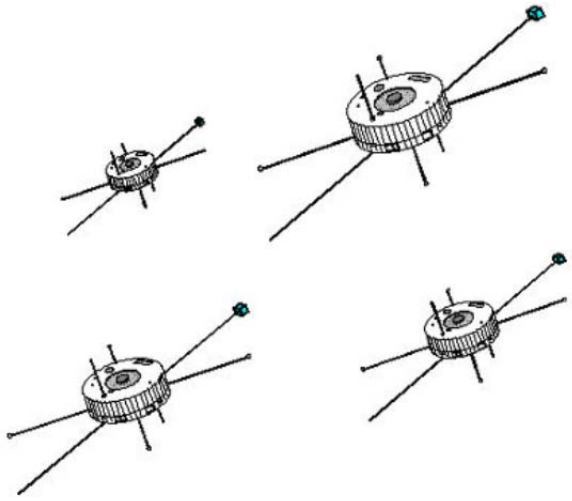
Science & Technology Facilities Council

RAL Space

DS-JSOC-SoW-0001

Cluster JSOC



Statement of Work for PEACE Operations Support

Issue 1.0 — 14-December-2016

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Document History

Issue	Date	Comment
1.0	14/12/2016	Released for tender.

Glossary of Acronyms and Abbreviations

CAA/CSA	Cluster Active Archive/ Cluster Science Archive
CSEQ	Command Sequence (defined according to ESOC standard)
CSDS	Cluster Science Data System
DEPV	Default Parameter Value (a JSOC defined interface file)
ESA	European Space Agency
ESOC	European Space Operations Centre
FCT	Flight Control Team (at ESOC)
IBMD	Instrument Baseline Mode Definition (a payload specific entity within the JSOC commanding database)
ICD	Interface Control Document
JSOC	Joint Science Operations Centre (for Cluster)
KPI	Key Performance Indicators
MLUT	Mode Look-Up Table (a payload specific entity within the JSOC commanding database)
MSP	Master Science Plan
PEACE	Plasma Electron and Current Experiment (a Cluster instrument)
PI	Principle Investigator
PIOR	PI Observation Request
PMRQ	PIOR Modification Request
RAL	Rutherford Appleton Laboratory
RAL Space	Formerly the Space Science and Technology Department at RAL
SOG	Satellite Operations Group (at RAL)
SoW	Statement of Work
SOWG	Science Operations Working Group
SPC	Science Programme Committee (of ESA)
STFC	Science and Technology Facilities Council
SWT	Science Working Team
TBC	To Be Confirmed
TLIS	Top Level Instrument Schedule
VAL	Parameter Value (a payload specific entity within the JSOC commanding database)

1 Introduction

1.1 Scope

ESA's Cluster mission was successfully launched in July and August 2000. Each Cluster spacecraft contains a complete suite of eleven instruments to measure magnetic and electric fields, electromagnetic waves, and particles. The Cluster nominal mission phase started on 1 February 2001. Planned to last for 2 years, it has been extended numerous times and it is currently approved up to the end of 2018 with an option on a further extension up to end 2020 (TBC by the ESA SPC meeting in February or June 2017). The history, and other details, of the Cluster mission can be found at http://sci.esa.int/cluster/52770-csds/ which is to be regarded as a Reference Document.

The Joint Science Operation Centre (JSOC) at the Rutherford Appleton Laboratory (RAL), UK, has been carrying out the science operations during the nominal mission and subsequent extensions. ESA has proposed that RAL shall continue to carry out the science operations of the Cluster instruments during the 2017+2018 extension phase since:

- They have the experience to carry out the Cluster science operations;
- They have developed, and maintain, a system to perform the science operations and have demonstrated its successful operation;
- There will be continuity of staff from the nominal mission;
- It will be cost effective since it will use an existing and well-proven system.

In addition to JSOC carrying out its baseline operational activities, ESA has requested, starting on 01/01/2017, that the Science and Technology Facilities Council (STFC – RAL's governing organisation) also carries out specific operations support for the PEACE instrument on each of the four Cluster Satellites. See the link http://www.mssl.ucl.ac.uk/www_plasma/missions/cluster/ for the history, and other details, of the PEACE instrument, this is to be regarded as a Reference Document. However, STFC does not possess the in-house expertise, or systems, to be able to carry out PEACE operations support and will therefore subcontract this work out.

The purpose of this document is to specify the responsibilities, tasks, requirements, deliverables and schedules necessary for the chosen subcontractor to carry out PEACE operations support.

