

**DRAFT MINUTES: SPIRE STtems Team Meeting**  
**Saclay, September 30, October 1 1999**  
**Colin Cunningham & Matt Griffin 19-Oct-99**

**Attendance:**

Jean Louis Augueres	CEA/SAp
Jamie Bock	JPL (Half of day 1)
James Caldwell	GSFC
Christophe Cara	CEA/SAp
Colin Cunningham	UKATC
Matt Griffin	QMW
Peter Hargrave	QMW
Ken King	RAL
Jerry Lilienthal	JPL
Harvey Moseley	GSFC
Juan Roman	GSFC
Louis Rodriguez	SAp
Rick Shafer	GSFC
Sunil Sidher	RAL
Bruce Swinyard	RAL
Laurent Vigroux	CEA/SAp
George Voellmer	GSFC
Berend Winter	MSSL
Lionel Duband	CEA/Grenoble
Françoise Loubere	CEA/SAp

Note: These minutes are to be read in conjunction with the viewgraph package, which contains most of the detailed information.

## Day 1

### 1. Introduction: aims of the meeting (Colin Cunningham)

Aims of the meeting:

- Translate operating modes into an updated IRD and hence Warm Electronics requirements
- Consider implications of the Cryostat Industrial Study on the Thermal model and how that feeds back to the Cryostat design
- Refine Interface Definition to enable subSTtem design
- Provide STtems Level input into the Warm Electronics Review

### 2. Review of actions

*Open Actions : Closed-S means closed at this meeting*

<i>Status</i>	<i>NewDate</i>	<i>Number</i>	<i>Title</i>	<i>Notes:</i>	<i>On:</i>
Open	21/1/99	AI-ST-0052-2	Matt report status of shutter	Window will close soon	MJG::
Open	28/1/99	AI-ST-0052-3	Draw up plan of activities leading up to	Ken will update by end of	KJK:
Open	15/6/99	AI-ST-0599-1	Provide information on frequency plan	See note in Oc1 Saclay	JB,
Open	15/6/99	AI-ST-0599-1	Provide BAU design to CRC by	Open for GSFC	GV
Open	31/10/99	AI-ST-0599-1	Provide notes on EGSE, MGSE and	Compilation of existing data	

Open	31/10/99	AI-ST-0599-2	Write section on EMC for IRD and send	By end Oct	CRC
Open PMs	31/10/99	AI-ST-0599-2	Draw up table of deliverables for	NOW Urgent for WE review	Inst
Open	28/2/00	AI-ST-0052-3	Establish membership and terms of	In time for DDR	KK
Open	31/3/00	AI-ST-0052-8	Recommend light tight aperture design:	New date is end March -	RAL:
Closed-S	26/5/99	AI-ST-0599-2	Write note to Steering Group making	Note produced	KJK
Closed-S	27/5/99	AI-ST-0599-9	Define what level of thermal analysis is		BMS,
Closed-S	1/6/99	AI-ST-0599-1	E-mail Thomas Passvogel about status	No reply as yet though!	MJG
Closed-S	1/6/99	AI-ST-0599-1	Include all relevant people in		CRC
Closed-S	7/6/99	AI-ST-0599-3	Distribute this note to Steering Group	Note sent	MJG
Closed-S PMs	11/6/99	AI-ST-0599-2	Provide SubSTtem Development Plans	At PDR	Inst
Closed-S GV,	15/6/99	AI-ST-0599-1	Comment on proposed CEA grounding	Discussed in Sacly ST	JJB,
Closed-S	20/6/99	AI-ST-0599-2	Include discussion of how instrument		MJG
Closed-S	20/6/99	AI-ST-0599-2	Provide input on FPU internal harness		CRC
Closed-S	20/6/99	AI-ST-0599-2	Write draft of Instrument Operations	Doc produced	KJK
Closed-S	20/6/99	AI-ST-0599-4	Provide advice on what elements of		WKG &
Closed-S	20/6/99	AI-ST-0599-2	Provide input on redundancy to BMS	In hand for WE review	KJK
Closed-S	20/6/99	AI-ST-0599-2	Draw up draft of autonomy	In ops mode doc	LV
Closed-S	20/6/99	AI-ST-0599-5	Decide on number of calibration sources	Closed at PDR	BMS
Closed-S	27/6/99	AI-ST-0599-1	Raise alignment and stability	See meeting minutes	KD
Closed-S	27/6/99	AI-ST-0599-1	Define plan for thermal model treatment	See meeting minutes	MJG,
Closed-S	27/6/99	AI-ST-0599-2	Review draft IRD		MJG,
Closed-S	27/6/99	AI-ST-0599-1	Raise Mech. design drawings for IID-B	See meeting minutes	BMS
Closed-S	30/6/99	AI-ST-0599-6	Analyse and document critical	In PDR	CRC
Closed-S	1/9/99	AI-ST-0599-7	Consider options for redundancy in	In hand for WE review	J-LA
Closed-S	1/9/99	AI-ST-0599-8	Update warm electronics model table in		J-LA

