GSE overview

Prepared by:

E.C.Sawyer (RAL) Date

Checked:

K. King (RAL) Date

Distribution

RAL	Ken King
	Eric Sawyer
	Bruce Swinyard
	Eric Clark
	John Delderfield
	Doug Griffin
	Dave Smith
Cardiff	Matt Griffin (PI)
	Peter Hargrave
CEA	Jean-Louis Augueres
JPL	Jerry Lillienthal
LAM	Dominique Pouliquen
	Kjetel Dohlen
MSSL	Berend Winter
	Chris Brockley-Blatt
ATC	Ian Pain
USK	Don Peterson
IFSI	Riccardo Cerulli-Irelli
	Anna Di Giorgio

Host system	Windows 2000 SP2
Word Processor	Microsoft Word 2000 SR1
File	GSE overview.doc

CCLRC Rutherford Appleton Laboratory, Chilton, Didcot, Oxfordshire OX11 0QX, United Kingdom

Tel: (44) +1235 445861 - Fax (44) +1235 445848

Document Change Record

Date	Index	Affected Pages	Changes
3-Feb-2002	0.1	All	First Draft

Contents

1 Scope of Document

This document is designed to give an overview of all the major GSE associated with the SPIRE instrument.
Further details can be found in the detailed AIV procedures.

2 Documents

2.1 Applicable Documents

AD01	EGSE User Requirements Document (FIRST-SPI-DOC-000102) 4th September 2000
AD02	Instrument Interface Document Part A (SCI-PT-IIDA-04624)
AD03	Instrument Interface Document Part B (SCI-PT-IIDB/SPIRE-02124)
AD04	Packet Structure Interface Control Document (SCI-PT-ICD-7527)
AD05	EGSE-ILT User Requirements Document (FIRST-SPI-DOC-000127)
AD06	Herchel EGSE Router Statement of Work (SRON-U/HIFI/SP/2001-5)
AD07	EGSE Test Control User Requirements Document
AD08	HCSS User Requirements Document (FIRST-FSC-DOC-0115)
AD09	Test Equipment Interface User Requirements Document (SRON-U/HIFI/SP/2001-009)
AD10	DRCU Simulator User Requirements Document (SPIRE-RAL-PRJ-000910)
AD11	FPU Simulator Requirements Document
AD12	QLA User Requirements Document (SPIRE-RAL-PRJ-000999)
AD 13	SPIRE Optical Alignment Verification Plan (SPIRE-LAM-PRJ-000445 Issue 3) 10-Apr-2001
AD 14	SPIRE Alignment Tools Specification (LAM.PJT.SPI.SPT>20000xInd0)

2.2 Reference documents

	Title	Reference	Date
RD1	Common Instrument EGSE Concepts)	(FIRST-SPI-NOT-000097	8th March 2000
RD2	SPIRE AVM Definition,	(SPIRE-RAL-COM-000387)	17th April 2000
RD 3	Instrument AIV Plan	SPIRE-RAL-PRJ-000410 Issue 2.1	29-Mar-2001
RD 4	Instrument Integration Plan	SPIRE-MSS-PRJ-000652 Issue 0.1D	Apr-2001
RD 5	SPIRE CQM Instrument Level Test Plan	SPIRE-RAL-DOC-000 Issue 0.1D	19 Dec-2001
RD 6	SPIRE Test Facility Requirements Specification	SPIRE-RAL-PRJ-000463 Issue 1.3	2-April-2001
RD 7	AIV Facility Description	ISO9:SPAP/AIV/000	01-July-2000

3 EGSE

3.1 Introduction

The SPIRE EGSE consists of those electrical systems, which together provide the functionality required to test and operate the SPIRE instrument at various stages of its development. The environments under which the EGSE will be used include: Instrument-Level Tests (ILT), performed at RAL; Integrated System Tests (IST), performed at ESA, the S/C Prime Contractor and the launch sites; and Commissioning Phase tests, performed at the Herschel MOC.

In addition, the EGSE also includes those tools and simulators required to install and simulate the instrument at any of the test sites.

