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<b>Cold Verification I – Master Procedure</b>		

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Date	Index	Affected Pages	Changes
Nov 2003	0.1	All	First Draft
22-Jan-2004	1.0	All	Formal Release



## 1 Scope of Document

This procedure describes the activities to be performed during the first CQM cold thermal test campaign, which is a key inspection point (AD 1). The details of the instrument integration and cryostat operations are given in AD 5 and AD 6 respectively. The aim of this document is to ensure that the test objectives are achieved.

## 2 Documents

### 2.1 Applicable Documents

	Title	Author	Reference	Date
AD 1	INSTRUMENT AIV PLAN	B.J. Swinyard	SPIRE-RAL-DOC-000410 Issue 3.0D	May 2003
AD 2	Functional Test Specification	S. Ronayette	SPIRE-RAL-NOT-1652 Issue 1.0D	22-Sep-2003
AD 3	SPIRE CQM THERMAL BALANCE TEST SPECIFICATION	A.S.Goizel		02-Dec-2003
AD 4	Performance Test Details For CQM Pre-Vibration Testing	T. Lim	SPIRE-RAL-NOT-1850 Issue 0.2	22-Oct-2003
AD 5	SPIRE Cryostat Integration Procedures	D.L. Smith		
AD 6	SPIRE Cryostat Operating Procedures	D.L. Smith	SPIRE-RAL-DOC-001556 Issue 1.0	Nov-2003
AD 7	SPIRE Cryolab Risk Assesment	D.L. Smith		
AD 8	SPIRE Instrument Operations Procedures	S. Sidher		
AD 9	SPIRE EGSE ILT Startup Procedures	S. Sidher and M. Requena	SPIRE-RAL-DOC-001630	24-Jun-2003
AD 10	DRCU Switch On Procedure	A. Aramburu	SPIRE-RAL-NOT-00	
AD 11	SPIRE Cleanliness Plan	B.J. Swinyard	SPIRE-RAL-DOC-001070 Issue 1.0	9-Jan-2002
AD 12	RAL Safety Codes	CCLRC	<a href="http://www-internal.clrc.ac.uk/staff/notices/clrc_safety_codes/sc2.html">http://www-internal.clrc.ac.uk/staff/notices/clrc_safety_codes/sc2.html</a>	July-2003

### 2.2 Reference Documents

	Title	Author	Reference	Date
RD 1	SPIRE Cryostat Operating Manual	AS Scientific	SPIRE-RAL-DOC-001472 Issue 1.0	08-Jan-2002



### 3 Test Objectives

This test will be the first occasion that a functioning SPIRE instrument system with an active detector (PLW), cooler, JFET, harness and warm electronics will be integrated and tested. The test flow as illustrated in section 6 includes the warm and cold functional tests, cold thermal balance and performance tests.

As this is the first time that the CQM FPU will have been connected to the warm electronics, this will be more of a shakedown of the functional test procedures. Therefore the warm, short and cold functional tests will be 'manually' executed in a stepwise manner rather than an automatic test sequence. The detailed procedure in section 7 calls the individual test sequences as defined in AD 2.

The objectives of the Thermal Verification as defined in AD 3 are reiterated as follows:

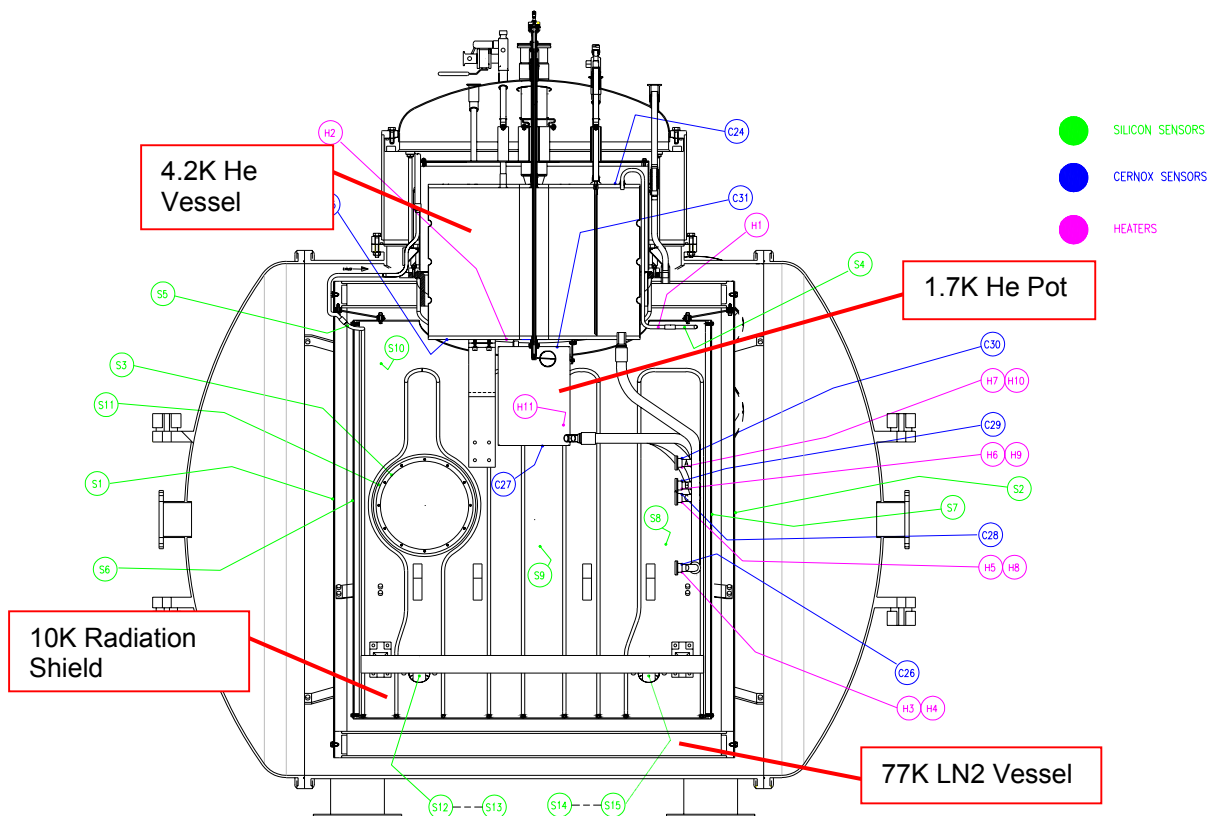
- To validate the instrument thermal control concept as far as possible, given hardware limitations (accuracy of the representation of the calibration cryostat wrt. Herschel, difference between the SPIRE CQM and FM hardware, dummy mechanisms and detectors, etc).
- To correlate the thermal mathematical model of the SPIRE with the TB test results and hence provide more accurate prediction of the instrument in-flight thermal performance.

To achieve the thermal objectives it is necessary that the thermal environment within the SPIRE test cryostat should be as close to the Herschel cryostat as possible. Also, the steady-state test phases have been selected in order to examine the instrument performances its various in-flight operating modes (photometer, spectrometer and off modes).

