

December 2000

**NUCLEAR
NONPROLIFERATION**

**Implications of the
U.S. Purchase of
Russian Highly
Enriched Uranium**



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Abbreviations

AVLIS	atomic vapor laser isotope separation (process)
DOE	Department of Energy
EOC	Enrichment Oversight Committee
GAO	General Accounting Office
HEU	highly enriched uranium
LEU	low enriched uranium
NRC	Nuclear Regulatory Commission
NSC	National Security Council
SWU	separative work units
Tenex	Techsnabexport
USEC	USEC, Inc.



United States General Accounting Office
Washington, D.C. 20548

December 15, 2000

The Honorable Tom Bliley
Chairman
Committee on Commerce
House of Representatives

Dear Mr. Chairman:

In February 1993, the United States agreed to purchase from Russia 500 metric tons of highly enriched uranium (HEU) extracted from dismantled Russian nuclear weapons over a 20-year period. Russia agreed to dilute, or blend-down, the material into low enriched uranium (LEU) so that it could be made into fuel for commercial nuclear power reactors before shipping it to the United States.¹ When the agreement to purchase HEU was signed, Russia was expected to receive about \$12 billion from the HEU purchase.

USEC, Inc. (USEC), acts as executive agent for the United States, implements the commercial contract to purchase LEU under the agreement, and pays Russia for the deliveries of LEU. USEC was originally created as the United States Enrichment Corporation by the Energy Policy Act of 1992 as a wholly owned government corporation to conduct and market the Department of Energy's (DOE) uranium enrichment services. USEC was privatized through an initial public offering in July 1998 that resulted in a payment of about \$1.9 billion to the U.S. Treasury.² (See app. I.) In addition to serving as executive agent for the purchase of Russian HEU, USEC leases DOE's uranium enrichment facilities in Paducah, Kentucky, and near Portsmouth, Ohio, to produce LEU for fuel in commercial nuclear power reactors.

From the time it was privatized in July 1998 through October 2000,

- USEC's stock lost over 60 percent of its value;

¹Formally known as "The Agreement Between the Government of the United States of America and the Government of the Russian Federation Concerning the Disposition of Highly Enriched Uranium Extracted From Nuclear Weapons" (Feb. 18, 1993). This report refers to the agreement as the HEU agreement. The agreement is implemented through a commercial contract that is periodically renegotiated to determine the price that USEC will pay for the material. The current pricing provision of the contract expires at the end of 2001.

²The United States also retained about \$1.2 billion in cash from accounts held by the United States Enrichment Corporation in the U.S. Treasury.

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- according to USEC, both the commercial demand for USEC's services and the total demand for uranium declined 18 percent; and
 - USEC announced in June 2000 that because of a global overcapacity in uranium enrichment and lower demand in an increasingly competitive market, it would cease enrichment operations at its Portsmouth uranium enrichment facility in June 2001. In October 2000, DOE announced that it would spend \$630 million to, among other things, maintain the Portsmouth plant in "cold standby" status for 5 years for possible restart in case the nation's supply of enriched uranium is significantly disrupted.

As agreed with your office, this report discusses (1) the status of the February 1993 HEU agreement's implementation, (2) USEC's performance as executive agent for the United States, (3) the impact of USEC's privatization and the HEU agreement on the United States' capability to produce fuel for nuclear power plants domestically, and (4) federal oversight of the HEU agreement's implementation.

Results in Brief

From June 1995 through October 2000, USEC paid Russia about \$1.6 billion for over 3,000 metric tons of low enriched uranium blended-down from about 103 metric tons of highly enriched uranium (about one-fifth of the total amount established in the agreement). The deliveries of low enriched uranium to USEC have been delayed on five occasions since 1995 because, among other reasons, Russia was dissatisfied with the level of revenue it was receiving under the agreement. As a result of these delays, by the end of 1999 the amount of highly enriched uranium that Russia had blended-down was about 19 metric tons less than called for by that point in the contract implementing the agreement. Some of this shortage was made up in early 2000, and U.S. government and USEC officials said that they anticipated that the remaining shortfall would be eliminated over the next few years. Because the existing pricing provision in the implementing contract expires at the end of 2001, USEC is currently negotiating with an entity of the Russian government that serves as Russia's executive agent to determine the price that USEC will pay for the material after 2001. In addition to the low enriched uranium obtained from blending-down highly enriched uranium from dismantled nuclear weapons, Russia is proposing to sell to USEC low enriched uranium that will be newly produced in Russia's commercial uranium enrichment facilities in order to increase the amount of revenue to Russia. We are recommending that this purchase of additional commercially produced low enriched uranium be assessed to determine its impact on the nuclear fuel industry and national security.

USEC has consistently paid Russia for deliveries of low enriched uranium and accepted shipments in a timely manner. By doing this, USEC has satisfactorily carried out its responsibilities as executive agent for the United States, according to officials from the National Security Council (NSC), the State Department, and DOE. However, some difficulties have occurred. USEC had considered resigning as executive agent in 1999 unless the United States paid the corporation \$200 million. USEC claimed that a decline in market prices for low enriched uranium was reducing the profit it was receiving as executive agent from the amount it expected when it was privatized. Although DOE disputed this claim and USEC did not receive any payment, USEC decided in December 1999 to remain executive agent. USEC continues to face challenges in balancing its commercial objectives with the national security interests of the United States. Although recognizing that it has important national security responsibilities, USEC has stated that its priority as a private company is to remain a profitable commercial enterprise and maintain maximum value to its shareholders.

Developments since USEC's privatization, combined with USEC's reliance on Russian low enriched uranium for nearly half of its annual sales, have created concerns about the United States' continued ability to domestically produce fuel for commercial nuclear power plants, according to officials from companies in the U.S. nuclear fuel industry. Regarding USEC's sales of uranium on the nuclear fuel market, these officials said that the sales of natural uranium transferred to USEC from DOE at the time of privatization might have contributed to an oversupply of uranium. This oversupply has contributed to a drop in uranium prices. The drop in prices has negatively affected the U.S. nuclear fuel industry, leading to lower domestic production of uranium and decreased employment in the industry. In addition, material from Russia now makes up over 50 percent of USEC's annual sales of low enriched uranium and almost 40 percent of the total U.S. sales of nuclear fuel. USEC recently announced that it would cease enrichment operations at its Portsmouth uranium enrichment plant in June 2001. This would leave USEC with one uranium enrichment plant to supply its customers' requirements for nuclear fuel, should there be extended delays of deliveries from Russia.

Federal oversight of the agreement's implementation is primarily conducted by the interagency Enrichment Oversight Committee, formed by a 1998 executive order. This committee, chaired by a senior official from NSC, consists of representatives from various executive branch departments, though the Departments of Energy and State have taken

primary roles. While the committee's efforts have been concentrated primarily on solving problems that have arisen over the course of the agreement's implementation, the committee has largely acted informally and has not fulfilled all of its responsibilities established by the 1998 executive order. For example, the committee was explicitly required to establish procedures for designating alternative executive agents to implement the agreement in the event that USEC needed to be replaced. However, the committee had no such procedures when USEC considered resigning as executive agent in 1999 and continues to lack a contingency plan, should USEC need to be replaced in the future. Furthermore, the committee is only beginning to conduct the required analysis of the impact of the agreement on the domestic nuclear fuel industry. This report recommends that a contingency plan be developed that would detail the circumstances and specific procedures under which USEC would be replaced as executive agent and the criteria for choosing alternative agents if USEC resigns or needs to be replaced in the future.

We presented a draft of this report to DOE, the State Department, NSC, and USEC for comment. DOE, the State Department, and NSC generally agreed with the report's findings, and DOE described the recommendations as reasonable. DOE, the State Department, and USEC also provided technical clarifications, which we incorporated as appropriate.

Background

The government-to-government agreement in which Russia agreed to sell approximately 500 metric tons of HEU extracted from dismantled Russian nuclear weapons to the United States was signed on February 18, 1993. USEC (at the time, a government corporation) and Technabexport (Tenex), an entity of the Russian government that serves as the executive agent for Russia, signed the initial implementing contract on January 14, 1994. Tenex annually blends-down an amount of HEU that is specified in the contract and converts it to LEU.³ The amounts of LEU actually delivered to USEC annually vary, depending upon the concentration of uranium-235 in the LEU. Specific concentrations of uranium-235 are

³Uranium, in its natural form, comprises a mixture of several isotopes—forms of the same element with different atomic weights. Less than 1 percent of natural uranium is the isotope uranium-235—the fissionable isotope used in nuclear weapons and reactors. Uranium that is enriched to a concentration of over 90 percent uranium-235 is highly enriched and is weapons-grade material. Uranium that is enriched to a concentration of from 3 to 5 percent uranium-235 is LEU, which is commercial-reactor-grade material.

ordered by USEC in response to its customers' requirements. The higher the concentration of uranium-235, the less LEU is produced from a given amount of HEU. Under the original contract signed in 1994, Tenex was to deliver LEU derived from 10 metric tons of HEU annually from 1995 through 1999. The contract was amended in 1995 and 1996 to allow Tenex to blend-down more HEU annually (12 metric tons in 1996, 18 in 1997, 24 in 1998, and 30 in 1999), thus increasing the revenue paid to Russia under the contract for these years. Beginning in 2000, Tenex would deliver LEU derived from 30 metric tons of HEU annually.