It has been agreed that an important contribution to minimising the resource requirements for the development and operation of the Herschel satellite is a common approach to instrument testing and in-flight operations, with the maximum reuse of equipment and software in all phases of the mission. In addition, it is advantageous for the three scientific instruments to collaborate on development of a common instrument test system (EGSE) to minimise the effort required, by removing duplication of work. Discussions have been held between the three Herschel instruments and ESA/ESOC, which have led to an agreed design for the EGSE, which is being implemented by all instruments.

3.2 EGSE Systems

3.2.1 Instrument -Level Testing

Figure 3-1 shows the complete EGSE used for instrument-level tests (ILT). Each EGSE system is shown as a shaded box. The different systems are the responsibility of different parties (instruments and ESA) and are described below:

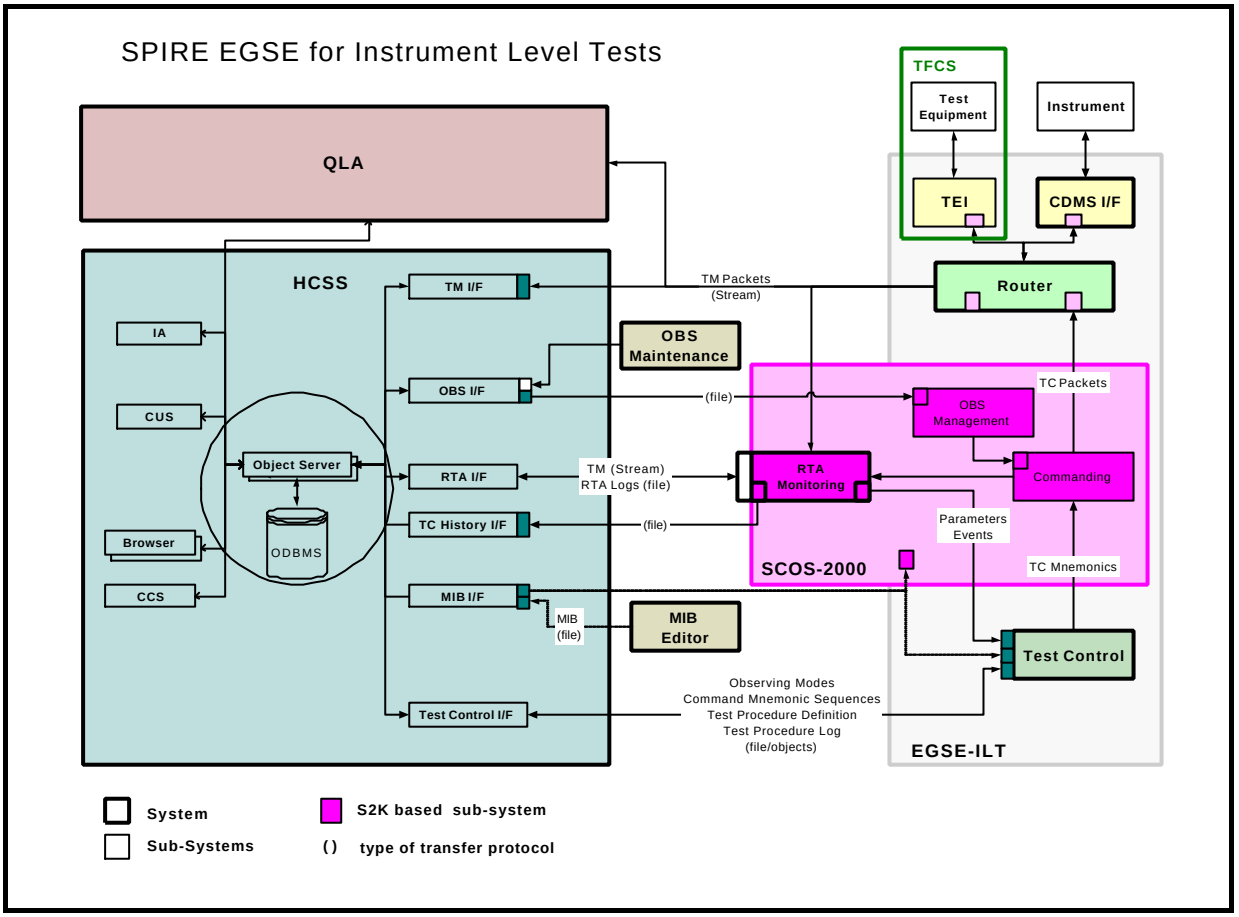

Figure 3-1 EGSE Configuration for ILT

3.2.1.1 CDMS Simulator

This system provides the following functionalities:

