibration of one flex switch at a time and can be repeated for calibrating the remaining Flex Switches.

Special Instructions

This procedure can be performed in the field, starting at (Section 5.1), or on the bench (Section 5.6). Steps 5.1.1 through 5.1.5 must be performed prior to starting either field or bench calibration.

Attachment 2 – Flex Switch Alarm Signal Table is available for reference.

If any step is not required for procedure completion, record “n/a” in the applicable space(s) on data sheet and record explanation in Data Sheet comments/remarks section.

5.1.1 ENSURE the as-found and as-left results of the calibrations/calibration checks are independently verified by qualified personnel at a separate occasion.

5.1.2 IF calibrating Flex Switches FSH/FSLL-CA1-20A and FSH/FSLL CA1-20B, ENSURE that different personnel perform calibration on each of these two Flex Switches and that the calibrations are separated by at least one minute.

5.1.3 IF calibrating Flex Switch FSH/FSLL-CA1-20A, PRINT names below:

_________________________ / _______________________/ FWS
Technician #1           Technician #2

5.1.4 IF calibrating Flex Switch FSH/FSLL-CA1-20B, PRINT names below:

_________________________ / _______________________/ FWS
Technician #1           Technician #2

5.1.5 IF performing bench calibration, GO TO Section 5.6.
5.1 FLT 93L Series Flex Switch Calibration Setup (Cont.)

### Table 1 - Isolation valve and Test Port Identification

<table>
<thead>
<tr>
<th>Flex Switch</th>
<th>Isolation Valve (Upstream)</th>
<th>Isolation Valve (Downstream)</th>
<th>Isolation Valve (Between Test Ports)</th>
<th>Test Port (Upstream)</th>
<th>Test Port (Downstream)</th>
<th>Test-Port (Downstream)</th>
<th>Check Complete (✓)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FSHH/FSSL CA1-8</td>
<td>5-114A</td>
<td>5-114C</td>
<td>5-114B</td>
<td>TP-CA1-8A</td>
<td>TP-CA1-8B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FSH/FSSL CA1-9</td>
<td>5-113A</td>
<td>5-113C</td>
<td>5-113B</td>
<td>TP-CA1-9A</td>
<td>TP-CA1-9B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FSH/FSSL CA1-20A</td>
<td>5-3D</td>
<td>5-3F</td>
<td>5-3E</td>
<td>TP-CA1-20A</td>
<td>TP-CA1-20B</td>
<td>TP-CA1-20C</td>
<td></td>
</tr>
<tr>
<td>FSH/FSSL CA1-20B</td>
<td>5-3D</td>
<td>5-3F</td>
<td>5-3E</td>
<td>TP-CA1-20A</td>
<td>TP-CA1-20B</td>
<td>TP-CA1-20C</td>
<td></td>
</tr>
</tbody>
</table>

5.1.6 **ISOLATE** Flex Switch as needed per Table 1.

5.1.7 **IF** PDT-CA1-4 must be isolated, **ISOLATE** PDT-CA1-4.

**NOTE** - Depending on the data point and the setup required for each switch, the test ports may be used as the technician sees fit, e.g. two downstream test ports for FSH/FSSL CA1-20A/B

5.1.8 **NOTIFY** HPT coverage is required during system breach.

5.1.9 **PLACE** a damp cloth over the upstream test port per Table 1 AND **OPEN** upstream test port.

5.1.10 **NOTIFY** HPT to perform survey at upstream test port.

5.1.11 **PLACE** a damp cloth over the downstream test port per Table 1 AND **OPEN** downstream test port.

5.1.12 **NOTIFY** HPT to perform survey at downstream test port.

**NOTE** - The flex switches can be calibrated using either system air or using an external air supply.

5.1.13 **AFTER** surveys are complete, **PERFORM** one of the following:

5.1.13.1 **IF** using system air, **CONNECT** M&TE per Figure 6 between upstream and downstream test ports.

**OR**

5.1.13.2 **IF** using external air supply, **CONNECT** external air supply/M&TE to test port upstream of switch being tested.
5.1 FLT 93L Series Flex Switch Calibration Setup (Cont.)

