



**SUBJECT:** ICC Software Project Management Plan

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**Project Document**

**ICC Software Project Management  
Plan**

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**Change Record**

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<b>Project Document</b>
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## 1. INTRODUCTION

This document presents an overview of the plan for the development of software for the SPIRE Instrument Control Centre (ICC). The ICC is a key part of the ground segment of the Herschel Space Observatory mission. The ground segment is a collaborative development between ESA and the scientific instruments on Herschel: SPIRE, PACS and HIFI. NASA is also involved as part of the NASA Herschel Science Centre. An implication of this collaboration is that the ICC acts both as a customer and as a supplier for the software.

The SPIRE ICC itself is comprised of:

- The ICC Operations Centre at RAL.
- Three “Data processing And Science Analysis Software” centres at:
  - Imperial College, London
  - Saclay, France
  - University of Lethbridge, Canada
- Contributions from other institutes, including:
  - University of Cardiff
  - University of Sussex
  - IPAC, USA
  - NAO, China
  - Padova, Italy
  - LAM, France
  - IAC, Tenerife

The institutes listed above contribute to SPIRE software and form part of the development team.

### 1.1 Scope

The elements that comprise this development are:

- Herschel Common Science System (HCSS).
- SPIRE data processing software. This includes pipeline processing, interactive analysis and data visualisation tools.
- Calibration and Trend Analysis software.
- Quick Look Analysis software.
- Miscellaneous tools.

Two additional EGSE subsystems that were developed by a different group to the ICC now come under ICC change control although their development is *not* within the scope of this document. These are:

- CDMS simulator
- Test Facility Control System (TFCS)

Note however that [AD2] is now applicable to the part of the CDMS code that is written in C. While this was not true of this code during its development, it is now configuration controlled in the same way as other ICC software. The EGSE systems as a whole are described in [AD8].

The HCSS is a shared development with the other contributors to the ground segment, under coordinating ESA management, see [AD4]. It includes common data processing software. The ICC contributes to this development.

Whilst the other elements fall under the management of the SPIRE ICC, their development shares the same general organisation, responsibilities, methodologies, tools, and key milestones of the Herschel ground segment in general. The SPMP for the HCSS [AD4] therefore remains applicable to the



developments also led by the SPIRE ICC. An additional SPMP describes additional tasks identified for “extended” Herschel data processing tasks, see [AD5].

These terms are used in this document with respect to common developments:

- **“Core HCSS”**: This refers to the software required to support the core operation of the Herschel Science Ground Segment. It excludes any data processing software.
- **“Common Data Processing”**: This refers to commonly developed data processing software as originally scoped for the mission.
- **“Extended Data Processing”**: This refers to a further data processing software development being provided as a result of additional funding.
- **“HCSS”**: refers to all common development i.e. it is comprised of all of the above.

## 1.2 Documents

### 1.2.1 Applicable Documents

<b>AD1</b>	SPIRE ICC Work Packages	SPIRE-RAL-DOC-001198	1.2	28 <sup>th</sup> October 2002
<b>AD2</b>	ICC Software Configuration Management Plan	SPIRE-RAL-PRJ-001106	2.1	1 <sup>st</sup> September 2008
<b>AD3</b>	Pipeline Development Schedule	SPIRE-ICS-NOT-002786	1.2	18 <sup>th</sup> December 2006
<b>AD4</b>	HCSS Software Project Management Plan	FIRST/FSC/DOC/0116	8	2 <sup>nd</sup> May 2007
<b>AD5</b>	Extended Herschel Interactive Analysis and Data Processing Software Project Management Plan	Herschel/HSC/DOC/0555	2.0	23 <sup>rd</sup> May 2007
<b>AD6</b>	SPIRE HCSS Acceptance Test Plan	SPIRE-RAL-PRC-002456	1.1	6 <sup>th</sup> January 2006
<b>AD7</b>	HCSS Software Verification and Validation Plan	HERSCHEL/HSC/DOC/0284	1	20 <sup>th</sup> January 2003
<b>AD8</b>	EGSE User Requirements	FIRST-SPI-DOC-000102	D2	4 <sup>th</sup> September 2000