As this model of SPIRE only has one working detector (PLW), no moving BSM and no spectrometer, only a limited range of performance tests will be carried out. The primary aim of these performance tests is to conform the baseline noise characteristics so that the design of the flight model warm electronics can proceed. To achieve this the detector temperature has to be below 400mK for the data to be meaningful. The details of the performance tests to be carried on this model are given in AD 4.

## 4 Test Configuration

### 4.1 Cryostat



**Figure 1:** Cross section of SPIRE test cryostat showing the different temperature stages and thermometer locations (Drawing ref RD 1).

The SPIRE Calibration Cryostat has four stages of cooling, an outer liquid nitrogen cooled vessel at 77K, a 10K radiation shield, a 4.2K liquid He vessel and a 1.7K pumped liquid He pot, Figure 1. A more detailed description of the cryostat and its operation is given in AD 6 and RD 1.



## **4.2 Optical Equipment**

## **4.3 EGSE Configuration**

The EGSE will be in ILT configuration with the TFCS active.



## 5 Constraints

### 5.1 Safety

All personnel working in the SPIRE test facility must read the facility risk assessment, especially as there are particular hazards associated with the cryostat and laser.

Great care should be taken when handling liquid nitrogen and helium. The main hazards associated with liquid Nitrogen and Helium are:

- Cold "burns" to the person.
- Explosions due to the vaporization of the liquefied gas into an enclosed space.
- Asphyxiation due to exclusion of oxygen.
- Spillage onto structural materials, which can cause thermal contraction of the metal, say steelwork, with resultant cracking.

All people working with the cryostat should have instruction on the safe handling of cryogenic liquids and familiarise themselves with the laboratory safety code [CCLRC Safety Code 2](http://www-internal.clrc.ac.uk/staff/notices/clrc_safety_codes/sc2.html) which can be found on [http://www-internal.clrc.ac.uk/staff/notices/clrc\\_safety\\_codes/sc2.html](http://www-internal.clrc.ac.uk/staff/notices/clrc_safety_codes/sc2.html) The safety code must be followed at all times when handling cryogenic liquids. A risk assessment shall be performed before operating the cryostat.

The personal oxygen monitors provided must be used when entering the lab when the cryostat is cold. These are calibrated every 6 months by the manufacturers (Crowcon in Abingdon).

When the oxygen monitor alarm sounds leave the room immediately and call ext 5996. DO NOT attempt to enter the room afterwards until the all clear has been given.

The gloves provided shall be worn when transferring liquid helium and nitrogen into the tank.

Any dewars with worn or damaged castors or which are difficult to wheel safely should be taken out of service and returned to stores immediately for repair or maintenance.

### 5.2 Cleanliness

To minimise the level of contamination, the FPU should remain covered until the particulate count is below that for a class 6 (old class 1000) clean room. The maximum concentration limits as specified by ISO EN 14644-1 1999 Standard (particles per m<sup>3</sup> of air) for particles greater than the considered sizes are

Size	Specification
0.1µm	1000000
0.2µm	237000
0.3µm	102000
0.5µm	35200
1.0µm	8320
5.0µm	293

The following clothing shall be worn at all times when working in the clean room

Hats





- Coats
- Overshoes
- Gloves – to prevent cross contamination via tools and test equipment

Facemasks provided must be worn when the instrument baffle cover is removed.

Where possible, personnel should work downstream of the instrument from the air-filters.

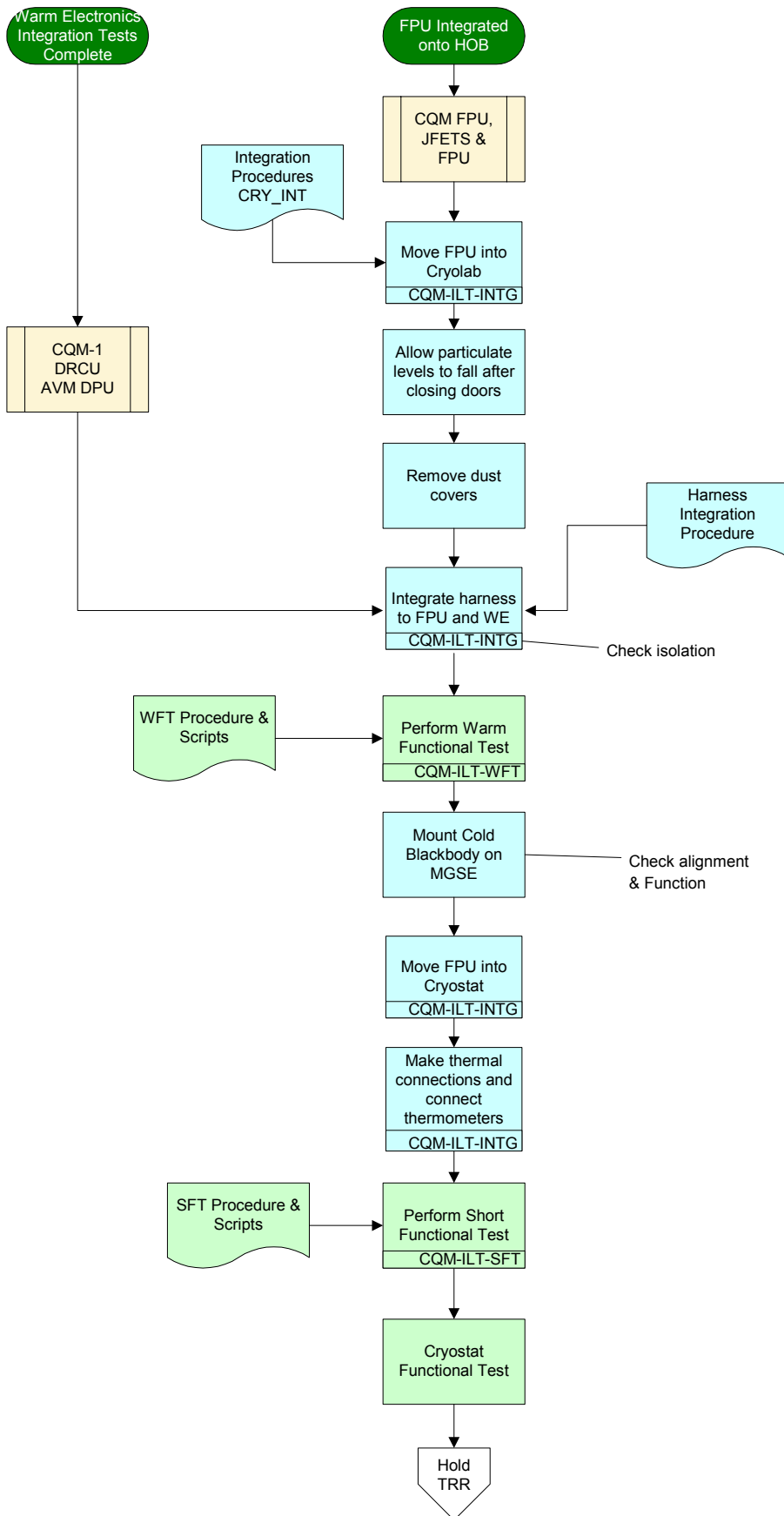
As space is extremely limited, only essential personnel are permitted to work in the clean room.

