3200BP0021 Issue 2.2: SALT HRS Instrument Schedule and Budget Narrative

### Southern African Large Telescope High-Resolution Spectrograph

## SALT HRS

# 3200BP0021 Instrument Schedule and Budget Narrative

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> Issue 2.2 13 March 2005

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

## **Issue History**

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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 in 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

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	SALT HRS Workflow (v3.5 Mar 11, 2005)								
ID	6	Task Name	Duration	Start	Finish				
1	ě	Provide SALT with High Resolution Spectrograph	1137 days	Mon 06/10/03	Tue 12/02/08	urra urra urra urra urra urra urra urra			
2	· ·	KEY DATES ARE HIGHLIGHTED IN PURPLE & UNDERLINED	0 days	Thu 01/07/04	Thu 01/07/04	04 ♦ 01/07			
3		Concept development Phase	109 days	Mon 06/10/03	Thu 04/03/04				
12		Preliminary Design Phase	97 days	Fri 05/03/04	Mon 19/07/04				
20	•	PDR	1 day	Thu 29/07/04	Thu 29/07/04	04 <b>◆ 29/07</b>			
21		revise PDR documentation	20 days	Thu 09/09/04	Thu 07/10/04				
20		Critical Design Phase	111 days	Tue 16/11/04	Tue 19/04/05	55			
37		CDR (spectragraph)	0 days	Tue 12/04/05	Tue 12/04/05	→12/04			
38		CDR (detectors)	0 days	Tue 12/04/05	Tue 12/04/05	12/04			
39		SALT technical approval received (at May Board Meeting)	0 days	Wed 11/05/05	Wed 11/05/05	25 <b>→</b> _11/05			
40	11	SALT - UC contract approved for signing (at May Board Meeting)	0 days	Wed 11/05/05	Wed 11/05/05	D5 ↓ 11/05			
41		HRS Construction Begins	0 days	Tue 31/05/05	Tue 31/05/05	15 ¥ 31/05			
42		Design & Construction Phase	391 days	Tue 18/01/05	Tue 18/07/06				
298		Integration Phase (in Christchurch) (UC)	205 days	Wed 17/05/06	Tue 27/02/07				
299		set up test laboratory	50 days	Wed 17/05/06	Tue 25/07/06				
303		integration testing	30 days	Wed 08/11/06	Tue 19/12/06	16 C MDA PROMP CITY AND A CONTRACT OF CONTRACT.			
305		perform full functional test	30 days	Wed 20/12/06	Tue 30/01/07				
306		finalise documentation	130 days	Wed 30/08/06	Tue 27/02/07				
314		Pre-ship acceptance tests (in Christchurch)	0 days	Tue 27/02/07	Tue 27/02/07	27/02			
315		Shipping Phase	85 days	Wed 28/02/07	Tue 26/06/07				
323		Commissioning Phase (at Sutherland)	325 days	Wed 28/06/06	Tue 25/09/07	77			
334		Project Complete	0 days	Tue 25/09/07	Tue 25/09/07	77 ◆ 25/09			
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Date: S	at 12/03/	05 Split Summ	nary	-	Rolled U	d Up Milestone 💠 Project Summary			
		Progress Rolled	d Up Task		Rolled U	d Up Progress External Milestone 🔶			
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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.

