


SOLAR-B E I S  EUV Imaging Spectrometer	Management Plan	manplan 2
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Change History

Issue, Date	Author	Section	Changes
1.2d, Feb 15 1999	M. Whyndham	2.2	Added contact list .
		2.2	Removed Organigram.
		3.5	Added material in Definition of System Design and Interface .
		3.11	Added material in Treatment of Risk.
2, July 16, 1999	M. Whyndham	2.1	Added actual institutes and WBS
		2.2	Restored Organigram Figure 1
			Added Interface Information Organigram (f. 2)
		2.3	Revised SDT roles
		2.4	Revised Planning & Reporting
		2.5	Elaborated Archive concepts
		3.1	Table (2) of Models Added
			Model Philosophy clarified
		3.3	Removed Requirements management chart
			Clarified Requirements concepts
		3.4	Design Criteria edited
3.5	Minor edits		
3.6-3.10	Edits throughout. Reference to future plans		
3.11	Updated		

1. Introduction

This document is the top level plan for management and systems engineering for Solar-B EIS (the EUV Imaging Spectrometer).

This plan will eventually supersede the management plan in the UK proposal. It also covers the activities of non-UK institutions.

The plan will be evolved as the project progresses.

2. General Management

2.1. Responsibilities of Institutions

The institutes who will contribute instrument hardware and software for EIS are:

Mullard Space Science Laboratory (MSSL), University College London

University of Birmingham (BU)

Rutherford Appleton Laboratory (RAL)











US Naval Research Laboratory (NRL)

NASA Goddard Space Flight Center (GSFC)

PPARC is the UK funding body for this instrument. NASA is the funding agency for the US teams. ISAS is the Japanese body responsible for the Solar-B project.

The US partner was selected under the auspices of the three agencies since the last issue of this plan.

The breakdown of responsibilities is indicated in the Work Breakdown Structure (WBS) *EIS-sys-eng-wbs*. The table below is copied from version 2 (12 July 99) of the WBS. Some details of allocation of responsibility remain to be finalised.

WBS Code	Task Name	Resp.	
1000	EIS Instrument		
1100	STR Structure	BU	
1200	DOR - Aperture Door	BU	
1300	<i>Optics</i>	NRL	
1310	Optical Design		
1320	MIR - Mirror Assembly		
1330	GRA - Grating Assembly		
1400	<i>Filters</i>	NRL	
1410	FFA - Front Filter Assembly		
1420	FPF - Focal Plane Filter Assembly		
1500	SLA - Slit Assembly	NRL	
1600	SHT - Shutter	MSSL?	
1700	CAM - CAMera	MSSL	
1800	QCM	RAL	
1900	Thermal Control	BU	
1A00	ICU - Instrument Control Unit	MSSL	
1B00	WIR - Wiring Harness	MSSL	
1C00	CLM - Clamshell	BU	
1D00	MHC - Mechanism/Heater Controller	MSSL	
1E00	PUR - Purge Harness	BU	
1F00	VAC - Vacuum Harness	BU	
1Z00	On-Board Software	MSSL	
2000	Systems Engineering	MSSL	
3000	AIV	RAL	
4000	Project Management	MSSL	
5000	Operations Preparation	All	
5100	Hardware		
5200	Planning Software		
5300	Quick-look Software		
5400	Operations preparations		
6000	Science	MSSL	
6100	Science Team Meetings	All	
6200	PI and Co-I activities	All	
7000	Post Launch Operations	ALL	
7100	Operations Support		
7200	Equipment Maintenance		

2.2. Organisation of Staff

The main chain of responsibility is from ISAS, through the UK Principal Investigator (PI) to the Project Manager.

An organigram showing staff roles and reporting lines - mainly within the UK is shown in Figure 1.

All science-related correspondence in the project shall be raised with the UK Project Scientist, Louise Harra, and copied to the UK PI, Len Culhane. All technical correspondence shall be raised with, or copied to, the Project Manager (PM). The flow of Solar-B spacecraft interface information is through the EIS secretariat, Dr. H. Hara at NAOJ. This is shown in Figure 2.

In order to formulate the scientific and technical requirements of the instrument, the PM will work closely with the PI and will attend meetings of the Science Team.

