Fermilab Meson 120 Experimental Areas

Safety Assessment Document / Experimental Area Readiness Review

December 12, 2002

Operated by Universities Research Association under contract with the US Department Of Energy

SAFETY ASSESSMENT DOCUMENT
READINESS REVIEW
DOCUMENTATION FORM

This form records the SAD review process required for operations at Fermi National Accelerator Laboratory.

PSAD/SAD TITLE AND DATE:

Fermilab Meson120 Experimental Areas

December 12, 2002

THIS DOCUMENT DESCRIBES:

New Facility	________	New Experiment	________
Existing Facility	XX	Major Modification	________
Entire Program	________	Decommissioning	________

FERMI NATIONAL ACCELERATOR LABORATORY:

Safety Document Approval XX Authorization to Operate Facility XX

Project Leader/Date: Winslow F. Baker

Fermilab Division/Section Head(s)/Date: 12/17/02

____

Fermilab Senior Laboratory Safety Officer/Date: William J. Griffing 12/23/02 *

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

Fermilab Director/Date: ________________________
(if appropriate)

* No further review + approval is necessary. -WJG.

Table of Contents

I. INTRODUCTION

A. Purpose, Location and Description of Project

Fermilab is operated by the Universities Research Association (URA) for the US Department of Energy (DOE). The mission of Fermilab is to conduct high energy particle physics and particle beam physics research. Fermilab provides the world's highest energy beams for this type of basic research. This mission is accomplished by the integration of operational and safety concerns at all levels of the Laboratory organization.

The 6,800 acre Fermilab site was acquired in the late 1960's by the Atomic Energy Commission from the State of Illinois. The dividing line between Kane County and DuPage passes through the site from north to south with the majority of the site located in DuPage County.

This Safety Assessment Document is meant to cover the period from 2002 to NuMI/MINOS turn-on in 2005. All of the experiments and tests that will be running in the Meson120 Program will be reviewed by the Fixed Target ES&H Review Committee and, following their recommendation, approved by the Particle Physics Division Head before they can take beam. It does not include an assessment of the beamlines, their shielding, radiation, interlocks, beam surveys, monitors and radiation impact on the environment, as these are now the responsibilities of the Beams Division (BD).

This SAD covers the Meson Test Beam Facility (MTBF) and Experiment 907 (E907). The test facility is located in the MTest beam and E907 in the MCenter beamline. MTBF enables experimenters who are planning experiments to test their detectors in an active beamline and also permits detectors for other types of research (cosmic rays, etc.) to be calibrated. E907(MIPP) –The Main Injector Particle Production Experiment will measure the production of particles by the 120 GeV Main Injector proton beam for the NuMI project targeting. It will also study particle production by pions and kaons as well as protons to check or derive scaling laws. A summary description of this experiment is given in the 2002 Fermilab Research Program Workbook[1].

These experiments and tests all have one or more of the following devices: a target, charged particle tracking detectors, particle identification detectors and calorimetric detectors. Some experiments use evacuated vessels or helium filled bags to minimize the amount of material in the beam or experiment detectors. These devices pose hazards which are not routinely accepted by the public and are described in Section II.

The character of the hazards associated with these planned experiments are all similar, but vary in magnitude. This has also been the case with experiments conducted in the past, and will likely be the case in the near future. The Fermilab Director may approve additional experiments for this run. New experiments are screened for hazards prior to approval. Such experiments would be similar in ES&H impact to those described here.

B. Organizational Responsibilities

1. DOE: The Manager, CH, has been delegated the responsibility and the authority for the Field Management Oversight of the Fixed Target Run, which includes the line management authority, responsibility, and accountability for overall project administration and contract administration. The Manager, Fermi Area Office (FAO), administers the URA-DOE contract and exercises day-to-day oversight of Fermilab, and has been delegated all the responsibility and authority for execution of the project.

2. Fermilab: Fermilab is responsible for the design, construction, installation, and operation of accelerators and experiments. The Fermilab Director retains ultimate authority over, and responsibility for, the achievement of the cost and goals for this project. Particle Physics Division (PPD), with support responsibilities carried out by the existing Fermilab service groups including: the Business Services Section, the Facilities Engineering Services Section, the ES&H Section, the Beams Division and the Technical Support Division, is primarily responsible for the experiments.

C. Environment, Safety and Health (ES&H)

The responsibility for the ES&H related aspects of the fixed target experiments has been assigned by the Director to the PPD Head. In carrying out those responsibilities, he is expected to establish and maintain an auditable ES&H program that is consistent with appropriate aspects of ES&H such as construction safety, environmental protection, industrial safety, fire protection, and radiation safety. To implement these responsibilities, the PPD Head has appointed a Senior Safety Officer as the principal person responsible for the ES&H issues relating to the commissioning and operation of experiments.

