Solar B - EIS

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SOLAR B - EIS RISK ASSESSMENT

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EIS Science	
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CHANGE RECORD

ISSUE	DATE	PAGES CHANGED	COMMENTS
01	9 June 2000	All New	Document re-issued in new numbering system. A major review of risks has been conducted in preparation for the EIS UK PDR
02	04 July 2000	3,4,5,6,7	Minor updates to paras 2 & 3. Par 4.1, EM changed to PM. Minor editorial changes to par 4.2. Par 5.1. addition of OE6.
03a	03 Oct 2000	 4 5,6,7,8,9 7	Early release for PPARC Steering Committee. EM changed to PM and STM changed to MTM/TTM in PE6. Update of all risks (changed ones are shaded) and addition of update timetable in Section 3. **New Risks:** PS19 added
04	09 Feb 2001	6,7,8,9,10	Update of all risks (changed ones are shaded) and addition of update timetable in Section 3.
05	30 May 2001	5 7 8 10	Update Recorded PS2 Updated to reflect change in EIS wavelengths PS11 Radiator – probability reduced to 1 PS9 reduced to 4 PS16 reduced to 2 Add risk PS20 – mounting of ACTELs Add risk PS21 – CCD voltages Add risk OS10 – CCD contamination
06	25 Jan 02	none	Temporary release to PMs prior to update, highlighting each institutes ownership of risks.
07	8 Jul 02	 6	Major updates prior to UK CDR: PE8.1 relating to PM delivery schedule removed PE8.2 relating to MTM delivery schedule removed Other interface risks reduced due to PM and MTM delivery

08	29 Oct 02	Cover 7 10 11 6 6 6 8 8 8 11 12	Updated distribution list to e-mail distribution PS7 reduced from 5 to 4 as procedures are defined OE6 risk reduced to 2 after statements from system side at CDR. OS2 reduced from 99 to 2 following assessment at NRL PE4 and 4.2 reduced from 2 to 1 following MTM/TTM system tests PE6 all reduced as MTM/TTM and PM both completed As above for PE7 except PE7.4 PS2 reduced from 6 to 2 with delivery of 'in spec' optics PS3 and PS4 reduced for same reason as above PS9 reduced in light of FPP experience at MSSL OE4 reduced to 1 following extensive testing of commanding on PM boards OS4 removed statement of redundant system for grating movement
09	21 Jul 03	All Pages	Complete update of ALL existing risks – no new risks added.

CONTENTS

1 SCOPE

This document constitutes the central element of the Solar-B EIS Risk Management Process. Here programmatic (i.e. risks to the delivery for flight of the EIS instrument within the schedule and budget constraints) and operational risks (i.e. risks to the quality and in-flight performance of the delivered instrument) are covered.

Risks are characterised in terms of their nature, likelihood, origin and ownership.

2 APPLICABLE DOCUMENTS

MSSL/SLB-EIS/SP007	EIS Science Requirements
MSSL/SLB-EIS/SP011	EIS System Definition
EIS-sys-eng-wbs	EIS Work Break-down Structure
MSSL/SLB-EIS/AD004	Management Plan

3 DISCUSSION

This document contains a risk analysis for the Solar-B EUV Imaging Spectrometer (EIS) at system and sub-system level. Its purpose is to record the sources of risk and their degree for EIS and its subsystems, and the means to reduce them to acceptable levels. Operational and Programmatic risks are considered.

The probability of risks is described in a qualitative way using the following Scheme:

Term	***Notation***
Impossible	0
Very unlikely	1
Unlikely	2
Moderately Unlikely	4
Moderately Probable	6
Probable	8
Very Probable	9
Certain	10
Unknown	99

Risks are numbered for reference, according to type.

- PE : Programmatic EIS (system or Mission) risk
- PS : Programmatic Subsystem risk
- OE : Operational (i.e. post-launch) EIS (system or Mission) risk
- OS: Operational Subsystem risk.

Each of the above risk types are described in separate section of this document.
The risk Category is the WBS code of the origin of the risk. 1000 = EIS instrument, 0000 = Solar-B mission.
Ownership indicates the institute that will be responsible for management of the risk. Within any Institute it is required that an individual take ownership of the risk.

3.1 Table Update

As detailed in the management plan, now that the PDR has happened, a risk register will be implemented to record the progress of the risk management process on a regular basis. This document, however, will still act a useful assessment and summary of outstanding risks and will highlight any new risks which have come to light. As part of the risk management process this document will be updated on a regular basis, once every 3 months. The table below reflects the dates when these updates will occur.

