



U.S. DEPARTMENT OF
ENERGY

OFFICE OF
SCIENCE

Closeout Report on the Review Committee

for the

NuMi Off-Axis Neutrino Appearance (NO ν A) Experiment

at the

Fermi National Accelerator Laboratory

May 8, 2012

Daniel R. Lehman

Review Committee Chair

Office of Science, U.S. Department of Energy

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



Charge Questions

1. Technical: Are the accomplishments to-date and remaining activities as planned sufficient to meet baseline scope objectives?
2. Baseline Cost and Schedule: Is project's plan and performance consistent with the approved baseline? Are remaining costs and schedule contingency adequate for the risks?
3. Management: Are the management resources adequate to deliver the project within specifications, budget and schedule, including management and mitigation of remaining technical, cost and schedule risks?
4. Has the project responded satisfactorily to the recommendations from the previous independent project review?

Department of Energy

Daniel R. Lehman, DOE, Chairperson

Observers

Ted Lavine, DOE/SC
Eli Rosenberg, DOE/SC
Pepin Carolan, DOE/FSO
Brian Huizenga, OECM

* Lead

Review Committee

Subcommittee 1: Accelerator and Beamlines

*Pat den Hartog

Subcommittee 2: Detector

* Bill Wisniewski, SLAC

Subcommittee 3: Electronics

*Peter Denes, LBNL

Subcommittee 4: Cost and Schedule

*Ethan Merrill, DOE/SC

Richard Elliott, DOE/OECM

Subcommittee 5: Management

*Kurt Fisher, DOE/SC



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2.2 Detector.....	Wisniewski*/SC2
2.3 Electronics.....	Denes*/SC3
3. Cost and Schedule (Charge Questions 2, 4).....	Merrill*/SC4
4. Management (Charge Questions 3, 4).....	Fisher*/SC5



1. Technical: Are the accomplishments to-date and remaining activities as planned sufficient to meet baseline scope objectives? **Yes**
4. Has the project responded satisfactorily to the recommendations from the previous independent project review? **Yes**

2.1 Accelerator and Beamlines

Den Hartog, ANL

■ Findings

- ANU is not directly on the project critical path- 400+ days of float from “Accelerator shutdown complete” to CD-4
- Accelerator work shows long slide down to CPI = 0.8. This was addressed labor in CR487. Added ~20% to base for the 1st 4 months of shutdown, reducing Management Reserve.
- Ceramic beam tube production which was identified as a project risk since 2006 has been retired
- The lab decision not to reduce intensity leading up to shutdown delayed start in MI30 by two weeks.
- Off-Project work is impacting available resources for accelerator upgrade installations. This may add 2 months to the installation. A detailed installation schedule that folds in on-project and off-project work has been created. The risk of not having sufficient manpower is one of two priority risks remaining.
- RF cavity fabrication is a year behind schedule (combination of vendor and technical problems) and over budget.



2.1 Accelerator and Beamlines

Den Hartog, ANL

■ Comments

- **Congratulations** on retiring the technical risk on the ceramic beam tubes.
- **The major risk in the fabrication of the RF cavities has been resolved** but testing has not been completed so cavity production is still a risk. **The project is encouraged to begin working on the engineering for the mitigation plan to ensure that no obstacles exist.**
- **Scheduling of the installation is complex.** The project is commended for vigorously working the scheduling of available technician/engineering manpower. Radiation exposure potential is significant and has been thoroughly planned with ALARA considerations. **Installation bottlenecks could have schedule impact if not carefully monitored and mitigated.** This effort will need to continue throughout the remainder of the project.
- **The project is cautioned to carefully watch safety during installation;** especially when working heavy overtime. This is when accidents occur.



2.1 Accelerator and Beamlines

Den Hartog, ANL

- Recommendations
 - Keep the pressure on Laboratory management to provide the needed installation manpower.



1. Technical: Are accomplishments to-date and remaining activities planned sufficient to meet baseline scope objectives?

Yes. Success here is dependent on proactive solution of problems.

4. Has the project responded satisfactorily to the recommendations from the previous independent project review?

Yes.



Findings and Comments

- The team has continued to make progress since the last review.
- Management has good understanding of the commodities situation, though market forces have stretched calls on contingency to cover the expanded costs.
- The decision date for adding additional fiber production is approaching. Production issues (see below) are not unlikely to require expanding the fiber order.
- Production of extrusions is moving ahead. Problems are being resolved as they arise. The team is considering the manufacture of a spare die. The Committee encourages this.
- Module production is moving ahead. The 2:1 stage is about 38% complete.
- The next stage where the production of a module is completed is in ramp-up phase. Production rate is about half the needed rate of 24/day. Failure rates are down to 7%, where the goal is 2%. At this stage, the failure rate has no single mode.



