

RAS 13472



February 28, 2006
AET 06-0036

Mr. Jack R. Strosnider
Director, Office of Nuclear Material Safety and Safeguards
Attention: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

**American Centrifuge Plant
Docket Number 70-7004
Submittal of Additional Information for the American Centrifuge Plant Related to Depleted Uranium Disposal Costs (TAC Nos. L32306, L32307, and L32308)**

Dear Mr. Strosnider:

By letter dated December 8, 2005, USEC Inc. (USEC) requested that the U.S. Department of Energy (DOE) provide USEC with a cost estimate for disposal of tails from the American Centrifuge Plant with a similar level of detail as was provided to the Louisiana Energy Services (LES) in support of its application for the National Enrichment Facility. In a letter dated December 12, 2005, the DOE provided a cost breakdown of the four principal cost components for disposal of depleted uranium and confirmed that \$4.83/kilogram uranium (\$3.26/kg depleted uranium hexafluoride) was a reasonable unit cost for the purposes of decommissioning funding for the American Centrifuge Plant.

Subsequently, during a telephone conference call between the U.S. Nuclear Regulatory Commission (NRC), DOE, and USEC that was conducted on December 19, 2005, the NRC staff requested that DOE "develop and provide USEC a cost estimate and supporting basis for dispositioning the depleted uranium that USEC would generate at its proposed American Centrifuge Plant." Based on USEC's December 27, 2005, formal request to DOE for such a report (Enclosure 1), DOE provided its response on February 10, 2006 (Enclosure 2).

The DOE response contained a redacted report prepared by DOE's consultant LMI, detailing its methodology for estimating the unit cost of disposal of depleted uranium. The report was initially prepared by DOE in response to a request by LES, but the methodology and underlying information is applicable to the American Centrifuge Plant with only minor adjustments. Utilizing the LMI methodology, USEC prepared an analysis that confirms that the \$4.83/kilogram uranium that USEC has assumed in the estimate for decommissioning funding for the American Centrifuge Plant is a conservative upper bound. The USEC-specific analysis is provided in Enclosure 3.

TEMPLATE = SECY-027

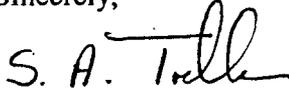
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~~NMSSO1~~

Mr. Jack R. Strosnider
February 28, 2006
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If you have any questions regarding this matter, please contact Peter J. Miner at (301) 564-3470.

Sincerely,



Steven A. Toelle
Director, Regulatory Affairs

cc: Y. Faraz, NRC HQ
B. Smith, NRC HQ

Enclosures: As Stated

Enclosure 1 of AET 06-0036

**USEC Request to DOE for Cost Estimate and Supporting Basis for
Depleted Uranium Disposal Costs**



Philip G. Sewell
Senior Vice President

301/564-3305 *phone*
301/564-3205 *fax*

December 27, 2005

Mr. Larry Brown
Senior Policy Advisor
Under Secretary's Office
U.S. Department of Energy
1000 Independence Avenue, S.W.
Room 7A-219
Washington, DC 20585

Dear Mr. Brown:

We have been discussing the estimate of the cost for DOE to dispose of tails generated at the proposed American Centrifuge Plant for a number of months. On December 8, 2005, USEC provided a letter requesting that that DOE provide USEC with a cost estimate for disposal of tails from the American Centrifuge Plant with a similar level of detail as was provided to LES. In a letter dated December 12, 2005, the DOE provided a cost breakdown of the four principal cost components for disposal of depleted uranium and confirmed that \$4.83/kilogram uranium as a reasonable unit cost for the purposes of decommissioning funding for the American Centrifuge Plant.

Subsequently, on December 19, a telephone conference call was held between the NRC (and consultant ICF) and DOE (and consultant LMI) concerning the basis for the depleted uranium disposition cost estimate of \$4.83/kilogram uranium. DOE participants included Linda Gunter, Ray Miskelley, and Jack Zimmerman. USEC also participated in the call.

Mr. Brian Smith of the NRC stated that the purpose of the telephone conference call was to help NRC understand the basis for DOE's estimate. The telephone conference call was necessary since the information provided in the DOE letter was not detailed enough to accomplish this. The NRC indicated that a report, similar in detail to what was prepared by DOE for LES, was needed. During the call, Mr. Smith requested that certain technical issues be specifically addressed by DOE during preparation of its report to support the unit cost estimate.

USEC Inc.
6903 Rockledge Drive, Bethesda, MD 20817-1818
Telephone 301-564-3200 Fax 301-564-3201 <http://www.usec.com>

Mr. Larry Brown
December 27, 2005
Page 2

Based on discussions with the NRC on December 20, it is our understanding that DOE needs a written request by USEC in order to expeditiously proceed with preparing and submitting the report. Accordingly, the purpose of this letter is to request that DOE prepare such a report, in the same detail as the report prepared for LES and addressing the technical issues requested by the NRC during the December 19 telephone conference call. USEC would submit the report to the NRC to support licensing of the American Centrifuge Plant. As previously stated, should DOE require, USEC would enter into a confidentiality agreement with DOE and/or its contractor and would request the NRC to protect the report from public disclosure in accordance with NRC regulations.

We would appreciate your timely response to this request so that it does not delay the licensing process for the American Centrifuge Plant and thereby jeopardize future milestones.

If you should have any questions, please do not hesitate to contact me.

Sincerely,

Philip G. Sewell

Philip G. Sewell

Enclosure 2 of AET 06-0036

**DOE Response to USEC Request for Cost Estimate and Supporting Basis for
Depleted Uranium Disposal Costs**



Department of Energy

Washington, DC 20585

February 10, 2006

Mr. Phil Sewell
Senior Vice President
USEC Inc.
6903 Rockledge Drive
Bethesda, MD 20817

Dear Mr. Sewell:

RE: Conversion and Disposal of Depleted Uranium Hexafluoride (DUF6) Generated by USEC at the American Centrifuge Plant in Piketon, Ohio

This letter follows our previous communications regarding USEC's inquiry, detailed in your initial letter dated December 8, 2005, as to anticipated storage, conversion and disposal costs for the DUF6 source material to be generated by USEC's proposed American Centrifuge Plant, in the event that USEC were to request that the Secretary accept the DUF6 for conversion and disposal.

