SPIRE

SUBJECT: **SPIRE Instrument Development Plan**

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1. INTRODUCTION

1.1 Purpose

The purpose of this document is to describe the development of the deliverable models of the FIRST SPIRE instrument, including their assembly, integration and test. It also includes the provision of the test equipment, test facilities and simulators necessary for this development.

This document is an applicable document to the subsystems development plans, which are to be written by the SPIRE Responsible Organisations (ROs) who will implement each subsystem (RD1 - RD14).

1.2 Scope

This document covers the development of the SPIRE instrument hardware and its on-board software and the additional equipment required for its assembly, integration and test. The development of the SPIRE contribution to the FIRST Ground Segment (the Instrument Control Centre) is described in the SPIRE Science Implementation Plan (RD15).

The development activities that contribute to the provision of the instrument models take place at many different centres, both at ROs and in industry. Those activities contributing to the development of subsystems are detailed in the individual subsystems development plans (RD1-RD14). This plan concentrates only on the deliveries made between ROs and those deliveries made to RAL for final integration into the instrument.

1.3 Glossary

DDR	Detailed Design Review
DPU	Digital Processing Unit
DRCU	Detector Readout and Control Unit
FIRST	Far Infrared and Submillimetre Telescope
FPU	Focal Plane Unit
IIR	Instrument Interface Review
PDR	Preliminary Design Review
RO	Responsible Organisation
SPIRE	Spectral and Photometric Imaging REceiver
WIH	Warm Interconnect Harness

1.4 References

1.4.1 Applicable Documents

Document Reference	Name	Number/version/date
AD1	FIRST/Planck Instrument Interface Document Part A	SPIRE-ESA-DOC-000178

	(IID-A)	(PT-IID-A-04624) Issue 0-3 15 May 2000
AD2	FIREST/Planck Instrument Interface Document Part B (IID-B) Instrument "SPIRE"	SPIRE-ESA-DOC-000275 (PT-SPIRE-02124) Issue 0-4 15 May 2000
AD3	SPIRE Management Plan	FIRST-SPI-PRJ-000011 (SPIRE-RAL-PRJ-000029) Issue 1.0 22nd June 1999

1.4.2 Reference Documents

Document Reference	Name	Number/version/date
RD1	SPIRE Structure Development Plan	SPIRE-MSS-PRJ-000426 Issue 1.0 11th June 2000
RD2	SPIRE Mirrors Development Plan	(LAM.PJT.SPI.NOT.200006) v0000601 13th June 2000
RD3	SPIRE Filters Development Plan	Draft 1.0 6th June 2000
RD4	SPIRE BSM Development Plan	Issue 1.0
RD5	SPIRE Cooler Development Plan	(PL/SBT/SPIRE/2000-01) Issue 1.1 May 2000
RD6	SPIRE Arrays Development Plan	TBW
RD7	SPIRE FET Box Development Plan	TBW
RD8	SPIRE Spectrometer Mirror Mechanism Development Plan	(LAM.PJT.SPI.NOT.200001) v0000105 6th June 2000
RD9	SPIRE Calibrators Development Plan	Draft 1.0 6th June 2000
RD10	SPIRE Shutter Development Plan	(SPIRE-USK-DOC-000001) Draft 0.2 15th June 2000
RD11	SPIRE DPU Development Plan	(F-13.06.00) Issue 1 13th June 2000
RD12	SPIRE DRCU & WIH Development Plan	(SAp-SPIRE-JLA-xxxx-00) Issue 1.0 6th June 2000
RD13	SPIRE DRCU Simulator Development Plan	Draft 4th May 2000
RD14	SPIRE Test Facility Development Plan	Draft 1.0 19th June 2000
RD15	SPIRE Science Implementation Plan (SIP)	
RD16	SPIRE Optical System Design Description	Draft

		25th May 2000
RD17	SPIRE Straylight Model Update	Draft 14th June 2000
RD18	SPIRE Optical Design - diffraction analysis and design	Issue 1.0 14th June 2000
RD19	SPIRE Optical Error Budgets	(LOOM.KD.SPIRE.2000.002) Draft 22nd May 2000
RD20	SPIRE AOV Plan	SPIRE-RAL-DOC-000410 Issue 01. 25th May 2000

1.5 Document Overview

Chapter 2 describes the development of the instrument in terms of the ESA schedule and deliverable instrument models required in the Instrument Interface Document Part A (AD1) and the SPIRE organisation described in the Instrument Interface Document (AD2) and the SPIRE Management Plan (AD3).

Chapter 3 describes aspects of the development of the instrument subsystems.

Chapter 4 describes the development plans for the test facilities, support equipment and simulators required for assembly, integration, test and calibration of the instrument at all levels.

Chapter 5 is devoted to the instrument Assembly, Integration and Test.

2. INSTRUMENT DEVELOPMENT

This document covers the development, manufacture and test of the different models of the SPIRE instrument. These activities require the development of three elements; the instrument itself; the Test Facility in which the instrument–level testing will take place and the simulators required to take the place of various instrument units during integration and testing.

2.1 Development Items

2.1.1 The Instrument

A description of the SPIRE instrument and its capabilities is given in AD2. The instrument consists of 5 units;

- **Focal Plane Unit (FSFPU)** - this consists of all the subsystems contained within the FIRST cryostat, excluding the cold electronics (i.e. FET amplifiers).
- **FET Box (FSFTB)** -this contains the cold preamplifiers for the detector signals from the FSFPU. It is assembled with the FSFPU and they are then mounted on the optical bench as one unit.
- **Detector Readout and Control Unit (FSDRC) - t**he electronics box external to the cryostat that houses the detector control and read out electronics; the mechanism control electronics, the subsystem housekeeping electronics and their power supply.
- **Digital Processing Unit (FSDPU)** - the instrument on board computer handling the command and telemetry interface to the spacecraft and the control of the operation of the instrument through the DRCU.
- **Warm Interconnect Harness (FSWIH)** - the harness connecting the DPU and DRCU.

All other harnesses; the cryoharness connecting the FPU and DRCU and the power, telemetry and telecommand harnesses are provided by ESA and do not form part of the instrument.

2.1.2 Simulators

Additional deliverable items will be the support equipment necessary to install and verify the installation of Instrument Units. These additional items include:

- **FPU Simulator** - this item simulates the FPU as far as their interfaces with the DRCU are concerned. This will be delivered to ESA at the time of the CQM model delivery, to be used to aid integration of the warm electronics units of all models into the S/C.
- **DRCU Simulator** - this item simulates the cold FPU and the warm electronics in the DRCU. It forms part of the AVM, simulating the instrument response to commands from the spacecraft and generating simulated telemetry data.

Figure 2-1 is a block diagram of the instrument showing the different units and the subsystems they contain. **Figure 2-2** shows the instrument broken down into its various deliverables.

2.1.3 Test facility

This facility provides; a cryostat to simulate the thermal environment in which the instrument will operate; a telescope simulator and calibration sources to allow verification of the instrument specifications and its calibration; and EGSE to control and monitor the instrument and test equipment during the test and calibration activities. A description of the facility is given in RD14.

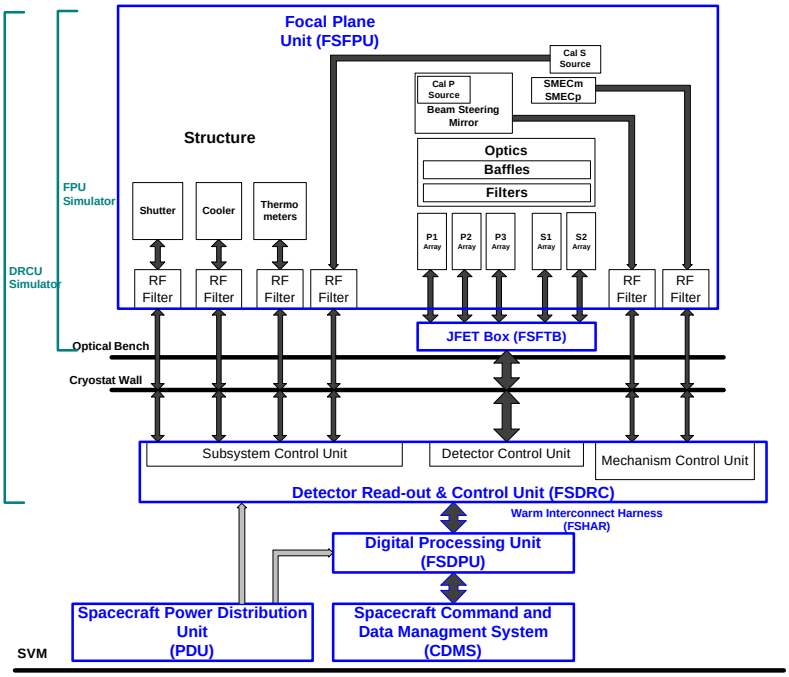


Figure 2-1 Instrument Block Diagram

2.2 Model Philosophy

The following SPIRE models will be produced;

- Avionics Model (AVM)
- Structural Thermal Model (STM)
- Cryogenic Qualification Model (CQM)
- Electronics Qualification Model (EQM)
- Proto-Flight Model (PFM)
- Flight Spare Model (FS)
-

The STM and EQM are for internal SPIRE use and will not be delivered to ESA

Additional qualification/test models of subsystems will be produced by each subsystem RO. These are detailed in the appropriate development plans. The following sections describe each model and **Table 2-1** summarises the contents of each model.

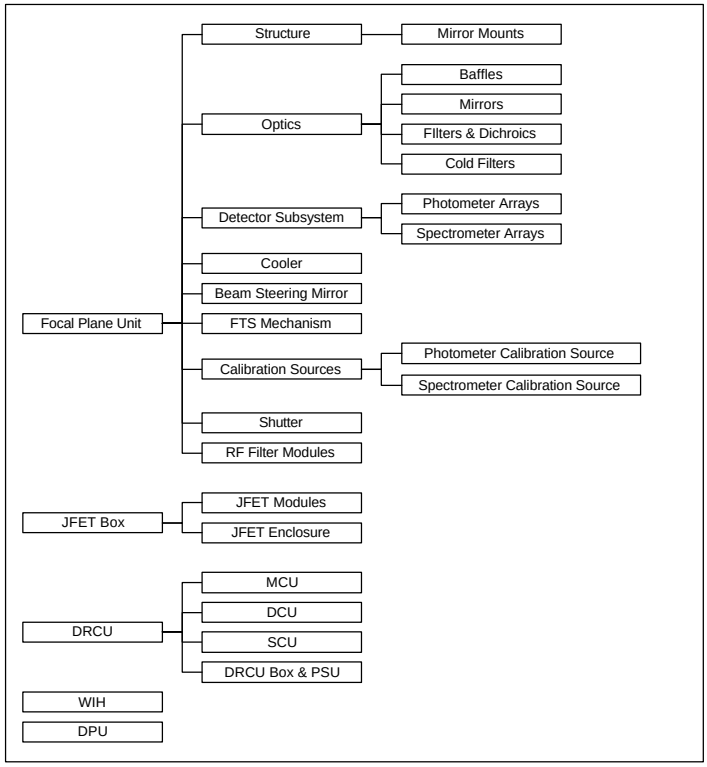


Figure 2-2 Instrument Product Tree

2.2.1 Avionics Model (AVM).

This model is required to validate the instrument electronics and software and their interfaces with the S/C. This will include:

- verification of information exchange with the S/C computer, mass memory and attitude control systems
- verification of the instrument autonomy functions

- validation of on-board software updates
- validation of AIV procedures

The AVM will consist of a DPU (FSDPU) plus a DRCU Simulator. The DRCU Simulator will provide sufficient simulation of the operation of the FPU, DRCU and WIH to allow the activities given above to be carried out.

The DPU will be built to flight representative standards using commercial parts, where possible with the same technology and from the same supplier as the PFM. This model will be form and fit identical to the PFM but will not implement any redundancy.

In addition the AVM DPU will be used during testing of the CQM (see below) both at instrument-level and during CQM testing at ESA.

2.2.2 Structural Thermal Model

This model is provided early in the development phase. Its purpose is;

- to gain confidence in the mechanical model of the structure, by comparison of the vibration response when warm with the Finite Element Analysis.
- to validate the thermal model of the instrument at the higher temperature levels (2K, 4K and 10K)
- to verify the optical alignment procedure

The model is not complete in itself. It consists of the CQM structure with additional mass/thermal models of subsystems (some also acting as optical dummies) integrated.

2.2.3 Cryogenic Qualification Model

This model will be used by the SPIRE consortium to qualify the cold instrument design against the proposed environmental test levels. On delivery to ESA it will be used to ensure the compatibility of the FIRST payload and spacecraft by performing a series of functional tests and a set of conductive EMC tests in the ISO Flight Spare Cryostat.

This model consists of an FPU (FSFPU and FSFTB). In addition, to allow its integration and test, the following units will be provided; DRCU, WIH, FPU Simulator and EGSE. It is assumed that the AVM DPU will be available for use for the duration of the CQM tests.

The CQM FPU will be built to flight standards with full redundancy. The performance capabilities of the instrument may be less than the PFM - i.e. fewer pixels in the focal plane arrays, but it will mimic as exactly as possible the thermal, electrical and mechanical properties of the flight instrument and will be capable of under going the full environmental qualification programme.

The DRCU will be built from non-flight grade components, but will be form and fit identical to the PFM. It will not provide any redundancy.

2.2.4 Electronics Qualification Model

This additional model is built to allow qualification testing of the warm electronics units independently of the CQM test programme. The following tests will be performed at the instrument level:

- EMC tests (Conduction, Emission, Susceptibility)

- Thermal Vacuum Test (TBC, the individula units will be tested by the ROs)
- Warm Vibration (TBC, the individual units will be tested by the ROs)

This model will be used to carry out the first testing of the PFM FPU while the PFM electronics is being manufactured.

The model consists of a DPU, DRCU and WIH. Each will be electrically, thermally and mechanically representative of the flight units, including redundancy. Components will be of the same type as the flight model, but at a lower quality level.

2.2.5 Proto-Flight Model

This is the instrument model that is intended for flight. It consists of all SPIRE Instrument Units. It will be built to full flight standards and will only have minor differences in thermal, electrical and mechanical properties to the CQM. It will have the same mechanical, thermal and electrical interfaces to the satellite as the CQM but, may, however, have minor internal design changes compared to the CQM. For instance the bolometer arrays may have many more pixels.

The PFM will undergo environmental testing to qualification levels for acceptance times - this applies to both the warm electronics boxes and the cold FPU.

2.2.6 Flight Spare Model

The Flight Spare Model provides for replacement of failed, or damaged, units during system level testing.

The FS will consist of a full flight standard, calibrated (TBC) FPU and tested spare parts (normally at board level) for the DPU, DRCU and BAU.

It is possible that the Flight Spare Units may be provided from refurbished AVM and CQM units.

	AVM	CQM	EQM	PFM	FS	Comments
Instrument Units						
FPU		CQM		PFM	FS	
FET Box		CQM		PFM	FS	
DRCU		QM1	QM2	PFM	FS[1]	
WIH		QM1	QM2	PFM	FS	
DPU	AVM		EQM	PFM	FS[2]	AVM Unit will be used for CQM testing at ESA
Support Equipment						
FPU Simulator		#1	#2			One unit (#1) will remain at ESA for use with all models
DRCU Simulator	#3					
EGSE		#4				One unit (#4) will remain at ESA for use with all models

Notes:

1. Possibly only spare cards will be provided
2. Only spare cards (shared with other FIRST instruments) will be provided

Table 2-1 Instrument Model summary of constituent Units

2.3 Qualification and verification

Qualification and verification of the instrument will be carried out both at subsystem and instrument levels;

1. All sub-systems will go through a type approval programme of one or more models, as necessary, before the Cryogenic Qualification version of the sub-system is delivered for the instrument AIV. The testing carried out on the CQM instrument is not considered to be the qualification test for each individual sub-system as the tests carried out on the instrument CQM will be neither exhaustive nor at the correct level for sub-system qualification.
2. The CQM will undergo a series of qualification and compatibility tests at levels and temperatures agreed between SPIRE and ESA.
3. Acceptance tests will be performed on each subsystem prior to delivery for the PFM and FS models.
4. An acceptance test programme will be performed on the instrument prior to delivery to ESA.
5. Characterisation and calibration of the subsystems will be made prior to delivery of all models.
6. Characterisation and calibration of the instrument will be made prior to delivery of all models.

2.3.1 Qualification Tests

Vibration: All sub-systems are to be vibrated at levels appropriate to their location within the instrument. The temperature at which the vibration will be done is subject to negotiation between the project and ESA. The group responsible for the structure will define the level at which each sub-system will be vibrated. This will either be by calculation or vibration of test structures.

Thermal cycle: All FPU sub-systems will be cooled down and warmed up a large number of times over the period leading up to launch. An accelerated thermal cycle test is therefore required for all FPU sub-systems. The temperatures, rate of temperature change and number of cycles are TBD.

Vacuum cycle: All sub-systems will be operating *in vacuo*. The long-term performance of all sub-systems *in vacuo* as well as their response to vacuum cycling must be assessed. All sub-systems will be vacuum cycled and critical items will undergo long-term life tests under vacuum conditions.

Lifetime: Where novel material processing or unqualified mechanisms are employed in a sub-system, accelerated life tests will be mandatory. For all ASICs and micro-machined components a programme of device selection will be required to guard against infant mortality.

Soak/cycle: All electronic sub-systems and/or components will need to be soak tested and operationally cycled as part of their lifetime test programme.

Radiation tolerance: All unqualified electronics sub-systems and/or components will have to be exposed to the appropriate level of radiation dose to ensure survival in orbit.

Thermal range: The operating temperature range of a sub-system will be characterised. If a sub-system does not operate within specification, or at all, at temperatures that are within the expected limits, it cannot be considered qualified.

Thermal stability: The response of a sub-system to thermal instabilities will be characterised as will the impact of sub-system operation on the thermal stability of the instrument. A sub-system that causes large thermal instability in the instrument during its normal operational cycle or is over sensitive to the expected level of thermal instability cannot be considered qualified.

Microphonics: The level of mechanical vibration from a sub-system will be characterised as well as the response of the sub-system to microphonic interference. Any sub-system that causes excessive mechanical vibration during its normal operation or is over sensitive to the expected level of mechanical vibration cannot be considered qualified.

Ionising radiation: The response of a sub-system (e.g. the detectors) to high energy ionising radiation (simulating cosmic ray proton hits), will be characterised. A sub-system will not be considered qualified if its performance is significantly reduced by the impact of high energy ionising radiation.

EMI: The sensitivity of a sub-system to electromagnetic interference will be characterised. If a sub-system is over sensitive to the expected level of electromagnetic emission it will be deemed not qualified.

EMC: The radiated and conducted electromagnetic emission of a sub-system will be characterised. Any sub-system that emits significant levels of electromagnetic radiation or interferes with power supplies or ground lines will not be considered qualified.

Materials conformance: All materials used in the manufacture of a sub-system must be approved for space use by ESA. Any materials not on an approved list must under go a materials approval test as laid down by ESA.

2.3.2 Subsystem Qualification

Table 2-2 is the test matrix for the SPIRE sub-systems qualification programme. Tests marked with an X are mandatory, those marked with a P are possibly required depending on the detailed design of the sub-system and/or the new of novel materials.

	Structure	Optics	FTS Mechanism	Chopper	Detector arrays	Cooler	Filters/grids/dichroics	Calibration Sources	DCRU	DPU
Vibration:	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Thermal cycle:	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**		
Vacuum cycle			**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Lifetime:		**P**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Soak/cycle:			**X**	**X**	**X**	**X**		**X**	**X**	**X**
Radiation tolerance:			**P**	**P**	**X**	**P**	**X**	**X**	**X**	**X**
Thermal range:			**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Thermal stability:		**P**	**X**	**X**	**X**	**X**	**P**	**X**	**X**	**X**
Microphonics:		**P**	**X**	**X**	**X**	**X**	**P**	**P**		
Ionising radiation:					**X**					
EMI:			**X**	**X**	**X**	**P**		**P**	**X**	**X**
EMC:			**X**	**X**	**X**	**P**		**P**	**X**	**X**

Table 2-2 Test Matrix for Subsystem Qualification

For some sub-systems the qualification and lifetime testing will be more appropriately carried out at component or test item level rather than at the level of the integrated sub-system. At what stage and under what conditions the tests are to be carried out is a matter for detailed consideration by the groups responsible for the sub-systems delivery.

2.3.3 Instrument-level Qualification

Table 2-3 is the test matrix for the instrument level testing. Q indicates a test carried out at qualification level for qualification times; QA a test carried out at qualification levels for acceptance test times and A a test carried out at acceptance level for acceptance times. An x indicates that this test is carried out and is a characterisation type test or the level is irrelevant. A dash indicates that no test will be done on this model/unit.

	CQM FPU	CQM DCRU	CQM SPU	CQM DPU	PFM FPU	PFM DCRU	PFM DPU	FS Focal Plane Unit	FS DCRU	FS DPU
Vibration:	**Q**	**Q**	**Q**	**Q**	**QA**	**QA**	**QA**	**A**	**A**	**A**
Thermal cycle:	**Q**	**Q**	**Q**	**Q**	**QA**	**QA**	**QA**	**A**	**A**	**A**

Vacuum cycle	x	x	x	x	x	x	x	x	x	x
Thermal range:	x	x	x	x	x	x	x	-	-	-
EMC (Instrument Level)	x	x	x	x	x	x	x	-	-	-
EMC (Satellite Level):	-	-	-	-	x	x	x	-	-	-

Table 2-3 Test Matrix for Instrument-level Testing

3. DEVELOPMENT OF SPIRE SUB-SYSTEMS

Figure 2-2 has shown the breakdown of the instrument into subsystems. Figure 3-1 shows how these subsystems are assembled to for the instrument units.

