FERMILAB

Report to the Director on the Fermilab Environment CY2002

1.0 Introduction

Environmental stewardship continued to be a guiding principle at Fermilab in 2002. That principle was translated into a working reality through the effective deployment of the environmental protection program. The environmental protection program (EPP) establishes policies and procedures to ensure compliance with regulatory requirements imposed by Federal, State and local agencies and with DOE orders. In addition, the EPP provides for the measurement and interpretation of the impact of Fermilab operations on the public and the environment via its comprehensive environmental monitoring and surveillance program.[1]

Surveillance and monitoring tasks are conducted to confirm compliance with standards and permit limits as well as ensure early detection of an unplanned pollutant release. The location and frequency of sampling are based on established routines, operational considerations and historic levels of pollutants found in each location. Sampling points are selected based on the potential for adverse impacts.

To evaluate the effects of Fermilab operations on the environment, samples of effluents and environmental media such as soil and groundwater are collected on the site and at the site boundary. These samples are analyzed and results are compared to applicable guidelines and standards. The status of environmental protection activities and the progress on environmental restoration, waste management and corrective action activities are discussed in this report. There were no abnormal occurrences that had an impact on the public, the environment, the facility or its operation in CY2002.[2]

2.0 Laboratory Highlights

In 2002 Fermilab diligently pursued the goal of increasing the Tevatron peak luminosity (number of particle collisions that occur in a second) of Run I by a factor of 5 in Run IIa. Systematic progress was made throughout the year to improve Tevatron performance. In October of 2002, Fermilab achieved an all-time Tevatron record for weekly integrated luminosity (inverse picobarns which correlates with the number of particle collisions during a store). The Lab also set several all-time records for the highest peak luminosity. In addition, an enhancement in performance was seen in the antiproton Recycler, which is an integral part of achieving Run II goals. Finally, electron cooling (process by which a high current electron beam carries heat away from antiprotons) experiments were initiated this year with promising results; this technology will also help to boost luminosity in the future.

The first phase of the Neutrinos at the Main Injector (NuMI) project was completed in 2002. Phase I included the excavation of two access shafts, four thousand feet of tunnel, two large underground halls and several alcoves. One of the halls will be home to the Main Injector Neutrino Oscillation Search (MINOS), a research project that will be carried out by over 200 physicists from 5 countries. The experiment will study neutrinos, one of the least understood types of particles in the universe.

Also in 2002, Fermilab's Technical Division completed highly successful tests of the first superconducting quadrupole assembly for the US Large Hadron Collider (LHC) Accelerator Project. The 19-foot, 12,000-pound magnets are bound for the LHC under construction at CERN, the new European Particle Physics Laboratory in Switzerland. The LHC superconducting magnets are designed to reach a peak magnetic field of 9 Tesla; superconducting magnets at Fermilab's Tevatron currently reach 4.4 Tesla.

The Mini Booster Neutrino Experiment (MiniBooNE) at Fermilab began collecting data in August of 2002 and announced it's first neutrino event in September. The main goal of MiniBooNE is to draw a definitive conclusion on the neutrino mystery.

Fermilab expanded it's computing power in 2002 via the purchase and installation of over 400 new computers; the majority of which will be used to reconstruct the data from particle collisions at the same pace that they are witnessed by experimenters. To accommodate this expansion, the Computing Center added new uninterruptible power supplies and installed a high capacity generator under the lab's Utility Incentives Plan.

2.1 Significant Environmental Accomplishments

The groundwater-monitoring program continued to show no adverse chemical or radiochemical impact from Fermilab operations on the Class I resource groundwater below the site. The modified monitoring protocol for both Solid Waste Management Unit 12 (Central Utility Building Tile Field) and SWMU 13 (Meson Hill) was enacted in 2002. The modified protocol allowed for a reduction in the number and frequency of chemical parameters to be monitored; this reduction was negotiated with the IEPA in 2001. Due to ongoing elevated concentrations of sulfates recorded in monitoring wells at SWMU 13, an updated notification of a "significant change in groundwater quality" was sent to the IEPA this year. An Assessment Monitoring Plan (AMP) addressing the sulfate issue, that was developed, reviewed and accepted by the IEPA in 2001, was implemented and results were reported to the IEPA during 2002. The AMP was developed to determine the source of the sulfate increase, concentrations and extent of sulfate migration, and assess any potential threat to human health and the environment. Results from the study indicated natural conditions were the source of the detected sulfate concentrations. A directive was received from the IEPA in 2002 requiring the Lab to submit a post-closure plan modification to install a new background well at SWMU 13; the plan was developed and sent to the IEPA. With respect to potentiometric concerns, the investigation of groundwater impacts from the NuMI tunnel continued to show no adverse effects on the potentiometric surface of groundwater in the Class I resource beyond the localized area of the construction. However, it was found that the combined influence of the localized drawdown of the NuMI tunnel along with that of the Lab's main supply well (W-1, which is located to the east of the NuMI tunnel) had adversely impacted beam alignment. The impact resulted from movement of the overlying glacial deposits. As a result, the Lab decided to put W-1 on a low constant draw and to use another onsite well, W-3, as the primary water supply.