Points of contact in each Institute for scientific and technical issues have been nominated as follows:

Institute	Science Contact	Technical Contact
MSSL, UCL	Louise Harra-Murnion cc. Len Culhane	Matthew Whyndham
Birmingham University	George Simnett	Saad Mahmoud Cc George Simnett cc Chris Castelli
RAL	Jim Lang	Jim Lang
Naval Research Lab	George Doschek	Clarence Korendyke cc George Doschek
NAOJ	Tetsuya Watanabe cc Hirohisa Hara	Hirohisa Hara cc Tetsuya Watanabe
ISAS	Takeo Kosugi	Takeo Kosugi
Cambridge University	Helen Mason	-
Imperial College	Peter Cargill	-
St Andrews University	Eric Priest	-

Individuals' email addresses and phone numbers are shown in the "Contact List" *EIS-man-contacts*. Institute addresses are found in the "Institutes List" *EIS-man-institutes*. Several email distribution lists have been established for Technical and Science topics, see the document "Mailing Lists" *EIS-man-mlists*.

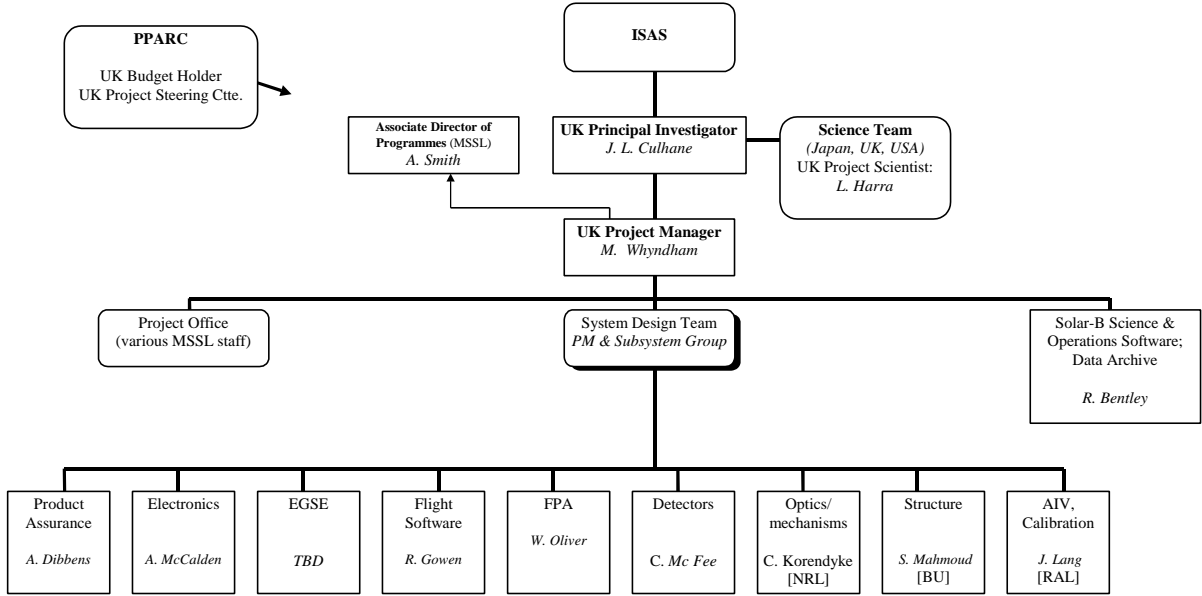


Figure 1. Organigram of Staff.

