

**U.S. Department of Energy
Finding of No Significant Impact and
Floodplain Statement of Findings**

Environmental Assessment for the Construction and Operation of the Long Baseline
Neutrino Facility and Deep Underground Neutrino Experiment at Fermilab, Batavia,
Illinois, and Sanford Underground Research Facility, Lead, South Dakota
(DOE/EA-1943)

AGENCY: U.S. Department of Energy

ACTIONS: Finding of No Significant Impact and Floodplain Statement of Findings

SUMMARY

The Long Baseline Neutrino Facility and Deep Underground Neutrino Experiment (LBNF/DUNE) would help to advance our understanding of the basic physics of elementary particles called neutrinos.

LBNF/DUNE would make use of an existing high-energy particle accelerator at Fermi National Accelerator Laboratory (Fermilab) in Batavia, Illinois to generate a beam of neutrinos and would utilize particle detectors to analyze the beam; there would be one at Fermilab and another detector with one or more modules would be approximately 800 miles away at the Sanford Underground Research Facility (SURF) in Lead, South Dakota. The detectors would be deep underground, which would shield them from cosmic radiation that could interfere with them.

Proposed activities at Fermilab include a wetlands action that would require a permit from the U.S. Army Corps of Engineers (USACE). Consequently, the Environmental Assessment (EA) incorporates a Floodplain/Wetlands Assessment. This Finding of No Significant Impact (FONSI) incorporates the Department of Energy's (DOE) floodplain findings pursuant to Title 10, *Code of Federal Regulations*, Part 1022 (10 CFR Part 1022), "Compliance with Floodplain and Wetland Environmental Review Requirements."

Based on the analysis in the 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: Under the Proposed Action, Fermilab would construct facilities that would extract a proton beam from Fermilab's existing particle accelerator, generate a high-intensity neutrino beam, and direct the beam at a detector to be constructed 800 miles away at SURF. The beam would be generated underground and would travel

through the Earth at depths of up to 20 miles. The Fermilab components of the Proposed Action would be constructed adjacent to Fermilab's existing accelerator ring and would include beamline facilities to extract and focus the beam (by means of target horns and magnets). The primary structures would include a Primary Beam Enclosure, Target Hall, Absorber Hall, Decay Pipe, and Near Neutrino Detector (NND). Most of these facilities would be constructed underground or within an earthen embankment to shield the surrounding environment from beamline radiation. The facilities and work areas would be housed in a series of underground experimental halls and aboveground service buildings.

Proposed facilities at SURF would include a large, underground liquid argon (LAr) detector with one or more detector modules, associated supporting facilities, and an aboveground service building. Construction of the underground detector—necessary to eliminate cosmic radiation that could interfere with the detector—would require excavation and transportation of a large volume of rock. The rock would be transferred to either the Gilt Edge Superfund site, or to the Open Cut in Lead, a former surface mining pit that was part of the former Homestake Mine. Truck, conveyor and/or a rail system would be used. The Gilt Edge Superfund site is a highly disturbed former gold mine in Deadwood—the Proposed Action would cover only transportation to the Gilt Edge Superfund site and not other activities being planned for its remediation.

At both Fermilab and SURF, the Proposed Action would include implementation of Standard Environmental Protection Measures (SEPMs), such as post-construction re-vegetation, erosion control, and traffic control, as well as occupational health and safety and radiation safety programs.

The facilities would be designed for an expected experimental lifetime of approximately 20 years. Since ultimate decommissioning, including potential repurposing, dismantling and disposal of radioactive and non-radioactive components would not occur for many years, it would be too speculative to evaluate future decommissioning impacts in this EA. Therefore, the environmental impacts of decommissioning would be evaluated in a future NEPA process.

Purpose and Need: LBNF/DUNE would help to advance our understanding of the basic physics of the elementary particles called neutrinos and thereby help us to understand the physical nature of our Universe. Neutrinos are elementary subatomic particles that have no electrical charge and are one of the most abundant particles in the Universe. In nature, they are produced in great quantities by sources such as our sun, stellar explosions known as supernovas, and in smaller quantities on earth by man-made facilities, such as nuclear power plants. Neutrinos stream to the earth each day. The very small size of neutrinos means that they pass right through matter largely unimpeded, and only very rarely interact with other particles. In the lab, at facilities such as Fermilab, scientists can make neutrino beams for experimental purposes with particle accelerators.

Neutrinos in flight naturally transform themselves quantum mechanically, by oscillating back and forth between three different states or “flavors” (muon neutrinos, electron

neutrinos, and tau neutrinos). LBNF/DUNE would enable the most precise measurements yet of this neutrino oscillation phenomenon, which could potentially help physicists discover whether neutrinos violate the fundamental matter-antimatter symmetry of the Universe. If they do, then physicists would be a step closer to answering the puzzling question of why the Universe currently is filled preferentially with matter, while the antimatter that was created equally by the Big Bang has all but disappeared. So far, other sub-atomic particles known as quarks are the only elementary particles known to violate the fundamental symmetry between matter and antimatter. However, the observed violation of this symmetry in the physics of quarks is not sufficient to explain the observed abundance of matter over antimatter in the Universe.

