



Department of Energy



Review Plan  
for External Independent Review of the  
NOvA Project  
at the  
Fermi National Accelerator Laboratory

September, 2007

Project No: (SC-25-06-1)



**Concurrence:**

\_\_\_\_\_  
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Office of Project Assessment  
Office of Science (SC-1.3)

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Date

**Approved by:**

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Michael Procaro  
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## SECTION 1 – REVIEW OVERVIEW

The following sections identify the type of review, define the scope and purpose of the review to be performed, identify previous reviews that have been performed, and establish the objectives of the review for the NUMI Off-Axis Electron Neutrino ( $\nu_e$ ) Appearance (NOvA) Project.

The Office of Science must approve the EIR review plan (see page 2) and the cost of the EIR prior to any funds being released and used for this EIR. This review will be conducted consistent with the External Independent Review Process for Office of Science Projects (Attachment 1).

Comment [p1]: Where is this document obtained from?

### 1.1 TYPE OF REVIEW

Prior to a Critical Decision (CD)-2 approval, an EIR is necessary to satisfy the CD-2 (App Performance Baseline) requirements of DOE Order 413.3, *Program and Project Management for the Acquisition of Capital Assets*. Therefore, the Office of Science has requested an EIR Team to evaluate the NOvA Project during an on-site review to be held at Fermi National Accelerator Laboratory (FNAL).

The EIR report for this review should be concise and provide a synopsis of the reasonable project's readiness for CD-2. The EIR Team will insert recommendations that correspond to all findings and selected observations in a Corrective Action Plan shell.

### 1.2 OBJECTIVES OF REVIEW

The objectives of conducting this EIR are to assist the Office of Engineering and Construction Management (OECM) in reviewing and validating the NOvA Project Performance Baseline to assess the overall status of the project management and control system. This EIR includes an assessment of review elements given in Section 1.3, Scope of Review, below. Generally, the elements address the cost, schedule, technical elements, and the project management for the performance baseline. All non-conformances to established requirements will be fully referenced, comparisons to documented benchmarks will be defined and contrasted, and observations involving professional judgment will be noted. The basis for each finding/observation should be identified. Each recommendation should clearly identify the necessary action and the proposed benefit to the project.

Comment [p2]: This reference does not generally seem applicable or appropriate for NOvA, it was found in other EIR plans—may remove it.

### 1.3 SCOPE OF REVIEW

The NOvA Project is a DOE funded Major-Item-of-Equipment (MIE) project that will upgrade an existing accelerator-based neutrino beam facility at FNAL, and will fabricate, assemble, and install the necessary detector facilities, including a large new detector located in Northern Minnesota to enable conducting neutrino research using the upgraded neutrino beam.

The NOvA Project is primarily DOE MIE funded, and also includes activity supported by Cooperative Agreement (CA) with the University of Minnesota for neutrino research, which includes the fabrication by the University of the detector enclosure building to be located in Northern Minnesota (~810 km or 504 miles northwest of FNAL). Although DOE O 4.13.3A does not apply to land, structures or equipment acquired by State or local government through DOI



financial assistance awards (including cooperative agreements), the NOvA Project recognizes the importance of the CA activities to the project, and will manage the project interface with these activities so as to further reduce and mitigate the risks identified and encountered with them. The scope of this EIR, then, should focus on the MIE scope of the project, i.e. completing near and far detector fabrication and accelerator and neutrino beam upgrades.

Documentation will be made available to the EIR team via a website or other media ~ four weeks prior to the review. The EIR Team should have reviewed the documentation prior to the on-site visit in preparation for the on-site review. The key review elements for this Performance Baseline EIR are described in the following sections.

### 1.3.1 Resource Loaded Schedule

For the selected WBS elements in Table 1 (typically, those constituting significant cost and schedule risk), the EIR Team will summarize the basis for the cost estimate and schedule duration. The EIR Team should assess the method of estimation and the strengths/ weaknesses of the cost and schedule estimates for each WBS element reviewed, and the reasonableness of the project duration based on the resources provided.

The EIR Team will evaluate the basis for the cost estimate and the schedule duration for the following WBS elements:

Table 1. NOvA Project WBS Elements Selected for Focused Review

WBS No. /Activity	Budget (PMB) (\$M)	Contingency (\$M)	Total Cost (\$M)	Duration (days)	Schedule Baseline	CD-4 Complete	Cor (mo)
2.0 Accelerator & NUMI Upgrades	30	9	39				
2.1 Far Detector Building + Cooperative Agreement	47	10	57				
2.2 Liquid Scintillator	20	6	26				
2.4 PVC Extrusions	26	7	33				
2.6 Electronics Production	13	4	17				
2.9 Far Detector Assembly	11	8	19				
Sub-Total	123, 100	32, 34	154, 134				
Total Project Cost	201	58	259				

**Comment [p3]:** Need to decide between Site & Building + Cooperative Agreement or, Far Detector Assembly and Electronics Production

**Comment [p4]:** Assume date is completion date within each subsystem that supports project completion definition.

Note: TEC/MIE = \$182M and OPC= \$77M

The above items were selected for detailed review because they constitute a significant portion of the estimated project cost, span the project requirements, and represent items critical to project success.



