SPIRE ICC

User Requirements Documents

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1 Version 1

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1.1 Introduction

1.1.1 Purpose & Scope

Requirements put on the ICC by the need to calibrate all the astronomical data taken by the instrument. This includes making calibration observations, producing calibration products and preparatory calibration observations (at other telescopes). It also includes calibration of the instrument itself.

1.1.2 Definitions of Terms and Acronyms

AIV	Assembly Integration and Verification
AVM	Avionics Model
BB	Building Block
BBID	Building Block Identifier
CCS	Central Checkout System
CDMS	Command and Data Management System
COTS	Commercial Off-The-Shelf
CQM	Cryo Qualification Model
CS	Calibration Scientist
CUS	Common Uplink System
CVS	Concurrent Versions System
DB	DataBase
DPU	Digital Processing Unit
EGSE	Electrical ground Support Equipment
ESA	European Space Agency
FCSS	FIRST Common Science System
FINDAS	Obsolete
FIRST	Far InfraRed and Submillimetre Telescope
FSC	First Science Centre
FTS	Fourier Transform Spectrometer of SPIRE

GST	Ground Segment Testing
HCSS	Herschel Common Science System
HCSSDT	HCSS Development Team (ESA +ICC's)
Herschel	Far InfraRed and Submillimetre Telescope (Formally FIRST)
HGS	Herschel Ground Segment
HSC	Herschel Science Centre (Formally FSC and FIRST Science Centre)
HSCDT	HSC Development Team (ESA)
IA	Interactive Analysis
ICC	Instrument Control Centre
IFSI	Istituto di Fisica dello Spazio Interplanetario
ILT	Instrument Level Test
ILT	Instrument Level Test
IST	Integrated System Test
MIB	Mission Information Base
OBS	On Board Software
OBSID	Observation Identifier
OPD	Optical path difference
PFM	Proto-Flight Model
Planck	Planck Surveyor
PR	Public Relations
PST	Project Science Team (User within HSC)
PV	Performance Verification
QCP	Quality Control Pipeline
QLA	Quick look analysis
S/C	SpaceCraft
SCOS	Spacecraft Control Operations System
SCUBA	Submm Common User Bolometer Array
SIRTF	Space InfraRed Telescope Facility
SMEC	Spectrometer Mechanisms
SOFIA	Stratospheric Observatory for Far Infrared Astronomy
SPIRE	The Spectral and Photometric Imaging REceiver for FIRST
SST	SPIRE Science Team.

TC	TeleCommand
TFCS	Test Facility Control System (for ILT)
TM	TeleMetry
UML	Unified Modelling Language
URD	User Requirement Document
WWW	World Wide Web
ZPD	Zero optical path difference

In addition two web pages are available describing terms applicable to SPIRE

http://www.ssd.rl.ac.uk/spire/consortium/information/FIRSTacronyms.shtm
http://www.ssd.rl.ac.uk/spire/consortium/information/FIRSTdefinitions.asp
which are to be updated.

2 URD-543 AIV

2.1.1 Related Documents

2.1.1.1 Applicable Documents

AD1 EGSE User Requirements Document (FIRST-SPI-DOC-000102)

2.1.1.2 Reference Documents

RD-1 SPIRE ICC URD Scope Descriptions (SPIRE-ICS-DOC-000484)
RD-2 FIRST-FSC URD
RD-3 FIRST-FSC Actor list

2.1.2 Overview

Several models of the SPIRE instrument will be built and used to qualify the design, characterise the instrument, verify operating modes and calibrate the flight model(s) on the ground before launch. These activities are carried out as a series of tests, which form part of the Assembly, Integration and Verification (AIV) plan for the instrument.

In order to perform these tests, Electrical Ground Support Equipment (EGSE) will be provided to allow the instrument to be commanded, to collect telemetry from the instrument and to provide input instrument stimuli relevant to each test. It has been decided that to minimise development effort and to remove the necessity to translate the instrument database (command and telemetry data structures) the environment in which the instrument is tested should be as far as possible identical to the operational environment. This is also true for the test environment used by the spacecraft Prime Contractor.

As a consequence, the EGSE will be based on the use of the SCOS2000 spacecraft control system, which will be used in the Mission Operations Centre (MOC), and the ICC must provide those components of the operational ICC necessary for; generation of commands for each test; collection and storage of telemetry data from the instrument (and EGSE); and provision for display and analysis of such data.

A more detailed description of the test environment and the requirements on both the EGSE and ICC components are to be found in the EGSE Users Requirements Document (AD1). In this document those high-level User Requirements applicable to the ICC have been extracted. Section 2 describes the users of the AIV facility and Section 3 describes those requirements placed on the ICC components by those users.

2.1.3 User Characteristics

2.1.3.1 Test Controller

Each test will be under the control of a Test Controller who has the responsibility to; configure the AIV facility for the test; to carry out the test according to a test plan; and to monitor the health and safety of the instrument during the test. It may be assumed that all the necessary test procedures and command sequences have already been produced and are available to the Test Controller.

2.1.3.2 Test Scientist

The Test Scientist is responsible for defining the tests to be carried out at each step of the AIV programme, for providing the necessary test procedures, test scripts, command sequences, databases and data analysis procedures to enable the test to be carried out. He/she will also be responsible for the analysis of the results of those tests and the evaluation of the scientific performance of the instrument.

2.1.3.3 Instrument Engineer

The Instrument Engineer is responsible for the analysis of the data produced by the instrument with respect to instrument performance, and characterisation. He/she may also need to generate additional diagnostic tests and associated information (commands, scripts, data analysis procedures etc) in the event of an anomaly being reported by the Test Controller, or as a result of the analysis of test results.

2.1.3.4 Calibration Scientist

The Calibration Scientist is responsible for the definition, and data analysis of the calibration tests carried out on the instrument.

2.2 Requirements

2.3 UR-AIV-100 Commanding Capabilities

2.3.1 UR-AIV-110 Command Sequences
A mechanism for generation of command sequences shall be provided.

Commanding of the instrument will be made through the SCOS2000 system. In general for a test, sets of commands may be generated off line and stored as command sequences to be uplinked by *the Test Controller, as required by the test procedure. These command sequences must be compatible with the SCOS2000 mechanism for command uplink (i.e. from 'schedules').*

1. **Source** [AD1]
2. **Importance/Priority** [High]
3. **Risk** [High]
4. **Phase** [late development]

2.3.2 UR-AIV-120 Command Sequence Scripts
Command sequences shall be specifiable in the form of a script composed of general purpose programming statements (providing; named variables; selection statements: if-else-then, switch etc.; and iteration statements: do-loop, do-while etc) and command definitions in the form of mnemonics plus parameters.

This will allow the Instrument Engineer and Test Scientist to specify specific sequences of commands to the instrument.

1. **Source** [AD1]
2. **Importance/Priority** [High]
3. **Risk** [High]
4. **Phase** [late development**]**

2.3.3 UR-AIV-130 Observations
It shall be possible to translate an observation input (AOT + parameters) into a command sequence.

The Test and Calibration Scientists will need to generate 'typical' observations to test the instrument operating modes, calibration strategy and data processing software

1. **Source** [AD1]
2. **Importance/Priority** [Medium]
3. **Risk** [Medium]
4. **Phase** [ILT**]**

2.3.4 UR-AIV-140 OBS Maintenance
It shall be possible to maintain the instrument On-Board Software

The On Board Software will be provided by IFSI. The development system need to maintain this will be provided as a stand-alone system (TBC) which generates complete memory images. These need to be transferred to the SCOS2000 system for conversion into command sequences to implement the changes on-board.

1. **Source** [AD1]
2. **Importance/Priority** [High/
3. **Risk** [High]
4. Phase [ILT]

2.4 UR-AIV-200 Storage Capabilities

2.4.1 UR-AIV-210 Data storage
The ICC shall provide a data storage facility.

This facility will be a copy of, or a part of the Ground Segment data storage facility (a.k.a. FINDAS). If it is a copy, then provision shall be made to ingest the data held into the central Ground Segment facility at a later date.

This facility will be used to store all test input data, generated telemetry data and test results. The amount of data storage provided should hold the data from at least one week of testing (~20Gbyte, TBC).

1. **Source** [AD1]
2. **Importance/Priority** [High]
3. **Risk** [High]
4. Phase [ILT]

2.4.2 UR-AIV-220 Test Input Data Storage
All input data to a test shall be available from the data storage facility

This includes; test procedures; test scripts; command sequences; OBS memory patches, the instrument database, data analysis procedures, operations procedures. All such data shall be readable by the SCOS2000 system.

1. **Source** [AD1]
2. **Importance/Priority** [Medium]
3. **Risk** [Low]
4. **Phase** [ILT]

2.4.3 UR-AIV-230 Telemetry Data Storage
All telemetry received from the EGSE shall be stored into the data storage facility according to the object model required for operations.

The EGSE will collect telemetry data from the instrument and test equipment and make it available in real time to the ICC components of the AIV facility. The data needs to be stored in the same way as in operations in order to be able to use the ICC data analysis software without changes.

1. **Source** [AD1]
2. **Importance/Priority** [Medium]
3. **Risk** [Low]
4. **Phase** [ILT]

2.5 UR-AIV-300 Analysis Capabilities

2.5.1 UR-AIV-310 Data Analysis
The ICC shall provide system for data analysis and display.

The system should allow extraction of data, processing methods and display parameters to be selected by a 'processing script' or interactively. It should be possible for the 'processing script' to be triggered automatically by a parameter in the instrument telemetry data stream.

1. **Source** [AD1]

2. **Importance/Priority** [High]
3. **Risk** [High]
4. **Phase** [late development]

2.5.2 UR-AIV-320 Real-Time processing

The data analysis system shall be able to process data in real-time.

The data collected from the instrument and test equipment will normally be stored into the data storage facility and processed from there. If this storage and retrieval takes a significant amount of time (or the facility is not available) it shall be necessary for the data analysis system to take the data directly from the SCOS2000 system. Again the data analysis system should be able to be controlled from 'processing scripts'.

The instrument generates data at ~100kbps. The EGSE will also generate its own telemetry data from the test equipment used. It should be assumed that the total data rate will be ~200kbps.

1. **Source** [AD1]
2. **Importance/Priority** [High]
3. **Risk** [High]
4. **Phase** [late development]

2.5.2.1 UR-AIV-330 Real-Time Display

The data analysis system shall be able to display telemetry data in real-time.

In this context 'real-time' implies the display of (science) data within a few seconds of it being generated by the EGSE. The extent of the processing required to generate the displays is TBD. Note: fully processed data may be displayed after a test has been completed.

1. **Source** [AD1]
2. **Importance/Priority** [High]
3. **Risk** [High]
4. **Phase** [late development]

2.6 UR-AIV-400 Constraints

2.6.1 UR-AIV-410 Test Environment

The ICC components shall operate in an environment compatible with the RAL AIV facility infrastructure and network design

The ICC systems should not place requirements on the AIV Facility infrastructure beyond those normally provided for office environments (power, heat, light, telephone and network connections etc)

When the ICC communicates via a network, this should be compatible with the RAL network design requirements (i.e. should be able to operate through firewalls etc).

1. **Source** [KJK]
2. **Importance/Priority** [High]
3. **Risk** [High]
4. **Phase** [ILT]

2.6.2 UR-AIV-420 Network Isolation

The data storage facility shall not require continuous access to the Internet.

In order to reduce the possibility of interference from outside sources, the test environment will be isolated from the laboratory, and global, networks. This means that the data storage facility must not depend on continuous communication with other facilities to do its work. If it forms part of a distributed facility, it must be able to store changes for some time (at least 1 week, TBC) and make the updates at the end of this period.

1. **Source** [KJK]
2. **Importance/Priority** [High]
3. **Risk** [High]
4. **Phase** [ILT]

2.6.3 UR-AIV-430 Development tools

The ICC components shall be based on maintainable tools and development software.

This provides insurance for the long-term maintainability of the system. These tools could be COTS from companies with a long track record in developing and maintaining such software, or tools based on Open Source development programmes.

1. **Source** [KJK]
2. **Importance/Priority** [High]
3. **Risk** [High]
4. **Phase** [ILT]

2.6.4 UR-AIV-440 Hardware

The amount, and different types, of hardware required to operate the ICC components shall be minimised.

The space available for AIV operations is limited. If possible, more than one ICC component should be able to be run on a single machine.

If possible, the ICC components should run on the same type of machine as the EGSE, to reduce the total number of types of machines required (including backup hardware). In practice this means that the ICC component should operate on SUN (solaris) workstations) and/or IBM PC compatible platforms (OS TBD).

1. **Source** [KJK]
2. **Importance/Priority** [High]
3. **Risk** [High]
4. **Phase** [early development]

2.7 UR-AIV-500 Maintenance

2.7.1 UR-AIV-510 Test Data and Scripts

The ICC shall maintain a facility to allow the update and verification of test scripts and databases.

This will require the provision of editors for modifying the scripts and databases and the availability of subsystem and instrument simulators to allow verification of test and database changes before use with the real instrument

2.7.2 UR-AIV-520 Software

The ICC shall provide editors, compilers, simulators and debugging software to enable the maintenance and update of ICC software.

3 URD-544 Calibration

3.1.1 Related Documents

RD-1	SPIRE ICC URD Scope Document
RD-2	FIRST-FSC URD
RD-3	ICC actor calibration scientist v 0.4
RD-4	SPIRE ICC URD-FSC-D2
RD-5	SPIRE ICC Calibration Files (Draft 1.0)
RD-6	SPIRE ICC Calibration Plan (Draft 1.0)

3.1.2 Overview

3.1.3 User Characteristics

3.1.3.1 The Calibration Scientist

The calibration scientist has a strong astronomical background and an in-depth knowledge of the properties and operations of the instrument. She plans the necessary calibration observations to characterize the instrument, determines and verifies the calibration parameters of the instrument and specifies how these parameters have to be applied in the standard product generation. [ICC actor v0.4]

3.1.3.1.1 Photometer Calibration Scientist

A calibration scientist with special responsibilities for the Photometer

3.1.3.1.2 FTS Calibration Scientist

A calibration scientist with special responsibilities for the FTS

3.1.3.2 Interactive Analysis Developer

The IA developer will need to be able to modify IA routines in response to proposed changes in calibration procedures.

3.1.3.3 Consortium Astronomers

The calibration can only be properly assessed when applied to real scientific measurements. Special scientific observations may require special calibration. Those involved with the calibration activity need to be closely corresponding with Astronomers, in particular Consortium Astronomers.

3.1.3.4 Non-Consortium Astronomers

The calibration can only be properly assessed when applied to real scientific measurements. Special scientific observations may require special calibration. Those involved with the calibration activity need to be closely corresponding with Astronomers, to a lesser extent with non-Consortium Astronomers via the FSC.

3.2 UR-CAL-001 Ultimate Accuracy Goal

It is hoped that ultimately the accuracy of any reasonable scientific measurement will be limited by the statistics of the data, rather than uncertainties in the calibration. There will be certain exceptions, e.g. very deep integrations may be limited by flat-field errors which would require an excessive amount of calibration time to accommodate. The ultimate accuracy may not be achieved until sometime after the mission, the uppermost priority during the mission must be to ensure that all necessary calibration measurements are taken to meet the eventual goal.

- Source here

- Importance Essential
- **Frequency** once/yearly
- Phase PV

3.3 UR-CAL-1**: Calibration Files

3.3.1 UR-CAL-110: Defining Calibration Files

The "files" (or objects or whatever) that will be required for complete calibration of instrument and scientific observations need to be defined. The specifications of these files might be different for different observing modes, although it would be an aim to keep them as similar as possible. It is hoped that most of necessary files will be specified at an early stage, although the contents of these files may not be known until much later). However, as knowledge of the instrument improves it is inevitable that new calibration files will be required. It should be possible to alter these files independently of any procedures that use them (I.e. calibration information should not be hard-wired into code). The file specifications should describe the formats (or interfaces), the parameters that are to be included, whether errors are needed and an allowance a drift of parameters with time, unless there are good reasons to believe that these are immutable (e.g. filter numbers). A rough draft of these files will be given in RD-5

- Source here
- SIRD-ICCF-140
- Importance Essential
- Frequency yearly
- Phase AVM

3.3.2 UR-CAL-120: Defining Calibration Procedures

Associated with the calibration files should be standard procedures for applying these files (these might be IA routines or scripts). It should be possible to modify these standard procedures independently of the content of the files themselves. It should also be possible to test new calibration procedures within the IA. Procedures demonstrably offering improvements should be implemented, though it should always be possible to use earlier procedures. It is the responsibility of the ICC to ensure that these procedures (and the associated files) represent the best achievable knowledge of the instrument at that time.

- Source here
- SIRD-ICCF-140
- Importance Essential
- Frequency monthly
- Phase AVM

3.3.3 UR-CAL-130: Maintaining Calibration files

Corrupted or missing calibration files should be replaced with very little delay. The calibration files available at different sites should be the same, with a few minor exceptions that may be required e.g. while testing.

