RPW Operation Centre

ROC Project Management Plan

ROC-GEN-MGT-PLN-00013-LES
Iss.01, Rev.04

Prepared by:	Function:	Signature:	Date
Yvonne de Conchy Xavier Bonnin	RPW Ground Segment Project Manager RPW Ground Segment Deputy Project Manager		17/11/2017
Verified by:	**Function:**	**Signature:**	**Date**
Yvonne de Conchy	RPW Ground Segment Project Manager		20/12/2106
Approved by:	**Function:**	**Signature:**	**Date**
Milan Maksimovic	RPW PI		Dd/mm/yyyy
For application:	**Function:**	**Signature:**	**Date**
Name	Team Member #4		Dd/mm/yyyy

CLASSIFICATION **PUBLIC** ☒ **RESTRICTED** ☐

l'Observatoire de Paris LESIA
Laboratoire d'Études Spatiales et d'Instrumentation en Astrophysique

CNRS-Observatoire de PARIS
Section de MEUDON – LESIA
5, place Jules Janssen
92195 Meudon Cedex – France

Change Record

Issue	Rev.	Date	Authors	Modifications
1	0	30/06/2016	X.Bonnin	First release
1	0	08/10/2016	X.Bonnin	Update ROC eng. doctree
1	2	15/11/2016	Y de Conchy	Update milestones Modifications of Institutes responsabilities
1	3	20/12/2016	X.Bonnin	Add SOV/SVT/LL in “Constraints of the project section” Update “ROC staff” and “Configuration” sections
1	4		X.Bonnin	- Update the Constraints section (project phases division and update of the information) - Update configuration section (Gitlab and JIRA) - Update meeting list - Update ROC documentation tree - Update engineering management section with Agile scrum and RCS development approach

Acronym List

Acronym	Definition
AR	Acceptance Review
CCSDS	Consultative Committee for Space Data Systems
CDF	Common Data Format
CNES	Centre National d'Etudes Spatiales
CP	Cruise Phase
CUC	CCSDS Unsegmented time Code
DA	Data Archive
DAL	Data Access Layer
DAS	DPU Application Software
DIO	Direction Informatique de l'Observatoire
DPM	Ground Segment Deputy Project Manager
DPS	Data Processing System
DPU	Digital Processing Unit
EPD	Energetic Particle Detector
ESA	European Space Agency
ESAC	European Space Astronomy Centre
ESOC	European Space Operation Centre
GIGL	Groupe Informatique Générale du LESIA
GSE	Ground Support Equipment
GUI	Graphical User Interface
HF	High Frequency
HFR	High Frequency Receiver
ICD	Interface Control Document
ID	Identifier
IT	Information Technology / Instrument Team
LEOP	Launch and Early Operation Phase
LESIA	Laboratoire d'Etudes Spatiales et d'Instrumentation en Astrophysique
LF	Low Frequency
LFR	Low Frequency Receiver
LL	Low Latency
MCS	Monitoring and Control System

MEB	Main Electronic Box
MIP	Mission Implementation Plan
MOC	Mission Operation Centre
NECP	Near Earth Commissioning Phase
NEOP	Near Earth Operation Phase
NMP	Nominal Mission Phase
PA	Pre-Amplifier
PDR	Preliminary Design Review
PM	Ground Segment Project Manager
PMP	Project Management Plan
QA/PA	Quality Assurance / Product Assurance
RCS	RPW Calibration Software
RGS	RPW Ground Segment
RGTS	ROC Ground Test SGSE
RLLP	RPW Low Latency Pipeline
RMU	RPW Monitoring Unit
ROC	RPW Operation Centre
RODS	ROC Operation and Data System
ROI	ROC Operation Interface
ROT	RPW Operation Toolkit
RPW	Radio and Plasma Waves instrument
RSS	ROC Software System
SBM	Selected Burst Mode
SCM	Search Coil Magnetometer
SDD	Software Design Document
SGS	Science Ground Segment
SGSE	Software Ground Support Equipment
SOC	Science Operation Centre
SolO	Solar Orbiter
SRS	Software Requirement Specification
SSS	Software System Specification
TDS	Time Domain Sampler
TNR	Thermal Noise Receiver
TV	TM/TC Viewier

Table of Contents

List of Figures

List of Tables

1 GENERAL

1.1 Scope of the Document

This document is the project management plan (PMP) of the RPW Operation Centre (ROC), which drives the RPW Ground Segment (RGS) activities.

According to [RD3] the PMP presents the main objectives and constraints of the project, and covers the following aspects:

- Project organization
- Project breakdown structures
- Configuration, information and documentation management
- Cost and schedule management
- Integrated logistic support
- Risk management
- Product assurance management
- Engineering management

The PMP shall address a project management in agreement with the requirements defined in the ROC Concept and Implementation Requirements Document (CIRD) [AD1].

The ROC is located at the Laboratoire d'Etudes Spatiales et d'Instrumentation en Astrophysique (LESIA) in Meudon, France.

1.2 Applicable Documents

This document responds to the requirements of the documents listed in the following table:

Mark	Reference/Iss/Rev	Title of the document	Authors	Date
AD1	ROC-GEN-SYS-PLN-00002-LES/1/3	ROC Concept and Implementation Requirements Document (CIRD)	Y. de Conchy X. Bonnin	15/11/2016
AD2	ROC-GEN-OTH-NTT-00045-LES/1/0	ROC Glossary of terms	X.Bonnin	24/01/2017
AD3				

1.3 Reference Documents

This document is based on the documents listed in the following table:

Mark	Reference/Iss/Rev	Title of the document	Authors	Date
RD1	RPW-GEN-PLN-00130-LES/1/0	RPW Operation Concept	M.Maksimovic	08/03/2012
RD2	ECSS-M-ST-10C/3/1	Project planning and implementation	ECSS consoritium	6 March 2009

RD3	ROC-GEN-SYS-PLN-00015-LES/2/1	ROC Software Development Plan	X.Bonnin	15/10/2015
RD4	ROC-GEN-OTH-BDG-00010-LES/1/6	Proposition Technique et Financière pour le ROC	Y. de Conchy	19/10/2015
RD5	ROC-GEN-SYS-NTT-00008-LES/1/1	ROC Engineering Guidelines	X.Bonnin	18/11/2015
RD6	ROC-GEN-SYS-NTT-00019-LES/1/1	ROC Engineering Guidelines for External Users	X.Bonnin	18/11/2015
RD7	SOL-ESC-PL-00001/1/1	Solar Orbiter Mission Implementation Plan	I.Tanco	31/01/2013
RD8	Marche Subsequent N°2018031	Accord-cadre N°504 relatif à la mise en place d'une assurance qualité et d'une assurance produit pour les laboratoires de l'INSU	N.Mayordomo	04/10/2016
RD9	2A- SOL-ESC-HO-05014/1/1	Instrument Command Workshop, ESOC : Commanding Interface and Testing	I.Tanco	05/09/2016
RD10	SOL-SGS-0006-TS/0/0	Solar Orbiter Instrument Teams – SOC Test Specification	Nana Bach, Chris Watson	25/05/2016
RD11	LL-pipelines at SOC schedule.pptx	LL-Pipelines@SOC Proposed schedule	Chris Watson	06/07/2015
RD12	ROC-TST-GSE-SUM-00035-LES/1/1	POPPy framework User Manual	Manuel Duarte	24/06/2016
RD13	RPW-GEN-DAT-SPC-00006-LES/01/00	RPW Data Products	Xavier Bonnin	23/12/2016
RD14	SOL-ESC-IF-05010/1/2	Planning Interface Control Document	L. Michienzi	07/2015
RD15	SOL-SGS-ICD-0009/1/0	Solar Orbiter File-Transfer SOC<-> Instrument Teams ICD	E Salazar, C.Watson	24/03/2017

1.4 About this document

1.4.1 Access policy

This document is public and can be accessible without any restriction.

Any modification of the present document requires formal approval of the RPW Ground Segment Project Manager (PM) before publication.

This latter shall ensure that the present document is always up-to-date and in accordance with the current project requirements and status.

1.4.2 Terminology

Except the terms listed in the table below, the definitions provided in [AD2] are applicable in the present document.

Name	Definition
Post-launch phases	Phases of the Solar Orbiter planned after the launch (i.e., LEOP, NECP, CP, NMP)

Table 1. Terminology.

2 OBJECTIVES AND CONSTRAINTS OF THE PROJECT

2.1 The RPW ground segment objectives overview

The RPW ground segment expected activities are already detailed in the CIRD [AD1], nevertheless for convenience the main objectives are summarized below:

- Support the definition of the science operations.
- Provide to the Solar Orbiter Science Operations Centre (SOC), inputs for the definition and implementation of the science operation planning, data handling and archiving concepts.
- Supervise the preparation of the instrument operation timelines
- Support the definition and implementation of the Solar Orbiter scientific data archive, as part of the pre-launch tasks.
- Agree on a long-term science activity plan and define the scientific priorities of scientific goals.
- Monitor and analyze instrument state in support to the Solar Orbiter Mission Operation Centre (MOC). Especially, the MOC does not plan to analyze instrument science telemetry (TM).
- Optimize instrument performances
- Perform the selection of the Selected Burst Mode (SBM) event data to be downlinked
- Make available the necessary resources during Near Earth Commissioning Phase (NECP) for the installation of equipment at the MOC, to monitor the operations execution in near-real time and to support GO/NOGO decisions at predefined steps in the procedures
- Deliver calibrated and high level data, including relevant calibration products, to the Solar Orbiter scientific archive at the European Space Astronomy Centre (ESAC)
- Provide to ESA unlimited access to all processed and analyzed data for public relation purposes during the 3-months proprietary period
- Provide summaries of the main scientific results at regular intervals
- Maintain the instrument flight software

All of the activities that support these objectives are under the supervision of the ROC, which has the two-tier function of a data processing centre and an operations centre for the RPW instrument. However, most of the ROC tasks are carried out in close collaboration with the other parties who have delegated responsibilities for the ground segment and operations.

In the framework of the ground calibration campaigns at RPW system level, it has been decided that the ROC shall also develop, deliver and maintain a SGSE dedicated to post-mortem analysis of data. The so-called ROC SGSE shall support calibration validation, but also be a milestone in the development of ROC infrastructure for in-flight RPW data processing as well as monitoring.

2.2 Constraints of the project

2.2.1 During the phase “D” of the Solar Orbiter mission

The phase “D” of the Solar Orbiter mission corresponds to the so-called “Qualification and Production” step, prior to the launch. The following sections present the main milestones at both mission and RPW levels, which involve the ROC during this period.

2.2.1.1 ROC involvement in the RPW instrument engineering activities: main milestones

The figure below gives the milestones before the launch, relative to the ROC involvement to the RPW engineering activities.

RPW engineering activity description	ROC involvement	Schedule / deadline
RPW DPU flight software SBM1/SBM2 detection algorithms ground validation campaign		
RPW DPU SBM1 detection algorithm validation campaign	Develop, run and maintain software to support the validation of the SBM1 detection algorithm by the RPW Flight Software team. Especially, this software must be able to simulate the detection and produce input files for the RPW DPU software.	Sept. 2015-June 2016
RPW DPU SBM2 detection algorithm validation campaign	Develop, run and maintain software to support the validation of the SBM2 detection algorithm by the RPW Flight Software team. Especially, this software must be able to simulate the detection and produce input files for the RPW DPU software.	Sept., 2015-June 2016
RPW system ground calibration campaigns		
RPW EM2 blank calibration campaign at CNES (Toulouse, France)	Develop, run and maintain a SGSE to support RPW teams in the analysis of the data produced during the EM2 calibration campaign. This SGSE will have to be deployed at the CNES site in Toulouse, as part of the RPW CNES GSE.	April-Sept. 2016
RPW PFM thermal calibration campaign at LESIA (Meudon, France)	Run and maintain the SGSE to support RPW teams in the analysis of the data produced during the PFM calibration campaign.	Nov. 2016 to Jan. 2017
RPW PFM delta-calibration campaign at CNES (Toulouse, France)	Run and maintain the SGSE to support RPW teams in the analysis of the data produced during the PFM delta-calibration campaign.	May-June 2017

Table 2. ROC involvement in the RPW engineering activities before the launch: main milestones.

2.2.1.2 ROC involvement in the Solar Orbiter mission engineering activities: main milestones

The table below gives the milestones prior to the launch, relative to the ROC involvement to the Solar Orbiter mission engineering activities. It concerns mainly testing activities driven by the Solar Orbiter SOC and/or MOC, namely:

- The Low Latency (LL) engineering activities [RD11]
- The SOC - Instrument Team (IT) interface tests [RD10]
- The MOC - IT interface tests [RD??]
- The System Operations Validation (SOV) [RD7, RD9]
- The System Validation Test (SVT) [RD7, RD9]

It must be noticed that the ROC has no visibility on the MOC – IT interface tests organization, specification and schedule at this stage of the project, as well as concerning the organization and validation of the infrastructure for the NECP RPW-related operations at ESOC.

