U.S. NUCLEAR REGULATORY COMMISSION

FINAL REPORT TO CONGRESS

ON THE HEALTH, SAFETY,

AND ENVIRONMENTAL CONDITIONS AT THE

GASEOUS DIFFUSION PLANTS

LOCATED NEAR

PADUCAH, KENTUCKY,

AND PORTSMOUTH, OHIO

October 1, 2013, to February 2, 2015

Enclosure 1

EXECUTIVE SUMMARY

The U.S. Nuclear Regulatory Commission (NRC) provides this report to Congress pursuant to Section 1701 of the Atomic Energy Act (AEA) that requires NRC reports on the health, safety, and environmental conditions of the gaseous diffusion uranium enrichment plants (GDPs) located near Paducah, Kentucky, and Portsmouth, Ohio. As of July 2013, uranium enrichment operations using the gaseous diffusion process no longer occur in the United States. The NRC terminated the Certificate of Compliance (CoC) for the Portsmouth GDP on October 12, 2011, and the Paducah GDP on February 2, 2015. Following the termination of the Paducah CoC, the NRC no longer regulates any GDP-related activities. Accordingly, this will be the last NRC report on the GDPs. This report covers the time period from October 1, 2013, to February 2, 2015, when the CoC for the Paducah GDP was terminated. As directed by the AEA, the NRC staff consulted with the U.S. Department of Energy (DOE) and the U.S. Environmental Protection Agency (EPA) in preparing this report.

The NRC initially issued CoCs to the GDPs in March 1997, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 76, "Certification of Gaseous Diffusion Plants." The GDPs had been operated by the United States Enrichment Corporation (USEC), a subsidiary of USEC Inc., its former parent corporation. Following bankruptcy proceedings concluded in 2014, USEC, Inc. now does business as Centrus Energy Corp. (Centrus). In October 2011, the NRC terminated the CoC for the Portsmouth GDP after USEC returned the Portsmouth GDP facilities to DOE. The DOE is fully responsible for the regulatory oversight of the Portsmouth GDP. Following termination of the CoC for the Portsmouth GDP, the DOE began major decontamination and decommissioning activities in most of the Portsmouth GDP buildings.

In June 2013, USEC notified the NRC that it was permanently terminating its enrichment activities at the Paducah GDP and began a deactivation process. The Paducah GDP facilities were returned to the DOE on October 21, 2014. The NRC's 10 CFR Part 76 CoC for the Paducah GDP was terminated following NRC's confirmation of USEC's compliance with all applicable NRC requirements, and DOE's confirmation that it accepted the return of the leased facilities in accordance with the July 1, 1993, *Lease Agreement Between the United States Department of Energy and the United States Enrichment Corporation*, and its subsequent revisions. Accordingly, the Paducah GDP is now under the DOE's regulatory oversight in conjunction with the EPA and the Kentucky Department for Environmental Protection, which regulate environmental activities at the 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. Such performance reviews were performed every 24 months and were in addition to the required GDP inspections. The NRC did not conduct a performance review for the Paducah GDP during the current reporting period because the NRC conducted routine inspections of USEC's operations at the site during this period and found no issues of concern. The NRC confirmed that the Paducah GDP continued to conduct operations safely and securely while protecting public health and the environment.

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CHAPTER 1

INTRODUCTION

During the time that operation of the Paducah and Portsmouth gaseous diffusion plants (GDPs [1]) was regulated by the U.S. Nuclear Regulatory Commission (NRC), each GDP was required to obtain a Certificate of Compliance (CoC) from the NRC pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 76, "Certification of Gaseous Diffusion Plants." The United States Enrichment Corporation (USEC) was the CoC holder of each GDP. Note that USEC is a subsidiary of its former parent corporation USEC, Inc., and that following bankruptcy proceedings concluded in 2014, USEC, Inc. now does business as Centrus Energy Corp. (Centrus).

In June 2013, USEC notified the NRC of its decision to permanently cease uranium enrichment activities at the Paducah GDP. Enrichment activities at the site permanently ceased on July 25, 2013, and by letter to the U.S. Department of Energy (DOE) dated August 1, 2013, USEC gave notice of its intent to terminate the lease of the Paducah GDP. In the early 2000s, a similar decision was made to cease uranium enrichment activities at the Portsmouth GDP, and for many years thereafter this GDP was kept in a cold shutdown condition. In October 2011, the NRC terminated the CoC for the Portsmouth GDP. Accordingly, this will be the last NRC report on the GDPs, and it covers the period from October 1, 2013, through February 2, 2015.

Located on the site of the Portsmouth GDP is the American Centrifuge Lead Cascade Facility (Lead Cascade) that continues to be regulated under an NRC license pursuant to 10 CFR Part 70, "Domestic Licensing of Special Nuclear Material." NRC License SNM-7003 for the Lead Cascade was issued in 2004, and USEC Inc. began operating the Lead Cascade in August 2006. American Centrifuge Operating, LLC (ACO), a subsidiary of Centrus, now holds the NRC license for the Lead Cascade. ACO continues to develop replacement uranium enrichment technology involving the use of gas centrifuges, with the purpose of demonstrating that the Lead Cascade's centrifuge enrichment technology can later produce enriched uranium (EU) for commercial use.

