U.S. Department of Energy's

Office of Science

Review Committee Report

NuMi Off-Axis Neutrino Appearance (NOνA) Experiment

Daniel R. Lehman, Chairperson

DOE/SC Review Committee

October 23-25, 2007

http://www.science.doe.gov/opa/

Charge Questions

1. Technical Scope: Review the technical scope in order to assure that the proposed design and associated implementation approach satisfies the performance requirements.
2. Cost Estimates: Is the cost estimate consistent with the plan to deliver the technical scope with the stated performance?
3. Does the project satisfy all 16 lines-of-inquiry?
4. Management: Evaluate the management structure as to its adequacy to deliver the proposed technical scope within specifications, budget, and schedule.
5. Limited Construction: Are the requested long-lead procurements and other construction activities scheduled for FY 2008 necessary to achieve the stated schedule? Have Fermilab and the project done the necessary preparations to execute these activities during FY 2008?
6. Are ES&H aspects being properly addressed and are future plans sufficient given the projects current stage of development?

U.S. Department of Energy

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Review Committee Participants

Department of Energy Review of the
NuMI Off-Axis Neutrino Appearance (NOvA) Experiment
October 23-25, 2007

Daniel R. Lehman, DOE, Chairperson

	SC1		SC2		SC3		SC4
	Commodities: PVC/Fiber/ Scintillator		**PVC Extrusion Module & Near/Far Detector Assembly**		**Electronics and Data Acquisition**		**Accelerator and Beamlines**
*	Richard Hahn, BNL	*	Bill Wisniewski, SLAC	*	Andy Lankford, UC Irvine	*	Rod Gerig, ANL
	Jim Proudfoot, ANL		Dick Loveless, U. of Wisconsin		John Haggerty, BNL		Fulvia Pilat, BNL
	Bill Louis, LANL		Jim Krebs, SLAC		Rick Van Berg, Penn		Graeme Murdoch, ORNL
			Martin Nordby, SLAC				

	SC5		SC6		SC7		SC8
	Sites and Buildings		**ES&H**		**Cost, Schedule, and Funding**		**Management**
*	Jim Lawson, ORNL	*	Steve Trotter, ORNL	*	Barb Thibideau, ORNL	*	Derrick Mancini, ANL
	Ove Dyling, BNL				Steve Tkaczyk, DOE/SC		David Dale, BNL
	David Saenz, SLAC						Scott Mallette, DOE/TJSO
							Gail Penny, DOE/BHSO

	Observers						**LEGEND**
	Dennis Kovar, SC-25		Pepin Carolan, DOE/FSO			SC	Subcommittee
	Mike Procario, SC-25		Steve Webster, DOE/FSO			*	Chairperson
						Count:	**24 (excluding observers)**

Report Outline/Writing Assignments

Executive Summary .... Tkaczyk

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     - 2.1.1 Findings
     - 2.1.2 Comm ents
     - 2.1.3 Recommendations
   - 2.2 PVC Extrusion Module and .... Wisnie w ski /Subcommittee 2
     Near/Far Detector Assembly
   - 2.3 Electronics and Data Acquisition .... Lankford /Subcommittee 3
   - 2.4 Accelerator and Beamlin es .... Gerig/Subcommittee 4
3. Sites and Buildings (Charge Questions 3, 5) ..... Lawson/Subc ommittee 5
4. Environment, Safety and Health (Charge Questions 3, 6) ..... Trotter /Subcomm ittee 6
5. Cost Estimate (Charge Questions 2, 3) ..... Thibideau /Subcommittee 7
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7. Mana gement (Charge Questions 3, 4) ..... . Mancini/Subcommittee 8

2.1 - Commodities

PVC

Wavelength-Shifting Fiber (WLS)

Liquid Scintillator

[LS = MO (Mineral Oil) + PC (pseudocumene) + fluors]

Subcommittee: Richard L. Hahn, BNL

Bill Louis, LANL

Jim Proudfoot, ANL

SC1 Response to Charge Questions

1. **Technical Scope:**

- Designs for PVC cells, the WLS fibers, and the LS are satisfactory to meet the physics goals
- QA procedures are thorough, well thought out

