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Solar Orbiter Mission Operations Report #16

Period [08 June 20 - 14 June 20]

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Table of contents

1	SUMMARY OF ACTIVITIES	5
2	SATELLITE STATUS	6
2.1	Platform	6
2.1.1	AOCS / propulsion	6
2.1.2	Mechanisms	7
2.1.3	TT&C	8
2.1.4	Thermal	8
2.1.5	Power	9
2.1.6	Data handling	10
2.2	Instruments	11
3.1	Ground Stations	13
3.2	Control Centre	13
4	SPECIAL EVENTS	14
5	ANOMALIES	15
6	FUTURE MILESTONES	16



1 SUMMARY OF ACTIVITIES

NECP is complete!

Please read the “special events” section for further clarifications on the SpW overload and the “cascade patch”. These are not directly related, and some instrument teams seem to be confused.

DoY	Date	Activity
160	08/06/2020	STP 16 (PL NECP week 15) METIS IT-7, SOL-SGS-TN-0036 0.3+Rolls WOL
161	09/06/2020	
162	10/06/2020	MAG successful power cycle RPW 1000s of compression error events disabling SSMM rerouting activities WOL
163	11/06/2020	SWA-HIS table update ESOC public holiday
164	12/06/2020	Time correlation test WOL ESOC public holiday
165	13/06/2020	
166	14/06/2020	LTP 1 start STP 100 and cruise start @ 17:55 1Hz-TM for MAG end (to be done on 15/06) SA relubrication OCM out of pass at start of STP 100

The table above only reports interactive activities. Many non-interactive activities run throughout the week for multiple instruments.

At the end of the reporting period (DoY 153, 01/06) Solar Orbiter was at:

- 131.1 million km from the Earth (0.87 AU); the one-way signal travel time was 7 min 17 sec (437 sec).
- 77.2 million km from the Sun (0.51 AU). With first perihelion on 15/06.

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.

[STR A FOTO dump took place on DoY 160 to complete the STR defective pixel activities.](#)

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
- 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)



Following urgent request from ADS to avoid the serious risk of triggering a safe mode due to a false alarm of the IMU FDIR (IMU consistency check) during the OCM on Sunday OBDB updates were performed.

AOCS has been seen reaching values higher than expected during OCM (maybe linked to THR 9). This has been documented in the Commissioning report and is under investigation.

The changes make SOLO robust to a safe mode by increasing the threshold of the IMU consistency check to the same level as SASM Deployed ($13.515 \text{ deg/h} = 6.55\text{e-}5 \text{ rad/s}$), instead of 3.697 deg/h or $1.79\text{e-}5 \text{ rad/s}$.

To improve visibility around the OCM on 15/06, AOCS SID 10 has been increased to 8 Hz.

AR SOL_SC-55 raised.

- 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 @ 16.4 bar
 - HE tank pressure @ 149.3 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.

2.1.2 Mechanisms

- SADE
 - SADE A ON and IN-USE
 - SADE B OFF
 - SA @ 70 degrees since 152.20.30. The next scheduled rotation is on 181.18.55 (29/06) to 60 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



The Fdyn attitude colleagues calibrated the MGA and the HGA. The MGA is fine, but for the HGA a 3dB half cone angle of 0.64 deg was estimated. The HGA pattern calibration was repeated on 01/06. Data is being analysed. ADS reports a slight bias of 0.1 to 0.2 degrees. Fdyn analysis is on-going.

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-2 since DoY 044 13/02/2020
- 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.

2.1.4 Thermal

TL97 (MAG OBS) latest setting is a regulation (in RAM only) of -90 to -88 degC.

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

In orbit thermal characterisation data acquired on 15/03 is being analysed offline.

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. This should solve the STIX issue. The set points may need further tuning (including FDIR update in the future), as a final solution.



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.

The batteries were shortly discharged during the SA relubrication on 14/06. This is expected.

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

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)



2.2 Instruments

EPD

Nothing to report.

EUI

The EUI team discovered that the science tables which were uploaded during IU-12 (2020-05-29), were overwritten by the custom science tables used for the EMC campaign (2020-06-02). The commands for STP-100 are based on the IU-12 tables, and executing those commands but with the wrong tables will not yield useful results (if any).

The issue will therefore be fixed via PDOR on 15/06/2020.

During the NECP IW6 campaign EUI was commanded to safe which triggers the REC_EUI2 and REC_EUI3 which closes the EUI HS Doors and disallows further movement.

Door movement was re-allowed on 10/06. A way forward to avoid this in cruise and beyond is being discussed with the EUI team and SOC.

MAG

MAG was successfully power cycled on 10/06 ending after the first attempt in its “normal power” state. Commands to configure MAG for STP 100 were uplinked to the SC.

METIS

METIS IT7 activities were uplinked on DoY 160 for out of pass execution.

PHI

PHI clean-up activities took place on DoY 160/161 before STP 100, with PHI OFF at the end.

RPW

RPW was requested to urgently disable the generation of the 1000s of compression error events to remove the risk of a second SpW overload.

SWA

Many events and failed TCs occurred during the last NECP campaign (06-07/06).

Very likely due to PAS and FDIR not managed properly (PAS MTL activities had not been fully disabled).

SoloHi

Nothing to report.

SPICE

Nothing to report.



STIX

STIX detected a flare and performed a data request to downlink the bulk science to ground.

Decontamination heater status

Current status:

- SPICE OU = ON
- SPICE CE = ON since DoY 155 (06/03)
- 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 CEB ESA station.

3.2 Control Centre

Solo MCS SW version [3.15.14](#) is used on all operational machines since [08/06/2020](#).

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

Version [3.15.15](#) was installed on [opslan](#) on [16/06](#).

Version 3.18 is under preparation.

MATIS (our automation tool) is used since 14/02 (DoY 045) to manage all links to the ground stations. Since 20/04 (DoY 111) MATIS is also used for some start of pass commanding. 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

Instruments teams are reminded to follow and respect the constraints defined in the “Special Events” section of MOR 13.

Else this could lead to another SpW overload with all instruments off.

The cascade patch which was applied on board (see MOR 13 too) now ensures that an issue affecting one instrument with consequences on SpW leads to the isolation of that instrument only (and not another 2 as was observed with METIS and SoloHI) hence the reference to a “cascade”. This is not directly related to a SpW overload.

The testing of that patch will happen naturally; it is just a matter of time that one of the 10 instruments provokes it again. It is therefore not recommended to try and provoke it as a test.



5 ANOMALIES

The following Anomaly Reports were raised in the reporting period:

Spacecraft

SOL_SC-54	[SSMM] EOFT reports incorrect number of FDUs in truncated LLFT
SOL_SC-55	OBDB update and increase of the IMU consistency check threshold for
OCM	

Ground Segment

None

Non Conformance Reports

None



6 FUTURE MILESTONES

This is the timeline of future milestones:

Milestone	Date	Comment
LTP1 start	DoY 166, 14/06/20	STP 100 started on 14/06
		PL checkout between 17 and 21/06
LTP2 start	DoY 181, 29/06/20	
	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