HERSCHEL SPIRE	Ref: **SPIRE-RAL-PRC-002223** Author: **D.L. Smith**	Issue: **1.0** Date: **28-Jan-2005**

PFM1 Cold Test – Master Procedure

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Document Change Record

Date	Index	Affected Pages	Changes
17-Dec-2004	0.1	All	First Draft
06-Jan-2005	0.2	23, 25, 27, 28, 32 28-30 7	DC thermometer checks reinstated Cold functional test sequence altered to move detector tests ahead of mechanism tests TFTS removed from list of OGSE as not required for spectrometer tests
17-Jan-2005	0.3		Constraint added for JFET switch on Functional test procedure names corrected
28-Jan-2005	1.0	All	Formal release for test

1 Scope of Document

This procedure describes the activities to be performed during the second PFM 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 4 and AD 5 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	PFM-1 Instrument Test Plan	D.L. Smith	SPIRE-RAL-DOC-	
AD 2	Functional Test Specification	S. Ronayette	SPIRE-RAL-NOT-1652 Issue 1.3D	10-Dec-2004
AD 3	PFM1 Performance Test Specification	T. Lim		
AD 4	SPIRE Harness Integration Procedures	D.L. Smith	SPIRE-RAL-PRC-2122 Issue 0.4D	Dec 2004
AD 5	SPIRE Cryostat Operating Procedures	D.L. Smith	SPIRE-RAL-DOC-001556 Issue 1.0	
AD 6	SPIRE Cryolab Risk Assesment	D.L. Smith	SPIRE-RAL-DOC-	
AD 7	SPIRE Instrument Operations Procedures	S. Sidher		
AD 8	SPIRE EGSE ILT Startup Procedures	S. Sidher and M. Requena	SPIRE-RAL-DOC-001630	24-Jun-2003
AD 9	DRCU Switch On Procedure	A. Aramburu	SPIRE-RAL-NOT-00	
AD 10	SPIRE Cleanliness Plan	B.J. Swinyard	SPIRE-RAL-DOC-001070 Issue 1.0	9-Jan-2002
AD 11	RAL Safety Codes	CCLRC	http://www-internal.clrc.ac.uk/staff/notices/clrc_safety_codes/sc2.html	July-2003
AD 12	JFET Switch on procedures for PFM1	Bruce Swinyard	SPIRE-RAL-NOT-002285	Jan-2005

3 Test Objectives

The primary objectives of the test campaign are:-

- Verify the functional performance of the spectrometer subsystems (SMEC, SCAL)
- Verify the functional performance of the BSM
- Verify the scientific performance of the SPIRE spectrometer

4 Test Configuration

4.1 Cryostat

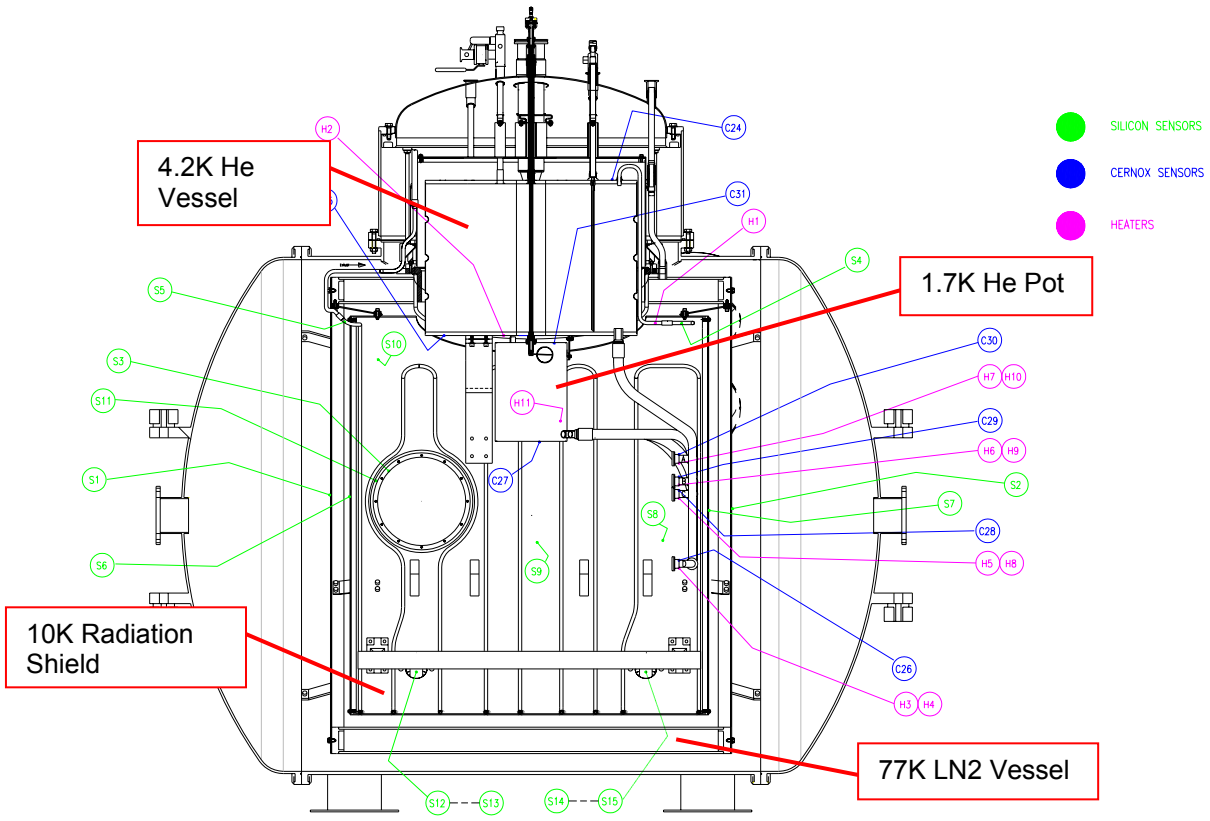


Figure 1: Cross section of SPIRE test cryostat showing the different temperature stages and thermometer locations.

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 5

4.2 Optical Equipment

4.2.1 Telescope Simulator

The telescope simulator will reproduce the Herschel telescope f8.68 beam, such that a point source is imaged at the SPIRE input focal plane. Many of the test & calibration procedures will require this beam to be steered & focused over the field-of-view range of the instrument, in order to check or measure such properties as pixel response, spatial resolution and image scale. A beam control system will use a series of movable mirrors to steer & focus the beam according to geometric 'control laws'.

4.2.2 Cold Blackbody

A 4K-20K-blackbody source provided by Cardiff University will be used as an absolute radiance standard. This will be mounted within the 4K enclosure of the cryostat and viewed via a relay mirror.

4.2.3 Hot Blackbody

An ISOTEC Pegasus hot, 1000°C blackbody with wavelength coverage over 200μm to 700μm will be used to back illuminate a point source at the input of the telescope simulator.

4.2.4 FIR Laser

An Edinburgh Instruments PR5 gas FIR laser with lines from 30μm to 1000μm and power up to 100mW will be used.