5.1.14 REMOVE the enclosure cover from Flex Switch.

5.1.15 OPEN the enclosure cover from junction box mounted near the Flex Switch.

NOTE - When connecting M&TE there is a 24V potential between contacts.

5.1.16 CONNECT DMM’s to junction box terminal per Figure 3 – DMM/Voltmeter Terminal Connections.

5.1.17 IF Flex Switch is not connected to 24 VDC power supply, CONNECT to 24 VDC power supply.

5.1.18 CHECK the orange LED is lit (Figure 1).

5.1.19 IF Flex Switch had been powered down, ALLOW 15 minutes for warm-up.

5.1.20 CHECK jumpers are correctly placed per Figure 2.

5.1.21 IF jumpers are not correctly placed, PLACE jumper in correct configuration per Figure 2.

5.1.22 IF Mode Switch (S1) is not in the RUN position, PLACE switch (S1) in the RUN position (Figure 1).
5.2  FLT 93L Series Flex Switch Calibration Check

Table 2 - Flow Adjustment Valves

<table>
<thead>
<tr>
<th>Flex Switch</th>
<th>Flow Adjustment Valves</th>
</tr>
</thead>
<tbody>
<tr>
<td>FSHH/FSL CA1-8</td>
<td>FIC-CA1-12</td>
</tr>
<tr>
<td>FSH/FSLL CA1-9</td>
<td>FIC-CA1-13</td>
</tr>
<tr>
<td>FSH/FSLL CA1-20A</td>
<td>FC-CA1-20</td>
</tr>
<tr>
<td>FSH/FSLL CA1-20B</td>
<td>FC-CA1-20</td>
</tr>
</tbody>
</table>

5.2.1  USING flow adjustment valve per Table 2 or external air supply, SET Normal Flow Conditions according to Data Sheet.

5.2.2  ALLOW process flow to stabilize AND RECORD As-Found normal M&TE flow meter output value on Data Sheet.

Check Low Flow Alarm & Alarm 1 Relay

NOTE -
- For correct LED to Alarm Set-point indication Figure 4 is available for reference.
- It takes 12-15 seconds for the alarm to change state after flow has stabilized.

5.2.3  USING flow adjustment valve or external air supply, SLOWLY DECREASE process flow rate until low flow alarm (Alarm 1 Red LED) illuminates.

5.2.4  WHEN the flow rate falls below the low flow alarm (alarm 1) set point, CHECK the following:

5.2.4.1  RECORD low flow alarm initiation (LED illumination) point, from M&TE flow meter in As-Found column of Data Sheet.

5.2.4.2  CHECK Low flow alarm initiation point is within tolerance limits.

5.2.4.3  USING DMM set to volt DC, CONNECT to alarm 1, contacts 4 and 5, (Figure 3) AND RECORD relay contact voltage.

5.2.5  USING flow adjustment valve or external air supply, SET process flow rate to Normal Flow Condition according to the Data Sheet.
5.2 FLT 93L Series Flex Switch Calibration Check (Cont.)

5.2.6 WHEN the flow rate rises above the low flow alarm (alarm 1) set-point, CHECK the following:

5.2.6.1 CHECK alarm 1 (Red) LED turns OFF.

NOTE - Contacts are open at 24VDC. Contacts are closed at 0 VDC.

5.2.6.2 USING DMM set to volt DC, connected to alarm 1, contacts 4 and 5 (Figure 3), RECORD relay contact voltage.

5.2.6.3 CHECK relay contacts change state AND RECORD results on Data Sheet.

5.2.6.4 IF relay contacts did not change state, GO TO Section 5.5.

5.2.7 IF Alarm Initiation Point As-Found values are within specified tolerance, but deemed marginal, and optimization is desired, PERFORM Section 5.3, OR

IF Alarm Initiation Point As-Found values are in tolerance and correct indications were received, RECORD As-Found values in As-Left column on Data Sheet.

5.2.8 IF Low Flow Alarm Initiation Point is out of tolerance or indication in Step 5.2.6.1 did not occur, PERFORM Section 5.3, OR

IF Low Flow Alarm Indication Point is out of tolerance or indication in Step 5.2.6.1 did not occur, and Section 5.3 has been performed. GO TO Section 5.5.
5.2 FLT 93L Series Flex Switch Calibration Check (Cont.)