- Source here
- SIRD-ICCF-140 SIRD-ICCO-075 SIRD-ICCA-025
- Importance Essential
- Frequency daily
- Phase AVM

3.3.4 UR-CAL-140: Improving calibration files

Some calibration files will require modification as a result of instrument "drifts" or as the knowledge of the instrument improves. It must be possible to make these changes either automatically e.g. as a result of a regular measurement or “interactively” perhaps in response to a one off measurement. It should always be possible to use the calibration files as they would have been at any earlier epoch.

- Source here
- SIRD-ICCF-140 SIRD-ICCO-075 SIRD-ICCA-025
- Importance Essential
- Frequency yearly
- Phase AVM

3.4 UR-CAL-2** Calibration observations & Analysis Pre-Launch

3.4.1 UR-CAL-210: Calibration plan

The ICC shall be responsible for producing a calibration plan. That is a sequence of observations, measurements and analysis that are necessary to provide the data to populate all the required calibration files. Before operations this plan needs to be updated rarely (yearly?) to account for changes in instrument knowledge or measurement/observing facilities. A rough draft of this plan will be given in RD-6

- Source here SIRD-ICCF-135 SIRD-ICCF-145
- Importance Essential
- Frequency yearly
- Phase AVM

3.4.2 UR-CAL-220: Ground based Laboratory measurements

The ICC needs to ensure that the necessary laboratory measurements of the instrument are made and that the analysis necessary to turn the laboratory data into calibration files is undertaken.

- Source here SIRD-ICCF-145
- Importance Essential
- **Frequency** hourly-weekly
- Phase AVM

3.4.3 UR-CAL-230: Ground based preparatory observations

The ICC needs to ensure that the necessary ground-based astronomical observations are made (or have been made) and need to undertake the analysis necessary to turn these data into calibration files.

- Source here SIRD-ICCF-145
- Importance Essential
- Frequency yearly
- Phase AVM

3.4.4 UR-CAL-240: Space based preparatory observations

The ICC needs to ensure that the necessary space-based astronomical observations are made (or have been made) and need to undertake the analysis necessary to turn these data into calibration files.

- Source here SIRD-ICCF-145
- Importance Essential
- Frequency yearly
- **Phase** SIRTF (2002)/SOFIA(2002)/ASTRO-F(2004)/Planck(2007)

3.4.5 UR-CAL-250: Calibration Analysis

Where astronomical or laboratory measurements exist the ICC need to perform the data reduction and analysis necessary to transform these data into calibration files. Where these analysis are repetitive and/or laborious it may be convenient to have these analysis performed automatically.

1. **Source** here
2. **Importance** Essential
3. **Frequency** daily (automatic) weekly (manual)
4. Phase AVM

3.5 UR-CAL-3**: Calibration observations & Analysis Post-Launch

A number of requirements in this section come from the FSC and are described in more detail in RD-3

3.5.1 UR-CAL-310: Calibration plan

The ICC shall be responsible for producing a calibration plan. That is a sequence of observations, and analysis that are necessary to provide the data to (re)populate all the required calibration files. Under normal circumstances this plan will be updated monthly, it needs to be possible to change this plan more rapidly in response to rejected calibration observations, anomalies in the instrument or in the PV phase.

- Source here SIRD-ICCO-042 SIRD-ICCO-050
- Importance Essential
- **Frequency** daily/monthly
- **Phase** PV/Operations

3.5.2 UR-CAL-320: SPIRE calibration observations

The ICC needs to ensure that the necessary observations with SPIRE (and other FIRST instruments are and need to undertake the analysis necessary to turn these data into SPIRE calibration files.

- Source here SIRD-ICCO-042 SIRD-ICCO-050
- Importance Essential
- Frequency hourly
- **Phase** PV/Operations

3.5.3 UR-CAL-330: Calibration Analysis

Where astronomical or laboratory measurements exist the ICC need to perform the data reduction and analysis necessary to transform these data into calibration files. Where these analysis are repetitive and/or laborious it may be convenient to have these analysis performed automatically.

- Source here SIRD-ICCF-145? SIRD-ICCO-042 SIRD-ICCO-050
- Importance Essential
- **Frequency** daily (automatic) weekly (manual)
- Phase AVM

3.5.4 UR-CAL-340: Scientific Assessment of Calibration

The calibration activity needs to be assessed in the context of real scientific measurements. Is the calibration adequate for the main scientific goals? Is the calibration accuracy sufficient, over specified, or lacking? Do new calibrations need to be made to address specific scientific goals?
What are the calibration priorities?

- Source here SIRD-ICCF-145? SIRD-ICCO-042 SIRD-ICC0-050
- Importance Essential
- **Frequency** daily (automatic) weekly (manual)

- Phase AVM

3.5.5 UR-CAL-350: Repeat Observations (RD-4 2.1.1)
- **Source** SIRD-ICC0-050 RD-4 2.1.1

3.5.6 UR-CAL-360: Observation Timescales (RD-4 2.1.2)
- **Source** SIRD-ICC0-050 RD-4 2.1.2

3.5.7 UR-CAL-370: Observation Day (RD-4 2.1.3)
- **Source** SIRD-ICC0-050 RD-4 2.1.3

3.5.8 UR-CAL-380: Failed Observations (RD-4 2.1.4)
- **Source** SIRD-ICC0-050 RD-4 2.1.4

3.5.9 UR-CAL-390: Rejected Observations (RD-4 2.1.5)
- **Source** SIRD-ICC0-050 RD-4 2.1.5

3.5.10 UR-CAL-400: Removed Observations (RD-4 2.1.5)
- **Source** SIRD-ICC0-050 RD-4 2.1.5

4 URD-545 Photometer

4.1.1 Purpose & Scope

Requirements put on the ICC by the Photometer observing modes. It will describe the form the data is expected to take and the information required to fully characterise it. It also puts requirements on the ICC by the need to produce a data reduction process for the photometer observation modes of SPIRE. These observation modes might have either a purely scientific goal or an engineering purpose. The potential users of the data reduction process might be either members of the SPIRE Consortium, or astronomers having access to the FIRST observations (via the FSC). (This description was taken from RD-1). This document does not cover the requirements from the need to calibrate the modes, nor the need to command the instrument which are covered in RD-3 & RD-4

4.1.2 Definitions of Terms and Acronyms

Listing of acronyms that are "unusual" to this URD

FIRST	Far InfraRed and Submillimetre Telescope
SPIRE	The Spectral and Photometric Imaging REceiver for FIRST
ICC	Instrument Control Centre
URD	User Requirement Document
ILT	Instrument Level Test
AVM	Avionics Model
CQM	Cryo Qualification Model
PFM	Proto-Flight Model
PV	Performance Verification
GST	Ground Segment Testing

In addition two web pages are available describing terms applicable to SPIRE
http://www.ssd.rl.ac.uk/spire/consortium/information/FIRSTacronyms.shtm
http://www.ssd.rl.ac.uk/spire/consortium/information/FIRSTdefinitions.asp
These are to be updated.

4.1.3 Related Documents

RD-1 SPIRE ICC URD Scope Document
RD-2 FIRST Common Science System Development Work Report
(Neal Todd, Edinburgh 20th October 2000)
RD-3 SPIRE ICC URD Calibration
RD-4 SPIRE ICC URD Common Uplink System
SIRD Science Implementation Requirement Document esp. ICCF-055 ICCF-130 ICCO-060 ICCO-065

4.1.4 Overview

4.1.5 User Characteristics

4.1.5.1 The Calibration Scientists

The calibration scientist has a strong astronomical background and an in-depth knowledge of the properties and operations of the instrument. He/She plans the necessary calibration observations to characterize the instrument, determines and verifies the calibration parameters of the instrument and specifies how these parameters have to be applied in the standard product generation. [ICC actor v0.4]

4.1.5.1.1 Photometer Calibration Scientist

A calibration scientist with special responsibilities for the Photometer

4.1.5.2 Interactive Analysis Developer

The IA developer will need to be able to modify IA routines in response to proposed changes in calibration procedures.

4.1.5.3 Instrument Engineer

The instrument engineer will provide information about the instrument necessary for the processing. S/he will also be making requirements on what processing steps and outputs are required.

4.1.5.4 Consortium Astronomers

The photometer processing is can only be properly assessed when applied to real scientific measurements. Special scientific observations may require special processing. It is the astronomers who will eventually be able to decide whether the processing is achieving the desired results. Those involved with the processing activity need to be closely corresponding with Astronomers, in particular Consortium Astronomers.

4.1.5.5 Non-Consortium Astronomers

The photometer processing is can only be properly assessed when applied to real scientific measurements. Special scientific observations may require special processing. Those involved with the processing activity need to be closely corresponding with Astronomers, to a lesser extent non-Consortium Astronomers via the FSC.

4.1.5.6 HSC

4.2 UR-PHT-1**: Instrument Modes

4.2.1 UR-PHT-110: Definition of various Instrument Modes

4.2.1.1.1.1 The ICC are required to define the various operating modes of the instrument

- **Source** SIRD-ICCF-055
- Importance Essential
- Frequency yearly
- Phase AVM

4.2.2 UR-PHT-115: Support specific modes

Support “specific” instrument modes (e.g. parallel and serendipity data) generated by the photometer.

- **Source** SIRD-ICCO-060

- Importance Desired
- Frequency yearly
- **Phase** Operations

4.2.3 UR-PHT-120: Process specific modes

Process as applicable "specific" instrument modes (e.g. parallel and serendipity data) generated by the photometer. Deliver to the HSC.

- **Source** SIRD-ICCA-040
- Importance Desired
- Frequency yearly
- Phase Archive

4.2.4 UR-PHT-130: Define Astronomical Observation Templates

ICCF-070 definition of the initial set of Astronomical Observation Templates (AOTs) required to carry out the instrument scientific and standard calibration observations. *Note: The AOTs implement, at user level, the instrument modes defined in ICCF-055.*

- **Source** SIRD-ICCF-070
- Importance Essential
- Frequency yearly
- Phase AIV

4.3 UR-PHT-2**: Development

The processing of instrument data is expected to be a continually evolving skill

4.3.1 UR-PHT-210: Design

The ICC is required to design the processing software

- **Source** SIRD-ICCF-130
- Importance Essential
- Frequency yearly?
- Phase AVM

4.3.2 UR-PHT-220: Implementation

The ICC is required to implement the processing software (TBD what this means), but see next section.

- **Source** SIRD-ICCF-130
- Importance Essential
- Frequency yearly
- Phase AVM

4.3.3 UR-PHT-230: Test

The ICC is required to test the processing software (TBD what this means)

- **Source** SIRD-ICCF-130
- Importance Essential
- Frequency yearly
- Phase AVM

4.3.4 UR-PHT-240: Validation

The ICC is required to validate the processing software (TBD what this means).

"support the validation of the scientific processing S/W prior to release for use by the community. Note: the scientific data processing software will evolve considerably during the mission from the basic, imperfect set available at launch. The ICC teams shall process "selected" observations in order to validate the various processing algorithms. Upon validation the S/W is released for use by the HSC and the community. The Observations to be checked shall be selected in such a way that all instrument modes (AOTs) are covered as well as possible"
"Support validation of the data products generated with improved algorithms/calibration data"

- **Source** SIRD-ICCF-130 SIRD-ICCF-065 SIRD-ICCA-035
- Importance Essential
- Frequency yearly
- Phase AVM

4.3.5 UR-PHT-250: Improvement
Improve processing algorithms. Deliver updates to HSC

- **Source** SIRD-ICCA-030
- Importance Essential
- Frequency yearly
- **Phase** PV phase

4.3.6 UR-PHT-260: Archive Tools
ICCA-015 define (jointly with the HSC) the processing tools and archive access tools to be provided, as well as data quality goals.

- **Source** SIRD-ICCA-015
- Importance Desirable
- Frequency once
- Phase Archive

4.4 UR-PHT-3**: Interactive Analysis: General
This section indicates some general requirements of the Interactive Analysis (IA).

4.4.1 UR-PHT-310: Platforms
IA should be multiplatform with goal of platform independence. The platforms that are currently required are Solaris, Linux, DecUltra with a goal of one Windows platform (NT/95/98 or 2000). The list of supported platforms will be subject to change at time scale of one tear (TBC).

- Source RD2
- **Importance** Essential/Desirable
- Frequency yearly
- Phase AVM

4.4.2 UR-PHT-320: Modularity
The IA should be designed such that new algorithms can be developed and interchanged with ease.

- **Source** SJO (here) SIRD-ICCF-130
- Importance Essential
- Frequency continuous
- Phase AVM

4.4.3 UR-PHT-330: IA consists of different generic types of modules

4.4.3.1 <u>interactively processing data</u>

4.4.3.2 <u>visualizing data; - at all stages of processing, not just final images</u>

4.4.3.3 <u>input/ output of data</u>

- Source RD2 SIRD-ICCF-130
- Importance Essential
- Frequency once
- Phase AVM

4.4.4 UR-PHT-340: Interfaces

Interactive analysis will consist of both GUIs and Command Line interfaces
A scripting language can be run within IA

- Source RD2 SIRD-ICCF-130
- Importance Essential
- Frequency continuous
- Phase AVM

4.4.5 UR-PHT-350: Data formats

IA will be able to export/ import data in formats than can be imported/exported to/ from other software – which?

- Source RD2 SIRD-ICCF-130
- Importance Essential
- Frequency once
- Phase AVM

4.4.6 UR-PHT-360: Interfaces to other software

The possibility that the IA will allow the calling of other data reduction packages and/ or libraries (possibly in other languages) whilst in IA is an open issue. This is expected to be difficult and so is very much a goal rather than a requirement.

- Source RD2
- Importance Desirable
- Frequency once
- Phase AVM

4.4.7 UR-PHT-370: User Help

IA will have a help system including reference guides and recipes

- Source RD2 SIRD-ICCF-130
- Importance Essential
- Frequency continuous
- Phase AVM

4.4.8 UR-PHT-380: Source code

Modules will be open source so that the Astronomer can see the algorithms applied and have the facility to locally modify and run code. – dangerous ?

- Source RD2
- Importance Essential
- Frequency once
- Phase AVM

4.4.9 UR-PHT-390: History

4.4.9.1.1.1 The product generation history will be a component part of the products

- Source RD2
- Importance Essential
- Frequency once
- Phase AVM

4.5 UR-PHT-4**: Data Products

The data products should be processed to the extent that is required by the quality of the data and by the nature of the observations being carried out. Under each observing mode we specify what the end results of the data processing are expected to be. We do this because the specific processing steps expanded below may not be the only ways of reaching these end-points. N.B. these are all science end points, it may be that there are other engineering/calibration end points which will be of interest.

- Source Here
- Importance Essential
- Frequency once
- Phase AVM

4.5.1 UR-PHT-410: POF1: Chop Without Jiggling

Flux (or upper-limit) of a point source with known position (which is expected to be in centre of central bolometer, but might later be found to be at a known position off centre?)
Error in Flux
Measure of Goodness of Fit

Average intensity recorded in each bolometer-sky position
Error in intensity

4.5.2 UR-PHT-420: POF2: Seven-Point Jiggle Map

Detection of previously unknown point sources?
Positions of previously unknown point sources?
Fluxes for previously unknown point sources?
Significance levels of detections?
Errors in positions?
Errors in fluxes?

Flux (or upper-limit) of a point source with known position (which could be anywhere within the boundaries of the map)
Error in Flux
Measure of Goodness of Fit

Map of Intensity
Error in Intensity

Average intensity recorded in each bolometer-sky position
Error in intensity

4.5.3 UR-PHT-430: POF3: N-Point Jiggle Map

Detection of previously unknown point sources
Positions of previously unknown point sources
Fluxes for previously unknown point sources
Significance levels of detections
Errors in positions

Errors in fluxes

Flux (or upper-limit) of a point source with known position (which could be anywhere within the boundaries of the map)
Error in Flux
Measure of Goodness of Fit

Map of Intensity
Error in Intensity

Average intensity recorded in each bolometer-sky position
Error in intensity

4.5.4 UR-PHT-440: POF4: Raster Map

Detection of previously unknown point sources
Positions of previously unknown point sources
Fluxes for previously unknown point sources
Significance levels of detections
Errors in positions
Errors in fluxes

Flux (or upper-limit) of a point source with known position (which could be anywhere within the boundaries of the map)
Error in Flux
Measure of Goodness of Fit

Map of Intensity
Error in Intensity

Average intensity recorded in each bolometer-sky position
Error in intensity

4.5.5 UR-PHT-450: POF5: Scan Map Without Chopping

Detection of previously unknown point sources
Positions of previously unknown point sources
Fluxes for previously unknown point sources
Significance levels of detections
Errors in positions
Errors in fluxes

Flux (or upper-limit) of a point source with known position (which could be anywhere within the boundaries of the map)
Error in Flux
Measure of Goodness of Fit

Map of Intensity
Error in Intensity

4.5.6 UR-PHT-460: POF6: Scan Map With Chopping

Detection of previously unknown point sources
Positions of previously unknown point sources
Fluxes for previously unknown point sources

Significance levels of detections
Errors in positions
Errors in fluxes

Flux (or upper-limit) of a point source with known position (which could be anywhere within the boundaries of the map)
Error in Flux
Measure of Goodness of Fit

Map of Intensity
Error in Intensity

4.5.7 UR-PHT-470: POF7: Photometer Peak-Up (TBD)
Position of point source with approximately known position
Flux (or upper-limit?) of a point source with determined position
Error in Flux
Measure of Goodness of Fit

4.5.8 UR-PHT-480: POF8: Operate photometer internal calibrator
Average intensity recorded in each bolometer-sky position
Error in intensity

4.5.9 UR-PHT-490: POF9: Special engineering modes (TBD)
TBD,

4.6 UR-PHT-5**: Interactive Analysis: Processing of Observing Modes
The Interactive analysis must be capable of processing all observing modes. This section indicates what we currently expect to be the procedures required for each mode. The procedures described here are currently indicated in a flow chart in the Appendix.

