30th July 2001



Schedule Overview

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BSM Schedule

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30th July 2001

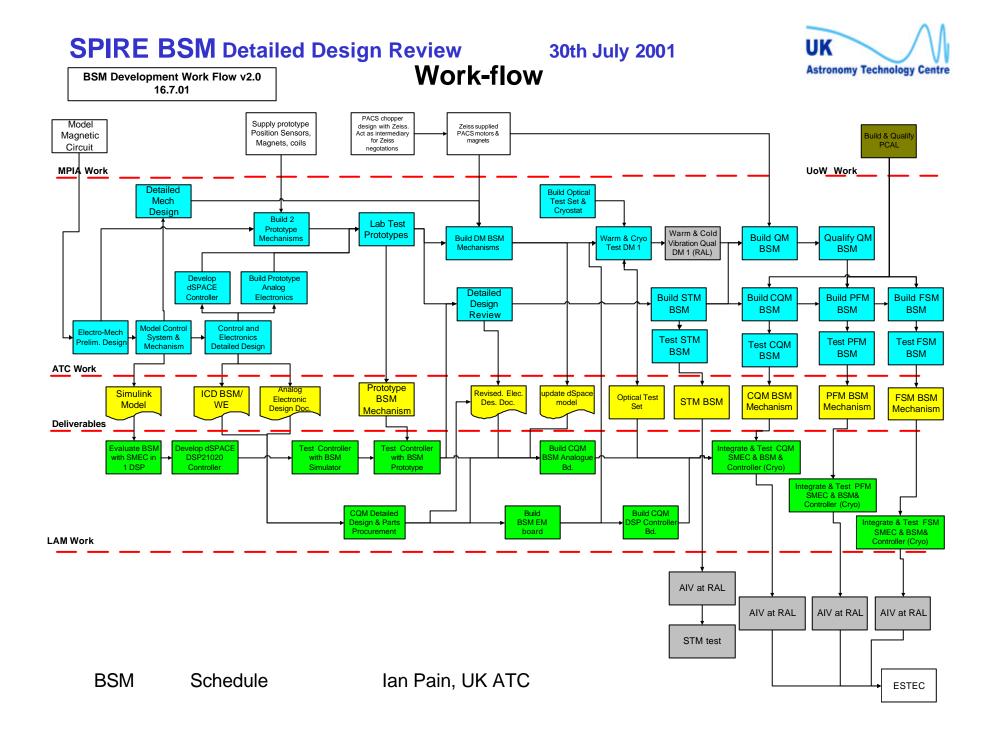


SPIRE BSM Development plan

• Last released 4.0 This review - Version 5.0 release

Doc Pack Sec.8

- Contents:
 - Constraints
 - Work flow
 - Calendar
 - Risk Analysis
 - Model Philosophy
 - Model description
 - Design phase description
 - Verification plan (as spec)
 - GSE
 - Calendar
 - Deliverables





Model Philosophy Summary

Model	Abbrev.	Quanti ty	Deliver ed to	Purpose
Single axis prototype	-	1	ATC	Initial proof of concept work
Two Axis prototype	-	1	ATC	Detailed cryogenic, vibration and cross talk tests. Refinement of design.
Development Model	DM	1 (or 2)	ATC, LAM	Detailed engineering development. Tests of LAM electronics with ATC hardware
Structural & Thermal Model	STM	1	ATC, RAL	Mass and thermal model. Representative vibration load on structure to obtain qualification loads. May also serve as the BSM alignment fixture.
Qualification Model	QM	1 (refurb DM)	ATC	Full verification of survivability, performance, life tests.
Cryogenic Qualification Model	CQM	1	RAL, ESA	Science performance of SPIRE at cryogenic temperature.
Proto-Flight Model	PFM	1	RAL, ESA	Flight Hardware.
Flight Spare Model	FSM	1	RAL, ESA	Flight spare if required (TBC). May be refurbished from CQM,STM,QM (TBD)



Development Calendar

Activity	Start	End
Preliminary Design	10 Apr '00	13 Feb '01
PDR	26 Jun '00	27 Jun '00
Detail Design & Prototypes	10 May '00	27 Aug '01
Detailed Design Review	19 Jun '01	30 Jul '01
DM	22 Mar '01	22 Mar '02
DM tests complete, indicate design concept valid	22 Mar '02	22 Mar '02
STM	04 Feb '02	09 Oct '02
confirm QM design loads	09 Oct '02	09 Oct '02
QM	22 Jun '01	27 Feb '03
QM tests complete, indicate flight design valid	27 Feb '03	27 Feb '03
CQM	04 Feb '02	05 Jun '03
Critical Design Review	02 Apr '03	04 Apr '03
PFM	13 Mar '01	20 May '04
Deliver FPU PFM to ESA	29 Oct '04	01 Nov '04
FSM	18 Apr '03	13 Dec '04
Deliver FPU FSM to ESA	19 Apr '05	21 Apr '05



Project Schedule

- Latest BSM project plan
 - updated 27.Jul.01
 - reflects progress, updates etc c.f. 17.Jul.01 dates for Dev. Plan v.5.0 in DDR pack
 - includes milestones agreed with LAM and which can now be confirmed with RAL
 - All deliverable milestones met with a margin of 5-20 days
 - However, some compromises due to late availability of cold vibration facility & STM structure.

