REPORT ON THE MINI-REVIEW OF THE EVLA PROJECT
14 October 2008

A brief review of the status and plans of the NRAO EVLA project was held in Socorro, NM on 10 September 2008. The review was convened by Dr. Vernon Pankonin, NSF Division of Astronomical Sciences, with the following reviewers participating: Todd Boroson (NOAO), Geoff Bower (University of California, Berkeley – via teleconference), Joseph Lazio (NRL), Joseph Salah (MIT Haystack Observatory), Katy Schmoll (UCAR), and Phil Schwartz (Aerospace Corp).

The review consisted of a detailed presentation on the EVLA project, its status, organization and plans by Mark McKinnon (EVLA Project Manager). The EVLA software work and plans were then described by Bryan Butler (EVLA Computing Division Head), the anticipated new science with the EVLA were outlined by Rick Perley (EVLA Project Scientist), and the EVLA Transition, Commissioning and Operations plans were described by Jim Ulvestad (NRAO Assistant Director). The review group also visited the EVLA site prior to the presentations as part of an overall AUI Management Review panel, and the group was shown the various mechanical and electronic subsystems associated with the EVLA project. The findings of the mini-review are summarized below.

Project Management: NRAO has made excellent progress on the EVLA project, and it has responded well to guidance from previous EVLA reviews such as the need to improve control of software tasks and to coordinate more closely with the Canadian partner on the correlator development so that technical risks and schedule slips can be minimized. The review group finds that the project is presently well managed, and the team which includes partners from Canada and Mexico, is well coordinated and cohesive. While the project manager noted that he has sufficient contingency to manage the delivery of the remaining project components on schedule, close attention needs to be maintained on those components to be completed in 2012 since the funds for that work will come from NRAO-contributed operations support which may be impacted by the availability of funds for the overall base NRAO budget. Moreover, if schedule slips occur that require additional support after the end of the direct EVLA support in 2011, the required funds may not be available. This situation poses risk which needs to be recognized and suitably managed. Based on the snapshot review at this time, the project is on track to meet its primary goals and deliver excellent science, although there are some uncertainties that are now emerging as a result of future budgetary considerations that will be discussed below.

Hardware construction: The review group was pleased to learn about some of the project's accomplishments to date. These include the retrofitting and successful operation of 17 of the 27 VLA antennas to EVLA specifications, installation of the 60 km-long wideband optical fiber, completion of the necessary infrastructure to house the correlator, and replacement of the old computer system and software that provides monitoring and control functions. Other subsystems such as the multi-frequency receivers and the local oscillator and intermediate frequency modules are well underway and do not appear to pose major risk, particularly since design and fabrication issues with the ortho-mode transducers for some of the receiver bands have been reported to have been recently resolved.

WIDAR Correlator: The next key project milestone to be met is the Critical Design Review for the Canadian-built WIDAR correlator that will be held at NRAO in December 2008 and will include external experts. A successful CDR will permit the start of large scale fabrication of the correlator boards so that their installation and integration into the EVLA can be completed. This is a crucial step for the project to meet its overall schedule successfully and begin full science operations in 2012. The panel saw the first two prototype boards of the WIDAR correlator which were being tested at the EVLA site. First fringes with those boards were obtained in August 2008 and demonstrate that the design approach and the custom computer chips and firmware meet specifications. While this is an important and necessary first step in

the testing of the correlator, much more work remains to be done. Further preparations are under way for two more boards to be available by the end of September 2008, and 6 more by the end of October 2008. With a 10-board system in place and a test plan that includes end-to-end signal processing, the WIDAR CDR should provide sufficient information to verify that the correlator can confidently move towards the board fabrication phase and integration. It is encouraging to note that all 12000 custom chips have now been fabricated and delivered and are ready to be populated on the correlator boards once the boards are manufactured. A realistically executable fabrication and testing schedule for the WIDAR correlator needs to be presented and reviewed at the CDR.