Check High Flow Alarm & Alarm 2 Relay

NOTE - Due to air flow restriction in the purge airline an additional test port will need to be opened to allow for testing the high flow alarm on Flex Switches FSH/FSLL CA1-20A and FSH/FSLL CA1-20B. The test port located at PSL-IA-2 may be used as an air source.

- For correct LED to Alarm Set-point indication Figure 4 is available for reference

5.2.9 IF checking the High flow alarm on Flex Switch FSH/FSLL CA1-20A or FSH/FSLL CA1-20B, OPEN test port TP-CA1-20C.

5.2.10 IF using flow adjustment valve, SLOWLY INCREASE process flow rate until high flow alarm (Alarm 2 Green LED) Turns OFF.

OR

IF using outside air source to obtain the required flow rate, ENSURE air source is dry and filtered AND SLOWLY INCREASE process flow rate until high flow alarm (Alarm 2 Green LED) Turns OFF.

5.2.11 WHEN the flow rate rises above the high flow alarm (Alarm 2) set-point, CHECK the following:

5.2.11.1 RECORD high flow alarm initiation (Led OFF ) point, from M&TE flow meter in Alarm Initiation Point As-Found column of Data Sheet.

5.2.11.2 CHECK High flow alarm initiation point is within tolerance limits.

5.2.11.3 USING DMM set to volt DC, CONNECT to alarm 2, contacts 3 and 12, (Figure 3), RECORD relay contact voltage.

5.2.12 USING flow adjustment valve or external air supply, ADJUST the process flow to “Normal Flow Condition” value recorded on Data Sheet.
5.2 FLT 93L Series Flex Switch Calibration Check (Cont.)

5.2.13 WHEN the flow rate drops below the High flow alarm (alarm 2) set-point, CHECK the following:

5.2.13.1 CHECK alarm 2 (Green) LED illuminates.

NOTE - Contacts are open at 24VDC. Contacts are closed at 0 VDC.

5.2.13.2 USING DMM, set to volt DC connected to alarm 2 contacts 12 and 3 (Figure 3), RECORD relay contact voltage

5.2.13.3 CHECK relay contacts change state AND RECORD results on Data Sheet.

5.2.13.4 IF relay contacts did not change state, GO TO Section 5.5.

5.2.14 IF Alarm Initiation Point As-Found values are within specified tolerance, but deemed marginal, and optimization is desired, PERFORM Section 5.4, OR

IF Alarm Initiation Point As-Founds values are in tolerance and correct actions/indications were received, RECORD As-Found values in As-Left column on Data Sheet.

5.2.15 IF High Flow Alarm Initiation Point is out of tolerance or the indication in Step 5.2.13.1 did not occur, PERFORM Section 5.4, OR

IF High Flow Alarm Initiation Point is out of tolerance or the indication in Step 5.2.13.1 did not occur, and Section 5.4 has been performed. GO TO Section 5.5.
5.2 FLT 93L Series Flex Switch Calibration Check (Cont.)

NOTE - For correct LED to Alarm Set-point indication Figure 4 is available for reference.

5.2.16 ENSURE the normal process flow rate is achieved AND

RECORD M&TE flow meter output value on Data Sheet.

5.2.17 CHECK that both alarms LED’s and relay contacts are reset AND

RECORD results on Data Sheet.