In early 2014, the DOE instructed UT-Battelle, LLC (UT-Battelle), the management and operating contractor for the Oak Ridge National Laboratory (ORNL), to assist in developing a path forward for achieving a reliable and economic domestic uranium enrichment capability. The DOE's intent is to promote private sector deployment of the Lead Cascade's enrichment technology, while also supporting national security purposes. Pursuant to those instructions, on May 1, 2014, UT-Battelle and ACO signed an agreement for continued cascade operations, while scaling back certain core research and technology activities at the Lead Cascade. Under this agreement, ACO provides periodic reports to ORNL regarding Lead Cascade operations. Minor amendments to NRC License SNM-7003 were issued in 2014 to reflect the reduced research and technology activities. ACO continues to operate the Lead Cascade and remains the NRC license holder.

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

Production of uranium using centrifuge enrichment technology may later occur in the partially constructed American Centrifuge Plant (ACP) that is co-located with the Lead Cascade. Construction of the ACP is governed by NRC License SNM-2011, and this license is now held by ACO. Initial ACP construction activities began in 2007 and included contractor mobilization, personnel training, and initial site preparation to remove legacy structures and components to accommodate the design for the ACP. During the summer of 2008, USEC Inc. submitted an application to DOE's loan guarantee program to fund and complete the construction of the ACP. However, as discussed further in Chapter 8 of this report, due to technical and financial issues identified by DOE during its review of USEC Inc.'s loan application, construction activities at the ACP were halted in August 2009 and have yet to resume.

Background

The 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, the DOE replaced virtually all the uranium processing equipment at the Paducah GDP as a result of a major upgrade project in the 1970s and 1980s. In addition, in September 2003, both the material condition of the plants and the design and safety bases documentation were substantially upgraded as part of the completion of the NRC's compliance plan requirements.

Energy Policy Act

In October 1992, Congress enacted the Energy Policy Act (EPAct), which amended the Atomic Energy Act of 1954 (AEA) to create USEC. Provisions of the AEA direct DOE to lease the GDPs near Paducah, KY, and Portsmouth, OH, to USEC. These GDPs produced EU. 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 to private investors. Following the passage of the USEC Privatization Act in 1996, the corporation was privatized through an initial public offering on July 28, 1998. In the *Lease Agreement Between The United States Department of Energy and The United States Enrichment Corporation* dated July 1, 1993 (hereafter referred to as the 1993 Lease), and in other subsequent agreements, DOE and USEC established the roles and responsibilities for each organization at both GDPs. The AEA also requires the 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."

The AEA assigns safety and safeguards regulatory responsibility to the NRC for operations within the leased areas of the GDPs. Further, the AEA required that within 2 years of the date of the passage of the EPAct, the NRC establish 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 an NRC 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 10 CFR Part 76 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 operation of the GDPs by USEC if the NRC approved the DOE-prepared plans for bringing the GDPs into compliance with any unsatisfied provisions of the NRC regulations. In March 1997, the NRC issued CoCs certifying USEC's operation of the GDPs in accordance with 10 CFR Part 76. On this date, the NRC also 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 fall 2003, all compliance plan issues associated with the initial certification were completed.

The NRC continued regulatory oversight of USEC's operations at the Paducah GDP for the entire period covered by this report. The NRC had regulatory oversight of the Portsmouth GDP until its CoC was terminated in October 2011, at which time regulatory oversight was returned to the DOE.

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 1993 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 holds the Federal arming and arrest authority at the GDPs, and controls the security force exercises 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 and DOE entered into their lease agreement in July 1993.

Decommissioning activities ongoing at the Portsmouth GDP require a significant DOE commitment. It is estimated that it may take 35 years or more to decommission 10 million square feet of floor space and complete the remediation of contaminated soils and ground water. The project will require an annual average employment of 1,000 workers. With this assignment, the DOE retains responsibility for environmental restoration activities and legacy[2] waste management at the GDP sites and for the operation of facilities used for the storage of DOE-owned special nuclear and source material. These storage areas and materials include the cylinder storage yards that contain depleted uranium hexafluoride (UF_6), and surplus uranium material in interim storage at the Portsmouth GDP.

The DOE and USEC entered into several agreements by which the DOE has assumed responsibility for virtually all depleted UF_6 at the two GDP sites. A list of agreements between USEC and the DOE related to depleted uranium management and disposition is included in

[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).

Appendix B of this report (Summary of Agreements Regarding the Paducah and Portsmouth Gaseous Diffusion Plants).

In December 1993, the NRC and the 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 the DOE. In August 1994, the NRC and the 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 the DOE exercised public health and safety and common defense and security regulatory oversight of the leased GDPs.

In October 1994, the NRC and the DOE signed an agreement providing for the conduct of inspection activities at the GDPs. This agreement defined the way the 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 GDPs.

In March 1995, the NRC and the 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's Division of Security*. This agreement supplemented the 1993 joint statement by defining in greater detail the security roles and responsibilities of the DOE and the NRC after the NRC assumed regulatory oversight of USEC activities.

In October 1997, the NRC and the 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 defined the responsibilities of the DOE and the NRC regarding continuing cooperation at the GDPs after the NRC assumed regulatory oversight of USEC's activities. The MOU also clarified 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, the DOE and the NRC: (1) agreed to exchange information and technical support; (2) defined responsibilities for emergency response; and (3) agreed that issues identified during an inspection by either agency would be resolved in accordance with the August 1994 agreement referenced above.

