SPIRE STM Instrument Level Test Plan

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Document Change Record

Date	Index	Affected Pages	Changes
10-Jan-2002	0.1	All	First Draft

Contents

1 Scope of Document

This document describes in detail how the SPIRE STM AIV will be implemented. It describes the step-by-step sequence of activities, high-level procedures, organisation, resources and facilities required.

2 Documents

2.1 Applicable Documents

	Title	Author	Reference	Date
AD 1	SPIRE Instrument Qualification Requirements	B. Swinyard	SPIRE-RAL-PRJ-000592 Issue 1.1	29-Mar-2001
AD 2	SPIRE STM Requirements	B. Swinyard	SPIRE-RAL-NOT-000613 Issue 1.0	30-Mar-2001
AD 3	Instrument AIV Plan	B. Swinyard	SPIRE-RAL-PRJ-000410 Issue 2.1	29-Mar-2001
AD 4	Instrument Integration Plan	B. Winter	SPIRE-MSS-PRJ-000652 Issue 0.1D	Apr-2001
AD 5	Ground-Based Calibration Plan	B. Swinyard	TBD	
AD 6	SPIRE EMC Control Plan	D. Griffin	SPIRE-RAL-PRJ-852 Issue 0.1D	7-Sep-2001
AD 7	Thermal test plan	S. Heys	TBD	
AD 8	SPIRE Optical Alignment Verification Plan	K. Dohlen	SPIRE-LAM-PRJ-000445 Issue 3	10-Apr-2001
AD 9	SPIRE Product Assurance Plan	D. Kelsh	SPIRE-RAL-PRJ-000017 Issue 1.0	11-Apr-2001
AD 10	Cleanliness Plan	B. Swinyard	TBD	
AD 11	SPIRE Major Milestone List	K. King	SPIRE-RAL-PRJ-000455 Issue 1.0	17-Jul-2000
AD 12	SPIRE Alignment Tools Specification	K. Dohlen, A. Origne		

2.2 Reference Documents

	Title	Author	Reference	Date
RD 1	SPIRE AVM Instrument Level Test Plan	E. Sawyer		
RD 2	SPIRE CQM Instrument Level Test Plan	D.L. Smith	SPIRE-RAL-DOC-000 Issue 0.1D	19 Dec-2001
RD 3	SPIRE Test Facility Requirements Specification	D.L. Smith	SPIRE-RAL-PRJ-000463 Issue 1.3	2-April-2001
RD 4	AIV Facility Description	G.M. Toplis	ISO9:SPAP/AIV/000	01-July-2000
RD 5	Herschel Ground Segment Design Description		FIRST-FSC-DOC-0146 Issue 1 rev 1	10-Dec-2001

3 STM AIV Requirements

3.1 STM Definition

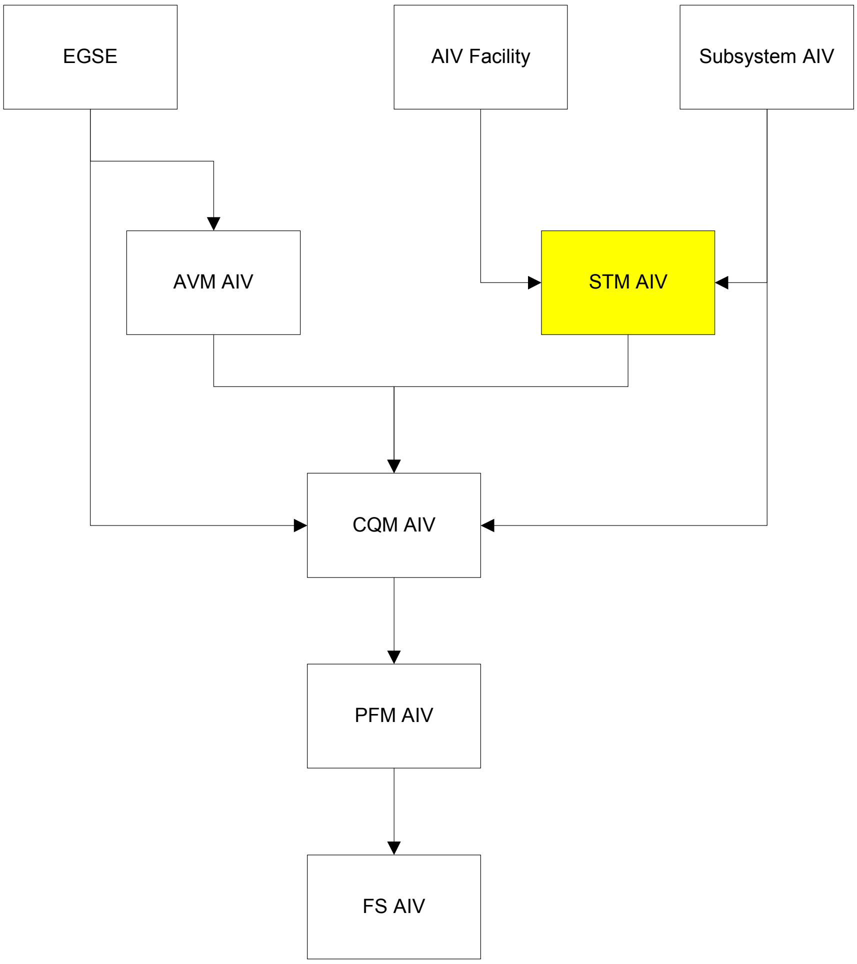


Figure 1: Flow chart showing the logical association of the SPIRE STM model within the SPIRE development programme.

