Department of Energy
Fermi Site Office
Post Office Box 2000
Batavia, Illinois 60510

January 25, 2018

Ms. Martha E. Michels
Chief Safety Officer
Fermilab
P.O. Box 500
Batavia, IL 60510

Dear Ms. Michels:

SUBJECT: NATIONAL ENVIRONMENTAL POLICY ACT DETERMINATION AT FERMI NATIONAL ACCELERATOR LABORATORY – OPERATIONS EFFORTS TOWARD A 1 MW PROTON BEAM AT NEUTRINOS AT THE MAIN INJECTOR

Reference: Letter, from M. Michels to R. Hersemann, dated January 23, 2018, Subject: National Environmental Policy Act Environmental Evaluation Notification Form for the Operations Efforts Toward A 1 MW Proton Beam at NuMI

The Fermi Site Office (FSO) has reviewed the National Environmental Policy Act (NEPA) Environmental Evaluation Notification Form (EENF) for the Operations Efforts Toward A 1 MW Proton Beam at Neutrinos at the Main Injector (NuMI). Based on the information provided in the EENF, the potential impacts from the proposed action are bounded by the NOvA Environmental Assessment (DOE/EA-1570) conducted in 2008 and the Generic Categorical Exclusion (CX) for Small-scale Research and Development Projects and Conventional Laboratory Operations, B3.6.

Project Name	Approved	CX
Operations Efforts Toward a 1 MW Proton Beam at NuMI	1/24/2018	B3.6 DOE/EA-1570

Enclosed is signed copy of the EENF for your records. No further NEPA review is required.

Sincerely,

Michael J. Weis
Site Manager

Enclosure:
As Stated

cc: N. Lockyer, w/o encl.
J. Lykken, w/o encl.
T. Meyer, w/o encl.
T. Dykhuis, w/encl.

FERMILAB ENVIRONMENTAL EVALUATION NOTIFICATION FORM (EENF) for documenting compliance with the National Environmental Policy Act (NEPA), DOE NEPA Implementing Regulations, and the DOE NEPA Compliance Program of DOE Policy 451.1

Project/Activity Title: Operations Efforts Toward 1 MW Proton Beam at NuMI

ES&H Tracking Number: 01143

I hereby verify, via my signature, the accuracy of information in the area of my contribution for this document and that every effort would be made throughout this action to comply with the commitments made in this document and to pursue cost-effective pollution prevention opportunities. Pollution prevention (source reduction and other practices that eliminate or reduce the creation of pollutants) is recognized as a good business practice which would enhance site operations thereby enabling Fermilab to accomplish its mission, achieve environmental compliance, reduce risks to health and the environment, and prevent or minimize future Department of Energy (DOE) legacy wastes.

Fermilab Action Owner: Mary Convery (X4390)
Signature and Date Mary C 1/22/18

I. Description of the Proposed Action and Need

Purpose and Need:
The purpose of this activity is to perform facility and beamline upgrades needed for the allowance of 1000 kW of beam power on target. Currently the facility can accept a maximum beam power of 700-770 kW. This increase in beam power is needed to further the reach of the NOvA experiment.

Proposed Action:
The Fermilab Accelerator Division would raise the beam power to the NuMI target from 700 kW up to 1 MW to extend the physics reach of the NOvA experiment. Higher beam power to NOvA with the existing accelerator complex can be achieved by increasing the proton per pulse intensity from the Proton Source (28%) and reducing the Main Injector cycle time (10%). Increased beam power would require modifications to the NuMI target station which was not designed to run at beam powers above 770 kW.

Increasing the number of protons per pulse from the Booster by roughly 30% would require further measures beyond those of the Proton Improvement Plan to keep beam losses at acceptable levels. A new two-stage collimation system would be designed, built, and installed in the Booster. This would help in near future as well as long term to localize the beam losses at injection energy thereby addresses environmental radiation safety issues. A subset of horizontally-defocusing style combined-function magnets in the Booster would be replaced with new larger-aperture magnets which would improve beam transmission and reduce losses on the magnets. Booster transverse damper modifications including new amplifiers, pickups, and boards would be put in place and firmware developed to control transverse beam instability from injection to the extraction. A new longitudinal damper mode-2 cavity and amplifier would be designed and built to reduce the beam oscillations which would reduce beam losses around the ring and would also help with beam loss in the Recycler and Main Injector. Booster extraction-related magnets would also be ramped down during injection to reduce beam loss at Booster injection.

In the Main Injector, Total Loss Monitors would be installed as necessary in any areas with shielding which is inadequate for increased beam flux, such as locations with penetrations from the tunnel to the surface. New quadrupole magnets would also be installed to allow crossing transition during acceleration more quickly, reducing beam losses in the Main Injector.

The NuMI target station would be upgraded to handle higher component temperatures and stresses due to beam heating. The shielding assessment would also be revisited and tritium mitigation systems would be retrofitted or expanded to handle increased radioactivation.

Alternatives Considered:
The 'No Action' alternative would not extend the physics reach of the NOvA experiment.