4.2.5 Beam Monitor

The output of the telescope simulator (i.e. input signal to SPIRE) will be picked off by a beam splitter and measured using a Golay cell. The output of the detector will be logged by the TFCS to allow correlation with the SPIRE measurements.

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 which can be found on 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 m³ 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.

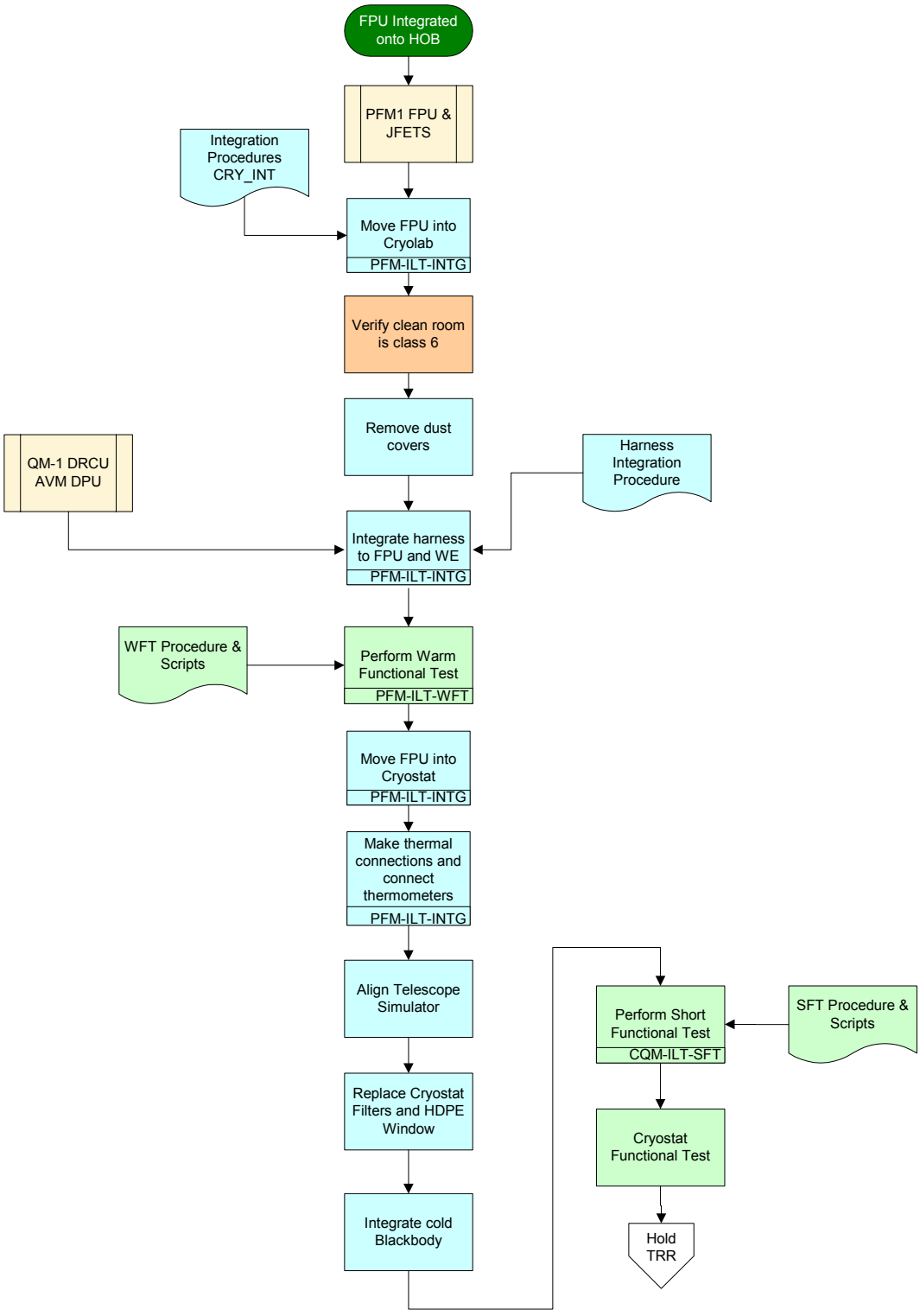
Where possible, personnel should work downstream of the instrument from the air-filters.

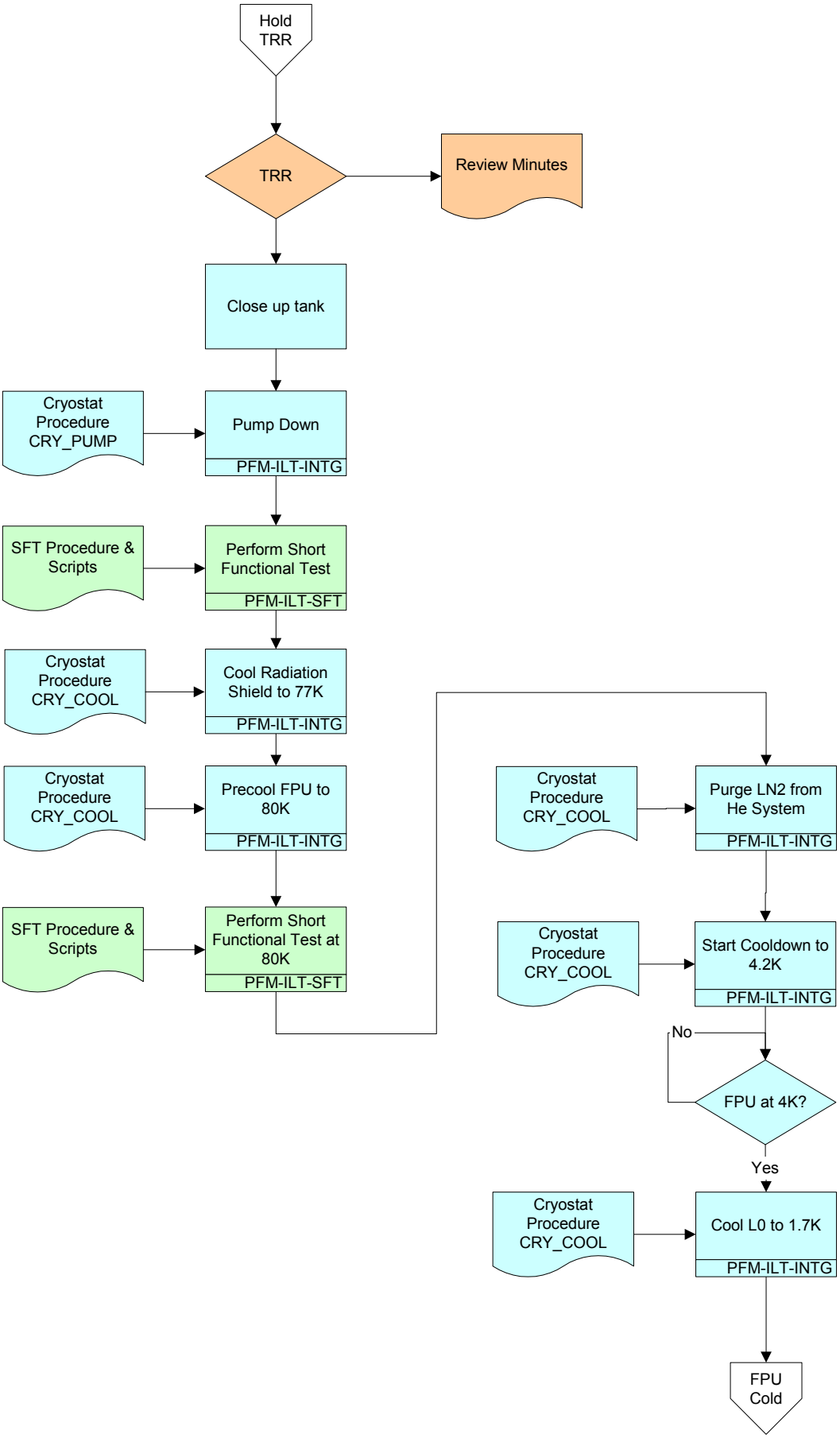
As space is extremely limited, only essential personnel are permitted to work in the clean room.

