C-Beta Cost and Schedule Review Closeout

Erik Johnson, Chair

February 7, 2017

Charge

1-Technical

2-Project Scope

3-Cost and Schedule

4-Management and ES&H

5-Risk

6-Documentation

- Six topical areas
- Nineteen charge questions in total!

Review – Subcommittees

- Technical
  - Timur Shaftan
  - Michael Harrison
- Cost and Schedule
  - Maria Chamizo Llatas
  - Xiaofeng Guo
  - Ferdinand Willeke
- Management
  - Diane Hatton
  - Don Hartill
  - Erik Johnson

Deliverables

- Closeout Report
  - Presented on Tuesday, February 7
- Final Report
  - Developed from closeout slides (no surprises!)
  - Final due Monday, February 13
- Thoughts
  - Committee is very impressed with the progress
  - Strength and Enthusiasm of the team is quite evident
  - Hope our comments are helpful

2-Technical Systems

1-Technical

- Is the overall technical design conceptually sound and likely to meet the project's technical performance requirements?
  - **Yes.** The design is conceptually sound and major components (Gun, MLC) are based on tested and proven technology.
  - Spreaders need to be further designed and element tolerance studies completed and iterated.

- Has a technical plan at a level of detail sufficient to support construction been presented and documented?
  - **Conditional yes.** Machine specifications matched to the commissioning requirements should be finalized and element specifications developed and iterated.
  - The technical plan should hinge on the minimum performance required by KPP and/or project milestones however it should not preclude the design performance at the full machine built-out.

2-Technical Systems

2-Project Scope

- Are the project scope and specifications sufficiently well-defined to support detailed cost and schedule estimates?
  - **Yes.** Design is mature and appears to be studied well. Specifications need to be clarified and made consistent between subsystems (i.e. magnets vs power supplies) prior to their procurement.
- Are the scope apportionment and deliverables that are split between BNL and Cornell clearly established and well defined?
  - **Yes**
- Is a viable scope contingency plan in place, including decision criteria and branch points?
  - Scope contingency needs further work.
  - Budgetary contingency is low. The project may contain additional scope contingency. Detailed commissioning simulations may indicate the minimal scope of power supplies and diagnostics needed for reaching KPP goals.
- Are the NYSERDA milestones well defined?
  - **Yes.** While NYSERDA milestones are well-defined but not all are harmonized with the KPPS. Requirements for milestones 11 and 12 could be clarified.

2-Technical Systems

5-Risk

- Are risk analysis and mitigation strategies in place?
  - **YES.** Some of the mitigation plans in the risk registry are missing. Risks still need to be quantified in $ and schedule. Risks of major failures in the Gun, ILC or MLC are not addressed in sufficient detail and do not appear to be contained by the project.
- Is there a viable plan in place to track the risks as the project evolves?
  - **Not yet**
- Does the contingency estimate properly take into account the project risks.
  - The contingency budget at 2% of project cost seems is insufficient at this time. More work is required to identify additional scope contingency and perform value engineering.

2-Technical Systems

6-Documentation

- Has the necessary documentation been developed?
  - Conditional YES. Project features a descriptive Design Report, set of interface spreadsheets and Technical notes. It appears that the specification of magnet and power supply tolerances is not uniform between various documents. A standard specifications list that is assigned to every element and maintained by the project would be helpful.
- Does it adequately support the start of construction?
  - YES. C-Beta project should develop and optimize requirements for the vendors and reflect them in procurement documents.

2-Technical Systems: Findings

T. Shaftan and M. Harrison

- There is some inconsistency between the KPPs and the final Project Milestones.
- The project presented engineering design that is sufficiently mature.
- The major subsystems have been tested in operations and well documented (Gun, ILC, MLC, high power dump). Magnets and girders are in the engineering phase, splitters, and other systems are still in a conceptual design phase.
- A few important elements, including magnets and power supplies, are missing tolerance specifications. Tolerances for all of the splitter magnets at different fields are specified at 1E-4 level.
- Engineering estimate for commissioning is at 600 hours, which is low. Some of the commissioning effort is accounted in subsystem WBS.