A parallel staff responsibility for ES&H at Fermilab rests with the Fermilab ES&H Section, which is responsible for monitoring programs and conducting audits of the implementation of the Laboratory's ES&H policies and procedures. The Fermilab ES&H Section has the responsibility to conduct reviews of new projects to assure that ES&H requirements are met. The Integrated Safety Management Plan[2] and Chapter 2010 of the Fermilab Environment Safety and Health Manual (FESHM)[3] describe the formal review procedures established by the Laboratory, including the review procedures for this document, to assure that facilities (such as this) and their operations comply with Fermilab ES&H standards. The Fermilab Radiological Control Manual (FRCM)[4] specifies a set of physical and administrative conditions that define the boundary conditions for safe operation of the facility.

A number of ES&H and operations manuals and handbooks have been developed at Fermilab. They include the following: FESHM, Fermilab Emergency Plan,[5] FRCM, and PPD Operating Manual.[6]

D. Safety Design Criteria

The design criteria utilized by the designers of this project are the applicable Fermilab Standards[7] as specified by the URA-DOE contract. The experimental areas are required to conform fully to the requirements imposed by all applicable Federal, State and local legal laws, orders, and regulations concerning the Environment, Safety and Health. The Fermilab ES&H Manual incorporates the applicable external requirements with internal standards and requirements and thus represents the full set of ES&H requirements used at Fermilab. When no specific codes or Fermilab standards exist, the designers use best engineering practices and peer review during the design stage.

II. INVENTORY OF HAZARDS AND MITIGATION

Operation of the experimental areas requires a variety of support functions and facilities. These include engineering, design, fabrication, installation and maintenance of experiment equipment. Many of these activities are routinely accepted by the public and are not described. Those which pose unusual hazards are described in this section.

All experiments use targets to produce the final particles which the experiment studies. Targets are constructed of light and heavy metals, ranging from beryllium to lead, cryogenic liquids such as hydrogen, or gas jets. Some targets such as beryllium pose toxic material hazards. Cryogenic targets pose thermal, oxygen deficiency and possibly flammable material hazards.

Most experiments use wire chambers to determine the trajectory of charged particles produced by the target. A wire chamber consists of many planes of fine wires at high voltage immersed in a volume of gas. Wire chambers range in size from several cm^2 to several m^2. Flammable and non-flammable gas mixtures are used. Wire chambers using flammable gas mixtures pose a fire hazard. Wire chambers do not function unless the oxygen concentration in the gas is less than several parts per million. A variant of the wire chamber design is the proportional tube or straw tube. These chambers restrict the gas to a small cylindrical volume around each wire. Otherwise, the function and degree of hazard is the same as wire chambers.

Most experiments use solid or liquid tracking detectors for triggering on charged particles. Solid tracking detectors are constructed of plastic with a small admixture of a scintillating material. Liquid tracking detectors use mineral oil with a small quantity of liquid scintillating material. These detectors pose a fire hazard only in large quantities.

Particle identification detectors all use non-flammable gases to measure the velocity of charged particles. The most commonly used particle identification detector is the Cerenkov counter, which detects the light produced by charged particles traversing a gas volume. Cerenkov counters pose oxygen deficiency and confined space hazards. In some installations, gas pressure in the Cerenkov counter is such that a pressure or vacuum vessel is required.

Large analysis magnets are used in concert with tracking detectors to determine charged particle momentum. Analysis magnets may have several m^2 of aperture, and pose DC magnetic field hazards to individuals with pacemakers. Kinetic energy hazards are also present due to flying objects or tools left in or near the magnet aperture.

Finally, calorimeters are used to measure neutral particle energy and position. Two broad types of detectors are used, hadronic calorimeters and electromagnetic calorimeters. Hadronic calorimeters measure a fraction of the particle energy deposited in layers of iron, lead or tungsten. Wire chambers, proportional tubes, or liquid argon detectors are placed between the layers to measure the energy produced in the shower. Electromagnetic calorimeters are generally constructed of lead glass or cesium iodide which serve the dual purpose of interaction material and detector. Calorimeters of both types pose hazards from toxic materials (lead), thermal and oxygen deficiency (liquid argon), and fire hazards (wire chambers with flammable gas).

Wire chambers and calorimeters use a mixture of commercially available equipment and specially designed electronics to amplify the small signals produced in these detectors. Most experiments use pre-amplifiers located on the detector. Amplified signals are routed to signal processing electronics located in relay racks in the experiment hall or in the experiment's control room. Detector electronics pose electrical fire hazards in the use of high current low voltage power systems.

A. Radiation Hazards

As noted above all radiation hazards relating to beam operations safety are the responsibility of the Beams Division. This includes all beamlines, their shielding, radiation, interlocks, beam surveys, monitors and impact of radiation on the environment and is addressed in the Fermilab Beams Division safety assessment document.[8]

Personnel and experimenters who work in experimental halls under PPD control will be trained in accordance with requirements set forth in FRCM[4]. All radiological work, posting, labeling and monitoring in experimental halls will be conducted in accordance with requirements described in FRCM. All experiments within PPD will participate in Fermilab's ALARA (As Low As Reasonably Achievable) program as described in Chapter 3 of FRCM.

