FILE

SPIRE/CEA/M/004610

SPIRE Systems Meeting, Saclay
July 17 1998

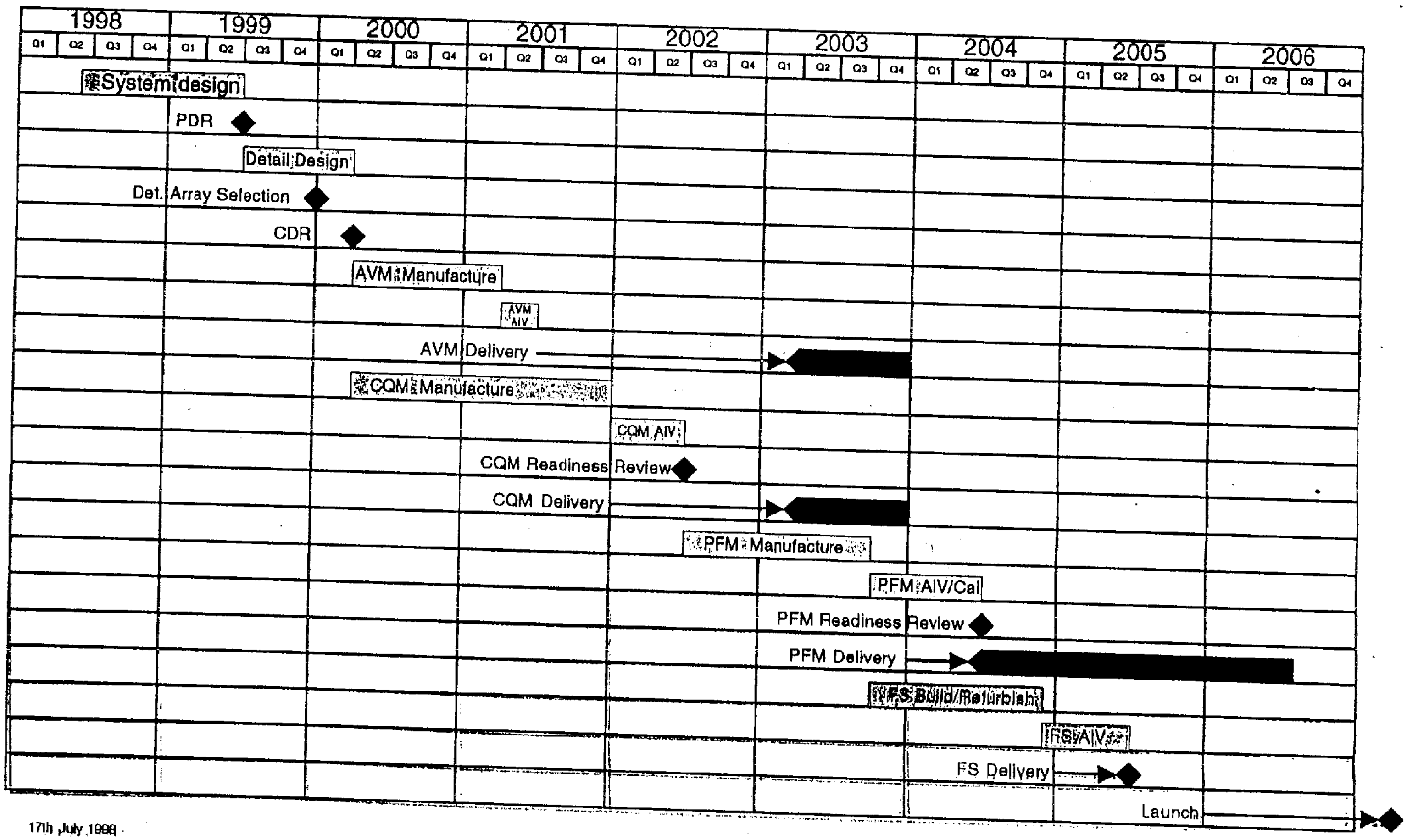
Provisional Agenda

09.30	Introduction and Agenda	Griffin
09.45	Review of SPIRE schedule	King
10.00	Organisation and documentation of work in Instrument Design phase	King
11.00	Definition of SPIRE subsystems and their interfaces with each other - Format for template documents describing each interface - How to deal with multiple options for detector arrays	Swinyard
13.00	Lunch	
14.00	On-board data processing requirements and implications for hardware design	Rodriguez
14.45	SPIRE Scientific specifications and [redacted] corresponding technical requirements	Griffin

15.15	Preparation for the July 29 meeting with ESA
	- List of IID-type questions we should ask
	- Clarification of model philosophy
	  - ESA's requirements
	  - Our proposals
	- IID-type information we will need to provide
		King

16.00	Documentation system	King
16.15	Definition of roles within the Systems Team and future work	Rodriguez

SPIRE Instrument Development Schedule



17th July 1998

Instrument Design Definition

Design Definition Stages

- Define Instrument Scientific Requirements
  - Project Scientist responsibility
- Document implied Instrument engineering Requirements
  - Instrument Scientist responsibility
- System Design
- Allocate budgets
- Define subsystem interfaces
- Subsystem Design

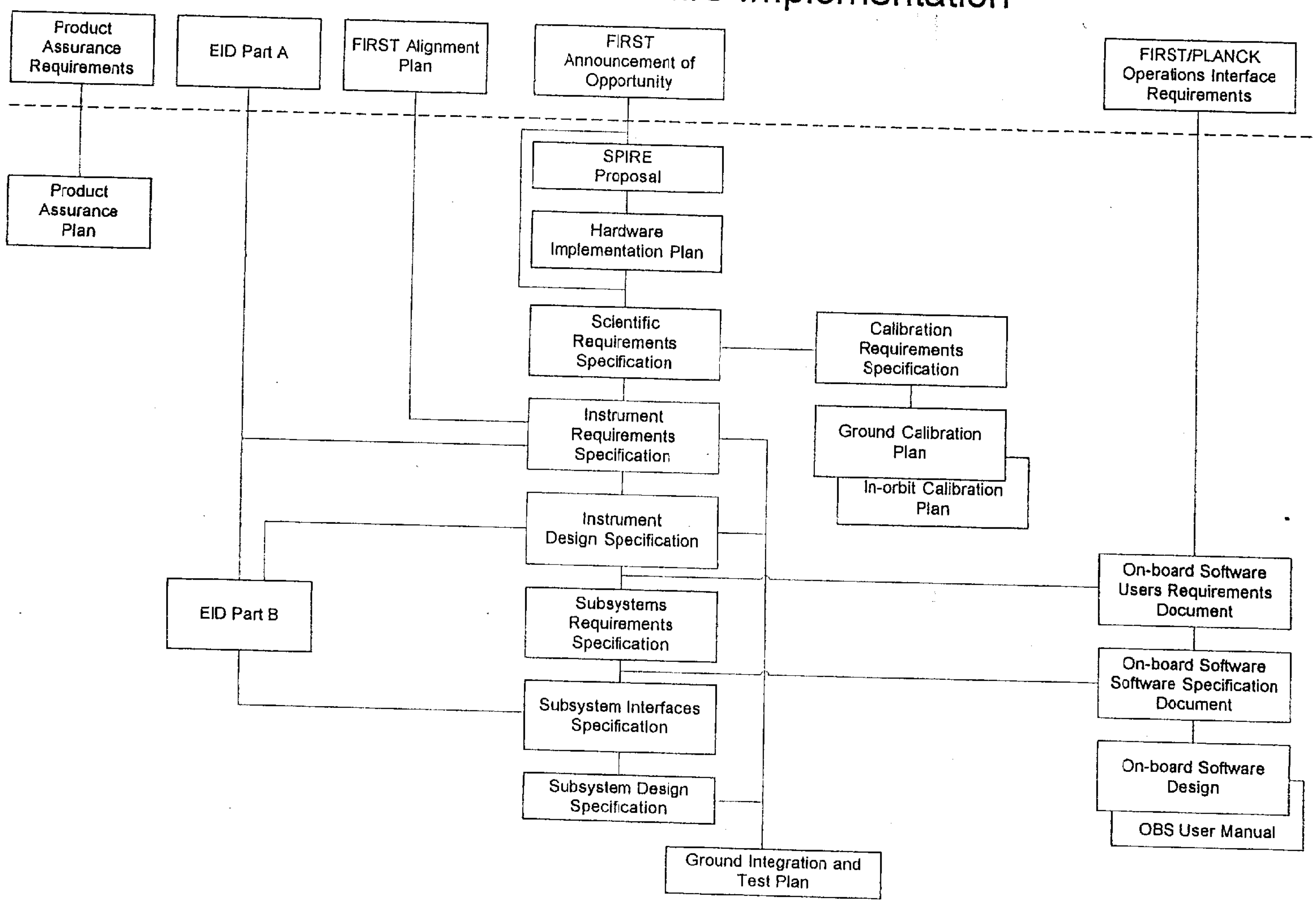
Definition is encapsulated in the Documentation Tree