The SPIRE instrument model philosophy is described in AD 1 and AD 3. The SPIRE STM model is mechanically and thermally representative of the flight model but has no functioning subsystems, other than heaters to simulate the thermal loads within the FPU. The main purpose of the STM model is to qualify the mechanical and thermal design of the FPU structure. The detailed requirements for the STM instrument model are described in AD 2.

3.2 STM Qualification Requirements

3.2.1 Mechanical

A qualification level vibration test will be performed on the STM instrument at room temperature to verify the mechanical design of the FPU structure. The input levels will be defined by MSSL and will be based on those specified in the IIDA. To confirm that the instrument has survived the qualification levels, optical alignment and thermal performance tests will be performed before and after the vibration test. The proposed sequence for each axis will be:

Configure Instrument
Electrical Checkout
Optical Alignment Check
Low-level survey
Sine test
Random test
Low-level survey
Optical Alignment Check
Reconfigure for next axis

If the STM instrument passes the warm qualification tests, a cryogenic vibration of the FPU and JFET modules to be carried out. The levels for these tests are TBD.

3.2.2 Thermal

The STM instrument will be tested in a test cryostat that will simulate as close as possible the thermal environment of the Herschel cryostat. A test campaign will be run in which the thermal model of the FPU structure will be verified. The STM will have a fully functioning cooler, and will have at least one thermally representative detector model. The STM thermal tests will provide the first opportunity to test the operation and thermal performance of the cooler within SPIRE. Details of the test conditions will be defined in the SPIRE thermal test plan (AD 7).

3.2.3 Optical

The STM instrument will have near flight standard optical components to allow the optical geometric model to be verified. The optics will be integrated and aligned in accordance with the optical alignment plan (AD 8). The alignment will be verified both at ambient and cryogenic conditions.

Because of program constraints, the STM structure will be reused as the CQM structure. The mirrors will remain installed and the alignment will be maintained during reconfiguration. Hence, for optical alignment purposes, the STM can be treated as the CQM.

3.2.4 Electrical

TBD

4 AIV Flowchart

The flowchart in this section is based on the flowchart presented in the SPIRE AIV Plan (AD 3) but expanded slightly to show each test campaign with the facilities and test equipment required to perform the activities.

Each test campaign will start with a test readiness review, at which all test procedures must be ready and the EGSE configuration will be 'frozen'. A formal post-test review will be held at the end of the test campaign after which the instrument can proceed with the next activity.