A DOE requested Cultural Resources Management Plan (CRMP), following guidelines outlined in DOE Publication DOE/EH-0501, was prepared for Fermilab. The CRMP assures continued compliance with the Natural Historic Preservation Act (NHPA), the Archaeological Resources Protection Act, and the Native American Graves Protection And Repatriation Act by providing a comprehensive overview for the locations and status of all archaeological resources within the Fermilab site boundaries thereby facilitating future NEPA reviews. The CRMP was completed in September 2002.

Fermilab conducted a PCB-related spill prevention activity in 2002. Twenty-four transformers from the old Main Ring that were removed from service as a result of the PCB cleanup work last year were stored at Site 55. The units were poor candidates for reuse due to their age and unusual secondary voltage and they posed a potential spill source if left in storage. In addition, sampling of the transformers revealed that two had experienced enough leaching of PCBs from their windings since their last retrofill and sampling that they had reverted to PCB-contaminated status. Therefore, in October the oil was drained from these transformers and sent off site for detoxification or fuel blending. The transformer carcasses were then shipped off site for decontamination and scrap metal reclamation.

Fermilab's Pollution Prevention Initiative consists of a Restoration and Reuse (R&R) Program and a Waste Minimization (reduction before and after generation) Program. Under the Restoration and Reuse (R&R) program, Meson West in the Fixed Target Area was cleaned out for future use; recovery of materials during this operation was highly successful. Approximately 4,100 metric tons of material composed primarily of concrete, steel and lead shielding was removed. Of that amount, 1,050 metric tons was specifically earmarked for other uses on site or to be recycled. The remainder of the recovered material was placed at the Railhead for future use. Only about 81 metric tons of obsolete material was disposed as low-level radioactive waste. In addition, under the Waste Minimization Program Fermilab installed a new compressed natural gas (CNG) vehicle refueling station costing $128,000 this

year. The Lab's motor pool fleet currently has twenty-six bi-fuel gasoline/natural gas vehicles that can now utilize natural gas, which is cleaner burning and cheaper than gasoline, as an alternative fuel source. Reduction of gasoline consumption is estimated at 18,000 gallons annually; this reduction is estimated to save the Lab approximately $10,000 per year.

In August 2002 the meteorological station was upgraded from a 10-foot tripod to a 30-foot tower following the DOE guidance publication, *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance* (published in 1991). Data from the meteorological station is used for input to run the CAP88-PC2 software required to perform radiation dose and risk assessments for compliance with 40 CFR 61.93(a).

2.2 Other Environmental Issues

Twelve National Environmental Research Park (NERP) projects remained underway. The projects are the following: Differences in Reproductive Success of Prairie Plant Species between Restored and Remnant Prairies; Carbon Sequestration in Terrestrial Ecosystems; Assessment of the Impact of Biological Controls on Garlic Mustard (Alliara petiolata) and on Non-target Species in Forest Communities; Bird Surveys at Fermilab; Feedbacks between Plants, Mycorrhizal Fungi, and Soil Nutrient Dynamics; Effects of Tree Removal on Recovery of Ground Cover in Big Woods at Fermilab; Observations of the Heron Rookery at Fermi National Accelerator Laboratory; Bat House Project at Fermilab; Translocation of Silver-bordered Fritillary; *Bolaria selene* at Fermilab; IDNR ForestWatch Monitoring Program at Fermilab; and Assessing Carbon Cycling in Restored Grasslands using Stable Isotopes.[3]

The Laboratory's Ecological Land Management Plan was updated in 2002. The plan can be viewed at www-esh.fnal.gov/ELM/ELM_Plan_2003.htm. Existing prairie tracts were enriched with forbs and burned or mowed to discourage intrusion of brush, trees and exotic plants.

U.S. Department of Agriculture Wildlife Service-contracted deer removal operations were effectively administered during the 2002-2003 season. An aerial count of deer on site conducted in March resulted in 120 animals observed. Subsequent removal of 20 animals brought the total observed number to 100. The projected population level for next season is in the 150 – 180 individual range. Vegetation studies conducted by a consultant during May and August of 2002 continued to show substantial recovery in the forest and fewer signs of deer browse damage. The deer management program continues to yield good results in the management of Fermilab's ecosytem. The consultant report recommended that efforts to manage the deer population should continue in order to ensure the protection of plant communities, especially wooded areas.

The moratorium, issued by the Secretary of Energy in July 2000, on recycling of scrap metals from posted radiological or radioactive materials areas, remained in effect throughout 2002. Measures continued to be taken throughout 2002 at Fermilab to separate materials subject to this moratorium. Due to this, materials were amassed that were considered non-radioactive according to Fermilab's DOE-approved release criteria and which had been recycled prior to the moratorium.

3.0 Environmental Monitoring and Surveillance

The goal of the Fermilab Environmental Monitoring Program (EMP) is to assist Laboratory management in decision-making by providing data relevant to impacts that Fermilab operations have on the surrounding environment. The EMP consists of effluent monitoring to confirm compliance with permits, generally at a particular point. Environmental surveillance is conducted at various locations to intercept the pathway of potential pollutants to receptors such as plants, animals or members of the public. Fermilab collects environmental data for reporting purposes or whenever it is necessary or useful in conducting the business of the Laboratory. Line organizations have the responsibility to recognize and understand the environmental aspects of their operations and to conduct their work in an environmentally sound manner.

