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U.S. NUCLEAR REGULATORY COMMISSION

REPORT TO CONGRESS

ON THE HEALTH, SAFETY,

AND ENVIRONMENTAL CONDITIONS AT THE

GASEOUS DIFFUSION PLANTS

LOCATED NEAR

PADUCAH, KENTUCKY,

AND PORTSMOUTH, OHIO

October 1, 2008, to September 30, 2013

EXECUTIVE SUMMARY

This report is provided to Congress as required by Section 1701 of the Atomic Energy Act (AEA). This is the fifth report issued on the health, safety, and environmental conditions of the gaseous diffusion uranium enrichment plants (GDPs) near Paducah, Kentucky, and Portsmouth, Ohio. It covers the 5-year period from October 1, 2008, to September 30, 2013. The information reported herein is current as of September 30, 2013, unless otherwise specified. As directed by the AEA, the staff of the U.S. Nuclear Regulatory Commission (NRC) consulted with the U.S. Department of Energy (DOE) and the U.S. Environmental Protection Agency (EPA) in preparing this report. DOE continues to be responsible for regulatory oversight of portions of the Paducah Gaseous Diffusion Plants (GDP). The Portsmouth GDP certificate of compliance was terminated and the leased facilities returned to DOE. Except for activities related to the American Centrifuge Lead Cascade Facility (Lead Cascade) and the American Centrifuge Plant (ACP), the DOE is fully responsible for the regulatory oversight of most of the Portsmouth plant. DOE also maintains the oversight of other non-enrichment activities in non-leased portions of both sites.

The Federal Reports Elimination Act of 1998 amended Section 1701 of the AEA to decrease the frequency of this report to Congress on the status of health, safety, and environmental conditions at the GDPs, from annually to a report required not later than the date on which a certificate of compliance is issued by the NRC. Certificates of compliance (CoC) for each of the GDPs must be re-applied for at least every 5 years. The current Title 10 of the *Code of Federal Regulations* (10 CFR) Part 76 certificates for the Paducah and the Portsmouth GDPs were issued on December 31, 2008.

The Paducah GDP certificate is set to expire December 31, 2013. The United States Enrichment Corporation (USEC) filed an application for certificate renewal with the NRC on April 2, 2013. The NRC is not currently conducting the review of the certificate renewal application since USEC permanently ceased enrichment operations in June 2013, and plans to terminate this certificate in 2014. USEC expects to return the Paducah GDP leased facilities back to DOE in 2014.

The Portsmouth GDP certificate was terminated on October 12, 2011, following the NRC's review and approval of USEC's request to terminate certified activities at the plant. Following return of the leased buildings to DOE and certificate termination, the DOE began major decontamination and decommissioning activities in most of the Portsmouth GDP buildings, except for those currently leased to USEC Inc. for the Lead Cascade and the ACP.

During this reporting period, USEC, as a privatized entity, generally met NRC regulatory requirements. The Paducah and Portsmouth GDPs had continuously provided adequate protection of public health, safety, safeguards, security, and the environment. Offsite radiological doses, as well as doses to the workers, are very low, and within regulatory limits. From October 1, 2008, until its de-certification, there were no significant events requiring activation of the Emergency Operations Center (EOC) at the Portsmouth GDP. However, on January 14, 2009, in accordance with plant procedures, the Paducah GDP EOC was activated for an Unclassified Emergency. The Unclassified Emergency was a result of a significant leak of cooling water in a feed facility. The leak did not involve a radiation release and, therefore, there were no radiological impacts. The Paducah EOC was also activated for an alert (i.e., events may occur, are in progress, or have occurred that could lead to a release of radioactive material[s] but that the release is not expected to require a response by an offsite response

organization to protect persons offsite) on July 27, 2011. The alert was due to a release of a non-radioactive toxic gas due to equipment failure. No events have resulted in a significant release of radioactive material at either site.

The NRC conducted the most recent review of USEC's performance at the Paducah GDP covering the period between January 1, 2011 and December 31, 2012. The NRC's review determined that the Paducah GDP continued to conduct its activities safely and securely, while protecting public health, and the environment, and that there were no areas needing improvement. A review of USEC's performance at the Portsmouth GDP, covering the period between July 6, 2008, and July 10, 2010, was also conducted. The review The NRC's review determined that the Portsmouth GDP continued to conduct its activities safely and securely, while protecting public health, and the environment, and that there were no areas needing improvement. The Portsmouth GDP certificate was terminated by the NRC on October 12, 2011.

Although the certificate of compliance for the Portsmouth GDP site was terminated in 2011, USEC (Inc.) continues to develop its replacement technology involving gas centrifuges at this site. The prototype for this technology is the Lead Cascade. The purpose of the Lead Cascade is to test and evaluate centrifuge enrichment technology for commercial use. The NRC received USEC Inc.'s license application for the Lead Cascade on February 11, 2003. After conducting detailed safety, security, and environmental reviews, the NRC issued Materials License SNM-7003 to USEC Inc. for the Lead Cascade on February 24, 2004. USEC Inc. began to operate the Lead Cascade in August of 2006.

On August 23, 2004, USEC Inc. submitted a license application for the ACP. Following its review of the application, the NRC issued Materials License SNM-2011 for the construction of the ACP. Construction activities for the ACP at the Portsmouth GDP site began in 2007. During the summer of 2008, USEC submitted an application to DOE's loan guarantee program to fund and complete the construction of the ACP. However, due to technical and financial issues identified during the review of USEC Inc.'s application, in August 2009, following a USEC Inc. and DOE agreement to defer DOE's final resolution on USEC Inc.'s application, construction activities of the ACP were halted.

USEC is the U.S. executive agent for the Megatons to Megawatts nuclear non-proliferation program, which implements the 1993 agreement between the United States and the Russian Federation, which expires on December 31, 2013. During calendar years (CYs) 2011 through 2012, the Paducah GDP operated between 900 and 1750 megawatts, and produced over 10 million separative work units (SWU) at record efficiency. Until enrichment operations were ended in 2013, the Paducah GDP was the leading supplier of uranium fuel for the commercial nuclear power plants and the only GDP operating within the United States.

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CHAPTER 1

BACKGROUND

ENERGY POLICY ACT

In October 1992, Congress enacted the Energy Policy Act (EPAct) of 1992, which amended the Atomic Energy Act of 1954 (AEA), to create the United States Enrichment Corporation (USEC).¹ Provisions of the AEA direct the U.S. Department of Energy (DOE) to lease the gaseous diffusion plants (GDPs) near Paducah, Kentucky, and Portsmouth, Ohio, to USEC. These GDPs produced enriched uranium. Although the AEA, as amended, established the Corporation as a Government entity, it also required that within 2 years after the transition date of July 1, 1993, the Corporation prepare a plan for transferring ownership of the Corporation to private investors. On July 28, 1998, the Corporation was privatized through an initial public offering. In the *Lease Agreement Between The United States Department of Energy and The United States Enrichment Corporation* (hereafter referred to as the Lease) dated July 1, 1993, and in other subsequent agreements, DOE and USEC established the roles and responsibilities for each organization at both GDPs. The AEA also requires the U.S. Nuclear Regulatory Commission (NRC) to report to Congress on the status of health, safety, and environmental conditions at the GDPs. The Federal Reports Elimination Act of 1998 (Public Law 105-363) was signed into law in November 1998. This bill amended Section 1701(b)(1) of the AEA to require the NRC to report to Congress “not later than the date on which a certificate of compliance is issued” instead of “at least annually.” This is the fifth of such reports. It encompasses the 5-year period from October 1, 2008, through September 30, 2013, unless otherwise stated.

The AEA assigns safety, safeguards, and security regulatory responsibility to the NRC for enrichment operations at the GDPs. Further, the AEA required that within 2 years of the date of the passage of the EPAct, the NRC established, by regulation, both (1) safety, safeguards, and security standards for the GDPs and (2) a certification process to ensure that USEC complies with these standards. This certification process is in lieu of any requirement for a license. Thus, the AEA made the NRC regulation of the GDPs conditional on the issuance of new regulations, which were to be promulgated by October 1994. In accordance with these requirements, the NRC promulgated Title 10 of the *Code of Federal Regulations*, Part 76, “Certification of Gaseous Diffusion Plants,” 10 CFR) in September 1994.

The EPAct changes to the AEA provided for the possibility that USEC might not initially be able to comply with the safety, safeguards, and security standards established by the NRC. To address this contingency, the AEA permitted the NRC to approve continued USEC operation of the GDPs if the NRC approved DOE-prepared plans for bringing the GDPs into compliance with any unsatisfied provisions of the DOE regulations. On November 26, 1996, the NRC issued certificates of compliance certifying the USEC’s operation of the GDPs in accordance with 10 CFR Part 76 and approved a compliance plan for each GDP for achieving compliance with the NRC regulations for those areas not in full compliance. After an interim period allowing for USEC to transition to the NRC regulation in an orderly manner, the NRC began regulatory oversight of USEC’s operations on March 3, 1997. In the fall of 2003, all compliance plan issues associated with the initial certification were completed. The NRC has continued

¹ A listing of abbreviations and acronyms can be found in Appendix A.

regulatory oversight of USEC's operation of the Paducah GDP for the entire period covered by this report and the Portsmouth GDP until its certificate termination in October 2011.

