European Space Agency
Research and Science Support Department
Planetary Missions Division

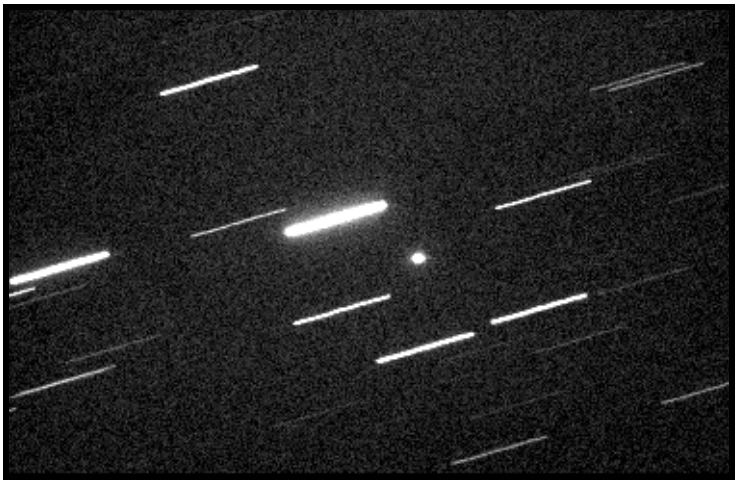
ROSETTA

Rosetta Earth-Swingby #1 Payload Operations Report

RO-EST-RP-3321

Issue 1 Rev.a

02 November 2005



Erich Meyer captured Rosetta by amateur telescope.

Modified by: V.J.F. Dhiri

Created by: V.J.F. Dhiri

Approved by: D.Koschny

Picture on front page is the winner of the 'Rosetta Up Close' photo contest.
Image taken by: Erich Meyer
Date: 04 Mar 2005
Time: 20h10m21s - 20h10m36s UT
Location: Davidschlag Observatory, Austria (IAU-Code 540)
Exposure duration: 15 sec
Telescope: 60 cm Reflector, f/3.3
Camera: SBIG ST-6
Pointing position: R.A.10h02m20s, Dec.: +09deg55'20", North is up, East is left.
Field of view: 16' x 11'
Estimated magnitude: TBD
Distance to Earth: TBA
Other info: The bright star on the is HIP49194 with 8,88mag (K0) Compensation the proper motion with an electronic-telescope-controller (8,5'/min)

CHANGE RECORD SHEET

Date	Iss.	Rev.	pages	Description/Authority	CR No.
26Jul2005	1	-	All	Initial Release	
02Nov2005	1	a	1.4	Added ref to Lander Report, updated RD07	
			1.4	Updated RD10	
			T2	Added ref to Lander Report	
			T2	Corrected AL results	
			T2	Added MIRO inputs	
			T3	Removed AR Status Column	
			4.3.2	Updated RPC report.	
			6	Added reference to OOL/Events analysis	
			T4	RPC evaluation added	
			T4	RPC evaluation added	
			All	Removed all TBD's	

Issue to issue revisions are indicated by a vertical bar at the outside border.

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1. General Remarks

1.1 Summary

All of the payload activities during the Earth Swing-By #1 shall be summerised. Firstly this is designed to be complementary to the daily pass reports being provided by RMOC by reporting the anomalies detected by P/L teams that do not show up as Events or OOL. Subsequent investigations are tracked. Secondly science achieved by each team is summerised with a view of the initial High Level requirements listed in the MSP. P/L Team reports shall be referenced.

1.2 ES1 Details

The following table gives ES1 dates.

Table 1 : Earth Swingby #1

Begin	End	Comments
DOY060: 01MAR05	DOY067: 08MAR05	Earth Swingby 1 Scenario Activities
DOY067: 08MAR05	DOY085: 26MAR05	Earth Swingby 1 Post Scenario Activities