2. **Cost Estimates:**

- The costs seem reasonable, especially for the early FY's. But the cap of $260 M may be insufficient <u>to build and fill ~15 kTon</u> detector
- Contingency ~27% not unreasonable
- Yearly escalation ~2.2% seems low but may be ok if cost & schedule risks are properly considered.
- <u>Risks: in FY-11 and 12, 4-5 years from now, will produce 85% of extrusions, 60% of fiber, 80% of LS. Is ~1/3 of total cost.</u>
- Vulnerability due to market-driven cost of oil has been considered. <u>Intrinsic cost/schedule risks have not</u>. <u>Possible mitigation steps</u>?
- **The 16 lines of inquiry for EIR** have been addressed

SC1 Response to Charge Questions

4. **Management:**

- In general, planning and execution are good; schedule OK
- But need to improve uniformity of written documents, traceability
- Some BOE's are unclear, too fragmented, lack supporting material e.g., MSDS's, QA procedures, which are often readily available

5. **Construction and long-lead items:**

a) In general most issues have been considered
b) Long lead time for WLS production is included in the schedule
c) Waiting for beneficial occupancy of detector **building is bottleneck. Consider decoupling commodity production from Ash River building?**

Details of SC1 Response

Findings

- The committee commends the commodities group on their impressive work and attention to technical details
- Basic cost estimates are sound
- The design of the detector area is good, with inclusion of secondary containment for potential LS leaks to prevent ESH problems
- The plan for an INPD integration prototype is excellent. But there are no plans at present to build a full-scale prototype
- Structural analysis is sound with appropriate engineering reviews
- **Cost/schedule risk analysis for FY-11-12 is inadequate**

Comments

- Shipping schedule is very tight, is “just in time shipping”
- The location of the toll blender is a key logistical issue
- Consider increasing storage capacity for extrusions and completed PVC modules
- We commend the group on the decision to use a commercial toll blender

Recommendations

1. **Reevaluate production schedule and budget profile to <u>mitigate</u> cost/schedule risks from significant procurements in FY-11-12.**
2. Procurement of PVC cells, PC, MO and fluors, should be coordinated to maximize the number of completed modules within the existing budget
3. Resolve the noted inconsistency in what different groups in the collaboration are quoting for the required number of photoelectrons.

READY FOR CD-2 ONCE THESE RECOMMENDATIONS HAVE BEEN ADDRESSED

2.2 PVC Module Production & Near/Far Detector Assembly

Jim Krebs, Dick Loveless, Martin Nordby, Bill Wisniewski

PVC Modules

EIR Lines of Inquiry:

1. Schedule & Resources: Satisfactory
2. Cost & Schedule Assumptions: Satisfactory
3. Critical Path: Satisfactory.
4. Funding Profile: Satisfactory. Just-in-time delivery.
5. WBS: Satisfactory.
6. Risk Management: Satisfactory
7. Basis of design: Satisfactory
8. Design review: Satisfactory.
9. System Functions & Requirements: Satisfactory
10. Hazards analysis: Satisfactory
11. Value Engineering: Satisfactory
14. Test Plan: Satisfactory.

Comments:

The committee commends the team for the outstanding work they have done since the CD-1 review:

- time and motion studies have been performed for the majority of tasks associated with PVC module production, providing a solid basis for cost and schedule estimates.
- value engineering has led to the consolidation of module production into a single factory, reducing costs and risks. Floor space adequate for the module production task, along with a small buffer space for extrusions and completed modules has been planned. The committee encourages the team to investigate cost effective ways of renting additional emergency buffer space.
- an elegant two glue solution, with specialized mechanical fitments, has been developed to maintain scintillator/oil purity while providing a strong structural seal against leaks at the manifold and bottom seal.

PVC Modules

Comments (continued):

- an extensive Q/A program has been developed to assure that the modules are leak-tight and the scintillator fibers are undamaged after stringing. Results are available at other production stages via a common database.
- plans for mitigation of safety issues with the PVC glue vapors have been developed. The committee encourages investigation of a curtain system to enhance worker safety. A safety review which includes external safety experts should be held well in advance of the beginning of production.
- contingency appears to be adequate to the task at hand. Although the labor contingency might appear light, effort can be readily expanded via an increase in the student labor force at modest cost.
- a risk analysis has been performed. Risks (13) are correctly identified as low priority. The critical path has been evaluated. Adequate performance measurement techniques have been developed.
- a number of design reviews have been held; more are scheduled. The production readiness review should include outside reviewers.