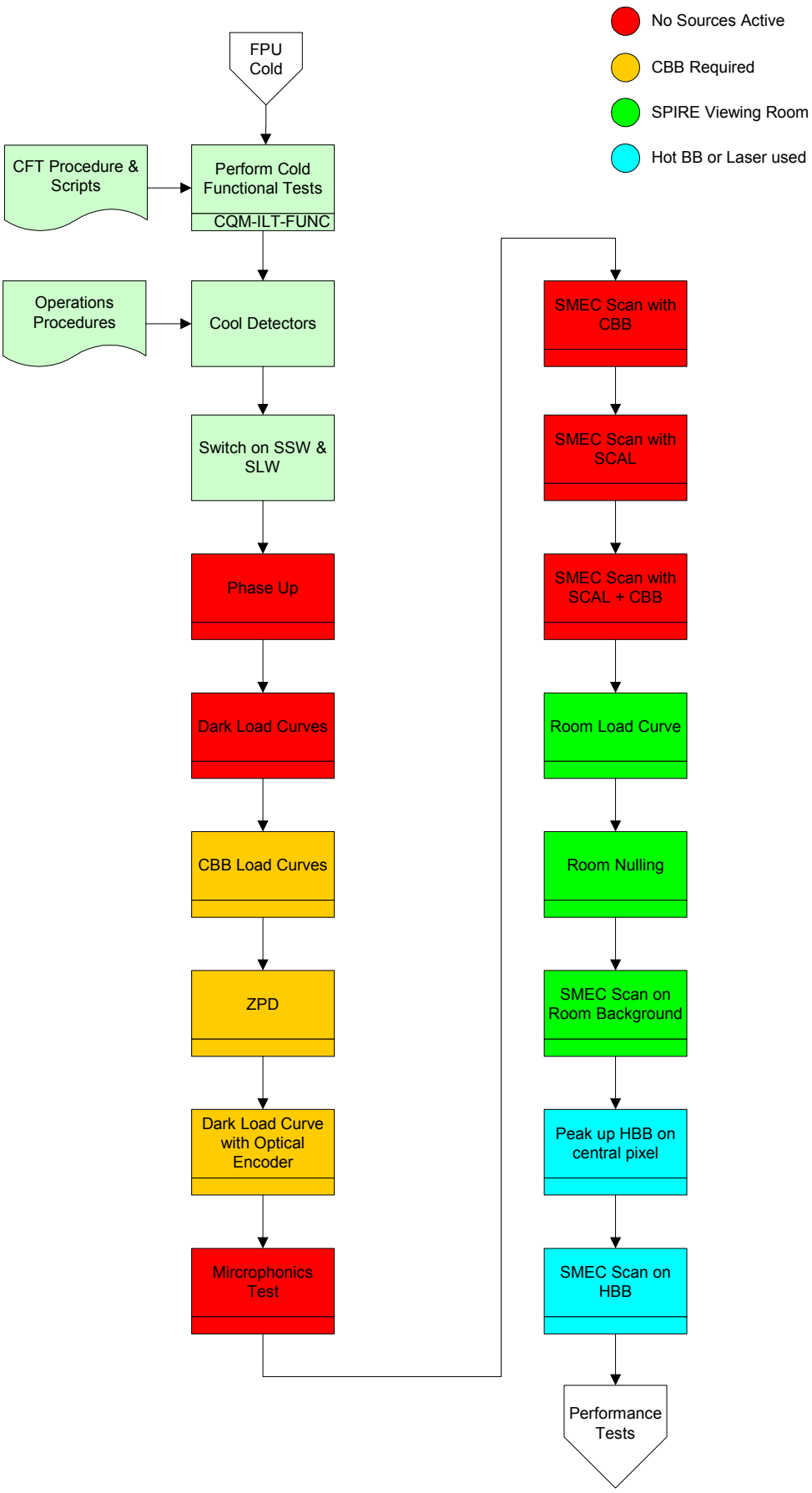
5.3 ESD Precautions

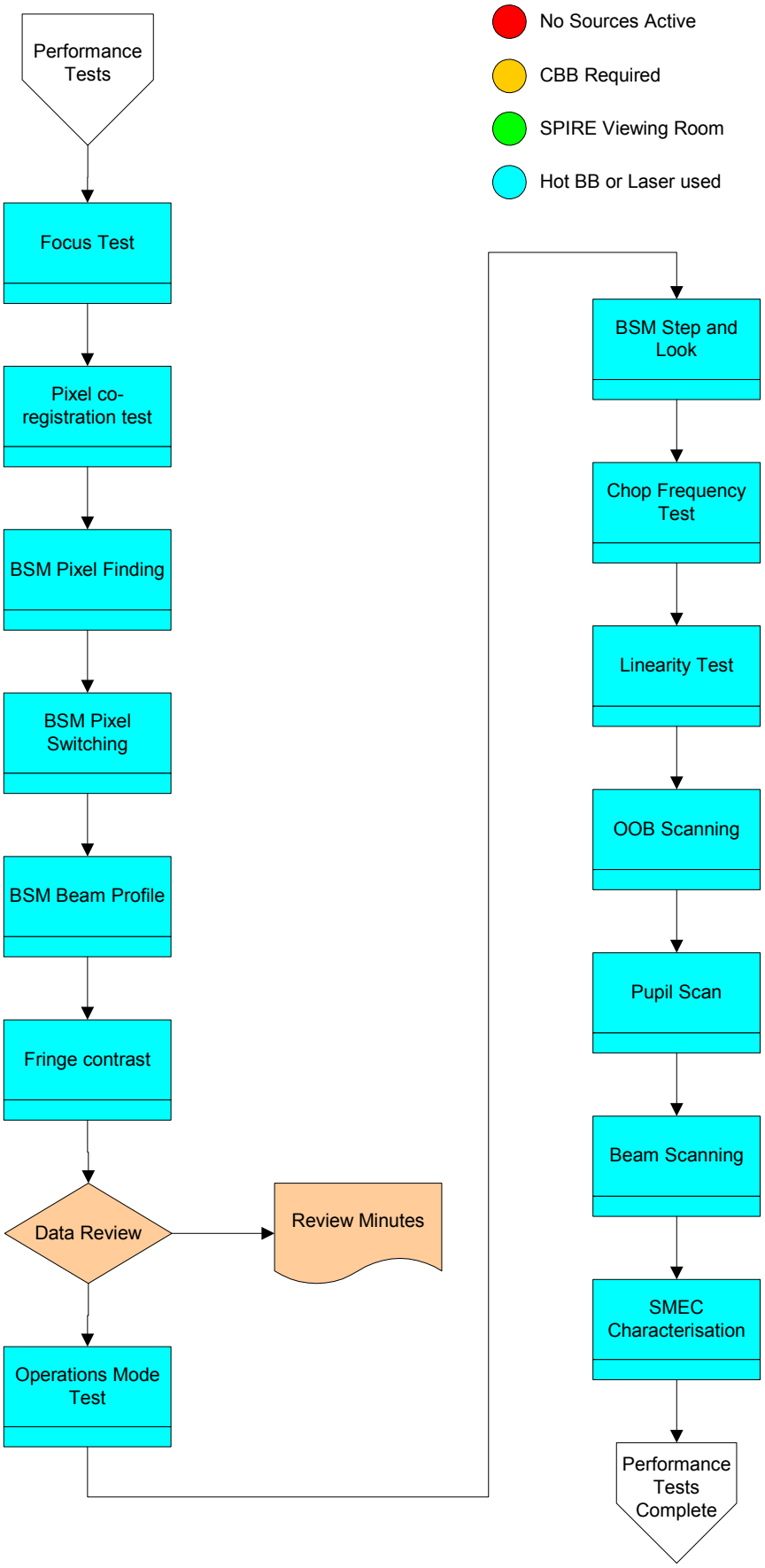
The SPIRE FPU, JFETS, DRCU and DPU are sensitive to electrostatic discharge. To prevent accidental damage to sensitive components, the units shall be grounded via a suitable earth strap while work is being performed. The earth straps may only be removed once the electronics have been connected together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

