Response to the EVLA Advisory Committee Report on the Meeting of September 6-7, 2007

December 5, 2007

The NRAO Director and the EVLA Project Team wish to thank the members of the EVLA Advisory Committee for their time and hard work at the meeting and for the valuable advice which they provided. This document provides the responses of the EVLA Project Team to the committee's comments and recommendations.

General Remarks: We share the concerns expressed by the committee in the areas of software development, correlator, and receivers. We have been taking a number of steps to address those concerns, as follows.

In the software development area, we have reached an agreement in principle with the Office of E2E Operations (OEO) to develop a WBS-based work package of deliverables based on available resources consistent with the overall schedule requirements of the EVLA project. In the case of receivers, we have already seen some positive results from the additional resources we assigned to the front end group; we are now reviewing the receiver production plan in order to expedite the receiver delivery schedule. We have also added managerial manpower to the receiver group to relieve the former head so that he can concentrate on design work.

The correlator poses a particularly difficult challenge. Historically, this group has not been directly managed by the EVLA project; rather, because all funding for the WIDAR correlator is supplied to the DRAO group by Canadian sources, this work element in the EVLA WBS was treated as a large, fixed-cost contract. Nevertheless, recent slippage and the movement of the WIDAR correlator toward the EVLA critical path has led us to the belief that closer oversight mechanisms are necessary, and several approaches are presently being explored.

Finally, we agree that it is important to produce a revised work breakdown structure (WBS) for the EVLA that integrates the completion of construction with a commissioning plan that terminates in full operations. We have begun the work of producing this new plan.

Responses to Specific Points Raised by the Committee:

(Numbered items correspond to the numbered comments listed in the committee's report of October 11, 2007.)

<u>Management</u>

1. Schedule.
    a. We agree with the committee that the project schedule and initial operations plans need to be more integrated. We are developing a science-

driven definition of the minimum capabilities required at the start of shared risk observations and for the first full year of operations.

b. The requirements and priorities for the development of EVLA software for post processing and Science Support Systems (SSS) have been established. The release dates for the SSS software are closely coupled to the scientific capability provided by the staged delivery of the WIDAR correlator. We will make the priorities and release dates more visible by developing a more detailed software schedule.

c. A Gantt chart for the EVLA project exists, but it was not presented to the committee at the meeting. The chart includes integration of the WIDAR correlator. The commissioning of the EVLA and its first full year of science operations have not previously been part of the EVLA project. These tasks have therefore not previously appeared in the work breakdown structure of the EVLA project. Again, we agree with the committee on the importance of integrating the project's activities with those of commissioning, first science, and initial operations. We will create a new, top level Gantt chart to show the integration of the project with WIDAR development and delivery, post processing software, and the tasks required for commissioning and the first year of science operations.

2. We are addressing the committee's recommendation of establishing a realistic schedule for CASA software development based on previous performance success. For example, we are currently in the process of completing a resource leveling exercise, where we categorize CASA requirements into features, estimate the effort required to complete each feature, identify the individuals who can develop the features, and load the schedule to determine if the current staffing allows the completion of all the features. The resource leveling exercise will be closely coupled to the schedule requirements of the EVLA project as a whole. In the coming year, personnel in the CASA group will be faced with supporting the beta release of the CASA software package, completing further development of the package, providing updates to the beta release, and completing the development of the fundamental functionality within the package.

3. Most of the personnel involved in software development, including their line managers, are in Socorro, and their sense of priority to the EVLA project is well established. Thus, resolution of priorities and task commitments have tended to happen naturally on an informal basis. However, it is prudent to plan for more formal commitments in situations where activities and managers are not necessarily co-located in Socorro. As noted, we are working with the OEO to establish commitments for the delivery of predefined sets of functions for CASA and E2E software that are based on the schedule requirements of the EVLA project.

4. We will naturally reevaluate the costs of software development and commissioning as part of the exercise to integrate the requirements of commissioning and first science operations in the project WBS.

5. The risks to correlator development will be included in a separate risk register for overall visibility to the EVLA project.

6. If a situation arises where we must contemplate a revision to a requirement, we will document an assessment of its impact on science and make that assessment available to the community. Any significant changes will be made in close consultation with the community through the EVLA Advisory Committee, the Science Advisory Group for the EVLA (SAGE), and the NRAO Users Committee.

7. The tests for scientific commissioning and testing of the EVLA have been identified, but these tests need to be included in a commissioning plan, as recommended by the committee. As discussed at the meeting, numerous test, verification, installation, and integration plans have been developed for the project over the last 18 months. We will continue to identify and develop these plans and to integrate them into the project WBS.

Hardware

8. The specific tests and software required for the on-the-sky tests of the prototype correlator have been identified in test plans. We will make these plans available to the committee at the next meeting, as requested. In keeping with the committee's recommendation, a schedule of the tests and integration tasks with major decision points will be developed to ensure their timely completion.

9. We will investigate the practicality of conducting long integration tests of the correlator and EVLA electronics in the laboratory. The duration of on-the-sky tests of the correlator may be reduced if the tests can be performed in the laboratory.

10. Contingency plans will be developed to address any further delays in the delivery of the prototype and final correlators. For example, additional delays may necessitate adopting interim scientific goals that focus on spectral line observations with the existing VLA correlator using the new frequency space provided by the wide bandwidth EVLA receivers, instead of emphasizing the sensitive, large bandwidth, continuum observations that are the promise of the WIDAR correlator.