- Simulation of the S/C hardware interface towards the instrument and the low-level (datalink layer) protocol between the S/C and instrument. This is specified in the IID Parts A (AD02) and B (AD03) and is an implementation of the Mil Std 1553B bus.
- Simulation of the high-level data transfer protocol between the S/C and instrument for the transfer of TC and TM packets and time synchronisation. This is specified in the Packet Structure ICD (AD04).
- Transfer of TC/TM packets to/from the Router used to distribute the packets around the EGSE system.
- Testing of the instrument implementation of the high-level data transfer protocol. (The low-level hardware and protocol interface will be tested by IFSI)

The requirements are described in AD05.

3.2.1.2 Router

This system provides a general purpose TC/TM packet distribution system which allows EGSE systems to access TC/TM data. The requirements for this system are included in the Router Statement of Work (AD06)

3.2.1.3 Test Control

This system provides the ability to write test procedures in terms of scripts which may issue commands and take action based on returned telemetry. The requirements on this system are described in the Test Control User Requirements Document (AD07)

3.2.1.4 SCOS2000

This system will be used by the MOC for controlling the spacecraft. The current version of SCOS is developed for ESOC and does not contain all the functionality required for use as part of the EGSE. The additional functionality will be provided by ESTEC and MPE.

3.2.1.5 MIB Editor

This system provides a method of creating/editing the contents of the Mission Implementation Base used by SCOS2000 to convert TC mnemonics to TC packets and to extract, convert, monitor and display telemetry parameters

3.2.1.6 OBS Maintenance Facility

This facility is provided by the OBS developers (IFSI), to allow the generation of OBS patches.

3.2.1.7 HCSS (Formerly FCSS)

This system performs the functions of

- Ingesting telemetry and delivering it to other systems for analysis and display, both in real-time and playback modes.
- Generation of command sequences for uplink by SCOS2000
- Archive of all data (uplink and downlink) generated during testing

The EGSE uses versions 0.1 and 0.2 of this system as they contain the functionality required. Later versions of the HCSS are used in the ground segment and provide additional functionality (e.g. proposal handling, scheduling) that are not required for testing.
The requirements on this system are described in AD08.

3.2.1.8 TEI

This system provides a simple interface to test equipment. The requirements are described in AD09.

3.2.1.9 QLA

This system is used to display, process and analysis telemetry data from the instrument both during and after the tests.

3.2.2 Other Test Environments

A reduced number of systems are required for instrument-level tests (IST) and the commissioning phase. The configuration for these environments is shown in Figure 3-2 and Figure 3-3. A summary of the deliverables for these two phases is given in Table 3-1.

