

**Report on the Effect the Low-Enriched Uranium  
Delivered Under the HEU Agreement Between the  
Government of the United States and the Government  
of the Russian Federation Has on the  
Domestic Uranium Mining, Conversion, and  
Enrichment Industries, and the Operation of the  
Gaseous Diffusion Plant**

**2003**



Information Date: December 31, 2003

## **Introduction**

*The Agreement Between the Government of the United States and the Government of the Russian Federation Concerning the Disposition of Highly Enriched Uranium Extracted from Nuclear Weapons* (HEU Agreement) was signed on February 18, 1993.

The HEU Agreement provides for the purchase over 20 years (1993–2013) of 500 metric tons (MT) of weapons-origin highly enriched uranium (HEU) converted to commercial grade low-enriched uranium (LEU) from the Russian Federation (Russia). The Russian LEU is sold in the United States (U.S.) nuclear fuel market to power commercial nuclear power plants. The LEU resulting from the HEU Agreement represents the equivalent of almost 400 million pounds of natural uranium concentrates as  $U_3O_8$ , about 150 million kilograms of uranium (kgU) conversion services in the form of enriched uranium hexafluoride ( $UF_6$ ), and approximately 92 million separative work units (SWU) of uranium enrichment services. This is enough fuel to satisfy about eight years of demand for uranium concentrates, conversion services and enrichment services in the U.S.

## **Purpose**

On April 26, 1996, the USEC Privatization Act (Privatization Act), Public Law 104-134 (42 U.S.C. 2297h) was enacted. It requires the President to “report to the Congress not later than December 31 of each year on the effect the low-enriched uranium delivered under the HEU Agreement is having on the domestic uranium mining, conversion, and enrichment industries, and the operation of the gaseous diffusion plants.”<sup>1</sup>

## **Report Layout**

This report, consistent with the legislative requirement, includes a review of the (i) implementation and status of the HEU Agreement deliveries; (ii) events impacting the HEU Agreement over the past year and, in recognition of the 10<sup>th</sup> anniversary of the HEU Agreement having been reached in February 2003, a review of the first ten years of the HEU Agreement; and (iii) the effects of the HEU Agreement on domestic industries including the uranium mining, conversion and enrichment industries. The report also provides a description of actions taken to prevent or mitigate any material adverse impact on such industries or any loss of employment at the gaseous diffusion plants as a result of the HEU Agreement.

The reports prepared by the U.S. Department of Energy (DOE) for the last four years on this subject can be found at <http://nuclear.gov/reports/reports-soon.html>

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<sup>1</sup> Section 3112(b)(10). In addition, the Privatization Act directed the transfer of title to DOE of an amount of uranium hexafluoride equivalent to the natural uranium feed component contained in the 1995 and 1996 deliveries (Section 3112(b)(1)) and its eventual sale (Section 3112(b)(2)), and set quotas for sales of the Russian origin natural uranium feed component into the U.S. commercial nuclear fuel market (Section 3112(b)(5)).

## Implementation of the HEU Agreement

The contractual arrangements for implementing the objectives of the HEU Agreement are carried out by the parties' respective executive agents. A contract implementing the terms of the HEU Agreement was signed on January 14, 1994, with USEC Inc.'s predecessor, the United States Enrichment Corporation, acting as the executive agent on behalf of the U.S., and Technabexport (Tenex)<sup>2</sup> representing Russia.

The HEU Agreement is a key element of U.S. nonproliferation policy and serves mutual U.S. and Russian interests. The HEU Agreement provides incentives for Russia to take fissile material in the form of HEU from its nuclear warheads and blend it down into LEU for use and sale as fuel for commercial nuclear power plants. The revenue stream from the HEU Agreement helps provide an ongoing financial incentive for Russia to reduce its inventory of HEU derived from surplus nuclear weapons. It also provides a structured mechanism permitting the sale of Russian enrichment services and uranium into an otherwise restricted U.S. domestic market.

## Status of Deliveries

As of December 31, 2003, it is expected that over 200 MT of Russian HEU will have been converted to LEU and delivered to the U.S. The success of the HEU Agreement is exemplified by the fact that the cumulative amount of HEU actually blended down and delivered under the HEU Agreement through 2003 is approximately 18 percent ahead of the original goals established for the program (as shown in Figure 1). However, there are 8.7 MT of HEU yet to be blended down and delivered from the 1999 order. To reach the total goal of 500 MT of HEU, deliveries of LEU from 30 MT of HEU are scheduled to continue each year from 2004 through 2012, together with the 8.7 MT of HEU yet to be delivered from 1999, and a final delivery of 20 MT of HEU in 2013.

