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NUREG-1834

Environmental Impact Statement for the Proposed American Centrifuge Plant in Piketon, Ohio

Draft Report for Comment

U.S. Nuclear Regulatory Commission
Office of Nuclear Material Safety and Safeguards
Washington, DC 20555-0001

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ABSTRACT

USEC Inc. (USEC) has submitted an application to the U.S. Nuclear Regulatory Commission (NRC) for a license to construct, operate, and decommission the American Centrifuge Plant (ACP), a gas centrifuge uranium enrichment facility located on the U.S. Department of Energy (DOE) reservation in Piketon, Ohio. The American Centrifuge Plant, if licensed, would enrich uranium for use in commercial nuclear fuel for power reactors. Feed material would be comprised of non-enriched uranium hexafluoride (UF_6). USEC proposes to enrich uranium up to 10 percent by weight of uranium-235. The initial license application is for a 3.5 million separative work unit[1] (SWU) per year facility. Because USEC indicated the potential for future expansion to 7.0 million SWU per year, the environmental review looks at the impacts from a 7.0 million SWU per year facility. The proposed ACP would be licensed in accordance with the provisions of the *Atomic Energy Act*. Specifically, an NRC license under Title 10, "Energy," of the *U.S. Code of Federal Regulations* (10 CFR) Parts 30, 40, and 70 would be required to authorize USEC to possess and use special nuclear material, source material, and byproduct material at the proposed ACP site.

This Draft Environmental Impact Statement (Draft EIS) was prepared in compliance with the *National Environmental Policy Act* and the NRC regulations for implementing the Act. This Draft EIS evaluates the potential environmental impacts of the proposed action and its reasonable alternatives. This Draft EIS also describes the environment potentially affected by USEC's proposal, presents and compares the potential environmental impacts resulting from the proposed action and its alternatives, and describes USEC's environmental monitoring program and mitigation measures.

[1] SWU relates to a measure of the amount of enriched uranium produced.

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tons per day). At current disposal rates, the Pike County Landfill has sufficient disposal capacity for 34 years and the Rumpke Beach Hollow has sufficient disposal capacity for 82 years. As shown in Table 2-3, approximately 1,270 metric tons (1,400 tons) of sanitary/industrial waste would be generated during site preparation and construction, which would not significantly affect the disposal capacity of the local landfills. Therefore, the impact of sanitary/industrial waste generated from site preparation and construction activities would be SMALL.

4.2.13.2 Facility Operation

Section 2.1.4.3 of this Draft EIS summarizes the types and quantities of wastes anticipated to be generated from facility operations over the 30-year license period, along with the proposed practices for managing each wastestream. These wastes include depleted uranium; other low-level radioactive waste; low-level mixed waste; hazardous waste; recyclable waste; classified waste; and paper, office waste, and other sanitary/industrial wastes. The potential impacts associated with the generation, storage, treatment, and disposal of each wastestream are assessed in turn below.

<u>Depleted Uranium</u>

Up to approximately 42,800 Type 48G cylinders of depleted UF_6 would be generated by the 7 million SWU plant operating full time for 30 years (USEC, 2005a). This is the most likely estimate of the amount of tails to be produced assuming USEC enriches product to the expected average of approximately 5 percent by weight of uranium-235. It is also a reasonably conservative estimate, as production of more highly enriched product at the same tails assay results in lower rates of tails generation. If the ACP were to generate product at the maximum licensed assay of 10 weight percent of uranium-235, the tails generation would be about 87 percent of the amount reported above (USEC, 2005a).

These cylinders would contain a total of approximately 571,000 metric tons (629,420 tons) of depleted UF_6. Each individual cylinder would contain the following amounts of radioactivity: 1.92×10^{10} becquerels (0.52 curies) of uranium-234, 1.48×10^{9} becquerels (0.04 curies) of uranium-235, and 9.25×10^{10} becquerels (2.5 curies) of uranium-238.

USEC currently manages depleted UF_6 at the DOE reservation in accordance with 40 CFR Part 266 and Ohio Administrative Code 3745-266, and these same management procedures would be used for the new depleted UF_6 cylinders produced by the proposed ACP. Ohio EPA establishes requirements for management, inspection, testing, and maintenance associated with the depleted UF_6 storage yards and cylinders owned by USEC at the DOE reservation, as stipulated in Section 9 of the ACP License Application.