1.2 Applicable Documents

DS-JSO-ID-0002	JSOC-PI ICD
DS-JSO-OR-0001	PI Operations and Interface Requirements Document
DS-JSO-SS-0001	JSOC System Specification
DS-JSO-TN-0002	JSOC Commanding Scenario
DS-JSO-TN-0007	JSOC Planning Scenario
CL-ESC-ID-2001	Data Delivery Interface Document
CL-ESC-ID-0003	Command Request Interface Document
DS-JSO-TN-0004	Specification of the TLIS file format
DS-MPA-TN-0015	Users Guide to the Cluster Science Data System
	JSOC weekly planning schedule as maintained on the JSOCweb at http://www.jsoc.rl.ac.uk/swt/PlanningDeadlines.php
	Cluster Payload Contingency Document

	CAA Cluster PEACE Science User Guide
PE-MSSL-UM-0051: Chapter 1	PEACE Instrument User Manual for Cluster II: Chapter 1 – contains a description of the PEACE instrument

PE-MSSL-UM-0052: Chapter 2	PEACE Instrument User Manual for Cluster II: Chapter 2 – contains information on calibration of all PEACE parameters, and OOL info on a selection of these
PE-MSSL-UM-0053: Chapter 3	PEACE Instrument User Manual for Cluster II: Chapter 3 – contains all allowable PEACE commands and CSEQs
PE-MSSL-UM-0054: Chapter 4	PEACE Instrument User Manual for Cluster II: Chapter 4 – contains details about the thermal and radiation environment
PE-MSSL-UM-0055: Chapter 5	PEACE Instrument User Manual for Cluster II: Chapter 5 – contains details about the PEACE commissioning plans
PE-MSSL-UM-0056: Chapter 6	PEACE Instrument User Manual for Cluster II: Chapter 6 – contains information on how to set the instrument up for certain science configurations
PE-MSSL-UM-0057: Chapter 7	PEACE Instrument User Manual for Cluster II: Chapter 7 – contains information on how to update the PEACE codes
PE-MSSL-UM-0058: Chapter 8	PEACE Instrument User Manual for Cluster II: Chapter 8 – contains information on how to recover the instrument after a problem
PE-MSSL-DS-0001	DPU HK Telemetry Specification Issue 6 for Cluster II – essential description of how HK parameters are to be investigated
PE-MSSL-DS-0050	DPU Science telemetry Format Specification – detailed specification of the PEACE science data telemetry format
PE-MSSL-DS-0051	DPU Commanding System Specification – essential description of how to calculate new command parameters

2 Relationship with the PEACE PI and Operations Team

The work offered in this tender is only part of the activities within the wide-ranging PEACE ground segment and science activities. The PEACE PI and the PEACE Operations Team:

- Possess a deep understanding of the PEACE instrument's capabilities, constraints, performance and quirks.
- They are also intimately involved in setting the overall science objectives for PEACE, in consultation with ESA, ESOC and the other Cluster PIs.
- They are responsible for the correct calibration of PEACE.
- They are responsible for the delivery of quicklook PEACE data and fully processed and calibrated PEACE data.
- They are also responsible for ensuring that all agreed PEACE data and products are ingested into the Cluster Active Archive (CAA) and Cluster Science Archive (CSA) according to schedules agreed with ESA.

Inevitably there will be areas where the work of the subcontractor impinges upon, and is itself impinged by, these other aspects of the PEACE ground segment. This leads to the following critical requirement:

- **PEA-REQ-0:** The subcontractor must define, establish and validate a credible working and operational relationship with the PEACE PI and the PEACE Operations Team in order that the global, and specific, science aims mandated for the PEACE instruments is successfully executed in a timely manner.

This requirement is of such importance to the ongoing success of the PEACE science program and the Cluster mission itself, that it has been highlighted in its own Section of this document.

3 Responsibilities

3.1 Nominal Operations

Since operations began in 2001 the platforms and payloads have behaved nominally for the vast majority of the mission lifetime. During nominal operations the subcontractor will be responsible for:

- The correct interpretation and usage of the PEACE science planning as agreed during the regular Science Operations Working Group (SOWG) meetings and, where necessary, other ad hoc discussions between ESA, ESOC and the Cluster PIs.

- The integrity and correctness of the PEACE commanding database held at JSOC. This implies:
  - Maintaining, under local configuration control, all PEACE command related entities which reside in the JSOC command database.
  - Requesting, as necessary for PEACE operations, updates to the PEACE section of the JSOC command database.
  - Validating all requested changes utilising the tools provided by JSOC.