The pathways available for movement of radioactive materials and chemicals from Fermilab operations to the public are the atmosphere, surface water and groundwater. Environmental surveillance consists of collecting and analyzing samples of various media and measuring penetrating radiation within and outside the site boundaries.

Ground and surface waters are sampled at locations near operating areas, potential contamination sources and along potential transport pathways. In addition to air and water surveillance, samples of soil are collected and analyzed for radioactivity to ascertain whether there is build-up of radioactive materials in the environment due to long-term operations.

Surface water, air, groundwater, soil and sediment samples are monitored for radionuclide concentrations. Surface waters are also monitored for potential chemical constituents. While levels of penetrating radiation are measurable near operational areas on the site, the levels decrease rapidly with distance from the sources. External penetrating radiation and airborne emissions are normally below instrument detection levels at the site boundary and must be estimated to provide information about the maximum potential radiation doses to offsite populations. The results of the environmental surveillance program are interpreted and compared with environmental standards where applicable. The Fermilab Environmental Monitoring Plan, which is maintained by the ES&H Section, provides more details.

The DOE advocates that sites address radiological protection of aquatic and terrestrial biota and has recommended that facilities review their monitoring programs for opportunities to improve and communicate their results. In response, Fermilab has used DOE's technical guidance (DOE-STD-1153-2002) and companion tool, the RAD-BCG Calculator, to evaluate the Laboratory's effect on both aquatic and terrestrial biota. On an annual basis soil and sediment samples are collected throughout the site in conjunction with water samples collected from sumps, ditches, and creeks according to routine sampling schedules. For the calendar year 2002, all locations analyzed passed the site screens.

3.1 Air Quality

The potential for public exposure to air pollution from Fermilab is very remote. Fermilab's Lifetime Operating Air Pollution permit issued by the Illinois Environmental Protection Agency (IEPA) under the Clean Air Act, includes a *National Emissions Standards for Hazardous Air Pollutants* or NESHAPs element, which covers airborne radionuclides. In addition, the permit takes into account those criteria pollutants such as particulate matter, nitrogen oxides, carbon monoxide, volatile organic materials and sulfur oxides associated with the operation of various pieces of equipment.

Airborne radionuclides are normally released to the atmosphere from operating target stations. Monitoring is conducted at targeting areas where air emissions are considered a significant contributor to the overall transport of radioactive materials offsite. The Magnet Debonding Oven at the Industrial Complex also contributes a small quantity of airborne radionuclides when operating. Our permit application states that total releases will average no greater than 100 Ci/year with a maximum of 900 Ci/year.

The radiation doses potentially received by the offsite public due to Fermilab operations are calculated from data gathered through environmental surveillance of the onsite sources. Selected vent stacks are monitored directly with stack monitors and indirectly by taking soil samples in the vicinity of the stacks. The dose for the air pathway is calculated using a Gaussian plume computer simulation model called CAP-88PC2. This model was created by USEPA to predict the movement of airborne radionuclides and its use is required by regulations governing hazardous air pollutants at 40 CFR 61. Maximum calculated concentrations offsite are predicted to be below the level that could be detected by monitoring.

Fermilab is not a significant source of chemical air pollution. Our permits cover emissions caused by open burning conducted for prairie/land management and fire extinguisher and firefighter training, a magnet debonding oven, a fuel dispensing facility, a vapor degreaser and the operation of several natural gas-fired boilers. Pollutant levels are estimated based on the knowledge of the processes that generate them and the characteristics of individual pollutants. The results are submitted to the Illinois Environmental Protection Agency in an annual air emissions report.

3.1.1 Radioactive Air Emissions

Debonding Oven operation is a potential source of tritium while radioactive components are being burned. In 2002 the debonding oven was used to burn 4 magnets, 3 of which were radioactive; this resulted in the release of approximately 4.5 microcuries of tritium. The Anti-Proton stack is estimated to have released a total of 26.13 Curies in CY2002. These radioactive air emissions were less than 27% of the limits of our current air pollution permit application on file with the Illinois Environmental Protection Agency (IEPA). No detectable levels of radionuclides reached the site boundaries. Doses to the public from emissions in CY2002 continued to be well below the Environmental Protection Agency (EPA) standard of 10 mrem/year to a member of the public and also much less than the EPA's continuous monitoring threshold of 0.1 mrem/year. Using the CAP-88PC2 gaussian dispersion model, the highest dose equivalent to any member of the public was estimated to be 0.00804 mrem.

Fermilab's CY2002 Radionuclide Air Emissions Annual Report was submitted to DOE in June 2003.

3.1.2 Non-Radioactive Air Emissions

The IEPA decided in late 1996 that the level of air emissions at the Laboratory did not warrant the issuance of a Federally Enforceable State Operating Permit (FESOP). In CY2000, the Agency issued Fermilab a revised Lifetime Operating Permit adding a vapor degreaser to the previously permitted air pollution sources. The new permit covers the Magnet Debonding Oven, three boilers at CUB, a 12,000-gallon tank of gasohol, accelerator tunnel ventilation stacks and a vapor degreaser at Industrial Building 3. Permit conditions require the monthly logging of fuel consumption for covered fuel combustion sources and solvent usage at the degreaser. Source operations were reviewed by Fermilab personnel again this year to ensure that permitted equipment continued to operate and be maintained in accordance with permit conditions. The estimated concentrations of pollutants emitted were slightly increased as compared to last year due to the operation of the magnet debonding oven. All source emissions were compliant in CY2002. The Annual Air Emission Report for CY2002, an estimate of criteria pollutant emissions, was submitted to the Illinois Environmental Protection Agency (IEPA) in May 2003.