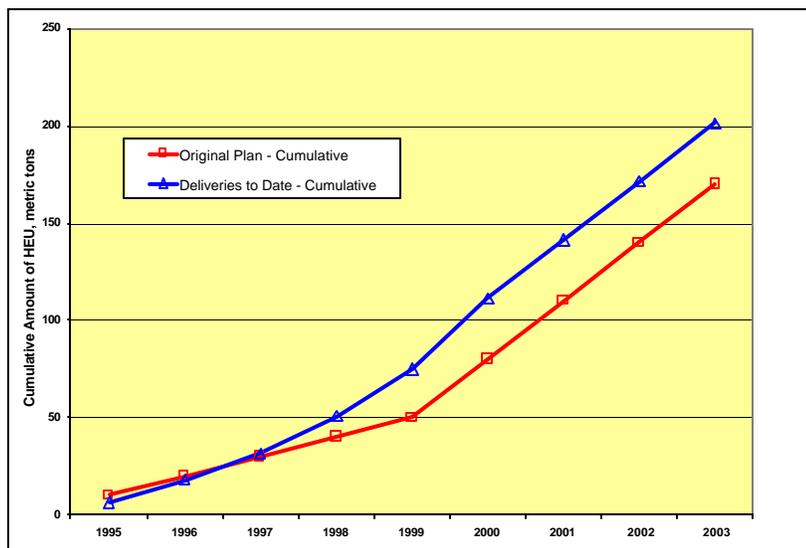


Figure 1. HEU Agreement Deliveries

<sup>2</sup> Technabexport is wholly owned by the Russian government and is controlled by the Ministry of Atomic Energy (Minatom).

Table 1 shows for each year, the estimated number of Russian warheads that have been dismantled, quantities of HEU and LEU contained in the warheads, and their equivalent natural uranium, conversion services, and enrichment services components that has been delivered to date, and the totals estimated over the life of the HEU Agreement.

**Table 1. Status of Deliveries Under the HEU Agreement**

<b>Contracted Year</b>	<b>Estimated Dismantled Warheads<sup>(a)</sup></b>	<b>Highly Enriched Uranium (MT HEU)</b>	<b>Low-Enriched Uranium (MT LEU)</b>	<b>Natural UF<sub>6</sub> Uranium Concentrates Component (million lb. U<sub>3</sub>O<sub>8</sub>(e))</b>	<b>Natural UF<sub>6</sub> Conversion Services Component (million kgU)</b>	<b>Uranium Enrichment Services Component (million SWU)</b>
1995	244	6.1	186.0	4.8	1.8	1.1
1996	479	12.0	371.0	9.5	3.7	2.2
1997	536	13.4	358.5	10.2	3.9	2.4
1998	764	19.1	571.5	15.0	5.7	3.5
1999	968	24.2	718.5	19.1	7.4	4.5
2000	1,464	36.6	1,038.0	28.3	10.9	6.7
2001	1,200	30.0	904.2	23.7	9.1	5.5
2002	1,200	30.0	879.0	23.5	9.0	5.5
2003	1,200	30.0	906.0	23.7	9.1	5.5
Total Delivered Through 2003	8,055	201.4 <sup>(b)</sup>	5,932.7	157.8	60.6	36.9
Total Expected over Life of Agreement <sup>(c)</sup>	20,000	500.0	15,000.0	394.0	151.0	92.0

Notes:

(a) Based on IAEA's definition of significant quantities (1987 IAEA Safeguards Glossary).

(b) The HEU Agreement allowed for up to 30 MTU of HEU to blend down to LEU for delivery in 1999. However, only 21.3 MTU (14.7 MTU in CY 1999 and 6.6 MTU in CY 2000) of the 1999 order was actually delivered. The remaining 8.7 MTU of HEU will be scheduled for blending down in future years.

(c) Assumes that remaining deliveries are made at average product assays received over the period 2001 through 2003.

As shown in Figure 1 and Table 1, which provides a quantitative year-by-year account of the very substantial deliveries that have been made under the Agreement, by all accounts the HEU Agreement has been a success. The following highlighted section provides key events or milestones that have occurred during the historic agreement's first ten years.

## **Review of the First 10 Years of the HEU Agreement**

- The HEU Agreement was signed on February 18, 1993.
- On January 14, 1994, USEC and Tenex, as Executive Agents for the U.S. and Russia, executed the Implementing Contract to implement the HEU Agreement.
- In June 1995, the first delivery of LEU that was derived from HEU arrived in the U.S.
- On April 26, 1996, the USEC Privatization Act, P.L. 102-486, was signed by President Clinton. This Act, in part, established the annual amount of natural uranium that can be imported for sale within the United States.
- During 1997 and 1998, almost no sales of the natural uranium were made by Russia and as a result, the deliveries of Russian LEU to the U.S. were delayed.
- On October 21, 1998, President Clinton signed P.L. 105-277 that, in part, provided for the U.S. to purchase, for up to \$325 million, the unsold natural uranium associated with the 1997 and 1998 deliveries of Russian LEU.
- In March 1999, the Transfer Agreement was signed together with associated annex, administrative agreement, and two diplomatic notes. Collectively this established the long-term framework for resolving the natural uranium issues.
- Also in March 1999, the Western Consortium and Tenex signed a Commercial Feed Agreement for the natural uranium that was instrumental in introducing the material into the market in a nondisruptive manner.
- In November 2001, the Western Consortium and Tenex signed an amendment to the Commercial Feed Agreement that exercised the Western Consortium's options to purchase the natural uranium for the period 2002 through 2013.
- On June 19, 2002, the U.S. and Russian governments approved the latest amendment to the contract between USEC and Tenex that implements the HEU Agreement. Under this new amendment, beginning in January 2003, a market-based pricing structure is being used for the remaining 11 years of the HEU Agreement.
- In December 2003, the deliveries under HEU Agreement reached the equivalent level of 8,000 nuclear warheads eliminated; a significant nonproliferation achievement.

