



## 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

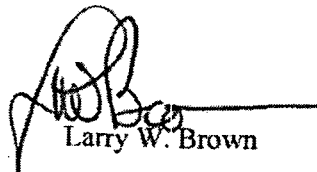
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~~Environmental Policy Act. Additionally, this letter does not commit the Department to the expenditure of funds, and any agreement for acceptance of DUF6 is subject to the negotiation of terms and conditions, must be in writing, and signed by the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

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

Sincerely,



Larry W. Brown

Enclosure

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

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

**AN ANALYSIS OF DOE'S COST TO DISPOSE  
OF DUF<sub>6</sub>**

**REVISION 1**

**REPORT DE523T1**

**LMI**  
GOVERNMENT CONSULTING

**JULY 2006**  


**APPROVED FOR RELEASE**  
H. H. Thomas

# LMF

## An Analysis of DOE's Cost to Dispose of DUF<sub>6</sub>, 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).

DOE asked LMI to help it determine an appropriate price to charge a firm for accepting and converting DUF<sub>6</sub> into products suitable for disposal.

DOE recently contracted with Uranium Disposition Services LLC (UDS) to design and build two conversion plants for processing DUF<sub>6</sub>—near Portsmouth, OH, and Paducah, KY—and then operate them for the first 5 years. DOE currently has a DUF<sub>6</sub> 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 DUF<sub>6</sub> through its contract with UDS or its successor.

We analyzed the costs associated with six scenarios regarding DOE's acceptance of additional DUF<sub>6</sub> for processing.

- If DOE extends the operating period at the Paducah plant to process the additional DUF<sub>6</sub> concurrently with the existing backlog, it should charge \$2.72 per kg of DUF<sub>6</sub>.

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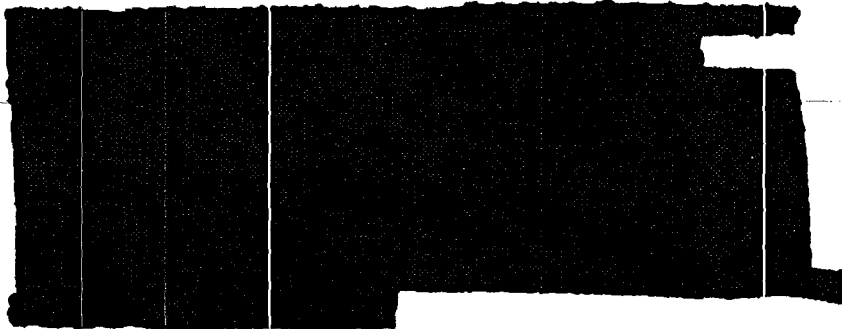
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## Chapter 1

# 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 DUF<sub>6</sub> 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 DUF<sub>6</sub>.
- ♦ The Appendix shows assumptions that we made during our analysis.

- ## ANALYSIS OF SCENARIOS

### Scenario 1

### ANNUAL OPERATIONS COSTS AT PADUCAH

**Table 2-1. Annual Operations Costs at DOE's Paducah Plant**

Cost category	Annual costs (\$ million) (FYD4)
[REDACTED]	[REDACTED]
Total	26.0

## Анализатор

1. Disposal costs include transportation from Paducah to the disposal site, disposal, and sampling, characterization, and preparation.
2. Baseline capacity = 15,000 metric tons per year DUF<sub>5</sub> (approximately 1,400 cylinders per year) at four conversion lines (2 conversion units/line).
3. Annual operations costs are based on FY03 proposed baseline costs for the Paducah plant and deescalated by 10.6 percent using DOE suggested escalation guidelines.
4. Total building size = 40,000 square feet.
5. Combined 20 percent allotted for management reserve and fee.