Solar Orbiter MOC/SOC	ROC involvement	Schedule / deadline

engineering activity description		
Low Latency Virtual Machine (LLVM) delivery schedule		
"Hello World" LLVM version delivery	To provide to the SOC a first "Hello world" version of the LLVM for RPW, that processes fake RPW LL packet data.	January, 31 2016
LL Data Description Document (DDD) delivery	To provide to the SOC the LL Data Description Document (DDD) for RPW.	February 29, 2016
LL Testcard delivery	To provide to the SOC the LL Testcard files for RPW.	March 31, 2016
LLVM processing version delivery	To provide to the SOC a second version of the LLVM that includes real RPW LL packet data processing.	June 30, 2016
LLVM processing + tests version delivery	To provide to the SOC a full version of the LLVM that includes real RPW LL packet data processing and self-testing processes.	August 31, 2016
SOC – IT interface tests		
Compatibility tests	The Compatibility Tests will consist of data exchange and manual check of the formats of the data products.	April – Oct. 2016
Integration tests	Integration Tests will consist on data exchange and running specific Sub-System(s) in order to read and execute some involved parts of the Sub-Systems and in order to be able to evaluate the output.	March – July 2017
Validation tests	The Validation Test Cases will be part of particular System Tests which will involve running the entire System or relevant part of it involving all the data product exchange needed for given Interface Test.	April 2018
System Operation Validation engineering activities		
SOV-0: Data Distribution interface Test	Test the data distribution interfaces between the MOC and the ROC.	Launch – 10 months
SOV-1: MOC/SOC interface Test	Will involve instrument inputs.	Launch – 9 months
SOV-2: Cruise Operations End-to-end Test	Will involve In Situ (IS) instruments, and some limited Remote Sensing (RS) participation	Launch – 6 months
SOV-3: OBSM End-to-End Test	Will involve all instruments	Launch – 6 months
System Validation Test engineering activities		
SVT-0: devoted to unit-level commanding	First set of flight procedures for RPW to be run during the SVT-0	Launch – 18 months
SVT-1: to validate closed loop behaviour	RPW User Manual complete. All the inputs required for Near Earth Commissioning Phase and Cruise Phase (timeline and procedures). Instrument Teams to provide inputs and	Launch – 9 months

	support iterations as necessary. All inputs required to test on the PFM to validate as far as possible instrument database and procedures. Instrument Teams to provide all test inputs. These inputs are expected to be delivered 3 months before the SVT-1. Instrument Team with decision authority to support test at test site. Up to two instruments tested in parallel.	
SVT-2: at the launch site, to perform last minute validation	Retest of any problems found with Instruments during SVT-1	Launch – 4 months

Table 3. ROC involvement in the ESA engineering activities before the launch: main milestones.

2.2.1.3 ROC key points and formal reviews

The table below lists the ROC key points and formal reviews planned prior to the launch. The details about the organization and the expected data packages are reported into the "ROC Software Product Assurance Plan" (SPAP) [RD8].

It must be noticed that no formal acceptance review of the instrument ground segments will be conducted by ESA before the launch.

Key points / Reviews	Purpose	Scheduled date/time
Preliminary Design Key point (PDKP)	Preliminary design key point of the ROC organization and design organized by CNES	2017/01/16
End of Design Key point (EDKP)	End of design key point of the ROC organized by CNES	Fall 2017
Validation Reviews	Internal review in preparation to the ROC validation campaign. This campaign will have to start with a Test Readiness Review (TRR) and to finish with an Test internal Review Board (TRB)	Launch – 12 months (TBC)
Acceptance Review (AR)	RPW ground segment acceptance review.	Launch – 3 months (TBC)

Table 4. ROC main key points and reviews.

2.2.2 During the phase "E" of the Solar Orbiter mission

2.2.2.1 Solar Orbiter mission phases

The "E", also called "utilisation", phase starts at the launch. Figure 1 indicates the timeline of the different phases of the Solar Orbiter mission and the corresponding operations planned during the "E" phase.

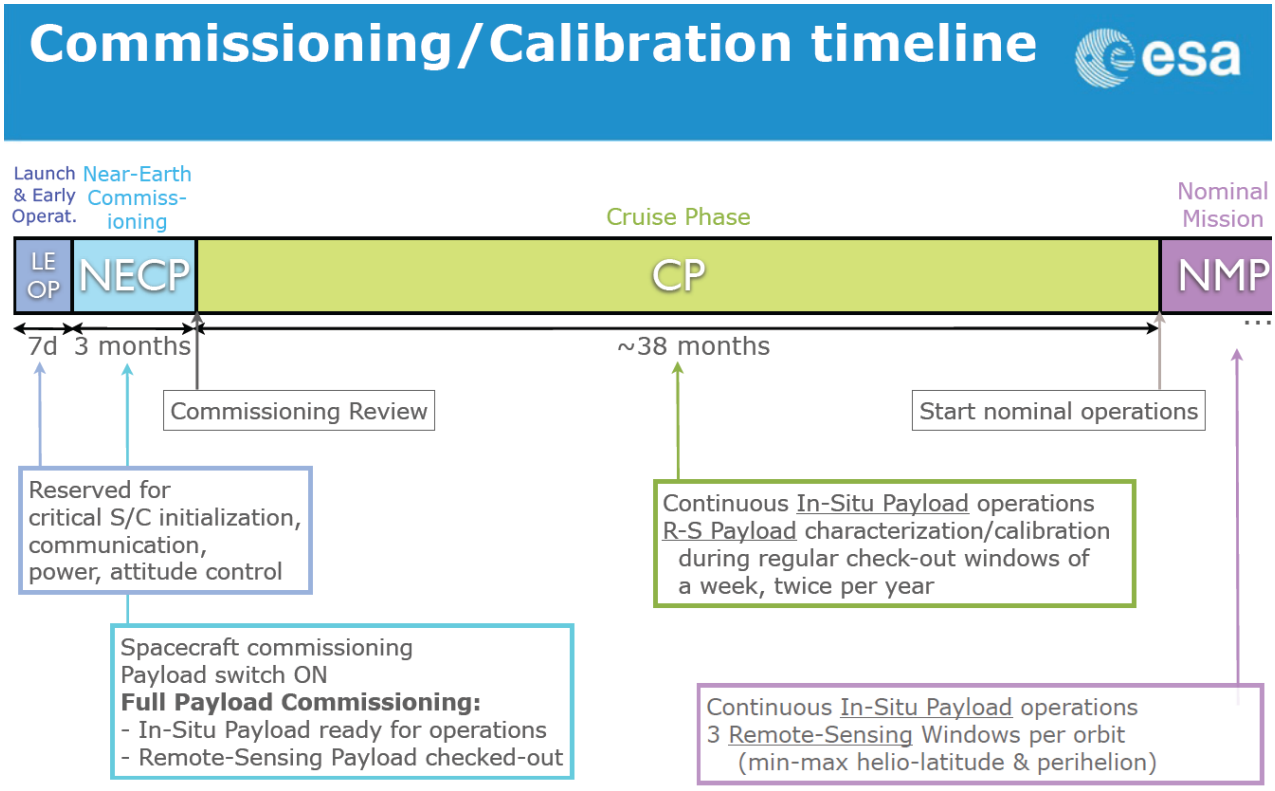

Figure 1. Solar Orbiter mission phases.

The "E" phase can be divided into two periods:

- The "E1" phase, which only covers the Launch & Early Operations Phase (LEOP) and the Near Earth Commissioning Phase (NECP).
- The "E2" phase, which begins with the Cruise Phase (CP) and continue with the Nominal Mission Phase (NMP)

The Extended Mission Phase (EMP) may prolong the NMP.

2.2.2.2 Key flight operations involving RPW

The key operations, involving RPW during the Solar Orbiter mission, are detailed in the "RPW Operation Concept" document [RD1].

During the LEOP:

- SCM boom & ANT (x3) deployments

During the NECP:

- Inter-Instruments interference campaign
- RPW-PAS filtering tune campaign
- RPW-SPICE heat shield door (HSD) Z antenna (ANT) bending effect characterization
- TDS/LFR software algorithms validation campaign

During CP:

- ANT calibration rolls

- SBM1/SBM2 detection algorithms validation campaign

During NMP and EMP:

- The SURVEY "NORMAL" mode
- The SURVEY "BURST" mode
- The detection mode for recording both SBM1 (shock crossings) and SBM2 (in-situ Type III) events

The preparation and organization of the RPW flight operations shall be described in the "ROC Operations Management Plan" (OMP) document.

2.2.2.3 ROC key points and formal reviews

Exact schedule and organization about ROC key points or reviews planned after the launch are not defined in details yet. Nevertheless, the commissioning phase will end with a dedicated review, which involves instrument ground segments.

2.2.3 Main phases of the ROC project

The following table summarizes the main phases and tasks of the ROC project related to the activities at Solar Orbiter and RPW projects levels. The list of documents referenced in the table can be found in the section 5.3.

Solo project phase	ROC project phase	ROC main tasks	RPW SolO main related activities/phases	
Phase D	**Phase 0**	- ROC concept and engineering requirement specification. It shall lead to the release of a first version of the ROC CIRD, PMP, SDP and SSS documents.	N/A	N/A /
Phase D	**Phase 1**	- First release of the PTF document for the phases D and E1. - Release of a preliminary version of the RPW packet parsing library for the ROC	EM	N/A
Phase D	**Phase 2**	- Release of the SBM validation software and products in support to the validation of the SBM algorithms at the RPW DPU Application Software (DAS) level. - Releases of the ROC SGSE versions for the RPW ground calibration activities (EM and PFM) - Releases of the preliminary RPW Low Latency Virtual Machine (LLVM) - ROC PDR - Release of the RPW Operations and Data Pipeline (RODP) preliminary version for the test bench activities at SolO level - Release of the ROC Operations And Data System (ROADS) for the ROC activities planned during the SolO mission, including the RLLP. - ROC AR	- EM2 (receiver/sensor stand alone calibrations and blank test calibrations at system level) - PFM (thermal calibrations)	- EM - FM (SolO payload test bench activities)
Phase E1	**Phase 3**	- RPW commissioning operations (instrument switch-on and antenna	RPW commissioning	LEOP

		deployment critical operations)		
Phase E2	**Phase 4**	- RPW Cruise Phase operations (instrument performance analysis and optimization) - RPW Nominal and Extended Phases operations (instrument monitoring and commanding activities, science data processing, dissemination and archiving activities)	Instrument exploitation phase	CP NMP, EMP

Table 5. ROC project main phases.

2.3 The Solar Orbiter mission operations implementation plan

The implementation plan for the Solar Orbiter mission operations is described in the "Solar Orbiter Mission Implementation Plan" (MIP) [RD7].

3 ROC PROJECT PRESENTATION

3.1 ROC function tree

Figure 2 presents the ROC function tree. The tree is divided into 6 main branches of activities, which must meet the requirements defined in the CIRD [AD1]:

- **Data processing**, which regroups functions related to the RPW data processing, including Low Latency data production, and the assessment of the science data products quality.
- **In-flight Performance optimization and Calibration**, which gathers functions related to the instrument performance optimization and calibration after the launch.
- **Operations**, which concerns all of the science and engineering activities to be coordinated by the ROC to perform the instrument operations.
- **Ground support**, which focus on the ROC functions related to the ground support activities; mainly GSE facilities for system calibrations, anomalies investigation and SBM detection algorithms validations).
- **Project management**, which gathers the functions concerning the management of the ROC as a project, including the documentation management and the ROC logistics.
- **Data dissemination and archiving**, which regroups functions related to the RPW data distribution and archiving.

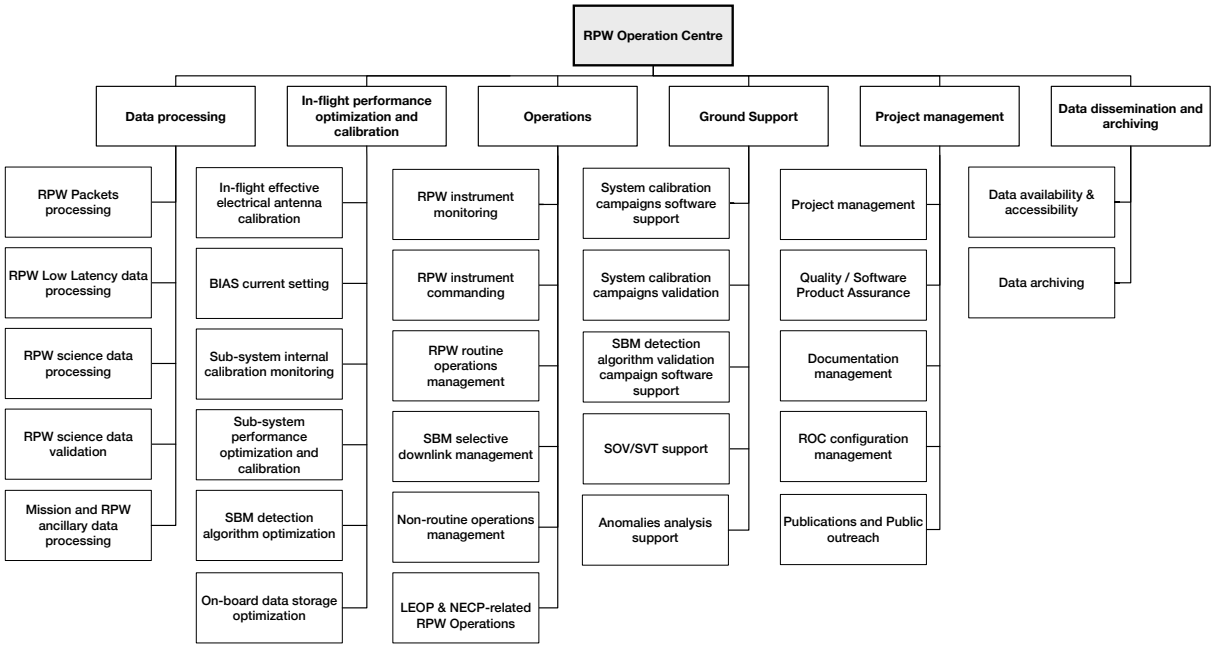

Figure 2. RPW Ground Segment function tree.