## **Events Impacting the HEU Agreement During 2003**

**Implementation of New Price Provisions for the HEU Agreement** - Beginning in January 2003, a market-based pricing structure, which had been approved in June 2002 by the U.S. and Russian governments as the latest amendment to the implementing contract between USEC and Tenex, became effective for the remaining 11 years (2003 through 2013) of the HEU Agreement.

The amendment to the implementing contract also notes that Russia is expected to earn at least \$7.5 billion over the 20-year period of the HEU Agreement. A previous amendment set the price for uranium enrichment services for calendar years 1997 through 2001 at a fixed initial price of \$82.50 per SWU, with annual adjustments for inflation. Because no agreement on price had been reached prior to the start of 2002, the 2001 price of \$90.42 per SWU was automatically carried over for 2002.

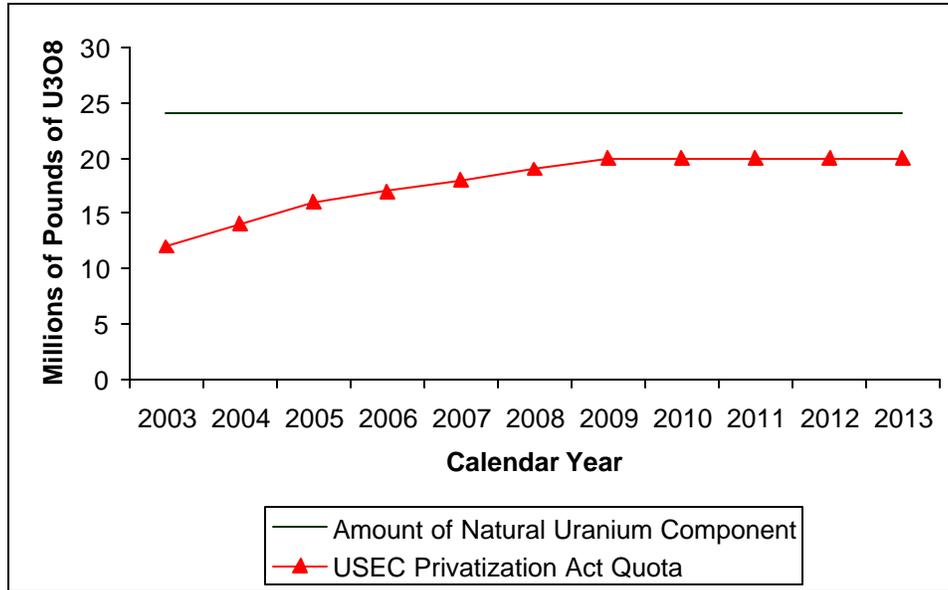
The new market-based pricing formula that went into effect in January 2003 includes a fixed discount from a weighted average of international and U.S. indices, including long-term and spot market prices for uranium enrichment services, over the previous three years. Accordingly, future revenues paid to Russia from SWU sales under the HEU Agreement may vary each year, increasing or decreasing to reflect changes in these market price indices.

## **Status of the Commercial Feed Agreement**

The natural uranium component of the LEU delivered under the HEU Agreement posed a significant and complicated problem in the early implementation of the Agreement. Unlike the enrichment portion of the Agreement, the natural uranium component did not have a clear path of entry into the commercial market under existing supply contracts. In addition, whereas there was only one primary supplier of enrichment services in the U.S., in the uranium industry there were many primary suppliers and substantial inventories to meet industry demand. As a result, it was exceedingly difficult to realize the full market value of the downblended HEU from dismantled weapons since the natural uranium could not easily be sold into the market without substantial adverse impact.

The Commercial Feed Agreement, which was signed in 1999, is the primary mechanism that provides economic value to Russia for the natural uranium component of the LEU delivered under the HEU Agreement while avoiding impacts to industry from its entry into the nuclear fuel market. The USEC Privatization Act, through quotas contained in Section 3112, restricts the annual amount of the natural uranium allowed to be imported for sale in the United States. The restricted amount increases each year until 2009, but is less than the total delivered under the HEU Agreement as shown in Figure 2.

The Commercial Feed Agreement then establishes an allocation of the natural uranium quota amount among Tenex and the Western Consortium. Natural uranium not purchased by Tenex or the Western companies is then placed into a Monitored Inventory maintained in Russia. The Commercial Feed Agreement has been and continues to be very important to the overall success of the HEU Agreement.



**Figure 2. Amount of Natural Uranium Components vs. USEC Allowable Imports**

Under the terms of the Commercial Feed Agreement, the Western Consortium committed to exercise their options to purchase quantities of natural uranium that are at least equal to their respective quota shares each year during the period 2002 through 2013. The amounts to be purchased by Tenex and the Western Consortium are shown in Table 2.

**Table 2. Amount of Natural Uranium to be Purchased**

	Amount of Uranium Over the 2002 through 2013 Timeframe (Millions of Pounds of U <sub>3</sub> O <sub>8</sub> )
Tenex	83
Cameco	53
Cogema	53
RWE NUKEM	18

During 2003, the Western Consortium purchased its share of the quota, and it is expected that Tenex will retain and sell its share as well. As a result, Russia will be able to obtain revenues for the full 12 million pounds U<sub>3</sub>O<sub>8</sub> and the related conversion component contained in the UF<sub>6</sub>. The value of the natural feed component under the U.S. quota for 2003 is estimated to be about \$150 million, the value of the conversion component is estimated to be approximately \$23 million.