Under the contract, the price for LEU includes charges for two components:

- Enrichment services (measured in terms of separative work units [SWU]—the standard U.S. measure of the effort expended to enrich uranium).
- Natural uranium.

USEC pays Tenex for the enrichment services (approximately two-thirds of the LEU's value) within 60 days of receipt. According to the original contract, USEC would pay for the remaining third (the natural uranium component) after USEC resold it to utilities or used it in the corporation's enrichment plants. As a result of a requirement in the USEC Privatization Act of 1996, the contract was amended so that USEC, upon receipt of the LEU, would transfer title of an amount of natural uranium equivalent to the natural uranium content of the LEU back to Tenex so that Russia could sell the material on the world uranium market.⁴

On the basis of the initial price for the LEU delivered under the contract, the total value of payments by the United States would be approximately \$12 billion over 20 years—the life of the contract (\$8 billion paid by USEC for the enrichment services and \$4 billion from the sale of the natural uranium component). The \$12 billion figure assumes a constant price over the life of the contract. However, under the contract, prices for future years may be adjusted as part of an annual review to account for U.S. inflation and changes in international market conditions. In November 1996, USEC

⁴The material originally was not physically returned to Russia. The material remained in the United States until Russia sold it, at which point, it was delivered from USEC to the purchaser. A March 1999 agreement provided for the physical return of natural uranium whose ownership had been transferred to Russia as a result of the deliveries of LEU.

and Tenex concluded an amendment to the implementing contract that agreed on quantities of HEU to be blended-down annually and the price to be paid for the enrichment services until January 1, 2002. USEC and Tenex are currently negotiating to determine the price that USEC will pay for the enrichment services component of the LEU after 2001.

Under a 1997 memorandum of agreement between USEC, DOE, and the State Department, USEC is responsible as the U.S. executive agent to, among other things,

- work with Tenex to ensure that the Russian HEU agreement and the implementing contract are fully implemented;
- agree with Tenex on the price and volumes of LEU to be delivered each year; and
- agree with Tenex, as necessary, on the technical specifications of the material to be delivered.

USEC agreed to provide DOE and the State Department with an annual report on the corporation's activities and performance as executive agent and to notify DOE and the State Department of any activities or other information affecting USEC's ability or Tenex's ability to fulfill the implementing contract or to successfully implement the Russian HEU agreement. In addition, USEC agreed to consult with the State Department on matters to be discussed with Tenex during annual reviews of the implementing contract. These reviews consider such things as the annual volumes of LEU to be delivered and the price that USEC will pay for this material.

Status of Russian LEU Deliveries

Since the shipments of LEU began in 1995, Russia has blended-down about one-fifth of the total HEU that it agreed to convert to LEU before 2013. The shipments of LEU to the United States have been delayed several times. The primary cause for the delays has been Russia's dissatisfaction with the reduced revenue that it was receiving under the agreement because it was unable to sell the natural uranium component of the LEU delivered to the United States. USEC and Tenex are currently negotiating to determine the price that USEC will pay for the enrichment services component of this material from 2002 through 2013. As part of these negotiations, USEC has tentatively agreed to purchase additional enrichment services that would not be derived from dismantled Russian nuclear weapons.

Deliveries of LEU Have Been Delayed on Five Occasions Since 1995

From 1995 through October 2000, USEC received from Russia about 3,000 metric tons of LEU blended-down from approximately 103 metric tons of HEU.⁵ USEC paid Tenex about \$1.6 billion for the enrichment services component of the LEU (about 18.9 million SWU). (See table 1.) USEC then sold the enrichment services to utilities for prices that are, on average, higher than the price it pays Tenex and has delivered the LEU to fuel fabricators to be fashioned into fuel assemblies for nuclear power plants.

Table 1: Annual Deliveries of LEU From Russia to USEC, 1995-2000

Calendar year	HEU to be blended-down under amended contract (metric tons)	HEU blended-down (metric tons)	LEU delivered to USEC (metric tons)	SWU	Amount paid by USEC to Tenex (dollars in millions)
1995	10	6.10	186.04	1,124,000	\$92.24
1996	12	11.98	370.93	2,212,000	181.64
1997	18	13.36	358.50	2,441,000	206.22
1998	24	19.09	571.48	3,518,000	299.91
1999	30	24.26	718.68	4,464,000	381.43
Total (1995-99)	94	74.79	2,205.64	13,758,000	\$1,161.44
2000 (through Oct. 2000)		27.85	803.88	5,115,000	442.60
Total (1995-Oct. 2000)		102.64	3,009.52	18,873,000	\$1,604.04

Notes: Totals may not add because of rounding. Amounts of LEU delivered are based on the actual date of delivery to USEC.

Source: GAO's analysis of data from USEC.

⁵According to USEC, this represents the equivalent amount of material from 4,000 nuclear warheads. However, as we reported in 1999, several key transparency measures implemented by DOE that are intended to provide confidence that the HEU is extracted from Russian nuclear weapons and that the HEU is then blended-down into LEU had not been put in place, and U.S. officials lack access to Russia's dismantlement facilities for its nuclear weapons and to the weapons dismantlement process. At the time of our review, the United States had spent \$44 million implementing these transparency measures and planned to spend an additional \$45 million for fiscal year 1999 through fiscal year 2001. (See *Nuclear Nonproliferation: Status of Transparency Measures for U.S. Purchase of Highly Enriched Uranium* [GAO/RCED-99-194, Sept. 22, 1999].)

By the end of 1999, the amount of HEU that Russia had blended-down was about 19.2 metric tons less than called for in the amended implementing contract.⁶ Of these 19.2 metric tons of HEU, about 3.9 metric tons were not blended-down in 1995 because of initial difficulties that Russia had with the equipment used in the blending-down process. USEC plans to make up this amount over the remaining term of the contract. The remaining 15.3 metric tons of HEU is the result of five delays in shipments of LEU since the onset of the HEU agreement. Approximately 7 metric tons of this shortfall was made up in early 2000, and from 2002 through 2004, USEC has tentatively agreed with Tenex to purchase additional enrichment services (beyond the 30 metric tons of HEU called for in the contract) that would make up the remaining approximately 8 metric tons of HEU.

One of the five delays was caused by the discovery in August 1999 that cylinders that were to be shipped by USEC to Russia for packaging and shipping the LEU to the United States did not meet industry specifications. When the cause of the defect was identified and corrected by the cylinder manufacturer, USEC accelerated the delivery of new cylinders to Russia. An October 1999 letter to the Secretary of Energy from Russia's Minister of Atomic Energy claimed that USEC's failure to ensure deliveries of empty cylinders to Russia made it impossible to complete all planned shipments of LEU by the end of 1999. USEC claims that a sufficient number of cylinders were in Russia by the end of November 1999, which would have allowed Tenex to complete deliveries of LEU by the end of 1999, as originally scheduled. However, according to USEC, Tenex did not deliver the LEU on a timely basis and deliveries of the LEU for 1999 were not completed until early February 2000.⁷

⁶DOE and USEC officials note, however, that USEC has taken delivery of more material to date than was originally planned when the implementing contract was signed in 1994.

⁷According to USEC officials, USEC agreed to an accelerated payment schedule to ensure that Tenex received revenue during this disruption in deliveries.

In May 2000, shipments were halted when Tenex advised USEC that legal proceedings in the United States concerning the claim of a Swiss company against the government of the Russian Federation could result in a judgment against payment for the enrichment services owed by USEC to Tenex or against natural uranium delivered to Tenex by USEC. As a result of this delay, the President issued an executive order on June 21, 2000, stating that the risk of nuclear proliferation created by the accumulation of a large amount of weapons-usable material in Russia was a threat to the national security and the foreign policy of the United States and declared a national emergency to deal with the threat.⁸ The executive order blocked the Russian government's assets directly related to the implementation of the HEU agreement from any judgment, thus allowing the shipments of LEU to resume.

The remaining three delays occurred when Tenex halted deliveries because it was unable to sell the natural uranium component of the LEU delivered to USEC. Russia halted deliveries of LEU to USEC through much of 1997 and from late 1998 into early 1999. Since deliveries began in 1995, the LEU delivered to USEC has contained approximately 80 million pounds of natural uranium. (See table 2.) As required by the USEC Privatization Act of 1996, DOE took title to the 14.3 million pounds from the 1995 and 1996 deliveries, for which USEC (at the time, a government corporation) paid Tenex approximately \$157 million. Since the USEC Privatization Act became law, title to the natural uranium component of LEU deliveries has been transferred from USEC to Russia for Russia to sell on the world uranium market.

⁸Exec. Order No. 13159 (Blocking Property of the Government of the Russian Federation Relating to the Disposition of Highly Enriched Uranium Extracted From Nuclear Weapons, 65 *Federal Register* 39279, [June 21, 2000]).

