U.S. Department of Energy
Finding of No Significant Impact

Construction and Operation of Neutrinos at the Main Injector (NuMI) Off-Axis Electron Neutrino (ν_e) Appearance Experiment (NOνA) at the Fermi National Accelerator Laboratory, Batavia, Illinois, and St. Louis County, Minnesota
(DOE-EA-1570)

AGENCY: U.S. Department of Energy

ACTION: Finding of No Significant Impact

SUMMARY:

The proposed action involves constructing and operating facilities for a new neutrino physics research program. The Department of Energy's (DOE) Fermi National Accelerator Laboratory (Fermilab) is the lead laboratory, and the University of Minnesota is the lead collaborating university through a Cooperative Agreement with the DOE. The program would generate neutrinos at Fermilab in Batavia, Illinois, for analysis in proposed detectors at Fermilab and near the Ash River, in St. Louis County, Minnesota.

Proposed activities at the Ash River site include a wetlands action that requires a permit from the U.S. Army Corps of Engineers (USACE). Consequently, the EA incorporates a wetlands assessment, and the USACE is a Cooperating Agency in the EA. This Finding of No Significant Impact (FONSI) incorporates DOE's wetlands finding, pursuant to Title10, *Code of Federal Regulations*, Part 1022 (10 *CFR* Part 1022) , "Compliance with Floodplain/Wetlands Environmental Review Requirements".

Based on the analysis in the Environmental Assessment (EA), DOE has determined that the proposed action does not constitute a major federal action significantly affecting the quality of the human environment within the meaning of the National Environmental Policy Act (NEPA).

DESCRIPTION OF THE PROPOSED ACTION:

Proposed Action: The proposed action would take place at both the Fermilab site and in St. Louis County, MN, near the U.S. – Canadian border. The region between the two sites would not be affected by construction, operation, or decommissioning of the proposed action. The proposed action consists of four main phases: (1) excavation and construction; (2) scintillator blending, detector assembly and testing; (3) performance of the NOνA experiment, and (4) decommissioning.

The construction phase at Fermilab would include an upgrade of the existing Fermilab accelerator complex with an increase of beam power in the Main Injector. A new underground cavern would be excavated at approximately 345 feet below grade adjacent to an existing tunnel. This excavation would remove about 1,000 cubic yards of rock

using conventional civil construction and mining techniques. The cavern would hold a new 222-ton "Near Detector" to monitor the neutrino beam as it leaves the Fermilab vicinity. Above-ground, a 90-ton prototype detector would be assembled in an existing Fermilab facility to provide development and optimization for the neutrino detector. In addition, to support the blending of approximately 4.2 million gallons of scintillation detector fluid, either a blending facility would be constructed at Fermilab or the services of a commercial blender near Chicago would be engaged. A constituent in the blending operation would be pseudocumene, a toxic organic liquid, at approximately 5% of the total volume. Blended scintillation fluid would be transported by tanker truck from the blending facility to the Ash River site.

A proposed new "Far Detector" Facility would be constructed at the Ash River site. The new building would be 67 feet wide by 375 feet long and would be sunk 40 feet below the existing grade into granite rock at the site. Site preparation would include improvement to an existing logging road to facilitate all-weather access. A proposed 20,000-ton Far Detector would be constructed with components identical to the ones used in the Near Detector, but with dimensions, number and total volume scaled to the larger size.

The schedule for the proposed action has construction/excavation and assembly starting in 2008. Construction and assembly would continue through 2013. Experiment performance would begin on parts of the devices during the construction period, but sustained operations would begin in 2013 and continue through at least 2019. Following achievement of experiment objectives, decommissioning would occur over a several-year period.

