

Memorandum

To: ALMA Executive Council (Brown, Rafal, Kurz, Guilloteau, Ishiguro, Kawabe)

Antenna Team Leaders (Andersen, Kingsley, Ukita)

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Date: 27 June 2001

Subject: The Diversified ALMA Antenna Procurement Model

1. Introduction

This Note is a follow-up on an earlier Memo and contributes to the discussion regarding the best “Model” for the organisation and management of the ALMA Antenna series production. Recently, following the discussion of the tripartite project in Paris, we have presented some ideas about the so-called vertical and horizontal models of antenna procurement (see Report of Antenna IPT - Paris Meeting, May 2001 by Jeff Kingsley). In further discussions, particularly at the meeting of the AMAC in Garching (8-9 June 2001), it has emerged that some combination of both models would be most attractive to meet financial, technical, schedule and political boundary conditions and goals.

In this Memo, I describe such a hybrid model with the purpose of providing a departing point for further discussions and decision making by the ALMA Management and the funding Agencies. I first list the conditions which must be obeyed, as I understand them. I then describe a procurement model which in my view approaches an acceptable way to satisfy the diverse conditions.

2. Assumptions and Boundary Conditions

1. The tripartite agreement between North America, Europe and Japan will be realised. Each of the three partners furnishes a prototype ALMA 12-m antenna to undergo comparative testing by a joint ALMA team at the VLA site in New Mexico.

2. In principle, one of the three prototype antennas will be selected for the series production of 64 in total. Schedule and financial constraints will allow at most some small modifications to the production antenna, which do not jeopardize the performance guarantee of the designer.

3. The total cost of the antennas absorbs 35-40 percent of the total ALMA construction budget. The antennas will be produced entirely by industry. Funding agencies in all three regions will require a certain “just return” to industries in their region. Thus significant orders for (parts of) the antennas will have to be made by each of the three ALMA executives (NRAO, ESO, NAOJ). In the management model of ALMA each executive “spends his own money”.

4. ALMA requires the delivery of identical antennas to Chile. There are both scientific and operational (maintenance) reasons for this requirement.

5. With high priority, ALMA wants to deal with a contractor who assumes responsibility for the full functionality of the delivered antennas.

6. A delivery of about a dozen antennas per year over a 5-6 year time span must be guaranteed in order to maintain the ALMA construction schedule.

3. Aspects of the procurement

1. With the delivery of the prototype antennas, the three contractors must provide a binding offer for the series fabrication of their antenna. It seems advisable to inform the companies that this bid should be based on a fabrication of the antennas, or parts of them, in all three geographical areas of the ALMA partners, North America, Europe and Japan. I believe that such an indication will be helpful to ALMA in its later decision making process on how to model the procurement method. It would also be beneficial for ALMA to obtain the detailed breakdown of the cost of the antenna, together with data on the prospective sub-contractors. It is not clear to me presently, whether such detail will or can be required from the bidder.

2. It is highly preferable to have one main contractor for the delivery of the 64 antennas. Even if the three executives would place separate contracts for their part in the order, ALMA would deal with only one responsible contractor. Ideally, the main contractor would form a consortium with the major fabricators in the other two regions in order to give the whole a more “international” character. Perhaps ALMA should encourage prospective main contractors to do so. As stated above, the contractor should in principle take responsibility for the functionality of the antennas. I am wary of ALMA delivering, and hence taking responsibility for the correctness, of a set of prints, to which the contractor fabricates. It will be difficult enough for ALMA to assemble a sufficiently capable and experienced group for supervision of the contractor’s work.

3. I consider it likely, although by no means certain, that the designer/deliverer of the successful prototype will be the main contractor of the series. This certainly has the advantage of a credible level of confidence in his capability to deliver to specifications and performance. It is for this reason that I would prefer to place the contract with the “winning” company.

4. The antennas contain a number of parts, which are acquired from specialized companies, either from the catalog or custom made. Examples are bearings, encoders, control electronics, motors. It is conceivable that such parts would be ordered “en bloc” at a cost saving by the main contractor or even one or more of the executives (ESO, NRAO, NAOJ) and put at the disposal of the antenna contractor(s). I return to the consequences of this approach below.

