Dear Wayne:

As I indicated on Thursday, we have now had Adrian review the draft concept. He commented at length to me. I will summarize our impressions.

First, as written, the terms of reference for the review are very broad. Given the very limited amount of time available to prepare material in response to the draft charge, we are very concerned that the committee will have expectations that cannot be met. We feel the review should focus on the key issue of cost verification of the North American component.

The Garmisch cost review considered the cost, schedule and risks of the ALMA project as a whole, and we now need to consider the NA component, in whatever level of detail the Committee feels necessary. We recognize that there are regional considerations - such as MREFC regulations - that may require different philosophies on cost to completion and, in particular, on contingency; these may not have been explored bilaterally. We believe that the North American review can not only more fully address the NA costs and risks, but address concerns identified by the Garmisch review, such as the hiring plan.

On the other hand, the charge does not recognize that ALMA is an integrated project. It is not possible to examine the NA component in isolation. On the instruction of the ALMA Board, and at the continued strong urging of the ALMA Management Advisory Committee chaired by Gary Sanders, we have delegated substantial technical and project management leadership to the JAO, under the ALMA Project Manager, and built a single unified Project Management Control System operated by the JAO. For example, while we have a hiring plan for staff working under the direction of the North American Executive, most of the staff in Chile will be to be hired under the staffing plan developed by the JAO in coordination with the Executives. We are critically dependent on the JAO for many of our deliverables and for the ultimate success of this integrated international project. JAO therefore must be a formal part of this review, even though the preparations for and conduct of the review will be led by the NA Executive's ALMA Project Director. **NRAO TASK**

On a related subject, the controlling management document for ALMA, essentially the overall ALMA Management Plan, is the ALMA Project Plan, approved and controlled by the ALMA Board. We do not maintain a separate formal North America ALMA Management Plan that is insulated from the JAO and the ALMA Project Plan. Nonetheless, I believe we understand the intent of the request, and will supply the relevant material. **NRAO TASK – BY ALL MEANS USE ALMA PROJECT PLAN**

Below is a modified and annotated version of the concept. I hope you understand the sense of our comments, and that we can all work together to make this important review a success.

Best regards,
Ethan

Draft Concept for the ALMA Delta Cost Review and the ALMA North American Delta Cost Review

Overall Process: The North American Delta Cost Review (NADCR) will follow, but be largely separate from, the ALMA Delta Cost Review (ADCR). The ADCR will report to the ALMA Board and will heavily utilize the personnel of the original cost review panel. The NACR will report to NSF, and will consist of an essentially separate group of reviewers.

[NOTE: why does it have to be largely separate?? There is by now a large body of knowledge within the original Cost Review Committee that the NA review could benefit from via a partial overlap. It will impose needless increased work and negatively impact the ALMA project to re-convey the same information to a largely new group.]

ALMA Delta Cost Review: The delta cost review will provide a detailed examination of the completeness, schedule impact, and cost of all changes to the proposed October 2005 baseline which stem from the

decision to procure two different ALMA antenna designs. It will utilize both the original baseline data provided in October as well as the new data pertaining to a hybrid array design which was delivered since that time. The presentations will be led by the Joint ALMA Office Project Manager and Project Engineer, assisted by the North American and European Regional Project Managers. The review will be attended by representatives of the ALMA Board and the three ALMA Executives who choose to be present.

The ADCR panel will be asked

1. to assess and evaluate in detail, based on material provided by and through the Joint ALMA Office (JAO), enhanced where appropriate by detailed discussions with ALMA project personnel at the review,

(a) the changes in management, scope, and specifications of the bilateral ALMA project which result from the decision to procure two antenna designs;
(b) the adequacy of the additional cost and contingency requirements for the two-antenna project
(c) the reliability of the revised schedule;
(d) the adequacy of the revised cost control and schedule risk mitigation processes necessitated by the decision to procure two antennas; and

2. to comment on

(a) any additional processes for meeting NAOJ requirements and for integrating the NAOJ enhancements into the two-antenna bilateral array;
(b) the impacts on Early Operations and Operations which stem from the two-antenna decision.

The Chair of the ADCR will provide an exit assessment for the project. The panel will provide a written evaluation within two weeks of the review.

North American Delta Cost Review:

The NADCR will consist of a separate review panel appointed by NSF. The NADCR panel will address its charge using the material provided for the original ALMA cost review and the subsequent delta review, in addition to material specifically provided by the North American ALMA project and the JAO, recognizing the highly integrated nature of the Project. Presentations for the NADCR will be led by the North American ALMA Project Manager and will be supported by the JAO, and NRAO staff and its AUI management.

Additional material will be provided by NRAO for the NADCR, and will include the ALMA Project Plan, which represents a management plan for the project as a whole, plus: a delta management plan which describes the North American project's interface to the rest of ALMA, and a detailed schedule, detailed work breakdown structure, and the NSF-funded cost to complete for the North American part of ALMA, along with the necessary annual expenditure levels. A critical path analysis, reflecting dependencies upon the performance of the JAO as well as the European parts of the project, and an analysis of North American risk and contingency, will also be provided.