Purpose and Need: Neutrinos are uncharged, non-ionizing elementary particles that only rarely interact with ordinary matter. The study of the oscillation of neutrinos from one type to another is considered a good way to study important physics questions, such as the properties of the weak interaction, neutrino mass, the contribution of neutrinos to the Dark Matter in the Universe, and the relationship between matter and antimatter. Understanding these particles is an important goal of the worldwide physics community and the DOE Office of Science, and operation of the NOνA facility would advance that goal.

Alternatives: NEPA requires evaluation of the impacts of "reasonable alternatives." "Reasonable Alternatives" are those that satisfy the purpose and need of the proposed action.

The presence of existing NuMI beamline infrastructure at Fermilab fixed the location for the origin of the neutrinos. During conceptual design for the project, several site alternatives for the location of the Far Detector Facility were contemplated for beamline termination. Screening criteria included:

- The ability to have the detector as far away from Fermilab as possible;
- The ability to have a detector ~ 12 km off-axis from the central NuMI neutrino beam;

- Access to the site by existing roads;
- The ability to do construction in all seasons on the experimental hall and on the detector;
- Access to power, telephone lines, and fiber optic data connections;
- The availability of a relatively flat area for construction;
- The availability of high ground, well above the water table with no wetlands;
- The absence of features likely to provoke controversy or litigation; and
- A location in the United States [A location in Canada would require participation by a Canadian institutional collaborator].

Only one site alternative, the proposed site, met the screening criteria for a more thorough evaluation in the EA:

Four non-site alternatives were considered. Three were not analyzed:

- Alternative access roads to the proposed Ash River site that avoid wetlands were considered, but were determined not to be feasible because they did not meet several of the screening criteria, above. For example, a more direct route from the north across St. Louis County 129 would be shorter and cheaper, but would be be controversial because of visibility from Voyageurs National Park, and impact old growth forest and protected wildlife.
- Alternative building designs for the Far Detector Facility were considered but did not address the need to maximize shielding of the detector from background radiation. The proposed design makes the best use of the excavated granite as a cosmic ray shield for the detector.
- Alternative detector technologies were considered for the Far Detector. Most were scientifically inferior, while one alternate required too many years of R&D to be considered viable.

One non-site alternative was considered reasonable for analysis.

- The NOνA EA analyzes two options for mechanically blending the scintillator materials. The first option was to use a local commercial toll blender in the Chicago area and transport blended materials from that location to Fermilab and Minnesota. The second option was to construct and operate a blending facility at an existing Fermilab site.

Additionally, the No Action alternative was analyzed. Under the No Action Alternative, the experiment would not be conducted and the scientific goals for the studies of neutrino oscillations would not be achieved in the U.S. in the near future. The No Action Alternative would avoid the potential environmental impacts of the Proposed Action, discussed below.

ENVIRONMENTAL IMPACTS:

The proposed construction site at Fermilab is limited to an underground excavation and a small surface stockpile for excavated rock. These areas are not known to contain historical resources or sensitive biological resources or habitats that would be affected by construction. Rock spoils generated during excavation would constitute a less than 2% increase in existing spoils piles at Fermilab. Labor staffing during construction would be a small fraction of the worker population currently accessing Fermilab. On-site impacts from traffic, air emissions, vibrations, and noise would be small. The EA projects that up to three cases of injury/illness can be expected, two during the excavation phase of construction. It also projects that five traffic accidents during worker commutes would occur, but that no traffic injuries or fatalities would result. Other off-site impacts from the proposed action would be extremely small and largely limited to air and noise impacts, but no noise or air quality standards are expected to be exceeded.

