The MINERνA Project and Experiment

Preliminary Safety Assessment Document

July 13, 2006

DRAFT

Fermi National Accelerator Laboratory

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Preface

The Main Injector ExperRiment for ν-A (MINERνA) Project Preliminary Safety Assessment Document (PSAD) has been prepared by the MINERνA Project staff of the Fermi National Accelerator Laboratory (FNAL) Particle Physics Division (PPD). Its purpose is to document the preliminary safety assessment of the project and installation and operation of the experiment. A Hazard/Risk Analysis for each phase of the project has been performed in order to identify systematically the hazards that may be associated with that phase. Through this analysis and the resulting PSAD, the MINERνA Project staff intends to assure that environmental protection and health and safety matters related to this project have been identified and that they can be adequately addressed in the design and construction of the MINERνA detector. This PSAD has been prepared in accordance with Fermilab ES&H Manual, Chapter 2010, dated 6/2005. This PSAD will provide the basis for the MINERνA Safety Assessment Document, which will describe in detail how each of the potential hazards described in the PSAD have been avoided or mitigated.

SAFETY ASSESSMENT DOCUMENT READINESS REVIEW DOCUMENTATION FORM

PSAD TITLE AND DATE: MINERνA Project and Experiment Preliminary Safety Assessment Document; July 10, 2006

THIS DOCUMENT DESCRIBES:

New Facility	New Experiment XXXXXXX
Existing Facility	Major Modification
Entire Program	Decommissioning
Readiness Review	

FERMI NATIONAL ACCELERATOR LABORATORY

Safety Assessment Document Approval: __X___ Completion of Readiness Review______________

Authorization to Operate Facility: ________

Project Leader/Date: ____

Fermilab Division/Section Head(s)/Date: ____

: ____

Fermilab Senior Laboratory Safety Officer/Date: ____

Fermilab Associate Director for Operations/Date: ____
(if appropriate)

Fermilab Director/Date: ____
(if appropriate)

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1 Introduction

This Preliminary Safety Assessment Document (PSAD) for the Main Injector ExpeRiment for ν-A (MINERνA) Project has been prepared to document a preliminary safety assessment of the project. As input to this analysis, the MINERνA staff has performed and documented a hazard/risk analysis for each phase of the project in order to identify systematically the hazards that may be associated with it. This review is intended to ensure that matters of environmental protection and worker health and safety related to this project have been identified and that they can be adequately addressed in the design and construction of the MINERνA detector. This PSAD has been prepared in accordance with Chapter 2010 of the Fermilab ES&H Manual (FESHM).

It is the intent of the authors that this document should maintain a narrow focus on the subjects described in the preceding paragraph. Hence, descriptions of other aspects of the project as given here will be highly abbreviated, with references indicating other MINERνA documents that give a more complete description. The interested reader should consult these documents, which are available from the MINERνA web page at: http://minerva.fnal.gov//.

1.1 Purpose of the MINERνA Project

The purpose of the MINERνA Project is to construct a detector to be used installed and operated in the Neutrinos at the Main Injector (NuMI) Beamline for a program of investigation into the properties of neutrinos, focusing on research on neutrino interactions with matter. Detailed descriptions of the motivation and justification of the MINERνA Project can be found in the DOE Critical Decision 0 (CD-0) documentation[1] and "The Physics Case and Proposed Detector Technologies for MINERνA"[2].

1.2 Description of the Project

The MINERνA Project staff, in cooperation with the MINERνA (E938) collaboration, has prepared a conceptual design report summarizing the MINERνA Project.[3] This section will provide a brief overview. The major elements of the detector are described.

The MINERνA Project includes the design of a neutrino detector, construction of the MINERνA detector at Wideband Lab, and the vertical slice test and cable preparation at Lab G. This PSAD will also cover the installation, assembly and operation of the MINERνA detector in the MINOS Hall of the NuMI Beamline.