- the documentation IS the design

These stages cannot be completed in series, or in isolation

- feedback is necessary between persons responsible
- several iterations will be required
- continuity of experience/knowledge is necessary

SPIRE Documentation Tree for Hardware Implementation



Instrument Design Definition

System Engineers provide this continuity:

A system engineer should be appointed for each type of interface

- Mechanical
- Thermal
- Optical
- Electrical
- Operations
- Software

Each System Engineer is responsible for:

- Production of System Design Specification in his/her area of expertise

- co-ordination is by the Instrument Scientist

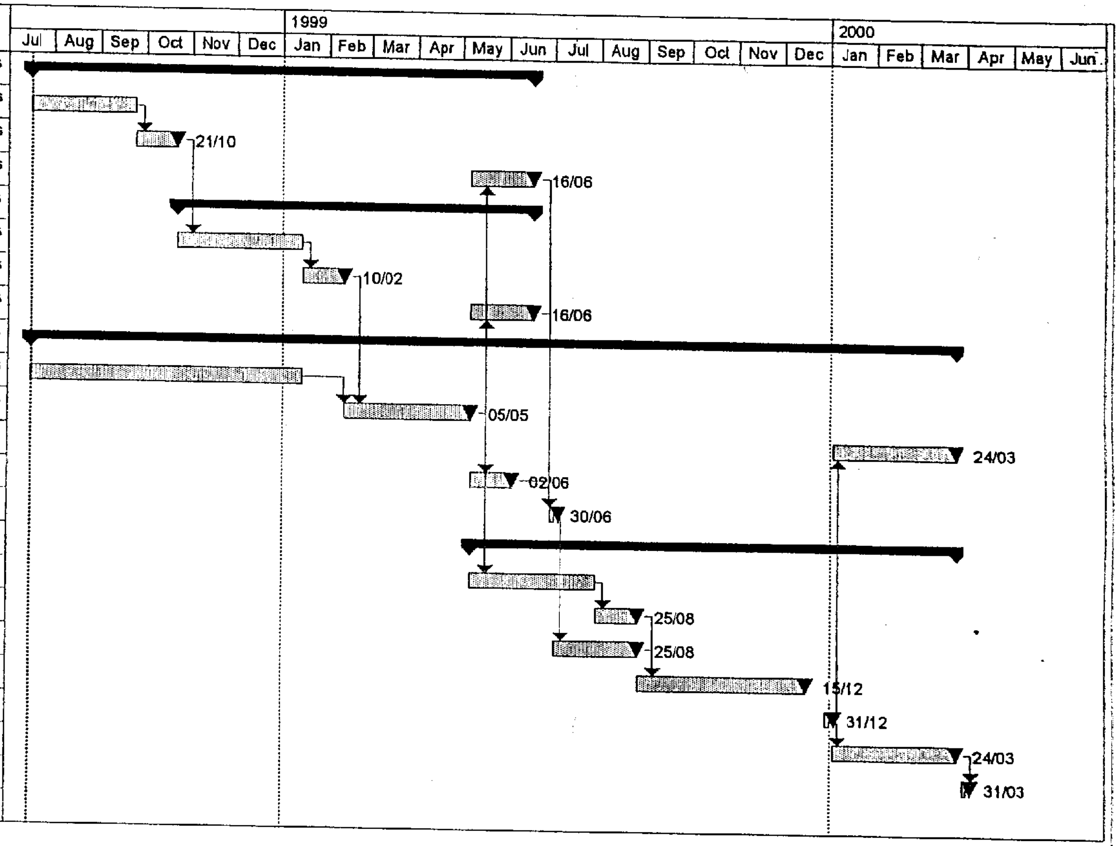
- Allocation of budgets between subsystems

- including definition of external interfaces (EID PartB)

- Documentation of subsystem interfaces

- agreement between the subsystems designers co-ordinated by the system engineer
- multiple interfaces to handle design options

Task Name	Duration
Science Requirements Document	240 days
Write Draft SciRD	10 wks
Review Draft SciRD	4 wks
Update SciRD to Isssue 1	6 wks
Instrument Requirements Document	170 days
Write Draft InstRD	12 wks
Review Draft linstRD	4 wks
Update InstRD to Issue 1	6 wks
System Design	442 days
System Design Development	26 wks
Draft System Design Definition	12 wks
Documentation of System Design	12 wks
Allocation of budgets	4 wks
Preliminary Design review	3 days
Subsystem Design	232 days
Write Draft Subsystem Requirements	12 wks
Review SubRD	4 wks
Definition of Subsystem Interfaces	8 wks
Draft Subsystem Design Definition	16 wks
Detector Array Selection	3 days
Documentation of Subsystem Design	12 wks
Critical Design Review	3 days
	1 day



Project: SPIRE Design Date: Thu 16/07/98	Task	Critical Milestone	Rolled Up Progress		
	Critical Task	Summary	External Tasks		
	Split	Rolled Up Task	Project Summary		
	Progress	Rolled Up Split			
	Milestone	Rolled Up Milestone ◇			

SPIRE Interface Control

Colin Cunningham 15th July 15, 1998

Ensuring compatibility among subsystems being designed and fabricated at locations throughout the world poses challenges in managing the multitude of interfaces which exist. To aid in managing this geographically diverse work, a formal interface control system should be set up.

Steps in this process:

- Rationalisation for subsystem breakdown
- Organisation of subsystems and interfaces
- Database tool for tracking interfaces
- Generation of Interface Control Documents and Drawings (ICDs)
- Central tracking of progress and revisions

Subsystem breakdown

- Generally follow work-package boundaries (from Product Tree or Work Breakdown Structure?)

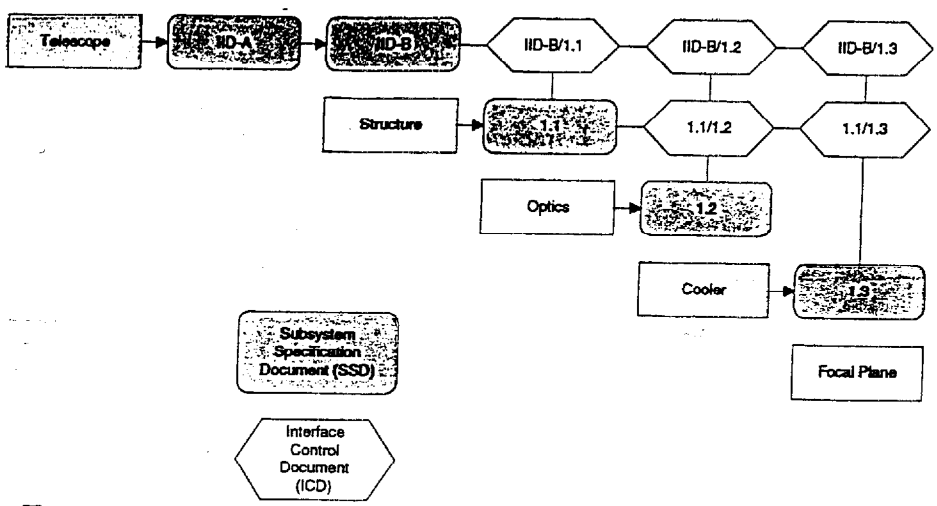
- Some interfaces will cross Institute group boundaries, some will be contained within.

- Both are to be defined in the interface control documents and drawings, but the priority should be placed upon interfaces which cross group boundaries.

- **ACTION: Define Subsystem Definitions**

Subsystem Interface Definition Matrix

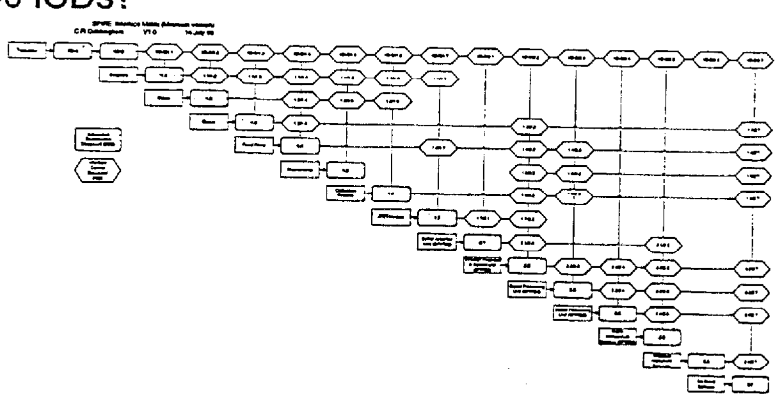
(Based on Gemini Model)



From this chart, we start with each subsystem, decide if there are any possible interfaces (mechanical, optical, electronic, data-flow, etc) with each of the other listed subsystems.