5.2.18 CHECK the FLT Flex Switch for loose connections.

5.2.19 IF loose connections are present, TIGHTEN all loose connections.

5.2.20 CHECK the condition of FLT 93 Series Flex Switches moisture barrier AND “O” Ring.

5.2.21 IF the Flex Switches moisture barrier is in poor condition, REPLACE it.

5.2.22 IF the “O” Ring is in poor condition, REPLACE it.

5.2.23 DISCONNECT M&TE from junction box.

5.2.24 IF Flex Switch was connected to temporary 24 VDC power supply, DISCONNECT 24 VDC power supply.

5.2.25 ATTACH enclosure cover to FLT Flex Switch.

5.2.26 CLOSE junction box cover.
5.2 FLT 93L Series Flex Switch Calibration Check (Cont.)

**Restore Operating Flow Path**

Table 3 Isolation valve and Test Port Alignment

<table>
<thead>
<tr>
<th>Flex Switch</th>
<th>OPEN Isolation Valve (Upstream)</th>
<th>OPEN Isolation Valve (Downstream)</th>
<th>OPEN Isolation Valve (Between Test Ports)</th>
<th>CLOSED Test Port (Upstream)</th>
<th>CLOSED Test Port (Downstream)</th>
<th>CLOSED Test-Port (Downstream)</th>
<th>Check Complete (✓)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FSHH/FSL CA1-8</td>
<td>5-114A</td>
<td>5-114C</td>
<td>5-114B</td>
<td>TP-CA1-8A</td>
<td>TP-CA1-8B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FSH/FSLL CA1-9</td>
<td>5-113A</td>
<td>5-113C</td>
<td>5-113B</td>
<td>TP-CA1-9A</td>
<td>TP-CA1-9B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FSH/FSLL CA1-20A</td>
<td>5-3D</td>
<td>5-3F</td>
<td>5-3E</td>
<td>TP-CA1-20A</td>
<td>TP-CA1-20B</td>
<td>TP-CA1-20C</td>
<td></td>
</tr>
<tr>
<td>FSH/FSLL CA1-20B</td>
<td>5-3D</td>
<td>5-3F</td>
<td>5-3E</td>
<td>TP-CA1-20A</td>
<td>TP-CA1-20B</td>
<td>TP-CA1-20C</td>
<td></td>
</tr>
</tbody>
</table>

5.2.27 REMOVE M&TE from test ports.

5.2.28 **RESTORE** system to operating condition by setting valve alignment according to Table 3 (above).

5.2.29 **RESTORE** PDT-CA1-4 IF the pressure transmitter was isolated.

5.2.30 IF performing calibrations on remaining Flex Switches, **GO TO** Section 5.1.

5.2.31 IF not performing additional Flex Switch calibrations, **GO TO** Section 5.7.
5.3 FLT 93L Series Flex Switch Low Flow Alarm Adjustment (Conditional Section).

NOTE - This Section is only performed if directed to do so in Section 5.2 or Section 5.6.

**Calibrate Low Flow Alarm**

5.3.1 **USING** M&TE flow meter, **ENSURE** process flow rate is set to low flow alarm value according to the Data Sheet.

5.3.2 **IF** the LED associated with alarm 1 (Red LED) is off, **PERFORM** the following:

5.3.2.1 **ADJUST** potentiometer R26 (Figure 1) slowly in the clockwise direction just until the Red LED turns on.

5.3.3 **IF** the LED associated with alarm 1 (Red LED) is on, **PERFORM** the following:

5.3.3.1 **ADJUST** potentiometer R26 (Figure 1) slowly in the counterclockwise direction just until the Red LED turns off and then slowly clockwise just until the Red LED turns back on.

5.3.4 **SET** process flow rate to normal As-Found flow rate per Data Sheet AND **ALLOW** flow to stabilize.

5.3.5 **IF** performing field calibration, **GO TO** Step 5.2.3

**OR**

**IF** performing bench calibration, **GO TO** Step 5.6.23.
5.4 FLT 93L Series Flex Switch High Flow Alarm Adjustment (Conditional Section).

NOTE - This Section is only performed if directed to do so in Section 5.2 or Section 5.6.

Calibrate High Flow Alarm

5.4.1 USING M&TE flow meter, ENSURE process flow rate is set to high flow alarm value according to the Data Sheet.

5.4.2 IF the LED associated with alarm 2 (Green LED) is on, PERFORM the following:

5.4.2.1 ADJUST potentiometer R25 (Figure 1) slowly in the counterclockwise direction just until the Green LED turns off.

5.4.3 IF the LED associated with alarm 2 (Green LED) is off, PERFORM the following:

5.4.3.1 ADJUST potentiometer R25 (Figure 1) slowly in the clockwise direction just until the Green LED turns on and then slowly counterclockwise just until the Green LED turns back off.

5.4.4 SET process flow rate to normal As-Found flow rate per Data Sheet AND ALLOW flow to stabilize.

5.4.5 IF performing field calibration, GO TO Step 5.2.10

OR

IF performing bench calibration, GO TO Step 5.6.30.
5.5 Initiate FLT 93L Series Flex Switch Repair/Replacement (Conditional Section).