In a letter dated December 12, 2005, I provided you with information on the Department's cost estimate of approximately \$3.34/kg DUF6 for converting and disposing of DUF6, broken out into components of conversion (capital and operating), transportation, and storage, and disposal (including D&D). USEC has provided this cost estimate to the Nuclear Regulatory Commission (NRC) in support of USEC's decommissioning cost estimate during the American Centrifuge Plant license application review.

The Department's cost estimate was initially developed by LMI Government Consulting (LMI) in response to a request by Louisiana Energy Services (LES). For a more detailed discussion of the assumptions used in preparing the estimated costs in the original report, I am enclosing a copy of that LMI study with all proprietary information redacted. If further explanation of the redacted LMI study is required, you should procure such services directly from LMI by calling Mr. Gerald Westerbeck at (703)917-7216. DOE will coordinate with LMI to obtain such information related to storage, conversion and disposal facilities.

The Department's cost estimate is a long-term forecast that is subject to recalculation and change as assumptions and circumstances change and the Department receives actual cost and performance from the conversion project after operations begin in 2007. We understand that if a license is granted to USEC, a process has been established at the NRC for a licensee to adjust its decommissioning cost estimate every three years, and that this process would account for future refinements in the cost estimate for the disposal of DUF6. Before accepting any DUF6, the Department would have to comply with all applicable laws, including the National



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Mr. Phil Sewell

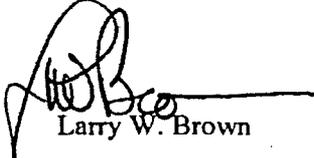
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February 10, 2006

Environmental Policy Act. Additionally, this letter does not commit the Department to the expenditure of funds, and any agreement for acceptance of DUF6 is subject to the negotiation of terms and conditions, must be in writing, and signed by the authorized Department of Energy official.

Should you have any questions, please feel free to contact me at 586-9500.

Sincerely,



Larry W. Brown

Enclosure

cc: S. Cuevas, EM
L. Gunter, NE-60
W. Murphie, EM/PPPO

[REDACTED]

This document redacted by UDS, LLC on January 31, 2006

**AN ANALYSIS OF DOE'S COST TO DISPOSE
OF DUF₆**

REVISION 1

REPORT DE523T1

LMĪ
GOVERNMENT CONSULTING

JULY 2005

[REDACTED]

APPROVED FOR RELEASE
H. H. Thomas

[REDACTED]

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LMI

An Analysis of DOE's Cost to Dispose of DUF₆, Revision 1

DE523T1/JULY 2005

Executive Summary

In December 2003, a firm submitted a license application and environmental report for its proposed gas centrifuge uranium enrichment plant to the Nuclear Regulatory Commission (NRC). [REDACTED]

DOE asked LMI to help it determine an appropriate price to charge a firm for accepting and converting DUF₆ into [REDACTED] products suitable for disposal.

[REDACTED]

DOE recently contracted with Uranium Disposition Services LLC (UDS) to design and build two conversion plants for processing DUF₆—near Portsmouth, OH, and Paducah, KY—and then operate them for the first 5 years. DOE currently has a DUF₆ backlog of 23.4 years at Paducah and 18.2 years at Portsmouth. We assume that DOE will continue to process existing backlog and any new DUF₆ through its contract with UDS or its successor.

We analyzed the costs associated with six scenarios regarding DOE's acceptance of additional DUF₆ for processing. [REDACTED]

- If DOE extends the operating period at the Paducah plant to process the additional DUF₆ *concurrently* with the existing backlog, it should charge \$2.72 per kg of DUF₆.

-
- ◆ If DOE extends the operating period at the Portsmouth plant to process the additional DUF₆ *concurrently* with the existing backlog, it should charge \$3.21 per kg of DUF₆.
 - ◆ If DOE extends the operating period at the Paducah plant to process the additional DUF₆ *after* treating the existing backlog, it should charge \$2.72 per kg of DUF₆.
 - ◆ If DOE extends the operating period at the Portsmouth plant to process the additional DUF₆ *after* treating the existing backlog, it should charge \$3.21 per kg of DUF₆.
 - ◆ If DOE expands the Paducah plant's annual capacity to process the additional DUF₆, it should charge \$2.70 per kg of DUF₆.
 - ◆ If DOE expands the Portsmouth plant's annual capacity to process the additional DUF₆, it should charge \$3.18 per kg of DUF₆.

These suggested unit rates are in FY04 dollars; therefore, these rates should be appropriately escalated to the year in which additional DUF₆ is received.

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Chapter 1 Introduction

BACKGROUND

In December 2003, a firm submitted a license application and environmental report for its proposed gas centrifuge uranium enrichment plant to the Nuclear Regulatory Commission (NRC). The firm projects that its plant will reach its full capacity of 3 million separative work units (SWUs) per year in 2010 or 2011, depending on market demand.



DOE asked LMI to conduct an independent review to help determine the rate to charge the firm for accepting and converting the DUF₆ into [redacted] uranium oxide and hydrofluoric acid—suitable for appropriate disposition. The acid may be sold or neutralized for disposal. The uranium oxide would be sent to an approved and licensed disposal site. This report provides our analysis of reasonable prices under various scenarios.

REPORT ORGANIZATION

The remainder of this report is organized as follows:

- ◆ Chapter 2 describes our economic analysis for determining the cost to DOE of accepting additional DUF₆.
- ◆ The Appendix shows assumptions that we made during our analysis.

Chapter 2

Economic Analysis

For our economic analysis, we assume that DOE will start to accept additional DUF₆ from the new uranium enrichment firm in 2011 at a rate of 7,400 metric tons (equivalent to 5,000 metric tons of uranium) per year for 30 years.

DOE recently contracted with Uranium Disposition Services LLC (UDS) to design and build two conversion plants for disposing of DUF₆—near Portsmouth, OH, and Paducah, KY—and then operate them for the first 5 years. DOE currently has a DUF₆ backlog of 23.4 years at Paducah and 18.2 years at Portsmouth. We assume that DOE will continue to process existing and any new DUF₆ through its contract with UDS or its successor.