3.2 Penetrating Radiation

Operation of the Fermilab accelerator and associated beamlines produce ionizing radiation such as muons. Beamlines and experiments are designed so that most of the radiation has ranged out before reaching the ground surface. The remaining radiation that emerges above the surface presents a small potential for radiation dose. Small muon fields have been measured in conjunction with the operation of the Fixed Target beam lines, the Meson Test (MT), Meson Center (MC), and Kaons at the Tevatron (KTeV) beamlines in the past. These beamlines were not operated in CY2002. After the removal of the Main Ring from the Tevatron tunnel, the C0 beam absorber is seldom used; the A0 beam absorber is now the primary absorber. The effective dose equivalent due to C0 muons, at the site boundary was 0.12 micro-rems for CY2002. Unlike the C0 absorber, the Tevatron beam has to be bent down into the ground to be directed to the A0 absorber. Due to this, the ground absorbs the muons emerging from of the AO absorber; therefore, no muons are detected from the operation.

Storage of radioactive materials at a centralized onsite location, known as the Railhead, resulted in another potential exposure to ionizing radiation. These sources of penetrating radiation were monitored periodically in CY2002 through onsite surveys. In past years the dose equivalent rate arising from this storage has not been measurably different from ambient background levels in the Railhead area. However, during the period from January 1–January 10, 2002 a large amount of radioactive steel from the PW8 building was stored in an unshielded area of the Railhead. This unshielded steel caused an indirectly measurable dose equivalent rate to rise at the site boundary. Dose estimates were calculated under the extremely conservative assumption that a single individual was exposed for the 10-day period (January 1-January 10, 2002) 24 hours per day, 7 days per week at the site boundary. Based on measurements made in CY2002, it is believed that radioactive materials stored at the Railhead contributed a dose equivalent at the site boundary in 2002 of approximately 0.659 mrem. The maximum radiation dose equivalent to an individual at the nearest offsite house was similarly estimated to be approximately 0.117 mrem in CY2002.

3.3 Water Quality

Fermilab discharges liquid effluent to surface water bodies and to sanitary sewers. The Lab holds National Pollutant Discharge Elimination System (NPDES) permits that govern discharges to surface water from stormwater runoff, cooling water, and effluents from various onsite construction projects. In addition to monitoring for the physical and chemical parameters required by NPDES permits, samples of surface water are taken annually from selected water bodies and analyzed for radionuclides. These surface waters are sampled for radionuclides based upon their potential for contamination. Aqueous process wastewaters are directed to sanitary sewers and ultimately discharged to publicly owned treatment works (POTWs) in Batavia and Warrenville. Wastewater discharges are controlled by criteria set forth in the Fermilab Environment, Safety, and Health Manual Chapter 8025.

The NuMI construction project holds a General NPDES permit issued by the IEPA covering construction related to mining activities. The permit was first issued in 1999 and subsequently renewed in 2002. This permit is primarily focused upon ensuring the safe discharge of effluents from the mining of dolomite during digging of the associated tunnel and providing erosion controls for construction areas and associated stockpiles. In concert with this project, several outfalls to onsite waterways were identified for monitoring. Monitoring for Total Suspended Solids (TSS), pH, and flow rate is performed at these NuMI-specific outfalls. In addition, the Corps of Engineers authorized NuMI activities for coverage under the Clean Water Act Section 404 permit program in August of 1999. This authorization was renewed in 2001.

The MiniBooNE construction project also holds a General NPDES permit and a project-specific Clean Water Act Section 404 wetlands permit authorization; both were issued in 2000. To ensure compliance with both permits, a Corps of Engineers contractor conducted inspections throughout the duration of this construction. Additionally, the permanent alignment of Indian Creek was re-established following its temporary re-routing to enable the construction of the 8 GeV line for MiniBooNE; this work was conducted in accordance with the Section 404 permit authorization. Erosion control structures and practices were routinely scrutinized to ensure conformance with the Surface Water Pollution Prevention Plan (SWPPP). The MiniBooNE construction project was completed in 2002 within the conditions of both permits mentioned above.

3.3.1 Radioactive Releases to Surface Water

Numerous sumps collect and drain water from building footings and from under beamline tunnels in the Tevatron, Main Injector and the Experimental Areas. Water collected by these sumps often contains detectable concentrations of radionuclides (primarily tritium, H^3) that have been leached by rainwater from radioactive soil near beam targets and absorbers or released accidentally to sumps from beamline cooling water systems. These sumps discharge to ditches and ponds onsite. Surface water monitoring conducted during CY2002 showed tritium concentrations to be well within the Department of Energy Derived Concentration Guides for allowable radionuclide releases to surface waters (2000 pCi/ml). Nine of the sixty-seven samples taken from onsite ditches, ponds and creeks in CY2002 showed a detectable level of tritium, the highest of which was 78.3 pCi/ml. Samples taken at NPDES outfall (discharge) locations to *Waters of the State* (as defined by the Clean Water Act) showed no detectable tritium and gross beta levels well below IEPA allowable limits.