NRC AND DOE INTERFACE AND RESPONSIBILITIES

The AEA does not require that DOE lease the entire GDP sites to USEC. For example, those areas containing legacy material from operations under DOE that are not required to support current enrichment activities are excluded from the Lease. Consequently, DOE retains responsibility and regulatory oversight for the environmental protection, safety, safeguards, and security for those portions of the GDP sites that are not leased to USEC.

While the DOE regulatory oversight is limited to only the areas within the GDP sites that are not leased to USEC, the DOE provides and regulate the Federal arming and arrest authority and the security forces exercise at the GDPs. The AEA further assigns responsibility to DOE for the payment of any costs of decontamination and decommissioning, response actions, or corrective actions that are related to conditions existing before USEC leased the GDPs.

Decommissioning activities ongoing at the Portsmouth GDP require a significant commitment by DOE. It is estimated that it may take 35 years or more to decommission 10 million square feet (ft²) of floor space and complete the remediation of contaminated soils and groundwater. The project will require an annual average employment of 1,000 workers. With this assignment, DOE retains responsibility for environmental restoration activities and legacy² waste management at the GDP sites and for the operation of facilities used for the storage of DOE-owned special nuclear and source material, such as the cylinder storage yards that contain depleted Uranium Hexafluoride (UF₆) generated before July 1993, and surplus uranium material in interim storage at the Portsmouth GDP. DOE and USEC have entered into several agreements by which DOE has assumed responsibility for virtually all depleted UF₆ at the two GDP sites. A list of agreements between USEC and DOE related to depleted uranium management and disposition is included in Appendix C of this report.

In December 1993, the NRC and DOE approved a "Joint Statement of Understanding between the Nuclear Regulatory Commission and the Department of Energy on Implementing the Energy Policy Act Provisions on the Regulation of Gaseous Diffusion Uranium Enrichment Plants." This joint statement established the areas of responsibility between the NRC and DOE. In August 1994, the NRC and DOE approved an "Agreement Establishing Guidance for the NRC Inspection Activities at the Paducah and Portsmouth Gaseous Diffusion Plants between Department of Energy Regulatory Oversight Manager and Nuclear Regulatory Commission." This agreement supplemented the joint statement by defining in more detail the role of the NRC observers at the GDPs in the interim period during which DOE exercised public health and safety and common defense and security regulatory oversight of the leased GDPs.

In October 1994, the NRC and DOE signed an agreement providing for the conduct of inspection activities at the GDPs. It defined the way DOE and the NRC would cooperate to facilitate obtaining information and knowledge regarding the GDPs and USEC's operation thereof, through routine and special inspection activities, during the interim before the NRC took regulatory control of the facility.

² The term "legacy" refers to items that are a carryover from the period before DOE leased the facilities to USEC (e.g., legacy waste and legacy equipment).

In March 1995, the NRC and DOE established the “Agreement Defining Security Responsibilities at the Paducah and Portsmouth Gaseous Diffusion Plants between the Department of Energy Office of Safeguards and Security and the Nuclear Regulatory Commission.” This agreement also supplements the joint statement by defining in greater detail the security roles and responsibilities of DOE and the NRC after NRC assumption of regulatory oversight of USEC activities.

In October 1997, the NRC and DOE signed a memorandum of understanding (MOU) entitled “Memorandum of Understanding between the Department of Energy and the Nuclear Regulatory Commission - Cooperation Regarding the Gaseous Diffusion Plants.” This MOU defines the responsibilities of DOE and the NRC regarding continuing cooperation at the GDPs after NRC assumption of regulatory oversight for USEC activities. The MOU also clarifies the framework for coordination regarding issues that may involve DOE and NRC areas of responsibility. In addition to the recognition of these continuing DOE responsibilities, DOE and the NRC (1) agreed to exchange information and technical support, (2) defined responsibilities for emergency response, and (3) agreed that the manner in which issues identified during an inspection by either agency would be resolved would be the August 1994 “Agreement Establishing Guidance for NRC Inspection Activities at the Paducah and Portsmouth Gaseous Diffusion Plants Between Department of Energy Regulatory Oversight Manager and Nuclear Regulatory Commission.”

In January 2001, the NRC and DOE signed a joint procedure (JP) entitled “Response to Emergencies in the Leased Areas at the Gaseous Diffusion Plants.” The JP provides that the NRC would be the lead Federal agency (LFA) for responding to emergencies in areas leased to USEC, unless it were later determined that DOE or another agency should be the LFA. The JP also provides for continuous exchange of information between DOE and the NRC concerning emergencies and for coordination of any response actions.

In 2004, DOE and the NRC entered into an MOU pertaining to the USEC Inc. Lead Cascade facility, leased from DOE at its GDP site near Portsmouth, Ohio. The purpose of the Lead Cascade is to test and evaluate centrifuge enrichment technology for commercial use. The purpose of the MOU was to delineate the respective roles and responsibilities of DOE and the NRC in the transition of regulatory oversight of the Lead Cascade and its facilities, to ensure adequate oversight, and to avoid dual regulation. Also in 2004, USEC Inc. notified the NRC that it intended to construct and operate a commercial enrichment facility at the Portsmouth GDP site, to be known as the American Centrifuge Plant (ACP). On April 13, 2007, DOE and the NRC entered into an MOU addressing the ACP, for the same general purposes as the earlier MOU for the Lead Cascade. Under this MOU, the NRC is solely responsible for activities that affect the safe operation of the ACP for compliance with NRC requirements. DOE retains responsibility for granting access to certain data related to the technology, as well as for DOE information security requirements that exceed or are not addressed by NRC security requirements. In addition, DOE continues to be solely responsible for, among other things, Export Controlled Information, personnel access authorization programs, and Foreign Ownership, Control, or Influence review for ACP activities.

In December 2007, DOE and USEC formally agreed to “Supplemental Agreement Number 1 to the Lease Agreement between the United States Department of Energy and the United States Enrichment Corporation.” This supplemental agreement allows for the long-term leasing of the gas centrifuge enrichment plant (GCEP) facilities.

Upon USEC's Certificate of Compliance (CoC) termination on October 12, 2011, for the Portsmouth GDP, all regulation of activities at this site has been conducted by DOE. NRC continues to exercise regulatory authority over the USEC Inc. Lead Cascade and ACP under its 10 CFR Part 70 licenses, as described above.

Through these aforementioned agreements, statements, formal MOUs, and other cooperative NRC and DOE efforts, the agencies have continued to coordinate activities of interest to both DOE and the NRC.

CHAPTER 2

GASEOUS DIFFUSION PLANT OPERATIONS

The principal process that the NRC regulates at the GDPs is the production of enriched uranium (EU) for reactor fuel. The GDPs receive UF_6 , enrich it (i.e., process the material to increase the concentration of fissionable uranium-235 [^{235}U]), and then ship the enriched UF_6 to other fuel cycle facilities, where it is processed into fuel assemblies for use in nuclear power reactors. In the gaseous diffusion separation process, UF_6 gas passes through a material (barrier) with small pores that are large enough to permit the transfer or diffusion of single molecules but are too small to permit bulk flow of the gas. The gas that emerges from the pores has a slightly higher concentration of ^{235}U atoms than the gas that does not pass through the barrier. This process creates two streams of gas, one with a higher ^{235}U concentration (enriched) and one with a lower concentration (depleted). Because the degree of enrichment achieved by the use of a single barrier (i.e., a single diffusion stage) is very small, the process must be repeated many times, employing a cascade of many stages to achieve the required enrichment levels. The outputs of the cascade are EU product and depleted uranium (DU). The DU is stored at the GDPs, awaiting ultimate disposition.

The main components of a GDP are (1) large cylindrical vessels called diffusers that contain the barrier, (2) compressors used to compress the gas to the pressures needed to flow through the barrier tubes and from one stage to another, (3) electric motors to drive the compressors, (4) heat exchangers, and cooling systems for removing the heat of compression from the UF_6 , (5) piping for the stage and inter-stage connections, and (6) block and control valves to adjust and direct the gas flow. In addition to this process stage equipment, GDPs require (1) auxiliary systems such as the UF_6 feed and withdrawal systems, (2) an extensive electrical power distribution system, and (3) cooling towers to dissipate the waste process heat.

The major areas of NRC oversight at the GDPs include (1) plant operations, (2) nuclear criticality safety, (3) physical protection, (4) security of classified information, (5) Material Control and Accounting (MC&A), (6) radiological controls for onsite and offsite personnel, (7) waste management, (8) transportation of radiological materials, (9) maintenance and surveillance, (10) training, and (11) emergency preparedness. The NRC is responsible for (1) regulatory oversight of the design, operation, and maintenance of hardware (i.e., structures, systems, and components) relied on for safe operation, (2) operational aspects involving the human element, such as training, staffing, and adherence to procedures, and (3) management organization and controls necessary to ensure effective management oversight of facility operations. Management organization and controls include (1) policies and procedures, (2) internal reviews and audits, (3) safety review committees, (4) configuration management, (5) records management, (6) event investigation and reporting, and (7) quality assurance programs. The NRC also reviews and approves accident analyses and technical safety requirements (TSRs) developed by USEC. The accident analyses describe potential credible accidents and the facility response to those accidents to demonstrate that the facility is capable of responding in a fashion that will not jeopardize public health and safety. The TSRs define the safety envelope and operating parameters within which the facility is required to operate for safety.