We assume that DOE will process the additional DUF₆ at the Portsmouth or Paducah sites. We also assume that the facilities at Portsmouth and Paducah will be decontaminated and decommissioned (D&D) at the end of the scenarios. (See the appendix for further assumptions regarding our analysis.)

ALTERNATIVE SCENARIOS

We analyzed six different scenarios for processing the additional DUF₆:

1. DOE extends the operating period at the Paducah plant to process the additional DUF₆, and the plant operates for 36 years starting in 2009; the existing backlog and additional DUF₆ are processed concurrently.
2. DOE extends the operating period at the Portsmouth plant to process the additional DUF₆, and the plant operates for 35 years starting in 2009; the existing backlog and additional DUF₆ are processed concurrently.
3. DOE extends the operating period at the Paducah plant to process the additional DUF₆, and the plant operates for 36 years starting in 2009; the existing backlog is processed first, followed by the additional DUF₆.
4. DOE extends the operating period at the Portsmouth plant to process the additional DUF₆, and the plant operates for 35 years starting in 2009; the existing backlog is processed first, followed by the additional DUF₆.
5. DOE expands the Paducah plant's annual capacity to process the additional DUF₆, and the plant operates for 32 years starting in 2009, allowing for 30 years of processing the additional DUF₆.

On the basis of Paducah's planned annual capacity of 18,000 metric tons and its annual operations cost of \$26 million, the average annual cost to operate the plant is \$1.45 per kg of DUF₆ treated. We estimate the cost to DOE of transporting the DUF₆ from New Mexico, where the firm is currently considering building its plant, to Paducah at approximately \$0.09 per kg, and we estimate the cost of [REDACTED] product disposal at approximately \$0.37 per kg. We estimate that the recapitalization cost will be \$0.28 per kg.¹ We also assume that the firm would share a portion of the surveillance and maintenance costs at the plants, and that translates into a cost of \$0.003 per kg. Therefore, we find a total annual operations cost to DOE of \$2.19 per kg of DUF₆ for transporting the DUF₆ to the Paducah plant, processing, and disposal.

CAPITAL COSTS AT PADUCAH

[REDACTED]
we also assume that the firm will be charged a proportionate share of construction and D&D costs.² The planned construction cost at Paducah is \$151.7 million, which translates to a pro rata cost to the firm of \$0.42 per kg.³ We estimate the D&D cost at \$57.15 million, which translates to a pro rata cost to the firm of \$0.04 per kg.⁴ In addition to the annual operations costs and the capital costs, we assume that DOE is authorized to charge 3 percent as a federal administrative charge (\$0.08 per kg). Table 2-2 shows further details of our analysis.

¹ Using probabilistic risk analysis with triangular distribution from 2 to 5 percent of capital costs, with 3 percent of capital costs as the most likely annual recapitalization cost.

² In this scenario, the proportionate share is 35 percent: 222,000 metric tons of additional DUF₆ will be processed, and 421,200 metric tons of backlog DUF₆ will be processed.

³ Construction costs are based on the proposed baseline costs for the conversion plant at Paducah.

⁴ National Research Council, *Affordable Cleanup: Opportunities for Cost Reduction in the Decontamination and Decommissioning of the Nation's Uranium Enrichment Facilities*, 1996, and LMI, *Evaluation of the Centrifuge Facility at Portsmouth: an External Independent Review*, Report DE427T1, June 2004.

Table 2-2. Annual Cost to DOE of Processing Additional DUF₆ at the Paducah Plant

Scenario 1: Process at Paducah in "Base" Plant			
Assumptions			
1. Plant remains in operation until the DOE backlog and 30 years of the firm's DUF ₆ are processed			
2. The firm's DUF ₆ is treated when received, concurrently with the DOE backlog DUF ₆			
3. Discount rate 3.50%			
	(\$FY04 Dollars)		
Investment costs			
Plant construction	\$181,700,000		
Life of the plant	38 years, starting	2009	
Start receiving the firm's DUF ₆	2011		
Current DOE backlog	421,200 MT		
Firm's production requirement	222,000 MT		
Firm's pro rata share	35%		
Firm's pro rata investment cost	\$62,359,142		
Investment cost in equivalent annual value	\$2,580,478		
Investment equiv. annual value cost per kg		\$0.42 per kg	
Annual operating costs			
Plant operations			
Plant recapitalization costs			
Transportation to Paducah costs			
product disposal			
Surveillance and maintenance costs			
Decon & Decommissioning			
Plant D&D cost	\$57,150,000		
Firm's pro rata share	35%		
Firm's pro rata D&D cost	\$19,725,250		
Firm's equivalent uniform annual cost	\$227,234 per year		
Firm's equiv. uniform annual cost per kg		\$0.04 per kg	
Federal administrative charge		\$1.08 per kg	
Firm's annual cost		\$2.72 per kg	

Note: Totals do not equal the sum of individual numbers due to rounding.

TOTAL COSTS AT PADUCAH

In summary, we estimate that it will cost DOE \$2.72 per kg (FY04 dollars) to process the additional DUF₆ at Paducah, a reasonable price for DOE to charge the firm. Table 2-3 shows the price in future years with the impact of inflation.

Table 2-3. Impact of Inflation on Future Years' Price

Year	Cost to process/dispose of 1 kg of DUF ₆ (\$)
FY04	2.72
FY11	3.42
FY27	6.76

Assumptions: Annual inflation is 3.3 percent; earliest processing of additional DUF₆ is FY11.

\$2.58 per kg of DUF₆ for transporting the DUF₆ to the Portsmouth plant, processing, and disposal.

CAPITAL COSTS AT PORTSMOUTH

we also assume that the firm will be charged a proportionate share of construction and D&D costs.⁶ The planned construction cost at Portsmouth is \$133.8 million, which translates to a pro rata cost to the firm of \$0.50 per kg.⁷ We estimate the D&D cost at \$47.6 million, which translates to a pro rata cost to the firm of \$0.04 per kg.⁸ In addition to the annual operations costs and the capital costs, we assume that DOE is authorized to charge 3 percent as a federal administrative charge (\$0.09 per kg). Table 2-5 shows further details of our analysis.