Table 2: Natural Uranium Component of LEU Delivered to USEC

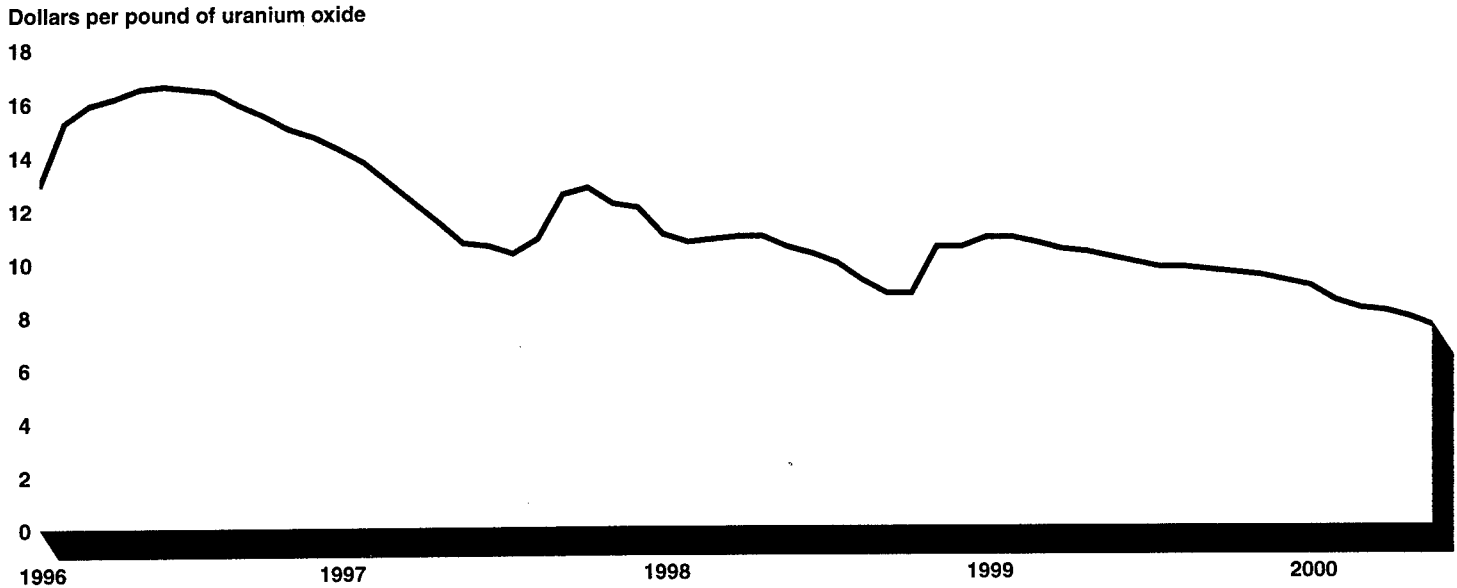
Calendar year	Natural uranium component (in pounds of uranium oxide)
1995	4,825,141
1996	9,521,980
1997	10,200,306
1998	15,026,203
1999	19,037,541
2000 (through Oct.)	21,693,171
Total	80,304,341

Source: GAO's analysis of data from USEC.

However, Russia has experienced difficulties in selling this material because restrictions on U.S. and European markets limit the amount of natural uranium from Russia that is allowed to be consumed in these countries.⁹ In addition, Russia has been unwilling to sell much of the natural uranium component because the market price of uranium has been in a state of decline in recent years (see fig. 2) and has fallen below a minimum selling price established by Russia. As a result of its inability or unwillingness to sell the natural uranium component of the LEU, Russia was not receiving income that it expected to receive when the HEU agreement was signed and halted deliveries of LEU to the United States.

⁹Under the USEC Privatization Act of 1996, a quota applies to the sale of the natural uranium for consumption in the United States. In addition, the material is subject to trade restrictions in the European Union.

Figure 1: Month-End Spot Market Uranium Prices, January 1996-September 2000



Source: GAO's presentation of data from Ux Consulting Company, LLC.

In an effort to restart LEU deliveries, in October 1998, the Congress appropriated \$325 million that DOE (after an agreement signed with Russia in March 1999) paid Russia in exchange for the natural uranium component of the 1997 and 1998 deliveries.¹⁰ In March 1999, Tenex and three Western companies agreed on a contract that gave the companies an exclusive option to purchase the natural uranium component of the LEU deliveries, provided that the market price for natural uranium was above a minimum price determined by Tenex.¹¹ However, the market price has remained below this minimum price, and thus, very little material has been sold by Tenex. The deputy director of Tenex stated in September 2000 that the U.S. purchase of the 1997 and 1998 natural uranium and the commercial contract with the three Western companies averted a potential crisis with

¹⁰DOE purchased the 28 million pounds of natural uranium from the 1997 and 1998 deliveries of LEU and agreed to keep this material and an additional 30 million pounds of DOE's own uranium inventory off the market for 10 years to stabilize declining market prices.

¹¹The three Western companies are Cameco (Canada), COGEMA (France), and NUKEM (Germany).

the HEU agreement. However, he said the underlying causes of Russia's difficulties in selling the natural uranium component—the restrictions under the USEC Privatization Act of 1996 limiting the uranium's use on the U.S. market and the trade restrictions in Europe—were still in place. Since March 1999, the vast majority of the natural uranium has been left unsold by Tenex and is now being delivered back to Russia at its expense. As a result, Russia is not receiving the income from the sale of the natural uranium component that it expected when the HEU agreement was signed. The State Department and DOE officials we spoke with indicated that Russia's continuing problems with receiving revenue from the sale of the natural uranium component raises the possibility that Russia may again halt deliveries of LEU to the United States in an effort to recover this lost income. These officials told us that unless the international uranium market experiences a recovery and Russia is able to then sell the natural uranium component of the LEU delivered to USEC, Russia may once again approach the United States for compensation for unsold natural uranium.

Negotiations Between USEC and Tenex Will Determine the Price That USEC Will Pay Through 2013

USEC and Tenex are currently negotiating to determine the price that USEC will pay for the enrichment services component of LEU delivered from 2002 through 2013. According to the U.S. government officials we spoke with, USEC has reached a tentative agreement with Tenex such that

- LEU containing 5.5 million SWU worth of enrichment services (from approximately 30 metric tons of HEU) would be delivered annually;
- the delivery shortfall resulting from delays in shipments, discussed above, would be made up by purchasing additional enrichment services from Tenex; and
- USEC would pay Tenex for the enrichment services at a price that would be based on an agreed discount below published market prices.

Currently, market prices for enrichment services are approximately 10 percent below the price that USEC pays Tenex. Thus, a discount below current market prices would result in less revenue for Russia than it is receiving under the current agreement.

To partially compensate Russia for this declining revenue, USEC has also tentatively agreed with Tenex to purchase additional enrichment services. These enrichment services, however, would not be derived from material from dismantled Russian nuclear weapons. Rather, USEC would pay Tenex for the enrichment services component of LEU that was newly produced in Tenex's uranium enrichment facilities and delivered to the United States. As under the HEU agreement, USEC would also deliver to Tenex an

equivalent amount of natural uranium as contained in the LEU. According to Tenex officials, this arrangement is attractive to Tenex because revenue resulting from the sale of these additional enrichment services to USEC would go directly to Tenex rather than to Russia's federal budget. Despite this purchase of additional enrichment services, if the market price for enrichment services remains at or falls from its current level for the remaining years of the HEU agreement, it is unlikely that Russia will receive the \$8 billion it expected to receive when the HEU agreement was signed for the enrichment services component of the LEU it delivers to USEC. The deputy director of Tenex stated that, faced with a loss of revenue as a result of this new pricing arrangement, Tenex might be forced to approach the U.S. government for compensation.

USEC's Performance as Executive Agent

USEC has consistently paid Russia for deliveries of LEU and has accepted shipments in a timely manner. By doing this, USEC has satisfactorily carried out its responsibilities as executive agent for the United States, according to officials from NSC, the State Department, and DOE. However, there have been some difficulties. USEC requested \$200 million in compensation from the U.S. government in 1999, stating that a drop in market prices for enrichment services was reducing the profit that USEC was receiving as executive agent from the amount it expected to receive at the time it was privatized. In addition, USEC, as executive agent, attempts to balance conflicting commercial and national security interests.

USEC Considered Resigning as Executive Agent in Late 1999

Because USEC has consistently accepted shipments of LEU and has paid Tenex for these deliveries, the officials we spoke with from NSC, the State Department, and DOE have concluded that USEC has performed its responsibilities as executive agent satisfactorily. However, USEC had considered resigning as executive agent in September 1999 unless the U.S. government paid it \$200 million (\$100 million in 2000 and 2001).¹² USEC claimed that a drop in the market price for enrichment services was causing it financial harm. Under the amended implementing contract, USEC pays Tenex a fixed price (adjusted annually for inflation) for the

¹²Under the 1997 memorandum of agreement, USEC may resign as executive agent by notifying the State Department and DOE in writing at least 30 days in advance. USEC would be required to continue to purchase enrichment services and accept delivery of LEU from Tenex for both the remainder of the calendar year in which it resigned and the following calendar year.

enrichment services content of the LEU delivered to the United States. Because of excess capacity in the world uranium enrichment industry and aggressive pricing by European competitors, market prices for enrichment services dropped below the price that USEC pays Russia for enrichment services. However, the majority of USEC's sales are concluded under long-term contracts negotiated years earlier. While market prices dropped below the price that USEC pays Tenex, USEC's contracts are still priced higher, on average, than both market prices and the price paid to Tenex for enrichment services. Therefore, while USEC was not losing money on its purchase of enrichment services from Tenex, it was not making as much profit as was projected at the time of its privatization, when market prices were projected to remain higher. USEC claimed that its operating margin resulting from its purchase of Russian material from October 1999 through December 2001 was being reduced by over \$300 million from the expected margins at the time of privatization. As USEC signed new contracts with utilities for enrichment services and renegotiated old ones, its average selling price was expected to fall into line with market prices, which, if they remained low, threatened USEC's profits. The \$200 million that USEC requested was to compensate it for forgone profits expected when it was privatized.