4.6.1 UR-PHT-510: General
The following processes will be required on all data regardless of observing mode (except where explicitly excluded in the observing mode specific sections below)

4.6.1.1 Data from FINDAS
Includes all SPIRE relevant data

4.6.1.2 Injection into SPIRE pipeline
1., 3.,4. are obvious, 5., may not be required, 2 may include real astrometric information as a function of UT but may require a software module which can interpret or reinterpret satellite pointing data as the reconstruction models are improved (these modules could be implemented at any stage in the pipe-line)

4.6.1.3 Construct Inst. Mode/Status history from H/K
Self explanatory. May be checked against requested mode?

4.6.1.4 Flagging missing and Bad data
Self explanatory

4.6.1.5 Converting mechanical data to Physical Units
Physical units would be Volts, x,y, positions in mm, angles in degrees, etc.

4.6.1.6 Validation of mechanical data
Checking e.g. that the position of the chopper mirror is appropriate (dependent on mode?). This includes checks which would not have been trapped by the usual out of limits (hard or soft).

4.6.1.7 Calibration Tables

Required as input to the two conversion processes. Presumably these are likely to be look-up tables or parameters for simple algorithms

4.6.1.8 Reports

Reports are required to indicate where the mode is non-standard in some way, or if there is an anomalously high rate of bad pixels

4.6.1.9 Stored data

There are two points at which data is stored. In general data should be stored at a point in the pipe-line that one may wish to return to (to run new procedures) without having to go further back. So it is likely that data should be stored after time-consuming or stable processes.

The two points indicated here for storage are not cast in stone, but appear after what are presumed to be reasonable stable processes

4.6.1.10 Visualisation

Two points are indicated where QLA visualisation routines would be required. I.e. we would like to be able to examine the most raw of data products, before any real processing has occurred, and we would like to be able to visualise the data in physical units.

4.6.2 UR-PHT-520: POF1: Chop Without Jiggling

4.6.2.1 0th Order Deglitching

Filtering out very high significance, short time-scale spikes in the time-line

4.6.2.2 Demodulation

Differencing on-off chop position

4.6.2.3 Gain Drift correction

Probably requires sensitivity measurements as a function of time and interpolates between. No reason to expect significant drift but I guess useful to have the capability. This is what the internal calibrator is for. The calibrator signal will be demodulated either at the same time as the astronomical signal or periodically, then for each detector the relative gain can be compared to the standard value and if necessary either adjusted or simply flagged.

4.6.2.4 Deglitch 2

Filtering out outliers from “average” of chopped signals at a single jiggle pointing

4.6.2.5 Flat-fielding

Taking out the differing responsivity of the different detectors. This should be a trivial step just multiplying by a lookup table.

4.6.2.6 Cross-talk

Self explanatory if hard. If necessary can in principle be removed by matrix inversion, where the matirix contains the crosstalk of each pixel to every other, messy though.

4.6.2.7 Glitch removal

Deviations between signals from sequential returns to the same jiggle position can be filtered out, iterative with previous step

4.6.2.8 Look at pointing data

Assign astrometric positions to co-added detector images. This doesn’t really belong in here with the basic number-crunching algorithmns, it’s more of a astronomical processing step.

4.6.2.9 Combine pairs of nod positions

Combine images which are taken at genuinely different telescope pointings, i.e. not different because of the jiggle and chop movements of the mirror

4.6.2.10 Calibration

Self-explanatory

4.6.3 UR-PHT-530: POF2: Seven-Point Jiggle Map

POF2 is a special case of POF3. No special, additional processing steps required.

4.6.4 UR-PHT-540: POF3: N-Point Jiggle Map

Same as for POF1, except for the following:

4.6.4.1 Coadd Jiggle Images

As we return a number of times to each jiggle position within a single nod pointing we need to average the signals within the nod pointing

4.6.4.2 Glitch removal

Deviations between signals from sequential returns to the same jiggle position can be filtered out, iterative with previous step

4.6.4.3 Calibration

Self-explanatory

4.6.5 UR-PHT-550: POF4: Raster Map

This is just an extension of POF3, whereby the telescope makes jiggle maps at a sequence of positions.

Additional requirements:

4.6.5.1 Combining raster positions

4.6.6 UR-PHT-560: POF5: Scan Map Without Chopping

Radically different from jiggle-mapping or photometry. The signal is now spread over a wide-range of frequency bandwidth, rather than in a narrow-band about the chop frequency, so the signal processing is completely different. If the detectors are DC-coupled then it is much simpler but it is not clear to me that they will be. This and POF5 need a proper system analysis by someone who undertsands signal processing.

4.6.7 UR-PHT-570: POF6: Scan Map With Chopping

Again radically different from EITHER the scan-map without chopping OR the jiggle-mapping modes. This time the signal still spread out in bandwidth but contained in sidebands about the chopping frequency. Consecutive samples contain the DIFFERENCE signal between points separated by the chop distance and once the whole scan has been completed these have to be inverted to recover the true signal (known as the “Emerson, Klein” and Haslam, “NOD2” or “EKH” method). In order to avoid Zero-crossings in the window function in spatial frequency space the true sky map can only be recovered by combining scans taken with different chop throws and ideally in difference directions as well, which is the way SCUBA does it for example (the “Emerson2” method). This means an “image” can only be properly made from several “observations”.

Despiking is very much more difficult as well

4.6.8 UR-PHT-580: POF7: Photometer Peak-Up (TBD)

Basically just several photometry points done sequentially and then some fitting routine used to find the peak signal position.

4.6.9 UR-PHT-590: POF8: Operate photometer internal calibrator

4.6.9.1 Demodulate internal calibrator signal, and then compare to standard values for each pixel.

4.6.10 UR-PHT-600: POF9: Special engineering modes (TBD)

5 URD-546 Fourier Transform Spectrometer

5.1.1 Purpose & Scope

Requirements put on the ICC by the Spectrometer observing modes. It will describe the form the data is expected to take and the information required to fully characterise it. It also puts requirements on the ICC by the need to produce a data reduction process for the spectroscopic observation modes of SPIRE. These observation modes might have either a purely scientific goal or an engineering purpose. The potential users of the data reduction process might be either members of the SPIRE Consortium, or astronomers having access to the HERSCHEL observations (via the FSC). (This description was taken from RD-1). This document does not cover the requirements from the need to calibrate the modes, nor the need to command the instrument which are covered in RD-3 & RD-4.

5.1.2 Related Documents

RD-1	SPIRE ICC URD Scope Document
RD-2	HERSCHEL Common Science System Development Work Report (Neal Todd, Edinburgh 20th October 2000)
RD-3	SPIRE ICC URD Calibration
RD-4	SPIRE ICC URD Common Uplink System

5.1.3 Overview

5.1.4 User Characteristics

5.1.4.1 The Calibration Scientists

The calibration scientist (CS) has a strong astronomical background and an in-depth knowledge of the properties and operations of the instrument. The CS plans the necessary calibration observations to characterize the instrument, determines and verifies the calibration parameters of the instrument and specifies how these parameters have to be applied in the standard product generation. [ICC actor v0.4]

5.1.4.1.1 FTS CS

A CS with special responsibilities for the FTS

5.1.4.2 Interactive Analysis Developer

The IA developer will need to be able to modify IA routines in response to proposed changes in calibration procedures.

5.1.4.3 Instrument Engineer

5.1.4.4 HSC

5.2 UR-FTS-1**: Instrument Modes

5.2.1 UR-FTS-110: Definition of various Instrument Modes

5.2.1.1.1.1 The ICC are required to define the various operating modes of the instrument

- **Source** SIRD-ICCF-055
- Importance Essential
- Frequency yearly
- Phase AVM

5.2.2 UR-FTS-115: Support specific modes

Support “specific” instrument modes (e.g. parallel and serendipity data) generated by the FTS.

- **Source** SIRD-ICCO-060
- Importance Desired
- Frequency yearly
- **Phase** Operations

5.2.3 UR-FTS-120: Process specific modes
Process as applicable "specific" instrument modes (e.g. parallel and serendipity data) generated by the FTS. Deliver to the HSC.

- **Source** SIRD-ICCA-040
- Importance Desired
- Frequency yearly
- Phase Archive

5.2.4 UR-FTS-130: Define Astronomical Observation Templates
ICCF-070 definition of the initial set of Astronomical Observation Templates (AOTs) required to carry out the instrument scientific and standard calibration observations. *Note: The AOTs implement, at user level, the instrument modes defined in ICCF-055.*

- **Source** SIRD-ICCF-070
- Importance Essential
- Frequency yearly
- Phase AIV

5.3 UR-FTS-2**: Development
The processing of instrument data is expected to be a continually evolving skill

5.3.1 UR-FTS-210: Design
5.3.1.1.1.1 The ICC is required to design the processing software

- **Source** SIRD-ICCF-130
- Importance Essential
- Frequency yearly?
- Phase AVM

5.3.2 UR-FTS-220: Implementation
The ICC is required to implement the processing software (TBD what this means), but see next section.

- **Source** SIRD-ICCF-130
- Importance Essential
- Frequency yearly
- Phase AVM

5.3.3 UR-FTS-230: Test
The ICC is required to test the processing software (TBD what this means)

- **Source** SIRD-ICCF-130
- Importance Essential
- Frequency yearly
- Phase AVM

5.3.4 UR-FTS-240: Validation
The ICC is required to validate the processing software (TBD what this means). *"support the validation of the scientific processing S/W prior to release for use by the community. Note: the scientific data processing software will evolve considerably during the mission from the basic, imperfect set available at launch. The ICC teams shall process "selected" observations in order to validate the various processing algorithms. Upon*

validation the S/W is released for use by the HSC and the community. The Observations to be checked shall be selected in such a way that all instrument modes (AOTs) are covered as well as possible"

"Support validation of the data products generated with improved algorithms/calibration data"

- **Source** SIRD-ICCF-130 SIRD-ICCF-065 SIRD-ICCA-035
- Importance Essential
- Frequency yearly
- Phase AVM

5.3.5 UR-FTS-240: Improvement

5.3.5.1.1.1 Improve processing algorithms. Deliver updates to HSC

- **Source** SIRD-ICCA-030
- Importance Essential
- Frequency yearly
- Phase AVM

5.3.6 UR-FTS-250: Archive Tools

ICCA-015 define (jointly with the HSC) the processing tools and archive access tools to be provided, as well as data quality goals.

- **Source** SIRD-ICCA-015
- Importance Desirable
- Frequency once
- Phase Archive

5.4 UR-FTS-3** Interactive Analysis: General

This section indicates some general requirements of the Interactive Analysis (IA).

5.4.1 UR-FTS-310 Platforms

IA should be multiplatform with goal of platform independence. The platforms that are currently required are Solaris, Linux, DecAlpha with a goal of one Windows platform (NT/95/98 or 2000). The list of supported platforms will be subject to change at time scale of one tear (TBC).

- Source RD2
- **Importance** Essential/Desirable
- Frequency yearly
- Phase AVM

5.4.2 UR-FTS-320 Modularity

The IA should be designed such that new algorithms can be developed and interchanged with ease.

- **Source** JPB (here)
- Importance Essential
- Frequency continuous
- Phase AVM

5.4.3 UR-FTS-330 IA consists of different generic types of modules

5.4.3.1 <u>interactively processing data</u>

5.4.3.2 <u>visualizing data;</u>

5.4.3.3 <u>input/ output of data</u>

- Source RD2
- Importance Essential
- Frequency once

- Phase AVM

5.4.4 UR-FTS-340 Interfaces

Interactive analysis will consist of both GUIs and Command Line interfaces

A scripting language can be run within IA

- Source RD2
- Importance Essential
- Frequency continuous
- Phase AVM

5.4.5 UR-FTS-350 Data formats

IA will be able to export/ import data in formats than can be imported/exported to/ from other software

- Source RD2
- Importance Essential
- Frequency once
- Phase AVM

5.4.6 UR-FTS-360 Interfaces to other software

The possibility that the IA will allow the calling of other data reduction packages

and/ or libraries (possibly in other languages) whilst in IA is an open issue. This is expected to be difficult and so is very much a goal rather than a requirement.

- Source RD2
- Importance Desirable
- Frequency once
- Phase AVM

5.4.7 UR-FTS-370 User Help

5.4.7.1.1.1 IA will have a help system including reference guides and recipes

- Source RD2
- Importance Essential
- Frequency continuous
- Phase AVM

5.4.8 UR-FTS-380 Source code

Modules will be open source so that the Astronomer can see the algorithms applied and have the facility to locally modify and run code.

- Source RD2
- Importance Essential
- Frequency once
- Phase AVM

5.4.9 UR-FTS-390 History

5.4.9.1.1.1 The product generation history will be a component part of the products

- Source RD2
- Importance Essential
- Frequency once

- Phase AVM

5.5 UR-FTS-4** Data Products

5.6 UR-FTS-5** Interactive Analysis: Processing of Observing Modes

The Interactive analysis must be capable of processing all observing modes. This section indicates what we currently expect to be the procedures required for each mode.

5.6.1 UR-FTS-510 General

The following processes will be required on all data regardless of observing mode (except where explicitly excluded in the observing mode specific sections below). The following steps are applicable for the two FTS operating modes, i.e. SOF1 (Point Source Spectrum) and SOF2 (Fully sampled spectral map within FOV).

Steps 3.4.1.1 to 3.4.1.15 will refer to the processing of any FTS 'scan'. Steps 3.4.1.16 to 3.4.1.25 will refer to link different scans relevant to one single position on the sky. Finally steps 3.4.1.26 and 3.4.1.27 producing spectral maps are used only for SOF2 processing.

Presently, the FTS/IA stops at step 3.4.1.27. We have to decide how far IA has to go before exporting (format to be defined) to another data processing package to carry out the later reduction/analysis steps.

5.6.1.1 Extraction of Data from FINDAS

Includes all SPIRE relevant data. Any observation with the FTS will consist of a number of 'scans'. All relevant data must be kept grouped by 'scan' for further data processing.

5.6.1.2 Flag bad data

Self explanatory for dead (or damaged) detector(s). Need construction of the instrument status history of both the FTS miror speed and the telemetry defects to identify bad portion(s) of the scan.

5.6.1.3 Store data (to local store)

In general data should be stored at a point in the pipe-line that one may wish to return to (to run new procedures) without having to go further back. So it is likely that data should be stored after time-consuming or stable processes.

5.6.1.4 Visualisation of raw data (interactive)

Visualisation routines would be required at some stages during the data processing. I.e., at least, we would like to be able to examine the most raw of data products, before any real processing has occurred, and we would like to be able to visualise the data in physical units.

5.6.1.5 Electrical cross-talk removal

Self explanatory (but may be difficult to implement)

5.6.1.6 Oth order deglitching

Correct for main glitches.

5.6.1.7 Convert position counter to mechanical position

Requires a calibration table.

5.6.1.8 Generate list of signal vs position

Two methods should be considered: either interpolate position to time of the detector sample or interpolate detector signal to time of the position sample. It is foreseen that this step should also be able to include/add missing data with the help of the missing position info.

5.6.1.9 Convert mechanical position to OPD for each detector

Self explanatory. Require also a calibration table.

5.6.1.10 Sensitivity correction

Needs change in sensitivity to be calculable from calibration measurements.

5.6.1.11 Correct for time-dependent variation in flux
Variation in flux may come from the emission of either the Herschel Telescope or the FTS internal calibrator.

5.6.1.12 Correct for position-dependent variation in flux
Requires a callibration table.

5.6.1.13 Correct for telescope pointing drift
Self explanatory (but may be difficult to implement)

5.6.1.14 Store and Visualisation
See points 3.4.1.3 and 3.4.1.4.

5.6.1.15 Re-grid if necessary
5.6.1.16 Correct for flux drift across multiple scans
Self explanatory.

5.6.1.17 1st order deglitching
Remove outliers (median-like method).

5.6.1.18 Phase correct, Apodise and Fourier Transform individual scans
5.6.1.19 Look for duff spectra
Automatic or interactive visualisation.

5.6.1.20 Removal of time-dependent spectral response
This should include the frequency response of each detector. Needs calibration tables.