In January 2001, the NRC and the DOE signed a joint procedure entitled *Response to Emergencies in the Leased Areas at the Gaseous Diffusion Plants*. The joint procedure provided 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 the DOE or another agency should be the LFA. The joint procedure also provided for continuous exchange of information between the DOE and the NRC concerning emergencies and for coordination of any response actions.

In 2004, the DOE and the NRC entered into an MOU pertaining to the USEC Inc.'s Lead Cascade located at the Portsmouth GDP. The purpose of the Lead Cascade is to demonstrate that its centrifuge enrichment technology is suitable for commercial use. The MOU delineated the respective regulatory roles and responsibilities of the DOE and the NRC over the Lead Cascade facility. In 2007, the NRC and the DOE entered into a similar MOU covering the ACP. Under the 2007 MOU, the NRC is responsible for ensuring that any future ACP operations are conducted safely and in compliance with NRC requirements. Further details regarding the Lead Cascade and the ACP are provided in Chapter 8 of this report.

In December 2006, the DOE and USEC established *Supplemental Agreement Number 1 to the lease agreement between the United States Department of Energy and the United States Enrichment Corporation*. This supplemental agreement allowed for the long-term leasing of the gas centrifuge enrichment plant facilities.

Since the NRC's termination of USEC's CoC for the Portsmouth GDP on October 12, 2011, all regulation of activities in non-leased areas of this site has been conducted by the DOE. The NRC continues to exercise regulatory authority over the Lead Cascade and the ACP facilities under their respective 10 CFR Part 70 licenses, as described above. Following the NRC's termination of USEC's CoC for the Paducah GDP on February 2, 2015, the DOE has exercised regulatory oversight in conjunction with the EPA and the Kentucky Department for Environmental Protection.

CHAPTER 2

GASEOUS DIFFUSION PLANT OPERATIONS

The principal process that the NRC regulated at the GDPs was the production of EU for reactor fuel. The GDPs received uranium hexafluoride (UF_6), enriched it (i.e., processed the material to increase the concentration of fissionable uranium-235 [^{235}U]), and then shipped the enriched UF_6 to other fuel cycle facilities where it was processed into fuel assemblies for use in nuclear power reactors.

The gaseous diffusion separation process was used at the GDPs to enrich uranium, but this process is no longer used in the United States. The diffusion process involved passing UF_6 gas through a material (barrier) containing small pores that were large enough to permit the transfer or diffusion of single molecules, but were too small to permit bulk flow of the gas. The gas that emerged from the pores had a slightly higher concentration of ^{235}U atoms than the gas that did not pass through the barrier. This process created 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) was very small, the process had to be repeated many times, employing a cascade of many stages to achieve the required enrichment levels. The outputs of the cascade were enriched uranium product and depleted uranium (DU). The DU is currently stored at the GDPs, awaiting ultimate disposition.

The main components of a GDP were: (1) large cylindrical vessels called diffusers that contained 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 required: (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.

NRC Oversight

The major areas of NRC oversight at the GDPs included: (1) plant operations; (2) nuclear criticality safety; (3) physical protection; (4) classified matter protection; (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. As indicated, the NRC was responsible for regulatory oversight of the design, operation, and maintenance of hardware (i.e., structures, systems, and components) relied on for safe operation; operational aspects involving human factors, such as qualifications, training, and adherence to procedures; and the management organization and controls necessary to ensure effective management oversight of GDP operations. Management organization and controls included: (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 evaluated accident analyses and technical safety requirements (TSRs) developed by USEC. The accident analyses described potential credible accidents and the facility response to those accidents to demonstrate that the facility was capable of responding in

a fashion that would not jeopardize public health and safety. The TSRs defined the safety envelope and operating parameters within which the GDPs were required to operate.

During the operation of the GDPs, any USEC requests for CoC amendments were only granted after a thorough review of design and operational information, and after specialists from both NRC headquarters and NRC Region II Office conducted field inspections. In October 2012, the NRC reduced annual inspection and oversight hours for the Paducah GDP because the plant had continued to operate safely for over a decade. The NRC's inspection and oversight activities found that during the time it was operated, the Paducah GDP continued to implement an effective nuclear safety program, and that most of the identified issues had been of minor safety significance.

In June 2013, USEC notified the NRC of its decision to permanently cease enrichment activities at the Paducah GDP. The NRC staff performed an evaluation of its inspection program at the site and determined that the current and expected material workload at the Paducah GDP were similar in risk to operations at a uranium conversion facility with additional aspects in the areas of MC&A, security, information security, and criticality safety. As a result of this determination, the NRC staff concluded that an adjustment to the NRC's core inspection program for the site was necessary and subsequently removed the Paducah GDP resident inspector from the site at the end of fiscal year (FY) 2013.

The NRC coordinated with DOE and USEC during the CoC termination process to accomplish a seamless regulatory transition of the Paducah GDP site to DOE, and conducted a detailed review of USEC's request to terminate its 10 CFR Part 76 CoC. Prior to CoC termination, the NRC conducted inspections that addressed information security, MC&A, and appropriate disposition of waste. Deactivation at the Paducah GDP is an ongoing project currently being performed by DOE's contractors.