NOTE - This Section is only performed if directed to do so in Section 5.2 or Section 5.6.

5.5.1 NOTIFY FWS of pending equipment replacement/repair.

5.5.2 REQUEST FWS to NOTIFY Shift Manager and contact planning for BOM.

5.5.3 REQUEST Planning to print new Data Sheet(s).

5.5.4 IF Lockout/Tagout is required, COMPLY with the DOE-0336, Hanford Site Lockout/Tagout Procedure.

5.5.5 REPAIR/REPLACE Instrument AND

PERFORM Section 5.1.
Calibrate FCI Nuclear Qualified FLT 93L Series Flex Switch at 242-A Evaporator

5.6 Perform Bench Calibration on FLT 93L Series Flex Switch

Table 4 - FLT 93L Series Flex Switch Isolation Valves

<table>
<thead>
<tr>
<th>Flex Switch</th>
<th>Terminal Block 4 Associated Fuses</th>
<th>Isolation Valve (Upstream)</th>
<th>Isolation Valve (Downstream)</th>
<th>Check Complete (✓)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FSHH/FSL CA1-8</td>
<td>FU 1</td>
<td>5-114A</td>
<td>5-114C</td>
<td></td>
</tr>
<tr>
<td>FSH/FSLL CA1-9</td>
<td>FU 2</td>
<td>5-113A</td>
<td>5-113C</td>
<td></td>
</tr>
<tr>
<td>FSH/FSLL CA1-20A</td>
<td>FU 3</td>
<td>5-3D</td>
<td>5-3F</td>
<td></td>
</tr>
<tr>
<td>FSH/FSLL CA1-20B</td>
<td>FU 4</td>
<td>5-3D</td>
<td>5-3F</td>
<td></td>
</tr>
</tbody>
</table>

NOTE - The fuses to de-energize the flex switches are located in CA1-ENC-L-205, terminal block 4.

5.6.1 DE-ENERGIZE Flex Switch power supply by opening the associated fuse per Table 4.

5.6.2 ISOLATE Flex Switch by performing the following:

5.6.2.1 CLOSE Upstream isolation valve for the Flex Switch being calibrated (See Table 4)

5.6.2.2 CLOSE Downstream isolation valve for the Flex Switch being calibrated (See Table 4)

CAUTION

Removing/handling PC control board without using standard electrostatic discharge precautions can result in equipment damage.

5.6.3 USE appropriate standard electrostatic discharge precautions in accordance with Attachment 1.

5.6.4 REMOVE Flex Switch cover.

5.6.5 REMOVE PC board from Flex Switch.

5.6.6 DISCONNECT power supply wiring from Flex Switch.

5.6.7 DISCONNECT Flex Switch alarm wiring from the junction box.
5.6 Perform Bench Calibration on FLT 93L Series Flex Switch (Cont.)

5.6.8 DISCONNECT Flex conduit for the Flex switch.

5.6.9 LOOSEN process tubing connections AND DISCONNECT process tubing from the Flex switch.

5.6.10 REMOVE Flex Switch AND HAVE HPT SURVEY Flex Switch for contamination.

5.6.11 TRANSPORT Flex Switch to shop for Calibration.

Setup Bench Calibration

5.6.12 CONNECT the following, calibrated M&TE to the Flex Switch:
   • Flow Meter
   • DMM/Ohmmeter to Control Circuit Socket terminals 4 and 5 (Alarm 1 relay contacts, See Figure 5)
   • DMM/Ohmmeter to Control Circuit Socket terminals 3 and 12 (Alarm 2 relay contacts, See Figure 5)

5.6.13 CHECK jumpers are correctly placed per Figure 2.

5.6.14 IF jumpers are not correctly placed, PLACE jumper in correct configuration per Figure 2.

5.6.15 IF Mode Switch (S1) is not in the RUN position, PLACE switch (S1) in the RUN position (Figure 1).

5.6.16 CONNECT 24VDC power supply to Flex Switch Control Circuit Socket terminals 1 and 2 (See Figure 5).

CAUTION

Removing/handling PC control board without using standard electrostatic discharge precautions can result in equipment damage.