3.3.2 Non-Radioactive Releases to Surface Water

Monitoring for non-radiological chemical constituents in surface water was limited to NPDES permit parameters (temperature, flow, TSS, TDS pH, chlorine, chloride and sulfate) this year. Discharge Monitoring Reports for six different outfalls were submitted monthly to the IEPA. In 2002 there was one occurrence of exceeding NPDES discharge limits. The NuMI project exceeded the pH limit at the MINOS outfall when a continuous automated chemical feed system ran afoul for several hours. The problem was corrected upon discovery.

3.3.2.1 Cooling Water System

An NPDES permit authorizes the discharge of commingled cooling water and stormwater runoff to surface waters through outfalls to Kress, Indian and Ferry Creeks. Due to the presence of the RCRA-permitted (Resource Conservation and Recovery Act) Hazardous Waste Storage Facility onsite, the NPDES permit also regulates

stormwater discharges from designated solid waste management units (SWMUs). The Stormwater Pollution Prevention Plan required by this NPDES permit is periodically modified to reflect changes that occur as part of the RCRA Facility Investigation (RFI) of the SWMU sites. Our site-wide NPDES permit dictates that water temperature, pH, and flow be monitored at all three outfalls. The results are reported to the IEPA on a monthly basis. Chlorine concentration is also reported for the Kress and Indian Creek outfalls.

In 2002 the CUB cooling towers were overhauled and upgraded. Changes in tower operation resulted in three new NPDES discharge parameters that must be reported at the Indian Creek outfall. In addition to flow, temperature, pH and chlorine, the Lab is now required to report to IEPA results for total dissolved solids, chlorides and sulfates on a monthly basis.

3.3.2.2 Releases to Sanitary Sewers

Another NPDES permit allows us to pre-treat and release effluent from the Central Utility Building (CUB) regeneration process to the City of Batavia sanitary sewer system. The pretreatment permit for the effluent generated by this process requires the collection and analysis of composite process effluent samples for specified metals on a quarterly basis. Samples were also collected and analyzed from each discharge for accelerator-produced radionuclides in order to confirm that amounts of radioactivity released meet DOE guidelines. In CY2002, samples from the process effluent were in compliance with the specified levels in the Batavia Sanitary Sewage Ordinance and the Department of Energy Derived Concentration Guide. Approximately 1.66 mCi of tritium, 195 uCi of beryllium-7, and 1.58 uCi of sodium-22 were released to the sanitary sewer from the CUB during CY2002.

Monitoring stations, located at the site boundary, sample sewer discharges to each municipality. The discharge at these locations is a mixture of all effluents contributing to that sanitary sewer system. Analytical results are compared to municipal discharge limits to track compliance. As in years past, the Batavia sewer sampler revealed exceedances of the iron discharge limit of 5.0 mg/l. Samples yielded iron concentrations ranging from 1 to 85 mg/L, with excursions occurring in six of the twelve sampling events. These excursions were thought to be due to the aging of the pipes and ongoing work to upgrade that infrastructure.

3.4 Groundwater Quality

The State (IEPA) publishes groundwater quality standards[4] and defines Class I groundwater as a non-degradable resource, which is to be highly protected. The water that is located in or near the dolomite aquifer 50 to 70 feet below ground surface of Fermilab is Class I groundwater according to criteria published by the State.[5] Water in the overlying till has been demonstrated to be Class II water and therefore has less stringent standards.

Four background monitoring wells in locations upgradient to Fermilab operations continued to be utilized to obtain representative samples of the upper Class I groundwaters for either chemical and/or radiochemical analysis. Ten wells at the Central Utility Building (CUB) Tile Field, four at the Meson and Neutrino Experimental Areas, and seven at Meson Hill were sampled as part of ongoing RCRA Facility Investigation (RFI) Corrective Actions at these sites. Over forty piezometers were used to gather information on the direction of groundwater flow sitewide. The information collected will be used in modeling the transport of potential contaminants. Piezometers that had been installed as part of the NuMI site characterization were monitored to assist the Lab in planning for groundwater protection at that facility. Fermilab continues to analyze groundwater issues associated with this project that involves construction within the dolomite aquifer. To date, the investigation of impacts on groundwater from the NuMI construction has shown no adverse effects on the potentiometric surface of groundwater in the Class I resource beyond the localized area of the construction.

Thirty-three of one hundred-four-onsite groundwater monitoring locations were sampled during the year for radionuclide or chemical parameters. The remainder were available for water level monitoring.

3.4.1 Groundwater Characterizations

No new characterizations were conducted during CY2002.

3.4.2 Monitoring Well Modification and Abandonment Activities

No new monitoring wells were installed or modifications or abandonments performed on existing monitoring wells during CY2002.

3.4.3 Radionuclides

The Department of Energy groundwater concentration guide and the Illinois Class I groundwater standard for tritium is 20 pCi/ml. Radionuclides were not detected in any samples taken during CY2002 in Class I groundwater.

3.4.4 Chemicals

Two rounds of groundwater samples were collected in CY2002 at several Solid Waste Management Units (SWMUs) under our RCRA RFI. (See Section 4.12.1 RFI Activities.)

