SOUTHERN AFRICAN LARGE TELESCOPE

High Resolution Spectrograph

CRITICAL DESIGN REVIEW

11 – 14 April 2005

University of Canterbury

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SALT Project Scientist

At the time of the issuing of this document, the following draft agenda was provided by the Peter Cottrell, the HRS PI:

Agenda

Monday, April 11
8.30am: Meet at UC for initial briefing
9.30am: To airport for trip to IRL, Wellington (45 minute flight)
12.30pm: IRL: tour of facilities, discussion of capabilities, etc
evening: Return to Christchurch

Tuesday, April 12
8.30am - 6pm CDR (details later)

Wednesday, April 13
8.30am - 7pm: Day trip to Mt John Observatory (3 hour drive each way), view facilities, particularly HERCULES, 1m telescope and other facilities built in-house at UC.

Thursday, April 14
8.30 - 11am: Reviewers report back and SALT HRS team response - alternatively this could be arranged on the Wednesday afternoon/evening

Reviewers

Name	*Role*	*Name*	*Role*
Gordon Bromage	SSWG: UK	Wolfram Kollatschny	SSWG: Göttingen
David Buckley	Project Scientist	Phillip MacQueen	SSWG: HET
Hans Dekker	External Reviewer	Blair Savage	SSWG: Wisconsin
Bernard Delabre	External Reviewer	Steve Shectman	External Reviewer
		David Walker	External Reviewer

List of downloadable PDR documents

The Critical Design Review documentation is available at:

http://www2.phys.canterbury.ac.nz/~mda45/CDR

The documents can be downloaded individually, or as zipped files.

Requirements for SALT Instruments

In order to assist instrument PIs in addressing the needs or requirements of SALT instruments, the Project Scientist has assisted the PI in writing an Instrument Statement of Work (SOW) document, which is one of the downloadable CDR documents. This document outlines the work to be carried out in building a SALT science instrument plus managerial requirements, including directives from the SALT Project. In this respect the SALT Board has delegated oversight responsibility to the SALT Project Scientist. The SOW provides a framework to ensure seamless integration of an instrument with SALT and to minimize possible short-falls in terms of instrument capability, costing and delivery. They cover the design phases, project planning, scheduling, fabrication, testing, delivery and commissioning of a SALT science instrument. In addition, they list the required associated deliverables, like documentation, spares, test equipment, mounting equipment and any other items in accordance with the SOW.

Reviewers are asked to consider whether the CDR documentation provided by the PI adequately covers all of the requirements as stated in the SOW. The relevant parts of the SOW are repeated below.

General requirements at instrument Critical Design Review

The following are selected descriptions of what is expected at CDR, and can be found in the instrument SOW:

(a) The PI shall prepare all documentation required to complete the detailed design of SALT HRS based upon the FPRD, the OCDD, the Preliminary Design Documentation and the requirements of the SOW.

(b) The completed Critical Design Documentation placed on the SALT Project website shall contain all aspects included in the Preliminary Design Documentation, modified as a result of the Preliminary Design Review and additional design efforts, and should also contain:

I. SALT HRS performance predictions;
II. a review of SALT HRS safety aspects;
III. a schedule for fabrication, assembly, test, and shipment of SALT HRS;
IV. scaled drawings showing each and every item, component, subassembly, assembly, item of equipment, and subsystem of SALT HRS in the “as finished” condition with all applicable dimensions, material designations, and specifications;
V. engineering calculations and analyses adequate to demonstrate that all requirements of the FPRD will be met;
VI. models of SALT HRS adequate to demonstrate that all requirements of the FPRD will be met;
VII. a means for handling SALT HRS;
VIII. final versions of all ICD’s;
IX. finite element analyses (FEA) of critical parts of SALT HRS (e.g. supporting structures). Any FEA models should be compatible with a finite element package mutually agreeable to the SALT Project, PS and PI. In the event that the SALT Project considers calculations and analyses to be inadequate, the PS may request that the PI perform further calculations and analyses to ensure that the requirements in the FPRD are met. The PS will assess the risk if the PI declines to pursue these analyses and report in writing to the SSWG and SALT Board.