The need for a long-term disposal path for depleted UF_6 has become clear; the current practice of storing the depleted UF_6 in cylinders on pads at the enrichment facility has been successful as an intermediate practice, but viable uses for large amounts of depleted uranium have not materialized. DOE has recognized that long-term disposal of the depleted uranium will require conversion to a non-reactive form such as U_3O_8 and has begun construction of a depleted UF_6 conversion facility at Piketon in order to convert the depleted uranium owned by DOE into a more non-reactive form suitable for long-term disposal.

Impact on DOE Conversion Facility Operation

Section 3113(a) of the *USEC Privatization Act* (Public Law 104-134) requires DOE to accept low-level waste, including depleted uranium that has been determined to be low-level waste, for disposal upon the request and reimbursement of costs by USEC. Section 3113 was recently amended (by HR4818, Omnibus Appropriations bill) to add the following new paragraph to subsection (a):

> *(4) In the event that a licensee requests the Secretary to accept for disposal depleted uranium pursuant to this subsection, the Secretary shall be required to take title to and possession of such depleted uranium at an existing depleted UF_6 storage facility.*

To date, this provision has not been invoked and the form in which the depleted uranium would be transferred to DOE has not been specified. However, it is likely that depleted uranium from the proposed ACP transferred under this provision of law in the future would be in the form of depleted UF_6, thus adding to the inventory of material needing conversion at the Piketon depleted UF_6 conversion facility. DOE is aware of the possibility that the conversion facility being constructed at Piketon may need to operate longer than initially planned in order to process waste transferred to DOE from the proposed ACP. DOE acknowledges in its EIS for the conversion facility that "...it is reasonable to assume that the conversion facilities could be operated longer than specified in the current plans in order to convert this material." (DOE, 2004a)

The Piketon conversion facility is planned to operate for 18 years beginning in 2006. The existing inventory planned for conversion is 243,000 metric tons (267,862 tons) of depleted UF_6 (DOE, 2004a). The projected maximum amount of 571,000 metric tons (629,420 tons) of depleted UF_6 generated by the proposed ACP represents a significant increase in this existing inventory. Converting the depleted UF_6 from the proposed ACP would require DOE to significantly extend the life of the conversion facility, or to construct a second conversion facility on the site. DOE has maintained that, with routine facility and equipment maintenance, periodic equipment replacements, or upgrades, the conversion facility could be operated safely beyond the 18-year planned life-time period to process the additional depleted UF_6 from the proposed ACP. In addition, DOE indicates the estimated impacts that would occur from prior conversion facility operations would remain the same when processing the proposed ACP wastes. The overall cumulative impacts from the operation of the conversion facility would extend proportionately with the increased life of the facility (DOE, 2004a).

Based on this analysis, the added inventory of depleted UF_6 coming from the proposed ACP should not change the nature or magnitude of the impacts from the DOE conversion facility operations, but it would extend those impacts for several additional years. As a result, the overall impacts to DOE conversion facility operations are considered MODERATE.

Transportation Impacts

Once the depleted UF_6 cylinders are filled at the proposed ACP and then cooled so that the gaseous

Consistent with assumptions made in the DOE EIS for the conversion facility at Piketon (DOE, 2004a), the NRC staff assumes that the depleted U_3O_8 from the conversion facility would be loaded into empty cylinders or bulk bags, which would be loaded onto railcars for shipment for disposal at either the Envirocare facility in Clive, Utah (the proposed DOE disposition site) or the DOE facility at the Nevada Test Site (the optional DOE disposition site). The calcium fluoride generated from the conversion process is also assumed to be packaged and shipped in this same manner. Given the quantities of material generated, the NRC staff estimates that approximately one train with 100 railcars would be needed every three months to ship the U_3O_8 and calcium fluoride to an offsite disposal facility.

The impacts associated with this rail shipment are assessed in Section 4.2.12.1. As shown in Table 4-15, this shipment is estimated to result in 2.8×10^{-5} latent cancer fatalities per year of operation from exposure to direct radiation during incident-free transport, and an additional 7.5×10^{-4} latent cancer fatalities per year from accidents that result in the release of radioactive material to the environment. The total latent cancer fatalities per year is estimated to be approximate 8×10^{-4} or less than one cancer fatality over 30 years of operation. Based on this analysis, the impacts associated with the offsite shipment of materials from the conversion facility are expected to be SMALL.

Disposal Impacts

DOE has analyzed the human health impacts from long-term disposal of uranium oxides in their Programmatic Environmental Impact Statement on disposal of depleted uranium (DOE, 1999b). Four forms of depleted uranium waste were examined in the study: disposal of U_3O_8 in either a grouted or ungrouted form, or disposal of uranium dioxide in either a grouted or ungrouted form. Ungrouted waste is typically in a powder or pellet form, while grouted waste is the material resulting from mixing the uranium oxide material with cement and repackaging in drums. Grouting the waste is intended to increase the waste's structural strength and reduce the leaching rate of the waste to water.

