

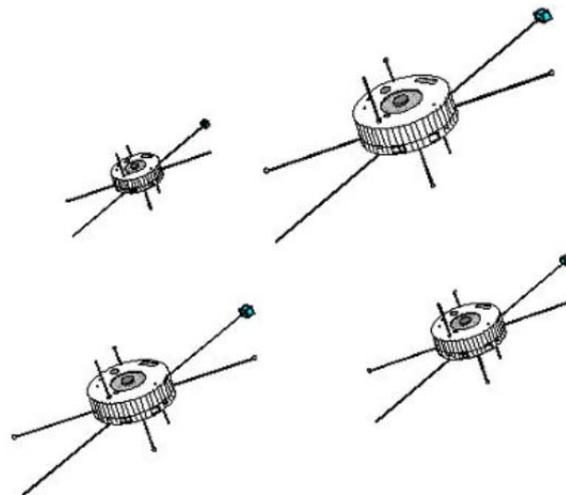


Science & Technology
Facilities Council

RAL Space 

DS-JSOC-SoW-0002

Cluster JSOC



Statement of Work for WEC#4 Operations Support

Issue 1.0 — 14-December-2016

Contents

1	Introduction	1
1.1	Scope.....	1
1.2	Applicable Documents	1
2	Relationship with the WEC#4 PIs and Operations Teams	3
3	Responsibilities	4
3.1	Nominal Operations	4
3.2	Contingency Operations	4
4	Tasks	5
5	Requirements	7
6	Deliverables & KPIs	8
6.1	Deliverables	8
6.2	KPIs	8
7	Schedule	9

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)
DWP	Digital Wave Processor (a Cluster instrument and part of the WEC)
EFW	Electric Field and Wave (a Cluster instrument and part of the WEC)
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 Indicator
MLUT	Mode Look-Up Table (a payload specific entity within the JSOC commanding database)
MSP	Master Science Plan
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)
STAFF	Spatio-Temporal Analysis of Field Fluctuations (a Cluster instrument and part of the WEC)
STFC	Science and Technology Facilities Council
SWT	Science Working Team

WEC#4 Operations Support

Doc. No: DS-JSOC-SoW-0002

Issue: 1.0 Date: 14/12/2016

Statement of Work

Page iii



TBC	To Be Confirmed
TLIS	Top Level Instrument Schedule
VAL	Parameter Value (a payload specific entity within the JSOC commanding database)
WBD	Wide Band Data instrument (a Cluster instrument and part of the WEC)
WEC	Wave Experiment Consortium – DWP, EFW, STAFF, WBD and WHISPER
WEC#4	Wave Experiment Consortium without WBD
WHISPER	Waves of High frequency and Sounder for Probing of Electron density by Relaxation (a Cluster instrument and part of the WEC)

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 Wave Experiment Consortium #4 (WEC#4) instruments. WEC itself consists of five instruments on each of the four Cluster satellites:

- DWP – see the link https://ssg.group.shef.ac.uk/ssg2013/proj_cluster.htm.
- EFW – see the link <http://cluster.irfu.se/>.
- STAFF – see the link <http://cluster.lpp.polytechnique.fr/accueil/framepa.html>.
- WHISPER – see the link http://ipc2e.cnrs-orleans.fr/www_experim/experim_espace_whisper_fr.php
- WBD – see the link <http://www-pw.physics.uiowa.edu/plasma-wave/istp/cluster/>

These links to the PI maintained websites provide the history, and other details, of the five WEC instruments. The WBD instrument operates in a different manner to the other four WEC instruments and its operational support is not included in this work and for this reason WEC without WBD is referred to as WEC#4 in this Statement of Work to avoid any confusion. The web links for the four WEC#4 instruments are to be regarded as Reference Documents. However, STFC does not possess the in-house expertise, or systems, to be able to carry out WEC#4 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 WEC#4 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

WEC#4 Operations Support

Doc. No: DS-JSOC-SoW-0002

Issue: 1.0 Date: 14/12/2016

Statement of Work

Page 2



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

CL-WEC-UM-0002: Chapter 1	WEC Instrument User Manual for Cluster II: Chapter 1
CL-WEC-UM-0002: Chapter 2	WEC Instrument User Manual for Cluster II: Chapter 2
CL-WEC-UM-0002: Chapter 3	WEC Instrument User Manual for Cluster II: Chapter 3
CL-WEC-UM-0002: Chapter 4	WEC Instrument User Manual for Cluster II: Chapter 4
CL-WEC-UM-0002: Chapter 5	WEC Instrument User Manual for Cluster II: Chapter 5
CL-WEC-UM-0002: Chapter 6	WEC Instrument User Manual for Cluster II: Chapter 6
CL-WEC-UM-0002: Chapter 7	WEC Instrument User Manual for Cluster II: Chapter 7
CL-WEC-UM-0002: Chapter 8	WEC Instrument User Manual for Cluster II: Chapter 8
CAA-DWP-ICD-0001	Cluster Active Archive: Interface Control Document for DWP
CAA-EFW-ICD-0001	Cluster Active Archive: Interface Control Document for EFW
CAA-STA-ICD-0001	Cluster Active Archive: Interface Control Document for STAFF
CAA-WHI-ICD-0001	Cluster Active Archive: Interface Control Document for WHISPER