#### Notes on Frequency plan:

No info provided has been provided so far by ESA. We want to know about RF environment, but at present we can only go on the ISO EMC spec – which is available on DMS. We agreed to draw up a plan based on what EM we produce ourselves. It was an Action from the Pasadena for all array groups to do conducted susceptibility tests – but we agreed to shelve this Action until after array selection.

Microphonics: Harvey Moseley was worried about microphonic environment due to reaction wheels etc, but thought we could get an idea of this level from other missions.

**Action 1:** George Voellmer to put a number on acceleration at the instrument interface based on Astro-E

We agreed that JLA should participate in the weekly STtems Telecons up to WE PDR.

### 3. Cryostat Industrial Study:

BMS gave a brief resume of the discussion at the detector meeting. MJG noted the need to support Oct. 20 meeting at Dornier.

**Action 2:** MJG to distribute response to Dornier fax (note on thermal loads)

We agreed that we would like to put pressure on ESA and Dornier to ensure we get a good solution to the cryostat design, including the lowest possible optical bench temperature. FST is best forum to exert pressure on ESA on cryostat optimisation.

**Action 3:** MJG to prompt Paul Harvey + Tom Phillips to press for motion on cryostat optimisation for the mission goals

#### **4. Thermal Modelling:**

We need a plan to develop the thermal model for our internal structural and STtems design, and to help ESA and Dornier optimise the cryostat.

**Action 4:** MJG/CRC/BMS/BW devise plan for thermal model development

#### **5. Cooler redundancy (BMS)**

BMS gave a summary of the note attached to these minutes:

Options:

VG1: Baseline: If heat switch to evaporator fails open: May be able to recycle but at cost to power and degraded operation (high bath temp).

VG2: Double cooler redundancy

VG3: One cooler for spectrometer and one for photometer

VG4,5: Multiple heat switches with one cooler

Lionel Duband stated that a switch is very unlikely to fail in ON state

VG6: shows table of options with a rough scoring.

BMS favoured option was to double up heat switches. LD: Can accommodate doubling of the heat switches within the existing envelopes.

We agreed that separate coolers for Phot and Spec is not a sensible option, as the photometer is so much more important than the spectrometer to the mission.

LD We are using He-3 and titanium for envelope, so XRS failure mode (superfluid leak of He-4) not possible. Need to look at failure modes of heat switch to clarify that the only expected failure mode is open.

LD is working to guarantee high-pressure integrity, so this failure mode, while catastrophic would have exceedingly small probability.

Laurent Vigroux urged that we take into account the electronics also - here it's easier to have two complete units.

CC noted that we must include failure modes of electronics – where they could fail so that a switch is permanently on.

LD: Another failure mode is failure of Kevlar cord, but the design is probably rigid enough with the failure of one cord.

Conclusions:

BMS to continue leading the ad hoc team to carry out the study as specified in the SPIRE response to the PDR Review Board. Christophe Cara to join it to include electronics failure modes. Need full reliability analysis. Need to look very carefully at failures at the warm electronics end - could dominate MTBF. Need to look at available reliability analysis software

**Action 5:** BMS to continue leading the ad hoc team to carry out the study as specified in the SPIRE response to the PDR Review Board

#### **6. Warm Electronics:**

Warm electronics consists of the BAU, DRCU, DPU and the warm HARNESS.