	SALT HRS Workflow (v3.5 Mar 11, 2005)									
ID	_	Task Name	Duration	Start	Finish	2004 2005 2006 2007 2008				
1	0	Descride OALT with Link Description On extrements	1177 dava	Man 00/10/02	Tue 10/00/00	<u>atr3</u> <u>atr4</u> <u>atr1</u> <u>atr2</u>				
2	<b>\$</b>	Provide SALT with High Resolution Spectrograph	n days	Tbu 01/07/04	The 12/02/08	A 01/07				
- 2		Concept development Phase	109 days	Mon 06/10/03	Thu 04/03/04	• • • • • • • • • • • • • • • • • • •				
12		Preliminary Design Phase	97 days	Fri 05/03/04	Mon 19/07/04					
20	<b>••</b>	PDR	1 day	Thu 29/07/04	Thu 29/07/04	◆ 29/07				
21		revise PDR documentation	20 days	Thu 09/09/04	Thu 07/10/04					
25		SSWG and SALT Board Meeting	1 day	Thu 18/11/04	Thu 18/11/04	♦ 18/11				
26	-	Critical Design Phase	111 days	Tue 16/11/04	Tue 19/04/05					
37		CDR (spectragraph)	U days	Tue 12/04/05	Tue 12/04/05					
30	101	SALT technical approval received (at May Board Meeting)	0 uays 0 days	Wed 11/05/05	Med 11/05/05	▲ 1105				
40	11.1	SALT - UC contract approved for signing (at May Board Meeting)	0 days	Wed 11/05/05	Wed 11/05/05	11.05				
41		HRS Construction Begins	n days	Tue 31/05/05	Tue 31/05/05	31/05				
42		Design & Construction Phase	391 days	Tue 18/01/05	Tue 18/07/06					
43		delay starting red path (retained for file structure reasons)	0 days	Tue 31/05/05	Tue 31/05/05	₩ 31/05				
44		build mechanical housings and supports	346 days	Tue 18/01/05	Tue 16/05/06					
133		procure optical parts (UC)	386 days	Tue 25/01/05	Tue 18/07/06					
163		make input fold mirror (IRL)	141 davs	Tue 22/02/05	Tue 06/09/05					
169		make collimator mirror (M1) (IRL)	281 days	Tue 25/01/05	Tue 21/02/06					
177		obtain echelle gratings (Richardson)	356 days	Tue 08/03/05	Tue 18/07/06					
185		make blue pupil mirror (M2) (IRL)	281 days	Tue 25/01/05	Tue 21/02/06					
193		make blue camera fold mirror (fixed)	141 days	Tue 22/02/05	Tue 06/09/05					
197		make blue VPH grating (Wasatch)	171 days	Tue 08/03/05	Tue 01/11/05					
206		make blue camera lens elements (IRL)	331 days	Tue 08/02/05	Tue 16/05/06					
217		obtain dichroic splitter (Barr Associates)	172 days	Tue 01/03/05	Wed 26/10/05					
234		make red pupil mirror (M3) (IRL)	331 days	Tue 25/01/05	Tue 02/05/06					
242		make red camera fold mirror (fixed)	141 days	Tue 22/02/05	Tue 06/09/05					
246		make red VPH grating (Wasatch)	177 days	Tue 08/03/05	Wed 09/11/05					
255		make red camera lens elements (IRL)	366 days	Tue 08/02/05	Tue 04/07/06					
266		make red path field flattener (CCD cryostat window) (IRL)	113 days	Fri 11/03/05	Tue 16/08/05					
274		obtain blue detector module (Spectral Instruments)	261 days	Wed 01/06/05	Tue 18/04/06					
203		build control system (including detector) (UC)	355 days	Wed 23/02/05	Tue 04/07/06					
298		Integration Phase (in Christchurch) (UC)	205 days	Wed 17/05/06	Tue 27/02/07					
314		Pre-ship acceptance tests (in Christchurch)	0 days	Tue 27/02/07	Tue 27/02/07	▲ 27/02				
315		Shipping Phase	85 days	Wed 28/02/07	Tue 26/06/07					
323		Commissioning Phase (at Sutherland)	325 days	Wed 28/06/06	Tue 25/09/07					
334		Project Complete	U days	Tue 25/09/07	Tue 25/09/07	20/09				
335		Administer Project	1107 uays	Mon 08/10/03	Tue 12/02/08					
Project Date: S	SALT H	RS v3.5 Split Milesto	ne iry	* *	Rolled C	Jp Split External Tasks Deadline ↔				
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Figure 3: SALT HRS Optical Construction