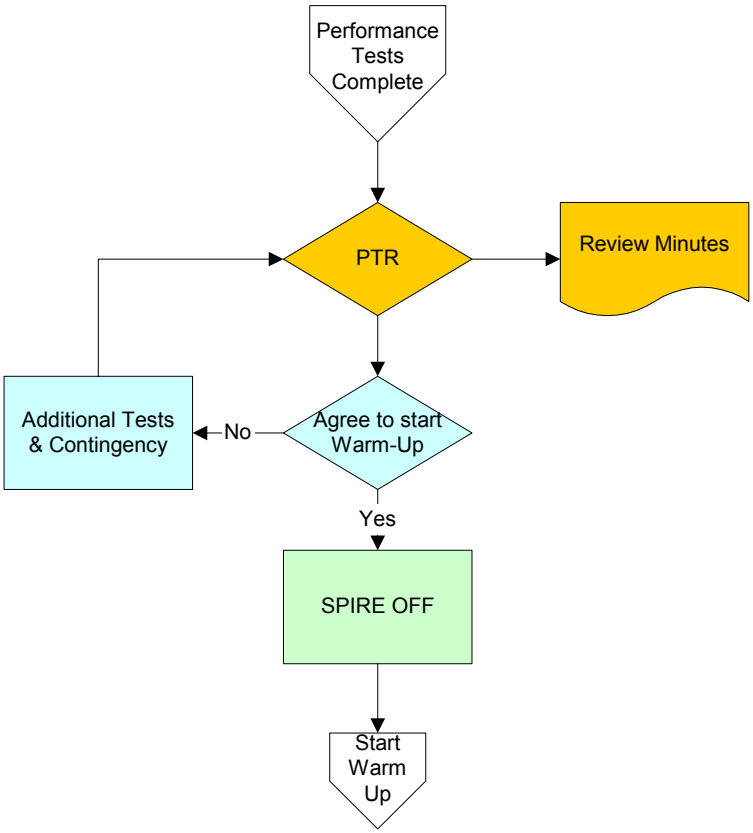
6 Procedure Flowchart

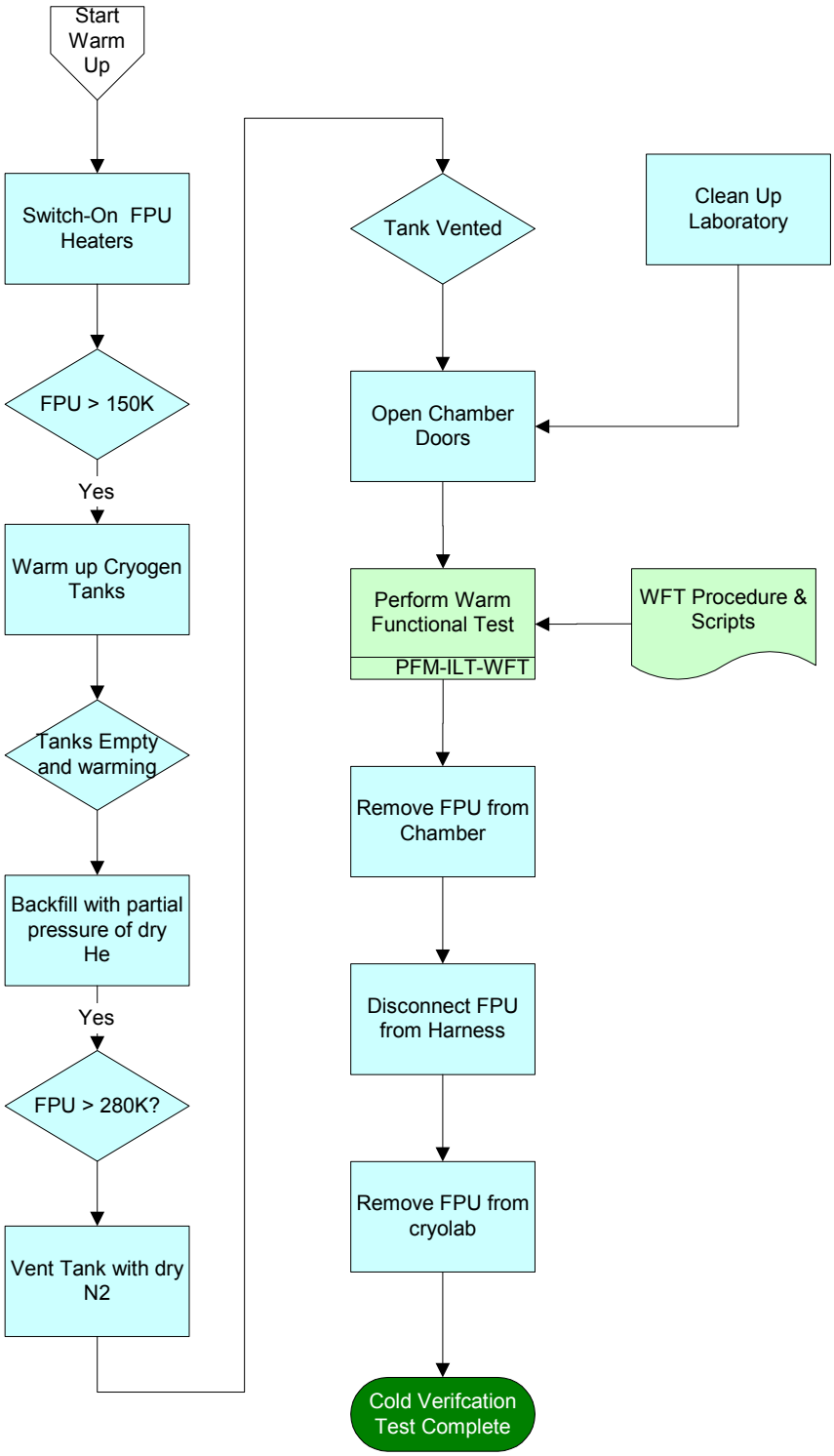



Hold TRR
TRR
Review Minutes
Close up tank
Cryostat Procedure CRY_PUMP
Pump Down
PFM-ILT-INTG
SFT Procedure & Scripts
Perform Short Functional Test
PFM-ILT-SFT
Cryostat Procedure CRY_COOL
Cool Radiation Shield to 77K
PFM-ILT-INTG
Cryostat Procedure CRY_COOL
Precool FPU to 80K
PFM-ILT-INTG
SFT Procedure & Scripts
Perform Short Functional Test at 80K
PFM-ILT-SFT
Cryostat Procedure CRY_COOL
Purge LN2 from He System
PFM-ILT-INTG
Cryostat Procedure CRY_COOL
Start Cooldown to 4.2K
PFM-ILT-INTG
No
FPU at 4K?
Yes
Cryostat Procedure CRY_COOL
Cool L0 to 1.7K
PFM-ILT-INTG
FPU Cold


No Sources Active
CBB Required
SPIRE Viewing Room
Hot BB or Laser used
FPU Cold
CFT Procedure & Scripts
Perform Cold Functional Tests
CQM-ILT-FUNC
Operations Procedures
Cool Detectors
Switch on SSW & SLW
Phase Up
Dark Load Curves
CBB Load Curves
ZPD
Dark Load Curve with Optical Encoder
Mircrophonics Test
SMEC Scan with CBB
SMEC Scan with SCAL
SMEC Scan with SCAL + CBB
Room Load Curve
Room Nulling
SMEC Scan on Room Background
Peak up HBB on central pixel
SMEC Scan on HBB
Performance Tests


No Sources Active
CBB Required
SPIRE Viewing Room
Hot BB or Laser used
Performance Tests
Focus Test
Pixel co-registration test
BSM Pixel Finding
BSM Pixel Switching
BSM Beam Profile
Fringe contrast
Data Review
Review Minutes
Operations Mode Test
BSM Step and Look
Chop Frequency Test
Linearity Test
OOB Scanning
Pupil Scan
Beam Scanning
SMEC Characterisation
Performance Tests Complete


Performance Tests Complete
PTR
Review Minutes
Additional Tests & Contingency
No
Agree to start Warm-Up
Yes
SPIRE OFF
Start Warm Up


Start Warm Up
Switch-On FPU Heaters
FPU > 150K
Yes
Warm up Cryogen Tanks
Tanks Empty and warming
Backfill with partial pressure of dry He
Yes
FPU > 280K?
Vent Tank with dry N2
Tank Vented
Clean Up Laboratory
Open Chamber Doors
Perform Warm Functional Test
PFM-ILT-WFT
WFT Procedure & Scripts
Remove FPU from Chamber
Disconnect FPU from Harness
Remove FPU from cryolab
Cold Verifcation Test Complete

7 Test Procedure

Objectives:	See section 3 This is a key inspection point.
Initial Conditions:	SPIRE PFM1 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
Final Conditions:	As before
Constraints:	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 JFETS must not be switched on until detectors have been cooled to 300mK
Total Duration:	73 Days

Step.	Action	Comments	Task Complete
1	**Hold Test Readiness Review**		
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		
2	**Move FPU into Cryolab**		
