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Solar Orbiter Mission Operations Report #21

Period [03 August 20 - 30 August 20]

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Reference **SOL-ESC-RP-10100**
Issue/Revision **21.0**
Date of Issue **31/08/2020**
Status **Issued**

European Space Agency
Agence spatiale européenne

APPROVAL

Title Solar Orbiter Mission Operations Report #21	
Issue Number 21	**Revision Number** 0
Author Sylvain Lodiot	**Date** 31/08/2020
Approved By	**Date of Approval**
Sylvain Lodiot, SolO SOM	Sylvain Lodiot Digitally signed by Sylvain Lodiot Date: 2020.08.31 15:37:46 +02'00'

CHANGE LOG

Reason for change	Issue Nr.	Revision Number	Date
Updated with reporting for new time period	21	0	**31/08/2020**

CHANGE RECORD

Issue Number 21	**Revision Number 0**		
Reason for change	**Date**	**Pages**	**Paragraph(s)**
New issue	31/08/2020	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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1SUMMARY OF ACTIVITIES

This report covers four weeks of cruise in LTP 2 (STPs 107 to 110).

The main issue during these 4 weeks was the triggering of the SSMM heartbeat monitor on 13/08 leading to all instruments off (with EUI left in safe). All instruments were bridged back in the week of 17/08 except SWA (which suffered two isolations due to SpW link errors on 05/08 and 20/08) and EUI (recovered on 28/08).

The preparation for CSW 3.1.1 upload on the spacecraft is well under way with all images already on board (as delayed TC files). The spacecraft will boot on the new software following the safe mode which will nominally be triggered in the night from 09 to 10 September. All instruments (which are on) will be switched off at the end of the current STP 111 for the full duration of STP 112.

DoY	Date	Activity
216	03/08/2020	***STP 107*** WOL CEB pass
217	04/08/2020	MLG pass
218	05/08/2020	SWA isolation
219	06/08/2020	CEB pass
220	07/08/2020	CEB pass
221	08/08/2020	WOL
222	09/08/2020	
223	10/08/2020	***STP 108*** WOL CEB pass
224	11/08/2020	
225	12/08/2020	CEB pass NNO pass
226	13/08/2020	SSMM HB monitor trigger
227	14/08/2020	

DoY	Date	Activity
228	15/08/2020	WOL
229	16/08/2020	
230	17/08/2020	***STP 109*** WOL NNO pass CEB pass
231	18/08/2020	
232	19/08/2020	CEB pass NNO pass
233	20/08/2020	SWA isolation
234	21/08/2020	CEB pass
235	22/08/2020	WOL
236	23/08/2020	WOL
237	24/08/2020	***STP 110*** NNO pass x2 CEB pass
238	25/08/2020	
239	26/08/2020	
240	27/08/2020	CEB pass
241	28/08/2020	CEB pass
242	29/08/2020	WOL
243	30/08/2020	SA rotation (30 to 0 deg)

At the end of the reporting period (DoY 243, 30/08) Solar Orbiter will be at:

- 260.1 million km from the Earth (1.74 AU); the one-way signal travel time was 14 min 28 sec (868 sec).
- 134.6 million km from the Sun (0.9 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 OFF since 05/06 (DoY 157), health set to 2
  - STR B ON (NEAT mode) and IN-USE since 05/06 (DoY 157), health set to 3

  STR-A EEPROM dump was attempted on 05/06. Only 2 out of 4 memory bank dumps were successful. The other 2 failed. This is further being investigated and may lead to an AR. AR SOL_SC-61 was raised.

  The gyro bias and null space calibration was updated in SGM on DoY 135.

  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

As part of the pointing AR investigations and following ADS request, the wheels have gone through various levels in the STPs 102 to 104. Inverting the wheel speed direction is being looked into and will be commanded in one of the next STPs.

- AOCS Flags
  - Sun Distance set to NEAR since 16/03/2020 (DoY 76)
  - Flyby set to NO FLYBY since launch

- AOCS HK and TM mode configuration: Default since DoY 052 (21/02/2020)

The gyroscopic torque compensation was re-enabled on 29/07.
The ADS investigation is complete and the flag was set back to its default value.

A new TM packet was also defined to gain more visibility. This packet is generated at 8 Hz and will remain enabled for a few more STPs. This new packet makes an increase of 6 kbps. This new packet will be enabled at least till STP 110.

