SOLAR-B EIS EUV Imaging Spectrometer	***UK Science and Technical Meeting*** *MSSL 2-3 June 1998* **Minutes**

Meeting chaired by Len Culhane (JLC) and Matthew Whyndham (MTW).
Minutes prepared by Matthew Whyndham on 01 July 1998.

Attendees

Name		Tue	Wed	Affiliation
Castelli, Chris	(cmc)	✓	✓	Birmingham University
Simnett, George	(gms)	✓	✓	Birmingham University
Mason, Helen	(hem)		✓	Cambridge University
Cargill, Peter	(pjc)		✓	Imperial College
Bentley, Bob	(rdb)	✓	✓	MSSL
Breeveld, Eddie	(erb)	✓		MSSL
Culhane, Len	(jlc)	✓	✓	MSSL
Gorel, Veronique	(vg)	✓	✓	MSSL
Gowen, Rob	(rag)	✓		MSSL
Harra-Murnion, Louise	(lkhm)	✓	✓	MSSL
McCalden, Alec	(ajm)	✓	✓	MSSL
Matthews, Sarah	(sam)		✓	MSSL
Oliver, Wilf	(wto)	✓		MSSL
Smith, Alan	(as)	✓		MSSL
Welch, Steve	(sjw)	✓		MSSL
Whyndham, Matthew	(MTW)	✓	✓	MSSL
Kano, Ryouhei	(rk)	✓	✓	NAOJ
Harrison, Richard	(rah)		✓	RAL
Lang, Jim	(jl)	✓		RAL

Agenda

Given delayed arrivals and consequent reorganisation of the original agenda[1], the order of topics in these minutes differs from the order in which the items were raised.

[1] circulated by e-mail (by Matt Whyndham - mwt@mssl.ucl.ac.uk).

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Opening Remarks

JLC opened the meeting by welcoming all participants to MSSL and introducing those present. The meeting was reminded that in consideration of the requirements of NASA's selection process, that this meeting should be regarded as confidential.

He then presented some notes[2] relating to :

- General status of Solar-B programme in UK, Japan and USA
- Detailed work programme and aims for project teams to 10/98
- NASA AO Process and AO Briefing meeting
- Discussions with Norwegian representatives

The NASA Announcement of Opportunity (AO[3]) briefing generated a series of questions and answers[4].

The overall goals of the work program to 10/98 (week 45) are embodied in the following actions. These are high-level actions in that they will be considered closed when their lower level actions have been undertaken. See "inputs" column of Summary of Actions table.

Action	**Consortium**	**Revisit the Solar-B scientific requirements and quantify the EIS response to them.**
Action	**Consortium**	**Be prepared to evaluate quantitatively designs proposed in response to the US AO.**
Action	**Consortium**	**Quantitatively compare the performance of all such designs with previous instruments e.g. SOHO/CDS.**

[2] distributed at the meeting.
[3] http://www.hq.nasa.gov/office/oss/ao/98-oss-05/ - copies also available on request from mwt.
[4] Two documents (source - Bill Wagner) distributed at the meeting. Set 1 comprising 50 Questions, Set 2 Comprising 7 Questions. They're all on the web: http://www.hq.nasa.gov/office/oss/ao/98-oss-05/s-b_ppb_q&a_6=5=8.html

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Project Organisation at MSSL

AS showed an organigram[5] showing staff roles and reporting lines - mainly within the UK. The main chain of responsibility is from ISAS, through the UK Principal Investigator (PI) to the Project Manager.

All science-related correspondence in the project should be copied to the UK PI, Len Culhane. All technical correspondence should be initiated with, or copied to, the Project Manager (PM), Matthew Whyndham (MTW@mssl.ucl.ac.uk).

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. The Management plan (as described in the UK Proposal) will be developed.

The System Design Team (SDT) will have a central role in forming the design of the instrument in response to the as-stated requirements, and implementation of that design. 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 MSSL, these represent the points of contact for those institutes. The SDT will seek advice and information from others from time to time. Minutes of SDT meetings will be made available to all project participants.

Action MTW Continue development of the management plan, distribute when mature

Action MTW Convene initial meeting of the System Design Team.