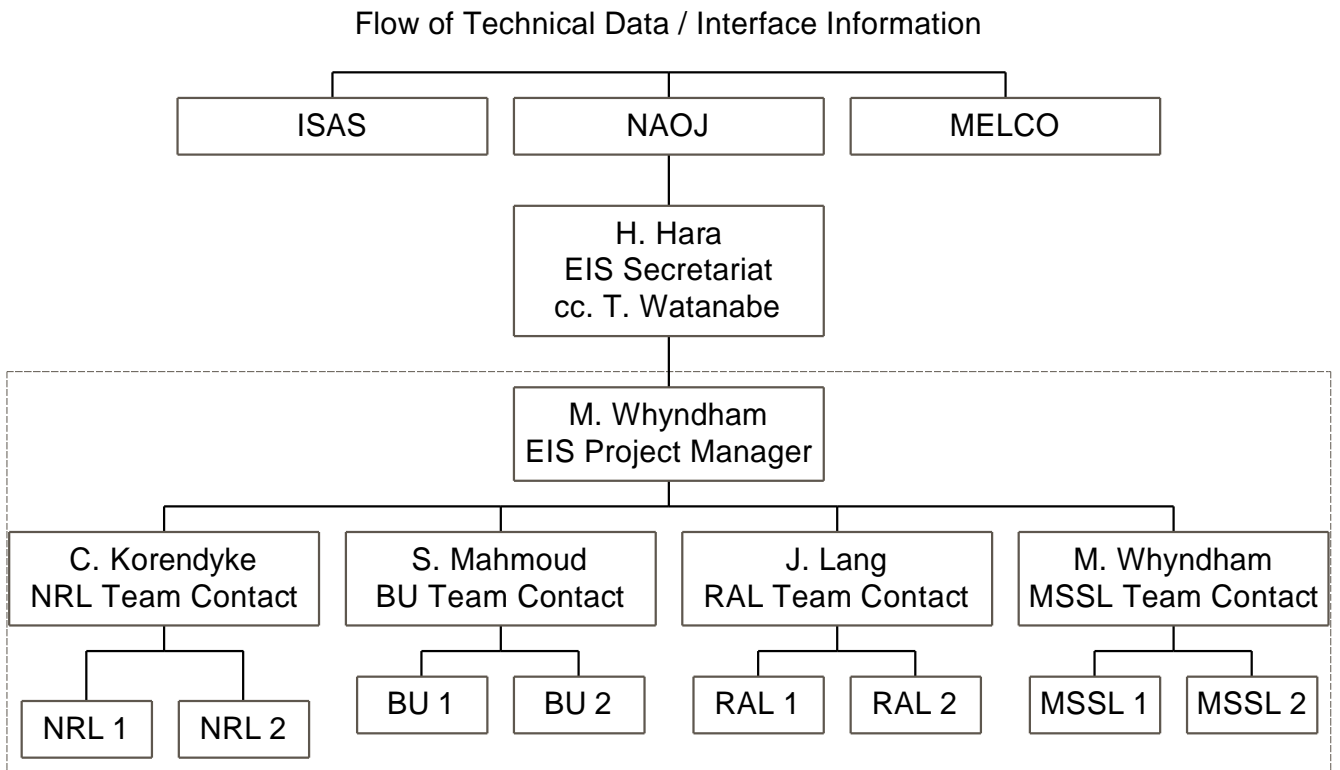


Figure 2. Flow of Interface Information.

2.3. The System Design Team

The System Design Team (SDT) will have the central role developing the instrument in response to the as-stated requirements. The SDT meetings will be chaired by the Project Manager and will include the individuals named in the technical disciplines shown in the diagram. For institutes other than MSSSL, these represent the points of contact for those institutes. The SDT will seek advice and information from others from time to time.

The SDT will hold regular meeting chaired by the PM. The main purpose of these meetings will be to advance the resolution of technical issues affecting the design and implementation, including test and calibration of the system. Other functions are listed (non-exclusively) in Table 1. Minutes of SDT meetings will be made available to all project participants.

<i>System Design Team Functions</i>	<i>Notes</i>
System Design	Identification and resolution of system-level issues
SEMP	System Engineering Management Plan, iteration and concurrence
WBS	Work Breakdown Structure, development and concurrence
Requirements	Development of system functional requirements, system specifications, system test requirements and any required subsystem documentation
System functional concepts	Development of operating concepts
Selection of design criteria	
Interface Definition	
Budget Management	For items which are subject to budgeting, such as mass, power, alignment, contamination etc.
AIV	Assembly, Integration and Verification (including system testing). Plans and oversight
Project Management Activities	Detailed Schedules and costing
Product Assurance	Plans and concurrence
Configuration Management	Plans and concurrence
Reviews	

Table 1. Roles of the system design team.

2.4. Planning and Reporting

In addition to this document, there are other key documents that relate to the planned work and actual progress of that plan. These include:

	<i>Document</i>	<i>Document ID¹</i>
•	The work breakdown structure	EIS-man-wbs
•	System Hierarchy	EIS-sys-des-hierarc
•	The overview schedule	EIS-man-schedule-overview

¹ A document having a document ID (EIS-...) is available on the project website, see <http://www.mssl.ucl.ac.uk/solar-b/>

- The budget (various documents)
- Risk Analysis EIS-sys-eng-risk
- Actions summary EIS-man-actions

Major areas of the system engineering activity will be embodied in their individual plans. These are either included in this document or presented separately should their size warrant it. They include:

- Requirements Management Plan
- Interface Management Plan
- Development Plan
- Product Assurance Plan
- Configuration Management Plan
- Integrated Logistics Support Plan

The Requirements Management Plan describes how the technical requirements of EIS are derived, recorded, validated and controlled.

The Interface Management Plan shows how system (EIS to spacecraft) and subsystem interfaces are recorded and controlled. Validation of interfaces of subsystems against the established design data is part of the Product Assurance (PA) Plan. The PA plan also covers other factors relating to assuring that the requirements can be shown to be met, either by design, or by demonstrating that the design is actually achieved. This includes all discussion of Risk.