- 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
    - HE tank pressure @ 149.7 bar (PT1)
    - PT2 (between pressure regulator and latch valves 1/2) @ 17.0 bar
    - NTO tank pressure @ 16.4 bar (PT3)
    - MMH tank pressure @ 16.4 bar (PT4)
    - PT5 (before latch valves 3/4 for MON) @ 16.4 bar
    - PT6 (before latch valves 3/4 for MMH) @ 16.4 bar
    - PT7 (between pressure regulator and latch valves 1/2) @ 17.0 bar

  - Pressure relief function period updated to 40 days on 17/04 (DoY 108) in RAM only; duration unchanged and at 8 cycles. SGM RAM values unchanged (18 days/8 cycles). The new RAM period applies following the pressure relief from 27/04.

The type 2 OCM slot on 10/08 was not used. The OCM would have been very small (1 cm/s) and was hence skipped.

2.1.2 *Mechanisms*

- SADE
  - SADE A ON and IN-USE
  - SADE B OFF
  - SA @ 30 degrees since 243.04.19. The next scheduled rotation is on 329.19.25 (24/11) to 30 degrees.

- 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 is selected as PRIME Antenna (SGM RAM) since 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
- TWTA-1 is in use, RF power nominal (from Helix Current telemetry reading)
- TRSP-2 back-up uplink is configured for X-band reception at 7.8 bps via LGA-1 since DoY 178 26/06/2020. LGA-1 is the better antenna till at least end of LTP 3.
- TWTA-2 is OFF and in cold redundancy
- MGA is selected as safe mode antenna since DoY 058.
- PN ranging is fully validated and used by default since DoY 057 (26/02). This allows to currently be on the max TM bit rate.

DST 1 and 2 output power was reduced on 19/06 as the TWTA was in overdrive.

The change was also applied in SGM.

2.1.4 *Thermal*

Thermal configuration is configured for the op range for some instruments (decontamination heaters were not touched).

Significant work has been done on SOL_SC-49 [NECP] Pointing Stability Disturbance.

To address the STIX Aspect System disturbances, the IMU200 set-points (TL 3) were updated to [-8; -7], with an immediate effect on the heater.

Regulation limits for TL#48 (-Y panel zone heater) were changed on 30/06 from [0.5, 1.0] to [-11.5, -11] on ADS request. This activity is part of ongoing investigations for the pointing stability AR. TCL048 set points were then updated to [-15.5,-15] at ADS request on 09/07.

SIS heater line set-points (TL 93) were updated from [-34, -30] to [-24, -20] as per PI request on 22/07. This update was requested to reduce the thermal shock for SIS in cases of prolonged Switch-Off as well as to reduce the time needed for SIS to reach the IRIS motor temperatures after the EPD ICU Switch On.

On 03/08, TL044 (METIS electronics box) and TL045 (PHI electronics box) were updated to:
TL044 (Switch-on = -16.5°C, Switch-off = -16°C)
TL045 (Switch-on = -16.5°C, switch off = -16°C)

It was hoped that by lowering these set-points, the heaters would switch off and temperatures would reach a “stable” temperature before eventually cooling to the point where the heaters will begin switching. This would provide a good indication of the maximum Sun distance where it can ensured that all heaters on the MY panel remain off (in current payload configuration).
This worked (apart from when all instruments were off following the SSMM heartbeat monitor trigger on DoY 226).

2.1.5 *Power*

The subsystem is in its nominal configuration and performing nominally.

- PCDU A OFF
- PCDU B ON and in use

PCDU A and B EEPROM table updates took place in flight on 05/06.

PCDU-B SGM & PM RAM health was set to 3 on 03/07 (to make B the preferred choice and avoid changing the SCV config in SGM EEPROM). After the safe mode post CSW 3.1.1 PCDU B will be in use again.

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.

SSMM ASW 02.07.00 was uploaded on DoY 052 in both ASW images and both supervisors. SSMM issues following the SpW overload are further being investigated.

SSMM rerouting activities took place as follows:
(a) SOC request: all of the EPD "selective" APIDs currently routed to store #7 (namely 844, 860, 908, 1612) re-routed to store #6, EPD bulk science
(b) reroute APID 924 from the EUI SSMM science packet store (PS12) to the low latency packet store (PS5) following EUI request at the end of the NECP

Some SSMM gap recovery for the EMC campaign was performed for stores 5 (LL), 9 (RPW) and 8 (MAG). The MAG retrieval failed due to unsynchronised packets in the packet store retrieval range. There is no workaround to recover that data.

