4.0 Environmental Management Practices

PGDP operations have resulted in the release of a variety of contaminants into the environment through stack and diffuse air emissions; discharges through sewers into lagoons, local ditches, and streams; accidental releases; and past waste disposal practices such as the burial of low-level and hazardous waste.

The primary mission of the Plant involved the enrichment of uranium to support defense and commercial nuclear industries. The uranium used in the Plant was obtained both from commercial industries and from the recycle of reactor tails through separating irradiated fuel and targets. These reactor tails contained trace levels of transuranic and fission products, which were introduced into the enrichment system and the resulting waste materials. Uranium was the largest contributor to environmental contamination. Because uranium was a valued commodity, uranium releases and transfers were minimized from the start of Plant operations in 1952. A variety of chemicals were used directly in the feed production and enrichment processes, or used to in support operations such as cooling water treatment and cleaning.

Requirements relating to the release of chemical and radionuclides into the environment were limited in the early years of Plant operations. AEC established allowable limits for the release of radionuclides into the environment, but Federal and state agencies had few restrictions on discharge and disposal activities until the late 1960s. Releases from U.S. industrial operations during the 1950s and 1960s, including those at Paducah, were significant. Past PGDP operations resulted in a significant environmental degradation in the vicinity of the Plant due to the accumulation and transport of contaminants associated with past disposal and spill sites as well as release and migration of contaminants to local streams and groundwater. DOE submitted a RCRA Part B permit on February 8, 1985; this permit and a RCRA Hazardous and Solid Waste Amendments permit were effective on August 19, 1991. In May 1994, PGDP was listed on the National Priorities under CERCLA, and in February 1998, and DOE, EPA, and the Commonwealth of Kentucky entered into a Federal Facility Agreement for environmental remediation. On February 20, 1992, DOE and EPA entered into the Uranium Enrichment Federal Facility Compliance Agreement that regulating PCB removal and disposal at PGDP. Site remediation of environmental contamination is currently estimated to cost 1 to 2 billion dollars, and it will take more than 20 years to complete.

4.1 Waste Management

- *Solid Waste Disposal*
- *Hazardous Waste Management*
- *Radioactive Waste Management*

Construction and operations at PGDP generated a wide variety of waste and scrap materials beginning in the early 1950s. An integrated waste management program did not

ENVIRONMENTAL MANAGEMENT PRACTICES

- ***Waste Management***
- ***Management and Disposal of Scrap and Surplus Materials***
- ***Liquid Effluents***
- ***Atmospheric Releases of Radioactivity and Fluorine***

begin at the Plant until the early 1980s. Before the establishment of this integrated program, each organization at the Plant disposed of its own waste. The Maintenance Department provided support by operating a number of common disposal sites.

Former and current workers provided information regarding past waste disposal practices at the site. Former workers recounted past disposal practices that involved discarding waste materials at locations around the site. With few exceptions, these locations correspond to past landfills, scrap yards, lagoons, and spill sites that have been identified as SWMUs as part of the current cleanup program. Several other possible disposal locations were identified to site management for their evaluation.

The formation of an integrated program began in response to a December 1978 report by the site Environmental Control Department on disposal of solid waste (including radioactive and hazardous waste). This report stated that the Plant was not meeting current and planned solid waste regulations. In addition to the recommendations for better management of existing facilities and the need for additional facilities, the report recommended that specific individuals be made responsible for operation, maintenance, record-keeping, and planning of solid waste storage and disposal areas. The resulting organization, the MTM Department, implemented the integrated waste management program by gaining control of the waste management facilities and developing waste management procedures for the Plant.

Solid Waste Disposal

During construction of the original Plant, the prime contractor established an inert disposal site for construction rubble north of the Plant. Over time, this site continued to be used for disposing of construction materials. As the Plant became operational and generated hazardous and radioactive waste materials, contaminated materials were introduced into this disposal site, including contaminated roofing material and concrete, asbestos, and chemically treated wood from the cooling towers. On the southwest side of the Plant, a borrow pit was used to dispose of ash from the Plant's coal-fired steam plant, which was subsequently designated as the C-746-K landfill.