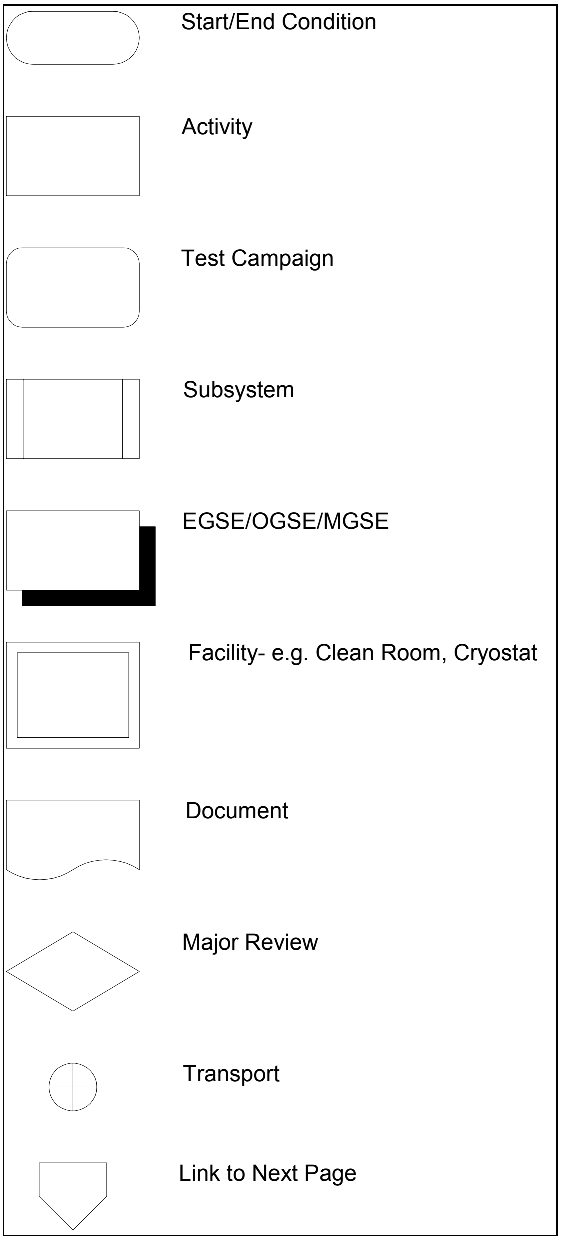
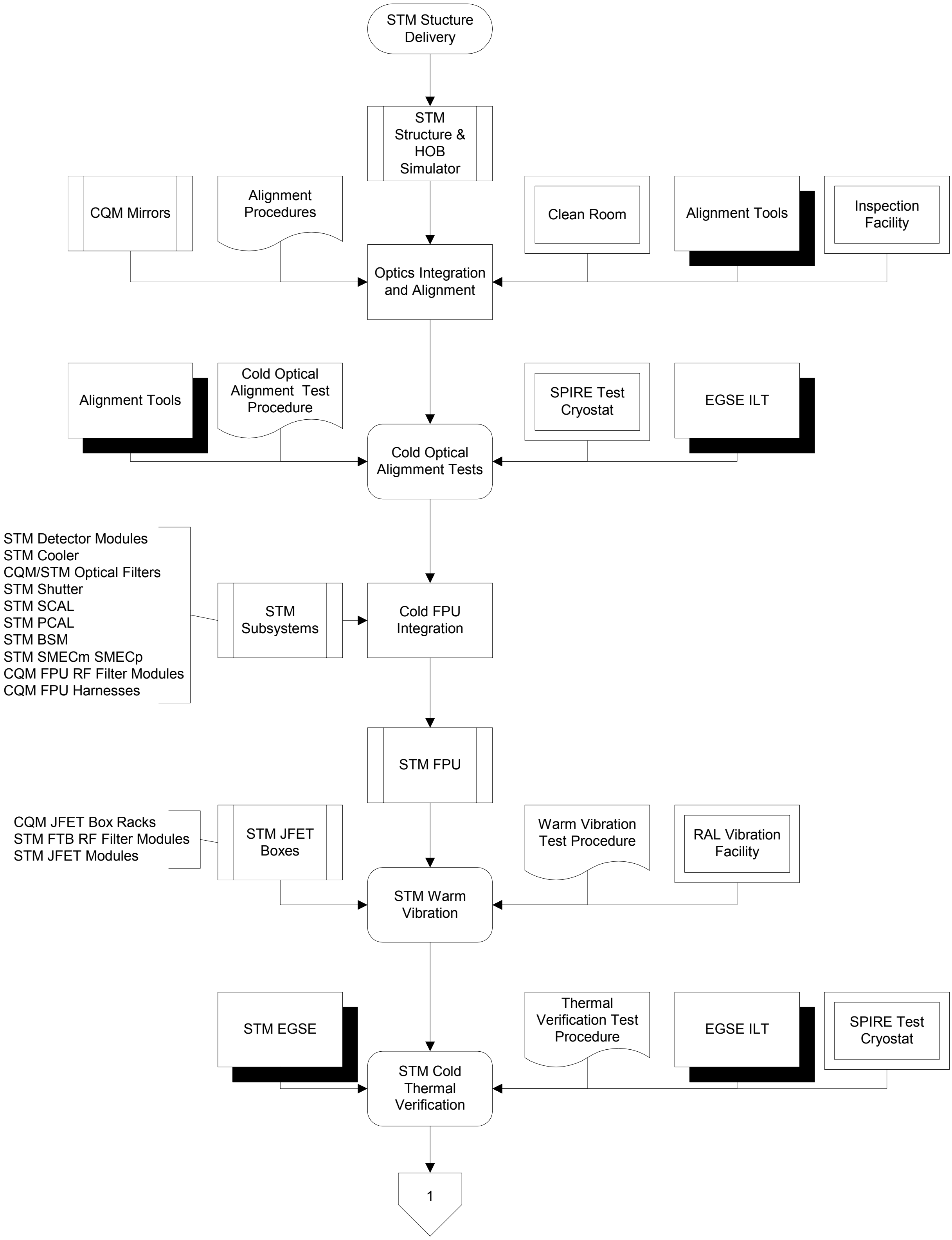