On DoY 226 (13/08) at 23.59.03z the REC_SSMM1 recovery action triggered out of pass on SSMM supervisor-A after an SSMM Heartbeat Monitor trigger.
As a consequence all payload units active at the time (EUI, EPD, MAG, STIX, SWA and RPW) were isolated and switched off (with the known exception of EUI, left in safe) and the SSMM was reconfigured to use SSMM supervisor-B. Telemetry analysis did not reveal any issues with the supervisor status before the triggering. A transient error in the SpW network was initially suspected as the root cause. AR SOL_SC-64 was raised.
The SSMM was recovered on 17/08 (the first pass after the issue).
Instruments were bridged back in on 19/08 and 21/08, except SWA (a further SpW trigger on 20/08 isolated the instrument once more and put in safe) and EUI (performed on 28/08).

The TC Link Monitor is configured back to a time-out of 7 days since 04/06 (DoY 157).
This is the configuration for cruise which is now set as follows (TC link TH1/TC link TH1 increase/TC link TH2):
PM RAM: 7d/24h/7d + 70h
SGM RAM: 7d/12h/7d + 34h

The TM generation mode is configured to NOMINAL.

The ADS patch (3.0.3p5) for SOL_SC-06 ([LEOP] OMM packet stores cannot be dumped) has been applied on board on DoY 098 (07/04).
Patch CSW V3.0.3p6 for the instrument “cascade switch-off effect” was applied on 26/05 .

OBCPs: an issue with timing in the METIS OBCP was identified and is being addressed.

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 CSW RAM version	3.0.3p6	
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)

Preparation for the CSW 3.1.1 installation on board the spacecraft is well under way with all PM and SGM images on the spacecraft already (as delayed TC files).

2.2 Instruments

EPD
Nothing to report.

EUI
EUI internal limits were updated on 06/08 then 12/08 to avoid the excessive generation of event [EUI_Ev_M_087_LIMIT].

MAG
Nothing to report.

METIS
Nothing to report.

PHI
Nothing to report.

RPW
Nothing to report.

SWA
Space wire link errors led to SWA isolation on 05/08 and 20/08 and power down of HIS on 05/08.
On 13/08, the SSMM heartbeat triggering led to SWA OFF (as well as all other instruments OFF, except EUI in safe).
ARs SOL_SC-64 and 65 were raised. The role (if any) of the SWA TC to dump the DPU error log is being further investigated with the SWA team. The TC is no longer allowed in flight for the time being.
SWA was recovered on 27/08. That recovery took longer than planned. Due to wrong initial inputs from the SWA team, a power cycle of the DPU was required.

SoloHi
Nothing to report.

SPICE
Switch on of the SPICE decontamination heaters took place on 07/08 (they were switched OFF by SWA-HIS autonomous switch OFF on 05/08) then on 17/08 following the SSMM HB trigger on 13/08.

STIX
Nothing to report.

Decontamination heater status

Current status:

- SPICE OU = ON
- SPICE CE = ON since DoY 155 (06/06)
- METIS = OFF since DoY 113 (22/04)
- EUI OU = OFF since DoY 106 (15/04)

3 GROUND FACILITIES

3.1 Ground Stations

During the reporting period mission operations have been conducted with the three ESA stations.

3.2 Control Centre

SolO MCS SW version D3.15.17 is used on all operational machines since 20/08/2020.
This version uses:

- GFTS SW version 3.1.6
- EDDS SW version 2.4.0 on 07/07 (with latest stream client now available)
- NIS SW version 5.2.0
- FARC SW version 3.2.1

Version 3.18 is installed on most devlan servers and clients for testing since 23/07.

MATIS should take over full start of pass commanding activities in the coming weeks. This needs MCS version 3.18 to address all open MATIS issues.

4 SPECIAL EVENTS

None

5 ANOMALIES

The following Anomaly Reports were raised in the reporting period:

Spacecraft

SOL_SC-64	[SSMM] REC_SSMM1 on SV-A
SOL_SC-65	SWA SpW failures following ZIA58705

Ground Segment

None

Non Conformance Reports

None

6 FUTURE MILESTONES

This is the timeline of future milestones:

Milestone	Date	Comment
LTP2	DoY 181, 29/06/20	LTP 2 runs till 28/12/2020 00:00
	week 37 07/09 to 11/09	CSW upload on the SC This implies a SC safe mode hence all instruments off that week
	27/12/2020	VGAM