

**Southern African Large Telescope
High-Resolution Spectrograph**

SALT HRS

3200BP0021 Instrument Schedule and Budget Narrative

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Issue History

Number and file name	Person	Issue	Date	Status
3200BP0021 R4 schedule.doc	PLC	1.0	5 July 2004	Revision of 3200BP0008
	JGH	1.1	8 July 2004	Gantt input
	PLC	1.2	9 July 2004	Finalise commentary
3200BP0021 R4Sched_Budg	PLC	1.3	11 July 2004	Include brief budget narrative
3200BP0021_sched_budg	PLC	2.0	8 March 2005	CDR update
	JGH	2.1	12 March 2005	Revise with current schedule and budget
	PLC	2.2	13 March 2005	Corrections

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1 Introduction

This document discusses both the schedule and the budget associated with the design (concept, preliminary and critical) and construction phase associated with all aspects of the Southern African Large Telescope High-Resolution Spectrograph (SALT HRS).

The following sections provide a commentary of the schedule Gantt chart associated with the project, including each of the component parts of SALT HRS, together with the integration and installation and commissioning of the instrument at SALT.

This replaces the PDR document with the same number except that it is Issue 2.

2 Overall Schedule

A full project plan covering all aspects of this project has been prepared in detail. Two software packages were used to do this. The first, APT Assistant, is a specialised work breakdown structure tool to help identify all tasks involved (down to level 6, which is considered adequate for this project). Once this was done, the resultant work structure was transferred into Microsoft Project as the prime management tracking tool for the project.

The project structure for level 1 can be summarised as follows:

- Concept Development Phase
- Preliminary Design Phase
- Critical Design Phase
- Construction Phase
- Integration Phase
- Shipping Phase
- Commissioning Phase

The details for each of these phases are discussed below. In parallel with these phases are the following project administration functions:

- Establishing and managing commercial contracts
- Preparing and tracking the project budget
- Regular reporting of progress against schedule and budget
- Regular project management review and team meetings
- Project accounting functions
- Project legal and commercial advice as required

The schedule currently assumes approval for construction to start will be granted at the SALT Board meeting in May 2005, following CDR in Christchurch, New Zealand. Due to the smaller optical component sizes than in the earlier designs, ordering glass and other items prior to CDR is not required.

The project construction phase is planned for commencement on May 31, 2005. This is considered adequate time following CDR for the SALT Board to approve both the technical and commercial aspects of the project.

At one point during the planning phase, it appeared that the échelle grating may need to be ordered before CDR to avoid holding up the project. However, this is currently not the case. Provided approvals are received as envisaged, the échelle can be ordered at the formal commencement of the project (May 31, 2005) with the grating delivery driving the project critical path, but only marginally. This is considered acceptable.

Construction of the mechanical sub-assembly consists of approximately 13 sub-groups of tasks and will take approximately 12 months from CDR, coming together as a complete structure during May 2006.

The SALT Board has requested that an earlier option of constructing the blue and red optics paths separately be dropped, and that planning for CDR be on the basis of both light paths being constructed together. Both the schedule and budget have now been modified to reflect this. (The “red path starting delay” task in the Gantt chart remains from earlier version for internal Microsoft Project structural reasons but has been set to zero.)

The first integration of the full HRS instrument in Christchurch is expected to occur in third quarter of 2006, with pre-ship acceptance testing in Christchurch during the first quarter of 2007. Assembly and final commissioning in the instrument room at Sutherland is anticipated for July 2007.

The SALT HRS project schedule currently has around 340 inter-linked tasks and is presented as a fully rolled out Gantt chart in document “3200BP0028_Gantt”. A number of detailed views of the various major stages of the project area are presented in the following sections. This level of detail has allowed the project team to obtain good visibility of the major milestones and task dependencies.

3 Critical Path View

Figure 1 shows the project’s critical path. This forms a visual summary of the most important time critical, inter-linked tasks which determine the total time for the project.

The key time driver for the project is the manufacture of the échelle grating. This represents around half the total project time between CDR and commissioning of the finished instrument. However, the manufacturing time of the optical components is quite close to that for the échelle, so if the échelle grating is supplied slightly earlier or the red path optics manufacture delayed slightly, the critical path could well be driven by the supply of the either the blue or red optics.

Other sub-assemblies are ready comfortably within the timeframes of these two groups and are not expected to move onto the critical path during the project.