5.6.1.21 Produce a spectrum per pixel per scan
Self explanatory.

5.6.1.22 Remove instrument signature
Remove telescope – calibrator emission.

5.6.1.23 Flat-fielding
Requires a calibration table.

5.6.1.24 Convert to relevant units
e.g. Jy or $W/m^2.cm^{-1}$ or W/m^2. Requires calibration tables.

5.6.1.25 Produce a spectrum per pixel per sky position
Average over scans.

5.6.1.26 Produce 3D data cube
3D are for the two celestial coordinates and the radiation frequency.

5.6.1.27 Select and display map over spectral range
TBC.

5.6.2 UR-FTS-560 Engineer Modes
TBD

6 URD-547 Routine Instrument Operations
6.1.1 Purpose & Scope

This document describes the requirements put on the ICC during routine instrument operations, including monitoring the performance of the instrument and changing observing plans. People involved will include ICC scientists, consortium scientists, FINDAS scientists or astronomers interacting with the ICC via the FSC.

The functions that the ICC needs to provide for routine instrument operation are the same as those described in specific user requirement documents. This URD is thus a textual description of routine operation linking together the relevant URDs.

6.1.2 Related Documents

6.1.2.1 Applicable Documents

AD-1	FIRST Ground Segment Design Description FIRST/FSC?DOC/0146
AD-2	FSC System URD
AD-3	FINDAS URD
AD-4	ICC as a Whole System Requirements
AD-5	SPIRE ICC Calibration Requirements
AD-6	SPIRE Photometer processing requirements
AD-7	SPIRE FTS processing requirements
AD-8	FSC Requirements of the SPIRE ICC
AD-9	Common Uplink Requirements
AD-10	Astronomical Observation Preparation Requirements
AD-11	AIV requirements

6.1.2.2 Reference Documents

RD-1	SPIRE ICC URD Scope Document
RD-2	FIRST-FSC URD
RD-3	FIRST-FSC Actor list
RD-4	SPIRE ICC AIV requirements

6.1.3 Overview

The functions that the ICC needs to provide for routine instrument operation are the same as those described in specific user requirement documents (AD1 - AD10). This URD is thus a textual description of routine operation linking together the relevant URDs to show their relationships to normal operations.

6.1.4 User Characteristics

6.1.4.1 ICC scientists
6.1.4.2 FINDAS scientists
6.1.4.3 SPIRE Instrument Scientist
6.1.4.4 SPIRE Calibration Scientists
6.1.4.5 Consortium Scientists
6.1.4.6 Astronomers in General

These roles and functions of these users of the ICC have been described in AD1-AD10

During routine instrument operations the following general processes are carried out : Astronomical and calibration observations are prepared, with requirements as set out in AD-10.

These observations are scheduled by the FSC and the relevant commands sent to SPIRE using the common ground segments. The requirements are set out in AD2, AD3, AD8, AD9

Data from SPIRE will be ingested into the database at FINDAS, and it is from here that the ICC will access the data and its associated header information. The FINDAS requirements are set out in AD-3.

ICC scientists and calibration scientists will examine the data for instrument health monitoring purposes, and confirm that reduced data is acceptable. To do this efficiently the data must be

reduced in real time, and other reduction or analysis steps or re-reduction that are later necessary must be carried out quickly in at least semi- automated fashion (like QLA) as well as with ILA tools. The data reduction tools and requirements are generally as set out in AD5, AD6, AD7, AD11. It is noted here that some specific algorithms that are applied to the data for health monitoring purposes may not be identical to those for astronomical or calibration purposes.

An additional requirement specific to health monitoring during normal operations is that the ICC should provide software that facilitates the measurement, storage, retrieval and display of values from data over long time periods. For example the mean level of a bolometer during a particular type of observation may be measured for each such observation and then used to track long term drifts in the instrument performance.

7 URD-548 Instrument Engineering

7.1.1 Purpose & Scope

This document describes the requirements put on the ICC by instrument engineering - i.e. non routine work with the instrument, and work to understand the instrument performance. For example we will need to be able to execute test observations and sets of observations, analyse the results, modify observing modes or create new ones.

7.1.2 Related Documents

7.1.2.1 Reference Documents

RD-1	SPIRE ICC URD Scope Document
RD-2	FIRST-FSC URD
RD-3	FIRST-FSC Actor list
RD-4	SPIRE ICC AIV requirements
RD-5	SPIRE ICC Calibration Requirements
RD-6	SPIRE Photometer processing requirements
RD-7	SPIRE FTS processing requirements

7.1.3 Overview

Many of the requirements for instrument engineering are similar to those for AIV and calibration, which are important forms of instrument engineering. Instrument engineering includes: modelling the instrument performance, tests and investigations of the instrument performance to diagnose problems (e.g. those indicated by routine health monitoring), ensuring the best possible instrument performance at all times, defining and investigating new operating modes. Such work is carried out on the ground during AIV, but we will need to be able to repeat it during flight as subtle and not so subtle performance factors may change, as a result of the changed environment or as a function of time. Rather than repeat the requirements all ready noted in RD-4 and

RD-5 this document draws together any additional requirements such as those placed by the need for "remote trouble shooting" after launch. People involved in instrument engineering may be calibration scientists, ICC scientists, instrument engineers or consortium members

7.1.4 User Characteristics

This section should be used to describe the users relevant for this URD.

7.1.4.1 Instrument Scientist

The instrument scientist has in-depth knowledge of the instrument design, function and expected performance.

7.1.4.2 Calibration Scientists

The calibration scientist has in-depth knowledge of the properties and operation of the instrument. S/he plans observations to characterise the instrument, as part of normal operations or as an engineering investigation, and determines and verifies the calibration parameters for the instrument. Since SPIRE has both a photometer and an FTS there will be a calibration scientist with responsibility for each of photometry and spectroscopy.

7.1.4.3 Test Scientist

The test scientist has overall responsibility for defining the tests to be carried out during AIV - e.g. the command sequences and data analysis procedures need to carry out a test, as well as for assessing the results of the tests.

7.1.4.4 Instrument Engineer

The instrument engineer analyses engineering data to investigate instrument performance and characterisation.

7.1.4.5 Software developers

The software developers will need to modify QLA and IA, and observation preparation tools in response to any proposed changes to instrument operation modes that result from engineering tests.

7.2 Requirements

Instrument engineering generally involves the acquisition and analysis of data and it thus places
requirements on both these stages. Instrument engineering during the construction phase involves modelling instrument performance and understanding what this means for data acquisition and reduction details.

7.2.1 UR-IE-100 URD-Modelling

The ICC will provide a detailed software model of the instrument performance, to be refined as the instrument hardware develops.
How the data reduction algorithms carry out steps such as de-convolution may depend on how the data and housekeeping information are sampled, as well as for example mechanical movement accuracy of the BSM or FTS mechanisms - modelling the options is

necessary to plan the best methods. This work needs to be carried out by the ICC team to ensure appropriate algorithms are developed to meet the requirements set out in RD-6, RD-7.
The analysis / model must have sufficient detail and be parameterised such that it may be used to assist diagnosis of problems during AIV and operations. Such models may also be used to refine requirements on instrument hardware and telemetry.

- Source [here]
- Importance [Essential]
- **Frequency** [as required]
- Phase [asap]

7.3 UR-IE-2** Data Acquisition

7.3.1 UR-IE-210 Command Sequences

Will need to write specific command sequences which may be high (observation type) or low (individual commands) level to carry out engineering tests.

- Source [here]
- Importance [Essential]
- **Frequency** [as required]
- **Phase** [ILT and subsequently]

Notes
Command sequence writing requirements are properly described in RD-4, and are mentioned here only to confirm that all types are required for engineering.

7.3.2 UR-IE-220 Preparation tool

Parameters and information in the observing preparation tool must be easy and quick to modify.
If new observing modes are derived as a result of instrument engineering tests it may be necessary to change the parameters and information in the observing preparation tool.

- Source [here]
- Importance [Essential]
- **Frequency** [as required]
- **Phase** [PV/Operations]

7.3.3 UR-IE-230 Scheduling

If there is a suspicion that the previous or concurrent operation of another instrument or function (i.e. not SPIRE) has a knock on effect on the SPIRE performance, it will be necessary to request a series of actions involving more than just one instrument to investigate such effects and determine what to do about them.

- Source [here]
- Importance [Essential]
- **Frequency** [as required]
- **Phase** [PV/Operations]

7.3.4 UR-IE-240 Status Information

The ICC will be monitoring telescope, spacecraft, and SPIRE parameters. The ICC shall also have access to the parameters for the other instruments to check they are not affecting SPIRE performance in some way, and access to the historical status information in the database.

- Source [here]
- Importance [Essential]
- **Frequency** [as required]
- **Phase** [PV/Operations]

7.3.5 UR-IE-300 Data Reduction

Real time processing and display requirements are as described for AIV in RD-4, section 3.3

- Source [Rd-4]
- Importance [Essential]
- **Frequency** [as required]
- **Phase** [PV/Operations]

7.3.6 UR-IE-310 Analysis

Data reduction system must be sufficiently flexible as to support the rapid implementation of new reduction algorithms.
Such changes may be needed for new or modified observing modes, or to remove new data artifacts identified as such by either routine health monitoring, or sometimes as a result of engineering tests (an example might be a noisy detector that cannot be fixed or worked around), or because new reduction steps needed to analyse data from a new engineering test.

- Source [here]
- Importance [Essential]
- **Frequency** [as required]
- **Phase** [PV/Operations]

7.3.7 UR-IE-320 Data storage

The results of any analysis of engineering data should be stored, ideally with the data, such that they can be easily accessed at a later date.
For example an engineering test sequence may take data to look at correlated noise and the data reduction may generate a number representing this which should be stored to facilitate monitoring of performance. (Similar requirement as for calibration files, but not actually used to calibrate science data).
Any test command sequences or observation definitions used to obtain engineering data should also be stored such that they can used for future reference, even if there is no requirement to re-run the test.

- Source [here]
- Importance [High]
- **Frequency** [as required]

- **Phase** [PV/Operations]

8 URD-549 ICC Infrastructure

8.1.1 Purpose & Scope

Requirements on the infrastructure needs of the ICC to allow it to function day-to-day, during the different phases of the mission. This includes procedural functions and high level requirements common to the other URD scopes (RD-1), for example the provision of a suitable database; communication channels within SPIRE and with the HSC, MOC and other ICCs.

8.1.2 Related Documents

8.1.2.1 Applicable Documents

AD-1	FIRST Ground Segment Design Description	FIRST/FSC/DOC/0146
AD-2	FSC Actor Definitions	FIRST/FSC/DOC/0157

8.1.2.2 Reference Documents

RD-1	SPIRE ICC URD Scope Document	SPIRE-ICS-DOC-000484
RD-2	FSC System URD	FIRST/FSC/DOC/0115

8.1.3 Overview

The ICC is split geographically into three parts, the control centre itself at RAL and two DAPSASs at IC and Saclay.

The Herschel Common Science System (HCSS) provides the software infrastructure common to the HSC and ICCs. This includes facilities such as the Common Uplink System, Proposal Handling, Version Control, Document Management and the (Versant) database. It also provides an environment for interfacing ICC-specific software (for example the local node of the database).

The HCSS forms a large part of the design for the software infrastructure of the ICC as a whole. This document does not in general describe URs that have already been covered by the HCSS, however it does specify particular requirements that the ICC places on the HCSS.

8.1.4 User Characteristics

The descriptions of the users can be found in AD-2.

8.1.4.1 ICC Actors

Calibration Scientist
ICC Manager
Instrument Engineer
Instrument Tester
Scientific Software Developer
Scientific Product Analyst
Software Tester
Software Maintenance Team

8.2 Requirements

This section describes the actual requirements. Note that the Phase flag indicated the *earliest* phase the requirement is made at. It is assumed, unless explicitly stated that the requirement holds for all subsequent phases.

8.3 UR-ICC-1** SPIRE Software

8.3.1 UR-ICC-110 Common environment

There will be a common development environment for software developers, including for example the software tools, tool versions, standard locations for spire-developed libraries, standard build scripts, etc.

Source	Here
Importance	Essential
Frequency	Weekly
Phase	ILT

8.3.2 UR-ICC-120 CVS

There will be a configuration control system in which all SPIRE software and related files that have reached a 'version 1' of maturity are stored.

Source	SIRD-ICCF-185
Importance	Essential
Frequency	Weekly
Phase	ILT

8.3.3 UR-ICC-130 Sandbox environment

A sandbox environment will be available for testing software on stored without affecting the 'live' software release(s), nor changing the data itself. This sandbox may or may not exist within the HCSS.

Source	Here
Importance	Essential
Frequency	Weekly
Phase	ILT

8.3.4 UR-ICC-140 Information local to ICC

Software for the development release of the HCSS is checked into the central repository. This logs what component of software it is, its version, the date, etc. However, it may be desirable to have a more readily readable source of information on the status of software that is local to the ICC and does not require a lot of interaction with the HCSS (especially for non-developers)

E.g. a forms based set of local web pages that developers can update with textural information of the status of a component of software; who it working on it, what's being done to it, last version submitted to CVS, what changes were made, estimated time of next version, etc.

Source	Here
Importance	Desirable
Frequency	Weekly
Phase	ILT

8.3.5 UR-ICC-150 Common system environment

There will be a common system environment set up for ICC Actors such that routine processing, analysis and calibration can be performed without requiring the user to set up their environment ad hoc.

Source	Here
Importance	Desirable
Frequency	Weekly
Phase	ILT

8.4 UR-ICC-2** Documentation

8.4.1 UR-ICC-210 Document format

A common document format will be used, which may be different for editable and non-editable documents (source code documentation may have its own format).

The current choice of document formats is Framemaker and Word for editable documents (Word exclusively for externally viewed documents since that is the standard Herschel format), and PDF for non-editable documents. Since Java is the implementation language of the HCSS, JavaDoc will be used for source code documentation.

Source	Here SPIRE IDT
Importance	Essential
Frequency	Monthly
Phase	ILT

8.4.2 UR-ICC-220 Document templates

Templates will be produced, for supported document formats, for standard types of document routinely produced by the ICC.

Source	Here
Importance	Desirable
Frequency	Monthly
Phase	ILT

8.4.3 UR-ICC-230 Document Standards

Provide to the HCSS, to the agreed standards all relevant ICC related documentation. This includes:

- The ground segment related ICC Operational Procedures (nominal and contingency)
- The ICC Operations Plan
- Monthly ICC reports

Source	SIRD-ICCF-115, SIRD-ICCF-190, SIRD-ICCO-085
Importance	Essential
Frequency	Monthly
Phase	ILT

8.5 UR-ICC-3** HCSS database and local computing system

The database part of the HCSS was formerly known as FINDAS.

8.5.1 UR-ICC-310 Local HCSS nodes

Each of the three geographically separated sites of the ICC shall have their own local HCSS node.

Since only RAL will host the SPIRE node itself, what the two DAPSASs actually have at their sites needs to be investigated. E.g. it could be a permenant, reliable and fast network connection, or a local read-only copy. The chosen implementation will impose additional requirements on the ICC.

Source	Here
Importance	Desirable
Frequency	Once
Phase	ILT

8.5.2 UR-ICC-320 Local HCSS support

Each site will have local support for development and maintenance of their HCSS node.

Source	SIRD-ICCF-176
Importance	Essential
Frequency	Weekly
Phase	ILT

8.5.3 UR-ICC-330 Local accounts

Local accounts created for ICC Actors will be set up with a common environment and registered as a database user. They shall also have access (read or write depending on role) to the configuration control system.

Source	Here UR-3[FSC-UR-3.2-1230/1240]
Importance	Essential
Frequency	Monthly/Yearly
Phase	ILT

8.5.4 UR-ICC-340 Remote connection for ICC actors

The ICC computing system will allow full access for ICC Actors with accounts who connect remotely whilst working at other sites (e.g. MOC).

TBD: whether this means Herschel sites or from anywhere.

Source	Here
Importance	Essential
Frequency	Daily
Phase	ILT

8.5.5 UR-ICC-350 Security

The ICC computing system will be maintained regarding security issues, e.g. security patches, firewall configuration, password checking, etc. This requirement has precedence over requirement 3.3.4 (i.e. if the only way to allow an ICC Actor remote access is to reduce the level of security then that access will not be allowed).

Source	Here
Importance	Essential
Frequency	Weekly/Monthly
Phase	ILT

8.6 UR-ICC-4** Communication

8.6.1 UR-ICC-410 Contact info for SPIRE members

There will be an up-to-date restricted-access web page listing all the SPIRE members, including details of name, position, address, telephone, email, etc. An up-to-date as possible list of the relevant personnel at the HSC, MOC, PACS & HIFI will be similarly available.

For SPIRE members at least, this web page might be kept dynamically up-to-date by using the user details of HCSS accounts. Peoples' details are subject to the Data Protection Act.

Source	*Here*
Importance	*Essential*
Frequency	*Daily*
Phase	*ILT*

8.6.2 UR-ICC-420 Staff on call

During the early stages of PV it may be necessary to have members of the ICC on 24 hour call to react to any unexpected behaviour in the spacecraft or the instrument. It may be the HSC or other ICC members who make such a call. Staff on call will have a means of quick communication (phone/pager) and be able to respond suitably (e.g. connect remotely to the ICC, travel into work, have access to documentation, etc).