The Development Plan, which may devolve to sub-system level development plans, will show what strategies are being used to develop a system design (such as which technologies are being employed or evaluated) or achieve a stated design. The development plan is a dynamic document. This will also describe the Build Standard to be used at each deliverable model.

A Design Status Document, to be described in the Configuration Management Plan, will identify which releases of all design documents, including design, documents and code, are associated with a particular iteration or model.

The manner in which the design evolves with respect to the various Design Reviews will be stated in the Configuration Management Plan.

Deviations of the actual hardware from the design condition are detailed in Non-conformance/Failure/Anomaly Reports. The format of these and the procedures for the resolution of the problems they describe will be described in Product Assurance Plan.

The Integrated Logistics Support plan relates to Maintenance, Support Equipment and Services, Test Equipment, Transport and Handling, Technical Data Packages, Facilities and Personnel issues.

Refer to the relevant sections of "Systems Engineering Management" in this document for references to each of the above plans.

- Minutes of meetings:
 - SDT meetings
 - MSSL project review meetings

Consortium Meetings

Funding agency steering committee meetings

Meetings of the SDT or relevant subsets are expected ~monthly on average, but no longer than two months apart. The meetings follow an agenda : *EIS-meet-sdt-genda*. Brief minutes of these meetings will be made generally available and circulated to the technical contacts. All significant systems engineering decision-making is done by or with the agreement of this group, which has representation from all parties having technical involvement in the instrument. A series of teleconferences between MSSL and NRL has been established. These are treated in the same way as SDT meetings. SDT meeting minutes are generally as *EIS-meet-sdt-minutesX*, X being the number of the meeting. The teleconference minutes are filed as *EIS-meet-sdt-tcXXXX*, where X is another serial number.

From time to time, there will be Engineering team meetings, with similar remit to the SDT, and Consortium Meetings, whose membership also includes the consortium science team and whose remit therefore extends to definition of the basic requirements. These meetings will also be minuted as *EIS-meet-cons-YYMMmins*, where YY and MM are the year and month of the meeting.

At MSSL, a Project Review Meeting (PRM) is held on a monthly basis at which the PM will make a report concerning the general progress of the project, with a particular focus on activities within MSSL. Other institutes may have similar internal mechanisms. The PM will make his PRM reports (*EIS-meet-prm-reportX*) available.

At intervals (~2 times per year) there will be a meeting of the PPARC EIS steering committee, to which each UK participant project manager will make a report and financial statement and other materials as requested.

2.5. Archiving of Project Material

It is intended that a project documentation distribution and archive system be developed which

- allows team members immediate access to up-to-date technical information
- allows visibility of the dependencies between information (documents)
- shows the configuration status of each item
- allows for historical use of the project material

The term Archive is used both in the sense of a repository of current material and a store of historical material. Certain types of electronic document will be permitted in the archive. See Appendix 1. Documentation standards.

The concepts of Configuration Control will bring additional requirements to the presentation of the documents. This issue will be addressed in the future.

Dependencies may be Illustrative references, or Substantive references between documents. Dependencies may be in either direction. It will be a goal to record, for a given document, what references are made by that document AND what references are made TO that document. A database system will be established to track these links.

It will be encouraged that all project documents are made available in electronic form.

The document archive will be propagated from MSSL to other team institutes, either by network transfer or by other media.

The present status is that a Document List now exists in the project website which is in common use. Propagation mechanisms to NRL have been established. However, the means to show dependencies, configuration status and historical data have not yet been developed.

3. Systems Engineering Management

3.1. General Approach

In this plan, the term "system" means the EIS instrument. The systems engineering approach adopted in this project should ensure that there is :

- Thorough understanding of the system requirements.
- Adequate knowledge and prediction of the system performance.
- Agreement as to the required function and performance of each subsystem.
- Adequate control of the development of subsystems and systems interfaces (to the required performance, on time, under budget).

Since the resources available do not extend to the employment of full time systems engineer, the responsibility for systems engineering is held collectively by the SDT. Additionally, the management techniques should not be laborious, and therefore the approach to systems engineering is relatively informal in most areas. However, particular attention is paid to documenting the needs, requirements and constraints of the system and subsystems. Refer to "Management of Requirements" later in this document.

3.2. Model Philosophy

The Model Philosophy describes the intermediate stages of design, development and test, the order and approximate timing of these stages and their relationship to the final, delivered instrument.

