2.1 Accelerator and Beamlines

(WBS 2.0)

Graeme Murdoch, ORNL
Fulvia Pilat, BNL

2.1 Findings

- The scope of the project includes upgrades to the recycler, main Injector and NuMi beam-lines
  - Bearing in mind the funding profile in the last two years significant progress has been made since the CD#2 review
- The overall ANU design is presently 60% complete, with some areas at an earlier design stage e.g. kicker design-30%. Smaller than is typical for a project ready for CD-3b approval
  - Design work on the critical MI gap clearing kicker has been accomplished, albeit off-project, to a level of 70% complete
  - Recycler design work is progressing with the kicker systems being furthest behind, however, experience gained from the gap clearing kicker work will advance this task

Findings, cont'd

- **The project is working with several vendors to guarantee success for the manufacture of the kicker system ceramic tubes, the plan is to install these with seven kickers in the coming shutdown**
- **The design of the new NOvA target, horn production and installation plans are well in place, no significant technical risks are foreseen**
- **All un-started ANU tasks have been moved to start no sooner than Jan 2010**
- **There is general concern regarding the availability of manpower to complete the remaining tasks**
- **The project has completed a comprehensive resource loaded schedule for remaining accelerator work**
- **No one person as yet has been identified as the lead for shutdown activities**

2.1.2 Comments

- The Project – and the Laboratory - have made efficient use of off-project programs that are necessary for NOvA completion, examples are the modification of the 700kW NuMi horns and the production of the gap clearing kicker for the main injector
- The major impediment towards advancement of remaining design work on accelerator and beam lines has been manpower availability. NOvA competes with Operations (Tevatron, NuMi) and until recently with other efforts in the Accelerator Division (Project-X, R&D)
- The areas of design that are not yet completed do not seem to present significant technical risks and the committee is confident that the very competent NOvA team has the necessary technical expertise well in hand. The main risk is associated with potential insufficient resources and schedule delays

Comments, cont'd

- **The operational experience with the low energy target and NuMi operations is important to plan operations and improve reliability of the NOvA beam-line**
- **The Tevatron will potentially end operations at the end of FY11. At present Recycler installation and beam line installation start well into 2012. This presents the project with an opportunity to advance the schedule**
- **The project team should identify what resources are necessary to advance the schedule for accelerator and beam lines to the end of FY11 and merge the Recycler and NuMi shut-downs**
- **The scope of removal/installation work is wide enough that plans for shutdown coordination should be put in place ASAP**

2.1.3 Recommendations

1. **Determine the resources required to complete the work and obtain a commitment from the laboratory management to supply the necessary resources. Update the resource loaded schedule to reflect the updated planned commitment.**
2. **Identify a shutdown coordinator to work on detailed organization of the complex shutdown activities**

Response to Charge

1. Final Design: Is the design sufficiently mature so that the project can initiate procurement and construction? For those elements of the design that are still not finalized, has the project convincingly shown that there are no major issues that need to be addressed and that they are on a clear path to a final design?

   Designs in the critically technical areas are either complete or mature enough to initiate procurement. Designs that are not finalized have no major technical issues and the project identified a clear path to final design

4. Construction: Has there been adequate progress on the construction activities approved under CD-3A? Have Fermilab and the project done the necessary preparations to execute the remaining construction activities?

   Approximately 50% of CD-3A items will be committed

5. Documentation: Is the documentation required by the DOE Order 413.3A for CD-3B complete? Has the CD-2 documentation been updated to reflect any changes resulting from the final design?

   Documentation for finished designs is complete. CD-2 documentation has been updated.

2.2 Sites and Buildings

Scope: Construction of Near Detector Cavern, Near Detector Surface Enclosure, and Ash River Access Road and Building.