B. Electrical Hazards

The electrical hazards encountered in the Fixed Target Experimental Areas are similar in nature to the existing hazards in the other areas at Fermilab. These hazards are high voltage power supplies, low voltage high current supplies, and distributed ac power to components. All equipment where the potential for serious injury exists is equipped with some means of disconnect and lockout as outlined in Section 5120 of the Fermilab ES&H Manual. This design feature enables operating and maintenance personnel to work safely on equipment. The disconnect switches are located as close to the equipment as practical. All electrical equipment is installed following the appropriate NEC standards and OSHA Regulations indicated in the Fermilab ES&H Manual (Sections 5040, 5120, and 7010).

Electrical bus work in beamlines and experiments is either protected by physical barriers or is automatically de-energized by the interlock system prior to personnel access to the area. Power supplies that feed power to exposed conductors are required by the Fermilab ES&H manual to be connected into the electrical interlock systems.

In addition to the common electrical hazards described above, most experiment electronics systems utilize low voltage (~5 VDC) high current (~200 amps) electronic power distribution systems which may initiate a fire if not properly protected. Although the potential for personal injury is slight, the potential for property loss and mission impact is not negligible. To address this concern, such systems must comply with Chapter 5046 of the Fermilab ES&H Manual.

In summary, electrical hazards have the potential for no more than minor impact on-site and negligible impact off-site.

C. Magnets

Analysis magnets require cooling water for safe operation. Closed loop cooling water systems which may experience freezing temperatures use anti-freezing agents. In addition to this toxic hazard, kinetic energy hazards exist from motors and pumps, and potential energy hazards in the piping systems. Analysis magnets also require DC currents of several thousand amps. Air or water cooled power supplies for magnets are located in service buildings. Magnets, power supplies and associated cables or busswork pose electrical, fire and magnetic field hazards. Environmental guidelines outlined in the Fermilab ES&H Manual are followed.

Exposure limits and controls for exposure to static magnetic fields are established in Chapter 5062.2 (Static Magnetic Fields) of the Fermilab ES&H Manual. The limits are those recommended by the American Conference of Governmental Industrial Hygienists (ACGIH).[9] During normal operation, magnets in enclosures may be powered only in non-access modes. This precaution eliminates the magnetic field hazards under these conditions. During commissioning of an experiment, access is permitted with special precautions to determine magnet polarities. The Particle Physics Division ES&H group surveys all experiment halls for stray magnetic fields which may exceed the above limits and posts these areas appropriately.

In summary, magnetic hazards pose the potential for not more than minor on-site impact and negligible off-site impact.

D. Mechanical Hazards

The mechanical components used in the Fixed Target Experimental Areas are similar in scope to components designed and built successfully in the past at Fermilab. The design of these components conforms to the standards detailed (or referenced) in Chapter 5 of the FESHM.

High pressure gas systems and pressure vessels as well as large vacuum tanks with thin windows give rise to potential mechanical hazards. A policy for safety reviews for all such vessels has been established at the Laboratory and is outlined in Chapters 5031 and 5033 of the Fermilab ES&H Manual. The Laboratory's policy requires that vessels purchased by Fermilab be fabricated in accordance with the American Society for Mechanical Engineers (ASME) code, Section VIII. Vessels built at Fermilab are required to be designed to the requirements of the ASME code and reviewed by an independent, qualified reviewer other than the designer and preferably from another group not reporting to the designer or the designer's supervisor. Engineering Notes, which are required of all vessels in use at Fermilab, include details of design calculations, materials specifications, test data, operating procedures and welding information. These Engineering Notes are all retained by the Fermilab ES&H Section. The Laboratory Director is authorized to grant an exception from the Laboratory policy if that exception is explained and analyzed in the Engineering Notes. The documentation of these exceptions is on file in the ES&H Section. In summary, by ensuring that all pressure and vacuum vessels are designed and constructed to meet nationally accepted standards and local codes the risks presented to personnel and the general public are minor on site and negligible off site.

Kinetic energy hazards are those associated with rotating machinery and the operation of hand and shop tools. Kinetic energy sources exist in several facilities. The hazards are mitigated by code compliance and engineered safety features (e.g. OSHA machine guarding). As a result, all kinetic energy hazards are standard industrial or occupational in nature and have no effect outside the experimental areas. Potential energy hazards are those associated with compressed gases and pressurized liquid containers, as well as those associated with hoisting and rigging operations. These hazards are all standard industrial or occupational in nature, handled by compliance with applicable codes, and thus have no effect outside the experimental areas.