1.3 Applicable Documents

AD01 RO-EST-PL-3278_4_2_MSP_Earth_Flyby_1_2005MAR01.doc

1.4 Reference Documents

RD01 ies-data.ppt; Livelink Rosetta/Meetings/ SWT#18

RD02 LAP_science_results_-_presented_at_SWT18.ppt

RD03 MIRO_swingby_quicklook.ppt

RD04 OSIRIS_Door_-_presented_at_SWT18.ppt

RD05 ROMAP_EarthFlyby.pdf
RD06 SONC Ops Report_Earth_Flyby_1.doc
RD07 RO-IGEP-TR-0014_2_0_Report the Earth Flyby (EF1); Time Period: March 01 - 07, 2005_2005AUG03
RD08 Anomaly report AR ROS-491
RD09 Anomaly report ROS_SC-83
RD10 RO-EST-LI-3326_PL_OOL_Events_Investigation.xls. On-Going.
RD11 sci.esa.int/Rosetta
RD12 "http://www.rssd.esa.int/index.php?project=ROSETTA&page=Earth_Flyby"
RD13 RO-EST-TN-3305_1_5_Rosetta_Payload_Boresight_Alignment_Details_2005APR05.pdf
RD14 RO-ESC-RP-5018_1_-_Mission_Operations_Report_#39_2005Mar25.pdf
RD15 RO-ESC-RP-5018_1_-_Mission_Operations_Report_#40_2005Apr08.pdf
RD16 RO-DSS-RP-1015_6_-_Power_Budget_RP.doc; 2002JUL27
RD17 RO-LAN-RP-30406_1_0_Rosetta_Lander_Report_For_Earth_Flyby_#1_2005AUG01
RD18 MIRO_swingby_quicklook.ppt
RD19 RO-EST-RP-3346_1_a_Rosetta_Payload_Open_Issues_Report_2005NOV03.doc

2. Science Return

Table 1 compares the high level requirements (table 3 in the Earth Swing-By#1 MSP AD01) of observations that run in the Earth Swingby#1 with the reported results. References to results reports are also given.

Table 2: High Level Requirements vs Results

OBS	Description	Objective	Results	Ref.
AL01	1) Flat Field Calibration	Alice has not yet obtained flat field calibration, and the Moon during this flyby is the only source large enough and bright enough throughout the UV to make an adequate flat field	Initial quick look at the data and HK show that Alice executed all commands as planned, and all expected data have been received. Initial examinations show the data are consistent with what was expected. The spectra of one background star appears in the data. These spectra will be interesting in their own right for looking at scattered light and relative flux calibrations using the stellar flux. The rows containing those stellar spectra will need to be removed/corrected for the analysis.	None
AL02	2) Extended Object Scattered Light Calibration	Need a large, bright extended object to perform this observation with flux throughout the Alice band. The Moon during this flyby is the only such target.	Initial quick look at the data and HK show that Alice executed all commands as planned, and all expected data have been received. Initial examinations show the data are consistent with what was expected.	None

OBS	Description	Objective	Results	Ref.
AL03	3) Absolute Solar Calibration	Obtain wavelength and flux calibration at short wavelengths. This is the only way to make such a calibration at the short UV wavelengths.	The spectra of two or three background star appears in the data. These spectra will be interesting in their own right for looking at scattered light and relative flux calibrations using the stellar flux. The rows containing those stellar spectra will need to be removed/corrected for the analysis.	None
AL05	Absolute Flux and Wavelength Calibration	This is a repeat of AL03 closer to the Moon to allow wide part of slit to take in the moon	Initial quick look at the data and HK show that Alice executed all commands as planned, and all expected data have been received. Initial examinations show the data are consistent with what was expected.	None
AL DPT	Door Performance Test	Our previous door performance test worked fine, but we saw a slight increase in door response times (msec). Since as you know the door performance test itself is new, it may simply be that we an unanticipated characteristic of the test, or it could be a transient, or it could be a real sign of a slight performance degradation. The test during EM-1 is to discriminate between these possibilities.	It ran as planned and we were pleased to see there was no indication of the anomalous behavior (increasingly longer times for door motion) that was seen during one previous test in September. These data will need to be analyzed in more detail, but it is possible that the behavior seen in September was temperature related, since that previous test was performed at a significantly higher temperature (14C vs. 4C during the recent test). As it stands, the door behavior is currently perfectly nominal, and we will continue throughout the mission to run the performance test to monitor the door.	None