4.0 Compliance with Specific Environmental Regulations

Below is a summary of Fermilab compliance with key environmental regulations.

4.1 Clean Air Act

Open burn permits to allow prairie/land management burning, maintenance of Meson Hill and fire extinguisher training were renewed by the IEPA in 2002. The annual air emissions report for CY2002 was submitted to the IEPA in April 2003 and the annual radionuclide emissions report was submitted to the USEPA in June 2003.

An estimated 26.1 Curies were released in conjunction with the operation of the Fermilab Anti-Proton Areas stack in CY2002; no Fixed Target experiments were conducted during the year. The Magnet Debonding Oven, a potential source of tritium was used to burn 4 magnets, 3 of which were radioactive, in 2002. The CAP-88PC2 dispersion model calculated the maximum dose equivalent delivered to a member of the public (at the boundary of the lab) to be 0.00804 mrem/year due to CY2002 Fermilab operations. This was a slight increase from the CY2001 calculated maximum dose equivalent of 0.00607 mrem/year; this resulted from increased beam intensities as the Main Injector ring was brought into operation. The collective effective dose equivalent for CY2002 was estimated to be 25.2 person-rem.

Fermilab is registered with the Clean Fuel Fleet Program (CFFP); one of several programs the IEPA has implemented to help improve air quality in the Chicago ozone non-attainment area.

4.2 Underground Storage Tanks

No compliance issues were identified in CY2002. The two Underground storage tanks (USTs) in use at the Fermilab Site 38 Fuel Dispensing Facility continued to be maintained and operated per current UST standards prescribed by the USEPA (40 CFR 280.80) and the Illinois State Fire Marshall.

4.3 The Endangered Species Act of 1973

No compliance issues were identified in CY2002.

4.4 Executive Order 11988, "Floodplain Management"

No compliance issues were identified in CY2002.

4.5 Clean Water Act Section 404 (and Executive Order 11990, "Protection of Wetlands")

Pre-evaluation of Fermilab activities in wetlands continued to be accomplished through the NEPA review process and construction design reviews. The Lab continues to use task manager training to instruct participants how to ensure that potential work areas are screened for the presence of wetlands and to be aware of all aspects of environmental compliance management.

4.6 Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)

In CY2002, the use of pesticides and herbicides at Fermilab was handled in accordance with FIFRA.

4.7 Illinois Department of Natural Resources "Rules for Construction and Maintenance of Dams"

Fermilab personnel inspected the permitted Fermilab Main Injector Class III Dam (the FMI berm) in April 2002 to ascertain that the dam was being maintained in accordance with the maintenance plan associated with the permit. The Main Injector berm is permitted by the Illinois Department of Natural Resources as a small Class III dam. The need for some minor remedial actions and routine maintenance was discovered and actions were taken. There were no compliance issues identified. The annual report was submitted to the State on time.

4.8 The Migratory Bird Treaty Act

There were no compliance issues identified in CY2002.

4.9 National Environmental Policy Act (NEPA)

Fermilab met the requirements of this Act by continuing to implement a program of reviewing all activities for compliance as set forth in the Fermilab Environment, Safety and Health Manual Chapter 8060. In 2002, a new Generic Routine Maintenance Categorical Exclusion (CX) was applied for and approved by the DOE; this CX covers several of the Lab's routine activities, in which environmental impact is realized to be minimal. DOE approved ten projects for Fermilab as being categorically excluded (CXs) from further review in CY2002.

4.10 National Historic Preservation Act (NHPA), Archaeological Resources Protection Act, Native American Graves Protection and Repatriation Act (NAGPRA) of 1990

Compliance with these Acts was accomplished through the NEPA review process that included an evaluation of all proposed land-disturbing projects in CY2002 to assess any potential impacts on historic resources. No compliance issues were identified in CY2002.

Additionally, a DOE requested Cultural Resources Management Plan (CRMP), following guidelines outlined in DOE Publication DOE/EH-0501, was prepared for Fermilab. The CRMP assures continued compliance with the above listed Acts by providing a comprehensive overview for the locations and status of all archaeological resources within

the Fermilab site boundaries thereby facilitating future NEPA reviews. The CRMP was completed in September 2002.

4.11 National Pollutant Discharge Elimination System (NPDES)

CUB continued throughout 2002 to operate within the conditions of a NPDES permit, to pretreat demineralizer regenerant waste that was reissued in August 2000. Also, the MiniBooNE project continued to be covered under a NPDES General Permit. In addition, a NPDES General Permit for Non-Coal Mines regulated discharges from the NuMI construction project.

In 2002, the site wide NPDES permit was modified to address operational changes at the CUB related to upgrades to the cooling towers. The new cooling system at the CUB changed the characteristics of the resultant effluent from this process. See 3.3.2.1 for further discussion

4.12 Resource Conservation and Recovery Act of 1976 (RCRA)

On 6/06/2002, the USEPA conducted its annual RCRA inspection of Fermilab's Hazardous Waste program. This included a review of waste manifests, annual reports, training records, the contingency plan, the closure plans, and the Part B permit and operating records. Satellite waste accumulation areas and the Hazardous Waste Storage Facility were visited. No deficiencies were cited.

The Annual Hazardous Waste and Illinois Generator Non-Hazardous Special Waste Reports for CY2002 were submitted to the DOE Fermi Area Office in January and February 2003 respectively. DOE subsequently submitted these reports to IEPA.