When in doubt, an ICD is listed (by a symbol at the 'intersection' on the chart) between the subsystems. It will be deleted later if found not needed. This method minimises important interfaces 'falling through the cracks'.

Final chart could be large – 35-60 subsystems & maybe 200 ICDs?



INTERFACE MATRIX DEFINITION

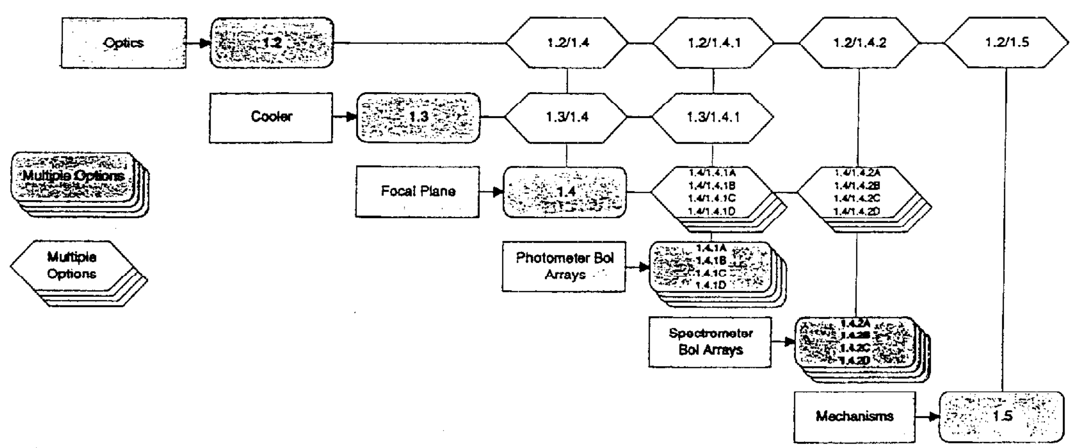
ACTIONS:

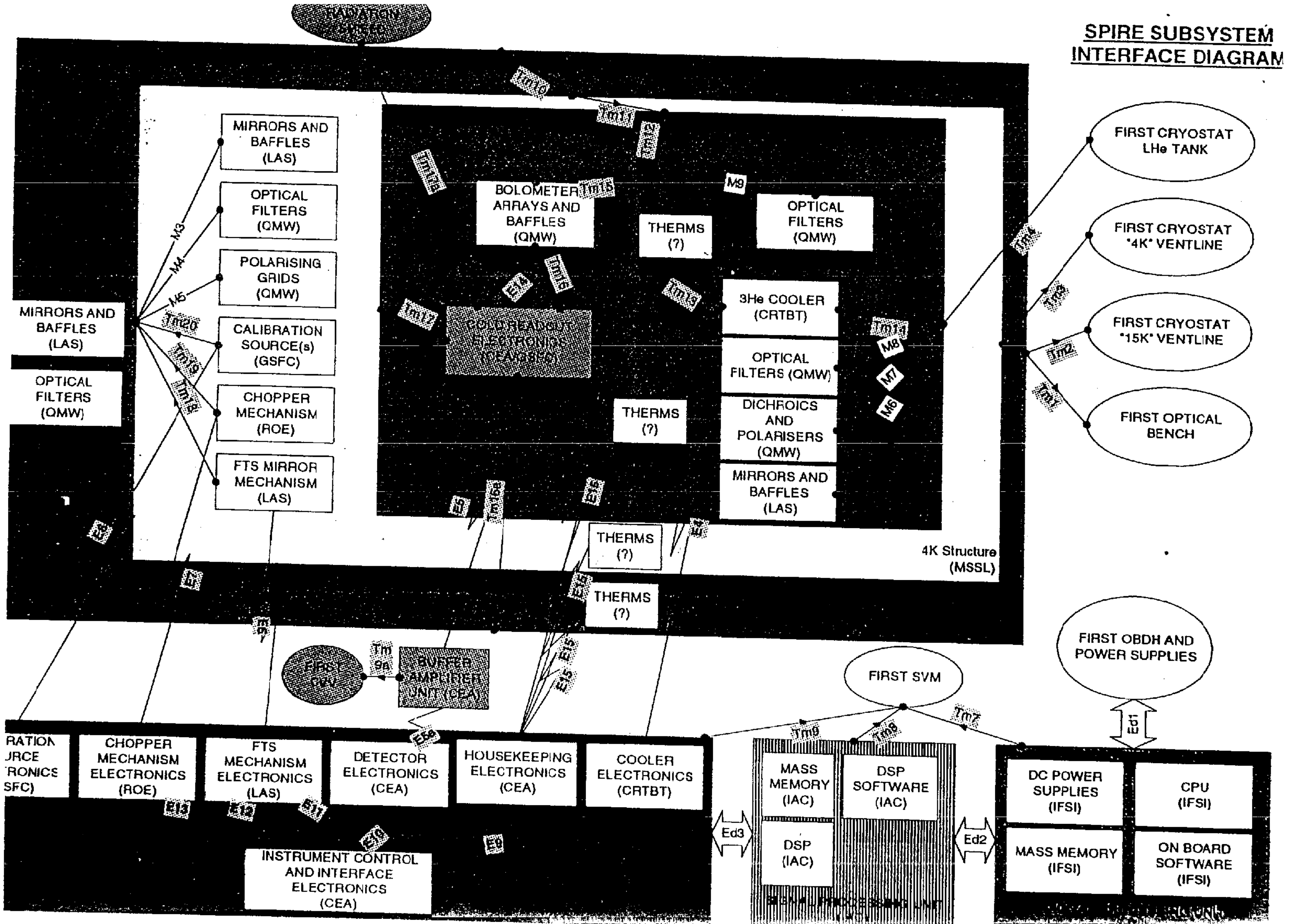
- **Draw up full chart**
- **Agree where intersections occur**
- **Set up data-base to track ICDs**
- **Agree policy for issue of active ICDs**
- **Write ICD & SSD (Subsystem Specification Document) Templates**
- **Define responsibilities for ICDs & SSDs**

How to deal with Array options?

The 4 bolometer array options introduce problems of dealing with multiple interface documents – unless we can really define common interfaces.
The FET box will only occur in the 'back-up' option, so will complicate the matrix.

A proposal:




SPIRE SUBSYSTEM INTERFACE DIAGRAM
FIRST CRYOSTAT LHe TANK
FIRST CRYOSTAT "4K" VENTLINE
FIRST CRYOSTAT "15K" VENTLINE
FIRST OPTICAL BENCH
FIRST OBDH AND POWER SUPPLIES
FIRST SVM
MIRRORS AND BAFFLES (LAS)
OPTICAL FILTERS (QMW)
POLARISING GRIDS (QMW)
CALIBRATION SOURCE(s) (GSFC)
CHOPPER MECHANISM (ROE)
FTS MIRROR MECHANISM (LAS)
BOLOMETER ARRAYS AND BAFFLES (QMW)
THERMS (?)
OPTICAL FILTERS (QMW)
3He COOLER (CRTBT)
OPTICAL FILTERS (QMW)
DICHROICS AND POLARISERS (QMW)
MIRRORS AND BAFFLES (LAS)
4K Structure (MSSL)
CHOPPER MECHANISM ELECTRONICS (ROE)
FTS MECHANISM ELECTRONICS (LAS)
DETECTOR ELECTRONICS (CEA)
HOUSEKEEPING ELECTRONICS (CEA)
COOLER ELECTRONICS (CRTBT)
INSTRUMENT CONTROL AND INTERFACE ELECTRONICS (CEA)
MASS MEMORY (IAC)
DSP SOFTWARE (IAC)
DSP (IAC)
DC POWER SUPPLIES (IFSI)
CPU (IFSI)
MASS MEMORY (IFSI)
ON BOARD SOFTWARE (IFSI)
Ed1
Ed2
Ed3
Tm1
Tm2
Tm7
Tm8
Tm9
Tm11
Tm12
Tm13
Tm14
Tm15
Tm16
Tm17
Tm18
Tm19
Tm20
M3
M4
M5
M6
M7
M8
M9
E9
E11
E12
E13
E14
E15