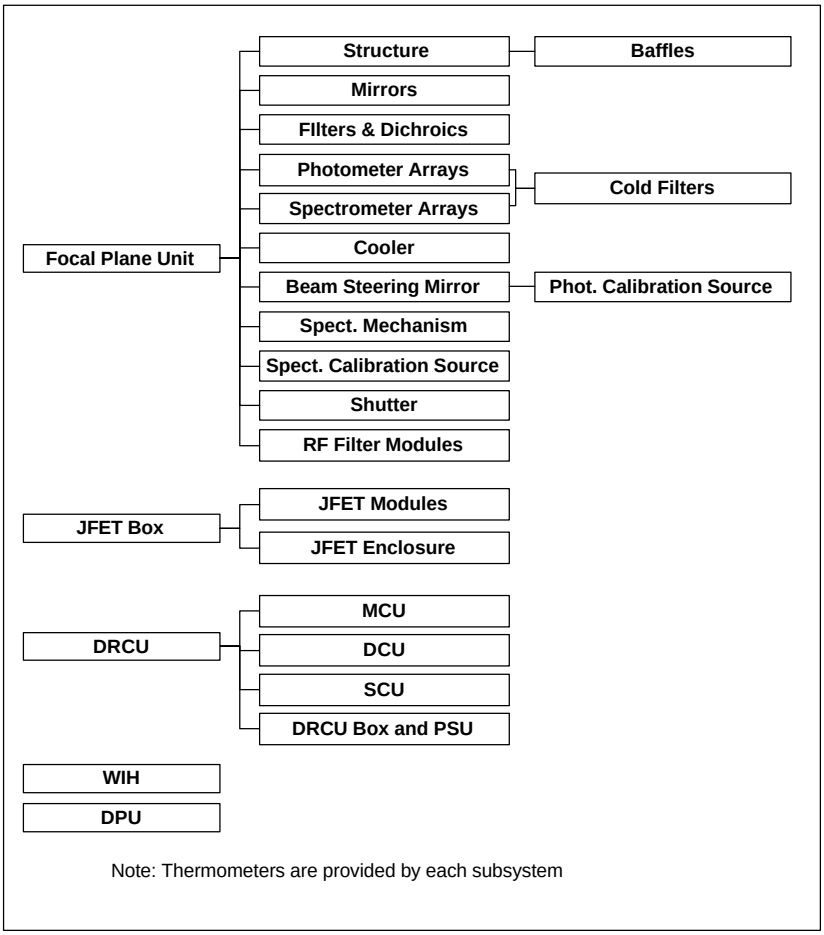


Figure 3-1 Instrument Assembly Tree

3.1 Focal Plane Unit

Table 3-1 is a summary of the FPU subsystem models to be delivered;

	Resp.	STM	CQM	PFM	FS	To	Comments
FPU Subsystems							
Structure	MSSL	CQM		PFM	FS	RAL	
Mirror Mounts	MSSL	CQM		PFM	FS	RAL	
Optics							
Mirrors	LAS	CQM		PFM	FS	RAL	
Filters & Dichroics	QMW	??	CQM	PFM	FS	RAL	
Cold Filters	QMW		CQM	PFM	FS	JPL	
Baffles	MSSL	CQM		PFM	FS	RAL	
Detectors							
Photmeter Arrray 1	JPL	STM	CQM	PFM	FS	RAL	
Photometer Array 2	JPL	STM	CQM	PFM	FS	RAL	
Photometer Array 3	JPL	STM	CQM	PFM	FS	RAL	
Spectrometer Array 1	JPL	STM	CQM	PFM	FS	RAL	
Spectrometer Array 2	JPL	STM	CQM	PFM	FS	RAL	
Cooler	Grenoble	STM	CQM	PFM	FS	RAL	
Beam Steering Mirror	ATC	OD	CQM	PFM	FS	LAM	Optical Dummy delivered to RAL
FTS Mechanism	LAM	OD	CQM	PFM	FS	RAL	
Calibration Sources							
Photometer	QMW		CQM	PFM	FS	ATC	
Spectrometer	QMW	STM	CQM	PFM	FS	RAL	
Shutter	USK						
RF Filter Modules	JPL	STM	CQM	PFM	FS	RAL	

Table 3-1 FPU Subsystem Deliverables

3.2 JFET Box

The table below gives a summary of the subsystems to be delivered;

	Resp.	STM	CQM	PFM	FS	To	Comments
JFET Box Subsystems							
JFET Modules	JPL		CQM	PFM	FS	RAL	
JFET Enclosure	MSSL/RAL	???	CQM	PFM	FS	RAL	

Table 3-2 FET Box Subsystem Deliverables

3.3 DRCU

The table below gives a summary of the subsystems to be delivered;

	Resp.	CQM	EQM	PFM	FS	To	Comments
DRCU Subsystems						RAL	
MCU	LAM	QM1	QM2	PFM	FS	SAp	

DCU	SAp	QM1	QM2	PFM	FS		
SCU	SAp	QM1	QM2	PFM	FS		
DRCU Box and PSU	SAP	QM1	Qm2	PFM	FS		

Table 3-3 DRCU Subsystem Deliverables

3.4 WIH

The table below gives a summary of the subsystems to be delivered;

	Resp.	CQM	EQM	PFM	FS	To	Comments
WIH Subsystems							
WIH	SAp	QM1	QM2	PFM	FS	RAL	

Table 3-4 WIH Subsystem Deliverables

3.5 DPU

The table below gives a summary of the subsystems to be delivered;

	Resp.	AVM	EQM	PFM	FS	To	Comments
DPU Subsystems							
DPU	IFSI	AVM	EQM	PFM	FS	RAL	

Table 3-5 DPU Subsystem Deliverables

4. TEST AND SUPPORT EQUIPMENT AND FACILITIES

The table below gives a summary of the test and support equipment and facilities required for development, test and calibration of the instrument models.

	Resp.	No.	To	Comments
Simulators				
FPU Simulator	SAp	2	RAL	One is delivered to ESA
DRCU Simulator	SO	3	IFSI/RAL(2)	One is delivered to ESA
Support Equipment				
EGSE	RAL	3	RAL	One is delivered to ESA
Test Facilities				
Calibration Cryostat	RAL	1		
Telescope Simulator	RAL	1		

Table 4-1 Test and Support Equipment Deliverables

5. SPIRE INTEGRATION AND TEST

All integration and testing at instrument-level is the responsibility of RAL. RAL will make use of its own facilities wherever possible for testing and requires only external facilities to perform the cold vibration of the CQM, PFM and FS models. It is assumed that ESA will provide these facilities.

The majority of the instrument-level testing will take place in the RAL Test Facility described in RD14.

The AIV Plan (RD20) details the steps that each of the instrument models undergoes during the integration, verification and calibration stages after delivery to RAL and before delivery to ESA.

6. SPIRE DEVELOPMENT AND SCHEDULE

6.1 Overall Schedule for the FIRST Programme

Table 6-1shows the current ESA high-level milestones defined for the FIRST development phases and the delivery dates of the instrument models.

Milestone	Date
Issue of ITT to industry	September 2000
Start Phase B	June 2001
Start of Phase C/D	June 2002
End of Phase C/D	July 2006
Launch	Q1 2007
Delivery of Instrument AVM	April 2003
Delivery of Instrument CQM	April 2003
Delivery of Instrument PFM	July 2004
Delivery of Instrument FS	July 2005

Table 6-1 ESA High-level Milestones

Figure 6-1shows the corresponding SPIRE baseline development schedule, which meets these milestones. A list of the instrument Major milestones is given in Appendix 1. Detailed Schedules for each Instrument deliverable model and each subsystem are given in Appendix 2

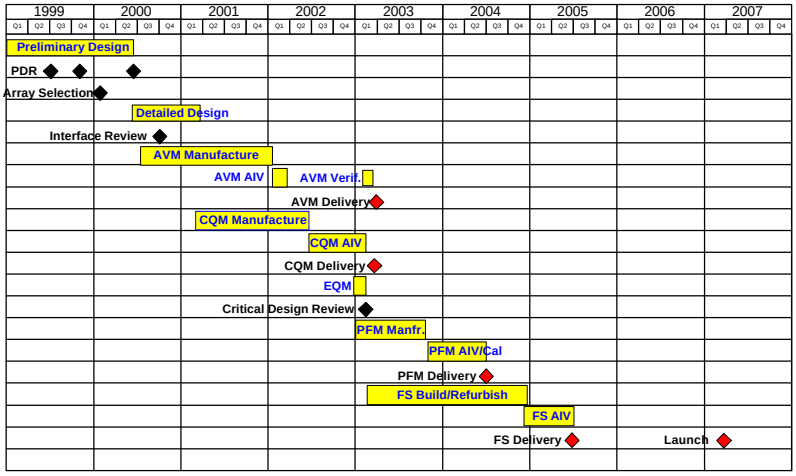


Figure 6-1 SPIRE Overall Schedule

Annex 1. LIST OF MILESTONES

Name	Resp.	Date
Detector Selection		Tue 1/2/00
Detector STM Delivery to RAL	JPL	Fri 1/2/02
Cooler STM Delivery to RAL	Grenoble	Fri 1/2/02
Shutter STM Delivery to RAL	USK	Fri 1/2/02
Spectrometer Calibration Source STM Delivery to RAL	QMW	Fri 1/2/02
CQM RF Filter Modules Delivery to RAL		Fri 1/2/02
Deliver Simulink Model to LAM	ATC	Fri 11/8/00
Deliver Analogue Board Design Doc to LAM	ATC	Fri 11/8/00
Deliver Prototype2 to LAM	ATC	Wed 13/9/00
Deliver Analogue Board Detailed Design to LAM	ATC	Mon 1/1/01
Delta PDR	RAL	Mon 26/6/00
Instrument Interface Review	RAL	Mon 9/10/00
"Structure, Optics, Cooler Detailed Design Review"		Mon 19/3/01
"SMEC, BSM Detailed Design Review"		Wed 31/1/01
WE Detailed Design Review		Tue 3/10/00
Deliver DM2 to LAM	ATC	Fri 30/3/01
CQM BSMm Delivery to LAM	ATC	Wed 13/3/02
CQM Arrays First Delivery to QMW	JPL	Fri 23/11/01
CQM Sparse Arrays Delivery to QMW	JPL	Fri 23/11/01
CQM JFET Modules Delivery to RAL		Fri 1/3/02
SMECm Simulator Delivery to SAp	LAM	Tue 20/2/01
MCU EM Delivery to Sap	LAM	Fri 21/9/01
QM1 MCU delivery to Sap	LAM	Fri 21/9/01
QM2 MCU Delivery to SAp	LAM	Wed 10/7/02
CQM Structure ready for Integration	MSSL	Fri 5/7/02
CQM Mirrors + OGSE Delivery to RAL	LAM	Fri 1/3/02
"STM/Alignment Filter, Dichroics and Beamsplitters Delivery to RAL"	QMW	Fri 1/3/02
BSM STM/Optical Dummy Delivery to RAL	ATC	Fri 1/3/02
SMECm STM/Optical Dummy Delivery to RAL	LAM	Fri 1/3/02
CQM PCAL Delivery to ATC	QMW	Thu 1/11/01
STM Test Review		Fri 5/7/02
CQM Detector Arrays Delivery to RAL	JPL	Sat 1/6/02
CQM SCAL Delivery to RAL	QMW	Sat 1/6/02
CQM SMECm Delivery to RAL	LAM	Sat 1/6/02
CQM BSMm Delivery to RAL	ATC	Sat 1/6/02
CQM Cooler Delivery to RAL	Grenoble	Sat 1/6/02
CQM Shutter Delivery to RAL	USK	Sat 1/6/02
CQM Filters Dichroics and Beamsplitters Delivery to RAL	QMW	Sat 1/6/02
CQM JFET Box Delivery to RAL	JPL	Sat 1/6/02
CQM RF Filter Modules Delivery to RAL		Sat 1/6/02
EGSE#1 Delivery to IFSI	PACS	Fri 1/6/01
DRCU Simulator#1 Delivery to IFSI	SO	Fri 1/6/01
DRCU Simulator#2 Delivery to RAL	SO	Fri 1/2/02
FPU Simulator#1 Delivery to RAL	SAp	Wed 1/5/02
AVM DPU Delivery to RAL	IFSI	Fri 1/2/02
QM1 DRCU Delivery to RAL	SAp	Wed 1/5/02
QM1 WIH Delivery to RAL	SAp	Wed 1/5/02
Test Facility Available	RAL	Fri 10/5/02
EGSE#2 Available	RAL	Fri 1/2/02

EGSE#3 Available	RAL	Fri 15/3/02
Delivery of CQM FPU to Cold Vibration Facility	RAL	Wed 23/10/02
Delivery of Cold-Vibrated CQM FPU to RAL	RAL	Wed 20/11/02
FPU Critical Design Review		Sat 1/2/03
EGSE#4 Available	RAL	Wed 1/1/03
CQM Delivery to ESA	RAL	Tue 1/4/03
QM DPU Delivery to RAL	IFSI	Wed 1/1/03
DRCU Simulator#3 to RAL	SO	Wed 1/1/03
QM2 DRCU Delivery to RAL	SAp	Mon 20/1/03
QM2 WIH Delivery to RAL	SAp	Mon 20/1/03
FPU Simulator#2 Delivery to RAL	SAp	Mon 20/1/03
WE Critical Design Review		Thu 20/3/03
AVM Delivery to ESA	RAL	Tue 1/4/03
PFM BSMm Delivery to LAM	ATC	Thu 11/9/03
PFM MCU Delivery to SAp	LAM	Tue 24/6/03
PFM Arrays First Delivery to QMW	JPL	Fri 1/8/03
PFM Arrays last Delivery to QMW	JPL	Wed 1/10/03
PFM PCAL Delivery to ATC	QMW	Thu 26/6/03
PFM JFET Modules Delivered to RAL	JPL	Mon 2/2/04
PFM Structure Ready for Integration	MSSL	Mon 1/9/03
PFM Mirrors Delivery to RAL	LAM	Fri 15/8/03
PFM Detector Arrays Delivery to RAL	JPL	Sat 1/11/03
PFM SCAL Delivery to RAL	QMW	Mon 1/12/03
PFM SMEC Delivery to RAL	LAM	Mon 1/12/03
PFM BSM Delivery to RAL	ATC	Mon 1/12/03
PFM Cooler Delivery to RAL	Grenoble	Mon 1/12/03
PFM Shutter Delivery to RAL	USK	Mon 1/12/03
PFM Filters Dichroics and Beamsplitters Delivery to RAL	QMW	Sat 1/11/03
PFM JFET Box Delivery to RAL		Mon 1/12/03
PFM RF Filter Modules Delivery to RAL		Sat 1/11/03
Delivery of PFM FPU to Cold Vibration Facility	RAL	Wed 18/2/04
Delivery of Cold-Vibrated PFM FPU to RAL	RAL	Wed 10/3/04
PFM DPU Delivery to RAL	IFSI	Wed 25/2/04
PFM DRCU Delivery to RAL	SAp	Mon 15/3/04
PFM WIH Delivery to RAL	SAp	Mon 15/3/04
PFM Delivery to ESA	RAL	Thu 1/7/04
Return of CQM from ESA	ESA	Mon 29/3/04
Delivery of QM DPU to IFSI	RAL	Thu 1/7/04
Delivery of QM2 DRCU to SAp	RAL	Thu 1/7/04
FS BSMm Delivery to LAM	ATC	Fri 2/1/04
FS Arrays First Delivery to QMW	JPL	Mon 2/8/04
FS Arrays last Delivery to QMW	JPL	Fri 1/10/04
FS PCAL Delivery to ATC	QMW	Fri 17/10/03
FS MCU Delivery to SAp	LAM	Tue 19/8/03
FS Structure Available for Integration	MSSL	Mon 1/11/04
FS Detector Arrays Delivery to RAL	QMW	Wed 10/11/04
FS SCAL Delivery to RAL	QMW	Wed 10/11/04
FS Cooler Delivery to RAL	Grenoble	Wed 10/11/04
FS Mirrors Delivery to RAL	LAM	Wed 10/11/04
FS SMECm Delivery to RAL		Wed 10/11/04
FS BSM Delivery to RAL	ATC	Wed 10/11/04
FS DPU Delivery to RAL	IFSI	Wed 10/11/04
FS Filters Dichroics and Beamsplitters Delivery to RAL	QMW	Wed 10/11/04
FS JFET Box Delivery to RAL		Wed 10/11/04

FS RF Filter Modules Delivery to RAL		Wed 10/11/04
MSSL (Version 0.4)	MSSL	Tue 1/7/97
Travel & Subsidence	MSSL	Tue 1/7/97
Travel Europe	MSSL	Thu 11/6/98
Travel outside Europe	MSSL	Thu 11/6/98
Travel UK	MSSL	Thu 11/6/98
Courses	MSSL	Tue 1/7/97
Pre-PDR	MSSL	Tue 20/7/99
PDR-interbellum	MSSL	Wed 2/7/97
Coupon testing	MSSL	Tue 20/7/99
Coupon definition	MSSL	Tue 20/7/99
Coupon production	MSSL	Mon 20/9/99
Coupon testing	MSSL	Mon 29/11/99
Coupon evaluation	MSSL	Mon 7/2/00
Drafting Concept	MSSL	Tue 20/7/99
Computing	MSSL	Wed 2/7/97
Alignment plan	MSSL	Mon 2/8/99
FEM concepts	MSSL	Fri 6/8/99
Defining interfaces	MSSL	Tue 3/8/99
Structure PDR	Project	Tue 27/6/00
Final Design	MSSL	Mon 10/4/00
Support test	MSSL	Thu 15/6/00
design test fixture	MSSL	Thu 15/6/00
design blade	MSSL	Thu 15/6/00
design fixed support	MSSL	Thu 22/6/00
support production	MSSL	Thu 13/7/00
support test	MSSL	Thu 27/7/00
Support test evaluation	MSSL	Thu 10/8/00
Drafting Final	MSSL	Thu 13/7/00
Spectrometer Mirror support	MSSL	Thu 13/7/00
Support corner mirror	MSSL	Thu 13/7/00
Support collimated mirror	MSSL	Thu 20/7/00
Spect. beam splitters support	MSSL	Thu 27/7/00
Spect. beam split. support	MSSL	Thu 27/7/00
Spect. Det. box	MSSL	Thu 3/8/00
Bottom	MSSL	Thu 3/8/00
Middle	MSSL	Mon 14/8/00
Top	MSSL	Wed 23/8/00
Photometer mirror support	MSSL	Thu 10/8/00
Secondary Opt. Bench	MSSL	Thu 10/8/00
M6 support	MSSL	Thu 31/8/00
M8 support	MSSL	Thu 21/9/00
Phot. Det. Box	MSSL	Fri 29/9/00
Bottom	MSSL	Fri 29/9/00
Middle	MSSL	Wed 11/10/00
Top	MSSL	Mon 23/10/00
Baffles	MSSL	Thu 13/7/00
Common structure	MSSL	Thu 2/11/00
Detector Box support	MSSL	Mon 19/3/01
Optical bench panel	MSSL	Thu 2/11/00
Side panel 1	MSSL	Tue 5/12/00
Side panel 2	MSSL	Wed 13/12/00
Side panel 3	MSSL	Thu 21/12/00
Side panel 4	MSSL	Fri 29/12/00
Side panel 5	MSSL	Mon 8/1/01
Side panel 6	MSSL	Tue 16/1/01

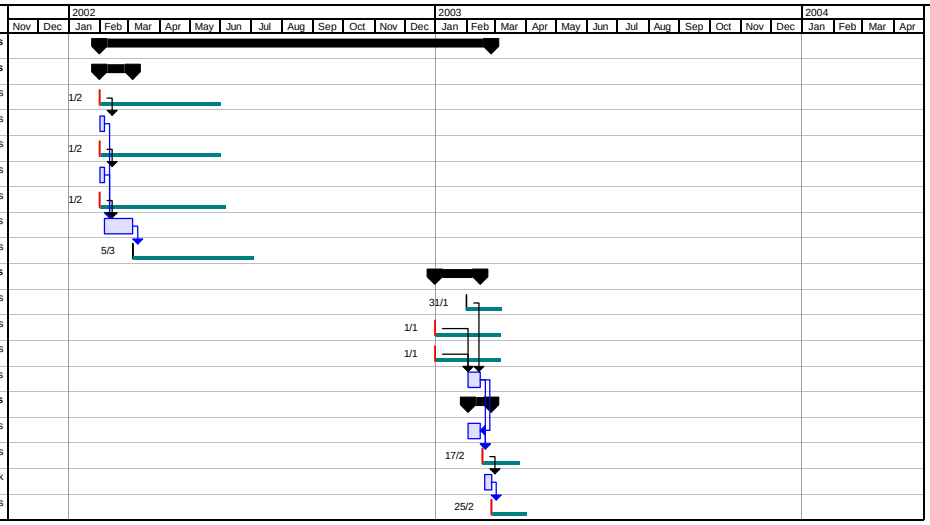
Side panel 7	MSSL	Wed 24/1/01
Side panel 8	MSSL	Thu 1/2/01
Cover panel +Y	MSSL	Fri 9/2/01
Cover Panel -Y	MSSL	Wed 28/2/01
Common structure Support	MSSL	Tue 27/3/01
Fixed point (final)	MSSL	Tue 27/3/01
Blade support (final)	MSSL	Thu 29/3/01
Final FEM	MSSL	Thu 15/6/00
Model creation	MSSL	Thu 15/6/00
Static Analysis	MSSL	Thu 7/9/00
Thermal deformation analysis	MSSL	Thu 28/9/00
Sine analysis	MSSL	Thu 19/10/00
Random analysis	MSSL	Thu 9/11/00
Shock Analysis	MSSL	Thu 30/11/00
MGSE design	MSSL	Thu 2/11/00
Interface plate	MSSL	Thu 2/11/00
OBP holder/Handling frame	MSSL	Thu 9/11/00
Transport Container	MSSL	Thu 21/12/00
Freeze interface definition	MSSL	Mon 10/4/00
Cooler	MSSL	Mon 10/4/00
FTS mechanism	MSSL	Fri 14/4/00
Mirrors	MSSL	Thu 20/4/00
Filters	MSSL	Wed 26/4/00
Baffles	MSSL	Tue 2/5/00
Shutter	MSSL	Mon 8/5/00
BMS	MSSL	Fri 12/5/00
Detectors	MSSL	Thu 18/5/00
S/C	MSSL	Wed 24/5/00
HiFi	MSSL	Tue 30/5/00
Spectrometer Calibration	MSSL	Mon 5/6/00
Photometer calibration	MSSL	Fri 9/6/00
Instrument Interface Review	MSSL	Tue 10/10/00
Structure Detailed Design Review	Project	Mon 19/3/01
CQM Structure Manufacture	MSSL	Mon 19/3/01
CQM Production	MSSL	Mon 19/3/01
Common structure	MSSL	Mon 19/3/01
Optical bench panel	MSSL	Mon 19/3/01
Cover panel +Y	MSSL	Mon 30/4/01
Cover Panel -Y	MSSL	Mon 21/5/01
Side panel 1	MSSL	Mon 11/6/01
Side panel 2	MSSL	Mon 25/6/01
Side panel 3	MSSL	Mon 9/7/01
Side panel 4	MSSL	Mon 23/7/01
Side panel 5	MSSL	Mon 6/8/01
Side panel 6	MSSL	Mon 20/8/01
Side panel 7	MSSL	Mon 3/9/01
Side panel 8	MSSL	Mon 17/9/01
Side panel 9	MSSL	Mon 1/10/01
Side panel 10	MSSL	Mon 15/10/01
MGSE production	MSSL	Mon 19/3/01
Interface plate	MSSL	Mon 19/3/01
OBP holder/Handling frame	MSSL	Mon 2/4/01
Transport Container	MSSL	Mon 4/6/01
Suspension	MSSL	Mon 30/7/01
Detector Box supports (6 x)	MSSL	Mon 30/7/01
Fixed point	MSSL	Wed 15/8/01