4 High Level Overview

The schedule has been back-dated to commence in quarter 4 of 2003 when the preparatory work began in earnest following approval of the R4 SALT HRS concept. Once approval to advance into the preliminary design phase was given (March 25, 2004), the more detailed design drivers were examined.

Figure 2 shows the project in high level view. At the time of writing, the next major project milestone is CDR set for April, 12, 2005 in Christchurch, New Zealand. Assuming that the review team is satisfied with the HRS technical design, the next key date is the SALT Board meeting on May 11, 2005. It is envisaged that both technical and commercial approval will be granted by the Board at this meeting, to permit construction to commence May 31, 2005. This is task 41 "HRS Construction Begins".

The design and construction phase (the group beginning with task 42) spans approximately six quarters. However the bulk of the first two are the finalising of the instrument design in preparation for CDR. The actual construction phase spans approximately 12 months.

Around the middle of 2006, the clean room laboratory will be established to allow the integration assembly process to commence. Once this is complete, the integration testing phase will get underway, leading up to the final acceptance testing in Christchurch, currently timed for the end of February 2007.

Shipping spans approximately four months, from March to June 2007 inclusive. This involves dismantling, crating, shipping the tank by sea (weight is around 2 tonnes) and most probably the optical components by air. (Also shipping the tank by air to accelerate this process will be investigated for its feasibility closer to the time.) An inspection period in Cape Town has been assumed, followed by the road transportation to Sutherland.

Preparations for commissioning on site at Sutherland will begin well ahead to minimise any delays on-site once the instrument arrives in June 2007. Assembly and commissioning is expected to take approximately 3 months with the project being completed towards the end of September 2007.

A project-wide contingency of 100 days has been included (shown in the Administration section, task group 335). This is felt to be realistic given the current unknowns surrounding the delivery of key components from external parties.

