The Cassegrain ADC for Keck I
Detailed Design Review Process and Charter
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INTRODUCTION

The Technical Facilities group of the UCO/Lick Observatory located on the campus of the University of California Santa Cruz (UCSC) is designing a Cassegrain Atmospheric Dispersion Corrector (ADC) for the Keck I telescope at the W.M. Keck Observatory (Keck) operated by the California Association for Research in Astronomy (CARA).

The Cassegrain ADC project is currently in the detailed design phase and this document describes the Detailed Design Review (DDR) process, the charter for the DDR committee and the DDR success criteria.

REVIEW PROCESS

Overview

The Cassegrain ADC is a comparatively simple instrument. The design has received intensive scrutiny in three reviews consisting of the conceptual design review, a delta conceptual design review and a preliminary design review (PDR). The optical performance of the proposed design has been thoroughly studied and the optics are now being fabricated. Because of the level of the reviews to date, and given the maturity of the design, the proposed process for the DDR is different from what might be undertaken for a more complex instrument.

The proposed DDR process consists of five steps:

1. The Cassegrain ADC design team submits the documentation items listed in Appendix A for review by CARA staff.

2. The CARA staff redlines drawings as required and prepares questions for the Cassegrain ADC design team.

3. The CARA staff and key members of the Cassegrain ADC design team meet to discuss the drawings and answer CARA's questions.

4. The design team and CARA co-author a detailed design report according to the outline given in Appendix B of this document.

5. A meeting via teleconference is held with a DDR committee (the membership of this committee will be substantially the same as the committee for the PDR) to discuss the detailed design report.

Documentation

The primary documentation for the DDR will be a detailed design report that consists of the sections identified in Appendix B of this document, "Cassegrain ADC Detailed Design Report Outline".

Committee

The DDR committee will use the detailed design report as the basis for its evaluation, which will take place in a one-half day teleconference meeting on May 21, 2004. The DDR committee will consist of 6 invited reviewers including 2 Keck staff members who will be personnel who are not directly involved in the CARA portion of the Cassegrain ADC project. The chair of the review committee will be one of the 4 external reviewers.

Objectives

The objective of detail design is to complete the design, fabrication and assembly documentation for the system and all components and show that the final design demonstrates compliance with all specifications and applicable standards.

The objective of the DDR is to evaluate the work done in the detailed design phase, and to determine the completeness of the design package and the readiness of the design to proceed to the full scale development phase. The DDR will also examine the schedule and budget proposed for completion of the instrument.

Review Process Guidelines

The charter for the detailed design review has been drafted by CARA in collaboration with the Cassegrain ADC design team. This charter clearly identifies all of the topics that the design team is expected to address for the review. In order to make the review as effective as possible we have established two guidelines for the DDR process:

1. The review will be made on the basis of a written report. This report should include all of the materials that the design team and CARA believe are appropriate to address the topics in the charter for the review committee. No additional materials should be presented at the review except for those needed to answer questions raised by the review committee prior to the review meeting.

2. The review agenda will include time for a brief presentation that summarizes the report, but it will be assumed that all of the attendees have reviewed the report in detail prior to the meeting.

COMMITTEE CHARTER

The review committee is asked to do the following:

1. Read the detailed design report prior to the review meeting.

2. Submit questions to the Cassegrain ADC design team prior to the review meeting as required for clarification or to obtain further information.

3. Consider the answers to any questions asked in item 2.

4. Hold a one-half day DDR teleconference meeting with the Cassegrain ADC design team to discuss the detailed design report and the questions asked in the review charter.

5. Hold an "executive session" at the end of the DDR meeting and finalize the committee's comments and recommendations consistent with item 7.

6. At the conclusion of the DDR meeting provide an oral summary of the review outcomes to the CARA instrument program manager, the Cassegrain ADC principal investigator and the Cassegrain ADC design team.

7. The CARA instrument program manager will draft the minutes of the meeting and a brief written report summarizing the committee's comments and provide them to the committee members for review and approval. The first draft of this report will be issued within 7 days of the meeting and the final version of the report will be issued within 21 days of the review meeting. This report will include the following:

    a. A summary of the review meeting's discussions

    b. Answers (and comments or recommendations) to these questions regarding technical and programmatic issues:

        i. Are all of the open issues from the PDR resolved?

        ii. Do the final specifications of the Cassegrain ADC meet the science requirements?

        iii. Do the final specifications for the Cassegrain ADC meet the observatory requirements?

        iv. Does the proposed design present any features that raise concern for maintainability and reliability?

v. What is the likelihood of success in performance, schedule and budget terms?

vi. Are there any other risks that should be considered in the continuation of the development plan?

8. The preliminary and final reports of the DDR committee will be delivered to the Keck Observatory Director.

SCHEDULE

The following timetable is proposed for this review process:

Date	Description
May 4 – 6, 2004	CARA staff and key members of the Cassegrain ADC design team meet
May 12, 2004	Detailed design report released
May 21, 2004	DDR telecon

SUCCESS CRITERIA

Success for a detailed design review means that the detailed design and final specifications presented in the report are accepted as meeting the science requirements and observatory requirements for the instrument, and that the remaining work to complete the instrument can be accomplished in a timely manner consistent with the overall project budget.