Blade +Y	MSSL	Wed 22/8/01
Blade -Y	MSSL	Wed 29/8/01
Dichroic and filter attachments	MSSL	Wed 5/9/01
Dichroic rings (2)	MSSL	Wed 5/9/01
Filters (2)	MSSL	Thu 13/9/01
Cold stops(3)	MSSL	Fri 21/9/01
Baffles	MSSL	Thu 4/10/01
Entry Photometer	MSSL	Thu 4/10/01
Separation Phot. 4 K - 2 K compartment	MSSL	Mon 22/10/01
Tube between Phot. - Spectr. entry	MSSL	Mon 12/11/01
Spectr. Mirror support	MSSL	Mon 19/3/01
Support Corner 1	MSSL	Mon 19/3/01
Support Corner 2	MSSL	Fri 23/3/01
Support Corner 3	MSSL	Thu 29/3/01
Support Corner 4	MSSL	Wed 4/4/01
Support Collimator 1	MSSL	Tue 10/4/01
Support Collimator 2	MSSL	Thu 19/4/01
Spectr. beam splitters support	MSSL	Mon 30/4/01
Spec.. beam split. supp. 1	MSSL	Mon 30/4/01
Spec.. beam split. supp. 2	MSSL	Fri 4/5/01
Photometer mirror support	MSSL	Thu 10/5/01
Secondary Opt. Bench	MSSL	Thu 10/5/01
M6 support	MSSL	Thu 14/6/01
M8 support	MSSL	Thu 5/7/01
Spectr. Det. box	MSSL	Thu 12/7/01
Bottom	MSSL	Thu 12/7/01
Top	MSSL	Thu 9/8/01
Phot.. Det. box	MSSL	Thu 30/8/01
Bottom	MSSL	Thu 30/8/01
Middle	MSSL	Thu 20/9/01
Top	MSSL	Thu 4/10/01
External Input	MSSL	Fri 4/1/02
Application Black Material (QMW)	MSSL	Fri 4/1/02
Thermal Finishes	MSSL	Fri 25/1/02
Structure Integration	MSSL	Thu 7/2/02
Integration Start	MSSL	Thu 7/2/02
Secondary OBP mounting	MSSL	Fri 8/2/02
OBP mounting in MGSE	MSSL	Mon 11/2/02
Mounting SDBX	MSSL	Tue 12/2/02
Mounting PDBX	MSSL	Wed 13/2/02
Photometer mirror support mounting	MSSL	Thu 14/2/02
Thermal Straps for detectors	MSSL	Fri 15/2/02
Beam splitters support mounting	MSSL	Mon 18/2/02
Spec.. mirror support mounting	MSSL	Tue 19/2/02
Mounting Baffles	MSSL	Wed 20/2/02
Mounting alignment tools? (OGSE?)	MSSL	Fri 22/2/02
Mounting sidepanels	MSSL	Mon 25/2/02
Mounting cover panels	MSSL	Fri 1/3/02
Mounting support for Common structure	MSSL	Tue 5/3/02
Ship to RAL	MSSL	Wed 6/3/02
Subsystem Deliveries	MSSL	Fri 1/2/02
Optics and OGSE Delivery to RAL	MSSL	Fri 1/3/02
Optics Acceptance	MSSL	Fri 1/3/02
STM/Alignment Filters Dichroics and Beamsplitters Delivery to RAL	MSSL	Fri 1/3/02
STM/Alignment Filters Dichroics and Beamsplitters	MSSL	Fri 1/3/02

Acceptance		
BSM STM/Optical Dummy Delivery to RAL	MSSL	Fri 1/3/02
BSM STM/Optical Dummy Acceptance	MSSL	Fri 1/3/02
SMEC STM/Optical Dummy Delivery to RAL	MSSL	Fri 1/3/02
FTS STM/Optical Dummy Acceptance	MSSL	Fri 1/3/02
Detector STM Delivery to RAL	MSSL	Fri 1/2/02
Cooler STM Delivery to RAL	MSSL	Fri 1/2/02
Shutter STM Delivery to RAL	MSSL	Fri 1/2/02
Spectrometer Calibration Source STM Delivery to RAL	MSSL	Fri 1/2/02
CQM RF Filter Modules Delivery to RAL	MSSL	Fri 1/2/02
CQM RF Filter Modules Acceptance	MSSL	Fri 1/2/02
Alignment verification	MSSL	Fri 8/3/02
Check alignment mechanical	MSSL	Fri 8/3/02
"Integrate mirrors, OGSE amd Optical Dummies"	MSSL	Fri 29/3/02
Integrate Mass Dummies	MSSL	Fri 19/4/02
Integrate RF Filter Modules	MSSL	Wed 24/4/02
Add Instrumentation	MSSL	Thu 25/4/02
Optical alignment check warm	MSSL	Fri 26/4/02
STM Warm Vibration	MSSL	Tue 30/4/02
visual inspection	MSSL	Tue 30/4/02
Mounting on shaker+instrum.	MSSL	Wed 1/5/02
"X-axis sine, random, shock"	MSSL	Fri 3/5/02
"Y-axis sine, random, shock"	MSSL	Fri 10/5/02
"Z-axis sine, random, shock"	MSSL	Fri 17/5/02
visual inspection	MSSL	Fri 24/5/02
Post STM Vibration Verification	MSSL	Mon 27/5/02
Optical alignment check warm	MSSL	Mon 27/5/02
Optical Quality Verification	MSSL	Mon 27/5/02
Bakeout	MSSL	Mon 10/6/02
Optical Alignment Check warm	MSSL	Mon 17/6/02
Test Cryostat Available	MSSL	Fri 10/5/02
Cold STM Testing	MSSL	Wed 19/6/02
Integration into Test Cryostat	MSSL	Wed 19/6/02
Cooldown	MSSL	Fri 21/6/02
Optical Alignment Check cold	MSSL	Wed 26/6/02
Thermal Balance Check	MSSL	Mon 1/7/02
Warm up	MSSL	Tue 2/7/02
STM De-integration	MSSL	Thu 4/7/02
Test Readiness Review	MSSL	Fri 5/7/02
PFM Structure Manufacture	MSSL	Wed 1/1/03
PFM production	MSSL	Wed 1/1/03
PFM Structure Ready for Integration	MSSL	Tue 26/8/03
FS Structure Manufacture	MSSL	Mon 29/3/04
CQM use by ESA	MSSL	Mon 29/3/04
FS refurbishment	MSSL	Tue 30/3/04
FS mechanical I/F check	MSSL	Tue 17/8/04
FS delivery to RAL	MSSL	Mon 1/11/04

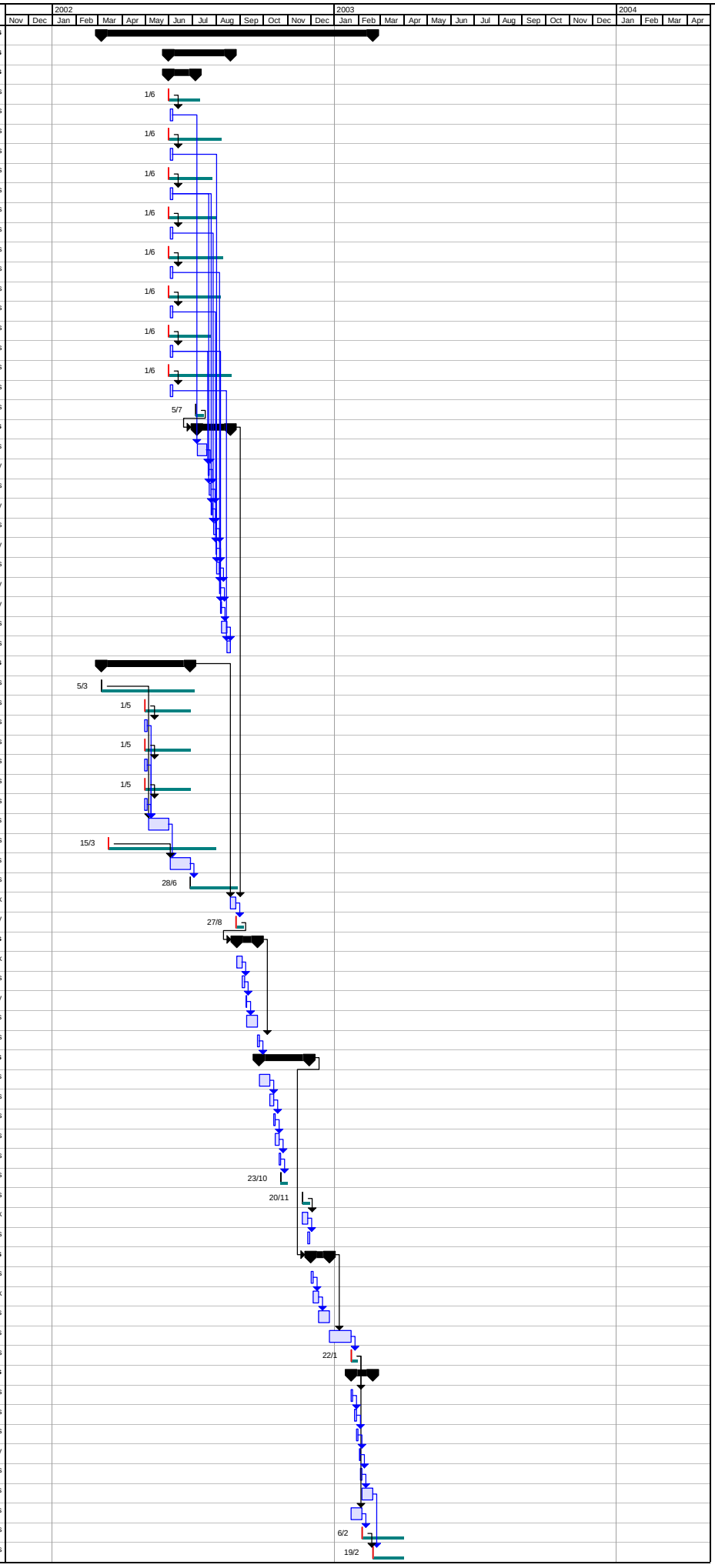
Annex 2. INSTRUMENT AIV SCHEDULES

ID	Task Name	Duration
80	**Avionics Model**	**55.6 wks**
81	**Preliminary Integration**	**4.6 wks**
82	AVM DPU Delivery to RAL	0 days
83	AVM DPU Acceptance	3 days
84	DRCU Simulator#2 Delivery to RAL	0 days
85	DRCU Simulator#2 Acceptance	3 days
86	EGSE#2 Available	0 days
87	DPU Verification	4 wks
88	AVM DPU Available for CQM Testing	0 days
89	**AVM Verification**	**6.6 wks**
90	AVM DPU Available for Delivery	0 days
91	DRCU Simulator#3 Delivery to RAL	0 days
92	EGSE#4 Available	0 days
93	AVM Verification	2 wks
94	**Delivery**	**3.4 wks**
95	Preparation of Delivery Data Package	2 wks
96	AVM Readiness Review	2 days
97	Pack and Ship to ESA	1 wk
98	AVM Delivery to ESA	0 days

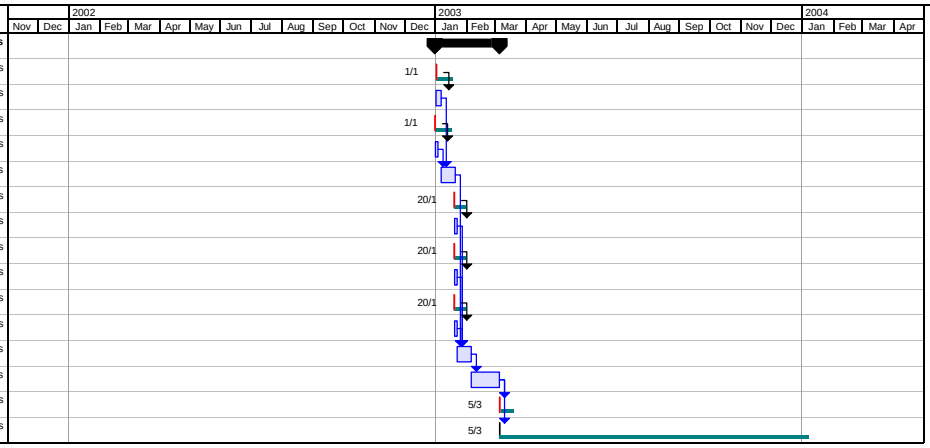


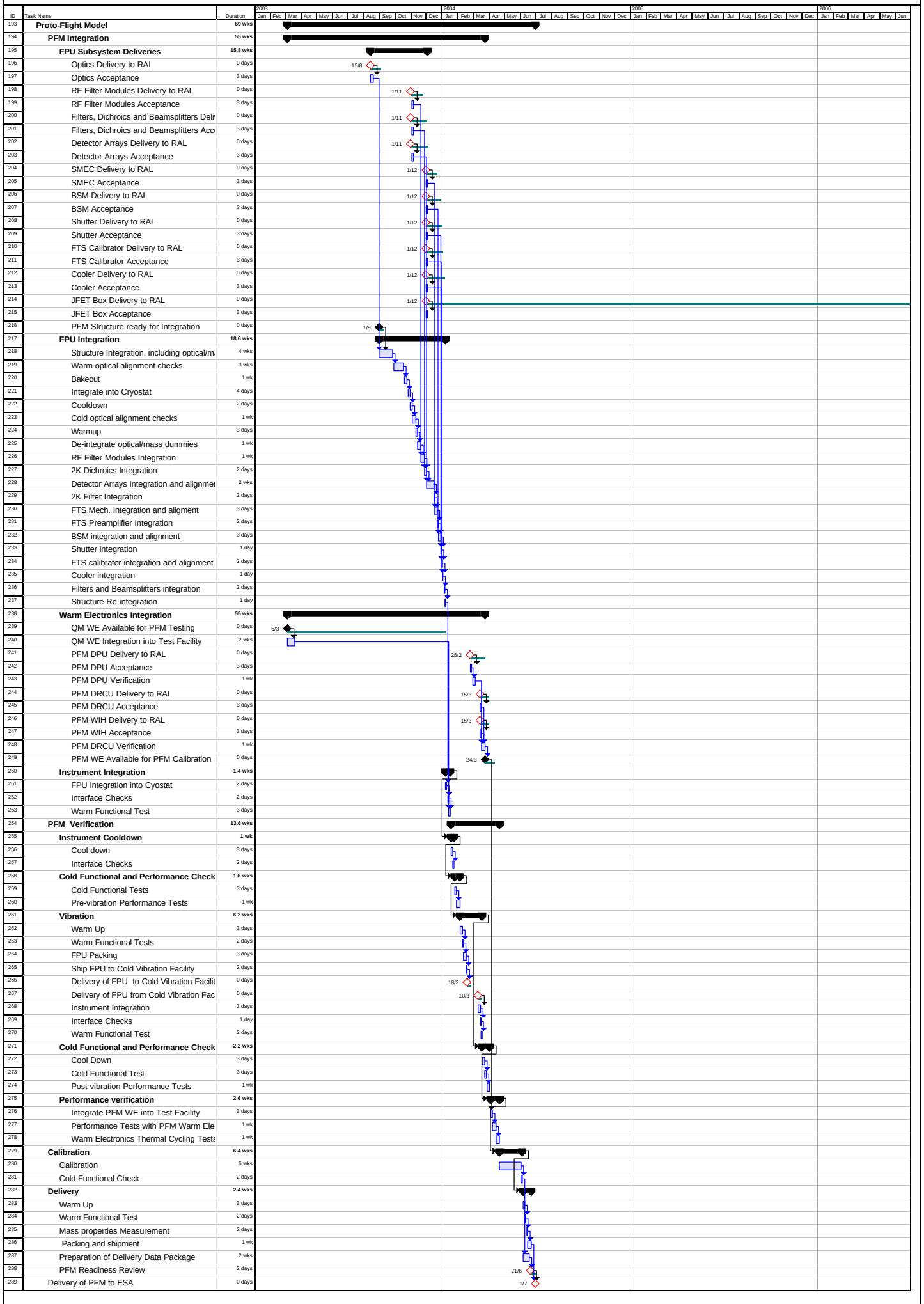
CQM AIV

ID	Task Name	Duration
99	**Cryogenic Qualification Model**	**50.2 wks**
100	**CQM Integration**	**11.2 wks**
101	**FPU Subsystem Deliveries**	**5 wks**
102	Detector Arrays Delivery to RAL	0 days
103	Detector Arrays Acceptance	3 days
104	FTS Calibrator Delivery to RAL	0 days
105	FTS Calibrator Acceptance	3 days
106	SMEC Delivery to RAL	0 days
107	SMEC Acceptance	3 days
108	BSM Delivery to RAL	0 days
109	BSM Acceptance	3 days
110	Cooler Delivery to RAL	0 days
111	Cooler Acceptance	3 days
112	Shutter Delivery to RAL	0 days
113	Shutter Acceptance	3 days
114	Filters, Dichroics and Beamsplitters Del	0 days
115	Filters, Dichroics and Beamsplitters Acc	3 days
116	JFET Box Delivery to RAL	0 days
117	JFET Box Acceptance	3 days
118	CQM Structure ready for Integration	0 days
119	**FPU Integration**	**6.2 wks**
120	Detector Arrays Integration and alignme	2 wks
121	2K Filter Integration	1 day
122	SMECm Integration and aligment	3 days
123	SMECp Integration	1 day
124	BSM integration and alignment	3 days
125	Shutter integration	1 day
126	FTS calibrator integration and alignmen	2 days
127	Cooler integration	1 day
128	Filters, Dichroics and Beamsplitters inte	1 day
129	Structure re-Integration and verification	5 days
130	Integrate into Cryostat	3 days
131	**Warm Electronics Integration**	**16.6 wks**
132	AVM DPU Available for CQM Testing	0 days
133	QM1 DRCU Delivery to RAL	0 days
134	QM1 DRCU Acceptance	3 days
135	QM1 WIH Delivery to RAL	0 days
136	QM1 WIH Acceptance	3 days
137	FPU Simulator#1 Delivery to RAL	0 days
138	FPU Simulator#1 Acceptance	3 days
139	DRCU Verification	4 wks
140	EGSE#3 Available	0 days
141	WE Integration into Test Facility	4 wks
142	WE Available for CQM Testing	0 days
143	Instrument Integration	1 wk
144	CQM Test Readiness Review	1 day
145	**Functional Testing**	**3.8 wks**
146	Warm Functional Test	1 wk
147	Cooldown	3 days
148	Preliminary Cold Functional Test	1 day
149	Cold Functional Test	2 wks
150	Thermal Balance Checks	2 days
151	**Vibration Testing**	**9.4 wks**
152	Pre-Vibration Performance Checks	2 wks
153	Warm Up	3 days
154	Warm Functional Check	2 days
155	FPU Packing	3 days
156	Pack and Ship FPU to Cold Vibration Facil	2 days
157	FPU Delivery to Cold Vibration Facility	0 days
158	Delivery of Cold Vibrated CQM FPU to RAL	0 days
159	Instrument re-integration	1 wk
160	Warm Functional Check	2 days
161	**Cold Functional and Performance Tests**	**3.6 wks**
162	Cooldown	3 days
163	Cold Functional Test	1 wk
164	Post-vibration performance Check	2 wks
165	Performance Verification	4 wks
166	FPU Critical Design Review	0 days
167	**Delivery Preparation**	**4 wks**
168	Cold Functional Check	2 days
169	Warm up	3 days
170	Warm Functional Check	2 days
171	Remove FPU from Cryostat	1 day
172	Mass properties Measurement	2 days
173	Packing and shipment	2 wks
174	Preparation of Delivery Data Package	2 wks
175	CQM Readiness Review	2 days
176	Delivery of CQM to ESA	0 days

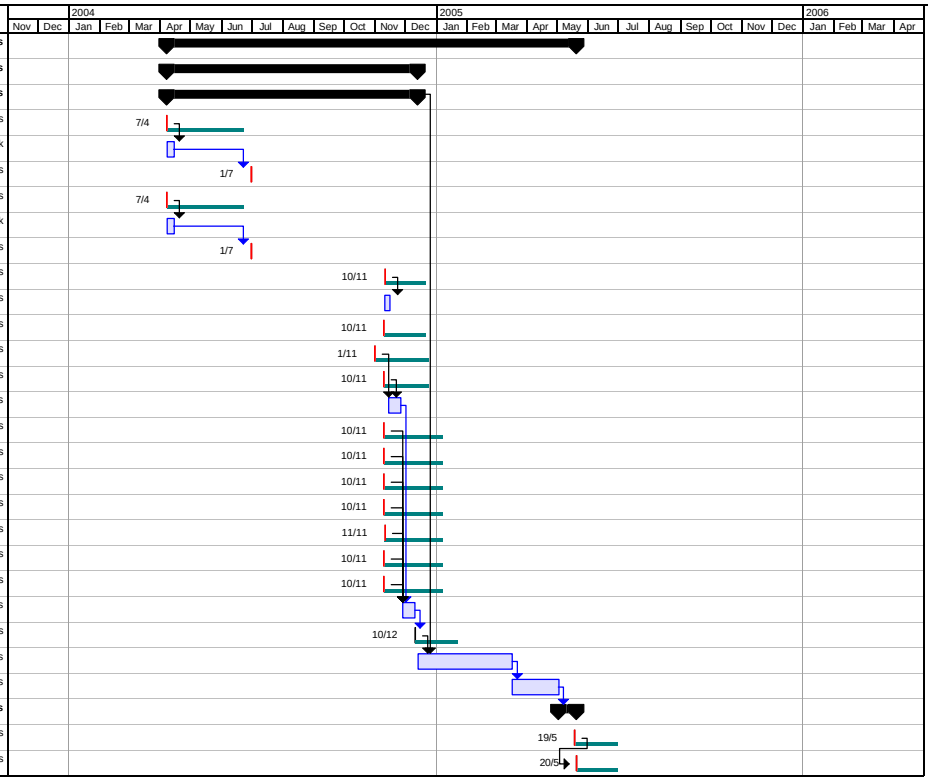


ID	Task Name	Duration
177	**Warm Electronics Qualification Model**	**9.2 wks**
178	QM DPU Delivery to RAL	0 days
179	QM DPU Acceptance	3 days
180	DRCU Simulator#3 Delivery to RAL	0 days
181	DRCU Simulator#3 Acceptance	3 days
182	QM DPU Verification	2 wks
183	QM2 DRCU Delivery to RAL	0 days
184	QM2 DRCU Acceptance	3 days
185	QM2 WIH Delivery to RAL	0 days
186	QM2 WIH Acceptance	3 days
187	FPU Simulator#2 Delivery to RAL	0 days
188	FPU Simulator#2 Acceptance	3 days
189	QM2 DRCU Verification	2 wks
190	Integrate and Verify QM Warm Electronics	4 wks
191	WE Critical Design Review	0 days
192	QM Warm Electronics available for PFM Testi	0 days