OBS	Description	Objective	Results	Ref.
LZ-CIVA01	Earth Picture with Camera # 2 or4.	refine the geometric and photometric calibration on well-known targets and to compare it to the on-ground calibration data and also to check the image quality	For CIVA all picture sequences were taken at the predicted pointing to Earth. Integration times and automated exposure algorithm were not adapted to the very specific configuration during this Earth Swing-by. The CIVA operation turned out to be a very good calibration exercise. The results will help to optimize the selection of the exposure time and to improve the algorithm for image processing for future activities.	RD17 RD06
LZ-ROMAP01	ROMAP/RPC Magnetic field data from the inbound (-2hr) to outbound (+2hr) bow shock crossing. Bow Shock Cross Positions assumed: Closest Approach -2d and Closest Approach +2d	1/ The large Earth field can be used to align the magnetic axes of the stowed Romap sensor and both RPC sensors. 2/ Scale values can be verified by comparison with known Earth field. 3/ The solar wind passages before and after bow shock crossing can be used to compare Rosetta data with magnetic field data of other satellites in the near Earth solar wind (ACE, Wind and properly Cluster)."	For ROMAP the measurements showed concurrent results with RPC and models. Although ROMAP measurements were disturbed by induced perturbation due to TCS heater operation, the known properties of the Earth's magnetic field could be measured successfully to verify the ROMAP data.	RD17 RD06

OBS	Description	Objective	Results	Ref.
MR01	AFM Test, Calibration, Science	Observe H2O lines in Earth, test Asteroid mode, radiometric calibration on Moon.	- Observe H2O lines in Earth. This was accomplished and high-quality data were obtained, of which the analysis is not yet complete. The observed Doppler shifts are consistent with the velocities of Earth and Rosetta. - Test Asteroid Mode. The test ran nominally, no major problems were encountered. It was discovered that the timing of the commands was a bit too tight and some unexpected packet sequences were encountered, but the data were not compromised. This will be taken into account in future planning. Small corrections to our ground processing of asteroid-mode data were also implemented as a result of these data. - Radiometric Calibration of the Moon. This work is still in progress, as it requires a detailed thermal model of the moon and modelling software which will take time to develop.	RD18
RP01	Flyby Science and Calibration	1/ Sensor Calibration 2/ Magnetospheric physics 3/ Verification of the science operations modes for the Mars flyby	LAP Loss of LAP science data for 41.5 hours (2005-03-01 19:00 -- 2005-04-03 12:30). The impact on the LAP science and calibration goals for the Earth flyby is small, as we are still far from the dense near-Earth plasmas that are our chief targets.	RD07
SE01	Data Accumulation	Data Accumulation		

OBS	Description	Objective	Results	Ref.
VR01	Co-Alignment M/H	Calibration	VR-H did not receive signal. Target does appear in M FOV.	4.3.3
VR02	Absolute calibration using the Moon (repetition of VR05)	Known Spectrum best target for calibration. repeated due to risk of ops loss closer to Moon.	No Input	RD11
VR05	Absolute calibration using the Moon	Known Spectrum best target for calibration. Closest opportunity.	No Input	RD11
VR06	Full Disc Earth imaging including exosphere over one rotation		No Input	RD11

3. Ground Based Observations

Rosetta was passed close enough to Earth to allow some ground based observations of the swing-by. Information and images are collected in RD12

ESA invited amateur astronomers to participate in the 'Rosetta Up Close' photo contest and received more than 45 fascinating images from all over the world. Eight winning images in two categories – still and animated – were chosen. the winning image is illustrated on the front cover of this document

The Astronomy Club at ESTEC (ACE) set up their equipment on the evening of 04-Mar-2005, but unfortunately they only saw snowflakes.

4. Payload Operations

All reported issues that impact payload operations, generated during the scenario are listed here. All issues are tracked in RD19 and RD10 giving the status of issues generated in this and all previous scenarios.

4.1 RMOC Reported Anomalies, Events & OOL

Table 3: EVENTS & OOL STATUS

INST	EVENTS	OOL	AR
AL	-	-	-
LZ	2	1	RD08
MR	-	8	-
RP	8	6	RD09
VR	9	10	-

4.2 RSOC Reported Anomalies

Anomalies that were encountered by RSOC teams during the scenario are listed and tracked in this section.

None

4.3 PI Reported Anomalies

Anomalies that were encountered by PI teams during the scenario are listed and tracked in this section.

4.3.1 OSIRIS

Door tests were performed due to anomalies raised during the commissioning. SR gave a late decision NOT to take part in the scenario until further investigations were made.