DOE's analysis determined that the long-term disposal of depleted uranium in the form of U_3O_8 at a "generic dry location" is expected to produce zero dose to the maximally exposed individual at a time of 1,000 years from disposal. The maximally exposed individual in this case is considered to be an individual living at the boundary of the disposal site who uses a well at the site boundary as a water source. In the DOE analysis, the critical pathway is groundwater transport to the well; however, in the dry site environment, uranium is not able to migrate to groundwater in the 1,000-year time period, and thus there is no calculated dose.

In a subsequent *National Environmental Policy Act* analysis, DOE proposed disposing the depleted uranium at Envirocare (i.e., "generic dry location") (DOE, 2004a). However, the Envirocare sites does not have potable groundwater sources under the disposal facility, so the groundwater pathway is not a concern even when the analysis is extended out to 10,000 years. Thus when applying the DOE analysis scenario to such a site, there would be no dose to the maximally exposed individual even in a 10,000-year analysis.

NRC staff also reviewed the Waste Acceptance Criteria for the Envirocare site which allows for the disposal of depleted uranium with no volume restrictions. During this review, NRC staff contacted the Division of Radiological Control of the State of Utah to discuss the Envirocare Waste Acceptance Criteria and performance assessment (NRC, 2005b). From this review and discussion it is apparent that the Division of Radiological Control has considered the disposal of depleted uranium at the Envirocare site. Several site-specific factors contribute to the acceptability of depleted uranium disposal at Envirocare, including a lack of potable groundwater, extremely low annual precipitation, and land use controls by Tooele County. As Utah is an NRC Agreement State, and Envirocare has met Utah's licensing requirements, the impacts from disposal of depleted uranium at the Envirocare facility would be SMALL.

Capacity Impacts

In a Memorandum and Order (CLI-05-05, Docket No. 70-3103-ML) dated January 18, 2005, the Commission concluded that depleted uranium is properly considered a form of low-level radioactive waste ("regardless of which form it may take," as stated in the Commission Order). Additionally, as described in 10 CFR § 61.55(a)(6), depleted uranium is Class A waste.

The quantity of depleted uranium potentially requiring disposition could affect the available disposal capacity for low-level waste. A June 2004 General Accounting Office report concluded there is sufficient disposal capacity for current volumes of Class A low-level radioactive waste to last for more than 20 years (GAO, 2004).

Further, access to the existing low-level waste disposal facilities is limited by certain agreements and is potentially subject to change. The Barnwell, South Carolina disposal facility currently accepts waste from all U.S. generators except those in Rocky Mountain and Northwest compacts. Beginning in 2008, however, the Barnwell facility will only accept waste from the Atlantic Compact States, which are limited to Connecticut, New Jersey, and South Carolina. The Richland, Washington disposal facility currently accepts waste only from the Northwest and Rocky Mountain Compacts, which together comprise Washington, Oregon, Idaho, Montana, Utah, Wyoming, Nevada, Colorado, New Mexico, Alaska, and Hawaii. Therefore, for the converted depleted uranium from the proposed ACP, the only viable existing disposal options are the Envirocare facility in Clive, Utah or the DOE-operated Nevada Test Site facility. The remaining estimated capacity for the Envirocare facility is approximately 2.1 million cubic meters (2.7 million cubic yards). Assuming a waste density 0.39 cubic meter per metric ton (0.46 cubic yard per ton), the total amount of depleted UF_6 estimated to be generated by the proposed ACP equates to approximately 222,485 cubic meters (291,000 cubic yards), which would take up approximately 11 percent of the remaining Envirocare capacity. Considering this small fraction, along with the fact that some of the proposed ACP's converted depleted uranium could go to the Nevada Test Site if needed, the impacts on available disposal capacity are expected to be SMALL.

Low-Level Radioactive Waste

Operation of the proposed ACP would result in generation of relatively small amounts of low-level radioactive waste in addition to the depleted uranium tails. These wastes include classified waste (failed centrifuges), heeled cylinders, and assorted other wastestreams. Much of this waste would be typically transferred to the XT-847 Facility, where the waste may be further sampled/measured to assist in determining the proper waste characterization and proper disposal/treatment. After containerization, characterization, labeling/marking, and other processing, the waste would be scheduled for off-reservation disposal/treatment at a Treatment, Storage, Disposal, Recycling Facility. Such offsite facilities to be used by the proposed ACP include the Envirocare facility in Utah for low-level radioactive waste and the Nevada Test Site in Nevada for classified waste. These are licensed facilities for the type of waste intended to be shipped to them from the proposed ACP. Handling of low-level radioactive wastes will be by workers monitored as part of the site radiological control program.