DOE was critical of USEC's request for \$200 million. An October 1999 letter from the Secretary of Energy to USEC stated that "the data USEC has provided...are insufficient to justify your request for assistance of approximately \$100 million per year. In particular, the cost data provided are very general and key assumptions are questionable.... In short, we believe the true financial need [of USEC] may be much lower, or zero." The Secretary also expressed concern that USEC's sales of natural uranium were causing market prices for uranium to fall and were negatively affecting the overall HEU agreement. In December 1999, USEC announced that it would remain as executive agent for the agreement, stating, "while there are quantifiable costs to USEC and its shareholders associated with the executive agent activities, the company would incur greater economic costs in the long run from not being the manager of this program."

USEC Strives to Balance Conflicting Commercial and National Security Interests as Executive Agent

Through its role as executive agent for the HEU agreement, USEC has received commercial benefits. In particular, USEC has had control over a large amount of LEU entering the nuclear fuel market. By ensuring that the HEU agreement is sustained and implemented as the U.S. government intends, USEC also has important responsibilities in furthering the national security interests of the United States. While recognizing its national

security responsibilities, however, USEC has stated that its priority as a private company is to remain a profitable commercial enterprise and maintain maximum value for its shareholders. DOE and State Department officials told us that maintaining the balance between the national security interests of the United States and USEC's commercial objectives is a challenge. An expert on the HEU agreement from the Massachusetts Institute of Technology told us that the agreement's current implementation is fundamentally flawed because USEC must always be beholden to its investors and its commercial interests rather than the national security goals of the United States.

Russian officials have also been critical of USEC. An October 1999 letter to the Secretary of Energy from Russia's Minister of Atomic Energy stated that although the amount of HEU to be blended-down each year and the method for determining the price for this material was fixed from 1997 to 2001 in the implementing contract, USEC was already proposing that the pricing method be reconsidered. According to the minister, USEC was insisting that the prices it pays for enrichment services be discounted from the current market prices. However, he said this would "considerably lower the income from sales of LEU in Russia" as compared with the planned amounts in the contract. The minister said that issues such as changing the pricing method are the prerogative of U.S. and Russian governmental agencies and not of their executive agents.

Impact of USEC's Privatization and the HEU Agreement on the United States' Domestic Capability to Produce Fuel for Nuclear Power Plants

Developments since USEC's privatization, combined with its reliance on Russian LEU for nearly half of its annual sales, have created concerns about the United States' continued ability to domestically produce fuel for commercial nuclear power plants, according to the officials we spoke with from U.S. uranium producing and conversion companies.¹³ These officials also said that USEC's sales, on the nuclear fuel market, of natural uranium that was transferred to USEC from DOE may have contributed to an oversupply of uranium. This oversupply has led to a drop in uranium prices, which has negatively affected the U.S. uranium mining and conversion industries, and has led to lower uranium production and decreased

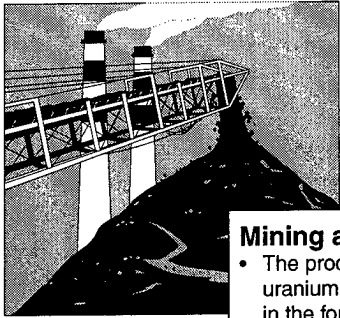
¹³In order to produce fuel for commercial nuclear power plants, uranium ore mined from the earth is milled to produce uranium oxide, which is then processed by a conversion facility to produce gaseous uranium hexafluoride. The uranium hexafluoride is then sent to an enrichment facility, where it is further processed to produce a mixture that is richer in the fissionable isotope uranium-235. (See fig. 2.)

employment in the industry. In addition, material from Russia now makes up over 50 percent of USEC's annual sales. USEC recently announced that it would cease enrichment operations at its Portsmouth uranium enrichment plant in July 2001. This would leave USEC with one uranium enrichment plant to supply its customers' requirements for nuclear fuel, should there be extended delays of deliveries from Russia. To counter this risk, DOE recently announced that it would maintain the plant in a "cold standby" status for 5 years to respond to significant disruptions in the supply of enriched uranium.

USEC's Sales of Uranium Transferred at Privatization Create Concern for Domestic Uranium Mining and Conversion

Nuclear power supplies approximately 20 percent of the United States' total electricity needs. (See fig. 2.) In 1999, 24 percent of the 47.9 million pounds of uranium purchased by U.S. utilities operating nuclear power plants was of U.S. origin, and 26 percent was Canadian. The remainder comes from other foreign sources. In 1995, the U.S. uranium industry produced 6 million pounds of uranium. By 1999, U.S. production had dropped to 4.6 million pounds—a reduction of about 23 percent. Employment in the U.S. industry dropped by 24 percent from 1995 through 1999 (almost entirely during 1998-99). Expenditures for uranium exploration in the United States fell from \$21.7 million in 1998 to \$9 million in 1999. In contrast, from 1995 through 1999, utilities' total purchases of uranium from domestic and foreign sources increased by nearly 10 percent. Through the USEC Privatization Act of 1996, the Congress intended that the sale of USEC to the private sector be conducted in a manner that would prevent or mitigate any adverse impact on the domestic uranium mining, conversion, and enrichment industries. However, according to uranium mining and conversion industry officials, USEC's sales from its inventory of nearly 73 million pounds of natural uranium transferred to it by DOE at privatization are a major contributor to their difficulties.

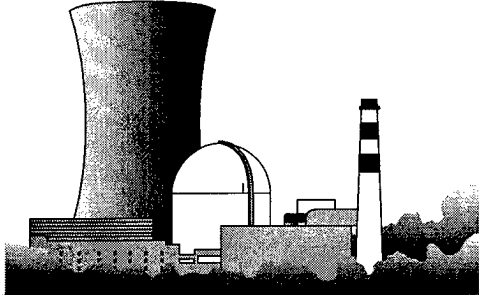
Figure 2: The Nuclear Fuel Cycle



1

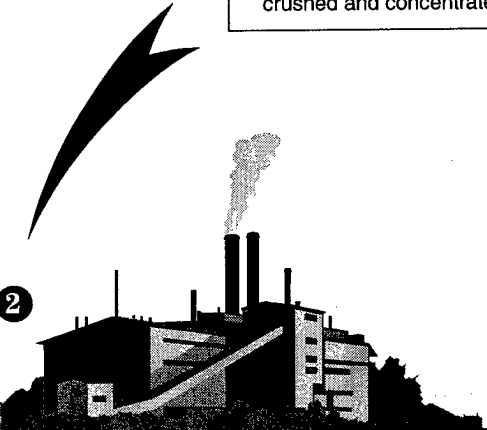
Mining and milling

- The process during which uranium is removed from earth in the form of ore and is then crushed and concentrated.



Nuclear power plants

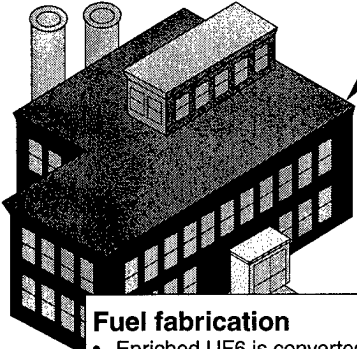
- Commercial facilities that use atomic energy to create steam, which turns turbines to generate electricity.
- A nuclear reactor may operate for up to 2 years before being refueled.
- Refueling requires that fuel assemblies be removed and replaced.
- Once used, this "spent" fuel is cooled and stored in either special protective containers or secure storage pools.



2

Conversion

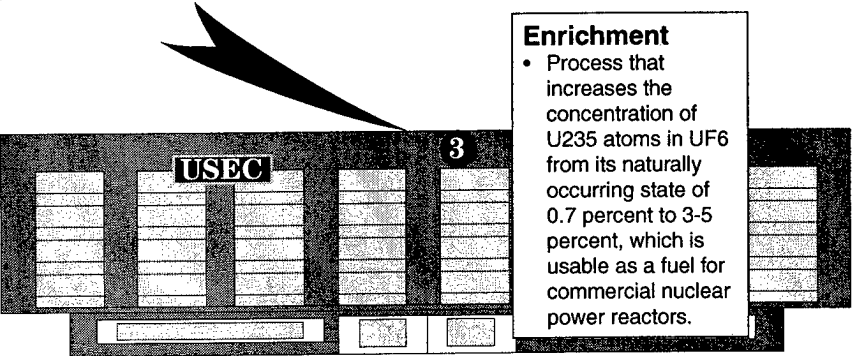
- Uranium is combined with fluorine gas to produce uranium hexafluoride (UF6), a powder at room temperature and a gas when heated.
- This process takes place at a conversion facility.
- The UF6 is then shipped to an enrichment facility.