The MINERνA detector will be constructed of modular pieces built both at Fermilab and at other collaborating institutions. The design is a hybrid of a fully-active fine-grained design and a more traditional calorimeter detector. The detector will have a fully active plastic scintillator core surrounded by electronic and hadronic calorimeters of steel and scintillator. The scintillator is instrumented with optical fibers, which are monitored by photomultiplier tubes and read out by custom-built electronics. In order to study neutrino cross-section dependence on atomic number, target sections of the detector will include graphite, iron and lead. The detector mass required to obtain the desired statistics is approximately 300 metric tons. Its dimensions will be approximately 3.5 m (width) × 4.0 m (height) × 4.6 m (length along the beam axis).

The components of the MINERνA detector will pass all applicable quality checks, including measured sensitivities to radioactive sources and cosmic rays. No construction of any new buildings or facilities is necessary. The design and partial assembly of the detector is fully described in the MINERνA Technical Design Report[4]

1.3 Roles, Responsibility and Organization

Management of the MINERνA Project by the Department of Energy and by Fermilab is discussed in the MINERνA Project Execution Plan[5] (PEP) and the MINERνA Project Management Plan[6] (PMP), respectively. Fermilab will have full safety responsibility for all work on the Fermilab site from design to installation and operation.

1.3.1 Line Management Responsibility for Safety

The MINERνA Project line management is responsible for all safety provisions and the preparation of all safety reports for the MINERνA Project. Particle Physics Division (PPD) line management is responsible for all safety provisions and the preparation of all safety reports for installation and assembly safety of the MINERνA detector.

The Fermilab Accelerator Division Head has established the Accelerator Division Shielding Review Committee (ADSRC), which has the responsibility to review the results of each shielding assessment for methodology, completeness and compliance with the Fermilab Radiological Control Manual (FRCM). The NuMI Beamline and MINOS Hall Shielding Assessment[7] will address all the issues related to running the MINERνA detector, as necessary.

Responsibility for ES&H aspects of the MINERνA detector at Fermilab is assigned to the Particle Physics Division (PPD) Head. The MINERνA Project has appointed a Project ESH Coordinator for the project who will provide ESH guidance and oversight to MINERνA project management during all phases of the project. In addition, the PPD Head will utilize the NuMI/MINOS ESH Review Committee to review the ESH aspects of the detector construction and installation that takes place on the Fermilab site in preparation and as part of the process for receiving Operational Readiness Approval.

The Fermilab ES&H Section provides an additional source of expertise in ES&H. The ES&H Section is responsible for monitoring programs and auditing the implementation of the Laboratory's Work Smart Standards. The ES&H Section is also responsible for reviewing safety-related documentation.

The work of all of these organizations as it pertains to the MINERνA Project is coordinated through the MINERνA Project Management Group, as described in the MINERνA Project Management Plan.

1.3.2 Quality Assurance

It is the policy of the MINERνA Project that all activities shall be performed at a level of quality appropriate to achieving the technical, cost, and schedule objectives of the project and at the same time insuring that all related ES&H considerations are properly addressed. All work on the MINERνA Project will be performed in compliance with the Quality Assurance program established by the Fermilab Director.[8] MINERνA will develop a Quality Assurance Plan that describes how QA is implemented on the project. All detector subsystems undergo reviews which address ES&H/QA aspects of the system. Internal reviews, Director's reviews and DOE reviews are an integral part of the Quality Assurance process for MINERνA.

2 Inventory and Mitigation of Hazards

This chapter is intended to identify those aspects of the MINERνA Project which present potential hazards; either to the project personnel, the environment, or the public at large. By determining the categories and analyses used for those hazards, this document purposes to show that each of them can be mitigated.

All of the hazards that will be encountered are the type which are routinely encountered during construction, operation, and decommissioning activities at Fermilab. The various risks associated with these activities were scored and ranked using the ES&H Risk-Based Priority Model (RPM). The results of the hazard assessment and risk analysis are documented in a set of *Hazard Assessment Tables,* which are posted at http://minerva-docdb.fnal.gov:8080/cgi-bin/ShowDocument?docid=310. The applicable regulations, standards, and safety and health requirements for the mitigation of these hazards are cited in the Fermilab ``Work Smart Set" (N&S) Standards, FESHM, and subcontractor contract exhibits.