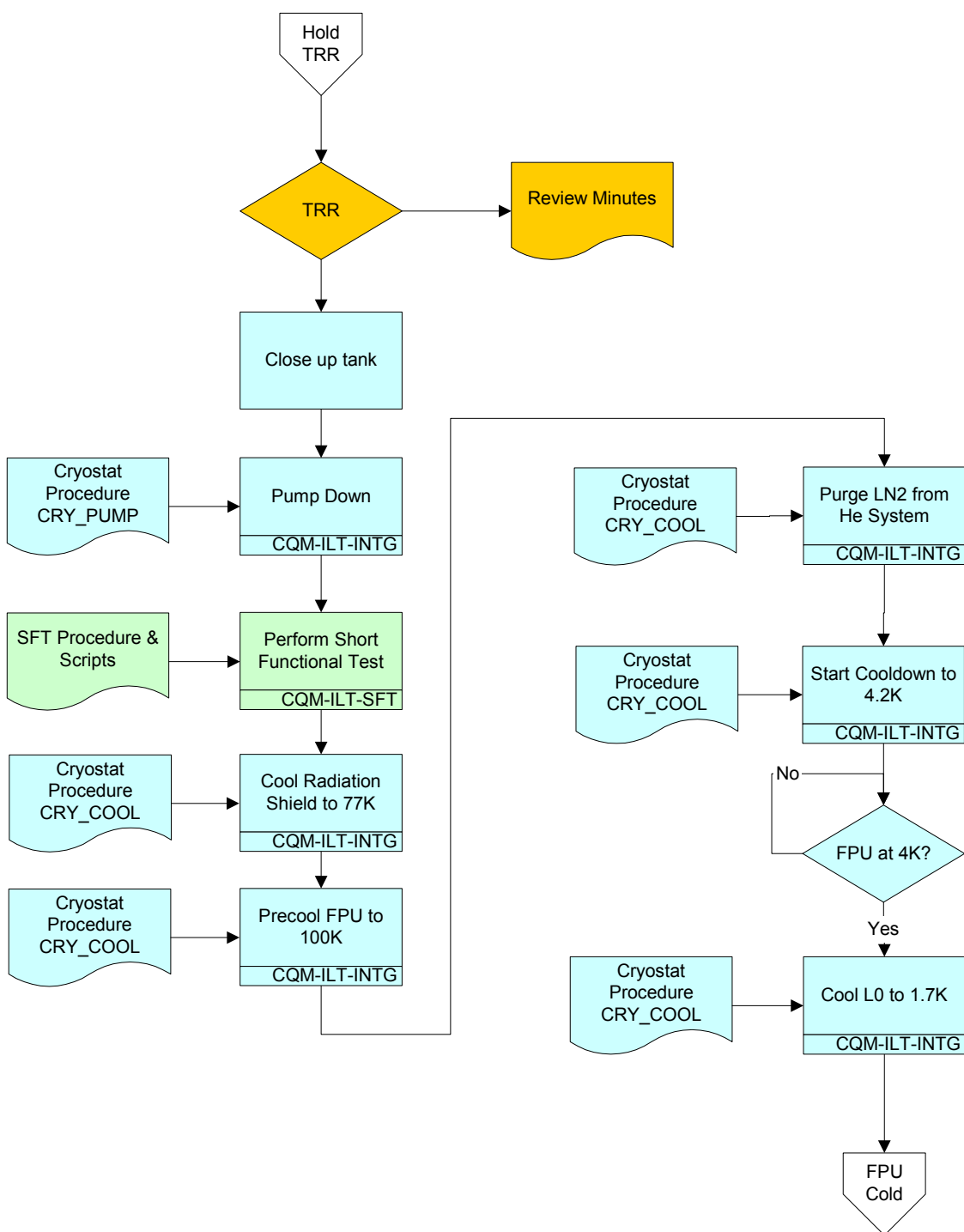
### **5.3 ESD Precautions**

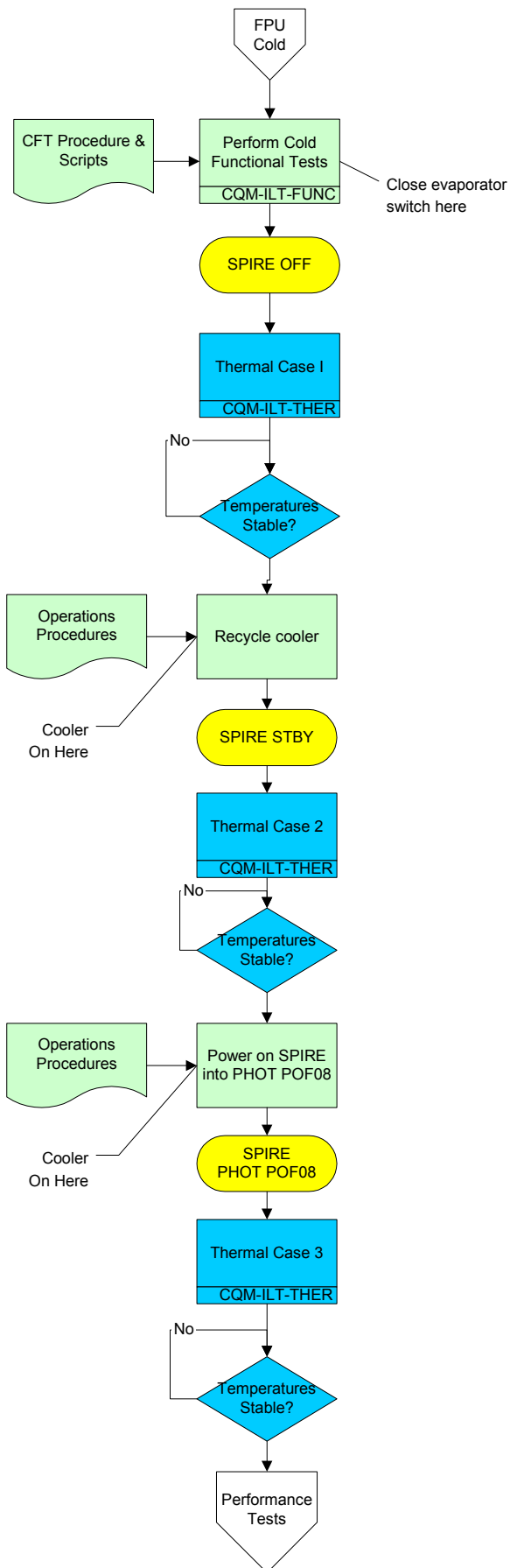
The SPIRE FPU, JFETS, DRCU and DPU are sensitive to electrostatic discharge. To prevent accidental damage to sensitive components, the units shall be grounded via a suitable earth strap while work is being performed. The earth straps may only be removed once the electronics have been connected together in accordance with the harness integration procedure. The ESD wrist straps provided must be worn at all times when working directly with the instrument.