SPIRE SUBSYSTEM INTERFACE DIAGRAM

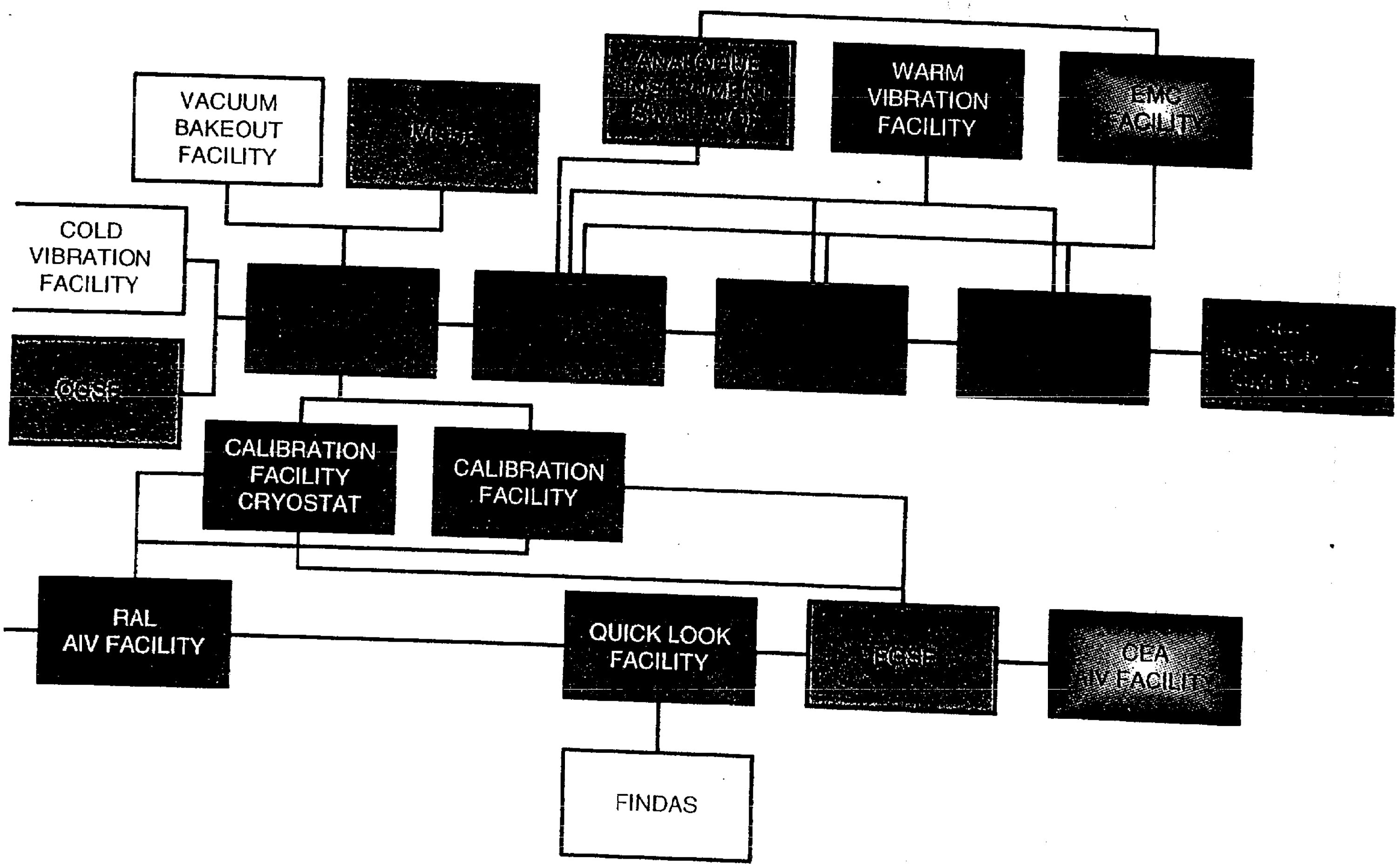
LEGEND

Thermal/mechanical interface - arrow indicates heat flow

Mechanical interface only - no heat source

Electrical interface (wiring)

Commanding, data and electrical interface.



SPIRE AIV INTERCONNECTIVITY

Interface Specification for different Array Options

Mechanical

- Define the mounting points between the detector array structure and the 2-K structure.
- The reference point should be taken as the focus position on the geometrical centre of the imaging portion of the array.
- Define the volume to be occupied by the detector structure including any feed-horns; filters or baffles.
- Define the number; type and positions of the electrical connectors.
- Give values for the first eigen-frequency of the array structure.
- Define the position for the connection of the thermal strap between the 300-mK cold surface and the array.

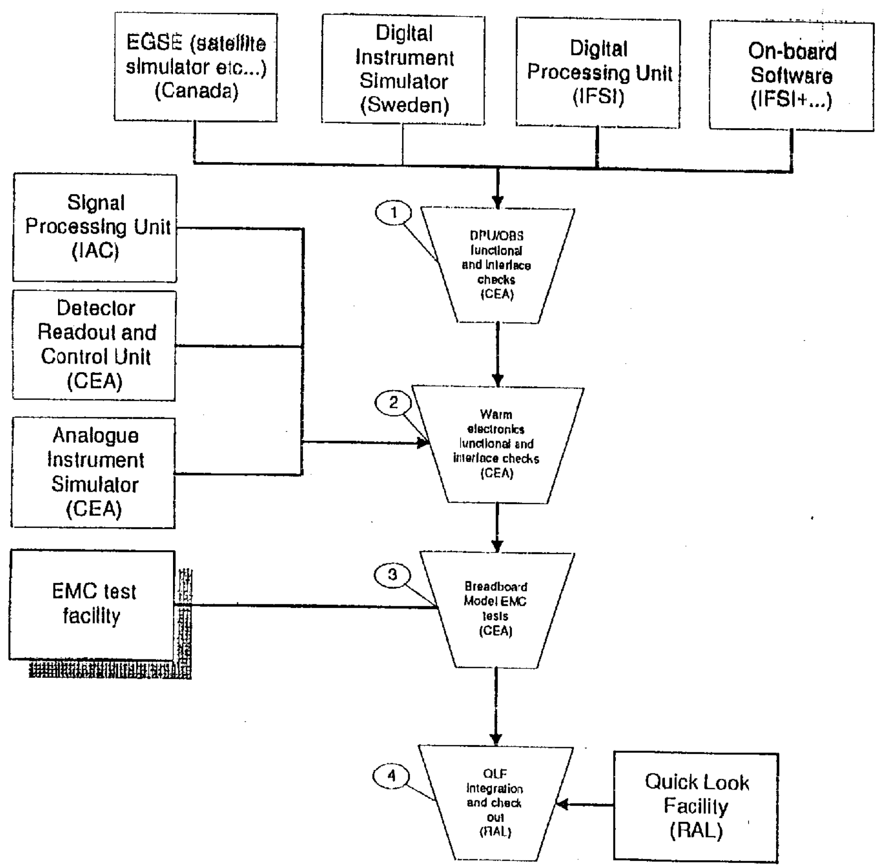
Thermal

- Give values for the thermal dissipation at 2 K and 300 mK in both tabular and diagrammatic form (heat flow diagram).