2-Technical Systems: Comments

- The engineering design is sufficiently mature to warrant the start of construction
- Magnet tolerances are defined in the good field region as Central field uniformity and Field integral uniformity. Can one manufacture and measure magnets that conform to these specs (Table 2.5.1 in the Design Report)? The prototype magnet series will prove crucial in this regard.
- There are TBD's in the parameter table associated with magnet tolerance/field quality. Uncertainty in magnet specs will translate into uncertainty in budgetary estimates from vendor and may result in iterations on magnet alignment, shimming and mag measurements → Budget / schedule risk
- Tolerances for power supply (stability / ripple) are not specified for the power supplies except for the correctors. Are the power supply specs consistent with the magnet specs?
- Requirements on extra testing requirements, measurements, project reporting and QA in could increase the cost of magnet procurement
- A more comprehensive set of technical specs and drawings is required to proceed through procurement and fabrication of some of the components.

2-Technical Systems: Recommendations

- Consider reducing scope of diagnostics and correction elements based on the outcome of detailed commissioning simulations and magnetic measurements of the arc and spreader magnets.

- We suggest to develop a more complete tolerance studies focusing on maximum expected beta-beat for the uncorrelated quadrupole errors in the machine from different installation scenarios and connect the beta-beat with the element tolerances.

- Committee recommends an invitation to the NSLS-II ID group to share their experience with handling Permanent Magnet Material for FFAG magnets.

3-Cost and Schedule

M. Chamizo Llatas, X. Guo, F. Willeke

3-Cost and Schedule

- Are the cost, schedule and contingency estimates in support of construction credible and realistic? Yes, but there are some concerns on contingency estimates.
- Is a statussing and reporting plan/structure in place to allow regular tracking of project progress and cost performance upon receipt of funds? Good mechanism to track the progress but still developing formal cost performance measurement.

5-Risk

- Are risk analysis and mitigation strategies in place? Yes
- Is there a viable plan In place to track the risks as the project evolves? Needs improvement.
- Does the contingency estimate properly take into account the project risks? The contingency estimate is low, and the project teams needs to work on a risk based contingency analysis.

3-Cost and Schedule

M. Chamizo Llatas, X. Guo, F. Willeke

6-Documentation

- Has the necessary documentation been developed? Almost, a few documents need to be finalized, such as project schedule and cost profiles.
- Does it adequately support the start of construction? The project should be able to start the construction while finalizing those documents

3-Cost and Schedule

M. Chamizo Llatas, X. Guo, F. Willeke

Findings (I)

- A comprehensive cost estimate has been presented. It is organized in 13 level 2 WBS elements. The cost is captured in about 1500 activities. The length of the activities in terms of calendar days is between 10-40 workdays. An exception the WBS element 1.05 (FFAG magnets) which is described by only about 20 activities, sum of which have considerable length of several months.
- The cost estimate for many items to be procured is backed up by recent vendor quotes. The labor effort is based on previous experience or professional judgement.
- Cost appear to be fully burdened. CORNELL has zero overhead rate on labor and materials, 61% for project management, commissioning, travel and safety. BNL applies overhead rates vary from 13% to 36% for labor depending on category, 20%-35% for material depending on magnitude, 55% for travel, and under discussion the Extraordinary Project Rates. The was no assumption document with this summarizing the information. The activities are not yet connected by schedule logics.
- The contingency of the project is estimated to $468,135 which corresponds to 2% of the project and is driven by what was cut from the construction scope after the project was vetted. The scope of the project includes quadrupole magnets in the lattice but no power supplies are budgeted to power them.

3-Cost and Schedule

M. Chamizo Llatas, X. Guo, F. Willeke

Findings (II)

- The project dates for single pass beam with energy recovery is set for the 31 Oct 2019, and the four pass beam with energy recovery (low current) on the 31 Dec 2019. The end of the project is expected 30 April 2020.
- The project has a good reporting procedure and established a document format for quarterly progress reports to funding agency
- The first quarterly report will be submitted in near term
- The project team plan to have monthly progress briefing between BNL and Cornell project management office, which will include areas of technical performance as well as the cost performance.
- The technical team has daily project meeting to track progress and report problems
- The project team also receives monthly labor and expenditure reports
- The project has established a process for invoicing, accrual, and payment to timely capture monthly expenditures and ensure forward funding.