The NRC ensures safe operations through issuance of CoC amendments after a thorough review of design and operational information and by field inspections conducted by specialists from both the NRC Headquarters and NRC Region II. In addition, one NRC resident inspector is located at the Paducah GDP. The resident inspector performs daily inspections covering a broad range of site activities.

In October 2012, the NRC reduced annual inspection and oversight hours for the Paducah GDP because the plant continued to operate safely for over a decade under NRC's oversight. The NRC's inspection and oversight activities have concluded that the Paducah GDP continues to implement an effective nuclear safety program, and inspection findings over the past 5 years indicate that most issues identified were of minor safety significance. Those more significant issues, typically associated with personnel performance and safety culture, have been adequately resolved, and the staff believes that the Paducah GDP has the elements of an effective corrective action program.

The GDP Lease agreement between USEC and DOE covered both the Portsmouth and Paducah GDPs and has a supplement that leases certain Portsmouth GDP facilities and property to USEC Inc. for the ACP. Although USEC no longer leases the facilities for enrichment operations at the Portsmouth GDP, the Lease for ACP operation continues and was last renewed on June 23, 2008. The renewed Lease runs for a period of 6 years, with a provision to extend for an additional 2 years, and the current expiration date is July 1, 2014.

ACTIVITIES AT THE PORTSMOUTH GDP

The GDP uranium enrichment operations at the Portsmouth GDP were discontinued in 2001, and the plant remained in cold shutdown until its certificate was terminated on October 12, 2011. As such, the NRC no longer has regulatory oversight of GDP activities at the site, except for those related to the Lead Cascade and the ACP. All GDP activities at Portsmouth have been regulated by DOE since that date.

The NRC coordinated with DOE and USEC during the certificate termination process to ensure a seamless regulatory transition of the Portsmouth GDP site to DOE. The NRC conducted a detailed review of USEC's request to terminate certified activities at the plant. Prior to certificate termination, the NRC conducted inspections at the Portsmouth GDP that addressed information security, material control and accounting and appropriate disposition of waste. Decontamination and decommissioning at the Portsmouth GDP is an ongoing project currently being performed by DOE's contractors.

ACTIVITIES AT THE PADUCAH GDP

The Paducah GDP continued to be a leading supplier of low enriched uranium (LEU) fuel for the commercial nuclear power industry until it ceased enrichment in June 2013, producing more than 5 million SWU in 2012. When the material from the Megatons to Megawatts program (described below) is included, USEC had approximately 27 percent of the worldwide market share in 2012. The plant had recently been producing in the 5-6 million SWU per year range. Operations over the past several years have been the most efficient in the past 25 years due to keeping a record number of cells in operation. USEC employs approximately 900 personnel at Paducah, but that level will decrease over the coming year as USEC's activities at the site concludes.

Paducah continues to participate in the commercially financed Government-industry partnership, Megatons to Megawatts, in which bomb-grade uranium from dismantled Russian nuclear warheads is being processed into LEU to produce fuel for nuclear power plants in the U.S. As of May 2013, 475.2 metric tons of weapons-grade (highly enriched uranium (HEU) has been down blended into 13,723 metric tons of LEU. According to USEC, this is equivalent to 19,008 nuclear warheads eliminated. This program has supplied the reactor fuel used to generate nearly 10 percent of U.S. electricity since 1995.

CHAPTER 3

STATUS OF COMPLIANCE PLAN ACTIVITIES

The AEA, as amended, permitted the NRC to authorize operation of the GDPs in the case where the plants do not fully comply with NRC regulations, provided that DOE prepared and NRC approved a plan (i.e., a compliance plan) for bringing the plants into compliance. In November 1996, the NRC approved compliance plans for each plant.

As documented in the 2003-2008 report to Congress, USEC completed all actions required by the compliance plans as of September 2003. The completion was confirmed by NRC inspection, and the non-compliance issues were addressed and closed.

CHAPTER 4

HEALTH, SAFETY, AND ENVIRONMENTAL STATUS

The NRC has responsibility to ensure that the health and safety of the public and the workers at the GDPs are protected from hazards involving radioactive material and radiation. NRC regulation 10 CFR 76.60, "Regulatory Requirements Which Apply," requires USEC to comply with applicable sections of 10 CFR Part 20, "Standards for Protection Against Radiation." Health, safety, and environmental (HS&E) conditions are reflected in radiation doses received by workers and in radioactive effluents. This chapter contains information relating to the HS&E conditions for the leased areas of the GDPs under NRC regulatory oversight. DOE was contacted in the preparation of this report, and the input from DOE is included as Appendix B.

The Paducah and the Portsmouth GDPs monitor air and water emissions to the environment, and maintains environmental dosimeters to monitor gamma radiation levels onsite and offsite. The most recent data from the environmental dosimeters show that ambient gamma exposure levels at the site boundaries for both GDPs are very small and well within regulatory limits. Maximum annual doses to the nearest offsite individuals from exposure to radioactive effluents from USEC operations (DOE operations are discussed below), for CYs 2008 through 2012, are calculated to be no more than 1.5×10^{-4} millisievert (mSv) [(0.0148 millirem (mrem))] at the Paducah GDP and 5.1×10^{-4} mSv [0.051 mrem] at the Portsmouth GDP. These values are far below the NRC regulatory limit of 1 mSv/year (100 mrem/year) for members of the public, as specified in 10 CFR Part 20. Table 4-1 provides the maximum offsite individual doses for CYs 2008 through 2012 for both GDPs.

Table 4-1
Maximum Offsite Individual Dose, Paducah and Portsmouth, 2008-2012^a

Calendar Year	Paducah Maximum Offsite Dose, mSv/yr (mrem/yr) ^b Airborne Emissions	Portsmouth Maximum Offsite Dose, mSv/yr (mrem/yr) Airborne Emissions
2008	8.2×10^{-5} (0.0082)	5.3×10^{-5} (0.0053)
2009	1.2×10^{-4} (0.0118)	6.9×10^{-5} (0.0069)
2010	1.5×10^{-4} (0.0148)	5.1×10^{-4} (0.051)
2011	4.0×10^{-5} (0.0040)	N/A
2012	4.7×10^{-5} (0.0047)	N/A

^a Data for 2013 will be provided in the National Emissions Standards for Hazardous Air Pollutants (NESHAP) report in mid-2014. Information on radiation doses for 2013 are to be provided through the NRC's Radiation Exposure Information and Reporting System (REIRS) in 2014.

^b Sv—Sievert; rem—röntgen equivalent man

Exposure to the public is not limited to USEC operations. DOE also continues to conduct operations at both Paducah and Portsmouth. Table 4-2 shows the maximum collective doses from all plant effluents (covering both USEC and DOE operations), to the population, within an 80-kilometer (km) (50-mile [mi]) radius, for both Paducah and Portsmouth, for CYs 2008-2013. These exposures are also very low.

Table 4-2
Collective 80-km (50-mi) Population Doses, Paducah and Portsmouth, 2008-2012*

Calendar Year	Paducah Collective 80-km (50-mi) Population Dose, person-Sv (person-rem)	Portsmouth Collective 80-km (50-mi) Population Dose, person-Sv (person-rem)
2008	6.0×10^{-4} (0.06)	1.0×10^{-3} (0.10)
2009	8.0×10^{-4} (0.08)	1.4×10^{-3} (0.14)
2010	1.3×10^{-3} (0.13)	8.1×10^{-3} (0.81)
2011	3.0×10^{-4} (0.03)	N/A
2012	4.0×10^{-4} (0.04)	N/A

* Information on radiation doses for 2013 are to be provided through the NRC's Radiation Exposure Information and Reporting System (REIRS) in 2014.

Both the maximum individual and collective population doses have been very low, and the major variation is attributable to the two dominating effects of non-routine releases and the conservative manner in which these releases are estimated.

Collective occupational and maximum individual occupational radiation dose for USEC employees for both plants for CYs 2008-2013 are provided in Table 4-3.

Table 4-3
Collective and Maximum Individual Occupational Dose,
Paducah and Portsmouth, 2008-2012*

Calendar Year	Paducah		Portsmouth	
	Collective Occupational Dose, person-Sv (person-rem)	Maximum Individual Occupational Dose, mSv (mrem)	Collective Occupational Dose, person-Sv (person-rem)	Maximum Individual Occupational Dose mSv (mrem)
2008	6.6×10^{-2} (6.600)	2.94×10^{-3} (.294)	Not available	Not available
2009	5.9×10^{-2} (5.883)	2.77×10^{-3} (.277)	Not available	Not available
2010	8.2×10^{-2} (8.205)	2.30×10^{-3} (.230)	Not available	Not available
2011	7.0×10^{-2} (6.956)	1.96×10^{-3} (.196)	Not available	Not available
2012	7.4×10^{-2} (7.432)	2.60×10^{-3} (.260)	N/A	N/A

* Information on radiation doses for 2013 are to be provided through the NRC's Radiation Exposure Information and Reporting System (REIRS) in 2014.