Document release number	Expected Release	Released Date	Notes
MSSL/SLB-EIS/AD005.03	End Oct 00		5.03a Early version for PPARC SC on 3/10/00
MSSL/SLB-EIS/AD005.04	End Jan 01	9 Feb 01	
MSSL/SLB-EIS/AD005.05	End Apr 01	30 May 01	
MSSL/SLB-EIS/AD005.06	End Jul 01	25 Jan 02	Re-release of previous version
	End Oct 01		
	End Jan 02		
	End Apr 02		
MSSL/SLB-EIS/AD005.07	End Jul 02	8 Jul 02	for CDR
MSSL/SLB-EIS/AD005.08	End Oct 02	29 Oct 02	Scheduled release
	End Jan 03		
	End Apr 03		
MSSL/SLB-EIS/AD005.09	End Jul 03	21 Jul 03	Full update for Steering Committee
MSSL/SLB-EIS/AD005.10	End Oct 03		
MSSL/SLB-EIS/AD005.11	End Jan 04		
MSSL/SLB-EIS/AD005.12	End Apr 04		
MSSL/SLB-EIS/AD005.13	End Jul 04		
MSSL/SLB-EIS/AD005.14	End Oct 04		

4 PROGRAMMATIC RISK

4.1 System level (PE)

Sources of programmatic risk to the project as a whole are considered first.

Category	Element	Risk #	Prob	Owner	Event	Effect	Management	Notes
0000	Solar-B	PE3	1	ISAS	Launch Delay	Extra costs in supporting s/c activities	Revise schedule Re-costing in progress	Has now occurred twice. Considered unlikely to occur again. Launch delayed again, now 2006. FM build is so far advanced that no further delay is envisaged.
1000	EIS	PE4 PE4.1 PE4.2 PE4.3 PE4.4 PE4.5 PE4.6	1 1 1 1 1 2 2	MSSL MSSL MSSL MSSL MSSL MSSL MSSL	Incompatibility of sub-system interfaces at pre delivery integration Mechanical interfaces Thermal interfaces Optical interfaces Electrical interfaces Cleanliness interfaces PA interfaces	Failure to integrate hardware or software. Delay and/or additional costs of re-work	Rigorous attention to interface management procedures. Regular system design team meetings. Early integration checks have occurred on all FM optical interfaces, these are also planned for ROE and MHC (although there is no change between MTM and FM interface for MHC). Early checks on FM optics interfaces complete Checked during MTM integration to s/c (except ICU, see separate item) End to end optics tests are planned in NRL, early performance measurements show no incompatibilities (all optics manufactured to spec.) Checked during integration of PM s/c EIS contamination plan makes use independent measurement during integration and test. Close monitoring of the system side, aided by Hiro advising on OTA cleanliness, ensure that s/c contamination to EIS and visa versa is understood and within allowable contamination budgets. Spacecraft wide contamination meetings now happening regularly have resulted in improved contamination procedures on all instruments and at spacecraft level These have been experienced now for both PM, MTM and FM. Good communication between ISAS and the EIS team has highlighted concerns from either side in a timely manner and resolution is followed through.	
1000	EIS	PE6 PE6.1 PE6.2 PE6.3	1 0 0 3	MSSL BU MSSL MSSL	System failure during environmental testing MTM/TTM PM FM	Delay in delivery whilst reworks and retests occur	Design margins and derating of components. AIV schedule to include contingency for such events. Items which are both critical and particularly susceptible to have spares available – within budgetary constraints. Schedule no longer allows for failures and consequent retests	Each subsystem item should have been qualified to appropriate levels by analogy, analysis or test prior to system test. Lessons learned during PM and MTM/TTM environmental tests should allow us to identify the susceptible items. Both PM and MTM tests are now complete (TTM system tests will occur in Nov 02). All the experimental evidence points to EIS being well designed with suitable margins. MTM/TTM completed with no failures PM integration completed with no failure Qualification occurred on MTM/TTM, FM optics have now been fully qualified. Slight increase of mass on monitor board means that qualification will need to be carefully monitored to avoid over test
1000	EIS	PE7 PE7.1 PE7.2 PE7.3 PE7.4	2 0 0 1 2	MSSL BU MSSL MSSL MSSL	Incompatibility with spacecraft discovered during integration MTM/TTM PM FM telescope mechanical FM ICU and electrical	Delays to entire mission. Increased costs of support of rework in Japan. Possibility that instrument performance be compromised.	Close co-operation with the spacecraft design teams. Identification and control of comprehensive interface specification.	This would arise from inadequacy of interface management between the EIS and spacecraft teams. There is a vital need for prompt and reliable exchange of accurate interface information with the spacecraft teams. Hiro visited BU prior to MTM/TTM delivery Hiro visited MSSL prior to PM delivery All mechanical interfaces checked at MTM integration ICD is in place and under configuration control but integration has not happened. At MTM stage a dummy mass from ISAS was used (need Hiro to confirm ICD interface was followed): Hiro confirmed ICD drawing used