5.6.17 USE appropriate standard electrostatic discharge precautions in accordance with Attachment 1.

5.6.18 RECONNECT PC board to Flex Switch.

5.6.19 CHECK the yellow LED is lit (Figure 1).
5.6 Perform Bench Calibration on FLT 93L Series Flex Switch (Cont.)

5.6.20 ALLOW 15 minutes for warm-up.

5.6.21 USING M&TE, SET Normal Flow Conditions according to Table 2 - Flow Adjustment Valves

5.6.22 ALLOW process flow to stabilize AND RECORD Flow Rate output value, from M&TE, on Data Sheet.

Check Low Flow Alarm & Alarm 1 Relay

5.6.23 USING M&TE, SLOWLY DECREASE process flow rate until low flow alarm (Alarm 1 Red LED) illuminates.

5.6.24 WHEN the flow rate drops below the low flow alarm (alarm 1) set-point, CHECK the following:

5.6.24.1 RECORD low flow alarm initiation (LED illumination) point, from M&TE flow meter in As-Found column of Data Sheet.

5.6.24.2 CHECK Low flow alarm initiation is within tolerance limits.

5.6.24.3 USING DMM/Ohmeter connected to alarm 1, contacts 4 and 5 (Figure 5), RECORD relay contact voltage.

5.6.25 USING M&TE, SET process flow rate to Normal Flow Condition value according to the Data Sheet.

5.6.26 WHEN the flow rate rises above the low flow alarm (alarm 1) set-point, CHECK the following:

5.6.26.1 CHECK alarm 1 Red LED turns offs.

5.6.26.2 USING DMM/Ohmmeter connected to alarm 1, contacts 4 and 5 (Figure 5), RECORD relay contact voltage

5.6.26.3 CHECK relay contacts change state AND RECORD results on Data Sheet.

5.6.27 IF the action stated in Steps 5.6.26.1 and 5.6.26.2 did not occur, GO TO Section 5.5.
5.6 Perform Bench Calibration on FLT 93L Series Flex Switch (Cont.)

5.6.28 IF Alarm Initiation Point As-Found values are within specified tolerance, but deemed marginal, and optimization is desired, PERFORM Section 5.3,

OR

IF Alarm Initiation Point As-Found values are in tolerance and correct indications were received, RECORD Alarm Initiation point As-Found values in As-Left column on Data Sheet.

5.6.29 IF Low Flow Alarm Initiation point is out of tolerance or indication in Steps 5.6.26.1 did not occur, PERFORM Section 5.3,

OR

IF Low Flow Alarm Initiation Point is out of tolerance or indication in Step 5.6.26.1 did not occur, and Section 5.3 has been performed. GO TO Section 5.5.
5.6 Perform Bench Calibration on FLT 93L Series Flex Switch (Cont.)

Check High Flow Alarm & Alarm 2 Relay

5.6.30 USING M&TE, SLOWLY INCREASE process flow rate until high flow alarm (Alarm 2 Green LED) turns OFF.

5.6.31 WHEN the flow rate rises above the high alarm initiation (alarm 2) set-point, CHECK the following:

5.6.31.1 RECORD high flow alarm initiation (LED OFF) point from M&TE flow meter in As-Found column of Data Sheet.

5.6.31.2 CHECK High flow alarm initiation point is within tolerance limits.

5.6.31.3 USING DMM/Ohmeter CONNECT to alarm 2, contacts 12 and 3, (Figure 5), RECORD relay contact voltages.

5.6.32 USING M&TE, ADJUST the process flow to “normal flow condition” value recorded on Data Sheet.

5.6.33 WHEN the flow rate drops below the High flow alarm (alarm 2) set-point, CHECK the following:

5.6.33.1 CHECK alarm 2 Green LED illuminates.

5.6.33.2 USING DMM/Ohmmeter connected to alarm 2, contacts 12 and 3 (Figure 5), RECORD relay contact voltage.

5.6.33.3 CHECK relay contacts change state AND RECORD results on Data Sheet.

5.6.34 IF the action stated in Steps 5.6.33.1 and 5.6.33.2 did not occur, GO TO Section 5.5.

5.6.35 IF Alarm Initiation Point As-Found values of M&TE flow meter are within specified tolerance, but deemed marginal, and optimization is desired, PERFORM Section 5.4,

OR

IF Alarm Initiation Point As-Found values of M&TE flow meter are in tolerance and correct actions/indications were received, RECORD As-Found values in As-Left column on Data Sheet.
5.6 Perform Bench Calibration on FLT 93L Series Flex Switch (Cont.)