(c) All Design Documentation shall:

I. have drawings generated in (or be transferable to) Mechanical Desktop 6, IGES, STEP, or a similar mutually agreeable format, or later in native (DWG) file format;
II. have their drawings organized by key SALT HRS subsystem (SALT3200), so that drawings related to each key subsystem are grouped together to assist in maintenance and operation of SALT HRS;
III. have their textual documents generated in MS-Word and/or PDF format; and
IV. have a prominent space within the title block on each drawing for a unique drawing number to be assigned by the SALT Project, which should be placed on each such drawing by PI as directed by PS near the completion of the Design Documentation effort.

(d) The PI shall conduct a safety review of the design of SALT HRS, as it relates to safety in installation, maintenance, repair and operation of SALT HRS, on a date to be specified by the PS. This safety review of the Design Documentation should determine compliance with all appropriate safety regulations then in effect at SITE. The SALT Project will assist the PI in determining what safety regulations are in effect at SITE. The review should include assessing risk to personnel and hardware during normal operations, maintenance operations, transportation, handling and while being subjected to the environments specified in the FPRD. Subsequent to the review, the PI shall prepare a written report detailing any safety problems inherent in the designs as represented in the Design Documentation, and this report shall be presented to the PS at the Critical Design Review. In the event that the SALT Project determines that any of the Design Documentation is inadequate with respect to safety issues, the PS may require the PI to promptly revise such Design Documentation.

(e) The Critical Design Documentation shall be completed and placed on the SALT Project website by the date specified in the Work Scope. The PS may provide the PI with a list of suggested changes to be made to the Design Documentation (consistent with the intent of this SOW) within two weeks after this date. The PI should incorporate changes that it agrees to in the Critical Design Documentation, and place the revised documents on the SALT Project website at least two weeks prior to the date specified by the Work Scope for the Critical Design Review. The PS will assess the risk if the PI declines to make some changes and report in writing to the SALT Board and SSWG.

Critical Design Review Meeting

(a) The PS will call and conduct a Critical Design Review of the Critical Design Documentation near the date specified in the Work Scope. Such date should not be less than three weeks after the date the Design Documentation is submitted. The Critical Design Review should ideally be held at the PI's institution. Appropriate representatives of the PI and its contractors should present the design at the review.

(b) The PS may request changes in the Design Documentation, as well as the design approach, that arise following comments received at the Critical Design Review and that are consistent with the FPRD. Changes declined by the PI will be noted by the PS and duly reported to the SALT Board and SSWG, along with an assessment by the PS of the likely impact on instrument scientific and operational performance, and on the likely delivery date. The PS will work with the PI to ensure that this report will present all viewpoints.

(c) The following items must be addressed in the Design Documentation for the Critical Design Review:

I. Safety Review
a.) Measures for avoidance of electrical shock, explosions, body parts getting pinched by moving parts on the outside SALT HRS, handling fixtures, vacuum.

II. Optical Design
a.) Ray trace of all optics, showing spot diagrams against the pixel box or Airy disk for different field angles. This must be repeated for each configuration, including any entrance windows.

b.) Predicted encircled energy (EE50 and EE80) and RMS spot radii of images, both as functions of wavelength and field angle. The effects of tolerancing errors in positioning of optical elements on these results should be discussed.

c.) Predicted instrumental throughputs for all expected observing modes, both before and after the detector DQE is taken into account. Slit, aperture or optical fibre losses should also be factored into throughput estimates, assuming several different seeing scenarios. These should be at least for the following seeing FWHMs: <0.5, 1.0, 2.0 and 3.0 arcsec.

d.) Stray and scattered light analysis (including ghosts) in all modes. Indicate through use of appropriate modelling, or other software tools, for a given ensemble of rays entering SALT HRS, where the light ends up and where the major problems are.

e.) Complete baffling design to reduce stray light.

f.) Alignment tolerances for all optical elements.

g.) Opto-mechanical tolerances for all mechanisms in all modes.

h.) Discuss any mitigation against optics being exposed to a hostile environment (e.g. dust, moisture, glycol leaks, etc).

i.) Optical mounting and alignment plan.

j.) Assessment of manufacturing risks arising from discussions with potential vendors.

