SPIRE ICC

User Requirements Documents
Instrument Engineering

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Version 2.0

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1 Introduction

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.

1.2 Definitions of Terms and Acronyms

AIV - Assembly, Integration and Test phase
PV - Performance Verification phase
GST - Ground Segment Testing
QLA - Quick look analysis
IA - Interactive analysis

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.

1.3 Related Documents

1.3.1 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

1.4 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

2 User Characteristics

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

2.1 Instrument Scientist

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

2.2 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.

2.3 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.

2.4 Instrument Engineer

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

2.5 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.

3 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.

3.1 URD-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]

3.2 URD-IE-200 Data Acquisition

URD-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.

URD-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]

URD-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]

URD-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]

3.3 URD-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]

URD-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]

URD-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]