

**Office of High Energy Physics
Office of Science**

**Critical Decision 3A (CD-3A)
Approve Project Start of Limited Construction for the
NuMI Off-axis electron neutrino (ν_e) Appearance (NOvA) Project**

Purpose

The purpose of this paper is to document the review by the Office of Science Energy Systems Acquisition Advisory Board-equivalent for Critical Decision 3A (CD-3A) “Approve Start of Limited Construction” for the NOvA Project at the Fermi National Accelerator Laboratory (Fermilab) and the Ash River, Minnesota site.

Project Description

The NOvA project consists of a small “near” detector located at the Fermilab site; a much larger 14,000 ton “far” detector located in Ash River, Minnesota; a detector enclosure for the far detector; and accelerator and NuMI beamline upgrades to increase beam power to 700 kW and operate in the medium energy neutrino configuration to provide the intense neutrino flux to the NOvA far detector. The near detector measures how many neutrinos are in the beam before it leaves Fermilab, while the far detector looks for the muon to electron neutrino oscillation. Both detectors will be constructed from alternating planes of vertical and horizontal cells of liquid scintillator contained in rigid polyvinyl chloride (PVC) extrusion modules and include optical fiber, electronics and data acquisition systems for signal and data processing and analysis.

Justification and Definition of CD-3a

CD-2 for the NOvA project was approved in September 15, 2008 establishing a performance baseline with a total project cost (TPC) of \$278 million, a phased project start and a CD-4 completion date of November 2014.

The phased project start, beginning with CD-3A, will enable start of activities along two parallel paths that are critical to the schedule: Ash River site construction, and Fermilab Accelerator and NUMI upgrades. In addition, certain long-lead items are included. The project is requesting CD-3A approval for the following: 1) Access road construction, site grubbing, utilities work, building excavation and some concrete work at the Ash River site, 2) Scintillator Wavelength shifting powder procurement (a long-lead, single vendor item), 3) Acquisition and packaging of electronics with completed design (analog-to-digital converters for front-end boards) and 4) Accelerator and NUMI magnet, kicker, radio-frequency, power supply and instrumentation system components, tooling and fabrication work. The estimated costs for the CD-3A items are presented in Table 1 at the end of this document.

On October 23-25, 2007, the Department of Energy (DOE) Office of Science conducted a CD-2/3A Independent Project Review (IPR) for the Office of High Energy Physics (OHEP) to assess baseline readiness for the NUMI Off-Axis Electron Neutrino Appearance (NOvA) Project, and

project readiness to carry out long lead procurements and a limited set of other construction activities. That review committee, comprised of 24 technical and management experts from DOE national laboratories, DOE headquarters and U.S. universities, was impressed with the technical design progress and concluded the designs were satisfactory to meet the physics goals, and procurement and fabrication plans were appropriate. The committee judged long-lead procurement and selected construction activities to be ready for CD-3A, including requested items for site preparation and access road construction, commodities (e.g. wavelength shifting powders), electronics, and accelerator and NUMI upgrade components.

Subsequent to that CD-3A review, the NOvA Project completed a DOE Office of Engineering and Construction Management (OECM) External Independent Review (EIR), just prior to the FY08 Omnibus Budget action that zeroed NOvA Project funding in FY08. This budget action required revising the project baseline cost and schedule to match a new OHEP funding profile, and completing additional IPR and EIR follow-up reviews of the revised baseline. These reviews were completed in the April-July 2008 timeframe. The IPR follow-up review concluded that all findings from previous reviews have been addressed, and the EIR follow-up closed all major findings and validated the NOvA Project performance baseline. In addition, the FY08 Supplemental funding provided in July 2008 restored some FY08 funding to NOvA, providing for a project start and an opportunity to advance the baseline schedule. The project is now ready to request DOE CD-3A approval for limited start of procurement and construction activities. Authority for this approval has been delegated by the Acquisition Executive to the Associate Director for the Office of High Energy Physics.

Schedule

The following list is the baseline schedule of critical decision dates for the NOvA Project:

Schedule	Completion, (A) = Actual
CD-0 Approve Mission Need	November 2005 (A)
CD-1 Approve Alternative Selection and Cost Range	May 2007 (A)
DOE Cooperative Agreement awarded	September 2007 (A)
CD-2 Approve Performance Baseline	September 2008 (A)
CD-3A Approve Start of Limited Construction/Procurement	February 2009
CD-3B Approve Start of Full Construction	October 2009
CD-4 Approve Start of Operations/Project Completion	November 2014

The baseline schedule can accommodate a limited Continuing Resolution for FY 2009. The FY 2008 Supplemental funding enables progress toward completing final design work on remaining items beyond CD-3A, as well as resuming accelerator and detector R&D work (including the Integrated Prototype Near Detector). The funding anticipated to be available in FY 2009, even during a limited continuing resolution, will enable an earlier start of the CD-3A limited procurement and construction activities, advancing the schedule in some areas by a few months with respect to a February 2009 CD-3A approval. In FY 2009 the project will also work on finalizing design and reaching readiness on the remaining project activities in preparation for CD-3B approval, scheduled for October 2009.

The DOE OECM External Independent Review of the NOvA project completed in July 2008 concluded that the NOvA Earned Value Management System (EVMS) system is in place and capable of accurate reporting, and it is in use for monitoring, tracking and reporting project progress. Based on prior agreement with OECM, the OECM endorsement for final approval of full construction start for NOvA requires DOE certification of Fermilab's EVMS. Fermilab EVMS certification is scheduled to be completed by September 2009, in advance of the baseline schedule for the final NOvA CD-3 approval.