The radiation exposures data indicate that, for this reporting period, individual worker exposures at both GDPs did not exceed 5 mSv (500 mrem), which is the administrative control level the plants use. These values are within the historical ranges for the sites and well within the NRC regulatory limit of 50 mSv/year (5000 mrem/year) specified in 10 CFR Part 20 for workers. There were no instances where the 10 CFR Part 20 individual limits for workers, including the 10 milligrams (0.000353 ounce) intake of soluble uranium per week, were exceeded.

During the period from 2008 to 2013, safety improvements made at the Paducah GDP included the following:

- USEC Radiation Work Permit violations continued to trend downward due to improved radiological worker ownership, human performance improvement initiatives, and programmatic enforcement by line management through both walk-around and self-assessments.
- USEC continues to successfully minimize the spread of contamination and occupational uptake through the use of engineered controls such as negative ventilation and containment systems.

Since the end of the last reporting period (2003-2008), there was a reduction in personnel exposures to radiation doses to at Portsmouth. This is primarily due to USEC's completion of the Technetium Removal Project and safety improvements that included:

- Focus on minimization of internal exposure during uranium recovery projects

- Transfer of approximately 100 radioactive sources for disposal during 2009-2010 in an effort to reduce the quantity of sources on site
- Working to reduce the number and size of radioactive materials storage areas
- Continued focus on Self Evaluation to strengthen Radiation Protection Program which included:
 - Management by Walking Around
 - Procedural Adherence Surveillances
 - Boundary Inspections
 - Organization Self-Assessments
 - Publishing a series of Open Line articles detailing site requirements for contamination control and radiation protection

CHAPTER 5

CERTIFICATION ACTIVITIES

The regulation in 10 CFR 76.45, "Application for Amendment of Certificate," describes the process for amending the certificates to cover new or modified activities. The NRC may also impose additional requirements by issuing Orders and/or adding conditions to the CoC.

AMENDMENTS TO THE PORTSMOUTH GDP CERTIFICATE

During the past 5 years, USEC has requested, and was granted, 4 amendments to its certificate of compliance for the Portsmouth GDP. The requests were generally administrative in nature but were required because they modified a licensing document such as a TSR. In addition, these were necessary to facilitate future de-lease of the facilities to the DOE.

The CoC for the Portsmouth GDP was terminated on October 12, 2011, following NRC's review of USEC's request to terminate the certificate. Since that date, all GDP-related activities at the Portsmouth GDP have been regulated by DOE.

AMENDMENTS TO THE PADUCAH GDP CERTIFICATE

During the past 5 years, USEC has requested, and was granted, 13 amendments to its CoC. Most of the requests were administrative in nature but were required because they modified a licensing document such as a TSR. One amendment was required to allow USEC to recover UF₆ feed material from cylinders that did not have a certified volume or water weight as required in American National Standards Institute (ANSI) standard N14.1 and that were designed and fabricated before the standard was initially issued. Another amendment was required to support a DOE aerial radiation survey.

INTERIM COMPENSATORY MEASURES

On June 17, 2002, in response to the terrorist attacks of September 11, 2001, and the intelligence information subsequently obtained, the NRC issued orders to USEC that modified its CoC to impose certain interim safeguards and security measures. USEC implemented all these compensatory measures for both GDPs, and the NRC confirmed their implementation by inspection. Since the original orders were issued, the measures were modified several times. Several changes were made at the request of USEC, because of changing conditions, and several were requested by the NRC staff. However, each modification was reviewed to ensure that both the capability and readiness of the GDPs to respond to a threat were maintained and enhanced. The NRC continued to inspect and ensure that the Paducah GDP maintained security and safeguards of their facility and personnel.

ORDERS ISSUED TO THE PADUCAH GDP IN THE PAST 5 YEARS

NRC Order EA-06-140, dated August 13, 2009, is a confirmatory order that applied only to the Paducah GDP and was issued to address specific commitments made by USEC associated with employee protection training. The Order was discussed during an alternative dispute resolution session and, subject to satisfactory completion of the commitments, the NRC did not pursue further enforcement action on this issue.

NRC Order EA-08-280, dated August 18, 2009, is a confirmatory order that applied only to the Paducah GDP and was issued to address specific commitments made by USEC associated with mailing of classified information. The Order was discussed during an alternative dispute resolution session and, subject to satisfactory completion of the commitments, the NRC did not pursue further enforcement action on this issue.

NRC Order EA-08-344, dated August 18, 2009, is a confirmatory order that applied only to the Paducah GDP and was issued to address specific commitments made by USEC associated with willful misconduct by certain employees. The Order was discussed during an alternative dispute resolution session and, subject to satisfactory completion of the commitments, the NRC did not pursue further enforcement action on this issue.

NRC Order EA-11-056, dated August 17, 2011, is a confirmatory order that applied only to the Paducah GDP and was issued to address specific commitments made by USEC associated with willful misconduct by an operator. The Order was discussed during an alternative dispute resolution session and, subject to satisfactory completion of the commitments, the NRC did not pursue further enforcement action on this issue.

ORDERS ISSUED TO THE PORTSMOUTH GDP IN THE PAST 5 YEARS

There were no Orders issued to the Portsmouth GDP during the period from October 1, 2008, until its certificate was terminated on October 12, 2011.

RECERTIFICATION OF THE PADUCAH GDP

USEC submitted to the NRC its application for renewal of the Paducah GDP CoC on April 2, 2013. USEC's renewal application relied on existing documentation. USEC did not request any changes to the application in the renewal request. The NRC staff performed an acceptance review of the renewal application and found it acceptable for docketing. Therefore, the NRC published a Notice in the *Federal Register* (78 FR 30342) on May 24, 2013, acknowledging the receipt of the application and providing an opportunity for public comment.

In a letter dated June 3, 2013, in accordance with 10 CFR 76.66(b), USEC notified the NRC of its decision to terminate its uranium enrichment operations at the Paducah GDP. Total shut down of enrichment activities at the plant was completed on July 25, 2013. USEC stated that it plans to continue managing its inventory of NRC-regulated material, and conduct clean-up related activities under its existing certificate, before returning the Paducah GDP facilities to DOE in 2014. Once USEC has completed these activities, it will request termination of the Paducah GDP CoC.

As a result of USEC's decision to terminate enrichment activities at the plant and its intention to return the leased facilities to DOE, the NRC suspended the review of USEC's certificate renewal application. In accordance with NRC's regulations, if a sufficient application for a CoC is timely filed, the existing certificate does not expire until a final determination on the application is made by the NRC. Therefore, USEC's activities at the Paducah GDP will continue to be governed by the existing certificate until its termination. The NRC will continue to monitor USEC's security and control of nuclear material, decontamination, decommissioning, and waste disposal until the certificate of compliance is terminated and the regulatory responsibility is appropriately transferred to the DOE.

TERMINATION OF THE CERTIFICATE FOR THE PORTSMOUTH GDP

By letter dated March 15, 2011, USEC notified the NRC of its intention to terminate operations and other activities authorized under the CoC. In this letter, USEC provided a description of its proposed actions to de-lease the remaining facilities at the Portsmouth GDP, and terminate operations under the certificate. Subsequently, by letter dated June 28, 2011, USEC requested the termination of the certificate.

The NRC staff reviewed USEC's submittals and determined that a sufficient basis existed to terminate the certificate. As such, after confirmation from USEC and DOE that the leased facilities and all NRC-regulated material and classified matter had been transferred to DOE, and confirmation that all applicable regulatory requirements were met, on October 12, 2011, the NRC terminated the CoC for the Portsmouth GDP.

CHAPTER 6

INSPECTIONS

Subparts F and G of 10 CFR Part 76, 10 CFR 76.70, 10 CFR 76.72, 10 CFR Part 95, and 10 CFR Part 2 address NRC inspections of the GDPs, violations of NRC regulations, and civil penalties. These regulations implement NRC authority to take enforcement action for violations of the AEA, NRC regulations, or conditions of a certificate, compliance plan, or Order. Further, these regulations state that the NRC may impose civil penalties for certain violations of NRC regulations.

Violations identified during NRC inspections are classified into one of four severity levels, with Severity Level (SL) I assigned to the most significant violations, and SL IV being assigned to the least significant. Additionally, there are violations characterized as “non-cited” violations (NCV) which are identified and promptly corrected by the licensee. They are considered non-recurring SL IV violations, corrected without NRC involvement, and not subject to formal enforcement action. Finally, there are other violations of minor safety or environmental significance that are below SL IV. These violations must meet certain criteria and are not subjected to formal enforcement action.

Escalated enforcement actions include SL I, II, and III Notice of Violations (NOVs); NOVs associated with an inspection finding that could be evaluated as having low to moderate or greater safety significance; civil penalties; NOVs to individuals; Orders to modify, suspend, or revoke NRC licenses or the authority to engage in NRC-licensed activities; and Orders issued to impose civil penalties. Non-escalated enforcement actions include NOVs that are dispositioned by the NRC as SL IV or minor violations. More information about the NRC’s enforcement policy is provided on the NRC web site at <http://www.nrc.gov/about-nrc/regulatory/enforcement.html>.