Over time, these two sites apparently evolved into landfills not requiring permits according to Commonwealth of Kentucky regulations; the Maintenance Department operated the landfills. The limit established during early site operations for radioactive material in these areas was 2 pounds of uranium per ton; however, no records of sampling were located to demonstrate compliance with this limit. For depleted uranium, the limit would correspond to a volumetric concentration of approximately 333 pCi/g or 670 pCi/g for natural uranium. Records from the 1960s and 1970s indicated that floor sweepings were disposed of at these landfills. Since process materials, including green salt and yellowcake, were routinely present in large quantities on floors and equipment in some buildings, it is clear that these radioactive materials, in much higher concentrations than allowed, were inappropriately sent to these landfills.

Site Posting - 1999

Within the Plant's security fence in the northwest corner, a 30-foot-high ramp and pit arrangement, known as the teepee, was used to burn combustible waste. As an aid to combustion, waste oils were added; however, these oils were not controlled and they were likely contaminated with solvents and PCBs. This operation continued until December 1, 1967, when air control regulations for open burning at disposal sites required termination. At that time, these waste streams were sent to the coal ash disposal site.

Although landfills were on government property and patrolled by Plant security, the public could access these areas. Some members of the public routinely retrieved scrap wood and others used construction items from the inert disposal site, starting during Plant construction and continuing into the 1970s. At the 746-K landfill, for example, redwood with brass bolts from the cooling towers and used wood paneling from Plant offices attracted salvaging from the public and possibly workers. Limited controls had been established on disposal of material from the cascade and other process and

operations buildings in order to keep highly contaminated items from going to the landfill. However, when surveillances were conducted at the landfill in later years, such items would occasionally be identified, indicating weaknesses in the implementation of management controls.

Maintenance workers operated these disposal sites during the day, implementing verbal guidance from their supervisors. These workers used bulldozers and other heavy equipment to compact and dress the working areas. Since their equipment did not have closed cabs, the workers were exposed to both unconfined asbestos and ash from the coal-fired steam plant. As the Plant's heavy equipment operators, these workers also hauled construction rubble to both the landfills and the inert disposal areas around the Plant, including parts of what is now the Kentucky Wildlife Area. Concrete rubble and debris, some with radioactive contamination, was sent offsite to areas in the former KOW, a fact that was known due to environmental investigations conducted under the Federal Facility Agreement and predecessor environmental regulations and confirmed by the team through visual inspection and walkover radiological surveys. The limited space available for disposal within the Plant security fence probably affected the decision to discard these materials on the KOW.

In the early 1980s, additional controls were implemented at the landfills. These controls eventually included controlled access to the landfills, waste acceptance criteria, record keeping, and licensing both the landfill and the operators with the Commonwealth of Kentucky. Controls were also applied to waste generators. Segregated dumpsters for both non-hazardous and radioactive wastes were acquired, and procedures and guidance on acceptable disposal practices in the Plant's sanitary landfills were established.

Biodegradation Site - 1999

Hazardous Waste Management

Hazardous waste regulations did not emerge in the United States until the early 1980s. In response to these regulations, the newly created MTM Department began to aggressively address hazardous waste disposal practices by identifying and controlling these practices. As an example, a discontinued attempt to use biodegradation for waste oil treatment left a legacy of drums containing not only used oil but also waste solvents. The practice had involved disking waste oil into the soil along with nutrients to allow microbial biodegradation. Although the practice had ceased, generators continued to bring drums of waste liquids to the site. The MTM Department, as one of its first actions, worked with generators to identify other disposal options and characterize the drums already at the biodegradation site. This approach was repeated for other disposal sites across the Plant.

The existing waste streams in numerous disposal sites were evaluated by the MTM Department to determine the generators, who were then contacted to determine the process that produced the waste. Disposal options were explored that would be in compliance with emerging new requirements under RCRA. In addition, MTM Department personnel began to develop standard practice procedures for waste management, assigning responsibility for implementing pollution control programs to the generators with support from several organizations, including the MTM and Environmental Control Departments. Plant Services was responsible for operating the disposal facilities and recording waste transactions. As an example of tightening controls, the blanket request for disposal used before 1983 was cancelled and a "request for disposal" form was required for each waste pickup.