Figure 2: Legend for STM AIV Flow Chart


STM Stucture Delivery
STM Structure & HOB Simulator
CQM Mirrors
Alignment Procedures
Clean Room
Alignment Tools
Inspection Facility
Optics Integration and Alignment
Alignment Tools
Cold Optical Alignment Test Procedure
SPIRE Test Cryostat
EGSE ILT
Cold Optical Aligmment Tests
STM Detector Modules
STM Cooler
CQM/STM Optical Filters
STM Shutter
STM SCAL
STM PCAL
STM BSM
STM SMECm SMECp
CQM FPU RF Filter Modules
CQM FPU Harnesses
STM Subsystems
Cold FPU Integration
STM FPU
CQM JFET Box Racks
STM FTB RF Filter Modules
STM JFET Modules
STM JFET Boxes
Warm Vibration Test Procedure
RAL Vibration Facility
STM Warm Vibration
STM EGSE
Thermal Verification Test Procedure
EGSE ILT
SPIRE Test Cryostat
STM Cold Thermal Verification
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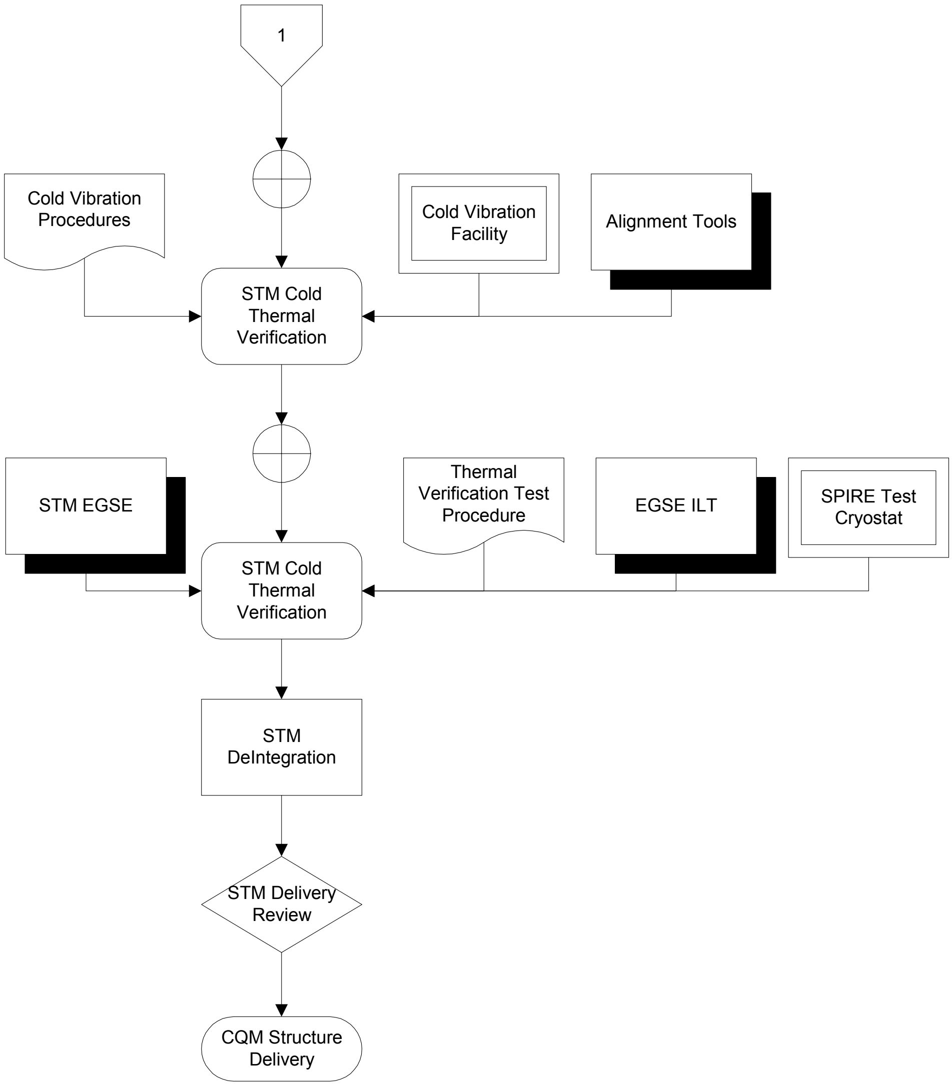
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Cold Vibration Procedures
Cold Vibration Facility
Alignment Tools
STM Cold Thermal Verification
STM EGSE
Thermal Verification Test Procedure
EGSE ILT
SPIRE Test Cryostat
STM Cold Thermal Verification
STM DeIntegration
STM Delivery Review
CQM Structure Delivery

5 Task List

The following table defines the step-by-step sequence of activities for the SPIRE STM AIV. The table will form the basis of the STM AIV master procedure.

Step	Activity	Identifier	Brief Description	Instrument Requirement
STM-1	**Optics Integration**	**STM_ILT_ALIGN**		
STM-1-1	Incoming inspection	ILT_INSP	Visual inspection of the SPIRE structure and optics mounts mounted on HOB simulator.	VRD-10
STM-1-2	3D Metrology	STM_ILT_ALIGN	Structure transferred to 3D inspection facility and the positions of the optical mounts measured	VRD-06, VRD-07, VRD-10
STM-1-3	Photometer/Common optics integration	STM_ILT_ALIGN	Install and align CQM photometer/common optics mirrors.	VRD-05, VRD-06, VRD-07, VRD-10
STM-1-4	Spectrometer optics integration and alignment.	STM_ILT_ALIGN	Install and align CQM spectrometer mirrors	VRD-06, VRD-07, VRD-10
STM-1-5	Pupil quality verification	STM_ILT_ALIGN		VRD-06, VRD-07, VRD-09, VRD-10
STM-1-6	Image quality verification	STM_ILT_ALIGN	Observe the image of D-tool sources in SPIRE object plane.	VRD-06, VRD-07, VRD-09, VRD-10
STM-2	**STM Cold Optical Alignment**	**STM_ILT_ALIGN**		
STM-2-1	Integrate SPIRE onto support frame	STM_ILT_INTG	Bolt down covers, secure structure to HOB simulator. Lift instrument onto MGSE and build up support frame.	
STM-2-2	Transfer SPIRE to Cryolab	STM_ILT_INTG	Bag up the FPU and HOB simulator and transfer to cryolab.	
STM-2-3	Integrate SPIRE into cryostat	CRY_INTG	Move instrument into cryostat, connect thermal straps, harness. Close up radiation shields, making light tight.	
STM-2-4	Test Readiness Review			
STM-2-5	Perform optical alignment	STM_ILT_ALIGN	Measure SOR wrt. HOR and D tool.	VRD-06, VRD-07, VRD-09, VRD-10
STM-2-6	Pump Down	CRY_PUMP		
STM-2-7	Cool to operating temperatures	CRY_COOL		
STM-2-8	Perform optical alignment	STM_ILT_ALIGN	Measure SOR wrt. HOR and D tool.	VRD-06, VRD-07, VRD-09, VRD-10
STM-2-9	Post test review			
STM-2-10	Warm up	CRY_WARM		
STM-2-11	Let up to air	CRY_LETUP		