The DOE-USEC Lease Agreement

The 1993 Lease between DOE and USEC, as supplemented in 2006, covered both the Portsmouth and the Paducah GDPs, as well as the Lead Cascade and the ACP at the Portsmouth site. Although USEC no longer leases the GDPs, the lease for the Lead Cascade and the ACP continues and was last approved for renewal on January 15, 2013. The renewed lease began on June 30, 2014, and runs for a period of 5 years. More information about additional NRC-licensed activities under 10 CFR Part 70 at the Portsmouth site is provided in Chapter 8, "Regulatory Activities," of this report.

Activities at the Paducah GDP

In April 2013, USEC submitted an application to renew its CoC for the Paducah GDP for a 5-year period with an expiration date of December 31, 2018. However, by letter dated June 3, 2013, USEC notified the NRC of its decision to terminate uranium enrichment operations at the Paducah GDP and its intention to return the leased facilities to DOE. Following its notification, USEC started a deactivation process, which concluded with the return of the leased facilities to DOE on October 21, 2014. During this process, the NRC continued its oversight of USEC's activities to ensure a smooth and orderly transition of the facilities to DOE oversight and to ensure USEC's compliance with the conditions of the CoC and the NRC regulations in 10 CFR Part 76. In support of the deactivation process, the NRC also conducted routine inspections,

including those related to information security, MC&A, and the appropriate disposition of DU and radioactive waste.

The NRC terminated the CoC for the Paducah GDP on February 2, 2015, following confirmation of USEC's compliance with all applicable NRC requirements, and DOE's confirmation of its acceptance of the return of the leased facilities in accordance with the 1993 Lease and its subsequent revisions. After USEC's return of the Paducah GDP facilities to DOE and the NRC's termination of the CoC, DOE became the Federal regulator of activities there in conjunction with the EPA and the Kentucky Department for Environmental Protection, which regulate environmental activities at the site.

Until December 2013, USEC continued to participate in the commercially financed Government-industry partnership, Megatons to Megawatts Program, in which highly enriched uranium from dismantled Russian nuclear warheads was being processed into low-enriched uranium (LEU) to produce fuel for nuclear power plants in the United States. This program supplied the reactor fuel used to generate nearly 10 percent of U.S. electricity since 1995. The last LEU delivery to the United States from Russia under this partnership arrived in the Port of Baltimore on December 11, 2013.

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 did not fully comply with NRC regulations, provided that the 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 noncompliance issues were addressed and closed.

CHAPTER 4

HEALTH, SAFETY, AND ENVIRONMENTAL STATUS

Until the NRC terminated the CoC for the Paducah GDP, the NRC had oversight responsibility to ensure that the health and safety of the public and the workers at the GDPs were protected from hazards involving radioactive material and radiation. The 10 CFR 76.60, "Regulatory Requirements Which Apply," required USEC to comply with applicable sections of 10 CFR Part 20, "Standards for Protection Against Radiation." Health, safety, and environmental conditions were reflected in radiation doses received by workers and in radioactive effluents. This chapter contains information relating to the health, safety, and environmental conditions for the leased areas of the GDPs under NRC regulatory oversight. The DOE was contacted in the preparation of this report, and the input from DOE is included as Appendix A to this report, "Summary of DOE Activities at the Paducah and Portsmouth Gaseous Diffusion Plants."

DOE and USEC maintained onsite and offsite environmental dosimeters to monitor gamma radiation levels at the Paducah GDP. Table 4-1 provides the maximum offsite individual doses for the Paducah GDP for calendar year (CY) 2013 only for both USEC and DOE operations combined. Data for CYs 2014 and 2015 could not be provided in this report; although the CY 2014 environmental dosimeter data has been collected and analyzed, the modeling to calculate off-site personnel dose will not be available until October 2015 as part of Paducah's Annual Site Environmental Report (ASER) for CY 2014. The CY 2015 data will not be calculated and available until October 2016, when the next Paducah Site ASER is to be released, and will be based on data from DOE only. However, based on the historical data for the site, and given USEC's shutdown of enrichment operations at the site in 2013, the NRC does not expect that these gamma radiation levels will exceed the regulatory limit of 1 millisievert (mSv)/year [100 millirem (mrem)/year] for members of the public, as specified in 10 CFR Part 20.

Data from the environmental dosimeters at Paducah show that ambient gamma exposure levels at the site boundaries for CY 2013 were very small and well within the NRC's regulatory limits. Maximum annual doses to the nearest offsite individuals from exposure to radioactive effluents from Paducah operations for CY 2013 were calculated to be 3.0×10^{-4} mSv (0.03 mrem), which is 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
Maximum Offsite Individual Dose at the Paducah GDP, 2013–2015

Calendar Year	Paducah Maximum Offsite Dose, mSv/yr (mrem/yr) [a] Airborne Emissions
2013	3.0×10^{-4} (0.03)
2014	Not Available
2015[b]	Not Available

[a] Sv—Sievert; rem—röentgen equivalent man
[b] Plant not in operations

Radiological exposures to the public at the GDP sites are not limited to those arising from past USEC operations. DOE 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 the Paducah GDP for CY 2013 only. For the reasons previously stated in this chapter, data for CYs 2014 and 2015 could not be provided in this report.