Some experiments also use mechanical transporters which present similar hazards. With the exception of beamline and experiment checkout, such devices in beamline enclosures are rarely operated while personnel are present. Devices which present pinch point hazards in occupied areas are appropriately guarded. Lockout/tagout procedures are used when performing maintenance on these devices. We consider these hazards to be routinely encountered and accepted by the general public.

Cryogenic liquids (See section "I" of this chapter.) and heat sources, such as soldering irons, exist in most facilities. Contact with cryogen materials due to spills or splashes may cause freezing of or cryogenic "burns" to sensitive tissues such as the eyes and to exposed flesh. This is considered to be an occupational hazard with no effect outside the experimental areas. Similarly, heat sources are very limited in scope and also pose only an occupational hazard within the facility, and no off-site impact.

Fermilab is located in an area of minor earthquake risk. Mechanical structures and supports are designed and built according to nationally accepted building codes to handle forces resulting from such earthquakes.

E. Fire Hazards

The Fire Safety requirements that are stated in Chapter 6000 of the Fermilab ES&H Manual and the NFPA 101 Life Safety Code guide the operation, maintenance, and modification of the Fixed Target Experimental Areas. Various fire protection systems are incorporated and upgraded on an as-needed basis throughout the experimental areas including automatic sprinklers, smoke detectors, pull boxes, alarm sirens, and fire suppression systems. A computerized Fermilab Incident Reporting and Utility System, FIRUS, monitors installed primary fire alarm systems. Fire protection related equipment or status that is monitored by FIRUS includes: smoke and heat detectors, sprinkler flows, fire suppression systems, pull stations, incipient fire detection systems, back-up power turbines, and water pressure booster pumps. FIRUS also monitors other equipment not related to fire protection. This equipment and its status concern installed site utility and security systems. FIRUS monitoring capability is routinely added to all new and/or upgraded primary alarm fire systems.

The Fixed Target Experimental Area buildings and tunnels are constructed primarily of non-combustible material. Some installed components present a limited combustible hazard. The primary hazard is from the numerous power and/or signal cables that are distributed throughout the buildings. Cable penetrations are plugged to protect against the spread of fire.

Gas mixing sheds have been designed according to industry standards. Specifically, the buildings have been designed in accordance with NFPA codes, the piping in accordance with ASME B31.3, pressure vessels in accordance with the ASME Boiler and Pressure Vessel Code, and electrical systems in accordance with NEC Chapter 5. The portions of the gas system inside the building have been designed in accordance with the above codes whenever practical. However, by design experiment detectors contain high voltages immersed in flammable gas mixtures. Because of this, a small localized explosion hazard which could result in equipment damage does exist; however this hazard presents minimal risk to personnel. This has been demonstrated through more than two decades of operation at Fermilab with no incidents of fire due to flammable gas. Since no statutory or external codes exist to control the hazard due to flammable gases in a research environment, the laboratory has developed the Fermilab ES&H Manual Chapter 6020.3.

General housekeeping is an accepted responsibility of line management throughout the experiment halls. Additionally, the Building Manager program and scheduled walk-through inspections of all areas contributes to the monitoring and minimization of excessive accumulations of flammable and combustible materials. Minimization of excess material and proper housekeeping for the beamline enclosures is specifically addressed by radiation worker training and waste minimization practices. Specially designed cabinets for the storage of flammable materials are available throughout the facility. Especially hazardous operations, such as welding, cutting, and brazing are regulated by appropriate permits that accommodate line management and Particle Physics Division ES&H group oversight.

To mitigate the hazards associated with fires, all of the buildings are protected by sprinklers and have installed fire/smoke detectors for early warning. Fire alarms are monitored by the Facility Incident Reporting and Utility System (FIRUS) which is continually monitored on a twenty-four hour basis by the manned Communications Center which in turn dispatches the Fire Department and other emergency services.

In summary, flammable materials have the potential for no more than minor impact on-site and negligible impact off-site.

F. Toxic Materials

Lead is sometimes used in experiments for targets and as interaction material in calorimeters. Other toxic and hazardous materials are used in small quantities

Whenever possible, lead and beryllium objects are wrapped in plastic to prevent accidental exposure to personnel. People working with lead and beryllium have received training on the hazards associated with these toxic materials along with the actions necessary to reduce the risk of personnel exposure. Work sites within the experimental areas are monitored by the Particle Physics Division ES&H personnel to ensure adherence to procedures developed for these materials. The experiment hazard screening process identifies the maximum inventory of these and other toxic materials planned for future experiments. The control of toxic material hazards is addressed through the application of the relevant OSHA standards and other applicable standards (such as ANSI and ACGIH) and the appropriate Chapters of the Fermilab ES&H Manual: Chapter 5052.3 for lead and Chapter 5052.5 for beryllium. Opportunities for waste minimization and pollution prevention are sought out.

In summary, toxic materials have the potential for no more than minor impact on-site and negligible impact off-site.