### 1.3.2 Key Project Cost and Schedule Assumptions

The EIR Team will evaluate if the cost and schedule assumptions are reasonable and provide an independent evaluation of DOE's TPC and Project Schedule. This evaluation will, to a large extent, depend on the assessment of the specific WBS elements reviewed under the Resource Loaded Schedule above. The EIR Team should assess the project's key cost and schedule assumptions. In addition, the EIR Team should assess cost and schedule contingency and cost and schedule factors related to TPC and the project completion schedule. The EIR Team should assess whether the TPC and project completion date incorporates all activities necessary to successfully complete the NOvA project.

### 1.3.3 Critical Path

The EIR Team will review the Critical Path schedule and assess whether the Critical Path is reasonable.

### 1.3.4 Funding Profile

The funding profile provided by the DOE Office of High Energy Physics for the NOvA TPC is shown in Table 2. The EIR Team will assess whether the resource loaded schedule is consistent with this project funding profile.

Table 2. DOE Estimated Funding Profile for NOvA Project

	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY2013	Total P
TEC	1.0	4.9	43.0	73.22	46.0	31.76	0	199
OPC	6.97	31.15	22.0	0	0	0	0	60
TPC	7.97	36.05	65	73.22	46	31.76	0	262

### 1.3.5 Work Breakdown Structure

The EIR Team should assess whether the Work Breakdown Structure (WBS) incorporates NOvA project work, and whether it represents a reasonable breakdown of the project work scope. The EIR Team will assess whether the resource loaded schedule is consistent with the WBS for the project work scope.

### 1.3.6 Risk Management

The EIR Team should understand the approach used to identify project risks and assess the adequacy of that approach. The EIR Team should assess whether appropriate risk mitigation actions have been incorporated into the baseline. Finally, the EIR Team will assess whether adequate contingency has been included in the TPC and Schedule.



### **1.3.7 Basis of Design**

The EIR Team should evaluate the adequacy of preliminary design including adequacy of drawings and specifications, and assess whether they are consistent with system functions requirements.

### **1.3.8 Design Review**

The EIR Team should review results of the preliminary design review and assess whether additional work identified in the design review has been incorporated into the Performance Baseline.

### **1.3.9 System Functions and Requirements**

The EIR Team should assess whether "design to" functions and requirements are reflected baseline, including safety and external requirements such as permits, licenses, and regulatory approvals. The EIR Team should evaluate whether system requirements are derived from consistent with Mission Need.

### **1.3.10 Hazard Analysis**

The NOvA Project does not include any category 1, 2, 3 or below nuclear facilities as defined in 10 CFR 830 subpart B. Hazard Analysis documentation for NOvA Project work has been prepared using a standardized hazard identification and assessment methodology, based on the approach used at FNAL, which is a non-nuclear low-hazard accelerator facility. A safety assessment process is used to address the safety of planned accelerator and detector operations. The EIR Team should evaluate the quality of the Hazard Assessment and assess whether a scope, schedule, and costs necessary for safety are incorporated into the baseline. The EIR Team should also assess the Hazard Assessment process.

### **1.3.11 Value Management/Value Engineering**

The EIR Team should assess the applicability of Value Management/Engineering, and whether Value Engineering analysis has been performed with results being incorporated into the baseline.

### **1.3.12 Project Control/EVMS**

FNAL and DOE have conducted an internal EVMS review for the NOvA project in preparation for final external certification. A DOE EVMS readiness assessment for FNAL is scheduled for June 2008 and the actual EVMS certification review is to be conducted in the third quarter of 2008. As per OECM agreement with SC-OPA, the EVMS requirement for DOE O 413.3A is satisfied for CD-2 purposes with the certification activity scheduled.

### **1.3.13 Project Execution Plan**

The EIR Team should review the Project Execution Plan (PEP) and determine if it reflects the way the project is being managed, is consistent with the other project documents, and establishes a plan for successful execution of the project. The EIR Team will also assess whether Key Performance Parameters needed for CD-4 approval of this MIE project are identified in the PEP.