Recommendations:

1. Ready for CD-2 approval

Near & Far Detector Assembly

EIR Lines of Inquiry:

1. Schedule & Resources: Satisfactory
2. Cost & Schedule Assumptions: Satisfactory
3. Critical Path: Satisfactory.
4. Funding Profile: Satisfactory. Small adjustments have the potential to ameliorate major risk.
5. WBS: Satisfactory.
6. Risk Management: Satisfactory.
7. Basis of design: Satisfactory
8. Design review: Satisfactory. Block pivoter conceptual design review before 12/31/07
9. System Functions & Requirements: Satisfactory
10. Hazards analysis: Satisfactory
11. Value Engineering: Satisfactory
14. Test Plan: Satisfactory.

Comments:

The committee commends the team for the outstanding work they have done since the CD-1 review:

- the committee was impressed with the FEA of the PVC block, as well as the detailed experimental verification of the performance of the PVC extrusions and glue.
- Near Detector planning complexity, seen during the CD-1 review, has been reduced by the introduction of the new cavern, though at a large cost.
- the cost estimate and contingency appear to be adequate to the task at hand on average. The schedule appears to be reasonably developed, with acceptable float.
- the WBS is quite well developed. However, the committee notes that access to back-up information for the BOEs is awkward for review.

Near & Far Detector Assembly

Comments (continued):

- considerable progress has been made adapting to changes in block module assembly required by the value engineering based reduction of the Far Detector building. There is some schedule risk associated with outcome of ironing out the block assembly procedure.

- safety has received consideration in the development of block assembly procedures. The team should consider incorporation of moveable platforms onto the block pivoter in order to ameliorate safety risks. A safety engineer will be available on site at the FD building for one shift a day. The committee feels that, in the early days of two shift operation, it would be beneficial for safety engineer oversight to be available during both shifts.

- the committee feels that safety engineering must be closely coupled to the design process and activities planning.

Near & Far Detector Assembly

Comments (continued):

- a number of design reviews have been conducted. A substantially larger number remain to be done. The committee encourages making key reviews more formal, with membership to include external reviewers. Costs associated with the reviews are perhaps best captured in the WBS element collecting management costs.

- integration issues among the detector systems continue to be a concern. This is a threat to the timely completion of detector assembly and checkout. Progress here has improved lately, but more coordinated effort is required. Better communication and focus are needed.

- the block pivoter is seen to be an item with large associated risk. It will be very challenging to achieve the flatness tolerances required with the conceptual design. Additional analysis is needed to address lateral loading and acceleration. The cost to move from conceptual to final design is inadequate. The conceptual design should be vetted soon, before more extensive engineering effort is invested. Earlier prototyping and construction would be beneficial to limit potential risks associated with this key device.

Near & Far Detector Assembly

Recommendations

- Ready for CD-2 approval.
- Hold a review of the conceptual design of the block pivoter that includes external reviewers. This review should be completed before 12/31/07.
- Advance the funding for the block pivoter to allow earlier prototyping and construction.
- Appoint before 12/31/07 an Integration Coordinator to improve communication and progress in intersystem interface issues.

2.3 Electronics & DAQ

WBS 1.6/2.6 & 1.7/2.7

SC3: A. Lankford (*UC Irvine*)

J. Haggerty (*BNL*)

R. Van Berg (*Pennsylvania*)

WBS 1.6/2.6 + 1.7/2.7 Lines of Inquiry

1. Resource Loaded Schedule: exists
2. Cost & Schedule Assumptions: ok
3. Critical Path: defined
4. Funding Profile: RLS consistent
5. Work Breakdown Structure: ok
6. Risk Management: ok
7. Basis of Design: ok
8. Design Review: needed
9. Requirements: ok

11. Value Engineering: ok, more possible, small impact

14a. Start-up test plan: Production testing: ok

14b. Start-up test plan: Commissioning plan not reviewed

WBS 1.6/2.6 + 1.7/2.7 Findings

- No design reviews have yet been held.
- Schedule
  - Resource-loaded schedule exists
  - 10-12mos off critical path
  - If not limited by funding profile, ~2yrs off
- Cost
  - APD is largest single cost item (5.6M$)
  - No contingency on pre-IPND R&D
- Installation included in WBS 2.8/2.9
- CD3a: Two procurements proposed:
  - FEB ADC packaging (95k$)
  - FEB ASIC production (232k$)