5.6.36 IF High Flow Alarm Indication Point is out of tolerance or the indication in Step 5.6.33.1 did not occur, **PERFORM** Section 5.4, OR

IF High Flow Alarm Initiation Point is out of tolerance or the indication in Step 5.6.33.1 did not occur, and Section 5.4 has been performed. **GO TO** Section 5.5.

**NOTE** - For reference on correct LED to Alarm Set-point indication Figure 4 is available for reference.

5.6.37 **ENSURE** the normal process flow rate is achieved **AND**

**RECORD** M&TE flow meter output value on Data Sheet.

5.6.38 **CHECK** that both alarms LED’s and relay contacts are reset **AND**

**RECORD** results on Data Sheet.
5.6 Perform Bench Calibration on FLT 93L Series Flex Switch (Cont.)

**CAUTION**

Removing/handling PC control board without using standard electrostatic discharge precautions can result in equipment damage.

5.6.39 **USE** appropriate standard electrostatic discharge precautions in accordance with Attachment 1.

5.6.40 **REMOVE** PC board from Flex Switch housing.

5.6.41 **DISCONNECT** Flex Switch from 24VDC power supply.

5.6.42 **DISCONNECT** M&TE from Flex Switch.

5.6.43 **CHECK** the condition of FLT 93 Series Flex Switches moisture barrier and “O” Ring.

5.6.44 **IF** the Flex Switches moisture barrier is in poor condition, **REPLACE** it.

5.6.45 **IF** the “O” Ring is in poor condition, **REPLACE** it.

5.6.46 **TRANSPORT** Flex Switch back to field for **RE-INSTALLATION**.

5.6.47 **CONNECT** process tubing to Flex Switch AND **TIGHTEN** process tubing connections.

5.6.48 **RECONNECT** Flex conduit to Flex Switch.

5.6.49 **RECONNECT** junction box wiring to the following Flex Switch alarm terminals:

- Alarm 1 terminals 4 (NO) and 5 (COM)
- Alarm 2 terminals 12 (NO) and 3 (COM).

5.6.50 **RECONNECT** power supply wiring to Flex Switch.
5.6 Perform Bench Calibration on FLT 93L Series Flex Switch (Cont.)

**CAUTION**
Removing/handling PC control board without using standard electrostatic discharge precautions can result in equipment damage.

5.6.51 USE appropriate standard electrostatic discharge precautions in accordance with Attachment 1.

5.6.52 RECONNECT PC Board to Flex Switch housing.

5.6.53 REINSTALL Flex Switch cover.

**Restore Operating Flow Path**

**Table 5 - FLT 93L Series Flex Switch Isolation Valves**

<table>
<thead>
<tr>
<th>Flex Switch</th>
<th>Terminal Block 4 Associated Fuses</th>
<th>Isolation Valve (Upstream)</th>
<th>Isolation Valve (Downstream)</th>
<th>Check Complete (✓)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FSHH/FSL CA1-8</td>
<td>FU 1</td>
<td>5-114A</td>
<td>5-114C</td>
<td></td>
</tr>
<tr>
<td>FSH/FSLL CA1-9</td>
<td>FU 2</td>
<td>5-113A</td>
<td>5-113C</td>
<td></td>
</tr>
<tr>
<td>FSH/FSLL CA1-20A</td>
<td>FU 3</td>
<td>5-3D</td>
<td>5-3F</td>
<td></td>
</tr>
<tr>
<td>FSH/FSLL CA1-20B</td>
<td>FU 4</td>
<td>5-3D</td>
<td>5-3F</td>
<td></td>
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</tbody>
</table>

5.6.54 RESTORE Flex Switch flow path by performing the following:

5.6.54.1 OPEN Upstream isolation valve for the Flex Switch being calibrated (See Table 5).

5.6.54.2 OPEN Downstream isolation valve for the Flex Switch being calibrated (See Table 5).

**NOTE** - The fuses to Energize the flex switches are located in CA1-ENCL-205, terminal block 4.

5.6.55 ENERGIZE Flex Switch power supply by closing the associated fuse per Table 5.

5.6.56 IF performing calibrations on remaining Flex Switches, GO TO Section 5.1.

5.6.57 IF not performing additional Flex Switch calibrations, GO TO Section 5.7.
5.7 Restoration

5.7.1 IF any faults or alarms were tripped due to the performance of this procedure, **RESTORE** faults and alarms to As-Found condition.