ID
Task Name
Duration
2003
2004
2005
2006
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
193 Proto-Flight Model 69 wks
194 PFM Integration 55 wks
195 FPU Subsystem Deliveries 15.8 wks
196 Optics Delivery to RAL 0 days 15/8
197 Optics Acceptance 3 days
198 RF Filter Modules Delivery to RAL 0 days 1/11
199 RF Filter Modules Acceptance 3 days
200 Filters, Dichroics and Beamsplitters Deli 0 days 1/11
201 Filters, Dichroics and Beamsplitters Acc 3 days
202 Detector Arrays Delivery to RAL 0 days 1/11
203 Detector Arrays Acceptance 3 days
204 SMEC Delivery to RAL 0 days 1/12
205 SMEC Acceptance 3 days
206 BSM Delivery to RAL 0 days 1/12
207 BSM Acceptance 3 days
208 Shutter Delivery to RAL 0 days 1/12
209 Shutter Acceptance 3 days
210 FTS Calibrator Delivery to RAL 0 days 1/12
211 FTS Calibrator Acceptance 3 days
212 Cooler Delivery to RAL 0 days 1/12
213 Cooler Acceptance 3 days
214 JFET Box Delivery to RAL 0 days 1/12
215 JFET Box Acceptance 3 days
216 PFM Structure ready for Integration 0 days 1/9
217 FPU Integration 18.6 wks
218 Structure Integration, including optical/m 4 wks
219 Warm optical alignment checks 3 wks
220 Bakeout 1 wk
221 Integrate into Cryostat 4 days
222 Cooldown 2 days
223 Cold optical alignment checks 1 wk
224 Warmup 3 days
225 De-integrate optical/mass dummies 1 wk
226 RF Filter Modules Integration 1 wk
227 2K Dichroics Integration 2 days
228 Detector Arrays Integration and alignmer 2 wks
229 2K Filter Integration 2 days
230 FTS Mech. Integration and aligment 3 days
231 FTS Preamplifier Integration 2 days
232 BSM integration and alignment 3 days
233 Shutter integration 1 day
234 FTS calibrator integration and alignment 2 days
235 Cooler integration 1 day
236 Filters and Beamsplitters integration 2 days
237 Structure Re-integration 1 day
238 Warm Electronics Integration 55 wks
239 QM WE Available for PFM Testing 0 days 5/3
240 QM WE Integration into Test Facility 2 wks
241 PFM DPU Delivery to RAL 0 days 25/2
242 PFM DPU Acceptance 3 days
243 PFM DPU Verification 1 wk
244 PFM DRCU Delivery to RAL 0 days 15/3
245 PFM DRCU Acceptance 3 days
246 PFM WIH Delivery to RAL 0 days 15/3
247 PFM WIH Acceptance 3 days
248 PFM DRCU Verification 1 wk
249 PFM WE Available for PFM Calibration 0 days 24/3
250 Instrument Integration 1.4 wks
251 FPU Integration into Cyostat 2 days
252 Interface Checks 2 days
253 Warm Functional Test 3 days
254 PFM Verification 13.6 wks
255 Instrument Cooldown 1 wk
256 Cool down 3 days
257 Interface Checks 2 days
258 Cold Functional and Performance Check 1.6 wks
259 Cold Functional Tests 3 days
260 Pre-vibration Performance Tests 1 wk
261 Vibration 6.2 wks
262 Warm Up 3 days
263 Warm Functional Tests 2 days
264 FPU Packing 3 days
265 Ship FPU to Cold Vibration Facility 2 days
266 Delivery of FPU to Cold Vibration Facilit 0 days 18/2
267 Delivery of FPU from Cold Vibration Fac 0 days 10/3
268 Instrument Integration 3 days
269 Interface Checks 1 day
270 Warm Functional Test 2 days
271 Cold Functional and Performance Check 2.2 wks
272 Cool Down 3 days
273 Cold Functional Test 3 days
274 Post-vibration Performance Tests 1 wk
275 Performance verification 2.6 wks
276 Integrate PFM WE into Test Facility 3 days
277 Performance Tests with PFM Warm Ele 1 wk
278 Warm Electronics Thermal Cycling Tests 1 wk
279 Calibration 6.4 wks
280 Calibration 6 wks
281 Cold Functional Check 2 days
282 Delivery 2.4 wks
283 Warm Up 3 days
284 Warm Functional Test 2 days
285 Mass properties Measurement 2 days
286 Packing and shipment 1 wk
287 Preparation of Delivery Data Package 2 wks
288 PFM Readiness Review 2 days 21/6
289 Delivery of PFM to ESA 0 days 1/7

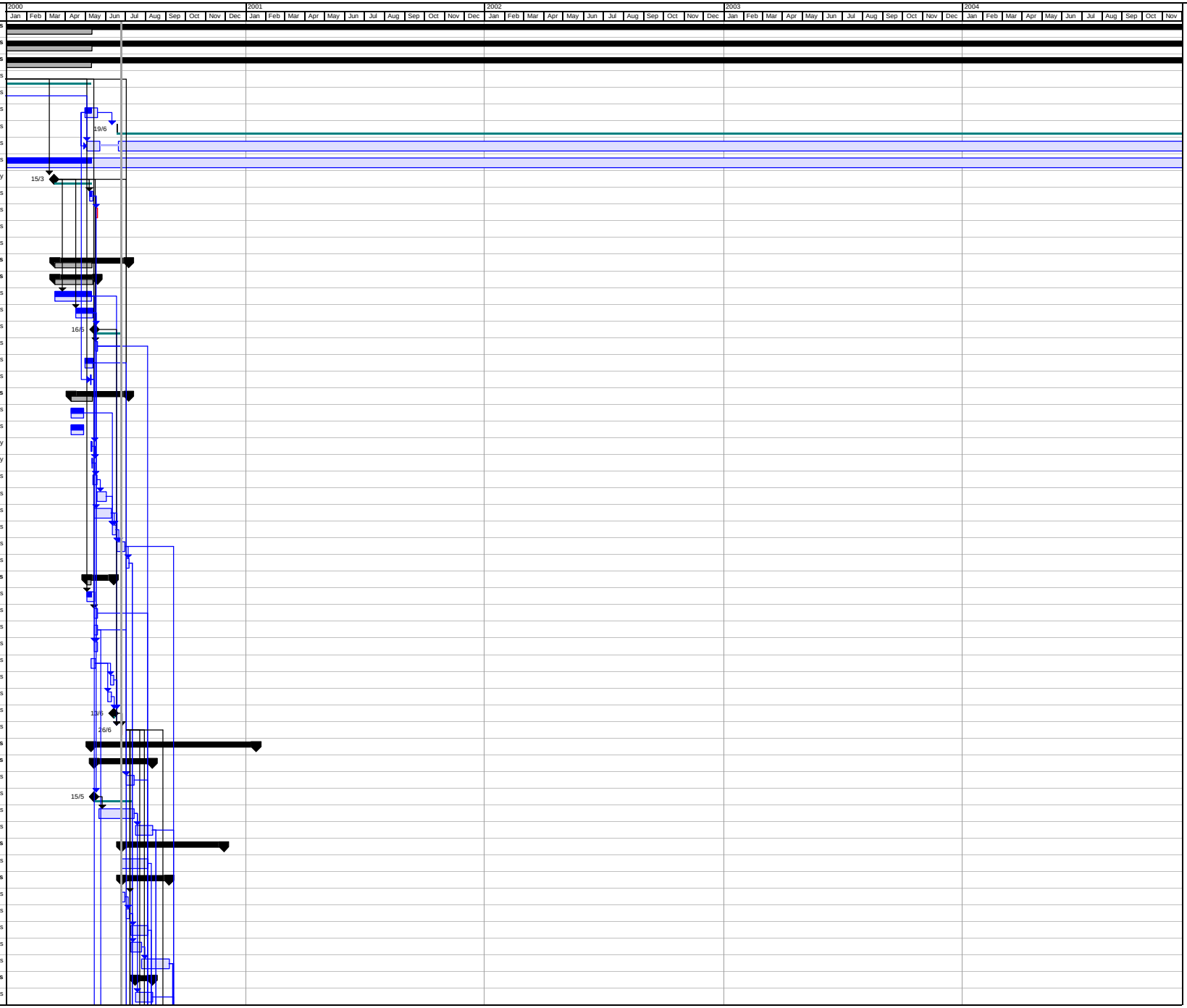
ID	Task Name	Duration
290	**Flight Spare Model**	**58.4 wks**
291	**FS Integration**	**35.6 wks**
292	**Warm Electronics Integration**	**35.6 wks**
293	QM DPU Available for FS Assembly	0 days
294	Pack and Ship QM DPU to IFSI	1 wk
295	Delivery of QM DPU to IFSI	0 days
296	QM2 DRCU Available for FS Assembly	0 days
297	Pack and Ship QM2 DRCU to Sap	1 wk
298	Delivery of QM2 DRCU to Sap	0 days
299	FS DPU Delivery to RAL	0 days
300	FS DPU Acceptance	3 days
301	FS DRCU Delivery to RAL	0 days
305	FS Structure Ready for Integartion	3 days
306	FS Mirrors Delivery to RAL	3 days
307	PFM Alignment Verification	2 wks
308	FS BSM Delivery to RAL	3 days
309	FS SMECm Delivery to RAL	3 days
310	FS Cooler Delivery to RAL	3 days
311	FS Shutter Delivery to RAL	3 days
312	FS SCAL Delivery to RAL	3 days
313	FS Detector Subsystem Delivery to RAL	3 days
314	FS Filters Delivery to RAL	3 days
317	FS FPU Integration	2 wks
318	FS FPU Integrated	0 days
319	FS Verification	13.6 wks
320	FS Calibration	6.4 wks
321	**FS Delivery**	**2.8 wks**
327	FS Readiness Review	2 days
328	FS Delivery to ESA	0 days



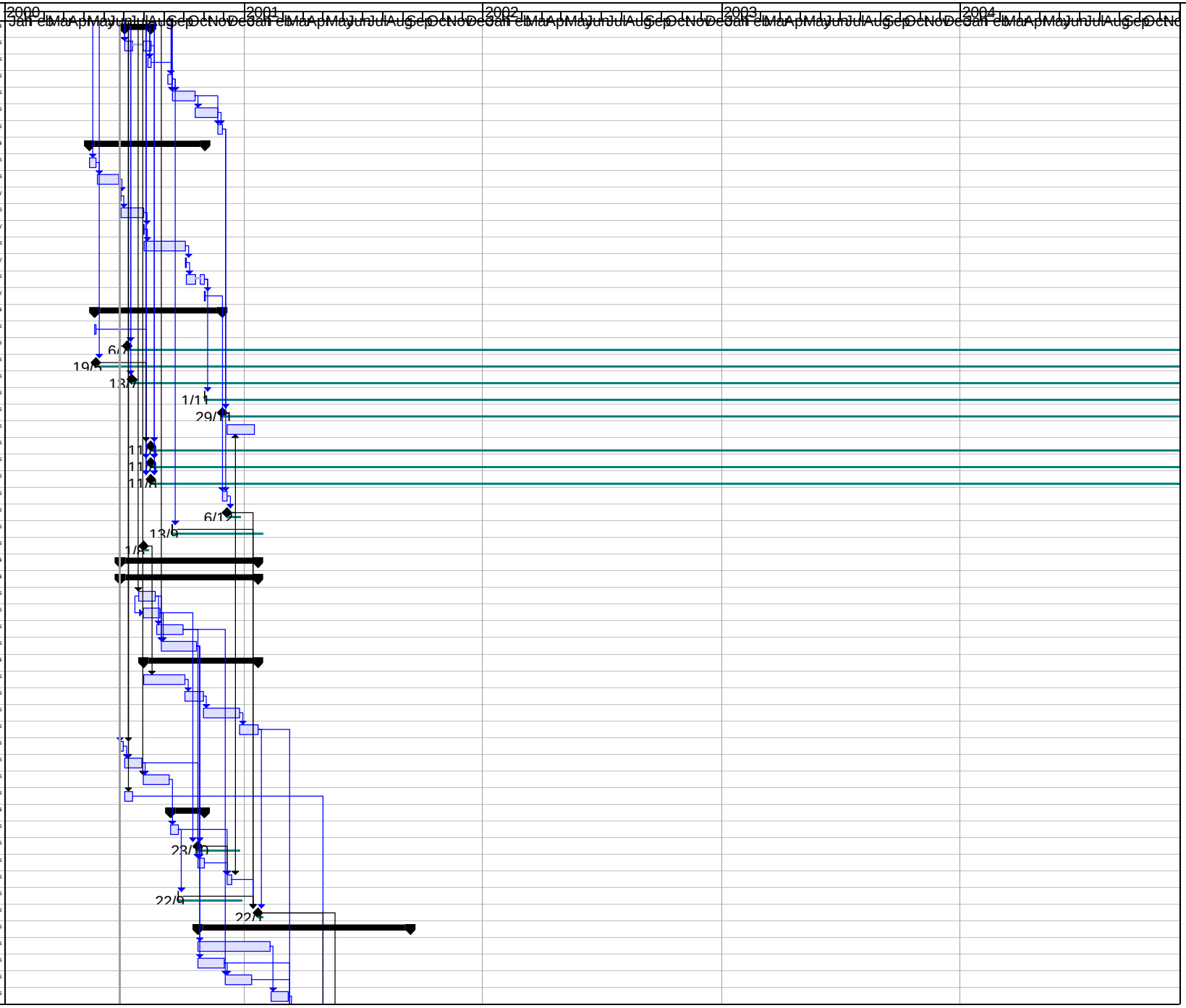
Annex 3. SUBSYSTEM SCHEDULES

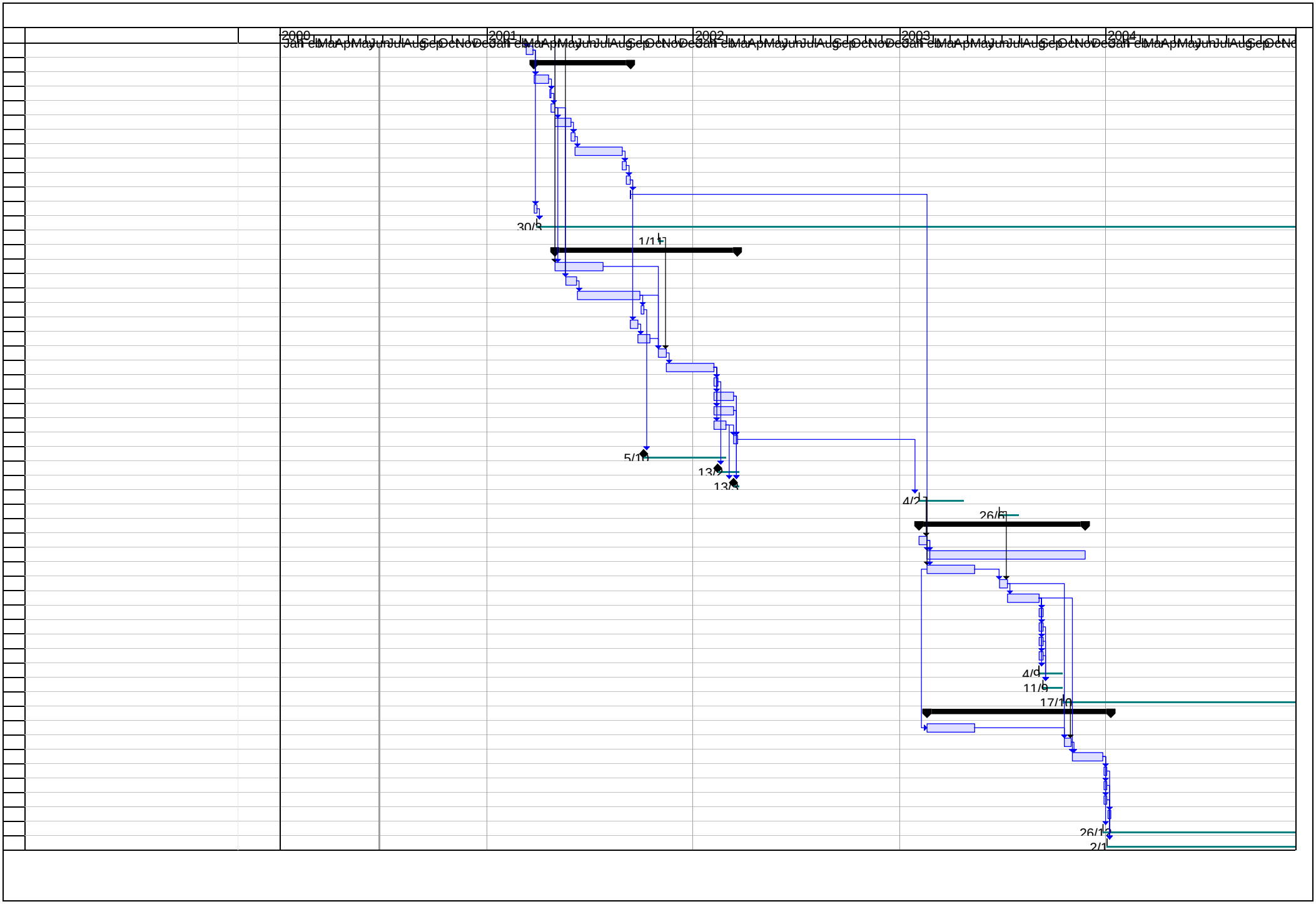
ATC

ID	Task Name	Duration
437	**ATC (Version 00b1)**	**412.8 wks**
438	**SPIRE BSM**	**412.8 wks**
439	**Project Management**	**412.8 wks**
440	Project Start	0 days
441	Manage Project (Phase B)	64 days
442	IP visit ATC	15 days
443	IP Full time at ATC	0 days
444	Manage Project (Phase C/D)	1260 days
445	Project Scientist	1817 days
446	Informal Review	1 day
447	Revise Development Plan	5 days
448	development plan to KK	2 days
449	Project Wrap up	20 days
450	Project End	0 days
451	**Preliminary Design (Phase B)**	**16.2 wks**
452	**Preliminary Design**	**9.4 wks**
453	Preliminary Design Mechanical	40 days
454	Preliminary Design Control System	20 days
455	Deliver preliminary Simulink Model to LAM	0 days
456	Magnetic Modelling - (1)	3 days
457	Locate ISOPHOT anolog design	10 days
458	Design progress meeting	0.25 days
459	**Rapid Prototype**	**12.8 wks**
460	Procure sensors	15 days
461	Procure flex pivots	15 days
462	Combine model mirror & support	1 day
463	Export Pro/E model for rapid prototype	1 day
464	Identify rapid prototype supplier & place PO	5 days
465	Machine mirror/support	10 days
466	Design/Build Prot Analog Brd	20 days
467	Build test jig & assemble	5 days
468	Test Position Sensors	10 days
469	Report on Rapid Prototype	4 days
470	**PDR Documentation**	**5.8 wks**
471	BSM Specification Document	8 days
472	ICD Structure	5 days
473	Draft WE ICD	5 days
474	PDR document prep	5 days
475	Design Justif.n & SubSys Spec draft	5 days
476	design justif.n & spec revision	3 days
477	PDR doc production	5 days
478	PDR document release	0 days
479	Delta PDR	0 days
480	**Build & Test Prototype Model**	**36.1 wks**
481	**Design Refinement**	**13 wks**
482	Preliminary Design Analog Board	10 days
483	Option if MF unavailable	0 days
484	Identify control sys consultant	40 days
485	Refine Design Control Sys	20 days
486	**Brassboard Prototype**	**22.5 wks**
487	Procure commercial components	30 days
488	**Mechanical Work**	**10.5 wks**
489	Incorporate PDR advice	5 days
490	Detailed Mech Design	5 days
491	Manufacture components	20 days
492	Preliminary Design Test Rig	12.5 days
493	Develop, Purchase & Build test rig x2	30 days
494	**Control Work**	**4 wks**
495	Develop dSPACE Controller	20 days



ID	Task Name	Duration
496	**Electronics**	**6 wks**
497	ICD Warm Electronics	20 days
498	Assemble prototype	5 days
499	Rig acceptance tests x 2	5 days
500	Test & characterise Prot Warm	25 days
501	Test Prot cold	25 days
502	Write Report on Prototype	5 days
503	**Alternate prototype CDL**	**25.4 wks**
504	Place alternate design contract	8 days
505	preliminary design	5 wks
506	PDR	1 day
507	DESIGN & BUILD	5 wks
508	CDR & vib. model delivery to ATC	1 day
509	Final Design, Manufacture	9 wks
510	Full model & doc. delivery	1 day
511	Test CDL prototype	15 days
512	Report on CDL	1 day
513	**LAM liaison**	**27.9 wks**
514	Meeting @ LAM to discuss deliverables	2 days
515	Report on sensor stability to LAM	0 days
516	Draft WE ICD to LAM	0 days
517	Deliver Rapid Proto to LAM	0 days
518	Report to LAM on CDL prototype	0 days
519	Prototype Report to LAM	0 days
520	Prototype continuous development as req'd	30 days
521	Deliver ICD WE to LAM	0 days
522	Deliver refined Simulink Model to LAM	0 days
523	Deliver Analog Board Design Doc to LAM	0 days
524	BSM Design Option Review	5 days
525	Design OptionSelection	0 days
526	Deliver Rig 2 to LAM	0 days
527	Decision on need for Launch Lock	0 days
528	**Detailed Design (Phase C)**	**30.2 wks**
529	**Detail Design**	**30.2 wks**
530	Concept design structure	20 days
531	Liaison with MSSL	20 days
532	Detail Design Structure	30 days
533	Detailed Design Mech	40 days
534	**Launch lock**	**25 wks**
535	contingency design of launch lock	45 days
536	contingency manufacture of launch lock	20 days
537	contingency test of launch lock	40 days
538	contingency integrate LL to DM	20 days
539	Magnetic Modelling - (2)	5 days
540	Design Motors	20 days
541	Detailed Design Analog Brd	30 days
542	ESA common parts procurement request	10 days
543	**Document**	**7.6 wks**
544	Document Board Design	10 days
545	Update ICD structure	2 days
546	Document Mech & Motor Design	8 days
547	DDR Doc production	5 days
548	Deliver Analog Board Detailed Design to LAM	0 days
549	Detailed Design Review	0 days
550	Build and Test Development Models	46.6 wks
551	Procure space type components	80 days
552	Manufacture 2 DM Mechanisms	30 days
553	Manufacture 2 DM structures	30 days
554	Manufacture 2 DM Analog Brds	20 days