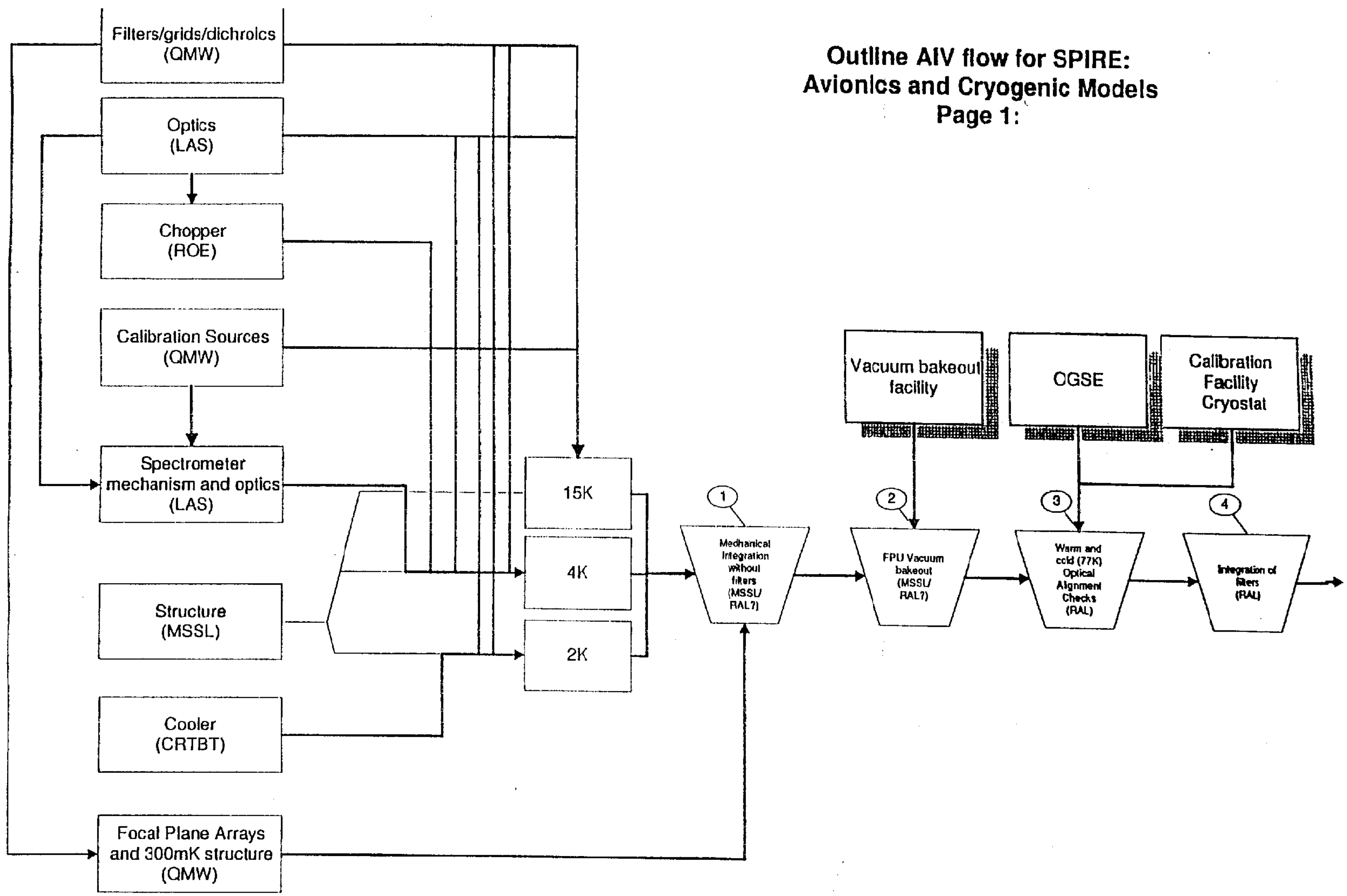
Electrical

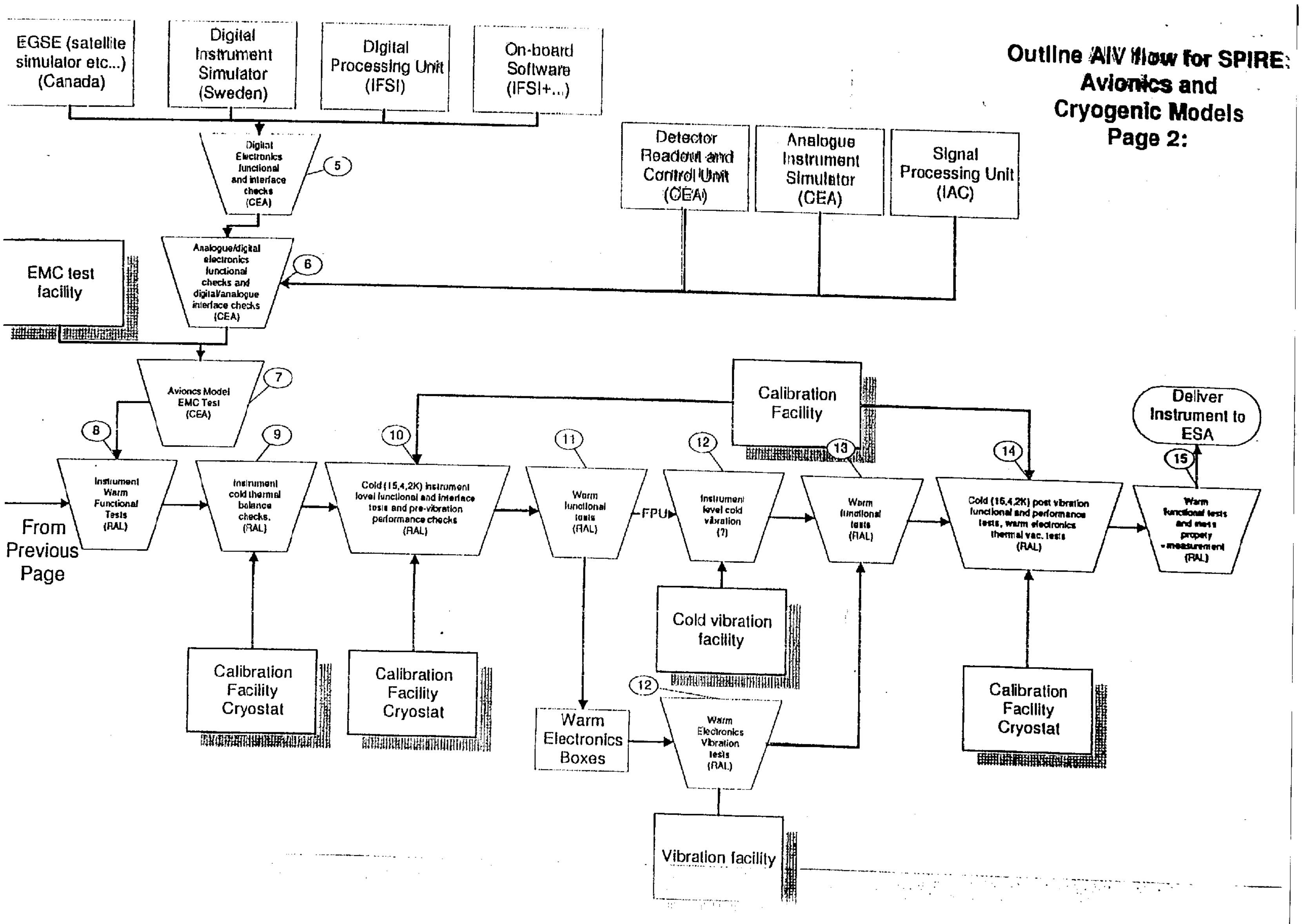
- Define each connection between the array and the cryostat harness – i.e. all connections between the warm electronics and the cold FPU (no matter what temperature they are at within the FPU i.e. include JFET connections etc for the NTD Ge option).
- Separate tables should be given for each start and end temperature 2 K to 15 K; 15 K to 300 K etc.
- Give values for the voltage; current and maximum switching frequency for each connection between the warm electronics and the arrays.

Outline AIV flow for SPIRE: Breadboard Model



Outline AIV flow for SPIRE: Avionics and Cryogenic Models Page 1:





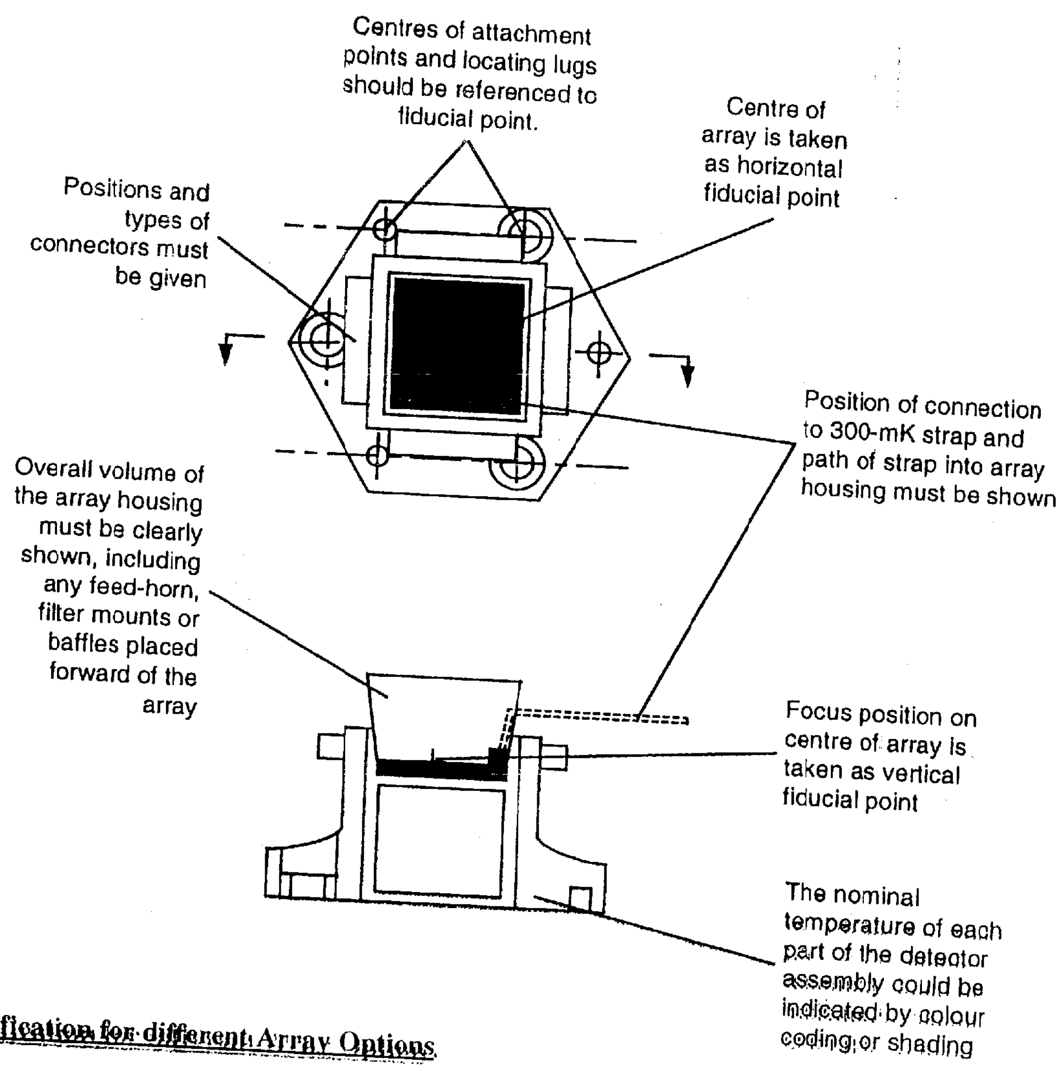
Outline AIV flow for SPIRE: Avionics and Cryogenic Models Page 2:
EGSE (satellite simulator etc...) (Canada)
Digital Instrument Simulator (Sweden)
Digital Processing Unit (IFSI)
On-board Software (IFSI+...)
Digital Electronics functional and interface checks (CEA)
5
Detector Readout and Control Unit (CEA)
Analogue Instrument Simulator (CEA)
Signal Processing Unit (IAC)
EMC test facility
Analogue/digital electronics functional checks and digital/analogue interface checks (CEA)
6
Avionics Model EMC Test (CEA)
7
Calibration Facility
Deliver Instrument to ESA
8
9
10
11
12
13
14
15
From Previous Page
Instrument Warm Functional Tests (RAL)
Instrument cold thermal balance checks. (RAL)
Cold (15,4,2K) instrument level functional and interface tests and pre-vibration performance checks (RAL)
Warm functional tests (RAL)
FPU
Instrument level cold vibration (?)
Warm functional tests (RAL)
Cold (15,4,2K) post vibration functional and performance tests, warm electronics thermal vac. tests (RAL)
Warm functional tests and mass property measurement (RAL)
Cold vibration facility
Calibration Facility Cryostat
Calibration Facility Cryostat
Warm Electronics Boxes
12
Warm Electronics Vibration tests (RAL)
Calibration Facility Cryostat
Vibration facility

Instrument Option	Baseline			Backup		
Instrument Model	AVM	CQM	PFM	AVM	EQM	PFM
Product Item						
Cold FPU (BOL1)						
Structure						
"15K" Box		x	x		x	x
"4K" Box		x	x		x	x
"2K" Box		x	x		x	x
"300 mK" Box		x	x		x	x
MGSE		x	x		x	x
Transport containers		x	x		x	x
Optics						
Photometer optical chain and fore optics						
M3 - "field" mirror		x	x		x	x
M4 - chopper mirror		x	x		x	x
Beam conditioning and folding mirrors (TBD)		x	x		x	x
Re-imaging mirrors (TBD)		x	x		x	x
Optics mounts		x	x		x	x
Spectrometer optical chain						
Beam conditioning mirrors (TBD)		x	x		x	x
Fold mirrors (TBD)		x	x		x	x
Moving mirror(s)		x	x		x	x
Mirror movement measurement system (may be integrated with mechanism)		x	x		x	x
Re-imaging mirrors (TBD)		x	x		x	x
Optics mounts		x	x		x	x
Photometer filters, fore optics filters and dichroics						
"15K" fore optics filter		x	x		x	x
"4K" filter		x	x		x	x
"2K" filter		x	x		x	x
Dichroics		x	x		x	x
Pass band filters		x	x		x	x
Filter and dichroic mounts		x	x		x	x
Spectrometer filters, dichroics and grids						
"4K" filter		x	x		x	x
"2K" filter		x	x		x	x
Dichroics		x	x		x	x
Passband filters		x	x		x	x
Filter and dichroic mounts		x	x		x	x
Polarising grids		x	x		x	x
Grid mounts		x	x		x	x

Photometer optical baffling and fore optics baffling						
Baffles (TBD)		x	x		x	x
Baffle mounts		x	x		x	x
Spectrometer baffling						
Baffles (TBD)		x	x		x	x
Baffle mounts		x	x		x	x
Cooler						
^{3}He Cooler Unit		x	x		x	x
Cold harness and connectors		x	x		x	x
Mechanical interface structure		x	x		x	x
Cold finger interface structure		x	x		x	x
Focal Plane						
Photometer Bolometer arrays						
Bolometer pixels					x	x
Feed Optics					x	x
Bolometer arrays		x	x			
Cold readout electronics		x	x			
Focal plane structure including filter mounts		x	x		x	x
Cold harness and connector(s)		x	x		x	x
Spectrometer Bolometer array						
Bolometer pixels					x	x
Feed Optics					x	x
Bolometer arrays		x	x			
Cold readout electronics		x	x			
Focal plane structure including filter mounts		x	x		x	x
Cold harness and connector(s)		x	x		x	x
Mechanisms						
Chopper						
Chopper motor		x	x		x	x
Interface structure		x	x		x	x
Cold harness and connector		x	x		x	x
Spectrometer Mechanism						
Spectrometer motor		x	x		x	x
Moving mirror support structure		x	x		x	x
Interface structure		x	x		x	x
Cold harness and connector		x	x		x	x
Calibration Sources						
Photometer calibration source						
Temperature controlled radiation source		x	x		x	x
Interface structure		x	x		x	x
Cold harness and connector		x	x		x	x

Spectrometer calibration source						
Temperature controlled radiation source		x	x		x	x
Interface structure		x	x		x	x
Cold harness and connector		x	x		x	x
JFET Module						
JFETs and asscoiated components					x	x
RF Filters and associated components					x	x
Box and interface structure					x	x
Cold harness and connectors					x	x
Warm Electronics						
Detector Buffer Amplifiers (BOL2)						
Box	x	x	x	x	x	x
Buffer amplifiers	x	x	x	x	x	x
Connectors	x	x	x	x	x	x
Savers	x	x	x	x	x	x
Detector Read Out and Control Electronics (BOL3)						
Box	x	x	x	x	x	x
Analogue amplification chain	x	x	x	x	x	x
Bias electronics	x	x	x	x	x	x
ADCs and associated components	x	x	x	x	x	x
Instrument Control electronics	x	x	x	x	x	x
Chopper drive electronics	x	x	x	x	x	x
Spectrometer mechanism drive electronics	x	x	x	x	x	x
Cooler control electronics	x	x	x	x	x	x
Calibration source control electronics	x	x	x	x	x	x
Temperature monitor electronics	x	x	x	x	x	x
Digital interface electronics	x	x	x	x	x	x
Connectors	x	x	x	x	x	x
Savers	x	x	x	x	x	x
Signal Processing Unit - SPU (BOL4)						
Box	x	x	x	x	x	x
Signal processing module	x	x	x	x	x	x
Memory module	x	x	x	x	x	x
DC/DC converters(?)	x	x	x	x	x	x
Connectors	x	x	x	x	x	x
Savers	x	x	x	x	x	x

Digital Processing Unit - DPU (BOL5)						
Box	x	x	x	x	x	x
CPU	x	x	x	x	x	x
Mass memory	x	x	x	x	x	x
Digital interface electronics	x	x	x	x	x	x
Power supplies (PSU)	x	x	x	x	x	x
Connectors	x	x	x	x	x	x
Savers	x	x	x	x	x	x
Warm Interconnect Harness (BOL6)						
DPU to SPU harness	x	x	x	x	x	x
SPU to detector read and control electronics harness	x	x	x	x	x	x
Detector readout and control electronics to detector buffer amplifiers harness	x	x	x	x	x	x
Analogue Instrument Simulator	x			x		
On Board Software						
Data handling and instrument command software	x	x	x	x	x	x
Real time instrument control software	x	x	x	x	x	x
Data processing software	x	x	x	x	x	x



Interface Specification for different Array Options.

