Fermilab

Calendar Year 2005 Fermilab As Low As Reasonable Achievable (ALARA) Project Summary

At the Fermi National Accelerator Laboratory (Fermilab), a policy consistent with integrated safety management and in accordance with 10 CFR 835 requirements is to conduct activities in such a manner that worker and public safety, and protection of the environment are given the highest priority. Fermilab senior management is committed, in all its activities, to maintain any safety, health, or environmental risks associated with ionizing radiation or radioactive materials at levels that are As Low As Reasonably Achievable (ALARA). Likewise, Fermilab management supports related work planning and review activities in support of Fermilab's ALARA program. Especially notable is the willingness to endorse cool-down periods and other scheduled modifications.

During the majority of calendar year 2005, Fermilab operated under normal beam-on conditions, which involves producing, accelerating and delivering protons to the Tevatron Collider program, the neutrino physics experiments, (MiniBooNE and NuMI/MINOS), and the 120 GeV Fixed Target experimental program in the Meson Area. Some radiological work was performed on radioactive accelerator components consisting of repairs and corrective maintenance necessary for maintaining accelerator performance. In addition, beamline components were removed from the Meson Detector Building during this year.

Meson Detector Building MP and ME Beamline Component Dismantle/Removal

The MP and ME beamlines located in the Meson Detector Building last operated in the early 1990's when high intensity 800 GeV beam was delivered to these locations. To create space for new research projects, these beamlines were dismantled and all beamline components were removed. Clean out work involved the removal of large amounts of shielding, extraction of radioactive beam absorption components, target stations, and work inside of a radiation-induced activated cavity. Cutting, torching, blasting, and weld grinding of SM12 magnet components were required for removal. Ambient exposure rates within the cavity of the SM12 magnet were approximately 75 mR/hr, with the maximum exposure rate of 850 mR/hr measured on the beam absorber. As magnet disassembly proceeded, previously inaccessible surfaces were exposed and higher radiation levels were revealed. To reduce potential radiation exposure, concrete shielding blocks were placed in front of hot spots along the exterior surfaces of the SM12 magnet. Additionally, a portable curtain of lead blankets were moved along the magnet as work progressed. Workers used the portable shielding while cutting and drilling directly on newly exposed surfaces. As a result of effective implementation of ALARA measures, the collective dose received for this phase of the work was approximately 30 person-mrem.

The most important aspect of radiological work regarding the ME beamline required the dismantling and removal of the beam absorber inside the beam cavity of the SM12 magnet. To minimize exposure, a special rectangular steel and lead blanket shield fixture was constructed to surround personnel working inside the beam cavity. The ambient exposure rate of 75 mR/hr was reduced to approximately 15 mR/hr with use of the shielding fixture. Furthermore, time limits were instituted to minimize doses in the area of highest activity within the beam cavity. The duration of work inside the beam cavity with the shielding fixture was limited to no more than four hours. The total collective dose for this phase of the project was 25 person-mrem which reflects an estimated dose reduction of approximately 100 person-mrem. The collective dose for all of the dismantling and removal work of the MP and ME beamlines in the Meson Detector Building was 200 person-mrem.

Shielding Fixture for SM12 Magnet Dismantling and Removal Project

Shielding Fixture Inside SM12 Magnet Beam Cavity


Worker Inside Shielding Fixture within SM12 Magnet Beam Cavity

Worker Coming Out of Shielding Fixture within SM12 Magnet Beam Cavity

Anti-Proton Zero (AP0) Target Replacement

Higher beam intensities were a necessary part of Fermilab's program to increase Tevatron luminosities. As a result of these increased beam intensities and a new design, the AP0 target needed to be replaced. The work involved to replace the AP0 target proceeded in a manner much different than that of previous target changes. The dose rates at the top of the modules were 50 to 100 mR/hr, compared with levels of 5 to 10 mR/hr as measured in the past. The highest exposure rate one foot from the target was 300 R/hr. The total collective dose was 237 person-mrem, which matched closely with the pre-job dose estimate of 245 person-mrem.

Anti-Proton Targets

Anti-Proton Prevault Enclosure Beam Pipe and Torroid Replacement

A vacuum leak developed in the beam pipe and the torroid instrument (a beam monitor) was damaged in the anti-proton prevault enclosure. As a result, a portion of the beam pipe and torroid needed to be replaced. Initial general area exposure rates were in excess of 2 R/hr. At these rates, the pre-job collective dose estimate for this task would have been about 1560 person-mrem. Because this preliminary dose estimate was so high, ALARA measures were instituted to require a twelve hour cool down time before workers were allowed to enter the area to start the task. The general area exposure rate after the twelve hour cool down period was reduced to 130 mR/hr. The total collective dose for this job was 96 person-mrem. Implementation of this required cool down wait time ultimately saved approximately 1460 person-mrem.

Anti-Proton Prevault Enclosure Vacuum Pump Hook Up to Beam Pipe

Vacuum was lost in a beam pipe, so an attempt was made to restore vacuum to the beam pipe by hooking a vacuum pump up to the beam pipe in the anti-proton prevault enclosure. A three hour cool down wait time was required before workers were allowed to enter the area. The exposure rates after the three hour cool down period were about 600 mR/hr at the hot spot near an overhead magnet and about 400 mR/hr in the aisle way. To minimize time, and increase worker efficiency, each step of the task was performed separately. For example, workers entered the High Radiation Area and then immediately exited to a low exposure rate area after each step of the task was completed. Further controls were instituted by the Radiological Control Technicians (RCT) who supervised the job by limiting the time allowed for each step to be completed. Also, the RCT verbally called out the expired time (in seconds) to the workers. This technique kept worker awareness at a high level as well as expedited the completion of each step. These ALARA practices resulted in the job being completed in less time and at a lower collective dose than would have otherwise occurred. As a result, it is estimated that 135 person-mrem was saved. The total collective dose for this job was only 8 person-mrem.

Reduction of Contamination Levels in MiniBooNE Target Enclosure

Prior to the re-start of MiniBooNE Experiment following a focusing horn change, secondary sealing and wrapping containment was added to all MiniBooNE target cooling system connections and readout ports. These ALARA actions reduced the potential for airborne as well as surface Beryllium-7 (Be-7) contamination. Inspections of the target cooling wrapping were made whenever Radiation Safety personnel made an access to the Main Injector (MI) 12B enclosure. Prior to returning the system to service following maintenance activities, Radiation Safety personnel required leak checking of any joints in the target cooling system which could have been affected. Comparison of pre and post horn change contamination wipe data show that contamination levels have been reduced from 17,000 pCi to 1,200 pCi as a result of this ALARA effort.

Replacement of Wand Sources in Radiation Physics Calibration Facility

Radioactive sources are used routinely for radiation instrument calibrations at the Radiation Physics Calibration Facility. Wand-type sources and use of a collimator were successfully replaced with an automated source projector. In this way, technicians no longer handle these sources manually by placing them into the collimator. Instead, these sources are operated automatically and remotely as part of the source projector system that houses other calibration sources. Also, an electronic sign was installed that indicates when the Source Projector Facility is in use. As a result of this new source projector, a greater than 90 percent reduction in exposure to the operators of this facility has been achieved.

Cylindrical Collimator Located in Center that Required Manual Insertion of Wand-Type Sources

New Automated Source Projector Containing Calibration Sources (Located in Center)