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#### **1.3.14 Start-Up Test Plan**

The EIR Team should evaluate whether the start-up test plan identifies the acceptance and operational system tests required to demonstrate that the system meets design operational specifications and safety requirements. Also review any key tests to ensure that sufficient description is provided to estimate cost and schedule durations associated with these tests.

#### **1.3.15 Acquisition Strategy**

The EIR Team should review the Acquisition Strategy to determine if it is consistent with way the project is being executed. The Review Team will evaluate any changes from CD- may impact whether the current strategy represents best value to the government.

#### **1.3.16 Integrated Project Team**

The EIR Team will assess whether the project management team is cable, if the staffing le appropriate, and determine if appropriate disciplines are included in the Integrated Project Team. The EIR Team should identify any deficiencies in the Integrated Project Team that could l successful execution of the project.



## SECTION 2 – BACKGROUND

The DOE Office of High Energy Physics conducts basic research to understand the nature of matter and energy at the most fundamental level. This includes the study of elementary particles using high-energy particle accelerators and specialized particle detectors. One of the least understood of the elementary particles is the neutrino.

The DOE CD-0 Mission Need for an Electron Neutrino Appearance experiment was approved by the Director of the Office of Science, Raymond L. Orbach, on November 22, 2005. The proposed NOvA experiment has been selected to meet that mission need, through the execution of the NOvA Project. The NOvA experiment will enable study of the pattern of neutrino oscillations and the details of neutrino mixing by using the Neutrinos at the Main Injector (NuMI) facility at FNAL to provide an intense flux of neutrinos to a large new detector in Northern Minnesota. The only existing DOE facility capable of producing the neutrino beam required to study the pattern of neutrino masses and the details of neutrino mixing is the NuMI facility. The NOvA Project will include accelerator upgrade and detector facilities and components at the Fermi National Accelerator Laboratory (FNAL) site, as well as a detector facility located 810 km northwest of FNAL in Ash River, MN.

CD-1 was approved for the NOvA Project by Raymond L. Orbach on May 11, 2007. A Total Project Cost expectation of \$260 M has been established for the NOvA Project. The performance baseline cost, schedule and scope for CD-2 have been developed to meet this expectation, meet the Mission Need within the DOE funding guidance and profile provided. The NOvA performance baseline is subject to a DOE Science Independent Project Review and, in accordance with DOE 413.3A, requires an EIR for performance baseline validation.

### 2.1 DESCRIPTION OF PROJECT

The NOvA project consists of a smaller near detector located at the FNAL site; a larger far detector located at Ash River, MN; a detector enclosure for the far detector, and FNAL accelerator and NuMI beamline modifications and upgrades needed to increase the beam intensity and provide the intense flux of neutrinos to the NOvA detectors. The major parts of scope

- The NOvA project accelerator and beamline upgrade scope consists of new accelerator kicker magnet systems; new particle beam injection and extraction lines; additional frequency (RF) particle acceleration stations; transport beamline power supply and quadrupole magnet upgrades; and neutrino target system design and cooling modifications.
- The NOvA far detector is conceived to be a multiple kiloton tracking calorimeter, approximately 16 m by 16 m by 100 m long. It will be constructed from alternating vertical and horizontal cells of liquid scintillator contained in rigid polyvinyl chloride (PVC) extrusion modules. A Wavelength Shifting (WLS) fiber is inserted into each liquid scintillator cell and terminates on a pixel of a 32-pixel Avalanche Photo Diode (APD) chip. The APD is followed by front-end electronics that amplify, multiplex



digitize and zero suppresses signals before passing them on to the data acquisition system.

- The NOvA far detector enclosure is an approximately 36,000 square foot space for NOvA far detector, an assembly area, mechanical/electrical spaces and office space for small operations crew.

## 2.2 STATUS OF PROJECT

Level	Major Milestones	Fiscal Year
1	CD-0 Approve Mission Need	Q1 2006 (A)
1	CD-1 Approve Preliminary Baseline Range	Q3 2007 (A)
1	CD-2 Approve Performance Baseline	Q1 2008
1	CD-3a Approve Start of Construction (early procurements, site prep, foundation)	Q1 2008
1	CD-3b Approve Balance of Construction	Q2 2008
1	CD-4 Project Completion	Q4 2013

Comment [p5]: Consider whether this should be Q3?

**SECTION 3 – REVIEW LOGISTICS****3.1 DATES AND LOCATION OF REVIEW**

The EIR Team will evaluate the performance of this project during an on-site review at Fermi National Accelerator Laboratory.

**3.2 REVIEW SCHEDULE**

The following schedule is applicable to the overall review sequence.