Action MTW Distribute a project contact list.

[5] Distributed with these minutes.

Spacecraft and EIS Schedules etc.

MTW displayed the current Solar-B top level schedule[6], and the top-level schedule for EIS. Both these charts are distributed with these minutes.

These schedules show the main phases of activity from the present through launch and the commencement of operations. The following are particularly noteworthy milestone dates:

Date (dd/mm/yy or mm/yy)	NASA AO milestone	Solar-B activities	Notes
15/06/98	Phase A model contract		
3/08/98	Proposal Deadline		
10/98	Selection of Investigators		
12/98	Phase A (concept study)		seven months duration
Dec 99		PDR	Preliminary Design Freeze
July 1 2002		SOT FPP delivery	Solar Optical Telescope Focal Plane Package
Aug-Oct 02		FM MIC/EIC	MIC = Mechanical Interface Checks EIC = Electrical Interface Checks
March 1 2003		Other Instrument Delivery	i.e. EIS
Feb 04		Launch	

There was a discussion relating to the Model Philosophy for Solar-B.

Action MTW Re-issue EIS schedule with NASA AO dates etc.

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Spacecraft Design

RDB summarised the presentations[6] of the Solar-B spacecraft design which were given at the AO briefing. These represent the latest information about the spacecraft properties. It was stressed that the spacecraft design is still evolving. A prime contractor for the spacecraft has not yet been selected.

A table of vibration levels was shown (page 20), based on earlier flights of the M-V rocket, however acceptance and qualification levels for instruments remain essentially undefined. A mathematical model of the spacecraft shows resonance frequencies of 18.9 Hz and 20.6 Hz (see pages 22 and 23 of the spacecraft description for explanations of these modes).

The spacecraft designer's desire was expressed that EIS should become shorter in length than shown (p. 17). Note the launch-lock shown in case 2 of this figure. The need for a launch lock is not settled.

If operation in eclipse season is required (it is seen as desirable by ISAS) then the thermal control requirement could be more severe.

Noted existence of "tent blanket" (p 29). Other thermal control measures at spacecraft level are TBD.

The spacecraft mass budget (p 30) indicates thruster fuel for 5 year mission, but BASELINE operation is 2 years. Nearer the launch the position will be made clearer. Thus the design life should be 2 years.

Attitude disturbance frequency distribution plots (jitter spectrum) and notes thereon were shown (p 49 and on).

Action All involved in Mechanical subsystem Design
The appropriate limits of generated attitude disturbance need to be included in the EIS system requirement. The limits may be achieved by including balance motions or other compensations in the mechanisms of EIS.

[6] Originally given by Saku Tsuneta. A selection was distributed at this meeting. 57 pages in complete set. Master Schedule is on p. 57.

EIS Science

Given the likely significance of constrained resources at NASA when the AO responses are being evaluated, it was recognized as essential to formulate a UK position which would allow -

1. Rapid and informed commentary on all aspects of the US proposals for involvement in EIS.

2. Quantitative comparison of EIS concepts and performance with previous instruments e.g. CDS, SUMER

3. Deployment of strong arguments as to the scientific importance of EIS for the Solar-B mission as a whole.

This input will require to be presented to Japanese colleagues as it is prepared and to NASA in the period from 3 August, 1998 (US proposal submission deadline) to mid-October (US proposal selection date)

Following a detailed discussion of the relative importance of spectroscopic determination of plasma velocity, density and temperature for coronal and transition region plasma, the need for broad temperature coverage, the role of abundance determinations and the interplay of spatial and spectral resolution, the following actions were agreed -

1. Assess the scientific strengths and weaknesses of several wavelength ranges namely 170 - 210 Å, 240 - 300 Å (EIS baseline), 308 - 380 Å, 517 - 633 Å and 1330 - 1428 Å

Action (RAH, HEM) Circulate first draft comments (strengths and weaknesses of several wavelength ranges) by early July and have final comments for the UK Science meeting 28 July.