Concurrent with these activities, the MTM and Environmental Control Departments began working with regulators to obtain permits for storage, treatment, and disposal facilities at the Plant. These facilities ranged from the C-400 gold dissolver precipitation system to the C-410 neutralization pit. As hazardous waste streams were identified and brought under control, storage needs were met by using several existing locations for storing all types of materials and waste. Subsequently, these facilities were permitted under the Commonwealth of Kentucky RCRA authority, with the RCRA Part A permit submitted on February 8, 1985, and the RCRA Part B permit effective on August 19, 1991.

Wastes were characterized only to determine compatible storage requirements; this characterization was not sufficient to ensure long-term storage and satisfy

final disposal acceptance criteria. In 1987, for example, 840 ash receivers from the 1977 shutdown of the feed plant that were stored in C-746B, a radioactive waste storage facility, were determined to also be hazardous under RCRA. Therefore, this facility became a non-permitted RCRA storage facility until the ash receivers could be overpacked and moved to a permitted RCRA facility. The limited degree of characterization has resulted in storage problems and a need for very large recharacterization efforts at the Plant, as discussed in the Office of Oversight Phase I investigation report.

Oversight for hazardous waste activities also increased from being a subset of landfill reviews to being focused inspections. In the 1970s, OR conducted annual appraisals of the C-746-K landfill and of water and air pollution control facilities at the Plant. These appraisals increased in scope and duration in the 1980s, with a section specifically focused on hazardous waste management practices. In addition, external regulators began inspecting RCRA facilities and operations in the 1980s. Generally, these appraisals and inspections praised the waste management programs. However, problems were identified, including Notices of Violation in 1985 for not performing detailed chemical and physical analysis, and concerns about contingency planning with local authorities and incomplete contingency plans. A Notice of Violation was issued in 1986 for routine disposal of sludge determined to be hazardous in the C-404 facility, which had not been permitted for hazardous waste. Conversely, the Plant also conducted evaluations to determine whether private disposal sites were adequately operated and capable of disposing of Plant waste in accordance with applicable environmental regulations.

Radioactive Waste Management

Radioactive waste management has been evolving since the 1950s. In April 1953, efforts were initiated to reduce the spread of contamination by using drums designed for disposal in work locations known for generating highly contaminated waste. Operating logs in C-340 from 1958 discuss using a supply of scrap drums from the holding pond for packaging black oxide rather than putting the oxide in dumpsters. Actions to segregate these wastes from the Plant's other waste streams resulted in establishing radioactive disposal sites. Although several small sites were used for special disposal activities, including contaminated aluminum and a modine trap, the Plant had three main radioactive disposal sites:

- C-749 Uranium Burial Ground. Used from 1957 to 1977, this site primarily contained pyrophoric uranium metal in the form of saw dust, shavings, and turnings covered in oil. The total amount of uranium placed in this site is approximately 540,000 pounds.

- C-340 Drum and Contaminated Burial Area. Used from the late 1950s until the mid-1970s, this area received C-340 uranium powder scrap. In the 1950s, 50 to75 drums were emptied into a pit 10 feet by 20 feet, and 7 feet deep. In the 1970s, two more 7-foot-deep pits were used for disposal of contaminated metals and equipment.

- C-404 Solid Radioactive Waste Disposal Area. This was the primary disposal site for radioactive waste at the Plant. This area was constructed as a holding pond for C-400 liquid waste, but in early 1957, it was converted to a solid waste disposal area. The pond was 380 by 140 feet, with 6-foot-high dikes. By 1977, approximately 6,400,000 pounds of uranium had been drummed and placed in the holding area. Waste streams included incinerator ash, contaminated alumina, highly contaminated roofing waste, and gold recovery sludge. This area continued in use into the mid-1980s. Subsequently, this area was determined to contain sludge that was also hazardous, thus requiring closure under RCRA in 1987.

After the formation of the MTM Department, radioactive waste disposal on site rapidly decreased. In 1978 and 1979, the amount of disposal was 330,690 pounds per year; in the 1980s, the average was 18,000 pounds per year. As a result of not burying radioactive waste on site and restrictions for offsite disposal, the site experienced a large buildup of contaminated waste and scrap, as discussed in the Office of Oversight Phase I investigation report.

4.2 Management and Disposal of Scrap and Surplus Materials

Large volumes of scrap metal and surplus materials were generated during construction, maintenance, and facility upgrade activities at PGDP. These materials were either managed as waste for disposal or stored and managed as a commodity for resale. Much of the material was contaminated, and large volumes have been