Table 4-2
Collective 80-km (50-mi) Population Doses, at Paducah (2013–2015**)**

Calendar Year	Collective 80-km (50-mi) Population Dose, person-Sv (person-rem)
2013	2.0×10^{-3} (0.2)
2014	Not Available
2015*	Not Available

* Plant not in operations

Table 4-3 provides collective occupational and maximum individual occupational radiation dose for USEC employees at the Paducah GDP.

Table 4-3
Collective and Maximum Individual Occupational Dose,
at Paducah (2013–2015)

Calendar Year	Paducah	
	Collective Occupational Dose, person-Sv (person-rem)	Maximum Individual Occupational Dose, Sv (rem)
2013	4.6×10^{-2} (4.576)	1.49×10^{-3} (0.149)
2014	7.6×10^{-3} (0.765)	4.3×10^{-5} (0.043)
2015*	N/A	N/A

* Plant not in operations

The radiation exposures data indicate that for the respective reporting periods, individual worker exposures at the Paducah GDP did not exceed 5 mSv (500 mrem), which was the administrative control level at the Paducah GDP. These values are within the historical ranges for both GDP 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.

CHAPTER 5

CERTIFICATION ACTIVITIES

The requirements in 10 CFR 76.45, "Application for Amendment of Certificate," state the process for amending the CoCs 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 Paducah GDP Certificate

From October 1, 2013, through February 2, 2015, USEC was granted three amendments to its Paducah CoC. These amendments addressed the reduced operations and staffing during the GDP deactivation process, and the last amendment terminated the CoC.

Orders Issued to the Paducah GDP During This Reporting Period

No Orders were issued by the NRC to the Paducah GDP between October 1, 2013, and February 2, 2015.

2013 Certificate Renewal Application for the Paducah GDP

On April 2, 2013, in accordance with 10 CFR 76.31, USEC submitted to the NRC its application for renewal of the Paducah GDP CoC that had been issued in 2008. USEC's renewal application relied on existing documentation. USEC did not request any changes to the application in the renewal request. After the NRC staff performed an acceptance review of the renewal application and found it acceptable for docketing, the NRC published a notice in the *Federal Register* on May 24, 2013 (78 FR 30342), acknowledging 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. In its June 3, 2013, letter, USEC stated that it planned 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. On August 1, 2013, USEC provided the DOE with a 2-year notice of its intent to terminate its lease of the GDP.

Due to USEC's decision to terminate enrichment activities at the Paducah GDP and its intention to return the leased facilities there to DOE, the NRC suspended the review of USEC's CoC renewal application and placed USEC's application on timely renewal status pursuant to 10 CFR 76.55. In accordance with 10 CFR 76.55, if a sufficient application for a CoC is timely filed, the existing CoC does not expire until a final determination on the application is made by the NRC. Therefore, USEC's activities at the Paducah GDP continued to be governed by the 2008 CoC, under which the NRC continued to monitor USEC's security and control of nuclear material, and its decontamination, decommissioning, and waste disposal activities. The NRC's regulatory authority was transferred to the DOE when the CoC was terminated on February 2, 2015.

CHAPTER 6

INSPECTIONS

Provisions in Subpart F, "Reports and Inspections" of 10 CFR Part 76, govern the NRC inspections of the GDPs. Based on such inspections, as documented in inspection reports, the NRC has authority to take enforcement action and issue civil penalties for violations of the AEA, NRC regulations, orders, or other applicable requirements. NRC provisions governing such actions are in 10 CFR Part 76, Subpart G, "Enforcement," and in 10 CFR Part 2, "Agency Rules for Practice and Procedure," among others.

Violations are enforcement actions identified during NRC inspections that are classified into one of four severity levels (SLs), with 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) that are identified and promptly corrected by the licensee or CoC holder. NCVs are considered nonrecurring 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 generally not documented in NRC inspection reports.

More significant violations, identified as escalated enforcement actions, include: (1) SL I, II, and III notices of violation; (2) civil penalties; and (3) orders to modify, suspend, or revoke NRC licenses or the authority to engage in NRC-licensed activities (may be issued for substantial safety concerns). 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.

As further detailed in Table 6-1 below, during the October 1, 2013, to February 2, 2015, reporting period, the NRC performed a total of 12 inspections at the Paducah GDP. These inspections were conducted by inspectors from the NRC's Region II and the headquarters' offices. The results of each inspection are documented in NRC inspection reports. Each report describes the completion of multiple inspection procedures of various disciplines by the resident inspectors, regional inspectors, and/or headquarters inspectors.

Table 6-1
Number of Inspections and Inspection Hours Spent at the Paducah GDP

	Paducah	
Fiscal Year	**Number of Inspections**	**Number of Inspection Hours**
2014	11	346
2015*	1	39
Total	**12**	**385**

*For the period covering October 1, 2014, until February 2, 2015

These inspections were focused on the following areas: (1) plant operations; (2) plant maintenance; (3) plant support; (4) engineering; (5) fire safety; (6) chemical process safety; (7) nuclear criticality safety; (8) MC&A; (9) security of classified information; and (10) physical security.

Violations at the Paducah GDP

There were no violations issued to the Paducah GDP for the time period from October 1, 2013, to February 2, 2015.