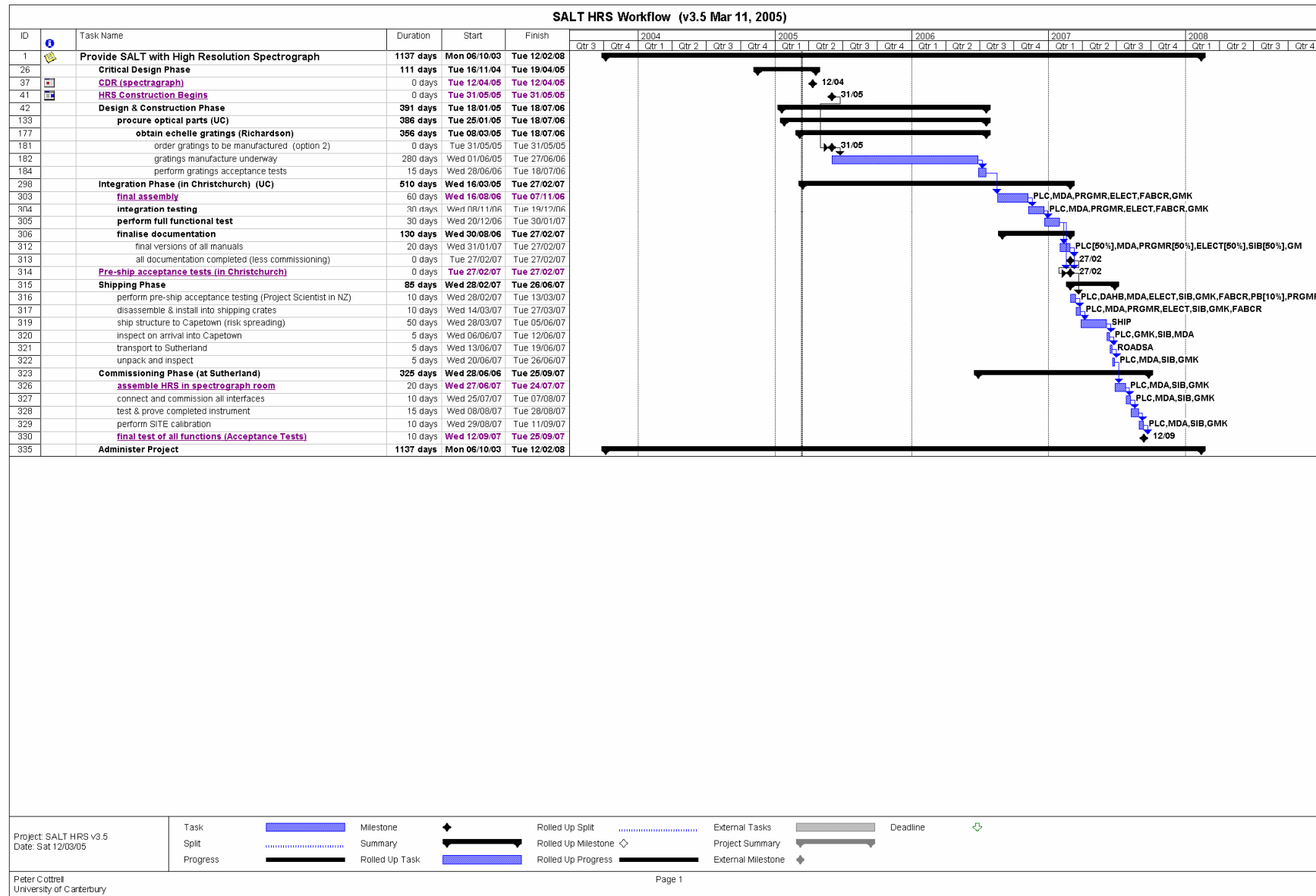


Figure 1: SALT HRS Schedule – Critical Path View

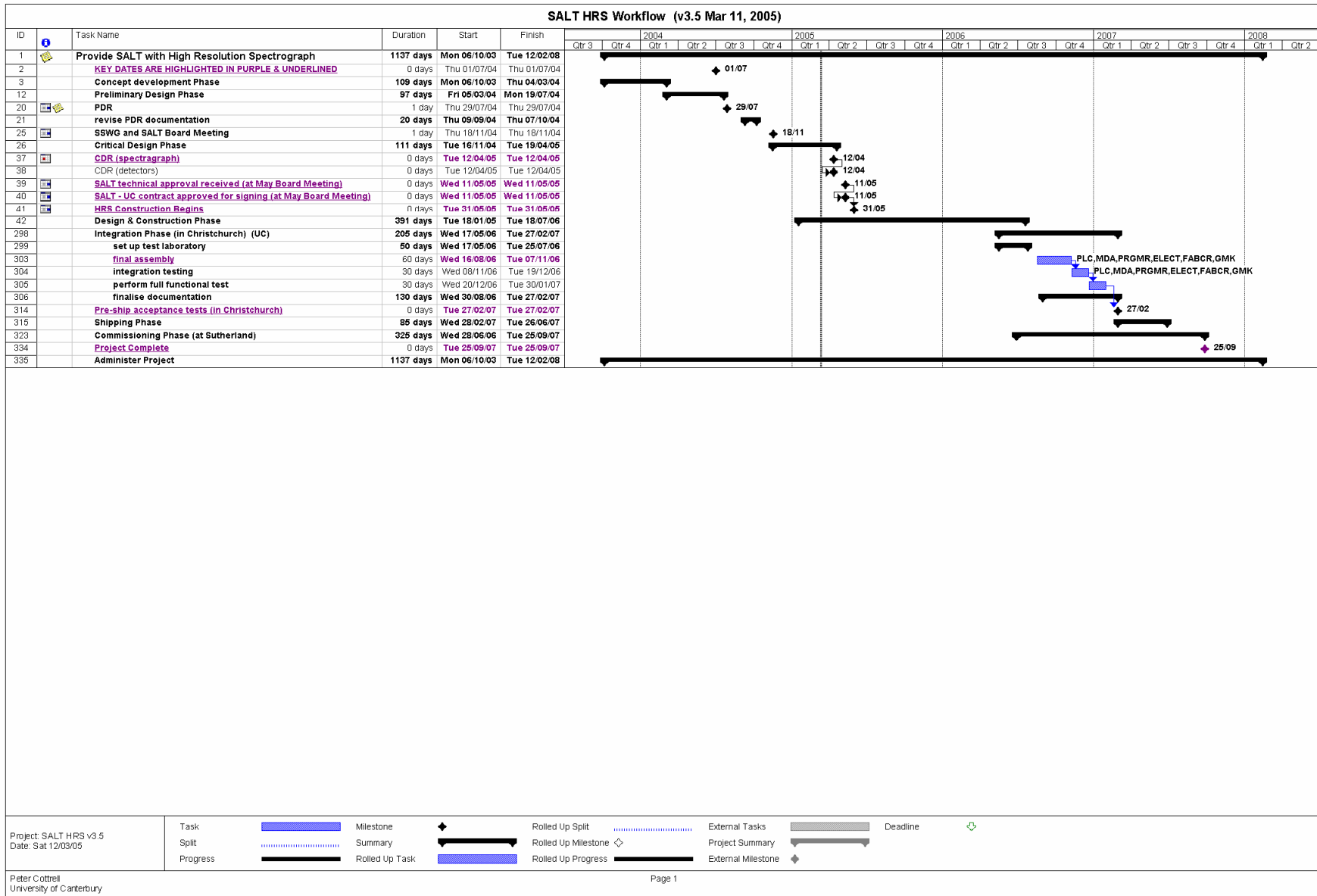


Figure 2: SALT HRS Schedule – Project High Level Overview

5 Optical Construction

There are a significant number of optical components in HRS. These are:

- 1 x spectrograph light input assembly
- 1 x collimator mirror
- 1 x échelle grating as a mosaic
- 2 x pupil mirrors
- 1 x dichroic mirror
- 2 x VPH gratings
- 2 x camera lens assemblies containing multiple elements
- 2 x CDD field flattening lenses (cryostat windows)

The view of the optical construction schedule is shown in Figure 3.

The supply of glass and construction of all optical components is expected to span approximately 12 months from the construction start (May 31, 2005). The exact order of manufacture of the optical elements has yet to be finalised, as this will rely on availability of suitable machines and personnel with the preferred sub-contractor for this work (KiwiStar Optics in Wellington, New Zealand). KiwiStar Optics is confident all items can be manufactured within this timeframe. A visit to KiwiStar Optics is planned as part of the CDR review process.

Although the supply of the échelle grating is currently on the project critical path, it is only just so, and is closely followed by the supply of the optics. A slight change in either delivery date during the project could see the situation reverse, but any flow-on impact of such a switch is anticipated to be minor.

6 Mechanical Construction Schedule

The HRS instrument is still physically large and heavy, albeit smaller than earlier designs. It will have a footprint approximately 4 metres by 2 metres and will weigh around 2000kg when completed. This means a number of special project planning considerations are being given to assist manufacture, transportation and on-going servicing once commissioning is complete.

The mechanical construction schedule involves a fairly steady workload, happening progressively from late 2005 through to mid 2006. Tasks in this sub-group remain well clear of the project's critical path and are not expected to generate any particular scheduling issue.

The view of the mechanical construction schedule is shown in Figure 4.



Figure 4: SALT HRS Mechanical Construction

7 Detector Subsystems Schedule