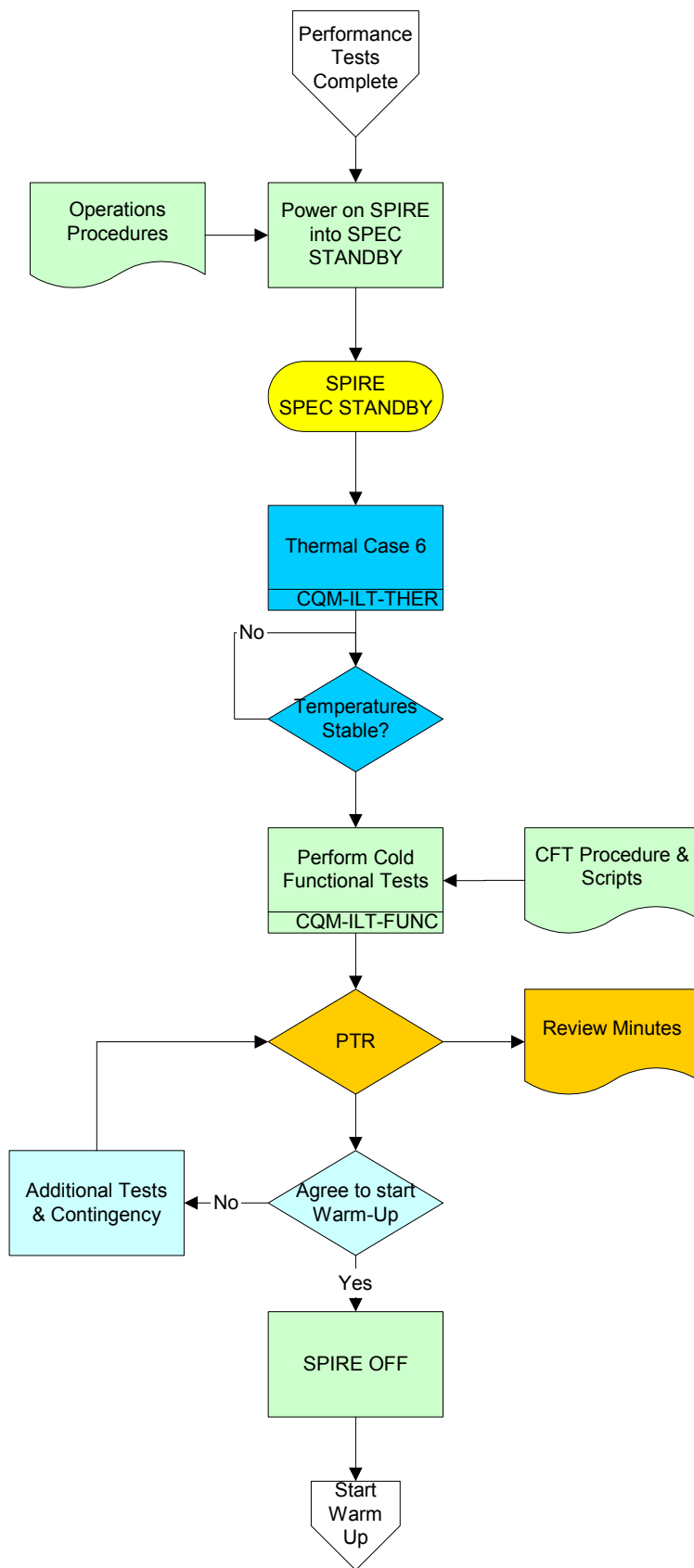


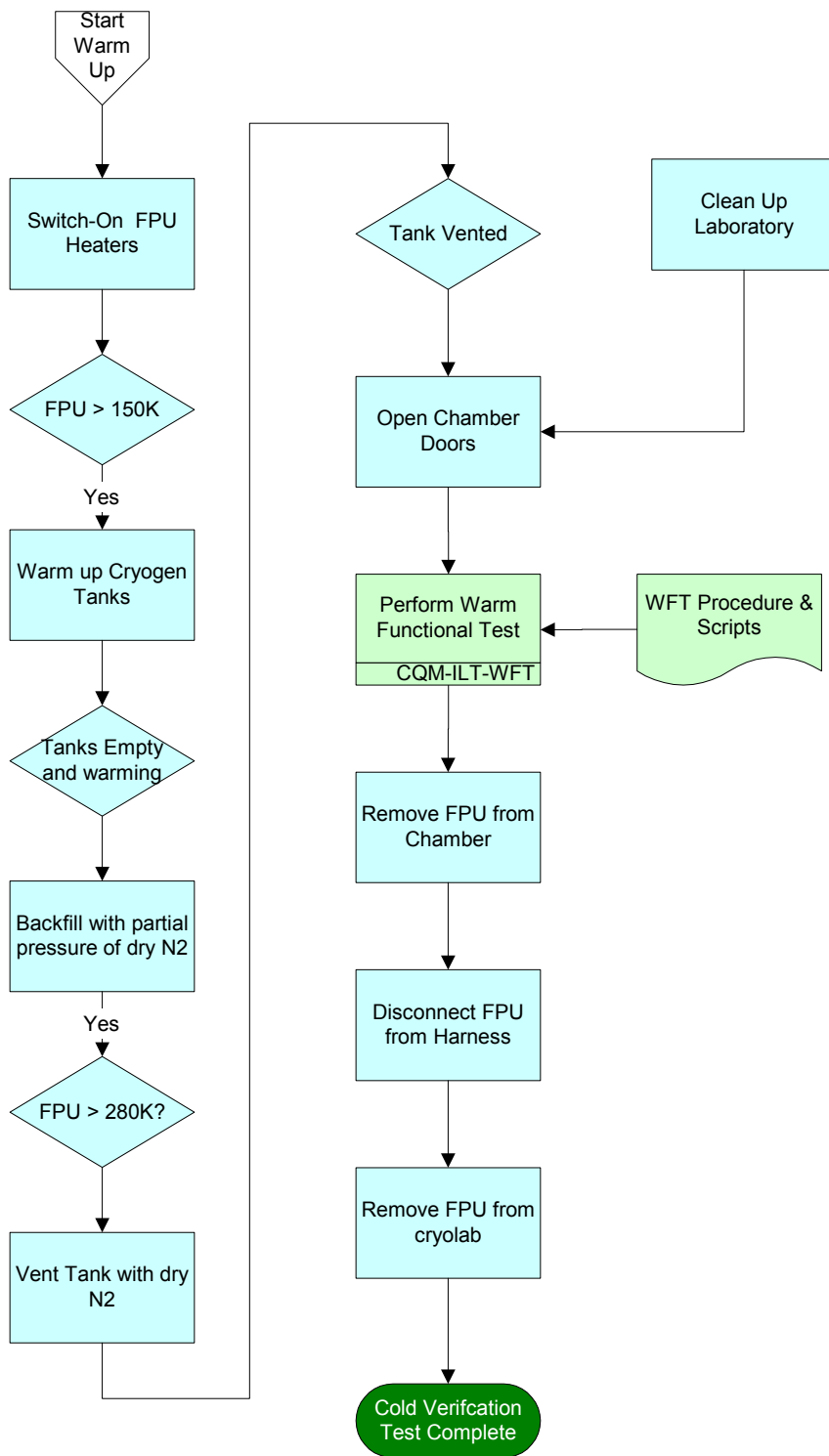
### 6 Procedure Flowchart













## 7 Test Procedure

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<b>Objectives:</b>	See section 3  This is a key inspection point.
<b>Initial Conditions:</b>	CQM SPIRE  Chamber at Atmospheric Pressure (~1000mbar) Tank doors open Vacuum system control electronics OFF Turbo Pump fan unit power OFF N2 supply closed 3 Phase supply OFF EGSE ILT OFF
<b>Final Conditions:</b>	As before
<b>Constraints:</b>	Pumping must not start until a test readiness review has been held and authorisation to proceed has been given.  Grounding straps provided must be worn at all times when working on FPU and WE
<b>Total Duration:</b>	32 Days