Step	Activity	Identifier	Brief Description	Instrument Requirement
STM-2-12	Optical alignment check	STM_ILT_ALIGN	Measure SOR wrt. HOR and D tool.	VRD-06, VRD-07, VRD-09, VRD-10
STM-2-13	Remove from cryostat	CRY_DEINT	Disconnect FPU from cryostat, remove HOB simulator from cryostat and install on MGSE.	
STM-3	**STM Warm Vibration**	**STM_ILT_VIB**		
STM-3-1	Transfer SPIRE to vibration facility	STM_ILT_INTG	Bag up spire and move to vibration facility. Transfer FPU to vibration fixture.	
STM-3-2	Test Readiness Review			
STM-3-3	Perform optical alignment check	STM_ILT_ALIGN	Measure SOR wrt. HOR and D tool.	VRD-06, VRD-07, VRD-09, VRD-10
STM-3-4	Perform vibration tests	STM_ILT_VIB RAL_VIB	3 axis vibration of FPU structure	VRD-01 VRD-02
STM-3-5	Perform optical alignment check	STM_ILT_ALIGN	Measure SOR wrt. HOR and D tool. Check for changes in alignment	VRD-06, VRD-07, VRD-09, VRD-10
STM-3-6	Inspect structural integrity	ILT_INSP	Visual inspection of the SPIRE structure following vibration test.	VRD-02
STM-3-7	Post test review			
STM-4	**STM Cold Thermal Verification**	**STM_ILT_THER**		
STM-4-1	Integrate SPIRE onto support frame	STM_ILT_INTG	Lift instrument onto MGSE and build up support frame.	
STM-4-2	Transfer SPIRE to clean room	STM_ILT_INTG	Bag up the FPU and HOB simulator and transfer to cryolab. Remove from support frame and lift onto optical bench.	
STM-4-3	Install STM Cooler	STM_ILT_INTG	Remove covers and install STM cooler.	
STM-4-4	Integrate SPIRE onto support frame	STM_ILT_INTG	Lift instrument onto MGSE and build up support frame.	
STM-4-5	Return STM to cryolab	STM_ILT_INTG	Bag up the FPU and HOB simulator and transfer to cryolab.	
STM-4-6	Integrate SPIRE into cryostat	CRY_INTG	Move instrument into cryostat, connect thermal straps, harness. Close up radiation shields, making light tight.	
STM-4-7	Test readiness review			
STM-4-8	Pump Down	STM_ILT_THER CRY_PUMP		
STM-4-9	Cool to operating temperatures	STM_ILT_THER CRY_COOL		VRD-12, VRD-14
STM-4-10	Measure thermal performance	STM_ILT_THER		VRD-12, VRD-14
STM-4-11	Test review			
STM-4-12	Warm up	STM_ILT_THER CRY_WARM		VRD-12, VRD-14
STM-4-13	Let up to air	STM_ILT_THER		

Step	Activity	Identifier	Brief Description	Instrument Requirement
		CRY_LETUP		
STM-4-14	Remove from cryostat	CRY_DEINT	Disconnect FPU from cryostat, remove HOB simulator from cryostat and install on MGSE.	
STM-5	**STM Cold Vibration**	**STM_ILT_VIB**		
STM-5-1	Prepare SPIRE for shipping to CSL	STM_ILT_INTG	Bag up the FPU and HOB simulator and transfer to cryolab. Remove from support frame and lift into transport container.	
STM-5-2	Ship to CSL			
STM-5-3	Unpack SPIRE and inspect on arrival at CSL	ILT_INSP	Visual inspection of the SPIRE structure following transportation.	VRD-10
STM-5-4	Transfer SPIRE to vibration rig	STM_ILT_INTG	Transfer FPU to vibration fixture.	
STM-5-5	Test Readiness Review			
STM-5-6	Perform optical alignment check	STM_ILT_ALIGN	Measure SOR wrt. HOR and D tool.	VRD-06, VRD-07, VRD-09, VRD-10
STM-5-7	Perform vibration tests	STM_ILT_VIB CSL_VIB	3 axis vibration of FPU structure at cryogenic temperatures.	VRD-01 VRD-02
STM-5-8	Perform optical alignment check	STM_ILT_ALIGN	Measure SOR wrt. HOR and D tool. Check for changes in alignment	VRD-06, VRD-07, VRD-09, VRD-10
STM-5-9	Inspect structural integrity	ILT_INSP	Visual inspection of the SPIRE structure following vibration test.	VRD-02
STM-5-12	Post test review			
STM-5-13	Prepare SPIRE for shipping to RAL	STM_ILT_INTG	Remove from vibration fixture and install into transportation container on HOB simulator.	
STM-5-14	Ship to RAL			
STM-5-15	Unpack SPIRE and inspect on arrival at RAL	ILT_INSP	Visual inspection of the SPIRE structure following transportation.	VRD-10
STM-6	**STM Cold Thermal Verification**	**STM_ILT_THER**	**Repeat thermal verification test after cold-vibration.**	
STM-6-1	Integrate SPIRE onto support frame	STM_ILT_INTG	Lift instrument onto MGSE and build up support frame.	
STM-6-2	Transfer SPIRE to clean room	STM_ILT_INTG	Bag up the FPU and HOB simulator and transfer to cryolab. Remove from support frame and lift onto optical bench.	
STM-6-3	Install STM Cooler	STM_ILT_INTG	Remove covers and install STM cooler.	
STM-6-4	Integrate SPIRE onto support frame	STM_ILT_INTG	Lift instrument onto MGSE and build up support frame.	
STM-6-5	Return STM to cryolab	STM_ILT_INTG	Bag up the FPU and HOB simulator and transfer to cryolab.	
STM-6-6	Integrate SPIRE into cryostat	CRY_INTG	Move instrument into cryostat, connect thermal	