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 m³ of air) for particles > than the considered sizes below.		

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 instrument covers when levels for class 6 clean room are achieved.		
3	**Integrate Harness to FPU and Warm Electronics**		
3.1	Connect Cryo-Harness to FPU according to integration procedure ref **ILT_INTG_HARN** (AD 4)		
4	**Perform Warm Functional Test PFM_ILT-WFT**		
4.1	Check that shorting plugs in cryostat warm harness have been connected		
4.2	Switch on DPU using procedure **PROC_OPER_DPU_ON**		
4.3	Switch on DRCU using procedure **PROC_OPER_DRCU_ON**		
4.4	Perform test **FUNC-SCU-01**, SCU Science packet generation check		
4.5	Perform test **FUNC-SCU-03**, SCU DC thermometry check		
4.6	Perform test **FUNC-SCU-06**, SCU AC thermometry check		
4.7	Perform test **FUNC-SCU-02**, SCU Science data check		
4.8	Perform test **FUNC-SCU-07**, SCU cooler heater check		
4.9	Perform test **FUNC-SCU-08**, SCU Test pattern test		
4.10	Perform test **FUNC-SCU-04**, SCU PCAL check		
4.12	Perform test **FUNC-SCU-05**, SCU SCAL check		
4.14	Perform test **FUNC-MCU-01,** Power on MCU		
4.15	Perform test **FUNC-MCU-02**, MCU Science Packet Generation Test		
4.16	Perform test **FUNC-MCU-03**, MCU Science data check		
4.17	Perform test **FUNC-MCU-04**, MCU test pattern test		

Step.	Action	Comments	Task Complete
4.18	Perform test **FUNC-BSM-01c**, BSM power on chop, perform small step		
4.19	Perform test **FUNC-BSM-01j**, BSM power on jiggle, perform small step		
4.20	Switch OFF BSM – **PROC-OPER-SPIRE-BSM-OFF**		
4.21	Perform test **FUNC-SMEC-01**, SMEC Power on		
4.22	Perform test **FUNC-SMEC-03**, SMEC LEDs test		
4.23	Perform test **FUNC-SMEC-04**, SMEC position test		
4.24	Switch OFF SMEC – **PROC-OPER-SPIRE-SMEC-OFF**		
4.25	Switch OFF MCU – **PROC-OPER-SPIRE-MCU-OFF**		
4.26	Perform test **FUNC-DCU-01**, DCU Science Packet generation check		
4.27	Perform test **FUNC-DCU-02**, DCU Science data check		
4.28	Perform test **FUNC-DCU-03**, DCU Test pattern test		
4.29	Perform test **FUNC-DCU-04S**, DCU Spectrometer LIAs switch on		
4.30	Switch OFF LIAs **PROC-OPER-SPIRE-LIO**		
4.31	Switch off thermometers – **PROC_OPER_SPIRE-THO**		
4.32	Switch off DRCU using **PROC-OPER-SPIRE-DRCU-OFF**		
4.33	Switch off DPU using **PROC-OPER-SPIRE-DPU-OFF**		
4.34	Check that all SPIRE subsystems have been switched OFF		
5	**Integrate FPU Into Cryostat**		
5.1	Ensure covers are on the FPU		
5.2	Move FPU off MGSE into Cryostat		
5.3	Remove MGSE from Laboratory and store in G56 clean room		
5.4	Secure MGSE to Cryostat Rails		