The following table gives more details about the functions of each branch.

Functional branch	Function	Description
Data Processing	**RPW Packets processing**	Retrieve from the SOC/MOC, identify and parse correctly the RPW TM packets. Retrieve and analyse the TC history catalogue.
Data Processing	**RPW Low Latency data processing**	Process RPW Low Latency data as required by the SOC.
Data Processing	**RPW science and HK data processing**	Process RPW science and HK data products, including calibrated science data.
Data Processing	**RPW science data validation**	Ensure that the RPW calibrated science data quality is as close as possible from the instrument science requirements
Data processing	**Mission and RPW ancillary data processing**	Ensure the retrieval, processing of the ancillary data (i.e., orbit/attitude/frame/time SPICE kernels)
In-flight performance optimization and calibration	**In-flight effective antenna calibration**	Perform the RPW effective electric antenna calibration after the launch.
In-flight performance optimization and calibration	**BIAS current setting**	Optimize the BIAS current values during the whole mission
In-flight performance optimization and calibration	**Sub-system internal calibration monitoring**	Monitor the sub-system internal calibrations
In-flight performance optimization and calibration	**Sub-system performance optimization and calibration**	Optimize the sub-system performance and calibration
In-flight performance optimization and calibration	**SBM detection algorithm optimization**	Optimize the SBM1/SBM2 algorithm detections
In-flight performance optimization and calibration	**On-board data storage optimization**	Optimize the on-board data storage
Operations	**RPW data monitoring**	Monitor the instrument data: TM/TC, HK and science data, the sub-systems status, event reporting, actual TM data rate, on-board memory storage, power consumption
Operations	**RPW instrument commanding**	Prepare and submit instrument operation requests in agreement with the mission operation planning and constraints (e.g., data rate, power

		consumption, events, etc.) Plan the GSE in support to this activity
Operations	**RPW routine operations management**	Plan and coordinate the RPW routine operations management in terms of procedures, team responsibilities, software and logistics
Operations	**SBM selective downlink management**	Plan and perform the SBM data selection life cycle
Operations	**Non-routine operations management**	Plan and coordinate the RPW non-routine operations (e.g., FDIR) management in terms of procedures, team responsibilities, software and logistics
Operations	**Commissioning**	Prepare and support the RPW specific operations planned during the commissioning phase
Ground support	**System calibration software support**	Provide software support during on-ground calibration tests at system level
Ground support	**System calibration validation**	Participate to the system calibration validation during ground calibration campaigns.
Ground support	**SBM algorithm validation**	Support RPW flight software team in the SBM detection algorithm test and validation on-ground.
Ground support	**SOV/SVT support**	Participate to the SOV/SVT campaigns
Ground support	**Anomalies analysis support**	Participate to the analysis of anomalies using RPW GSE facilities.
Project management	**Project management**	Manage the ROC project
Project management	**Quality Software Product Assurance**	Ensure the Quality Assurance / Produce Assurance of the ROC project
Project management	**Documentation management**	Ensure that documentation management
Project management	**ROC logistics**	Ensure that ROC logistics (hardware/software support equipment, logistics for meetings, collaboration tools, etc.)
Project management	**Publication and public outreach**	Manage the publication and public outreach activities around RPW
Data Dissemination and Archiving	**Data availability & accessibility**	Ensure that availability and the accessibility of RPW data in terms of products, documentation, user interfaces and software
Data Dissemination and Archiving	**Data archiving**	RPW data archiving activities with ESA and CDPP. Primary data storage at the LESIA.

Table 6. ROC functions.

3.2 ROC product tree

3.2.1 ROC Software System (RSS)

The ROC Software System (RSS) is the top-level system of the ROC. It gathers all of the software systems required to ensure the ROC functions listed above. It is divided into two systems:

- The ROC Ground Equipment Support (ROC GSE), which regroups software equipment in support to the instrument system and sub-system tests performed on-ground, before the launch and during the operations in-flight.
- The ROC Operations And Data System (ROADS), which concerns software equipment to perform the on-board instrument data processing and operations.

Figure 3 shows the RSS product tree. The sub-systems of the ROC GSE and ROADS are briefly presented in the next sections. More details can be found in the "ROC Software Development Plan" (SDP) document [RD3]. The RSS specification and design will have to be

defined in dedicated "ROC Software System Specification" (RSSS) document and "ROC Software System Design Document" (RSSD).

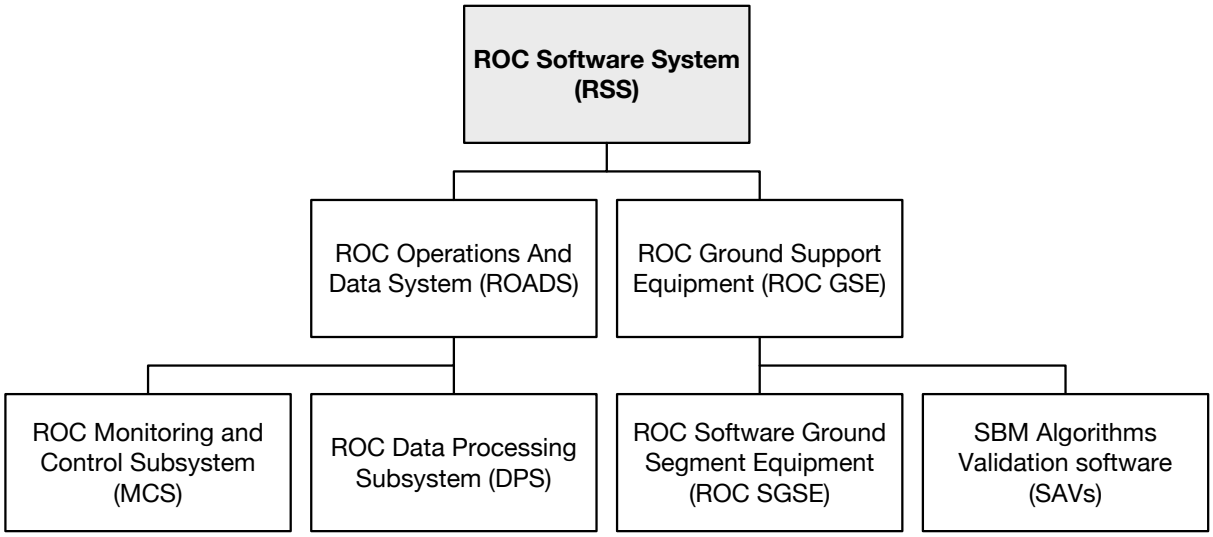

Figure 3. ROC Software System product tree.

3.2.1.1 ROC Operations And Data System (ROADS)

The ROC Operations And Data System (ROADS) contains the software tools in support to the RGS activities during the Solar Orbiter mission.

It is composed of the two sub-systems:

- The ROC Monitoring and Control Subsystem (MCS), which gathers at least the following software units:
  - The "MCS User Interfaces" (MUSIC); a Web interface allowing the ROC team to prepare, submit and verify the RPW operations, view the mission planning and monitor RPW data.
  - The RPW "TM data Rate Calculator" (TRAC); a software tool capable of the compute the TM data rate as a function of the instrument operating modes.
- The ROC Data Processing Subsystem (DPS) contains at least the following software units:
  - The ROC Operations and Data Pipeline (RODP); the main RPW data processing pipeline, which must also support some automated tasks relative to the operations. The list of RPW data sets to be produced by the RODP is available in [RD13].
  - The RPW Calibration Software (RCS); a set of software dedicated to the RPW science data calibration and L2 science data files production. The RCS is expected to be delivered by the RPW analyser/sensor teams (i.e., TDS, LFR, THR, Bias, SCM) and run as components of the RODP.
  - The RPW Low Latency Virtual Machine (LLVM); the virtual appliance hosting the RPW Low Latency Data Pipeline (RLLP), in charge of processing the RPW Low Latency data. The primary instance of the LLVM shall be delivered to the SOC to be run at ESAC.

- The RPW Data Archive (DArc); the infrastructure and tools use for RPW data archiving tasks
- The RPW Data Access Layer (DAL); the interfaces and services that allow RPW data users to retrieve the instrument data at the ROC site.

Figure 4 shows the overall software product tree of the ROADS. The description and functionalities of the MCS and DPS software units, including the data products and databases, are presented in the SDP.

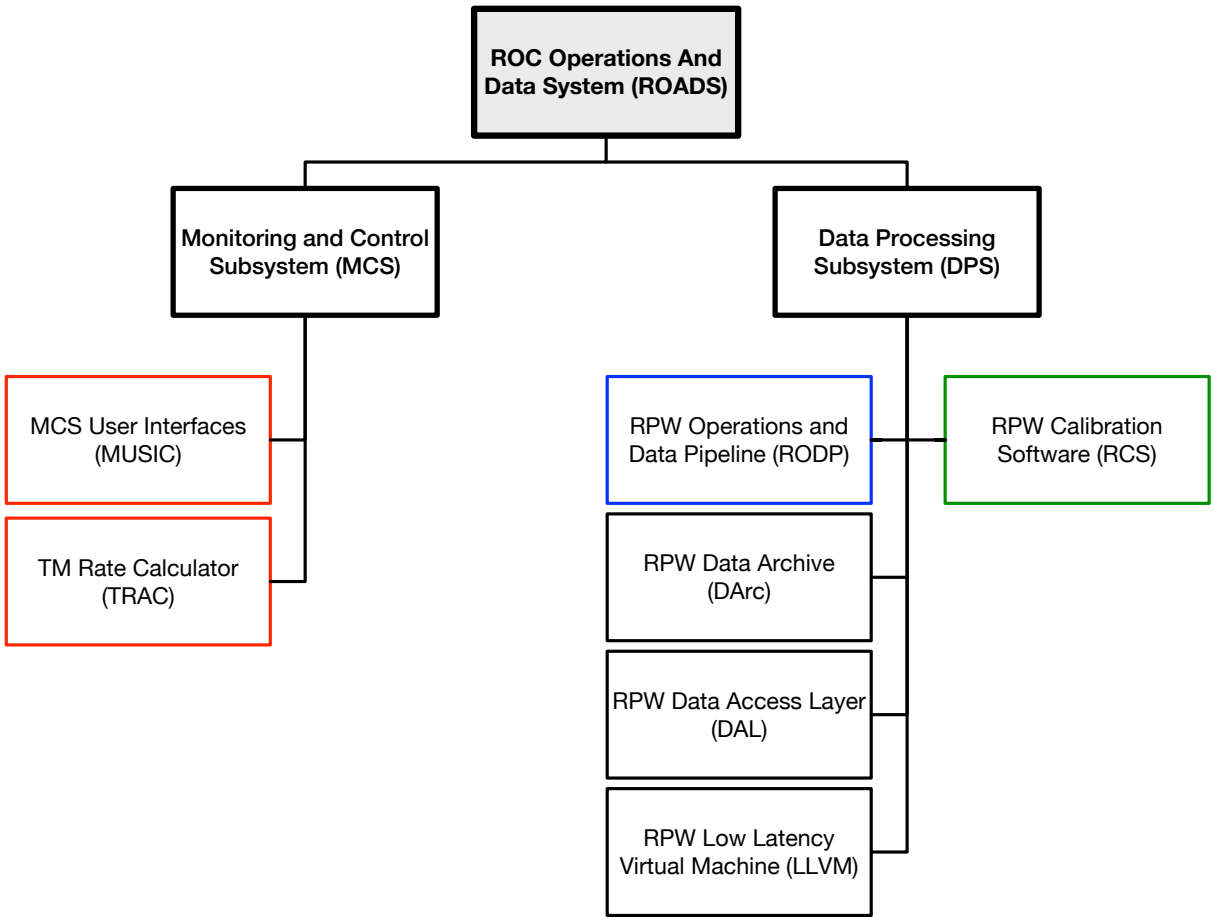

Figure 4. ROADS software product tree.