Table 2-5. Annual Cost to DOE of Processing Additional DUF₆ at the Portsmouth Plant

Scenario 2: Process at Portsmouth in "Base" Plant			
Assumptions			
1. Plant remains in operation until the DOE backlog and 30 years of the firm's DUF ₆ are processed			
2. The firm's DUF ₆ is treated when received, concurrently with DOE backlog DUF ₆			
3. Discount rate: 3.00%			
	(FY04 Dollars)		
Investment costs			
Plant construction	\$132,800,000		
Life of the plant		33 years, starting	2009
Start receiving the firm's DUF ₆		2011	
Current DOE backlog	245,700 MT		
Firm's production requirement	222,000 MT		
Firm's pro rata share	47%		
Firm's pro rata investment cost	\$63,508,542		
Investment cost in equivalent annual value	\$5,175,592		
Investment equiv. annual value cost per kg			\$0.50 per kg
Annual operating costs			
Plant operations			
Plant recapitalization costs			
Transportation to Portsmouth costs			
Product disposal			
Surveillance and Maintenance costs			
Decommissioning			
Plant D&D cost	\$47,600,000		
Firm's pro rata share	47%		
Firm's pro rata D&D cost	\$22,690,970		
Firm's equivalent uniform annual cost	\$285,321 per year		
Firm's equiv. uniform annual cost per kg			\$0.04 per kg
Federal administrative charge			\$0.09 per kg
Firm's annual cost			\$1.21 per kg

Note: Totals do not equal the sum of individual numbers due to rounding.

⁶ In this scenario, the proportionate share is 47 percent: 222,000 metric tons of additional DUF₆ will be processed, and 245,700 metric tons of backlog DUF₆ will be processed.

⁷ Construction costs are based on the proposed baseline costs for the conversion plant at Portsmouth.

⁸ See Note 4.

TOTAL COSTS AT PORTSMOUTH

In summary, we estimate that it will cost DOE \$3.21 per kg (FY04 dollars) to process additional DUF₆ at Portsmouth, a reasonable price for DOE to charge the firm. Table 2-6 shows the price in future years with the impact of inflation.

Table 2-6. Impact of Inflation on Future Years' Price

Year	Cost to process/dispose of 1 kg of DUF ₆ (\$)
FY04	3.21
FY11	4.03
FY27	8.78

Assumptions: Annual inflation is 3.3 percent; earliest processing of additional DUF₆ is FY11.

Scenario 3

In Scenario 3, DOE extends the operating period at the Paducah plant to process backlog and additional DUF₆ with an annual plant capacity of 18,000 metric tons. We assume that the plant operates for 36 years starting in 2009 and that the existing backlog is processed first, followed by the additional DUF₆. We assume D&D occurs in 2045.

The analysis for Scenario 3 is identical to the analysis for Scenario 1 with one exception: the year that DOE starts processing the firm's DUF₆. In Scenario 1, DOE accepts the firm's DUF₆ in 2011 and starts processing it in 2011. In Scenario 3, DOE accepts it in 2011 and starts processing it in 2032.

Regardless of when DOE starts processing the additional DUF₆, a reasonable price for DOE to charge the firm is the same: \$2.72 per kg (FY04 dollars).

Scenario 4

In Scenario 4, DOE extends the operating period at the Portsmouth plant to process backlog and additional DUF₆ with an annual plant capacity of 13,500 metric tons. We assume that the plant operates for 35 years starting in 2009 and that the existing backlog is processed first, followed by the additional DUF₆. We assume D&D occurs in 2044.

The analysis for Scenario 4 is identical to the analysis for Scenario 2 with one exception: the year that DOE starts processing the firm's DUF₆. In Scenario 2, DOE accepts the firm's DUF₆ in 2011 and starts processing it in 2011. In Scenario 4, DOE accepts it in 2011 and starts processing it in 2027.

Regardless of when DOE starts processing the additional DUF₆, a reasonable price for DOE to charge the firm is the same: \$3.21 per kg (FY04 dollars).

Scenario 5

In Scenario 5, DOE expands the Paducah plant's annual capacity (one additional conversion line with three conversion units) by 6,750 metric tons to process backlog and additional DUF₆, with a total annual plant capacity of 24,750 metric tons. We assume that the plant stays open for 32 years starting in 2009 and that D&D occurs in 2041.

ANNUAL OPERATIONS COSTS AT EXPANDED PADUCAH PLANT

We assume that the annual operations costs remain the same as in Scenarios 1 and 3 with one exception: the recapitalization cost decreases from \$0.28 per kg to \$0.23 per kg. The resulting annual operations cost is \$2.13 (compared to \$2.19 in Scenarios 1 and 3).⁹

CAPITAL COSTS AT EXPANDED PADUCAH PLANT

[REDACTED] we assume that the firm will be charged a proportionate share of construction and D&D costs.¹⁰ We estimate the construction cost for an expanded plant at Paducah at \$167.9 million, which translates to a pro rata cost to the firm of \$0.44 per kg.¹¹ We estimate the D&D cost at \$71.5 million, which translates to a pro rata cost to the firm of \$0.05 per kg.¹² In addition to the annual operations costs and the capital costs, we assume that DOE would charge 3 percent as a federal administrative charge (\$0.08 per kg). Table 2-7 shows further details of our analysis.

⁹ Totals do not equal the sum of individual numbers due to rounding.

¹⁰ See Note 2.

¹¹ See Note 3.

¹² See Note 4.

Table 2-7. Annual Cost to DOE of Processing Additional DUF₆ at Expanded Plant at Paducah

Scenario 4: Process at Paducah in Expanded Plant

Assumptions

1. Plant operates until the DOE backlog DUF₆ and 30 years of the firm's DUF₆ are processed
2. The firm's DUF₆ is treated when received, concurrently with DOE backlog DUF₆
3. Discount rate: 3.80%

	(FY04 Dollars)	
Investment costs to accommodate	7,400 MT per year from the firm	
Plant construction (expansion)	\$167,800,000	
Life of plant	32 years, starting	2001
Start receiving the firm's DUF ₆	2011	
Current DOE backlog	421,200 MT	
Firm's production requirement	222,000 MT	
Firm's pro rata share	35%	
Firm's pro rata investment cost	\$57,980,560	
Investment cost in equivalent annual value	\$3,039,015	
Investment equiv. annual value cost per kg		\$0.44 per kg
Operating costs		
Annual costs		
Recapitalization costs		
Transportation to Paducah costs		
Product disposal		
Surveillance and Maintenance costs		
Decon & Decommissioning		
Plant D&D cost	\$71,490,250	
Firm's pro rata share	35%	
Firm's pro rata D&D cost	\$24,874,808	
Firm's equivalent uniform annual cost	\$982,356	per year
Firm's equiv. uniform annual cost per kg		\$0.05 per kg
Federal administrative charge		\$0.05 per kg
Firm's annual cost		\$2.70 per kg

Note: Totals do not equal the sum of individual numbers due to rounding.