CHAPTER 7

EVENT REPORTS

The provisions in 10 CFR 76.120, “Reporting Requirements,” state the requirements for reporting certain events to the NRC. These provisions 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. During the time the Paducah GDP was governed by a CoC, USEC was required to report to the NRC Operations Center, within 1 hour after discovery, any criticality event, loss of special nuclear material, or emergency conditions that had been declared an Alert or Site Area Emergency. Events that prevented immediate protective actions necessary to avoid releases or exposures to radiation or radioactive materials that could exceed regulatory limits had to be reported to the NRC Operations Center within 4 hours after discovery. In addition, USEC was required to report to the NRC Operations Center within 24 hours: (1) certain contamination events, (2) failure of certain TSR-required safety equipment with no backup equipment available, (3) fires or explosions that damaged radioactive material or containers holding radioactive material, and (4) events that required offsite medical treatment of a contaminated person. Further, USEC had to report losses and compromises or possible compromises of classified information or materials pursuant to 10 CFR 95.57, “Reports.” USEC also reported any loss of contingency for Nuclear Criticality Safety in accordance with NRC Bulletin 91-01, “Reporting Loss of Criticality Safety Controls,” dated October 18, 1991. Although not required by 10 CFR Part 76, “Certification of Gaseous Diffusion Plants,” USEC also reported safety system actuations and notifications made to other State and Federal agencies.

Event Notification Summary for the Paducah GDP

The Paducah GDP was the only GDP in operation during this reporting period and reported a total of five events between October 1, 2013, and February 2, 2015. Of these, two events were retracted by USEC as not meeting the reporting criteria. For the three NRC-reportable events, USEC stated that one event was caused by defective or failed parts. The second event was caused by an issue with the shipping label of a UF_6 samples container. The third event was caused by weather or ambient condition. There were no radiological impacts associated with these events. There were no events requiring activation of the Paducah or the NRC Operations Center during this reporting period.

The defective or failed parts event involved the failure of safety equipment required to be available and operable. Specifically, this event was caused by previous maintenance activities which had left the sprinkler heads for a High Pressure Fire Water System without adequate pressure and flow, a condition that did not meet design specifications. Upon further investigation of the lack of pressure, it was determined that the operating mechanism for the sectional supply valve was in a partially closed position, which caused the restricted water flow.

The shipping label event involved the loss and recovery of one drum (from a shipment of seven) containing UF_6 samples. Upon further investigation it was determined that at some point, within the Federal Express package sorting and handling facility, the shipping label was separated from the missing drum, which caused the drum to not be delivered on the expected date. The missing drum was later found within the package sorting and handling facility and was then delivered to its destination. The drum’s tamper indicating device was found to be intact.

The weather and ambient condition event involved the declaration of an alert due to a tornado that passed within the controlled access area. The tornado caused flying debris, damage to plant buildings and structures, and damage in the switchyards that resulted in a loss of power throughout sections of the site. The high pressure fire water system experienced a breach, which caused the storage tank water level to drop. The breach was isolated and the tank water level was restored. A section of perimeter fencing and lighting was damaged, resulting in security contingency measures being put in place until repairs were made. There were no injuries and no hazardous or radiological material released. Security of the site and sensitive areas was maintained throughout the event. The alert was terminated after completion of a security check of the site perimeter and a compilation of the damages sustained by the site.

CHAPTER 8

REGULATORY ACTIVITIES

Until the NRC terminated the CoC for the Paducah GDP, USEC was required to comply with all applicable NRC regulations, primarily those in 10 CFR Part 76, "Certification of Gaseous Diffusion Plants." Other NRC regulations or portions thereof that were applicable included the following:

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"
8. 10 CFR Part 95, "Security Facility Approval and Safeguarding of National Security Information and Restricted Data"

Rulemaking Activities

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

Emergency Preparedness Exercises at Paducah

Under the requirements of 10 CFR 76.91 "Emergency Planning," USEC formerly had to conduct onsite exercises once every 2 years at both GDPs to test response to simulated emergencies. Participation of offsite response organizations, although recommended, was not required. In addition to the exercises, inspections of the emergency preparedness program at the GDPs were conducted once a year. Emergency preparedness exercises were not conducted at the Paducah GDP during this reporting period.

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 the centrifuge process, UF_6 gas is placed in a centrifuge machine, consisting of a large vertical rotating cylinder and piping to feed UF_6 and withdraw 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.

The Lead Cascade is located at the Portsmouth site, and it uses gas centrifuge technology in accordance with an NRC license issued under the provisions of 10 CFR Part 70, "Domestic Licensing of Special Nuclear Material." In this regard, on December 20, 2002, USEC 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. (USEC's parent company) submitted a

license application for the Lead Cascade to the NRC 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 on January 28, 2004. The staff then issued USEC Inc. a 10 CFR Part 70 materials license (SNM-7003) on February 24, 2004, for the Lead Cascade demonstration facility. USEC Inc. began operating the Lead Cascade in August 2006. ACO now holds the NRC license for the Lead Cascade, following an NRC review and approval of a USEC Inc. (now Centrus) request for authorization to transfer the NRC license from USEC Inc. to ACO, its corporate subsidiary. ACO continues to develop replacement uranium enrichment technology involving the use of gas centrifuges, with the purpose of demonstrating that its centrifuge enrichment technology can later produce enriched uranium for commercial use.

The primary goals at the Lead Cascade continue to be to demonstrate the reliability of the technology by eliminating technical risks, and to demonstrate the commercial configuration cascade's reliability and performance. USEC previously transferred the ownership of the technology to DOE under a 2012 cooperative agreement to fund the Lead Cascade. Provided that the ACP later becomes operational, it is expected that ownership of the centrifuges will be transferred back to Centrus.