This is essential if there will be any situations that have to be dealt with outside of normal office hours.

Source	Here
Importance	Essential
Frequency	Daily
Phase	PV

8.6.3 UR-ICC-430 Video link and common desktop

To allow efficient communication between the three sites of the ICC users will be able to have a video link with other users from their computers and be able to use a common desktop (i.e. one in which the users can see and interact with same desktop on their computer displays to discuss, for example, code or the results of interactive analysis).

Source	Here
Importance	Desirable
Frequency	Weekly
Phase	Operations

8.6.4 UR-ICC-440 Staff availability schedule

A restricted-access dynamic web page or some such equivalent that informs HSC, MOC and ICCs members as to which members of the ICC are available on a given day and how they can be contacted.

The intention here is for some system that allows rapid communication rather than, for example, someone sending an email requesting information on a short time scale, or having important information about the health of the instrument but not knowing if the person is in to read it, or if not when they will be.

Source	Here
Importance	Desirable
Frequency	Daily

Phase	ILT

8.7 UR-ICC-5** Management

8.7.1 UR-ICC-510 Management

The ICC Manager shall:

1. Establish jointly with ESA the detailed list of ICC tasks and deliveries.
2. Generate the ICC SIP.
3. Establish and maintain the ICC schedule.
4. Manage the ICC interfaces with the ESA Project Team, the other ICCs, the HSC and the MOC.
5. Support the ground segment reviews.
6. Attend the meetings of the F-GSAG.
7. Establish jointly with SCI-SA the set of documents to be produced by the ICC.
8. Provide the infrastructure and facilities to support the work of the ICC.

Source SIRD-ICCF-005 to SIRD-ICCF-045, SIRD-ICCO-080 SIRD-ICCA-050

Importance	Essential
Frequency	Daily
Phase	Definition

9 URD-550 Herschel Science Centre

9.1.1 Purpose & Scope

This document describes the requirements put on the SPIRE ICC by the Herschel Science Centre (HSC) such that the HSC is able to perform observations with the instrument and allow the Proposer to receive and, possibly, process the scientific data. This includes interfaces for the provision by the ICC of calibration files, AOTs and data processing software. The requirements also include the need for SPIRE to be able to work with/in environments provided by the HSC such as the HCSS.

9.1.2 Related Documents

9.1.2.1 Applicable Documents

AD-1	FIRST Ground Segment Design Description	FIRST/FSC/DOC/0146
AD-2	FSC System Actor Definitions	FIRST/FSC/DOC/0157

9.1.2.2 Reference Documents

RD-1	SPIRE ICC URD Scope Document	SPIRE-ICS-DOC-000484
RD-2	FIRST Operations Scenario Document	Draft 0.95 22 February 2000
RD-3	FSC System Use Case Definitions	FIRST/FSC/DOC/0158
RD-4	FSC System URD	FIRST/FSC/DOC/0115
RD-5	FINDAS URD	FIRST/FSC/DOC/????
RD-6	FSC IRD	FIRST/FSC/DOC/0117
RD-7	Technical Note on the Coding Standards for the FCSS development	FCSDT/TN-009

9.1.3 Overview

The HSC is the single-point interface to the outside community, handling proposals and support. It coordinates cross-calibration between ICCs, uplink of schedules to the MOC and provides quality control and scientific product production. It manages the Herschel Common Science System (HCSS) comprising of sub-systems such as the Common Uplink System (CUS) and the Quality Control Pipeline (QCP). At the core of the HCSS is an Object-Oriented database, used to store, distribute and retrieve all mission artifacts relevant to science and instrument operations.

The ICC is responsible for the operation, monitoring and calibration of the SPIRE instrument. To this end the HSC requires from the ICC calibration and engineering observations, observation quality data, instrument onboard software, scientific product production software, instrument procedures and commands and updates to the instrument database, e.g. calibration files. It also requires the ICC to provide instrument and software documentation and support for queries on the instrument behaviour/functionality that may come from the HSC (e.g. arising from QCP), the MOC or the external community.

9.1.4 User Characteristics

The descriptions of the users can be found in the document HSC System Actor Definitions.

9.1.4.1 HSC-side Specific

9.1.4.1.1 Archive User
9.1.4.1.2 Astronomer
9.1.4.1.3 Configuration Control Board
9.1.4.1.4 Configuration Controller
9.1.4.1.5 FIRST Observation Time Allocation Committee (FOTAC)
9.1.4.1.6 General Public
9.1.4.1.7 Helpdesk
9.1.4.1.8 Mission Planner
9.1.4.1.9 Mission Operations Centre (MOC)
9.1.4.1.10 Problem Analyst
9.1.4.1.11 Project Science Team (PST)

9.1.4.2 ICC Specific

9.1.4.2.1 Calibration Scientist
9.1.4.2.2 ICC Manager
9.1.4.2.3 Instrument Engineer
9.1.4.2.4 Instrument Tester
9.1.4.2.5 Scientific Software Developer
9.1.4.2.6 Scientific Product Analyst

9.1.4.3 Either

9.1.4.4

9.1.4.5 Software Tester

9.1.4.6 SW Maintenance Team

9.2 Requirements

This section describes the actual requirements made on the ICC by the HSC. Note that the Phase flag indicated the *earliest* phase the requirement is made at. It is assumed, unless explicitly stated that the requirement holds for all subsequent phases.

9.3 UR-HSC-1** Common Uplink System / Mission Planning

9.3.1 UR-HSC-110 Repetitive observations

Repetitive calibration/engineering observations must be submitted as a series of observations (as opposed to submitting a type of observation once and requesting it be re-executed after some specified intervals).

Source	RD-2[5.2.1]
Importance	Essential
Frequency	Weekly
Phase	ILT

9.3.2 UR-HSC-120 Time-scale for observation planning

Calibration or engineering observations will normally be submitted at fixed times (interval TBD) within the agreed nominal scheduling cycle (duration TBC). For non-nominal instrument behaviour the timescale for submission and planning of an observation will be at least 3 days (TBC).

Source	RD-2[5.2.1]
Importance	Essential
Frequency	Daily/Weekly
Phase	Operations

9.3.3 UR-HSC-130 Mixing calibration and science on OD

FSC schedule to MOC may mix calibration and engineering observations with science observations. i.e. requirement on ICC not to assume a complete OD is available for calibration or engineering observations (unless there is some instrument problem and science observations cannot be performed anyway).
SPIRE must place a UR on HSC to allow it to specify what we want to do in terms of how we submit calibration observations. E.g. we must be able to observe at certain times.

Source	RD-2[5.2.1]
Importance	Desirable
Frequency	Infrequent
Phase	Operations

9.3.4 UR-HSC-140 Re-requesting failed observations

Failed calibration or engineering observations must be specifically re-requested by the ICC. The HSC will only reschedule failed science observations.

Source	RD-2[5.2]
Importance	Essential
Frequency	Daily
Phase	ILT

9.3.5 UR-HSC-150 Modifying observations

A scheduled observation must be unscheduled before it can be modified. I.e. it may not get the same slot on resubmission.

Source	RD-2[5.3.1.2]

Importance	Essential
Frequency	Weekly
Phase	ILT

9.3.6 UR-HSC-160 Observation rejection by MP

Mission Planning can reject a calibration or engineering observation from a particular OD if it results in a poor Figure of Merit for the schedule.
This is a possibility, to be confirmed or otherwise by HSC, that requires the implications to be addressed.

Source	Here
Importance	Desirable
Frequency	Weekly
Phase	Operations

9.3.7 UR-HSC-170 Replacement of schedule by PS

A schedule containing calibration or engineering observations can, on the approval of the Project Scientist, be replaced with one that does not contain the observations, for example in the case of a ToO.
This is a possibility, to be confirmed or otherwise by HSC, that requires the implications to be addressed.

Source	Here
Importance	Desirable
Frequency	Monthly/Yearly
Phase	Operations

9.4 UR-HSC-2** Software Deliverables

9.4.1 UR-HSC-210 Java

Any software provided to the HSC for HSC use or use by the community will be written in Java.
For scripting purposes (within IA for example) the JPython scripting language is currently under investigation. It integrates seamlessly with Java .

Source	Use-Case meeting #5
Importance	Essential
Frequency	Monthly
Phase	ILT

9.4.2 UR-HSC-220 Coding standards

Any software provided to the HSC for HSC use or use by the community will follow the coding standards for the HCSS.

Source	RD-7 SIRD-ICCF-180
Importance	Essential
Frequency	Monthly
Phase	ILT

9.4.3 UR-HSC-230 Provide quality check tools

Provide IA/QCP tools for the HSC to carry out parallel/cooperative assessment (with the ICC instrument specialists) of the status and behaviour of the instrument.

Source	RD-2[5.2.2] SIRD-ICCF-130
Importance	Essential
Frequency	Monthly
Phase	PV

9.4.4 UR-HSC-240 Provide interactive analysis

Provide IA tools for interactive analysis of data by the Astronomer using the HSC environment, and IA tools that can be installed at the Astronomer's institute subject to (TBD) supported platforms.
These IA tools will most likely be identical to those provided in the previous requirement. The tools for both remote (i.e. at the HSC) and local installation use will be the same, i.e. SPIRE will only support platforms available at the HSC. The requirement that IA tools can be installed locally has implications for remote access of observations from HCSS databases and possible off-line use.

Source	RD-3[UCF-493]
Importance	Essential
Frequency	Monthly
Phase	Operations

9.4.5 UR-HSC-250 Scope of quality check tools

The QCP tools provided to the HSC will allow the systematic and automatic generation of quality control data for each science observation

Source	RD-3[UCF-331]
Importance	Essential
Frequency	Monthly
Phase	Operations

9.4.6 UR-HSC-260 Review Instrument parameters after QCP

As a result of routine QCP carried out by the HSC, the ICC will undertake joint review with the HSC to establish new 'nominal' values for instrument/observation parameters if it is thought that current parameters do not produce optimal products.

Source	RD-2[5.2.2] SIRD-ICCO-075
Importance	Essential
Frequency	Monthly
Phase	IST

9.4.7 UR-HSC-270 Calibration reports

The ICC will provide periodic calibration status reports.

Source	RD-2[5.2.2] SIRD-ICCO-075
Importance	Desirable
Frequency	Weekly/Monthly
Phase	ILT

9.4.8 UR-HSC-280 Provide/Update calibration plan

The ICC will provide the long-term calibration plan and strategy, updated as necessary by ongoing calibrations. The HSC informs the community of the calibration status and strategy at regular intervals.

Source	RD-2[5.2.2] SIRD-ICCO-075
Importance	Desirable
Frequency	Monthly/Yearly
Phase	ILT

9.5 UR-HSC-3** HCSS database

9.5.1 UR-HSC-310 Support HCSS at ICC

The ICC must provide support for the running and maintenance of the local HCSS node at the ICC.

There needs to be an Actor at the ICC with sufficient knowledge of how the local node runs to be able to fix it if it stops, or know who to contact if the problem is serious.

Source	Here
Importance	Essential
Frequency	Daily
Phase	ILT

9.5.2 UR-HSC-320 Support HCSS development

The ICC shall provide support to the HSC for definition, design, integration, test and validation of the HCSS.

Source	SIRD-ICCF-175 SIRD-ICCF-177
Importance	Essential
Frequency	Daily
Phase	ILT

9.6 UR-HSC-4** HCSS Maintenance / Configuration Control System

9.6.1 UR-HSC-410 Updating the OBS

On the raising of an appropriate SPR/SCR the ICC will update code to generate an onboard software memory image and deliver it to the HSC with a software release note describing its implications and updated documentation. This will be more frequent during IST/PV phases.

The OBS URD needs to indicate who is responsible for maintaining code, since IFSI is not around in the operations phase.

Source	RD-2[5.11.1]
Importance	Essential
Frequency	Monthly/Yearly
Phase	IST

9.6.2 UR-HSC-420 Using a common CC system

The ICC shall use the Configuration Control System of the HCSS for all software and documentation of the common system that is jointly supported and maintained by the HSC and ICCs.

CVS (Concurrent Versions System) is currently the implementation of a Configuration Control System
.

Source	RD-2[5.11.2]
Importance	Essential
Frequency	Daily
Phase	ILT

9.6.3 UR-HSC-430 Update of calibration/engineering files

ICC submit, under configuration control, updates of calibration/engineering files and AOTS to the HCSS such that the best, verified parameters, procedures, etc are used to perform and reduce observations. More frequent during ILT/IST.

Source	RD-2[5.2]
Importance	Essential
Frequency	Monthly
Phase	ILT

9.6.4 UR-HSC-440 Changing a system artifact

Changes to any system artefact upon which the HSC has a dependency must be preceded by the submission of a SCR.

Source	RD-3[UCF-421]
Importance	Essential
Frequency	Daily
Phase	ILT

9.6.5 UR-HSC-450 Responding to an SCR

Following submission of a SCR the relevant artefacts must be checked out of the HCSS and a test plan and test environment created. Updated artefacts must be verified with the CC and CCB prior to checking into the HCSS.

Source	RD-3[UCF-395]
Importance	Essential
Frequency	Daily
Phase	ILT

9.6.6 UR-HSC-460 Traceability of configuration and inputs

Persistent processing results have to be reproducible, implying traceability of the configuration and input products used to produce new or updated artefacts.

Source	Here
Importance	Essential
Frequency	Daily
Phase	ILT

9.6.7 UR-HSC-470 Updating software delivered to HSC

The ICC will produce updates to software it delivers to the HSC, for integration into the HCSS.

To update software we only need submit new versions to the configuration control system. The HSC rebuild the development release of the HCSS each night. The HSC makes development releases 'live' on a six weekly cycle.

Source	FSC
Importance	Desirable
Frequency	6 weekly
Phase	ILT

9.7 UR-HSC-5** HSC Collaboration

9.7.1 UR-HSC-510 Interface with FSC

ICC interfaces directly with the HSC Helpdesk (community support) for questions and answers. During office hours

Source	RD-2[5.1.4] RD-3[UCF-605] SIRD-ICCO-025
Importance	Desirable
Frequency	Daily
Phase	Call for proposals #1

9.7.2 UR-HSC-520 Responding to FSC PR requests

The ICC shall participate as required in pre-launch ground segment integration tests, validation tests and simulations.

Source	SIRD-ICCF-200
Importance	Essential
Frequency	Daily
Phase	Definition

9.7.3 UR-HSC-530 Information for PR

ICC provides information, material and staff appearances requested by the HSC for PR purposes.

Source	Here RD-3[UCF-92]
Importance	Desirable
Frequency	Daily/Weekly
Phase	Operations

9.7.4 UR-HSC-540 Joint Information Provision

The ICC shall provide, jointly with the HSC:

- Instrument Observers Manual
- Definition of instrument data to be stored in the science archive and their relationship with HSC & MOC provided items.
- Data and operational interface between ICC and HSC.

Source	SIRD-ICCF-102 SIRD-ICCF-120 SIRD-ICCF-125 SIRD-ICCF-165
Importance	Essential

Frequency	Daily/Weekly
Phase	Operations

9.7.5 UR-HSC-550 Instrument Information Provision

The ICC shall provide to the HSC:

- Instrument calibration, engineering, diagnostic etc requests to the HSC for the upcoming mission planning period.
- Proposed changes to instrument operations scenario and coordinate with MOC and HSC.

Source	SIRD-ICCO-030 SIRD-ICCO-055
Importance	Essential
Frequency	Daily/Weekly
Phase	Operations

9.8 UR-HSC-6** Training

9.8.1 UR-HSC-610 Development Staff Training

The ICC shall ensure development staff are adequately trained.

Source	Here
Importance	Essential
Frequency	Daily/Weekly
Phase	ILT

9.8.2 UR-HSC-620 Operations Staff Training

The ICC shall set up and train the ICC operations team.

Source	SIRD-ICCO-05
Importance	Essential
Frequency	Daily/Weekly
Phase	Operations

9.8.3 UR-HSC-630 HSC/MOC Staff Training

The ICC shall provide instrument training, as required, to selected HSC and MOC staff.

Source	SIRD-ICCO-010
Importance	Essential
Frequency	Daily/Weekly
Phase	Operations

9.9 UR-HSC-7** Archive Phase

9.9.1 UR-HSC-710 Archive Support

The ICC shall, jointly with the HSC:

- Monitor the run-down activities in order to ensure that all required spacecraft data are secured.
- Define the type of data and products to store in the archive.
- Support users in data reduction.
- Define processing and archive access tools.

Source	SIRD-ICCA-005 SIRD-ICCA-010 SIRD-ICCA-015 SIRD-ICCA-020

Importance	Essential
Frequency	Daily/Weekly
Phase	Operations

10 URD-551 CUS

10.1.1 Purpose & Scope

This document defines those requirements put on the ICC by the need to be able to send commands to the instrument to carry out scientific, calibration and engineering observations. The Common Uplink System (CUS) is expected to provide the required functionality during all phases: from instrument testing on the ground through to the commissioning and routine phases. The CUS is a component of the Herschel Common Science System (HCSS). A more detailed description is given in Section 1.4.