4.3.2 RPC

Anomaly - EC_AutoShutDown event and following ICA unit switch off: Event was raised (preceded by a EC_ParamMntrWrning and a EC_ParamMntrDanger events) by PIU as a consequence of ICA temperature having reached the danger level.
Actions - After the pass the RPC team submitted a change request to the MTL commands to prevent re-activation of ICA in the near future, until the event is explained. Description of changes:

2005.063.00.50.00 ARPS803A
Parameter VRPD1261 changed from SID2_HV_ON to OFF
Parameter VRPD1266 changed from 0x0B to 0xFF

2005.063.23.16.27 ARPS803A
Parameter VRPD1261 changed from SID2_HV_ON to OFF
Parameter VRPD1266 changed from 0x0B to 0xFF

2005.064.20.40.00 ARPS803A
Parameter VRPD1261 changed from SID2_HV_ON to OFF
Parameter VRPD1266 changed from 0x0B to 0xFF

2005.066.16.50.00 ARPS803A
Parameter VRPD1261 changed from SID2_HV_ON to OFF
Parameter VRPD1266 changed from 0x0B to 0xFF

Conclusion - AR raised RD09.

Anomaly - LAP had a software hickup at present, which resulted in a loss of LAP science data for 41.5 hours (2005-03-01 19:00 -- 2005-04-03 12:30). Details:

"We have looked at all LAP Earth flyby data received up to now. All worked well for 19 hours up to the start of the LAP-MIP LDL mode at 19:00 yesterday (2005-03-01). At that point, we lose the science data, though HK is all right and all bias commands are executed as they should (we can see that from the small amount of science data we put into HK). The science data do a brief comeback at the end of the LDL, but then disappears and is missing as long as we can follow the data. We would like the MIP team to check the LDL data: as far as we can see in HK, MIP has access to LAP probe 2 so that the LDL should work as intended, but this needs to be verified.

We do not expect this to be cleared up until the LAP power cycling tomorrow (2005-03-03 12:30). This means that we expect to lose some 41.5 hours of data from the very far tail. If the macro upload tomorrow at 12:10 (i.e. before the power cycle) is compromised as well, we expect to lose 2 more hours of data."
Actions - A LAP power cycle scheduled for 12:30 the next day, so there is no need for any extraordinary measures.
Conclusion - The issue will have to be investigated in detail. We do not fully understand it at present, but considering that it occurs at start of the LDL by OBCP, we suspect some problem with this. A radiation induced bit-flip on s/w in LAP RAM is possible but unlikely, considering the appearance of the problem at the start of the LDL. We do not believe the problem is related to PIU: some missing macro identifiers in LAP HK clearly points to an internal LAP s/w execution problem. We do not think the LAP flight s/w in the EEPROM is corrupted, as this should have been detected by the checksum control at boot. Hence, we expect the problem to disappear after tomorrows power cycle. It could reappear at the very end of the Earth flyby operations, during the LDL operations starting at 18:00 in 2003-03-07. This is just to confirm that things worked as expected, with LAP science data reappearing after 12:30 today. As for the problem, we have not been able to reproduce it on ground. It remains to see if it is reproduced in space the next time we run LDL (2005-03-07 18:00).
LAP investigation came to no conclusion since all tests performed on ground have given nominal expected results. The problem occurred when operating LDL mode via OBCP and we cannot test OBCP other than on S/C EQM. We are waiting to reinstall RPC on S/C EQM (at present the RPC unit is undergoing upgrade) and request a time slot for running a test sequence which might shed some light on the issue.

4.3.3 VIRTIS

Anomaly - the VR-H boresight did not detect the target.
Actions - A VR internal investigation: No signal in the H data, despite efforts to check for faint signal; target should have been detectable with Virtis-H performances, conclusion is that VR-H was not pointing to the star during the raster scan. The exact slit dimension of VIRTIS-H are 0.49 mrad (in X) and 1.47 mrad (in Y), or 1.684 arcmin and 5.053 arcmin respectively. Our measured PSF confirms that the signal falls very rapidly when a point source is placed outside the slit : so there is a possibility that the star unfortunately was placed just between two rows in X; since the spacing of the raws was 2 arcmin, there is a 15% chance for this to happen, not taking into account pointing uncertainties.

The good point is that we have observed the night side disk of the Earth, and we therefore confirm the functionality of Virtis-H on astronomical sources.
Conclusion - VR think that by repeating the observation with a 1arcmin spacing in X (instead of 2), and 2 arcmin in Y it should not miss the target. The question is when it will be possible. On-going.

5. Planning Feedback

5.1 PI Feedback

PI comments on planning process used for PC0 are listed here.

5.1.1 ALICE

Alice performed the flat field drift scans (observation AL01) on March 8, the scattered light test (AL02) and aperture door performance test on March 9, and the medium-distance flux calibration on March 11 (AL05). Still to be executed is one more flux calibration (AL03) on March 26. The passive checkout will be executed on March 27th.