III. Mechanical Design

a.) Enumeration and description of all major components and/or sub-systems, including mass estimates where appropriate.

b.) Assessment of the opto-mechanical tolerances (in previous section) given by the optical designer and any derived mechanical requirements that they imply (e.g. tolerances on lens cells).

c.) Assembly drawings of all mechanisms, and analysis to show they meet the opto-mechanical tolerances.

d.) Flexure and vibration analysis of SALT HRS as a whole, and major sub-systems (including the detector/dewar with respect to focal plane) with electronics cabinets.

e.) For cryogenic components, thermal cold strap design for distributing cooler capacity to mechanisms and optics; each strap length, number of strands, and size of strands should be specified.

f.) For cryogenic components, steady-state FEA thermal analysis showing temperature distribution at the end of the cool-down cycle; include all shields, all strapping in the Critical Design, and lump masses for mechanisms.

g.) For cryogenic components, cool-down analysis incorporating the cooler capacity as a function of temperature, strap capacity, shields, and other items. The model should be adequately detailed to give the prediction a maximum error of 10%.

h.) All fabrication drawings complete to a standard TBD.

i.) Detailed instrument mass estimate for each mechanism and structure, including the electronics cabinets. Indicate mass and location of any ballast needed to meet the mass and CG requirements.

j.) Show the complete instrument, with electronics and ballast mounted in some sort of structure.

k.) As an Appendix, generate an error budget showing how opto-mechanical errors are distributed across the instrument and lead to a value that is within the overall error budget allocation for SALT HRS in the SALT environment.

l.) As an Appendix, or a separate document, fabrication drawings of every part and a drawing tree showing the hierarchy of drawings. This does not necessarily have to be duplicated for all reviewers, but should be available for general perusal at PDR. All drawings shall have SALT-approved drawing numbers in each title block.

IV. Electronics Design

a.) System overview of the instrument from the electronics perspective.

b.) Enumeration of all mechanisms and electronic subsystems with a described approach to each of them (e.g. commercial off-the-shelf (COTS), custom, hybrid, etc.)
c.) Details of each major subsystem. For modification of existing electronics, list each modification to be made.
d.) Listing of all specification sheets for COTS equipment and components, which shall be gathered together in an Appendix.
e.) Include, as an Appendix, detailed circuit schematics for all custom hardware.
f.) Layouts of the electronics cabinets showing where each piece of electronics will go. Include everything, including power supplies and SALT-furnished LAN hubs and other equipment. Show every board in each major subsystem, so the review committee can verify that all the interface boards are accounted for.
g.) Detailed power consumption calculation for each cabinet, including power for each board, if possible.
h.) Overall mass estimate for each cabinet.

V. Software
a.) Review the requirements – items to be controlled, major pieces of software to be developed.
b.) Overall description of how the approach meets the SALT Software Requirements, TCS architecture and software design philosophy. Address whether LabVIEW will be the instrument control software, and if not, a description of how the software will meet the requirements.
c.) Software design overview, giving each major item of software and how it fits into the grand scheme of things (e.g. a data flow diagram, hierarchical chart, LabVIEW Virtual Instrument (VI), or some other graphical representation) and interfaces with other telescope sub-systems (e.g. the TCS).
d.) Describe for each VI, the function it performs, total lines of code, or equivalent, to develop, and degree of difficulty of the code (give % of LabVIEW code, % of C code in DLL/shared libraries, etc.).
e.) Review the tools needed to do the development, prototyping and testing, and indicate which are already obtained and those still needing to be procured.
f.) As an Appendix, include a compliance list with all software requirements (e.g. SALT Software Standard).

VI. Project Management
a.) Review the overall design, fabrication, assembly, integration and test schedule, including the dates for remaining project milestones listed in the SOW and contracts, and dates for obtaining any remaining SALT/other furnished equipment or major purchased items (e.g. cryocoolers, detector arrays, array controllers, etc.).
b.) Show, as an Appendix, a complete bottom-up schedule that includes all the remaining tasks discussed in the earlier presentations. For example, each major piece of software should be listed, each electronics custom board, each major mechanical assembly, optics fabrication and testing, etc.
c.) Show a detailed bottom-up cost estimate based on the above detailed schedule.
d.) Supply a complete list of recommended spares.

Completion of Critical Design Review

Following the CDR presentations by the HRS team, it is anticipated that the reviewers will meet together to discuss the CDR documentation and make a list of recommendations for consideration by the PI. This is expected to occur on Thursday morning. Following the CDR meeting, the SALT Project Scientist will issue his report, within 3 weeks of the review.