Interface Specification for different Array Options

Table N: Connections from 2 K to 15 K

ALLOWED [illegible]

ID	Description	Name	No. of Conductors	No. of Shields	Max. Allowed Resistance (Ω)	Current (A)	Duty Cycle	Max. Volts (V)	Max Freq. (Hz)	Wire Type
1	Detector Signals	DSIG	120	30	1000	10^{-9}	1	1	30k	SST

ON BOARD DATA PROCESSING

TWO OPERATION MODES:

➔ IMAGING PHOTOMETRY:

Max number of Pixels:	32^2	1024		
	24^2	576		
	16^2	256		
TOTAL		**1856**	@ 20 Hz min	
&14 bits resolution:------------------------------------>				**>519 680** bps

Need compression at least by a factor 16 (close to 1 frame/sec)
Implies degliching

➔ SPECTRO-IMAGING

Max number of Pixels:	16^2	256		
	12^2	144		
TOTAL		**400**	@ 20 Hz min	
&14 bits resolution:------------------------------------>				**>112** 000 bps

without any oversampling.

Need compression:

The "easiest" way to compress data in this mode is coherent addition of interferograms. This implies a lot of memory to store 400 interferograms if one way recording; and 800 if recording during flyback.
Here again we need a degliching scheme, but much more efficient than in imaging mode.

DEFINITION OF ROLES WITHIN THE SYSTEMS TEAMS & ORGANISATION

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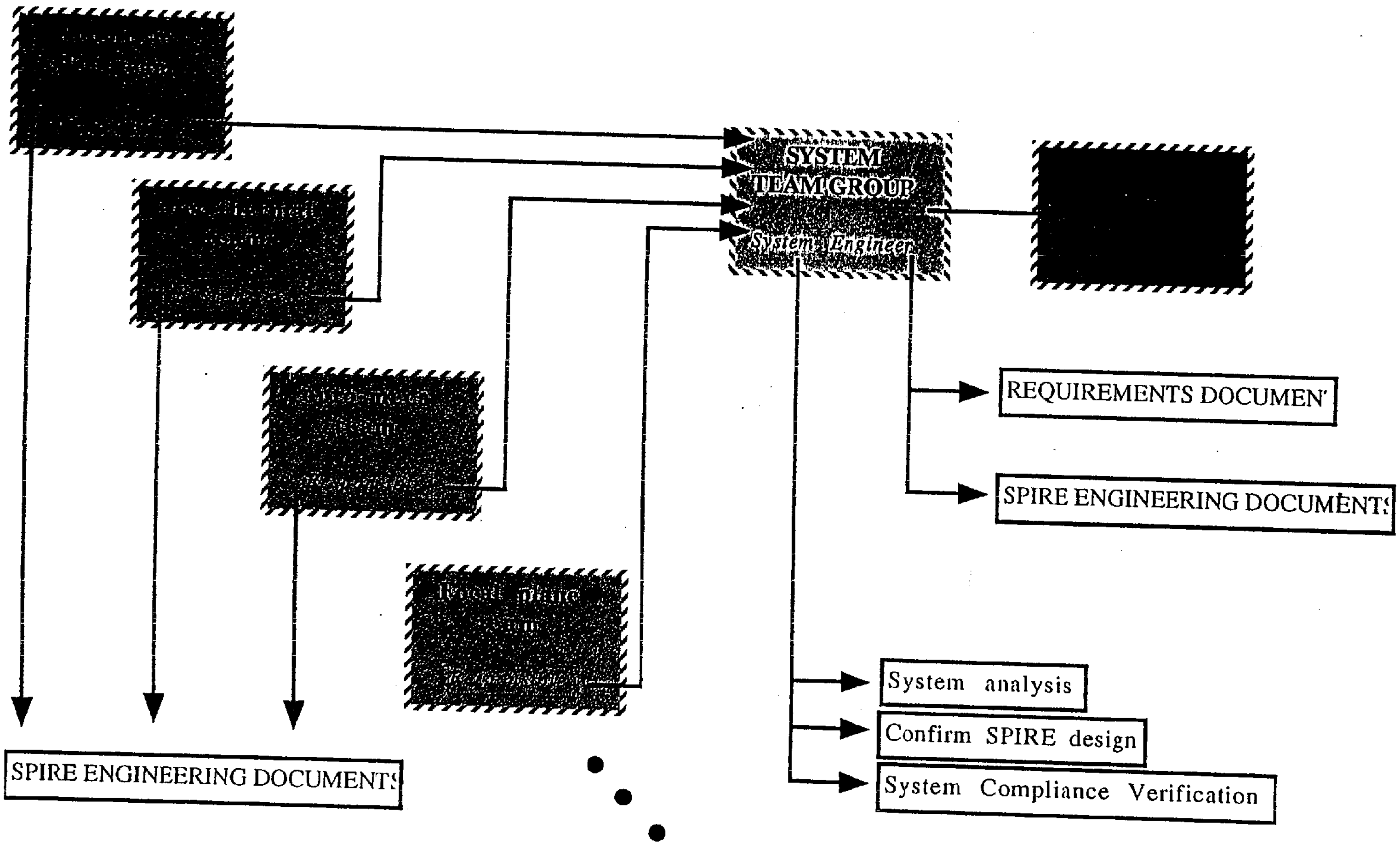
July 17th 1998

PROPOSED ORGANISATION



SUB-SYSTEM TEAMS

- SCIENTIFIC REQUIREMENTS
- OPTO-THERMAL & MECHANICAL
- FOCAL PLANES
- ELECTRONICS
  - HARD
  - SOFT
- AIV & CALIBRATION
- FLIGHT OPERATIONS
- GROUND SUPPORT EQUIPMENT (?)
- PRODUCT ASSURANCE
- RADIATIONS

➡ SCIENTIFIC REQUIREMENTS

Fields of view.
Image Quality.
Spectral Range .
Spectral resolution.
Noise Equivalent Power.
Radiometric Calibration accuracy
Data Products and Operations

➡ OPTO, THERMAL & MECHANICAL

MECHANICAL
- Structure - Mass
- Mechanical & thermal interfaces
- Structure vibration susceptibility

THERMAL
- Operating temperatures
- Thermal Budgets

OPTICAL
- Shutter
- Optical tolerencing.
- Boresight Alignment to Telescope
- Stray Light
- Optical Efficiency Performances
- Spectral Range & resolution
- Interferometer Requirements
  - Scan lenght & ZPD location
  - Tilt & shear
  - Polarisers
- Calibration sources

- FOCAL PLANES

  Sizes : complexity, pixel size, overall.

  Performances:

  NEP,

  Thermal and electrical speed of response

  Oper. temperatures

- ELECTRONICS
  - HARD

  Read-out

  FTS mechanism and sampling scheme

  HK

  INSTRUMENT CONTROL

  DATA PROCESSING

  - SOFT

  DATA COMPRESSION

- **AIV & CALIBRATION**
  The group has already met to define the AIV flow.
- **FLIGHT OPERATIONS**
- **GROUND SUPPORT EQUIPMENT (?)**
  Do we need a team responsible for all subsystems coordination?
- **PRODUCT ASSURANCE**
  Environmental and electronics parts requirements.
- **RADIATIONS**
  Instrument radiation Model and help to other sybsytems.

IIO-type Questions

- Where is heat sink for JFET module & what power can be dissipated
- How do we integrate our thermal model with S/C model
- What do they require from us in terms of I/F definition for different array options (e.g. cryoharness)
- Update on telescope study
- Where are constraints on Mass / Power
- Pointing
- TLM rate
- Focal plane Temperatures – in orbit / on ground
- Flushing of Lid.
- Cold vibration temperature (77K, 20K?)
- Orientation of cryostat during testing
- Impact of Cooler recycling on power profile

Model Philosophy

- purpose of AVM
  - what does it consist of.
  - how will it be used.
- purpose of CQM
- requirements on CQM specs
- Flight Spare
  - purpose
  - does schedule allow refurbishment of CQM
- Proto-Flight Model
  Testing philosophy - instrument level.

Management

- Meeting Plan
- Delivery dates (FM)
- EMC study group

Date: Fri, 31 Jul 1998 10:34:57 +0100 (BST)
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Subject: Notes on technical meeting with ESTEC team

Dear Colleagues,

Below is a note on the recent technical meeting with the ESTEC project team. When reading it, please check for actions to which you may need to contribute.

Best regards,

Matt

Summary of Technical Meeting between SPIRE and ESTEC Project Team, 29 July 1998
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Present: SPIRE: Jean-Louis Augueres
Christophe Cara
Matt Griffin
Ken King
Bruce Swinyard
ESA: Michel Anderegg
Bernard Guillaume
Thomas Passvogel

Harm Schaap

Note: All SPIRE ACTION deadlines are October 9 unless otherwise stated.

1. Instrument management:
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Action: KJK to produce a note making the instrument management structure and internal lines of communication within the project more clear than on the project organogramme in the proposal. (ESA will provide a list of questions as prompts.)

