

Integral Users Group - MOC

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Flight Control Team



- Richard Southworth (Ops Manager, System, also 50% CHEOPS)
- Jutta Huebner (Ops Engineer, P/L, maternity leave until June 2019)
- Bruno Gandolfo (Ops Analyst, planning + Ops DB)
- Dave Salt (Ops Engineer, AOCS, also 50% XMM)
- Liviu Toma (Ops Engineer, AOCS, also 50% XMM)
- Stefano De Padova (Ops Engineer, MCS + OBDH)
- Timothy Finn (Ops Engineer, P/L, also 50% XMM)
- Norbert Pfeil (Ops Engineer, EPS + TCS + MCS, also 50% XMM)
- Thomas Godard (Ops Engineer, P/L + automation, also 50% XMM)

Temporary support:

- Jim Martin (my B/U during CHEOPS activities @ 20% in 2019)
- Frederic Schmidt (B/U for Jutta @ 30% until end 2019)
- Arnfried Magunia (B/U for Jutta @20% in 2019)



- No major activities currently
- Simulator ported to LINUX (old HW was bought in 1998!)
- Negotiating use of VIL2 (INTA) again, hopefully better performance than WHM
- KIR availability, reliability and coverage are very good

SPACON Merger with Gaia



- Since 11/4/2018
- No significant issues for Integral
- Mission performance unaffected
 - Highly automated and Robust operational concept before the merger
 - Realistic planning at MOC and SOC
- All Software tools in place
 - Deconflicting Tool prevents planning of simultaneous events for all 3 missions
 - System Monitoring Tool detects critical problems when SPACON is busy elsewhere



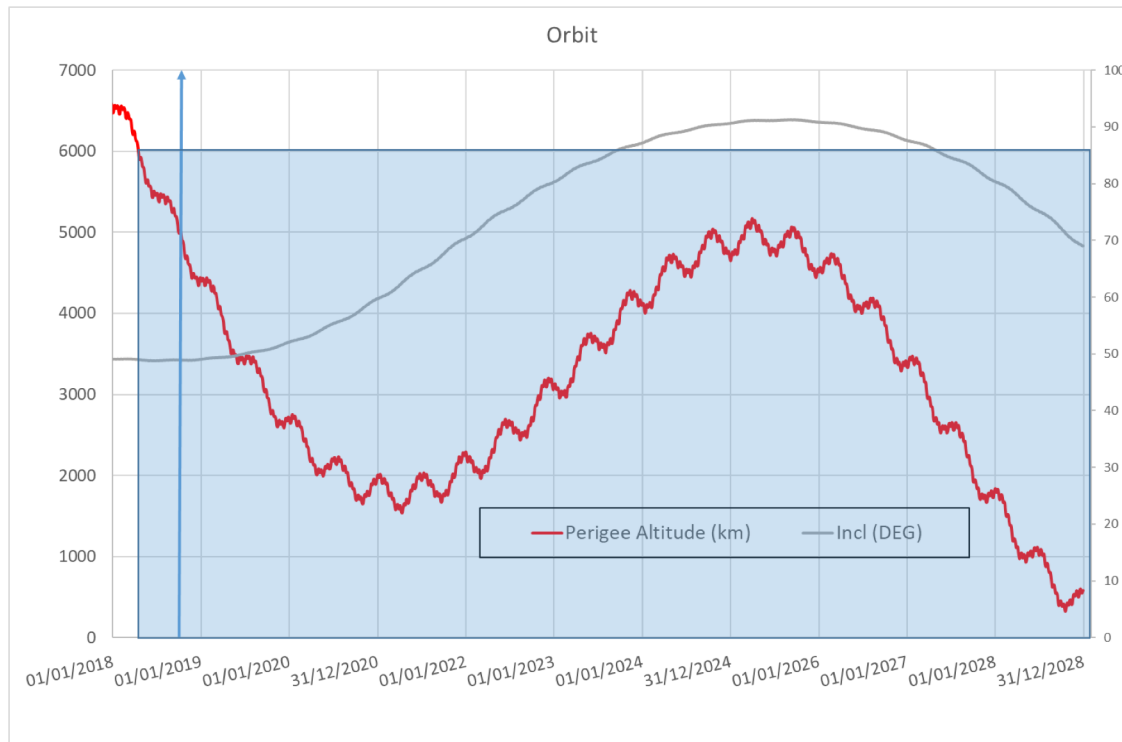
Orbital Evolution

Perigee below 6000km until end of mission

- Faster rate of SA degradation
- Other consequences for components?