### 1.2.2 Reference Documents

<b>RD1</b>	SPIRE Product Assurance Plan	SPIRE-RAL-PRJ-000017	1.3	4 <sup>th</sup> January 2007
<b>RD2</b>	SPIRE Configuration Management Plan	SPIRE-RAL-PRJ-000626	1.3	28 <sup>th</sup> January 2002
<b>RD3</b>	SPIRE Science Implementation Plan	SPIRE-RAL-PRJ-000018	1.2.1	19 <sup>th</sup> December 2006
<b>RD4</b>	SPIRE ICC Scenarios	SPIRE-RAL-DOC-001195	1.0	3 <sup>rd</sup> May 2002
<b>RD5</b>	Software Engineering and Product Assurance Requirements for the FSC/ICC Common System	FIRST/FSC/DOC/0127	1.0	17 <sup>th</sup> August 2000
<b>RD6</b>	ECSS – Space Engineering – Software	ECSS-E-40A		13 <sup>th</sup> April 1999
<b>RD7</b>	ECSS – Space Product Assurance – Software Product Assurance	ECSS-Q-80A		19 <sup>th</sup> April 1996
<b>RD8</b>	SPIRE Functional Test Specifications	SPIRE-RAL-DOC-001652	1.4	22 <sup>nd</sup> July 2005
<b>RD9</b>	HCSS System Test Plan	HSC/DOC/0211	1.20	17 <sup>th</sup> May 2007
<b>RD10</b>	Herschel Data Processing System Test Plan	HERSCHEL-HSC-DOC-0846	2.0	
<b>RD11</b>	SPIRE Pipeline Description	SPIRE-RAL-DOC-002437	1.0	2 <sup>nd</sup> August 2008
<b>RD12</b>	SPIRE Calibration Plan	SPIRE-RAL-DOC-001866	0.1	12 <sup>th</sup> November 2003



### 1.2.3 List of Acronyms

<b>CDMS</b>	Command and Data Management System
<b>EGSE</b>	Electronic Ground Support Equipment
<b>ESA</b>	European Space Agency
<b>HCSS</b>	Herschel Common Science System
<b>HIFI</b>	Heterodyne Instrument for FIRST
<b>ICC</b>	Instrument Control Centre
<b>PACS</b>	Photoconductor Array Camera and Spectrometer
<b>QLA</b>	Quick Look Analysis
<b>SPIRE</b>	Spectral and Photometric Imaging Receiver
<b>TFCS</b>	Test Facility Control System
<b>UML</b>	Unified Modelling Language





## 2. ICC SOFTWARE DEVELOPMENT

The following topics are addressed by the HCSS Software Project Management Plan [AD4], and are applicable to all software development in the SPIRE ICC:

- Project phase breakdown.
- Project reviews.
- Managerial responsibilities.
- Project organisation.
- Tools, techniques and methodologies.
- Risk management plan.
- Initial schedule and milestones.

Further background is described in [RD3] and [RD4]. Configuration control procedures within the ICC are specifically described in the ICC Software Configuration Management Plan [AD2].

As noted above, all ICC software development subscribes to the methodology as described in [AD4]. This methodology is compatible with [RD5], which is a tailoring note to [RD6] and [RD7] to bring them into line with a more collaboration-focused model rather than a customer-supplier one. The development methodology includes the features:

- An iterative feature-driven development rather than a waterfall model.
- Modelling using the Unified Modelling Language (UML).
- Requirements expressed both with use cases (typically user-system interactions) and in “traditional” form (typically high-level), as appropriate.
- Object-oriented analysis and design.
- Continual integration and regular system builds.
- A strong focus on unit-testing.

### 2.1 HCSS Development

The SPIRE ICC will contribute to this development as described in [AD4].

Customer            All collaborators  
Schedule            [AD4]  
Work Packages    Appendix to [AD4]

#### 2.1.1 Software Verification and Validation

The high-level plan is described in [AD7].

System testing is an ESA responsibility and is covered in:

- [RD9] for “core” HCSS components
- [RD10] for common data processing components

Acceptance testing of the HCSS at the ICC is covered by [AD6]. This deals with “core” HCSS as well as some common data processing functionality. This acceptance test plan needs to be extended in future to cover more of the data processing functionality as it comes more into use.



## 2.2 SPIRE Data Processing Software

This development includes a data processing pipeline and an interactive analysis system. Formally it is a delivery by the ICC to ESA, although the ICC also depends on it itself.