**Table 2-2. Annual Cost to DOE of Processing Additional DUF<sub>6</sub> at the Paducah Plant**

<b>Scenario 1: Process at Paducah in "Base" Plant</b>			
<b>Assumptions</b>			
1. Plant remains in operation until the DOE backlog and 90 years of the firm's DUFs are processed			
2. The firm's DUFs is treated when received, concurrently with the DOE backlog DUFs			
3. Discount rate 3.50%			
(FY04 Dollars)			
<b>Investment costs</b>			
Plant construction	\$151,700,000		
Life of the plant	30 years, starting	2009	
Start receiving the firm's DUFs	2011		
Current DOE backlog	421,200 MT		
Firm's production requirement	222,000 MT		
Firm's pro rata share	33%		
Firm's pro rata investment cost	\$62,366,742		
Investment cost in equivalent annual value	\$2,885,478		
Investment equiv. annual value cost per kg			\$0.42 per kg
<b>Annual operating costs</b>			
Plant operations			
Plant recapitalization costs			
Transportation to Paducah costs			
Product disposal			
Surveillance and maintenance costs			
<b>Decon &amp; Decommissioning</b>			
Plant D&D cost	\$57,160,000		
Firm's pro rata share	33%		
Firm's pro rata D&D cost	\$18,725,280		
Firm's equivalent uniform annual cost	\$237,234	per year	
Firm's equiv. uniform annual cost per kg			\$0.04 per kg
Federal administrative charge			\$0.08 per kg
<b>Firm's annual cost</b>			<b>\$2.72 per kg</b>

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 DUF<sub>6</sub> 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 <sub>6</sub> (\$)
FY04	2.72
FY11	3.42
FY27	5.78

Assumptions: Annual inflation is 2.5 percent; earliest processing of additional DUF<sub>6</sub> is FY11.



\$2.58 per kg of DUF<sub>6</sub> for transporting the DUF<sub>6</sub> 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.<sup>6</sup> 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.<sup>7</sup> 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.<sup>8</sup> 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 DUF<sub>6</sub> at the Portsmouth Plant

Scenario 2: Process at Portsmouth in "Best" Plant			
Assumptions			
1. Plant remains in operation until the DOE backlog and 30 years of the firm's DUF <sub>6</sub> are processed			
2. The firm's DUF <sub>6</sub> is treated when received, concurrently with DOE backlog DUF <sub>6</sub>			
3. Discount rate 3.50%			
	(FY04 Dollars)		
Investment costs			
Plant construction	\$133,800,000		
Life of the plant	35 years, starting	2009	
Start receiving the firm's DUF <sub>6</sub>	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	\$63,508,942		
Investment cost in equivalent annual value	\$3,175,582		
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			
Decom & Decommissioning			
Plant D&D cost	\$47,800,000		
Firm's pro rata share	47%		
Firm's pro rata D&D cost	\$22,593,970		
Firm's equivalent annual cost	\$255,521	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			\$0.63 per kg

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

<sup>6</sup> In this scenario, the proportionate share is 47 percent: 222,000 metric tons of additional DUF<sub>6</sub> will be processed, and 245,700 metric tons of backlog DUF<sub>6</sub> will be processed.

<sup>7</sup> Construction costs are based on the proposed baseline costs for the conversion plant at Portsmouth.

<sup>8</sup> See Note 4.

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Regardless of when DOE starts processing the additional DUF<sub>6</sub>, 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 DUF<sub>6</sub>, 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).<sup>9</sup>

### CAPITAL COSTS AT EXPANDED PADUCAH PLANT

we assume that the firm will be charged a proportionate share of construction and D&D costs.<sup>10</sup> 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.<sup>11</sup> 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.<sup>12</sup> 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.

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<sup>9</sup> Totals do not equal the sum of individual numbers due to rounding.

<sup>10</sup> See Note 2.

<sup>11</sup> See Note 3.

<sup>12</sup> See Note 4.

## 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 DUF<sub>6</sub>, 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).<sup>13</sup>

### 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.<sup>14</sup> 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.<sup>15</sup> 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.<sup>16</sup> 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.

<sup>13</sup> Totals do not equal the sum of individual numbers due to rounding.

<sup>14</sup> See Note 6.

<sup>15</sup> See Note 3.

<sup>16</sup> See Note 4.

## Appendix

# Assumptions for Economic Analysis

### GENERAL ASSUMPTIONS REGARDING DUF<sub>6</sub> DISPOSAL

For all scenarios, we assume the following:

- ◆ DOE accepts 7,400 metric tons of DUF<sub>6</sub> (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 DUF<sub>6</sub> 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 DUF<sub>6</sub> 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 DUF<sub>6</sub> to the processing site,
    - processing of the DUF<sub>6</sub> (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.

### *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 DUF<sub>6</sub> 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 DUF<sub>6</sub> annually.
- ◆ Portsmouth's current backlog of DUF<sub>6</sub> is 18.2 years.
- ◆ The existing backlog DUF<sub>6</sub> and the additional DUF<sub>6</sub> 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 DUF<sub>6</sub> (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.

## **Scenario 6—Portsmouth**

For Scenario 6, we assume the following:

- ◆ The plant has an expanded capacity to process 20,250 MT of DUF<sub>6</sub> 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 DUF<sub>6</sub> 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.