

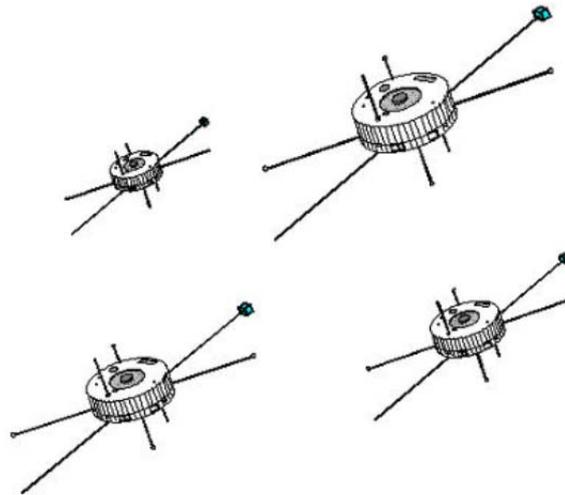


Science & Technology
Facilities Council

RAL Space 

DS-JSOC-SoW-0003

Cluster JSOC



Statement of Work for WBD 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
CSDS	Cluster Science Data System
BM2	Burst Mode 2 (one of the Cluster telemetry modes)
CDF	Common Data Format
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
FGM	Flux Gate Magnetometer (a Cluster instrument)
ICD	Interface Control Document
JSOC	Joint Science Operations Centre (for Cluster)
KPI	Key Performance Indicator
MSP	Master Science Plan
PI	Principle Investigator
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
TBC	To Be Confirmed
TLIS	Top Level Instrument Schedule
WBD	Wide Band Data instrument (a Cluster instrument and part of the WEC)
WEC	Wave Experiment Consortium

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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 Wide Band Data (WBD) instrument. See the link <http://www-pw.physics.uiowa.edu/plasma-wave/istp/cluster/> for the history, and other details, of the WBD instrument, this is to be regarded as a Reference Document.

Although WBD is one of the five instruments of the Cluster Wave Experiment Consortium (WEC) on each of the four Cluster satellites it has unique operational requirements which distinguish it from the other WEC instruments. For reference, the other WEC instruments are DWP, EFW, STAFF and WHISPER. However, STFC does not possess the in-house expertise, or systems, to be able to carry out WBD 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 WBD 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

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	Cluster Payload Contingency Document
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CAA-WBD-ICD-0001	Cluster Active Archive: Interface Control Document for WBD
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2 Relationship with the WBD PI and Operations Team

The work offered in this tender is only part of the activities within the wide-ranging WBD ground segment and science activities. The subcontractor must therefore establish a credible working relationship with the WBD PI and his WBD Operations Team in order that the global, and specific, science aims mandated for the WBD instruments is successfully executed in a timely manner.

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

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

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

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

3 Responsibilities

The WBD instrument was designed and built by the University of Iowa, and still operates under the overall control of the Iowa Principle Investigator (PI). However, Iowa no longer have the resources to support day to day planning, control and data processing tasks. WBD operates in two main modes, one where data is transferred directly to the ground station in real time, the other where data is recorded first on the on-board solid state recorder.

3.1 Nominal Operations

This statement of work concerns the second of the above two modes, known as Burst Mode 2 (BM2). 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:

- Providing, in conjunction with the WBD PI and JSOC, appropriate inputs to the Cluster Master Science Plan (MSP) for WBD science operations in the BM2 mode.
- Determining, in conjunction with the WBD PI, the WBD mode for each BM2 observation and provide this information to the WEC operations group (who coordinate instrument commanding for all WEC instruments).
- As soon as practical after each BM2 observation, making a preliminary assessment of the data to confirm that the instrument operated correctly.
- Producing the science data products for the Cluster Science Archive when the necessary supporting datasets become available.
- The integrity and correctness of the WBD commanding database held at JSOC. This implies:
 - Maintaining, under local configuration control, all WBD command related entities which reside in the JSOC command database.
 - Requesting, as necessary for WBD operations, updates to the WBD section of the JSOC command database.
 - Validating all requested changes utilising the tools provided by JSOC.
- 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.