For the completed operations, all Alice data (science, HK, and memory) were dumped in the next available pass. The dump and DDS data delivery response was fast and without any problems. We continue to be pleased with the performance of the DDS. AL01 started during visibility, allowing near real time monitoring of the startup activities and first exposures (dark frames). Initial quick look at the data and HK show that Alice executed all commands as planned, and all expected data have been received.

5.2 RSOC Feedback

RSOC comments on planning process used for PC0 are listed here.

5.2.1 Radiation Belts

The RPC team highlighted the dangers of passing through the Van Allen belts for the instruments on Rosetta. Earth Swingby 1 passed through each of the 2 belts once on the way in and once on the way out. Making this a general announcement caused several teams to react by a cancellation of their operations around closest approach. The planning process did not take into account this factor but facilitated the pooling of information. Future Swingbys should take early consideration of the Van Allen belts.

5.2.2 Boresight Data

Planning required the creation of a file that centralised the P/L boresight data: RD13.

5.2.3 Resources Investigation

EPS could not be used effectively to analyse power usage and data volume flow to ground. The main problem lies with difficulty in simulating SSMM processes. Not all instruments are modeled yet which disallows a complete investigation. Existing EDF models are incomplete and not tested.

5.2.4 Naming Conventions

During iterations on the OIOR it was found to be more convenient to use email submissions. The final official submission was via ORF-A. To be able to track OIOR that are submitted via email and to make a distinction between submissions via email and those via ORF-A a new naming convention was invented. This was an "E" replacing the first digit of the file sequence number. Numbers were then increased upon each iteration. This method will not necessarily be maintain. For instance, in DI "V" for "version" was used instead of the "E".

5.3 MOC Feedback

RMOC comments on planning process used for PC0 are listed here.

- No comments.

6. Payload Resources Analysis

A comparison with predicted resource usage, EPS simulation and real resource usage. EPS using EDF models as of 26th July2005 for Data Vol. power is from an earlier version. Real values have been provided by RMOC for Data Volume and from the ESTEC local S2K from derived data on VC1 for the ES1 period. Real Data Volume values for the period between DOY067 to DOY077 have still not been recovered, hence the indication of applicable OBS in the Real column.

Legend: After value, ↑ means value has greater then real, ↓ means value has less than real, ↔ means value is equal to real, ? means unknown. Percentage of inaccuracy is also given. Values in bold are closer to real values recorded.

Being within a margin of 20% is considered sufficient in the current mission phase.

Table 4: Data Volume and Power Estimates

Team/OBS	Resourses	PI Estimate	EPS	Real	Comments
AL	**HK(MBytes)**	AL01 0.08 AL02 0.04 AL03 0.07 AL05 0.5 Tot: 0.2	-	-	• Data period between DOY067 to DOY077 missing. No analysis. • Estimated power value is accurate to that indicated in RD16 (4). • EPS/EDF discussed in next table.
	SCI(MBytes)	AL01 0.92 AL02 0.88 AL03 0.91 ↔ AL05 0.69 AL DPT 0.0335 Tot: 3.4335	AL01 0.83 AL02 0.83 AL03 0.62 ↓32% AL05 0.82 ALDPT - Tot:3.09	0.91 (AL03)	
	PWR(W)	4 **↑3%**	4 peak 7.5 **↑3%**	3.89(AL03) Peak: 4	

Team/OBS	Resourses	PI Estimate	EPS	Real	Comments
LZ	**HK(MBytes)**	6.76 HK 1.12 Evt	N/A	-	• Platform, ESS data not included in analysis. • PI estimate is above the 20% margin for power. LZ • EDF model not developed. • Real power is for all LZ ops averaged over the entire scenario period.
	SCI(MBytes)	6.0 Platform + 4.2 ESS	N/A	-	
	PWR(W)	Inst.ToT: 7.91 **↓44%** peak 10.5 **↓49%**	N/A	13.74 Peak: 20.51	
LZ-CIVA01	**HK(MBytes)**	-	N/A	-	• 8 W peaks during imaging. • EDF model not developed.
	SCI(MBytes)	3.29 **↑15%**	N/A	2.81	
	PWR(W)	2.65/8	N/A	-	
LZ-ROMAP01	**HK(MBytes)**	-	N/A	-	• EDF model not developed
	SCI(MBytes)	5.26 ↔	N/A	5.26	
	PWR(W)	2.5	N/A	-	
MR01	**HK(MBytes)**	-	-	-	• Peak is not covered in PI estimate. • EPS/EDF discussed in next table.
	SCI(MBytes)	83.1 **↑10%**	7.03 ↓91%	74.68	