10.1.2 Related Documents

10.1.2.1 Applicable Documents

AD-1 SIRD (Herschel Science Operations Implementation Requirements Document)

10.1.2.2 Reference Documents

RD-1 HGSDD Herschel Ground Segment Design Description (FIRST/FSC/DOC/0146)
RD-2 SPIRE ICC URD Scope Document
RD-3 HCSS URD
RD-4 Herschel-HSC Actor list
RD-5 Technical Note on Observation and Building Block Identifiers for Herschel (ICC/2001-001)

10.1.3 Overview

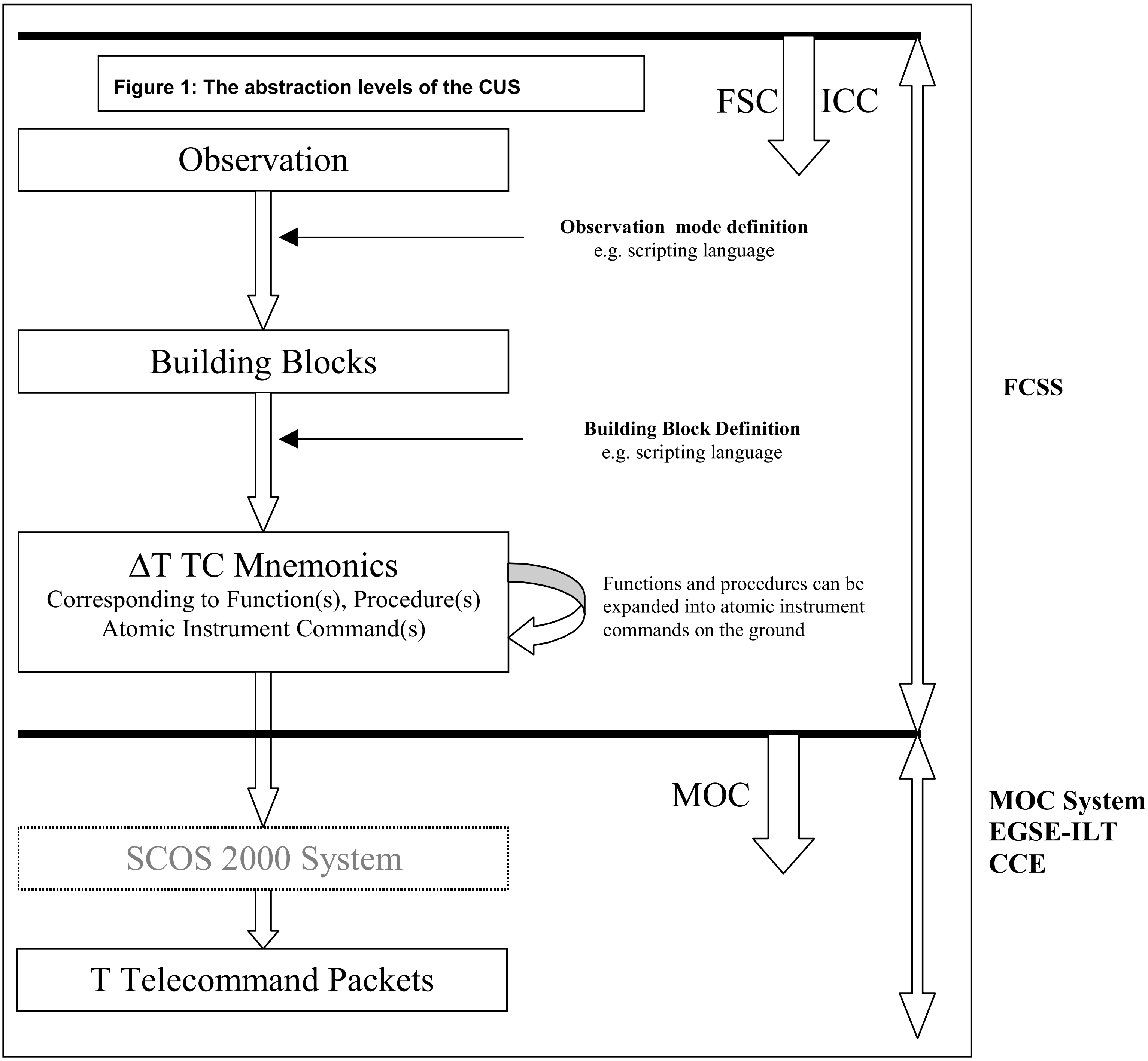
The Common Uplink System (CUS) allows the user to enter details of an observation to be performed (viz. an observation request) by the instrument and translates them into instrument commands which eventually get executed by the instrument. The CUS will use the same mechanism to define observation modes and building blocks (see definitions given below) for all types of observations. It could be an observation request originating from an astronomer, or it could be a calibration or an engineering observation request (e.g. instrument characterisation) from an instrument engineer or a calibration scientist. A scripting language will be used for this purpose.
The CUS component is expected to be identical for all three instruments on Herschel (apart from the actual contents of the CUS database of course). It will be developed jointly by the HSCDT and the ICC's for the HCSS (hereafter referred to as the HCSSDT).
Figure 1 shows the four abstraction levels of the CUS (see the HGSDD (RD-1) for further details). At the highest level is the *observation,* which could be a scientific, calibration or an engineering observation. The next level refers to *Building Blocks* (*BB's*), which are essentially a high level description of the *observation* in the user domain (e.g. perform_calibration, perform_scan, etc). The *BB's* themselves are scripted in the same language as an *observation.* The relative time-tagged *TC mnemonics*, occurring at the third abstraction level, are instrument commands. These first three levels of the CUS abstraction are within the scope of the overall HCSS. At the fourth level of abstraction, the TC mnemonics are translated into TC packets by SCOS 2000. This translation itself is

achieved by referring to the MIB instrument database in ILT, IST and operations using the EGSE-ILT, CCS and MOC systems respectively. The TC packets, which are tagged with absolute times by SCOS-2000, can be executed by the OBS without any further expansion. It is important to note that during ILT the CUS will be used to generate instrument test sequences, calibration measurements and instrument characterisation measurements for input to the EGSE Test Facility Control System. For IST these test sequences and measurements will be supplied to the CCS without any interactive facility for modifications.
The CUS is therefore responsible for generating TC mnemonics for observations. It knows about the structure of an observation and how to break it down into a set of TC mnemonics.

10.1.4 User Characteristics

The users of the CUS have been identified with the actor definitions given in the HCSS. These have been described elsewhere but their roles in the context of the CUS are briefly

Figure 1: The abstraction levels of the CUS



outlined below:

10.1.4.1 <u>**Instrument Engineer**</u>

The Instrument Engineer will provide the CUS database and generate observation modes.

10.1.4.2 <u>**Calibration Scientist**</u>

The Calibration Scientist will use the CUS to generate observation requests for calibrating the instrument.

10.1.4.3 Configuration Con

10.1.4.4 troller

The Configuration Controller will keep track of the various CUS databases and their status.

10.1.4.5 Astronomer

The Astronomer will use the CUS indirectly via the Proposal Handling System (PHS) to generate observation requests in astronomically meaningful terms (e.g. given signal-to-noise, integration times, etc).

10.2 Requirements

This section describes the actual requirements on the ICC by the CUS.

10.3 UR-CUS-1**: Instrument Information

10.3.1 UR-CUS-110: Provision Of CUS DB Information

UR-CUS-110: It shall be possible to provide to the HSC all instrument information needed for the CUS.

Instrument information includes operating mode definitions, building block definitions, TC mnemonics, translation of TC's, sequences of commands for manual commanding by the MOC. The actual mechanism and data format of delivery to the HSC is TBD but is expected to vary depending on the information.

For manual commanding the sequences of commands will be delivered to the MOC via the FSC.

- **Source** [SIRD requirements: ICCF-050, 055, 060, 065]
- Importance/Priority [High]
- Risk [High]
- **Phase** [Mid ILT/Operations]

10.3.2 UR-CUS-120: CUS and Instrument Command Database

UR-CUS-120: It shall be possible to associate CUS commands with the low level instrument commands via a database.

CUS commands are uplinked to the instrument via the S/C CDMS which passes them on to the DPU. On receptiom the DPU OBS transmits these commands to the appropriate instrument sub-system. Within a sub-system each such command corresponds to low level commands which are executed sequentially to carry out the instrument operations. The required database associates these low level commands with the CUS commands.

- Source [SDS]
- Importance/Priority [High]
- Risk [High]
- **Phase** [Mid ILT/Operations]

10.3.3 UR-CUS-130: Telemetry Contents

UR-CUS-130: All the uplink TC information needed to associate it with the downlinked TM should be present within the TM itself.

The HGS design provides the concept of Observation Identifiers (OBSID's) and Building Block Identifiers (BBID's). The OBSID uniquely identifies an observation execution during all phases of the mission while the BBID divides up an individual observation execution into its key *components. The HK and science TM packets form an observation will be tagged with these identifiers enabling packages such as IA and QLA to process the data easily. It is therefore important that the BB's in observations are defined to make the TM processing tasks as smooth and as self-reliant as possible. This requirement puts an explicit requirement on the instrument team.*

- **Source** [SIRD requirement: ICCF-080]
- Importance/Priority [High]
- Risk [High]
- **Phase** [Mid ILT/Operations]

10.3.4 UR-CUS-140: Configuration Control

UR-CUS-140: It shall be possible to keep all the instrument information relevant to the CUS under configuration control.

The CUS DB needs to be kept under configuration control locally at the ICC as well as at the HSC.

- Source [SDS]
- Importance/Priority [Medium]
- **Risk** [Medium]
- **Phase** [Mid ILT/Operations]

10.4 UR-CUS-2**: Installation and Testing

10.4.1 UR-CUS-210: Installation

UR-CUS-210: It shall be possible to install the CUS after delivery from the HCSS on a local system.

Resources will be available locally to take delivery, install and run the CUS component in the overall HCSS release. The most likely scenario is that the entire HCSS will be delivered to the ICC by the HCSSDT, including the CUS.

- Source [SDS]
- Importance/Priority [High]
- Risk [High]
- **Phase** [Mid ILT/Operations]

10.4.2 UR-CUS-220: Test facility for the CUS

UR-CUS-220: A test facility shall be available at the ICC to ensure that the CUS does not have any adverse effects on the instrument.

This test facility will perform preliminary checks on the CUS before being used on the instrument to carry out ground tests, calibrations and observations. Note that this requirement puts explicit requirements on the AIV programme and facility.

- Source [SDS]
- Importance/Priority [High]
- Risk [High]
- **Phase** [Mid ILT/Operations]

10.4.3 UR-CUS-230: Testing of observation modes

UR-CUS-230: It shall be possible to test and check an observation mode to ensure that it does not compromise the safety of the instrument.

An observation mode consists of a series of BB's. The ICC must test and validate these modes in such a way that the execution of one BB does not leave the instrument in a state in which the following BB cannot be executed. This could happen, for example, because either the instrument is not in the correct mode to continue observing or it has failed in some way.

To perform this task the CUS implementation at the ICC will need to support several CUS DB's.

- Source [SDS]
- Importance/Priority [High]
- Risk [High]
- **Phase** [Mid ILT/Operations]

10.5 UR-CUS-3**: Problem reporting

10.5.1 UR-CUS-310: Problem reporting

UR-CUS-310: It shall be possible to send CUS problem reports to the CUS developers in the HCSSDT.

The ICC would need to communicate with the overall HCSSDT to ensure that all problems encountered are effectively reported. It is expected that this process will be handled seamlessly in the HCSS.

- Source [SDS]
- Importance/Priority [Medium]
- **Risk** [Medium]
- **Phase** [Early ILT/Operations]

10.6 UR-CUS-4**: Access to the HSC system

10.6.1 UR-CUS-410: Access to the HSC system

UR-CUS-410: It shall be possible to access the HSC CUS system.

The ICC should have full network access to the HSC system to use the CUS implementation in the officially released CUS DB.

- Source [SDS]
- Importance/Priority [Medium]
- **Risk** [Medium]
- **Phase** [Early ILT/Operations]

11 URD-552 Astronomical Observations

This subsection of the SPIRE ICC URD is intended to cover the topics described in the URD Scope Description as follows:

> **Requirements for the need to be able to prepare astronomical observations using the instrument. Those preparing observations might be ICC calibration scientists or astronomers interacting with the ICC via the HSC.**

One should note that the HSC indeed expects the SPIRE ICC to provide a software tool to allow the preparation of SPIRE observations by non-specialist SPIRE users. One should also note that this is different from a tool that would allow to actually enter an observation into the database of schedulable HERSCHEL observations. It is expected that this tool will be produced and developed in the HSC, incorporating the AOT to instrument logic "translator" developed by the SPIRE ICC (which is not referred to either in this section, see below).
This document is written under the following assumptions:

1 SPIRE observing modes (the AOTs) have been defined and documented.
   1. The logic that converts AOT parameter values into actual command sequences for SPIRE exists or is well documented.
   2. A detailed knowledge of the instrument performances will have been gathered from ground-based calibration.

We also remind that the aim of such a facility is to allow the preparation of astronomical observations. Therefore its aims are not to fully simulate the observation (e.g. from a model of the sky to a model of the output data, an aspect covered in another section of the URD). It should rather help observers compute the value of the different AOT parameters that will allow them to reach their scientific/calibration goals in terms of signal-to-noise ratio.
Following the above remarks, it is clear that the main users of the facility will be observers (from the ICC or external to it). However, one can foresee that the instrument capacities will vary. This should then be reflected in this observing time estimator tool. Therefore, developers of the system can also be thought of as users, in the sense that the necessity of being able to adapt the system to new instrument conditions also place requirements on it.
Therefore the requirements are distributed in 3 sections:

- Systems requirements that cover issues dealing with the conception, functioning and upgrading of the system
- Observers requirement that deals more specifically with those driven by the main users of the system.
- Host requirements, which stems from the fact that the ICC will be the host for the system development and quite likely its use as well, and this implies the definition of some interfaces and policies with the users.

In the rest of this document, the above-mentioned facility or system will be called "time estimator tool". This is only for simplicity reasons. It may very well be the case that this "tool" is not materialized as an independent system, but is in fact a particular property of a larger facility (e.g. the interactive analysis, etc…). This term also applies to any parameter file that may be required to run the tool.
As a final note, we mention that the URD listed here could be considered more as URD on the tool itself, rather than on the ICC. However, given that it is the ICC's responsibility to

develop and maintain such a tool, it seems that any requirement on the system actually places a requirement on the ICC.
Note: (MS) in short, it seems to me that for a system that has to be developed in the ICC, any requirements such as "the system shall be able to do that" can be rephrased as "the ICC shall ensure that the system is able to do that".

11.1.1 Modification history

Date	Version	Author	Change description
16/07/00	D1	M. Sauvage	Document creation
5/12/00	D2	M. Sauvage	Rephrased some requirements, used document template.
18/05/01	D3	M. Sauvage	Numbered requirements for cross-checks
2/6/01	V2.0	S. Oliver	FIRST→ Herschel, FSC→ HSC

System requirements

11.2 UR-AOP-1**: development –

11.2.1 UR-AOP-110: Readiness –

The time estimator is one the key element in estimating the actual feasibility of given science programs (the other one being the simulator tool described in another section of the URD). Therefore it should in principle be available at the time the Guaranteed Time science program is elaborated.

1 - Source	Here
2 - Importance	Essential
3 - Frequency	Not applicable
4 - Phase	Ground Segment Testing

11.2.2 UR-AOP-120: Flexibility -

Almost by definition, the time estimator tool will be used from or at different institutes. It is therefore advisable that the tool be available in such a way that it requires little or no modification to run on different platforms.

1 - Source	Here
2 - Importance	Highly desirable
3 - Frequency	Not applicable
4 - Phase	Ground Segment Testing

11.2.3 UR-AOP-130: Supported AOTs -

Although this is already implicit, the time estimator should support all official SPIRE observing modes, for both broad-band imaging and spectro-imaging.

1 - Source	Here
2 - Importance	Essential
3 - Frequency	Not applicable
4 - Phase	Ground Segment Testing

11.2.4 UR-AOP-140: Files for instrument parameters -

The instrument parameters (noise levels, sensitivities, transmissions, …) accessed by the time estimator tool must be able evolve as rapidly as our knowledge of them. The system shall be designed in such a way that the resources required by this task are kept to a minimum.

1 - Source	Here
2 - Importance	Essential

3 - Frequency	Yearly
4 - Phase	Ground Segment Testing

11.2.5 UR-AOP-150: Values of instrument parameters -

To avoid mismatches between predicted times and actual observing times, values of the instrument parameters should strictly reflect our knowledge of them. No rounding should occur.

1 - Source	Here
2 - Importance	Essential
3 - Frequency	Not applicable
4 - Phase	Ground Segment Testing

11.2.6 UR-AOP-160: Instrument's logic -

The instrument's logic and principally its timing, should be followed as close as possible. This is in order to include all possible dead-times (telescope motion, buffer times to avoid command collisions…) so that the time computed to reach a certain goal is as close as possible to the actual observing time. Any modification of the instrument's logic shall be reflected in the time estimator tool as soon as possible.