2.2.1 Findings

- Final Design of the Near Detector Cavern has not started.
  - No technical issues identified.
  - Preliminary cost estimate reasonable.
  - Selection of A/E for Near Detector Cavern final design is in negotiation phase.
  - IDIQ-type contract for design services exist.
  - Final Design duration planned for 12 months.
  - Construction Contract Award planned 6 months PRIOR to shutdown.
  - Key staff assigned to this task.

SC-2 Sites and Buildings

Jess Albino, SLAC
Ove Dyling, BNL

- Final Design of Near Detector Surface Enclosure
  - No technical issues identified.
  - Cost estimate appears adequate and maybe a little high.
  - Project team must select type of construction
  - Complete final design (relatively small expense)
  - Construction enclosure.
  - Key staff assigned to this task.
- Construction of Ash River Site underway (approved as part of CD-3A)
  - No technical issues identified.
  - Cost is under the Owner's estimate.
  - Schedule is shorter than baseline.
  - Key Staff assigned to this task.
  - Construction of Access Road is underway
  - BLAST OFF! First round of excavation started with a blast Monday July 20, 2009.

2.2.2 Comments

- **Final Design of Near Detector Cavern**
  - **The design and construction of the cavern pose no technical issues. The size, shape and location of the cavern are based on preliminary, two-dimensional geotechnical analyses in shale.**
  - **The ground is well characterized. The new underground construction represents approximately 10% of the previous excavation for the MINOS cavern and due to the proximity, the ground characterization is well known and understood.**
  - **The most significant aspect of the design for the new cavern is the size of the rock pillar that will remain between the new and existing tunnel/cavern. The size of this pillar will be evaluated during the final design.**
  - **A second access will be provided between the two caverns for emergency exit reasons.**
  - **The preliminary cost estimate is reasonable and complete. Two separate cost models have been provided by separate consultants. The cost models were reconciled and the construction method was selected. This will assist with the preparation of the final design and future construction cost estimates.**

SC-2 Sites and Buildings

Jess Albino, SLAC
Ove Dyling, BNL

- The design phase should be completed as soon as possible. Complete the design in time to award a construction contract well in advance of the planned beam shutdown. Assuming some conservative durations for the design and construction periods, the final design should start within the next few months. This will provide the best opportunity for the project to meet schedule for installation of the 6-block detector test assembly in the Near Detector Cavern.
- Negotiations for the final design are underway with a selected A/E firm with experience at FNAL so the project is well positioned to take advantage provided the funding is released soon. The design cost estimate in hand needs some review to align with the current construction plan. FNAL has on-call contracts with several A/E firms so awarding this design should not be a prolonged process. The duration is estimated to be 12 months and this should allow the advertising for construction to proceed in time for contract award well in advance of the planned year-long shutdown. This is a good thing.
- FNAL has assigned the key staff to undertake this task. The task is appropriately staffed to undertake the final design of the Near Detector Cavern.

- Final Design of Near Detector Surface Enclosure
  - No technical issues identified. A study of various locations for the near detector has taken place including placing it inside an existing building. The general consensus is that a temporary stand along building will be the best option. The near detector will be located near an existing building to take advantage of existing utilities being available.
  - Cost estimate appears conservative and maybe a little high.
  - A comprehensive study of various building material has taken place and a precast concrete structure has been determined to meet the needs for a temporary structure and could be disassembled and relocated after it has served its purpose of housing the near detector. An IDIQ order Architect/Engineering firm can complete the design in a relatively short time. A key staff member has been assigned to this project and the programming should be a smooth familiar process. The same person however is not assigned to the Near Detector Cavern project which will have the same programming as the near detector surface enclosure.
  - The near detector enclosure should be designed, awarded and constructed prior to the detectors arriving from Argonne to avoid double handling of the detector.