3.2.2 ROC Ground Support Equipment (ROC GSE)

Figure 5 shows the product tree concerning the ROC Ground Support Equipment (GSE). The ROC GSE application firstly concerns RPW instrument tests performed on-ground before launch, namely: EM2/PFM instrument calibrations at system level and RPW DPU SBM1/SBM2 detection algorithm validation campaigns. Nevertheless, dedicated instances of this software equipment will be used during the Solar Orbiter mission, in order to support possible GSE activities on the instrument.

Two main components are supplied:

- The ROC Software Ground Support Equipment (ROC SGSE), which provides SGSE to analyse RPW packet data during the EM2/PFM ground calibration tests at system level. An instance of the ROC-SGSE will also be deployed at LESIA and used to support the ground test activities during the mission (e.g., TCs sequences validation and anomalies investigation on a RPW "spare" model).

- The SBM Algorithm Validation software (SAVS), supplying software to support the validation of the Selected Burst Modes (SBM) algorithms of the RPW DPU. Tailored instances of the SAVS will be used to optimize the detection rate of the on-board SBM algorithms during the Cruise Phase (CP).

The functionalities of the GSE units are presented in the SDP.

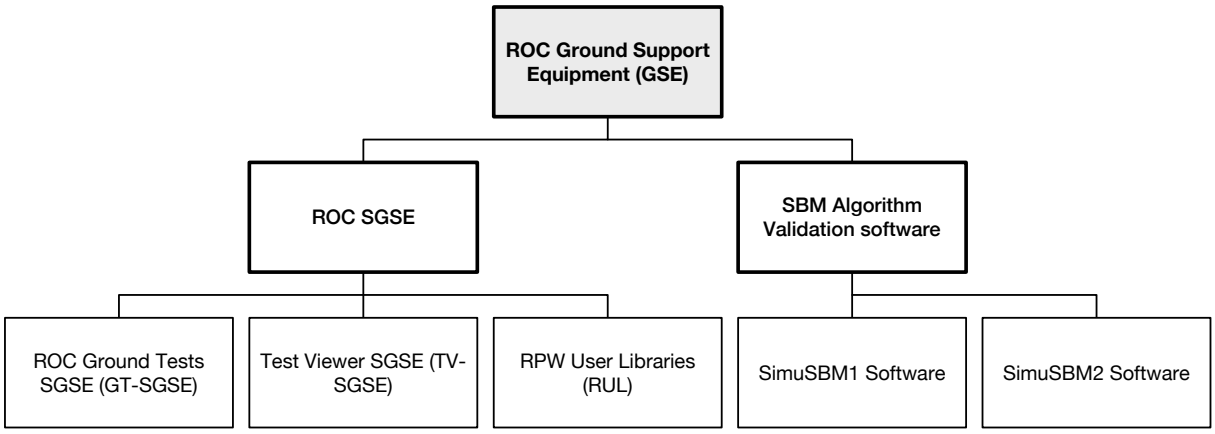

Figure 5. ROC Ground Support Equipment (ROC GSE) related software products.

4 ROC PROJECT ORGANIZATION

4.1 Key personnel responsibilities

The definitions and responsibilities of the key personnel involved in the ROC are established in the CIRD [AD1].

4.2 Institutes responsibilities

The responsibilities of the institutes relative to the ROC activities are summarized in the table below.

Institute	Main responsibilities
CNES	- Develop, test, validate, run and maintain software and/or interfaces allowing ROC to: * Retrieve the data produced by the CNES instance of the ROC SGSE - Provide to the ROC, the calibration metadata related to the EGSE setup. - Supervise the writing of and the deliver of the RPW user manual - Assist the ROC team in the preparation and conduct of the LEOP/NECP operations related to RPW - Provide support (system and control/command) in the preparation of the CP and NMP operations (until the end of the NECP) - Coordinating RPW AIV/AIT activities until the end of the NECP

ESAC (SOC)	- Develop, test, validate, run and maintain software and interfaces allowing ROC to: * Submit IORs [RD8] to the SOC via the SOC GFTS interface [RD15] * Retrieve auxiliary data (e.g., SPICE kernels) via the SOC GFTS, as well as the inputs for the science operations preparation (TM corridor, Power consumption range, etc.) * Archive Solar Orbiter final data sets * Provide a dedicated interface for data archiving process [RD7] * Deliver and run the RPW low latency data pipelines [RD5] - Write, deliver and keep up-to-date associated documentation - Coordinate Solar Orbiter science observation campaigns (i.e., SAP, SOOP)
ESOC (MOC)	- Develop, test, validate, run and maintain software and interfaces allowing ROC to: * Submit RPW flight procedures to the MOC * Submit Memory Direct Operation Request (MDOR) and Payload Direct Operation Request (PDOR) to the MOC [RD14] via the MOC GFTS interface. * Retrieve RPW TM packet raw data through the MOC EDDS interface [RD11] * Ensure the analysis of instrument data in quasi-real time during the LEOP/NECP RPW-related operations at ESOC. * Retrieve the Mission information Base (MiB) - Write, deliver and keep up-to-date associated documentation - Monitoring the instrument - Alert ROC in case of instrument failures/anomalies
IAP (TDS)	- Calibrating TDS sub-system - Assist the ROC in the definition of L1 and HK data sets for TDS - Deliver to the ROC the CDF skeletons for TDS L2 data sets - Deliver to the ROC the calibration tables for TDS - Develop, test, validate, deliver and maintain TDS software allowing ROC to produce * TDS science data files at L1R level (only for waveform data) * TDS science data files at L2 level (only for non-waveform data) - Contribute to the validation of the science data produced by the TDS S/W - Write, deliver and keep up-to-date associated documentation
IRF Uppsala (BIAS)	- Calibrating Bias unit - Assist the ROC in the definition of L1and HK data sets for Bias - Deliver to the ROC the CDF skeletons for TDS/LFR electrical waveform L2 data sets - Deliver to the ROC the calibration tables for Bias unit - Develop, test, validate, deliver and maintain Bias software allowing ROC to produce * TDS/LFR electrical waveform science data files at L2 level - Contribute to the validation of the science data produced by the Bias S/W - Write, deliver and keep up-to-date associated documentation
LESIA (GIGL)	The Groupe Informatique Générale du LESIA (GIGL) is in charge of: - Maintaining the ROC servers and services (JIRA, Confluence) - Creating the LDAP user accounts, which allow ROC users to access to the ROC servers and services on the Paris Observatory intranet. - Ensure that the ROC team can use the LESIA visiocon facilities and providing helpdesk
LESIA (MEB)	- Ensure the availability of the RPW MEB “spare” model during the mission - Provide MEB expertise support
LESIA (MEB GSE)	- Ensure the availability of the MEB GSE during all the phases of the project. - Write and deliver the up-to-date MEB GSE documentation
LESIA (ROC)	- Develop, test, validate, run and maintain software and/or interfaces in order to: * Monitor the instrument during the mission, starting at the NECP. * Plan the observation campaigns * Prepare and submit the operation requests for RPW * Produce and distribute as soon as possible RPW data to the instrument

	consortium * Produce and deliver RPW calibrated science data to the instrument consortium, the ESAC (Madrid) and CDPP (Toulouse) for archiving - Provide S/W support during the ground calibration campaigns at the system level - Deliver and run a low latency pipeline for RPW to the SOC. - Write, deliver and keep up-to-date associated documentation
LESIA (RPW DPU flight software)	- Deliver the RPW Instrument Database (IDB) to the ROC - Provide expertise support for the RPW command/control and monitoring operations involving the flight software (e.g., FDIR, flight software patching, etc.) - Write and deliver the corresponding up-to-date documentation
LESIA (THR)	- Calibrating THR sub-system - Calibrating electrical antennas in-flight - Assist the ROC in the definition of L1 and HK data sets for THR - Deliver to the ROC the CDF skeletons for THR L2 data sets - Deliver to the ROC the calibration tables for THR and antennas - Develop, test, validate, deliver and maintain THR software allowing ROC to produce * THR science data files at L2 level - Contribute to the validation of the science data produced by the THR S/W - Write, deliver and keep up-to-date associated documentation
LPC2E (SCM)	- Calibrating SCM sensor - Assist the ROC in the definition of L1and HK data sets for SCM - Deliver to the ROC the CDF skeletons for TDS/LFR magnetic waveform L2 data sets - Deliver to the ROC the calibration tables for SCM - Develop, test, validate, deliver and maintain SCM software allowing ROC to produce * TDS/LFR magnetic waveform science data files at L2 level - Contribute to the validation of the science data produced by the SCM S/W - Write, deliver and keep up-to-date associated documentation
LPP (LFR)	- Calibrating LFR sub-system - Assist the ROC in the definition of L1 and HK data sets for TDS - Deliver to the ROC the CDF skeletons for LFR L2 data sets - Deliver to the ROC the calibration tables for LFR - Develop, test, validate, deliver and maintain LFR software allowing ROC to produce * LFR science data files at L1R level (only for waveform data) * LFR science data files at L2 level (only for non-waveform data) - Contribute to the validation of the science data produced by the LFR S/W - Write, deliver and keep up-to-date associated documentation
Paris Observatory (DIO)	The Direction Informatique de l'Observatoire de Paris (DIO) is in charge of: - Maintaining the Gitlab server used by the ROC - Maintaining the sympa mailing list server used by the ROC - Maintaining the COTRANET documentation system manager - Ensuring the availability of the network access over the Meudon site and to Internet.

Table 7. Institute responsibilities overview

4.3 ROC staff

This section presents the personnel involved in the ROC project. A detailed list can be found in the table 8.

4.3.1 ROC staff at the LESIA

Figure 6 shows the structure of the ROC science and engineering personnel at the LESIA.

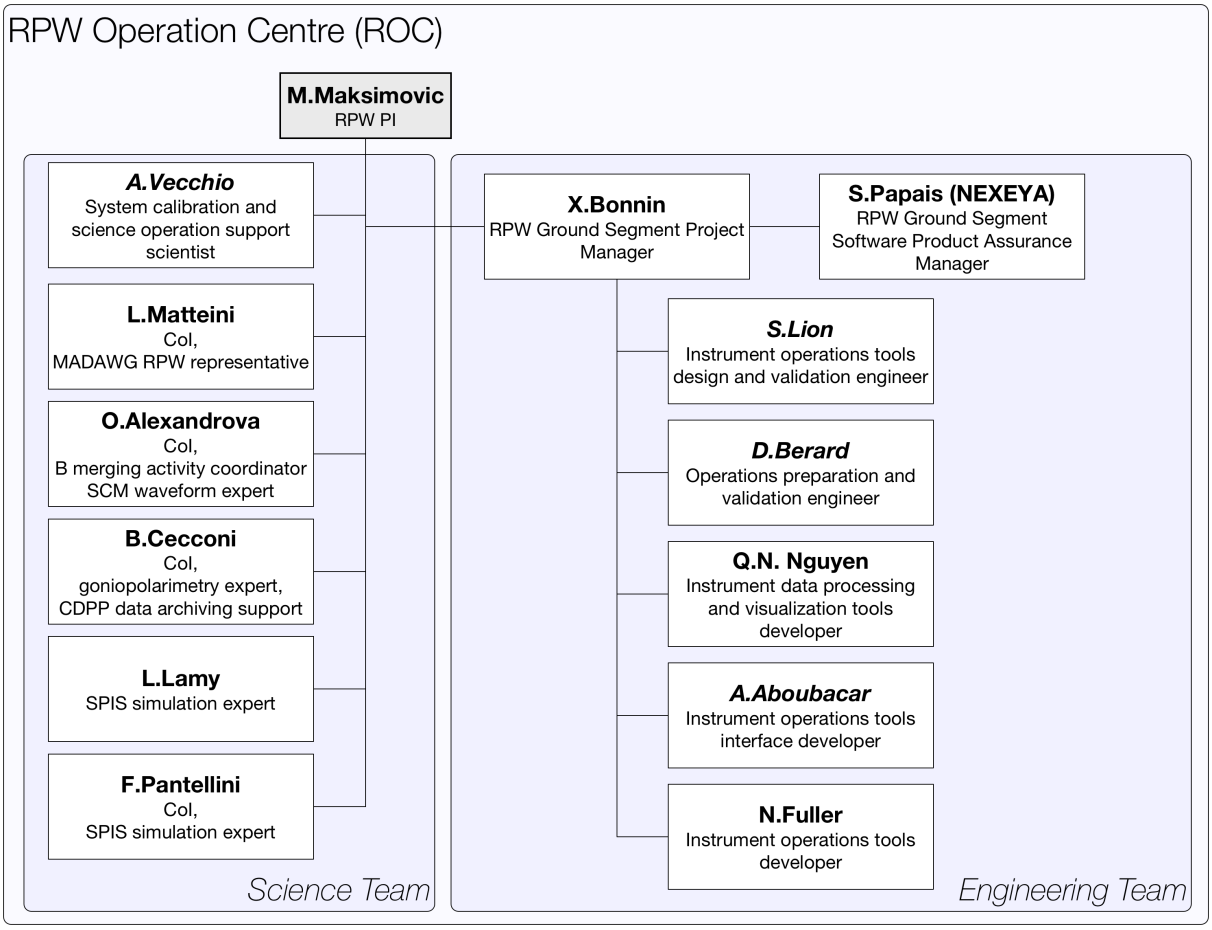

Figure 6. ROC staff at the LESIA.