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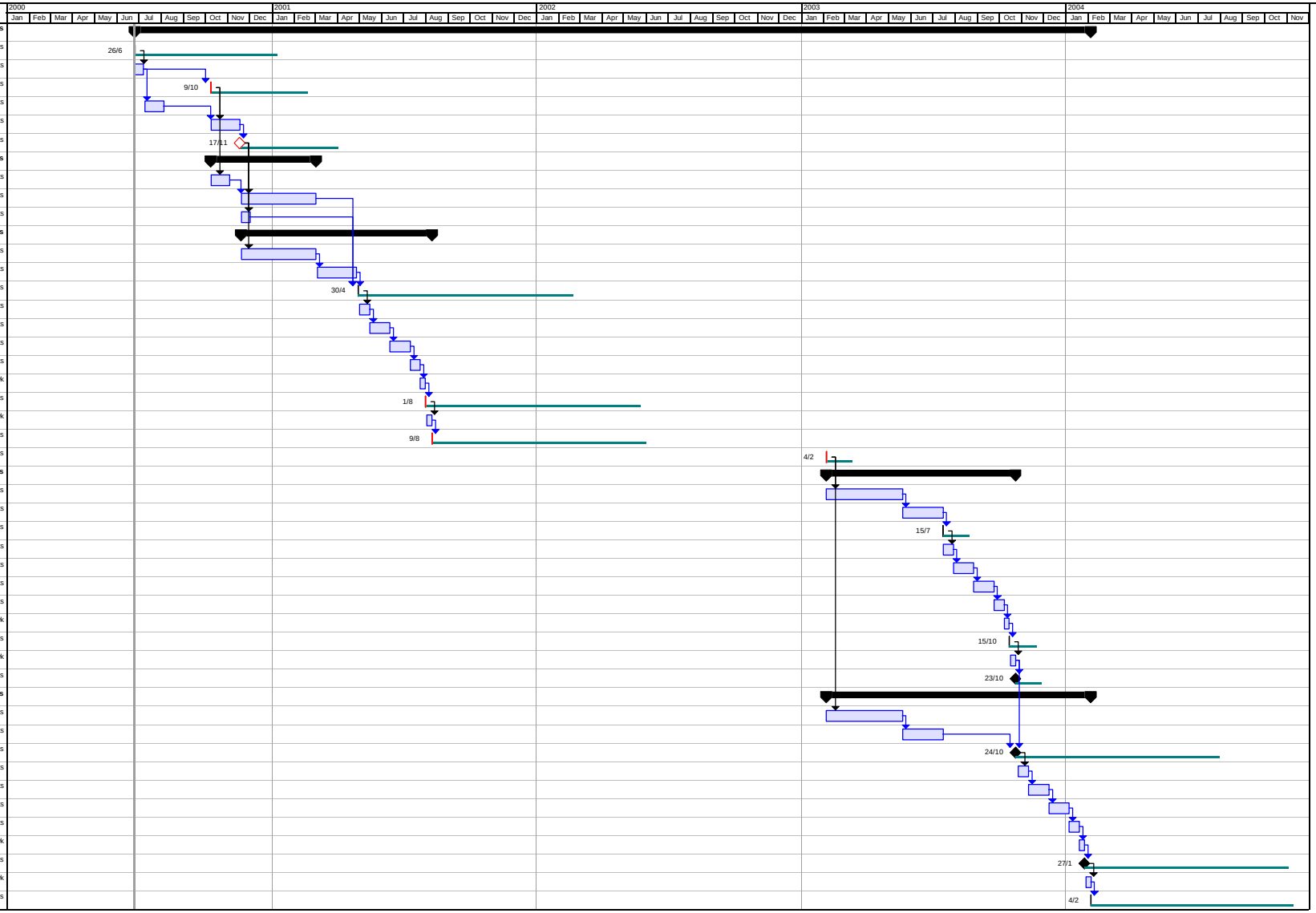
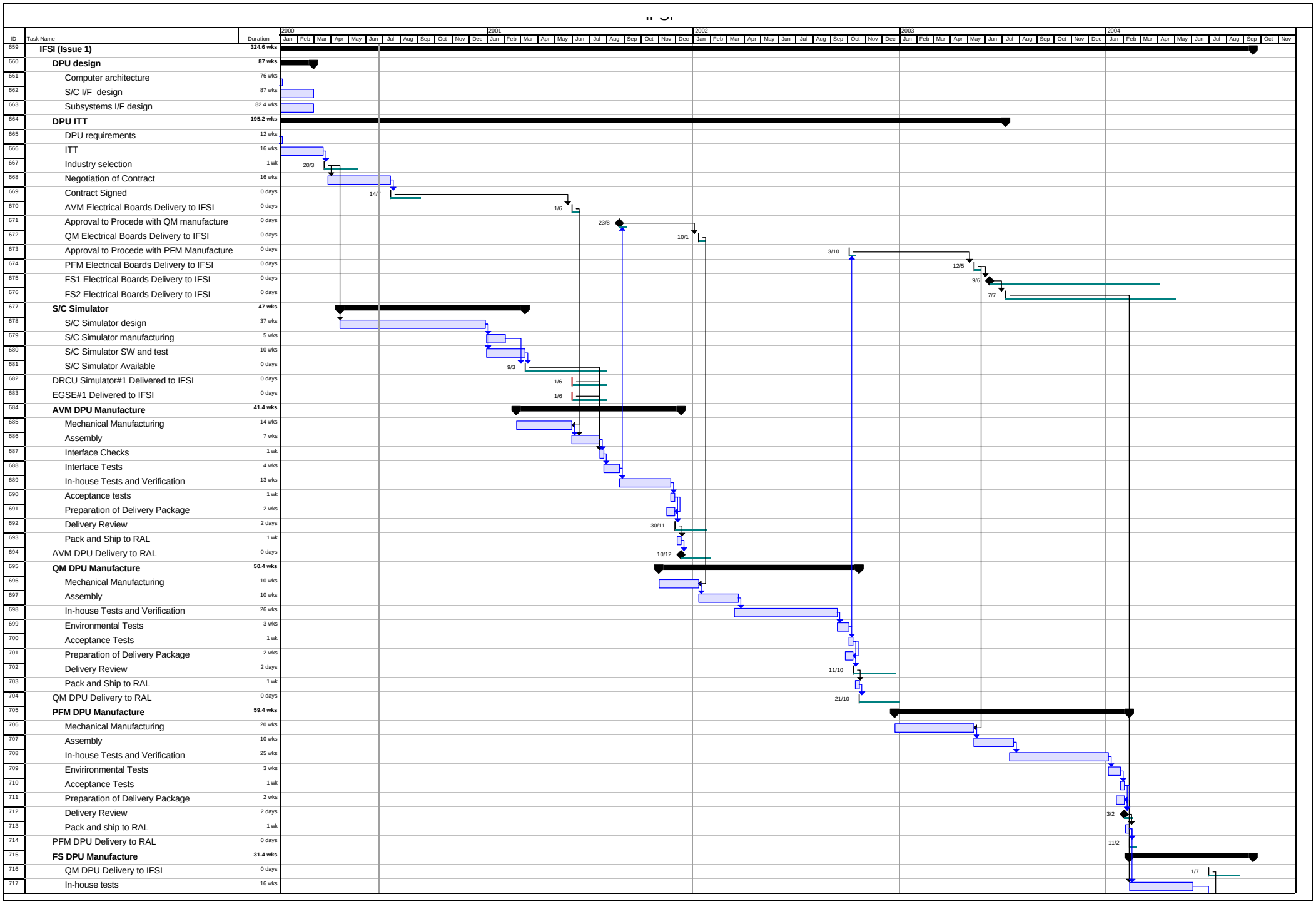
Grenoble



ID	Task Name	Duration
611	**Grenoble (issue 1.1)**	**188.6 wks**
612	Delta PDR	0 days
613	Technical Requirements Definition	2 wks
614	Instrument Interface Review	0 days
615	Overall design	4 wks
616	Detailed Design	6 wks
617	Cooler Detailed Design Review	0 days
618	**Testing Setup**	**21 wks**
619	Test Plan/Test Setup design	4 wks
620	Test Setup Manufacture	15 wks
621	Test Predictions	2 wks
622	**CQM Cooler Manufacture**	**37.8 wks**
623	Cooler Manufacture	15 wks
624	Cooler Asembly	8 wks
625	Test Readiness Review and Approval	2 days
626	Prequalification Test	2 wks
627	Thermal Test Programme #1	4 wks
628	Environmental Test Programme	4 wks
629	Thermal Test Programme #2	2 wks
630	Preparation of Delivery Package	1 wk
631	Delivery Review	2 days
632	Pack and ship to RAL	1 wk
633	CQM Cooler Delivery to RAL	0 days
634	Critical Design Review	0 days
635	**PFM Cooler Manufacture**	**37.4 wks**
636	Cooler Manufacture	15 wks
637	Cooler Asembly	8 wks
638	Test Readiness Review and Approval	0 days
639	Prequalification Test	2 wks
640	Thermal Test Programme #1	4 wks
641	Environmental Test Programme	4 wks
642	Thermal Test Programme #2	2 wks
643	Preparation of Delivery Package	1 wk
644	Delivery Review	2 days
645	Pack and ship to RAL	1 wk
646	PFM Cooler Delivery to RAL	0 days
647	**FS Cooler Manufacture**	**52.2 wks**
648	Cooler Manufacture	15 wks
649	Cooler Asembly	8 wks
650	Test Readiness Review and Approval	2 days
651	Prequalification Test	2 wks
652	Thermal Test Programme #1	4 wks
653	Environmental Test Programme	4 wks
654	Thermal Test Programme #2	2 wks
655	Preparation of Delivery Package	1 wk
656	Delivery Review	2 days
657	Pack and Ship to RAL	1 wk
658	FS Cooler Delivery to RAL	0 days


IFSI
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659 IFSI (Issue 1) 324.6 wks
660 DPU design 87 wks
661 Computer architecture 76 wks
662 S/C I/F design 87 wks
663 Subsystems I/F design 82.4 wks
664 DPU ITT 195.2 wks
665 DPU requirements 12 wks
666 ITT 16 wks
667 Industry selection 1 wk
668 Negotiation of Contract 16 wks
669 Contract Signed 0 days
670 AVM Electrical Boards Delivery to IFSI 0 days
671 Approval to Procede with QM manufacture 0 days
672 QM Electrical Boards Delivery to IFSI 0 days
673 Approval to Procede with PFM Manufacture 0 days
674 PFM Electrical Boards Delivery to IFSI 0 days
675 FS1 Electrical Boards Delivery to IFSI 0 days
676 FS2 Electrical Boards Delivery to IFSI 0 days
677 S/C Simulator 47 wks
678 S/C Simulator design 37 wks
679 S/C Simulator manufacturing 5 wks
680 S/C Simulator SW and test 10 wks
681 S/C Simulator Available 0 days
682 DRCU Simulator#1 Delivered to IFSI 0 days
683 EGSE#1 Delivered to IFSI 0 days
684 AVM DPU Manufacture 41.4 wks
685 Mechanical Manufacturing 14 wks
686 Assembly 7 wks
687 Interface Checks 1 wk
688 Interface Tests 4 wks
689 In-house Tests and Verification 13 wks
690 Acceptance tests 1 wk
691 Preparation of Delivery Package 2 wks
692 Delivery Review 2 days
693 Pack and Ship to RAL 1 wk
694 AVM DPU Delivery to RAL 0 days
695 QM DPU Manufacture 50.4 wks
696 Mechanical Manufacturing 10 wks
697 Assembly 10 wks
698 In-house Tests and Verification 26 wks
699 Environmental Tests 3 wks
700 Acceptance Tests 1 wk
701 Preparation of Delivery Package 2 wks
702 Delivery Review 2 days
703 Pack and Ship to RAL 1 wk
704 QM DPU Delivery to RAL 0 days
705 PFM DPU Manufacture 59.4 wks
706 Mechanical Manufacturing 20 wks
707 Assembly 10 wks
708 In-house Tests and Verification 25 wks
709 Envirironmental Tests 3 wks
710 Acceptance Tests 1 wk
711 Preparation of Delivery Package 2 wks
712 Delivery Review 2 days
713 Pack and ship to RAL 1 wk
714 PFM DPU Delivery to RAL 0 days
715 FS DPU Manufacture 31.4 wks
716 QM DPU Delivery to IFSI 0 days
717 In-house tests 16 wks
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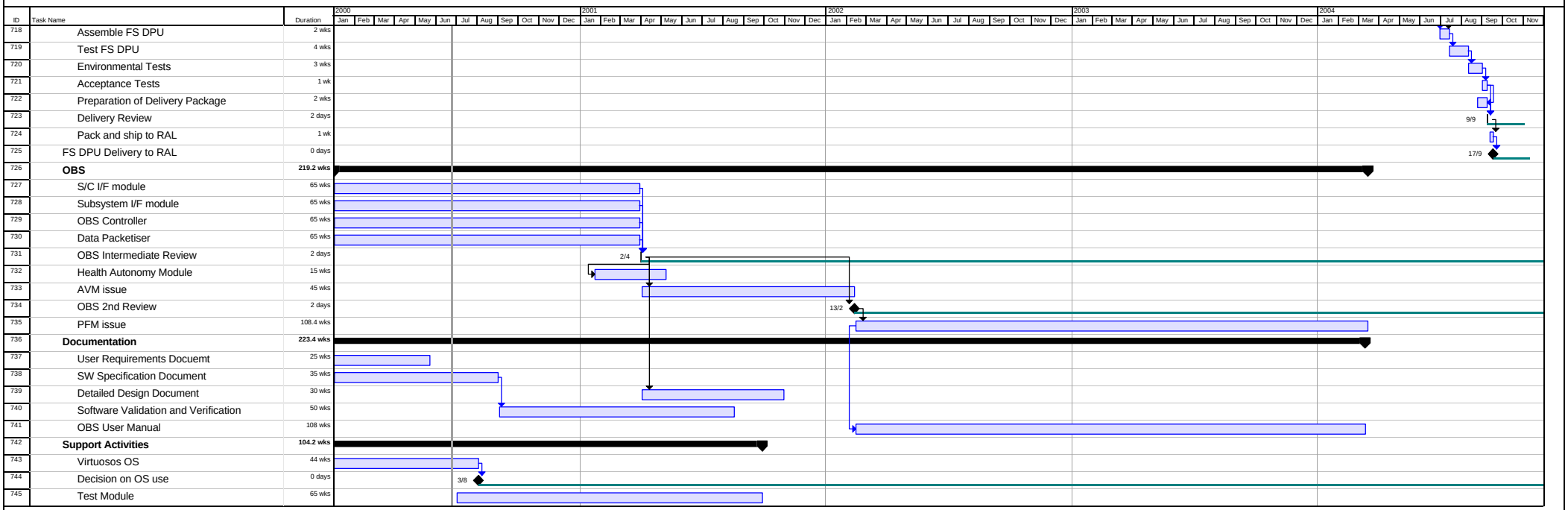
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718 Assemble FS DPU 2 wks
719 Test FS DPU 4 wks
720 Environmental Tests 3 wks
721 Acceptance Tests 1 wk
722 Preparation of Delivery Package 2 wks
723 Delivery Review 2 days
724 Pack and ship to RAL 1 wk
725 FS DPU Delivery to RAL 0 days
726 OBS 219.2 wks
727 S/C I/F module 65 wks
728 Subsystem I/F module 65 wks
729 OBS Controller 65 wks
730 Data Packetiser 65 wks
731 OBS Intermediate Review 2 days
732 Health Autonomy Module 15 wks
733 AVM issue 45 wks
734 OBS 2nd Review 2 days
735 PFM issue 108.4 wks
736 Documentation 223.4 wks
737 User Requirements Docuemt 25 wks
738 SW Specification Document 35 wks
739 Detailed Design Document 30 wks
740 Software Validation and Verification 50 wks
741 OBS User Manual 108 wks
742 Support Activities 104.2 wks
743 Virtuosos OS 44 wks
744 Decision on OS use 0 days
745 Test Module 65 wks
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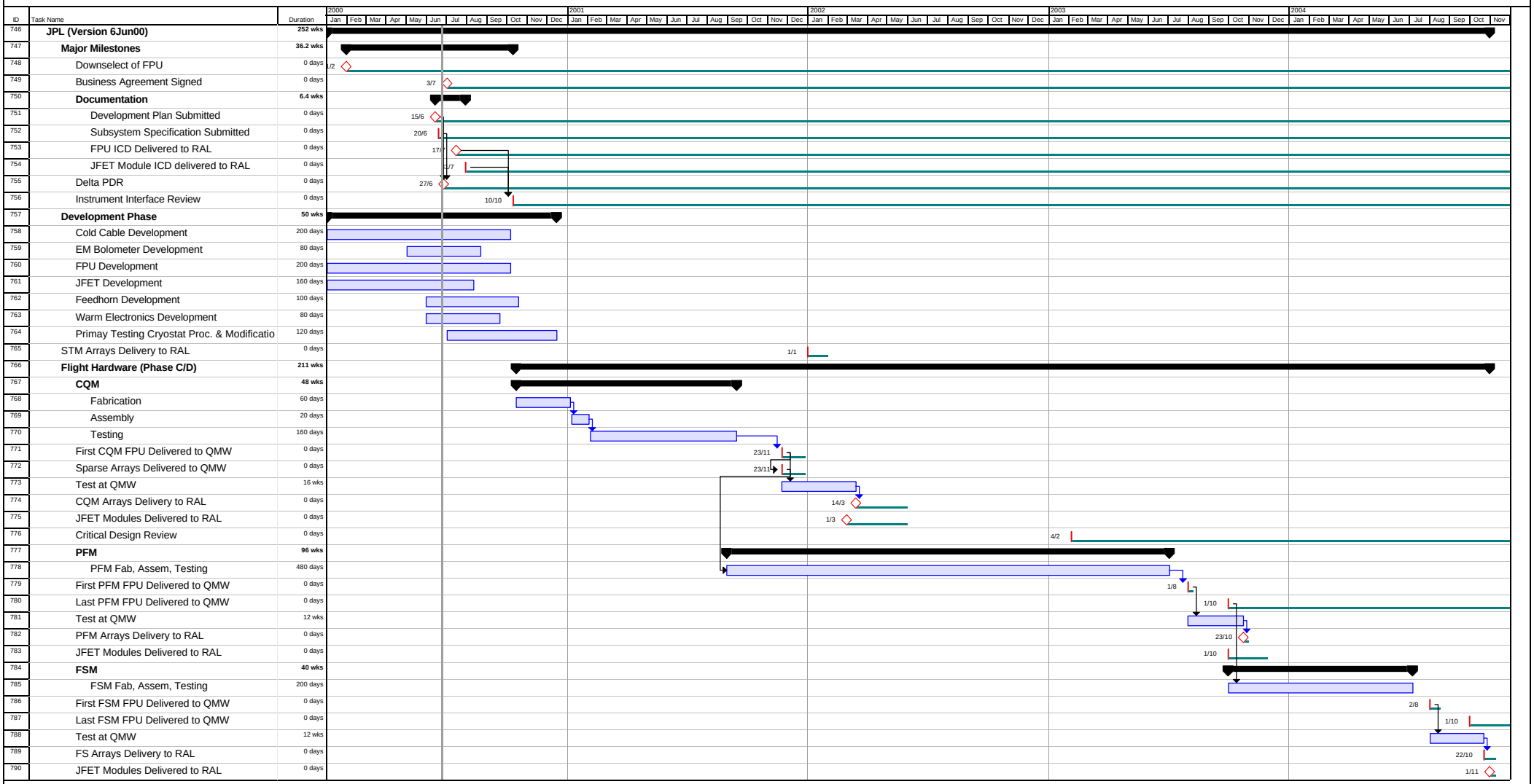
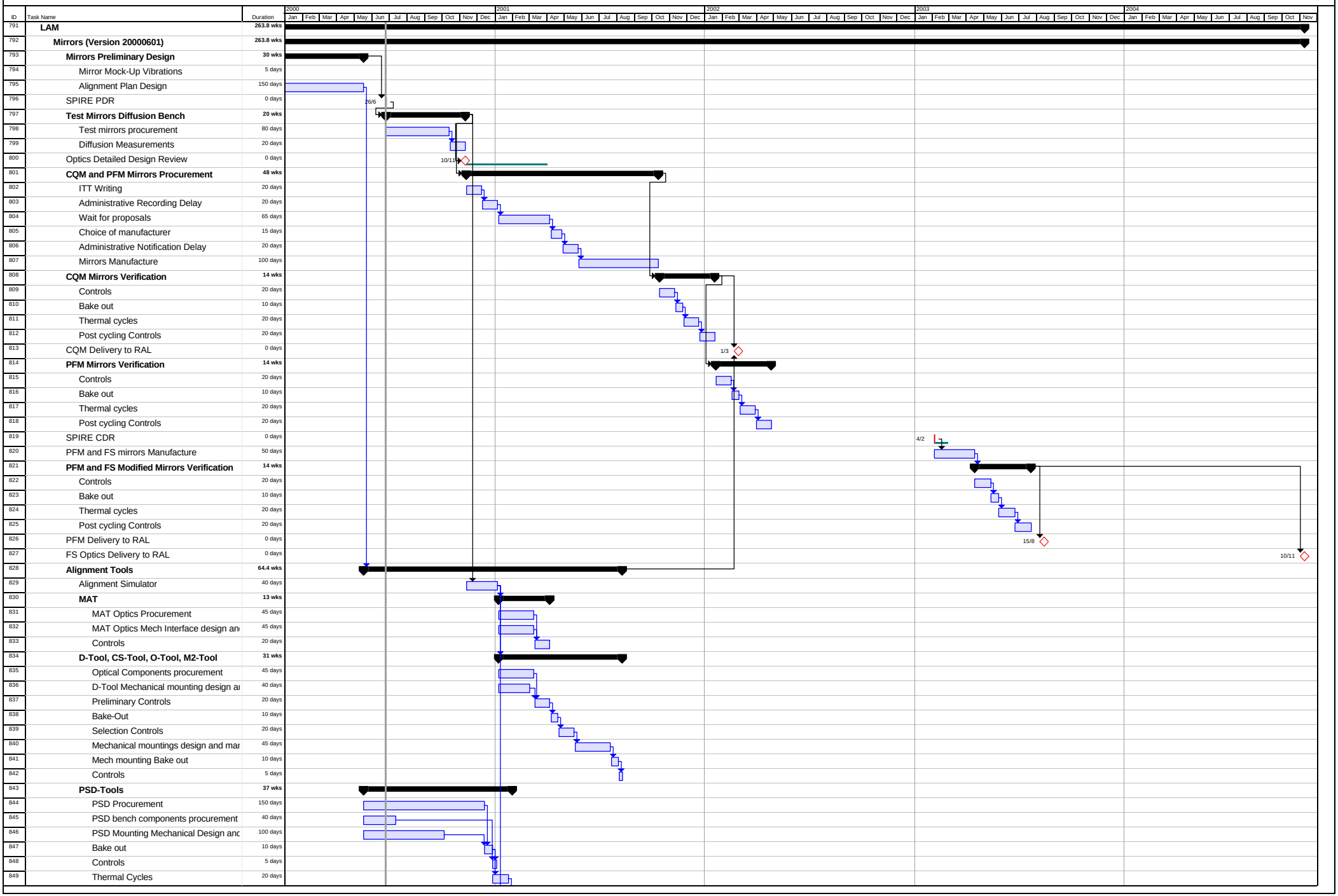