- The timely generation of the final weekly PEACE consolidated payload command schedule.

- The provision of appropriate status reports.

Details of the tasks implied by these responsibilities are to be found in Section 4 below.

3.2 Contingency Operations

But, since operations began in 2001, the platforms and payloads have occasionally experienced anomalous behaviour. As a consequence, during the mission lifetime ESOC has developed a wealth of experience in dealing with platform and payload anomalies and can recover from anomalies most of the time by following tried and tested procedures. However, from time to time anomalous payload behaviour has required the support and/or intervention of the PI Team(s) and it is possible that during the two years of this subcontract PEACE on one or more platforms may exhibit anomalous behaviour requiring a contingency response. During contingency operations the subcontractor will be responsible for:

- Supporting ESOC to aid PEACE recovery activities.

Details of the tasks implied by these responsibilities are to be found in Section 4 below.

4 Tasks

The following is the list of tasks to be carried out by the subcontractor in order to deliver PEACE science operations.

- **PEA-TASK-1:** To perform the planning and commanding of the eight PEACE sensors (the LEEA and HEEA sensors on each of the four Cluster spacecraft) in conformance with:
  - The agreed weekly schedules.
  - The operational interface with JSOC.
  - The instrument modes appropriate to the prevailing science priorities and operational environments as requested by the PEACE PI.

  This latter point is significant because the weekly commanding activities are not identical week to week. This can be due to changes in the scientific aims, the plasma environments encountered and the increasing operational complexity due to the ageing platforms and instruments, for example, to accomodate ESOC power sharing schemes The core task here is the timely execution of the weekly PIOR-PMRQ cycle with JSOC.

- **PEA-TASK-2:** To provide, when required, updates to the PEACE CSEQ(s) or to generate new CSEQ(s). This may require working with the PEACE Operations Team.

- **PEA-TASK-3:** To provide, when required, updates to the PEACE commanding tables in the JSOC Commanding Database. This could encompass the IBMD, MLUT and VAL database entities. This may require working with the PEACE Operations Team.

- **PEA-TASK-4:** To provide PEACE on-board software updates to JSOC in the agreed IPCH format. This may require working with the PEACE Operations Team.

- **PEA-TASK-5:** To provide PEACE Henceforth Parameter updates to JSOC in the agreed DEPV format. This may require working with the PEACE Operations Team.

- **PEA-TASK-6:** To monitor the health of the PEACE sensors utilising data retrieved from ESA. This may require working with the PEACE Operations Team.

- **PEA-TASK-7:** To support ongoing PEACE CAA activities according to the plans agreed between the Cluster Project Scientist and the PEACE PI.

- **PEA-TASK-8:** To provide regular PEACE operations status reports to the Cluster Project Scientist and the PEACE PI.

- **PEA-TASK-9:** To provide PEACE related input, as appropriate, to the Cluster Mission Manager and the PEACE PI for regular Science Working Team, Science Operations Working Group and Cluster Workshop meetings.

- **PEA-TASK-10:** To attend, as requested by the PEACE PI, relevant meetings of the Cluster Science Working Team, the Cluster Science Operations Working Group, the Cluster Active Archive Working Group(s) and Cluster Workshops.

- **PEA-TASK-11:** To provide, when requested by ESA during declared periods of contingency, detailed expert PEACE support to the Flight Control Team (FCT) at ESOC to aid payload recovery activities.
  - After a spacecraft recovery activity, ESOC typically contacts the PEACE Operations Team to request appropriate commanding to restart the instrument into whichever

mode it should have been in according to the Master Science Plan, after checking whether the PEACE PI wishes to carry out any health checks.
  - The PEACE Operations Team provides instrument commanding information directly to ESOC to recover the payload in order to minimise the data loss.
  - During this process the subcontractor may be required to work closely with the FCT and the PEACE Operations Team and, depending upon the circumstances, this may require physical attendance at ESOC.
  - Once the contingency is over the subcontractor could be involved in follow-up activities with JSOC to update CSEQ, IBMD, MLUT, VAL or Henceforth Parameters before nominal PEACE operations through JSOC can resume.