The Model philosophy for Solar-B (including EIS) is very similar to that employed in previous missions conducted by the ISAS (the Japanese Agency for space science). Some of the details, such as the names given to certain models, differ somewhat from ESA and NASA practice. This document adopts the ISAS terminology.

The spacecraft model philosophy consists of a Prototype Model (PM), a mechanical test model MTM (MTM), a Thermal Test Model (TTM), and the Flight Model (FM). As well as delivering the FM instrument, the EIS experiment team is also expected to participate in the PM, MTM, and TTM test programs.

This is a prototype (as opposed to protoflight) philosophy in that the qualification tests are performed on non-flight models.

The models of subsystems, the EIS System and their purpose are shown in Table 2.

<i>Model</i>	<i>Deliverable</i>	<i>Corresponding Spacecraft Model</i>	<i>Purpose</i>
Breadboards (Subsystem only)	No	none	Technology development
PM	Yes	PM	Verification of Electrical Interface Design. Development and testing at System level.
STM	Yes	MTM and TTM	Verification of Mechanical Interface and Thermal Interface Design.
QM	No	none	Qualification
FM	Yes	FM	Flight

Table 2. EIS models.

Breadboards (BB)

Breadboard models of many subsystems will be developed, the purpose of which will be to demonstrate the suitability of technology to be employed in later models, to expose any unforeseen problems which may exist and to further refine the system requirements.

The areas to be addressed within the UK are : Camera (focal plane assembly and readout electronics), instrument control unit, mechanism/heater drivers, structure and door. There will be a need for a software development platform.

Subsystem level tests (exact content of these tests is TBD) will be performed on these partial breadboards. Some partial integrations may be achieved at breadboard level.

The NRL group may elect to produce an optical breadboard system. This is TBD.

Pre-flight models (PM, MTM, TTM)

The Prototype Model (PM) is used to verify the functional operation of the system, including its electrical interfaces with the spacecraft and ground segment. Another model (or two models) is used for further (Mechanical and Thermal) spacecraft level interface design verification.

The PM will not be fully functional in that it will not contain optical elements. Mechanical and thermal properties need not be representative of the final design, except where necessary for validation in the areas which are tested. The validation tests to be performed on this model will include (TBD) :

- electrical interfaces with spacecraft
- initial system (EIS) level electromagnetic compatibility
- instrument software
- interaction with spacecraft and ground segment software

The PM may also be used as a platform for further electronic and software development.

It is possible that the PM units may be refurbished to FM build standards. These units will be termed Qualification Model (QM). They will be used for qualification tests of the flight design.

There will be two models of the spacecraft which will be used for mechanical and thermal tests. They are called the Mechanical Test Model (MTM) and the Thermal Test Model (TTM). These will undergo separate programs of tests. Consequently there is a need for a suitable model of EIS to participate in each of these tests. It is anticipated that a single model strand (the STM) of EIS units and system will satisfy both tests.

Mechanical test Model (MTM): this is highly representative in mechanical terms but will contain no optics or electronics. All the mechanical qualification tests will be done on this model :

- vibration and acoustic tests
- confirmation of subsystems vibrations level
- mechanical qualification of various subsystems

Thermal Test Model (TTM): This will have sufficient representation to allow thermal qualification of the design. It will contain no optics or electronics. The following qualification tests are done on this model:

- thermal balance
- thermal vacuum

The results of both the MTM and TTM tests could be used in the further development of the instrument flight model (although the schedule does not allow significant interval between MTM/TTM test and FM manufacture).

Comment : There are no optical components in any of the preflight models. Some additional methods of gaining confidence in the optical technology (production, alignment, etc.) may be necessary.

Flight Model (FM)

At this stage of development a high level of confidence in the design will have been obtained from previous models.

The flight model (FM) is the only model to be fully calibrated. It is also the only model that contains a set of optical elements (not including optics breadboards).

It will be used for system level mechanical and thermal testing together with performance verification/ validation tests to demonstrate full compliance with requirements. The level of the testing is TBD (e.g. environmental tests could be at a lower - "acceptance" - level than the qualification tests carried out during the MTM/TTM phase).

Some further, minor, development of the FM design can be expected during FM integration.

Spares

There will not be a complete spare instrument, nor indeed a complete set of spare parts, but rather a spares philosophy will be adopted which involves the provision of key items and contingency planning. This posture is adopted as a means of reducing costs. Critical items which require spares will be identified prior to FM parts procurement.

3.3. Management of Requirements

Requirements Management Plan

The development of the system (the EIS instrument) is controlled at the highest level by three documents, namely the User Requirements document, the System Requirements document and the System Specifications document.