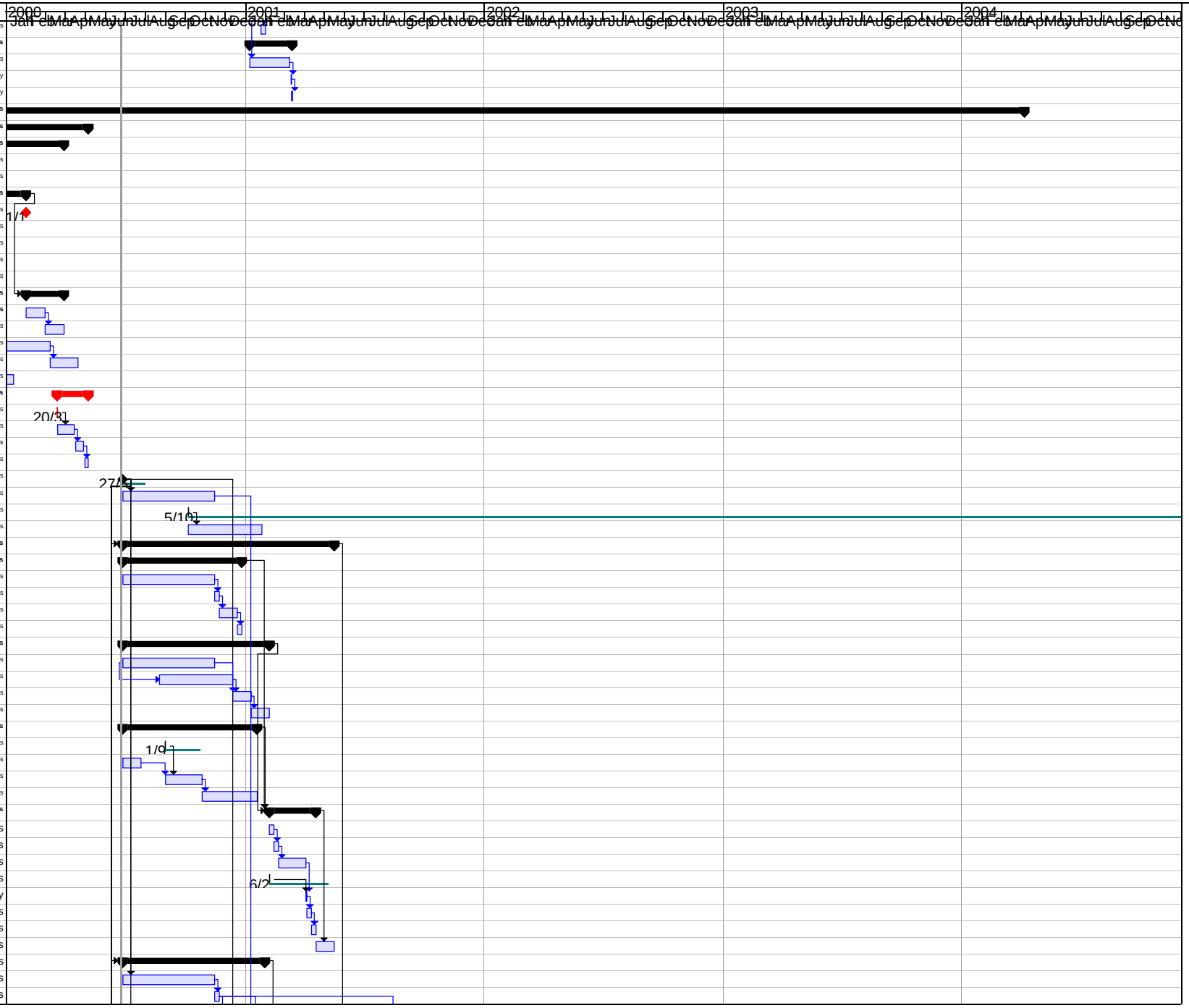
ID	Task Name	Duration
746	**JPL (Version 6Jun00)**	**252 wks**
747	**Major Milestones**	**36.2 wks**
748	Downselect of FPU	0 days
749	Business Agreement Signed	0 days
750	**Documentation**	**6.4 wks**
751	Development Plan Submitted	0 days
752	Subsystem Specification Submitted	0 days
753	FPU ICD Delivered to RAL	0 days
754	JFET Module ICD delivered to RAL	0 days
755	Delta PDR	0 days
756	Instrument Interface Review	0 days
757	**Development Phase**	**50 wks**
758	Cold Cable Development	200 days
759	EM Bolometer Development	80 days
760	FPU Development	200 days
761	JFET Development	160 days
762	Feedhorn Development	100 days
763	Warm Electronics Development	80 days
764	Primay Testing Cryostat Proc. & Modificatio	120 days
765	STM Arrays Delivery to RAL	0 days
766	**Flight Hardware (Phase C/D)**	**211 wks**
767	**CQM**	**48 wks**
768	Fabrication	60 days
769	Assembly	20 days
770	Testing	160 days
771	First CQM FPU Delivered to QMW	0 days
772	Sparse Arrays Delivered to QMW	0 days
773	Test at QMW	16 wks
774	CQM Arrays Delivery to RAL	0 days
775	JFET Modules Delivered to RAL	0 days
776	Critical Design Review	0 days
777	**PFM**	**96 wks**
778	PFM Fab, Assem, Testing	480 days
779	First PFM FPU Delivered to QMW	0 days
780	Last PFM FPU Delivered to QMW	0 days
781	Test at QMW	12 wks
782	PFM Arrays Delivery to RAL	0 days
783	JFET Modules Delivered to RAL	0 days
784	**FSM**	**40 wks**
785	FSM Fab, Assem, Testing	200 days
786	First FSM FPU Delivered to QMW	0 days
787	Last FSM FPU Delivered to QMW	0 days
788	Test at QMW	12 wks
789	FS Arrays Delivery to RAL	0 days
790	JFET Modules Delivered to RAL	0 days

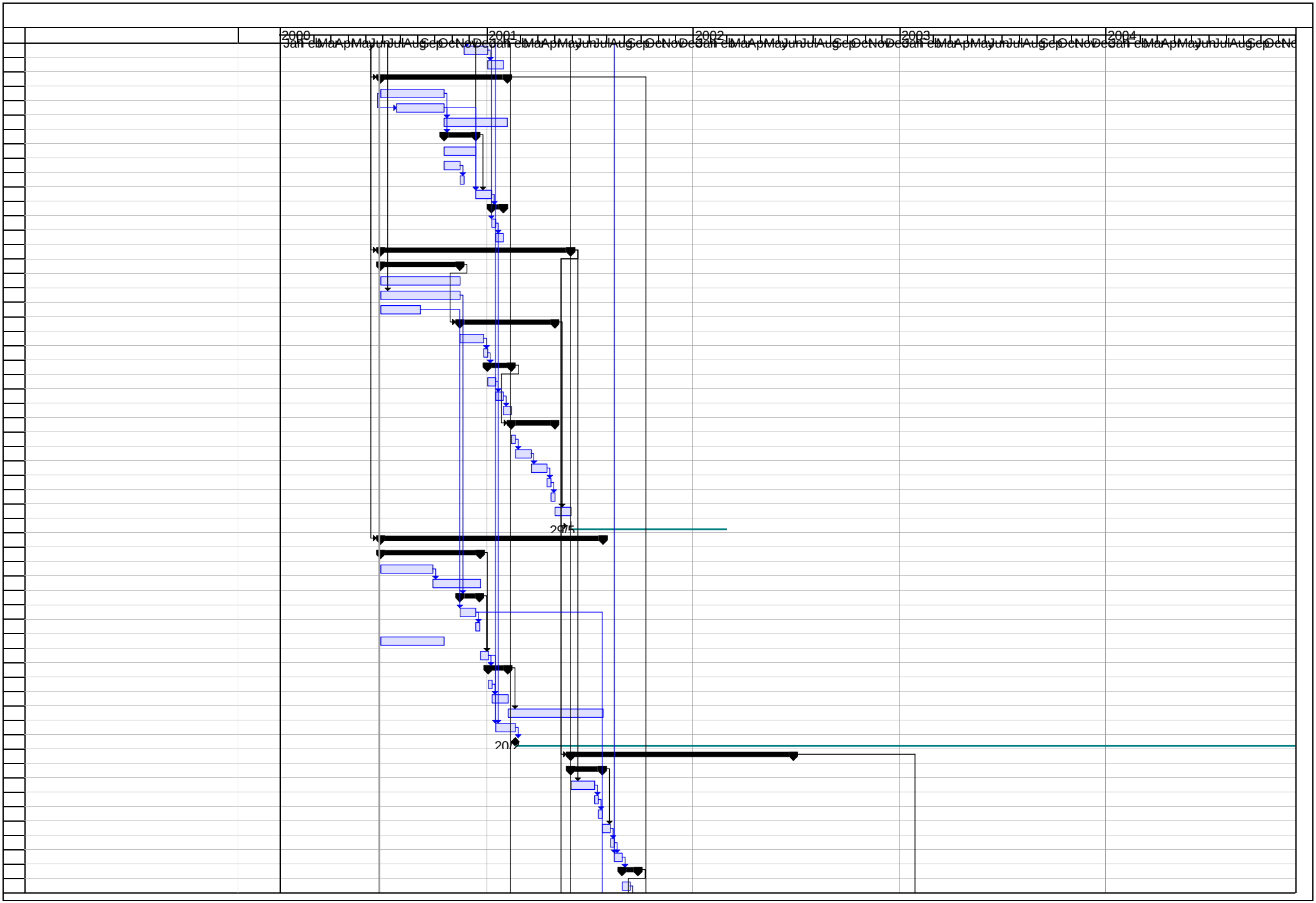
LAM



ID	Task Name	Duration
791	**LAM**	**263.8 wks**
792	**Mirrors (Version 20000601)**	**263.8 wks**
793	**Mirrors Preliminary Design**	**30 wks**
794	Mirror Mock-Up Vibrations	5 days
795	Alignment Plan Design	150 days
796	SPIRE PDR	0 days
797	**Test Mirrors Diffusion Bench**	**20 wks**
798	Test mirrors procurement	80 days
799	Diffusion Measurements	20 days
800	Optics Detailed Design Review	0 days
801	**CQM and PFM Mirrors Procurement**	**48 wks**
802	ITT Writing	20 days
803	Administrative Recording Delay	20 days
804	Wait for proposals	65 days
805	Choice of manufacturer	15 days
806	Administrative Notification Delay	20 days
807	Mirrors Manufacture	100 days
808	**CQM Mirrors Verification**	**14 wks**
809	Controls	20 days
810	Bake out	10 days
811	Thermal cycles	20 days
812	Post cycling Controls	20 days
813	CQM Delivery to RAL	0 days
814	**PFM Mirrors Verification**	**14 wks**
815	Controls	20 days
816	Bake out	10 days
817	Thermal cycles	20 days
818	Post cycling Controls	20 days
819	SPIRE CDR	0 days
820	PFM and FS mirrors Manufacture	50 days
821	**PFM and FS Modified Mirrors Verification**	**14 wks**
822	Controls	20 days
823	Bake out	10 days
824	Thermal cycles	20 days
825	Post cycling Controls	20 days
826	PFM Delivery to RAL	0 days
827	FS Optics Delivery to RAL	0 days
828	**Alignment Tools**	**64.4 wks**
829	Alignment Simulator	40 days
830	**MAT**	**13 wks**
831	MAT Optics Procurement	45 days
832	MAT Optics Mech Interface design an	45 days
833	Controls	20 days
834	**D-Tool, CS-Tool, O-Tool, M2-Tool**	**31 wks**
835	Optical Components procurement	45 days
836	D-Tool Mechanical mounting design a	40 days
837	Preliminary Controls	20 days
838	Bake-Out	10 days
839	Selection Controls	20 days
840	Mechanical mountings design and mar	45 days
841	Mech mounting Bake out	10 days
842	Controls	5 days
843	**PSD-Tools**	**37 wks**
844	PSD Procurement	150 days
845	PSD bench components procurement	40 days
846	PSD Mounting Mechanical Design and	100 days
847	Bake out	10 days
848	Controls	5 days
849	Thermal Cycles	20 days

ID	Task Name	Duration
850	Controls	5 days
851	**3D and APEX tool**	**9.4 wks**
852	Mechanical Design and manufacture	45 days
853	Bake-Out	1 day
854	Controls	1 day
855	**SMEC (Version 20000606)**	**232.6 wks**
856	**SMEC Preliminary Design**	**28.4 wks**
857	**SMEC Control System Engineering**	**23 wks**
858	Principles specifications	52 days
859	Principle analysis and simulations	52 days
860	**Breadboard development**	**14.6 wks**
861	Actuator procurement	0 days
862	PWR Amplifier breadboard	29 days
863	PLL servo control breadboard	52 days
864	Trajectory controller breadboard	52 days
865	OEPS electronics procurement	29 days
866	**Control system breadboard AIT**	**8.4 wks**
867	**Bench intergation**	**21 days**
868	Measurements and control system	21 days
869	OEPS Preliminary Tests	100 days
870	SMECp Requirements	30 days
871	SMECm preliminary mechanical design	60 days
872	**GSFC prototype**	**7 wks**
873	Delivery from GSFC	0 days
874	Repairs	20 days
875	Testings	10 days
876	Simulation with OEPS	5 days
877	SMEC PDR	0 days
878	Long delay cryogenic components procurem	100 days
879	WE Detailed Design Review	0 days
880	DRCU Simulator Development	80 days
881	**MAC Card Detailed design**	**46.2 wks**
882	**Interface electronic development**	**26 wks**
883	Detailed Design	100 days
884	Test with DPU	5 days
885	Design modif	20 days
886	Test with DPU	5 days
887	**Multi Axis Controller (MAC) developmer**	**32 wks**
888	Detailed design	100 days
889	Components procurement	80 days
890	Manufacture	20 days
891	Electrical tests	20 days
892	**Software development**	**29.4 wks**
893	BSM Simulator Simulink delivery to LA	0 days
894	SMECm simulator development	20 days
895	DSP tests for contorl of both mecanis	40 days
896	DSP Software draft version	60 days
897	**MAC Card integration and tests**	**10.2 wks**
898	FPGA Integration and test	5 days
899	Software integration (EEPROM)	5 days
900	Functional tests	30 days
901	BSMm DM delivery to LAM	0 days
902	Tests with BSMm DM and SMECm pr	1 day
903	Software transfert from EEPROM to F	5 days
904	Final Tests	5 days
905	MAC Design update	20 days
906	SMEC board development	31 wks
907	Detailed design and EM manufacture	100 days
908	Electrical tests	5 days