2.1 Construction and Installation Phase

This Section addresses the hazards, and means of mitigation, which will be encountered in the assembly and installation of the MINERνA detector.

2.1.1 Fire Safety

The inventory of plastic scintillator presents a potential fire hazard. This is mitigated to a large extent by the segmented structure of the detectors, wherein the layers of scintillator are tightly sandwiched between layers of steel, lead, or carbon providing a supplemental fire barrier. This would make it very difficult for a fire to spread even if one of the modules were ignited. Since the scintillator strips will be wrapped in a non-flammable material prior to installation, the ignition of a single module is made less likely. The NuMI Underground Facilities, the Wideband Lab (where module assembly will occur) and Lab G are equipped with appropriate sprinkler systems. The underground facility is also equipped with appropriate smoke detectors. All potentially flammable materials to be used in the MINERνA detector will be tested (and pass) burn tests before being used in the detector.

The installation of electronics, power supplies, and all other electrical components of the MINERνA experiment performed in the Wideband, Lab G, and MINOS Hall will be in accordance with the guidelines of the FESHM to ensure that they do not constitute a fire hazard.

2.1.2 General Construction Safety

The MINERνA detector will be partially constructed into frames of planes at Wideband Lab. These planes will then be moved underground to the MINOS Hall in a manner very similar to what was done for the MINOS Near Detector. A very minimal amount of work may be subcontracted out. The subcontractors performing work will be pre-qualified and each will develop a hazard analysis and a safety plan for the work to be done. These plans will comply with applicable OSHA requirements.[9] Fermilab will appoint Construction Coordinator(s) or Task Manager(s), who will provide Laboratory oversight of the subcontractor's QA and ES&H programs on a continuous basis. They will fulfill an auditory role to ensure that all work is carried out in accordance with the subcontractor's safety and Quality Assurance plans. The MINERνA Project ESH Coordinator will provide ES&H support for the Construction Coordinators and Task Managers. The subcontractor will be required to have a OSHA Competent Person on site at all times while work is ongoing to provide appropriate ESH Oversight. The qualifications of this competent person will be commensurate with the work activity and as dictated by FESHM.

2.1.3 Flooding Hazards

Flooding in the MINOS Hall does not pose a threat to personnel safety, but does represent a threat to equipment. Incoming groundwater from the length of the NuMI tunnels collects in the MINOS shaft sump pit at the rate of approximately 170 gallons per minute. The water is pumped to the surface. If the pumping system is non-operational, approximately one hour can pass before the water will reach the MINOS shaft floor level, which is defined as the beginning of the flooded condition.

Flooding could be caused by electrical power interruptions, electrical power lightning/transient voltage failures, discharge pipe abuse failure, and pumping equipment failure. These risks were identified in the NuMI Drainage Pump System Reliability Study completed by Hanson Professional Services Inc[10], and have been mitigated by the following:

- Three independent pumps with separate controllers are available to pump the full capacity of the water incoming to the sump at the MINOS shaft should one of the pumps become non-operational. In normal operations, two of the three will function in a duplex system. In emergency operations, any of the three are capable and are configured to pump the water independently.
- Transient voltage surge protection has been added to sump pump controllers and the main electrical switchboard. One of the three sump pumps has been isolated from the incoming electrical system via a contactor to protect it specifically from lightning strikes and power surges.

- The two discharge pipes up the MINOS shaft are not located adjacent to each other, so that if one became impaired due to physical damage, the other would still be available.
- In the event of a power interruption to the MINOS site, a backup natural gas emergency generator powers the sump pumps. The generator is regularly maintained by FESS/Operations. In the unlikely event the generator should fail, a separate outlet on the exterior of the building is available for direct connection of a portable generator to one of the three sump pumps.