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No.     O     No.		SALT HRS Workflow (v3.5 Mar 11, 2005)													
• Prevent But 7 with 1 got	ID	6	Task Name	Duration	Start	Finish		2004		2005	0**2 0**2 0	2006		2007	2008
	1	ě.	Provide SALT with High Resolution Spectrograph	1137 days	Mon 06/10/03	Tue 12/02/08	utra utra	utr 1	utr2   utr3   utr4	utr 1	utr2   utr3   u	tr 4 Utr 1	utr2   utr3   utr4	utri utri utri utri utri	
	2	۲ <u>ــــــــــــــــــــــــــــــــــــ</u>	KEY DATES ARE HIGHLIGHTED IN PURPLE & UNDERLINED	0 days	Thu 01/07/04	Thu 01/07/04			• 01/07						
	3	1	Concept development Phase	109 days	Mon 06/10/03	Thu 04/03/04		<b></b>							
Important	12	-	Preliminary Design Phase	97 days	Fri 05/03/04	Mon 19/07/04		-							
	20	<b>•••</b>	PDR revise PDR documentation	20 days	Thu 29/07/04	Thu 29/07/04			↓ 29/07						
	25		SSWG and SALT Board Meeting	1 day	Thu 18/11/04	Thu 18/11/04			<b>↓</b> 18	3/11					
	26	-	Critical Design Phase	111 days	Tue 16/11/04	Tue 19/04/05			÷		•				
Implementation       Imple	37		CDR (spectragraph)	0 days	Tue 12/04/05	Tue 12/04/05	]				12/04				
Term	38		CDR (detectors)	0 days	Tue 12/04/05	Tue 12/04/05					♦ 12/04				
	39		SALT technical approval received (at May Board Meeting)	0 days	Wed 11/05/05	Wed 11/05/05					▲ 11/05				
The step 1 is desident in the set of the set o	40		HRS Construction Begins	0 days	Tue 31/05/05	Tue 31/05/05					31/05				
etc.       the set of the state se	42	-	Design & Construction Phase	391 days	Tue 18/01/05	Tue 18/07/06				<b>+</b>		_			
41       0	43		delay starting red path (retained for file structure reasons)	0 days	Tue 31/05/05	Tue 31/05/05					▶♦ 31/05				
The set of th	44		build mechanical housings and supports	346 days	Tue 18/01/05	Tue 16/05/06				¥ I	CMAK				
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Production       Tate       Number of the specific scale speci	54		build external tank (UC)	141 days	Tue 12/04/05	Tue 25/10/05						- T			
Bit is constructive type register (V)       Lif 2 ger to tool tool tool tool tool tool tool	59	1	build light input housing (UC)	121 days	Tue 19/04/05	Tue 04/10/05					·				
1       build optical dimiter support (UC)       111 dip       111 dip<	63	1	construct light input sub-system (UC)	144.5 days	Thu 03/03/05	Wed 21/09/05				-					
Method Name And Na	71		build input fold mirror support (UC)	111 days	Tue 05/04/05	Tue 06/09/05				1					
Prime       Note:       Note: <td< td=""><td>/4</td><td></td><td>build collimator mirror (M1) support assembly (UC)</td><td>136 days</td><td>Tue 05/04/05</td><td>Tue 11/10/05</td><td></td><td></td><td></td><td>- I T</td><td></td><td></td><td></td><td></td><td></td></td<>	/4		build collimator mirror (M1) support assembly (UC)	136 days	Tue 05/04/05	Tue 11/10/05				- I T					
The status dation curve regular passed regular pas	87		build dichroic mirror support (UC)	91 days	Tue 05/04/05	Tue 09/08/05									
Number of the super transmise seeme (in hundow)         20 days         West 100/05         The Super seeme (in hundow)         20 days         West 100/05         The Super seeme (in hundow)         20 days         West 100/05         The Super seeme (in hundow)         20 days         West 100/05         The Super seeme (in hundow)         20 days         West 100/05         The Super seeme (in hundow)         20 days         West 100/05         The Super seeme (in hundow)         20 days         West 100/05         The Super seeme (in hundow)         20 days         West 100/05         The Super seeme (in hundow)         20 days         West 100/05         The Super seeme (in hundow)         20 days         West 200/05         The Super seeme (in hundow)         20 days         West 200/05         The Super seeme (in hundow)         20 days         West 200/05         The Super seeme (in hundow)         20 days         West 200/05         The Super seeme (in hundow)         20 days         West 200/05         The Super seeme (in hundow)         20 days         West 200/05         The Super seeme (in hundow)         20 days         West 200/05         The Super seeme (in hundow)         20 days         West 200/05         The Super seeme (in hundow)         20 days         West 200/05         The Super see seeme (in hundow)         20 days         West 200/05         West 200/05         West 200/05         West 200/05         West 200/05         We	88		finalise dichroic mirror support assembly design	10 days	Tue 05/04/05	Mon 18/04/05				1	· · ·				