Changes in work activities at Fermilab related to the operational phase of the proposed project are few. Increasing the Main Injector beam power to 700 kW would increase estimated radionuclide emissions and tritium in ground water. Increased beam power would also lead to increased activation of accelerator and beamline components. Such increases could be expected to proportionally increase the potential estimated dose rate to workers. However, increased dose "rates" only refers to the potential for dose – DOE does not contemplate an actual increased dose to workers (or the public), since engineered and administrative barriers will be put into place to limit dose to current limits. The Fermilab radiation exposure control program has been effective in limiting exposure to workers, and doses will remain considerably below the DOE 10 *CFR* Part 835.202 total effective dose limit of 5 rem (5,000 mrem) and the Fermilab administrative dose goal of 1,500 mrem annually. The estimated maximum annual radiation dose at the site boundary that would result from airborne releases is 0.04 mrem. This hypothetical dose is far below the regulatory limit of 10 mrem in a year. Based on established conversion rates, radiation from the experiment would be responsible for no latent cancer fatalities to either workers or the public.

The Far Detector site in Minnesota is currently undeveloped, so the proposed project would change the appearance and current use of the site. The proposed project would include clearing, grading and excavation disturbing greater than 5 acres, and therefore would require a permit issued for the discharge of storm water associated with construction activity under National Pollutant Discharge Elimination System as implemented by the Minnesota Pollution Control Agency. The erosion controls required by the permit, as well as the site location and Facility design, would minimize potential impacts to surface water. During construction there would be short-term, localized impacts on air quality from vehicular traffic exhausts and earth-moving operations, similar to construction of any commercial facility of comparable size.

Construction of the access road would result in filling approximately 3.5 acres of wetlands, requiring a permit from the USACE under Section 404 of the Clean Water Act and conformance with the requirements of the Wetland Conservation Act of Minnesota. Approximately 5.2 acres of banked wetlands would be purchased to mitigate impacts to existing wetlands due to excavation and construction at the Ash River site. Under

Executive Order 11988, *Floodplain Management*, and Executive Order 11990, *Protection of Wetlands*, Federal agencies are required to consider the impact of proposed actions on wetlands and floodplains. The DOE requirements for compliance with Executive Orders 11988 and 11990 are found in 10 *CFR* Part 1022. A wetland assessment was included in the EA, and satisfies all the requirements of 10 *CFR* 1022. The wetlands permitting process has not been completed due to a USACE requirement to first have NEPA documentation in place.

Concerns over the potential for archeological resources to be affected in the project area at the Ash River site have been resolved through the negotiation of a Programmatic Agreement under Section 106 of the National Historic Preservation Act. Signatories include DOE, the Minnesota State Historic Preservation Office, the Bois Forte Band of Minnesota Chippewa, and the White Earth Band of Minnesota Chippewa. The programmatic agreement includes a stipulation that DOE perform an archeological survey of the project area in the spring of 2008, prior to construction. The survey would include further investigation of historical resources, including both architectural (i.e., to address potential impacts to a historic logging railroad grade) and cultural.

To address concerns of the National Park Service, the Far Detector Facility will be designed to minimize its visual impact on Voyageurs National Park. For example, the tallest section of the building (which would have an above-ground height of approximately thirty-seven feet or approximately two stories), will not have any windows facing north (i.e., toward Voyageurs) to minimize reflected sunlight. In addition, an earthen berm with native grasses would surround much of the Far Detector Facility up to the roof line. Exterior colors for all buildings would be muted grays and browns. All north facing building walls would be in neutral colors to decrease contrast and visibility. Native plants and trees would be planted to soften the outlines of all buildings. In addition, the NOνA Project would work with the National Park Service to design additional measures to screen or soften the appearance of the site buildings if needed

100% secondary containment of liquid scintillator and other liquids at every stage of the assembly and installation process, is designed to prevent any release to ground water during assembly, installation and operation. The adhesive that would be used to assemble the detector modules contains methyl methacrylate (MMA), a volatile organic compound and a federal hazardous air pollutant. The health and safety plan developed for the project would detail the proposed ventilation controls intended to comply with occupational and environmental concentration standards. Site workers and contractors would conduct work under a University of Minnesota site health and safety plan and procedures for installation and assembly operations.