Water from the sump is pumped into the FNAL industrial cooling water system (ICW) for reuse site-wide. The sump discharge arrangement sends the water from the discharge pipes up the shaft to a holding tank on the surface. The water in the holding tank is pumped into the buried ICW piping. In the event of equipment problems related to the holding tank, water will overflow from the tank into the adjacent swale to preclude backing up into the shaft and causing flooding in the tunnel.

Each of the three main sump pumps has an independent float and monitoring devices. Should a flooding condition occur, an alarm is sent via FIRUS to the FNAL Communications Center, which is manned, round-the-clock. Procedures at the Communications Center will provide for notification of FNAL maintenance staff to immediately react to the alarm status and take necessary precautions.

2.1.4 Mechanical Hazards

Construction, installation and assembly of the detector will involve transporting, lifting, moving, positioning, and assembly of large, heavy, and awkward components. A hazard risk assessment will be conducted to evaluate and mitigate the hazards to personnel during the construction, installation and assembly.

Access to the MINOS Hall will be through the MINOS access shaft. The components will be lowered into the enclosures by permanently installed cranes or hoists. There are extensive OSHA regulations and procedures describing the safe usage of vertical shafts and hoistways, which have been implemented for the MINOS Shaft at Fermilab.

Any support structure that must carry over 15 tons will be reviewed for adherence to standard FNAL engineering practices. Special lifting fixtures and transports will be designed for use with those components that require them. All lifting fixtures will be engineered, fabricated, reviewed, and tested in accordance with ANSI/ASME Standard B30.20 (*Below-the-Hook Lifting Devices*). All applicable Fermilab design standards governing lifting devices will also be met. The maximum allowable lifting load will be legibly marked on each fixture. Sufficient space will be available inside the enclosures for personnel to remain clear of all lifting operations. Crane training, crane interlocks, inspections, and periodic maintenance will follow the procedures listed in the FESHM.

MINERνA plane installation will be very similar to MINOS plane installation. It will use the lesson's learned from the MINOS experience to safely and efficiently install the MINERνA detector. The appropriate lifting plans and hazard analysis will be completed as part of the installation process.

Fermilab is located in Earthquake Zone 1, an area of minor risk. The calculated horizontal seismic force on each item of equipment is less than 6% of its weight, which corresponds to a tipping angle of about 3 degrees.[11] Mechanical structures and supports will be designed to handle such horizontal force.

2.1.5 Electrical Hazards During Installation

The electrical systems used in the MINERνA Project/Experiment and the hazards associated with them are, for the most part, similar to those of other experimental areas at Fermilab. The MINERνA detector will be installed in the MINOS Hall with the MINOS magnet coil potentially operating. Established Particle Physics Division ES&H procedures and Lock out/Tag out procedures will be employed to assure safety. Hazards associated with electrical systems will be mitigated through the use of such procedures and through a system of interlocks. Electrical bus work will be either protected by physical barriers or automatically de-energized by the electrical interlock system prior to personnel accessing the area.

Humidity levels in the underground enclosures will be controlled in order to avoid debilitating corrosion of electrical equipment, lighting fixtures, or detector components.

2.1.6 Industrial Safety

Industrial Hygiene issues to be addressed during the construction and installation phase include hazardous atmospheres and hazardous material control. In addition, there are numerous general safety issues to be addressed during the construction of the detector components at Wideband Hall and the installation of detector components in the MINOS Hall. These include the movement of heavy equipment, working from ladders, installation of electrical circuits and utilities, coordination of work areas and general safety issues associated with working in underground enclosures. Also the MINERνA detector will be installed in the MINOS Hall with the MINOS magnet coil potentially operating which creates possible exposure to magnetic field hazards. The magnetic field from the MINOS magnet coil has been mapped and is well understood which will aid addressing hazard mitigation during the hazard analysis process.

