



esoc

European Space Operations Centre
Robert-Bosch-Strasse 5
D-64293 Darmstadt
Germany
T +49 (0)6151 900
F +49 (0)6151 90495
www.esa.int

Solar Orbiter Mission Operations Report #1

Period [10 February 20 - 23 February 20]

Prepared by	Sylvain Lodirot
Reference	SOL-ESC-RP-10100
Issue/Revision	1.0
Date of Issue	24/02/2020
Status	Issued



APPROVAL

Title Solar Orbiter Mission Operations Report #1	
Issue Number 1	Revision Number 0
Author Sylvain Lodirot	Date 24/02/2020
Approved By	Date of Approval
Sylvain Lodirot, Solo SOM	

CHANGELOG

Reason for change	Issue Nr.	Revision Number	Date
Updated with reporting of new period of time	1	0	24/02/2020

CHANGE RECORD

Issue Number	Revision Number		
Reason for change	Date	Pages	Paragraph(s)
New issue	24/02/2020	All	all

Note: no change record is kept for this document since every new issue corresponds to a new reporting period.



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1 SUMMARY OF ACTIVITIES

The orbit injection of Solar Orbiter by ULA was excellent. No launcher injection correction maneuver was needed. The spacecraft is on its way to Venus with a planned flyby at 2020-361T07:25:29.000Z (ie 26/12/2020!).

LEOP was extended by one day due to issues on day 2 and completed on DoY 044 (13/02/2020). Platform commissioning is complete with some small activities carried over to the next weeks. Payload commissioning is about to start. It will last till mid to end May 2020.

DoY	Date	Activity
41	10/02/2020	Launch and transition to NM
42	11/02/2020	RPW PZ deployment Commanded safe mode (SM) to preserve pin pullers
43	12/02/2020	SM2 SC SM recovery Pin puller removal Bridge back into boom deployment timeline I boom and PY/MY boom deployment
44	13/02/2020	HGA deployment, swap to HGA up and downlink End of LEOP (delayed by one day due to DoY 42 issues)
45	14/02/2020	Test OCM type 1; No LIC needed due to perfect injection
46	15/02/2020	SM3 while trying to regain OMM redundancy
47	16/02/2020	SM3 recovery completion, on time for PF NECP start
48	17/02/2020	MGA deployment Alternative IMU-A config RIU-B ON and OFF IMU B Gyro Bias calibration STR EEPROM dump DOR tones commissioning
49	18/02/2020	MGA up and downlink testing MGA/HGA pattern characterization SSMM SW upload
50	19/02/2020	STR B acquisitions (out of pass) IMU B switch ON

DoY	Date	Activity
		STR B foto dump (out of pass) Transponder delay characterization and redundant DST checkout
51	20/02/2020	de-icing slew (out of pass) SADE-B testing Solar arrays to end stop + characterization
52	21/02/2020	SSMM SW update PHI SW upload
53	22/02/2020	OMM redundancy regaining OMM mirroring restart
54	23/02/2020	PHI SW upload continuation. 6 files missing; this will be completed on DoY 055

At the end of the reporting period (DoY 054, 23/02) Solar Orbiter was at:

- 6.5 million km from the Earth (0.04 AU); the one-way signal travel time was 0 min 21 sec (21 sec).
- 148 million km from the Sun (0.99 AU).



2 SATELLITE STATUS

2.1 Platform

2.1.1 AOCS / propulsion

The AOCS configuration at the end of the reporting period is:

- AOCS in NCM mode
 - with attitude control based on Wheels (all 4 Wheels)
 - using the gyro stellar estimator (GSE) on STEADY gains
 - with inertial reference attitude guidance
- AOCS Sensors
 - IMU A (all 4 Channels) ON and IN-USE
 - IMU B (all 4 Channels) OFF and all 4 Channels PRESELECTED
 - ACC (all 4 Channels) OFF
 - FSS A (XP and ZM) ON and IN-USE, with FSS A XP having SUN Presence
 - FSS B (XP and ZM) OFF
 - STR A ON (NEAT mode) and IN-USE
 - STR B OFF

IMU B and STR B units were switched on for commissioning. Alignment activities are ongoing. Multiple STR reconfigurations were observed during the de-icing slew due to loss of track. AR is TbW. A way forward for next de-icing slews as well as type 1 OCMs needs to be defined/identified.