1000	EIS	PE8 PE8.3	2 4	MSSL MSSL	Late delivery of instrument FM	Schedule impact on spacecraft programme	Establish and agree realistic delivery schedule Establish and agree realistic requirements for each model Rigorously control internal schedules	As program progresses the number of technical problems is reduced and the accuracy of the scheduling is increased. The current flight delivery schedule is realistic and achievable Schedule is still realistic but does not achieve delivery date of 1 May 04. Although we hope to make up some time there is a risk we will be late. Absolute deadline will be discussed with s/c team closer to delivery date and efforts will be made to avoid any impact on s/c schedules. Last resort (although NOT recommended) is to return EIS to UK during period Oct 04 to Apr 05 when telescopes are returned to PI control and do calibration then.

4.2 Sub-system level (PS)

Programmatic risks are now considered for major WBS items in the Hardware (WBS Code 1000) and AIV (3000) branches.

Category	Element	Risk #	Prob	Owner	Event	Effect	Management	Notes
1100	Structure	PS1	1	BU	Composite material shows excessive out-gassing	Contamination of optical components/CCDs	Select and evaluate materials. Plan out-gassing paths. Investigate with Contamination Model.	Samples being sent to 2 tests houses to check outgassing performance of panels (samples for this will be first produced from McLaren). Measurements show that outgassing is within specification. Bake-out of FM panels shows that they are cleaner than MTM panels. Analysis of MTM cleanliness shows that EIS was within the contamination budget with a good margin.
1300	Optics	PS2	1	NRL	Multilayer coating fails to provide adequate reflectivity or other property	Instrument throughput threatened.	Seek to fully understand the coating technology and the sources of variation of performance. Consider possibility of re-coating or provision of uncoated spares. Allow contingency for this. Consider alternative coating technologies.	All flight coatings now in and within EIS spec.
1300	Optics	PS3	1	NRL	Optic inadequately figured or polished	Poor focusing properties leading to loss of spatial and spectral resolution. Possible need for re-work.	Form an error budget for each optical surface, allowing the system PSF to be estimated. Measure samples to validate the error budget. Unit level test. Correctly figured optics have been delivered and tested.	
1300	Optics	PS4	1	NRL	Grating manufacturing faults	Loss of throughput.	Error budget, with quantified error sources, is required. Test of grating performance prior to multilayer coating.	One flight grating, in spec., and a suitable backup, have been delivered to NRL Flight grating now fully tested and qualified
1300	Optics	PS5	2	NRL	Proposed mechanism fails to meet spacecraft disturbance torque requirement	Other Solar-B instrumentation performance degraded.	Seek alternative mechanisms (mass penalties are likely), or propose spacecraft-level observation (i.e. mechanism) control protocol. Seek to avoid this risk in the early stages of the programme.	This is an important requirement for the successful operation of Solar-B SOT. Life tests successful for mechanism. Disturbance analysis from s/c shows no problems and they have not requested a disturbance test for MTM Analysis of disturbances measured during FM testing sent to MELCO for inclusion in system level testing. Known deviations from requirements (on coarse mirror movement) have been indicated by EIS team leading to an operational constraint agreed by both EIS and the s/c
1600	Shutter	PS6	0	NRL	Motor unavailable	Shutter redesign, possible life test program (costs & schedule affected)	Explore likelihood of this, if necessary study replacement options.	Motor is now fully tested and qualified as part of the FM shutter
1400	Filters	PS7	4	NRL	Accidental breakage of filter	Possible debris in the instrument. Excessive light at CCDs. Excessive heat input.	non-flight protective covers, spares, design for exchange procedures (including cleaning)	The risk remains the same. We have designed the front end of EIS to allow for easy removal of the front baffles and the clamshell so that a late filter change is possible.
1500	Slit	PS8	2	NRL	Slit exchange mechanism fails disturbance torque criteria	Other Solar-B instrumentation performance degraded.	Choose a single slit (or slit/slot) that gives best all-round performance, or seek alternative mechanisms. Merge operational sequences with other instruments.	See also the comments on PS2 – PS6 Life tests successful for mechanism. Measurements of disturbance frequencies and torques presented to MELCO for analysis where there is concern about resonance with the solar array panels. Awaiting results from MELCO models