The following volumes of non-radioactive waste were generated by Fermilab and managed for disposal by the Hazard Control Technology (HCT) Team of the Safety and Environmental Protection Group in the 2002 Fiscal Year.

378.3 m^3	Non-Routine Hazardous Waste (RCRA + TSCA)
1.9 m^3	Routine Hazardous Waste (RCRA + TSCA)
53.4 m^3	Non-Routine Non-Hazardous (Special) Waste
32.1 m^3	Routine Non-Hazardous (Special) Waste
9,670.7 m^3	Dumpster/Landfill Waste

4.12.1 RFI Activities

As a condition of the Lab's RCRA Part B permit, the IEPA required Fermilab to undertake a RCRA Facility Investigation (RFI). The purpose of the RFI was to investigate whether hazardous constituents had been released to the environment from identified solid waste management units (SWMUs) located onsite. In addition to requiring the reporting of newly identified SWMUs, RCRA also required that IEPA be notified of any changes to previously identified SWMUs. A total of three SWMUs are still being addressed in accordance with the corrective action requirements of Fermilab's RCRA permit: the CUB Pipe and Clay Tile Field, the Meson and Neutrino Experimental Areas, and the Meson Hill Landfill. Further investigation is not required at the Village Machine Shop and the Railhead Storage Yard, so long as institutional controls remain in place.

Village Machine Shop (SWMU# 5)

No information was requested or generated at this unit during CY2002.

CUB Tile Field (SWMU# 12)

The CUB Tile Field has previously been removed along with all chromate-contaminated soil and gravel. The soil was properly disposed and the surrounding soil sampled and analyzed. Fermilab continues to monitor all of the CUB Tile Field wells. Monitoring wells at SWMU 12 were sampled during the 2nd, and 4th quarters. Wells MWS1, MWS2, MWS3 and MWD1 indicated chloride levels above the Class II standard in CY2002. MWBD4 showed levels of lead slightly above the Class I standard during the second quarter in CY2002.

Meson Hill (SWMU# 13)

Closure activities for Meson Hill were completed in 1998. This included moving concrete, grading, installing a clay cap, placing topsoil on the clay cap, hydroseeding the top of the hill, and a site inspection. Fermilab continues sampling of all monitoring wells at this unit. Monitoring wells at SWMU 13 were sampled during the 2nd, and 4th quarters. Statistical analyses confirmed that the concentrations of total dissolved sulfates in samples from monitoring wells G101, G102, G103, G104, G105 and G106 have exceeded the 99% confidence level. Concentrations of total dissolved sulfate in monitoring wells G101 and G105 have also exceeded the Class II groundwater standard.

Due to the elevated concentrations of sulfates recorded in monitoring wells at SWMU 13, an updated notification of a "significant change in groundwater quality" was sent to the IEPA. An Assessment Monitoring Plan was developed, reviewed and accepted by the IEPA in CY2001, and implemented and reported to the IEPA during CY2002. The plan was developed to determine the source of the increase, concentrations and extent sulfate migration, and assess any potential threat to human health and the environment. Results from the study indicated natural conditions were the source of the detected sulfate concentrations. A directive was received from the IEPA in CY2002 to submit a post-closure plan modification to install a new background well. The plan was developed and sent to the IEPA.

During December 2001, a small portion of the northern slope at SWMU 13 failed causing a limited amount of material to slide to the base of the slope. Remedial measures were taken during CY2002 to reestablish the slope and vegetate the surface.

Railhead Storage Yard (SWMU #14)

No information was requested or generated at this unit during CY2002.

Meson Neutrino (SWMU #15)

Fermilab continues to sample four monitoring wells at this unit on a quarterly schedule for accelerator-produced radionuclides. The results of samples from the Class I groundwater along with flow directions in the upper dolomite are reported annually to IEPA.

4.13 Safe Drinking Water Act

Fermilab provides drinking water to its employees through two Fermilab-operated public water supplies and a satellite supply connected to the City of Warrenville public water supply. Full jurisdiction for Fermilab's public water supplies was transferred from the Illinois Environmental Protection Agency (IEPA) to the Illinois Department of Public Health (IDPH) in 1996. Initially, this involved an IDPH review of our existing monitoring program, which determined that our program was compliant with their regulations.

During CY2002, water samples were collected and analyzed for required parameters and at the prescribed frequencies in compliance with United States Environmental Protection Agency (USEPA) Regulations and the Drinking Water Systems Code adopted by the Illinois Department of Public Health. All results were acceptable and met requirements.

Also during CY2002, a Utility Corridor Project was completed from CDF to D-Zero. Domestic water is now delivered from the main site water supply to several of the buildings along Eola Road, including the D-Zero complex. The local site-specific domestic water wells were sealed.

4.14 SARA TITLE III or Emergency Planning and Community Right-To-Know Act of 1986 (EPCRA)

Under these regulations Fermilab is required to provide the EPA, State, and local officials with an annual accounting of hazardous, toxic, and extremely hazardous chemicals used or stored onsite in quantities greater than a given threshold. Fermilab filed a Toxic Chemical Release Inventory Report (TRI) for CY2002 with the USEPA and IEPA in June 2003. The only toxic chemical processed or used at Fermilab at threshold activity levels defined by SARA Title III Section 313 was copper. As required by Section 312 of SARA Title III, Fermilab also submitted a Tier II Emergency and Hazardous Chemical Inventory (CY2002) to State and local emergency services and disaster agencies in February 2003.