G. Non-ionizing Radiation

Lasers are used in some experiments to provide light sources for detector calibration. Their use is governed by the rules found in section 5062.1 of the Fermilab ES&H Manual. Most lasers are Class I or Class II. Typically an ultraviolet laser is used to illuminate a small piece of scintillating plastic which fluoresces to create visible light. The visible light is transmitted through numerous optical fibers to various parts of the detector. The following measures are in place to control this hazard: 1) the laser is mounted inside a housing which must be disassembled for direct exposure to the ultra-violet light to occur, 2) the housing is posted with the appropriate laser warning signs, 3) the visible light intensity through the optical fibers is well below any level of concern. In summary, non-ionizing radiation has the potential for no more than minor impact on-site and negligible impact off-site.

H. Radioactive Sources

Radioactive sources are used extensively by experiments for calibration and testing of detectors. Commonly used sources are Co-60, Sr-90, Cs-137, Fe-55 and Ru-106. Radioactive source controls described in the Fermilab Radiological Control Manual include requirements on 1) source accountability records to be maintained by the ES&H Section, 2) ES&H Section notification and supervision for changes in use, storage, transfer, disposal or loss, 3) labeling, 4) source cabinets and source monitors responsible for issuing sources to users, and 5) source procurement. Radioactive source monitors and source users will be trained in accordance with requirements set forth in Chapter 4 of the FRCM. Radioactive sources pose a contamination hazard if they are not handled properly. Contamination hazard is mitigated by following policies set forth in FRCM.

The hazards presented by radioactive sources are such that the potential impacts to personnel are minor on site and negligible off site.

I. Oxygen Deficiency Hazards

As there are no cryogenic magnets in the fixed target run experimental areas, so there are no oxygen deficiency hazards (ODH) induced therefrom. Other gas filled equipment such as Cerenkov counters, cryogenic targets or large helium bags, etc. could cause an ODH condition.

The Laboratory has developed a policy and procedures for addressing potential oxygen deficiency hazards that would be implemented as applicable to the experimental program covered by this SAD. The objective of the policy is to require that in potential ODH areas the probability of a significant accident shall be clearly below the value for workers in U.S. industry as a whole. This policy is detailed in FESHM. The ODH policy requires a calculation for each such work area and specifies the appropriate administrative controls and protective measures to be followed. Each operation or event with the potential for causing oxygen deficiency in a given area is evaluated for its probability of occurrence and the associated ODH consequences. In addition, buildings adjacent to potential event areas, which have a leakage path, are also evaluated. The appropriate ODH Class is then assigned

J. Industrial Safety

Industrial safety hazards are mitigated by utilizing trained and qualified Fermilab task managers to oversee any trade personnel hired to perform the installation or removal of equipment. The Fermilab task managers are experts in their particular area and all of them receive the appropriate level of OSHA training. All of the OSHA and Fermilab requirements are followed during all phases of the operation of this facility.

The only confined spaces are those associated with the sump pits and equipment manholes spaced throughout the enclosures. The confined-space issues are dealt with by trained maintenance personnel (Facility Engineering Services Section (FESS) personnel) who have prescribed procedures and training for performing maintenance in these areas. See FESHM Chapter 5063 for further details regarding confined spaces.

K. Flooding Protection

The experimental enclosures have sump water-level alarms with remote status readout through FIRUS system monitors in the Communications Center. In the event of a high water alarm, an access is made into the enclosure by FESS personnel to verify the alarm and to repair faulty sump pumps. Flooding in these enclosures does not pose a threat to personnel safety but does represent a minor threat to equipment. During extended power outages under conditions where water accumulation is possible, the enclosures are inspected, and if necessary temporary sump pumps powered by mobile generators can be installed.

L. Emergency Preparedness

No new categories of emergency scenarios are introduced as a result of the operation of this program. In accordance with the Fermilab Emergency Plan,[5] the Laboratory remains in a state of readiness to respond to any type of emergency that may arise in this area, and has long-standing mutual aid agreements for additional emergency support from surrounding municipalities, if necessary. The Laboratory's Fire Department personnel have familiarized themselves with the layout of the Experimental Areas and understand how to gain access to an area in the event of an emergency. As new Fermilab or user personnel are assigned to work in the experimental areas, they are trained on the emergency response procedures and how to summon aid.

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 Plan[5] prescribes procedures to be followed in the event of a tornado on or near the Fermilab site. Tornado shelter areas have been designated in all of the Experimental Areas buildings. Fermilab has a site-wide warning and notification system.

M. Environmental Monitoring Program

The strategy for environmental monitoring and surveillance at Fermilab is established in the Fermilab Environmental Monitoring Plan. This plan outlines a program that ensures compliance with legal and regulatory requirements, confirms adherence with permit conditions, provides data for permit revision/renewal, detects unplanned releases to the environment, and provides data to support environmental management decisions. The comprehensive site-wide monitoring plan assesses the effect of past, current, and future activities by measuring and monitoring effluents and emissions from Fermilab operations and by calculating the effects of those operations on the environment and public health. An important consideration in the development and implementation of the monitoring plan has been to ensure that the monitoring activities at specific sites are consistent with individual facility operations.