SC-2 Sites and Buildings

Jess Albino, SLAC
Ove Dyling, BNL

- Construction of Ash River Site underway (approved as part of CD-3A)
  - No technical issues identified. Six bids received and they were within 1.3% of each other.
  - To mitigate risk on the site an Unforeseen Condition clause was added to the bid package and the successful general contractor accepted this clause.
  - The successful bid was $15 million below the CD-3A estimate. The general contractor preliminary construction schedule has the project being completed three months earlier than the baseline schedule. Construction of access road is under way and the first round of rock removal took place on Monday. A key staff member is assigned to manage this project for FNAL in conjunction with University of Minnesota which will oversee the construction.

2.2.3 Recommendations

- 1. Award the final design contract for the Near Detector Cavern and the Near Detector Surface Enclosure by October 1, 2009.
- 2. Re-evaluate contingency for the various projects. Suggest 15% contingency estimate be added to the construction (Ash River Project) for owner-directed and contractor changes. Suggest 30% contingency estimate for work to go on the Near Detector Facilities. Complete by October 1, 2009.
- 3. Prepare a list of tasks that can be advanced to the benefit of the project. This list should include purchase of equipment and materials that can be purchased now and effectively obligate the current funding. Complete by September 1, 2009.

SC-2 Sites and Buildings

Jess Albino, SLAC
Ove Dyling, BNL

- **Charge Questions**

1. **Final Design:** Is the design sufficiently mature so that the project can initiate procurement and construction? For those elements of the design that are still not finalized, has the project convincingly shown that there are no major issues that need to be addressed and that they are on a clear path to a final design?

   Construction at Ash River is underway. The construction documents resulted in good bid results and the supplemental project funds allowed the project to combine two construction contracts into one. The Near Detector facilities are ready to advance to final design.

2. Baseline Cost and Schedule: Are the current cost and schedule projections consistent with the approved baseline cost and schedule? Is the contingency remaining adequate for the risk?

   Cost for construction and design are consistent with the current baseline, however the project schedule should be re-evaluated due to the increase in ARRA funds. Project contingency is adequate, but distribution for sites and buildings should be reviewed.

SC-2 Sites and Buildings

Jess Albino, SLAC
Ove Dyling, BNL

3. Management: Evaluate the management structure as to its adequacy to deliver the proposed final design within specifications, budget, and schedule. Has the project responded satisfactorily to the recommendations from the previous independent project review?

   The subcommittee was advised that field supervision on the Ash River portion is provided by a consultant. The consultant has no authority to act on behalf of the Laboratory. This effectively means that the Laboratory does not have representative with contractual authority on the construction site.

4. **Construction**: Has there been adequate progress on the construction activities approved under CD-3A? Have Fermilab and the project done the necessary preparations to execute the remaining construction activities?

   Construction progress at Ash River is satisfactory to the staff however, earned-value is low and may continue until corrective actions are employed. Project needs to approve the selection of the A/E for final design of the Near Detector facilities.

5. **Documentation:** Is the documentation required by the DOE Order 413.3A for CD-B complete? Has the CD-2 documentation been updated to reflect any changes resulting from the final design?

   Documentation required for CD-3B has been completed. CD-2 Documentation has been updated.

2.3 Commodities: PVC Extrusions, Fiber, Scintillator

2.3.1 Findings

- Commodities include the PVC Extrusions, Fiber, and Scintillator.
- The design is at the ~95% level (varying from ~80% to 100%).
- The Commodities are fully specified and vendors have been identified.
- The QC and QA plans are well defined.
- The shipping and transportation plans are well defined.
- The cost and schedule contingency appear adequate with a few concerns as discussed in the comments.
- Mineral oil costs assume a crude oil price of $75/barrel with increased contingency that would cover a price up to $128/barrel.
- There is only one vendor (Kuraray) for the fiber. However, there is a reliable quote for a fixed fiber price (JPY).
- The schedules for PVC Extrusions, Fiber, and Scintillator have been advanced recently by 5-10 months.

SC3: Bill Louis, LANL
Kevin McFarland, Rochester

2.3.1 Findings (Cont.)

- CD3a has allowed for the purchase of waveshifters (PO issued), PVC extrusion tooling, and the purchase of 1000 km of fiber.
- There are clear lines of responsibility for Commodities.
- The personnel involved with Commodities are experts in their field and well aware of various problems that may arise.