2. Prepare one page Summaries on the importance of EIS on Solar-B for a range of science topics. Format and content to be loosely modeled on the SOHO CDS Blue Book Study Form[7] and based on the current EIS baseline design. Each Summary should conclude with a positive argument for the necessity of EIS in obtaining the necessary data. Topics and agreed authors are -

Network Dynamics	Richard Harrison	
Active Region Cool Loop Dynamics	Louise Harra-Murnion	
Coronal Holes	Len Culhane	
Particle Acceleration Issues	George Simnett	
Flares - Mass Motions in Coronal Lines	Peter Cargill	
Flares - Reconnection inflow/outflow	Peter Cargill/Saku Tsuneta	
Flares - Plasma Dynamics/evaporation	Len Culhane	
Flares - Non-thermal Line Broadening	Louise Harra-Murnion	
Abundance Anomalies	Helen Mason	
CMEs - Role of Reconnection in the Onset	Richard Harrison	
Diffuse Corona - Streamer Dynamics	Len Culhane	
Loop Heating	[Eric Priest]	[Suggestion for Eric by JLC]

The role of EIS in the context of the photospheric magnetic field and velocity measurements should be briefly addressed in each case. All present agreed to consider other possible topics in consultation with Japanese colleagues e.g. Hara, Kano, Kosugi, Tsuneta, Watanabe.

[7] Blue Book a.k.a CDS Scientific Report - sample of Study description distributed with these minutes.

ACTION (those listed above) One page science summaries of EIS's utility in various applications
First drafts circulated by early July. Final comments by 28 July

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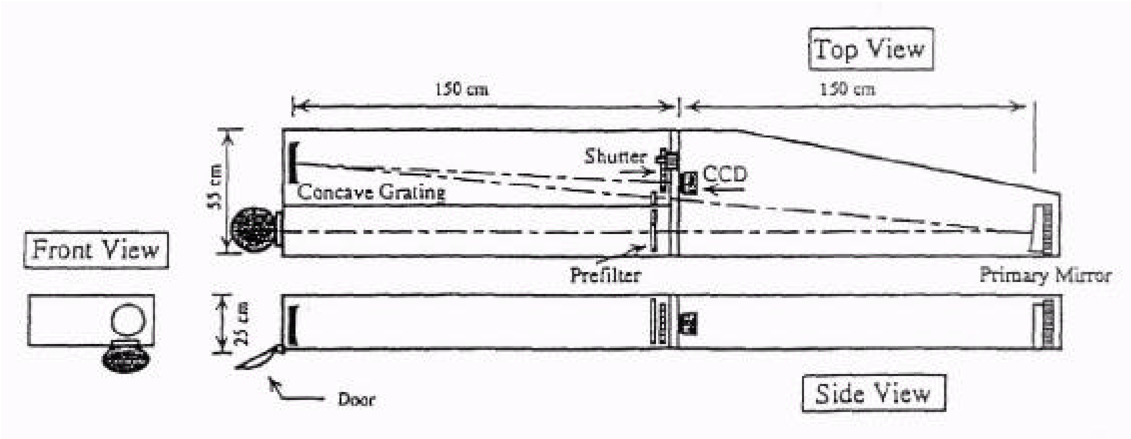
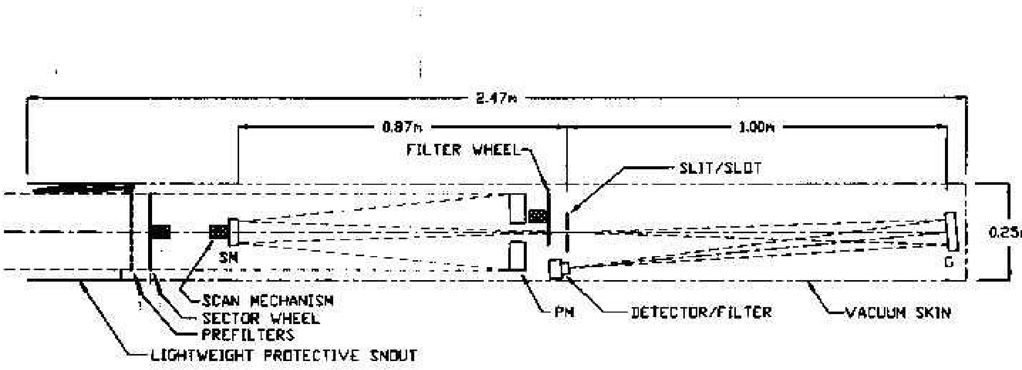
EIS Design



Baseline Design



Cassegrain Option

The Baseline design was shown (Figure 22 from the Science Definition Team report[8]), as well as a configuration (Cassegrain) favoured by Doschek et al.