The scope of the environmental surveillance conducted on-site encompasses potential and identified effluents to air, surface waters, drinking water, storm and sanitary sewers, soil, and ground water and includes analysis for both chemicals and beam produced radionuclides. Penetrating radiation outside of the accelerator and beamline shielding is also monitored. Numerous samples are collected and analyzed according to a pre-defined schedule. Measured concentrations of radioactive materials and chemicals are compared to applicable standards, concentration guides, natural levels, and previous results. A detailed description of the environmental monitoring and surveillance program can be found in The Fermilab Environmental Monitoring Plan. More information about the radiation protection program can be found in the Fermilab Radiological Control Manual. The Fermilab Annual Report to the Director on Environment contains a summary of monitoring results, subsequent exposure pathway analysis, and dose assessment where applicable.

III. READINESS FOR COMMISSIONING AND OPERATION

A. Experiment Operations

Experiments are conducted by personnel who are generally not Fermilab employees. These personnel form a collaboration which designates a Spokesperson to represent the experiment in interactions with the laboratory. The Spokesperson also has limited ES&H responsibilities which are specified in Chapter 1030 of the Fermilab ES&H Manual. As a consequence of these considerations, the review, approval and operation of experiments is distinct from that for beamlines. The following sub-sections, from the Procedures for Experiments document, describe Particle Physics Division and experiment collaboration responsibilities during the entire life cycle of the experiment.

A.1. Experiment Proposal

Upon the receipt of an experiment proposal, the Director's Office notifies Particle Physics Division management of the need for an impact statement. The impact statement identifies the potential PPD commitment required to conduct the experiment, i.e. cost, manpower requirements, and ES&H impact. A list of potential hazards is compiled using a standard Hazard Identification Checklist supplied by the experiment spokesperson along with the proposal. The impact statement assists the Particle Physics Division head in recommending approval or denial of the experiment to the director. The impact statement is usually drafted by Particle Physics Division personnel familiar with the experiment and beamline. The impact statement is used solely for estimating and is not a binding document. In addition, the Particle Physics Division head is responsible for notifying the director of any scientific or technical concerns with the experiment proposal, i.e. achievability of physics goals and technical specifications.

A.2. Stage I Approval

The director grants Stage I approval to an experiment based on the information in division/section impact statements and advice from the Physics Advisory Committee. Following Stage I approval, the Director's Office distributes a draft Memorandum of Understanding (MOU) to the experiment collaboration and affected divisions and sections. The Particle Physics Division head is responsible for ensuring that Particle Physics Division commitments specified in the MOU are achievable and are consistent with the division mission and budget. During this phase, the experiment collaboration and Fermilab divisions and sections refine the technical specifications and cost estimates.

Also during this phase, a determination is made by the Particle Physics Division head whether the hazards associated with the proposed experiment will be suitably addressed by an existing SAD from a previous experiment. To accomplish this goal, the Hazard Identification Checklist is expanded into a Preliminary Hazards Assessment, which is then compared to all existing experiment Safety Envelopes. There are two possible outcomes from this comparison:

1. The hazards associated with the planned experiment are not different in character or magnitude from those described in an existing SAD. Particle Physics Division will document this determination and request concurrence from the ES&H Section and the directorate. With this determination made, Particle Physics Division may authorize all succeeding phases of the experiment.

2. The hazards are significantly different in character or magnitude from those described by an existing SAD. In this situation, a new SAD must be developed, or an existing SAD expanded, to describe the controls for the new hazards.

A.3. Stage II Approval

When the costs and Laboratory impacts of the experiment are fully understood, the director may grant Stage II approval. Stage II approval is an agreement in principle to sign a Memorandum of Understanding with the experiment collaboration. From the Particle Physics Division perspective, the MOU describes the Particle Physics Division commitments to the experiment collaboration. The MOU may also specify a liaison physicist who provides a communication path between the experiment collaboration and Particle Physics Division.

When Stage II approval is granted by the director, and an MOU exists, the experiment achieves <u>installation/checkout</u> status. During this phase, detector design, construction, installation and checkout are completed. All equipment regardless of its origin must be built according to the appropriate local codes, including the Fermilab ES&H Manual. Each experimental hall has a building manager who is responsible for ensuring compliance with building related safety rules and codes.

Also during this phase, Particle Physics Division is responsible for conducting ES&H reviews of those systems that have unusual hazards as identified in the Preliminary Hazard Assessment. Documentation of these reviews is the first part of the Operational Readiness

Clearance (ORC). The ORC process is described in detail below and permits operation of subsystems for checkout purposes before full commissioning of the experiment.