Bit build build puil mirror (M3) support assembly (U0)         131 day         Tuo 604/000         Tuo 604/000           Bit build doue camera buelling (U0)         264 day         Tuo 604/000         Tuo 804/000         Tuo 804/000           Bit build doue camera buelling (U0)         264 day         Tuo 604/000         Tuo 804/000	89		build dichroic mirror support assembly (in-house)	20 days	Wed 13/07/05	Tue 09/08/05					- <b>1</b>				
91       build red spipilintrer (N)       14 days	90		build blue pupil mirror (M2) support assembly (UC)	131 days	Tue 05/04/05	Tue 04/10/05									
Implementation       Imple	97		build red pupil mirror (M3) support assembly (UC)	146 days	Tue 05/04/05	Tue 25/10/05									
Image: SALTING VIS       Tak       Mixed or mage: space spa	104		build blue camera housing (UC)	256 days	Tue 05/04/05	Tue 28/03/06					,				
131       procure optical parts (UV)       100 etain bite detact module (Spectral Instruments)       200 etain b	120		assemble mechanical sub-system (less cameras) (UC)	140 days	Wed 02/11/05	Tue 16/05/06				- IT			<u> </u>		
274       obtain vie decorp mulei (spectral instruments)       28 days       Tue 20108       Tue 20108 </td <td>133</td> <td></td> <td>procure optical parts (UC)</td> <td>386 days</td> <td>Tue 25/01/05</td> <td>Tue 18/07/06</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>_</td> <td></td> <td></td> <td></td>	133		procure optical parts (UC)	386 days	Tue 25/01/05	Tue 18/07/06						_			
283       obtain a detector madei (spectral instruments)       29 de ys       Wed 20.600       Tue 180.600         283       hudia dont system incluiding detector; (UC)       28 de ys       Wed 20.600       Tue 20.6070         283       noting phase       29 de ys       Wed 20.600       Tue 20.6070         283       commissioning Phase (attal in Dhrischurch)       29 de ys       Wed 20.600       Tue 20.6007         283       commissioning Phase (attal in Dhrischurch)       29 de ys       Wed 20.600       Tue 20.6007         283       commissioning Phase (attal in Dhrischurch)       29 de ys       Wed 20.600       Tue 20.6007         283       commissioning Phase (attal in Dhrischurch)       29 de ys       Wed 20.600       Tue 20.6007         283       commissioning Phase (attal in Dhrischurch)       20 de ys       Wed 20.600       Tue 20.6007         283       dominister Project       1197 de ys       Men 061001       Tue 12.62.00       Tue 20.6007         284       commissioning Phase (attal in Dhrischurch)       0 de ys       Partial Takis       Destine       0         284       commissioning Phase (attal in Dhrischurch)       Ride Up Phage (attal in Dhrischurch)       Partial Takis       Destine       0         284       commissina de tattal in Dhrischurch)       R	274		obtain blue detector module (Spectral Instruments)	261 days	Tue 25/01/05	Tue 24/01/06	]								
200         Duilo centrol system (including detector) (v)         200 detector)         200 detector) <td>283</td> <td></td> <td>obtain red detector module (Spectral Instruments)</td> <td>230 days</td> <td>Wed 01/06/05</td> <td>Tue 18/04/06</td> <td></td> <td></td> <td></td> <td></td> <td>-</td> <td></td> <td></td> <td></td> <td></td>	283		obtain red detector module (Spectral Instruments)	230 days	Wed 01/06/05	Tue 18/04/06					-				
141       Ptraching acceptance tasis (in Chritischurch)       0 days       Tue 20007       Tue 20007 <td>290</td> <td></td> <td>Integration Phase (in Christchurch) (UC)</td> <td>205 days</td> <td>Wed 23/02/05 Wed 17/05/06</td> <td>Tue 04/07/06</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>	290		Integration Phase (in Christchurch) (UC)	205 days	Wed 23/02/05 Wed 17/05/06	Tue 04/07/06									
315       Shupping Phase in the strukturianal in the strukturiana in the strukturianal in the strukturi the strukturianal in the strukturianal in the struktur	314		Pre-ship acceptance tests (in Christchurch)	0 days	Tue 27/02/07	Tue 27/02/07							•	27/02	
323         Commissioning Phas (at Sutherland)         325 day         Wed 28 00 for (395 Tus 28 00 fr)         Tus 28 00 fr           335         Administer Project         1137 days         Mon 06 (10.0)         Tus 12 02 08 <ul> <li>Tus 12 02 08</li> <li>Tus 12 08 08</li></ul>	315	1	Shipping Phase	85 days	Wed 28/02/07	Tue 26/06/07								÷	
334       Projekti Completiti       0 days       Tue 20007	323	]	Commissioning Phase (at Sutherland)	325 days	Wed 28/06/06	Tue 25/09/07	]						-		
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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.