2. FSEC report:
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MJG presented our response to the FSEC report:

* We are adopting low resolution as the design driver with a goal of implementing the higher resolution as in the proposal.

* We are studying a double-FTS to try to improve the efficiency. (final decision on which sort of FTS to fly in Jan. 99).

* We have rejected the idea of combining the photometer and spectrometer as it is impractical and scientifically unacceptable.

* We agree to study on-board data processing requirements in detail and make results known to ESA.

Telemetry rate: ESA are studying the practicalities and costs. Options for increasing the telemetry rate by a factor of 3-4 are being looked at (that would certainly make a big difference to us). In the meantime, we will design for the current allocation.

3. Instrument Design Status
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Array options:

Action: SPIRE to provide ESA with detailed system designs for the different detector array options by early Oct. (following the Goddard meeting for which these will be available). Naturally, ESA want a full description of the interfaces with the spacecraft, in particular:

- The cryoharness (detailed IID-B table for each option)
- The power dissipation at the various temperatures
- The FET box:
  - power load on the "30-K" shield is currently 3-500 mW. So if we add something like another 150-200, this will have some impact on the thermal balance of the cryostat. This will need to be studied.
  - Space for accommodating the box: ESA are not too worried about where it goes as long as it doesn't get in the way of anything else. There is a good deal of space available in the vicinity of the instrument enclosures.
  - mass: not a big deal except that our overall mass is something we are supposed to be pushing down rather than up.
  - shield temperatures: we can use the Collaudan & Passvogel Kona paper numbers as indicative.

Note: This action is critical for our own needs anyway, and must be completed by the time of the September Array Group meeting.

Array selection schedule and selection plan: ESA want to have full visibility of our plans for and progress towards array selection. (This is effected already through invitation of Goran Pilbratt to Array Group meetings and circulation of minutes to him).

FPU mass:

Increasing the mass has implications for the lifetime. ESA are not quoting a fixed mass budget for us at this stage, but are worried that our current estimate is on the high side and they certainly don't want it to go up.

Action: SPIRE to provide updated mass estimate (BMS, CRC to coordinate).

He-3 cooler:

The TRP contract does not replace the cooler qualification although it may be helpful in this respect. We will be expected to put the cooler through the same level of qualification as for other items under development such as detector arrays and mechanisms.

ESA are happy with the hold-time and cycle time specifications that we have adopted.

Cooler cycling is not expected to have any serious impact on the shield temperatures.

The possible high power level for a short period during recycling is not foreseen as a problem (but ESA would still like to know the details of the power profile).

ACTION: SPIRE (BMS) to check with Lionel Duband on the implications of the orientation of the S/C during ground testing.

FPU temperature stability:

Action: SPIRE to analyse temperature stability requirements for the various shields (MJG)

Action: SPIRE to prepare first cut power profiles for typical observing sequences and modes based on envisaged operation of mechanisms and calibrators (BMS, MJG to coordinate).

Buffer Amplifier Unit for CEA arrays:

Action: SPIRE to provide updated specification of the BAU for the IID-B assuming MDM 37-way connectors (CEA to provide information to HS and copy to KJK).

4. Instrument development plan:
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KJK presented the current development schedule, emphasising the fact that there was no contingency and that the QM and FM schedules were butted right against one another.

Action: SPIRE (MJG) to keep ESA fully informed on progress towards key selections: FTS (Jan. 99) and detector arrays (early 2000, but hopefully before). Write a note on the selection procedure for the FTS

Action: SPIRE (BMS/KJK) to produce a qualification plan for the instrument (including sub-systems)

5. Test sequences and Model Philosophy

Avionics model:

- The purpose of this is to test the electrical and S/W functionality of the whole system.
- It will need to have a real DPU (at least brassboard level) + at least faithful emulation of what's behind it, including any S/W involved in communicating with the AOCS (peak-up mode for the feedhorn array option) or instrument autonomy functions.
- It will be held by ESA almost until launch

Cryogenic Qualification Model:

- ESA will do the same tests on this as for the ISO units
- Tests: Compatibility between instruments and spacecraft (thermal, mechanical, electrical, simple EMC (conducted)
- Inside cryostat:
  - "Flight representative"
  - Questions of detector array population, detector sensitivity, filter throughput etc. are TBD. The basic requirement is that the tests be able to convince US that our FM will work in the cryostat.
  - Shield temperatures and sensitivity of temperatures to FPU dissipation will not be completely representative in the ISO dewar.
  - With a cold cover, the instrument may be able to view a black body at 10-20 K at best. This will be much higher than our designed background so if we need to simulate it we will have to consider either having a 4-K shutter inside the instrument or inserting extra filtering for the tests. This same problem applies to the PFM, where, of course, we can't put in extra filtering - so we may need to consider incorporating a shutter in any case if we are going to be able to test the detectors properly on the ground.
- Outside cryostat: TBD - we can agree sensible requirements with ESA later
- ESA could use the AM units for the CQM tests - this would mean putting a gap into the AM test schedule, which may be feasible as the CQM tests do not take very long.
- The CQM will be returned to us shortly after the tests (early 2004), so that it will be possible to re-furbish it as the flight spare if we are required to provide one.

Cold vibration:

- Frequencies are similar at 77 K and 4 K but Q-factors are not.
- 10-20 K is acceptable to ESA for cold vibration

Action: SPIRE to check whether LAS facility can accommodate SPIRE for 20 K vibration tests (BMS to coordinate).

PFM schedule:

Since the AO, the launch date has slipped by more than a year but the FM delivery date by only 6 months. SPIRE requested a slip in the delivery date for the PFM, to ease the pressure on our QM-PFM programme.

ESA explained that this would compromise essential testing of the carrier and that the extra time was really needed for their tests.

It is likely that the other instruments will be making a similar request, so perhaps ESA will review the PFM schedule.

Flight spare:

SPIRE requested that ESA consider an alternative to the currently required identical twin flight spare. We proposed that spare subsystems be built and calibrated at subsystem level. In the event of a problem with the PFM in the cryostat, it would be returned to us, a new unit installed as appropriate, functionally checked, vibrated and returned.

ESA don't like this idea because this phase of the project is the most expensive for them (team size at its maximum), with a cost of ~ 2 MAU per month. So any delays will translate directly into heavy costs for them. We indicated a turn-around time of ~ 6 weeks for repairing and returning the PFM - they were skeptical about this and said that 3 months was probably more realistic.

Action: SPIRE to evaluate how long would be needed to repair and return the PFM (BMS, KJK)

Action: ESA (probably through FIRST Science Team) to establish what the criteria would be for opening the dewar and repairing or replacing the PFM.

Action: SPIRE (BMS) to redraft AIV plan to include new model philosophy.

6. IID-B update:
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Action: Harm Schaap is updating the IID-B and will send it to us electronically. We will update it as appropriate (MJG, BMS, CRC).

There will be a major IID-B update in October.

Action: Thomas Passvogel will update the current version of the mathematical thermal model which he made available to us some time ago.

7. Telescope etc.:
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Baseline (NASA-provided CFRP):
- Industry will build a 2-m demonstrator which will be tested (inc. low temperature) in mid 1999.
- Design work has started on the 3.5 m
- ESA-Industry review meeting planned for early Sept.
- Technical readiness review mid-1999
- If results not satisfactory, spacecraft ITT may need to include provision of back-up SiC telescope
- MMS are making a 1.35-m SiC demonstrator which will be tested by the end of 1998
- The QM CFRP telescope is needed by early 2002 - this may be an impossible schedule if the back-up is chosen
- Possibility of having D > 3.5 m: this depends on (i) the outcome of the demonstrator programme and (ii) a full study of all the system implications of having a larger antenna. [Encouragingly, there was not the usual loud and emphatic "NO" response that ESA have made to such queries in the past.]

Action: SPIRE (BMS/MJG to coordinate) to compile a list of questions that we would like raised with the telescope contractors (deadline early September).

Telescope temperature and temperature gradient stability:

Action: MJG to provide TP with some estimates of SPIRE's temperature stability requirements for provision to the telescope contractors (as indicative numbers only at this stage - we have not yet done a proper analysis, and so are not in a position to quote firm requirements). Industry will determine if our numbers are consistent with what they think can be achieved. [Deadline July 30]

Stray light model:

Action: BMS to provide ESA with ASAP/APART model of the photometer. (Deadline: end August.)

8. Future meetings:
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- Another technical meeting like this one in October (based largely on completion of all actions above)

- Another in January

- Then roughly quarterly + additional technical meetings as appropriate.

- The FIRST Alignment Working Group will be re-convened

- A Contamination Working Group will be created

- Pierre Estaria will be coordinating Ground Segment activities

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