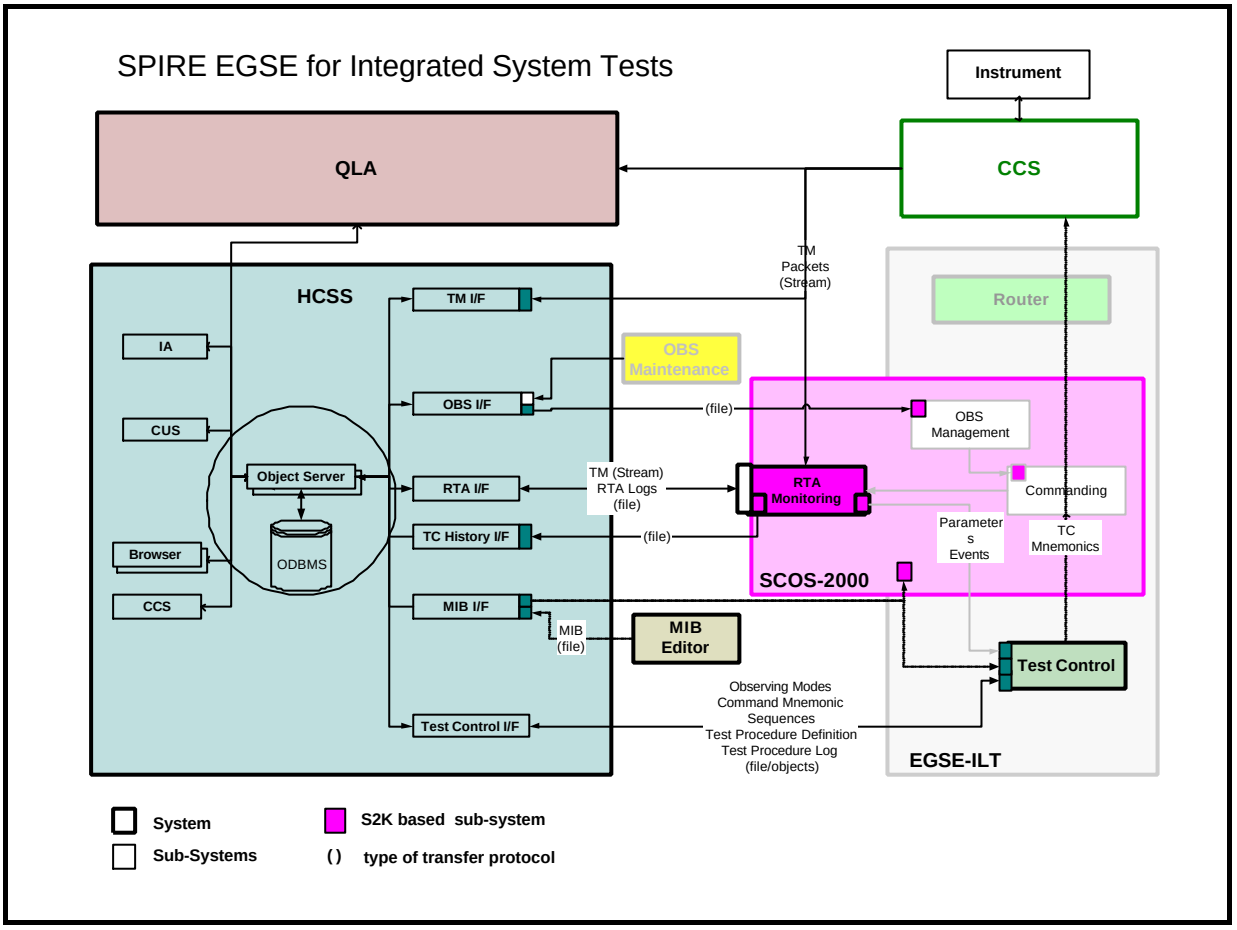

Figure 3-2 EGSE Configuration for IST

3.2.3 Simulators

3.2.3.1 DRCU Simulator

The DRCU Simulator forms part of the deliverable Avionics Model (AVM) of the instrument (see RD-02), and is also used during the acceptance testing of the DPU at IFSI and RAL. As such it is subject to the product assurance and configuration control requirements applied to all SPIRE deliverables

This system simulates the DRCU and FPU units of the instrument to allow integration testing of the EGSE Test systems and testing of the DPU and OBS by providing simulated housekeeping and science telemetry. The requirements are described in AD10.

3.2.3.2 FPU Simulator

This system simulated the operation of the FPU and FTB instrument subsystems allowing the DRCU to be testing with representative analogue signals. It is used during installation of the DRCU in the test environments. The requirements are described in AD11.