Step.	Action	Comments	Task Complete
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		
6	**Align Telescope Simulator with SPIRE**		
6.1	Check that alignment cubes are attached to HOB simulator and FPU		
6.2	Remove HDPE window, 10K and 77K filters if not already done.		
6.3	Mount optical window on cryostat		
6.4	Set MAT to be aligned with centre mark on imaging mirror of telescope simulator.		
6.5	Adjust position of telescope simulator so that CFIL1 comes into view and focus		
6.6	Adjust MAT to locate cubes on FPU and HOB		
6.7	Adjust telescope simulator so that cubes and MAT are autocollimated		
6.8	Move MAT back to position where CFIL1 is observed and check field of view		
6.9	Repeat process until full FOV of CFIL1 is covered AND both alignment cubes are auto-collimated with MAT		
6.10	Use white light source in MAT to illuminate CFIL1 through optics – point should be in focus – adjust if necessary		
6.11	Replace fold mirror and illuminate TS with HeNe laser – adjust fold mirror so that beam is at centre of CFIL-1.		
6.12	Run telescope simulator to scan over full field of view to verify scan table.		

Step.	Action	Comments	Task Complete
6.13	Remove alignment cubes		
7	**Install Cold Blackbody**		
7.1	Place CBB on MGSE Frame		
7.2	Connect thermal strap to cold I/F of CBB – torque to TBD NM		
7.3	Secure feet to MGSE baseplate		
7.4	Connect electrical harness to CBB		
7.5	Power on CBB EGSE		
7.6	Switch on CBB control from TFCS Main Menu		
7.7	Send command to close flip mirror (to allow SPIRE to view room)		
7.8	Illuminate Telescope Simulator with HeNe laser		
7.9	Run telescope simulator to scan over full field of view and check for any vignetting by CBB aperture.		
7.10	Send command to open flip mirror (to allow SPIRE to CBB)		
7.11	Power off CBB electronics		
7.12	Replace 10K, 77K filters		
7.13	Replace HDPE window		
8	**Perform Short Functional Test – PFM-ILT-SFT**		
8.1	Switch on DPU using procedure **PROC-OPER-SPIRE-DPU-ON**		
8.2	Switch on DRCU using procedure **PROC-OPER-SPIRE-DRCU-ON**		
8.3	Perform test **FUNC-SCU-01**, SCU Science packet generation check		
8.4	Perform test **FUNC-SCU-03**, SCU DC thermometry check		
8.5	Perform test **FUNC-SCU-06**, SCU AC thermometry check		

Step.	Action	Comments	Task Complete
8.6	Perform test **FUNC-SCU-07**, SCU cooler heater check		
8.7	Perform test **FUNC-SCU-04**, SCU PCAL check		
8.8	Perform test **FUNC-SCU-05**, SCU SCAL check		
8.9	Perform test **FUNC-MCU-01,** Power on MCU		
8.10	Perform test **FUNC-MCU-02**, MCU Science Packet Generation Test		
8.11	Perform test **FUNC-BSM-01c**, BSM power on chop, perform small step		
8.12	Perform test **FUNC-BSM-01j**, BSM power on jiggle, perform small step		
8.13	Switch OFF BSM – **PROC-OPER-SPIRE-BSM-OFF**		
8.14	Perform test **FUNC-SMEC-01**, SMEC Power on		
8.15	Perform test **FUNC-SMEC-03**, SMEC LEDs test		
8.16	Perform test **FUNC-SMEC-04**, SMEC position test		
8.17	Switch OFF BSM – **PROC-OPER-SPIRE-SMEC-OFF**		
8.18	Switch OFF MCU – **PROC-OPER-SPIRE-MCU-OFFF**		
8.19	Perform test **FUNC-DCU-01**, DCU Science Packet generation check		
8.20	Perform test **FUNC-DCU-04S**, DCU Spectrometer LIAs switch on		
8.21	Switch OFF LIAs		
8.22	Switch off thermometers – **PROC_OPER_SPIRE-THO**		
8.23	Switch off DRCU using **PROC_OPER_SPIRE-DRCU_OFF**		
8.24	Switch off DPU using **PROC_OPER_SPIRE-DPU_OFF**		
8.25	Check that all SPIRE subsystems have been switched OFF		
9	**Cryostat Functional Test**		

Step.	Action	Comments	Task Complete
9.1	Verify operation of cryostat instrumentation using procedure **CRY_CHECK** (ref AD 5)		
9.1	Verify correct operation of Pump System		
9.2	Verify thermometer connections		
9.3	Verfiy cryostat heater operations		
9.4	Verify cold-blackbody function		
10	**Close Cryostat**		
10.1	Replace 10K end-cap at west end of cryostat		
10.2	Connect thermometer harness and check function		
10.3	Replace 77K end-cap at west end of cryostat		
10.4	Connect thermometer harness and check function		
10.5	Replace 10K end-cap at east end of cryostat		
10.6	Connect thermometer harness and check function		
10.7	Clamp instrument cryoharness to 10K shield and verify electrical isolation		
10.8	Replace cowl on 10K end plate		
10.9	Replace 77K end-cap at east end of cryostat		
10.10	Place loose harness between MLI and 77K shield – ensuring that electrical isolation is maintained.		
10.11	Close doors of vacuum chamber and fasten clamps.		
11	**Pump-Down Cryostat**		
11.1	Start cryostat pump-down using procedure CRY_PUMP (ref AD 5)		
12	**Perform Short Functional Test – PFM-ILT-SFT**		
NOTE: DC Thermometry Check not done for PFM1			

Step.	Action	Comments	Task Complete
12.1	Vacuum chamber at 10^{-5}mbar?		
12.2	Switch on DPU using procedure **PROC-OPER_SPIRE-DPU-ON**		
12.3	Switch on DRCU using procedure **PROC-OPER-SPIRE-DRCU-ON**		
12.4	Perform test **FUNC-SCU-01**, SCU Science packet generation check		
12.5	Perform test **FUNC-SCU-03**, SCU DC thermometry check		
12.6	Perform test **FUNC-SCU-06**, SCU AC thermometry check		
12.7	Perform test **FUNC-SCU-07**, SCU cooler heater check		
12.8	Perform test **FUNC-SCU-04**, SCU PCAL check		
12.9	Perform test **FUNC-SCU-05**, SCU SCAL check		
12.10	Perform test **FUNC-MCU-01,** Power on MCU		
12.11	Perform test **FUNC-MCU-02**, MCU Science Packet Generation Test		
12.12	Perform test **FUNC-BSM-01c**, BSM power on chop, perform small step		
12.13	Perform test **FUNC-BSM-01j**, BSM power on jiggle, perform small step		
12.14	Switch OFF BSM – **PROC-OPER-SPIRE-BSM-OFF**		
12.15	Perform test **FUNC-SMEC-01**, SMEC Power on		
12.16	Perform test **FUNC-SMEC-03**, SMEC LEDs test		
12.17	Perform test **FUNC-SMEC-04**, SMEC position test		
12.18	Switch OFF SMEC – **PROC-OPER-SPIRE-SMEC-OFF**		
12.19	Switch OFF MCU – **PROC-OPER-SPIRE-MCU-OFF**		
12.20	Perform test **FUNC-DCU-01**, DCU Science Packet generation check		
12.21	Perform test **FUNC-DCU-04S**, DCU Spectrometer LIAs switch on		
12.22	Switch off detectors		