Step	Activity	Identifier	Brief Description	Instrument Requirement
			straps, harness. Close up radiation shields, making light tight.	
STM-6-7	Test readiness review			
STM-6-8	Pump Down	CRY_PUMP		
STM-6-9	Cool to operating temperatures	CRY_COOL, STM_ILT_THERM		VRD-12, VRD-14
STM-6-10	Measure thermal performance	STM_ILT_THERM		VRD-12, VRD-14
STM-6-11	Test review			
STM-6-12	Warm up	CRY_WARM, STM_ILT_THERM		VRD-12, VRD-14
STM-6-13	Let up to air	CRY_LETUP		
STM-6-14	Remove from cryostat	CRY_DEINT	Disconnect FPU from cryostat, remove HOB simulator from cryostat and install on MGSE.	
STM-7	**STM De-Integration**			
STM-7-1	Transfer SPIRE to clean room	STM_ILT_INTG	Bag up the FPU and HOB simulator and transfer to cryolab. Remove from support frame and lift onto optical bench.	
STM-7-2	Remove sub-system STMs	STM_ILT_INTG	Remove covers and STM subsystems.	
8	**STM Post Test Review**			

6 Test Procedure List

This section lists the main test procedures to be used for the STM AIV. For each major step there is a high level procedure that references other standard procedures such as those for operating the facilities. All necessary test procedures must be approved at the test readiness reviews.

6.1 STM ILT Master Procedure (STM_ILT_AIV)

The master procedure will cover the complete STM AIV phase from delivery of the STM structure to the start of the CQM phase.

6.2 STM Optical Alignment Procedure (STM_ILT_ALIGN)

This procedure will cover all the activities defined in the optical alignment verification plan. The procedure will include the alignment tests to be performed during mechanical integration and the cold test campaigns.

6.3 STM Thermal Verification Procedure (STM_ILT_THER)

This procedure will describe the full sequence of activities for the thermal verification tests. The procedure will be based on the thermal test plan and will define the test conditions, instrument performance tests and all success failure criteria.

6.4 STM Warm Vibration Procedure (STM_ILT_VIB)

This procedure will describe the full sequence of activities for the instrument warm vibration tests. The procedure will be based on the TBD plan and will define the input levels, the instrument functional tests, optical alignment checks and all success failure criteria.

6.5 STM Cold Vibration Procedure (STM_ILT_VIB)

This procedure will describe the full sequence of activities for the instrument cryogenic vibration tests to be performed at CSL. The procedure will be based on the TBD plan and will define the thermal conditions, input levels, instrument functional tests, optical alignment checks and all success failure criteria.

6.6 General Procedures

The following are more general procedures that will be called up by the main test procedures.

6.6.1 Visual inspection (ILT_INSP)

This will describe how the visual inspection of the mechanical structure is to be performed upon delivery of the instrument to RAL, before and after environmental test campaigns (i.e. vibration, thermal) and upon delivery to ESA. This procedure will be defined by MSSL.

6.6.2 Structure Mechanical integration (ILT_INTG)

This will describe the full sequence of activities to integrate the SPIRE structure. This procedure will be produced by MSSL.

6.6.3 Cryostat integration procedures

SPIRE test facility procedures describing the steps to prepare and install SPIRE into the test cryostat (CRY_INT) and removal of SPIRE from the test cryostat (CRY_DEINT)

6.6.4 Cryostat operations procedures

This will be a set facility procedures describing the safe operation of the calibration cryostat. The procedures will cover the sequence for pumping down (CRY_PUMP), cryogenic cool-down (CRY_COOL), operation at test conditions, warm-up (CRY_WARM) and let-up to air (CRY_LETUP).

6.6.5 STM subsystem functional test procedures

To ensure that the instrument subsystems are performing correctly, functional tests will be executed at the various stages of the AIV phase. The following test levels are proposed:

- Warm Functional Test (WFT)– basic test to be performed at room temperature. The main purpose will be to check that electrical connections are intact.
- Cold Short Functional Test (CSFT)– the minimum level of test required to check that the subsystem is functioning correctly.
- Cold Full Functional Test (CFFT)– a thorough test verifying the performance of the instrument subsystem. This test would normally be performed before and after an environmental test to confirm that the subsystem characteristics have not been affected.

The subsystem providers will initially define the tests, providing the required test configuration, command sequences (if applicable) and success/failure criteria.