Table 1. NOvA Project CD-3A Scope and Cost

WBS	Activity Description	BAC Labor + Material (AY \$M)	Contingency On BAC (AY \$M)
	Total for all NOvA CD-3a Items	19.044	4.872
2.0	Accelerator & NuMI Upgrades	6.281	1.772
2.0.1	Recycler Upgrades	4.437	1.324
	Recycler Beam Lines (Transfer, Abort & RR 30 Straight): Procure tooling parts, stands, parts for magnets, and cables and start some magnet assembly	1.407	0.537
	Procure parts for Recycler 53 Mhz System	0.364	0.083
	Oversight for non Kicker Magnet Modifications	0.043	0.004
	Recycler Kicker System		
	Procure beam tubes and resistors for Recycler Injection Kicker Magnet	0.106	0.023
	Procure Recycler Extraction and Injection Kicker Magnet beam tubes and cooling skid parts and start cooling skid fabrication	0.361	0.098
	Procure Recycler Extraction Line Kicker Power Supply Parts and cables and start	0.666	0.201
	Procure Beam Abort Kicker Magnet beam tubes and cooling skid parts	0.214	0.062
	Procure pulser parts and pulse forming line frames and start assembly	0.288	0.090
	Oversight of Kicker Magnet Construction	0.020	0.002
	Recycler Instrumentation		
	Procure Beam Position Monitor cables, connectors and transition boards	0.644	0.110
	Procure DC Current Transducer, cables and connectors	0.063	0.013
	Procure longitudinal and transverse damper and start testing longitudinal ones	0.261	0.102
2.0.2	Main Injector Upgrades	1.153	0.288
	MI Modifications		
	Procure New Transformer	0.153	0.046
	Procure equipment racks and cable for MI-14 Building	0.013	0.004
	Procure equipment racks and cable for MI-39 Building	0.013	0.004
	MI RF Cavities		
	Procure material for MI RF Cavities Bus Bar, fabricate and install	0.086	0.020
	Procure series tube modulator, parts for cavities power amplifier, controls rack, solid state amplifiers and ferrite bias supply	0.889	0.215
2.0.3	NuMI Upgrades	0.691	0.160
	NuMI Primary Proton Beam		
	Procure & install NuMI Dipole power supply regulation system and cycle time	0.232	0.059
	Procure 75KW power supplies & regulation parts for NuMI Quadrupoles	0.297	0.059
	Procure parts for profile monitors upgrade and start assembly	0.162	0.042
2.1	Ash River, Minnesota: Site & Building	10.387	2.477
2.1.1	Site Preparation Package		
	Build Phase - Mobilize, Build Access Road, Excavate Site	8.567	2.065
	Build Phase - Utilities Work	1.373	0.412
	Cooperative Agreement Fees	0.447	-
2.2	Liquid Scintillator	2.253	0.563
2.2.3	Waveshifters		
	Production and Delivery of waveshifter powders	2.243	0.561
	Quality Assurance on waveshifters	0.010	0.003
2.6	Electronics	0.123	0.060
2.6.2	Front End Board Readout		
	Package ADCs from CERN CMS ECAL wafers	0.123	0.060

Critical Decision 3A, Approve Limited Construction
of the NOvA Project

Submitted by:

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Pepin Carolan
Federal Project Director
Fermi Site Office

10/15/08

Date

Joanna M. Livengood

Joanna Livengood
Manager
Fermi Site Office

10/16/08

Date

Michael Procario

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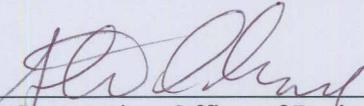
10/24/08

Date

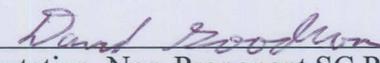
**Critical Decision 3A, Approve Limited Construction
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Recommendations:

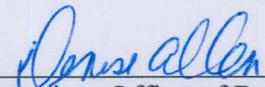
The undersigned "Do Recommend" (Yes) or "Do Not Recommend" (No) approval of CD-3A, Approve Limited Construction, for the NOvA Project as noted below.



ESAAB Secretariat, Office of Project Assessment Date 10/24/08 Yes X No _____



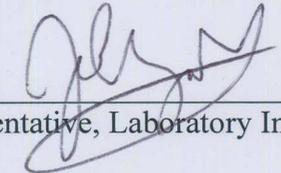
Representative, Non-Proponent SC Program Office Date 10/24/08 Yes ✓ No _____



Representative, Office of Budget Date 10/24/08 Yes ✓ No _____

Representative, Environmental, Safety and Health Division Date Yes _____ No _____

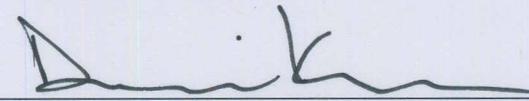
Representative, Security Management Team Date Yes _____ No _____



Representative, Laboratory Infrastructure Division Date 10/24/08 Yes ✓ No _____

Representative, Grants and Contracts Division Date Yes _____ No _____

Approval of CD-3A



Dennis Kovar, Acquisition Executive
Associate Director for High Energy Physics
Office of Science Date 10/24/08