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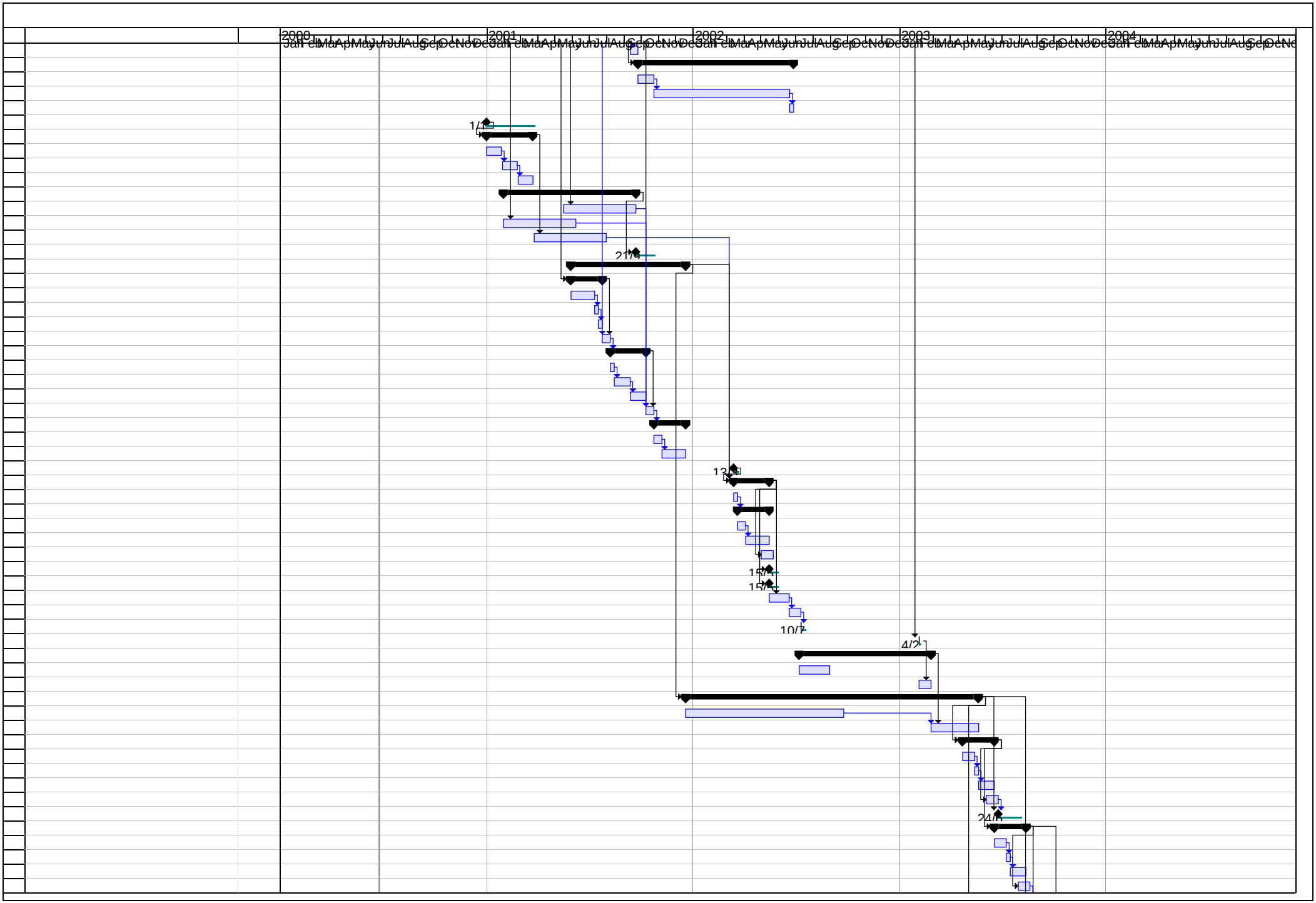
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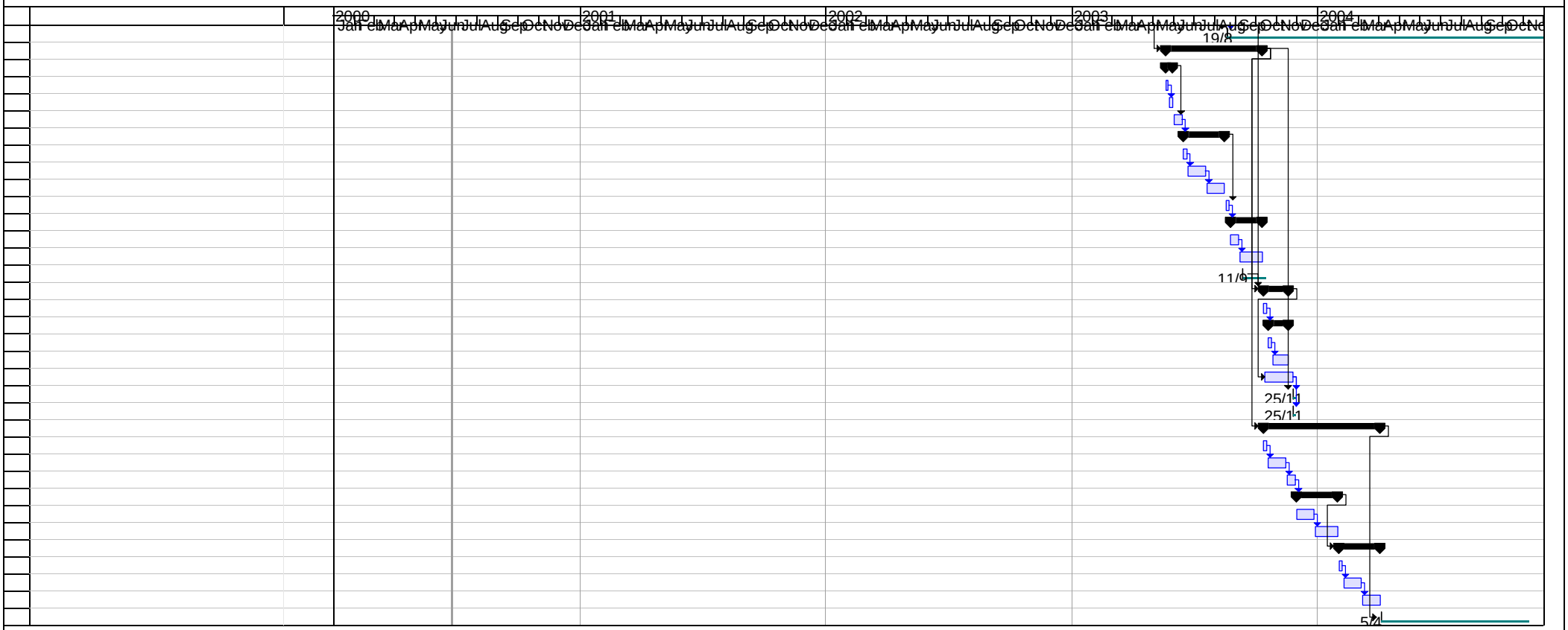
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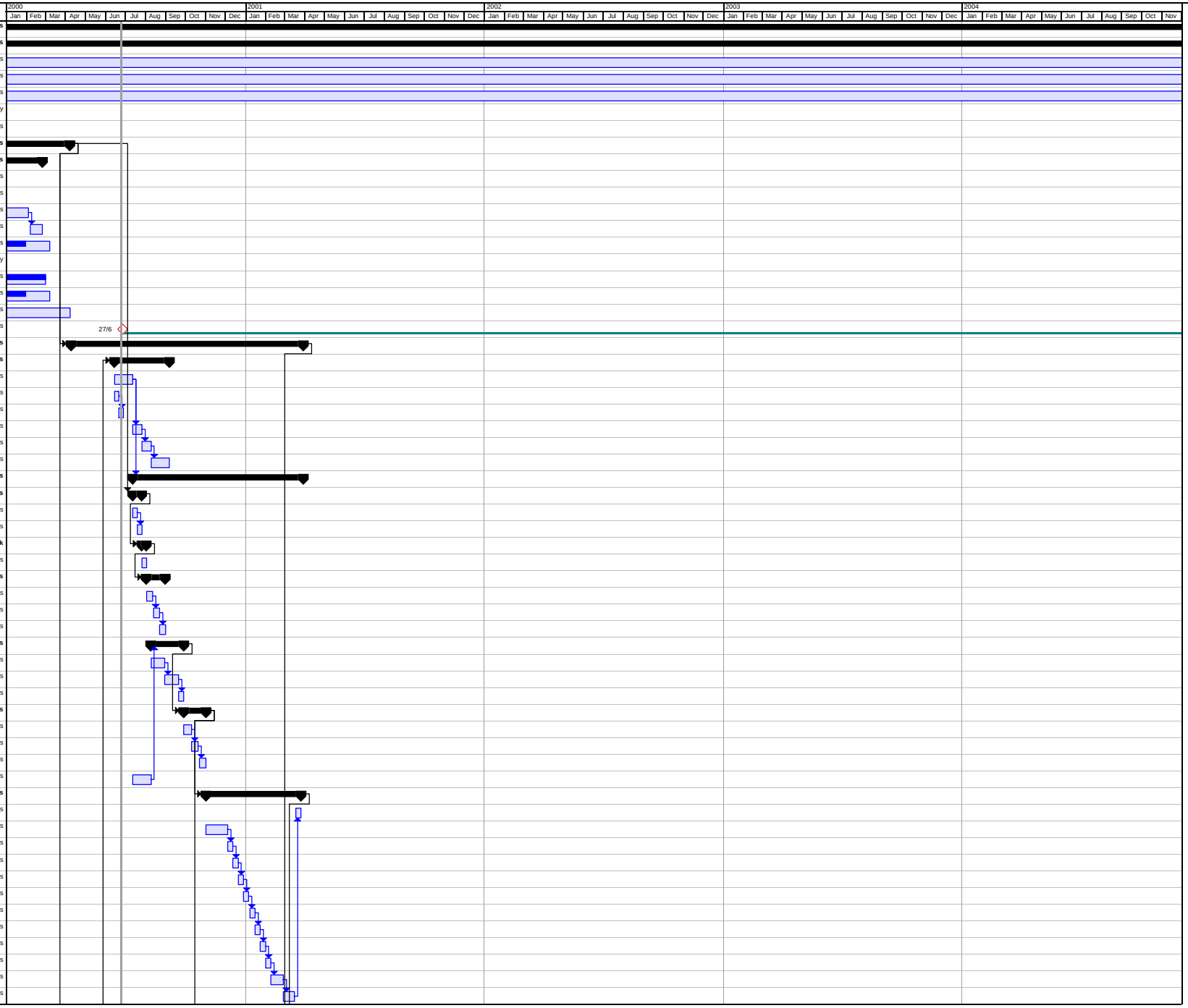
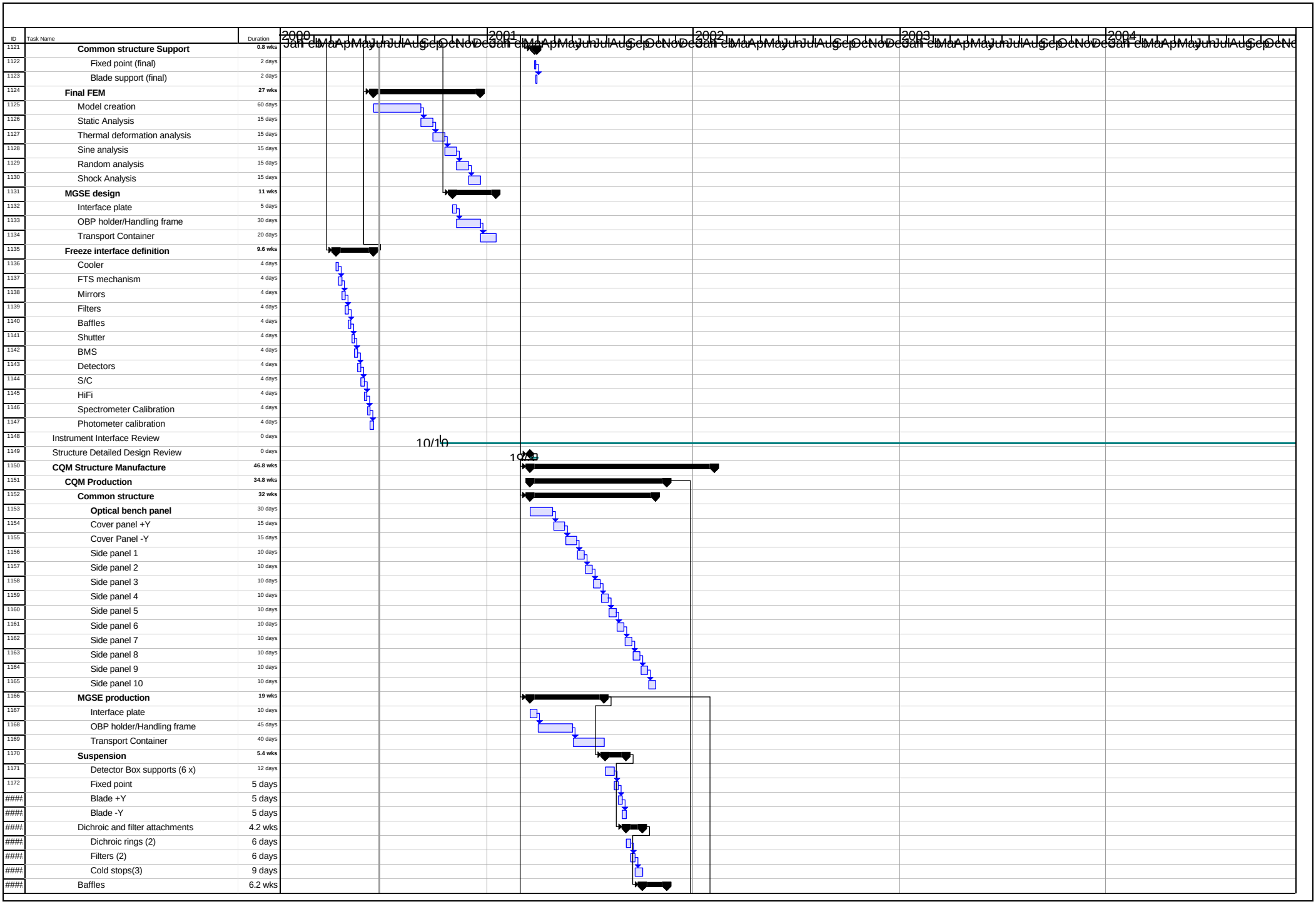
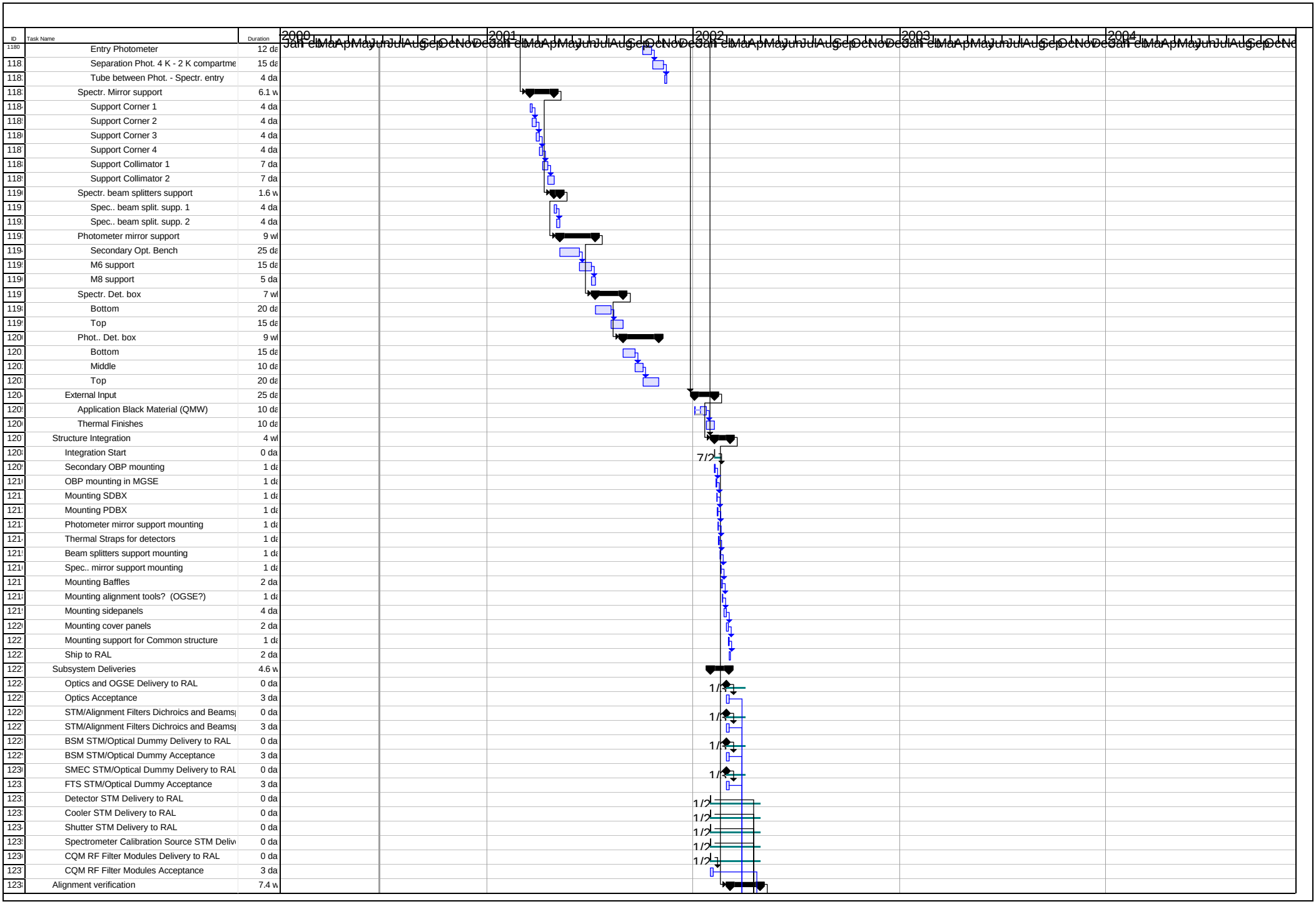
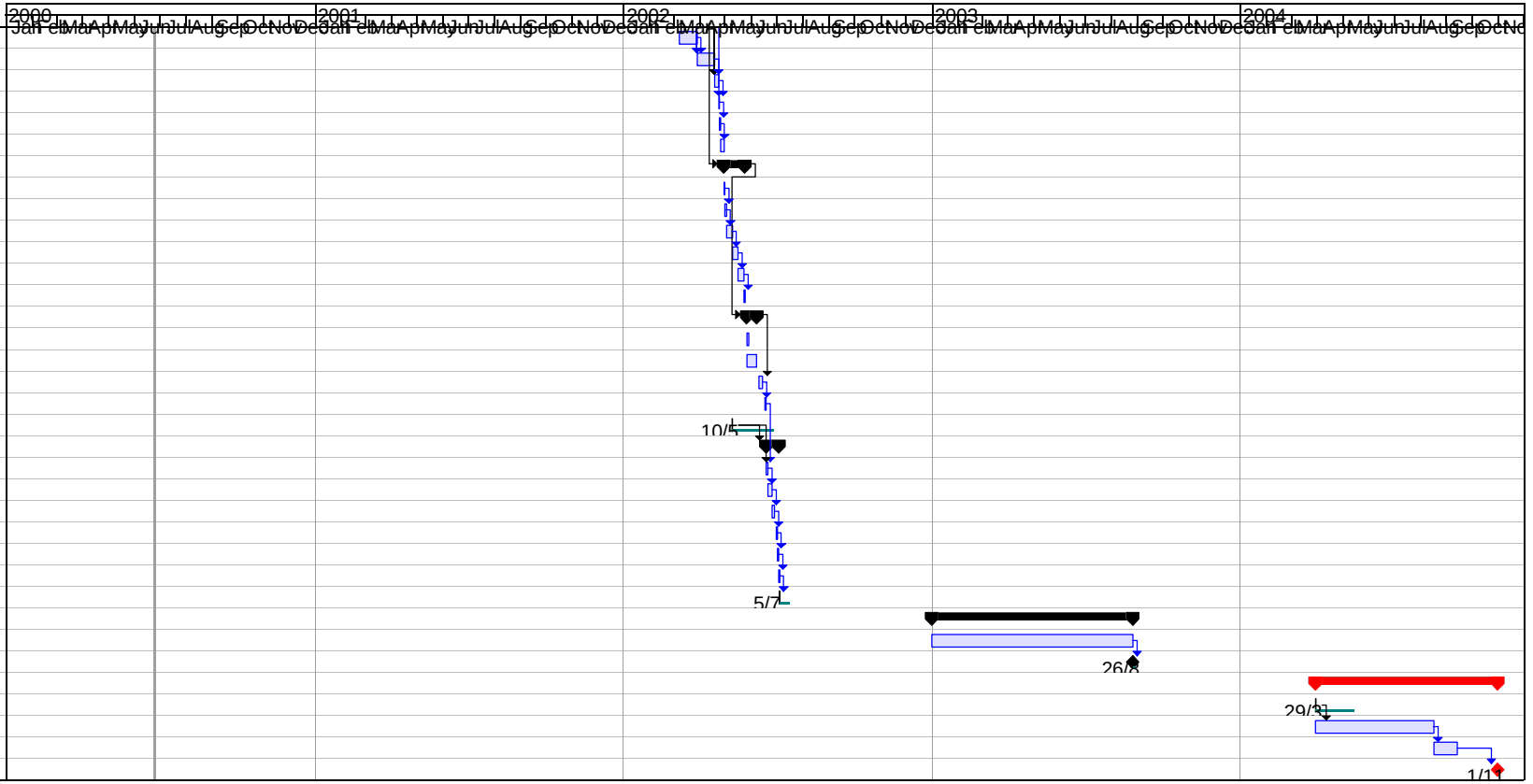
ID	Task Name	Duration
1062	**MSSL (Version 0.4)**	**548 wks**
1063	**Travel & Subsidence**	**548 wks**
1064	Travel Europe	2493 days
1065	Travel outside Europe	1697 days
1066	Travel UK	1697 days
1067	Courses	1 day
1068	Pre-PDR	3 days
1069	**PDR-interbellum**	**144.6 wks**
1070	**Coupon testing**	**31.8 wks**
1071	Coupon definition	30 days
1072	Coupon production	50 days
1073	Coupon testing	50 days
1074	Coupon evaluation	15 days
1075	Drafting Concept	166 days
1076	Computing	1 day
1077	Alignment plan	153 days
1078	FEM concepts	153 days
1079	Defining interfaces	179 days
1080	Structure PDR	0 days
1081	**Final Design**	**51 wks**
1082	**Support test**	**12 wks**
1083	design test fixture	20 days
1084	design blade	5 days
1085	design fixed support	5 days
1086	support production	10 days
1087	support test	10 days
1088	Support test evaluation	20 days
1089	**Drafting Final**	**37.4 wks**
1090	**Spectrometer Mirror support**	**2 wks**
1091	Support corner mirror	5 days
1092	Support collimated mirror	5 days
1093	**Spect. beam splitters support**	**1 wk**
1094	Spect. beam split. support	5 days
1095	**Spect. Det. box**	**4.2 wks**
1096	Bottom	7 days
1097	Middle	7 days
1098	Top	7 days
1099	**Photometer mirror support**	**7.2 wks**
1100	Secondary Opt. Bench	15 days
1101	M6 support	15 days
1102	M8 support	6 days
1103	**Phot. Det. Box**	**4.8 wks**
1104	Bottom	8 days
1105	Middle	8 days
1106	Top	8 days
1107	Baffles	20 days
1108	**Common structure**	**20.6 wks**
1109	Detector Box support	6 days
1110	Optical bench panel	23 days
1111	Side panel 1	6 days
1112	Side panel 2	6 days
1113	Side panel 3	6 days
1114	Side panel 4	6 days
1115	Side panel 5	6 days
1116	Side panel 6	6 days
1117	Side panel 7	6 days
1118	Side panel 8	6 days
1119	Cover panel +Y	13 days
1120	Cover Panel -Y	13 days

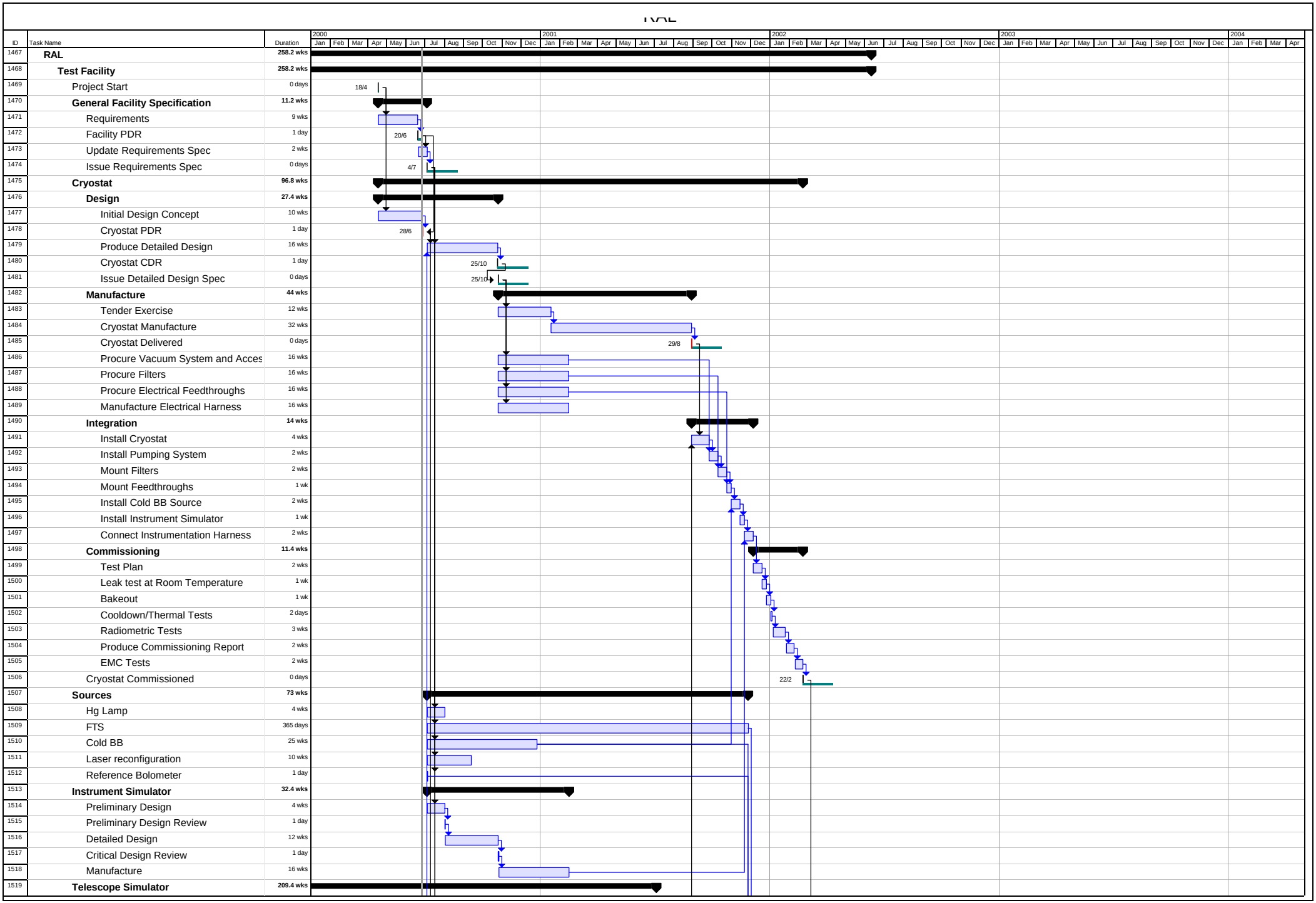



ID
Task Name
Duration
2000
2001
2002
2003
2004
1121 Common structure Support 0.8 wks
1122 Fixed point (final) 2 days
1123 Blade support (final) 2 days
1124 Final FEM 27 wks
1125 Model creation 60 days
1126 Static Analysis 15 days
1127 Thermal deformation analysis 15 days
1128 Sine analysis 15 days
1129 Random analysis 15 days
1130 Shock Analysis 15 days
1131 MGSE design 11 wks
1132 Interface plate 5 days
1133 OBP holder/Handling frame 30 days
1134 Transport Container 20 days
1135 Freeze interface definition 9.6 wks
1136 Cooler 4 days
1137 FTS mechanism 4 days
1138 Mirrors 4 days
1139 Filters 4 days
1140 Baffles 4 days
1141 Shutter 4 days
1142 BMS 4 days
1143 Detectors 4 days
1144 S/C 4 days
1145 HiFi 4 days
1146 Spectrometer Calibration 4 days
1147 Photometer calibration 4 days
1148 Instrument Interface Review 0 days
10/10
1149 Structure Detailed Design Review 0 days
1150 CQM Structure Manufacture 46.8 wks
1151 CQM Production 34.8 wks
1152 Common structure 32 wks
1153 Optical bench panel 30 days
1154 Cover panel +Y 15 days
1155 Cover Panel -Y 15 days
1156 Side panel 1 10 days
1157 Side panel 2 10 days
1158 Side panel 3 10 days
1159 Side panel 4 10 days
1160 Side panel 5 10 days
1161 Side panel 6 10 days
1162 Side panel 7 10 days
1163 Side panel 8 10 days
1164 Side panel 9 10 days
1165 Side panel 10 10 days
1166 MGSE production 19 wks
1167 Interface plate 10 days
1168 OBP holder/Handling frame 45 days
1169 Transport Container 40 days
1170 Suspension 5.4 wks
1171 Detector Box supports (6 x) 12 days
1172 Fixed point 5 days
Blade +Y 5 days
Blade -Y 5 days
Dichroic and filter attachments 4.2 wks
Dichroic rings (2) 6 days
Filters (2) 6 days
Cold stops(3) 9 days
Baffles 6.2 wks