[NOTE: No analysis of the detailed impact of Japan on the project schedule can be carried at this time, until the RFQ is reissued and analysed. This is scheduled for next summer. Also note that the reason that the Japanese participation was structured as an add-on to the bilateral ALMA project was to minimize dependencies of the bilateral critical path on Japanese deliverables.]

Utilizing the review presentations, the report of the ALMA Cost Review, the preliminary report of the ALMA Delta Cost Review panel, and the material presented by NRAO, the panel is asked to:

1. Drill down into selected Level 1 areas of the ALMA WBS for the TBD IPTs to check the completeness of the full project WBS at a detailed level.

[Note that there are some 250 work elements in ALMA, each with many individual line items. To drill down on every element would likely be impossible in less than a month. Can the committee specify a few IPTs in advance?] **Certainly.**

2. Review the schedule and consider risk implications and effects on contingency

[We question what level of detail is requested. We are in the process of capturing the cost implications of the risk register as a top down sanity check on the bottom up DOE contingency methodology for this review. To analyze the schedule impact of all of our risks, while worthwhile, is many weeks of work. A detailed analysis of the schedule delay of any given risk, and its impact on marching army costs, is possible with the available tools, but requires a very high level of JAO/PMCS effort. While we could do this for perhaps the top few risks, analysing the entire risk register (~170 risks) is impossible on a month timescale. Even a limited analysis will require the PMCS staff who are currently working round the clock to prepare the cost information for the 2-antenna Delta Review and who will have to support the provision of cost information for our review as well. A subjective assessment based on the risk score could be provided, but it would be less than rigorous.]

I understand the thrust of this argument. However broad this charge element, it should nevertheless be considered as suggesting a previously-omitted, or only partially analyzed element of the project preparation. If this is so – and I am not saying that it is – there will have to be some cover provided at this stage.

My basic concern here is simple: The ALMA Cost Review allegedly explored a verifiably complete (revised) plan to build the array; the validation process included confirmation that the contingency level was appropriate and solidly determined. If quantifying the risk register and integrating its implications into the contingency essential to confirm the appropriateness of the contingency estimates, then it is essential to do this (and the Garmisch cost review was defective in not noting the inadequacy of contingency estimates). If establishing a quantitative flow-down from the risk register is merely desirable, I think this charge element should be finessed and/or clarified.

3. Verify the cost increment associated with a hybrid array;

[It seems needless to do this twice in a week, especially as it is implicit in the NA cost to complete. In addition, it appears insulting to the other review members.]

Sorry. Made necessary by the imposed linear independence of the two reviews.

4. Validate the proposed North American costs, schedule, and funding profile;

5. Assess the adequacy of contingency for the North American part of ALMA;

6. Assess whether the proposed mechanisms for quality assurance and quality control **of what ?** are adequate

[Suggest this is Deleted. This has come from comments made by the cost review. The BE/FE IPT review said that the PA/QA plans were in place and that management should continuously verify that they are being implemented. To provide more material is possible, but will take effort away from the main theme of costs. We will be auditing QA plans at all manufacturing readiness reviews in line with the QA requirements document.]

I agree that this is a minor comment – originally made with only with respect to the Vertex antenna contract, and later conceded to be just fine – that has grown out of proportion due to ignorance and lack of coherent oversight. It is not clear that this Charge element can be eliminated at this point. Indeed, it might be highly beneficial to review at a high level the project's mechanisms for maintaining QC/QA within the project.

7. Comment on the sensitivity of the NSF-funded share of ALMA to complicating factors outside the North American part of the project;

8. Comment on the JAO Chilean Systems Engineering staff hiring plan.

9. Evaluate whether AUI Management of ALMA is
   a. dedicating adequate resources to the oversight and management of the project;
   b. optimally configured to oversee ALMA;
   c. staffing key project management positions in a timely manner and with effective people;

Comment on what changes - if any - should be made to AUI's management practices to help assure the ultimate success of the ALMA project on both the regional and international levels.

[QUESTION: What does this item address? Is it ALMA management at NRAO, or AUI management of NRAO? If the latter, NSF conducted a major independent management review of AUI within the last few years and the results can be provided.]

It's ALMA, and stems from Michael Turner's point that NSF is not funding the JAO to build ALMA, but AUI. Due diligence requires that this point be addressed.

10. Evaluate whether the necessary relationships and agreements among AUI, ESO, the Joint ALMA Office and the ALMA Board are in place to help assure the success of ALMA as a joint venture.

Actually, this element is the most dangerous (*i.e.*, open-ended) for a non-expert committee to have in front of it: if you're sick of all this BS about LOs, front ends, FIR filters and all the other radio crap that you don't know anything about, you can discuss the organizational vulnerabilities of ALMA for days. And everyone will have an opinion….