TOTAL COSTS AT EXPANDED PADUCAH PLANT

In summary, we estimate that it will cost DOE \$2.70 per kg (FY04 dollars) to process additional DUF₆ at an expanded Paducah plant, a reasonable price for DOE to charge the firm. Table 2-8 shows the price in future years with the impact of inflation.

Table 2-8. Impact of Inflation on Future Years' Price

Year	Cost to process/dispose of 1 kg of DUF ₆ (\$)
FY04	2.70
FY11	3.39
FY27	5.70

Assumptions: Annual inflation is 3.3 percent; earliest processing of additional DUF₆ is FY11.

Scenario 6

In Scenario 6, DOE expands the Portsmouth plant annual capacity (one additional conversion line with three conversion units) by 6,750 metric tons to process backlog and additional DUF₆, with a total annual capacity of 20,250 metric tons. In this scenario, DOE expands the Portsmouth plant by equipping and using the currently planned fourth line with three conversion units versus the planned two conversion units. We assume that the plant stays open for 32 years starting in 2009 and that D&D occurs in 2041.

ANNUAL OPERATIONS COSTS AT EXPANDED PORTSMOUTH PLANT

We assume that the annual operations costs remain the same as in Scenarios 2 and 4 with one exception: the recapitalization cost decreases from \$0.33 per kg to \$0.25 per kg. The resulting annual operations cost is \$2.49 (compared to \$2.58 in Scenarios 2 and 4).¹³

CAPITAL COSTS AT EXPANDED PORTSMOUTH PLANT

[REDACTED]
[REDACTED], we also assume that the firm will be charged a proportionate share of construction and D&D costs.¹⁴ We estimate the construction cost for an expanded plant at Portsmouth at \$144.1 million, which translates to a pro rata cost to the firm of \$0.63 per kg.¹⁵ We estimate the D&D cost at \$57.15 million, which translates to a pro rata cost to the firm of \$0.06 per kg.¹⁶ In addition to the annual operations costs and the capital costs, we assume that DOE would charge 3 percent as a federal administrative charge (\$0.09 per kg). Table 2-9 shows further details of our analysis.

¹³ Totals do not equal the sum of individual numbers due to rounding.

¹⁴ See Note 6.

¹⁵ See Note 3.

¹⁶ See Note 4.

Table 2-9. Annual Cost to DOE of Processing Additional DUF₆ at Expanded Plant at Portsmouth

Scenario 1: Process at Portsmouth in Expanded Plant	
Assumptions	
1. Plant operates until the DOE backlog DUF ₆ and 30 years of the firm's DUF ₆ are processed	
2. The firm's DUF ₆ is treated when received, concurrently with DOE backlog DUF ₆	
3. Discount rate 3.60%	
	(FY04 Dollars)
Investment costs to accommodate	7,400 MT per year from the firm
Plant construction (re-suspension)	\$149,250,000
Life of UDS plant	32 years, starting 2009
Start receiving the firm's DUF ₆	2011
Current DOE backlog	245,700 MT/year
Firm's production requirement	222,000 MT/year
Firm's pro rata share	47%
Firm's pro rata investment cost	\$70,843,469
Investment cost in equivalent annual value	\$3,715,139
Investment equiv. annual value cost per kg	\$0.54 per kg
Operating costs	
Annual costs	
Plant recapitalization costs	
Transportation to Portsmouth costs	
Product disposal	
Surveillance and Maintenance costs	
Decon & Decommissioning	
Plant D&D cost	\$57,160,000
Firm's pro rata share	47%
Firm's pro rata D&D cost	\$27,127,004
Firm's equivalent uniform annual cost	\$598,388 per year
Firm's equiv. uniform annual cost per kg	\$0.06 per kg
Federal administrative charge	\$0.06 per kg
Firm's annual cost	\$3.18 per kg

Note: Totals do not equal the sum of individual numbers due to rounding.

TOTAL COSTS AT EXPANDED PORTSMOUTH PLANT

In summary, we estimate that it will cost DOE \$3.18 per kg (FY04 dollars) to process additional DUF₆ at an expanded Portsmouth plant, a reasonable price for DOE to charge the firm. Table 2-10 shows the price in future years with the impact of inflation.

Table 2-10. Impact of Inflation on Future Years' Price

Year	Cost to process/dispose of 1 kg of DUF ₆ (\$)
FY04	3.18
FY11	3.89
FY27	6.70

Assumptions: Annual inflation is 3.3 percent; earliest processing of additional DUF₆ is FY11.

Appendix Assumptions for Economic Analysis

GENERAL ASSUMPTIONS REGARDING DUF₆ DISPOSAL

For all scenarios, we assume the following:

- ◆ DOE accepts 7,400 metric tons of DUF₆ (equivalent to 5,000 metric tons of uranium) annually for 30 years from a uranium enrichment firm for processing and disposal starting in 2011.
- ◆ DOE processes the additional DUF₆ under its current contract with UDS, or a successor firm, under current terms and conditions.
- ◆ The contractual agreement between UDS and DOE does not include the cost to transport the DUF₆ to the processing site (Paducah or Portsmouth). Therefore, we calculate the transportation from New Mexico to the processing plant, and we add it to the annual operations cost at the plants to reflect the actual operations cost to DOE.
- ◆ A reasonable price for DOE to charge is based on:
 - > Operations costs:
 - transportation of the DUF₆ to the processing site,
 - processing of the DUF₆ (annual operations at a DOE plant site),
 - recapitalization costs at the DOE plants,
 - surveillance and maintenance costs at the DOE plants,
 - [REDACTED] product disposal, and
 - transportation to the [REDACTED] disposal site [REDACTED]
 - > Capital costs:
 - the annualized cost of construction, and
 - the annualized cost of D&D of the processing facilities.
 - > A federal administrative charge of 3 percent.