In total, the natural uranium component of the HEU Agreement is equivalent to 24 million pounds  $U_3O_8(e)$  per year of production capacity, which is comparable in size to annual mine production from Canada or Australia. Since annual mine production is only expected to provide uranium to meet approximately one half of world demand over the next several years, the HEU Agreement is currently and will remain an essential source of uranium supply.

The Department is also monitoring closely, the November 2003 TENEX notification to its agent GNSS that effective January 1, 2004, TENEX was terminating its sales contract of the natural uranium resulting from the HEU Agreement because “the terms of the contract with GNSS are contrary to the interests of the Russian Federation”. Under the terms of this contract GNSS has asked for arbitration of this decision in Sweden. At the same time GNSS asked the U.S. District Court in Maryland for an injunction that would compel Tenex to continue to make deliveries to GNSS while the arbitration proceedings continue. The District Court heard arguments in the dispute in December but declined to provide immediate injunctive relief. The court found that this was an issue between the Russian government and its agent; and thus, outside of U.S. law. This decision is being appealed.

### **Effect of the HEU Agreement on Domestic Industries<sup>3</sup>**

The following sections discuss the state of the market and domestic uranium mining, conversion, and enrichment industries.

#### **Uranium Mining**

World uranium demand during 2003 was approximately 171.6 million pounds  $U_3O_8$ , up slightly from the 169.7 million pounds  $U_3O_8$  during 2002. World uranium production was about 91.1 million pounds  $U_3O_8$  during 2003, a decrease of 2.3 million pounds or 2.5 percent from the 2002 level of about 93.4 million pounds.

U.S. demand during 2003 of 57 million pounds  $U_3O_8$  is slightly greater than the 55 million pounds  $U_3O_8$  during 2002. U.S. uranium production is equivalent to only about 4 percent of the annual demand for uranium used in U.S. commercial nuclear power plants.

In 2003, uranium spot market prices began the year at \$10.20 per pound, but increased to \$14.50 per pound by the end of the year. With the sharp increase in uranium prices that has occurred during the past year, current prices are now above the \$10.11 per pound  $U_3O_8$  average annual price that characterized the market during 1993, the year that the HEU Agreement was signed. See Figure 3 for actual pricing over the 1993 through 2003 timeframe as well as key events that occurred during the time. It is important to note that market prices change for multiple reasons and should not be solely attributed to one event or factor.

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<sup>3</sup> All data provided in this section is sourced to The Ux Consulting Company, LLC, 2003. Additional details about the events can be found in “Description of Events.”



**Figure 3. Average Annual U.S. Spot Market Price for Uranium Concentrates**

The U.S. uranium mining industry faces a myriad of complex and varied factors to achieving viability. U.S. uranium deposits are of less quality and, therefore, more costly to mine than deposits containing relatively higher concentrations of uranium in other parts of the world. The industry competes with lower cost production from Australia, Canada, countries of the Former Soviet Union (FSU), as well as with secondary supplies—stockpiles and inventories held by utilities, commercial suppliers, and governments. Because of relatively low cost of sales, secondary supplies have displaced a considerable amount of uranium production capacity since about 1980.

While the natural uranium feed component resulting from the HEU Agreement has been a contributing factor in the decline of the U.S. uranium industry, until 1999, the vast majority of the natural uranium feed component deliveries were either returned to Russia or purchased by the U.S. Government.<sup>4</sup> Since 1999, the Western Consortium has purchased the portion that was not returned to Russia under the Commercial Feed Agreement.

With the measured integration of the uranium into the commercial markets, the HEU Agreement deliveries have now become an important source of supply to meeting utility uranium needs.

<sup>4</sup> A majority of the Russian uranium feed component was purchased between the years 1995 and 1998 by the U.S. Government and held in its inventory to facilitate continuation of the HEU Agreement.

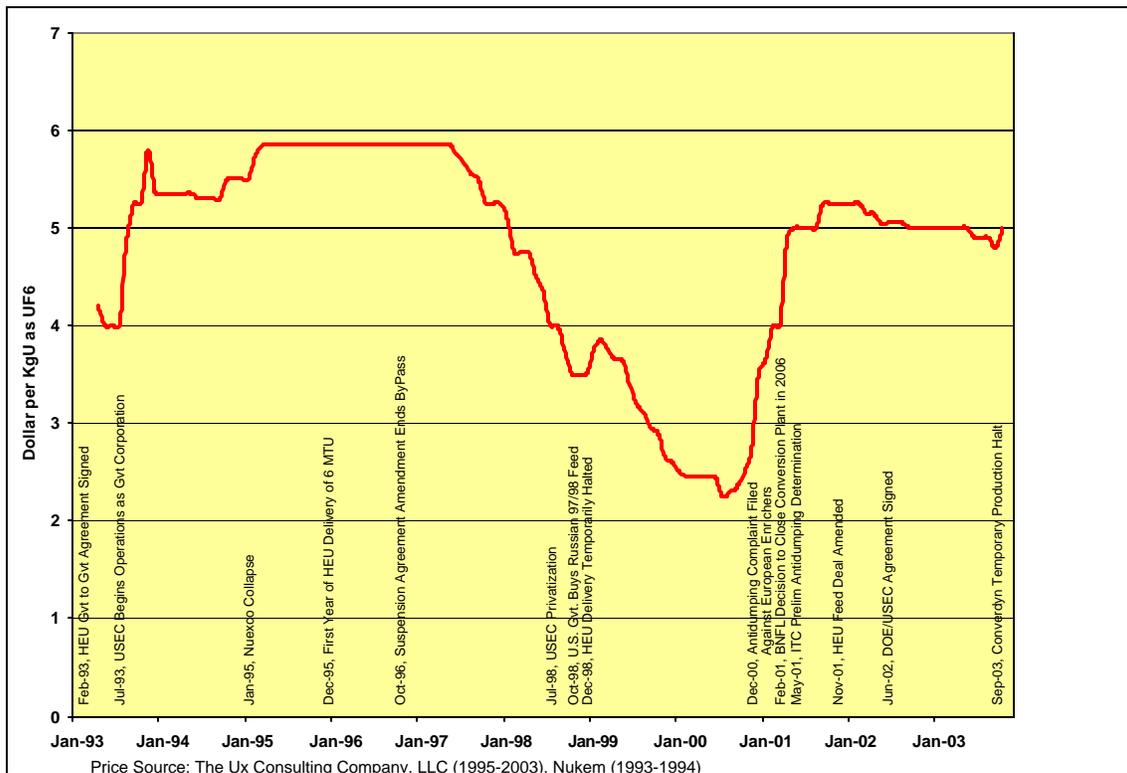
The natural uranium feed component from the HEU Agreement, as well as other secondary supplies such as from the reprocessing of spent fuel in the European Union and re-enrichment of depleted uranium in Russia, have played and are expected to play a key role in filling the production shortfall throughout this decade.