2.3.2 Comments

- Just-in-time purchase of oil, pseudocumene, PVC resin and additives carries cost and availability risk. We encourage a re-investigation of early procurement and storage (in whole or in part) to reduce these risks.
- We encourage consideration of increasing the baseline amount of fluor by 20%. This would increase light output by 10% and would reduce number of modules that do not meet the goal of 28 photoelectrons.

2.3.2 Comments (Cont.)

- Documentation of WLS Fiber QA/QC is required for CD-3B. Procedures are well developed, and a document incorporating results from R&D spools is in preparation.
- Extrusion costs (>$10M) are based on a quote from a single vendor dated May 2007. The risks of reliance on a single vendor may mean that contingency of 25% is too small.
- Some commodities waste fractions (0% on scintillator elements and 3% on fiber) are very small. A more pessimistic waste assumption could be included in the base cost and not as part of cost contingency.

2.3.3 Recommendations

1. Procure the PVC Resin, Extrusions, Fiber, and Scintillator as soon as needed.

2.4 PVC Module and Production

Dick Loveless, U. of Wisconsin
Steve Kane, BNL
Charlie Pearson, BNL

•Findings

- PVC module factory will assemble 12,000 modules in about 2 years
- Optical fibers for readout installed in all cells (32 cells per module).
- Factory area is about 60,000 sq. ft with additional 65,000 sq.ft. for storage of extrusions and finished modules
- Assembly team of ~30 students and 5 technicians will produce 30 assembled modules per day.

Comments

- Design is well-advanced but some details remain. They still need work on integration with other subsystems.
- Manifold design looks good, although prototyping is late (probably Nov) which is delaying full-size prototype testing.
- U. of Minnesota team should be commended for a thorough and enthusiastic approach to the assembly task.
- Training procedures for students/technicians seem well-designed, most tasks have extensive time/motion studies, and the assembly task looks possible, although ambitious.
- Gluing procedures have been extensively prototyped and the two-glue solution looks very good. Full-sized prototypes (with manifolds) should be assembled as soon as possible to identify potential problems.
- Many QA procedures have been developed and extensively tested.

Recommendations

1) Improve integration coordination to devise effective scintillator loading/draining procedures.

2) Provide additional engineering to finish factory tooling items and certify compliance with safety codes.

3) Complete documentation of assembly, test, QA, and training procedures and have them reviewed by NOvA management.

Findings

The Electronics system consists of ~12,000 detector-mounted avalanche photodiodes modules (APD), front end boards (FEB) and associated power and cooling.

The DAQ system consists of data concentrator boards and timing distribution boards. In addition there is DAQ software and DCS hardware and software for slow controls.

About 50% of the total cost is in the APD assemblies, purchased components, whose cost will be determined after the vendor's prototype run in late 2009.

The front end board (FEB) is in near final state of prototyping and incorporates a NOvA custom ASIC.

A new cooling concept has been proposed which would greatly simplify the system integration by eliminating cooling H2O.

R. Van Berg, P. O'Connor

Findings

A vertical slice test has been performed which couples a single prototype APD and FEB to a small but representative detector element and the performance was found to be adequate.

An integration test of FEB to DCM is underway.

High and low voltage power supplies from two possible vendors are under evaluation.

Test stands and test procedures are being developed for the APD and FEB.

Detailed designs and mockups have been made for detector services routing.

There are advanced designs for the DAQ custom hardware.

Resources to re-staff the DAQ effort after the effects of the budget crisis have been identified and requirements documents are in place.

R. Van Berg, P. O'Connor

Comments

The Near Detector surface test is a 1/50th scale test of the far detector and provides a critical opportunity to identify possible performance issues not uncovered in the vertical slice test. It may also be useful in demonstrating the completeness of the integration plan and verifying the new cooling concept. This test, conducted aggressively, should serve to qualify all the final hardware designs.