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Step.	Action	Comments	Task Complete															
<b>1</b>	<b>Hold Test Readiness Review</b>																	
1.1	Required Personnel Instrument Manager – Eric Sawyer AIV Manager – Dave Smith PA Manager – Eric Clark System Engineer – Doug Griffin Thermal Engineer – Anne Sophie Goizel Calibration Scientist – Tanya Lim Instrument Specialist – Sunil Sidher Instrument Scientist – Bruce Swinyard																	
<b>2</b>	<b>Move FPU into Cryolab</b>																	
2.1	Open Lab Doors and Move FPU into Lab on MGSE																	
2.2	Monitor Particulate levels in laboratory																	
	Particulate levels for class 6 clean room (old class 1000) Maximum concentration limits (particles per m <sup>3</sup> of air) for particles > than the considered sizes below.																	
	<table border="1"> <thead> <tr> <th>Size</th> <th>Specification</th> <th>Measured</th> </tr> </thead> <tbody> <tr> <td>0.1µm</td> <td>1000000</td> <td></td> </tr> <tr> <td>0.2µm</td> <td>237000</td> <td></td> </tr> <tr> <td>0.3µm</td> <td>102000</td> <td></td> </tr> <tr> <td>0.5µm</td> <td>35200</td> <td></td> </tr> </tbody> </table>	Size	Specification	Measured	0.1µm	1000000		0.2µm	237000		0.3µm	102000		0.5µm	35200			
Size	Specification	Measured																
0.1µm	1000000																	
0.2µm	237000																	
0.3µm	102000																	
0.5µm	35200																	





Step.	Action	Comments	Task Complete
	1.0µm	8320	
	5.0µm	293	
2.3	Remove covers when levels for class 6 clean room are achieved		
<b>3</b>	<b>Integrate Harness to FPU and Warm Electronics</b>		
3.1	Connect Cryo-Harness to FPU according to integration procedure ref ILT_INTG_HARN (reference <b>Doug Griffin</b> )		
3.2	When harness integrated disconnect grounding strap between FPU and HOB simulator		
<b>4</b>	<b>Perform Warm Functional Test CQM_ILT-WFT</b>		
4.1	Switch on DPU using procedure <b>PROC_OPER_?</b>		
4.2	Switch on DRCU using procedure <b>PROC_OPER_?</b>		
4.3	SPIRE in REDY mode? <b>PROC_OPER_?</b>		
4.4	Perform test <b>FUNC-SCU-01</b> , SCU Science packet generation check		
4.6	Perform test <b>FUNC-SCU-03</b> , SCU DC thermometry check		
4.7	Perform test <b>FUNC-SCU-06</b> , SCU AC thermometry check		
4.8	Perform test <b>FUNC-SCU-02</b> , SCU Science data check		
4.9	Perform test <b>FUNC-SCU-07</b> , SCU cooler heater check		
4.10	Perform test <b>FUNC-SCU-08</b> , SCU Test pattern test		
4.11	SPIRE in REDY mode + thermometers on <b>PROC_OPER_?</b>		
4.12	Perform test <b>FUNC-SCU-04</b> , SCU PCAL check		
4.13	Perform test <b>FUNC-PCAL-01</b> , PCAL characterisation test		
4.14	Switch OFF PCAL – <b>PROC-OPER-PCO</b> set bias = 0		
4.15	Perform test <b>FUNC-SCU-05</b> , SCU SCAL check		



Step.	Action	Comments	Task Complete
4.16	Perform test <b>FUNC-SCAL-01</b> , SCAL characterisation test		
4.17	Switch OFF SCAL – <b>PROC-OPER-SCO</b>		
4.18	Perform test <b>FUNC-MCU-01</b> , MCU power on		
4.18	Perform test <b>FUNC-MCU-02</b> , MCU Science packet generation check		
4.19	Perform test <b>FUNC-MCU-03</b> , MCU Science data check		
4.20	Perform test <b>FUNC-MCU-04</b> , MCU test pattern test		
4.21	Perform test <b>FUNC-BSM-01</b> , BSM power on motor and sensor		
4.22	Switch OFF BSM – <b>PROC-OPER-BOF</b>		
4.23	Switch OFF MCU – <b>CQM-MCU-OFF</b>		
4.24	Perform test <b>FUNC-DCU-01</b> , DCU Science Packet generation check		
4.25	Perform test <b>FUNC-DCU-02</b> , DCU Science data check		
4.26	Perform test <b>FUNC-DCU-03</b> , DCU Test pattern test		
4.27	Perform test <b>FUNC-DCU-04</b> , DCU LIAs switch on		
4.28	Switch OFF LIAs – <b>PROC_OPER_LIO?</b>		
4.29	Switch off thermometers – <b>PROC_OPER_THO?</b>		
4.30	Switch off DRCU – <b>PROC_OPER_DRO?</b>		
4.31	Switch off DPU – <b>PROC_OPER_DPO?</b>		
4.32	Check that all SPIRE subsystems have been switched OFF		
<b>5</b>	<b>Integrate FPU Into Cryostat</b>		
5.1	Ensure covers are on FPU		
5.2	Move FPU off MGSE into Cryostat		
5.3	Remove MGSE from Laboratory and store in G56 clean room		



Step.	Action	Comments	Task Complete
5.4	Secure MGSE to Cryostat Rails		
5.5	Connect CBB to cold strap and harness		
5.6	Connect L2 straps to HOB Plate and MGSE frame		
5.7	Connect L3 straps to JFET Units		
5.8	Connect FPU Thermal Interfaces to Cryostat Links		
5.9	Connect remaining cryostat thermometers		
5.10	Mount and Connect Heaters to HOB simulator and FPU		
5.11	Check Electrical Isolation of FPU to Cryostat		
<b>6</b>	<b>Perform Short Functional Test – CQM-ILT-SFT</b>		
6.1	Switch on DPU using procedure <b>CQM_DPU_ON</b>		
6.2	Switch on DRCU using procedure <b>QQM_DRCU_ON</b>		
6.3	SPIRE in REDY mode?		
6.4	Perform test <b>FUNC-SCU-01</b> , SCU Science packet generation check		
6.5	Perform test <b>FUNC-SCU-03</b> , SCU DC thermometry check		
6.6	Perform test <b>FUNC-SCU-06</b> , SCU AC thermometry check		
6.7	Perform test <b>FUNC-SCU-07</b> , SCU cooler heater check		
6.8	Perform test <b>FUNC-SCU-04</b> , SCU PCAL check		
6.9	Switch OFF PCAL – <b>PROC-OPER-PCO?</b>		
6.10	Perform test <b>FUNC-SCU-05</b> , SCU SCAL check		
6.11	Switch OFF SCAL – <b>PROC-OPER-SCO</b>		
6.12	SPIRE in REDY mode + thermometers on?		
6.13	Perform test <b>FUNC-MCU-01</b> , MCU power on		