Failed Centrifuges

Centrifuges that fail during operation would be maintained onsite to be crushed and disposed during decommissioning. The rate of centrifuge failures is expected to be very low, so this waste stream is expected to be small in volume (12-15 cubic meters per year [420-520 cubic feet per year]) (USEC, 2005a). The radiological activity in the failed centrifuge waste is expected to be low, since the centrifuges hold only a small amount of uranium at any given time.

Table D-5 Radioactive Waste Shipment Routes

Route	Radioactive Shipments							
	Feed Material (Natural UF_6)	Product (Enriched UF_6)	Heeled Containers	LowLevel Radioactive Waste	Mixed Low-Level Radioactive Waste	Low-Level Liquid Radioactive Waste	Depleted Uranium (U_3O_8)	Calcium Fluoride (CaF_2)
Metropolis, IL to ACP	✓							
Port Huron, ON to ACP	✓							
Wilmington, DE to ACP	✓							
ACP to Richland, WA		✓	✓					
ACP to Columbia, SC		✓	✓					
ACP to Wilmington, NC		✓						
ACP to Seattle, WA		✓						
ACP to Clive, UT				✓			✓	✓
ACP to Nevada Test Site, NV				✓				
ACP to Gainsville, FL					✓			
ACP to Oak Ridge, TN						✓		

Source: USEC, 2005.

Table D-12 Number of Latent Cancer Fatalities Expected from the Incident-Free Transportation of Radioactive Materials for One Year of Operation

Route	Material	Latent Cancer Fatalities							
		MEI	Drivers	Off-Link Public	On-Link Public	Rest Stop	Inspection Stop	Loading	Total
Metropolis, IL to ACP	Feed Material	6.2×10^{-9}	1.2×10^{-3}	6.8×10^{-5}	4.4×10^{-4}	8.1×10^{-4}	1.1×10^{-3}	3.0×10^{-3}	4.0×10^{-3}
Port Hope, ON to ACP	Feed Material	9.4×10^{-9}	1.4×10^{-3}	1.4×10^{-4}	1.1×10^{-3}	1.2×10^{-3}	6.9×10^{-4}	5.2×10^{-4}	5.1×10^{-3}
Wilmington, DE to ACP	Feed Material	1.5×10^{-9}	2.5×10^{-4}	2.2×10^{-5}	1.7×10^{-4}	2.0×10^{-4}	1.8×10^{-4}	9.7×10^{-5}	9.1×10^{-4}
ACP to Richland, WA	Product	5.0×10^{-10}	2.8×10^{-4}	1.3×10^{-5}	1.1×10^{-4}	2.6×10^{-4}	1.1×10^{-4}	6.5×10^{-5}	8.3×10^{-4}
ACP to Columbia, SC	Product	5.9×10^{-10}	8.8×10^{-5}	8.8×10^{-6}	5.2×10^{-5}	3.8×10^{-5}	7.1×10^{-5}	7.7×10^{-5}	3.3×10^{-4}
ACP to Wilmington, NC	Product	6.7×10^{-10}	1.2×10^{-4}	1.2×10^{-5}	7.0×10^{-5}	8.7×10^{-5}	6.4×10^{-5}	8.7×10^{-5}	4.4×10^{-4}
ACP to Seattle, WA (Korea)	Product	1.3×10^{-10}	1.1×10^{-4}	4.0×10^{-6}	3.6×10^{-5}	8.3×10^{-5}	3.3×10^{-5}	1.6×10^{-5}	2.8×10^{-4}
ACP to Seattle, WA (Japan)	Product	1.9×10^{-10}	1.5×10^{-4}	7.7×10^{-6}	7.0×10^{-5}	2.3×10^{-4}	5.4×10^{-5}	2.2×10^{-5}	5.4×10^{-4}
Richland, WA to ACP	Heels	8.9×10^{-11}	5.1×10^{-5}	2.3×10^{-6}	1.9×10^{-5}	4.7×10^{-5}	1.9×10^{-5}	4.9×10^{-5}	1.9×10^{-4}
Columbia, SC to ACP	Heels	8.9×10^{-11}	1.3×10^{-5}	1.3×10^{-6}	8.0×10^{-6}	5.8×10^{-6}	1.1×10^{-5}	4.9×10^{-5}	8.8×10^{-5}
ACP to Clive UT	LLW	3.5×10^{-10}	1.3×10^{-4}	7.4×10^{-6}	6.4×10^{-5}	1.6×10^{-4}	4.1×10^{-5}	7.3×10^{-5}	4.7×10^{-4}
ACP to Nevada Test Site, NV	LLW	1.4×10^{-10}	1.6×10^{-4}	3.6×10^{-6}	3.4×10^{-5}	8.1×10^{-5}	3.8×10^{-5}	3.0×10^{-5}	3.5×10^{-4}
ACP to Gainsville, FL	Mixed LLW	7.3×10^{-11}	2.5×10^{-5}	1.6×10^{-6}	9.3×10^{-6}	1.4×10^{-5}	1.4×10^{-5}	1.0×10^{-5}	7.5×10^{-5}
Piketon, OH to Clive, UT	U_3O_8	3.2×10^{-11}	2.2×10^{-7}	7.3×10^{-7}	7.3×10^{-8}	2.7×10^{-5}	0	0	2.8×10^{-5}
Piketon, OH to Clive, UT	CaF_2	3.2×10^{-15}	2.2×10^{-10}	7.3×10^{-11}	7.3×10^{-11}	2.7×10^{-9}	0	0	3.1×10^{-9}
Total		9.4×10^{-9}	4.0×10^{-3}	2.9×10^{-4}	2.2×10^{-3}	3.3×10^{-3}	2.4×10^{-3}	1.4×10^{-3}	1.4×10^{-2}