During the 5-year reporting period from October 1, 2008, to September 30, 2013 (until October 12, 2011, for the Portsmouth GDP), the NRC performed a total of 42 inspections, at the Paducah GDP and 21 at the Portsmouth GDP, totaling 12,186.6 inspection-hours. These inspections included the activities of two resident inspectors at the Paducah GDP and inspections performed by inspectors from the NRC’s Region II and the Headquarters’ offices (at both GDPs). As listed in the table below, the number of inspections represents the number of inspection reports issued during the fiscal year (FY). For the Paducah GDP, each report describes the completion of multiple inspection procedures of various disciplines by the resident inspectors, regional inspectors, and/or Headquarters staff. For the Portsmouth GDP, each report describes the completion of multiple inspection procedures of various disciplines by regional inspectors and/or Headquarters staff. The number of inspections and the number of inspection hours are detailed in Table 6-1. It should be noted that, due to the termination of its certificate in FY 2011, there were no inspections in FYs 2012 and 2013 at the Portsmouth GDP. The reductions in inspections and inspection hours at the Paducah GDP for FY2013 were due to the initial elimination of one resident inspector as a result of continued implementation of an effective nuclear safety program, inspection findings over the past 5 years with minor safety significance, and the subsequent elimination of the remaining resident inspector and adjustment of inspection hours after the discontinuation of enrichment activities at the plant.

Table 6-1
Number of Inspections and Inspection-Hours
Spent per Fiscal Year

Fiscal Year	Paducah		Portsmouth	
	Number of Inspections	Number of Inspection-Hours	Number of Inspections	Number of Inspection-Hours
2009	8	2,312.3	7	228.7
2010	9	2,148.8	9	407.3
2011	10	2,954.7	5	153.6
2012	10	2,880.7	0	0
2013	7	1,734	0	0
Total	44	12,030.5	21	789.6

These inspections were focused on the following areas of (1) plant operations; (2) plant maintenance; (3) plant support; (4) engineering; (5) fire safety; (6) chemical process safety; (7) nuclear criticality safety; (8) material control and accounting; (9) security of classified information; and (10) physical security. One significant violation was identified as detailed below.

ESCALATED ENFORCEMENT VIOLATIONS AT THE PADUCAH GDP

There were no escalated enforcement actions issued to the Paducah GDP for the time period from October 1, 2008 to September 30, 2013.

ESCALATED ENFORCEMENT VIOLATIONS AT THE PORTSMOUTH GDP

In 2009, a SL III violation was issued to the Portsmouth GDP for moving a cylinder containing liquid uranium hexafluoride to a storage pad with mobile equipment instead of an approved crane. The NRC considered whether credit should be warranted for corrective actions in accordance with the civil penalty assessment process in Section VI.C.2 of the NRC's Enforcement Policy. After further evaluation, and in accordance with the NRC's Enforcement Policy, the NRC decided to warrant credit for USEC's corrective action and did not recommend a civil penalty since the implemented corrective action would be effective to prevent recurrence of a similar incident and since USEC had not been the subject of escalated enforcement within the previous two years.

OTHER VIOLATIONS AT PADUCAH AND PORTSMOUTH

Table 6-2 illustrates the total number of violations in each FY covered by the reporting period. A brief description of the violations follows.

Table 6-2
 Number of Violations Identified per FY 2009–2013

	Paducah	Portsmouth
FY	Number of Violations	Number of Violations
2009	0	2
2010	1	0
2011	3	0
2012	3	0
2013	1	0
Total	8	2

For the Paducah GDP, a SL IV violation was identified in Fiscal Year 2010 due to facility staff performing safety functions in excess of the work hour limits. The violations issued to the Paducah GDP in FY 2011 included one involving the failure to correctly label critical equipment, which created a significant safety hazard. The second violation was associated with the failure to use the double contingency principle, as described in the Safety Analysis Report (SAR), for the design and operation of the crawl space above the C-310 Product Withdrawal room. The third violation involved the failure to make a required 24-hour report following an unplanned contamination event. These were all SL IV violations. The violations issued in FY 2012 included three SL IV violations. One violation involved crane operators failing to follow procedures when conducting overhead crane operations while handling, and in the area of, liquid-filled uranium hexafluoride cylinders. The second violation involved the failure to maintain information that was not complete and accurate in all material respects. The third violation involved the failure to maintain one leg of the double contingency, as described in the SAR. One SL IV violation was issued to the Paducah GDP in FY 2013, and it involved the failure to follow an operational procedure which resulted in a release of UF₆ to the environment.

For the Portsmouth GDP, two violations were identified in the areas of plant operations and material control and accounting activities. These included the SL III violation described above involving the movement of a cylinder containing liquid UF₆ utilizing a mobile device other than an approved overhead crane or scale cart, and a SL IV violation for failure to perform verification audits of controlled items at the specified frequencies stated in the Fundamental Nuclear Materials Control Plan.

For each of the violations described in this section, USEC took immediate corrective actions to bring the facilities back into compliance with NRC regulations and implemented comprehensive corrective action plans to prevent recurrence.

CHAPTER 7

EVENT REPORTS

The regulation in 10 CFR 76.120, "Reporting Requirements," describes the requirements for reporting certain events to the NRC. The regulations specify events that must be reported to the NRC within three different time limits and describe the contents and schedule for submitting written follow-up reports. First, USEC is required to report any criticality event, loss of special nuclear material, or emergency conditions that have been declared an Alert or Site Area Emergency, to the NRC Operations Center, within 1 hour after discovery. Second, events that prevent immediate protective actions necessary to avoid releases or exposures to radiation or radioactive materials that could exceed regulatory limits must be reported to the NRC Operations Center within 4 hours after discovery. The third reporting requirement specifies that (1) certain contamination events, (2) failure of certain TSRs - required safety equipment with no backup equipment available, (3) fires or explosions that damage radioactive material or containers holding radioactive material, and (4) events that require offsite medical treatment of a contaminated person, must be reported to the NRC Operations Center within 24 hours. USEC reports losses and compromises or possible compromises of classified information or materials as required by 10 CFR 95.57, "Reports." Also, USEC reports any loss of contingency for Nuclear Criticality Safety (NCS) as required by NRC Bulletin 91-01, "Reporting Loss of Criticality Safety Controls," dated October 18, 1991. Although not required by 10 CFR Part 76, USEC reports safety system actuations and notifications made to other State and Federal agencies. DOE has a separate event reporting system for DOE-regulated operations, and DOE statistics are not included in this summary.

During this reporting period, there were a total of 29 reportable events at the Paducah GDP. There were also three reportable events at the Portsmouth GDP. A summary of event reports for those that occurred between October 1, 2008, and September 30, 2013, is provided below.

EVENT NOTIFICATION SUMMARY FOR THE PADUCAH GDP

The Paducah GDP reported a total of 39 events during this period. Of these, 10 events were retracted by USEC as not meeting the reporting criteria. Therefore, USEC reported a total of 29 NRC-reportable events during the reporting period. The causes for these events, as reported by USEC, included defective or inadequate procedures (3.4%); design, manufacturing, or installation error (7%); failure to follow procedure or wrong procedure used (3.4%); equipment failure (7%); defective or failed parts (41%); management deficiency (14%); human error (17.2%); no cause reported (7%).

There were instances in which safety equipment required to be available and operable, or to function as designed, failed or was discovered not in a ready-to-use condition. The Paducah GDP reported 11 events of this kind, which were mainly related to autoclaves, UF₆ release-detection systems, a defect affecting a basic component that is subject to licensing requirements, Criticality Accident Alarm System, and fire protection equipment failures. Autoclave-related events consisted of failures of autoclave subsystems. Events related to UF₆ release detection systems mainly consisted of detector head failures, control power loss, or inadvertent actuations of the alarm system. There were also events reported for instances in which fire protection equipment was declared inoperable. These incidents were mainly caused by corrosion, water leaks, or potential frozen conditions from ambient temperatures.

The Paducah GDP reported staffing their Emergency Response Center on January 14, 2009, in accordance with plant procedures, when operators saw a white cloud at one of the autoclaves' buildings and fled that area. The Paducah GDP staff later found that the white cloud was a steam and water vapor mixture that resulted from a recirculating cooling water leak that was wetting steam pipes under the concrete floor of the facility. There were no radiological impacts associated with this event.

A total of 6 events were reported at the Paducah GDP under NRC Bulletin 91-01, which requires reporting to the NRC any loss or degradation of NCS controls. For these events, the safety significance was minimal because of the maintenance of at least one of the two controls normally required.

EVENT NOTIFICATION SUMMARY FOR THE PORTSMOUTH GDP

During the period of October 1, 2008 up to the time of certificate termination on October 2011, the Portsmouth GDP reported three events. These included an alert on July 16, 2009, due to a fire lasting more than 15 minutes at the DOE portion of the site, a spill of approximately 25 liters of enriched uranyl nitrate hexahydrate due to an incorrect replacement of a plug in a valve, and a release of radioactively contaminated material to an offsite location were a contractor's staff performing work at the GDP was housed. The Portsmouth GDP did not report any events under NRC Bulletin 91-01.

CHAPTER 8

REGULATORY ACTIVITIES

RULEMAKING ACTIVITIES

There were no significant GDP rulemaking activities during this reporting period.