- **PEA-TASK-12:** To continue to maintain, under configuration control, all the PEACE calibration parameters for the whole mission. This will require working with the PEACE Operations Team.
  - PEACE calibration parameters have been updated a number of times during the mission lifetime and this updating is expected to occur during the remainder of the mission.
  - The secure maintenance of this calibration parameter history is critical to enable the contents of the post-eclipse recovery patch IPCH files to be generated. These must be sent to ESOC after every power-down eclipse (that is, when the KAL has been lost).

- **PEA-TASK-13:** To continue to maintain and update, under configuration control, the Hard and Soft OOLs on the PEACE currents and voltages. This may require working with the PEACE Operations Team.
  - PEACE Hard and Soft OOLs limits have changed during the mission lifetime and are expected to change during the remainder of the mission as the PEACE instruments continue to age.
  - These hard and Soft OOLs are utilised by ESOC in real time during downlink to monitor the safety of the PEACE instruments and so the correct setting of these limits is critical to the continued safe operation of PEACE.

5 Requirements

The following is the list of PEACE science operations requirements relevant to the subcontractor's procedures, software and processing systems, response times, and documentation.

- **PEA-REQ-1:** The subcontractor's system(s) must be fully compatible with JSOC's systems, as defined in the relevant ICDs.

- **PEA-REQ-2:** The subcontractor's system(s) must be fully compatible with ESOC's systems, as defined in the relevant ICDs.

- **PEA-REQ-3:** The subcontractor's system(s) shall be available for routine operations for 99% of the time on a monthly basis.

- **PEA-REQ-4:** The subcontractor's system(s) shall be secured against loss of data, and against unauthorised access and must demonstrate that they have taken all reasonable measures to ensure the continuing security of their systems.

- **PEA-REQ-5:** The subcontractor must demonstrate conformance with all reasonable measures mandated by JSOC to ensure the security of the their access to JSOC and ESOC systems; these measures will change as needed to address evolving security threats.

- **PEA-REQ-6:** The subcontractor's system(s) must be flexible to cope with unexpected operations adjustments on a reasonable effort basis.

- **PEA-REQ-7:** The subcontractor shall respond ideally within one working day (or as negotiated with JSOC) to the initial weekly PEACE PIOR generated by JSOC. The response shall be a PMRQ which conforms to the agreed science plan specified in the SOWG-sanctioned Master Science Plan (MSP).
  - It is expected that in order to reduce operational latency in the PIOR-PMRQ cycle the subcontractor will make use of the PMRQchecker facility on JSOCweb.

- **PEA-REQ-8:** The subcontractor shall continue the weekly iterative PIOR-PMRQ cycle until a final PIOR, generated by JSOC, has been agreed by the PEACE PI (or delegate) and an acknowledgement of such has been communicated to JSOC.
  - The deadlines defined in the operations planning cycle shall be strictly adhered to.

- **PEA-REQ-9:** The subcontractor must maintain under configuration control its own records of JSOC command data. That is, CSEQs, IBMDs, MLUTs, VALs, Henceforth Parameters.

- **PEA-REQ-10:** The hardware and software systems used by the subcontractor for the execution of this work must be adequately maintained so as to guard from unexpected, or prolonged, outages.

- **PEA-REQ-11:** The subcontractor shall generate documentation which adequately describes all processes and procedures necessary to execute this work. Such documentation may be reviewed by JSOC, the PEACE PI or ESA.

6 Deliverables & KPIs

6.1 Deliverables

The subcontractor shall be responsible for delivering the following to JSOC:

- **PEA-DEL-1:** The weekly PMRQ(s) in response to the PIORs.
- **PEA-DEL-2:** Updates, as necessary and mandated by the PEACE PI, to the PEACE commanding database entries held by JSOC.
- **PEA-DEL-3:** Updates, as necessary and mandated by the PEACE PI, to the PEACE on-board software in the agreed IPCH format.
- **PEA-DEL-4:** Updates, as necessary and mandated by the PEACE PI, to the PEACE Henceforth Parameters in the agreed DEPV format.
- **PEA-DEL-5:** Inputs, as required, to the JSOC Progress Report for ESA review.
- **PEA-DEL-6:** Inputs, as required, to support the PEACE PI at SWT meetings.
- **PEA-DEL-7:** Inputs, as required, to support the PEACE PI at SOWG meetings.

6.2 KPIs

The Deliverables together with the published JSOC Schedule, in Section 7, constitute the Key Performance Indicators (KPI).

7 Schedule

The JSOC weekly planning schedule as maintained on the JSOCweb shall be followed. This can be found via http://www.jsoc.rl.ac.uk/swt/PlanningDeadlines.php.