5.7.2 IF any problems were encountered with calibration, **INFORM** FWS.

5.7.3 **RECORD** the Test Equipment information and calibration status on Data Sheet.

5.7.4 **CHECK** equipment restoration by observing indications are consistent with expected conditions.

5.7.5 **NOTIFY** Operations that testing is complete and system may be returned to desired configuration.

5.8 Acceptance Criteria

Acceptance Criteria has been met when Steps in this procedure have been satisfactorily performed and As-Left values meet the specifications and tolerance(s) per the Data Sheet.

5.9 Review

5.9.1 **INFORM** FWS test is complete.

5.9.2 **REQUEST** FWS to **REVIEW AND ENSURE** the following:

- Completed Data Sheets meet the acceptance criteria.
- Comments sections are filled out appropriately.
- Work requests needed as a result of this procedure are identified and generated.
- Work request number(s) of any work documents generated as a result of this procedure, are recorded in the Comments/Remarks section of the Data Sheet.
5.10 Records

This procedure is performed within a work package, as such, the procedure in its entirety will be maintained as a record per the Work Control process.

The record custodian identified in the Company Level, Records Inventory and Disposition Schedule (RIDS) is responsible for record retention in accordance with TFC-BSM-IRM_DC-C-02.
Calibrate FCI Nuclear Qualified FLT 93L Series Flex Switch at 242-A Evaporator

**Signature Sheet**

Participating personnel enter their printed name, signature, and initials below.

<table>
<thead>
<tr>
<th>Name (Printed)</th>
<th>Signature</th>
<th>Initials</th>
</tr>
</thead>
<tbody>
<tr>
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</table>
Figure 1 – FLT 93L Series Flex Switch Component Locations
Figure 2 - FLT 93L Series Flex Switch Jumper Locations
Figure 3 – DMM/Voltmeter Terminal Connections for Field Calibration
Figure 4 – FLT 93L Series Flex Switch LED/Alarm Set-point Diagram

100 % Flow

Green LED "OFF" (Alarm 2)

Hi Flow Alarm (Alarm 2 Setpoint)

Red LED "OFF" (Alarm 1)

Normal Flow Range

Low Flow Alarm (Alarm 1 Setpoint)

Green LED "ON" (Alarm 2)

Red LED "ON" (Alarm 1)

0 % Flow
Figure 5 – DMM to Terminal Connections for Bench Calibration
Use standard ESD precautions when opening an instrument enclosure or handling the control circuit. FCI recommends the use of the following precautions:

- Use a wrist band or heel strap with a 1 megohm resistor connected to ground. If the instrument is in a shop setting there should be static conductive mats on the work table and floor with a 1 megohm resistor connected to ground.

- Connect the instrument to ground. Apply antistatic agents to hand tools to be used on the instrument. Keep high static producing items away from the instrument such as non-ESD approved plastic, tape and packing foam.
### Attachment 2 – Flex Switch Alarm Signal Table

<table>
<thead>
<tr>
<th>Flex Switch</th>
<th>205 Panel Relays</th>
<th>MCS Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>FSHH/FSL CA1-8</td>
<td>TDR1 LED de-energizes</td>
<td>(NONE)</td>
</tr>
<tr>
<td>FSH/FSLL CA1-9</td>
<td>TDR2 LED de-energizes</td>
<td>(NONE)</td>
</tr>
<tr>
<td>FSH/FSLL CA1-20A</td>
<td>K-14 LED de-energizes</td>
<td>ALARM</td>
</tr>
<tr>
<td>FSH/FSLL CA1-20B</td>
<td>K-15 LED de-energizes</td>
<td>ALARM</td>
</tr>
</tbody>
</table>
Calibrate FCI Nuclear Qualified FLT 93L Series Flex Switch at 242-A Evaporator

Figure 6 – M&TE Flow Meter Hook-Up