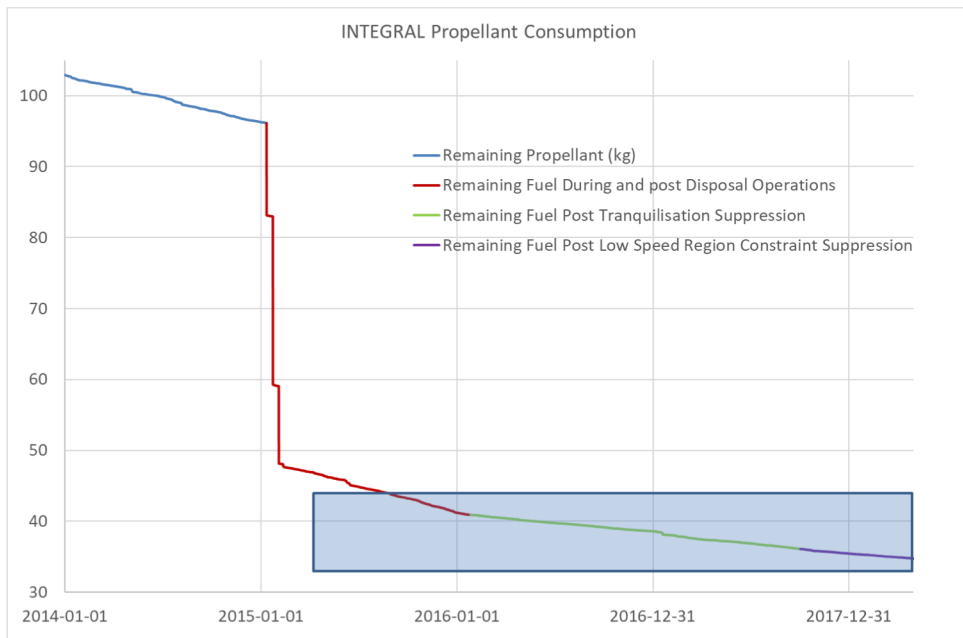
Increasing inclination **good for station visibility**

Re-entry in early 2029



Propellant Usage

Disposal manoeuvres in 2015 used half remaining propellant



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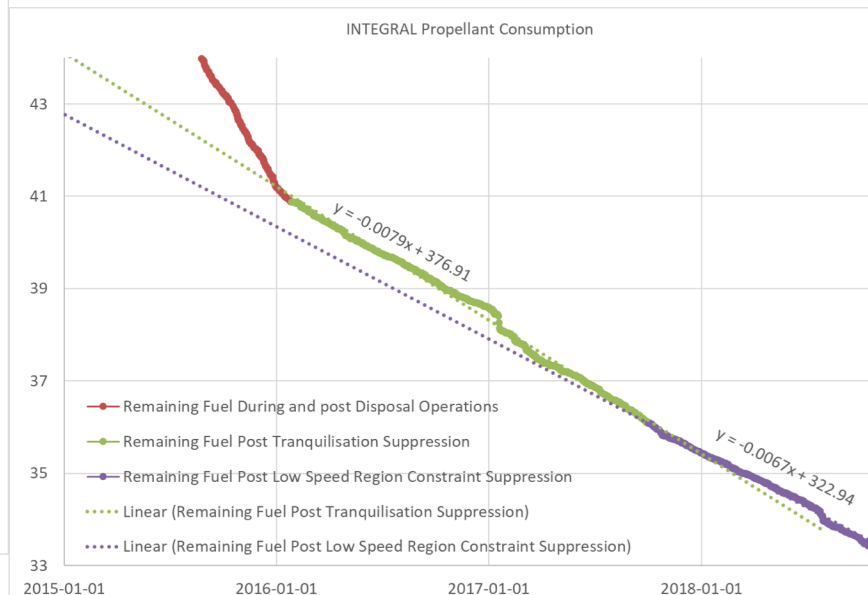
Consumption reduced by:

Stopping thruster tranquillisation post wheel bias:

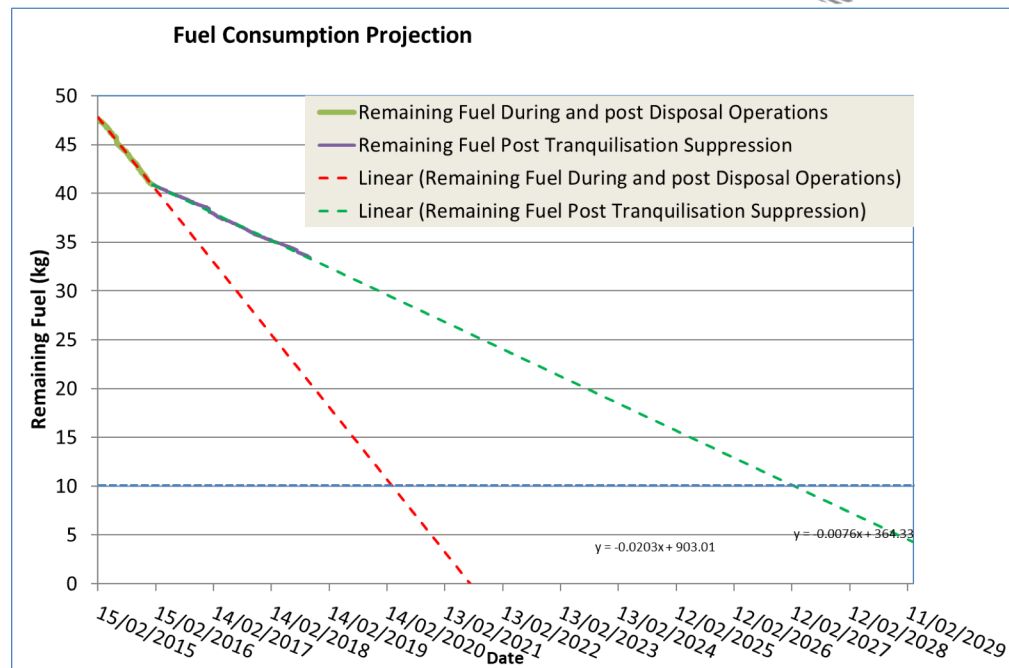
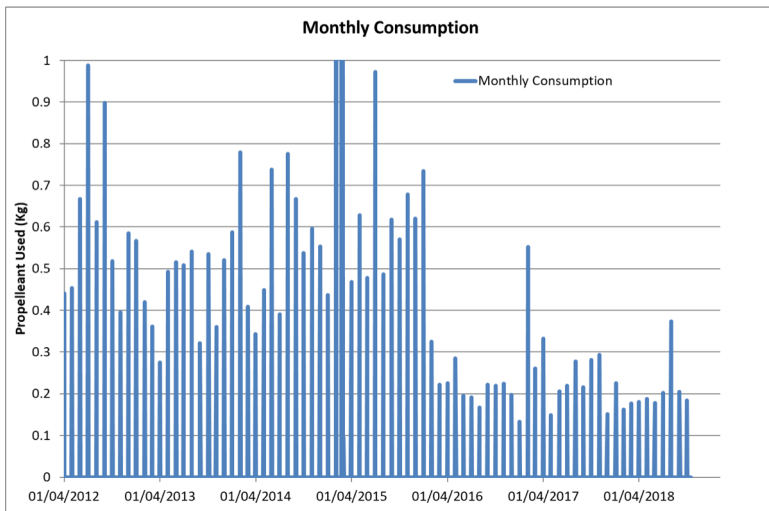
- 20 to ~9g/day (attitude stability OK)

Removal of Reaction Wheels low speed constraint:

- 9g to ~6g/day (attitude stability + wheel health OK)
- Chance of safe mode entry reduced by ~50%!!