The design of the system services and DAQ and DCS components is complete and opportunities to bring forward some procurements should be identified.

Packaging and testing of the ADCs from CERN was approved at CD3A but there has been little progress. Delays related to export control issues have been cited but follow up is needed.

Comments

The ease of access, the programmability of many hardware parameters and in-situ firmware updating of the system provide great flexibility to deal with unanticipated experimental conditions.

There is an ambitious plan for signal processing firmware in the FEB. A detailed requirements document should be put in place and the adequacy of the available resources should be evaluated. Including another collaboration member in this activity could mitigate some risk.

Despite repeated recommendations to hold technical reviews, none appear to have been held. The present review was too brief to serve as a detailed technical review taking advantage of available external expertise.

Comments

The newly assembled DAQ software team appears to be off to a good start. However, the team is spread over several institutions and many individuals. The effectiveness of this team in completing their tasks should be carefully monitored.

The electronics cost, at roughly $50 / channel, is in line with other similar systems, but the basis of estimate has not been revised since the previous Lehman review and should be revisited / updated.

The formal schedule shows roughly a year of float. Management should carefully monitor and plan for possible delays in critical components (APD, ASIC, ADC) . In addition, early physics opportunities may be missed unless some fraction of the electronics system is available prior to the schedule driven dates.

R. Van Berg, P. O'Connor

Recommendation

- **Conduct technical design review(s), including outside experts, prior to procuring critical components.**

R. Van Berg, P. O'Connor

2.6 Near/Far Detector Assembly

Bill Wisniewski, SLAC
Richard Boyce, SLAC

- **Findings and Comments**
  - There has been significant progress in the last six months in moving WBS 1/2.8 and WBS 1/2.9 forward:
    - Design of Near Detector Technical Systems is ~75% complete. For the active detector and south bookend, the design is at ~95% level. Other items, such as the muon catcher, are less mature, but there is a clear path forward. Construction of the Near Detector blocks is ready to proceed.
    - Design of the Far Detector is estimated at ~70% complete. Some of the critical tooling has been prototyped, with lessons learned from use fed back into completing final design. There is a clear path forward on design. However, matrixing of engineering effort at Fermilab presents a serious challenge to completing the design. The design should be finished in less than a year if adequate engineering resources are available.

2.6 Near/Far Detector Assembly

Bill Wisniewski, SLAC
Richard Boyce, SLAC

- **Findings and Comments**
  - The validity of the finite element analysis of block stability was confirmed by expert review, and, more importantly, by the measured performance of prototypes.
  - The construction of the full Near Detector, for installation in a surface building, has been advanced. Design of the muon catcher should be aggressively pursued. The completed mechanical detector provides a critical test bed for the readout, as well as an excellent opportunity to gain experience with the performance of detector before it is lowered into the cavern. The full instrumentation of this detector should be given high priority.
  - The Near Detector Surface Enclosure construction must be pursued in a timely manner to provide maximum benefit from the Near Detector tests.

2.6 Near/Far Detector Assembly

Bill Wisniewski, SLAC
Richard Boyce, SLAC

- **Findings and Comments**
  - The module lifter and gluing machine have been prototyped at full scale. The process took three months longer than expected, but the resulting devices have performed very well.
  - Time and motion estimates for Far Detector block assembly have been validated, with minor adjustments, via experience gained in the construction of the Full Size Assembly Prototype.
  - Planning for the Full Height Engineering Prototype is well advanced. This provides a test bed for the Block Pivoter, a device critical to the construction of the Far Detector.
  - Construction of the Block Pivoter has been advanced ~six months with respect to the baseline schedule. Design of this device has progressed. A conceptual design review was held, with feedback from the review folded into the design. Weld-up of the FHEP bookend gives some confidence that the welding scheme that will be used to assemble the Block Pivoter will produce a surface that meets flatness requirements for block assembly.