5

Fuel fabrication

- Enriched UF6 is converted to uranium oxide powder and formed into ceramic pellets about the size of a pencil eraser.
- The pellets are loaded into metal tubes that are bundled to form fuel assemblies.
- The fuel assemblies are then shipped to a nuclear power plant, where they are loaded into a reactor.



3

Enrichment

- Process that increases the concentration of U235 atoms in UF6 from its naturally occurring state of 0.7 percent to 3-5 percent, which is usable as a fuel for commercial nuclear power reactors.

4

Source: GAO.

USEC's revenues from the sale of natural uranium to electric utility customers were \$25.9 million in fiscal year 1997, when USEC (then, the U.S. Enrichment Corporation) was a wholly owned government corporation. While USEC has not publicly stated how much natural uranium it has sold annually since privatization, revenues resulting from the sale of natural uranium increased to \$53.6 million in fiscal year 1999 and to \$101.6 million in fiscal 2000. As figure 1 indicates, the spot market price of uranium decreased throughout this period. Therefore, such a large increase in USEC's revenue resulting from uranium sales indicates that USEC has sold increasingly large amounts of natural uranium into the market. USEC officials told us that its sales of natural uranium have been conducted in a prudent manner. According to an official from the U.S. uranium conversion industry, uranium prices are also being affected by the implementation of the HEU agreement. Although the natural uranium returned to Russia by USEC in exchange for LEU is partially restricted from entering the United States under quotas established by the USEC Privatization Act of 1996, the practice has led to a perception of oversupply in the uranium market. This perception, according to the official, has also led to some downward pressure on uranium prices.¹⁴

According to a U.S. uranium mining industry official, the domestic industry is competitive with foreign uranium producers. However, this official stated that USEC's sales have pushed the price of uranium below the cost of production of most producers worldwide, which threatens the continued viability of domestic uranium production. While USEC's inventories are likely to be depleted within the next several years, this official told us the domestic industry might not survive that long. Also, because the Nuclear Regulatory Commission (NRC) requires a producer to begin to decommission a uranium mill no more than 2 years after production has ceased, this official stated that it is difficult to maintain uranium production capacity in a standby status. In contrast, USEC officials provided us with a letter from another uranium mining industry official, which states that, although USEC is being blamed for the uranium mining industry's problems, "in truth there are many low cost sources of uranium in this world that are competing to drive the price down."

¹⁴ In addition, trade restrictions against imports of uranium from Kazakhstan were lifted in July 1999. According to a uranium conversion industry official, while Kazakh uranium production is considered to be small—about 2.4 million pounds annually—it does represent another source of material that can add to the oversupplied U.S. market.

In addition, according to a uranium conversion industry official, the natural uranium that USEC has sold, which has been in the form of uranium hexafluoride, has supplanted the conversion of uranium oxide to uranium hexafluoride at ConverDyn's uranium conversion facility in Metropolis, Illinois—the only uranium conversion plant in the United States—accounting for 60 percent of the conversion capacity in North America. Normally, utilities purchase uranium oxide from producers and deliver it to ConverDyn to be converted to uranium hexafluoride before sending it to a uranium enrichment facility. However, since USEC is selling uranium hexafluoride instead of uranium oxide, the conversion step in the fuel cycle has been unnecessary for utilities purchasing natural uranium from USEC. In 1998, ConverDyn converted approximately 33 million pounds of uranium oxide to uranium hexafluoride. By 1999, the amount converted decreased by 25 percent to approximately 24 million pounds, and employment at the conversion facility was reduced by nearly 13 percent. According to the president of ConverDyn, sales are expected to decline another 10 percent in 2000, while the prices for new contracts are averaging 30 percent below price levels for 1999, which were already 20 percent below 1998 levels. According to this official, it is doubtful that ConverDyn can survive much longer at these operating rates and at these decreased revenues. The closure of the Metropolis facility, therefore, would force U.S. utilities to rely on foreign sources of conversion capacity. According to U.S. government officials we spoke with, conversion capacity exists in Canada, but it is insufficient alone to meet U.S. needs. Utilities would likely have to look to European or other foreign sources to fill the remaining demand, should ConverDyn's plant close.

**Ceasing Operations at
USEC's Portsmouth
Uranium Enrichment Plant
Could Affect U.S. Capability
to Supply Commercial
Nuclear Reactors With LEU**

USEC provides nearly 75 percent of the total uranium enrichment services (SWU) purchased by North American utilities. USEC projected sales of about 10.5 million SWU in fiscal year 2000.¹⁵ About 5.5 million SWU were to be derived from deliveries of Russian LEU. The remainder was either to be produced domestically at USEC's Portsmouth or Paducah uranium enrichment plants or purchased from other sources.

Since over 50 percent of USEC's annual sales come from enrichment services derived from Russian LEU, USEC has not been able to operate both uranium enrichment plants at an economically efficient level. However, under a July 1998 agreement with the Department of the

¹⁵USEC's fiscal years are from July 1 through June 30 of each year.

Treasury, USEC was not allowed to close either plant before January 2005. Nevertheless, this agreement was subject to exceptions that would allow USEC to close a plant if a “significant event” occurred, including, among other things,

- events beyond the reasonable control of USEC, such as natural disasters;
- a decrease in the annual worldwide demand for enrichment services to less than 28 million SWU;
- a decline in the average price for all enrichment services under USEC’s long-term contracts to less than \$80 per SWU; and
- the downgrading of USEC’s corporate credit rating below investment grade or a reasonable expectation of such downgrading in the next 12 months.

In February 2000, Standard and Poor’s and Moody’s Investors Service revised their credit ratings of USEC’s long-term debt to below investment grade, thus allowing USEC to close a plant. Following this downgrade, NRC initiated a review of USEC’s financial condition as part of NRC’s process to certify USEC’s compliance with safety standards at the corporation’s uranium enrichment facilities. Under the Atomic Energy Act of 1954, NRC may not issue a certificate of compliance to USEC if issuing a certificate would be harmful to the maintenance of a reliable and economical source of domestic enrichment services. While the results of NRC’s review have not been publicly disclosed, NRC’s Chairman wrote in September 2000 that—notwithstanding the findings of the review—denial, suspension, or revocation of USEC’s certificate of compliance would itself harm the maintenance of reliable and economic enrichment services. Therefore, NRC determined that it would not take any action to modify, suspend, or revoke USEC’s certificate of compliance, which allows the corporation to operate the uranium enrichment plants.

Given its inability to operate both plants at an economically efficient level, USEC announced in June 2000 its intention to cease uranium enrichment operations at the Portsmouth plant in June 2001 and to shift domestic enrichment services to Paducah after that plant receives regulatory approval from NRC to enrich uranium above Paducah’s currently allowed maximum level of 2.75 percent uranium-235.¹⁶ According to a DOE official,

¹⁶USEC will continue to operate Portsmouth’s uranium shipping facilities at least until similar facilities are available at the Paducah plant.

Paducah must be certified by NRC to be able to enrich uranium to 5.5 percent uranium-235 in order to meet USEC's contract requirements to utility customers.

Ceasing operations at Portsmouth, however, means that USEC will no longer have uranium enrichment capacity as readily available to respond to delays in deliveries of LEU from Russia. USEC has stated that, in the event of delivery interruptions, it plans to increase production at Paducah to the levels necessary to continue to fill its customers' orders. However, to do so for extended periods of time would increase USEC's production costs significantly. In addition, according to a DOE official, risks associated with the operations of only one plant are increased because of the Paducah plant's age and because the plant lies within an earthquake zone. DOE's recent announcement that it would maintain the Portsmouth plant in a "cold standby" status is, according to DOE officials, based on concerns about the future of domestic enrichment supply and its effects on U.S. nonproliferation policy.

Federal Oversight of the HEU Agreement's Implementation

Oversight of the implementation of the HEU agreement is conducted by the interagency Enrichment Oversight Committee (EOC), which was organized under a May 1998 executive order.¹⁷ Chaired by NSC and consisting of about a dozen federal agencies, EOC's efforts have been primarily focused on resolving problems that have occurred over the course of the HEU agreement. However, EOC has not fulfilled all of the responsibilities given to it by the executive order.

Implementation of the HEU Agreement Is Monitored by the Interagency Enrichment Oversight Committee

Under the executive order, EOC was organized to monitor and coordinate U.S. government efforts to support the following objectives:

- The full implementation of the HEU agreement and related contracts and agreements by USEC as executive agent.
- The application of statutory, regulatory, and contractual restrictions on foreign ownership, control, or influence over USEC.

¹⁷Exec. Order No. 13085 (Establishment of the Enrichment Oversight Committee, 63 *Federal Register* 29333 [May 28, 1998]).

-
- The development and implementation of U.S. government policy regarding uranium enrichment and related technologies, processes, and data.
 - The collection and dissemination of information relevant to any of the above on an ongoing basis.