Propellant Usage and Predictions



Remaining 17/10/2018: 33.4kg

- Usage 2014: 6.7kg!!
- Usage 2017: 3.2kg
- Usage over last year 2.53kg
- Expected 2019 onwards: ~2.2kg
- Effects of disposal manoeuvres fully compensated
- => Propellant will probably not be exhausted before re-entry

Array Degradation



From IUG 19

Action 19–3 on RS Due: end 2017

Prepare Technical Note on options for Eclipse Entry handling when array currents approach critical threshold.

2 issues:

- Power Budget evolution
- Autonomous reconfiguration ECL(s/e) at eclipse entry may occur in sunlight at high pitch angles => unplanned instrument switch-off

TN not yet updated but clear strategy proposal for both issues

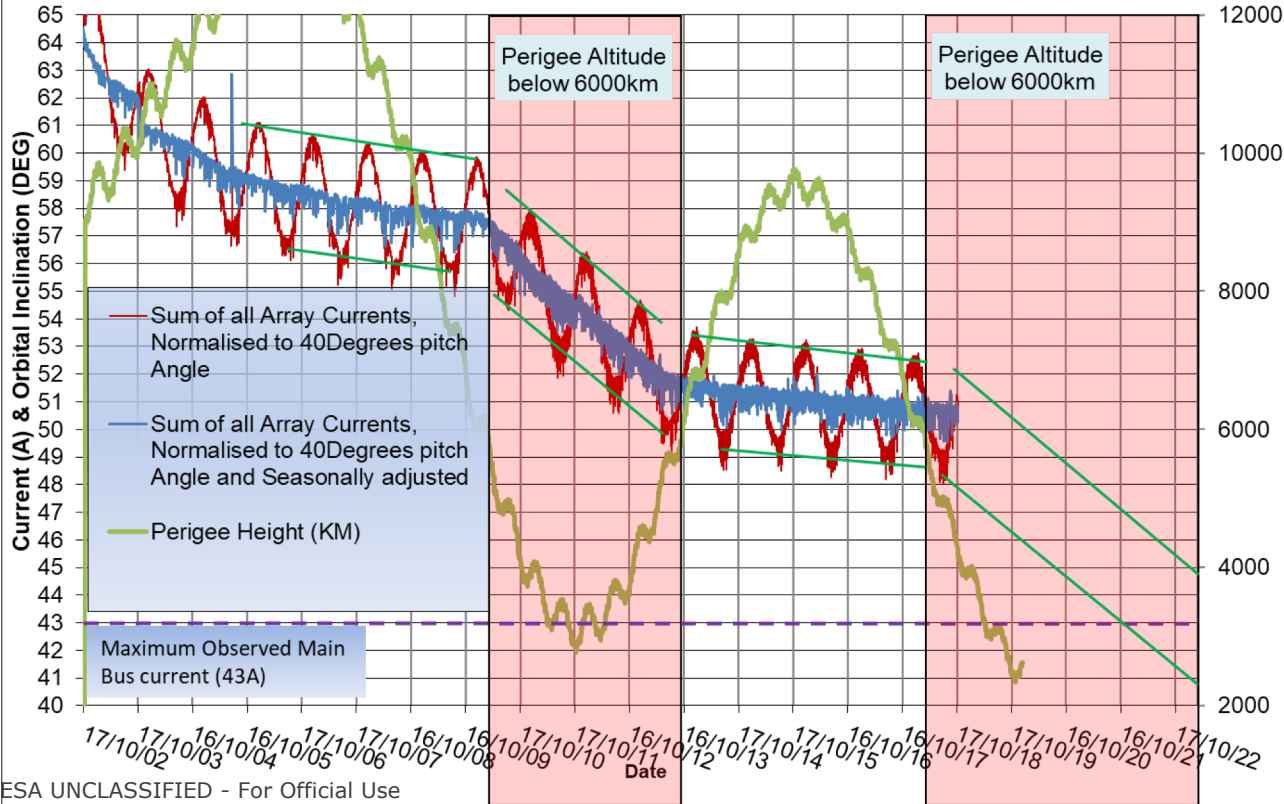
Exact timing is tbd, depends on further evolution



Array Degradation – Power Budget



Integral Solar Array Output Current Evolution.