Some impacts to employees would be expected from the NOνA experiment. The multiple shipments of materials via truck, tanker or rail car on and between the project sites are subject to routine traffic accidents. Based on traffic accident statistics, one accident and one injury can be expected during transportation of materials (during all phases of the project) and nine accidents and two injuries can be expected during worker commutes (during all phases of the project). No transportation fatalities are expected.

OSHA reportable cases would be approximately 19, or about 1~2 per year of the project schedule.

The spill of MMA or pseudocumene (a hazardous component of the largely mineral oil scintillation fluid) in an accident during delivery from the distributor to the NO*v*A Project in a wetland or other sensitive area could impact exposed sensitive species. Although an accident during transport has a calculable probability of *occasional* (approximately 0.03~0.04), the probability that an accident would occur that also causes a spill at an environmentally sensitive area would be several orders of magnitude less (1E-04).

Cumulative: Radiological impacts of the NO*v*A experiment result from increasing the beam power from 400 kW to 700 kW in the NuMI accelerator. As discussed in the EA, the NO*v*A proposed action would be an incremental change to the existing Fermilab operational base and would be offset by decreases due to completion of the Tevatron Collider research program. Increases in beam power would primarily affect radiological conditions. There are no other current or reasonably foreseeable future projects at Fermilab that may interact with the project described in the EA in such a way as to cause cumulative impacts.

There are no current activities or future phases of development planned for the Ash River site, nor are there any other activities or developments proposed by others that are reasonably foreseeable in the area of the proposed project. Therefore no cumulative impacts are anticipated with respect the project in the Ash River area. Future logging efforts are not considered "reasonable and foreseeable actions" in terms of evaluating cumulative impacts, as logging has been occurring in the area for over a hundred years and would continue indefinitely in the region as a renewable and managed resource.

DETERMINATION:

Based on the analysis in the final EA and consideration of public comments received on the draft EA, DOE has determined that the proposed construction and operation of NO*v*A at Fermilab and near Ash River, and the use of either a toll blender in the Chicago area or construction of a support facility at the Fermilab to mechanically blend scintillator materials would not individually or cumulatively have a significant affect on the quality of the human environment within the meaning of NEPA. Therefore, the proposed action does not constitute a major federal action within the meaning of NEPA, and an environmental impact statement is not required. With this determination, DOE can proceed with the NO*v*A project. However, since a permit from the USACE under Section 404 of the Clean Water Act is still required (and per USACE procedures, can not be issued until the NEPA process is complete), any activity involving wetlands will be contingent upon receipt of that permit. Likewise, the terms of the Programmatic Agreement under Section 106 of the National Historic Preservation Act will need to be met before any activities with the potential to effect historic properties are undertaken.

PUBLIC AVAILABILITY:

Copies of the EA are available by contacting:

Sally C. Arnold
Document Manager
U.S. Department of Energy
P.O. Box 500
Kirk Road and Pine Street
Batavia, IL 60510-0500
Telephone: 630/840-2239
E-Mail: sally.arnold@ch.doe.gov

Copies of the EA are also available for review at the following locations:

Batavia Public Library
10 S. Batavia Avenue
Batavia, IL

Warrenville Public Library District
28W751 Stafford Place
Warrenville, Illinois

University Librarian's Office
499 Wilson Library
309 19th Avenue South
Minneapolis, Minnesota

Municipal Building
600 4th Street
International Falls, Minnesota

Fermi National Accelerator Laboratory
Library
Wilson Hall, 3rd Floor
Kirk Road and Pine Street
Batavia, Illinois

The EA may be viewed on-line at: http://www.fnal.gov/pub/neighbors/nova/NOvA-final-EA.pdf

For further information regarding the DOE NEPA process, contact:

Peter R. Siebach
NEPA Compliance Officer
U.S. Department of Energy
Chicago Office (STS)
9800 S. Cass Avenue

Argonne, IL 60439
Telephone: 630/252-2007
E-Mail: peter.siebach@ch.doe.gov

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Joanna M. Livengood, Manager
Fermi Site Office