2 Relationship with the WEC#4 PIs and Operations Teams

The work offered in this tender is only part of the activities within the wide-ranging WEC#4 (that is, DWP, EFW, STAFF and WHISPER) ground segments and science activities. Between them, the WEC#4 PIs and the WEC#4 Operations Teams:

- Possess a deep understanding of the DWP, EFW, STAFF and WHISPER instrument's capabilities, constraints, performance and quirks.
- They are also intimately involved in setting the overall science objectives for DWP, EFW, STAFF and WHISPER, in consultation with ESA, ESOC and the other Cluster PIs.
- They are responsible for the correct calibration of DWP, EFW, STAFF and WHISPER.
- They are responsible for the delivery of quicklook DWP, EFW, STAFF and WHISPER data and fully processed and calibrated DWP, EFW, STAFF and WHISPER data.
- They are also responsible for ensuring that all agreed DWP, EFW, STAFF and WHISPER 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 DWP, EFW, STAFF and WHISPER ground segments. This leads to the following critical requirement:

- **WEC#4-REQ-0:** The subcontractor must define, establish and validate a credible working and operational relationship with the DWP, EFW, STAFF and WHISPER PIs and the DWP, EFW, STAFF and WHISPER Operations Teams in order that the global, and specific, science aims mandated for the DWP, EFW, STAFF and WHISPER instruments is successfully executed in a timely manner.

This requirement is of such importance to the ongoing success of the DWP, EFW, STAFF and WHISPER science programs 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 WEC#4 science planning (that is, the DWP, EFW, STAFF and WHISPER 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.
 - This must take into account, where necessary and appropriate, specific inputs from the DWP PI, the EFW PI, the STAFF PI and the WHISPER PI.
- The integrity and correctness of the DWP, EFW, STAFF and WHISPER commanding databases held at JSOC. This implies:
 - Maintaining, under local configuration control, all DWP, EFW, STAFF and WHISPER command related entities which reside in the JSOC command database.
 - Requesting, as necessary for DWP, EFW, STAFF and WHISPER operations, updates to the DWP, EFW, STAFF and WHISPER section, as appropriate, of the JSOC command database.
 - Validating all requested changes utilising the tools provided by JSOC.
- The timely generation of the final weekly WEC#4 consolidated payload command schedule.
- The provision of appropriate status reports.
- The provision of DWP data products to the CSDS and CAA

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 one or more of the WEC#4 instruments 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 WEC#4 (that is, DWP, EFW, STAFF and WHISPER) 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 WEC#4 science operations.

- **WEC#4-TASK-1:** To perform the planning and commanding of the four WEC#4 instruments (DWP, EFW, STAFF and WHISPER) 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 DWP, EFW, STAFF and WHISPER PIs.

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 accommodate ESOC power sharing schemes. The core task here is the timely execution of the weekly PIOR-PMRQ cycle with JSOC.

- **WEC#4-TASK-2:** To provide, when required, updates to the DWP, EFW, STAFF and WHISPER CSEQ(s) or to generate new CSEQ(s). This may require working with some or all of the DWP, EFW, STAFF and WHISPER Operations Teams.
- **WEC#4-TASK-3:** To provide, when required, updates to the WEC#4 commanding tables in the JSOC Commanding Database. This could encompass the IBMD, MLUT and VAL database entities. This may require working with some or all of the DWP, EFW, STAFF and WHISPER Operations Teams.
- **WEC#4-TASK-4:** To provide DWP, EFW, STAFF and WHISPER on-board software updates to JSOC in the format agreed with ESOC. This may require working with some or all of the DWP, EFW, STAFF and WHISPER Operations Teams.
- **WEC#4-TASK-5:** To provide DWP, EFW, STAFF and WHISPER Henceforth Parameter updates to JSOC in the agreed DEPV format. This may require working with some or all of the DWP, EFW, STAFF and WHISPER Operations Teams.
- **WEC#4-TASK-6:** To monitor the health of the DWP, EFW, STAFF and WHISPER instruments utilising data retrieved from ESA. This may require working with some or all of the DWP, EFW, STAFF and WHISPER Operations Teams.
- **WEC#4-TASK-7:** To support ongoing DWP, EFW, STAFF and WHISPER CAA activities according to the plans agreed between the Cluster Project Scientist and the DWP, EFW, STAFF and WHISPER PIs.
- **WEC#4-TASK-8:** To provide regular operations status reports to the Cluster Project Scientist and to the DWP, EFW, STAFF and WHISPER PIs.
- **WEC#4-TASK-9:** To provide input, as appropriate, to the Cluster Mission Manager and the DWP, EFW, STAFF and WHISPER PIs. for regular Science Working Team, Science Operations Working Group and Cluster Workshop meetings.
- **WEC#4-TASK-10:** To attend, as requested by the DWP, EFW, STAFF or WHISPER PIs, relevant meetings of the Cluster Science Working Team, the Cluster Science Operations Working Group, the Cluster Active Archive Working Group(s) and Cluster Workshops.