II. Description of the Affected Environment

Modifications would be made to components in the MI-65 building, the Main Injector and the Booster.

III. Potential Environmental Effects (If the answer to the questions below is "yes", provide comments for each checked item and where clarification is necessary.)

A. Sensitive Resources: Would the proposed action result in changes and/or disturbances to any of the following resources?

- ☐ Threatened or endangered species
- ☐ Other protected species
- ☐ Wetland/Floodplains
- ☐ Archaeological or historical resources
- ☐ Non-attainment areas

B. Regulated Substances/Activities: Would the proposed action involve any of the following regulated substances or activities?

- ☐ Clearing or Excavation
- ☐ Demolition or decommissioning
- ☐ Asbestos removal
- ☐ PCBs
- ☐ Chemical use or storage
- ☐ Pesticides
- ☒ Air emissions
- ☒ Liquid effluents
- ☐ Underground storage tanks
- ☒ Hazardous or other regulated waste (including radioactive or mixed)
- ☒ Radioactive exposures or radioactive emissions
- ☒ Radioactivation of soil or groundwater

C. Other Relevant Disclosures: Would the proposed action involve any of the following actions/disclosures?

- ☐ Threatened violation of ES&H permit requirements
- ☐ Siting/construction/major modification of waste recovery or TSD facilities
- ☐ Disturbance of pre-existing contamination
- ☐ New or modified permits
- ☐ Public controversy
- ☐ Action/involvement of another federal agency
- ☐ Public utilities/services
- ☐ Depletion of a non-renewable resource

IV. Comments on checked items in section III.

Air Emissions
An increase in air emissions would be seen through the NuMI stacks at the EAV1, EAV2 and EAV3, and at the MI-65 facility in the form of tritiated water vapor. This additional gaseous radioactivity and tritium are being accounted for in the analysis for the lab as a whole, and would be incorporated into the total release limits Fermilab must abide by. Tritium emissions from the NuMI beamline has been calculated in the NuMI beamline, using a NuMI beam power of 1000 kW and estimated to be 210 Ci/yr. Fermilab's total air

emissions, due to these upgrades, is below the regulatory limit of 2,000 Ci/yr imposed by Fermilab's NESHAPS permit.

Liquid Effluents
An increase to tritium levels in surface and sanitary water is to be expected with increased beam power as NuMI sump water contains tritium. NuMI sump water is directly injected into the ICW system. There are cross connections with ICW system and the sanitary system including at the CUB. There are known cross connections with the sanitary system from the evaporator at MI-65 (via the air handling units at MI-65 and and MI-8). The effluents would be monitored under existing protocols.

Hazardous or other regulated waste
Some portion of waste materials would be generated from posted radiological areas in the form of concrete debris, metal debris, and used beamline components. These materials would be removed, classified and disposed as waste. Existing procedures and personnel are currently setup to accept these waste materials, and no planned work is outside the scope of what is typically done during standard shutdown and maintenance activities.

Radioactive exposures or radioactive emissions
Multiple employees would be exposed to radiation as part of retrofitting the target hall devices. These employees are trained in the best practices and methods of completing this work, and do so at every summer shutdown as part of ongoing operations and maintenance work. All activities would be monitored by a radiation safety technician, as is standard practice, and the principles of ALARA would be implemented in all activity planning. Specific areas where technicians would be exposed to radiation occur in the immediate chase area, during component replacement related to the target or the horn. Additional areas where exposure could occur exist on top of the support modules during the drive assembly replacement and testing activities in the remote handling work cell. Shielding assessments would be updated in the Booster, Main Injector, and NuMI to ensure that adequate shielding is in place to prevent radioactive exposures or emissions during beam delivery.

Radioactivation of soil or groundwater
It is anticipated that operation at this increased beam power may result in low level irradiation of the soil and groundwater. This would be monitored in accordance with existing established Fermilab policies and procedures (e.g. sump discharges to surface water from Booster and Main Injector as well as ground water monitoring adjacent to the NuMI target hall. These upgrades would follow all requirements of the Fermilab tritium monitoring and mitigation efforts and plan.

V. NEPA Recommendation

Fermilab staff has evaluated the proposed action and believe that the potential impacts from the proposed action are bounded by a combination of the analyses conducted in the NOvA EA (DOE/EA-1570) in 2008 and the Generic Categorical Exclusion for Small-scale Research and Development Projects and Conventional Laboratory Operations, B3.6.

Fermilab NEPA Program Manager: Teri L. Dykhuis
Signature and Date Teri L. Dykhuis 1/22/2018

VI. DOE/Fermi Site Office (FSO) NEPA Review

Based upon my review of information conveyed to me and in my possession concerning the proposed action, as NEPA Compliance Officer (as authorized under DOE Policy 451.1), I have determined that the potential impacts from the proposed action are bounded by the NOvA EA (DOE/EA-1570) in 2008 and the Generic Categorical Exclusion for Small-scale Research and Development Projects and Conventional Laboratory Operations, B3.6, and no further NEPA analysis and documentation is needed.

FSO NEPA Compliance Officer: Rick Hersemann
Signature and Date Rick Hersemann 1/24/2018