WBS 1.6/2.6 + 1.7/2.7 Comments

- Technical design
  - Will address performance requirements
  - Advanced beyond requirements for CD2
  - Vertical test essential to demonstrate noise levels & finalize FEB & APD specs
  - IPND will also be valuable for integration testing
  - Specifications remain to be formalized
  - Design reviews will be beneficial.
- Cost
  - APD cost estimate and contingency are appropriate
    - APD cost is necessarily uncertain at this point
    - Exposure will exist until firm quotation shortly before procurement in Oct 09
  - Overall cost appropriate to technical design
    - Some contingencies optimistic, including R&D contingency
    - Some value engineering still possible
  - Basis of estimate needs improvement for EIR
    - Some items out-of-date
    - Some bases of major items inadequate

WBS 1.6/2.6 + 1.7/2.7 Comments – p2

- Schedule is appropriate for CD2
- Manpower
  - Technical expertise/experience matched to design
  - Marginally adequate DAQ Software staffing now available
- Management
  - Proactive management is required following CD2.
  - Strengthen systems/project/integration engineering.
- Summary: Ready for CD2
- CD3a
  - ADC packaging
    - Prudent to proceed in order to reduce risk of chip degradation, but should seek multiple vendors
  - ASIC production
    - Not ready yet (need final prototype & vertical test)

WBS 1.6/2.6 + 1.7/2.7 Recommendations

- Improve Basis of Estimate in preparation for EIR
- Perform timely design reviews

Lehman CD-2/3a Review of NOvA

Section 2.4, WBS 1.0, 2.0
Accelerator and NuMI Upgrades (ANU)

Rod Gerig

Graeme Murdoch

Fulvia Pilat

October 25, 2007

Accelerator and Beamlines

- EIR lines-of-inquiry:
  - The project asserted that the 16 EIR elements have be satisfactorily met for this work scope. The committee concurs with this assessment.
  - To verify the committee performed several drill-downs, among them:
    - **WBS 1.0.3.2, 2.0.3.2 Numi Target Hall Technical Components – Engineering and design, and construction**
    - **WBS 2.0.1.1.1 , Abort & RR 30 Straight**

Accelerator and Beamlines

- EIR lines-of-inquiry, continued:
  - EIR Element 1 and 3: (Resource Loaded Schedule and Critical Path) In each case we found that the schedules were credible. Nothing in this work scope is on project critical path.
  - EIR Element 2: (Key Project Cost Assumptions) The cost bases are traceable and defendable
  - EIR Element 7: (Basis of Design) We note that for the majority of the work in these WBS elements, the bases of design are existing components.

Accelerator and Beamlines

- EIR lines-of-inquiry, continued:
  - EIR Element 8: (Design Review) In cases where modifications are being made to the existing designs, design reviews are in place as specified by the ANU Design Review Table (Doc 2052).
  - EIR Element 9: (System Functions and Requirements) System designs meet performance requirements in existing designs, new component requirements are not more stringent

Accelerator and Beamlines

- EIR lines-of-inquiry, continued:
  - EIR Element 11 (Value Engineering) Value Engineering has been performed across the work scope and documented.
    - The committee reviewed several examples (Using T-blocks instead of dummy module, docdb ref 2331)
      - Resulted cost savings of 10% on $1.5M WBS element

Accelerator and Beamlines

- EIR lines-of-inquiry, continued:
  - EIR Element 14 (Start-Up Test Plan)
    1. general checkout (no beam) - individual systems
    2. integrated checkout (no beam) - integration tests
    3. commissioning (with beam)
    - Phase 1 and 2 are responsibility of the NOvA project and a reasonably detailed plan for tests is already laid out, for the accelerator, and NuMI beamline systems. Phase 3 is outside the scope of the project and responsibility of the Accelerator Division. The commissioning with beam will happen at the earliest in FY12 for the accelerator, and FY13 for the NuMI beamline.
    - Significant parts of the NOvA testing will be done in advance in the Main Injector (slip stacking).