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 for the proposed ACP, a commercial facility that would also use gas centrifuge technology at the Portsmouth site. In 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 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 a mandatory hearing and rendered its decision on April 13, 2007, authorizing the staff to issue a 10 CFR Part 70 license for the ACP. The staff subsequently issued Materials License SNM-2011 to USEC Inc. As with the Lead Cascade license, the NRC reviewed and approved a USEC Inc. (now Centrus) request for authorization to transfer the NRC license for the ACP from USEC Inc. to ACO.

Pursuant to the 2004 MOU between the DOE and NRC regarding the ACP, the 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.

Commercial production of uranium using centrifuge enrichment technology may later occur in the partially constructed ACP, which is co-located with the Lead Cascade. Construction of the ACP is governed by NRC License SNM-2011, which as discussed above is now held by ACO. Initial ACP construction activities began in 2007 and included contractor mobilization, personnel

training and initial site preparation to remove legacy structures and components to accommodate the design for the ACP. During the summer of 2008, USEC Inc. 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 by DOE during its review of USEC Inc.'s loan application, construction activities at the ACP were halted in August 2009 and have yet to resume.

CHAPTER 9

CONSULTATION WITH DOE AND EPA

The AEA, as amended, requires that the NRC report to Congress, in consultation with the EPA and 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 this reporting period, the DOE Portsmouth/Paducah Project Office informed the NRC that it continued to discharge its regulatory and oversight responsibilities at the Paducah and Portsmouth GDP sites. DOE conducted its activities in a manner to enhance and improve health, safety, and environmental 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 from each of the sites operating under its authority that 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, and members of the public. The annual site environmental report for DOE activities at the Portsmouth GDP is located at http://energy.gov/pppo/downloads/portsmouth-annual-site-environmental-reports. The annual site environmental report for DOE activities at the Paducah GDP is located at http://energy.gov/pppo/downloads/paducah-annual-site-environmental-reports.

Consultation with EPA

The Paducah GDP

On April 22, 2015, the EPA informed the NRC that its data for the period beginning October 1, 2013, indicates that the Paducah GDP had a pattern of continued noncompliance under the Clean Water Act (CWA) with one quarter in significant noncompliance (SNC) and a period of noncompliance for the past five quarters. For the period prior to October 1, 2013, EPA data also showed noncompliance including additional periods of SNC. In addition to monitoring self-reporting from Paducah, the Commonwealth of Kentucky has regularly conducted CWA inspections, including an evaluation inspection and a sampling inspection in August 2013 and in August 2014. Furthermore, Kentucky has issued four Notice of Noncompliance letters since December 10, 2013, with the latest issued on February 25, 2015. Based on EPA's current review of its available data, Paducah appears to be having continued CWA compliance challenges.

CHAPTER 10

SUMMARY ASSESSMENT OF PERFORMANCE

During the reporting period, USEC provided adequate protection of health and safety at the Paducah GDP site, and generally operated in compliance with the NRC regulatory requirements. There were no radiation-related deaths or illnesses from the use of radioactive materials and no significant radiation exposures. Offsite radiological doses, as well as doses to the workers, remained very low and well within NRC regulatory limits. There were no nuclear criticality events.

During enrichment operations, the NRC had conducted licensee performance reviews (LPRs) at the Paducah GDP to determine whether safety and safeguards had been adequately maintained. The performance areas evaluated during the LPRs included safety operations, safeguards, radiological controls, and facility support. The NRC did not conduct an LPR for the Paducah GDP during this reporting period due to the cessation of operations at the site and return to DOE regulatory oversight. However, the NRC monitored and inspected USEC's activities during the deactivation process as discussed in Chapter 2 of this report, and did not identify any issues of concern. The NRC determined that USEC continued to provide adequate protection of public health and safety until the CoC was terminated.

CHAPTER 11

LEAD FEDERAL AGENCY/EMERGENCY COORDINATION

GDPs

In the 2001, *Joint Procedure between the U.S. Department of Energy (DOE) and the U.S. Nuclear Regulatory Commission (NRC) on Response to Emergencies in the Leased Areas at the Gaseous Diffusion Plants (GDPs),* the DOE and the NRC agreed that the NRC was to be the initial LFA for events at the GDPs having actual or potential adverse impacts on safety and/or common defense and security. However, following the return of the leased GDP buildings to DOE, and the termination of the Paducah CoC on February 2, 2015, the NRC no longer regulates activities at the Paducah GDP. Accordingly, DOE is now the LFA for any emergencies at the site.

ACP and Lead Cascade

As discussed in Chapter 8, “Regulatory Activities,” the Lead Cascade and the ACP are located at the Portsmouth site and both are subject to NRC’s regulatory oversight under their 10 CFR Part 70 NRC licenses. Both are also subject to a 2002 lease between DOE and USEC. Similar to the LFA agreement between the NRC and DOE documented in the 2001 joint procedure discussed above, the NRC and DOE signed an MOU in 2004 addressing the Lead Cascade. In 2007, the NRC and DOE signed an MOU addressing the ACP. Both MOUs designate NRC as the LFA for emergencies at the Portsmouth site, if the emergency pertains to either the Lead Cascade or the ACP.