Software Development: The EVLA software work is well led and managed. The development steps are properly organized, but it was noted the requirements and the scope of EVLA software have grown since the initial project was started. This was driven primarily by the desire to satisfy NRAO's vision of 'One Observatory' and simplify access to radio astronomical data from all its facilities by the broad user community. While this is commendable, care must be taken to ensure that the main software components that enable EVLA operations be completed first and on schedule. Thus, the EVLA project manager and the software manager must constrain further growth in the scope of the EVLA software. Software, as is usual in a large project, can continue to evolve and improve with time in the future, but it is important that the required suite of EVLA software be ready at the time of initial science operations in order to minimize complaints from the community and ensure that there are adequate capabilities if future funding is constrained.

Commissioning and Science: The planning for the gradual commissioning of the EVLA as the correlator system is built up and the approach for initial science operations with shared risk are both reasonable. However, information about these plans should be shared with the wide community as soon as feasible so that potentially interested members of the community can develop plans to participate in the initial scientific observations and become aware of anticipated changes in EVLA capabilities such as the staged growth of EVLA system parameters and the scheduled retirement of the VLA correlator. The rich and broad scientific research that can be carried out with the EVLA as it is equipped with its complement of receivers and as the WIDAR correlator achieves full capacity is most impressive and exciting. This research will assuredly lead to many discoveries particularly in high-redshift line science as outlined in the science presentation by the EVLA project scientist.

Budgetary Impacts: The primary difficulty encountered by the review group during the EVLA mini-review involved our understanding of tasks that would not be done under the budget guidance provided by NSF for the overall NRAO program. Three items illustrate this difficulty. *First* is the reported suspension of EVLA antenna azimuth bearing replacement beyond 2010 which can lead to catastrophic shutdown of array elements. For a cost of ~$50K per year, this would greatly jeopardize the large investment made in the EVLA and is obviously unadvisable. *Second* is the projected decrease in telescope reliability during commissioning and thereafter, and a stretched-out commissioning schedule for the WIDAR correlator resulting in significant delays in first science. Any action to avoid these problems should be pursued. *Third* is the deferred work on science support systems for EVLA users which would detract from full and efficient use of the EVLA at the completion of the project. Some of the items such as autonomous dynamic scheduling could be stretched into the future, but others such as the lack of automatic pipeline reduction and lack of support of non-standard observing modes will likely disappoint users. A review of these tasks relative to those that were added when the scope of software work was increased and to other tasks such as the post-processing software may be useful. Basically, a careful reexamination of the priorities for the software is recommended while the budget guidance issues are settled and the overall NSF budget outlook becomes clearer.

Prioritization: Since some of the EVLA issues noted above relate to the overall NRAO program and its budget, it is difficult to decouple them from the topic of overall prioritization within NRAO. For example, the EVLA software development plan presented to the mini-review group concluded that 'many EVLA requirements, of all priorities but the most critical, cannot be completed under the guidance budget'. Given the high priority accorded the EVLA project in the list of prioritized NRAO goals for the next few years and the large investment in the EVLA upgrade, the deferred EVLA tasks need to be re-examined and potential reallocation of resources considered so that adequate support for the EVLA is provided. Furthermore, as noted earlier in this report, some of the EVLA work in 2012 is planned to be supported with operations funds. This poses some risk if the operations budget is constrained at that time as expected from guidance levels and if all contingency funds have already been spent. Therefore, careful attention and priority need to be given to those tasks to ensure successful completion.

Given its charge, the EVLA mini-review group recognizes that it is considering only what is best for the EVLA project exclusive of other work at NRAO. Moreover, the group does not wish to jeopardize other facilities in NM such as the VLBA which is already suffering a tortuous path for survival due to the Senior Review recommendations. Whether other efforts within the overall NRAO program can be deferred in order to satisfy the established requirements and capabilities promised for the EVLA in the face of budget uncertainties and constraints is at the discretion of the NRAO director.

Concluding Remarks: It is important to congratulate the NRAO team for keeping the VLA in operation while carrying out the EVLA upgrade. While this strategy has posed a challenge for the team due to the added complexity in the hardware and software system evolution, it has resulted in important scientific work by the user community during the interim construction period. It has also helped maintain the user community which is anxiously waiting to use the full EVLA for new and exciting science projects. Finally, this report would not be complete without specifically commending Mark McKinnon and Bryan Butler for their excellent grasp of the key issues associated with the project management tasks and software development, respectively.