Optical and Mechanical Design of Structure

The table of mechanical tolerances of the optical components due to Hiro Hara (from the material shown at EIS design meeting at ISAS May 98) was also reviewed.

Comments invited from BU:

BU have already performed finite element modelling of baseline. This was OK (e.g w.r.t. resonant frequency) given 20 kg allocation. It seems desirable to change to composite technology, in order to save mass, as well for other technical reasons (An electronics box for SMEI is being designed in a composite to develop expertise).

[8] http://wwwssl.msfc.nasa.gov/ssl/pad/solar/sdt-rpt.htm - if you can't wait for the 87 MB postscript file to download ask mwt for a paper copy.

Regarding the maturity of composites for space, it was noted that there is now a wide range of available technologies (e.g. CFRP, Graphite-Cyanate, Graphite Epoxy). Stability problems of old are becoming solved. The outgassing properties of any candidate material would need to be known.

Frequency response for composite structures was not seen as a problem (generally such structures are sufficiently stiff to avoid such problems).

There are various options for obtaining the required mechanical tolerances. Regardless of the material chosen for the structure as a whole, a metering system could be used to define the positions of the optical components. This could be fabricated from metal (e.g. Invar) or a composite.

There is a need to develop an optical mathematical model of the candidate spectrometers.

Action (AS, +RH, MTW) develop a Zemax model of the baseline and others. Parameters which must emerge from this model include
- What are the required tolerances of the optics? Position? Alignment?
- What is the allowed envelope for the camera head?
- Where is the direct (zero order) image?

Contamination Control

Control of contamination to the optical surfaces in the spectrometer is a serious issue.

The consensus was that purging was a very much preferable approach to constructing the spectrometer as a vacuum vessel. A quick review recalled that CDS, TRACE and LASCO were purged whereas EIT was a sealed vessel.

Matters to be addressed in future relate to shipping and pre-launch activities. (For example what manifolds, umbilicals etc. may be needed to carry purge gas to the instrument at various times including in the launch fairing?)

The details of the Quartz Crystal Monitor (QCM) used on CDS to monitor contamination levels was were received from RAL. Design of the necessary drive electronics can now be commenced.

It was felt that two monitors would be required in the baseline EIS, one being placed close to the primary mirror and another close to the grating.

Spectrometer Thermal Design

BU is baselined to supply a radiator for EIS. The problem of a side-facing radiator was recalled (wherein the radiation due to the Earth cause the radiator temperature to rise well above the target temperature for the CCD.)

Solutions to this problem could be found

- by having shields associated with the radiator (e.g. as in TRACE)
- by angling the radiator toward the rear of the spacecraft (noting that the fairing envelope would be somewhat limiting in this regard, but also that deployable radiators are in principle possible (cost?))

The coupling of any radiator to the CCD was considered. If this was performed by a long bar then this could be a vibration sensitive component. Previous missions have utilised locking mechanisms (e.g. JET-X). The issue of whether the design should include a cold finger (colder than the CCD surface) was considered but not settled.

It was also noted that the camera will most likely need a bakeup facility.

Action (MTW, +DMW) Determine ideal CCD temperature. Consider: Dark Current, CTE, Radiation Damage.

Action (MTW, +DMW) Determine need for CCD baking cycles (e.g. EIT?).

Action (WTO, +MSC) Examine JET-X use of thermo-mechanical elements for radiator coupling.

Action (WTO) Examine options for radiator - angle, shielding, deployment.

Action (+SM, WTO) study need for active thermal control of structure.

There is also a need to have more detailed information about the thermal properties of the spacecraft.