- ◆ Costs are shown in FY04 dollars unless otherwise specified.

SCENARIO-SPECIFIC ASSUMPTIONS

We premise each scenario on the above assumptions, but make specific assumptions for each scenario, which we describe below.

Scenario 1—Paducah

For Scenario 1, we assume the following:

- ◆ The plant has the capacity to process 18,000 metric tons (MT) of DUF₆ annually.
- ◆ Paducah's current backlog of DUF₆ is 23.4 years.
- ◆ The existing backlog DUF₆ and the additional DUF₆ are processed concurrently.
- ◆ The plant construction cost is \$151.7 million.
 - > Construction costs are based on the proposed performance baseline costs (September 2004) for the conversion plant at Paducah, KY.
 - > Costs include conversion building, potassium hydroxide (KOH) regeneration building, administration building, warehouse/maintenance building, hydrofluoric acid (HF) neutralization building, all site preparation and improvements, utilities, and site infrastructure.
 - > Costs include management reserve and contractor fee.
 - > The baseline capacity is 18,000 MT per year of DUF₆ (approx. 1,400 cylinders) with four conversion lines, each with two conversion units/line.
 - > The total building size is 90,000 square feet.
- ◆ The plant D&D cost is \$57.15 million.
 - > The same assumptions for the construction cost apply to the D&D cost.
 - > D&D occurs in 2045.
 - > D&D costs include all engineering and design, planning, permitting, remedial activities, project and construction management, contingency, and contractor fee.

Assumptions for Economic Analysis

- > Costs assume appropriate allowance for decontamination of contaminated structures and equipment.
- > Costs assume returning the site to green-field status.
- > On the basis of an NRC study and an LMI external independent review (EIR), we used \$600 per square foot for process equipment removal. This includes all environmental permitting and planning, remedial actions, decontamination of equipment and surfaces, shipping, and disposal.
- > For building debris, 80 percent by weight is reused or recycled at no cost to the project; 20 percent is disposed of in a local landfill.
- > D&D of building structures is estimated at \$35 per square foot. Costs include removal of concrete slab and foundations.
- ◆ The firm's pro rata share of the capital costs is 35 percent (222,000 MT → 643,200 MT).
- ◆ The total annual operations cost is \$2.19 per kg of DUF₆ treated.
 - > Costs include \$26 million in annual operations costs at Paducah.

Scenario 2—Portsmouth

For Scenario 2, we assume the following:

- ◆ The plant has the capacity to process 13,500 MT of DUF₆ annually.
- ◆ Portsmouth's current backlog of DUF₆ is 18.2 years.
- ◆ The existing backlog DUF₆ and the additional DUF₆ are processed concurrently.
- ◆ The plant construction cost is \$133.8 million.
 - > The same construction cost assumptions apply as in Scenario 1.
 - > The baseline capacity is 13,500 MT per year of DUF₆ (approximately 1,050 cylinders) with three conversion lines, each with two conversion units/line.
 - > The total building size is 75,000 square feet.
- ◆ The plant D&D cost is \$47.6 million.
 - > The same D&D cost assumptions apply as in Scenario 1.

> D&D occurs in 2044.

◆ The firm's pro rata share of the capital costs is 47 percent (222,000 MT + 467,700 MT).

◆ The total annual operations cost is \$2.58 per kg of DUF₆ treated.

> Costs include \$23.8 million in annual operations costs at Portsmouth.

Scenario 3—Paducah

For Scenario 3, we assume all of the same conditions apply as in Scenario 1. The only difference is the timing of the processing of the additional DUF₆. The additional DUF₆ is processed after the existing backlog, starting in 2032.

Scenario 4—Portsmouth

For Scenario 4, we assume all of the same conditions apply as in Scenario 2. The only difference is the timing of the processing of the additional DUF₆. The additional DUF₆ is processed after the existing backlog, starting in 2027.

Scenario 5—Paducah

For Scenario 5, we assume the following:

◆ The plant has an expanded capacity to process 24,750 MT of DUF₆ annually.

◆ The total plant construction cost is \$167.9 million.

> The same construction cost assumptions apply as in Scenario 1.

> The expanded capacity is 24,750 MT per year of DUF₆ with five conversion lines, four with two conversion units/line and one with three conversion units/line.

> The total building size is 105,000 square feet.

◆ The plant D&D cost is \$71.5 million.

> The same D&D cost assumptions apply as in Scenarios 1 and 3.

> D&D occurs in 2041.

◆ The firm's pro rata share of the capital costs is 35 percent, the same as in Scenarios 1 and 3.

◆ The total annual operations cost is the same as in Scenarios 1 and 3.

Scenario 6—Portsmouth

For Scenario 6, we assume the following:

- ◆ The plant has an expanded capacity to process 20,250 MT of DUF₆ annually.
- ◆ The total plant construction cost is \$149.25 million.
 - The same construction cost assumptions apply as in Scenario 1.
 - The expanded capacity is 20,250 MT per year of DUF₆ with four conversion lines, three with two conversion units/line and one with three conversion units/line.
 - The total building size is 90,000 square feet.
- ◆ The plant D&D cost is \$57.15 million.
 - The same D&D cost assumptions apply as in Scenario 1.
 - D&D occurs in 2041.
- ◆ The firm's pro rata share of the capital costs is 47 percent, the same as in Scenarios 2 and 4.
- ◆ The total annual operations cost is the same as in Scenarios 2 and 4.

Enclosure 3 of AET 06-0036

**USEC-Specific Cost Estimate for Depleted Uranium Disposal Costs
Utilizing the DOE/LMI Methodology**

**USEC-SPECIFIC ANALYSIS OF
DEPLETED URANIUM DISPOSAL COSTS
UTILIZING THE DOE/LMI METHODOLOGY**

for the American Centrifuge Plant

Revision 0



**Prepared by: USEC Inc.
February 2006**

**USEC-SPECIFIC ANALYSIS OF
DEPLETED URANIUM DISPOSAL COSTS
UTILIZING THE DOE/LMI METHODOLOGY
for the American Centrifuge Plant**

By letter dated December 8, 2005 (Reference 1), USEC Inc. (USEC) requested that that U.S. Department of Energy (DOE) provide USEC with a cost estimate for disposal of tails from the American Centrifuge Plant with a similar level of detail as was provided to the Louisiana Energy Services (LES) in support of its application for the National Enrichment Facility (NEF). In a letter dated December 12, 2005 (Reference 2), the DOE provided a cost breakdown of the four principal cost components for disposal of depleted uranium and confirmed that \$4.83/kilogram (kg) uranium (U) (\$3.26/kg depleted uranium hexafluoride [DUF₆]) was a reasonable unit cost for the purposes of decommissioning funding for the American Centrifuge Plant.