Details about the tasks of the ROC science and engineering team are listed in the Table 8. The personnel workload is given in the *ROC workload management schedule file* (see section 5.1.1.1).

4.3.2 External staff directly involved in the ROC activities

Figure 7 shows the main teams directly involved in the ROC project. It includes:

- The TDS, LFR, TNR-HFR, BIAS and SCM teams, in charge of calibrating their sub-systems, delivering the RPW Calibration Software (RCS) to the ROC and providing expertise during the operations. Especially, the BIAS team will have to support the ROC in the setting of the Bias currents to apply on-board during the mission.
- The MEB GSE and flight software teams located at the LESIA, which supply respectively the interfaces to the MEB GSE facilities and to the RPW instrument database (IDB) respectively.
- The CNES teams in support to the ground segment activities. The participation of the RPW instrument team at CNES will be effective until the end of the commissioning phase. During the CP, NMP and EMP, only CNES support to the instrument exploitation is planned. Nevertheless, the instrument staff may be temporary re-activated on the LESIA demand, in case of anomalies.

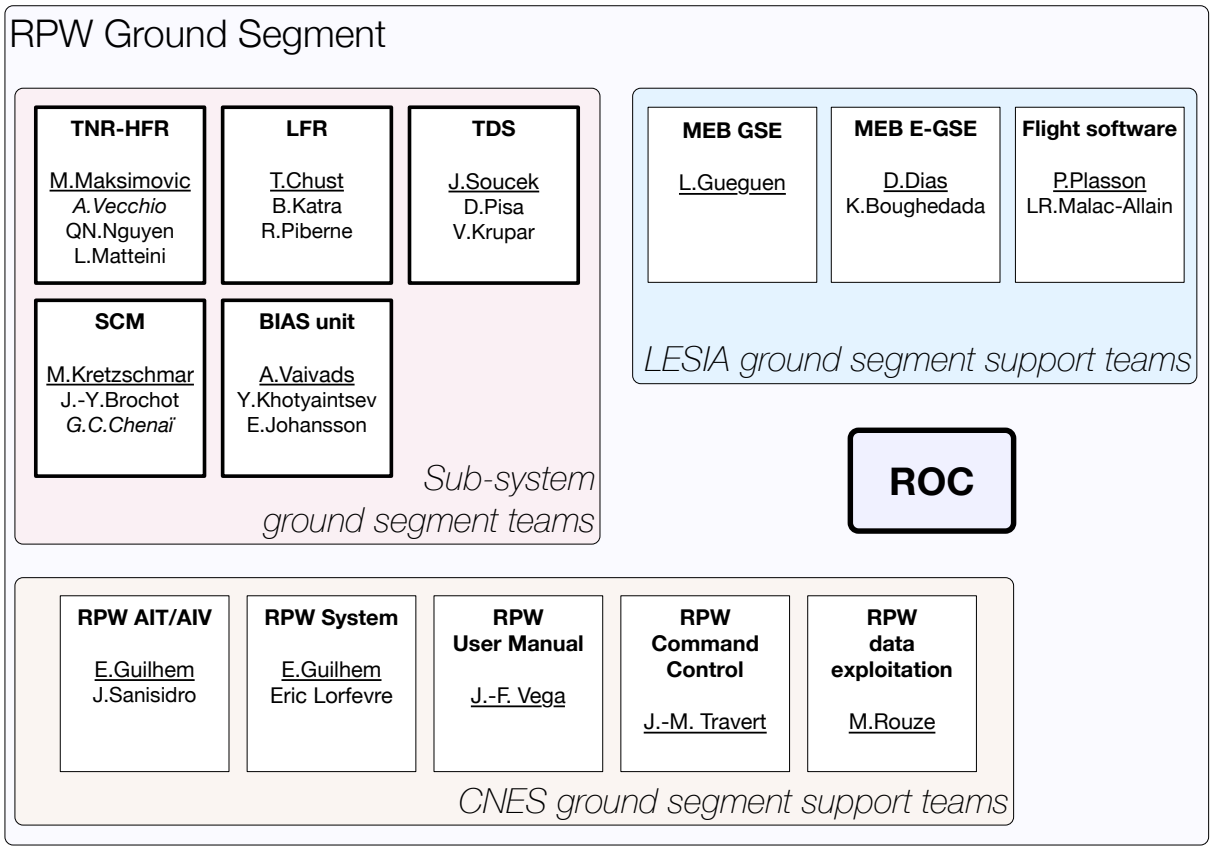

Figure 7. ROC support teams.

Additionally, the ROC will also rely on the RPW MEB and AIT/AIV teams at LESIA, in order to support investigations in case of anomalies during the mission.

4.3.3 Summary list of personnel

The table 8 gives a detailed list of main people involved in or that interact with the ROC.

People in bold font are directly involved in the ROC project, people in italic font are contract employees, and people that don't work anymore in the project are indicated in grey. The list is given in alphabetical order and by team.

Since people can belong to several teams, they can appear several times in the table.

Name	Function(s)	Institut	Contact
ROC			
A.Aboubacar Amadou	**MCS User Interfaces Software engineer**	**LESIA**	**aichatour.aboubacar@obspm.fr**
O.Alexandrova	**Co-I, B merging activity coordinator, SCM waveform expert**	**LESIA**	**olga.alexandrova@obspm.fr**
Diane Berard	**Instrument operations preparation and validation**	**LESIA**	**diane.berard@obspm.fr**
X.Bonnin	RPW ground segment project manager (since Sept. 2017)	LESIA	xavier.bonnin@obspm.fr
B.Cecconi	MADAWG RPW member, CDDP data	LESIA	baptiste.cecconi@obspm.fr

	archiving support, Virtual Observatory (OV) expert		
Y.de Conchy	**RPW ground segment project manager / ROC budget / operation preparation engineering coordinator (until Aug. 2017)**	**LESIA**	**yvonne.deconchy@obspm.fr**
M.Duarte	ROC SGSE and TV SGSE software engineer	LESIA (VIVERIS)	manuel.duarte@obspm.fr
E.Holle	ROC software developer	LESIA	eleonore.holle@obspm.fr
L.Lamy	Spacecraft potential simulation with SPIS tool	LESIA	laurent.lamy@obspm.fr
S.Lion	ROC Operations and Data Pipeline – MCS units software engineer	LESIA	sonny.lion@obspm.fr
L.Matteini	CoI, MADAWG RPW representative member TNR-HFR calibration leader	LESIA	lorenzo.matteini@obspm.fr
M.Maksimovic	**RPW PI**	**LESIA**	**milan.maksimovic@obspm.fr**
QN.Nguyen	ROC RODP and MUSIC software developer / RPW user library developer	LESIA	quynh-nhu.nguyen@obspm.fr
F.Pantellini	CoI, spacecraft potential simulation with SPIS tool	LESIA	filippo.pantellini@obspm.fr
S.Papais	ROC software product assurance manager	*LESIA (Nexeya)*	Stephane.PAPAIS@nexeya.com
T.Sausiere	RPW Packet parsing library software engineer	LESIA (AVISTO)	thierry.sauziere@obspm.fr
A.Vecchio	System calibration / operation preparation science coordinator	*LESIA*	antonio.vecchio@obspm.fr
TNR-HFR team			
B.Cecconi	TNR-HFR CoI, goniopolarimetry expert	LESIA	baptiste.cecconi@obspm.fr
M.Maksimovic	TNR-HFR Lead Co-I	LESIA (ROC)	milan.maksimovic@obspm.fr
L.Matteini	TNR-HFR data calibration software co-responsible (after April, 2017)	LESIA	lorenzo.matteini@obspm.fr
QN.Nguyen	TNR-HFR data calibration software engineer	LESIA	quynh-nhu.nguyen@obspm.fr
K.Boughedada	TNR-HFR flight software engineer	LESIA	kamal.boughedada@obspm.fr
A.Vecchio	TNR-HFR data calibration software co-responsible (until April 2017)	LESIA	antonio.vecchio@obspm.fr
LFR team			
T.Chust	LFR Lead Co-I	LPP	thomas.chust@lpp.polytechnique.fr
B.Katra	LFR flight et data calibration software engineer	LPP	bruno.katra@lpp.polytechnique.fr
R.Piberne	LFR calibration software support engineer	LPP	rodrigue.piberne@ lpp.polytechnique.fr
TDS team			
V.Krupar	TDS data definition and software support scientist	IAP	vk@ufa.cas.cz
D.Pisa	TDS data calibration	IAP	dp@ufa.cas.cz

	software engineer		
J.Soucek	TDS Lead Co-I	IAP	soucek@ufa.cas.cz
BIAS team			
E.Johansson	BIAS data calibration software engineer	IRF Uppsala	erik.johansson@irfu.se
Y.Khotyaintsev	BIAS CoI / RPW data definition support	IRF Uppsala	yuri@irfu.se
A.Vaivads	BIAS Lead Co-I	IRF Uppsala	andris@irfu.se
SCM team			
J.Y.Brochot	SCM data calibration software engineer	LPC2E	Jean-Yves.Brochot@cnrs-orleans.fr
G.C.Chenaï	SCM data calibration software support engineer	LPC2E	Gamil.Cassam-Chenai@cnrs-orleans.fr
M.Kretzschmar	SCM CoI / SCM data calibration and ground segment manager	LPC2E	matthieu.kretzschmar@cnrs-orleans.fr
CNES AIT/AIV engineer Team			
E.Guilhem	RPW CNES AIT/AIV manager EMC & Performance Support	CNES (ALTRAN Technology)	emmanuel.guilhem@cnes.fr
J.Sanisidro	EMC & Performance Support	CNES	julien.sanisidro@cnes.fr
J.Segur	EMC & Performance Support	CNES (Sogeti)	jerome.segur@sogeti.com
LESIA AIT/AIV engineer Team			
G.Barbary	MEB AIT Manager	LESIA	gaele.barbary@obspm.fr
A.Habet	*MEB AIT engineer*	*LESIA*	*abderrahmane.habet@obspm.fr*
S.This	MEB AIT engineer	LESIA	simone.this@obspm.fr
LESIA Flight software / Command control Team			
L.R. Malac-Allain	Command and Control Architect / Flight Software manager support	LESIA	leeroy.malac-allain@obspm.fr
P.Plasson	Command and Control Architect / Flight Software Manager	LESIA	philippe.plasson@obspm.fr
CNES Command control / ground segment engineering support			
J.M. Travert	Command control / ground segment engineering support	CNES	jean-michel.travert@cnes.fr
CNES RPW User Manual leader team			
E.Guilhem	RPW CNES AIT/AIV manager EMC & Performance Support	CNES (ALTRAN Technology)	emmanuel.guilhem@cnes.fr
J.F Vega	CDR actions, ICDS, User Manual, harness, system budgets	CNES	jean-françois.vega@cnes.fr
System			
S.Chaintreuil	RPW System Manager	LESIA	sylviane.chaintreuil@obspm.fr
E.Guilhem	RPW CNES AIT/AIV manager EMC & Performance Support	CNES (ALTRAN Technology)	emmanuel.guilhem@cnes.fr
Eric Lorfevre	RPW System engineer	CNES	eric.lorfevre@cnes.fr
Bernard Pontet	RPW System engineer	CNES	bernard.pontet@cnes.fr
MEB			

M.Dekkali	MEB/PA Project Manager	LESIA	moustapha.dekkali@obspm.fr
MEB GSE (LESIA)			
L.Gueguen	MEB GSE Software Manager	LESIA	loic.gueguen@obspm.fr
MEB EGSE (LESIA)			
K.Boughedada	RPW E-GSE software support	LESIA	kamal.boughedada@obspm.fr
D.Dias	RPW E-GSE manager	LESIA	daniel.dias@obspm.fr
Project management (CNES)			
E.Bellouard	RPW Project Manager	CNES	elise.bellouard@cnes.fr
I.Fratter	Solar Orbiter Project Manager (French contribution)	CNES	isabelle.fratter@cnes.fr
C.Laffaye	RPW Project Manager	CNES	catherine.laffaye@cnes.fr
M.Rouze	RPW Project exploitation Manager	CNES	michel.rouze@cnes.fr
Ground segment software development support (CNES)			
D.Raulin	RPW and SPICE ground segment development support	CNES	desi.raulin@cnes.fr
FIELDS / Solar Probe Plus (NASA)			
S.Bale	FIELDS PI / RPW Lead Co-I	SSL	bale@ssl.berkeley.edu
K.Goetz	FIELDS system	University of Minnesota	goetz@umn.edu
M.Pulupa	FIELDS ground segment lead	SSL	pulupa@berkeley.edu
STIX team (LESIA)			
N.Vilmer	STIX CoI, STIX-RPW joined science exploitation main interlocutor at LESIA	LESIA	nicole.vilmer@obspm.fr

Table 8. Key personnel involved in the RPW Ground Segment activities.