The control of hazards in these categories is addressed through the application of OSHA and other relevant standards, such as ANSI and ACGIH, as well as the FESHM. Work performed at Fermilab will be conducted in conformance with these standards. Hazards in the Industrial Safety category may be mitigated by utilizing trained and certified Fermilab task managers to oversee the trade personnel hired to perform the installation of equipment or, when necessary, industry experts in underground safety.

2.1.7 Environmental Protection During Construction and Installation

Fermilab has implemented an Environmental Management System (EMS) as part of its Integrated ES&H Management Plan. The EMS integrates environmental considerations into the planning and decision-making process at Fermilab, with the aim of evaluating the environmental impact of actions and mitigating any adverse effects. Compliance with the

National Environmental Protection Act (NEPA) is part of this system. The MINERνA Project submitted an Environmental Evaluation Notification Form, on the basis of which a Categorical Exclusion was granted on December 2, 2005.

2.2 Operational Phase

Prior to operation of the MINERνA detector, it will be subject to an operational readiness review by the Particle Physics Division.

2.2.1 Life Safety – Egress

The Life-safety egress/Fire design criteria for the NuMI underground where the MINOS Hall is located were analyzed in relation to comparable projects, such as the Tunnel and Reservoir Plan (TARP) deep tunnel project in Chicago. The criteria included the number and location of shafts, elevators and stairways; the configuration of the access tunnel; and other fire safety considerations. The final report of the Gage-Babcock study[12] provides the basis of the life safety design of the NuMI underground.

The above-ground MINOS service building does not present an unusual hazard in terms of fire prevention or life safety issues. Thus fire protection and life safety issues are addressed for this facitliy in accordance with Fermilab's Work Smart Standards. An independent fire department, risk inspections, and prompt on-site fire department response enhance fire prevention and protection. The service building fire alarm system gives local indications of system status and information to the site FIRUS. The system is continually monitored by the Communications Center, which in turn dispatches the Fire Department and other emergency services. Fire protection related equipment or status that is monitored by FIRUS includes: smoke and heat detectors, automatic sprinkler flows, fire suppression systems, and pull stations. Components in the underground areas will be designed to greatly minimize or eliminate combustible material. All Firewall penetrations are sealed to meet the National Fire Protection Association (NFPA) fire rating of the firewall.

Fire exiting was a primary design criterion for the NuMI facility, and is summarized for the MINOS Hall in the following discussion. In the MINOS/absorber areas, where MINERνA will be located, the primary exiting is via the isolated MINOS Shaft elevator. The capacity of the MINOS Shaft elevator is rated as 13 persons for emergency egress. The design permits two cycles of the elevator, setting a maximum occupancy limit of 26 persons entering at the MINOS Shaft[1]. The secondary exit is provided via the decay tunnel walkway upstream to the Target area and out. Extensive, separately (positive pressure) air supplied fire exit passageways are provided underground with fire rated doors and walls leading to the emergency assembly area at the base of the MINOS Shaft elevator. A secondary 3-person elevator is also in the enclosed portion of the MINOS Shaft for Fire Department use. It is possible to align the two elevators at any point and transfer (on cab-roof levels) from one elevator to another under Fire Department direction. The elevator cab's are also equipped with emergency decent devices which allow the cab, if disabled, to return to the base of the shaft within the emergency passageway.

During normal beam operations and commissioning there is a 10-person occupancy limit at MINOS underground facilities. During installation and maintenance period when the beam operations are off or during controlled or supervised access periods, there is a 26-person occupancy limit at MINOS. These occupancy limits are enforced by a badge exchange system which is reviewed and audited by the responsible division ES&H Organization and Building Management. Any person making an underground access must exchange a FNAL badge for an underground access badge prior to underground access, and re-exchange upon exiting. This provides a positive count of staff underground, as well as an exact identity for each person underground. Throughout the underground areas, smoke and heat detector systems are installed, and sprinkler systems

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[1] The Gage-Babcock report (reference 10) states an occupancy of 24 persons based on the ability to evacuate the facility in two elevator loads presuming an elevator capacity of 12 persons. After reviewing NFPA 101 Life Safety Code and discussions with Rick Glenn (Gage-Babcock) and Jim Niehoff (FESS-ENG), it was found that, based on the elevator dimensions and a 3 sq. ft. per occupant requirement the elevator occupancy could be increased to 13. Thus the occupancy was increased to 26 people.