Team/OBS	Resourses	PI Estimate	EPS	Real	Comments
	PWR(W)	65 **↓6%**	81 ↑15%	69.06 Peak: 72.43	
RP01	**HK(MBytes)**	4	-	-	• PI estimate is above the 20% margin for data vol. • PI estimate is above the 20% margin for power. • Peaks of around 8.68 W are observed. • PI estimates include the power and data volume for ICA which operated for only a few hours due to overtemp switch-off and do not take into account LAP's data loss (incidents reported in chapter 4.3.2.). This explains the discrepancies.
	SCI(MBytes)	24.9 **↑32%**	28.05 ↑39%	17.02	
	PWR(W)	12 ↑43%	6.2 Normal **↓9%** 9.0 Burst **↑5%**	6.84 Peak: 8.57	
SE01	**HK(MBytes)**	-	N/A	-	• EDF model not developed.
	SCI(MBytes)	5	N/A	No Analysis	
	PWR(W)	2.5	N/A	No Analysis	
SR	**HK(MBytes)**	-	N/A	-	• SR did not take part in ES1 due to malfunctions. • EDF Modeling for SR incomplete. • Values include Sci. and HK but HK is considered negligible.
	SCI(MBytes)	SR01 37.9 SR02 1.9 SR04 44.7 SR05 135 SR06 18.9 SR07 3.4 SR09 9.5 Tot: 251.3	N/A	-	

Team/OBS	Resourses	PI Estimate	EPS	Real	Comments
	PWR(W)	40	N/A	-	
VR	**HK(MBytes)**	-	-	-	• EPS/EDF discussed in next table.
	SCI(MBytes)	VR01 32.88 ======== VR02 74.88 VR05 61.13 VR06 88.56 Tot: 224.57 **↓14%**	VR01 33.29 ======== VR02/05/06 Tot: 378.33 ↑31%	260.4 (VR06/05/02)	
	PWR(W)	56/45 Av: 50.5 **↑12%**	31.8 ↓29% 41.6 max ↓21%	44.55(VR06/05/02) Peak: 52.6	
Totals	**HK(MBytes)**	**11.45**			• SR information has been removed. • Tot of EPS values and Real is pending remaining data.
	SCI(MBytes)	**392.63**	**N/A**	**N/A**	
	PWR(W)	**194.85 Max**			

Table 5: Payload Resource Analysis

Team	Data Volume	Power Consumption
Estimates	• All HK and Science data was downloaded in the first PC dedicated pass and there was no need for the backup pass. • Due to SR non-participation data vol was not as expected. • All instruments overestimated their data vol apart from VR.	• 2/5 teams underestimated their power consumption. • peaks are considered by most teams, accuracy for some teams should be improved. • comparison with profiles are necessary for a deeper analysis, especially for peak evaluation.
EPS/EDF General	• several instrument models need to be investigated	• several instrument models need to be investigated
AL	• EDF inaccurate to within 20% margin.	• EDF accurate to within 20% margin.
LZ	• No EPS/EDF currently.	• No EPS/EDF currently.
MR	• EDF inaccurate to within 20% margin.	• EDF accurate to within 20% margin.
RP	• EDF inaccurate to within 20% margin. • Note section 4.2.2	• EDF accurate to within 20% margin. • Note section 4.2.2 can void this observation.
SE	• No EPS/EDF currently.	• No EPS/EDF currently.
SR	• No EPS/EDF currently.	• No EPS/EDF currently.
VR	• EDF inaccurate to within 20% margin.	• EDF marginally inaccurate to within 20% margin.

7. Conclusions

All operations ran smoothly as planned. SR finally did not take part and VR was unable to align there boresite H.

Events and OOL that were reported during PC0 are under investigation and will be closed out as soon a possible. RD10 remains alive and tracks progress.

In terms of resource analysis, although the analysis is incomplete due to not all data being recovered as of yet, the report still shows the need for several modifications in the EDF modelling and for PI teams to revise their estimates. A deeper analysis is required to measure the impact of inaccuracies in prediction and modelling. Currently a 20% margin is considered adequate for planning purposes. This should be revised along with EDF modelling accuracies.

All other anomalies generated in this document are tacked in RD19. This report will be referenced to aid continued investigations.