5 CONFIGURATION, INFORMATION AND DOCUMENTATION MANAGEMENT

5.1 Configuration management plan

5.1.1 Project management files and tools

5.1.1.1 ROC workload management schedule file

The workload management schedule of the ROC shall be written in a dedicated file in the Excel© 2007 format. It shall provide the workload for each ROC agent at LESIA, its:

- Name,
- Agent category (e.g., “engineer”, “scientist”)
- Function (e.g., “developer”, “Project Manager”, etc.)
- Position type (e.g., “permanent position”, “temporary contract”)
- Eventually its arrival/departure dates in the project
- Percentage of workload over the timeline of the project.

The PM shall ensure that this document is always up-to-date.

5.1.1.2 ROC project planning file

The ROC project planning shall be written in a dedicated file in the Microsoft Project© file format. This file shall contain the detailed planning of the project, including the main milestones, the phases of software development, validation campaigns and delivery deadlines. It shall also permit to identify the origin and contribution of the person in charge.

Two separated files can be used to distinguish between the preparation/validation phase (i.e., the phases 1, 2 and 3, including the commissioning in-flight) and the exploitation phase (i.e., the phase 4).

The PM shall ensure that this document is always up-to-date.

5.1.1.3 ROC mailing lists

In addition to the RPW mailing lists, the ROC team shall maintain the following lists:

- **roc.cal** – List of people involved in the instrument calibration activities
- **roc.rcs** – List for the discussions related to the RCS engineering activities (i.e., development, integration, data production, etc.)
- **roc.ops** – List for discussions concerning the RPW operations (only engineering part).
- **roc.sci-ops** – List for discussions concerning the RPW science operations.
- **roc.rpw-um** – List for discussions concerning the RPW User Manual.
- **roc.sgse** – List of people involved in the ROC-SGSE development, interface and data product definition
- **roc.lesia** – Internal list used by the ROC science and engineering teams at LESIA.
- **roc.tech** – Mailing list of the ROC engineering team at LESIA
- **roc.teams** – List of all of the personnel directly concerned by the ROC activities.
- **rpw-roc.recrut** – Internal mailing-list dedicated to the ROC personnel hiring.
- **roc.support** – Mailing list to be used by the ROC data and software users for assistance.

The PM shall be a moderator of these lists.

5.1.1.4 ROC project issue tracker tool

The ATLASSIAN JIRA© software shall be used as the main issue tracker tool by the ROC team. Especially the following JIRA projects shall be implemented:

- **ROC-ADMIN** – administrative management of the ROC project
- **ROC-DATAPROD** – issues about the RPW science data production. Especially, the RCS teams shall use it in order to report issues related to their software and data.
- **ROC-OPERATIONS** – issues relative to the instrument operations
- **ROC-PIPELINE** – ROC pipelines (RODP) issues project
- **ROC-GITLAB** – project used to archive Gitlab issues.
- **ROC-RPWLIB** – issues relative to the instrument packet analysis

- **RPW-TESTS-SOL** – issues relative to the ROC GSE
- **RPW-REVIEWS** – issues relative to the ROC key points and reviews

In addition to JIRA, the ROC developer team at LESIA shall also use the Gitlab tool as an internal issue tracker, in order to monitor the software development, as explained in the SDP.

5.1.1.5 ROC Project Wiki page

The ROC team shall maintain a Wiki page for the project, in order to give a centralized access to the people involved in the project. Especially this Wiki shall permit to:

- Centralize and view the list of action-items and anomalies of the project (including the JIRA issues)
- Archive the meeting notes and associated items (documents or presentations)
- Share information, documentation and resources with people involved in the project.

The ROC Wiki page relies on an ATLASSIAN Confluence© server to work.

5.1.2 Software development specific files and tools

The specific files and tools in support to the software development shall be listed in the SDP.

5.2 Information management plan

5.2.1 Regular meetings involving the ROC

The following table gives the list of regular meetings planned during the project. The latest column on the right gives the approximate cadence of the meetings. This cadence is likely to change depending of the phases of the project.

Meeting name	Purpose	Participants	Approx. Cadence
Science Working Team (SWT) Meeting	Discussions and decision about the scientific objectives to reach during the Solar Orbiter mission	SOC + MOC + IT	Every 6 months
Science Operation Working Group (SOWG) Meeting	Preparation of the mission operations according to the science objectives and operational constraints	SOC + MOC + IT	Every 6 months
Modelling and Data Analysis Working Group (MADAWG) Meeting	Discussion concerning data format, science data analysis tools and models for Solar Orbiter	SOC + MOC + IT	Every 6 months
RPW Consortium Meeting	Discussions inside the RPW consortium about the instrument manufacturing, performance, calibration and	RPW consortium	Every 6 months

	ground segment activities		
ROC project management telecon	Discussions between the ROC and CNES RPW management team in order to take stock of the progress of the ROC project	ROC + CNES RPW management team	Every month
ROC software development telecon	Discussions between the ROC and CNES ground segment development support team in order to take stock of the progress of the ROC software development	ROC + CNES ground segment development support team	Every week (before the launch)
ROC developer "sprint" meeting	Internal meeting of the ROC developer team at LESIA, in order to discuss the development "sprints". See section **Erreur ! Source du renvoi introuvable.**.	ROC developer team	Every 2 weeks (before the launch)
RPW Ground Segment telecon	Discussions about the RPW Ground Segment activities with RPW teams involved	ROC team + RPW analyser/sensor teams	Every month
RPW calibration telecon	Discussions about RPW calibrations	ROC + AIT CNES + RPW consortium	Every month
ROC SGSE telecon	Technical discussions about the ROC SGSE implementation	ROC + RCS teams	Every month (before the launch)
ROC RCS telecon	Technical discussions concerning the RCS development and integration (including data products)	ROC + RCS teams	Every month (before the launch)
RPW operations telecon	Discussion to discuss about the instrument operations between the RPW teams involved.	ROC + RPW PI + RPW sub-system teams	Every 2 weeks (TBC)
RPW SBM telecon	Discussion to decide the SBM event data to downlink	ROC + RPW PI + In-situ instrument PIs + FIELDS/PSP PI (TBC)	Every week
Low latency	Discussion	ROC + SOC + other IT	Every month

working group telecon	concerning the low latency data processing implementation		

Table 9. ROC regular meetings.

5.2.2 RPW Web portal

The ROC team shall maintain up-to-date a Web portal at LESIA to provide public information concerning the RPW instrument and project. In particular, this portal shall provide access to:

- Overview of the instrument description, its objectives, the Solar Orbiter mission and teams involved in the RPW and ROC projects
- Servers, data centre and services, where RPW data can be downloaded as well as the associated documentation
- Information about software and services that allow the science community to retrieve and use the RPW science data.

5.3 Documentation management plan

5.3.1 ROC documentation organization

The following table gives the list of allowed Object (“Objet”) and Type of document for the ROC project, with the corresponding node trees and acronyms.

Rubriques Arbre OT pour le projet ROC					
Objet			Type		
1	GEN	General	1.1	MGT	Management
1	GEN	General	1.2	SYS	System
1	GEN	General	1.3	SCI	Science
1	GEN	General	1.4	QAP	Quality Assurance Produit
1	GEN	General	1.5	DPK	Datapackage
1	GEN	General	1.6	OTH	Other
2	PRO	Processing	2.1	CAL	Calibration
2	PRO	Processing	2.2	DAT	Data all levels
2	PRO	Processing	2.3	SFT	Software all levels
2	PRO	Processing	2.4	PIP	Pipeline
2	PRO	Processing	2.5	OTH	Other
3	OPS	Operations	3.1	SBM	Selected Burst Mode
3	OPS	Operations	3.2	SYS	System
3	OPS	Operations	3.3	ANA	Analysis
3	OPS	Operations	3.4	COM	Commissionning
3	OPS	Operations	3.5	LLD	Low Latency Data
3	OPS	Operations	3.6	OTH	Other
4	TST	Tests	4.1	GSE	Ground Support Equip.
4	TST	Tests	4.2	SBM	Selected Burst Mode
4	TST	Tests	4.3	OTH	Other

Table 10. ROC documentation objects and types.

5.3.2 ROC document file naming convention

The ROC documentation management inherits the RPW project convention in terms of reference and file naming convention.

Each ROC document shall be referenced with a unique ID number. The naming convention shall be as followed:

ROC-*Object*-*Type*-*DocType*-*XXXXX*-*Provider*_Iss*YY*_Rev*ZZ*(*Title_of_the_doc*).*ext*

, where *Object*, *Type* and *DocType* fields are the Object, Type and Type of document (see next section for the list of possible Object and Type). *XXXXX* is the ID number, *YY* and *XX* are respectively the issue and revision numbers. *Title_of_the_doc* corresponds to the title of the document and *ext* is the extension of the file.

5.3.3 ROC project management main documentation tree

Figure 9 shows the current management main documentation tree of the ROC project. It provides the main deliverable documents that shall ensure the project activities are fully covered.

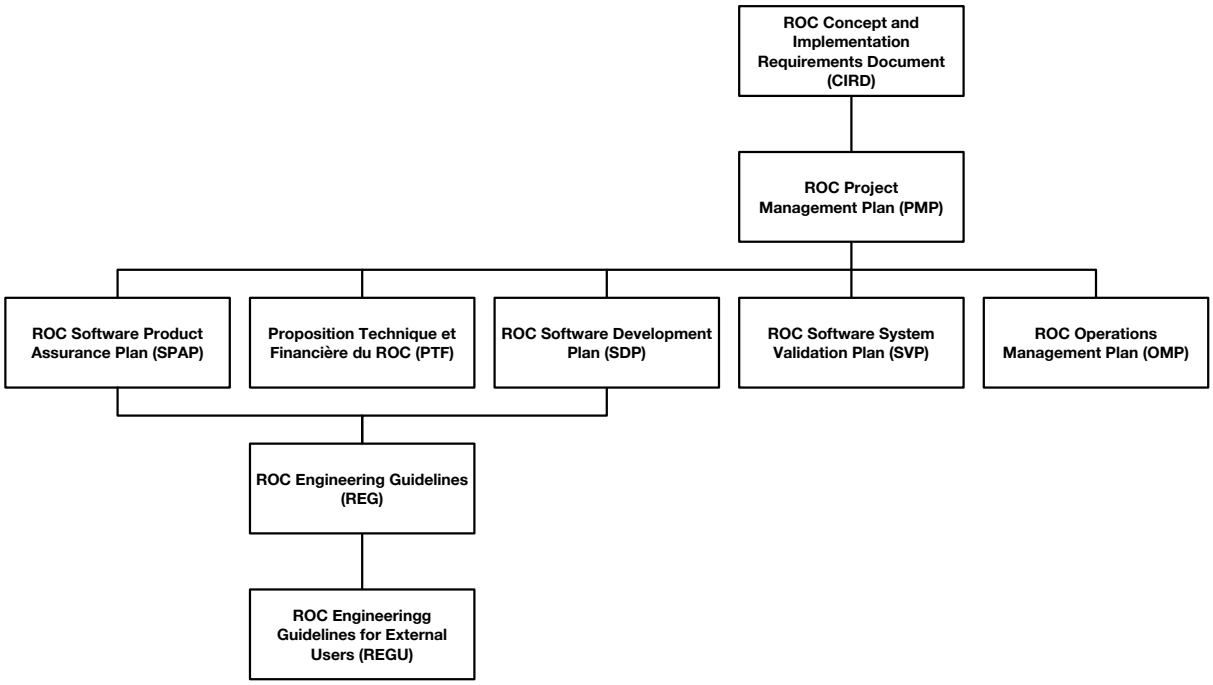

Figure 8. ROC project management main documentation tree.

Table below gives the reference and a short description of the ROC project management documentation.