are included in areas with any substantial combustible loads. The protect-a-wire heat detection is installed in the carrier region, pre-target, target hall, absorber hall and MINOS hall. VESDA smoke detection is installed in the carrier region, pre-target, target hall, MINOS hall, and emergency passageways. Spot smoke detection is located in the target hall support rooms, absorber passageway, muon alcoves, and MINOS passageway. Fire suppression sprinkler systems are located in the downstream carrier region, pre-target, target hall, target hall support rooms, MINOS shaft area, MINOS hall and emergency passageways. All of these systems are monitored through FIRUS.

In case of a fire emergency, the MINOS Hall is equipped with additional personal protective equipment to aid in an emergency escape. It is also equipped with Ocenco M-20 escape packs, which are MSHA/NIOSH approved, with an approved minimum duration of 10-15 minutes, to provide breathing air to personal during emergency egress from either facility. The escape packs are located just adjacent to the elevator at the base of the shaft in the emergency passageway. All personnel accessing the underground facility will be trained on the usage and need for this life safety equipment. All personnel accessing the NuMI underground are also required to have a flashlight immediately available, at all times, in case of power loss or if there is a need to travel the decay pipe emergency egress passageway, which is 2200 feet long and not illuminated.

In additional, all personnel working in the underground facility at the MINOS site are required to attend a one hour training course entitled NuMI/MINOS Underground Safety Training (FNAL TRAIN course 380) This course includes discussion on facility layout, significant hazards, occupancy requirements, personnel protective equipment requirements, access control procedures, and emergency procedures. Additional training also presently required prior to accessing or working in the underground facility is General Employee Radiation Training (GERT). These training requirements are tied to the ITNA program. At present the FNAL Fire Department takes an annual mine rescue training class.

2.2.2 Fire Protection

As stated in Section 2.2.1, the NuMI facility does not fall within the general standards of the Uniform Building Code or Life Safety Codes. A fire hazard analysis was therefore conducted by an outside consultant (Gage-Babcock & Associates) under the guidance of a Fermilab Fire Protection Engineer. The MINOS Hall includes fire protection and ventilation systems as recommended in Reference 12.

2.2.3 Electrical Hazards

Administrative rules, enforced by use of the electrical interlock system, will prohibit personnel from being in NuMI enclosures upstream of the muon shield when the beam transport magnets are energized.

Access to the MINOS Hall and thus the MINERνA Detector will not be restricted when the magnetic fields are present in the MINOS near detector. Physical barriers and electrical interlocks will be used to avoid personnel contact with energized conductors.

2.2.4 Radiological Hazards

Radiological protection issues relevant to the operation of the NuMI facility are described in the *NuMI Beamline and MINOS Hall Shielding Assessment* (Reference 7). This document will be updated for MINERνA if necessary. The update will be subject to a shielding review as required by the Fermilab Radiological Control Manual (FRCM). All radiological work, posting and monitoring will be done in accordance with the FRCM. Groundwater activation, air activation and prompt radiation will all be addressed by the NuMI Beamline and MINOS Hall Shielding Assessment. Radiological training presently required prior to accessing or working in the underground facility is General Employee Radiation Training (GERT).

2.2.4.1 Prompt Radiation

Prompt radiation, that which is present only when the beam is operating, consists of the beam itself and radiation directly produced by it. The prompt radiation rates in the

MINOS hall, where the MINERnA detector will be installed, are just above background. Thus the area is posted as a Controlled Area.

2.2.4.2 Residual Activation

The radiation levels both beam on and beam off are too low in the MINOS hall to produce any residual activation.

2.2.4.3 LCW and RAW Systems

There are no LCW or RAW systems in the MINERνA detector.