1 - Source	Here
2 - Importance	Essential
3 - Frequency	Yearly
4 - Phase	Ground Segment Testing

11.2.7 UR-AOP-170: Outputs -

The time estimator tool is however not meant to produce a meaningful instrument command sequence, which is of no use to the observer. In designing the output content and format, one must remember that parameters such as sensitivity, signal-to-noise, observing time, should be easily accessible to the user. The output of one estimation shall be in a form that allows a quick comparison with outputs from previous estimations.

1 - Source	Here
2 - Importance	Essential
3 - Frequency	Not Applicable
4 - Phase	Ground Segment Testing

11.3 UR-AOP-2**: Maintenance -

11.3.1 UR-AOP-210: Documentation -

It is expected that, due to the rather long lifetime of the HERSCHEL telescope, the time estimator tool will be maintained by persons that may not have participated in its development. Thus the tool shall be well documented, both in its algorithmic part and in its structure, to allow quick identification of the parts to upgrade.

1 - Source	Here
2 - Importance	Essential
3 - Frequency	Not Applicable
4 - Phase	Ground Segment Testing

11.3.2 UR-AOP-220: Versions -

It is almost inescapable that the time estimator will be upgraded to reflect either real changes in the instrument performances, modification of AOTs, or improvements regarding the knowledge of the instrument. These changes should therefore proceed through clearly identified and documented versions in order to minimize the risk of users unknowingly running obsolete versions.

1 - Source	Here
2 - Importance	Essential
3 - Frequency	Yearly
4 - Phase	Ground Segment Testing

11.3.3 UR-AOP-230: Evolving calibration -

Given the foreseen lifetime of HERSCHEL/SPIRE, it is clear that the tool will be used during the mission, and there is a high probability that instrument parameters will vary. Thus care should be taken to reflect any modification of the instrument parameters that could be introduced in other ICC subsystems in this system as well.

1 - Source	Here
2 - Importance	Essential
3 - Frequency	Yearly
4 - Phase	Ground Segment Testing

11.4 Observer requirements

11.5 UR-AOP-3**: Inputs -

11.5.1 UR-AOP-310: Minimal input -

The tool shall allow the user to rapidly explore the parameter space for a given observation. Therefore a minimal set of input values shall be defined that ensure that all these values are absolutely mandatory for the computation, and cannot be meaningfully replaced by default values.

1 - Source	Here
2 - Importance	Essential
3 - Frequency	Not applicable
4 - Phase	Ground Segment Testing

11.5.2 UR-AOP-320: Sources -

The tool is not intended to provide an accurate simulation of the actual observation, but rather allow the observer to find an instrumental set-up that will permit to reach the scientific goals. Therefore the tool should be able during its computation to distinguish between point and extended source (selected by the user), but it is not required that it is able to simulate the observation of a given map.

1 - Source	Here
2 - Importance	Essential
3 - Frequency	Not applicable
4 - Phase	Ground Segment Testing

11.5.3 UR-AOP-330: Backgrounds -

In the operating wavelength range of SPIRE, the background can be important and place limitations to the observing capabilities of some AOT. Since the FIR/Submm background is not constant on the sky, the time estimator tool should be able to provide the user with suitable background data or allow the to enter background values.

1 - Source	Here
2 - Importance	Essential

3 - Frequency Not applicable
4 - Phase Ground Segment Testing

11.5.4 UR-AOP-340: Spectral energy distribution -

SPIRE has broad imaging bands and is also a spectrometer. Therefore a complete description of the targets also includes their spectral energy distributions. The time estimator tool should allow its user to choose between various spectral energy distributions and modify their parameters at will. A meaningful default set of values shall also be defined

1 - Source Here
2 - Importance Essential
3 - Frequency Not applicable
4 - Phase Ground Segment Testing

11.5.5 UR-AOP-350: Noises -

All sources of noise should be included in the computation of the estimated signal-to-noise ratio, i.e. all instrumental but also all sky sources of noise. Confusion noise should thus be considered as well in the computation. Given that the value of the confusion noise can be definition-dependent, the noise sources and their amplitude should be well-documented.

1 - Source Here
2 - Importance Essential
3 - Frequency Not applicable
4 - Phase Ground Segment Testing

11.6 UR-AOP-4**: Outputs -

11.6.1 UR-AOP-410: Synthetic output formats -

It is foreseen that users will play with the time estimator tool, make a number of test cases, and then use them off-line to design an observing strategy. Therefore the tool shall be able to create synthetic outputs where the values of input parameters (sources, background, AOT parameters), the time estimator tool version number, and the result of its computations (preferably on a graphic form) are all available.

1 - Source Here
2 - Importance Highly desirable
3 - Frequency Not applicable
4 - Phase Ground Segment Testing

11.6.2 UR-AOP-420: Easy replay -

A mechanism shall be defined that allow the parameters of a given time estimation to be stored and replayed, without forcing the user to enter/select them one by one from independent notes. This will also allow quick comparison between different versions of the tool.

1 - Source Here
2 - Importance Highly desirable
3 - Frequency Not applicable
4 - Phase Ground Segment Testing

11.7 UR-AOP-5**: Interaction with the tool -

11.7.1 UR-AOP-510: Main command mode -

The main mode of interaction with the time estimator tool should be through a graphical user interface, allowing selection of input information from buttons, menus and command boxes.

1 - Source Here

2 - Importance	Highly desirable
3 - Frequency	Not applicable
4 - Phase	Ground Segment Testing

11.7.2 UR-AOP-520: Replay mode -

The tool should be able to read its complete set-up from a single user-defined location (e.g. a file) so that the user can rapidly configure the tool in a given set-up and replay a test case.

1 - Source	Here
2 - Importance	Highly desirable
3 - Frequency	Not applicable
4 - Phase	Ground Segment Testing

11.8 UR-AOP-6**: Host requirements -

11.8.1 UR-AOP-610: Common elements -

It is clear that the system described here shares some common modules with the instrument simulator described in another section of this URD, although it is intended toward simpler-minded users that do not make a complete simulation of the sky they want to observe. Therefore the ICC shall make sure that common modules between the time estimator tool and the instrument simulator are identified and developed only once, or at least by the same team.

1 - Source	Here
2 - Importance	Essential
3 - Frequency	Not applicable
4 - Phase	Ground Segment Testing

11.8.2 UR-AOP-620: Overview -

A number of systems are already identified that provide some sort of simulation of the instrument. The ICC shall regularly survey the internal consistency of all these systems, and take appropriate actions when such a consistency is no longer maintained.

1 - Source	Here
2 - Importance	Essential
3 - Frequency	Yearly
4 - Phase	Ground Segment Testing

11.8.3 UR-AOP-630: User's training -

Herschel users of the time estimator tool will be members of the SPIRE consortium. The ICC shall therefore ensure that it has the proper resources, both in manpower and documentation, to provide the necessary training for the consortium members.

1 - Source	Here
2 - Importance	Highly desirable
3 - Frequency	Not applicable
4 - Phase	Ground Segment Testing

11.8.4 UR-AOP-640: Interface with the HERSCHEL Science Center – Development -

The time estimator tool is expected to be delivered or made available to the HSC for use by the broader community of HERSCHEL observers. The SPIRE ICC shall ensure that the development choices made for the time estimator tool comply with the HSC expectation.

1 - Source	Here
2 - Importance	Highly desirable
3 - Frequency	Not applicable

4 - Phase	Ground Segment Testing

11.8.5 UR-AOP-650: Interface with the HERSCHEL Science Center – Delivery -

General observers will use the time estimator tool independently of the ICC, and will only interact with the HSC. In SPIRE's interest, the ICC shall make sure that along with the tool's actual delivery, necessary expertise and documentation are also transferred to the HSC.

1 - Source	Here
2 - Importance	Highly desirable
3 - Frequency	Not applicable
4 - Phase	Ground Segment Testing

11.8.6 UR-AOP-660: Interface with the HERSCHEL Science Center – Person -

It is expected that the HSC will probably not be able to handle all user's question on the time estimator tool, or will discover problems in the tool's functioning. The ICC shall identify a contact person, in the team responsible for the development and maintenance of the time estimator tool, to ensure proper information exchange between the ICC and the HSC.

1 - Source	Here
2 - Importance	Highly desirable
3 - Frequency	Not applicable
4 - Phase	Ground Segment Testing

12 URD-553 OBS

12.1.1 Purpose & Scope

This document defines those requirements put on the ICC by the need to have On Board Software (OBS) for operating and controlling the instrument and for collecting housekeeping (HK), scientific and event data for transmission back to the ground. A more detailed description is given in Section 1.4.

12.1.2 Related Documents

12.1.2.1 Applicable Documents

AD-1 SIRD (Herschel Science Operations Implementation Requirements Document)

12.1.2.2 Reference Documents

RD-1	The Herschel DPU/ICU OBS User Requirements Document
RD-2	SPIRE ICC URD Scope Document
RD-3	HGSDD Herschel Ground Segment Design Description (FIRST/FSC/DOC/0146)
RD-4	The Herschel Operations Scenarios Document
RD-5	HCSS URD
RD-6	Herschel-HSC Actor list
RD-7	The Packet Structure Interface Control Document (PS ICD)
RD-8	ICC Interface Requirements Document (TBW)

12.1.3 Overview

The Digital Processing Unit (DPU) On Board Software (OBS) provides the capabilities for handling all uplinked commands from the ground and forwarding them to the instrument or instrument sub-systems for immediate execution. It is responsible for receiving all science and housekeeping data generated by the instrument and then passing it to the S/C for downlink via the on-board solid state memory. It also monitors the status and health of the instrument and runs processes which respond to anomalous events by taking appropriate action. Anomalies which could endanger the health of the instrument will lead the OBS to put the instrument into a safe mode.

The OBS is designed to handle commands and data in terms of packets: in practice this means that it will encode and decode packets using the standards defined in the Packet Structure ICD. The satellite's Command and Data Management System (CDMS) will pass

command packets to the OBS for execution and will expect to receive housekeeping (HK), science and event packets for eventual transmission back to the ground.

IFSI in Frascati, Italy are providing the OBS for all three instruments on Herschel. During all phases of the mission the DPU OBS maintenance will be performed by the ICC using its OBS Maintenance Facility (OBSMF).

12.1.4 User Characteristics

The users of the OBS have been identified with the actor definitions given in the FCSS. These have been described elsewhere but their roles in the context of the CUS are briefly outlined below:

12.1.4.1 OBS Maintainer

The OBS Maintainer maintains the OBS and develops and tests the new functions needed in the OBS.

12.1.4.2 Instrument Engineer

The Instrument Engineer will investigate problems with the instrument functions, determine how they need to be updated or if new functions need to be added. Detailed specifications will need to be provided to the OBS Maintainer for code updates.

12.1.4.3 Calibration Scientist

The Calibration Scientist will analyse data from observations and recommend improvements in the on-board instrument functions.

12.1.4.4 Configuration Controller

The Configuration Controller at the ICC will keep track of the various OBS images and their respective status.

12.2 Requirements

This section describes the actual requirements made on the ICC by the need to have the DPU OBS.

12.2.1 UR-OBS-100 Provision Of OBS Information

UR-OBS-100: It shall be possible to provide to IFSI all the instrument information needed for the OBS development in a TBD format.

OBS information includes all operating mode definitions, HK and science parameter definitions, TC mnemonics, translation of TC's, etc.

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1. **Source** [SDS]
2. **Importance/Priority** [High]
3. **Risk** [High]
4. **Phase** [ILT/Operations]

12.2.2 UR-OBS-110 Provision of OBS Maintenance Facility (OBSMF)

UR-OBS-110: The ICC shall have in house facilities to maintain and modify the OBS, recompile it and generate new memory images for subsequent installation.
This resource is required for all phases of the mission. It is envisaged that during ILT substantial OBS updates will take place, whereas during IST, SCP and operations phases the updates will consist of relatively small changes.

1. **Source** [SIRD requirements: ICCF-155, ICCO-020]
2. **Importance/Priority** [High]
3. **Risk** [High]
4. **Phase** [ILT/Operations]

12.2.3 UR-OBS-120 Testing of OBS

UR-OBS-120: It shall be possible to test and check the OBS to ensure that it does not compromise the safety of the instrument.
The ICC must test and validate the OBS functions to ensure that the execution of one function does not leave the instrument in a vulnerable state or whereby the next instrument command or function cannot be executed.
To perform this task the OBS implementation at the ICC will need to support several OBS images All the testing activity should happen in the context of the OBSMF.

1. **Source** [SIRD requirement: ICCF-160]
2. **Importance/Priority** [High]
3. **Risk** [High]
4. **Phase** [ILT/Operations]

12.2.4 UR-OBS-130 Configuration Control

UR-OBS-130: It shall be possible to keep all the OBS memory images under configuration control at the ICC.
The OBS images need to be kept under configuration control locally at the ICC as well as at the HSC.

1. **Source** [SDS]
2. **Importance/Priority** [Medium]
3. **Risk** [Medium]
4. **Phase** [Mid ILT/Operations]

12.2.5 UR-OBS-140 Installation

UR-OBS-140: It shall be possible to install the OBS image from the OBSMF.
Resources will be available locally to receive and install the new OBS image from the OBSMF. It is expected that this task will be performed by the On Board Software

Management (OBSM) component of SCOS-2000. During operations the MOC will use SCOS-2000 to compare the new image (supplied by the ICC via the HSC) with the one already installed, generate patches and then upload them via a series of TC's. (What happens during ILT and IST? It is not clear whether memory patching with SCOS-2000 is possible with the current release, i.e. 2.0)

1. **Source** [SIRD requirement: ICCF-160]
2. **Importance/Priority** [High]
3. **Risk** [High]
4. **Phase** [ILT/Operations]

12.2.6 UR-OBS-150 Problem reporting and resolving

UR-OBS-150: It shall be possible to communicate OBS problem reports and achieve satisfactory solutions.
The Instrument Engineers within the ICC would need to communicate with the OBS maintainer (i.e. IFSI) to ensure that all problems encountered are effectively reported and resolved.

1. **Source** [SDS]
2. **Importance/Priority** [Medium]
3. **Risk** [Medium]
4. **Phase** [ILT/Operations]

13 URD-554 Consortium

13.1.1 Purpose & Scope

Requirements placed on the ICC by the SPIRE Consortium as a special user. A mechanism must exist that allows a strong interaction between the SPIRE Consortium and the ICC.

13.1.2 Related Documents

RD-1	SPIRE ICC URD Scope Document
RD-2	FIRST-FSC URD
RD-3	SPIRE ICC AIV URD

13.1.3 Overview

This document first describes the **users** relating to the SPIRE ICCs interaction with the consortium and then the **requirements** they make on the ICC.

13.1.4 User Characteristics

13.1.4.1 The SPIRE Consortium Experts

The SPIRE consortium has a wealth of expertise relating to the instrument and its use. The ICC will want to draw on that expertise frequently and efficiently. In this context the Consortium **Experts** are *users* in the sense of being **information providers**. The actual individuals concerned may of course be members of the ICC as well as having other roles. It may be sensible to divide the consortium experts into sub-divisions of expertise, since the interactions may be different for different types of experts.

13.1.4.1.1 Instrument specialist expert

Able to provide detailed knowledge of an instrument sub-system

13.1.4.1.2 Instrument system expert

Able to provide knowledge of sub-systems interactions

13.1.4.1.3 Science expert

Able to provide advice on expected science returns.

13.1.4.1.4 Data-reduction expert

Able to provide experience and good-practice for data reduction from other missions or other wavelengths.

13.1.4.2 <u>The SPIRE Consortium users</u>

SPIRE consortium members will make demands on the ICC that are special in some ways.

13.1.4.2.1 Consortium Astronomer

It is expected that SPIRE Consortium Astronomers wishing to use the instrument will mainly interact with the ICC via the FSC as any other Astronomer would do. However, it is inevitable and perhaps desirable that **Consortium Astronomers** will expect privileged access to the ICC, for example access to new data reduction algorithms. In these cases we would expect a **Consortium Astronomer** to be an expert in using the instrument and prepared to invest more time and effort into understanding their data and working with the software to achieve the best results.

13.1.4.2.2 Instrument Engineers

Will require special access to data and interactions with the instrument via the ICC in particular during the ILT (see AIV user requirements document RD-3)

13.2 Requirements

13.3 UR-CONS-1**: Information from Consortium to ICC

13.3.1 UR-CONS-110: Solicited Information Retrieval

The ICC will need to be able to extract specific information from the relevant expert(s) swiftly and painlessly. This information might be specifications of instrument sub-systems; models of sub-system behaviour; example scientific data; simulated data; expected results; etc. etc. The information could be in any format, document; image; phone-call; software; etc. etc..

- Source here
- Importance essential
- Frequency daily
- Phase Now

13.3.2 UR-CONS-120: Unsolicited Information Collection

The ICC should be open to suggestions and advice from Consortium Experts.