APPENDIX A

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

The U.S. Department of Energy (DOE) activities at the Paducah Gaseous Diffusion Plant (GDP) between October 1, 2013, and February 2, 2015, are described below.

Inspection and Investigation Activities at Paducah

- Participated in a full participation emergency management exercise at the Paducah GDP. (FY 2013)

- Inspected USEC's activities implemented to meet the Arming and Arrest Authority Security Plan requirements to ensure that the activities are being conducted safely and in accordance with the requirements of the DOE-USEC Regulatory Oversight Agreement, Exhibit D of the Lease Agreement between DOE and USEC, dated July 1, 1993, as amended. One item that was identified to be in non-compliance was a random drug test collection that was performed incorrectly. Normally this item would have been cited as a Notice of Violation. However, the item was immediately resolved and there was no evidence of any further non-compliance; therefore, it was recorded as a Non-cited Violation. (FY 2014)

- Inspected USEC's activities implemented to meet the Arming and Arrest Authority Security Plan requirements to ensure that the activities are being conducted safely and in accordance with the requirements of the DOE-USEC Regulatory Oversight Agreement, Exhibit D of the Lease Agreement between DOE and USEC, dated July 1, 1993, as amended. All open issues from previous inspections were satisfactorily closed and no new issues were identified. (FY 2015)

Overall Status of the Paducah and Portsmouth GDPs

During this reporting period, the DOE Paducah/Portsmouth Project Office 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 environmental safety and health 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 B

SUMMARY OF AGREEMENTS REGARDING THE PADUCAH AND PORTSMOUTH GASEOUS DIFFUSION PLANTS

I. Agreements Between the U.S. Department Of Energy (DOE) and the U.S. Nuclear Regulatory Commission (NRC) Describing Interface and Responsibilities at the Paducah and Portsmouth Gaseous Diffusion Plants (GDPs)

- 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, dated December 1993.

- 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, dated August 1994.

- Agreement for the Conduct of Inspection Activities at the Gaseous Diffusion Plants, dated October 1994.

- 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's Division of Security, dated March 1995.

- Memorandum of Understanding between the Department of Energy and the Nuclear Regulatory Commission - Cooperation Regarding the Gaseous Diffusion Plants, dated October 1997.

- Joint Procedure Between the U.S. Department of Energy and the U.S. Nuclear Regulatory Commission - Response to Emergencies in the Leased Areas at the Gaseous Diffusion Plants, dated February 2001.

- Memorandum of Understanding Between the Department of Energy and the Nuclear Regulatory Commission on Cooperation Regarding the Gas Centrifuge Lead Cascade Facilities at the Portsmouth Gaseous Diffusion Plant Site, dated March 2004.

- Memorandum of Understanding Between the Department of Energy and the Nuclear Regulatory Commission on Cooperation Regarding the American Centrifuge Plant in Piketon, Ohio, dated April 2007

II. Agreements between DOE and USEC for the Paducah and Portsmouth GDPs

- Lease Agreement Between the United States Department of Energy and the United States Enrichment Corporation, dated July 1, 1993.

- Lease Agreement Between the United States Department of Energy and the United States Enrichment Corporation for the Gas Centrifuge Enrichment Plant, dated December 7, 2006.

III. 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 separative work unit (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 DU 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 DU to be transferred. Therefore, the liability to dispose of the full amount of USEC's DU specified in the agreement now rests with DOE, further reducing the quantity of DU 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. This agreement is complete and no further action is required.

- 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 to DU from USEC operations during USEC's FYs 2002 and 2003 and one-half the amount of DU generated during USEC's FYs 2004 and 2005. Therefore, as a result of this June 17, 2002, agreement, USEC's liability associated with the disposal of USEC generated DU was reduced by the quantity of DU 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 metric ton (MT) depleted uranium hexafluoride (26,505 MT of DU at USEC tails purity).

APPENDIX C

ABBREVIATIONS AND ACRONYMS

ACO	American Centrifuge Operating, LLC - Current licensee for the ACP and the Lead Cascade
AEA	Atomic Energy Act
ASER	Annual Site Environmental Report
Centrus	Centrus Energy Corp. (formerly known as USEC Inc.)
CFR	*Code of Federal Regulations*
CoC	Certificate of Compliance
CWA	Clean Water Act
CY	calendar year
DOE	U.S. Department of Energy
DU	depleted uranium
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
EPAct	Energy Policy Act of 1992
EU	enriched uranium
FY	fiscal year
GDP	gaseous diffusion plant
kg	kilogram
km	kilometer
LEU	low-enriched uranium
LFA	lead Federal agency
LPR	licensee performance review
MC&A	material control and accounting
mi	mile
MOU	memorandum of understanding
mrem	millirem
mSv	millisievert
MT	metric ton
NCS	nuclear criticality safety
NCV	non-cited violation
NRC	U.S. Nuclear Regulatory Commission
RD&D	Research, Development and Demonstration Project
SL	severity level
SNC	significant noncompliance
SWU	separative work unit
TSR	technical safety requirement
^{235}U	uranium-235
^{238}U	uranium-238
UF_6	uranium hexafluoride
USEC	United States Enrichment Corporation - Certificate holder for the GDPs
USEC Inc.	USEC's former Parent Company, and former licensee for the ACP and the Lead Cascade