Christophe: gave outline of Laurent's document on the warm electronics subSTtem requirements.

Comments:

BMS: Placeholders should be for subSTtem parameters rather than STtem-level eg BMS in terms of currents, voltages and deflection angles, not angles on the sky through the optics.

This sort of information should be in the ICDs.

BMS: ICDs should be controlled documents and this a reference documents (like the Ops Mode Document)

JLA: agreed, and pointed out we need this doc and the Obs Modes Doc to guide design of the WE.

Going through the document:

### 6.1 Thermometry:

CRC noted it was not the same as the IID-B table

Need to add:

- 4 or 2 wire
- Diode or resistance thermometer, and type eg Germanium, Ruthenium Oxide
- Current or voltage drive
- Resolution (in bits) and accuracy of measurement , and over what ranges of temperature
- Sampling rates

LV: have assumed 1 sec for housekeeping (rather arbitrarily) and 10 ms for science-related temperatures. We need to determine what sampling rate needed for 0.3 K thermometers, especially if they are used for temperature control.

Use one blind bolometer for each array as a thermometer, but still need conventional thermometers to monitor cool-down.

**Action 6:** CRC/BMS/MJG go through IID-B thermometry and define what we think is appropriate (end next week).

Pass on to all subSTtem groups for comment/revision.

Separate engineering and monitoring "thermometers" on the arrays. Attach "importance/criticality" to each.

GV: need 3 thermometers for TES option

Redundancy: KJK suggests sampling all of the thermometers all the time with both DPUs.

### 6.2 Cooler:

Temp regulation will be at the cooler end of the 0.3K straps, if implemented

Cooler should be recyclable at any time (not just during the ground-contact period)

### 6.3 Arrays:

**Action 7:** Array groups to provide comments/information for Laurent's note by Oct. 15

### 6.4 BSM:

CRC: Change specification to voltage, current, resolution

**Action 8:** CRC to update BMS section by Oct. 15. Need to put a spec on what settled means. CRC comment on how much better it might be for small motions.

## 6.5 FTS:

SAP will have meeting with LAS next week

## 6.6 Shutter:

Needs to be mentioned at review. If ground only - driven by EGSE.  
If flight, need fail-safe electronics.

Decision: Include for now as flight-operable mechanism. So basic description of WE needed for the review. In-flight operation = goal. WE to be designed for the goal.

## 6.7 Photometer Calibration Sources:

**Action 9:** GSFC to write (need to write the relevant part of the Obs. Mode Document)  
Failsafe operation important.

## 6.8 Spectrometer Calibration source:

BMS review of proposed design change following the FTS meeting

Black plate with photometer calibrator as small source in the middle  
Plate should be heatable.

**Action 10:** BMS/MJG to revise the FTS calibrator specification

## 6.9 JFET/Filter box:

**Remove from this document, as not part of the warm electronics.**

## 6.10 BAU:

**Action 11:** Array groups to provide all requirements for Warm Electronics. Oct. 15

**Action 12:** CRC update IID-B with 6 W TBC for TES BAU dissipation.  
Bring up at Oct. 20 Cryostat Study meeting

## 6.11 Detector readout and control:

Synchronisation of the BSM is TBD pending the definition of how the detector data are transformed into the telemetry stream.  
{GSFC: don't want to subtract chop half-cycles on board}

FTS: Should it run synchronous or asynchronous?

**Action 13:** BMS to make sure Peter Hamilton's FTS simulations produce recommendation for data compression by October 31.

## 6.12 DPU/DRCU redundancy:

Françoise Loubere: Redundancy analysis shows that cross-coupling of the DRCU/DPU is not favoured (not more reliable and introduces single point failure). Report is available.

**Action 14:** FL to provide report to KJK

**Action 15:** CRC/LR/BMS produce criticality analysis for SPIRE.

**Action 16:** SAp to produce proposal for redundancy implementation by Oct. 31

**Action 17:** CRC and LR to devise a plan for SPIRE STtem level reliability analysis. Meet at QMW on date TBD to get work started.