- Source here
- Importance desirable
- Frequency daily
- Phase Now

13.3.3 UR-CONS-130: Information Storage and Retrieval

The ICC should be able to store and retrieve the information it extracts from the Consortium Experts. This “knowledge database” should be easily searchable probably using keywords as entered by the person who requested the data. “Off the shelf” products are likely to be available and required for other purposes.

- Source here
- Importance desirable
- Frequency daily
- Phase Now

13.4 UR-CONS-2**: Information from ICC to Consortium & Feedback

13.4.1 UR-CONS-210: Beta Testing

The ICC should enable Consortium Astronomers to use the latest, experimental data-reduction techniques and have a responsive feedback mechanism to utilise their experiences. Software that is available in Beta test should feel as similar as possible to alpha released software.

- Source here
- Importance desirable
- Frequency monthly
- **Phase** Pre Launch

13.5 UR-CONS-3**: Specific Roles

13.5.1 UR-CONS-310: Key Programmes

ICCF-146 provide support to “key programme” (e.g. large surveys) as required, including *(see corresponding HSC requirement: FSCF-02*5): – support in the definition processing of (selected) programme inputs (TBD) – (specific) data processing (TBD)

- **Source** SIRD-ICCF-146
- Importance desirable
- Frequency monthly
- **Phase** Pre Launch

14 URD-555 Mission Operation Centre

14.1.1 Purpose & Scope

Requirements put on the SPIRE ICC by its direct interfaces with MOC, for example queries to the ICC about the instrument. Requirements in this area will also arise because of the need to mimic the MOC - to some TBS level - during ILT.

Interface requirements relating to this are in the FGS IRD (1.0) issued by the FGSSE (SPIRE rep: Sunil Sidher).

14.1.2 Related Documents

RD-1	SPIRE ICC URD Scope Document
RD-2	FIRST-FSC URD
RD-3	SPIRE ICC AIV URD

14.1.3 Overview

This document first describes the **users** relating to the SPIRE ICCs interaction with the MOC and then the **requirements** they make on the ICC.

14.1.4 User Characteristics

14.1.4.1 The MOC Users

14.2 Requirements

14.3 UR-MOC-1**: Functional Requirements

14.3.1 UR-MOC-110: Definition of Interfaces
ICCF-170 define jointly with the MOC the data and operational interface between the ICC and the MOC. – the interface will be defined in an ICD produced by the MOC. – the interface will be identical for all ICCs. *Note: ICCF-170 refers to the so-called ICC@MOC i.e. to the ICC system deployed at the MOC to support the Commissioning and Performance Verification phases. This system which will be left at the MOC can be "re-activated" in case of serious instrument problems during the routine phase. In routine phase there is no direct MOC-to-ICC (i.e. the so-called ICC@ICC) interface. The interface is non-real time and is via the HSC. Note: There are no formal data or operational interfaces between the ICCs. It is expected, however, that communications between the ICCs will be frequent and extensive in order to achieve the commonality objectives of the Herschel programme*

- **Source** SIRD: ICCF-170
- Importance essential
- Frequency once?
- Phase AIV

14.3.2 UR-MOC-120: Delivery of Hardware
Deliver to the MOC the necessary hardware (Instrument Station) and software (RTA and QLA, etc.) required to support the Commissioning and Performance Verification phases (the so-called ICC@MOC). Support installation as required.

- **Source** SIRD: ICCF-205
- Importance essential
- Frequency once?
- Phase AIV

14.4 UR-MOC-2**: Operational Requirements

14.4.1 UR-MOC-210: Provision of operations staff
Provide to the MOC the operations staff (instrument specialists) required to support the Commissioning and Performance Verification phases.

- **Source** SIRD: ICCO-015
- Importance essential
- Frequency once?
- Phase PV →

14.4.2 UR-MOC-220: Provision of instrument Training
Provide instrument training, as required, to selected HSC and MOC staff. Note: Training shall take place in accordance with a training plan approved by ESA. The plan shall identify duration of each training activity and number of staff involved -trainers and trainees

- **Source** SIRD: ICCO-010
- Importance essential
- Frequency once?
- Phase PV →

14.4.3 UR-MOC-230: Update of instrument Databases
Support the MOC by providing updated instrument databases. Note: This extends requirement ICCF-085 into the context of operations

- **Source** SIRD: ICCO-027
- Importance essential
- Frequency once?
- Phase PV →

15 URD-556 Other ICCs

This subsection of the SPIRE ICC URD is intended to cover the topics described in the URD Scope Document as follows:

Requirements stemming from the need (1) to cross-check calibration measurements obtained by other HERSCHEL instruments, (2) to transfer information SPIRE may obtain on instrument and telescope status, and (3) to coordinate observations of a given source with multiple HERSCHEL instrument. There are also requirements stemming from areas of commonality.

In fact the last sentence of this description is concerned with actions that will have to be taken earlier in the development of the project than all first three points.

Before going on to the requirement section, let us make this summary more explicit by describing in more details the type of interactions that are foreseen between the ICCs. These will actually be different when one is dealing with building ICC systems or with the actual instrument control.

When building ICC systems, the main reason to interact with other HERSCHEL ICCs is to try and identify areas when common system can exist and design, if possible, ways to make a single development rather than one in each ICC. When dealing with actual instrument control, the main reason to interact with other HERSCHEL ICCs will be to exchange knowledge on the status of the instruments. Similar interaction should occur between the SPIRE ICC and the FSC, but these are covered in a different section of the ICC URD.

The two distinct areas we have just identified lead us to two distinct sections of the present URD section

15.1.1 Modification history

Date	Version	Author	Change description
16/07/00	D1	M. Sauvage	Document creation

5/12/00	D2	M. Sauvage	Rephrased some requirements, used document template.
7/12/00	D3	M. Sauvage	Expanded Requirement on telescope status to one on satellite status
18/05/01	D4	M. Sauvage	Numbered requirements for cross-checks
2/06/01	V2.0	S. Oliver	FIRST→Herschel

15.2 UR-OTHER-1**: Development of ICC systems -

Once again, the main rationale here is to identify areas of common interests of need between the ICCs

15.2.1 UR-OTHER-110: Commonality –

The ICC shall make sure that all possible sources of commonality between its systems and those developed in the other HERSCHEL ICCs are searched for and identified. The SPIRE ICC shall team up with the other HERSCHEL ICC to try and design ways to make single developments of these common systems possible.

1 - Source	Here
2 - Importance	Highly desirable
3 - Frequency	Yearly
4 - Phase	AVM

15.2.2 UR-OTHER-120: Visibility -

We assume that the other HERSCHEL ICCs will also try and identify these common areas. Thus the SPIRE ICC shall implement an internal structure that clearly identifies a person leading each development of the ICC, so that interfaces between the SPIRE and the PACS and HIFI ICCs can be promptly established.

1 - Source	Here
2 - Importance	Highly desirable
3 - Frequency	Yearly
4 - Phase	AVM

15.2.3 UR-OTHER-130: Notification -

As new needs, or new systems, are found to be requested by the SPIRE ICC, it shall design a system such that these decisions can be easily noticed and understand by the other ICCs. This is to allow them to notify the SPIRE ICC of their possible interest in participating to this new development.

1 - Source	Here
2 - Importance	Highly desirable
3 - Frequency	Yearly
4 - Phase	AVM

15.3 UR-OTHER-2**: Instrument Control and Monitoring –

Here we are mainly dealing with the first part of the above summary.

15.3.1 UR-OTHER-210: Preparatory program -

It is likely that there will be a ground- or space-based preparatory calibration program for HERSCHEL. The SPIRE ICC shall be in close contact with, or participate to, the team in charge of this program, in order to make sure of its relevance for the SPIRE instrument.

1 - Source	Here
2 - Importance	Highly desirable
3 - Frequency	Yearly

4 - Phase AVM

15.3.2 UR-OTHER-220: Calibration sources -

Given that the three HERSCHEL instruments have some wavebands in common, the SPIRE ICC shall check whether its chosen external calibration sources can be shared with the other ICCs, or whether it can use other instrument's calibration sources.

1 - Source Here
2 - Importance Highly desirable
3 - Frequency Yearly
4 - Phase AVM

15.3.3 UR-OTHER-230: Calibration models -

Prediction of the calibration sources flux will very likely rely on models. The SPIRE ICC shall ensure the compatibility of its models with those used by the other ICCs, or design ways, possibly through new HERSCHEL calibration measurements, to ensure this compatibility.

1 - Source Here
2 - Importance Highly desirable
3 - Frequency Yearly
4 - Phase AVM

15.3.4 Publication of calibration sources and models - UR-OTHER-240

To allow an easy access to its calibration source lists and models, for consultation by the other ICCs, the SPIRE ICC shall make this information available to the other ICCs in one form or another and maintain it up-to-date.

1 - Source Here
2 - Importance Highly desirable
3 - Frequency Yearly
4 - Phase AVM

15.3.5 UR-OTHER-250: Instrument status -

Due to the build-up of instrument expertise, it is assumed that the calibration accuracies of the SPIRE instrument as well as other calibration-related properties (i.e. photometric calibration, spectral response) will evolve in time. The SPIRE ICC shall make sure that the information on the calibration status of the instrument is made available in an appropriate form to the other ICCs.

1 - Source Here
2 - Importance Highly desirable
3 - Frequency Yearly
4 - Phase AVM

15.3.6 UR-OTHER-260: Satellite status -

It is also foreseen that the increased instrument expertise will lead to the ability for the SPIRE ICC to derive information on the telescope status itself (e.g. beam profile), as well as on the satellite performances as a whole (background levels, pointing accuracies and so on). This information can be quite relevant to other ICCs (it can be cross-checked with PACS, and is of key importance to a non-imaging instrument such as HIFI). The SPIRE ICC shall make sure that this general information on the Satellite status is made available in an appropriate form to the other ICCs.

1 - Source	Here
2 - Importance	Highly desirable
3 - Frequency	Yearly
4 - Phase	Commissioning

15.3.7 UR-OTHER-270: Observing expertise -

It is to be expected that as the SPIRE ICC gains a better knowledge of the instrument behavior, it will be able to issue recommendations on the proper/best use of each SPIRE AOTs. The SPIRE ICC shall make sure that this information is properly conveyed to the other HERSCHEL ICCs.

1 - Source	Here
2 - Importance	Highly desirable
3 - Frequency	Yearly
4 - Phase	AVM

15.3.8 UR-OTHER-280: Instrumental effects -

It is to be expected that the HERSCHEL instruments will suffer from similar instrumental effects. Much insight can be gained in their treatment and correction when comparing the approach chosen by other instrumental team. Therefore the SPIRE ICC shall make sure that it has the right interfaces for these collaborations to occur.

1 - Source	Here
2 - Importance	Highly desirable
3 - Frequency	Yearly
4 - Phase	Commissioning

15.3.9 UR-OTHER-290: PACS and HIFI expertise -

It will quite likely happen that some calibration observation will highly benefit from joint measurements by two or more HERSCHEL instrument. To be able to judge the feasibility of such measurements the SPIRE ICCs shall make sure that it has gathered the proper training and expertise with PACS and HIFI. In particular, the SPIRE ICC shall make sure that it has internal access to the tools required to prepare an observation with PACS and HIFI.

1 - Source	Here
2 - Importance	Highly desirable
3 - Frequency	Yearly
4 - Phase	Ground Segment Testing

15.3.10 UR-OTHER-300: External SPIRE expertise – resources

Similar needs for SPIRE expertise will quite likely occur in the other HERSCHEL ICCs. The SPIRE ICC shall make sure that it has the necessary resources to provide the training and information required by external ICC members to obtain this expertise.

1 - Source	Here
2 - Importance	Highly desirable
3 - Frequency	Yearly
4 - Phase	Ground Segment Testing

15.3.11 UR-OTHER-310: External SPIRE expertise – persons -

If possible, the SPIRE ICC should contact the other HERSCHEL ICC to identify early on the person in charge of acquiring SPIRE expertise, so that close contact can be maintained with them throughout the mission.

1 - Source	Here
2 - Importance	Highly desirable
3 - Frequency	Not applicable
4 - Phase	Ground Segment Testing

16 URD-557 Public

16.1.1 Purpose & Scope

Requirements put on the ICC by the need to interact with the general public. These might include the provision of WWW pages or other publicity material. Most of this interaction will be via the HSC, in the first instance at least (i.e., the public has no direct first contact with the ICC).

16.1.2 Related Documents

RD-1	SPIRE ICC URD Scope Document
RD-2	Herschel-HSC URD
RD-3	Herschel-HSC General Public actor description (A5?)
RD-4	Herschel-HSC General Public uses cases (HSC-UCF 91, 92 and 93)

16.1.3 Overview

This document first describes the **users** relating to the SPIRE ICCs interaction with the general public and then the **requirements** they make on the ICC.

16.1.4 User Characteristics

16.1.4.1 The general public

The general public may (mostly indirectly) use the system to get SPIRE general information. This will include information on the instrument, its objectives and achievements in a clear and concise way as well as on educational aspects (e.g., material for schools and planetariums, explanations to understand SPIRE science in a more general astronomy context).

[adapted from RD-2]
The General Public is interested in scientific conclusions and results deduced from Herschel data. Results may be in the form of images, spectra and textual information. The general public may want to learn about press-conferences related to Herschel-results and retrieve images/spectra/textual information via a browser. The PST brings the information for the General Public on the WWW and makes links to the ESA PR service WWW-pages.

[taken from RD-3]
The General Public might also be interested in specialist but non-astronomical aspects of the instrument e.g. technical specifications or financial.

16.1.4.1.1 General Public: Journalist
16.1.4.1.2 General Public: Educator
16.1.4.1.3 General Public: Other Adult
16.1.4.1.4 General Public: School Child
16.1.4.1.5 General Public: Amateur Astronomer
16.1.4.1.6 General Public: VIP (e.g. Politician)
16.1.4.1.7 General Public: Industry
16.1.4.1.8 General Public: Non-astronomer Scientist

16.1.4.2 The Herschel Science Centre

In general the HSC will be the first point of contact for the public. The HSC will request information from the ICC to assist in its responsibility to provide information to the public. The HSC will also be the main conduit through which the ICC will pass information it would like made known to the public.

16.1.4.3 The SPIRE Consortium

The SPIRE consortium is the most likely source of scientific information relating specifically to SPIRE. The SPIRE consortium may decide that a scientific result or technological breakthrough relevant to SPIRE is suitable/desirable for promotion to the General Public (whether or not the result was generated within the consortium). Requests for scientific or technical information relating to SPIRE will ultimately be answered by the consortium.

16.1.4.3.1 SPIRE Science Team.

16.2 Requirements

In general Public Relations activities from the ICC centres will need to be met with normal institutional resources, Specialised activities, such as graphics provided by artists, would be provided by HSC.

16.3 UR-PUS-1**: Reactive Requirements

16.3.1 UR-PUS-110: Press Releases

The SPIRE ICC may be requested (by HSC) to assist in generating Press Releases to accompany e.g. publication of science articles using SPIRE. This assistance might take the form of proof reading, or providing instrument specific expertise.

- **Source** HSC-UCF-91/92/93
- Importance desirable
- Frequency monthly
- **Phase** Mainly post-launch and immediately pre-launch

16.3.2 UR-PUS-120: Public WWW pages

The SPIRE ICC may be requested (by HSC) to assist in generating permanent Public WWW pages. This assistance might take the form of proof reading or providing instrument specific expertise (TBC).

- **Source** HSC-UCF-91/92/93
- Importance desirable

- Frequency monthly
- **Phase** late development

16.3.3 UR-PUS-130: Other Public Relations

The SPIRE ICC might be requested (by the HSC) to assist in other Public Relations activities (e.g. public talks, educational tools, commissioning PR products). This assistance might take the form of proof reading, locating text/images or providing instrument specific expertise.

- **Source** HSC-UCF-91/92/93
- Importance desirable
- Frequency monthly
- **Phase** late development

16.3.4 UR-PUS-140: Visits

Components of the ICC might be visited by members of the public e.g. VIPs or school children.

16.4 UR-PUS-2**: Proactive Requirements

16.4.1 UR-PUS-210: Press Releases

The SPIRE ICC (prompted by the SPIRE consortium) might decide to initiate a Press Release. There needs to be a suitable mechanism to do this.

- Source here
- Importance desirable
- Frequency monthly
- **Phase** Mainly post-launch and immediately pre-launch

16.4.2 UR-PUS-220: Public WWW pages

The SPIRE ICC might decide that it wants its own public WWW pages.

- Source here
- Importance desirable
- Frequency monthly
- **Phase** development

16.4.3 UR-PUS-230: Other Public Relations

The SPIRE ICC might want to undertake other Public Relations initiatives (e.g. to satisfy internal funding authorities). This might include educational tools, posters etc. It might be worth noting where other ICC activities could be adapted for Public Relations with minimal effort.

- Source here
- Importance desirable
- Frequency monthly
- **Phase** development

16.4.4 UR-PUS-240: Access to Herschel PR material

The SPIRE ICC might require privileged access to general Herschel PR material in order to fulfil other PR tasks.