### **Uranium Conversion Services**

World demand for UF<sub>6</sub> conversion services during 2003 was approximately 63.9 million kgU as UF<sub>6</sub>, which is an increase of less than one percent from the level of conversion services demand of 63.5 million kgU during 2002. World conversion services production was about 46.0 million kgU during 2003, about the same as during 2002, and about 72 percent of world demand. The shortfall between production and demand during 2003 was made up from a combination of uranium and plutonium recycling in some European countries, the conversion services equivalent feed component obtained from the HEU Agreement, and other commercial inventories of conversion services component equivalent.

U.S. demand during 2003 of 21.8 million kgU of conversion services was about 800,000 kgU higher than 2002. ConverDyn is the single source of conversion services production in the United States. ConverDyn's production during 2003 is equivalent to about 50 percent of the U.S. demand from the operation of commercial nuclear power plants.

During 2003, the spot market price of conversion remained at about \$5 to \$5.25 per kgU. By way of comparison, the spot market price of conversion services bottomed at \$2.25 per kgU in July 2000. However, the spot market price for conversion services has increased substantially since then and is presently about 5 percent above the 1993 average spot market price of \$4.74 per kgU.



**Figure 4. Average Annual U.S. Spot Market Price for Conversion Services**

The conversion component of the HEU Agreement is equivalent to almost 9,200 kgU per year of production capacity, which is comparable in size to any of the major conversion production facilities. The introduction of the HEU Agreement deliveries into the market has impacted the conversion market. However, with the already existing shortfall of about 26 percent in production capacity versus demand and British Nuclear Fuels Limited plc (BNFL) planning to cease conversion operations after March 2006, the HEU Agreement is an essential source of supply.

The conversion market experienced severe difficulties on December 22, 2003, when ConverDyn’s conversion facility located in Metropolis, Illinois accidentally released UF6 gas off site, as a result of a operator error. The Nuclear Regulatory Commission (NRC) has investigated and determined that the release had minimal impact on worker or public health and safety, however, the facility will not restart operation until the NRC approves. The Department is monitoring closely this development and its energy security ramifications.