3-Cost and Schedule

M. Chamizo Llatas, X. Guo, F. Willeke

Findings (III)

- The team plan to do more robust project task status once the Resource Loaded Schedule (RLS) is completed.
- The project started the discussion of developing a formal process for task statussing and comparing the cost performance against the project plan.
- The project has developed a set of BoE in the format of Excel spreadsheets. The BoE contains summary of labor, material, travel cost input. The backup documentation, such as vendor quotes were presented, and are centrally managed
- The resource loaded schedule is still developing, and expect to be finished in 1 to 2 months
- The project presented cost summaries at WBS Level 2 and Level 3.
- The project plans to generate yearly cost profile reports once RLS is completed

3-Cost and Schedule

M. Chamizo Llatas, X. Guo, F. Willeke

Comments (I)

- The detail and granularity of the cost estimate is considered adequate for a project of this size. The length of the activity is about right to ensure satisfactory accuracy. Drill down of the cost indicate that the cost estimate is likely to be complete in capturing all the necessary activities in general.
- The labor for FFAG PM Procurement however does not show the same level of detail (20 activities) which does not match this judgement.
- The labor required for accompanying procurements (vendor visits, regular status meeting, and resolving issues, helping the vendor with technical problem etc.) is not explicetely shown everywhere.
- The absence of the resource leveled schedule makes it hard to calculate escalation of the cost accurately. Nevertheless, the overall credibility and completeness of the cost estimate appears to be satisfactory.
- The risks are clearly documented but need to include a date when the risk is over. This would help to track and remove the risks as the project evolves.

3-Cost and Schedule

M. Chamizo Llatas, X. Guo, F. Willeke

Comments (II)

- It is beneficial to establish a process for monthly task statussing and tracking of cost performance, at a level that is appropriate for the size of the project for efficient management, for example, it could be done at WBS Level 3 or Level 2.
- The risk table, though very detailed, should include the impact on the cost and schedule should the risk occur. At this stage it is not possible to asses if the contingency estimate presented by the project, 2%, properly takes into account the risks as there is no information on the impact on the cost and schedule of any of the risks.
- It is important to check the labor estimates to ensure that it does not contain hidden contingency, which will accumulate linearly and could lead to overestimation of the cost. The hidden contingency should be made explicit as an uncertainty of the estimate. Such uncertainties would contribute to the overall contingency but the contributions would be expected to accumulate statistically.
- The project team appear to be able to work closely together in monitoring the work progress.

3-Cost and Schedule

M. Chamizo Llatas, X. Guo, F. Willeke

Comments (III)

- Timely invoicing and payments need to be monitored carefully to ensure continuity in funding
- Monthly cost profiles are necessary for proper planning for cash flow and funding amendments
- A procurement schedule and fund obligation profile are useful in planning for advance funding request. Describe the activities for FFAG magnet procurement in a more detailed fashion after the procurement strategies have been finalized.
- It would be useful to clarify if milestone 12 (4 turns) and end of the project is considered as schedule contingency.

3-Cost and Schedule

M. Chamizo Llatas, X. Guo, F. Willeke

Recommendations (II)

- Complete the project schedule by April 7, 2017
- Review the cost estimate to ensure that all contingency is removed from individual estimates and collected at the highest level. Complete the review by March 17, 2017.

4-Management

D. Hatton, D. Hartill, E. Johnson

2-Project Scope

- Are the project scope and specifications sufficiently well-defined to support detailed cost and schedule estimates? Yes, and the estimates are maturing. Schedule details have yet to be incorporated.
- Are the scope apportionment and deliverables that are split between BNL and Cornell clearly established and well defined? Yes. The WBS structure clearly defines the deliverables and the responsible organizations.
- Is a viable scope contingency plan in place, including decision criteria and branch points? No. Some scope contingency items have been identified, but they are not sufficient to provide adequate flexibility to deal with challenges that are likely to arise. Decision dates and associated risk elements with impact dollars need to be included in the plan.
- Are the NYSERDA milestones well defined? Generally, yes. Requirements for milestones 11 and 12 may need to be clarified.