Originally it was planned to have the SALT HRS CCD detectors manufactured by the SAAO team in South Africa. However, the preferred contractor is now Spectral Instruments in the USA. Although this change of supplier results in both a reduced cost and earlier delivery time, the software interface to the Spectral Instrument CCD modules happens at a lower level (i.e. closer to the hardware) than that proposed by SAAO. The HRS team will undertake this additional work which has been factored into a slightly longer period for the building of the control system sub-system, but with the advantage that it can happen in parallel to the supply of the detector modules.

In order not to delay the assembly and testing of the overall spectrograph a COTS CCD system will be specified and purchased for testing purposes.

The schedule for the manufacture and delivery of these detectors is shown in Figure 5, along with the control system schedule.

8 Assembly, Integration and Testing Phases

The first assembly of HRS is anticipated to commence during the third quarter of 2006. It is anticipated that there will be a need to fine tune various mounting arrangements during this task, as until assembly is attempted for the first time it is difficult to be certain that such a large structure has been machined to the required precision.

The integration phase is shown in more detail in Figure 6. This will be a fairly critical time for the project. Even though all the individual subsystems will have been tested at this point, this integration phase will be first time all the components have been brought together.

A healthy period of time (around 14 weeks) has been allowed for the total process of final assembly, integration testing and for performing all functional tests in the clean room at Christchurch. All documentation will be finalised during this period to ensure it accurately reflects the “as built” status of the final instrument.

The project scientist will be required in Christchurch in early March 2007 to witness the pre-ship acceptance testing process, prior to dismantling and crating the instrument for shipping to South Africa.

9 Shipping

The shipping and commissioning phases are shown in Figure 7.

At this stage it is anticipated that the main SALT HRS structure will travel to South Africa by surface with the optical elements travelling in several consignments by air to minimise risk exposure.

