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Dr. Gregory Fahlman
Director General
NRC Herzberg Institute of Astrophysics
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Dear Dr. Fahlman,

The EVLA WIDAR Correlator Critical Design Review was held in Socorro, NM, on December 2-3. Overall, the committee was impressed by the design, the magnitude of the engineering effort encompassing that design, and the high level of technical competence shown by the design team. Also significant was the thought given to issues of manufacturability, reliability, and long-term maintainability.

The following charges were addressed to the review committee by the Director of DRAO and WIDAR project manager, Sean Dougherty. Our responses follow each specific charge. In summary, though, the committee recommends that the station and baseline boards both be released for full scale production, contingent upon a satisfactory resolution of the two issues called out in item 2 below.

Charge to the Review Committee

1. Does the EVLA Correlator implementation meet the formal requirements as defined in the EVLA Project Book, Chapter 8, version 2007-Aug-23? If not, what are the specific requirements that have not been met or demonstrated, and are there specific recommendations for action before proceeding with full production?

The committee finds that the specifications are met in all respects, other than the phased array mode. This mode has not yet been implemented, but it is expected to be implemented in FPGA code on the baseline boards. In the event that this proves unfeasible, a new board would be daisy-chained to the baseline board. In any event, the design for the baseline board would not be affected.

2. *Have sufficient tests of the Beta prototypes been performed to establish, to a high certainty, that full production units can be successfully manufactured? If not, what are the specific recommendations and work that should be done before proceeding with full production?*

The hardware has been extensively tested with artificial test vectors, in order to validate the correctness of the digital logic. In addition, substantial on-the-sky testing has been

performed with 4 EVLA antennas, and the results were presented to the committee. Such testing has the capability of showing up systemic problems that would not be revealed by the purely digital testing. No such problems were revealed.

With one exception, we feel that sufficient testing has already been done. That exception is the desirability of testing multiple baseline boards, which has not been done yet due to a lack of boards with which to test. We note that such (multiple board) testing of the station boards proved critical for revealing certain power supply issues. **Now that baseline boards are available in the necessary quantity, it would be prudent to delay production until testing can be performed on a larger suite of prototype boards, and we recommend that this be done.**

Pursuant to the above-mentioned power supply issues, **we recommend that full production of boards commence only after power supply module failures and power-related FPGA deconfiguration are completely understood.** There is a low, but non-negligible possibility that the power supply board problems are related to the board design. A few weeks of careful analysis should be sufficient to thoroughly understand these failures, and assess their implications.

3. *Does the design and implementation of the correlator meet acceptable reliability, redundancy, and maintenance requirements?*

Yes. The system has been designed to adhere to best practices used in the telecom industry.

4. Are production plans, testing plans, personnel, and infrastructure at DRAO in Penticton sufficient to handle full production and deliver high-quality, reliable units within the scheduled period of time? Is NRAO infrastructure sufficient to properly handle (receive, install, test, maintain, re-work, operate) boards of this size, complexity, and quantity?

The facilities and practices used at DRAO appear to the committee to meet or exceed project requirements. NRAO also appears to be well-prepared to both install and maintain the large, complex circuit boards of the correlator system. Conservative ESD precautions have been undertaken at both sites, and the correlator room at the EVLA site is being maintained as a clean room to increase the system-wide MTBF.

5. Have reasonable estimates of risk been made?

The technical risks appear to be low, given the extensive testing that has been done. The cost risks appear to be well within normal contingency ranges. Schedule risks are present, but seem unlikely to affect the schedule for observing.

Overall, we appreciate the depth and thoroughness of the presentations that were made to us. We will be writing a separate report, addressed to the project team, containing our detailed observations, as well as questions that we had with regard to the functionality of

the system, which were answered prior to and during the review. If you also desire a copy of the detailed report, we would of course be happy to pass it along to you.

We are confident that the EVLA in conjunction with the WIDAR correlator will be a world class astronomical instrument for many years to come.

Sincerely,

EVLA WIDAR Correlator CDR
Review Team

Roger Cappallo (chair)
Dave Hawkins
Barry Clark
Mike Revnell

cc: S. Dougherty, Director DRAO