			S	ALT HRS Workflow (v3.5 Mar 11, 2005)							
ID	Task Name	Duration Start	Finish	2004 2005 2006 2007 2008							
1	Provide SALT with High Resolution Spectrograph	1137 days Mon 06/10/	03 Tue 12/02/08	atrs atr4 atr1 atr2 atr3 atr4 atr1 atr2							
2	KEY DATES ARE HIGHLIGHTED IN PURPLE & UNDERLINED	0 days Thu 01/07/	04 Thu 01/07/04	↓ 01/07							
3	Concept development Phase	109 days Mon 06/10/	03 Thu 04/03/04								
12	Preliminary Design Phase	97 days Fri 05/03/	04 Mon 19/07/04								
20	PDR revise PDR documentation	1 day Thu 29/07/ 20 days Thu 09/09/	14 Thu 29/07/04								
25	SSWG and SALT Board Meeting	1 day Thu 18/11/	04 Thu 18/11/04								
26	Critical Design Phase	111 days Tue 16/11/	04 Tue 19/04/05								
37	CDR (spectragraph)	0 days Tue 12/04/	05 Tue 12/04/05	◆12/04							
38	CDR (detectors)	0 days Tue 12/04/	15 Tue 12/04/05								
40	SALT technical approval received (at May Board Meeting) SALT - UC contract approved for signing (at May Board Meeting)	0 days Wed 11/05/	05 Wed 11/05/05								
41	HRS Construction Begins	fi days Tue 31/05/	05 Tue 31/05/05	↓ <b>↓ ↓ ↓ ↓</b>							
42	Design & Construction Phase	391 days Tue 18/01/	05 Tue 18/07/06								
43	delay starting red path (retained for file structure reasons)	0 days Tue 31/05/	05 Tue 31/05/05	13105							
133	procure optical parts (UC)	346 days Tue 18/01/ 386 days Tue 25/01/	5 Tue 16/05/06								
274	obtain blue detector module (Spectral Instruments)	261 days Tue 25/01/	05 Tue 24/01/06								
283	obtain red detector module (Spectral Instruments)	230 days Wed 01/06/	05 Tue 18/04/06								
284	create red detector specification	35 days Wed 01/06	05 Tue 19/07/05	MDA,PLC,SIB							
285	choose red detector manufacturer	15 days Wed 20/07/	J5 Tue 09/08/05	2200							
200	making red detector	140 days Wed 24/08	15 Tue 23/08/05								
288	assist sub-contractor as needed	140 days Wed 24/08	05 Tue 07/03/06								
289	perform red detector acceptance tests	30 days Wed 08/03/	06 Tue 18/04/08								
290	build control system (including detector) (UC)	355 days Wed 23/02/	05 Tue 04/07/06								
291	build bardware components	120 days Wed 23/02/	15 Tue 15/11/05								
293	write software for controlling blue detector	120 days Wed 01/06	05 Tue 15/11/05	PRGMR							
294	write software for controlling red detector	120 days Wed 24/08/	05 Tue 07/02/08								
295	write software for controlling mechanical subsystems	120 days Wed 26/10	35 Tue 11/04/08								
296	test control system	20 days Wed 12/04/ 20 days Wed 07/06/	16 Tue 06/06/06	MDA20%J.PROM.ELECT							
298	Integration Phase (in Christchurch) (UC)	205 days Wed 17/05/	6 Tue 27/02/07								
314	Pre-ship acceptance tests (in Christchurch)	0 days Tue 27/02/	07 Tue 27/02/07	♦ 27/02							
315	Shipping Phase	85 days Wed 28/02/	07 Tue 26/06/07								
334	Project Complete	0 days Tue 25/09/	07 Tue 25/09/07	25/09							
335	Administer Project	1137 days Mon 06/10/	3 Tue 12/02/08								
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Figure 5: SALT HRS CCD Detector and Control System Schedule