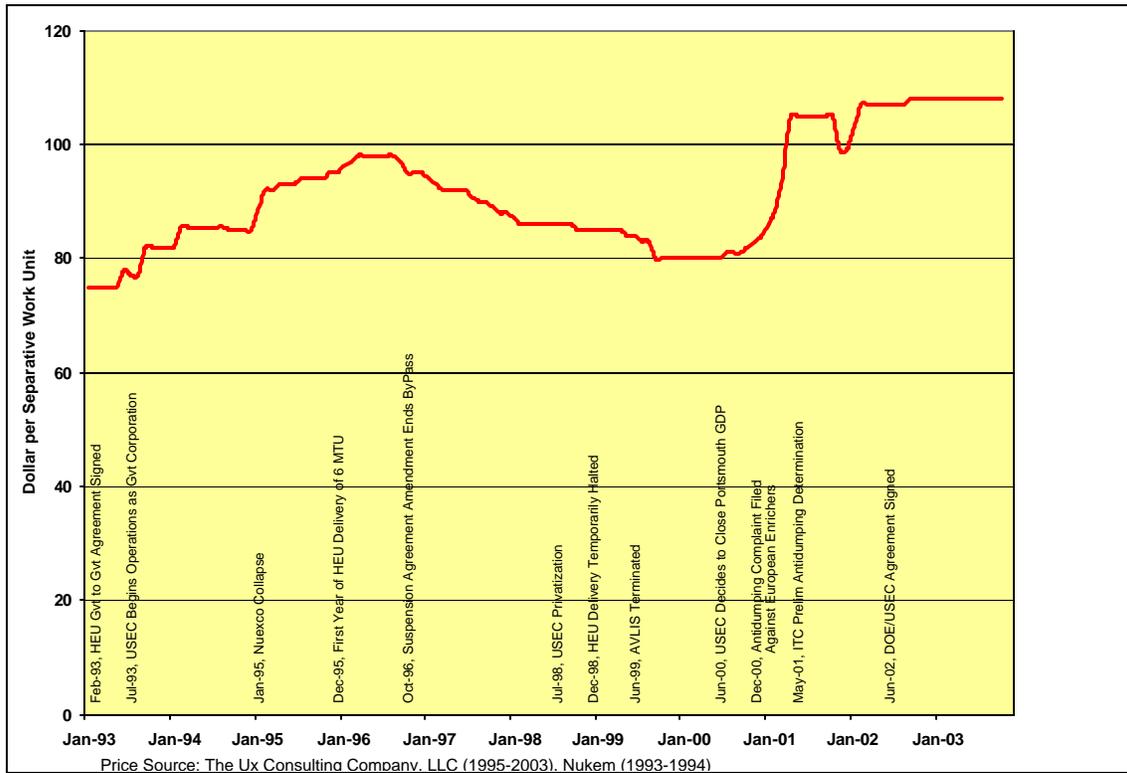
### Uranium Enrichment Services

World demand for enrichment services during 2003 was approximately 38.8 million SWU, which is a slight increase from the level of enrichment services demand (38.5 million SWU) during 2002. World sources of economically competitive and usable enrichment services capacity, including that obtained through the HEU Agreement, are in total about equal to world demand.

U.S. demand during 2003 of 11.6 million SWU was virtually unchanged from the 2002 level of 11.5 million SWU. USEC's Paducah Gaseous Diffusion Plant (GDP) is the single source of enrichment services production in the U.S. USEC's estimated production during 2003 of 5.5 million SWU is equivalent to about 47 percent of the U.S. demand from the operation of commercial nuclear power plants. The enrichment services component of the HEU Agreement is equivalent to 5.5 million SWU per year of production capacity, which is approximately one-half the annual U.S. demand for uranium enrichment services. With the tight situation between world supply and demand for uranium enrichment services, the HEU Agreement will remain an essential source of supply throughout the decade and beyond.

Spot market prices for enrichment services have remained constant in 2003. Throughout 2003 the price has remained at \$108 per SWU. This is 39 percent higher than the 1993 average spot price for uranium enrichment of \$78 per SWU when the HEU Agreement was signed (see Figure 5). The combination of the LEU Antidumping trade action; the cessation of uranium enrichment activities at the Portsmouth GDP in May 2001, which decreased worldwide enrichment capacity by 16 percent; and the increase in demand due to higher operating capacity factors for commercial nuclear power plants in the U.S. and overseas contributed to an upward trend in market prices.

With regard to prospects for new technology, USEC has announced plans to replace the Paducah GDP with a new 3.5 million SWU per year centrifuge enrichment plant. It plans to begin enrichment operations at the new plant in 2010 or 2011, with full capability by 2011 or 2012. Louisiana Energy Services partnership has announced its plan to build a new 3 million SWU per year enrichment plant, the National Enrichment Facility, in the U.S., using Urenco centrifuge technology. It expects to bring the new plant into operation beginning in 2008 and to achieve full capability of 3 million SWU per year in 2013. Outside the U.S., Eurodif plans for a new centrifuge enrichment plant have been announced. It plans to replace its existing gaseous diffusion plant with a new 7.5 million SWU per year enrichment plant that utilizes Urenco centrifuge technology. It expects to bring the new plant into operation beginning in 2007 and achieve full capability operation of 7.5 million SWU per year by 2016.



**Figure 5. Average Annual U.S. Spot Market Price for Enrichment Services**

### LEU Antidumping Trade Case

In February 2002, the U.S. Department of Commerce (DOC) issued final determinations in eight separate antidumping (AD) and countervailing duty (CVD) investigations involving LEU from France, Germany, the Netherlands, and the United Kingdom. Specifically, DOC conducted four separate AD investigations (LEU from France, Germany, Netherlands, UK), but issued only one final AD order on imports from France. DOC did not issue final AD orders on LEU imports from the other three countries. On the CVD side, DOC conducted four separate CVD investigations (France, Germany, UK, Netherlands), and issued final CVD orders in all four cases, finding that the respective governments subsidized LEU imports in every case.

Various parties to the proceedings challenged at the U.S. Court of International Trade (CIT) each of the DOC's final AD and CVD determinations. On March 25, 2003, a three-judge panel of the CIT found unanimously that the February 2002 determinations by the DOC with regard to the antidumping and countervailing duties imposed upon low enriched uranium from France, Germany, the Netherlands, and the United Kingdom were "neither supported by substantial evidence nor in accordance with law". In particular, the CIT overturned DOC's findings that USEC is the sole "domestic producer" for standing purposes, and that enrichers were the appropriate "foreign producers" for purposes of calculating dumping margins. The CIT also overturned DOC's decision that the CVD law applies to LEU imported into the U.S. pursuant to SWU transactions. Accordingly, it remanded the determinations back to DOC for reconsideration.

On June 23, 2003, the DOC filed with the CIT a final remand determination addressing the court's concerns. In its remand, the DOC strengthened its underlying reasoning, but essentially reached the same conclusions on all the major issues as in its original AD and CVD final determinations. In a separate ruling issued on September 16, 2003, the CIT sustained DOC's remand findings that USEC had standing to bring the cases, and that LEU imported pursuant to SWU transactions was subject to the CVD laws. However, the CIT rejected DOC's remand findings that the foreign enrichers were the producers for purposes of calculating AD margins on SWU transactions. The CIT rejected the DOC's findings that purchases of SWU are legally equivalent to those of enriched uranium product. Finally, there are numerous opportunities for challenge in the courts by all parties.