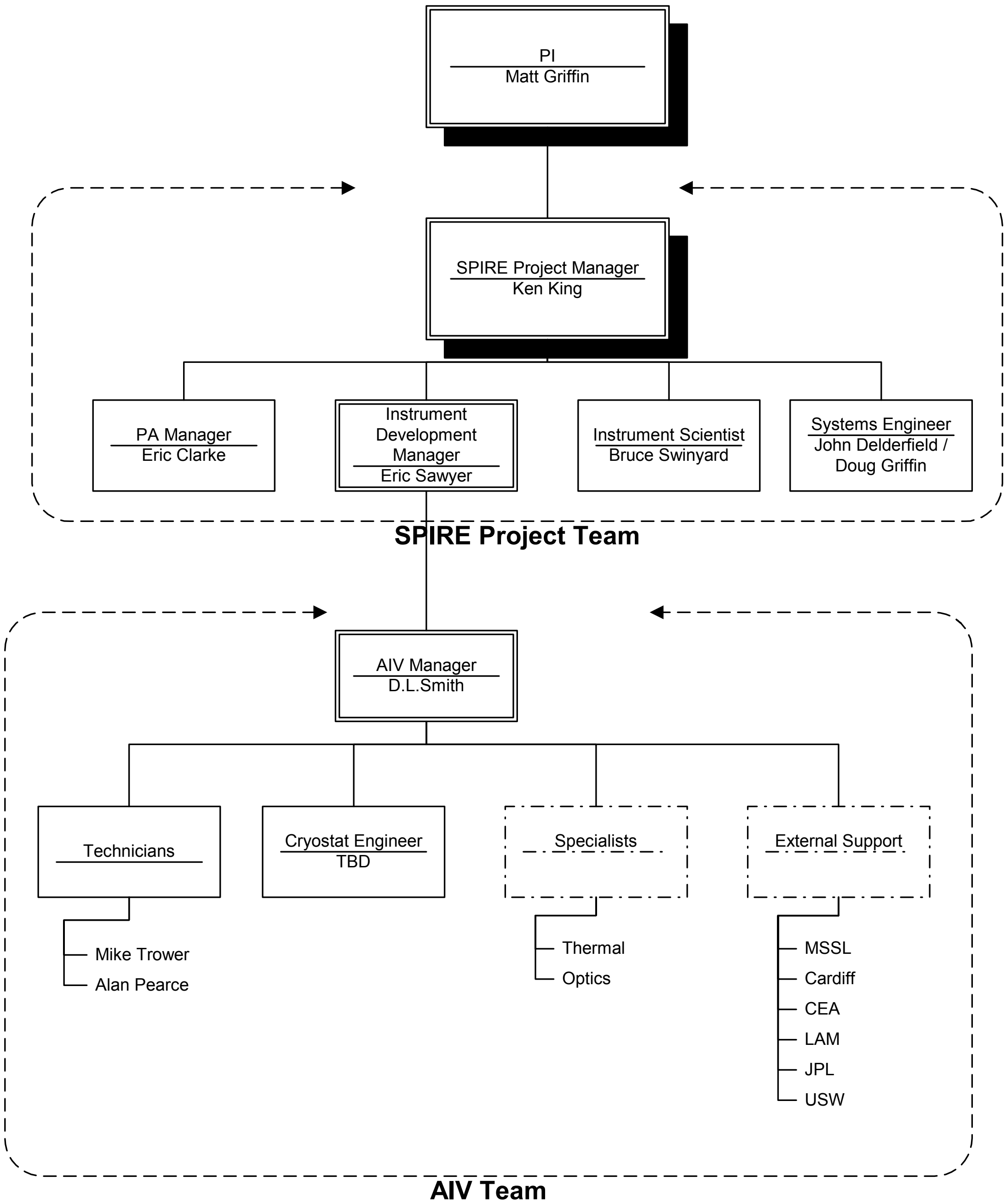
6.6.6 RAL Vibration facilities procedures (RAL_VIB)

This will be a standard facility procedure for the preparation and safe operation of the vibration facility.

6.6.7 CSL vibration facilities procedures (CSL_VIB)

This will be a set of standard procedures for the preparation and safe operation of the cryogenic vibration facility.

7 Organisation



STM AIV Organisation

8 Resource Requirements

8.1 Manpower

This section describes the roles and responsibilities of the personnel required to support the STM integration and test activities. The majority of the team will be from RAL, but specialists from the SPIRE subsystem providers will also be required to support the AIV activities.

8.1.1 AIV Team

8.1.1.1 AIV Manager

- Planning and co-ordinating the AIV activities including the mechanical and electrical integration, verification tests and calibration.
- Responsible for obtaining agreement, prior to the commencement of any activity, of test plans and procedures.
- Responsible for decisions requiring work-around plans, modification of test procedures, repeat tests etc arising from non-conformance reports.
- Co-ordinate activities of technical experts, technicians during AIV phase.
- Prepare review documentation and acceptance data packs.
- Reports to Instrument Development Manager

8.1.1.2 Cryostat Engineer

- Preparation of cryostat for instrument tests
- Operation of cryostat during instrument tests
- Ensure supply of cryogens
- Clean room maintenance

8.1.1.3 Technicians

- Mechanical integration of instrument
- Test support
- Preparation of instrument for testing and transport

8.1.2 Specialist Support

8.1.2.1 Optics Specialist

- Optical alignment verification
- Stray light analysis

8.1.2.2 Thermal Engineer

- Thermal modeling and analysis
- Thermal test plan
- Support for thermal tests.