EOC is chaired by a senior official from NSC and consists of representatives from the Departments of State, the Treasury, Defense, Justice, Commerce, and Energy; the Office of Management and Budget; NSC; the National Economic Council; the Council of Economic Advisers; and the intelligence community. Although EOC's membership is governmentwide, NSC, the State Department, and DOE have taken the primary role in overseeing the HEU agreement's implementation.

Officials with NSC, the State Department, and DOE told us that EOC's oversight role has, in general, been limited to dealing with problems that have arisen through the course of the HEU agreement. For example, officials told us that EOC spent significant time attempting to resolve delays in deliveries caused by Russia's dissatisfaction with the lack of payment for the LEU's natural uranium component. These officials also told us that Tenex's halting of shipments in early 2000 because of its fear that the money that USEC paid the former would be used to settle an arbitration judgment against Russia required considerable effort to resolve on EOC's part .

We asked officials from NSC, the State Department, and DOE for records of EOC's periodic meetings or documentation of the decisions made. However, these officials told us that EOC has primarily acted in an informal manner, meeting only as required and involving only those agencies that have an interest in the topic under discussion, and that there are no available records or minutes from these meetings. For example, Treasury and Commerce officials have not been as involved in the national security deliberations of EOC because, according to these officials, their primary interest does not involve national security issues. Similarly, Department of Defense officials are not involved in EOC's deliberations regarding the privatization of USEC, except as they relate to the national security implications of the privatization.

EOC Has Not Fulfilled All of Its Responsibilities Under the May 1998 Executive Order

EOC has not fulfilled all of its responsibilities as laid out in the executive order that established the committee. Specifically, the order required EOC to establish procedures for designating alternative executive agents to implement the HEU agreement. However, EOC lacked such procedures when USEC considered resigning as executive agent in 1999. While EOC interviewed several companies that would be willing to take over as executive agent if USEC were to resign, EOC did not provide us with any analyses of the companies' relative advantages and disadvantages, nor of the impact of a change of executive agent on the implementation of the HEU agreement. NSC, State Department, and DOE officials told us that they weighed the merits of replacing USEC with several other companies. According to DOE officials, USEC, while not unique, has several advantages relative to potential replacements. For example, USEC has a large customer base and can more readily incorporate the Russian material into its existing enrichment contracts. In addition, USEC possesses an existing inventory of natural uranium that it can transfer to Russia upon the delivery of LEU.

EOC continues to lack a contingency plan, should USEC resign in the future or should the U.S. government choose to take over USEC's responsibilities or replace USEC as executive agent with another company. According to an NSC official, such a plan is unnecessary because USEC is unlikely to resign and there is no need for such a formal plan. USEC, NSC, State Department, and DOE officials told us that the corporation plans to continue as executive agent for the foreseeable future.

EOC was also required to collect and analyze information related to the maintenance of the domestic uranium mining, conversion, and enrichment industries. Under the USEC Privatization Act of 1996, the President is to report to the Congress annually on the impact that the HEU Agreement is having on these industries. Under the May 1998 executive order, EOC was given responsibility to prepare these reports. The 1998 and 1999 reports stated that the domestic mining, conversion, and enrichment industries did not experience material adverse impacts as a result of the HEU agreement. However, from our discussions with the DOE officials who were responsible for preparing these reports, the information used to prepare the analyses supporting these assertions was unclear to us. In the August 2000 report to the Congress, EOC concluded that there had been an adverse impact on these industries. EOC's conclusion was made after market prices for uranium had been falling for several years as a result of the large quantities of uranium anticipated from the HEU agreement and the marketing of USEC's natural uranium inventory. In July 2000, we raised

the difficulties faced by the domestic uranium mining and conversion industries with an NSC official. This official acknowledged that EOC had not done sufficient analysis on the uranium mining and conversion aspects of the nuclear fuel cycle, concentrating primarily on enrichment instead. EOC has produced a draft study on the maintenance of a viable domestic uranium enrichment industry and is now beginning to analyze the domestic uranium mining and conversion industries, which are also essential steps in the nuclear fuel cycle. EOC now expects to issue a report on U.S. energy security needs—including issues involving uranium mining, conversion, and enrichment—in December 2000.

According to a DOE official, EOC's oversight of USEC has been hampered by a lack of access to information from USEC so that EOC can analyze the HEU agreement's implementation. This official told us that when USEC requested \$200 million in compensation for its role as executive agent from the U.S. government, DOE lacked sufficient information to analyze USEC's claims about the impact of its role as executive agent on its profitability. DOE depended upon USEC to provide information and analysis regarding, among other things, the difference between USEC's costs of producing LEU domestically and the price being paid to Tenex for LEU. The Secretary of Energy said the data that USEC provided were insufficient to justify the request. USEC officials disputed this claim and told us that all information required to be reported or that was requested by EOC has been provided by USEC.

Conclusions

The HEU agreement's implementation has had a beneficial impact on the national security of the United States, namely, the removal of over 100 metric tons of weapons-grade material from Russia. Achieving this benefit, however, has not been without cost. Not only has the U.S. government spent \$325 million in purchasing natural uranium from Russia, but the United States also faces a growing dependence on Russian-origin material for nuclear fuel, which now makes up almost 40 percent of annual U.S. sales. The Congress intended that the federal government ensure that neither the privatization of USEC nor the implementation of the HEU agreement would be harmful to the domestic uranium industry. However, factors subsequent to USEC's privatization and the implementation of the HEU agreement have affected U.S. nuclear fuel production. EOC, which is responsible for coordinating federal policy, has been largely passive in its responsibilities to monitor the impact of privatization and the HEU agreement on the industry. Nevertheless, we are encouraged that EOC is now examining the most effective ways to maintain the U.S. domestic

uranium mining, conversion, and enrichment industries. EOC needs to prevent or mitigate the negative effects of the HEU agreement through careful monitoring, analysis, and reporting of the impact of USEC's activities on the entire domestic uranium industry to key decisionmakers to aid in charting the optimal path to the industry's continuation, as the Congress intended. Specifically, regarding USEC's current negotiations with Tenex on the price that USEC will pay for enrichment services from 2002 through 2013, EOC needs to make clear what the benefits would be of importing newly produced LEU rather than additional LEU derived from dismantled Russian nuclear weapons and what impact this would have on the domestic uranium production and conversion industries and on U.S. national security objectives.

We recognize the challenges posed by having a private company implement an agreement with important nuclear nonproliferation objectives and the difficulties posed by federal oversight of the actions of that private company. While successful implementation of the HEU agreement requires some balancing of commercial interests with national security objectives, in the end, the national security interests of the United States must take priority. Therefore, careful and thorough oversight of the government's executive agent is needed to ensure that its actions are compatible with national security interests. If the actions of any private company in performing its role as executive agent are contrary to these interests, the U.S. government should be prepared to either replace it or to take on the responsibilities itself. A contingency plan that would detail the circumstances under which USEC would be replaced is needed along with clear criteria for choosing the replacement. Such a plan was envisioned by the executive order that formed EOC and would, we believe, amplify to USEC and its successors as executive agent, if any, that the overriding priority of the U.S. government in the implementation of the HEU agreement is the removal from Russia and delivery to the United States of nuclear material from dismantled nuclear weapons.

Recommendations for Executive Action

We recommend that the Assistant to the President for National Security Affairs direct the chair of the Enrichment Oversight Committee to

- study and report to the Congress on the benefits and the national security implications to the United States, in addition to the impact on the domestic nuclear fuel industry, of importing newly produced LEU from Russia (rather than additional weapons-origin material) as is being proposed in USEC's current negotiations with Tenex on the price of the

enrichment services component of LEU to be delivered to the United States through 2013, and

- prepare and transmit to the Congress a contingency plan that would detail the circumstances under which a replacement for USEC would be needed, the criteria for choosing the entity or entities (including U.S. government agencies) that would serve as the replacement, and the specific procedures to be followed in the event that USEC withdraws or is replaced as executive agent for the HEU agreement.

Agency Comments and Our Evaluation

We provided DOE, the State Department, NSC, and USEC with a draft of this report for their review and comment.

We received written comments from DOE and we spoke with officials from the State Department, including the Senior Adviser to the Under Secretary for Arms Control and International Security; NSC, including the Special Assistant to the President and Senior Director, Nonproliferation and Export Controls; and USEC, including its Senior Vice President; to obtain their comments. In general, DOE, the State Department, and NSC agreed with the draft report's findings and DOE described the recommendations as reasonable. DOE, the State Department, and USEC provided us with technical clarifications, which we incorporated as appropriate.