Step.	Action	Comments	Task Complete
6.14	Perform test <b>FUNC-MCU-02</b> , MCU Science packet generation check		
6.15	Perform test <b>FUNC-BSM-01</b> , BSM power on motor and sensor		
6.16	Switch OFF BSM – <b>PROC-OPER-BOF</b>		
6.17	Switch Off MCU – <b>CQM-MCU-OFF</b>		
6.18	Perform test <b>FUNC-DCU-01</b> , DCU Science Packet generation check		
6.19	Perform test <b>FUNC-DCU-04</b> , DCU LIAs switch on		
6.20	Switch off LIAS – <b>PROC_OPER_LIO</b>		
6.21	Switch off thermometers – <b>PROC_OPER_THO</b>		
6.22	Switch off DRCU – <b>PROC_OPER_DRO</b>		
6.23	Switch off DPU – <b>PROC_OPER_DPO</b>		
<b>7</b>	<b>Cryostat Functional Test</b>		
7.1	Verify operation of cryostat instrumentation using procedure <b>CRY_CHECK</b> (ref AD 6)		
<b>8</b>	<b>Pump-Down Cryostat</b>		
8.1	Start cryostat pump-down using procedure <b>CRY_PUMP</b> (ref AD 6)		
<b>9</b>	<b>Perform Short Functional Test – CQM-ILT-SFT</b>		
9.1	Vacuum chamber at $10^{-5}$ mbar?		
9.2	Switch on DPU using procedure <b>PROC_OPER_DPON?</b>		
9.3	Switch on DRCU using procedure <b>PROC_OPER_DRON?</b>		
9.4	SPIRE in REDY mode?		
9.5	Perform test <b>FUNC-SCU-01</b> , SCU Science packet generation check		
9.6	Perform test <b>FUNC-SCU-03</b> , SCU DC thermometry check		



Step.	Action	Comments	Task Complete
9.7	Perform test <b>FUNC-SCU-06</b> , SCU AC thermometry check		
9.8	Perform test <b>FUNC-SCU-07</b> , SCU cooler heater check		
9.9	Perform test <b>FUNC-SCU-04</b> , SCU PCAL check		
9.10	Switch OFF PCAL – <b>PROC-OPER-PCO?</b>		
9.11	Perform test <b>FUNC-SCU-05</b> , SCU SCAL check		
9.12	Switch OFF SCAL – <b>PROC-OPER-SCO</b>		
9.13	SPIRE in REDY mode + thermometers on?		
9.14	Perform test <b>FUNC-MCU-01</b> , MCU power on		
9.15	Perform test <b>FUNC-MCU-02</b> , MCU Science packet generation check		
9.16	Perform test <b>FUNC-BSM-01</b> , BSM power on motor and sensor		
9.17	Switch OFF BSM – <b>PROC-OPER-BOF</b>		
9.18	Switch Off MCU – <b>PROC_OPER_MCO?</b>		
9.19	Perform test <b>FUNC-DCU-01</b> , DCU Science Packet generation check		
9.20	Perform test <b>FUNC-DCU-04</b> , DCU LIAs switch on		
9.21	Switch off LIAs – <b>PROC_OPER_LIO?</b>		
<b>10</b>	<b>Cool LN2 Radiation Shield</b>		
10.1	SPIRE in REDY mode + thermometers on?		
10.2	Fill LN2 Radiation shield according to procedure CRY_COOL (ref AD 6)		
<b>10.3</b>	<b>Monitor following temperatures during cooldown....</b>		
<b>11</b>	<b>Precool FPU to 100K</b>		
11.1	Cool SPIRE FPU to 100K using procedure CRY_COOL (ref AD 6)		
<b>12</b>	<b>Perform Short Functional Test Before Filling with He – CQM-ILT-SFT</b>		



Step.	Action	Comments	Task Complete
12.1	FPU at 100K? – Specify thermometers		
12.2	SPIRE in REDY mode + thermometers on?		
12.3	Perform test <b>FUNC-SCU-01</b> , SCU Science packet generation check		
12.4	Perform test <b>FUNC-SCU-03</b> , SCU DC thermometry check		
12.5	Perform test <b>FUNC-SCU-06</b> , SCU AC thermometry check		
12.6	Perform test <b>FUNC-SCU-07</b> , SCU cooler heater check		
12.7	Perform test <b>FUNC-SCU-04</b> , SCU PCAL check		
12.8	Switch OFF PCAL – <b>PROC-OPER-PCO?</b>		
12.9	Perform test <b>FUNC-SCU-05</b> , SCU SCAL check		
12.10	Switch OFF SCAL – <b>PROC-OPER-SCO</b>		
12.11	SPIRE in REDY mode + thermometers on?		
12.13	Perform test <b>FUNC-MCU-01</b> , MCU power on		
12.14	Perform test <b>FUNC-MCU-02</b> , MCU Science packet generation check		
12.15	Perform test <b>FUNC-BSM-01</b> , BSM power on motor and sensor		
12.16	Switch OFF BSM – <b>PROC-OPER-BOF</b>		
12.17	Switch Off MCU – <b>PROC_OPER_MCO</b>		
12.18	Perform test <b>FUNC-DCU-01</b> , DCU Science Packet generation check		
12.19	Perform test <b>FUNC-DCU-04</b> , DCU LIAs switch on		
12.20	Switch off LIAs – <b>PROC_OPER_LIO</b>		
<b>13</b>	<b>Cool instrument to 4.2K</b>		
13.1	SPIRE in REDY mode + thermometers on?		
13.2	Cool SPIRE to 4.2K using procedure CRY_COOL (ref AD 6)		



Step.	Action	Comments	Task Complete
<b>14</b>	<b>Cool to 1.7K</b>		
14.1	FPU at 4.2K?		
14.2	Cool L0 interface to 1.7K using procedure CRY_COOL (ref AD 6)		
14.3	If FPU L0 at 1.7K proceed to step 15		
<b>15</b>	<b>Perform Cold Functional Tests</b>		
15.1	FPU at 1.7K?		
15.2	SPIRE in REDY mode + thermometers on ?		
15.3	Perform test <b>FUNC-SCU-01</b> , SCU Science packet generation check		
15.4	Perform test <b>FUNC-SCU-03</b> , SCU DC thermometry check		
15.5	Perform test <b>FUNC-SCU-06</b> , SCU AC thermometry check		
15.6	Perform test <b>FUNC-SCU-02</b> , SCU Science data check		
15.7	Perform test <b>FUNC-SCU-07</b> , SCU cooler heater check		
15.8	Perform test <b>FUNC-SCU-08</b> , SCU Test pattern test		
15.9	SPIRE in REDY mode + thermometers on?		
15.10	Perform test <b>FUNC-SCU-04</b> , SCU PCAL check		
15.11	Perform test <b>FUNC-PCAL-01</b> , PCAL characterisation test		
15.12	Switch OFF PCAL – <b>PROC-OPER-PCO</b>		
15.13	Perform test <b>FUNC-SCU-05</b> , SCU SCAL check		
15.14	Perform test <b>FUNC-SCAL-01</b> , SCAL characterisation test		
15.15	Switch OFF PCAL – <b>PROC-OPER-SCO</b>		
	<b>Cooler functional tests ???</b>		
	<b>CLOSE Heat Switches Here?</b>		