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Overview Project Plan

9	Task Name bsm_jul_01f.mpp 🗸 🗸	Start 💌	Finish 💌	2000	2001	2002	2003	2004	2005
1				Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	
	SPIRE BSM	14 Apr '98							
2		14 Apr '98	29 Nov '05						
15	🗉 Preliminary Design	10 Apr '00	20 Jul '01	Prelimina	ry Design				
34	PDR	26 Jun '00	27 Jun 100	27/06					
35	🗉 Detail Design & Prototypes	10 May '00	24 Dec '01	L Detail De	sign & Prototy	pes			
122	Detailed Design Review	30 Jul '01	30 Jul '01		◇ ♦30/07				
123	IBDR resp.ESA per milestones 1.2_2	01 Nov '01	01 Nov '01		• 0	1/11		Loads not	1 1
124	⊕ DM	13 Jul '01	12 Jul '02		DM			until QM	1 1
148	DM tests complete, indicate design conc	14 May '02	14 May '02			<mark>♦1⁄</mark> /05		nearly co	inpiete:
149	⊞ STM	22 Mar '02	14 Feb '03			STM			
166	confirm QM design loads	06 Dec '02	06 Dec '02				06/12		
167	⊞ QM	30 Jul '01	21 Apr '03		OM				
189	QM tests complete, indicate flight desigr	21 Apr 103	21 Apr 103				4 21/04		
190	⊞ CQM	22 Mar '02	15 Jul '03			COM			
218	Critical Design Review resp.RAL per mile	27 Jun '03	27 Jun '03				27/06		
219	WE Critical Design Review resp.RAL per	02 Jul '03	02 Jul '03				02/07		
220	⊞ PFM	04 Jul '01	11 Jun '04		PEM				
249	PFM Delivery to ESA resp.RAL per mile:	15 Jun '04	15 Jun '04					 15/06	
250	⊞ FSM	03 Sep '03	10 Aug '05				L ES	M	
271	FS Available to ESA resp.RAL per miles	29 Nov '05	29 Nov '05						🔷 🔶 🔶 29/1



Design & Development Phase Overview

fask Name 🗾	Start 💌	Finish 💌	2000 2001 2002 2003 2004 Q2 Q3 Q4 Q1 Q2 Q3 Q4
🗆 Detail Design & Prototypes	10 May '00	24 Dec '01	Detail Design & Prototypes
🗉 Mechanical Design	26 Jun '00	28 Sep '01	Mechanical Design
🗄 Test Rig	17 Jul '00	24 Dec '01	Test Rig
Electronics	26 Jun '00	23 Aug '01	Electronics
Analog Brd Detailed design to LAM	26 Jul '01	26 Jul '01	♦26/07
WE ddR	24 Sep '01	24 Sep '01	♦ • • • • • • • • • • • • • • • • • • •
🗄 Controls	23 May '00	08 Feb '01	Controls
deliver d-space controller to LAM	08 Feb '01	08 Feb '01	◇08/02
🗄 Assy & Test 2 axis Prototype	23 Jul '01	25 Sep '01	Assy & Test 2 axis Prototype
BSM prototype complete	25 Sep '01	25 Sep '01	♦ ♦ ♦ ♦ ♦ ♦ ♦ ♦ ♦ ♦ ♦ ♦ ♦ ♦ ♦ ♦ ♦ ♦ ♦
Deliver Prototype to LAM for 1 week bug-finding integrat.	03 Dec '01	03 Dec '01	
2-AP at LAM for 1 week bug-finding integration	03 Dec '01	07 Dec '01	
🗄 Alternate prototype CDL	10 May '00	30 Apr '01	Alternate prototype CDL
🗄 Detailed design closeout	20 Jul '01	04 Oct '01	Detailed design closeout
Detailed Design Review	30 Jul '01	30 Jul '01 !	Might do a DM cold
IBDR resp.ESA per milestones 1.2_2	01 Nov '01	01 Nov '01	♦ 01/11 if facility available.
🗆 DM	13 Jul '01	12 Jul '02	
Procure milspec & near-space components	13 Jul '01	05 Oct '01	
Manufacture DM	27 Sep '01	15 Mar '02	Manufacture DM
🛨 Test DM Mech	06 Mar '02	30 Jun '02	Test DM Mech
🛨 cold vibration campaign DM (optional)	14 May '02	12 Jul '02	cpld vibration campaign DM (optional)
go/no-go on STM flex pivots	12 Jul '02	12 Jul '02	♦12/07
DM tests complete, indicate design concept valid	14 May '02	14 May 102	♦1⁄05

BSM

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Qualification Phase Overview