Detectors

Activity in the detector area is mostly focussed on determining the ideal temperature for the CCD. See **Spectrometer Thermal Design.**

MTW will accompany the team from NAOJ calibrating CCDs at the UVSOR synchrotron facility in Nagoya, where beam time has been booked 30/6/98 to 3/7/98.

MSSL has now received funding for a full-time Detector Scientist to be permanently attached to the team. This person will be appointed as soon as possible.

Filters and Shutters

The primary filter's main purpose is to reduce the heat load to the spectrometer. It also reduces visible light input. Being a large unsupported sheet of material, the primary filter will be subject to acoustic stresses during launch assuming that the spectrometer is not sealed. In that case it must be protected on both sides by a "clamshell" device.

Damage to the primary filter is possible due to impacts with orbital debris and meteoroids. MTW is in receipt of a calculation (origin MSFC, courtesy of Saku Tsuneta) of the debris/meteroid threat to Solar-B.

Action (MTW) study the Debris document, assess need for "snout"

The secondary filter ensures that the CCD does not see visible light. It is not be confused with additional, deployable, filters which might incorporated in order to improve the dynamic range of the instrument.

The shutter is the only way of controlling the exposure times if, as in the baseline device, the CCD is not a frame-transfer device.

A shutter design from Lockheed was shown. This can be used as a basis for EIS. A suitable form for its vane can be produced if the exposure times are known.

Action (JLC, MTW) study dynamic range issues and likely exposure times.

Information about filters from Luxel[9] was available.

[9] Luxel of Friday Harbor, WA. www.luxel.com

Instrument Electronics

The block diagram of the EIS electronics, as prepared for the UK proposal was compared to the Shimizu "Data Flows" and "Telescope Controls" diagrams. In both diagrams, "extreme case (2)" showed a level of EIS functionality that was felt to be normal for an instrument, whilst it was recognised that a central MDP would give benefits to the mission as a whole.

Action (AJM, +PRG) Need to develop a posture concerning the architecture, from science and engineering points of view, for Baseline and, later, Proposals.

There are various divisions within EIS itself (CCD driver, analogue electronics, digital electronics), and there are several possible ways of allocating functionality among these blocks.

Action (AJM, +PDT) to study tradeoffs, for example between "analogue" and "digital" styles of camera, with regard to complexity, thermal, power, contamination, mass, EMC, etc. properties.

Alignment Methods

Meaning "obtaining the pointing at any time during the mission".

JLC showed a range of options in this area[10].

Of these options, the second (external limb-sensor) represents the low-cost route (the others are additional imaging devices). An external limb-sensor (as used on TRACE) would need to have the pointing adjusted to gain a number of views of the limb.

Action (JLC) to investigate existing (e.g. Lockheed) designs of this type.

The third route involves an adjustable width slot (additional mechanism).

The fourth (slit-jaw CCD) is strictly not limited to the Cassegrain configuration.

The idea of using the images from the existing slot for alignment was raised. Alignment could be made easier in this method if one of the slots were larger (meaning that a limb would likely be closer to the field of view). Why were there two identical slots in the baseline design?

Action (RDB, +TW, +HH) Consider rationale behind two identical slots.

Action (JL) Consider feasibility of obtaining pointing information from existing slot, in baseline wavelength ranges. Do the lines present have useful intensity and spatial distribution?

Action MTW, WTO Need to consider accuracy/reproducibility of 1) instrument scanning mechanism, 2) spacecraft pointing.

Calibration

Jim Lang spoke about the planned pre-launch calibration activities for EIS. Essentially the plan is as outlined in the proposal to PPARC and involves the use of the same equipment (diagram circulated with these minutes) used to calibrate CDS and SERTS.

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[10] Sheet circulated with these minutes.

Since the calibration source produces a narrow beam of radiation, the aperture of the spectrometer is scanned to exercise the instrument field of view. It was also noted that the radiation from the source is strongly polarised, which was not thought to have a great effect on the CCD's repsonse.

The calibration activities will take 1-2 months, not including the time required to integrate the flight optics with the structure.