The User Requirements document expresses the scientific goals which the system's operation will achieve.

The System Requirements document is partly a Functional Requirements Document. It reflects the User Requirements by stating the functional requirements of the system in measurable terms (what the system must do and how well it must do it). Any additional requirements or technical and managerial constraints are also contained in this document. This covers the spacecraft resource allocation, interfaces and environmental characteristics.

The System Specification document describes how the system will meet the requirements. This will refer to the technology to be employed (whereas the Requirements do not). It is recognised however that there will be some iteration between the capabilities of the solution and these requirements, the aim being to arrive at an achievable set of requirements.

Each of these documents is described in more detail below.

If there are competing solutions, which otherwise meet the requirements, then each will have its own Specifications document. Each Specification document will refer for further detail to a Design Document. The Design document refers to all other technical documentation related to that solution, including where appropriate a set of Requirements, Specifications and a Design for each subsystem.

Competing solutions will be subject to evaluation based on the Design Criteria.

The User Requirements document

There is a wide interest in the outcome of the Solar-B mission in the solar physics communities of the U.K., Japan and the U.S.A. The interests of these communities are partly represented by the funding agencies in each countries. Their interests have also been expressed in reports such as Solar-B Science Definition Team - Final Report, and others. These are the broad needs.

However, it is not the intention of the PM or the SDT to comprehensively address the broad needs. The User Requirements document records the specific requirements of the EIS consortium, as represented by the Principal Investigator (PI) and the Science Team. It will be the responsibility of the SDT to ensure that the User Requirements are well formed and measurable.

For the purposes of the User Requirements Document the PI and the Science Team are regarded as the Users of EIS.

The System Requirements document

This document contains the System Requirements that emanate from the User Requirements (scientific requirements), and the other requirements. The latter are technical constraints (due to accommodation of the instrument on the spacecraft), managerial constraints, interface requirements, and others. The origin of these will be justified.

This document states what should be achieved but does not state how it is to be done.

The System Specifications document

This document elaborates on the System Requirements document and will contain an outline of a technical solution to the problem posed by the requirements.

This document will contain a statement of what elements comprise the system and what interfaces exist, both between them and externally (with the spacecraft). It will also refer to a document known generally as the Design Document.

This document will be subject to review at the PDR and CDR.

The Design Document

This is the top-level design document for the system. It contains or refers to

- System hierarchy
- Interface List
- System-level interface properties, including interface drawings etc
- Subsystem details – function of each subsystem, description or reference to further details
- Matrix relating system and subsystem requirements
- Performance data for each subsystem, and relationship to the system performance

The management of interfaces is described in section 3.5.

3.4. Design Criteria

Design Criteria constitute the rules for prioritising competing designs. Competing designs are those which meet the requirements (and are therefore satisfactory in other respects). Very often these choices are made implicitly. Here we explicitly state each

Criterion that is presently known, firstly in general areas applicable to the whole system and secondly in particular technology areas or subsystems.

This list is presented as material for discussion in the SDT.

The general criteria are as follows:

Management : success is defined in relation to three main drivers.

- Performance. The stated performance must be met. Moreover, it would be advantageous to exceed the performance levels indicated in some of the requirements. These include at least Temporal Resolution, Spatial Resolution, Spectral Resolution and Sensitivity. Others of this nature should be indicated in the requirements.
- Cost. Budgets are fixed, and there are penalties for exceeding agreed budgets. Therefore cost savings should be sought on each item, since the savings could be utilised elsewhere. Costs are under continual review.
- Schedule. The date of the main schedule driver (the launch) is fixed. Intermediate milestones in the Spacecraft schedule are also fixed.

Technology

- Innovation: A balance must be reached between the use of existing skills and technical heritage and the development of new technologies. The SDT should address this by discussion of risks, development costs and technical performance.
- Modularity : allow sharing of the work. (e.g. with other institutes) or re-use of previously developed technology.
- Complexity of Interfaces. If interfaces are simple, then sub-systems are more complex. If interfaces are complex then modularity is more difficult to achieve. There is a human cost of interfaces. Interface design must find a balance between these drivers.
- Ease of Integration/Testability
- Lifetime / Reliability
- Commercial Value

3.5. Definition of System Design and Interfaces

Interface Management Plan

Two aspects of system design over which control will be exercised are

- Interfaces with the system (the spacecraft interface is one such)

- Interfaces internal to the system.