1710	CCD	PS9	2	MSSL	Loss of device due to (e.g.) static discharge	Replacement needed	Provide for (in contract) adequate test-grade devices during development programme and spares of flight devices. Design for late replacement of CCD. Consider static discharge protection procedures.	Simulators may be used for many test purposes. All flight components stored in ESD protected environment. Assembly areas have ESD protection i.e. antistatic chairs, benches, floors. Daily checks of ESD protection procedures introduced for FM program.
1730	ROE	PS10	1	MSSL	High power consumption of readout electronics	Exceed instrument power budget	Carefully engineer for low power. Demonstrate at breadboard level	Possible tradeoff between readout rate and power consumption Power within specification (and budget) FM components are exhibiting higher power demands than expected – analysis ongoing (this only effects transients rather than average power consumption which is lower than PFM)
1922	Radiator	PS11	**2**	MSSL	Radiator cannot provide necessary CCD cooling	Radiation damage (see Operational Risks - 1740 CCD) causes unacceptable performance degradation	Seek to minimise CCD radiation damage by alternative clocking regimes and/or shielding. Consider radiator designs that avoid viewing the Earth.	The orbit and spacecraft configuration mean that Earthshine becomes a problem for efficient thermal design with a simple radiator. Updated thermal model shows current design provides adequate cooling of CCDs. – Now tested in TTM. Subsequent analysis of true CCD power and a redesign of the thermal link between CCDs and Radiation Shield will keep CCD temperatures within spec at all times.
3410	Electronic Ground Support Equipment (EGSE)	PS12	0	MSSL	EGSE software not ready for AIV programme caused by lack of continuity of Norwegian effort	AIV cannot be accomplished	Design for interoperability with sub-system EGSE. Specify early delivery of an EGSE version which is capable of supporting a subset of functions for test use. Front end EGSE code nearing completion and Norwegian effort now started on interpretation of mission data. Full functionality exists in EGSE software now and can be readily updated with any new requirements from the engineers during FM AIV activities. Second system is being commissioned.	
3420	Mechanical Ground Support Equipment (MGSE)	PS13	1	BU	Gas purge equipment – contaminates instrument	Dismantle, clean and reassemble structure and optics. This is unachievable in the current schedule.	Obtain certificates of purity or equip with in-line gas analysers. Verify purity of equipment. All pipework was cleaned and baked for MTM, this will be repeated for FM. Procedures will be clarified and updated based on MTM experience.	A purged structure is considered to be considerably easier to produce than a vacuum vessel (especially given the Solar-B mass constraints). The baseline transport case is now a purged container, definition of the purge system from a cleanliness point is a priority. Purge system identified and in use for MTM This will be cleaned and re-calibrated for FM use. During storage at ISAS daily checks on purge system and gas supply integrity will be checked by EIS team member in ISAS.
3800	Calibration	PS14	2	RAL	Insufficient time to complete calibration	Poor knowledge of in-flight performance - value of science data reduced	Allow schedule contingency at this stage of the programme. Rehearse calibration procedures prior to arrival of FM instrument. Ensure adequate testing of the individual optical elements (esp. efficiencies) before delivery to RAL.	MSSL removed from responsibility column. Only one individual should own each risk. This risk may need to be broken down to manage it easier and spread the ownership more sensibly. Time for calibration scheduled in with some contingency. Need to protect this time. This has not been possible, calibration is now on a success assumed basis. Individual QE measurements will allow some knowledge of overall system and act to check calibration. QE measurements of filters, mirror and grating have happened.
3800	Calibration	PS22	1	MSSL	No QE measurements of CCD	Makes calibration difficult	Schedule QE measurements in Re-analysis of results, consider other options of QE measurement.	This was done but results are still been analysed – recent tests by other groups, however, show that QE of these devices at EUV wavelengths is less than predicted by theory.
3800	Calibration	PS23	0	NRL	No QE measurements of optics	Makes calibration difficult	Schedule QE measurements in	These measurements now available for FM optics
1100	Structure	PS15	1	BU	Non-delivery of suitable structure	Probable termination of project.	BU to commission expert help in design and manufacture of composites.	BU have now employed an external expert and a new contract with McLaren composites should ensure the production of the structure. MTM structure complete and tested. FM panels almost complete.