Document	Reference	Description
ROC Concept and Implementation Requirements Document (CIRD)	ROC-GEN-SYS-PLN-00002-LES	- Presents the concept of the ROC design. - Lists the responsibilities as well as the centre implementation requirements, in agreement with higher-level requirements defined at RPW and Solar Orbiter system levels. - Gives traceability matrix with higher-level requirements (can be delivered in separated file)
ROC Project Management Plan (PMP)	ROC-GEN-MGT-PLN-00013-LES	- Presents the project management plan of the ROC to be followed for implementing, coordinating, and maintaining a full operational centre.
ROC Software Development Plan (SDP)	ROC-GEN-SYS-PLN-00015-LES	- Describes the software development plan of the ROC
ROC Software System Validation Plan (SVP)	ROC-GEN-SYS-PLN-00040-LES	Plan to test and validate the ROC concept and engineering infrastructure. Especially it shall provide the list of tests to be performed, the reason, the procedure and the expected results and the reports to be written.
Proposition Technique et Financière du ROC (PTF) – Phases D et E1	ROC-GEN-OTH-BDG-00010-LES	ROC technical and financial proposal to be addressed to the CNES for the phases D and E1 (in French)
Proposition Technique et Financière du ROC (PTF) – Phase E2	ROC-GEN-OTH-BDG-00048-LES	ROC technical and financial proposal to be addressed to the CNES for the phase E2 (in French)
ROC Software Products	ROC-GEN-QAP-PLN-00033-LES	ROC Quality Assurance / Product

Assurance Plan (SPAP)		Assurance Plan
ROC Operations Management Plan (OMP)	ROC-GEN-MGT-PLN-00041-LES	Lists and details the organization, tools, procedures and responsibilities required to perform the instrument operations during the mission
ROC Engineering Guidelines (REG)	ROC-GEN-SYS-NTT-00008-LES	Lists the guidelines to be applied by the ROC engineering team at LESIA.
ROC Engineering Guidelines for external users (REGU)	ROC-GEN-SYS-NTT-00019-LES	Extension of the REG for the teams external to the LESIA, but involved in the RPW Ground Segment engineering activities

Table 11. ROC project management documentation.

5.3.4 ROC engineering main documentation tree

5.3.4.1 ROADS main documentation tree

Figure 9 shows the current main documentation tree of the ROADS. It provides the main deliverable documents relative to the instrument operations and data processing activities, supported by the ROC during the mission. This set of documents shall ensure that the concept and the technical approaches fully satisfy the functional requirements defined at both RPW and Solar Orbiter levels.

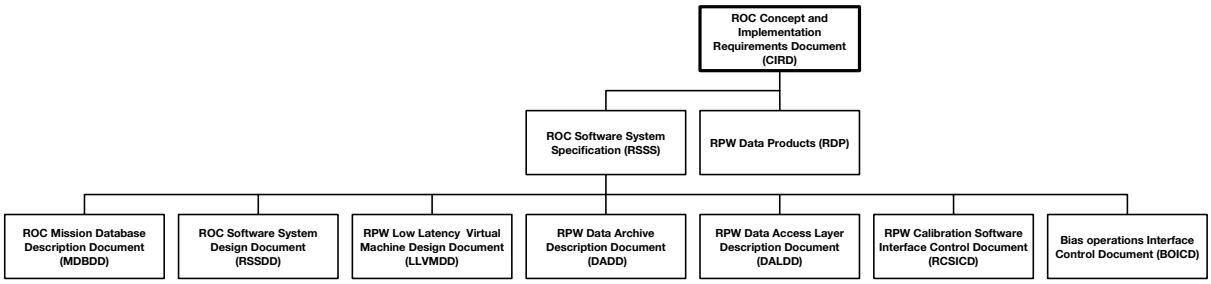

Figure 9. ROC Operations And Data System main documentation tree.

Table below gives the reference and a short description of the ROADS main documentation. The documents in italic are not showed on the figure above. The items in grey has been removed from the project, or the content has been merged into another document.

Document	Reference	Description
ROC Concept and Implementation Requirements Document (CIRD)	ROC-GEN-SYS-PLN-00002-LES	- Presents the concept of the ROC. - Lists the science and operational activities as well as the engineering capabilities implementation requirements, in agreement with requirements defined at RPW and Solar Orbiter system levels. - Lists the responsibilities of the key personnel
RPW Data Products (RDP)	ROC-GEN-DAT-NTT-00006-LES	List and description of all of the RPW data products to be generated by the ROC during the Solar Orbiter mission.
ROC Software System Specification (RSSS)	ROC-GEN-SYS-SPC-00026-LES	It is the Software System Specification (SSS) of the ROC. It covers mainly the specification requirements concerning the ROADS.
ROC Human-Machine Interfaces User Requirements	ROC-OPS-SFT-SWU-00039-LES	The content of this file has been inserted into the RSSS.

ROC Software System Design Document (RSSDD)	ROC-PRO-PIP-SPC-00036-LES	RSSDD gathers the Software Design Documents (SDD) for the RSS
RPW Calibration Software Interface Control Document	ROC-PRO-SFT-ICD-00037-LES	Interface Control Document for the RPW Calibration Software implementation into the RODP.
ROC Software System User Manual (RSSUM)	*ROC-GEN-SYS-SUM-XXXXX-LES*	*Software user manual of the RSS*
ROC Software System Reference Manual (RSSRUM)	*ROC-GEN-SYS-SUM-XXXXX-LES*	*Technical reference manual of the RSS*
RPW Low Latency Virtual Machine Design Document (LLVMDD)	ROC-OPS-LLD-SPC-00018-LES	Software Design Document of the RPW Low Latency Virtual Machine (LLVM)
RPW Low Latency Virtual Machine User Manual (RLLP SUM)	*ROC-OPS-LLD-SUM-00032-LES*	*Software User Manuel of the LLVM*
Dataset Description Document for RPW Low Latency CDF files (DDD RPW LL)	*ROC-OPS-LLD-NTT-00028-LES*	*Description of the RPW Low Latency Dataset to be produced by the RLLP*
ROC Mission Database Description Document (MDBDD)	ROC-OPS-SYS-SPC-00038-LES	Description of the ROC Mission Database (MDB) architecture and content
RPW Data Access Layer Description Document (DALD)	TBD	Description of the ROC DAL facilities concerning RPW data.
RPW Data Archive Description Document (DAD)	TBD	Description of the ROC DArc facilities concerning RPW data.
Bias Operations Interface Control Document	ROC-OPS-OTH-ICD-00022-LES	Description of the interface to be implemented between the Bias and ROC teams in order to perform Bias-related operations.

Table 12. ROC Operations And Data System main documentation tree.

5.3.4.2 ROC GSE main documentation tree

Figure 10 shows the main documentation tree of the ROC GSE.

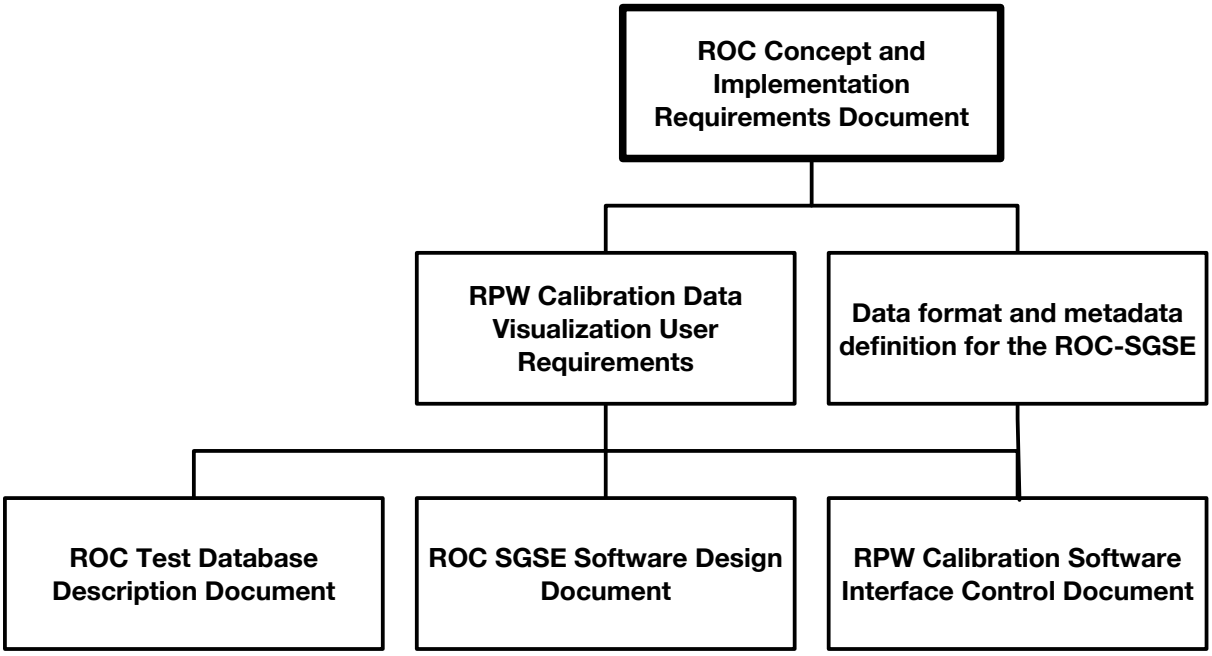

Figure 10. ROC GSE main documentation tree.

Table below gives the reference and a short description of the ROC GSE main documentation. The documents in italic are not showed on the figure above.

Document	Reference	Description
ROC Concept and Implementation Requirements Document (CIRD)	ROC-GEN-SYS-PLN-00002-LES	- Presents the concept of the ROC. - Lists the science and operational activities as well as the engineering capabilities implementation requirements, in agreement with requirements defined at RPW and Solar Orbiter system levels. - Lists the responsibilities of the key personnel
RPW Calibration Data Visualization User Requirements	ROC-TST-GSE-SWU-00003-LES	List the user requirements in terms of RPW ground calibration data visualization functionalities.
Data format and metadata for the ROC-SGSE	ROC-TST-GSE-NTT-00017-LES	Data format and metadata definition for the ROC-SGSE
ROC SGSE Software Design Document (ROC SGSE SDD)	ROC-TST-GSE-SPC-00004-LES	Software Design Document of the ROC-SGSE.
ROC-SGSE Test Database Description	ROC-TST-GSE-NTT-00021-LES	Description of the ROC-SGSE test database
RPW Calibration Software Interface Control Document	ROC-PRO-SFT-ICD-00037-LES	Interface control document (ICD) of the RPW Calibration Software to be implemented into the ROC-SGSE (the ROC-PRO-SFT-ICD-00037-LES document has superseded ROC-TST-GSE-ICD-00023-LES, which has become obsolete.)
SimuSBM1 Software Design Document	*ROC-TST-SBM-NTT-00005-LES*	*Software Design Document of the SimuSBM1 software, dedicated to simulate SBM1 event detections*
SimuSBM2 Software	*ROC-TST-SBM-NTT-00016-LES*	*Software Design Document of the*

Design Document		*SimuSBM2 software, dedicated to simulate SBM2 event detections*
Test Viewer SGSE specification	*ROC-TST-GSE-SPC-00012-LES*	*Technical specification of the Test Viewer (TV)*
Plugin Oriented Pipeline for Python (POPPy) framework User Manual	*ROC-TST-GSE-SUM-00035-LES*	*Software User Manual of the POPPy framework used to design the ROC-SGSE and RODP pipelines.*
ROC-SGSE Calibration Software Validation Tool User Manual	*ROC-TST-SFT-SUM-00027-LES*	*Software User Manual of the ROC-SGSE versus RCS interface validation tool.*

Table 13. ROC GSE main documentations

5.3.5 ROC requirement identification

The ROC requirements shall be clearly identified in the project documentation. The following conventions shall be applied over the entire project documentation.

Except if it is explicitly mentioned, the ROC requirements are valid during the entire life of the project. They can be cited from a document to another using the requirement identifier keyword.

Every requirement definition shall be assigned a unique identifier (ID). This requirement ID shall have the following structure:

REQ-ROC-ZZZ-XXXX

, where "REQ" refers to requirement, "ROC" indicates the name of the project, "ZZZ" is a 3-characters name which permits to identify the origin of the requirement, and "XXXX" is a 4-digits number starting at 0001, and that must be incremented by 1 each time a new requirement is provided for a given requirement origin "ZZZ".

5.3.6 ROC requirement structure

The structure of a requirement is the following:

Requirement ID	*Requirement Title*	Dependencies
Requirement Body		

The dependencies indicate the IDs of the possible upper level requirements. Only the 3-characters name and the 4-digits number separated by the "-" of the IDs can be displayed or the dependencies (e.g., "REG-0001).

5.3.7 ROC documentation management system

The ROC will rely on the COTRANET documentation management system (DMS) of the LESIA, to book reference and archive its documents.

COTRANET will be also used to build and archive the data packages for the ROC reviews and key points.

6 COST AND SCHEDULE MANAGEMENT

6.1 Cost management

The estimation of the cost of the ROC project shall be reported into the "Proposition Technique et Financière" document [RD4]. Two documents, one for the 1-2-3 phases and one

for the 4 phases, can be written. The real cost will be monitored using the "Geslab" application (https://**geslab**.dsi.cnrs.fr) used by the LESIA.

6.2 Schedule management

The schedule is maintained with the ROC project planning file (see section 5.1.1.2).

7 INTEGRATED LOGISTIC SUPPORT

7.1 Hardware and software logistic supports

The Groupe Informatique Générale du LESIA (GIGL), the computer service of the LESIA, will be the main interlocutor concerning both the hardware and software logistic supports.