Step.	Action	Comments	Task Complete
13	**Cool LN2 Radiation Shield**		
13.1	Fill LN2 Radiation shield according to procedure CRY_COOL (ref AD 5)		
14	**Pre-cool FPU to 80K**		
14.1	Cool SPIRE FPU to 80K using procedure CRY_COOL (ref AD 5) – NOTE This procedure will take several days to complete		
15	**Perform Short Functional Test Before Filling with He – PFM-ILT-SFT**		
NOTE: DC Thermometry Check not done for PFM1			
15.1	FPU thermometers at 80K?		
15.2	Perform test **FUNC-SCU-03**, SCU DC thermometry check		
15.3	Perform test **FUNC-SCU-06**, SCU AC thermometry check		
15.4	Perform test **FUNC-SCU-07**, SCU cooler heater check		
15.5	Perform test **FUNC-SCU-04**, SCU PCAL check		
15.6	Perform test **FUNC-SCU-05**, SCU SCAL check		
15.7	Perform test **FUNC-MCU-01,** Power on MCU		
15.8	Perform test **FUNC-MCU-02**, MCU Science Packet Generation Test		
15.9	Perform test **FUNC-BSM-01c**, BSM power on chop, perform small step		
15.10	Perform test **FUNC-BSM-01j**, BSM power on jiggle, perform small step		
15.11	Switch OFF BSM – **PROC-OPER-BOF**		
15.12	Perform test **FUNC-SMEC-01**, SMEC Power on		
15.13	Perform test **FUNC-SMEC-03**, SMEC LEDs test		
15.14	Perform test **FUNC-SMEC-04**, SMEC position test		
15.15	Switch OFF SMEC – **PROC-OPER-SOF**		

Step.	Action	Comments	Task Complete
15.16	Perform test **FUNC-DCU-01**, DCU Science Packet generation check		
15.17	Perform test **FUNC-DCU-04S**, DCU Spectrometer LIAs switch on		
15.18	Switch off detectors		
16	**Cool instrument to 4.2K**		
16.1	Cool SPIRE to 4.2K using procedure CRY_COOL (ref AD 5)		
17	**Cool to 1.7K**		
17.1	FPU at 4.2K?		
17.2	Cool L0 interface to 1.7K using procedure CRY_COOL (ref AD 5)		
17.3	If FPU L0 at 1.7K proceed to step 15		
18	**Perform Cold Full Functional Tests**		
NOTE: DC Thermometry Check not done for PFM1			
18.1	FPU at 1.7K?		
18.2	SPIRE DPU + DRCU ON?		
18.3	Perform test **FUNC-SCU-01**, SCU Science packet generation check		
18.4	Perform test **FUNC-SCU-03**, SCU DC thermometry check		
18.5	Perform test **FUNC-SCU-06**, SCU AC thermometry check		
18.6	Perform test **FUNC-SCU-02**, SCU Science data check		
18.7	Perform test **FUNC-SCU-07**, SCU cooler heater check		
18.8	Perform test **FUNC-SCU-08**, SCU Test pattern test		
18.9	Perform test **FUNC-SCU-04**, SCU PCAL check		
18.10	Perform test **FUNC-PCAL-01**, PCAL characterisation test		
18.11	Perform test **FUNC-SCU-05**, SCU SCAL check		

Step.	Action	Comments	Task Complete
18.12	Perform test **FUNC-SCAL-01**, SCAL characterisation test		
18.13	Perform test **FUNC-SCAL-02**, SCAL PID Test		
18.14	Perform test **FUNC-SCU-07**, SCU cooler heater check		
18.15	Recycle cooler using procedure "**SPIRE COOLER RECYCLING SCOS PROCEDURE"**		
18.16	Wait for Evaporator **T_CEV** temperature to cool to <300mK		
18.17	Perform test **FUNC-DCU-01**, DCU Science Packet generation check		
18.18	Perform test **FUNC-DCU-02**, DCU Science data check		
18.19	Perform test **FUNC-DCU-03**, DCU Test pattern test		
18.20	Perform test **FUNC-DCU-04/S**, DCU Spectrometer LIAs switch on		
18.21	Perform test **FUNC-DCU-05/S**, DCU Offset test		
NOTE: JFETS must not be powered on until detectors have reached 300mK (as indicated by T_CEV)			
18.22	Perform test **FUNC-DCU-06/S,** DCU JFET heaters following procedure SPIRE-RAL-NOT-002285 to switch on JFETs		
18.23	Allow JFET temperatures to stabilise		
18.24	Switch On Detectors - **FUNC-DCU-12/S**, Spectrometer detector settings		
18.25	Perform test **FUNC-DCU-08/S**, DCU Phase shift test		
18.26	Perform test **FUNC-DCU-09/S**, DCU Bias frequency test		
18.27	Perform test **FUNC-DCU-10/S**, DCU Bias amplitude test		
	NOTE: Detector phase-up, load-curve and noise tests may be carried out at this point.		
18.28	Perform test **FUNC-MCU-01,** Power on MCU		
18.29	Perform test **FUNC-MCU-02**, MCU Science Packet Generation Test		

Step.	Action	Comments	Task Complete
18.30	Perform test **FUNC-MCU-03**, MCU Science data check		
18.31	Perform test **FUNC-MCU-04**, MCU test pattern test		
18.32	Perform test **FUNC-BSM-01c**, BSM power on chop, perform small step		
18.33	Perform test **FUNC-BSM-01j**, BSM power on jiggle, perform small step		
18.34	Perform test **FUNC-BSM-02c** BSM chop axis in open loop		
18.35	Perform test **FUNC-BSM-02j** BSM jiggle axis in open loop		
18.36	Perform test **FUNC-BSM-03c**, BSM position test with closed loop, chop axis		
18.37	Perform test **FUNC-BSM-03j**, BSM position test with closed loop, jiggle axis		
18.38	Perform test **FUNC-BSM-04c**, BSM scan with closed loop, chop axis		
18.39	Perform test **FUNC-BSM-04j**, BSM scan with closed loop, jiggle axis		
18.40	Perform test **FUNC-BSM-05c**, BSM scan with open loop, chop axis		
18.41	Perform test **FUNC-BSM-05j**, BSM scan with open loop, jiggle axis		
18.42	Perform test **FUNC-BSM-06**, BSM operating mode test		
18.43	Switch OFF BSM – **PROC-OPER-SPIRE-BSM-OFF**		
18.44	Perform test **FUNC-SMEC-01**, SMEC switch on and initialisation		
18.45	Perform test **FUNC-SMEC-03**, SMEC LEDs test		
18.46	Perform test **FUNC-SMEC-04**, SMEC position test		
18.47	Perform test **FUNC-SMEC-05**, SMEC step and look scan test		
18.48	Perform test **FUNC-SMEC-06**, SMEC saw tooth scan test		
18.49	Perform test **FUNC-SMEC-07**, SMEC triangular scan test		
18.50	Perform test **FUNC-SMEC-08**, SMEC open loop position test		
18.51	Perform test **FUNC-SMEC-09**, SMEC open loop scan test		