A.4. Commissioning

As detector subsystems are installed, the experiment must request a review of these systems before they may be commissioned. Following the review and any necessary corrections, a partial Operational Readiness Clearance (ORC) will be granted by the Particle Physics Division head for these subsystems. When all subsystems are installed and individually approved to operate, the subsystem permits are combined with additional requirements to justify the final ORC. The Particle Physics Division head grants approval to commission the experiment with beam when the final ORC documentation is complete. Note that commissioning of the beamline may occur prior to approval of the experiment ORC.

A.5. Operation

Commissioning is concluded and operation begins when the experiment spokesperson declares to the Program Planning office of the Directorate that the experiment is taking physics quality data. During operation, the experiment's primary contact with Particle Physics Division is through the liaison physicist, who provides or arranges services such as emergency repairs of equipment and coordinating emergency technician, alignment services and T&M requests.

A.6. Complete/Inactive

The Program Planning office declares an experiment complete when it has received it's allotted integrated beam or hours of operation specified in the MOU.

An experiment is inactive when all unusual hazards associated with the operation of the experiment have been removed. Upon completion of the experiment, an inspection is performed by Particle Physics Division to ensure that flammable gas systems are inoperative, mechanical transporters are locked out, pressure and vacuum vessels are vented, etc. The only experiment hazards remaining during the inactive state are those routinely accepted by the general public.

During this phase, the Director makes a decision to decommission the experiment or to authorize modifications and improvements for future running. Note that subsystems may be operated for testing purposes after a review and with the approval of the Particle Physics Division head.

A.7. Decommissioning

An experiment is in the decommission state when the director has decided to remove the experiment detector. During this phase, detector subsystems provided by outside collaborating institutions are removed from the laboratory, and Fermilab owned equipment is made available for use in other experiments. Particle Physics Division is responsible for ensuring that Particle Physics Division supplied equipment is properly retained and stored for future use.

B. Experiment ES&H Reviews

As described above, the Particle Physics Division head is responsible for all ES&H aspects of experiment operation. ES&H reviews are the primary means of ensuring that experiments are designed, installed and operated according to good ES&H practices. The starting point for ES&H reviews is the Preliminary Hazard Assessment which identifies all equipment that poses unusual hazards. ES&H reviews are conducted by ad-hoc or standing review committees that report their results to the Particle Physics Division head. Reviews are conducted with the following philosophy:

1. All new equipment meeting criteria as specified in the Fermilab ES&H Manual and designed at Fermilab must pass a design review prior to construction.
2. Collaborating institutions are responsible for conducting design level reviews for all new equipment built by outside institutions.
3. Unmodified, previously used equipment does not require a design level review.
4. ALL equipment will receive an inspection prior to commissioning.

The depth of ES&H reviews is determined by the ES&H Review Committee chair, Particle Physics Division senior safety officer, and Particle Physics Division management to ensure adherence to federal, DOE and Laboratory standards and to be consistent with good engineering practices.

C. Operational Readiness Clearance (ORC)

The Operational Readiness Clearance is a permit approved by the Particle Physics Division head for commissioning and operation of an experiment system and/or an entire detector. To facilitate experiment checkout, the experiment may desire that sub-systems be approved for commissioning prior to commissioning of the entire detector. As experiment checkout progresses and partial ORC's are granted for systems, all subsystems will be approved and operating. Prior to initial data taking with beam, the Particle Physics Division head must grant a final ORC which has the following components:

1. Copies of sign-offs from ES&H review committee(s). (This is a collection of partial ORC'S)
2. Particle Physics Division determination statement that the experiment is covered by an existing or new SAD. (This statement specifies that the experiment complies with the requirements of a specific version of a Safety Assessment Document.)
3. Particle Physics Division determination statement of the need for an experiment Conduct of Operations document. (This statement documents the determination that sufficient engineered controls are in place to obviate the need for formal Conduct of Operations.)
4. Copy of an experiment hazard communications document.
5. Verification statement from spokesperson that any required procedures are approved and in effect. (In the unlikely event that safety procedures are required, the experiment must demonstrate to the Particle Physics Division head that these procedures are in place and that appropriate training has been given.)
6. Copy of the commissioning beamline Running Condition.

D. Qualification Of Personnel

The Particle Physics Division has a long-standing, well-documented and up-to-date training program for its personnel and users, consisting of reading materials, video tapes, lectures, walk-arounds and on-the-job training (OJT). Personnel training records are maintained by the ES&H Section.

E. Safety Envelope

The following items are the components of the safety envelope for these experiments:

1. The experiments shall be operated only with an approved Operational Readiness Clearance (ORC) or signed permits for specific subsystems.

2. The maximum beam allowed in the beamlines for each of the experiments is in compliance with the Fermilab Radiological Control Manual[4] as addressed in reference 8.