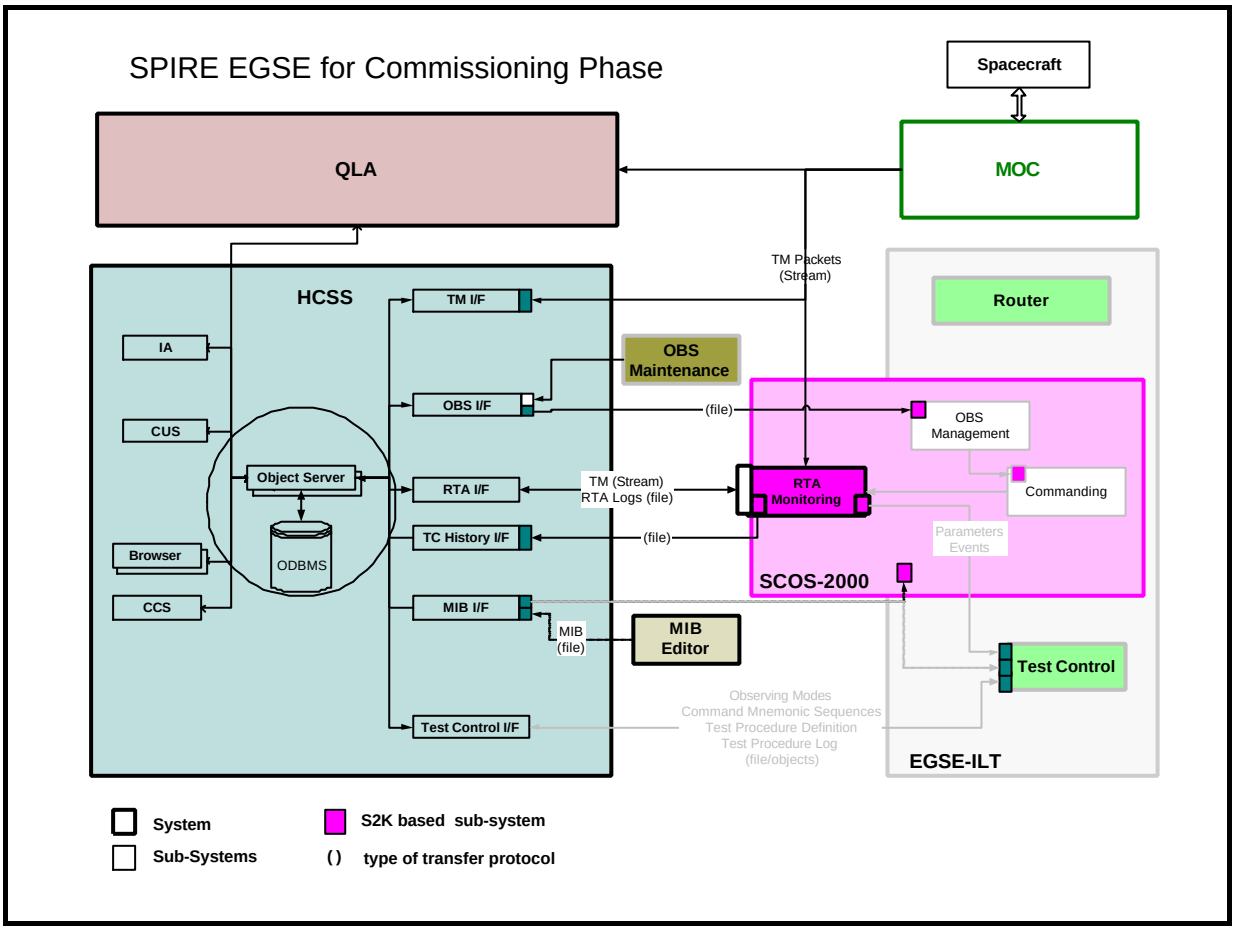

Figure 3-3 EGSE Configuration for Commissioning Phase

3.3 Deliverables

The following table indicates the systems provided for each environment.

The set of IST equipment will be provided to ESA with the first instrument model delivery (AVM) and will be used for all subsequent testing at the payload and spacecraft system level (i.e. at ESTEC, Alcatel and the launch site). ESA is responsible for transport of the systems between sites after first delivery. SPIRE will support installation at each site (TBC).

Note: it is assumed that other instruments provide a similar set of equipment and this will provide sufficient redundant systems.

Subsystem	**ILT**	**IST**	**Commissiong Phase**	**Comments**
CDMS Simulator	3	1	-----	One ILT unit delivered to IFSI Redundant system at RAL
Router	3	------	------	One ILT unit delivered to IFSI Redundant system at RAL
Test Control	2	1	-----	Redundant system at RAL
SCOS2000	2	1	1	Redundant system at RAL
MIB Editor	1	1	1	
OBS Maintenance Facility	1	-----	-----	
HCSS	2	1	1	Redundant system at RAL
TEI	-----	-----	------	Not Used
QLA	2	1	1	Redundant system at RAL
DRCU Simulator	2	1	------	One ILT unit delivered to IFSI IST unit forms part of the AVM
FPU Simulator	1	(1)	------	IST delivery is temporary, for installation of warm electronic units only

Table 3-1 EGSE Deliverables

4 OGSE

The alignment verification plan for the SPIRE instrument calls for several phases of verification. These are detailed in the SPIRE Alignment Verification Plan (SPIRE-LAM-PRJ-000445) or (LOOM.KD.SPIRE.2000.001). In brief the stages are as follows:

1. Mechanical inspection of the mirror mount interfaces using a 3-D position measurement machine
2. Integration and alignment verification of the mirrors using visible light optical methods
3. Verification of the alignment of the complete optics train warm using visible light optical methods
4. Verification of the instrument alignment on the Herschel Optical Bench following cooldown using visible light optical methods
5. Verification of the instrument internal optical alignment following cooldown using visible light optical methods
6. Final verification of the instrument optical alignment using Far-Infrared radiation with the bolometer detectors in place.

The plans calls for the use of the following pieces of optical support equipment – for a detailed description of the SPIRE specific alignment tools see the Alignment Tool specification (LAM.PJT.SPI.SPT.20000x Ind0):

Tool	Functions	Description	Note
3-D Position Measurement Equipment	Used to verify the position of each mirror interface before installation of the mirrors in conjunction with the "3D Tool"		Available at RAL
Herschel telescope simulator	Used to simulate the FIR beam from the Herschel telescope. Used for the final verification of the optical alignment of the instrument	Combination of powered mirror and flats that gives the correct f-number and focal surface to the SPIRE instrument. (See SPIRE-RAL-NOT-000621 and SPIRE-RAL-NOT-000622)	Available at RAL
Visible window for cryostat	A special vacuum window that allows transmission of visible wavelengths is required for the cryostat to allow for visible light optical alignment	288 mm diameter clear aperture silica glass wedged window fitted into standard vacuum flange	Provided as part of the SPIRE test cryostat
MAT	used to check the position of the reticule on the alignement tools	Standard Micro Alignment Telescope	Used at room temperature only
Apex Tool	Used to check the position of each mirror Apex in the SPIRE structure.	An aluminium flat mirror with a central reticule whose plane is at the real mirror Apex distance from the interface plane with the SPIRE structure.	Used at room temperature only
3D Tool	Used to check the position of each mirror interface with the SPIRE structure.	An aluminium monobloc piece associating a disk and a sphere.	Used at room temperature only
D Tool	Acts as a source in the place of the detectors.	A plate containing central and peripheral sources. Each source is individually lightable.	Used at room temperature only.
CCA Tool	Replaces SMECm during the spectrometer alignment.	Corner cubes mirrors placed at the ZPD position (TBC)	Used at room temperature only.
CS-Tool	Materializes the cold stop location	A glass plate with central reticule	Used at room temperature only
O-Tool	Materializes the SPIRE object plane	A glass plate with central and perophperal reticules	Used at room temperature only
M2-Tool	Materializes the telescope pupil (M2)	A glass plate with central and peripheral reticules	Used at room temperature only
PSD-Tool	Used to check the position of the incoming beam on the entrance	2-D position sensitive diode	Used at room and croygenic

	plane of the detectors.		temperature.

5 MSGE

The MGSE for Spire consists of the following items.

- Assembly jig.
- HOB simulator
- Support trolley
- Transport container
- The SPIRE Calibration Facility

Assembly jig.
This jig consists of a baseplate and 'A' frames that allows the FPU to be supported and rotated to enable integration to be performed. It will be designed and manufactured by MSSL.

HOB simulator.
As the name implies this equipment simulated the optical bench within the Herschel cryostat. It forms part of the SPIRE calibration facility and supports all the SPIRE units that fit on the HOB. It is also used as a baseplate in the transport container.

Support trolley
This is used to load the instrument and HOB simulator into the SPIRE calibration facility.

Transport container.
The AVM will be supplied in rigid re-usable containers.
One instrument transport container will be produced. The container will be of a type commonly used for this purpose and will contain the necessary vibration isolation and environmental protection necessary to ensure adequate protection of the instrument.
The container will be used for the CQM and then re-used for the FM and FS.
Warm electronics units will be supplied in rigid re-useable containers.
EGSE will be supplied in rigid re-useable containers.

The SPIRE Calibration Facility.
This is a purpose built facility that replicated conditions similar to on orbit. It consists of a cryostat with reference sources and a telescope simulator together with the necessary EGSE to operate the instrument and the facility.
The requirements are specified in SPIRE-RAL-PRJ-000463.