1710	CCD	PS16	0	MSSL	CCD quality poor	Degraded science performance	Take out option to purchase further devices, as necessary.	Contract for CCD foresees this possibility. More experience with MAT suggests this is unlikely All CCDs delivered and are all within specification on image quality requirements.
	Sub-system Structure Camera ICU QCM Optics/Mech' MHC Software GSE	PS17 PS17.1 PS17.2 PS17.3 PS17.4 PS17.5 PS17.6 PS17.7 PS17.8	2-6 4 4 4 0 6 6 4 3	See below BU MSSL MSSL RAL NRL MSSL MSSL Var	Late delivery of subsystem for integration	Schedule delay	Establish realistic schedule and then rigorously enforce. Order QCMs as early as possible	All sub-systems are now late as progress is dependent on structure being ready and/or integration with NRL components both of which have been delayed. It is still planned to deliver a calibrated instrument in May 04. QCMs purchased
	MHC	PS18	2	MSSL	NRL software not transferable to flight standard	Schedule delay through need for extra work	Close Liaison between NRL and MSSL	Issue raised at NASA PDR Pre-shipment review for flight software of MHC occurring at the end of this month. ICD agreed between NRL and MSSL. Integration of FM will confirm flight readiness.
1730	ROE	PS19	0	MSSL	LTC1419 14bit ADC fails during qualification program	Schedule delay and cost whilst new ADC and new design found or shielding applied	Close monitoring of qualification for these chips and awareness of alternative device.	No 14bit space qualified ADC is available in the marketplace at the moment. Decision to use these chips is based on the expectation of the successful qualification of these parts (based on preliminary tests performed in the US) and the technological advances and increased scientific return. These devices have passed qualification.
1A00 1730	ICU ROE	PS20	0	MSSL	Damage to ACTEL device or processor from poor mounting or removal after poor mounting	Loss of device or increase to schedule if rework required	Ensure competence of qualified wiremen at MSSL to do this task or find suitable outside contractor	One outside contractor was found but proved unreliable. One wireman at MSSL has successfully soldered PM processor and ACTELs (will re-appraise at FM stage) Further successful attempts to mount devices on PM boards makes us confident that we can do this safely All flight ACTELS safely mounting and tested
1710	CCD	PS21	2	MSSL	Loss of device due to (e.g.) wrongly applied voltages	Replacement needed	Careful design of test power supplies and switch on procedures. Design for late replacement of CCD.	An analysis of this is needed Using EIS PM electronics protects the CCDs, using test electronics the procedures are well established with no problems

5 OPERATIONAL RISK

5.1 System Level (OE)

Category	Element	Risk #	Prob	Owner	Event	Effect	Management	Notes
1000	EIS	OE2	2	RAL	Contamination - optics or detector	Progressive loss of sensitivity and ultimate loss of instrument, uncertainty in intensity calibration	Contamination control plan, Front door closure, Purging, QCM, CCD Heater, venting paths MTM/TTM experience (witness plates, QCM, TQCMs in bakeouts) leads us to believe that this risk is low. From the NRL analysis a conservative degassing cycle has been proposed for flight. The largest concern from a contamination point of view is on the outside of the filters – we need an estimate of outgassing rates for the solar panel to improve the current estimates. NRL are trying to obtain a sample for analysis. (Analysis now shows that this is not a concern. Solar panels will be baked for flight.) Analysis of MTM results and the contamination models show that the cleanliness plan (confirmed at MTM level) keeps EIS within the required contamination budget.	
1000	EIS	OE3	2	MSSL	Electronic Component failure	Possible loss of instrument or reduced scientific return	Appropriate component quality, fault tolerant design, redundant interfaces	Failure mode analysis to unit, board or component level will be carried out as the designs mature. Components chosen to highest possible specifications. (see mssl/slb-eis/sp020)
1000	EIS	OE4	1	MSSL	“bad command”	Ranges from severe (damage to hardware?) to nearly benign (although an observation could be missed).	Identify hazardous states of the instrument. Do not allow these to be reached without operator confirmation. Allow detection of such conditions (e.g. by recording all tele-commands).	A bit error in a command sequence should be detected by checksum mechanisms incorporated into the data link protocols. This risk concerns the possibility that the operator sends a valid command that nevertheless is not the intended or appropriate one. Basic operation code has now been under test for almost 2 years and the code hardened to any such errors. Potentially damaging commands require 2 commands to operate (‘arm’ and ‘fire’). Pre-commanding checks in planning software will also prevent errors.
1000	EIS	OE5	2	MSSL	On-board software error	Control program halt, output data error, & effects in "bad command"	Allow detection and reboot, periodically compare memory checksum with nominal value	probable cause: SEU memory used is SEU immune Full code upload is possible and flight code is stored on EPROM on board.
1000	EIS	OE6	2	ISAS	Disturbance from mechanism of another instrument	Degraded science data	Need to manage observing sequence. Control disturbing source budget	MTM disturbance tests carried out but awaiting final report. S/c analysis shows that this is not a problem. At CDR Kosugi-san re-iterated that no other on board mechanisms should affect EIS observations.