F. 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 will be done in accordance with the provisions of FESHM, Chapter 8070.

The Head of the Fermilab Particle Physics Division is responsible for assuring that the requirements of the D&D policy are followed for the fixed-target experiments; this includes the responsibility to inform the Laboratory's Senior Environmental Protection Officer, who is responsible for the Laboratory's master D&D files, concerning any activities affecting possible future D&D activities. Regularly updated "as built" drawings, are maintained by the Facilities Engineering Support Section. Accelerator and beamline facility usage records are maintained and updated annually. The Senior Environmental Protection Officer is notified of any changes of facility usage, for inclusion in the D&D files.

All actions taken to decontaminate a facility or to fix contamination prior to actual D&D work are documented by the laboratory organization which supervises the D&D work. The procedures to be used for maintaining D&D documentation are described in the Fermilab ES&H Manual. The Fermilab Low Level Waste Certification Plan describes the Fermilab program for managing radioactive and mixed wastes. It is written to satisfy the requirements of DOE and the Hanford Site for disposal of waste at Hanford, the DOE-approved waste disposal site for Fermilab.

Examples of typical types of information which are included in D&D files are as follows:

1. Location and magnitude of radioactivity - in soil, structures, shielding materials, and liquids such as closed-loop cooling systems; and

2. Location of chemicals, and other pollutants.

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 Fermilab Radiological Control Manual and the Fermilab ES&H Manual.

IV. CONCLUSION

On the basis of the discussion in this Safety Assessment Document, it is concluded that operation of the experiments in the Fermilab Meson120 Experimental Areas will have negligible impact on the health and safety of the public and negligible impact on the environment. As stated above, all of these experiments will be reviewed and approved for fixed target running. There will be minor or negligible impact from radiation hazards, electrical hazards, and conventional hazards on the health and safety of operating personnel and negligible impact on the health and safety of all other Laboratory personnel.

V. REFERENCES

1. 2002 Fermilab Research Program Workbook

2. Fermilab Integrated Safety Management Plan.

3. Fermilab Environment, Safety and Health Manual.

4. Fermilab Radiological Control Manual.

5. Fermilab Emergency Plan.

6. Particle Physics Division Operating Manual

7. Fermilab N&S Standards Pilot: Table I - Issues and Standards Spreadsheet

8. Safety Assessment Document for the Beams Division Areas – Addendum to 2002 SAD Switchyard 120 Fixed Target Beamlines

9. ACGIH - Threshold Limiting Values for Static Magnet Fields

Appendix A

Hazards associated with facilities in the Meson 120 project.

1. **Meson Test Beam Facility**. The MTBF has the following specific hazards associated with its infrastructure: a) vacuum windows, b) pressurized or evacuated vesels, c) pressurized gas systems, including a gas shed, d) mechanical movers, e) distributed electrical systems. All of these hazards meet the specifications defined above and will be reviewed by the Particle Physics Division safety committee for Operational Readiness Clearance. Each separate installation of test equipment identified by its own MOU will also be reviewed by the same committee and receive its ORC before allowing beam to be delivered.

2. **E907 (MIPP):** E907 (MIPP) has the following equipment that will be reviewed by the safety committee before an Operational Readiness Clearance can be given: magnets with their power supplies, pressurized or evacuated vessels, hydrogen and various other targets, drift chambers, a calorimeter and a time projection chamber. Appendix B lists the specific hazards that these may present.

Appendix B

Example of Experiment E907. Other experiments will have similar lists.

E907 HAZARD IDENTIFICATION CHECKLIST

3. Items for which there is anticipated need have been checked

Cryogenics		**Electrical Equipment**		**Hazardous/Toxic Materials**	
X	Beam Line Magnets	X	Cryo/Electrical Devices	List hazardous/toxic materials planned for use in a beam line or experimental enclosure:	
X	Analysis Magnets		Capacitor Banks		
X	Target	X	High Voltage (> 5 Kv)		Methylal (dimethoxymethane)
	Bubble Chamber		Exposed Equipment Over 50 V		
Pressure Vessels		**Flammable Gasses Or Liquids**			
	Inside Diameter	Type:	Ar 10% CH_4 (P10) Ar 15% Isobutane		
	Operating Pressure	Flow Rate:			
	Window Material	Capacity:			
	Window Thickness				
Vacuum Vessels		**Radioactive Sources**		**Target Materials**	
30 cm	Inside Diameter		Permanent Installation		Hydrogen (H)
0–760 T	Operating Pressure		Temporary Use		Beryllium (Be)
	Window Material	Type:			Lithium (Li)
	Window Thickness	Strength:			Carbon ©
Lasers		**Hazardous Chemicals**		**Mechanical Structures**	
	Permanent Installation	X	Methane	X	Motion Controllers
	Temporary Installation				
	Calibration				
	Alignment				
Type:					
Wattage:					
Class:					