- AOCS Actuators
 - RW 1-4 ON and IN-USE used for Attitude Control since DoY 042 and LEOP day 1
 - RW Momentum Target Levels @ 18/-18/-18/18 Nms
 - CPS B OFF and PRESELECTED, CPS A OFF
- AOCS Flags
 - Sun Distance set to FAR since launch
 - Flyby set to NO FLYBY since launch
- AOCS HK and TM mode configuration: Default since DoY 052 (21/02/2020)
- Propulsion system
 - Valves in default configuration (all TLVs + LFLV closed, except for LFLV 3+4)

- The propulsion system is configured in regulated mode since launch
- The pressure relief function is activated when needed
- Pressure levels
 - NTO tank pressure @ 16.5 bar
 - MMH tank pressure @ 149.9 bar
 - HE tank pressure @ 16.5 bar

2.1.2 *Mechanisms*

- SADE
 - SADE A ON and IN-USE
 - SADE B OFF

Several ARs related to solar array alignment issues were raised (ARs 15 to 17). A full FDIR revisit is required as the current FDIR settings are considered far too tight at this Sun distance. Also solar array misalignment management needs to be looked into based on inflight experience.

- HGA APME
 - HGA Deployment Status = TRUE
 - HGA selected as PRIME Antenna (PM and SGM RAM)
 - APME A OFF and PRESELECTED
 - APME B OFF
- MGA APME
 - MGA Deployment Status = TRUE
 - MGA will be selected as PRIME Antenna (SGM RAM) on DoY 058
 - APME A OFF and PRESELECTED
 - APME B OFF

2.1.3 *TT&C*

The performance of the subsystem is nominal.

- TRSP-1 X-band up and down via HGA, 4 kbps uplink, downlink bit rate is selected according to the used ground station
- Back-up uplink is configured for X-band reception at 7.8 bps via LGA-2 since DoY 044 13/02/2020.



2.1.4 Thermal

TL 56 (PHI) temperature issues could be due to an undersized heater. TL-56 SMON low limits were changed to avoid FDIR triggering. These new settings need to be incorporated into the new TC init file which is being prepared. TL56 (due to values outside FDIR range) caused PCDU reconfigurations at each of the 3 safe modes. SOL_SC-1 was raised.

TL97 (MAG OBS) was regularly updated and is being fine-tuned. A permanent solution (including management of TL98 (MAG IBS)) will be defined in the coming weeks. SOL_SC-11 was raised.

2.1.5 Power

The subsystem is in its nominal configuration and performing nominally.

- PCDU A OFF
- PCDU B ON and in use

PCDU EEPROM table updates are ongoing. PCDU EEPROM B tables 2-4 were found totally misconfigured. These tables are used at safe mode entry to disconnect all non-essential loads. This explained the unexpected switch off of SSMM memory modules as well as a RIU propulsion board during safe mode 2. For this reason, all RPW PZ science deployment data (from MAG and RPW) was lost.

PCDU B EEPROM tables have now been updated with some minor final update still pending. PCDU A EEPROM tables will require some clean up as well. This is covered by SOL_SC-14.

2.1.6 *Data handling*

The subsystem is in its nominal hardware and software configuration.

The SSMM is ON and fully configured in 3 MM Configuration.

The TC Link Monitor is configured with a time-out of 3 days. Low level thresholds (ex TH1_increase will need to be further fine-tuned as 12h setting is not adequate).

The TM generation mode is configured to NOMINAL.

SSMM ASW 02.07.00 was uploaded on DoY 052 in both ASW images and both supervisors.

A patch to fix the instrument TC counter error management was applied on DoY 052 in PM RAM. This TC error counter was not properly handled. With this patch any missed instrument TC on the space wire link results in that instrument being immediately isolated (expected behaviour). This is SOL_SC-21.

A tentative to regain OMM redundancy following safe mode 2 resulted in safe mode 3 on DoY 046. This is SOL_SC-10.

Redundancy has finally been regained on DoY 053 (once a way forward had been fully defined and tested on the Solo ETB) with full mirroring now complete.

Management of OMM pointers is not working properly and workarounds are being looked into until pointer management is fully and properly fixed and addressed in CSW 3.1. These issues currently complicate dumping data from the OMM. This is reported in SOL_SC-6.

The current DMS configuration is:

Item	A	B
OBC PM	Active	Off
OBC CSW Image Select	0	0
OBC CSW Version	3.0.3p1	3.0.3p1
OBC EEPROM Segs	1 : Code 2 : Data 3-8 : Profiles	1 : Code 2 : Data 3-8 : Profiles
RM PAP Prog. Set	1 (PM-A Nominal)	1 (PM-A Nominal)
RM	Enabled	Enabled
SSMM SV	Active	Off
SSMM ASW Image	1	1
SSMM ASW Version	02.07.00	02.07.00
RIU	Active	Off
OMM	On and in use (slave)	On and in use (Master)



2.2 Instruments

EPD

Nothing to report

EUI

Nothing to report.