The optical elements require quite a lot of handling, for instance:

- blanks being supplied to sub-contractor for figuring and testing;
- tested elements to coating supplier;
- transport to UC for first assembly into SALT HRS carcass;
- removal and crating for trip to Cape Town (optics probably by Airfreight);
- transport from Cape Town to Sutherland;
- final assembly in Spectrograph Room at SALT.

Careful attention is being paid to ensuring suitable mounting and packaging arrangements for the optical elements, including ensuring that all parties handling these elements on route are well aware of their cargo and the responsibility they are accepting.

Some of these areas are discussed in detail in 3200BP0019 Testing, Assembly and Commissioning Plan.

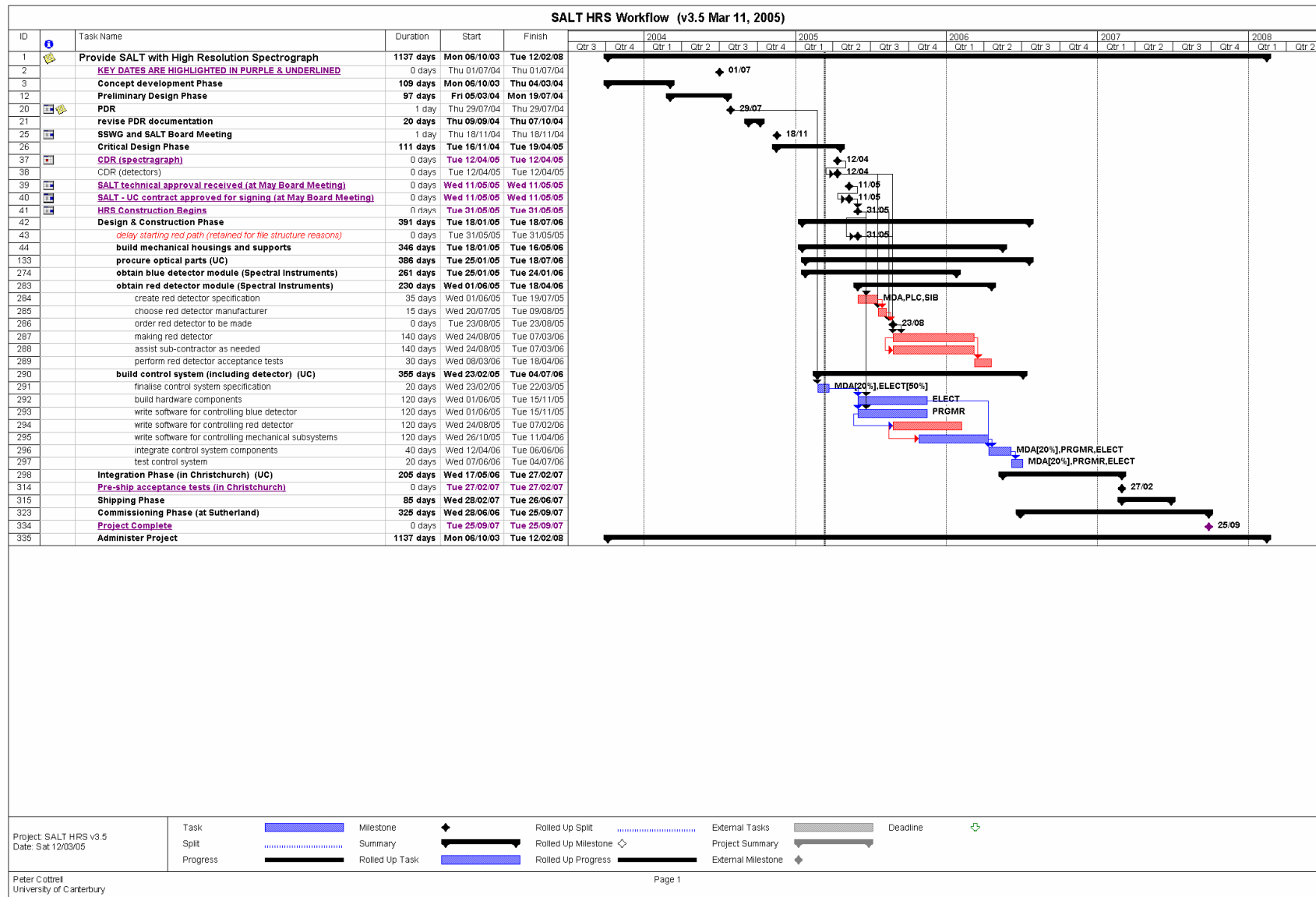


Figure 5: SALT HRS CCD Detector and Control System Schedule



Figure 6: SALT HRS Construction and Integration Phases

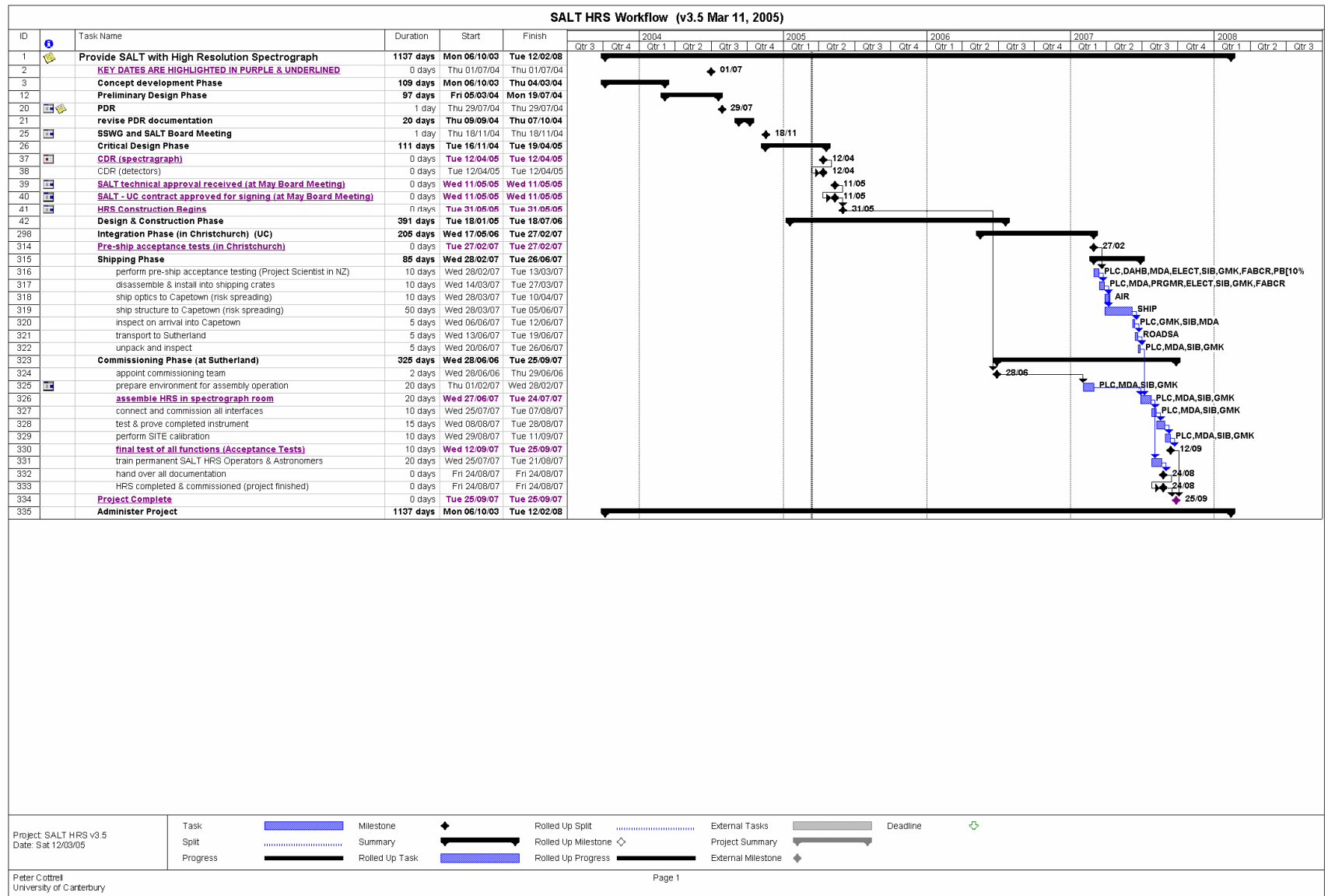


Figure 7: SALT HRS Shipping and Commissioning Phases

10 Commissioning Schedule

A generous time allowance (around 50 working days) has been made for commissioning this instrument once assembled in its final location. This includes some work that will need to be done ahead of time at Sutherland to prepare for the arrival of SALT HRS.