8.1.3 SPIRE Project Team

8.1.3.1 SPIRE Project Manager

- SPIRE Project Management
- UK SPIRE Management

8.1.3.2 Instrument Development Manager

- Subsystem Development
- Subsystem Deliveries

- Instrument Deliveries

8.1.3.3 Instrument Scientist

- Instrument performance
- AIV Plan
- Calibration Plan
- Optical Straylight Analysis

8.1.3.4 Systems Engineer

- Systems engineering
- System thermal design
- Parts procurement

8.1.3.5 PA Manager

- Product assurance
- Quality assurance
- Acceptance data packages

8.1.4 External Support

Support from the instrument subsystem providers will be required during the AIV activities. They will not be expected to perform the integration tasks but rather be on hand to provide technical support when needed.

8.1.4.1 MSSL

- Support mechanical integration, optical alignment and thermal tests.

8.1.4.2 LAM

- Support optical alignment activities.
- Support the integration and testing of the STM SMEC.

8.1.4.3 Cardiff

- Support integration of the SCAL, PCAL, 300mK strap system, optical filters and thermal verification tests.

8.1.4.4 JPL

- Support integration and alignment of detector modules, and integration of JFET units.

8.1.4.5 ATC

- Support integration and testing of the BSM units.

8.1.4.6 Grenoble

- Support integration of the cooler systems and thermal verification tests.

8.1.4.7 USW

- Support integration and tests of the STM shutter.

8.2 Facilities

The following facilities are required for the SPIRE STM AIV activities.

8.2.1 Cryogenic Test Facility

The SPIRE dedicated cryostat facility will be used for the cold optical alignment and thermal verification tests [RD 3]. The instrument and cryostat will be in a class 1000 clean area. Access to the clean room will be limited to key personnel to minimise any potential contamination of the optics.

For the optical alignment tests the cryostat will house only the cold FPU. Because the alignment will be performed at visible wavelengths, the instrument filters will not be installed and the cryostat filters will be replaced with quartz windows. This will obviously affect the thermal loads on the instrument and hence the performance of the cryostat.

The cryostat will be reconfigured for the thermal verification tests, replacing the quartz windows with the blocking filters supplied by Cardiff University.

8.2.2 Assembly Clean Rooms

Mechanical and electrical integration of the SPIRE FPU will be conducted in Clean Room 2 within building R25 at RAL. The room comprises[1]

- Main area: 12m x 7m class 10,000
- Horizontal laminar flow unit: 5m x 3m at class 100
- 2 laminar flowbenches: 1m x 0.5m at class 100
- Central changing room: lockers for up to 20 people
- Cleaning facility: Ultrasonic bath,fume cupboards

8.2.3 Mechanical Inspection Facility

The 3D metrology of the SPIRE structure and optical interfaces will be performed at the RAL inspection facility. This has temperature-controlled inspection facilities having the ability to measure components by conventional or optical means. Co-ordinate Measuring Machines (CMM) are also available. These can be used conventionally, or in a non-contact mode using an optical microprobe.

8.2.4 Warm Vibration Facility

The vibration facility at RAL will be used for the warm vibration tests. Details of this facility can be found in RD 4.

8.2.5 Cryogenic Vibration Facility

[1] Extracted from RAL document ISO9:SPAP/AIV/000

8.3 EGSE

For the STM instrument level test campaign the warm electronics units (DRCU, DPU) will not be present. Therefore the full EGSE-ILT configuration (see RD 5) will not be required since there will be no instrument commanding and telemetry. Nevertheless, EGSE will be required to monitor and control the cryostat, the STM cooler and the instrument temperatures.

The Test Facility Control System will be required for monitoring the cryostat temperatures, cryogen levels and vacuum pressure during the STM tests. Control and monitoring of the telescope simulator is also required for the optical alignment checks. For the STM tests the TFCS will be run autonomously (i.e. not from SCOS-2000) and will therefore be required to log all data from the test campaigns.

In addition to the cryostat temperatures, it will be necessary to provide monitoring of the instrument thermometers and control the STM subsystem heaters. The EGSE requirements for this are TBD.

The STM will have a mechanically representative cooler that will be supplied with its own EGSE including drive electronics, temperature readout, heater control and data logging system.

8.4 OGSE

8.4.1 Alignment Tools

A suite of dedicated alignment tools will be provided by LAM as defined in AD 12.

8.4.2 Telescope Simulator

The telescope simulator will be used for the end-to-end alignment tests at cryogenic conditions.

8.5 MGSE

8.5.1 Transportation Container

A purpose built (TBC) transportation container provided by MSSL will be used whenever SPIRE is to be moved between facilities (i.e MSSL, RAL, CSL, ESTEC).

8.5.2 HOB Simulator

The HOB simulator will be the primary mechanical interface between the SPIRE FPU and the calibration cryostat. It will have a number of optical references to enable optical alignment measurements to be performed. To ensure that optical alignment between the references on the SPIRE optical bench and the HOB are maintained throughout integration and testing, the HOB simulator will act as the main integration plate and will travel with the instrument in the transportation container.

8.5.3 Support Trolley

SPIRE will be mounted on the HOB simulator with the +X axis up during mechanical integration and transport. However, because the SMEC cannot work against gravity the instrument has to be rotated by 90° so that the +Y axis is up. A purpose built support trolley will be provided to rotate the integrated FPU and JFET units on the HOB simulator about 90° in a controlled manner. The trolley will also allow the instrument to be moved between the AIV clean rooms and the cryogenic test facility.