Specific success criteria for the detailed design review consist of the following:

- The established project scope reflects a reasonable balance of performance and cost
- The detailed design for the instrument is complete and the project is ready to proceed to the full scale development phase
- The final specifications are complete and consistent with the science requirements
- The final specifications are acceptable to the observatory and consistent with the observatory requirements as established in the requirements document and verified by the compliance matrix
- The cost to complete has been established consistent with the project budget
- No known performance, cost and schedule risks remain
- The interface control document for the instrument is complete and consistent with the interface requirements for the proposed design
- The observatory's work plan for the implementation of the ICD is complete

ISSUES RAISED IN THE PDR REPORT

The PDR report made a number of comments and recommendations regarding the Cassegrain ADC. Several of these are found in the body of the report. In addition a list of points to be addressed was included in the conclusions section of the PDR report.

Mechanical Design

Gravity acting on the prism cells as the telescope elevation changes will cause the prism cells to place a moment on the lead screw via the nut. The deflection produced is minimal as the lead screws are 25 mm in diameter. Cyclic loading due to the deflection is well below the endurance limit and the estimated life of the nut and bearing is not impacted. The end of each lead screw is turned down to a shaft, which passes through two bearings, so eccentric motion of the shaft end is not expected, but this will be reviewed in the detail design phase.

Stress Induced Birefringence

Stress induced birefringence may have an impact on precision polarimetry, Jacques Beckers recommends that the ADC design team contact Keller at the National Solar Observatory for comments on this issue. Christoph Keller is evaluating these effects for the LADC design for the LBT. In lieu of other information the best recommendation is that the ADC not be used when precision polarimetric observations are done with LRIS.

Maintainability and Reliability

The PDR charter asked a number of specific questions about the Cassegrain ADC. Question 6 was as follows:

6. Does the proposed design present any features that raise concern for maintainability and reliability?

The committee answered with the following concerns:

Answer: Yes, in two areas. First, the design should address the possibility of dust ingress to the second prism upper surface when the telescope is at zenith with the ADC installed. An effort should be made to minimize the paths for dust to reach that second prism surface. Second, the durability and aging characteristics of the Sol-gel coating should be investigated and discussed with the observatory along with cleaning procedures and requirements.

Conclusions Section – Points to be addressed in Detailed Design

The following specific points were given with the recommendation that each should be addressed in the detailed design phase activities (the numbering matches that given on pages 9 and 10 of the PDR report):

2. A detailed assembly and alignment procedure for the ADC should be developed during the detail design phase.

4. Additional attention should be given to characterizing the coatings and confirming the transmission that will be achieved. In particular test coatings should be done to confirm the transmission and to evaluate compatibility with various cleaning procedures.

5. The field flattener from the original HIRES dewar should be removed after the upgrade is complete and sent to Livermore for measurement of transmission. The original and new transmission curves can then be compared to look for aging effects. Other groups should also be contacted for information about coating durability and aging effects.

6. The effect of the ADC should be evaluated in terms of the acceptable tolerances for pointing and focusing accuracy.

7. Any software GUI designs required by the ADC should be defined in the detail design phase.

Note that the first portion of item 5, measuring of the old HIRES field flattener cannot be accomplished since the HIRES upgrade is not yet complete.

APPENDIX A: CASSEGRAIN ADC DETAILED DESIGN DOCUMENTATION DELIVERABLES

The deliverables for the Cassegrain ADC Detailed Design phase consist of the following:

1. Complete optical fabrication drawings
2. Results of coating tests
3. A description of the effect of the ADC on pointing and focusing including quantitative data
4. Complete mechanical fabrication drawings
5. Mechanical design description
6. Complete electronics design drawings
7. Electronics design description
8. Interconnection list including connector types and pinouts
9. Complete bill of materials
10. Software design description including GUI designs
11. Assembly and alignment procedure
12. Project plan, schedule and budget to completion
13. Configuration control plan
14. Final specifications
15. Updated compliance matrix
16. Draft test plan

APPENDIX B: CASSEGRAIN ADC DETAILED DESIGN REPORT OUTLINE

The Cassegrain ADC Detailed Design Report outline, in draft form, is as follows:

1. Summary
2. Introduction
3. Specifications and Requirements
    - 3.2 Final Instrument Specifications
    - 3.3 Compliance Matrix for Requirements

4. Detailed Design
    - 4.1 Optical Design
        - 4.1.1 Design summary
        - 4.1.2 Coating test results
        - 4.1.3 Effect of the ADC on pointing and focusing
    - 4.2 Mechanical Design
        - 4.2.1 Design summary
        - 4.2.2 Assembly and alignment procedure
    - 4.3 Electrical Design
        - 4.3.1 Design summary
        - 4.3.2 Interconnection list
    - 4.4 Software
        - 4.4.1 Design summary
        - 4.4.2 Keyword definitions
        - 4.4.3 GUI designs
    - 4.5 Interface with the K1 Telescope and CARA facilities

5. Project Schedule to Completion
6. Project Budget to Completion
7. Full Scale Development and Commissioning Work Plan
8. Observatory ICD Implementation Plan
9. Detailed Design Report Revision History
10. References