Accelerator and Beamlines

- **Findings** – Since the CD-1 review, accelerator and beamline work has been incorporated into the NOvA project. (Known as ANU)
  - This work builds on the “Proton Plan” work scope to increase the power on the NuMI target from 320 kW to 700 kW
  - The cost of the work in these WBS elements is $52.3M including contingency (34%).
  - The schedule is based around two shutdowns
    - Oct 2010 – Dec 2011 for accelerator upgrades
    - April - June 2012 for NuMI beamline upgrades

Accelerator and Beamlines

- Comments:
  - The ANU work scope satisfies the performance requirements of the NOvA project, although we note that the ultimate deliverable of 700kW on target does partially depend on off-project elements (e.g., the proton plan)
  - The committee considers the cost estimate to be credible with adequate contingency
  - ANU management is experienced, well prepared
  - The schedule for meeting CD-4 is adequate, although various internal milestones are tighter (but can be met)

Accelerator and Beamlines

- Justification for long-lead procurement
  - A table of procurements was provided
  - The project is ready to use these procurements (most of the procurements are for existing designs)
  - The justification is based on the resource loaded schedule, procurements needed to match effort profile.

Accelerator and Beamlines

- Comments:
  - The project pointed out that among the highest risks is insufficient manpower, particularly in the near term. The committee encourages the ongoing discussions with the Accelerator Division to resolve this.
  - High intensity running of NuMI over the next few years will further activate components in the Main Injector and NuMI enclosures. Fermilab is encouraged to keep these levels as low as possible to allow for the scheduled shutdown work to take place.

Accelerator and Beamlines

- Comments:
  - Losses during slip-stacking continue to be a general concern for future NOvA performance. The committee encourages the continuation and refinement of simulations and the comparison with measurements in the Main Injector, with the goal of improving the agreement for high booster bunch intensity and implementation in the Recycler.
  - Ready for CD-2/3A!!

3.0 Site and Building

Reviewers:
Jim Lawson, ORNL
Ove Dyling, BNL
David Saenz, SLAC

3.0 Findings

- The Title I estimate for the Far Detector is $54.8M, including 22% contingency. This includes the design and construction costs, University of Minnesota fees and the fee of their Construction Manager.

- A Value Engineering study by the Lab was performed for the Far Detector design which resulted in a cost reduction of $1.8M.

- Three independent estimates were prepared for the Far Detector construction and the baseline estimate was developed with Monte Carlo techniques.

- A site investigation was conducted of the Far Detector site including site borings and some geophysical logging to assess the competency of the rock.

3.0 Findings, cont.

- The conventional scope for the Near Detector (WBS 2.8) was added recently. The concept is well understood, but the details and costs need to be developed.

3.0 Comments

- The Far Detector site preparation package meets the technical performance requirements and with minor revisions is ready for execution.
- The project should be commended for evaluating the sub-surface to determine the suitability of the building location.
- Project documentation supports the project schedule.
- The Title 1 design for the Far Detector is well developed.
- It’s planned to have an independent assessment of the means and methods for constructing the Far Detector building.

3.0 Recommendations

- Assign the portion of WBS 2.8 that pertains to conventional construction to WBS 2.1
- Develop a document to support the MOU with Univ. of Minn. which clearly defines roles and responsibilities
- Reassess contingency for WBS 2.1 assigning risks at lowest level of WBS
- Univ. of Minn. should provide Title II requirements for their future operation and maintenance of the Far Detector facility
- Proceed with design of Near Detector conventional work as soon as practical

3.0 Recommendations, cont.

- Since the construction of the Far Detector Building is on the critical path the schedule should be reviewed for methods to reduce the schedule.

- Conventional Facilities Far Building is ready for CD-2

SC6
Environment, Safety, and Health

Steven M. Trotter, ORNL

4.1 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. All required permits have been identified, and plans are underway to acquire the appropriate permit(s) to support construction at the Ash River site. NEPA documentation is undergoing final review and should be completed in time to support the project. The State of Minnesota Environmental Assessment Worksheet has been prepared and submitted, and approval is anticipated in by mid-November 07.

- Integrated Safety Management (ISM) principles are effectively incorporated into the project.

4.2 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 initial 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. For the Accelerator and NuMI Upgrades, the appropriate radiation safety calculations have been performed and these serve as the foundation for regulatory permitting decisions and ultimate commissioning.