In its written comments, DOE said that the report was useful and integrated information from a wide variety of sources in the United States, Russia, and the nuclear industry, illustrating the complexity of the HEU agreement. However, DOE said that the report understates the sustained record of successful government action and focuses too narrowly on procedural provisions, such as the requirement in the executive order to develop procedures to replace the executive agent. Our report notes that EOC has spent significant time resolving problems that have arisen through the course of the HEU agreement. We continue to believe, however, that the requirements laid out in the executive order need to be fully implemented and that a contingency plan would serve more than just a procedural purpose. It would also serve as a means to emphasize to USEC and any successor executive agents that the priority of the United States in the implementation of the HEU agreement is the removal of weapons-grade material from Russia. DOE states that if USEC had resigned in December 1999, EOC would have had over a year to choose a replacement. A contingency plan, however, would provide a mechanism that could be rapidly implemented not only if USEC were to resign, but also if it were no longer capable of fulfilling its duties as executive agent. We agree with DOE

that market conditions would affect EOC's selection of alternative executive agents. Therefore, when developing criteria for choosing alternative agents as we recommend, EOC should examine how prevailing market conditions would affect these criteria. DOE also said that the report understates the steps EOC has taken to address domestic market and fuel cycle interests. Specifically, DOE notes EOC's efforts to withhold uranium from the market in an effort to support prices and the proposal to maintain the Portsmouth uranium enrichment plant in a standby status. Our report notes both of these efforts, and, as we point out, we are encouraged that EOC is now examining the most effective ways of maintaining the domestic uranium mining, conversion, and enrichment industries. However, EOC's analyses are still being developed and it remains to be seen what impact the actions resulting from these analyses will have on the domestic nuclear fuel industry. Furthermore, we continue to believe that the proposal to import commercially produced LEU from Russia needs to be evaluated to determine its impact not only on the nuclear fuel industry, but also on U.S. national security. DOE's comments are reprinted in appendix II.

Scope and Methodology

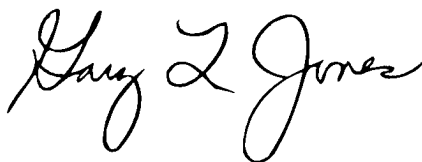
To obtain information for this report, we reviewed and analyzed the 1993 HEU agreement, the 1994 implementing contract and subsequent amendments, executive orders, memorandums of agreement, congressional testimony, and applicable U.S. laws. We reviewed annual reports to the Congress on the impact of the HEU agreement on the domestic uranium mining, conversion, and enrichment industries submitted by DOE in accordance with the USEC Privatization Act of 1996. In addition, we reviewed an April 2000 draft study prepared by EOC on the maintenance of a viable domestic uranium enrichment industry. We also examined an August 2000 financial review of USEC conducted by NRC in response to the February 2000 downgrade of USEC's corporate credit rating. We reviewed and analyzed documentation that USEC provided us with, including data on LEU deliveries, USEC's annual reports, reports and correspondence to EOC, and USEC's annual and quarterly filings with the U.S. Securities and Exchange Commission. We compared USEC's data on LEU deliveries with similar data from DOE to determine the consistency of the data. We interviewed cognizant officials from the Departments of Commerce, Defense, Energy, State, and the Treasury. We also interviewed an official from NSC and officials from NRC. In addition, we spoke with representatives of USEC, Inc.; Urenco, Inc.; NUKEM, Inc.; New York Nuclear Corporation; Global Nuclear Services and Supply, Ltd.; the Nuclear Energy Institute; ConverDyn; General Atomics; Energy Resources International, Inc.; Commodore Nuclear; the Paper, Allied Chemical, and

Energy Workers Union; and the Uranium Producers of America. We also spoke with Dr. Thomas Neff from the Center for International Studies at the Massachusetts Institute of Technology. Dr. Neff has advised both the United States and Russian governments on the implementation of the HEU agreement. Additionally, we visited Moscow, Russia, in September 2000 to meet with officials from Techsnabexport, the executive agent for the Russian Federation. We performed our work from March to November 2000 in accordance with generally accepted government auditing standards.

As agreed with your office, unless you publicly announce its contents earlier, we plan no further distribution of this report until 14 days after the date of this letter. At that time, we will send copies of this report to the appropriate congressional committees; the Honorable Samuel R. Berger, Assistant to the President for National Security Affairs, the Honorable Bill Richardson, Secretary of Energy; the Honorable Madeleine K. Albright, Secretary of State; the Honorable William S. Cohen, Secretary of Defense; the Honorable Lawrence H. Summers, Secretary of the Treasury; the Honorable Norman Y. Mineta, Secretary of Commerce; the Honorable Richard A. Meserve, Chairman of the Nuclear Regulatory Commission; the Honorable Jacob J. Lew, Director of the Office of Management and Budget; William H. Timbers, President and Chief Executive Officer of USEC, Inc.; and other interested parties.

If you have any questions about this report, please call me on (202) 512-3841. Key contributors to this report are listed in appendix III.

Sincerely yours,



(Ms.) Gary L. Jones
Director
Natural Resources and Environment

The Privatization of USEC

The United States Enrichment Corporation (USEC) was created by the Energy Policy Act of 1992 as a wholly owned government corporation to assume responsibility for conducting and marketing the Department of Energy's (DOE) uranium enrichment services. The USEC Privatization Act of 1996 authorized the corporation's sale to the private sector in a manner that provided for the corporation's long-term viability; the continuing operation of DOE's uranium enrichment plants; the protection of the public interest in maintaining a reliable and economical domestic source of uranium mining, conversion, and enrichment services; and to the extent not inconsistent with these purposes, secured the maximum proceeds to the United States.

The corporation was privatized through an initial public offering on July 28, 1998, resulting in proceeds to the U.S. government of nearly \$1.9 billion, consisting of

- nearly \$1.4 billion from the sale of USEC stock, and
- \$500 million borrowed by USEC and paid to the government.

In addition, the United States retained about \$1.2 billion in cash from accounts held by the corporation in the U.S. Treasury.

According to USEC's privatization prospectus, as of March 31, 1998 (4 months prior to privatization), USEC had over \$3.1 billion in assets and accounts receivable (primarily, cash held at the U.S. Treasury and about 73 million pounds of uranium transferred to USEC by DOE) and liabilities of over \$1 billion. In addition, USEC had the exclusive commercial rights to the atomic vapor laser isotope separation (AVLIS) process that, at privatization, was expected to significantly reduce USEC's production costs. AVLIS is a new uranium enrichment technology that uses lasers to enrich uranium. DOE spent more than \$1.7 billion developing the technology and transferred it to USEC in an April 1995 memorandum of agreement. USEC announced in June 1999 that it was suspending further development of the AVLIS process, on which it had spent over \$100 million since privatization. The suspension left USEC without a complete plan to replace its existing gaseous diffusion enrichment technology, which is nearly 50 years old and very costly when compared with its competitors' centrifuge enrichment technology.¹ USEC is currently evaluating both centrifuge technology and another laser-based technology called SILEX as a replacement for its gaseous diffusion technology.

Pursuant to the Energy Policy Act of 1992, the USEC Privatization Act of 1996, and memorandums of agreement between USEC and DOE, DOE made seven transfers of approximately 73 million pounds of uranium to USEC from 1993 through 1998. (See table 3.)

¹ The gaseous diffusion process involves the passage of uranium hexafluoride in a gaseous form through a series of filters. Because uranium-235 is lighter, it passes through the filters more readily than uranium-238, resulting in gaseous uranium that is enriched in uranium-235—the fissionable isotope. The other enrichment process—gas centrifuge—employs rapidly spinning cylinders containing uranium hexafluoride to separate the fissionable uranium-235 from the nonfissionable uranium-238. The centrifuge process is significantly less power intensive than the gaseous diffusion process.

Table 3: DOE Transfers of Uranium to USEC, 1993-98

Transfer date	Amount transferred (in millions of pounds of uranium)
July 1993	22.9
December 1994	6.2
November 1995	0.9
April 1998	13.0
April 1998	18.2
May 1998	11.1
May 1998	0.5
Total	72.8

Note: 42.3 million pounds was subject to various restrictions that limited the amount of uranium that USEC was allowed to sell over a specified period of time.

Source: DOE.

USEC was also the beneficiary of several other favorable arrangements with the U.S. government, including

- an advantageous lease providing for nominal rent payments for the use of the two enrichment plants with an open-ended renewal option,
- low-cost power purchase arrangements whereby USEC purchases electricity (which represents nearly 60 percent of USEC's production costs) from DOE at an average cost of less than 2 cents per kilowatt hour, and
- the U.S. government's retention of substantially all liabilities arising from the operation of the enrichment plants prior to privatization, including nearly all environmental clean-up and decommissioning liabilities.

USEC also received from DOE contracts with 64 nuclear utility customers operating 273 nuclear reactors in 14 countries. As of March 31, 1998, these contracts were worth \$3.2 billion through fiscal year 2000 and \$7.4 billion through fiscal 2009.

At the time of privatization, USEC estimated that it held a 75-percent market share in North America and 40 percent worldwide in the highly competitive uranium enrichment industry. However, in 1999, USEC reported some decrease in its worldwide market share because of, among

other things, the adverse impact of a strengthened U.S. dollar and increased competition among uranium enrichment suppliers.

USEC's total revenue decreased from about \$1.6 billion in fiscal year 1995 to about \$1.5 billion in fiscal 2000, and its cost of sales (the cost of the enrichment services that USEC sold to its customers, which depends upon both production costs at the two uranium enrichment plants and the costs of LEU delivered from Russia) has increased from \$1.1 billion to \$1.2 billion in the same period. The increase in costs occurred largely since privatization, increasing by about \$174 million from fiscal year 1998 through fiscal year 2000 alone. As a result of decreasing revenue and increasing costs, USEC's gross profit has declined from \$522.6 million in fiscal year 1995 to \$233.6 million in fiscal year 2000, a reduction of 58 percent. After being offered in July 1998 at \$14.25 per share, USEC's stock dropped to \$3.50 per share in March 2000 before recovering somewhat to \$5.19 per share in October 2000.