Step.	Action	Comments	Task Complete
15.16	Perform test <b>FUNC-MCU-01</b> , MCU power on		
15.17	Perform test <b>FUNC-MCU-02</b> , MCU Science packet generation check		
15.18	Perform test <b>FUNC-MCU-03</b> , MCU Science data check		
15.19	Perform test <b>FUNC-MCU-04</b> , MCU test pattern test		
15.20	Perform test <b>FUNC-BSM-01</b> , BSM power on motor and sensor		
15.21	Switch OFF BSM – <b>PROC-OPER-BOF</b>		
15.22	Switch OFF MCU – <b>PROC_OPER_MCO?</b>		
15.23	Perform test <b>FUNC-DCU-01</b> , DCU Science Packet generation check		
15.24	Perform test <b>FUNC-DCU-02</b> , DCU Science data check		
15.25	Perform test <b>FUNC-DCU-03</b> , DCU Test pattern test		
15.26	Perform test <b>FUNC-DCU-04</b> , DCU LIAs switch on		
15.27	Perform test <b>FUNC-DCU-05</b> , DCU Offset test		
15.28	Perform test <b>FUNC-DCU-06</b> , DCU JFET heaters		
15.29	SPIRE in REDY & JFET on?		
15.30	Allow JFET temperatures to stabilise		
15.31	SPIRE in STBY?		
15.32	Perform test <b>FUNC-DCU-08</b> , DCU Phase shift test		
15.33	Perform test <b>FUNC-DCU-09</b> , DCU Bias frequency test		
15.34	Perform test <b>FUNC-DCU-10</b> , DCU Bias amplitude test		
15.35	Switch On Detectors - <b>FUNC-DCU-11</b> , DCU detectors switch on		
15.36	Switch OFF Detectors – <b>PROC_OPER_PDO?</b>		
15.37	Switch OFF JFETS – <b>PROC_OPER_JFO?</b>		





Step.	Action	Comments	Task Complete
15.38	Switch OFF LIAs – <b>PROC_OPER_LIO?</b>		
15.39	Switch off thermometers – <b>PROC_OPER_THO?</b>		
15.40	Switch off DRCU – <b>PROC_OPER_DRO?</b>		
15.41	Switch off DPU – <b>PROC_OPER_DPO?</b>		
<b>16</b>	<b>Thermal Test Case 1 – SPIRE OFF</b>		
16.1	SPIRE OFF?		
16.2	Monitor FPU temperatures and allow to stabilise		
16.3	If thermal balance conditions have been reached then proceed to step 17		
<b>17</b>	<b>Thermal Test Case 2 – Recycle Cooler</b>		
17.1	SPIRE OFF?		
17.2	Command SPIRE into PHOTOMETER Standby Mode using procedure reference <b>PROC-OPER-PSY</b>		
17.3	Recycle cooler – <b>PROC_OPER_?</b>		
17.4	Allow temperatures to stabilise		
<b>18</b>	<b>Thermal Test Case 3 – Photometer Calibrate Mode – POF08</b>		
18.1	SPIRE in STBY?		
18.2	Command SPIRE into Photometer Calibrate Mode – POF08 using procedure reference <b>PROC-OPER-PCO?</b>		
18.3	SPIRE in POF08?		
18.4	Monitor FPU temperatures and allow to stabilise		
18.5	While temperatures are stabilising perform the Photometer Noise Test <b>ILT-PERF-DNA-P</b>		
18.6	While temperatures are stabilising perform the PCAL Level test <b>ILT-PERF-CPC-P</b>		



Step.	Action	Comments	Task Complete
18.7	While temperatures are stabilising perform the PCAL Frequency test <b>ILT-PERF-CPT-P</b>		
18.8	If thermal balance conditions have been reached and the above performance tests have been completed, then proceed to step 18		
<b>19</b>	<b>Performance Tests</b>		
19.1	At the start of each day's operation perform the Daily Check <b>ILT-PERF-DCK</b>		
19.2	Noise with Telescope Background <b>ILT-PERF-DNC-P</b>		
19.3	Optical Load Curve <b>ILT-PERF-DAL-P</b>		
19.4	HBB Peakup <b>ILT-PERF-PKB</b>		
19.5	HBB Beam Scan <b>ILT-PERF-OSB-P</b>		
19.6	Laser Peakup <b>ILT-PERF-PKL</b>		
19.7	Laser Time Constant <b>ILT-PERF-DRL-P</b>		
19.8	Spectral Response <b>ILT-PERF-DSR</b>		
19.9	Laser or HBB Peakup Pixel C2 <b>ILT-PERF-PKB</b> or <b>ILT-PERF-PKL</b>		
19.10	Laser or HBB beam scan Pixel C2 <b>ILT-PERF-OSB</b> or <b>ILT-PERF-OSL</b>		
19.11	Laser or HBB Peakup Pixel C8 <b>ILT-PERF-PKB</b> or <b>ILT-PERF-PKL</b>		
19.12	Laser or HBB beam scan Pixel C8 <b>ILT-PERF-OSB</b> or <b>ILT-PERF-OSL</b>		
19.13	Laser or HBB Peakup Pixel A5 <b>ILT-PERF-PKB</b> or <b>ILT-PERF-PKL</b>		
19.14	Laser or HBB beam scan Pixel A5 <b>ILT-PERF-OSB</b> or <b>ILT-PERF-OSL</b>		
19.15	Laser or HBB Peakup <b>ILT-PERF-PKB</b> or <b>ILT-PERF-PKL</b>		
19.16	Spectral Response <b>ILT-PERF-DSR</b>		
19.17	Laser or HBB beam scan <b>ILT-PERF-OSB</b> or <b>ILT-PERF-OSL</b>		
19.18	HBB time constant <b>ILT-PERF-DRB-P</b>		