- Project spans two national laboratories, numerous educational institutions, and two States. Examined two Memorandum of Understandings (ANL and FNAL, UM and FNAL); ESH responsibilities and jurisdictions are clearly identified. These MOUs should serve as models for additional MOUs with remaining institutions.

- Project support documents are extensive and well-written, and efforts to update and maintain the documents are planned.

4.3 Recommendations

- ESH interfaces between all parties need to be formalized, and this is currently planned through the MOU process.

- DOE CH, FSO and Fermilab/NOvA Project parties, in coordination with the University of Minnesota, need to provide all necessary and sustained effort required to ensure that the NEPA process is successfully completed. The Project can then address any comments on the EA that may arise during the the State/public comment period in Illinois, and move successfully on to the next stage.

- UM should submit application(s) for Aquatic Resource Alteration Permit(s) (ARAPs) as soon as practical to support construction of Ash River access road in Spring 08.

5.0 COST ESTIMATE and 6.0 SCHEDULE AND FUNDING

Barbara Thibadeau

Steve Tkaczyk

Assessment of Readiness for EIR

EIR Element	SC Review Team Assessment	Comment
1. Resource Loaded Schedule	**Satisfactory**	There is a resource loaded schedule which contains over 5,970 activities for the line item scope and >7,200 schedule relationships.
2. Key Project Cost and Schedule Assumptions	**Satisfactory once recommendations are implemented**	The project has identified key cost and schedule assumptions in the basis of estimate, the work breakdown structure, and other documents. Cost and schedule contingency has considered the risks identified by the project. Both cost and schedule contingency are too low. M&S escalation should be increased from ~2%/year and schedule contingency should be increased.
3. Critical Path	**Satisfactory**	The project has developed a reasonable integrated critical path. BOD for the building IS CRITICAL for the schedule
4. Funding Profile	**Satisfactory**	The resource loaded schedule is consistent with the funding profile provided.
5. Work Breakdown Structure	**Satisfactory**	The project has developed a WBS that incorporates all work elements at a reasonable level and consistent with the schedule.
6. Risk Management	**Satisfactory once recommendations are implemented**	The project has a formal Risk Management Plan which identifies the risk process. The project has used the risks identified in the risk registry to confirm the confidence in the cost and schedule contingency.
12 Project Controls/EVMS	**Satisfactory**	The project has an earned value management system with documented procedures but has not yet implemented it.

5.0 Cost Estimate

- 5.1.1 Findings:
  - The cost baseline is supported by detailed, well thought out cost estimates
  - The project has clearly identified resources, by type, organization and function, making it easy to apply appropriate burdens and determining staffing requirements.
  - The massive amount of documentation supporting the project estimate may be daunting to the EIR
    - Path to find magnitude of conventional construction risk=

  1461→1886 →2105 → 2482
- 5.1.2 Comments:
  - It is clear that the project has put a lot of effort in developing a sound basis of estimate and contingency and should be commended.
- 5.1.3 Recommendation:
  - The project should plan on providing personnel to assist the EIR team and guide them in following and finding documentation

5.0 Cost Estimate

- 5.2.1 Findings:
  - The performance baseline utilizes 3 sets of escalation
    - One for labor (4.8%/year)
    - One for construction (variable)
    - One for all other procurements (~2%/year)
  - The funding profile requires that the project delay critical procurements
- 5.2.2 Recommendation:
  - Re-evaluate the appropriateness of the procurement escalation rate used, particularly for the 3 major cost drivers (liquid scintillator, PVC extrusions and WLS fiber) that are now using the 2% factor
  - The project should pursue obtaining a reduced overhead rate for those purchase orders that will not be received and handled at FNAL
  - The project cost estimate will be ready for CD-2 once ***increased flexibility, either in scope or in cost***, is obtained

6.0 Schedule and Funding

- 6.1.1 Findings:
  - The project schedule contains 5,970 activities and 7,284 relationships. Most activities are resource loaded. Milestones are not resource loaded.
  - Some logic ties are absent (e.g. LOE activities) and some are incorrect (e.g. receipt of mineral oil not tied to appropriate QA and fabrication activities).
  - 4 random BoE's were selected to validate traceability (2.6.2.1.7.1-3, 2.5.3.1.1, 2.4.5.3.1.1, 2.1.1.4). Documentation errors that have no significant impact on the project cost were found in 2 of the 4.
- 6.1.2 Comments:
  - The project has done an excellent job in developing and resource loading the schedule
- 6.1.3 Recommendations:
  - All schedule logic should be verified to ensure that ALL activities are logically tied and that the ties are correct before the EIR