4-Management

D. Hatton, D. Hartill, E. Johnson

4-Management and ES&H

- Is the project being appropriately managed? Yes.
- Will the management model properly support the project goals? Yes.
- Have the anticipated roles and responsibilities of both the institutions and the project principals been adequately defined and understood by all parties? Yes. The roles are described in the Project Management Plan.
- Is the project team populated with sufficiently dedicated personnel to the necessary WBS level, and in the Project Office? Yes.
- Is there a sufficient level of Laboratory and University support to provide necessary oversight? Yes.
- Is the project's ES&H plan well-tailored to the project's technical goals and scope, and is it soundly based? Yes. The Project Management Plan refers to the ES&H policies and procedures at each institution.

4-Management

D. Hatton, D. Hartill, E. Johnson

5-Risk

- Are risk analysis and mitigation strategies in place? A foundational registry was presented but it needs further development to be an effective tool.
- Is there a viable plan in place to track the risks as the project evolves? The tracking of risks is not yet fully developed. Impacts should be quantified and estimated retirement dates should be included.
- Does the contingency estimate properly take into account the project risks? No. Without the above information, there is no way to tell how much contingency is enough based on risk.

6-Documentation

- Has the necessary documentation been developed? Not yet. Some project documents and scope definition are fairly mature, but the schedule needs further development. A Assumptions Document should also be developed.
- Does it adequately support the start of construction? It is adequate for the initial phase of execution, but needs further development to successfully carry the project through to completion. The project schedule needs to be completed and the scope contingency needs to be documented with decision points.

4-Management

D. Hatton, D. Hartill, E. Johnson

Findings

- The organizational structure for managing CBETA is articulated in the Project Management Plan and was presented to the review team.
- NYSERDA milestones have been identified and agreed to.
- A project schedule is under development.
- Contingency was presented at ~2% and a limited amount of scope contingency was identified.
- A Risk Register was developed and presented to the review team.
- Cash Flow issues related to NYS funding were identified and presented.
- The BNL Extraordinary Project Rate (EPR) has been assumed in developing the BNL cost estimate.
- The CBETA Project team presented their approach to managing the CBETA project – combining best practices from both Cornell and Brookhaven.

4-Management

D. Hatton, D. Hartill, E. Johnson

Comments

- Excellent progress has been made in the development of the CBETA plans!
- The organizational structure of the CBETA project appears appropriate and to be working well. The assignment of the BNL Project Manager is a valuable addition to the team.
- The review team found NYSERDA milestones 11 and 12 might be unclear and believe that some clarification could be beneficial.
- The project schedule is under development but needs to be completed so that the project team can be confident on their plans to successfully deliver the scope.
- The contingency as presented was not adequate for this stage of the project. There may be hidden contingency in the current estimates that should be identified and moved to the highest level to increase the % of contingency available to cover all project uncertainties and risks. Scope contingency will likely need to increase and value engineering efforts should continue.
- The risk registry needs to have a quantitative assessment of cost and schedule impact for each identified risk.

4-Management

D. Hatton, D. Hartill, E. Johnson

Comments

- The project team has a reasonable plan for addressing the NYS cash flow issues.
- Given the very tight scope, cost, and schedule constraints of this project, it is imperative that the Project team confirms the assumption regarding the use of the BNL Extraordinary Project Rate.
- The Cornell and Brookhaven CBETA team members are working well in combining their best practices for managing projects. They should continue to capitalize on these as they track work progress and cost against their plan.

4-Management

D. Hatton, D. Hartill, E. Johnson

Recommendations

- Add impacts (cost and schedule) to the risk register to tie risk to contingency. Complete by March 3, 2017.
- Identify additional items for scope contingency and include decision dates for removal. Complete by March 17, 2017.
- Perform a cost and schedule re-evaluation before April 14, 2017.