Subsequently, during a telephone conference call that was conducted on December 19, 2005 between USEC, the DOE, and the U.S. Nuclear Regulatory Commission (NRC), the NRC staff requested that DOE "develop and provide USEC a cost estimate and supporting basis for dispositioning the depleted uranium that USEC would generate at its proposed American Centrifuge Plant." The telephone conference call was documented in Reference 3. Subsequently, USEC requested in a letter dated December 27, 2005 (Reference 4), that DOE provide such a report. On February 10, 2006, DOE provided its response to our request (Reference 5):

The DOE response contained a redacted report prepared by DOE's consultant LMI (LMI report, Reference 6), detailing its methodology for estimating the unit cost of disposal of depleted uranium. The report was initially prepared by DOE in response to a request by LES but the methodology and underlying information is applicable to the American Centrifuge Plant with only minor adjustments.

Utilizing the methodology contained in the LMI report, USEC prepared an analysis of the estimated disposal costs specific to the American Centrifuge Plant. The analysis is attached as Tables 1 and 2. Table 1 analyzes the costs in kg DUF₆ and Table 2 utilizes the unit of kgU.

The analysis utilized Scenarios 1 – 4 from the LMI report for the LES NEF (referred to as the "new uranium enrichment facility" in the LMI Report) as the base cases for the Paducah and Portsmouth conversion facility cost estimates. USEC did not reanalyze Scenarios 5 and 6 from the LMI report since the report identified that the costs would be less than comparable Scenarios 1 – 4, and thus, the analysis utilizing Scenarios 1 – 4 is conservative for determining the upper bound for depleted uranium disposal costs.

A decontamination and decommissioning (D&D) adjustment has been conservatively included in USEC's analysis to reconcile the LMI methodological assumptions with the DOE's December 12, 2005 estimate and the statements made by LMI personnel during the December 19, 2005 telephone conference call where the unit cost for disposal (including D&D) was assumed to be \$0.55/kg DUF₆. This adjustment has increased the conservatism of USEC's analysis for the American Centrifuge Plant compared with LMI's analysis for the new uranium enrichment facility.

Using the assumptions provided in the LMI report, USEC also provides the breakdown of the estimated costs comprising the DOE estimate provided in its letter dated December 12, 2005, which validates the assumption of \$4.83/kgU.

Two other scenarios are also addressed. The first addresses the USEC-specific cost estimate for disposal of the depleted uranium from the American Centrifuge Plant utilizing LMI Scenarios 2 or 4 (Portsmouth conversion plant) as the basis, with adjustment for USEC's volume of tails, which is less than the new uranium enrichment firm analyzed in the LMI report. The resulting estimated cost is \$4.83/kgU, consistent with the assumption already utilized in the estimate for decommissioning funding for the American Centrifuge Plant. The cost for disposal utilizing Scenarios 1 or 3 (Paducah conversion plant) would be less than the presented scenario, thus utilizing Scenarios 2 or 4 is conservative for determining the upper bound for depleted uranium disposal costs.

The second scenario addresses the case where both the USEC and the new uranium enrichment firm have their depleted uranium converted at the same facility. This scenario is based on utilizing the Portsmouth conversion facility (Scenarios 2 or 4), which has a higher cost than the Paducah option. The resulting estimated cost is \$4.62/kgU. The \$4.83 kgU utilized by USEC in its estimate for decommissioning funding liability for the American Centrifuge Plant is more conservative than this unit cost estimate.

During the December 19, 2005, conference call, the NRC noted that the management of empty cylinders needed to be discussed in the analysis. In the Final Environmental Impact Statement for the conversion facility (Reference 7), it states that the contractor proposes to use the emptied cylinders as disposal containers to the extent practicable. Thus, there would be no additional cost for disposal of the cylinders.

Accordingly, USEC's analysis confirms that the \$4.83/ kgU that USEC has assumed in the estimate for decommissioning funding for the American Centrifuge Plant is a conservative upper bound.

References:

1. Philip G. Sewell (USEC) letter to Mr. Larry Brown (DOE), dated December 8, 2005.
2. Larry Brown (DOE) letter to Mr. Philip Sewell, Conversion and Disposal of Depleted Uranium Hexafluoride (DUF6) Generated by USEC at the American Centrifuge Plant in Piketon, Ohio, dated December 12, 2005.
3. Yawar Faraz (NRC) Memorandum to James W. Clifford (NRC), December 19, 2005, Telephone Meeting Summary: USEC Inc. Depleted Uranium Disposition Cost Estimate, dated January 11, 2006.
4. Philip G. Sewell (USEC) letter to Mr. Larry Brown (DOE), dated December 27, 2005.
5. Larry W. Brown (DOE) letter to Mr. Phil Sewell, Conversion and Disposal of Depleted Uranium Hexafluoride (DUF6) Generated by USEC at the American Centrifuge Plant in Piketon, Ohio, dated February 10, 2006.
6. LMI Government Consulting, Report DE523T1, An Analysis of DOE's Cost to Dispose of DUF₆, Revision 1, July 2005 [Redacted January 31, 2006].

7. U.S. Department of Energy, Office of Environmental Management, *Final Environmental Impact Statement for Construction and Operation of a Depleted Uranium Hexafluoride Conversion Facility at the Portsmouth, Ohio, Site (DOE/EIS-0360)*, June 2004.