11. A plan for the development and installation of the "scientifically most useful" receivers has been in place for some time. The delivery of the highest priority receivers (e.g. Ka- and C-bands) is being expedited for receiver installation now, and the installation of the lower priority receivers (e.g. X- and Ku-bands) has been scheduled for later in the project. The receiver production plan is currently being reviewed to optimize receiver delivery. Our development plan for orthomode transducers (OMTs) is also based on the highest priority bands, thus our emphasis on C-band OMT development over L-band.

12. The design of the 3-bit, 4Gsps sampler is based upon a commercially available digitizer chip. The chip has been used in other applications, and we have demonstrated with laboratory tests of the prototype sampler that the chip meets project specifications. The chip is under production, and its delivery does not currently affect schedule because its capabilities cannot be used without the new correlator. We will carry the sampler on the project risk register, but we believe that its risk to the project is low.

13. EVLA electronics modules are maintained as part of the routine operations and maintenance procedures we have used at the VLA for many years. Some, but not all, of the EVLA electronics modules have been recently included in the existing repair tracking system so that we can identify recurring problems and assess module reliability. Over the coming year, we will evaluate the existing system to determine if it provides the capability we need. Thereafter, we will implement an appropriate repair tracking system.

Software

14. An initial plan for common software and reuse within all of NRAO (including EVLA and ALMA) has been developed and agreed to by the concerned parties within the Observatory. Further refinement of this plan will proceed in the coming year.

15. The CASA team membership remains unchanged, except for the team leader, Joe McMullin. There has been an active search for his replacement. The selection committee, which consists of six scientists and two software engineers, has so far reviewed 19 candidates, examined 13 applications in depth, and identified two promising candidates who will be interviewed very soon.

16. Algorithm development falls under the purview of the OEO, and is not specifically a deliverable of the EVLA project, although active participation by EVLA scientists will be required for the algorithm development to be successful. The EVLA project has identified the types of algorithms it needs. The EVLA project, NRAO-NM Operations, and the OEO are currently developing joint plans for algorithm development that are aligned with the hardware and software schedule for the EVLA. Ed Fomalont is responsible for coordinating algorithm development across the Observatory. The assignment of an algorithm development leader specifically to focus on ensuring that EVLA needs are met will be determined as a result of this planning process.

17. Plans for engaging the astronomical community more concretely in algorithm definition and development are being refined. Although formal agreements have not been a part of our strategy in the past, we will consider developing cooperative agreements with our colleagues in the community (especially for closely related projects like eMerlin) to strengthen our ability to deliver results in a timely fashion.

18. We have conducted some preliminary analyses of the computing performance required for the post-processing of EVLA data. These analyses show that for straightforward observations, such as those of simple sources above 10 GHz, sufficient computing power exists in modern computers. That said, we will develop a more comprehensive and clear, scientifically based set of performance requirements for computing power that is integrated with software and algorithm developments plans, and operational requirements. We note that it will be difficult to make accurate estimates of computing power when we don't have a clear definition of the final algorithms we need for the more difficult post-processing problems, such as full-polarization, full-beam imaging at L-band. Furthermore, we suspect that moving data, rather than reducing it, may place the most stringent requirements on computing power. A prototype parallel processor is being purchased to investigate its performance and to gain experience with parallel distribution of computing in a cluster environment, parallel input/output and file systems, and code parallelization at the task level.

Commissioning and Operations

19. This recommendation is very similar to the committee's recommendation in item 1. We will implement the recommendation as part of our plans to integrate the schedules for the project, on-the-sky tests of the correlator, commissioning, and the initial science operations.

20. We will consider the impact of commissioning on science operations as part of our effort to integrate commissioning and initial science operations with the WBS of the EVLA construction project. We will adjust resources as needed. We agree that it may be necessary to reduce support to the community for limited periods in order to facilitate delivery of the EVLA.

21. The development of policies pertaining to shared risk science of the EVLA is the purview of the Assistant Director for NRAO-NM Operations. As the committee recommends, these policies will be developed in consultation with the SAGE in time to support the first call for shared risk programs.

Three additional comments were highlighted in the text of the committee's report, but were not included in the itemized list at the end of the report. Those comments (in italics) and our response to them are listed below.

1. *If feasible, software should be developed to simulate as much of the correlator hardware control input and data output to minimize schedule delays caused by these problems* (page 5). The software that controls the configuration of the correlator hardware and its data output is being developed concurrently with the correlator hardware. The software will be tested and integrated with the prototype correlator in 2008. Given our limited staffing and the resources required to develop a correlator software simulator, we will conduct further testing of the

software with the prototype correlator after on-the-sky tests are complete, instead of investing throw away effort in simulation software.

2. *The OMT development is still on the critical path and this development effort needs to be closely monitored* (page 6). The critical nature of OMT development has been fully recognized for some time, and we will continue to monitor OMT development closely. As mentioned at the meeting, we assigned additional resources to expedite the design and development of the OMTs. We are already seeing the results of this action, as the C-band OMT has passed its performance tests, a prototype S-band OMT will be fabricated in 2007, and the design of the X-band OMT is underway. The project's receiver production plan is being reviewed to expedite the delivery of the OMTs.

3. *The plan for adding the new ADC boards should receive very careful scrutiny* (page 6). As with all EVLA electronics modules, the modules containing the new ADC boards will be measured for RFI. We will conduct tests of the ADC boards in the module to verify their performance and thermal stability.