Since SALT HRS will be assembled on site, a suitable “clean room” environment will be required for this process. This will become a permanent part of the SALT facility, since any operation requiring the opening of SALT HRS will need to respect the on-going cleanliness the optics require.

Commissioning all interfaces, performing calibration measurements and training the permanent SALT HRS operators are also scheduled in this phase of the plan.

This commissioning phase is shown in Figure 7.

11 Other Schedule Issues

The plan has received much scrutiny over the period leading up to CDR. Project review meetings in the period between PDR and CDR have been held at least two weekly, and this frequency is anticipated to continue once formal approval is received to commence construction.

Once CDR is completed and the required SALT Board approvals are received, the project itself will be put under full change control. This includes the project schedule, the instrument design, and the construction budget. The baseline will be formally recorded and all deviations from this reported on in the quarterly project reports.

This plan has been prepared on the best available information available at this point in time.

12 Budget Issues

The detailed SALT HRS budget is presented as a series of inter-linked worksheets in 3200BP0022. All amounts are shown in nominal USA dollars as at March 2005.

The instrument construction budget is structured as follows:

- Summary Sheet
- Labor Calculation Sheets
- Capital Items Sheet
- Sub-Contractors Sheet
- Overhead & Contingency Calculation Sheet
- Travel & Accommodation Calculation Sheet
- Spending Profile Sheet
- Notes and Assumptions Sheet

As with the project schedule, the budget was modified to reflect the SALT Board request that both blue and red arms of the instrument be built together. (Previously, it has been structured so that the blue and red arms would be constructed separately, with the main structure and blue arms built first, and the red optics fitted at a future date to be decided.)

Currently, the budget for constructing SALT HRS is approximately \$USD 2.1m, made up as follows:

Budget Category	Total*	Major Items in Category	
		Item	Cost
Capital Items	\$395,430	Echelle gratings	\$231,000
		Dichroic	\$55,430
		VPH gratings	\$22,000
Subcontractors	\$882,468	CCD Detectors	\$316,650
		Optical Fabrication	\$306,310
		Glass	\$90,720
Labor	\$505,005		
Overheads	\$227,252		
Travel & Accommodation	\$89,400		
Project Support	\$23,300		
Total	\$2,122,854		

Contingency \$386,523

Total including Contingency \$2,509,377

* USD

The major items are identified for the Capital and Subcontractors categories. The distinction between these categories was helpful in earlier versions of this budget, but has eroded over the planning process. In essence, both categories result in the supply of the externally sourced components of the finished instrument.

Quotes have been updated for CDR. The US dollar has been moving recently which has altered the prices for some items not supplied from the USA but quoted in US dollars. This applies particularly to Labor and Optical Fabrication costs, where the NZD has appreciated against the USD by 5.6% since November 2004 and by 13% since the R4 PDR in July 2004.

The contingency has been calculated at 20% of the remaining portion of the project in the capital, subcontractors, labor, overheads and travel/accommodation categories.

The budget makes provision for insurance on items being shipped around, but does not currently have any allowance for duties or taxes as they may apply to the final instrument delivered into South Africa.

It is envisaged that the following items will be supplied under a supply contract established directly between SALT and the item supplier:

1. Echelle Grating
2. Dichroic
3. VPH Gratings
4. Optical Glass Blanks
5. Optical Fabrication
6. Image Slicers
7. CCD Detectors

The SALT HRS team in Christchurch will be SALT's agent for administering these contracts. This will include supplying the item specification, managing the contractor to ensure the item is delivered to schedule, and ensuring the acceptance test is carried out before advising SALT that it is in order to make final payments. The spending profile (discussed below) assumes up-front payments on items where these are reasonable and likely to be required.

13 Cash Flow Issues

The likely cash flow for the project has been estimated in some detail. This is shown on the "Spending Profile" sheet in the budget file document 3200BP0022.

The timing of the payments for each of the major items is using best available information as at March 2005. The likely cash flow requirement involved in the contracts directly between SALT and the major component suppliers has been estimated, along with the total SALT payments schedule. This has been done to aid SALT in planning its cash flow needs as this project progresses.

The quarterly reports on project progress will contain updated spending profile and cash flow requirement information, adjusted as contracts are negotiated and payment terms determined more closely. A deviation from the initial baseline forecast will also be included.