**Action 18:** KJK to ask IFSI to arrange accommodation details

We agreed that WE PDR presentations would be in PowerPoint or PDF.

## 7. Planning for Dec. review (Jean-Louis Augueres):

VG1:

Reviewed goals and required inputs

Comment: LV - need to review development plan in the light of the detector development and iterate on when things are delivered. KJK: That's what has been/is being done. MJG: Also need to define exactly what's required for the CQM - will have to wait until detector selection.

**Action 19:** Jean Louis Augueres to send out the draft WERD to all concerned (Tuesday Oct. 5)

Work plan:

WE group meetings: For purposes of WE review, expanded to include relevant STtems Team members

- First review of drafts late October
- Second meeting mid Nov to review and finalise the circulation of the documents

## 8. Grounding scheme:

Purpose of the grounding scheme was explained: see Colin's viewgraph

Assume ISO grounding scheme for now (and let ESA know what we're doing).

We have proposed grounding schemes from IFSI, CEA, & JPL - need one from GSFC.

**Action 20:** CRC to put these top-level requirements in the IID-B, and raise need for spacecraft grounding scheme at Oct. 20 meeting

## Location of star point:

HM: Having it warm is good for trouble-shooting, so that it can be disconnected to check for alternative ground paths.

HM: In COBE used shields to protect against high frequency ground loops

Option of putting the star point at the RF shield may be best for overall performance but difficult to get the references out and difficult to troubleshoot.

HM: Possibility of high  $T_c$  superconducting lead from FPU to CVV connector, to ensure low impedance path – but note that lead inductance usually results in a high impedance to RF return currents.

**Action 21:** Juan to investigate COBE and SIRTf grounding schemes and provide to CRC/LR

**Christophe's proposal (see viewgraph):**

Comments: Star point in BAU. Sensitivity to ground loops depends on physical implementation of the harness from WE to BAU. Also have subsidiary star point at the cold end - CRC not sure about this.

CRC noted that Morrison's book (Grounding & Shielding in Instrumentation) is the Bible, but not always easy to implement in practice – for instance it says each independent signal should have an independent shield.

Returning the RF currents from the RF filters to the warm power supply is critical, and not trivial for a cryogenic instrument. Also note that the mechanism servo position sensors may need low impedance wires to preserve stable transfer functions. In the absence of detailed models, we will assume the need for low impedance wires.

**Action 22:** CRC to revise harness specification to specify low impedance for critical wires for mechanism servo STems.

**Action 23:** MJG to draft note to ESA emphasising urgency of setting up EMC/grounding study team

**9. Report on Alignment meeting (Bruce Swinyard)**

See viewgraphs.

Difficult problem: Accessibility without disturbing the alignment

Still need to define the plan for the spectrometer

Need to define whether or not the BSM and FTS carriage need to be there or replaced with simulators for some of the tests.

**10. Preparation for WE Review:**

**Jean-Louis's viewgraphs:**

**VG1:**

Overall instrument STem definitions (assumption and design)

IDP

Overall WE STem requirements

Overall WE STem architecture

Overall WE development plan

Basic internal I/Fs

**VG2**

**SubSTems:**

DPU

DRCU

BSM

FTS

Cooler

Cal sources

Shutter  
Detector readout - the three options  
DRCU Sim  
FPU Sim

**Presentations under following headings:**

Requirements  
Logical block diagram  
Description of functionality supported by WE  
Specific constraints  
H/W implementation  
Development plan

**LV:** Need to elaborate the overall architecture of the OBS

Draft agenda compiled at the meeting, but note that harnesses/connectors needs to be added to the agenda.

Review Meetings:

Feb.	Requirements review	Venue TBD
March	Delta PDR	RAL
April	Interface freezing meeting	Venue TBD

**11. Interface Control Documents**

See Colin's viewgraph:

CRC will go through IID and work out which chapters relevant to which subSTtem, and produce a cross-reference table, instead of the series of documents for each subSTtem/IID-B as originally planned.