Especially, the GIGL will:

- Host and keep available the ROC servers, data disks and network interfaces (hereafter called ROC device).
- Ensure that the ROC device is rapidly replaced in case of failure.
- Provide assistance to the ROC team in order to maintain, recover or upgrade software environment installed on the ROC device.
- Ensure that the LESIA collaboration tools, services and software, which are used by the ROC, are always operational.

It must be noticed that in the case of the mailing lists and Gitlab tools, the ROC team shall directly request support from the Direction Informatique de l'Observatoire (DIO), which is in charge of the computer service management at the Paris Observatory level.

7.2 Project logistic supports

In support to its operations activities, the ROC shall have a dedicated operations room at LESIA. Especially, this room will have to supply visioncon system with presentations sharing and to allow ROC team to promptly view via dedicated monitors the latest RPW science and HK data as well as instrument status.

8 RISK MANAGEMENT

8.1 Risk management at the project level

The following table attempts to identify the types of risk that could potentially become points of potential failures for the ROC project activities.

Type of risk	Cause(s)	Consequence(s)	Severity	Occurrence probability	Proposed solution(s)	Solution(s) to mitigate the risk
Personnel reduction in the project	Transfer, voluntary redundancy, contract end,	Under-sized team, loss of expertise, delays in the project,	High	Low	- Partially assign an available resource at LESIA	- Be sure that the LESIA has potentially another

	disease, pregnancy, ...	ground segment human or/and system deficiency			- Prompt hiring of non permanent post	person available - Be sure that funds can be promptly invested for hiring - Sharing information inside the project - Maximizing the redundancy of competences

Table 14. Types of risk at the ROC project level.

8.2 Risk management at the engineering level

The following table attempts to identify the types of risk that could potentially become points of potential failures for the ROC engineering activities.

Type of risk	Cause(s)	Consequence(s)	Severity	Probability	Solution(s) to mitigate the risk
Hardware/Operating System (OS) failure at LESIA	Obsolescence, overvoltage	Loss of instrument operation and monitoring capabilities, science data delivery delay	High	Medium	Plan backup systems to be rapidly deployed. To mitigate the risk at OS level, the ROC uses virtual machines as primary servers for the RSS. (Hardware/OS recovery is the responsibility of the GIGL)
ROC Software System failure at LESIA	Bugs, regression, retro-compatibility not supported	Loss of instrument operation and monitoring capabilities, science data delivery delay	High	TBD	A stable version of the RSS shall be ready to be deployed quickly (use of Git repos + Python installation

					package capabilities)
Hardware/OS/RSS failure at the MOC site during the RPW related NECP operations	See previous risks	NECP operations related to RPW cannot be performed correctly by the ROC team	Critical	TBD	Plan to have two backup software systems ready to be used at the MOC. This solution might impact the hardware/software facilities to be deployed at the MOC site.
Obsolete software/hardware	Software updates are not retro-compatible, unavailable hardware devices	Risk of software facilities failures, loss of ROC facilities	Low	Low	Use as much as possible stable, portable and time-honoured software technology
Unexpected personnel reduction in the developer team	Transfer, voluntary redundancy, contract end, disease, pregnancy, ...	Under-sized team, loss of expertise	High	Low	Prompt Non permanent post hiring or internal replacement by the LESIA
Lack of experience	Developer not familiar with a software technology	Software quality loss, required specification not reached, software delivery delay	Medium	Medium	The ROC shall offer the possibility to its developer team to get professional training.

Table 15. Identified types of risk at the ROC engineering level.

The identification and the management of the risks related to the ROC software system development shall be described in the SDP document.

9 QUALITY/PRODUCT ASSURANCE MANAGEMENT

The ROC project plans to include QA/PA management in order to:

- Assist the ROC team to define the QA/PA requirements.
- Write the ROC QA/PA plan document
- Ensure that the ROC software and interface products to be delivered are compliant with the requirements defined at RPW and Solar Orbiter levels, including RPW calibration software from analyzer/sensor teams.
- Participate to the preparation of the risk management plan of the ROC
- Support ROC team in the preparation of the preliminary design and acceptance reviews

- Support teams involved in the RPW ground segment activities in the delivery of software product for the ROC.

The requirements, tasks and actors concerning the QA/PA are presented in the SPAP [RD8].

10 ENGINEERING MANAGEMENT

The ROC engineering management mainly concerns software system and data of the ROC.

10.1 ROC software development approach

The ROC development approach in terms of software infrastructures, logistics, resources and schedules shall be detailed in the SDP document; however the main concept is given in the next section.

10.1.1 ROC software development Agile Scrum approach

10.1.1.1 Concept

The development, testing and validation of the main RSS units at LESIA, namely: RODP, MUSIC, ROC-SGSE and LLVM shall rely on the Agile Scrum approach. It must be noticed that this scheme is not applied for the development of the RCS, which must be done by the Lead CoI teams in charge (see section 10.1.2 for more details about the development approach for the RCS).

As illustrated on the Figure 11, the development timeline shall be composed of several main RSS releases ("R1" and "R2" for instance on the figure), for which the required functionalities shall be listed (see section 10.1.1.2.4). The releases date and functionalities will have to be driven by the constraints of the project; especially it is expected that releases are done prior to the SOV end-to-end tests, acceptance review and commissioning review.

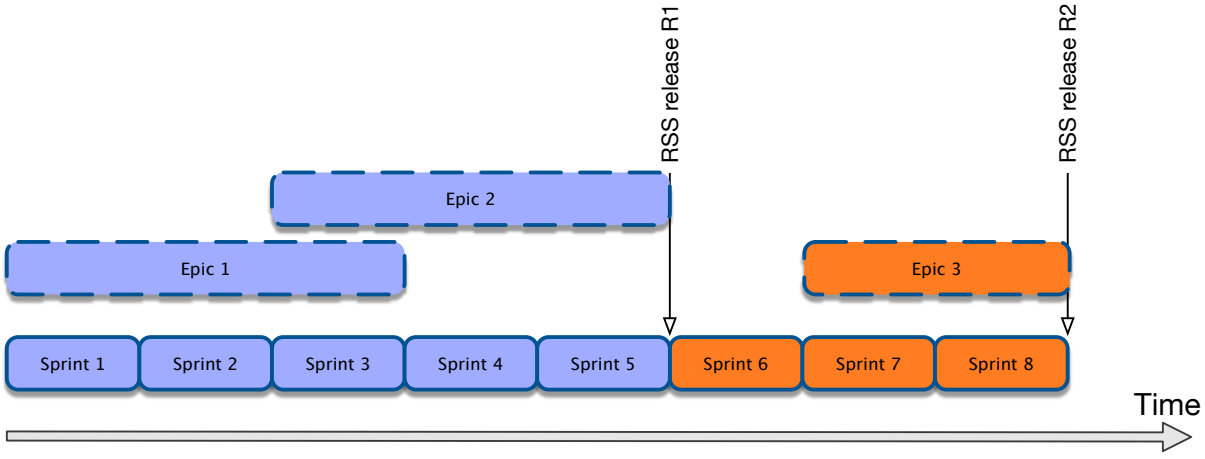

Figure 11. ROC software development sprint concept.

For each release, the software development timeline will have to be split into 2-weeks named "sprints", where the design of the priority functionalities will be developed and/or tested. The priority will have to establish during the sprint kick-off meeting (see next section).

10.1.1.2 ROC sprint implementation

10.1.1.2.1 Sprint planning convention

Here are some general rules concerning the sprint planning:

- A typical sprint duration shall be 15 days (11 working days). This duration can be occasionally changed if required.
- Every sprint shall end/start with a sprint meeting, where progresses are reviewed for the ending sprint in one hand, and the developer team agrees on the tasks to be done and things to improve for the next starting sprint in another hand. Note that depending of the project planning the development priorities can be changed from a sprint to another.
- A sprint meeting takes place on Friday at 10:00. This day can be occasionally changed, if members of the team cannot attend the meeting.

The GM shall ensure that these rules are strictly respected, and the ROC developers are available to attend the sprint meetings.

10.1.1.2.2 Sprint planning dashboard

In addition, the GM shall report the sprint planning for each release as tables in the ROC Wiki. These tables shall have the following columns:

- **Sprint #** - The sequence number of the sprint (must be a integer starting at 0)
- **Sprint name** - Name of the sprint
- **Working days** - Duration of the sprint in working days (i.e., without week-ends and public holidays)
- **Start date** - Date when the sprint starts
- **End date** - Date when the sprint ends
- **Tasks** – List of tasks for the current sprint. In practice, this list will be managed using the Issue tracker of the ROC Gitlab server.
- **Sprint meeting notes** - It should contain meeting notes concerning the current sprint.
- **Comments** - column to report any comment concerning the sprint.

These tables will have to be accessible by the ROC developers at LESIA.

10.1.1.2.3 Sprint tasks management

The sprint tasks will have to be monitored using Gitlab issue mechanism; one issue shall be created for each task. Especially, an issue shall be only closed: (i) in agreements with the PM and other developers during the sprint meetings. (ii) If the corresponding task has been fully tested and validated.

Moreover, the sprint tasks will have to be classified by software (e.g., “RODP” or “MUSIC”) and be labelled according to the priority (e.g., “low”, “normal”, “high” and “critical”), the type of tasks (e.g., “spec”, “feature”, “bug”, “hotfix”) and the status (e.g., “backlog”, “to do”, “in progress”, “testing”, “terminated”).

It shall be possible to create sub-tasks in such a way design-related tasks, i.e., “feature”, can be associated with their corresponding higher level specification-task i.e., “spec”. The “spec” tasks will have to match the specification requirements defined in the ROC SSS document.

10.1.1.2.4 RSS release functionalities management

The expected functionalities for each RSS release will have to be detailed in the SDP.

In addition, the GM shall also report into the ROC Wiki, the list of expected functionalities for each RSS release, w.r.t. to the specification requirements defined in the RSSS.

In practice, it can be done by sorted the specifications between “low”, “medium”, “high” and “critical” for each of the releases.

Besides, all of the RSSS specification requirements will have to be fulfilled in the latest release.

10.1.2 RPW Calibration Software (RCS) development approach

The RCS will have to be delivered to the ROC by the RPW Lead CoI teams in charge. The organization, schedule and expected interfaces and environments are presented in the SDP.

However, the GM will have to ensure the current status of the RCS development and delivery, including the data products definition, is reported into the ROC planning file.

Additionally, the GM shall provide a dedicated dashboard in the ROC Wiki, which allow the RCS teams to have user-friendly interface to follow the RCS development activities.

Especially, the GM will use this dashboard during the dedicated RCS telecons to monitor the status, the actions-items and possible anomalies.

10.2 ROC software validation approach

The ROC validation strategy shall be presented into the "ROC Software System Validation Plan" (SVP) document.

The SVP shall at least provide:

- The list of compatibility, integration and validation tests to be performed to ensure the validation of the ROC software system
- A description of the validation environment and configuration
- For each test, the reason, the procedures, the person in charge, the people involved, and the expected results and reports
- A schedule of the tests during the validation campaign

10.3 ROC engineering conventions and rules

In addition to the ROC SPAP, the engineering conventions concerning the ROC project shall be listed into a dedicated REG [RD5]. The REG shall help the ROC team to ensure the quality and homogeneity of the software development and application, providing standard rules and procedures.

Any additional rules and procedures that could concern external users should be reported into an extra "ROC Engineering Guidelines for External Users" (REGU) document [RD6].

11 LIST OF TBC/TBD/TBWS

TBC/TBD/TBW			
Reference/Page/Location	Description	Type	Status

12 DISTRIBUTION LIST

LISTS See Contents lists in "Baghera Web": Project's informations / Project's actors / RPW_actors.xls and tab with the name of the list or NAMES below		Tech_LESIA
		Tech_MEB
		Tech_RPW
		[Lead-]CoIs
		Science-CoIs

INTERNAL

LESIA CNRS		

LESIA CNRS		

EXTERNAL (To modify if necessary)

CNES		C. FIACHETTI
		C. LAFFAYE
		R.LLORCA-CEJUDO
		E.LOURME
		M-O. MARCHE
		E.GUILHEM
		J.PANH
		B.PONTET
IRFU		L. BYLANDER
		C.CULLY
		A.ERIKSSON
		SE.JANSSON
		A.VAIVADS
LPC2E		P. FERGEAU
		G. JANNET
		T.DUDOK de WIT
		M. KRETZSCHMAR
		V. KRASNOSSELSKIKH
SSL		S.BALE

AsI/CSRC		J.BRINEK
		P.HELLINGER
		D.HERCIK
		P.TRAVNICEK
IAP		J.BASE
		J. CHUM
		I. KOLMASOVA
		O.SANTOLIK
		J. SOUCEK
		L.UHLIR
IWF		G.LAKY
		T.OSWALD
		H. OTTACHER
		H. RUCKER
		M.SAMPL
		M. STELLER
LPP		T.CHUST
		A. JEANDET
		P.LEROY
		M.MORLOT