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Solar Orbiter Mission Operations Report #19

Period [29 June 20 - 26 July 20]

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APPROVAL

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CHANGE LOG

Reason for change	Issue Nr.	Revision Number	Date
Updated with reporting for new time period	19	0	**27/07/2020**

CHANGE RECORD

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

Distribution list

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- SolO MOR
- SolO MOR cc

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1SUMMARY OF ACTIVITIES

This report covers the first 4 weeks of LTP 2 (cruise).

On the platform side, the main activity remains the investigations related to the pointing AR.

On the payload side, and as reported in MOR 16, “the testing of that (cascade SpW) patch will happen naturally; it is just a matter of time that one of the 10 instruments provokes it again”. This did not take very long, as SWA and EUI provoked it and it is now flight proven that the patch works.
The four weeks were not as quiet as hoped on the payload front, with significant work induced by EUI and SWA.
STIX was switched back on in safe (now the default STIX cruise mode) to allow to acquire useful STIX aspect data.

On the ground side, preparation for CSW 3.1.1. upload continued nominally and on track for the September upload.
CEB and MLG over performance has now been taken into account and improved TM bit rates (and hence data volume) should be visible to SOC and PIs shortly.

The S13 downlink file MCS ingestion issues have been investigated. It turns out that most instruments do not follow a GDIR (general design and interface requirements document) requirement imposing even 16-bit words for SpW packets. Although of no help for SolO, it is believed that understanding how this requirement was not properly flown down is important for future missions. This is therefore being looked into.
Ways forward are being discussed with each instrument team to hopefully find a solution as well as fix and properly address the SolO case and finally enable S13 downlink.

DoY	Date	Activity
181	29/06/2020	***STP 102*** WOL SA rotation (70 to 60 deg) ZFZT OCM performed on 179.23.30.00z (STP 101) CEB pass (TTCP 1 issues)
182	30/06/2020	TL 48 (-Y panel) regulation limit update CEB pass
183	01/07/2020	CEB pass

DoY	Date	Activity
184	02/07/2020	CEB pass
185	03/07/2020	PCDU-B SGM & PM RAM health was set to 3 CEB pass (TTCP 1 issues)
186	04/07/2020	WOL CEB pass
187	05/07/2020	
188	06/07/2020	***STP 103*** EUI SpW trigger WOL CEB pass
189	07/07/2020	MLG pass (bad weather, data lost)
190	08/07/2020	NNO pass
191	09/07/2020	TL 48 (-Y panel) regulation limit update SWA SpW trigger
192	10/07/2020	CEB pass
193	11/07/2020	WOL SA relubrication
194	12/07/2020	
195	13/07/2020	***STP 104*** WOL STIX switch on in safe CEB pass
196	14/07/2020	CEB pass
197	15/07/2020	CEB pass
198	16/07/2020	CEB pass
199	17/07/2020	
200	18/07/2020	WOL
201	19/07/2020	WOLx2 Calibration rolls MAG

DoY	Date	Activity
202	20/07/2020	***STP 105*** WOL CEB pass
203	21/07/2020	
204	22/07/2020	TL 93 (EPD SIS) regulation limit update CEB pass
205	23/07/2020	WOL CEB pass
206	24/07/2020	SA rotation (60 to 56 deeg)
207	25/07/2020	WOL CEB pass
208	26/07/2020	

At the end of the reporting period (DoY 208, 26/07) Solar Orbiter was at:

- 225.6 million km from the Earth (1.5 AU); the one-way signal travel time was 12 min 33 sec (753 sec).
- 106.1 million km from the Sun (0.71 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 as follows.

STP	Time	During activity	Central levels
102			
	181T00:05:00.000	WOL	9.6 Nms
	186T12:05:00.000	WOL	12.8 Nms
103			
	188T00:05:00.000	WOL	16.0 Nms
	193T12:05:00.000	WOL	19.2 Nms
104			
	195T00:05:00.000	WOL	23.2 Nms
	195T08:57:03.000	MAINT/ANY Slot	(1) 5.6 Nms for 5 hours (2) 29.6 Nms for 5 hours (3) 18.0 Nms in order to have the full range available for the upcoming OCM
	200T12:05:00.001	WOL	26.4 Nms
	201T00:00:00.000	WOL	18.0 Nms in order to be able to perform the CALIB_ROLL_MAG that follows just after.
	201T16:16:40.000	WOL	26.4 Nms

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)

As part of the AR SOL_SC-49 investigations (pointing), the gyroscopic torque compensation was disabled on 15/06.
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 @ 149.8 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.

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

o 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
- 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.

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

S13 downlink usage was attempted on 13/07. The configuration on MOC end had to be updated to complete the 2 file transfers on PS4 (HK) and 5 (low latency).
The MCS could then not inject the data (AR SOL_SC-62). After further investigation it turns out that most instruments do not follow GDIR requirement 1440 imposing even 16-bit words for SpW packets.

The SSMM relies on the requirement that all packets have an overall even length (GDI-1440 specifies "..even number of 16-bit words..") and odd ones can cause misalignments in the FDU building process.

This is no issue with S15. The main difference is that S15 reads the packets as they are stored in memory and the HW guarantees that they don't overlap. In S13 they are first transferred from memory to the Supervisor then packed by ASW into the FDUs.
ASW reads the packet length in the process, but uses 32-bit data variables and counts accordingly, misalignments are inevitable.