September, 2007	Draft Review Plan Issued
October 5, 2007	Final Review Plan Approved/Issued by SC-1.3
October 8, 2007	DOE provides Documents for EIR Team Review
November 12-16, 2007	On-Site EIR Review
November 19, 2007	Draft Report and Draft Corrective Action Plan (CAP) Shell Issued For Factual Accuracy Review and Comment
November 26, 2007	Receive Factual Accuracy Review Comments
December 6, 2007	Final Report, Corrective Action Plan (CAP) Shell, and Comment Resolution Document Issued

**3.3 PRE-REVIEW TELECONFERENCES AND PREMEETINGS**

A review kick-off teleconference between the EIR Team, the Program Manager, Federal Facility Director and NOvA Project personnel will be scheduled as needed.

**3.4 INFORMATION AVAILABLE PRIOR TO ON-SITE MEETINGS**

The documents provided in preparation of this Project Review are listed in Section 5.1.

**3.5 REPORT DISTRIBUTION**

This EIR Team will make distribution of the draft and final EIR reports to the distribution provided in Attachment C.

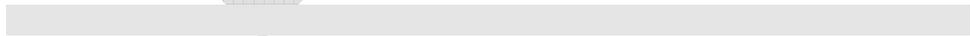


**SECTION 4 – TEAM MEMBERS AND ASSIGNMENTS**

The principal areas of focus of the EIR Team members are presented in the table below:

Review Area	Team Member Name*	Name **	Name	Name
Resource Loaded Schedule				
Total Project Cost and Project Schedule				
Work Breakdown Structure				
Risk Management				
Basis of Design and Design Review				
System Functions and Requirements				
Hazard Assessment				
Value Engineering				
Project Control				
Project Execution Plan				
Start-up Test Plan				
Acquisition Strategy				
Integrated Project Team				

\* Team Leader / \*\*Cost Lead





**SECTION 5 – REFERENCES**

**5.1 AVAILABLE DOCUMENTATION**

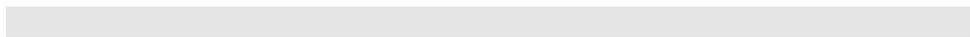
Documentation will be made available to the EIR team at a website ~ four weeks prior to onsite review.

Document Number	Document Title	Document
NOVA-DOC-Database	NOvA Technical Design Report Performance Baseline-Scope Project WBS WBS Dictionaries Design Criteria Preliminary Design Scope, Cost & Schedule Overview	Sept 07
NOVA-DOC- Database	Performance Baseline – Schedule Resource Loaded Schedule Summary Schedule Milestone Summary Critical Path	Sept 07
NOVA-DOC- Database	Performance Baseline – Cost & Contingency Estimate NOvA Funding Profile Guidance NOvA Project Level Budget Authority NOvA Project Cost Estimate by WBS NOvA Project Cost Estimate by Control Account Project Basis of Estimate	Sept 07
NOVA-DOC-616	Contingency Analysis Rules for NOvA	Jan 2007
NOVA-DOC-2272	NOvA Risk Management Plan & Risk Summaries	Jun 07



**ATTACHMENT A – EXTERNAL INDEPENDENT  
PROCESS FOR OFFICE OF SCIENCE PI**

<b>Document Number</b>	<b>Document Title</b>	<b>Document</b>
NOVA-DOC-618	NOvA Hazard Analysis Document	Mar 2
	NOvA Preliminary Safety Assessment Document	
NOVA-DOC-1354	NOvA Environmental Assessment for NEPA	Aug 2
NOVA-DOC-1353	NOvA Quality Management Program	Jun 2
NOVA-DOC-131	NOvA Configuration Management Program	May 2
NOVA-DOC-1945	NOvA Earned Value Management System description	Jun 2
DOE PEP	Project Execution Plan	Oct 2
NOVA-DOC-129	Project Management Plan Management, Organization & Responsibilities Technical, Cost & Schedule Baseline Project Controls System Value Management Engineering Design Review	Jun 2
NOVA-DOC-Database	Start-Up Test Plan	Sept 2
DOE AS	Acquisition Strategy	Mar 2
NOVA-DOC-1321	Procurement Plan for NOvA	May 2





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**ATTACHMENT A – EXTERNAL INDEPENDENT REVIEW PROCESS FOR OFFICE OF  
SCIENCE PROJECTS**



**ATTACHMENT C – DISTRIBUTION LIST**

The following is the planned distribution list for the draft and final EIR Report:

<b>Organization</b>	<b>Name</b>	<b>Location</b>	<b>E-mail Address</b>
SC-1.3	Dan Lehman	DOE HQ, GTN	daniel.lehman@science.doe.gov
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\*Five hard copies will also be provided.