4.15 Oil Spill Prevention

Oil inventory at Fermilab consists of numerous oil-filled electrical transformers ranging in volume from 4 gallons to 17,300 gallons. There are no above ground oil storage tanks at Fermilab. The total volume of oil in transformers onsite is estimated to be about 250,000 gallons. Potential onsite oil spill sources are located such that surface water discharge spillways can be effectively used to prevent any oil spills from leaving the site and entering regulatory defined *state waters*. The only exception is the transformer at Giese Road (1695 gallons) near Indian Creek. This transformer was previously located downstream of the Indian Creek outfall to *state waters*. Even though the outfall has been moved to a location further downstream in Indian Creek, this transformer still has the potential to spill into regulated waters because there is no in-stream mechanism to prevent a discharge from making it to *waters of the state*. As an added precaution, the Giese Road transformer and others onsite utilize secondary containment. In accordance with 40 CFR 110-112, Fermilab maintains a Spill Prevention Control and Countermeasures plan (SPCC) for the Giese Road transformer; this plan is periodically reviewed and revised as necessary.

4.16 Toxic Substance Control Act (TSCA)

Fermilab conducted a PCB-related spill prevention activity in 2002. Twenty-four transformers from the old Main Ring that were removed from service as a result of the PCB cleanup work last year were stored at Site 55. The units were poor candidates for reuse due to their age and unusual secondary voltage and they posed a potential spill source if left in storage. In addition, sampling of the transformers revealed that two had experienced enough leaching of PCBs from their windings since their last retrofill and sampling that they had reverted to PCB-contaminated status. Therefore, in October the oil was drained from these transformers and sent off site for detoxification or fuel blending. The transformer carcasses were then shipped off site for decontamination and scrap metal reclamation.

4.17 Pollution Prevention and Waste Minimization

There were numerous activities conducted throughout the Lab in 2002 to prevent pollution and minimize waste. Highlights of these activities are summarized below.

Waste Minimization

Fermilab installed a new compressed natural gas (CNG) vehicle refueling station costing $128,000 this year. The Lab's motor pool fleet currently has twenty-six bi-fuel gasoline/natural gas vehicles that can now utilize natural gas, which is cleaner burning and cheaper than gasoline, as an alternative fuel source. Reduction of gasoline

consumption is anticipated at 18,000 gallons annually; this reduction is projected to save the Lab approximately $10,000 per year.

The volume of low-level radioactive metals was reduced by torch cutting out only those areas from large pieces that were contaminated. This process reduced the amount of low-level radioactive metal waste by 30.6 cubic meters (240 metric tons). Using a hydraulic press reduced the volume of metal waste pipe by an additional 17.5 cubic meters.

The Beams Division developed a new standardized procedure to flush oxide deposits out of large accelerator magnets in a way that eliminates the need to release large amounts of rinse water to surface water ponds. This change in procedure reduces both the amount of wastewater discharged to the sanitary system and the amount discharged to surface water.

Fermilab's Housing Office implemented a way to deal with discarded bicycles left behind by departed residents from the Village. Usable bikes were collected, repaired, cleaned up and then loaned out (for a small deposit) to current housing residents that need transportation around the Fermilab site. The loaner bike program provides visiting researchers an alternative way to get around that prevents fossil fuel use. It also reuses bikes that otherwise would have been disposed.

Smaller scale waste minimization/pollution prevention solutions included the following. Storage cribbing (for storing excess radioactive materials awaiting reuse or disposal) made from recycled plastics was purchased this year. Not only is it more durable but also reduced the potential for metal pieces that flake off to become imbedded in the wood fibers of the formerly used wood cribbing. The Computing Division recycled over seven thousand outdated magnetic tapes, which avoided 1.7 metric tons of waste and generated $10,500 from salvage. In addition, the Beams Division's ES&H group began a pilot program that replaced conventional alkaline batteries with rechargeable batteries in small portable equipment (mainly flashlights and pagers).

Restoration and Reuse

Under the Restoration and Reuse (R&R) program, Meson West in the Fixed Target Area was cleaned out for future use; recovery of materials during this operation was highly successful. Approximately 4,100 metric tons of material composed primarily of concrete, steel and lead shielding was removed. Of that amount 1,050 metric tons was specifically earmarked for other uses on site or to be recycled. The remainder of the recovered material was placed in the Railhead for future use. Approximately 81 metric tons of obsolete material was disposed as low-level radioactive waste. Also under the R&R program, the PC4 experimental hall was converted into long-term storage space. Many of the components of the experimental apparatus were found to be reusable by either Fermilab or other DOE facilities.

5.0 Conclusion

The operations at Fermilab during CY2002 had no significant adverse impact on the environment or on public safety.

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[1] Details of the Fermilab Environmental Monitoring Program (FEMP) can be found on the ES&H home page.

[2] Supporting data are available upon request from the Fermilab ES&H Section.

[3] Fermilab Annual Ecological Land Management Plan for calendar year 2002.

[4] 35 IAC 620

[5] 35 IAC 620.210