Customer	ESA
Schedule	[AD4] common schedule [AD3] SPIRE-specific
Work Packages	[AD1] originally agreed contribution [AD5] "extended" data processing funded by ESA

### 2.2.1 Software Verification and Validation

In general, [AD7] applies with the following additions or remarks:

- The high-level data processing requirements are specified in [RD11].
- Each data processing module shall contain among its documentation:
  - A set of requirements. Use Cases are generally inadequate for capturing the requirements on these modules.
  - Specification and design, including descriptions of algorithms.
  - Detailed design as Javadoc comments.
  - User Guide input.
  - Test plan. These specify tests in *addition* to the required unit tests.
- Acceptance testing is an ESA responsibility.
- A scientific verification plan is **TBW** by the ICC.

## 2.3 Calibration and Trend Analysis

Customer	SPIRE ICC
Schedule	[AD3]
Work Packages	[AD1]

This is an additional development built on top of the Data Processing software. While these systems are an ICC responsibility there appears to be much potential commonality between the three instruments in the trend analysis area. The ICC will strive to reduce development costs in this area by sharing them where possible.

The software development in these areas falls into more than one category:

1. Software provided by the ICC software team to *support* the work of the calibration and operations teams. This may or may not be a common Herschel development.
2. Software produced by the calibration team to generate calibration data. This is a data analysis activity and is expected to be in the form of scripts.
3. Scripts produced by the calibration or operations teams for trend analysis activities, either routine or one-off.

### 2.3.1 Software Verification and Validation

The high-level requirements for this software are specified in [RD12].

- For software in category (1) above, [AD7] applies. Requirements may be specified in a form other than Use Cases, as appropriate.



- The following applies to the software in categories (2) and (3) above:
  - Configuration control procedures as specified in [AD2] normally apply. This requirement is waived for one-off trend analysis scripts.
  - Unit test harnesses are preferred but not required.
  - It shall be possible to trace calibration analysis scripts to their requirement, normally in [RD12].
  - Scripts that are run as part of an operational procedure shall be tested as part of a test plan or procedure.

## 2.4 Quick Look Analysis

The Quick Look Analysis software is used as part of the EGSE by the SPIRE ICC. It does however make use of common components from the HCSS and Data Processing software. Parts of the QLA are also reused for SPIRE-specific data processing software.

Customer        SPIRE ICC  
Schedule        [AD3]  
Work             [AD1]  
Packages

### 2.4.1 Software Verification and Validation

In general, [AD7] applies with the following additions or remarks:

- Use cases are supplemented with additional requirements to provide clarity and context.
- Scripts are provided by the instrument test team specific to functional, integration and performance tests of the instrument. Whilst these scripts are delivered with the QLA system, they are highly dependent on the real-time behaviour of the instrument, and it is therefore infeasible to provide unit tests for them. The unit test requirement is therefore waived in these cases.

Releases of the QLA are tested in two phases:

1. As a part of the EGSE system during the HCSS Acceptance Test [AD6]
2. By exercising it to perform the warm functional tests, see [RD8]. Note that this still allows time to fix bugs before it is used in a more critical phase e.g. cold testing.

A dedicated QLA test plan might be written at a later date.

## 2.5 Miscellaneous Tools

This represents the development of tools that could not be foreseen at the beginning of the project. Placeholders for this exist in [AD1]. These tools are expected to be provided not only by the software team, but also by members of the test, operations and calibration teams, as well as elsewhere within the ICC.

When a need is identified for such a tool, this will be signalled by the raising of an SCR (Software Change Request), using the ESA-provided system at [http://www.rssd.esa.int/herschel\\_webapps/servletsuite/ProblemReportServlet?area=spire](http://www.rssd.esa.int/herschel_webapps/servletsuite/ProblemReportServlet?area=spire). The requirements for the tool will be specified in the SCR. The SCR system will also be used to track the development of the tool.



### **2.5.1 Software Verification and Validation**

- Requirements shall be specified by entering them into the SCR system, or by referencing a document from the SCR system.
- These tools are subject to the same configuration control procedures as other ICC software as specified in [AD2].
- These tools generally do not require a unit test harness, although one should be provided when applicable. Typically they are expected to be GUI-based.
- A test procedure is only required if a tool is run as part of an operational procedure.