Step.	Action	Comments	Task Complete
19.19	Laser time constant <b>ILT-PERF-DRL-P</b>		
19.20	Beam attenuation HBB <b>ILT-PER-DBA-P</b>		
19.21	Laser Polarisation <b>ILT-PERF-DPL-P</b>		
19.22	Laser beam attenuation <b>ILT-PERF-DLA-P</b>		
19.23	Laser OOB sensitivity <b>ILT-PERF-OBL-P</b>		
<b>19.24</b>	<b>Pupil Scan ILT-PERF-OPI-P</b>		
<b>20</b>	<b>Power On SPIRE into SPEC STANDBY</b>		
20.1	Command SPIRE into spectrometer standby <b>PROC_OPER_?</b>		
<b>21</b>	<b>Thermal Test Case 6</b>		
21.1			
<b>22</b>	<b>Perform Cold Functional Test</b>		
22.1	FPU L0 at 1.7K?		
22.2	SPIRE in REDY mode + thermometers on? <b>PROC_OPER_?</b>		
22.3	Perform test <b>FUNC-SCU-01</b> , SCU Science packet generation check		
22.4	Perform test <b>FUNC-SCU-03</b> , SCU DC thermometry check		
22.5	Perform test <b>FUNC-SCU-06</b> , SCU AC thermometry check		
22.6	Perform test <b>FUNC-SCU-02</b> , SCU Science data check		
22.7	Perform test <b>FUNC-SCU-07</b> , SCU cooler heater check		
22.8	Perform test <b>FUNC-SCU-08</b> , SCU Test pattern test		
22.9	SPIRE in REDY mode + thermometers on?		
22.10	Perform test <b>FUNC-SCU-04</b> , SCU PCAL check		
22.11	Perform test <b>FUNC-PCAL-01</b> , PCAL characterisation test		



Step.	Action	Comments	Task Complete
22.12	Switch OFF PCAL – <b>PROC-OPER-PCO</b>		
22.13	Perform test <b>FUNC-SCU-05</b> , SCU SCAL check		
22.14	Perform test <b>FUNC-SCAL-01</b> , SCAL characterisation test		
22.15	Switch OFF PCAL – <b>PROC-OPER-SCO</b>		
	<b>Cooler functional tests ???</b> <b>CLOSE Heat Switches Here?</b>		
22.16	Perform test <b>FUNC-MCU-01</b> , MCU power on		
22.17	Perform test <b>FUNC-MCU-02</b> , MCU Science packet generation check		
22.18	Perform test <b>FUNC-MCU-03</b> , MCU Science data check		
22.19	Perform test <b>FUNC-MCU-04</b> , MCU test pattern test		
22.20	Perform test <b>FUNC-BSM-01</b> , BSM power on motor and sensor		
22.21	Switch OFF BSM – <b>PROC_OPER_BOF</b>		
22.22	Switch OFF MCU – <b>PROC_OPER_MCO?</b>		
22.23	Perform test <b>FUNC-DCU-01</b> , DCU Science Packet generation check		
22.24	Perform test <b>FUNC-DCU-02</b> , DCU Science data check		
22.25	Perform test <b>FUNC-DCU-03</b> , DCU Test pattern test		
22.26	Perform test <b>FUNC-DCU-04</b> , DCU LIAs switch on		
22.27	Perform test <b>FUNC-DCU-05</b> , DCU Offset test		
22.28	Perform test <b>FUNC-DCU-06</b> , DCU JFET heaters		
22.29	SPIRE in REDY & JFET on? <b>PROC_OPER_?</b>		
22.30	Allow JFET temperatures to stabilise		
22.31	SPIRE in Photometer standby? <b>PROC_OPER_PRC</b>		



Step.	Action	Comments	Task Complete
22.32	Perform test <b>FUNC-DCU-08</b> , DCU Phase shift test		
22.33	Perform test <b>FUNC-DCU-09</b> , DCU Bias frequency test		
22.34	Perform test <b>FUNC-DCU-10</b> , DCU Bias amplitude test		
22.35	Switch On Detectors - <b>FUNC-DCU-11</b> , DCU detectors switch on		
<b>23</b>	<b>Post Test Review</b>		
23.1			
<b>24</b>	<b>SPIRE OFF</b>		
24.1	Switch OFF Photometer Detectors – <b>PROC_OPER_PDO?</b>		
24.2	Switch OFF JFETS – <b>PROC_OPER_JFO?</b>		
24.3	Switch OFF LIAs – <b>PROC_OPER_LIO?</b>		
24.4	Switch off thermometers – <b>PROC_OPER_THO?</b>		
24.5	Switch off DRCU – <b>PROC_OPER_DRO?</b>		
24.6	Switch off DPU – <b>PROC_OPER_DPO?</b>		
<b>25</b>	<b>Warm Up</b>		
25.1	Warm SPIRE to ambient using procedure CRY_WARM (ref AD 6)		
<b>26</b>	<b>Let Up to Atmosphere</b>		
26.1	Let up chamber to atmospheric pressure using procedure CRY_LETUP (ref AD 6)		
<b>27</b>	<b>Perform Warm Functional Test</b>		
27.1	Switch on DPU using procedure <b>CQM_DPU_ON</b>		
27.2	Switch on DRCU using procedure <b>QQM_DRCU_ON</b>		
27.3	SPIRE in REDY mode?		



Step.	Action	Comments	Task Complete
27.4	Perform test <b>FUNC-SCU-01</b> , SCU Science packet generation check		
27.6	Perform test <b>FUNC-SCU-03</b> , SCU DC thermometry check		
27.7	Perform test <b>FUNC-SCU-06</b> , SCU AC thermometry check		
27.8	Perform test <b>FUNC-SCU-02</b> , SCU Science data check		
27.9	Perform test <b>FUNC-SCU-07</b> , SCU cooler heater check		
27.10	Perform test <b>FUNC-SCU-08</b> , SCU Test pattern test		
27.11	SPIRE in REDY mode + thermometers on <b>PROC_OPER_?</b>		
27.12	Perform test <b>FUNC-SCU-04</b> , SCU PCAL check		
27.13	Perform test <b>FUNC-PCAL-01</b> , PCAL characterisation test		
27.14	Switch OFF PCAL – <b>PROC-OPER-PCO</b>		
27.15	Perform test <b>FUNC-SCU-05</b> , SCU SCAL check		
27.16	Perform test <b>FUNC-SCAL-01</b> , SCAL characterisation test		
27.17	Switch OFF PCAL – <b>PROC-OPER-SCO</b>		
27.18	Perform test <b>FUNC-MCU-01</b> , MCU power on		
27.18	Perform test <b>FUNC-MCU-02</b> , MCU Science packet generation check		
27.19	Perform test <b>FUNC-MCU-03</b> , MCU Science data check		
27.20	Perform test <b>FUNC-MCU-04</b> , MCU test pattern test		
27.21	Perform test <b>FUNC-BSM-01</b> , BSM power on motor and sensor		
27.22	Switch OFF BSM – <b>PROC-OPER-BOF</b>		
27.23	Switch OFF MCU – <b>PROC_OPER_MCO?</b>		
27.24	Perform test <b>FUNC-DCU-01</b> , DCU Science Packet generation check		
27.25	Perform test <b>FUNC-DCU-02</b> , DCU Science data check		



Step.	Action	Comments	Task Complete
27.26	Perform test <b>FUNC-DCU-03</b> , DCU Test pattern test		
27.27	Perform test <b>FUNC-DCU-04</b> , DCU LIAs switch on		
27.28	Switch OFF LIAs – <b>PROC_OPER_LIO?</b>		
27.29	Switch off thermometers – <b>PROC_OPER_THO?</b>		
27.30	Switch off DRCU – <b>PROC_OPER_DRO?</b>		
27.31	Switch off DPU – <b>PROC_OPER_DPO?</b>		
<b>28</b>	<b>Remove SPIRE from Cryostat</b>		
28.1	Remove SPIRE from chamber using procedure ref. CRY_DEINT (ref: AD 5)		