EMERGENCY PREPAREDNESS EXERCISES

Under the requirements of 10 CFR 76.91, "Emergency Planning," USEC must conduct biennial onsite exercises at both GDPs to test response to simulated emergencies. Participation of offsite response organizations, although recommended, is not required. In addition to the exercises, inspections of the emergency preparedness program at the GDPs were conducted annually. Emergency preparedness exercises were conducted at both plants from October 1, 2008, to September 30, 2013, and the most recent are discussed below.

PADUCAH GDP EXERCISES

The NRC staff from the Region II office conducted an inspection of a Paducah GDP biennial emergency response exercise conducted in September 2010. The inspectors determined that the exercise objectives and scenario adequately and thoroughly exercised major elements of the emergency plan. The inspectors concluded that the scenario was realistic and posed multiple challenges to the certificate holder and to off-site response agencies and determined that the Incident Commander (IC) and other responding personnel performed in a manner that would have protected the workers' safety and resulted in appropriate response to the scenario. The inspectors observed that the IC and the field staff, along with personnel in the Emergency Operations Center (EOC), were successful in managing a large number of verbal and written communications. The general emergency response by the EOC management and staff was successful in appropriately addressing the declared Emergency Action Level created by the stipulated scenario. The EOC properly evaluated emergency conditions and appropriately recommended protective actions. Personnel performed emergency classification and external notifications according to procedural requirements. The inspectors observed several critiques and concluded that they were effective in identifying exercise issues and suggestions for improvements. In addition, the inspectors reviewed the Paducah GDP's tracking system for emergency exercise findings (Emergency Management Lessons Learned and the Assessment Tracking Report) and found that personnel were adequately implementing corrective actions to address previous findings.

The NRC staff from the Region II office also conducted an inspection of a second Paducah GDP biennial emergency response exercise in September 2012. This was a "full participation" exercise involving not only the NRC (both Headquarters and Region II) but also local, State, and Federal agencies with responsibilities at the Paducah GDP. The inspectors determined that the exercise objectives and scenario adequately and thoroughly exercised major elements of the emergency plan. The inspectors determined that the Paducah GDP's IC and other responding personnel performed in a manner that would have protected the public and workers' safety and resulted in timely mitigation of the simulated event. Weaknesses identified from a previous exercise did not recur. However, a self-identified weakness was noted and properly documented to avoid reoccurrence. Overall, the Paducah GDP's performance in responding to the postulated accident was considered a successful demonstration, in that the emergency response program has been maintained in a state of

operational readiness and trained personnel who are familiar with procedures for implementing the emergency plan are available and capable of responding to an emergency.

PORTSMOUTH GDP EXERCISE

The NRC staff from the Region II office conducted an inspection of a biennial emergency response exercise that was conducted at the Portsmouth GDP in September 2009. The inspectors determined that the scenario developed for this exercise was challenging and provided a unique learning opportunity that adequately tested elements of the emergency response program. In addition, the inspectors determined that, overall, command and control by the IC was good and the accident assessment, event classification, and protective action recommendations were made in a timely and accurate manner. Dispatch of emergency teams was well coordinated and the EOC for the off-hours exercise was staffed and activated in a timely manner. Command and control by the Crisis Manager (CM) in the EOC was found appropriate. Notifications and other communications with off-site agencies were also timely and effective. Briefings by the CM to keep EOC personnel aware of the ongoing status of incident conditions were held at the appropriate frequency. Overall, technical issues were properly identified and resolved in a timely manner. The exercise critique was a candid assessment of the response, and numerous items were identified by the certificate holder for program improvement and entered into the problem reporting system for tracking the completion of corrective actions. The Portsmouth GDP's performance in responding to the postulated accident was considered a successful demonstration of an emergency response program maintained in a state of operational readiness with personnel who were trained and familiar with procedures for implementing the emergency plan.

NEW TECHNOLOGIES AT THE PORTSMOUTH SITE: GAS CENTRIFUGE ENRICHMENT TECHNOLOGY

Gas centrifuge technology involves the use of centrifugal forces to achieve the separation and subsequent extraction of uranium enriched in the ^{235}U isotope. Similar to the gaseous diffusion process, it employs the use of gaseous UF_6 feedstock. However, in this process, UF_6 gas is placed in a centrifuge machine, consisting of a large vertical rotating cylinder and piping to feed UF_6 and the withdrawal of enriched and depleted UF_6 streams. The cylinder is rotated at high speed to achieve separation of the heavier gas molecules (containing ^{238}U) and the lighter gas molecules (containing ^{235}U). Several hundred centrifuge machines may be connected in either a series or parallel arrangement to form a cascade to achieve the desired ^{235}U assay. It should be noted that this technology has been licensed under the provisions of 10 CFR Part 70, "Domestic Licensing of Special Nuclear Material."

On December 20, 2002, USEC Inc. signed a lease with DOE for use of centrifuge-related equipment and facilities owned by DOE for its former Gas Centrifuge Enrichment Program. USEC Inc. submitted its license application for the Lead Cascade facility on February 11, 2003. On January 27, 2004, the NRC staff issued a Notice in the *Federal Register* containing its Finding of No Significant Impact and an announcement of availability of the environmental assessment, pursuant to its regulations implementing the National Environmental Policy Act. The staff issued its safety evaluation report (SER) for the Lead Cascade facility on January 28, 2004. The staff then issued USEC Inc. a materials license (SNM-7003) on February 24, 2004, for the Lead Cascade demonstration facility.

In March 2004, the NRC and DOE entered into an MOU to foster cooperation between the two agencies regarding the USEC Inc.'s Lead Cascade facility and the ACP. On August

2006 the Lead Cascade began operations and the NRC assumed regulatory oversight of the facility from DOE, pursuant to the MOU.

On August 23, 2004, USEC Inc. submitted its license application for its commercial facility, to be known as the ACP. In May 2006, after a period that included multiple public meetings and public review and comment of its draft environmental impact statement (EIS), the NRC staff completed its environmental review of the proposed ACP and issued its final EIS. On September 11, 2006, the staff completed its safety and security reviews of the proposed ACP and issued its SER. In March 2007, the Atomic Safety and Licensing Board held its mandatory hearing and rendered its decision on April 13, 2007, authorizing the staff to issue a license for the ACP. The staff issued Materials License SNM-2011 to USEC Inc. on the same day.

USEC began construction on the ACP in May 2007. During the summer of 2008, USEC submitted an application to DOE's loan guarantee program to fund and complete the construction of the ACP. However, due to technical and financial issues identified during the review of USEC's application, in August 2009, following the USEC and DOE agreement to defer DOE's final resolution on USEC's application, construction activities of the ACP were halted.

In order to further develop the technology, the Lead Cascade is currently being operated under a Research, Development and Demonstration (RD&D) Project. This project was the result of a Cooperative Agreement with the DOE under which a 120-centrifuge cascade has been built in a commercial configuration. The period of performance is June 2012 through December 2013, with costs shared between USEC (20%) and DOE (80%). The main goals of the project, among others, are to demonstrate the reliability of the technology by eliminating technical risks and to demonstrate commercial configuration cascade's reliability and performance. It is expected that, following completion of the project, ownership of the centrifuges will be transferred back to USEC provided that it proceeds to deploy the commercial plant.

CHAPTER 9

CONSULTATION WITH THE U.S. ENVIRONMENTAL PROTECTION AGENCY AND THE U.S. DEPARTMENT OF ENERGY

The AEA, as amended requires that the NRC report to Congress, in consultation with the U.S. Environmental Protection Agency (EPA) and the DOE, on the status of health, safety, and environmental conditions at the GDPs, no later than the date on which a CoC is issued.

CONSULTATION WITH DOE

During the 5-year period of this report, DOE Portsmouth/ Paducah Project Office (PPPO) continued to discharge its regulatory and oversight responsibilities at the Paducah and Portsmouth GDPs. DOE conducted its activities in a manner to enhance and improve HS&E conditions and achieve compliance with all applicable Federal and State laws and regulations. In those instances where potential violations of these laws and regulations were identified, actions were taken to notify appropriate authorities, identify the cause, and institute corrective measures.

DOE requires an Annual Site Environmental Report (ASER) from each of the sites operating under its authority. This report presents the results from the various environmental monitoring programs and activities carried out during the year. These reports are public documents that are distributed to government regulators, businesses, special interest groups, and members of the public. The ASER for both DOE activities at the Portsmouth and Paducah GDPs can be found at: <http://www.pppo.energy.gov/annual.html>

CONSULTATION WITH EPA

THE PADUCAH GDP

On June 11, 2013, USEC held an Administrative Conference with the Kentucky Department of Enforcement's (KDOE's) representatives in Frankfort, KY in order to resolve outstanding NOV's issued to USEC over the past 5 years concerning Kentucky Pollutant Discharge Elimination System (KPDES) permit exceedances. The Kentucky Division of Water (KDOW) specifically referenced 11 NOV's that cited 16 specific exceedances of KPDES permit limits by USEC during this time frame. The exceedances cited at the conference were inclusive of those causing the 10 consecutive quarters of non-compliance.