5.2 Sub-system level (OS)

Risks associated with individual WBS elements are considered.

Category	Element	Risk #	Prob	Owner	Event	Effect	Management	Notes
1200	Door	OS1	2	BU	Clamshell Door(s) mechanism failure	Fail closed - Loss of instrument. Fail open - possible contamination during thruster firings.	Life-test programme Redundant heaters in actuators	There is design heritage from the TRACE instrument for the clamshell mechanism Flight qualification program will be carried out
1300	Optics	OS2	2	NRL	Ageing of multilayer coatings	Instrument throughput reduced.	Perform life tests on coatings whose ageing properties are unknown.	Reduced to 2 on advice from NRL
1300	Optics	OS3	2	NRL	Scanning mechanism failure	Loss of scanning and alignment compensation	No possibility to move outside of functional position. Monitoring and management of movements during mission. Successful qualification and lifetest program performed	
1300	Optics	OS4	2	NRL	Grating focus mechanism failure	(fail in focused position) Flat-fielding of detector no longer possible. (fail in de-focused position) loss of science	. Successful qualification and lifetest program performed.	
1600	Shutter	OS5	1	NRL	Shutter failure	(fail closed) Loss of instrument (fail open) image smearing	Select proven technology	. Successful qualification and lifetest program performed
1400	Filters	OS6	1	NRL	meteoroid strike on front filter	possible debris in the instrument. White light ingress to detector - worsens SNR. Heat input to instrument - thermal stresses and consequent misalignment	Recess filter in exterior baffle. Use segmented filter design to limit area of breakage.	
1500	Slit	OS7	2	NRL	Slit exchange mechanism fails	Fail in a nominal slit position - loss of rapid imaging facility Fails in viewfinder position - loss of spectroscopy in intermediate position - some spectroscopy retained	Select proven technology.	(assuming mechanism with one or more spectroscopy slit and a wide viewfinder slit) Life test for slit mechanism completed successfully
1710	CCD	OS8	2	MSSL	Radiation Damage to CCD	1. Dark current distribution 2. CTE change 3. clock bias drift 4. no longer operates (output FET latch-up)	Appropriate shielding to ensure life commensurate with mission Monitor dark current distribution periodically. Provide means to adjust operating temperature and clocking rate. Provide ability to adjust the clock bias levels. Above solutions are in place.	
1A00	ICU/MHU	OS9	2	MSSL	Radiation Damage to electrical component	Data degradation Latch-up – loss of function	Component selection to be rad hard to required level. Local shielding as required.	Radiation screening program is being investigated for susceptible components where rad hard componenets are unavailable (mainly analogue devices) Above program completed successfully
1710	EIS	OS10	4	MSSL	Contamination of CCDs (other than described in OE2 i.e. prior to delivery to RAL)	Progressive loss of sensitivity and ultimate loss of instrument, uncertainty in intensity calibration	Contamination control plan, Front door closure, Purging, QCM, CCD Heater, venting paths	Review of MSSL handling procedures in light of contamination control plan MSSL cleanroom upgraded with charcoal filters, CCDs held in bonded stores and chamber cleaned to be in line with cleanliness budget (although the present chamber life is short)