## **Mitigating Actions**

Recognizing the vital importance of the nuclear fuel cycle to U.S. energy and national security, Congress, the Department and industry have worked diligently to help mitigate the impacts of the HEU Agreement deliveries upon commercial nuclear fuel industries. Key mitigating actions include:

- Congress provided, under the USEC Privatization Act, a graduated level of quotas that allowed the natural uranium component of the HEU Agreement to enter into the U.S. in a measured and stable manner.
- The USEC Privatization Act also provided for the purchase and transfer of the 1995 and 1996 natural uranium component to the Department. The Department has responsibly managed the uranium to avoid adverse impacts to the market.
- Congress provided the authority and funding for the Department to purchase and hold the 1997 and 1998 natural uranium component to avoid oversupplying the uranium and conversion markets.
- Russia and the Western Consortium have successfully implemented the Commercial Feed Agreement to ensure the reliable and stable supply of uranium and conversion into the market.
- USEC and Tenex, the respective Executive Agents for the U.S. and Russian Governments, have ensured the successful introduction of the enrichment services into the U.S. market under existing contracts to avoid adverse market impacts.
- The Department of Energy and USEC reached agreement in 2002 on several enrichment issues and the U.S. Government approval of new terms for the HEU Agreement that will provide a solid foundation for the continued successful implementation of the HEU Agreement. This agreement will also provide a path for the deployment of advanced centrifuge enrichment technology in the U.S. by the end of the decade.

## Description of Events

The events cited in Figures 3, 4 and 5 are described in this section.

- **Feb-93, HEU Gvt to Gvt Agreement Signed.** On February 18, 1993, the U.S. and the Russian Federation signed a government to government agreement concerning the disposition and purchase of 500 MT of HEU obtained from nuclear weapons and converted into LEU fuel.
- **Jul-93, USEC Begins Operations as Govt Corporation.** On July 1, 1993, USEC began operation as a wholly owned government corporation.
- **Jan-95, Nuexco Collapses.** Early in 1995, the Nuexco Trading Corporation, the largest uranium trader, filed for bankruptcy protection under U.S. laws. This triggered a significant increase in spot market activity as market participants reacted to the threat of delivery defaults. In addition, companies retreated from making further inventory loans; thereby, reducing market liquidity.
- **Dec-95, First year of HEU Delivery of 6 MTU.** During 1995, for the first time, uranium in nuclear warheads from the former Soviet Union was transformed into fuel for commercial nuclear power plants and delivered to the United States.
- **Oct-96, Suspension Agreement Amendment Ends Bypass.** In October 1996, the DOC and the Russian Federation amended the Russian suspension agreement. The amendment clarified that Russian uranium enriched in a third country could no longer be considered to have undergone substantial transformation and is subject to the suspension agreement quotas, effectively eliminating the enrichment bypass of Russian uranium.
- **Jul-98, USEC Privatization.** On July 28, 1998, the privatization of USEC was completed with the transfer of the U.S. government's entire ownership in USEC to the private sector.
- **Oct-98, US Govt Buys Russian 97/98 Feed.** On October 21, 1998, President Clinton signed into law a bill that provided for the U.S. to purchase, for up to \$325 million, the unsold backlog of Russian natural uranium component associated with the 1997 and 1998 deliveries under the HEU Agreement.
- **Dec-98, HEU Delivery Temporarily Halted.** Russia suspended HEU-derived LEU shipments to USEC, as Russia continued to negotiate a uranium purchase agreement with the Western Consortium, which was composed of Cameco, Cogema and Nukem.
- **Mar-99, Commercial Feed Agreement.** In March 1999, an agreement between the DOE and Minatom for the transfer of source material to the Russian Federation, together with an associated annex, administrative agreement, and two diplomatic notes that collectively established the long-term framework for resolving the feed component issues were signed. Subsequently, the Western Consortium and Tenex signed a Commercial Feed Agreement for the natural uranium feed component associated with the Russian LEU deliveries that were scheduled in 1999 and beyond.