The issue is being further iterated with all instrument teams to see if this can be changed with new instrument SW for the instruments not following the requirement.

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
SIS heater line set-points (TL 93) were updated from [-34, -30] to [-24, -20] as per PI request. 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.

EUI
On 29/06, commands to diagnose the uncorrectable memory errors reported by the EUI scrubber were sent. The generation of uncorrectable memory errors was then stopped on 30/06.

YIU51809 [data read error] triggered a SPW link error on 06/07, with the subsequent commanding to safe of EUI. Some recovery actions were undertaken to recover EUI, but further FDIR triggered, leaving the instrument isolated. It was agreed with PI to postpone further recovery attempts to the following day.

EUI was recovered on 13/07 as follows:
1) Perform a reboot of EUI from Basic to Safe
2) Command EUI to Configuration mode and submode wicom in order to initialise the memories
3) Command EUI again to Safe.
4) Clean up : allow door movement, disable HKTM in VC0, enable MTL

On 22/07 further commanding was needed to reapply necessary changes for the reliable operation of the filter wheels. The changes had been over-written by the last EUI reboot.

AR SOL_SC-59 (EUI: Data read error provoked EUI FDIR triggering) was raised.

MAG
Nothing to report.

METIS
Nothing to report.

PHI
PHI was briefly switch on on 20/07 for a flush of data.

RPW
Nothing to report.

SWA
30/06, SWA PAS. A patch test took place.

30/06, SWA HIS. S/C FDIR FMON_SWA4 triggered, which switched off SWA HIS.
Commands had to be inserted into the MTL to disable SSID 109 around call to sequence AIAF017A (SWA HIS switch on).
SWA HIS remains off, pending the investigation for the FDIR triggering on DoY 182.

06/07, SWA PAS. SWA PAS FDIR triggered at switch-on.

09/07, SpW trigger. SWA SpW Failure events lead to SWA being isolated.

SWA was switched back on 15/07.
16/07, SWA HIS HV Ramp up & down, part of investigation for [SOL_SC-56] took place.

22/07 SWA-EAS; the configuration from the missed TC on DOY 202 was performed. The sensor was not in any danger, but the sensor was not putting any science data in the science packets.

The following ARs were raised.
SOL_SC-58 [SWA] SpW Error on 2020.191; PL isolated - DPU Reboot
SOL_SC-57 [SWA] PAS FDIR trigger on 2020.188
SOL_SC-56 [SWA] HIS unexpected switch off 2020.182

SoloHi
AR SOL_SC-60 ([SOLOHI] Corrupt packet forwarded to OBC & SSMM) was raised.

SPICE
Re-asserting on the SPICE OU decontamination heaters after the SWA HIS FDIR triggering was required on 30/06.

STIX
STIX was commanded from OFF to SAFE on 13/07. SAFE is from now onwards the default mode for the instrument throughout Cruise. STIX is able to produce aspect data in this mode (part of HK even in SAFE mode), which has been pretty useful for the mission so far.

On 22/07, the following activities were performed:
- Copy ASW v179 from flash location B1 to A1 and A2
- Check the correctness of the image in the new locations
- Configure STIX aspect system in CONFIGURATION mode

STIX aspect system signals are at a very low level after the last boot and the STIX team found that configuration parameters in a safe mode need to be updated.

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 3 ESA stations.

(1) CEB TTCP1 gave an error during the Ranging calibration activities before the pass on 29/06. The SPACON was instructed to connect the TM/TC links to TTCP2.

(2) TTCP1 was partly unavailable on 03/07 over CEB with TTCP2 made prime. The links to the TTCP.
This is a known issue, although rare. The issue is fixed in the next SPU software release (already operational in MLG). In the meantime, TTCP1 needed to be rebooted in order to recover. The software upgrade at CEB is not scheduled yet.
That means TTCP2 could be Prime for some other passes in the future (this has not happened since the above incident). Moving to TTCP2 will always be coordinated between NOC and the SPACON.

As a precaution the next CEB passes were taken manually (MATIS Link handling PAUSED for CEB, for remainder of STP-102 and -103.

(3) Due to bad weather at the MLG station on 07/07 there are many data gaps beginning around 14:10 on all VCs. OMM Dumps completed for PS_EVENT, PS_ACK but PS_HK is affected. Dumps (OMM & SSMM) were stopped.

VC0 sporadically recovered but all pass activities were abandoned at 15:50.

3.2 Control Centre

SolO MCS SW version D3.15.16 is used on all operational machines since 20/07/2020.
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-62	[SSMM] Corrupted S13 downlink
SOL_SC-61	[STR] Failed STR-A EEPROM dump on DOY 157

Ground Segment

SOL_SC-60	[SOLOHI] Corrupt packet forwarded to OBC & SSMM
SOL_SC-59	EUI: Data read error provoked EUI FDIR triggering
SOL_SC-58	[SWA] SpW Error on 2020.191; PL isolated - DPU Reboot
SOL_SC-57	[SWA] PAS FDIR trigger on 2020.188
SOL_SC-56	[SWA] HIS unexpected switch off 2020.182

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