5. We have earlier presented two models for an antenna fabrication, distributed over all three geographical regions. In the *horizontal model*, certain sections of all antennas are made by one company and the companies are distributed over the three regions. A System Integrator assembles all parts to a complete antenna in Chile and delivers to ALMA with responsibility for

performance. In the *vertical model* a set of complete antennas is produced in each of the three regions, based on **one** design, presumably by three different contractors. The complete antennas are delivered to ALMA, again with responsibility for performance, from each of the three contractors.

The recent discussions have indicated that each of these models has good and bad aspects in the context of the ALMA organisational and political situation. I shall now describe a hybrid model, which I hope will combine the attractive aspects of each of the models, while avoiding most of the drawbacks. I call this model “diversified procurement”.

4. The diversified procurement model

As noted earlier, political conditions force us to place significant parts of the ALMA antenna fabrication in the three participating regions, NA, EU and JA. However, we want the antennas build to one and the same design; they should be as identical as possible. In particular, all parts for which spares are required should be identical (encoders, motors, etc).

One of the three prototypes will have been selected for series fabrication on technical and budgetary grounds. I assume that ALMA negotiates the main contract for the series with the winning company of the prototype competition. This contractor can assume responsibility for performance without limitations and without additional costs. The contract negotiations will presumably be carried out by the executive of the region of the contractors location.

The main aspect of this contract is the responsibility for the performance of the delivered antennas from all three regions, regardless how the actual fabrication and assembly will be organized. Furthermore the contractor is bound to arrange for roughly equal expenditures in the three regions. To this end he is strongly advised (perhaps even required) to enter into some form of consortium with a “sub-main-contractor” in each of the other two regions. This could take the form of the “leader-follower” arrangement, shortly discussed at the AMAC meeting. (In such a scheme it would be possible that the “losing” prototype contractors emerge as “followers” and thereby maintain their visibility as ALMA industrial participants. I guess that this might be politically expedient and attractive to the companies. I’ll return to this scheme at the end.

Depending on the level at which ALMA wants to participate in the procurement of certain parts of the antennas (see Section 3. par 4), this must be announced to and discussed with the prospective contractors *ab initio*. Based on the distribution of subcontractors and deliverers, proposed by the main contractor, the three ALMA executives now negotiate contracts with the main contractor and his two “followers” in the other regions for their specific part of the work.

It could be argued that we give up any competitive aspects in this course of action. However, we do negotiate on the basis of binding bids from each of the prototype antenna deliverers, so they have little room to maneuver the price upwards. The extent to which we will be able to base our position on the original bids will depend on changes in the conditions of the bidding process.

The ALMA antennas contain three different kinds of parts:

- i) standard construction (steel section, foundation), which can be made by many firms,
- ii) special design parts (reflector panels, CFRP section), which need a specialized company,
- iii) standard components (encoders, gearboxes, bearings, motors) from OEM deliverers.

Ad i): each contractor (leader and followers) places subcontracts for these on an entirely competitive basis to industries within his region. There is little risk for performance in this area.

Ad ii): here, the choice of subcontractors is small, if not limited to the original prototype fabricator. Also the performance risk is high in this area, so sufficient guarantees must be build into the contract(s) for these parts. Concurrently, the amount of expenditure on this section of the antenna is considerable, as is the technological reward for the contractor. Considering the amount of production to be delivered on ALMA's tight schedule, it is quite possible that no single company is capable to enter into this task. A division of the fabrication over more than one company would be attractive, because it removes the risk of a single point failure in case one company falters. It might also help towards an equitable way of subdividing the funds, especially in this area of new technology. In such a case it will be necessary to assure that the production follows exactly one design. Because we own the design, this should not be problematic. In practice this will probably also mean that the main designer/contractor licenses his special technology to the other contractors. It is hard to estimate, whether objection against this might be expected from the designer. I expect not, because already in the prototype phase some of the companies subcontracted the CFRP section to more than one firm.