Findings and Comments (cont'd)

- Modules have been transported to Ash River. Transport of modules for the Prototype Near Detector went smoothly, with negligible breakage of fibers. However, a substantial number of fibers failed in the two shipments of completed modules to Ash River. It is not clear whether these failures happened on loading, in transit, or in unloading. This is a serious issue demanding prompt attention. The Committee endorses the team's proposal to transport a load of modules round trip to Ash River, with follow-up check-out. This should be done as soon as possible. An autopsy of the failed modules to understand this problem should also be performed ASAP.
- In order to understand whether there are any design or construction issues that might cause fiber breakage during block filling, the team should conduct filling tests of full size modules as soon as possible.



Findings and Comments (cont'd)

- Block Pivoter problems have been dealt with, but with consequent schedule loss. Other tooling for assembly of blocks is in place, and awaits completion of safety reviews in the next month. Though planning for block assembly appears to be in good shape, **the schedule situation can not be evaluated until construction of the first few blocks is complete.**
- Preparations for outfitting of the detector at the Ash River site are in good shape. Many of the procedures are complete. The balance should be done in time for commissioning.
- The Near Detector work is progressing to cavern excavation.



Recommendations

1. Conduct an autopsy of the modules damaged in transport as soon as is possible.



1. Technical: Are accomplishments to-date and remaining activities planned sufficient to meet baseline scope objectives?

APDs: a level of risk remains, and should be planned for

All other electronics: yes.

4. Has the project responded satisfactorily to the recommendations from the previous independent project review?

APDs: partly (in process)

All other electronics: N/A



Findings

- Electronics (all but APD) proceeding well.
- Production testing and installation of APDs appears to be adequately staffed and equipped.
- **The precise failure mechanism** of the APDs is **not understood**, however **empirical tests** show that insufficient sealing of the device leads to failures.
- Newest devices are (for the 1st time) **passivated** – which appears to be helpful.
- The team is studying silicone vs. paralyne coating
- **Higher light output** appears to be within reach – which could help warm operation of the APD (reducing condensation-related failures)



Comments

- It is now too late to make changes to the APD (and meet schedule)
- The dry gas system appears promising, but has only been in operation for a few weeks.
- During FY13, 12,000 APDs will be delivered and installed. This will allow an early determination of the most probable installation failure rate. Sufficient spares should be planned for.

Recommendations

- Prior to starting production, convene an expert review once there are sufficient statistics to justify a coating choice.
- Once a coating is selected, begin long-term aging studies, including with the dry gas system.



3. Cost and Schedule

Merrill, DOE/SC/Elliott, DOE/OECM

2. Baseline Cost and Schedule: Is project's plan and performance consistent with the approved baseline? **YES**
Are remaining costs and schedule contingency adequate for the risks? **YES, but continued diligent cost and schedule contingency management is required.**

4. Has the project responded satisfactorily to the recommendations from the previous independent project review? **YES**



3. Cost and Schedule

Merrill, DOE/SC/Elliott, DOE/OECM

Findings/Comments:

- Based on BAC, cost contingency has decreased from \$34M to \$26.6M since August 2011
- Based on LRE, \$19M cost contingency remains with only \$2.1M still unassigned.
- Since August 2011, schedule contingency has decreased from 10 months to 8 months.
- Basis of Estimate has been recently revised
- Project is approximately 65% complete
- CPI – 0.95, SPI – 0.98
- Critical production and assembly activities have been recently initiated and performance trends are uncertain; next 6 months will be critical in determining project success.

- **Recommendations:** None



PROJECT STATUS as of May 8, 2012		
Project Type	MIE / Cooperative Agreement	
CD-1	Planned: 5/2007	Actual: 5/2007
CD-2	Planned: 10/2008	Actual: 9/2008
CD-3	Planned: 3a – 2/2009 3b – 10/2009	Actual: 3a – 10/2008 3b – 10/2009
CD-4	Planned: 11/2014	Actual:
TPC Percent Complete	Planned: _65%	Actual: _64%
TPC Cost to Date	\$170.0M	
TPC Committed to Date	\$219.3M	
TPC	\$278M	
TEC	\$204.2M	
Contingency Cost (w/Mgmt Reserve)	\$26.6M	_29% to go
Contingency Schedule on CD-4b	_8 months	_33%
CPI Cumulative	0.98	
SPI Cumulative	0.95	



4. Management
*Fisher, DOE/SC

3. Management: Are the management resources adequate to deliver the project within specifications, budget and schedule, including management and mitigation of remaining technical, cost and schedule risks? **Yes, although the project team must remain vigilant to ensure that all the known (and unknown) challenges are being addressed in a timely manner.**
4. Has the project responded satisfactorily to the recommendations from the previous independent project review? **Yes**



Comments

The project team has implemented a structured readiness / operations process for production activities.

The module production rate is improving

The project team needs to more quickly understand and act expeditiously in resolving major issues

The APD issue requires timely resolution

The project needs to fully evaluate and understand the fiber breakage issues



Recommendations

Initiate discussions during the weekly HEP / FNAL conference call with specific detail on the APD and fiber breakage issues, status, and path forward.

Schedule a mini review in three months on major issues such as:

Avalanche Photo Diode coating

Fiber integrity during transportation, assembly and filling of the modules