Table D-13 Number of Latent Cancer Fatalities Expected from Accidents Resulting from the Transportation of Radioactive Materials for One Year of Operation

Route	Material	Latent Cancer Fatalities				
		Ground	Inhaled	Resuspended	Cloudshine	Total
Metropolis, IL to ACP	Feed Material	5.2×10^{-6}	4.8×10^{-4}	3.2×10^{-4}	3.5×10^{-10}	8.0×10^{-4}
Port Hope, ON to ACP	Feed Material	1.3×10^{5}	1.2×10^{-3}	8.0×10^{-4}	8.8×10^{-10}	2.0×10^{-3}
Wilmington, DE to ACP	Feed Material	9.8×10^{-6}	8.0×10^{-4}	5.2×10^{-4}	2.5×10^{-10}	1.3×10^{-3}
ACP to Richland, WA	Product	7.5×10^{-6}	6.6×10^{-4}	2.1×10^{-4}	2.0×10^{-10}	8.7×10^{-4}
ACP to Columbia, SC	Product	4.9×10^{-6}	4.3×10^{-4}	1.3×10^{-4}	1.3×10^{-10}	5.6×10^{-4}
ACP to Wilmington, NC	Product	6.5×10^{-6}	5.7×10^{-4}	1.8×10^{-4}	1.8×10^{-10}	7.5×10^{-4}
ACP to Seattle, WA (Korea)	Product	2.5×10^{-6}	2.1×10^{-4}	6.9×10^{-5}	6.6×10^{-11}	2.8×10^{-4}
ACP to Seattle, WA (Japan)	Product	3.5×10^{-6}	3.0×10^{-4}	9.6×10^{-5}	9.2×10^{-11}	3.9×10^{-4}
Richland, WA to ACP	Heels	5.2×10^{-8}	3.2×10^{-6}	7.2×10^{-6}	1.0×10^{-12}	1.0×10^{-5}
Columbia, SC to ACP	Heels	2.8×10^{-8}	1.8×10^{-6}	4.0×10^{-6}	5.5×10^{-13}	5.8×10^{-6}
ACP to Clive UT	LLW	5.2×10^{-8}	4.4×10^{-6}	5.1×10^{-6}	5.7×10^{-12}	9.5×10^{-6}
ACP to Nevada Test Site, NV	LLW	8.8×10^{-9}	5.5×10^{-7}	1.7×10^{-6}	4.5×10^{-12}	2.2×10^{-6}
ACP to Gainsville, FL	Mixed LLW	2.0×10^{-9}	1.3×10^{-7}	5.7×10^{-7}	1.0×10^{-12}	7.0×10^{-7}
Piketon, OH to Clive, UT	U_3O_8	1.7×10^{-6}	7.4×10^{-4}	6.1×10^{-7}	9.1×10^{-10}	7.5×10^{-4}
Piketon, OH to Clive, UT	CaF_2	3.5×10^{-11}	2.9×10^{-9}	1.3×10^{-8}	3.6×10^{-15}	1.6×10^{-8}
Total		5.4×10^{-5}	5.4×10^{-3}	2.3×10^{-3}	3.1×10^{-9}	7.8×10^{-3}