Alternatives: Alternative A consists of other smaller, reasonably foreseeable experiments that would make efficient use of LBNF/DUNE or SURF infrastructure. These alternatives are not mutually exclusive and could be constructed in addition to the Proposed Action or they could be constructed independently. DOE also considered other siting alternatives and a less ambitious alternative with fewer facilities at Fermilab and a smaller surface detector at SURF. However, these alternatives were eliminated and not evaluated in the EA because they did not meet the Purpose and Need for the LBNF/DUNE and/or certain other criteria deemed necessary for the project.

As required by Council on Environmental Quality (CEQ) regulations, the LBNF/DUNE EA evaluates a No Action Alternative to serve as a basis for comparison with the action alternatives. Under the No Action Alternative, LBNF/DUNE would not be constructed and operated and the enhanced opportunities for neutrino research would not be pursued.

ENVIRONMENTAL IMPACTS

Land Use and Recreation

Fermilab: LBNF/DUNE is consistent with current Fermilab land use and its science mission. There would be no land use impacts off-site because the Proposed Action is contained within the Fermilab site. Recreational use of the Illinois Prairie Path on the Fermilab site would not change.

SURF: Land use would be consistent with current use. The majority of the construction for the Proposed Action would be underground. The land needed above ground has been previously disturbed.

Biological Resources/Wetlands and Floodplains

Fermilab: Filling 5.0 acres of wetland would require a USACE permit and replacement of wetland functions. Temporary impacts on plants and animals would be minimized. There would be no or very low impacts on Federal or State protected species.

Given the fixed location of the particle accelerator and orientation of the beamline required to direct neutrinos to the one far site location that met siting criteria (i.e., SURF), avoidance of a floodplain was not possible; however, impacts from construction in the 100-year floodplain would have no or very low impacts to the extent of the floodplain.

SURF: Construction would be underground and in previously disturbed, above ground areas. Vegetation would be restored following construction. There would be no or very low impacts on Federal or State protected species.

Cultural Resources

Fermilab: There are no known historic properties or paleontological resources in the proposed construction area. DOE has completed consultations with the Illinois State Historic Preservation Office (SHPO) pursuant to Section 106 of the National Historic Preservation Act (NHPA). Fermilab maintains a Cultural Resource Management Plan (CRMP).

SURF: DOE and SURF conducted consultations with local government, the South Dakota SHPO, and the American Indian tribes regarding the presence of historic and traditional cultural properties. Consistent with Section 106 of the NHPA, a Programmatic Agreement (PA) for the LBNF/DUNE project has been developed to avoid or mitigate potential impacts to the Lead Historic District. Traditional cultural properties are not addressed in the PA, however, construction and operation would occur in the Black Hills, a Cultural Resource important to many tribes.

Health and Safety

Fermilab: Impacts would be similar to those from current activities. Operations would result in radiation exposure of less than the DOE standard to a limited number of workers and people authorized to enter the facility. Current Fermilab administrative annual dose goals would be observed. Work would be managed by existing policies that limit exposure to as low as reasonably achievable.

SURF: Fermilab would manage construction and operation. Workers constructing the LBNF/DUNE at SURF would encounter typical workplace hazards associated with underground construction, material handling and storage, blasting, and hauling excavated rock to the surface. Neutrinos arriving at SURF, or anywhere along their course from Fermilab, would not result in any radiation exposure.

Hydrology and Water Quality

Fermilab: There would be potential temporary impacts from nearby construction and re-direction of Indian Creek. Permits would be obtained from resource agencies. Operation of the facility/experiment would result in low levels of tritium below regulatory limits in

surface water in the area. Management of surface water would be consistent with current operations and limited by permit conditions.

SURF: Water from underground construction would be captured and treated by existing water treatment facilities. The operation of the Proposed Action would not measurably affect groundwater or surface water.

Noise and Vibration

Fermilab: During construction, noise levels would temporarily increase above ambient levels at residences directly across Kirk Road in Batavia, Illinois. Blasting, limited to day-time, could result in noticeable vibration levels in nearby houses and would be monitored. Operational noise impacts would be low and limited to chillers and air handling equipment.

SURF: Aboveground construction would result in temporary noise increases including noise from trucking along the transportation routes. Operation of the Cryogen Support Building would increase noise slightly above existing nighttime ambient noise levels.

Transportation

Fermilab: Construction would result in a modest increase in the annual average daily traffic on public roadways near Fermilab, notably Kirk and Butterfield Roads. Construction traffic would be managed to minimize impacts.

