E-ELT Phase B Final Design Review
September 21-24 2010
Report of the Review Board – Executive Summary

Project Response to the Report

Cost.

The project notes that the committee considers the design to be cost effective. The project considers this to be the outcome of the engagement of industry at all levels at the earliest possible moments during phase B. Moreover, the multiple sourcing of industrial contracts with build options (FEED) has resulted in "competition in design" to provide the most cost-effective solutions.

The project notes that the cost effectiveness of the solution is also an indication that there is little margin for significant cost savings in the programme without a change in scope.

As the committee notes in some cases the suppliers have provided different solutions to the same problem (e.g. hexapods) whereby the imposition by ESO of a favoured solution may allow the selection of a common solution. The committee suggests possible guiding of the suppliers towards a better solution while not compromising the validity of the industrial procurement strategy.

The project has considered this option in the past and retains its principle not to interfere with contractors on choices of components assuming specifications are met. Fundamentally this permits proper competition by suppliers without the imposition by ESO of solutions or artificial standards. Moreover, this principle underlies ESO industrial procurement policy. Of course if there is an opportunity to meet the spirit of this recommendation, it will be done. In past projects, the imposition of ESO standards on suppliers has resulted in significant contractual challenges during programme execution. The project has considered the possibility that the maintenance cost of a particular component is higher than a competing solution from an alternate supplier. In a multi-million Euro contract the risk exposure of imposing a particular ESO favoured solution is considered to exceed the cost of replacing the component during routine maintenance in future operations of the observatory[1]. The life-cycle costs to ESO are considered to be lower when we do not impose upon suppliers the current thinking of ESO but rather solve problems when they occur.

Schedule

The schedule presented to the committee had a start date of January 1, 2011 and was technically paced. The total duration was 8½ years. The committee wisely addresses the actual construction time of 6-7 years. The schedule has largely been driven by input from industrial contracts that have a clear preference for faster construction times which reduce the commercial risk to the supplier and reduce the cost to the project.

Three major areas of concern were identified and are also clearly identified in the risk register and the construction proposal.

1. The overlap between the dome and the main structure contracts during erection. The overlap is scheduled for a period of six months. It is possible to artificially extend the schedule by delaying the procurement of the main structure by six months to create a buffer. However, the overlap is considered likely in any case due to normal delays or issues arising during acceptance. Contractually the project has to be ready to handle the

[1] Due to obsolescence of components replacements will take place in the normal lifetime of the observatory. The cost of these replacements forms part of the operations budget and therefore forcing a particular solution up front only makes ESO pay twice.

overlap and therefore the planning by the project and the contractors has to include the necessary provisions.

2. The production of the primary mirror segments. The committee correctly notes that no manufacturer has produced a segment per day in the past and therefore the credibility of the proposed schedule can be questioned. It must be noted that one of the contractors schedule has been constructed using experts in serial production. The production has a one year slack in it. Extending the schedule deliberately will increase the cost of production as the operations of the dedicated facility will be extended. The project considers it wise to allow the supplier to dictate the schedule on commercial terms allowing them to reap the benefit of fast production while buffering ESO from potential delays.

3. The AIV schedule is considered by the committee not to be credible. The E-ELT project has taken on board lessons from many past ESO projects. The baseline schedules are based on a Paranal model of small and efficient AIV crews based on ESO and contractor personnel. Baselining the operations at Armazones on a Paranal model allows full utilization of the culture and processes of the observatory. The details of the schedule allow for one year to integrate the optomechanics into the telescope structure. This requires 7 day a week integration but no more that the normal ESO 10 hour working day. It is recalled that AIV is not commissioning. The project considers that while challenging the schedule is credible. Extending it artificially to permit for delays would not benefit the project.

However, the project considers the advice of the committee towards ESO management to be wise, namely that *ESO must be prepared for the likelihood that the actual time to complete the telescope will be considerably longer (by perhaps 2-3 years) than is called for in the schedule*. However, the project would argue against an artificial imposition of an extended schedule as this will increase the cost to ESO and possibly the risk to the contractors. The schedule should be aggressively managed to be as short as possible without artificial slack.

It is important to note that the schedule presented at review assumed a January 2011 start and was technically paced. It did not foresee a delta Phase B activity and the subsequent retendering of work. This activity will naturally extend the duration of the project and will have the benefit of easing of the payment schedule that would enable positive cash flow. In this the project concurs with the committee. The issue is how to manage this. Preparing for the likelihood of delay but not imposing it, reduces the cost to ESO.

The project recognizes the risk of making important programmatic decisions, that might compromise the technical performance of the completed facility, because of unrealistic considerations regarding the schedule and endorses the sentiments of the committee.

Contingency

The project has projected a variety of calculations on the potential sources of cost escalation. However, as the committee also notes the level of *contingency must be interpreted in view of the tolerance of ESO for different levels of uncertainty.* A projection of contingency applicable to a US Federally funded project has to cover all possible eventualities based on the fact that returning to Congress for additional funds is exceedingly difficult, if not impossible. This leads to a contingency that may be higher than is strictly needed. Within the framework of ESO, there is the possibility that the project can carry formal contingency, but also manage risk (at ESO Council level) by a second level of contingency – in effect holding future parts of the ESO programme as potential contingency. However, this does imply that the risk is low. The organization must have the resources to absorb the totality of the risk.

The project has undertaken a number of independent cost escalation analyses. All these calculations largely confirm the estimates of the contingency needed to execute the project. The different metrics calculated are not orthogonal to each other, nor are they necessarily to be

added in a linear manner. The interdependencies are complex. The project considers that the contingency allocated to the project shall be what is considered necessary to execute but shall not contain the entire risk exposure of the organization. The following rationale underpins this position. Funds allocated to E-ELT are removed from the long term ESO budget restricting the flexibility of the governing bodies to manage the overall programme. By allocating higher contingency than absolutely necessary the resource base for the organization is reduced. However, this logic does not imply that the total exposure to risk by the organization has been addressed by the allocation of the requested contingency. Rather it retains the authority over the contingency at the appropriate level, i.e. Council.

The project **concurs** with the committee that the *contingency held by the contractors shall not be considered to be available contingency funds at the project level.* These funds are clearly necessary for the execution of the contracts. It is a lien on contingency.

The 45-Million Euro projected cost escalation based on the formulae provided by the contractors for the dome and main structure FEEDs is based on past performance of these indices[2]. The number could be higher or lower depending on economic conditions at the time of application. It is therefore, as the committee identified, correctly held at the project contingency level.

Technical Points

Replies to the technical points that the board raised are not summarized here, as they were addressed point by point in a rather detailed reply. We note that none of them were critical and that the project concurs with the board that the current design is technically feasible.

[2] The indices are based on the CPI in the supply member states, the cost of steel, concrete and fuel in the countries of supply and the CPI in Chile. The index has been calculated for the past five years and an average deviation from the inflation correction of the ESO budget used to generate the differential escalation of the costs.