MAG

MAG was ON during LEOP for the instrument boom deployments and behaved beautifully.

METIS

Nothing to report.

PHI

Nothing to report.

RPW

RPW was ON during LEOP for the instrument boom deployments. Initial SCM switch ON (before safe mode 1) was thermally NOK and ended up in an autonomous switch off of SCM. SCM thermal issues were handled at the next deployment resuming on LEOP day 3, and SCM then remained on. The issue is further being investigated. See AR SOL_SC-9.

SWA

Nothing to report.

SoloHi

Nothing to report.

SPICE

Nothing to report.

STIX

Nothing to report.



3 GROUND FACILITIES

3.1 Ground Stations

During the reporting period mission operations have been conducted with all ESA stations. PN ranging is being commissioned and should soon replace standard ranging.

3.2 Control Centre

Solo MCS SW version D3.15.9 is used on all operational machines since week 08/2020.

This version uses:

- GFTS SW version 3.1.6
- EDDS SW version 2.3.0
- NIS SW version 5.2.0
- FARC SW version 3.2.1

MCS issues with the uplink of the huge number of commands (34K TCs) for the PHI SW upload are being investigated.

MCS issues related to the OOL management on the off line datastream are being investigated and will need proper fixing.

Gaps in data are regularly seen (ex in webmust) and reported by PIs (missing data in their retrievals). These could be related to EDDS and are being investigated.

4 SPECIAL EVENTS


Solar Orbiter LEOP mission control team (MCT)



5 ANOMALIES

The following Anomaly Reports were raised in the reporting period:

Spacecraft

SOL_SC-xx	TbW	STR loss of track (x4) during de-icing slew
SOL_SC-xx	TbW	Wrong TC rate configured when running Configure COMMs after preselecting DST-B
SOL_SC-22	[NECP]	SSMM - Continuous increase of number of corrected errors 
SOL_SC-21	[LEOP]	CSW Problem with SpW TC Forwarding FDIR
SOL_SC-20	[LEOP]	TC Init file enables TCS SMON 183 (Iboom Hinge)
SOL_SC-19	[NECP]	Truncated idle packets in OMM reads (VC1)
SOL_SC-18	[LEOP]	CPS mZ shear panel temperatures
SOL_SC-17	[LEOP]	Solar Array Steering Function not completed after Steering
SOL_SC-16	[LEOP]	Solar Array Position Deviation missing ADS input
SOL_SC-15	[LEOP]	Solar Array Position Deviation before IBOOM/RPW Dply
SOL_SC-14	[LEOP]	Incorrect entries in PCPU B EEPROM tables 2, 3 and 4
SOL_SC-13	[LEOP]	RPW RSA does not show deployed after PZ deployment
SOL_SC-12	[LEOP]	SADE FMON ID 91 and 92 UNPROTECTED
SOL_SC-11	[NECP]	management of MAG OBS thermal line 97
SOL_SC-10	[NECP]	SAFE MODE #3 : HW/SW ALARM at OMM-A Power Off
SOL_SC-9	[LEOP]	RPW issues (SCM/Voltage/DPUAHB correctable error/S5 events to be...
SOL_SC-8	[LEOP]	DEU switch-over during safe mode recovery
SOL_SC-7	[LEOP]	SAFE MODE#2: FMON_OBC3 triggered while setting packet Store...
SOL_SC-6	[LEOP]	OMM packet stores cannot be dumped
SOL_SC-5	[LEOP]	SAFE MODE #1: Unexpected Pin Pullers temperatures during booms...
SOL_SC-4	[LEOP]	Solar Array misalignment after LEOP AS
SOL_SC-3	[LEOP]	Software error generated when updating Solar Array Profile
SOL_SC-2	[LEOP]	Unexpected temperature reading of iBoom hinge 2
SOL_SC-1	[LEOP]	PHI HE heater saturated

Ground Segment

SOL-347	[NECP]	SM 3 and interaction with ESTRACK
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Non Conformance Reports

None



6 FUTURE MILESTONES

This is the timeline of future milestones:

Milestone	Date	Comment
Start of PL NECP week 1		
	DoY 055, 24/02/20	MAG interactive and non interactive RPW non interactive OOP SPICE interactive and non interactive SPICE CMS interactive
	DoY 056, 25/02/20	EUI interactive and non interactive PHI interactive
	DoY 057, 26/02/20	SPICE interactive SPICE CMS interactive non interactive
	DoY 058, 27/02/20	METIS ineractive
	DoY 059, 28/02/20	EPD interactive and non interactive PHI interactive and non interactive SOLOHI interactive and non interactive