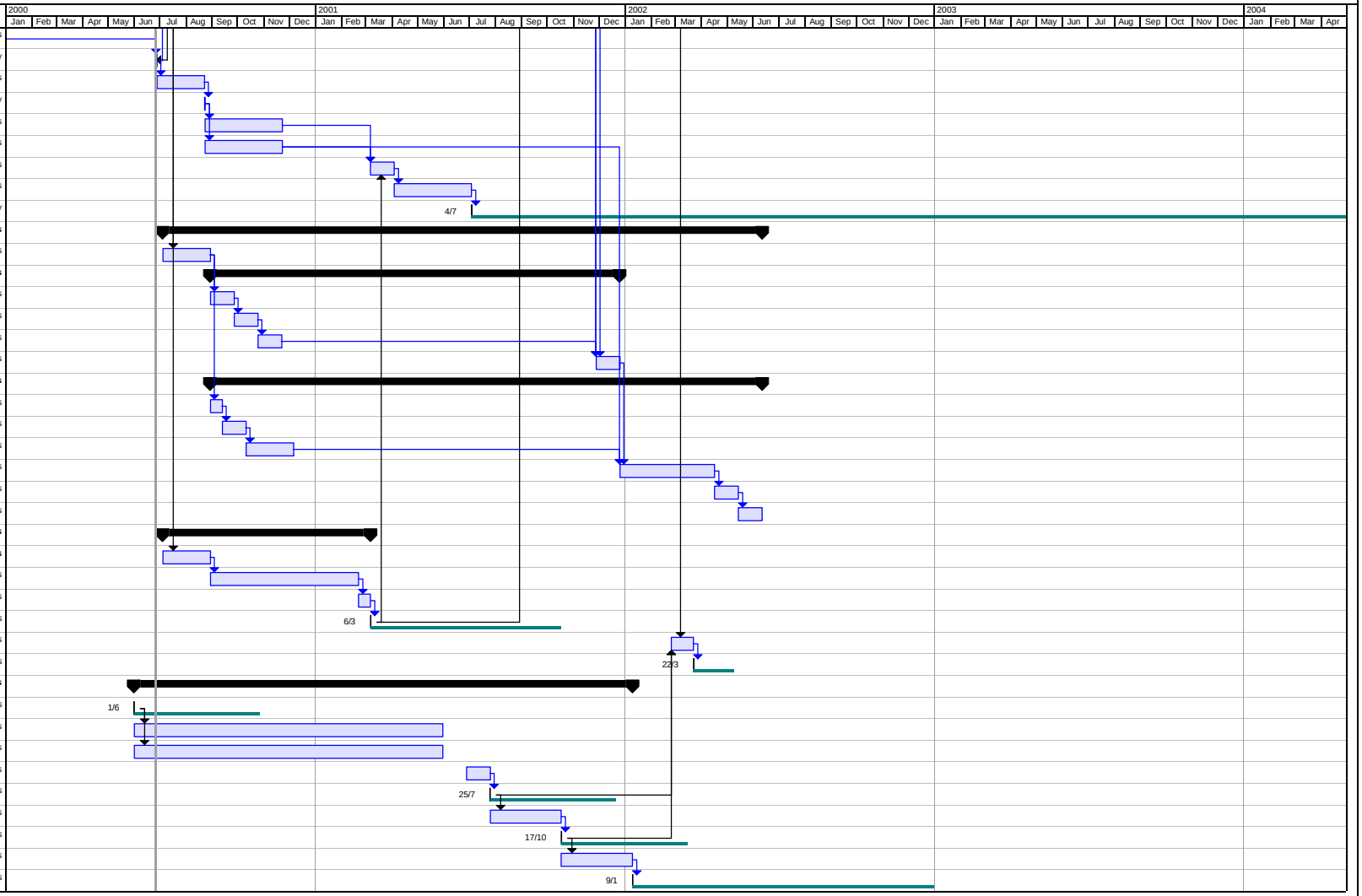

ID
Task Name
Duration
2000
2001
2002
2003
2004
1180 Entry Photometer 12 da
Separation Phot. 4 K - 2 K compartme 15 da
Tube between Phot. - Spectr. entry 4 da
Spectr. Mirror support 6.1 w
Support Corner 1 4 da
Support Corner 2 4 da
Support Corner 3 4 da
Support Corner 4 4 da
Support Collimator 1 7 da
Support Collimator 2 7 da
Spectr. beam splitters support 1.6 w
Spec.. beam split. supp. 1 4 da
Spec.. beam split. supp. 2 4 da
Photometer mirror support 9 wl
Secondary Opt. Bench 25 da
M6 support 15 da
M8 support 5 da
Spectr. Det. box 7 wl
Bottom 20 da
Top 15 da
Phot.. Det. box 9 wl
Bottom 15 da
Middle 10 da
Top 20 da
External Input 25 da
Application Black Material (QMW) 10 da
Thermal Finishes 10 da
Structure Integration 4 wl
Integration Start 0 da
Secondary OBP mounting 1 da
OBP mounting in MGSE 1 da
Mounting SDBX 1 da
Mounting PDBX 1 da
Photometer mirror support mounting 1 da
Thermal Straps for detectors 1 da
Beam splitters support mounting 1 da
Spec.. mirror support mounting 1 da
Mounting Baffles 2 da
Mounting alignment tools? (OGSE?) 1 da
Mounting sidepanels 4 da
Mounting cover panels 2 da
Mounting support for Common structure 1 da
Ship to RAL 2 da
Subsystem Deliveries 4.6 w
Optics and OGSE Delivery to RAL 0 da
Optics Acceptance 3 da
STM/Alignment Filters Dichroics and Beams 0 da
STM/Alignment Filters Dichroics and Beams 3 da
BSM STM/Optical Dummy Delivery to RAL 0 da
BSM STM/Optical Dummy Acceptance 3 da
SMEC STM/Optical Dummy Delivery to RAL 0 da
FTS STM/Optical Dummy Acceptance 3 da
Detector STM Delivery to RAL 0 da
Cooler STM Delivery to RAL 0 da
Shutter STM Delivery to RAL 0 da
Spectrometer Calibration Source STM Deliv 0 da
CQM RF Filter Modules Delivery to RAL 0 da
CQM RF Filter Modules Acceptance 3 da
Alignment verification 7.4 w

ID	Task Name	Duration
1239	Check alignment mechanical	15 days
####	Integrate mirrors, OGSE amd Optical Dummies	15 days
####	Integrate Mass Dummies	3 days
####	Integrate RF Filter Modules	1 day
####	Add Instrumentation	1 day
####	Optical alignment check warm	2 days
####	STM Warm Vibration	3.8 wks
####	visual inspection	1 day
####	Mounting on shaker+instrum.	2 days
####	X-axis sine, random, shock	5 days
####	Y-axis sine, random, shock	5 days
####	Z-axis sine, random, shock	5 days
####	visual inspection	1 day
####	Post STM Vibration Verification	2 wks
####	Optical alignment check warm	2 days
####	Optical Quality Verification	10 days
####	Bakeout	5 days
####	Optical Alignment Check warm	2 days
####	Test Cryostat Available	0 days
####	Cold STM Testing	2.2 wks
####	Integration into Test Cryostat	2 days
####	Cooldown	3 days
####	Optical Alignment Check cold	3 days
####	Thermal Balance Check	1 day
####	Warm up	2 days
####	STM De-integration	1 day
####	Test Readiness Review	1 day
####	PFM Structure Manufacture	34 wks
####	PFM production	170 days
####	PFM Structure Ready for Integration	0 days
####	FS Structure Manufacture	30.8 wks
####	CQM use by ESA	0 days
####	FS refurbishment	100 days
####	FS mechanical I/F check	20 days
####	FS delivery to RAL	0 days



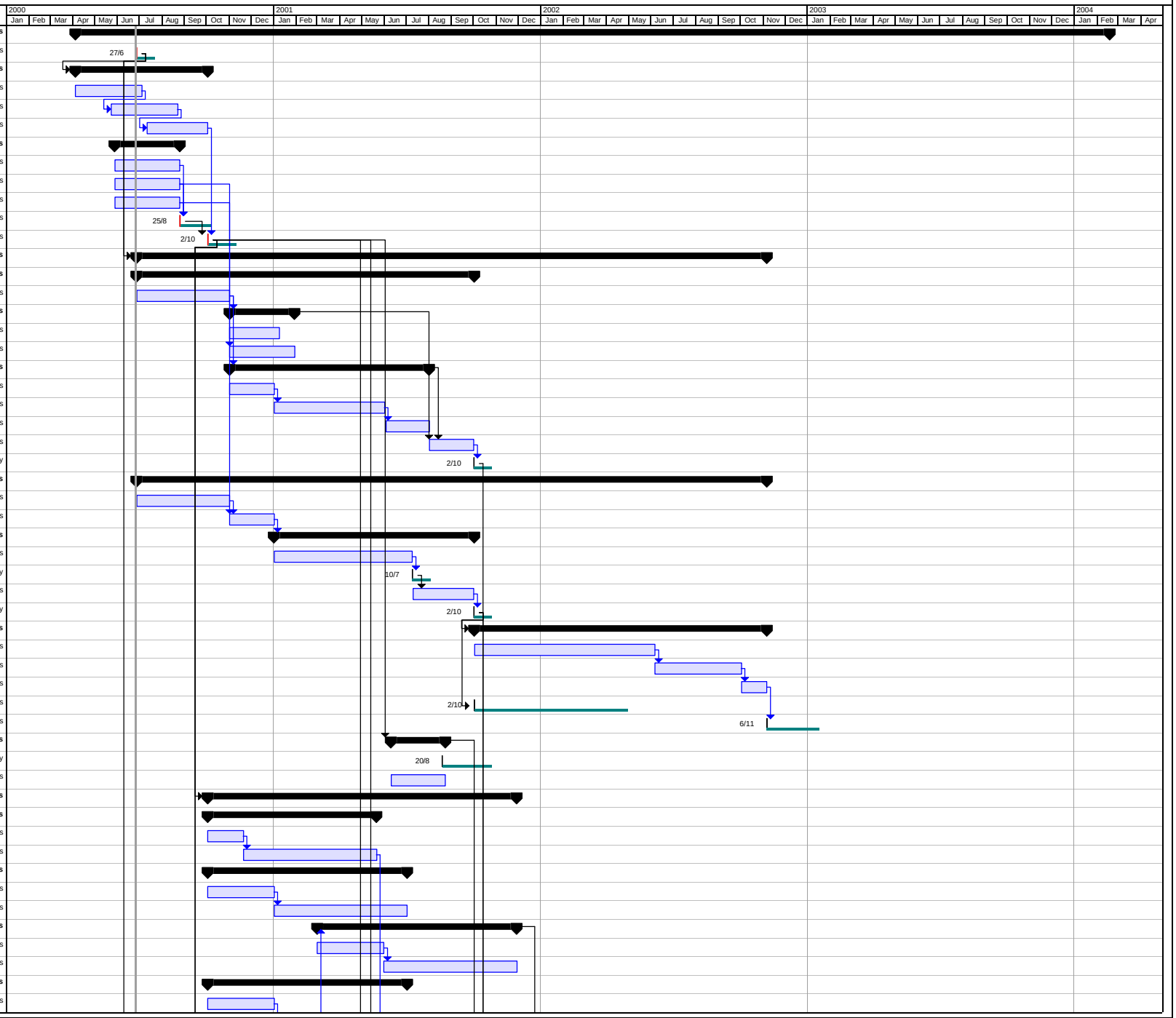

RAL
ID
Task Name
Duration
2000
2001
2002
2003
2004
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
1467 RAL 258.2 wks
1468 Test Facility 258.2 wks
1469 Project Start 0 days 18/4
1470 General Facility Specification 11.2 wks
1471 Requirements 9 wks
1472 Facility PDR 1 day 20/6
1473 Update Requirements Spec 2 wks
1474 Issue Requirements Spec 0 days 4/7
1475 Cryostat 96.8 wks
1476 Design 27.4 wks
1477 Initial Design Concept 10 wks
1478 Cryostat PDR 1 day 28/6
1479 Produce Detailed Design 16 wks
1480 Cryostat CDR 1 day 25/10
1481 Issue Detailed Design Spec 0 days 25/10
1482 Manufacture 44 wks
1483 Tender Exercise 12 wks
1484 Cryostat Manufacture 32 wks
1485 Cryostat Delivered 0 days 29/8
1486 Procure Vacuum System and Acces 16 wks
1487 Procure Filters 16 wks
1488 Procure Electrical Feedthroughs 16 wks
1489 Manufacture Electrical Harness 16 wks
1490 Integration 14 wks
1491 Install Cryostat 4 wks
1492 Install Pumping System 2 wks
1493 Mount Filters 2 wks
1494 Mount Feedthroughs 1 wk
1495 Install Cold BB Source 2 wks
1496 Install Instrument Simulator 1 wk
1497 Connect Instrumentation Harness 2 wks
1498 Commissioning 11.4 wks
1499 Test Plan 2 wks
1500 Leak test at Room Temperature 1 wk
1501 Bakeout 1 wk
1502 Cooldown/Thermal Tests 2 days
1503 Radiometric Tests 3 wks
1504 Produce Commissioning Report 2 wks
1505 EMC Tests 2 wks
1506 Cryostat Commissioned 0 days 22/2
1507 Sources 73 wks
1508 Hg Lamp 4 wks
1509 FTS 365 days
1510 Cold BB 25 wks
1511 Laser reconfiguration 10 wks
1512 Reference Bolometer 1 day
1513 Instrument Simulator 32.4 wks
1514 Preliminary Design 4 wks
1515 Preliminary Design Review 1 day
1516 Detailed Design 12 wks
1517 Critical Design Review 1 day
1518 Manufacture 16 wks
1519 Telescope Simulator 209.4 wks

ID	Task Name	Duration
1520	Initial Optical Design	8 wks
1521	Preliminary Design Review	1 day
1522	Detailed Design	8 wks
1523	Critical Design Review	1 day
1524	Manufacture/Procure Optics	13 wks
1525	Procure Stepper Motors	13 wks
1526	Integrate and Align Telescope	4 wks
1527	Test	13 wks
1528	Review and Accept	1 day
1529	**Test Facility Control System**	**101 wks**
1530	System Specification	8 wks
1531	**Hardware**	**69 wks**
1532	Procure Control PC	4 wks
1533	Thermometer Logging System	4 wks
1534	EGSE Interface	4 wks
1535	Source Interfaces	4 wks
1536	**Software**	**93 wks**
1537	URD	2 wks
1538	ADD	4 wks
1539	DDD	8 wks
1540	Code	16 wks
1541	Integrate	4 wks
1542	System Tests	4 wks
1543	**Facility**	**35 wks**
1544	**Design Facility**	**8 wks**
1545	Rebuild Facility	25 wks
1546	**Commission Clean Room**	2 wks
1547	Clean Room Ready	0 days
1548	Test Facility Integration	4 wks
1549	Test Facility Available	0 days
1550	**EGSE**	**84 wks**
1551	EGSE System requirements	0 days
1552	Interface Unit Development	52 wks
1553	SCOS2000 Development	52 wks
1555	EGSE Acceptance Test	4 wks
1556	EGSE#2 Available	0 days
1557	EGSE #3 Manufacture and Test	12 wks
1558	EGSE#3 Available	0 days
1559	EGSE#4 Manufacture and Test	12 wks
1560	EGSE#4 Available	0 days

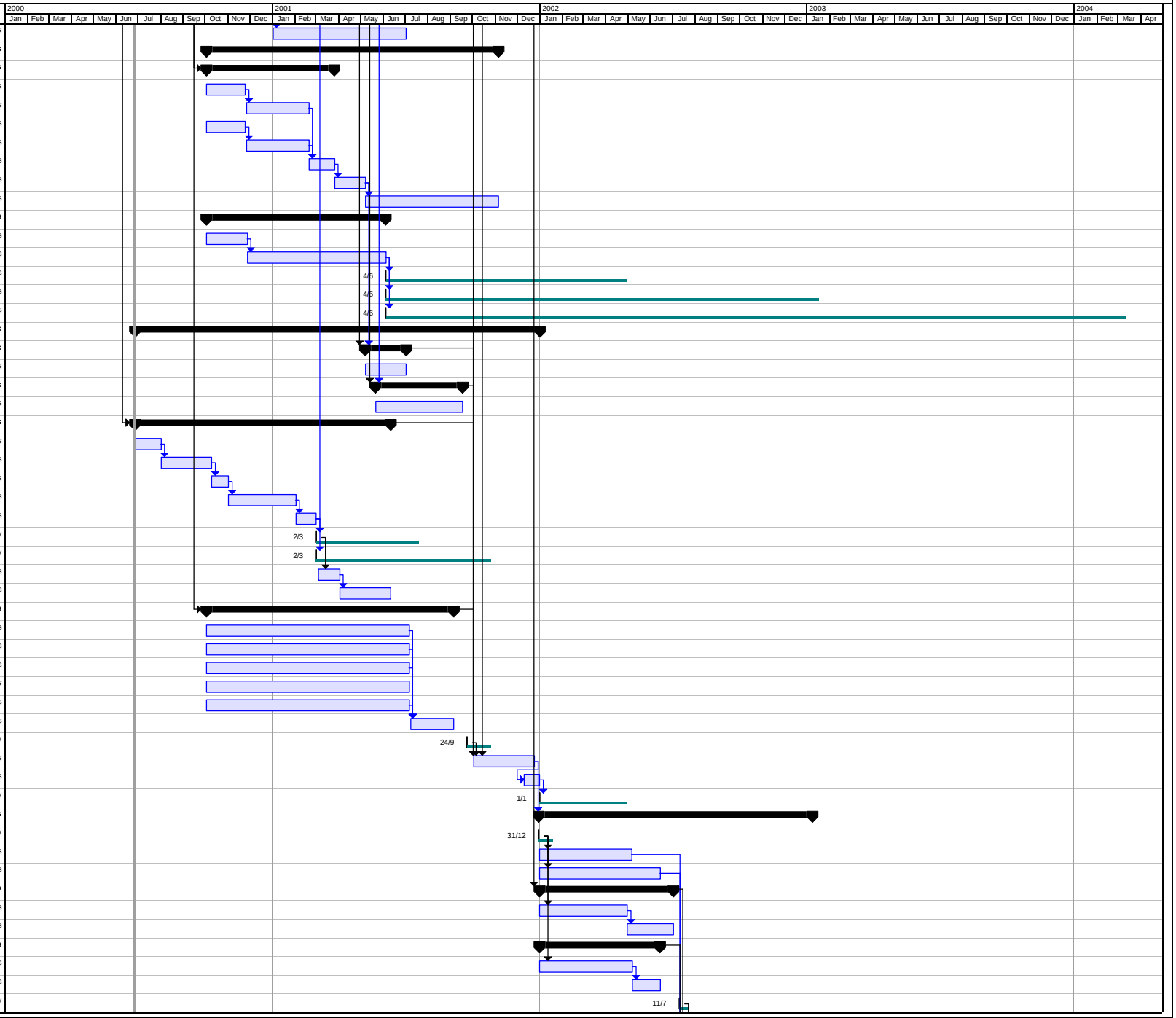


Saclay

ID	Task Name	Duration
1561	**Saclay**	**202.2 wks**
1562	SPIRE PDR	0 days
1563	**DRCU Development Basic Inputs**	**25.8 wks**
1564	DRCU requirements	65 days
1565	DRCU Architectuel Design	65 days
1566	DRCU Detailled Design	59 days
1567	**DRCU I/Fs**	**13 wks**
1568	DRCU S/C I/F	65 days
1569	DRCU/DPU I/F	65 days
1570	DRCU/FPU I/F	65 days
1571	Instrument Interface Review	0 days
1572	DRCU Detailed Design Review	0 days
1573	**Test Means Development**	**123.2 wks**
1574	**DRCU Test Unit**	**66 wks**
1575	DTU Requirements & Specifications	91 days
1576	**DTU H/W**	**12.6 wks**
1577	DTU Station procurement	48 days
1578	DTU/DRCU I/F Proc. & Impl.	63 days
1579	**DTU S/W**	**39 wks**
1580	DTU S/W Specification	43 days
1581	DTU S/W Code Writing	109 days
1582	DTU S/W Test	43 days
1583	DTU I&T	43 days
1584	DTU Delivery to SAp	1 day
1585	**FPU Simulator**	**123.2 wks**
1586	FPU Sim. Requirements	91 days
1587	FPU Sim. Specif. & Archit. Design	43 days
1588	**FPU Simulator Prototype**	**39.2 wks**
1589	FPU Sim. Prototype Implementation	135 days
1590	FPU Unit Simulator deliveries	1 day
1591	FPU Sim. Prototype I&T	59 days
1592	FPU Sim. Prototype Available	1 day
1593	**FPU Simulator (ESA deliverable)**	**57.2 wks**
1594	FPU Sim. Implementation	177 days
1595	FPU Sim. I&T	84 days
1596	FPU Sim. Preparation for delivery to	25 days
1597	FPU Simulator#1 Delivery to RAL	0 days
1598	FPU Simulator#2 Delivery to RAL	0 days
1599	**Test Harnesses**	**10.8 wks**
1600	DRCU to FPU Test Harness Delivery	1 day
1601	WIH Test Harness	54 days
1602	**DRCU Main ITTs**	**60.6 wks**
1603	**DRCU Power Supply**	**33 wks**
1604	DRCU Power Supply Requirements	35 days
1605	DRCU Power Supply Realisation ITT	130 days
1606	**DRCU long delay Part Procurement**	**39 wks**
1607	DRCU Component List	65 days
1608	DRCU Part Procurement ITTs	130 days
1609	**DRCU DCU Electronics Realisation**	**39 wks**
1610	DRCU DCU Specification	65 days
1611	DRCU DCU Realisation ITT	130 days
1612	**DRCU SCU Electronics Realisation**	**39 wks**
1613	DRCU SCU Specification	65 days



ID	Task Name	Duration
1614	DRCU SCU Realisation ITT	130 days
1615	**DRCU Mechanics**	**57 wks**
1616	**DRCU Mechanics Overall Design**	**25 wks**
1617	DRCU Box Design	39 days
1618	DRCU Box Prototype realisation	61 days
1619	DRCU Board Design	39 days
1620	DRCU Board Prototype realisation	61 days
1621	DRCU Mechanics Validation	25 days
1622	DRCU Mechanics Specification	30 days
1623	DRCU Mechanics Realisation ITT	130 days
1624	**WIH Realisation**	**35 wks**
1625	WIH Specification	40 days
1626	WIH Realisation ITT	135 days
1627	WIH QM1 Delivery to RAL	0 days
1628	WIH QM2 Delivery to RAL	0 days
1629	WIH PFM Delivery to RAL	0 days
1630	**DRCU QM1**	**79 wks**
1631	**DRCU QM1 Mechanics**	**8 wks**
1632	DRCU QM1 Mec. Procurement	40 days
1633	**DRCU QM1 Power Supply**	**17 wks**
1634	DRCU QM1 Power Supply Procuremen	85 days
1635	**DRCU QM1 Detector Control Unit**	**49.8 wks**
1636	DRCU DCU Electronics Design	25 days
1637	DRCU DCU BB Model Realisation	49 days
1638	DRCU DCU BB Test at JPL	17 days
1639	DRCU DCU QM1 Realisation	66 days
1640	DRCU DCU QM1 Test At JPL	20 days
1641	DRCU DCU QM1 Delivery to Sap	1 day
1642	Detector Test Cryostat Delivery to SAp	1 day
1643	Detector Test Cryostat Installation at SA	21 days
1644	DRCU DCU QM1 Test at SAp	50 days
1645	**DRCU QM1 SCU**	**48.4 wks**
1646	DRCU QM1 Subs. Digital Control	199 days
1647	DRCU QM1 H/K Subsystem	199 days
1648	DRCU QM1 Cal. Sources Subsystem	199 days
1649	DRCU QM1 Cryo-Cooler Subsystem	199 days
1650	DRCU QM1 PS Switch Control Subsyst	199 days
1651	DRCU QM1 SCU I&T	43 days
1652	DRCU QM1 MCU Delivery from LAM	1 day
1653	DRCU QM1 I&T	59 days
1654	DRCU QM1 Preparation for Delivery to RA	15 days
1655	DRCU QM1 delivery to RAL	1 day
1656	**DRCU QM2**	**53.6 wks**
1657	DRCU QM2 Part Available	1 day
1658	DRCU QM2 Mechanics Manufacturing	90 days
1659	DRCU QM2 Power Supply Manufactruring	119 days
1660	**DRCU QM2 Detector Control Unit**	**26.2 wks**
1661	DRCU QM2 DCU Manufacturing	86 days
1662	DRCU QM2 DCU Validation Test	45 days
1663	**DRCU QM2 SCU**	**23.8 wks**
1664	DRCU QM2 SCU Realisation	91 days
1665	DRCU QM2 SCU Validation Test	28 days
1666	DRCU QM2 MCU Delivery from LAM	1 day



ID	Task Name	Duration
1667	DRCU QM2 I&T	68 days
1668