2.2.4.4 Radiation on the Surface

The deep underground location of the NuMI enclosures, combined with the planned shielding, ventilation and work procedures for handling activated materials, will ensure that the sources discussed in the preceding sections will not present any significant radiological hazard to personnel on the surface.

2.2.5 Mechanical Hazards

There are no significant Mechanical hazards due to the operation of the MINERνA detector.

2.2.6 Stray Magnetic Fields

The MINERνA detector will not have a magnetic coil, but the MINOS detector contains a magnet coil. Access to the experimental hall will not be restricted when the MINOS magnetic field in the detector assemblies are present. Physical barriers and electrical interlocks will be used to avoid personnel exposure to any magnetic fields that may pose a safety concern.

2.2.7 Hazardous/Flammable Materials

The MINOS Hall will contain some small amount. of hazardous or toxic materials. The primary source of flammable material is the large amount of plastic scintillator to be incorporated into the MINERνA detector. As stated in Section 2.2.2, the fire protection systems in this area is in accordance with the recommendations of the fire hazard analysis conducted by Gage-Babcock & Associates.

Lead will be used in the MINERνA detector. The lead pieces will be fabricated off site and will be isolated during assembly and in the detector. This material will be inaccessible to personnel during operations and will never be handled directly. All persons working with lead will have the appropriate training as dictated through the FNAL TRAIN database.

2.2.8 Cryogenics and Oxygen Deficiency Hazards

There are no cryogenics systems planned for use in the MINERνA Project. No ODH hazards are anticipated. The ventilation of the NuMI underground facility are based upon the recommendations of Reference 12 and take into consideration any possible ODH areas, radon mitigation and air activation. The focus of HVAC design, however, is on life safety and fire protection. Monitoring for radioactivity and/or potentially harmful gases will be performed as appropriate.

2.2.9 Flooding Hazards and Underground Water Control

The MINOS Hall has sump water level alarms, which are monitored by the FIRUS system. Flooding in these enclosures does not pose a threat to personnel safety but does represent a minor threat to equipment. In the event of an extended power outage, during which accumulation of water is possible, temporary sump pumps powered by mobile generators will be installed to remove it. The threat of flooding is greatest at the deep end of the tunnel due to the downward slope of the beamline. Water from the sump pit in this location is pumped to a holding tank on the surface and then into the Fermilab ICW system.

2.2.10 Environmental Protection

MINERνA detector operations have no potential to impact the environment. Fermilab has implemented an Environmental Management System (EMS) as part of its Integrated ES&H Management Plan. Compliance with the National Environmental Protection Act (NEPA) is part of this system. The MINERνA Project submitted an Environmental Evaluation Notification Form, on the basis of which a Categorical Exclusion was granted on December 2, 2005.

3 Operational Readiness Requirements

As stated in Section 2.2, the MINERνA detector will be subject to operational readiness reviews. This section summarizes the general goals to be met prior to obtaining the requisite operational readiness clearances.

3.1 Emergency Preparedness and Emergency Communications

In accordance with the Fermilab Emergency Preparedness Plan the Laboratory will remain in a state of readiness to respond to any type of emergency that may arise in the NuMI facilities during MINERνA installation and operation, during both the construction phase as well as the commissioning and operations phases. The Laboratory has long-standing mutual aid agreements for additional emergency support from surrounding municipalities, if necessary. Fermilab is located in a tornado area and is occasionally subject to severe weather in the form of high winds and heavy rains. The Fermilab Emergency Preparedness Plan prescribes procedures to be followed in the event of a tornado on or near the Fermilab site. Tornado shelter areas have been designated for the NuMI underground. From an emergency planning standpoint, the construction, commissioning and operation of the MINERνA detector does not present scenarios for which Fermilab is incapable of responding.

3.2 Procedures for Safe Commissioning and Operations

The following Fermilab policies are applicable to the commissioning and operational phases of the MINERνA Experiment.