Step.	Action	Comments	Task Complete
18.52	Switch OFF SMEC – **PROC-OPER-SPIRE-SMEC-OFF**		
18.53	Switch OFF MCU – **PROC-OPER-SPIRE-MCU-OFF**		
19	**Performance Tests – Phase 1**		
19.1	Phase up		
19.2	Dark Load Curves		
19.3	Load Curves with cold blackbody		
19.4	Locate Zero Path Difference		
19.5	Perform dark load curve with SMEC optical encoder running		
19.6	Microphonics Test		
19.7	SMEC scan with CBB		
19.8	SMEC scan with SCAL		
19.9	SMEC scan with SCAL+CBB		
19.10	Room Load Curve		
19.11	Room Nulling		
19.12	Peak-up/set-up telsim central pixel		
19.13	Move SMEC on HBB		
19.14	Focus Test		
19.15	Peak-up on co-located pixels		
19.16	BSM Pixel Finding		
19.17	BSM Pixel Switching		
19.18	BSM Beam Profile		
19.19	Fringe contrast central pixel while scanning		

Step.	Action	Comments	Task Complete
19.20	Possible fringe contrast step+look		
19.21	Fringe contrast on other pixels		
20	**Hold Intermediate Data Review**		
20.1	Review results of phase 1 of performance testing and assess need to repeat tests.		
21	**Observations Tests**		
	TBD		
22	**Performance Tests – Phase 2**		
22.1	Repeat tests from phase 1 as necessary		
22.2	BSM Step and Look		
22.3	BSM chop frequency test		
22.4	Beam scans		
22.5	Pupil Scans		
22.6	Linearity test		
22.7	Polarisation response		
22.8	Out of band scanning		
22.9	SMEC Characterisation		
23	**Post Test Review**		
23.1	Hold test review to assess need for additional/repeat tests before warming up.		
24	**SPIRE OFF**		
24.2	Switch OFF JFETS – **PROC_OPER_SPIRE-JFET-OFF**		
24.3	Switch OFF LIAs – **PROC_OPER_SPIRE-LIO**		

Step.	Action	Comments	Task Complete
25	**Warm Up**		
25.1	Warm SPIRE to ambient using procedure CRY_WARM (ref AD 5)		
26	**Let Up to Atmosphere**		
26.1	Let up chamber to atmospheric pressure using procedure CRY_LETUP (ref AD 5)		
27	**Perform Warm Functional Test**		
NOTE: DC Thermometry Check not done for PFM1			
27.1	Switch on DPU using procedure **PROC-OPER-SPIRE-DPU-ON**		
27.2	Switch on DRCU using procedure **PROC-OPER-SPIRE-DRCU-ON**		
27.3	Perform test **FUNC-SCU-01**, SCU Science packet generation check		
27.4	Perform test **FUNC-SCU-03**, SCU DC thermometry check		
27.5	Perform test **FUNC-SCU-06**, SCU AC thermometry check		
27.6	Perform test **FUNC-SCU-02**, SCU Science data check		
27.7	Perform test **FUNC-SCU-07**, SCU cooler heater check		
27.8	Perform test **FUNC-SCU-08**, SCU Test pattern test		
27.9	Perform test **FUNC-SCU-04**, SCU PCAL check		
27.10	Perform test **FUNC-PCAL-01**, PCAL characterisation test		
27.11	Perform test **FUNC-SCU-05**, SCU SCAL check		
27.12	Perform test **FUNC-SCAL-01**, SCAL characterisation test		
27.13	Perform test **FUNC-MCU-01,** Power on MCU		
27.14	Perform test **FUNC-MCU-02**, MCU Science Packet Generation Test		
27.15	Perform test **FUNC-MCU-03**, MCU Science data check		

Step.	Action	Comments	Task Complete
27.16	Perform test **FUNC-MCU-03**, MCU test pattern test		
27.17	Perform test **FUNC-BSM-01c**, BSM power on chop, perform small step		
27.18	Perform test **FUNC-BSM-01j**, BSM power on jiggle, perform small step		
27.19	Switch OFF BSM – **PROC-OPER-SPIRE-BSM-OFF**		
27.20	Perform test **FUNC-SMEC-01**, SMEC Power on		
27.21	Perform test **FUNC-SMEC-03**, SMEC LEDs test		
27.22	Perform test **FUNC-SMEC-04**, SMEC position test		
27.23	Switch OFF SMEC – **PROC-OPER-SPIRE-SMEC-OFF**		
27.24	Switch OFF MCU – **PROC-OPER-SMEC-MCU-OFF**		
27.25	Perform test **FUNC-DCU-01**, DCU Science Packet generation check		
27.26	Perform test **FUNC-DCU-02**, DCU Science data check		
27.27	Perform test **FUNC-DCU-03**, DCU Test pattern test		
27.28	Perform test **FUNC-DCU-04S**, DCU Spectrometer LIAs switch on		
27.29	Switch OFF detectors		
27.30	Switch off thermometers – **PROC-OPER-SPIRE-THO**		
27.31	Switch off DRCU using **PROC-OPER_SPIRE-DRCU-OFF**		
27.32	Switch off DPU using **PROC-OPER-SPIRE-DPU-OFF**		
27.33	Check that all SPIRE subsystems have been switched OFF		
28	**Open Cryostat**		
28.1	Return MGSE from G56 clean room		
28.2	Monitor Particulate levels in laboratory		

Step.	Action	Comments	Task Complete
	Particulate levels for class 6 clean room (old class 1000) Maximum concentration limits (particles per m³ of air) for particles > than the considered sizes below.		

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

28.3	Open cryostat doors – ensure that Oxygen monitor is on person at all times during this procedure as the chamber will be full of nitrogen gas – allow oxygen levels to recover before returning to lab		
28.4	Remove 77K end caps and store in cryostat doors		
28.5	Remove cowl from 10K shield		
28.6	Unclamp instrument harness from 10K shield		
28.7	Remove 10K end-caps		
29	**Remove FPU from Cryostat**		
29.1	Remove CBB from cryostat – bag and return to G56 clean room		
29.2	Replace aperture cover		
29.3	Disconnect cryostat flexibles from the FPU and move out of way		
29.4	Unclamp and lower the FPU and HOB frame onto wheels		
29.5	Connect MGSE trolley rails to cryostat rails		

Step.	Action	Comments	Task Complete
29.6	Move FPU out of cryostat onto MGSE trolley.		
29.7	Secure FPU and HOB assembly onto MGSE		
29.8	Disconnect Cryo-Harness to FPU according to integration procedure ref **ILT_INTG_HARN** (AD 4)		
29.9	Replace covers on FPU		
29.10	Return FPU to G56 clean room		