2.6 Near/Far Detector Assembly

Bill Wisniewski, SLAC
Richard Boyce, SLAC

- **Findings and Comments**
  - An attractive solution for the worker platforms that surround three sides of the assembly table atop the Block Pivoter, and which must provide a safe elevated work platform, has been identified. The cost of this commercial procurement is reasonable.
  - Work on electronics associated infrastructure has moved forward with the addition of university personnel to the effort. Concern remains for the effectiveness of the overall integration effort.
  - Scintillator filling system design has progressed adequately.
- **Recommendations**
  - Conduct a final design review of the Block Pivoter incorporating the experience gained from the FHEP block pivot prototype before release to fab. Include a thorough look at worker safety; fall protection issues need very careful consideration.
  - Near Detector Assembly is ready for CD3B approval.

2.6 Near/Far Detector Assembly

Bill Wisniewski, SLAC
Richard Boyce, SLAC

Near Detector: WBS 2.8

1. Final Design: Is the design sufficiently mature so that …they are on a clear path to a final design?

   Design for Technical Systems is ~75% complete. For the active detector and south bookend, the design is at ~95% level. Other items, such as the muon catcher, are less mature, but there is a clear path forward. Construction of the Near Detector blocks is ready to proceed.

4. Construction: Has there been adequate progress …

   Change control actions added this early Near Detector assembly to the CD3A scope recently, advancing the construction schedule by two years. Tooling needed for the construction is in hand.

5. Documentation: Is the documentation …complete?

   Documentation exists in the NOvA repository. Drawings have been completed.

Far Detector: WBS 2.9

1. Final Design: Is the design sufficiently mature so that …they are on a clear path to a final design?

   Design for this WBS is estimated at 70% complete. Some of the critical tooling has been prototyped, with lessons learned from use fed back into completing final design. There is a clear path forward on design. However, matrixing of engineering effort at Fermilab presents a serious challenge to completing the design. The design should be finished in less than a year if adequate engineering resources are available.

4. Construction: Has there been adequate progress …

   No items from this WBS are CD3A.

5. Documentation: Is the documentation …complete?

   Documentation exists in the NOvA repository. Many drawings are already complete and are available from the drawings repository.

3.1 Findings

- The Environment, Safety, and Health programs are effective and properly staffed. The staff is highly experienced and provides appropriate support to the project.
- The Environment, Safety, and Health aspects of the project are being properly addressed. NEPA documentation has been finalized, and all required permits have been identified and acquired to support construction at the Ash River site.
- Integrated Safety Management (ISM) principles are effectively incorporated into the project.
- The project has responded satisfactorily to the recommendations from the previous independent project review!

3.2 Comments

- **Staffing levels and areas of expertise are appropriate for this stage of the project; the ESH program will provide appropriate and timely support.**
- **ESH staff were properly involved in all phases of work planning, and have excellent knowledge of the plans. Of note, the appropriate hazard analyses have been completed, and the respective safety documentation is sufficient for this stage of the project.**
- **Project spans two national laboratories, numerous educational institutions, and two States. Examined Project Execution Plan as well as Memorandum of Understanding (UM and FNAL); ESH roles, responsibilities, and jurisdictions are clearly identified.**
- **Project support documents are extensive and well-written, and efforts to update and maintain the documents are planned.**

3.3 Recommendations

- **ESH interfaces between all parties have been formalized; staff should ensure communications are maintained throughout project (ANL, FNL, and UM). Specific examples are IH monitoring of PVC Operations and Hoisting and Rigging Operations at Ash River.**

5. Schedule and Funding

Tom Fornek, SLAC
Kurt Fisher, DOE/SC

- **Findings**
  - **A comprehensive work breakdown structure (WBS) exists for the NOvA project and fully identifies the project scope.**
  - **The NOvA total project cost is 278 million dollars of which 255.5 is to-go work and includes 80.5 million dollars of contingency.**
  - **The current NOvA project schedule completion, CD-4 date is November, 2014**
  - **The project is 11% complete.**
  - **The NOvA project baseline schedule has 200 days of float, the current NOvA project working schedule has 275 days of float.**