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EIS Interfaces and Functionality

Mechanical Interfaces

It was noted that the likely site of the EIS main (digital) electronics box would be on (outside of) the Optical Bench component of the spacecraft structure (refer to sheet 11 of preproposal briefing spacecraft description) . There are no problems in principle with this location.

Details to be resolved later include

- method of attachment
- required thermal finish or MLI

Other interface issues were discussed as part of the mechanical and thermal design of the structure - see later sections.

Instrument / Spacecraft data interfaces

No indication of the orbit's radiation environment was given explicitly. But we noted that the TRACE[11] orbit was similar, and so was that of SMEI[12].

Action (GMS, CMC) comment on the radiation environment expected for SMEI.

The material (origin: Shimizu-san) relating to design concepts of Solar-B's Mission Data Processor (MDP) was shown. Note particularly the extreme cases (1) and (2) in "Overview of Data Flows".

There ensued a tentative discussion on the functionality of EIS main electronics. There is a tension here, in that generally, Instruments (or their designers) wish to have a certain degree of control with regard to data flows, whereas the Solar-B spacecraft, being oriented toward common science objectives among its instruments, "wishes" to coordinate instruments' activities. This topic was returned to later (in **EIS Design : Instrument Electronics**).

Data Compression may logically be separated. It would be beneficial to EIS to have this performed outside (it was felt that the ideal of packet telemetry could still be preserved). There should always be the option of by-passing any compression scheme.

Action (Science Team) Need to study likely data output of EIS given certain science scenarios. (This action subsumed by actions of Science Team.)

Effect of Data compression on EIS

A number of data compression algorithms are currently being contemplated for Solar-B instrument data. One proposition is to use JPEG compression on image data and to implement this function in hardware (thus conferring a speed advantage over software-driven JPEG compression). In general, compression is useful if it reduces the data volume from the instrument AND can be done quickly enough to allow the data rate to be maintained.

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[11] http://www.lmsal.com/TRACE/

[12] Solar Mass Ejection Imager - see e.g. Jackson, B.V., A. Buffington, P.L. Hick, S.W. Kahler, G. Simnett and D.F. Webb, "The solar mass ejection imager"', in proceedings of EGS XXI meeting, the Hague, Netherlands, 6-10 May, 1996;

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Action (RAH, RDB, MTW, JLC)
Study options for compression of images and spectra, e.g. summing of spectra, windows, etc.

There is an issue relating to the occurrence of background counts in the CCD. These spikes (being pixels relatively full of charge) occur due to earth-trapped particles that the spacecraft encounters in orbit. They have been observed in TRACE data. If these are present in an image which is subsequently JPEG-compressed, then additional artifacts can be introduced. Refer to notes[13] by RDB.

Action (Consortium) Study the effects of JPEG compression on images, including the appearance of spikes.

It may be possible to remove spikes from the data stream before compression, e.g. if the spikes have a signature (pulse height) which distinguish them from genuine image pixels then they could be suppressed with a discriminator.

Action (MTW, RDB) Study options for in-line CCD image pre-processing strategies.

EGSE

There was a general discussion about EGSE architecture. There seemed to be agreement that the functionality of EGSE blocks should be decided, and the interfaces defined, in such a way that would encourage

a) straightforward use of EGSE modules at various times during instrument Development, Test and Integration with spacecraft.

b) portability of EGSE blocks

c) possibility of other groups' effort being devoted to EGSE preparation

d) evolution of the EGSE toward use as QL/operations software base

A further meeting to assess the main requirements for EIS EGSE and to review recent practice will be convened in the near future.

Action (MTW) convene an EGSE meeting within MSSL.

[13] With the minutes.