6.0 Schedule and Funding

- 6.2.1 Finding
  - The schedule is optimistic in that it assumes that receipt of the materials associated with these phase-funded contracts occurs in October of the next fiscal year.
    - As an example, delivery of mineral oil in FY11 and FY12 is scheduled to begin 1 October 2011 and 1 October 2012, respectively.
- 6.2.2 Recommendation
  - Change the delivery activities to allow appropriate time for the contracts to be modified and the vendors to receive funding before delivery can begin.

6.0 Schedule and Funding

- 6.3.1 Finding:
  - The schedule contingency is approximately 8 months which is approximately 12.5% of the total project's duration.
- 6.3.2 Recommendation
  - Re-evaluate schedule float once recommendations 6.1.3 and 6.2.2 have been incorporated into the project schedule
  - Investigate acceleration of activities to minimize project risk
  - The project schedule will be ready for CD-2 once these recommendations are implemented

7. Management

NOvA CD-2 Review

October 25, 2007

7.0 Management

- Derrick C. Mancini, ANL
- David Dale, BNL
- Scott Mallette, DOE/TJSO
- Gail Penny, DOE/BHSO

EIR Lines of Inquiry and Responses

6: Risk Management: Risks have been identified and properly classified as high, medium, and low. Appropriate risk mitigation has been incorporated into the baseline. Contingency is barely adequate, the project would benefit from increased schedule and cost contingency. There is no scope contingency with a 15kt required deliverable. Values associated with risks for contingency analysis are difficult to trace. No risk owners identified.

7: Basis of Design: Preliminary design is adequate for this stage of this project.

8: Design Review: The results of preliminary design reviews have been incorporated into the performance baseline. The Director's review provided feedback to the preliminary designs and TDR. Adequate design review has been conducted for most technical elements needed for this stage of the project, with future reviews planned and identified in the schedule. Review is needed for 2.6 Electronics & 2.7 Data Acquisition.

9: System Functions and Requirements: Functions and requirements are reflected in the baseline. System requirements are derived from and consistent with Mission Need. Project would benefit with better integration across Level 2 activities.

EIR Lines of Inquiry and Responses

10: Value Management/Engineering: Value engineering has been performed and incorported into the baseline. Value engineering is ongoing, and is generally good, although the 2.6 Electronics & 2.7 Data Aquisitions can benefit with continued VE. 13: Project Execution Plan:. The PEP with the PMP reflects and supports they way the project is managed and is consistent with other project documents. The PEP should be updated to appropriately identify the baseline technical scope.

14: Start-up Test Plan: Start-up test plans are appropriately defined and are sufficiently described to be included in cost estimates and schedule durations. We note that 2.0 ANU has testing with beam (commissioning) occuring later and outside the scope of the project.

15: Acquisition Strategy: The Acquisition Strategy is consistent with the way the project is being executed. The current strategy represents a best value to the government.

16: Integrated Project Team: The integrated project team appears to be suited to support the project. The project management staffing is at an appropriate level with all of the appropriate disciplines included in the IPT. A charter has been prepared and is an appendix to the PEP.

7.1 Findings

- The PEP has been updated in October for CD-2 and reviewed by the DOE but has not been finalized. The PMP has also been updated.

- The Technical Design Report and other project management documents are largely complete, and have been updated for a 15kt baseline detector.

- A single page master schedule with critical path was shown for the overall project.

- Schedule contingency is at 8 months.

- Formal change control is planned, and is ready to be used upon establishing baseline.

- Monthly reports are being carried out in narrative reform, and will include earned value upon establishing baseline.

- Draft MOU's and SOW's were available to the committee. The CA with UM is in place and a draft MOU is ready to be signed.

- In addition to the Acquisition Strategy, the project developed an Acquisition Plant for each major procurement that includes: procurement description, identification of suppliers and/or market survey, evaluation criteria, procurement schedule and milestones, and cost estimates.

- The project is using the regular FNAL procurement staff with a dedicated expediter assigned to the project.