5. Schedule and Funding

Tom Fornek, SLAC
Kurt Fisher, DOE/SC

- **Findings (Cont'd)**
  - **A critical path schedule for the NOvA project has been developed and is being utilized. This schedule has 3688 activities and 463 milestones.**
  - **A robust risk management process has been developed, subject matter expert opinion is utilized to identify affects on contingency. There are 16 high risks, they are the only ones with risk mitigation plans required.**
  - **Funding Profile – Post recovery act funding profile exceeds the cumulative costs and obligations.**
  - **Project Controls / EVMS - An EVMS system has been established and is being implemented.**
  - **The approved baseline provides the approved CD-2 plan for cost, scope and schedule modified with Estimate to Complete information.**

5. Schedule and Funding

Tom Fornek, SLAC
Kurt Fisher, DOE/SC

- **Comments**
  - **The schedule is assumed to be constrained by labor resources, this hinders the opportunity to take advantage of schedule advancement opportunities.**
  - **The NOvA project "to go" contingency of 46 percent is healthy.**
  - **ARRA funds were received on May 15, 2009, some advantage was taken to advance portions of the schedule. Opportunities exist to be more aggressive with advancing the schedule.**
- **Recommendations**
  - **Evaluate additional opportunities to further advance schedule with available contingency prior to CD-3B.**
  - **Utilize a structured risk management review process to pro-actively improve performance.**

6.0 Management

Derrick Mancini, ANL
Howard Gordon, BNL
Kathy Johnescu, DOE/BSO

6.1 Findings

- MOUs and contracts are in place for all institutions.
- The PEP has recently been updated, but it has not been finalized and further adjustments are underway.
- A checklist was provided indicating the CD-3 documentation required, what documents satisfied these requirements, and where the documents could be found posted on the review website.
- A single page master schedule with critical path was shown. Overall schedule contingency is at 10 months in the baseline and 13 months in the working schedule.

6.1 Findings

- All project management systems are in use by the project, including configuration control, project document control, engineering document control, and change control (the EVMS and costing system (Open and Cobra), the NOνA DocDB, the Change Control Database (MS Access), and existing Fermilab engineering document management systems). The methods of configuration control are aligned with the PEP.
- Formal change control is in place, is a robust system that has been regularly exercised with 80 changes to date.
- The EVMS has recently been reviewed for DOE certification.

6.2 Comments

- The project should be commended for their efforts to respond to continuing changes in funding profile since baselining the NOνA project.
- The project team is a good one with the WBS managers fully engaged in executing their level 2 elements of the project.
- MOUs and contracts are in place for all institutional partners and appear to be working.
- The required documentation is in place for final CD-3.
- Staffing has remained an issue as resource requirements of the project and availability of resources change.

6.2 Comments

- Risk registry is detailed, but unclear if it is being fully utilized and updated on a regular basis.
- In some cases, contingency estimates may not reflect all risk, although there is more than adequate total contingency in cost and schedule available at this stage of the project.
- Delineation of "unassigned contingency" is unclear, especially with respect to planning for future contingency use when risk is retired. For the unassigned contingency, the project should distinguish between those funds that are in fact held to mitigate risks, and those that are unencumbered and could be used for enhancements or acceleration of the project.
- All the tools are in place and operating to successfully manage the project, but management should make more use of project management tools for what-if scenario analyses.

6.3 Recommendations

1. Update and finalize the PEP.
2. Update the schedule to take into account the changes that have occurred in funding profile, and currently anticipated changes in resource allocation and availability and work planning.
3. Update the contingency estimates to include all risks.
4. Utilize available contingency funds to mitigate risks and advance the schedule.
5. Approve CD-3b for the NOνA project after addressing these recommendations.