During contingency operations the subcontractor will have no WBD operations responsibilities.

4 Tasks

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

- **WBD-TASK-1:** In conjunction with the WBD PI and JSOC, producing a detailed plan for WBD science operations in the BM2 mode. The task is performed on a cycle of normally two months duration starting with the release of the Master Science Plan (MSP) template by JSOC. In consultation with the WBD PI, the subcontractor then prepares a draft list of science observations and submits these to JSOC for inclusion in the MSP. JSOC then release a draft plan, and after some iteration a final plan. On receipt of the final plan the subcontractor then prepares the schedule of WBD instrument operations, including the specific instrument mode for each operation.
- **WBD-TASK-2:** The detailed commanding of the Cluster scientific payload is performed on a weekly planning period cycle. For each planning period, the subcontractor must submit to the WEC operations group the WBD instrument modes for BM2 observations.
- **WBD-TASK-3:** As soon as practical after each BM2 observation, the subcontractor must make a preliminary assessment of received data to confirm that the instrument operated correctly. This requires downloading the raw telemetry data from ESOC, reviewing the housekeeping telemetry, and processing the science telemetry to make preliminary plots.
- **WBD-TASK-4:** When the necessary supporting datasets become available, the subcontractor must produce the science data products for the Cluster Science Archive (CSA). Supporting data sets include the TCOR (time correction) dataset from the DWP team and magnetometer calibrations from the FGM team. Data sets are 'Level 1' waveform data and plots, and calibrated waveform data in CDF format.
- **WBD-TASK-5:** The subcontractor must provide regular operations status reports to the Cluster Project Scientist and the PI.
- **WBD-TASK-6:** The subcontractor must provide input, as appropriate, to the Cluster Mission Manager and the WBD PI for regular Science Working Team, Science Operations Working Group and Cluster Workshop meetings.
- **WBD-TASK-7:** The subcontractor must attend, as requested by the WBD 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.

5 Requirements

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

- **WBD-REQ-1:** The subcontractor's system(s) must be fully compatible with JSOC's systems, as defined in the relevant ICDs.
- **WBD-REQ-2:** The subcontractor's system(s) must be fully compatible with ESOC's systems, as defined in the relevant ICDs.
- **WBD-REQ-3:** The subcontractor's system(s) shall be available for routine operations for 99% of the time on a monthly basis.
- **WBD-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.
- **WBD-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.
- **WBD-REQ-6:** The subcontractor's system(s) must be flexible to cope with unexpected operations adjustments on a reasonable effort basis.
- **WBD-REQ-7:** 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.
- **WBD-REQ-8:** 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 WBD PI or ESA.

6 Deliverables & KPIs

6.1 Deliverables

The subcontractor shall be responsible for delivering the following to JSOC, other subcontractors or the WEC PI:

- **WBD-DEL-1:** The draft list of WBD observation requests for input to the Cluster Master Science Plan (every two months or as required).
- **WBD-DEL-2:** The schedule of WBD instrument modes for each weekly planning period.
- **WBD-DEL-3:** Processed WBD BM2 data products for input to the Cluster Science Archive.
- **WBD-DEL-4:** Inputs, as required, to the JSOC Progress Report for ESA review.
- **WBD-DEL-5:** Inputs, as required, to support some or all of the DWP, EFW, STAFF, WHISPER and WBD PIs at SWT meetings.
- **WBD-DEL-6:** Inputs, as required, to support some or all of the DWP, EFW, STAFF, WHISPER and WBD PIs 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 schedule for Cluster Master Science Plan production shall be followed. This can be found at: http://www.jsoc.rl.ac.uk/msp/MSP_gen_plans.php.

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>.