7.1 Findings (continued)

- The project office staffing is projected to be 9 FTE's in FY'08, and about that in FY'09-FY12, before ramping down substantially in FY13. The project office is fully staffed including all level 3 managers. The project manager, the deputy project manager, associate project manager, and head project scheduler are all full time and fully engaged and competent. The federal project director is currently 80% assigned to the project, with balance of time toward final completion of another project this year, and is assisted by a part-time deputy. The FPD is Level II certified. The project relies heavily on operations staff to supplement project staff. The Lab director has assigned a representative who can resolve staffing issues between the current accelerator staff and project staff.

- Current overall project staffing is now 66.5 FTEs, which is near the average projected requirement for FY'08 and FY'09. Staffing may be an issue as resource requirements increase over time after FY'10.

- A database group is in place for maintaining databases and applications for the project. Schema is developed from L2 manager's requirements, such as inventory, fabrication, simulation, and testing data. The database can be used to support quality control.

- Configuration control, including project document control, engineering document control, and change control, utilize a combination of the EVMS and costing system (Open and Cobra), the Nova DocDB, the Change Control Database (MS Access), and existing FNAL engineering document management systems. The methods of configuration control are aligned with the PEP and PMP. Change Requests Forms and Document Change Notices have been defined and will be used to manage and communicate changes. Configuration control is ready to implement upon approval of the baseline.

7.2 Comments

- The project should be commended for their continued progress towards baselining the NOvA project. The project team is a good one, and they have nearly all the tools in place to successfully manage the project. The project team did an excellent job of answering the reviewer's questions.

- The PEP and PMP should be modified to reflect clear definition of technical goal versus minimum technical baseline scope (13kt vs. 15kt). Details of current design should be in the TDR or similar documentation instead of the PEP. The draft PMP should also allow the potential for a future management reserve to be established.

- The federal project director is highly capable and engaged. The project would benefit from having his full-time assignment to the project going forward. For a project of this size, Level III certification is required and should be accomplished in a timely manner.

- Given the recent history of a continuing resolution and tight funding for FY2009 the project should review the budget vs. allocation on a monthly basis to ensure that the project is not impacted by a continuing resolution.

- Estimation and management of contingency: consider implementing a contingency management plan which identifies how the contingency will be controlled by the Federal Project Director and the project.

7.2 Comments

- The project should ensure that the key personnel interfaces between work conducted by University of Minnesota and Fermi project are clearly defined in terms of personnel responsibilities and scope to be delivered. Thus, project planning depends on the drafted MOU between Fermilab and UM, especially with regards to safety and contingency utilization, where these issues should be addressed.

- It is important to finalize MOU's and SOW's and have them approved by all parties. Understanding of the resources being planned on by the project, and committed by the collaborating institutions will avoid misunderstandings and put planning on more solid ground.

- The migration to WelcomRisk is a good and has been completed. However, it is difficult to easily trace the quantitative relationship of risk analysis to contingency determination.

- There is no impact should the Tevetron operate for up to one year.

- The technical goal of 15kt has been estimated to be achievable with a cost of $260M at a 95% confidence level for the statistical analysis of the price of crude oil and a 2.2% escalation on M&S. These assumptions may not be suitably conservative to guarantee achieving the 15kt goal. It would be valuable to analyze the affect of increasing confidence level and escalation rates on baseline cost and evaluate versus establishing a baseline technical scope slightly less than the established technical goal to allow for scope contingency.

7.3 Recommendations

- Complete and approve the MOU between Fermilab and the University of Minnesota to supplement the Cooperative Agreement prior to CD-2. Include configuration management for Far building in MOU with the University to ensure configuration management is in place for conventional facilities while the project completes equipment installation and transitions into operations.

- Finalize all MOU's and SOW's for all institutions prior to CD-2.

- Review and update both PEP and PMP prior to the EIR, including proposing CD3 and CD4 approvals be delegated to AD for OHEP.

- Scrub all CD-2 related documentation for self consistency before the EIR.

- Because schedule contingency is tight, evaluate amount of schedule contingency before the EIR.

- Combine management reserve and contingency at this stage of the project.

- Verify that a reasonable cost contingency and escalation is being applied to address commodity pricing risks.

- Ready for CD-2 after addressing these recommendations.