SURF: Two destinations (the Homestake Mine Open Cut and the Gilt Edge Superfund Site) and a combination of transportation modes (truck, conveyor, and/or rail system) were considered for excavated rock. After conveying the rock a short distance via conveyor or rail system to facilitate truck transport, the trucking distance to the Open Cut would be 4.1 miles and to Gilt Edge, 7.4 miles. Either option would require an average of 75 round trips per day. In the Open Cut option, a more extensive use of rail or pipe conveyer modes would eliminate the need for trucks to transport excavated rock, but some traffic above the normal level would be present during construction of the conveyor or rail system. In the Gilt Edge option, truck traffic would substantially increase on Kirk and Gilt Edge Roads in Lead, South Dakota. Based on Lead's history as a mining area, these impacts would be within the historical context.

Air Quality

Fermilab: Emissions from construction would be minimized by existing policies and would be temporary. Tritium and other short-lived radionuclides would be produced as a normal by-product of facility operations, but offsite levels would be low compared to DOE and EPA limits and Fermilab administrative limits.

SURF: Assuming trucking of excavated rock 8 miles to the Gilt Edge Superfund site as the most conservative scenario, air emissions would not exceed air quality standards. Operational emissions from the LBNF/DUNE would be below air quality standards.

Visual Resources

Fermilab: The earthen embankment and service buildings would be visible from Kirk Road in Batavia, Illinois during construction. The facility would blend in with the existing landscape as vegetation re-establishes.

SURF: Construction of LBNF/DUNE and transportation of excavated rock would be visible throughout Lead and surrounding areas. Operation would be carried out mostly underground and have low visual impact.

Geology and Soils

Fermilab: Up to 950,000 cubic yards (yd³) of soils would be removed and re-used or stored on site. Up to 45,000 yd³ of rock would be excavated, but important geological resources would not be affected. Construction would implement an LBNF/DUNE-specific erosion plan. Operation would have very low impacts on soils or bedrock.

SURF: Construction of the Proposed Action would require excavation of approximately 460,000 yd³ of rock from underground areas. Above ground construction would incorporate erosion control. Alternative A would result in an additional excavation of approximately 153,000 yd³ of rock. Operation would not require additional excavation or grading aboveground.

Socioeconomics and Environmental Justice

Fermilab: Construction and operation would have a beneficial economic impact on the local construction and associated industries. Potential negative impacts would not disproportionately impact minority and low-income communities.

SURF: Construction and operation of the Proposed Action would result in direct and indirect beneficial economic impacts. Potential negative impacts would not disproportionately impact minority and low-income communities.

Sustainability

Fermilab: Construction and operation of the LBNF/DUNE would conform to goals of Federal Executive Order (EO) 13693 for energy efficiency, waste reduction, sustainable acquisition, greenhouse gas emissions reduction, water use efficiency, and recycling.

The existing site sustainability plan and environmental management system would implement this.

SURF: Construction and operation of the LBNF/DUNE would be consistent with EO 13693 and with SURF sustainability plan goals of reducing energy use, efficient use of resources, minimizing emissions, and minimizing waste.

Utilities

Fermilab: Construction would require additional power, water, wastewater treatment, and natural gas resources. Power needed for operations would constitute approximately 15% of the total demand estimated for Fermilab operations. The power required for construction followed by 20 years of operation would not exceed power or distribution system capacity of the local utility company.

SURF: Construction of the underground detector would require an additional 4 MW of power over the current 3 MW demand. Operation of the detector would require 10.5 MW of additional power over the current demand. The increased usage would not affect municipal utilities and would be well within the power delivery capability of the Ross substation and Black Hills Power.

Waste Management

Fermilab: Construction activities would generate debris, which would largely be recycled. Operation of LBNF/DUNE would generate domestic and regulated waste and low-level radioactive waste that would be managed according to existing regulations and Fermilab policies. Waste minimization practices would be observed and compliance with waste management standards maintained.

SURF: Regulated and non-regulated waste would be expected due to construction activities. Operations would generate small quantities of solid waste that would be managed according to existing regulations and SURF policies. Existing waste minimization practices would be followed.

Cumulative Impacts

Fermilab: Projects with potential cumulative impacts include those existing or planned on the Fermilab site (e.g., PIP II) or in the immediate area, including improvement of adjacent roadways, including Butterfield Road and Kirk Road in Batavia, Illinois. No major cumulative-impacts are expected resulting from LBNF/DUNE.

SURF: Projects with potential cumulative impacts include those on the SURF site (e.g., LUX, Majorana, and CASPAR), which are or would be primarily conducted underground, and offsite (e.g., the Gilt Edge Superfund Site remediation). Construction

and operation schedules may overlap in the immediate area. Cumulative impacts resulting from LBNF/DUNE are expected to be minor.