USEC representatives presented to KDOW representatives details on each exceedance and the actions USEC had taken to mitigate the cause of the exceedances. The specific details for the exceedances are described below:

- The phosphorous exceedance in Sep 2008 was due to failure of a cooling tower windage collection lift station at C-633. The lift station pumps were repaired and USEC returned to compliance without issue since.
- Toxicity failures at Outfall 013 in Sept 2008, Oct 2008, Jul 2009, Jan 2010, and Jan 2011. The toxicity failures were due to zinc from USEC cylinders stored in the Outfall 013 drainage area. A Toxicity Reduction Evaluation (TRE) was initiated and approved by KDOW immediately after the Oct 2008 failure that mitigated zinc toxicity in 2011. All toxicity failures at Outfall 013 were related to the zinc issue and the number of

toxicity failures increased during the period due to the permit requirement to increase testing frequency from quarterly to monthly following the initial failure. All five toxicity exceedances at Outfall 013 cited in the NOV's resulted from the same issue that was being resolved in the KDOW approved TRE. There have been no toxicity failures due to zinc at Outfall 013 since the TRE actions were completed in 2011.

- Toxicity failures at Outfall 010 in 1QTR 2009, Outfall 009 in 4QTR 2009, Outfall 010 in 1QTR 2010, and Outfall 008 in 3QTR 2010 were due to pathogen interference of the toxicity test and not attributable to USEC discharges. EPA published methods for toxicity testing identifying pathogen interference as a problem in certain tests and listed techniques to minimize the potential failure due to this problem. USEC notified our contract laboratory conducting the toxicity tests to use the multiple replicate technique for the vulnerable outfalls in 4QTR 2010 at an increase in cost of \$8400/yr. There have been no failures due to pathogen interference since the multiple replicate technique was initiated.
- Toxicity failures at Outfall 002 in 1QTR 2011 and 4QTR 2011. In both cases the required re-tests did not demonstrate toxicity to tested organisms and the limited chemical analytical results available for review did not provide a toxicity source. No determination on the cause or source of either toxicity failure could be made.
- The fecal coliform exceedance (>200% above limit) at Outfall 004 in Jul 2012 was caused by wildlife or some other contamination source not attributable to USEC. Operating data from C-615 sewage treatment plant round sheets during the day of the exceedance demonstrated that the effluent from the plant was well below the permit limit and that a chlorine concentration existed in the effluent that would continue to serve as a disinfectant. The Outfall 004 sampling location is exposed to wildlife and a sodium thiosulfate feed removes the chlorine prior to the sampling location leaving it vulnerable to animal contamination.
- A total suspended solids exceedance at Outfall 006 in Jul 2012 was attributed to an algae bloom in the C-611 lagoon during a prolonged period of heat. The algae that forms in those conditions tend to have a fine floating texture that elevates suspended solids results. Suspended solids concentrations returned to normal after the algae bloom dissipated.
- A phosphorous limit exceedance at Outfall 008 in Sep 2012 was attributable to USEC operations. Phosphates added to sanitary water as a corrosion inhibitor in pipes and the phosphorous existing in the sewage treated at the C-615 Sewage Treatment Plant is the source. Normally phosphorous levels measured at Outfall 008 are well below the permit limit. No operational upset or failure could be identified as the reason for this outlier concentration. Concentrations returned to normal the following week.

At the conclusion of the exceedances discussion, KDOE representatives presented proposed corrective actions for USEC to resolve the enforcement proceedings. An official Demand for Remedial Measures and Civil Penalty letter was delivered to USEC on July 16, 2013. USEC agreed to the remedial measure terms and paid the \$6000.00 civil penalty to bring the enforcement action to a close.

THE PORTSMOUTH GDP

On May 3, 2010, the Ohio EPA (OEPA) issued an Order to USEC for violations identified by OEPA in November 2008. The violations involved USEC's non-compliance with the Ohio Administrative Code (OAC) for storing hazardous wastes in several tanks that were (1) not appropriately managed in accordance with the provisions of the OAC, (2) not appropriately labeled, and, (3) were stored for more than 90 days. The Order also requested USEC to, within 90 days of the effective date of the Order, submit to the Ohio EPA, for review and approval a Closure Plan(s) (Plan) for the hazardous waste tanks. The Order also imposed a \$ 64,150.00 fine for USEC's failure to appropriately manage the wastes. In July 2010, USEC agreed to implement corrective actions, accepted the civil penalty, and provided a draft Plan for OEPA's review and approval. On September 23, 2010, the OEPA Director approved the Plan as submitted without comment or change. USEC completed the corrective actions as depicted in the Plan and, on October 22, 2010, OEPA issued an approval letter for the completion of the Plan for the management of the wastes. Finally, on November 5, 2010, USEC issued the Termination of Obligation to OEPA to formally close out the OEPA Order.

On May 24, 2010, the U.S. EPA issued an NOV to the Portsmouth GDP as a result of RCRA non-compliances discovered during a June 2009, EPA RCRA Compliance Inspection. There were no civil penalties assessed and all findings and concerns were addressed by USEC in 2009. USEC provided closure of all cited violations by letter dated June 17, 2010.

CHAPTER 10

SUMMARY ASSESSMENT OF PERFORMANCE

During the review period, the Paducah and Portsmouth GDPs provided adequate protection of health and safety and the environment and generally operated in compliance with NRC regulatory requirements. There were no radiation-related deaths or illnesses from the use of radioactive materials and no significant radiation exposures. At both plants, offsite radiological doses, as well as doses to the workers, remained very low and well within NRC regulatory limits. Neither facility incurred a loss or diversion of certified material, nor were there any nuclear criticality events. During the assessment period, the Portsmouth plant remained in a cold-shutdown condition until October 12, 2011, when its certificate of compliance was terminated.

The Paducah and Portsmouth GDPs started enriching uranium in the 1950s. These facilities were built at a time when design standards and quality assurance standards were significantly different from current requirements, and documentation requirements were less stringent. However, DOE replaced virtually all the uranium equipment at the Paducah GDP as a result of a major upgrade project in the 1970s and 1980s. In addition, both the material condition of the plants and the design and safety bases documentation were substantially upgraded as part of the completion of compliance plan requirements in September 2003.

ASSESSMENT OF THE PADUCAH GDP PERFORMANCE

Overall performance and conduct of plant operations at the Paducah GDP were adequate. The NRC staff conducted a review of USEC's performance at Paducah covering the period from October 4, 2008, to December 31, 2010. The NRC staff evaluated USEC's performance in the areas of safety operations, radiological controls, facility support, and licensing activities. The results of the review were discussed in a public meeting held on May 24, 2011. No areas needing improvement were identified.

The NRC also conducted a review of USEC's performance at the Paducah GDP covering the period from January 1, 2011, to December 31, 2012. The NRC staff evaluated USEC's performance in the areas of safety operations, radiological controls, facility support, and other topics. The results of the review were discussed in a public meeting held on May 2, 2013. No areas needing improvement were identified.

Paducah plant maintenance and surveillance activities associated with safety-related systems, structures, and components were adequate. Reliability was demonstrated as shown in the plant personnel's handling of the cascade-related equipment during a period when the Paducah GDP operated at the highest power levels in the past 20 years.

ASSESSMENT OF THE PORTSMOUTH GDP PERFORMANCE

Overall performance at the Portsmouth GDP and conduct of plant operations were adequate. During the review period, the plant remained in a cold shutdown condition and started undertaking some remediation activities. The NRC conducted the most recent review of USEC's performance at the Portsmouth GDP covering the period from July 6, 2008, to July 10, 2010. The NRC staff evaluated USEC's performance in the areas of safety operations, radiological controls, facility support, and special topics. The results of the review were

discussed in a public meeting held on October 14, 2010. No areas needing improvement were identified.

The Portsmouth GDP's certificate was terminated on October 12, 2011. As of that date, the NRC found that USEC's performance and conduct of plant operations were adequate.

CHAPTER 11

SUMMARY OF COMPLIANCE WITH APPLICABLE NRC REGULATIONS

USEC is required to comply with all NRC regulations applicable to the GDPs, most specifically, 10 CFR Part 76. Other NRC regulations or portions thereof that apply include (1) 10 CFR Part 19, "Notices, Instructions, and Reports to Workers: Inspection and Investigations"; (2) 10 CFR Part 20, "Standards for Protection Against Radiation"; (3) 10 CFR Part 21, "Reporting of Defects and Non-compliance"; (4) 10 CFR Part 70, "Domestic Licensing of Special Nuclear Material"; (5) 10 CFR Part 71, "Packaging and Transportation of Radioactive Material"; (6) 10 CFR Part 73, "Physical Protection of Plants and Materials"; (7) 10 CFR Part 74, "Material Control and Accounting of Special Nuclear Material"; and (8) 10 CFR Part 95, "Security Facility Approval and Safeguarding of National Security Information and Restricted Data."

As described in Chapter 5 of this report, USEC filed an application for certificate renewal for the Paducah GDP with the NRC on April 2, 2013. USEC subsequently notified the NRC of the cessation of enrichment operations at the Paducah GDP and intention to terminate this certificate once the leased GDP facilities are returned to DOE. As such, the NRC suspended the review of the certificate renewal application and will not be issuing a renewed certificate of compliance for the Paducah GDP. Instead, USEC's activities at the Paducah GDP will continue to be governed by the existing certificate until its termination. The NRC will continue to monitor USEC's security and control of nuclear material, decontamination, decommissioning, and waste disposal at the Paducah GDP until its certificate is terminated and the regulatory responsibility is appropriately transferred to the DOE.