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Summary of Actions

#	Initiated by/on	Who	Title	Description	Need Date
	UK Science and Technical Meeting **=** UK June98	**2-3 June 98**	**MSSL**		
1	UK June98	consortium	Revisit science and EIS response	Summarises Actions 4, 5, 10-13, 16-22, 25-28	28/7/98
2	UK June98	consortium	Prepare to assess US proposals	Actions 4, 5, 16, 17, 20-22	28/7/98
3	UK June98	consortium	Compare EIS w/ others	Actions 4, 5	28/7/98
4	UK June98	RAH, HEM	Wavelength ranges	Assess the scientific strengths and weaknesses of several wavelength ranges namely 170 - 210 Å, 240 - 300 Å (EIS baseline), 308 - 380 Å, 517 - 633 Å and 1330 - 1428 Å. Drafts by Early July.	28/7/98
5	UK June98	Science Team	Summary EIS uses in various topics	One page science summaries of EIS's utility in various applications. Drafts by Early July. Final vers 28/7/98.	28/7/98
6	UK June98	MTW	Management Plan	Update and Circulate the Project Management Plan	19/6/98
7	UK June98	MTW	SDT meeting	Convene initial meeting of the System Design Team	19/6/98
8	UK June98	MTW	Contact List	Distribute a project contact list	19/6/98
9	UK June98	MTW	Re-Issue EIS schedule	Re-issue EIS schedule with NASA-AO dates etc	19/6/98
10	UK June98	System Design Team	attitude disturbance limit	The appropriate limits of generated attitude disturbance need to be included in the EIS system requirement. The limits may be achieved by including balance motions or other compensations in the mechanisms of EIS.	26/6/98
11	UK June98	GMS	SMEI radiation environment	comment on the radiation environment expected for SMEI	17/6798
12	UK June98	RAH, RDB, MTW, JLC	compression options	Study options for compression of images and spectra, e.g. summing of spectra, windows, etc.	28/7/98
13	UK June98	consortium	JPEG ramifications	Study the effects of JPEG compression on images, including the appearance of spikes.	28/7/98
14	UK June98	MTW, RDB	image pre-processing options	Study options for in-line CCD image pre-processing strategies.	17/7/98
15	UK June98	MTW	EGSE meeting	convene an EGSE meeting within MSSL	19/6/98
16	UK June98	AS, +RH, MTW	Zemax model	develop a Zemax model of the baseline and others. Parameters which must emerge from this model include - What are the required tolerances of the optics? Position? Alignment? - What is the allowed envelope for the camera head? - Where is the direct (zero order) image?	17/7/98
17	UK June98	MTW +DMW	CCD temperature requirement	Determine ideal CCD temperature. Consider: Dark Current, CTE, Radiation Damage	17/7/98
18	UK June98	MTW +DMW	CCD baking requirement	Determine need for CCD baking cycles	17/7/98
19	UK June98	WTO, +MSC	JET-X radiator coupling	Examine JET-X use of thermo-mechanical elements for radiator coupling	17/7/98
20	UK June98	WTO, +SM	radiator options	Examine options for radiator - angle, shielding, deployment	17/7/98
21	UK June98	+SM, WTO	thermal control requirement	study need for active thermal control of structure need to have more detailed information about the	17/7/98

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				thermal properties of the spacecraft	
22	UK June98	JLC, MTW	dynamic range	study dynamic range issues and likely exposure times	17/7/98
23	UK June98	AJM, +PRG	electrical interface architecture	Need to develop a posture concerning the [interface] architecture, from science and engineering points of view, for Baseline and, later, Proposals	17/7/98
24	UK June98	AJM, +PDT	camera style tradeoffs	to study tradeoffs, for example between "analogue" and "digital" styles of camera, with regard to complexity, thermal, power, contamination, mass, EMC, etc. propertiesjlc	17/7/98
26	UK June98	JLC	limb sensor design	investigate existing (e.g. Lockheed/TRACE) [limb sensor] designs of this type	24/7/98
27	UK June98	RDB, +TW, +HH	two slots rationale	Consider rationale behind two identical slots	17/7/98
28	UK June98	JL	alignment through baseline slot	Consider feasibility of obtaining pointing information from existing slot, in baseline wavelength ranges. Do the lines present have useful intensity and spatial distribution?	17/7/98
29	UK June98	MTW, WTO	Pointing/scanning reproducibility	Need to consider accuracy/reproducibility of 1) instrument scanning mechanism, 2) spacecraft pointing	17/7/98
30	UK June98	MTW +*Sys. Des. Team*	Assess debris damage	study MSFC data, assess need for "snout"	31/7/98