Ad iii): although the special requirements of ALMA make it unlikely that such "standard" components can be ordered straight form the catalog, the choice of manufacturer for such parts is limited to specialized companies. Moreover, the components will have been designed or selected in the prototype phase and this leaves us essentially with a sole source procurement for these parts. I suggest that it might be financially attractive to have the leader-contractor order these components directly in their total amount and supply them to the follower-contractors for inclusion in their fabrication process. Within the constraints of the overall ALMA schedule, the manufacturer of these components could choose his preferred delivery schedule. This appears preferable to a scheme, whereby the ALMA executive(s) would contract for these components directly and supply them to all contractors.

This diversified procurement model is sketched in the diagram (Fig. 1). I believe that it provides the possibility for the three executives to satisfy their special requirements regarding contracting and expenditure within their region. It is not the simplest way, both managerially and contractually. It appears however manageable and it would assure the delivery of identical antennas with acceptably low risk. It also has the advantage of providing a "backup" situation in case one of the contractors fails in his task.

It has been assumed in all models that the antennas will be assembled at the OSF in Chile. In order to meet the scheduled production of 12-15 antennas per year, more than one assembly line will have to be established at the OSF. In the procurement model sketched here, each of the three contractors (leader and 2 followers) could set up his own assembly line. It is also feasible that one of the contractors would assume responsibility for the assembly of all 64 antennas, taking delivery of the antennas sections from the three regional contractors. This flexibility could be useful for the final distribution of funds over the three ALMA regions.

Finally, I want to return to the aspects of competition and initialization of the procurement contracting. I assume that a form of “leader-follower” contract will be at the basis of the antenna production. As suggested above, I see technical and political advantages in getting the lead contractor (the “winner” of the prototype “contest”) to employ the two “losers” as follower-contractors. In that case it might be advantageous to have the companies start their initial discussions already during the testing phase of the prototype antennas. The ALMA management should then inform the companies of the political and financial boundary conditions, under which they are supposed to function during the construction phase.

It is true that under this scheme we are more or less abandoning the idea of a completely open bidding after the selection of the winning design. Strictly speaking, we can still do this but it is unlikely that other groups of companies would have much of a chance. Actually, in my view this situation would not be very different, if we did not have the need to spread the expenses and could go for just one contractor. On the other hand, maintaining the notion that in the end we will have open competitive tendering, puts pressure on the “prototype” companies.

The proposed scheme indeed has the danger to put the companies in a perceived state of monopoly where they could agree to jointly increase the price. Our weapon against that would be the three independent binding offers from each of the prototype firms for the construction of the antenna series. Our goal should be to stay as close to those bids as possible and avoid exaggerated “handling fees” from the companies because of their need to have a consortium and spread fabrication geographically. We should bear in mind that fabrication would be spread significantly anyway because of the specialized nature of many of the antenna components.

5. Summary

In summary, this diversified procurement proposal would go roughly as follows:

1. ALMA, in conjunction with the three partner executives, establishes the political conditions under which the antenna production will have to take place. This should, in principle, not include instructions to employ certain preselected companies.

2. After the three prototypes have been delivered and the companies have presented ALMA with their binding bid for the series production, ALMA informs the companies of the

conditions sub 1. At the same time ALMA informs the companies of its plan to have bidders form a company consortium of the “leader-follower” type, whereby the leader contractor would in principle be the winner of the prototype evaluation and the followers be companies in the other two world-regions of ALMA participation. Also ALMA indicates that it would look favourably at a consortium consisting of the three prototype deliverers.

3. Upon the selection of the winning prototype antenna, the companies should be ready to present their consortium structure and bid for the production of the series within the political context sub1. If the total price is acceptably close to the available binding bids, ALMA convinces the three executives that no further open tendering is required (nor advisable). If the consortium appears to be unreasonable in their financial requirements, ALMA takes recourse to open bidding.

This procedure hinges strongly on the notion that it will be difficult, if at all possible, to obtain independent open bids for these highly sophisticated antennas which will be competitive and technically reliable, that is where each bidder would take performance responsibility for the “common” design.

4. On the basis of the offer, ALMA discusses with the consortium the details of the package. This includes the division of subcontracts over the three regions, any decision to let ALMA buy specialized, sole source, components and the modalities of the assembly in Chile. The form of contracts and payments schedules with the three individual executives are also agreed. The leader-contractor assumes responsibility for the antenna performance.

I mention with appreciation discussions with and comments from Jeff Kingsley, Robert Fischer and Richard Kurz.