Both are controlled through the mechanism of subjecting interface control documents to configuration control procedures. All interface control data progress through the same stages through the project:

1. Definition of Interface Document Form and Content
2. Interface Requirements Stated
3. Design of Interface Details
4. Statement of Interface Specifications
5. Interface Test Procedures
6. Verification of Interface Specifications by Test

The system interface requirements are essentially derived from the system requirements. The remaining Interface Requirements (2) express the Functional Baseline (output of the System Requirements Review). The Preliminary Design Review validates the Allocated Baseline and approves the start of Interface Detail Design (3). The Critical Design Review validates the Interface Specifications (4). Review of the Subsystem Test Reports (6) will allow system integration to proceed. System Test Reports (6) will confirm that the instrument is ready for integration with the spacecraft.

In this project, all interfaces are listed in a master interface list [*EIS-sys-des-mintlist*]. It states for each known interface:

- the subsystems which share the interface
- the institutes who will contribute to its definition
- the status of the interface (e.g. Draft, Functional Baseline, Allocated Baseline)
- a reference to the Interface Control Documents

Four Interface Control Documents (ICD) may be present for each interface.

1. Mechanical Interface - including Mechanical Interface Control drawings, details of mating surfaces, connector type and location, vibration environment
2. Thermal Interface, Thermal Properties and environment, thermal radiation and conduction properties of interface points, heat capacities, permitted temperature ranges.
3. Electronic Interface - connector pin function, data link specifications and equivalent circuits, data protocol, data inputs and outputs (a software interface), EMC emission/susceptibility, magnetic properties
4. Other Interface - Environmental details not already covered (radiation, molecular and particulate contamination), optical properties, - Reliability and Quality levels, - Human interface, - Safety constraints.

Each ICD will be prepared to a format specified by the Project Manager. These formats will be specified in [*EIS-sys-eng-icdform*]. They (ICDs) will be authored jointly by the institutes concerned. Approval for the project will be by the Project Manager. Approval for incorporation of an interface document to be part of a baseline design (Functional, Allocated) will be by Review as indicated above.

3.6. Design Reviews

This section will contain details of all the reviews. The following are scheduled at the time of writing:

- Preliminary design review (PDR)
- Critical design review (CDR)

Other reviews may be required during the programme. These may include the following:

- System requirements review (SRR) - prior to the PDR
- Flight model critical design review
- Flight readiness review

Other reviews may be undertaken at subsystem (unit) level, depending on the criticality of each subsystem.

Preliminary design review

The purpose at the preliminary design review is to demonstrate the feasibility of the design. The following will be submitted for review:

All specification documents, including software specifications

- The Design Document
- System hierarchy
- Interface description (i.e. documentation of each subsystem interface)
- Test plans
- Logistic support plans
- The management plan itself and associated reference documents

Following this review detailed design can begin. The interfaces are frozen (under configuration control?).

Details (internals) of the subsystems need not be fixed at this time. There could be major areas requiring further study.

Critical design review

The purpose of the critical design review is to gain confidence in the detailed design so that production (of PM and STM level subsystems) can begin. The risks of implementation should be well understood and acceptable.

Material to be available at this review will include (as well as updated versions of the documents brought before the PDR):

- Schematics
- Interface and drawings
- Drawings of major components
- Data flow diagrams
- Results of feasibility studies and tradeoff analyses

3.7. Evaluation of System Performance

The System Test Plan, which will later be included here, will show how system performance is to be evaluated at various times, give an outline of full and abbreviated performance tests, and their relationship with calibration tests.

3.8. Assembly, Integration and Verification (AIV) Plan

The AIV Plan will show how the instrument will be brought together as a system from its units, for each of the models which exists as a system. This will include full references to all the necessary assembly and test procedures. An important aspect of the system verification is the End-to-End calibration of the instrument.

3.9. Integrated Logistics Support Plan

This plan will be elaborated in future editions. Topics will include:

- Supply (e.g. purchasing)
- Test equipment
- Transportation and handling
- Technical Data Packages
- Facilities
- Personnel and Training
- Other Services

3.10. Product Assurance Plans

A PA plan will be developed for EIS, based on existing PA plans.

The topics will include

Quality Assurance

- Procurement Controls
- Incoming Inspections
- Test Witnessing
- Surveillance of Manufacturing
- Manufacturing Logs
- Cleanliness and Contamination Control
- Non-conformance Control
- Metrology and Calibration
- Handling, Storage, Packaging Procedures

Configuration Management

Project Documentation
Design Freezes
Baselines
Contractor and Supplier Management

Reliability Assurance

Risk Register and Risk Analysis
Failure Modes
Design Rules

Component Quality

Procurement Guidelines

Materials and Processes Selection

Safety Assurance

3.11. Treatment of Risk

(This section will be later included in the Product Assurance Plan).