ICDs to be formulated after Dec review

**Action 24:** CRC to distribute the ICD template

Priorities: Any interfaces that affect the Warm Electronics Review need attention first.



**SPIRE STtems Team Meeting, Saclay, September 29, 30 1999**

<b>Actions</b>				
<b>Action Number</b>	<b>Description</b>	<b>Responsible</b>	<b>Due Date</b>	<b>Status (19/10/99)</b>
AI-ST-0999-01	Provide a number on acceleration at the instrument interface based on Astro-E	Voellmer	Oct. 31	Open
AI-ST-0999-02	Distribute note on thermal loads sent in response to Dornier fax	Griffin	Oct. 8	Closed
AI-ST-0999-03	Prompt Paul Harvey, Tom Phillips to press for motion on cryostat optimisation for the mission goals	Griffin	Before FST meeting	Open
AI-ST-0999-04	Devise plan for thermal model development	Griffin, Cunningham, Swinyard, Winter	Oct. 31	Open- but progress made
AI-ST-0999-05	Continue leading the <i>ad hoc</i> team to carry out the study as specified in the SPIRE response to the PDR Review Board.	Swinyard		Open
AI-ST-0999-06	Go through IID-B thermometry and define what we think is appropriate (end next week). Pass on to all subsystem groups for comment/revision. [Temprange/accuracy/sampling rate/suggested implementation/no of bits]. Separate engineering and monitoring "thermometers" on the arrays. Attach "importance/criticality"	Cunningham, Swinyard, Griffin		Closed – in new IID-B ch5
AI-ST-0999-07	Provide comments/information for Array section of WESRD (Laurent's document) subsystem note	Array groups	Oct. 15	Open
AI-ST-0999-08	Update BSM section. Need to put a spec on what settled means. Comment on how much better it might be for small motions.	Cunningham	Oct. 15	Open
AI-ST-0999-09	Provide input to WESRD photometer calibration source (needs relevant part of the Obs. Mode Document) Failsafe operation important.	Moseley	Oct. 15	Open
AI-ST-0999-10	Revise the FTS calibrator specification	Swinyard	Oct 15	Open
AI-ST-0999-11	Provide all BAU requirements for Warm Electronics.	Array groups	Oct. 15	Open
AI-ST-0999-12	Update IID-B with 6 W (TBC) for TES BAU	Cunningham	Oct. 20	Closed

	dissipation. Bring up at Oct. 20 Cryostart Study meeting			
AI-ST-0999-13	Ensure that Peter Hamilton's FTS simulations produce recommendation for data compression by October 31.	Swinyard	Oct. 31	Open
AI-ST-0999-14	Provide DPU/DRCU redundancy report to KJK	Loubere	Oct. 4	Closed
AI-ST-0999-15	Produce draft criticality analysis for SPIRE	Swinyard/Cunningham/Rodriguez	Oct. 11	Open
AI-ST-0999-16	Devise proposed scheme for WE redundancy	Vigroux	Oct. 31	Open
AI-ST-0999-17	CRC and LR to devise plan for system-level reliability and redundancy analysis. Iterate as part of WE Review preparation. Meet at QMW on date TBD to get work started.	Cunningham, Rodriguez	By WE meeting in October	Open – but meeting held
AI-ST-0999-18	Request IFSI to send out Frascati hotel details	King	Oct. 15	Open
AI-ST-0999-19	Send draft WERD to all concerned	Augures	Oct 5	Closed
AI-ST-0999-20	Put top-level grounding scheme requirements in IID-B. And raise grounding scheme as issue at October 20 mtg.	Cunningham	Oct. 20	Closed
AI-ST-0999-21	Seek out information on COBE and SIRTF grounding schemes	Roman	Nov. 15	Open
AI-ST-0999-22	Revise harness specification to specify low impedance for critical wires for mechanism servo systems	Cunningham	Oct. 20	Closed- in IID-B
AI-ST-0999-23	Draft note to ESA emphasising urgency of setting up EMC/grounding study team. CRC/LR to comment/revise. Raise at Oct. 20 meeting.	Griffin	Oct. 20	Open
AI-ST-0999-24	Distribute the ICD template	Cunningham	Oct 20	Open