- **WEC#4-TASK-11:** To provide, when requested by ESA during declared periods of contingency, detailed expert DWP, EFW, STAFF or WHISPER, as appropriate, support to the Flight Control Team (FCT) at ESOC to aid payload recovery activities.
 - After a spacecraft recovery activity, ESOC typically contacts the relevant Operations Team(s) (DWP, EFW, STAFF or WHISPER) to request appropriate commanding to restart the instrument(s) into whichever mode it/they should have been in according to the Master Science Plan, after checking whether the DWP, EFW, STAFF or WHISPER PI(s) wishes to carry out any health checks.
 - The DWP, EFW, STAFF or WHISPER Operations Team(s) provide instrument commanding information directly to ESOC to recover the payload(s) in order to minimise the data loss.
 - During this process the subcontractor may be required to work closely with the FCT and the DWP, EFW, STAFF or WHISPER Operations Team(s) 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 DWP, EFW, STAFF or WHISPER operations through JSOC can resume.

5 Requirements

The following is the list of WEC#4 (that is, the DWP, EFW, STAFF and WHISPER) science operations requirements relevant to the subcontractor's procedures, software and processing systems, response times, and documentation.

- **WEC#4-REQ-1:** The subcontractor's system(s) must be fully compatible with JSOC's systems, as defined in the relevant ICDs.
- **WEC#4-REQ-2:** The subcontractor's system(s) must be fully compatible with ESOC's systems, as defined in the relevant ICDs.
- **WEC#4-REQ-3:** The subcontractor's system(s) shall be available for routine operations for 99% of the time on a monthly basis.
- **WEC#4-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.
- **WEC#4-REQ-5:** The subcontractor must demonstrate conformance with all reasonable measures mandated by JSOC to ensure the security of their access to JSOC and ESOC systems; these measures will change as needed to address evolving security threats.
- **WEC#4-REQ-6:** The subcontractor's system(s) must be flexible to cope with unexpected operations adjustments on a reasonable effort basis.
- **WEC#4-REQ-7:** The subcontractor shall respond ideally within one working day (or as negotiated with JSOC) to the initial weekly WEC#4 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.
- **WEC#4-REQ-8:** The subcontractor shall continue the weekly iterative PIOR-PMRQ cycle until a final PIOR, generated by JSOC, has been agreed by the DWP, EFW, STAFF and, WHISPER PIs (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.
- **WEC#4-REQ-9:** The subcontractor must maintain under configuration control its own records of JSOC command data. That is, CSEQs, IBMDs, MLUTs, VALs, Henceforth Parameters for DWP, EFW, STAFF and WHISPER.
- **WEC#4-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.
- **WEC#4-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, some or all of the DWP, EFW, STAFF and WHISPER PIs or ESA.

6 Deliverables & KPIs

6.1 Deliverables

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

- **WEC#4-DEL-1:** The weekly PMRQ(s) in response to the PIORs.
- **WEC#4-DEL-2:** Updates, as necessary, to the WEC#4 (that is, DWP, EFW, STAFF and WHISPER) commanding database entries held by JSOC.
- **WEC#4-DEL-3:** Updates, as necessary, to the WEC#4 (that is, DWP, EFW, STAFF and WHISPER) instrument on-board software in the format agreed with ESOC.
- **WEC#4-DEL-4:** Updates, as necessary, to the WEC#4 (that is, DWP, EFW, STAFF and WHISPER) Henceforth Parameters in the agreed DEPV format.
- **WEC#4-DEL-5:** Inputs, as required, to the JSOC Progress Report for ESA review.
- **WEC#4-DEL-6:** Inputs, as required, to support some or all of the DWP, EFW, STAFF, and WHISPER PIs at SWT meetings.
- **WEC#4-DEL-7:** Inputs, as required, to support some or all of the DWP, EFW, STAFF, and WHISPER PIs at SOWG meetings.
- **WEC#4-DEL-8:** DWP data products for the CAA as agreed with the DWP PI.

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>.