Short duration peak power demand (10min)

EPS limits battery charge in case of excess demand

- Flexible margin of about 6A
- Occasional reduction in charge rate from 2021
- Mitigated by:
 - Long recharge time between eclipses
 - Low Depth of Discharge

Limited discharge in sunlight allowable – **we know the batteries are healthy**

No power constraints expected before end 2022

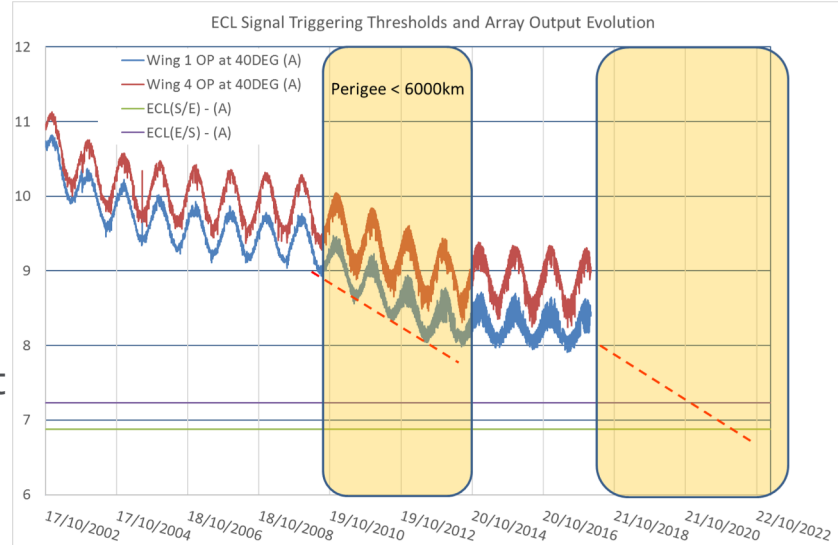
Constraint only when discharge in sunlight is significant



Array Degradation – ECL (s/e)

The ECL Issue

- Autonomous reconfiguration at eclipse entry
- Based on array output I (Fixed threshold 6.9A)
- Reconfiguration for power (safety) reasons
- Approaching threshold at max pitch angle in sunlight
- Powers off PLM units unexpectedly – long recovery!
- Not before 2020



The proposed solution

- Limit pitch angle to in eclipse season only, disable ECL(s/e) outside eclipse season,
 - Initially limitation to 35DEG is sufficient, later 30DEG
 - Ensure safety with OBM entry to re-enable ECL(s/e) signal at anomalously low array output (5A tbc)
 - Temporary loss of part of celestial sphere visibility for about 90 days / year

Start depends on observed degradation

Study of observed and predicted array degradation initiated

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Richard Southworth | ESOC | 23/10/2018 | Slide 11



SPI Status

29/10/2018 02:14 Multiple single EDAC error messages received

- Memory corruptions on 2 neighbouring locations
- 29/10/2018 07:49 The DPE crashed, possibly double memory error

29/10/2018 17:36z Multiple single EDAC error messages were received again.

- Memory corruptions on 2 neighbouring locations
- 29/10/2018 21:31 The DPE crashed, possibly double memory error

31/10/2018 17:22z Further SPI reset commanded - Not responding after tests

1/11/2018 13:40z SPI Returned to science - VETO Spectra generation disabled

SPI Operating nominally again from MOC operations point of view

Further diagnostics / test plan will be issued

- Disable reset after double memory error detection?
- Memory Patch?
- Leave as is?

SDPE 2 basic functionality checked out after 16 years!

- Boot, HK data, TC, basic physical health