During the 5-year reporting period from October 1, 2008, to September 30, 2013, the NRC performed 63 inspections, at both Paducah and Portsmouth, totaling 12,186.6 inspection-hours. These inspections included the activities of two resident inspectors at Paducah and specialist inspections conducted by inspectors from the NRC's Region II and Headquarters offices. The inspection effort identified a total of 10 violations; however, only one was considered to be significant.³

For those instances where non-compliances with NRC regulations were identified, plant management took immediate corrective actions to bring the facility back into compliance with NRC regulations and implemented comprehensive correction action plans to prevent recurrence. In many cases, USEC also identified long-term actions to prevent recurrence.

In summary, the NRC's reviews of USEC's performance have repeatedly concluded that the operations at both of the GDPs, in addition to the remediation activities at the Portsmouth GDP, have been adequate and protective of the public health and safety and the environment, and in compliance with all applicable regulations.

³ Chapter 6 of this report gives details of this violation.

CHAPTER 12

LEAD FEDERAL AGENCY/EMERGENCY COORDINATION

DOE and the NRC agree that the NRC is the initial LFA for GDP events having actual or potential adverse impacts on safety and/or common defense and security. However, the nature of GDP events could warrant DOE or another organization becoming the LFA. In this regard, the NRC and DOE have agreed to notify each other before transfer of the LFA responsibility and confirm acknowledgment of the transfer at the time another organization assumes the LFA role. DOE and the NRC will continue information exchanges before, during, and after the transfer.

APPENDIX A

ABBREVIATIONS AND ACRONYMS

ACP	American Centrifuge Plant
AEA	Atomic Energy Act
ALARA	as low as reasonably achievable
CFR	<i>Code of Federal Regulations</i>
CWA	Clean Water Act
CY	calendar year
D&D	decontamination and decommissioning
DOE	U.S. Department of Energy
DU	depleted uranium
DUF ₆	depleted uranium hexafluoride
EIS	environmental impact statement
EOC	emergency operations center
EPA	U.S. Environmental Protection Agency
EPAct	Energy Policy Act of 1992
ETTP	(DOE's) East Tennessee Technology Park
EU	enriched uranium
FY	fiscal year
GCEP	Gaseous Centrifuge Enrichment Plant
GDP	gaseous diffusion plant
HEU	highly enriched uranium
HS&E	health, safety, and environmental
ISMS	Integrated Safety Management System
JP	joint procedure
kg	kilogram
km	kilometer
LEU	low-enriched uranium
LFA	lead Federal agency
LTLT	long-term low-temperature
MC&A	material control and accounting
mi	mile
MOU	memorandum of understanding
mrem	millirem; a measure of radiological dose
mSv	millisievert; SI (System Internationale) measure of radiological dose
NCS	nuclear criticality safety
NCV	non-cited violation
NOV	Notice of Violation
NRC	U.S. Nuclear Regulatory Commission
RCRA	Resource Conservation and Recovery Act
RD&D	Research, Development and Demonstration Project
RIIs	recordable injuries/illnesses
SGI-M	Safeguards Information Modified Handling
SSAB	site-specific advisory board
SWU	separative work unit
TSR	technical safety requirement
²³⁵ U	uranium-235
UF ₆	uranium hexafluoride
USEC	United States Enrichment Corporation

wt%

weight percent

APPENDIX B

SUMMARY OF DOE ACTIVITIES AT THE PADUCAH AND PORTSMOUTH GASEOUS DIFFUSION PLANTS

U.S. Department of Energy (DOE) activities at both the Paducah and Portsmouth gaseous diffusion uranium enrichment plants (GDPs) between October 1, 2008, and September 30, 2013, are described below.

INSPECTION AND INVESTIGATION ACTIVITIES AT PADUCAH

- Reviewed USEC's completed activities to resolve the Notice of Violation (NOV) issued as a result of the return of a Weapons Authorization Card (WAC) without the required training, and the non-cited violations (NCV) issued as a result of the incorrect application of the annual random drug testing selection process. The closure documentation provided was found to adequately resolve these violations. (FY2009)
- Reviewed USEC's completed activities to resolve the issue of an intoxicated armed on duty Security Police Officer (SPO) at the Paducah GDP. The closure documentation provided was found to adequately resolve this issue. (FY2010)
- Reviewed USEC's completed activities to resolve the NCV issued as a result of inadequate training of the Paducah GDP's SPOs on changes to the drug testing program. The closure documentation provided was found to adequately resolve the issue. (FY2013)
- Reviewed USEC's completed activities to resolve the NOV issued as a result of an unacceptable arrangement of plumbing in the drug testing program collection facility at the Paducah GDP. The closure documentation provided to date was found to adequately resolve the issue; however, further closure documentation will be reviewed at the annual inspection scheduled for the Fall of 2013. (FY2013)
- Conducted a special review of USEC's Emergency Preparedness Program and participated in a Full Participation Emergency Management exercise at the Paducah GDP. (FY2010 - FY2012)

INSPECTION AND INVESTIGATION ACTIVITIES AT PORTSMOUTH

- Performed a one hundred percent inspection of the Portsmouth GDP SPOs with WACs as a result of weaknesses identified during the DOE annual inspection. (FY2010)
- Reviewed USEC's completed activities to resolve an accidental discharge of a weapon at the Portsmouth GDP. The closure documentation provided was found to adequately resolve this issue. (FY2010)
- Conducted a special review of USEC's Emergency Preparedness Program and participated in a Full Participation Emergency Management exercises at the Portsmouth GDP. (FY2009)

- Regulated activities associated with uranium enriched to greater than or equal to 10 percent ²³⁵U assayed discovered or accessible in USEC-leased areas under the Lease Agreement/Regulatory Oversight Agreement. (FY2009 - FY2010)

OVERALL STATUS OF THE PADUCAH AND PORTSMOUTH GASEOUS DIFFUSION PLANTS

During the 5-year period of this report, DOE PPPO continued to discharge its regulatory and oversight responsibilities at the Paducah and Portsmouth GDPs. DOE conducted its activities in a manner to enhance and improve ES&H conditions and achieve compliance with all applicable Federal and State laws and regulations. In those instances where potential violations of these laws and regulations were identified, actions were taken to notify appropriate authorities, identify the cause, and institute corrective measures.

APPENDIX C

AGREEMENTS BETWEEN DOE AND USEC RELATED TO DEPLETED URANIUM MANAGEMENT AND DISPOSITION AT PADUCAH AND PORTSMOUTH

- The "Memorandum of Agreement Between the United States Department of Energy and the United States Enrichment Corporation Relating to Depleted Uranium," dated June 30, 1998, the "Agreement Between the U.S. Department of Energy ("DOE") and USEC Inc. ("USEC")," dated June 17, 2002, the "Cooperative Agreement Between Department of Energy and USEC Inc. Concerning the American Centrifuge Demonstration Project," dated March 23, 2010, the contract between DOE and USEC for DOE acquisition of SWU, dated March 13, 2012, and the "Cooperative Agreement Between Department of Energy and USEC, Inc. and American Centrifuge Demonstration, LLC Concerning the American Centrifuge Cascade Demonstration Test Program", dated June 12, 2012.
- The "Memorandum of Agreement Between the United States Department of Energy and the United States Enrichment Corporation Relating to Depleted Uranium," dated June 30, 1998 provided for the transfer to DOE of 2,026 48G cylinders containing approximately 16,674,000 Kg of depleted uranium generated by USEC's operations. In accordance with the agreement, USEC made the required full payment of over \$50M to DOE, covering the entire quantity of depleted uranium to be transferred. Therefore, the liability to dispose of the full amount of USEC's depleted uranium specified in the agreement now rests with DOE, further reducing the quantity of depleted uranium to be ultimately disposed of by USEC. Within these major parameters of the agreement, USEC and DOE agreed to implement the actual transfer of the material on a schedule covering the period of FY 1999 through 2004.
- The "Agreement Between the U.S. Department of Energy ("DOE") and USEC Inc. ("USEC")," dated June 17, 2002, provided, in part, for the DOE taking title of depleted uranium from USEC operations during USEC's fiscal years 2002 and 2003 and one-half the amount of depleted uranium generated during USEC's fiscal years 2004 and 2005. Therefore, as a result of this June 17, 2002 agreement, USEC's liability associated with the disposal of USEC generated depleted uranium was reduced by the quantity of depleted uranium specified in this June 17, 2002 agreement.
- The "Cooperative Agreement Between Department of Energy and USEC Inc. Concerning the American Centrifuge Demonstration Project," dated March 23, 2010, transferred title to 13,312,411 kg of DU from USEC to DOE to enable USEC to release encumbered funds to support continued development and demonstration of the American Centrifuge technology. In 2012, DOE and USEC entered into a contract in which DOE acquired SWU in exchange for DOE's accepting title to, and eventual disposal responsibility for, 13,073,045 kg of DU.
- The "Cooperative Agreement Between Department of Energy and USEC Inc. and American Centrifuge Demonstration, LLC Concerning the American Centrifuge Cascade Demonstration Test Program", dated June 12, 2012, transferred title and responsibility for disposition from USEC to DOE of up to 39,200 MT DUF₆ (26,505 MT of DU at USEC tails purity).