3.2.1 Conduct of Operations

The NuMI beamline is integrated into the overall operation of the Fermilab accelerators in compliance with Section 2010 of the FESHM. Operations are conducted following the 18 requirements specified in the *Accelerator Division Operations Department Guidelines for the Conduct of Operations*. It is an Accelerator Division policy that beam will not be introduced into any accelerator facility until

- Equipment and components are configured in a manner to safely allow beam,
- Operational beam limits have been established consistent with the requirements of the shielding assessment for the given beamline enclosure.

In accordance with Accelerator Division Policy ADAP-11-0001 a valid Beam Permit and a Valid Accelerator System Restart (Start) sign-off are required before a given accelerator system may accept and/or accelerate beam.

The MINERνA Experiment will compile a complete hazard analysis in accordance with the Fermilab *Review Procedures for Experiments.* The MINERνA detector will be subject to review by Fermilab personnel with expertise in ES&H and relevant technical areas. The MINERνA detector will meet the criteria specified in the course of these reviews prior to operation.

3.2.2 Qualification of Personnel

Fermilab users in the MINERνA Collaboration will be trained in accordance with the provisions of Fermilab *Procedures for Experimenters*.

3.2.3 Waste Handling, Storage and Disposal

For many years the Laboratory has been carrying out comprehensive programs for the handling, storage, and disposal of both radioactive wastes and hazardous chemical wastes. The various waste programs are described in the FESHM, Chapter 8020. These programs will apply also to waste produced as a result of the MINERνA Project.

3.3 Decontamination and Decommissioning

It is the policy of Fermilab to maintain information necessary for future decontamination and decommissioning (D&D) of any or all of the facilities at the Laboratory. The eventual D&D of the beamlines, accelerators and other facilities at Fermilab, will be done in accordance with the provisions of FESHM, Chapter 8070.

4 Conclusions

It is the intent of MINERνA Project management that the technical and scientific goals of the MINERνA Project and experiment be achieved in a safe and environmentally sound manner. This document summarizes a variety of potential ES&H hazards that might be encountered in the construction, installation and operation of the MINERνA detector at Fermilab. The conclusion of MINERνA Project management is that all major hazards have been identified and can be addressed by the means discussed here and in the references. This PSAD will serve as the basis for a Safety Assessment Document (SAD) for MINERνA. The MINERνA SAD will document the actual procedures and actions taken to achieve the construction, installation and operation of MINERνA in compliance with applicable regulations and with Fermilab policy.

5 References

[1] DOE Statement of Mission Need (CD-0) for the MINERvA Project, June 2006: http://minerva.fnal.gov//news/MINERvA_CD-0_MNS_appr.pdf

[2] The MINERvA Collaboration, *The Physics Case and Proposed Detector Technologies for MINERvA, A High Statistics Neutrino Scattering Experiment Using a Fine-grained Detector in the NuMI Beam*, December 2004. http://minerva-docdb.fnal.gov/cgi-bin/ShowDocument?docid=218

[3] The MINERvA Project Staff and the MINERvA Collaboration, *The MINERvA Project Conceptual Design Report*, July 2006.

[4] The MINERvA Collaboration, *The MINERvA Technical Design Report*, July 2006.

[5] U. S. DOE FSO Group, *MINERvA Project Execution Plan (DRAFT),* July 2006.

[6] The Fermilab MINERvA Project Staff, *MINERvA Project Management Plan (DRAFT)*, July 2006.

[7] N. Grossman, *NuMI Beam Line & MINOS Hall Shielding Assessment*, July 2004.

[8] Fermilab Director's Policy Manual, Policy 10, *Quality Assurance*, January 1, 1999.

[9] 29 CFR Part 1926, Subpart S, *Underground Construction, Caissons, Cofferdams and Compressed Air.*

[10] "NuMI Drainage Pump System Reliability Study", Hanson Professional Services, Inc, Farnsworth Group, Inc., April 2003.

[11] Fermilab KTeV SAD, April 1994

[12] Gage-Babcock & Associates, *Fire Protection/Life Safety Recommendations for the Fermilab NuMI Project*, October 1998.