PUBLIC COMMENT ON THE DRAFT EA

In May, 2015, DOE announced via letters to various stakeholders, press release, and advertisement in local newspapers the availability of the LBNF/DUNE Draft Environmental Assessment for comment. Additional letters were sent by Fermilab and SURF to their respective neighbors. The comment period on the LBNF/DUNE EA was held from June 8 to July 10, 2015. During that period, DOE held three public meetings:

- June 17, 2015, at the Copper Mountain Resort, 900 Miners Ave., Lead, SD.
- June 18, 2015, the Surbeck Center at the South Dakota School of Mines & Technology, 501 E. St Joseph St., Rapid City, SD.
- June 24, 2015, in the atrium of Wilson Hall, the main administrative building at Fermilab, near Kirk Road and Pine Street in Batavia, IL.

Other announced mechanisms for commenting included letter, e-mail, and the LBNF/DUNE project website. Some commenters also submitted comments via social media. A total of 27 comments (some multi-part) were received.

Appendix G was added to the EA to document the comments and respond to them. Primary concerns related to sound and vibration from blasting and other construction activities, transportation of excavated rock, hazards associated with the neutrino particle, and impacts to surface and groundwater resources. As a result, some edits and clarifications were made to the EA. A number of commenters also expressed support for the project and the associated science program.

DETERMINATION

The LBNF/DUNE EA is hereby approved. Based on the analysis contained therein and consideration of public comments received on the draft LBNF/DUNE EA, DOE has determined that the Proposed Action and Alternative A would not individually or cumulatively have a significant effect on the quality of the human environment within the meaning of NEPA. Therefore, they do not constitute a major federal action within the meaning of NEPA, and an environmental impact statement is not required. DOE has determined that its 10 CFR 1021 and 1022 Floodplain and Wetland Environmental Review Requirements as well as Section 106 of the NHPA have been satisfied. With this determination, DOE may proceed with the LBNF/DUNE EA Proposed Action and Alternative A. Either or both destinations (the Homestake Mine Open Cut and the Gilt Edge Superfund Site) and any or all modes of transportation identified in the Proposed Action for SURF, i.e., truck, conveyor, and/or rail system, for excavated rock are authorized. Conveyor can refer to the “pipe” conveyor specifically identified in the EA or any similar class of conveyor.

Authorization is contingent upon the following:

1. Transportation of excavated rock and other materials is subject to transportation management planning carried out together with local and state government as necessary.
2. Establishment of a program to monitor for sound during construction, both onsite and in adjacent areas. Monitoring would be at the homeowner's request and Fermilab's discretion.
3. Documentation, at homeowner's request and Fermilab's discretion, of baseline conditions of home foundations and other areas that could potentially be damaged by vibration.
4. Receipt of a permit from the USACE under Section 404 of the Clean Water Act for wetland activities at Fermilab. Per USACE procedures, the permit cannot be issued until the NEPA process is complete. Work on non-wetland related activities may proceed in the interim.
5. Receipt of any other necessary regulatory authorizations.
6. Compliance with the terms of the Programmatic Agreement under Section 106 of the National Historic Preservation Act. Work that is not of the kind that has the potential to impact historic properties (assuming they are present) may proceed.

PUBLIC AVAILABILITY

The EA may also be viewed on-line at: <http://lbnf.fnal.gov/env-assessment.html>

Copies of the EA are available by contacting:

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Kirk Road and Pine Street
Batavia, IL 60510-0500
Telephone: 630-840-4122
E-Mail: rick.hersemann@science.doe.gov

Copies of the EA have also been made temporarily available at the following locations:

Batavia Public Library
10 S. Batavia Avenue
Batavia, IL 60510

Warrenville Public Library District
28W751 Stafford Place
Warrenville, IL 60555

Fermi National Accelerator Laboratory Library
Wilson Hall, 3rd Floor
Kirk Road and Pine Street
Batavia, IL 60510

Sturgis Public Library:
1040 2nd St #101
Sturgis, SD 57785

Belle Fourche Public Library
905 5th Ave
Belle Fourche, SD 57717

Spearfish Public Library
625 N 5th St.
Spearfish, SD 57783

Rapid City Public Library
Downtown:
610 Quincy St.
Rapid City, SD 57701

Rapid City Public Library
North:
10 Van Buren St.
Rapid City, SD 57701

Hearst Library (Lead, SD)
315 W Main St
Lead, SD 57754

Black Hills State University Library
1200 University St.
Spearfish, SD, 57799- 9676

Devereaux Library (South Dakota School of Mines & Technology)
501 E. St. Joseph Street
Rapid City, SD 57701

Deadwood Public Library
435 Williams Street
Deadwood, SD 57732

For further information regarding the LBNF/DUNE NEPA process or the DOE NEPA process in general, contact:

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