Comments From the Department of Energy



The Under Secretary of Energy

Washington, DC 20585

November 29, 2000

Ms. Gary L. Jones
Director, Natural Resources
and Environment
United States General Accounting Office
Washington, D.C. 20548

Dear Ms. Jones:

I am responding to your letter of November 21, 2000 concerning the draft GAO report, *Nuclear Nonproliferation: Implications of the U.S. Purchase of Russian Highly Enriched Uranium* (GAO-01-148). The report is useful and integrates information from a wide variety of sources in the United States, Russia and the nuclear industry, illustrating the complexity of the 1993 U.S.-Russia HEU agreement. I appreciate the opportunity to provide comments for the record on several general themes raised by the report. DOE staff will provide you with specific technical comments separately.

First, I would like to note areas of broad thematic agreement:

- ***The report affirms that "The HEU agreement's implementation has had a beneficial impact on the national security of the United States..."*** The metrics are clear: the equivalent of 4,000 nuclear weapons has been removed since 1995 from Russia by processing highly enriched uranium from Russian weapons into commercial reactor fuel. The report also recognizes the challenges of implementing a national security agreement through a commercial executive agent to achieve national objectives through commercially generated revenues and that this has not been without some difficulty. That said, when the U.S. government has intervened directly to keep the agreement on track, drawing on bipartisan support for congressional appropriations in 1996 and 1998, funds have been used to purchase Russian uranium that can be sold in a stronger market in the future with proceeds returning to the Treasury.
- ***The report emphasizes the important role that U.S. energy security plays in implementing the HEU agreement with Russia.*** We agree that the more successful the agreement has been in blending down Russian weapons material, the more the agreement has come to be an important source of uranium for the U.S. It was precisely to address this balance of achieving national security objectives and sustaining energy security that the Administration announced in October a plan and source of funds to keep Portsmouth in a reserve capacity over the next five years and to demonstrate a pilot centrifuge plant over the same period (more on this below).
- ***The "Recommendations for Executive Action" in the report are reasonable.*** Specifically, the report recommends providing information to Congress on the implications of importing newly produced low enriched uranium from Russia in

conjunction with the HEU agreement, and on the issues associated with the appointment of any new replacement agent. We believe that it is possible to provide this information in a manner that respects ongoing negotiations and commercially sensitive information.

I would also like to take this opportunity to note areas in which we do not necessarily disagree but feel that the emphasis is misplaced or that require additional comment:

- ***The GAO report understates the sustained record of successful government action on the HEU agreement achieved through interagency deliberation.*** Instead, it sometimes focuses narrowly on, and makes overly broad generalizations about, select procedural provisions of the Administration's own May 1998 Executive Order 13085 that formed the Enrichment Oversight Committee (EOC).

It is worth recounting that since the HEU agreement was signed with Russia in 1993, an implementing contract was signed in 1994, and downblending of weapons grade material and deliveries began in 1995. Advance payments to Russia -- all repaid by future deliveries -- were made in 1994 (\$60M), 1995 (\$100M) and 1996 (\$100M) that achieved our national security interests by loaning to Russia its own future revenues. More specifically, they contributed in 1994 to arrangements permitting the denuclearization of Ukraine and, after 1996, to obtaining unprecedented transparency at Russian facilities diluting the weapons material. Repeatedly, through direct U.S. involvement, it proved possible to overcome the difficulties that arose in such a unique arrangement at a time of such fundamental change in Russia, including interruptions of shipments in each year since 1997. In March 1999, after months of complex negotiations with a variety of parties, the U.S. and Russia signed the "Transfer Agreement" that provided a market-based solution to the natural uranium track of the HEU agreement, thereby addressing a key cause of previous shipment interruptions. The Transfer Agreement required two decrees by the Prime Minister of Russia and the filing of a U.S. Statement of Interest in federal court litigation to ensure the successful implementation of that agreement. The U.S. also dealt with a more recent case of private litigation that hampered the HEU agreement through Executive Order 13159 issued in June 2000 that enabled the agreement to resume operation. In short, there is a record of success and activity in the stewardship and oversight of this agreement by the EOC and the interagency group that preceded the EOC.

The GAO report focuses significant attention on the issue of EOC procedures for replacing the U.S. executive agent. This focus stems from USEC's consideration in late 1999 of resigning as U.S. executive agent for the HEU agreement after little more than a year as a private entity. Presented with USEC's possible resignation in October 1999, the EOC established a process for designating alternative agents to implement the agreement. Potential alternative agents were identified and interviewed, indicating considerable interest, and had USEC resigned in December 1999, requests for proposals would have been solicited in short order. If USEC had resigned, it would still have had to perform for over a year, allowing the EOC ample

time to act. Detailed proposals by the potential new agents would have had different attributes that would have required evaluation in light of the market conditions known at that time. Therefore, in our view, the GAO report over emphasizes the role that the procedures could play in addressing this issue. The government has an obligation to be prepared, but at the same time not create market uncertainty in advance of the need for an alternative or additional agent. (It would be a policy decision with marketplace impact to define or make public triggering events for appointment of an additional agent, such as progress in taking deliveries.) The EOC earlier this year formed a lawyer subgroup to ensure that the government can bring to bear all necessary legal expertise to address the full array of HEU agreement issues.

- ***The GAO report understates the steps the Enrichment Oversight Committee has taken to address domestic market and fuel cycle interests.***

The Administration has provided annual reports to the Congress on the full range of impacts on enrichment, mining and conversion industries. The report analyzing 1999 was the first report in which there was a finding of adverse impact.


In regard to the uranium mining and conversion industries, in the aftermath of the privatization of USEC in July 1998, as authorized by the Department of Treasury, the EOC approved several actions to address domestic impacts of the 72.8 million pounds of uranium inventories that the U.S. government transferred to USEC. In September 1998, DOE announced a decade-long moratorium on the sale of 30 million pounds of uranium in its inventory. In March 1999, the Transfer Agreement involved purchase of 28 million pounds of Russian natural uranium (unsold from 1997 and 1998 deliveries) and identified this as part of 58 million pounds of uranium that DOE would withhold from the market for a ten-year period. In addition, the Transfer Agreement provided additional restrictions on the sale of Russian uranium, with any unsold amounts under quotas set out in 1996 U.S. law being returned to a monitored stockpile in Russia. Thus, in the implementation of the HEU agreement, the U.S. Government acted to withhold from the market quantities of uranium comparable to the transfer of inventories to USEC. Moreover, because current market prices are below a floor price for Russian material, little Russian natural uranium has actually entered the U.S. market. This is not to say that the market impacts on domestic conversion and mining are not significant, but rather that they cannot be attributed solely to the HEU agreement or USEC privatization. In the post-Cold War world former military stocks that represent previous conversion and mining services are impacting market expectations worldwide in terms of availability of supply.

On the issue of domestic enrichment services, in the aftermath of USEC's June 27, 1999 business decision to terminate AVLIS, an advanced enrichment technology, the EOC in August 1999 directed that a study be prepared on the implications for future U.S. enrichment options. This study, *Enrichment Oversight Committee Study on the Maintenance of a Viable Domestic Uranium Industry*, was completed this spring. In late June 2000, USEC announced its intention, over the clear written objections by the Administration, to terminate enrichment operations at the Portsmouth enrichment

plant in June 2001. USEC avoided its express commitment to operate two enrichment plants until 2005 as a result of the significant downgrading of its financial condition. In light of these changed conditions, a set of options on how to meet U.S. energy security needs and obligations was developed and refined under EOC auspices during the July through October period. The resulting Administration plan was announced in early October: Portsmouth would be kept in a stand-by condition that would allow operations to resume if necessary during a five-year period, while an advanced, U.S.-origin centrifuge capacity would be demonstrated over this same period. Meanwhile, in connection with this announcement, the Administration has engaged in an active dialogue with the Congress on what measures might be appropriate to prevent or mitigate adverse impacts with respect to U.S. conversion and mining industries. In short, this course of action adopted by the EOC, based on analysis and adaptation to rapidly changing market conditions and business decisions of a private company, represents a very active approach.

In conclusion, the HEU agreement is being implemented successfully. It is a unique agreement that breaks new ground in the relations among nuclear weapons states. The bulk of the funds to purchase the equivalent of thousands of nuclear weapons worth of uranium from Russia have been generated from the private sector. Although there is an ongoing challenge associated both with the transformation of the Russian economy and the need to address national security objectives through commercial transactions, it is essential that we maintain our focus on the key objective: the nonproliferation results achieved by removing weapons material from Russia. The U.S. Government will necessarily continue its ongoing and vigorous role in overseeing and addressing the practical challenges of implementing this historic agreement that extends until 2013. The U.S. has already acted to address such challenges. The bipartisan support in the United States Congress for the agreement has been strong to-date and will be critical in the years ahead in balancing national security and energy security considerations. We appreciate the contribution made by the GAO report in highlighting some of the key challenges and issues.

Sincerely,



Ernest J. Moniz

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