USEC-Specific Estimate Utilizing the DOE/LMI Methodology
Table 1

BASIS: KgUF6

Site	Scenarios 1 or 3 Paducah	Scenarios 2 or 4 Portsmouth	Weighted By Annual Capacity	DOE Estimate (c)	Adjusted to USEC Volume (d)	Adjusted to Both UE Firm and USEC Volume (d)
Total Volume (MT):						
DOE (a)			704,000		704,000	704,000
New Uranium Enrichment Firm (b)			222,000		-	222,000
USEC - ACP			-		179,380	179,380
Total			926,000		883,380	1,105,380
Annual Capacity (MT)	18,000	13,500	31,500			
Average Annual Operating Cost	\$ 1.45	\$ 1.76	\$ 1.58	\$ 1.76	\$ 1.76	\$ 1.76
Recapitalization	\$ 0.28	\$ 0.33	\$ 0.30	\$ 0.33	\$ 0.33	\$ 0.33
Construction	\$ 0.42	\$ 0.50	\$ 0.45	\$ 0.50	\$ 0.52	\$ 0.42
Federal Administrative Charge	\$ 0.08	\$ 0.09	\$ 0.08	\$ 0.09	\$ 0.09	\$ 0.09
Conversion (capital and operating costs)	\$ 2.23	\$ 2.68	\$ 2.41	\$ 2.68	\$ 2.70	\$ 2.60
Disposal	\$ 0.37	\$ 0.37	\$ 0.37	\$ 0.37	\$ 0.37	\$ 0.37
D&D	\$ 0.04	\$ 0.04	\$ 0.04	\$ 0.04	\$ 0.04	\$ 0.03
D&D - adjustment	\$ 0.14	\$ 0.14	\$ 0.14	\$ 0.14	\$ 0.15	\$ 0.12
D&D - per 12/19/05 telephone conference	\$ 0.18	\$ 0.18	\$ 0.18	\$ 0.18	\$ 0.19	\$ 0.15
Disposal (including D&D)	\$ 0.55	\$ 0.55	\$ 0.55	\$ 0.55	\$ 0.56	\$ 0.52
Transportation	\$ 0.09	\$ 0.11	\$ 0.10	\$ 0.03 (e)	\$ - (f)	\$ -
Storage	\$ 0.003	\$ 0.003	\$ 0.003	\$ 0.003	\$ 0.003	\$ 0.003
TOTAL	\$ 2.87	\$ 3.34	\$ 3.06	\$ 3.26	\$ 3.26	\$ 3.12

(a) "About 704,000 metric tons" of DUF6 per DOE/IG-0642, Audit Report, Depleted Uranium Hexafluoride Conversion, March 2004, page 1.

(b) "7,400 metric tons (equivalent to 5,000 metric tons of uranium) per year for 30 years" per LMI study, page 2-1.

(c) DOE letter to USEC dated December 12, 2005 - Based on Scenarios 2 or 4

(d) Construction and D&D cost per unit vary based on total volume. Cost adjusted by a factor of 926,000kg/883,380kg (USEC), or 926,000kg/1,105,380kg (both USEC and other firm)

- Based on Scenarios 2 or 4

USEC-Specific Estimate Utilizing the DOE/LMI Methodology
Table 2

Site	Basis: KgU		Weighted By Annual Capacity	DOE Estimate (c)	Adjusted to USEC Volume (d)	Adjusted to Both UE Firm and USEC Volume (d)
	Scenarios 1 or 3 Paducah	Scenarios 2 or 4 Portsmouth				
Total Volume (MT):						
DOE (a)			478,720		478,720	478,720
New Uranium Enrichment Firm (b)			150,960		-	150,960
USEC - ACP			-		121,978	121,978
Total			629,680		600,698	751,658
Annual Capacity (MT)	12,240	9,180	21,420			
Average Annual Operating Cost	\$ 2.14	\$ 2.60	\$ 2.34	\$ 2.60	\$ 2.60	\$ 2.60
Recapitalization	\$ 0.41	\$ 0.49	\$ 0.44	\$ 0.49	\$ 0.49	\$ 0.49
Construction	\$ 0.62	\$ 0.74	\$ 0.67	\$ 0.74	\$ 0.78	\$ 0.62
Federal Administrative Charge	\$ 0.12	\$ 0.13	\$ 0.12	\$ 0.13	\$ 0.13	\$ 0.13
Conversion (capital and operating costs)	\$ 3.29	\$ 3.98	\$ 3.57	\$ 3.98	\$ 4.00	\$ 3.84
Disposal	\$ 0.55	\$ 0.55	\$ 0.55	\$ 0.55	\$ 0.55	\$ 0.55
D&D	\$ 0.06	\$ 0.06	\$ 0.06	\$ 0.06	\$ 0.06	\$ 0.05
D&D - adjustment	\$ 0.21	\$ 0.21	\$ 0.21	\$ 0.21	\$ 0.22	\$ 0.18
D&D - per 12/19/05 telephone conference	\$ 0.27	\$ 0.27	\$ 0.27	\$ 0.27	\$ 0.28	\$ 0.23
Disposal (including D&D)	\$ 0.82	\$ 0.82	\$ 0.82	\$ 0.82	\$ 0.83	\$ 0.78
Transportation	\$ 0.13	\$ 0.16	\$ 0.14	\$ 0.04 (e)	\$ - (f)	\$ -
Storage	\$ 0.004	\$ 0.004	\$ 0.004	\$ 0.004	\$ 0.004	\$ 0.004
TOTAL	\$ 4.24	\$ 4.94	\$ 4.53	\$ 4.82	\$ 4.83	\$ 4.62

(a) "About 704,000 metric tons" of DUF6 per DOE/IG-0642, Audit Report, Depleted Uranium Hexafluoride Conversion, March 2004, page 1.

(b) "7,400 metric tons (equivalent to 5,000 metric tons of uranium) per year for 30 years" per LMI study, page 2-1.

(c) DOE letter to USEC dated December 12, 2005 - Based on Scenarios 2 or 4 [Total does not equal \$4.83 due to rounding.]

(d) Construction and D&D cost per unit vary based on total volume. Cost adjusted by a factor of 629,680kg/600,698kg (USEC), or 629,680kg/751,658kg (both USEC and UE firm)
- Based on Scenarios 2 or 4

(e) Adjusted to be USEC-specific - Based on Scenarios 2 or 4. See (f) below for further adjustment.

(f) Transportation costs to Portsmouth facility not applicable to USEC.