Task Name 🗾	Start 💌	Finish 💌	2000 Q2 Q3 Q4	2001 Q1 Q2 Q3 Q4	2002 2003
⊟ STM	22 Mar '02	14 Feb '03			STM
🗆 design STM	22 Mar '02	25 Apr '02			design STM
Decide STM static or dynamic	22 Mar '02	22 Mar '02			↓ 2 [*] ∕03
Design STM & OGSE	25 Mar '02	25 Apr '02			
🗄 Build & Test STM	25 Apr '02	24 Jun '02			Build & Test STM
STM BSMm Delivery to RAL resp.ATC per milestones 1.	01 Jul '02	01 Jul '02			01/07
	01 Jul '02	14 Feb '03			STM support
refurb STM as OGSE (if reqd)	14 Feb '03	14 Feb '03			♦14/02
update design models & modify design (select flex pivots)	28 Nov '02	06 Dec '02			H
confirm QM design loads	06 Dec '02	06 Dec '02	1		♦ ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ●
E QM	30 Jul '01	21 Apr '03		QM.	
Procure space components	30 Jul '01	27 Feb '02			
Procure QM flex pivots	30 Jul '01	26 Apr '02			
🗄 Manufacture QM	14 May '02	20 Dec '02			Manufarture QM
∃ Test QM	20 Dec '02	21 Apr '03			Test QM
QM tests complete, indicate flight design valid	21 Apr 03	21 Apr 103			◆ 21/04

re-design or re-work.



CQM & Flight Hardware Phase Overview

Task Name 💌	Start 💌	Finish 💌	2000 2001 2002 2003 2004 2009 Q2 Q3 Q4 Q1 Q2 Q3
E CQM	22 Mar '02	15 Jul '03	
Manufacture CQM	22 Mar '02	13 Aug '02	Mangracture CQM
1 Test CQM	13 Aug '02	11 Jan '03	TestjCQM
CQM support	01 Jun '02	15 Jul '03	CQM support
± CDR prep	19 May '03	06 Jun '03	CDR prep
Critical Design Review resp.RAL per milestones 1.2	27 Jun '03	27 Jun '03	◆27/06
WE Critical Design Review resp.RAL per milestone	02 Jul '03	02 Jul '03	◆02/07
B PFM	04 Jul '01	11 Jun '04	PEM
PFM long lead procurement	04 Jul '01	08 Feb '03	PFM long lead procurement
🗄 PFM design changes	21 Apr '03	30 Jul '03	PFM design changes
🛨 PFM build	05 May '03	25 Aug '03	PFM build
PFM BSMm Delivery to LAM resp.ATC per milestones 1.	25 Aug '03	25 Aug '03	∠€25/08
PFM integration to MCU	15 Jul '03	02 Oct '03	PIM integration to MCU
PFM BSMm Delivery to RAL resp.LAM per milestones 1.	01 Oct '03	01 Oct '03	♦ 01/10
PFM Support	01 Jul '03	11 Jun '04	PFM Support
PFM Test Readiness Review resp.RAL per milestones 1	09 Dec '03	09 Dec '03	09/12
PFM Delivery to ESA resp.RAL per milestones 1.2_	15 Jun '04	15 Jun '04	* 15/06
⊞ FSM	03 Sep '03	10 Aug '05	LESM
FS Available to ESA resp.RAL per milestones 1.2	29 Nov '05	29 Nov '05	



BSM Schedule issues

- Problem:
 - Cold vibration for BSM models
 - facility not available before end of DM tests
 - probable clashes for facility when it does exist (ie BSM QM cannot get on because it's probably full of SPIRE CQM at the time).
 - cold vibration too costly to test as often as desired (e.g. 3-4 times)
 - STM results not available prior to QM or CQM design, manufacture (and most of QM tests!)
- Consequence
 - BSM will be designed and qualified based entirely on warm vibration data to a theoretical load spectrum.
- Risk
 - is that we would need to re-qualify after STM (with a 4 month delay to PFM delivery).
 - Or that re-tests will result in budget over-run

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BSM Schedule issues

- Problem: STM functionality is not firmed up
 - option 1: mass dummy only
 - cheap to make
 - but extra design time unless very crude
 - option 2: as DM,
 - need to make extra hardware, as DM is required for refurb as CQM thus cannot use as STM. May be able to partly re-use 2 axis prototype if size, materials etc don't change 'too much'.
 - 2A: with cold rated flex pivots
 - if can procure in time (only just)
 - free cold vibration test!
 - Flex pivot survivability only determined by STM test, thus risk to STM programme.
 - 2B: as DM, without flex pivots
 - replace pivots with solid shafts.
 - 2C: as DM, with non-cold flex pivots
 - Could be 'interesting'



Key decision branch points

- Flex Pivot procurement
 - based on technical acceptability
 - and on affordability. E.g. may have to collaborate on procurement and take a non-optimum pivot for BSM
 - interaction with motor coil material
- Motor Coil selection
 - confirm material
 - absorb minor changes from Zeiss c.f. PACS prototype
- Launch Lock
 - required or not? Decide after warm (& cold?) vibration, with and without LL.
- STM test result availability
 - re-design BSM for higher launch loads
 - set up QM tests to match STM data