It is necessary that the EIS instrument perform in accordance with its requirements throughout the planned mission and that the development programme be conducted in a timely and cost effective manner. There is always a finite probability that the development programme may not result in the delivery of an instrument that meets its initial requirements (termed "programmatic risk") or that the instrument may not perform to requirements throughout the mission life ("operational risk"). The programme will be managed to ensure an acceptable level of each these risks.

The degree to which risks can be reduced depends broadly on the time and resources available for development in relation to the requirements. Given that the programme has finite resources and a limited schedule, the first task must be to ensure that there are no unnecessary requirements.

The consortium will declare what its attitude to risk will be in relation to the likely scientific return of the instrument.

Certain established design criteria may be in conflict with risk reduction - for example a desire to use innovative technology. These conflicts will be exposed where they exist and a stance taken at consortium level.

Within the framework established by time, resources and requirements and attitude to risk, particular elements of the total risk can be ameliorated in several ways.

Programmatic risks are first reduced by assessing the system requirements. Excessive requirements are avoided.

The production processes of technological items are then studied. Margin in performance may be included in the specification of subsystems. Where the

performance of a subsystem can deviate from an ideal value a budget for errors will be calculated, or its quality will be controlled to the required level. This is the subject of the Product Assurance plans. A means of escaping the consequences of failures, should they occur, will be sought. The existence of such fall-back options will be considered for each item where there is an appreciable development risk. In cases where the risks are high such options will be actively developed.

Management of operational risks demand the following types of responses: avoidance of hazardous conditions (processes, materials, operational procedures), escape from consequences of failure (e.g. by redundancy), management of degradation (by monitoring of condition).

Assessment of programmatic and operational risks will be a function of the Project Manager/Systems Engineer and the System Design Team, and will result in a series (at various stages during the life of the project) of system-level risk analyses.

This document is "Risk Analysis" *EIS-sys-eng-risk*
Issue 1, 15 July 99

This includes a statement of the programmatic risk and operational risk for each WBS element (all level 2 items and some level 3 items) in the system as well as for the system as a whole. Reference may be made to sub-system level risk analyses - these will be prepared by the responsible groups.

Each risk source will have an "owner", whose task it is to manage that risk, i.e. make quantitative assessment, suggest mitigation, provide evidence of achievement of quality etc. The ownership of each risk is stated in the Risk Analysis.

Appendix 1. Documentation standards

Document Identification System

All documents in EIS are uniquely identified by an alphanumeric string. Document Identifiers in the EIS project conform to the following general scheme. As far as possible, all documents are stored electronically, and the storage location in the archive (the file name) can be identified directly with the document identifier.

There is a system for documents generated within EIS and a notation for documents generated outside.

Documents created within EIS

Internal Document identifiers have five fields

Field	1	2	3	4	5
Purpose	Project Name	Subsystem	component or lower level system	Label	Issue details
Notes	"EIS" is used to distinguish project documents from those in other projects	These are the first level items in the WBS	Lower level items in WBS	This field describes the content of the document. If possible use a unique, memorable string.	Any numeral with optional suffix "d" indicating draft status. A single point may be used to differentiate minor releases.

Fields 2 and 3 should be taken from the WBS issued by the project manager.

The full document identifier is constructed from these fields, separated by '-' (hyphen). "EIS" is written in capitals and the rest are lower case. It is recommended to show such identifiers in italic to distinguish them from surrounding text.

For example, the following shows the format : *EIS-unit1-section2-swnotes-3.27*, where Unit 1 and Section 2 are phrases in the WBS. The Label "swnotes" indicates that the document might contain Software Notes. The final numeral indicates that the document is at Issue 3, release 27.

File names are constructed from the same document identifier fields, using whatever separator characters are required by the file system (e.g. '/' or '\'). An additional suffix is used to denote the document format (e.g. .txt, .doc, .pdf).

The file types which may be encountered are TBD.

The full location is found by prefixing the location of the document archive (this may vary depending on site and implementation).

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Documents which originate outside EIS

External documents are denoted differently. If the document has a clear number or other concise reference (as in a Journal Paper) then that is used. Otherwise If the document does not have a clear number then it is given a serial number in a table of such documents maintained by the project manager. These are of the form

EIS-x-###

The letter x denotes the fact that it is an external document. ### may be any number. For example:

EIS-x-2 : *The Solar-B Mission - Final Report of the Science Definition Team*, June 19, 1997. (Various authors). <http://www.ssl.msfc.nasa.gov/ssl/pad/solar/sdt-rpt.htm>