Figure 6: SALT HRS Construction and Integration Phases

	SALT HRS Workflow (v3.5 Mar 11, 2005)										
ID	_	Task Name	Duration	Start	Finish	2004	. ,	2005	2006		2007 2008
1	0	Provide CALT with Link Decelution On other month	1197 days	Man 06/10/02	Tue 10/02/08	Qtr3 Qtr4 Qtr1 Qtr2	Qtr 3 Qtr 4	Qtr 1 Qtr 2	Qtr3 Qtr4 Qtr	1 Qtr2 Qtr3 Qtr4	Qtr1 Qtr2 Qtr3 Qtr4 Qtr1 Qtr2 Qtr3
2	<b>\$</b>	KEY DATES ARE HIGH IGHTED IN PURPLE & UNDERLINED	D days	Thu 01/07/04	Thu 01/07/04	•	▲ 01/07				•
3		Concept development Phase	109 days	Mon 06/10/03	Thu 04/03/04		•				
12		Preliminary Design Phase	97 days	Fri 05/03/04	Mon 19/07/04	· · · · · · · · · · · · · · · · · · ·					
20	💷 终	PDR	1 day	Thu 29/07/04	Thu 29/07/04		29/07				
21		revise PDR documentation	20 days	Thu 09/09/04	Thu 07/10/04						
25		SSWG and SALT Board Meeting	1 day	Thu 18/11/04	Thu 18/11/04		♦ 18/	/11			
26	<b>1</b>	Critical Design Phase	111 days	Tue 16/11/04	Tue 19/04/05		-	12/04			
38		CDR (detectors)	0 days	Tue 12/04/05	Tue 12/04/05			12/04			
39		SALT technical approval received (at May Board Meeting)	0 days	Wed 11/05/05	Wed 11/05/05			▲,11/0	5		
40	11	SALT - UC contract approved for signing (at May Board Meeting)	0 days	Wed 11/05/05	Wed 11/05/05			<b>11/0</b>	5		
41		HRS Construction Begins	0 days	Tue 31/05/05	Tue 31/05/05			<b>X</b> 31	/05		
42		Design & Construction Phase	391 days	Tue 18/01/05	Tue 18/07/06			-			
298		Integration Phase (in Christchurch) (UC)	205 days	Wed 17/05/06	Tue 27/02/07						4 27/02
314		Chinning Phase	95 days	Wed 28/02/07	Tue 26/06/07						2//02
316		perform pre-ship acceptance testing (Project Scientist in NZ)	10 days	Wed 28/02/07	Tue 13/03/07						PLC.DAHB.MDA.ELECT.SIB.GMK.FABCR.PB(10%
317		disassemble & install into shipping crates	10 davs	Wed 14/03/07	Tue 27/03/07						PLC,MDA,PRGMR,ELECT,SIB,GMK,FABCR
318		ship optics to Capetown (risk spreading)	10 days	Wed 28/03/07	Tue 10/04/07	1					AIR
319		ship structure to Capetown (risk spreading)	50 days	Wed 28/03/07	Tue 05/06/07						SHIP
320		inspect on arrival into Capetown	5 days	Wed 06/06/07	Tue 12/06/07						PLC,GMK,SIB,MDA
321		transport to Sutherland	5 days	Wed 13/06/07	Tue 19/06/07						
322		Commissioning Phase (at Sutherland)	325 days	Wed 20/06/07	Tue 25/06/07						PLC, MDA, SIB, GMK
324		appoint commissioning trase (at Sathernard)	2 days	Wed 28/06/06	Thu 29/06/06					28/06	
325	11	prepare environment for assembly operation	20 days	Thu 01/02/07	Wed 28/02/07					•	
326	_	assemble HRS in spectrograph room	20 days	Wed 27/06/07	Tue 24/07/07	1					PLC,MDA,SIB,GMK
327		connect and commission all interfaces	10 days	Wed 25/07/07	Tue 07/08/07						PLC,MDA,SIB,GMK
328		test & prove completed instrument	15 days	Wed 08/08/07	Tue 28/08/07						▶ <u>•</u>
329		perform SITE calibration	10 days	Wed 29/08/07	Tue 11/09/07						PLC,MDA,SIB,GMK
330		train nermanent SALT HDS Operators & Astronomers	10 days 20 days	Wed 12/09/07	Tue 25/09/07						
332		band over all documentation	0 days	Fri 24/08/07	Eri 24/08/07						24/08
333		HRS completed & commissioned (project finished)	0 days	Fri 24/08/07	Fri 24/08/07						24/08
334		Project Complete	0 days	Tue 25/09/07	Tue 25/09/07	1					25/09
335		Administer Project	1137 days	Mon 06/10/03	Tue 12/02/08						
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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:

Pudget Category	Total*	Major Items in Category				
buuget Category	Totar	Item	Cost			
		Echelle gratings	\$231,000			
Capital Items	\$395,430	Dichroic	\$55,430			
		VPH gratings	\$22,000			
		CCD Detectors	\$316,650			
Subcontractors	\$882,468	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.