- **Jun-99, AVLIS Terminated.** On June 9, 1999, USEC announced that it was suspending further development of its AVLIS enrichment technology.
- **Jun-00, USEC Decides to Close Portsmouth.** On June 21, 2000, USEC announced that it would cease uranium enrichment operations at the Portsmouth Gaseous Diffusion Plant in Piketon, Ohio beginning in June 2001.
- **Dec-00, Antidumping Complaint Filed Against Eur. Enrichers.** On December 6, 2000, USEC charged that Eurodif and Urenco were pricing enriched uranium below their cost of production, and in the case of Eurodif, below prices that it charged in its home market, and petitioned the DOC and the U.S. International Trade Commission to conduct an investigation and to impose duties upon future imports of enriched uranium from France, Germany, the Netherlands and the United Kingdom.
- **Feb-01, BNFL Decision to Close Conversion Plant in 2006.** In February 2001, British Nuclear Fuels plc (BNFL) announced that it would cease uranium hexafluoride (UF<sub>6</sub>) conversion operations at its Springfield facility after March 2006.
- **May-01, ITC Prelim Antidumping Determination.** On May 8, 2001, the DOC issued a preliminary ruling that European producers of enriched uranium imported into the U.S. were unfairly subsidized by their governments and determined on a preliminary basis that countervailing duties should be imposed on future imports of enriched uranium produced by Eurodif and Urenco.
- **Oct-01, Olympic Dam Mine Fire.** On October 22, 2001, production was shutdown as a result of a mine fire at the Olympic Dam mine in South Australia, which is one of the world's largest uranium mines.
- **Nov-01, HEU Feed Deal Amended.** In November 2001, the Western Consortium and Tenex signed an amendment to the Commercial Feed Agreement that had originally been signed in March 1999. Under the terms of the amendment, the members of the Western Consortium committed to exercise their options to purchase quantities of natural uranium at least equal to their respective quota shares each year for the period 2002 through 2013.
- **Jun-02, DOE/USEC Agreement signed.** On June 17, 2002, the DOE and USEC signed an agreement whereby both the DOE and USEC made long-term commitments that are designed to provide stability for the U.S. uranium enrichment industry.
- **Apr-03, McArthur River Mine Flood.** On April 6, 2003, Cameco reported the McArthur River mine flood that resulted in a shutdown of production for a four month period of time.
- **Dec-03, Converdyn Temporary Production Halt.** On December 22, 2003, the Converdyn UF<sub>6</sub> conversion facility in Metropolis, Illinois was shut down after experiencing two unrelated plant incidents.

## HEU Report Glossary

**advanced enrichment technology** – The use of advanced technologies such as centrifuges or lasers to separate the uranium-235 isotope from the more common uranium-238 isotope to create enriched uranium. In this sense, advanced means in comparison to the gaseous diffusion technology that has been operating on an industrial scale for over 50 years.

**blending or blend down** – The term used to describe the process whereby highly enriched uranium is mixed with depleted, natural, or low enriched uranium to create low enriched uranium. For example, one ton of highly enriched uranium can be mixed or blended with approximately 30 tons of natural or low enriched uranium to create 31 tons of commercial grade low enriched uranium.

**Cameco** – A Canadian company that is the world's largest supplier of uranium and one of the largest suppliers of uranium conversion services. One of the members of the Western Consortium under the Uranium Feed Agreement.

**COGEMA** – A French company that is active in all phases of the nuclear fuel cycle including uranium production. One of the members of the Western Consortium under the Uranium Feed Agreement.

**centrifuge** - A device that can spin at extremely high speeds and separate materials of different densities. For uranium, centrifuges working in series are able to separate the uranium-235 isotopes from the uranium-238 isotopes based on their difference in atomic weight, but because the difference is so small it requires highly classified processes to achieve success.

**Commercial Feed Agreement** – An agreement between members of the Western Consortium and Russia whereby the natural uranium feed component associated with the Russian LEU delivered under the HEU Agreement after 1998 is purchased for resale in the commercial uranium market. Sales of this natural uranium in the U.S. is subject to quotas set forth in the USEC Privatization Act.

**conversion** – The process whereby natural uranium in the form of an oxide is converted to uranium hexafluoride (see uranium hexafluoride or UF<sub>6</sub>).

**depleted uranium** – Uranium whose content of the fissile isotope uranium-235 is less than the 0.7 percent (by weight) found in natural uranium, so that it contains more uranium-238 than found in natural uranium.

**enriched uranium** – Uranium whose content of the fissile isotope uranium-235 is greater than the 0.7 percent (by weight) found in natural uranium. (See uranium, natural uranium, and highly enriched uranium.)

**Executive Agent** – Under the HEU Agreement, these are the commercial companies responsible for implementing the HEU Agreement on behalf of the U.S. (USEC) and Russia (Tenex).

**fissile material** – Any material fissionable by thermal (slow) neutrons. The three primary fissile materials are uranium-233, uranium-235, and plutonium-239.

**gaseous diffusion** – A uranium enrichment process where uranium hexafluoride in gaseous form is forced through a series of semi porous membranes to increase the concentration of uranium-235 isotopes.

**highly enriched uranium or HEU** – Uranium whose content of the fissile isotope uranium-235 has been increased through enrichment to 20 percent or more (by weight). (See natural uranium component, enriched uranium, and depleted uranium.)

**kgU** – Kilograms of uranium.

**long-term price** – In the context of this report, refers to the price paid for nuclear fuel materials and services that will be delivered more than one year after the contract is signed.

**low-enriched uranium or LEU** – Uranium whose content of the fissile isotope uranium-235 has been increased through enrichment to more than 0.7 percent but less than 20 percent by weight. Most nuclear power reactor fuel contains low-enriched uranium containing 3 to 5 percent uranium-235.

**MTU** – Metric tons of uranium.

**natural uranium component** – The feed material provided to a uranium enricher for producing enriched uranium and uranium tails. The natural uranium feed component consists of  $U_3O_8$  from the mining industry and  $U_3O_8$  to  $UF_6$  conversion.

**Paducah Gaseous Diffusion Plant** – The only remaining operating uranium enrichment plant in the U.S., located in Paducah, Kentucky.

**Portsmouth Gaseous Diffusion Plant** – A shutdown uranium enrichment plant with a portion of the plant maintained in a restartable cold standby condition located in Piketon, Ohio.

**Privatization Act** - On April 26, 1996, the USEC Privatization Act, Public Law 104-134 (42 U.S.C. 2297h) was enacted.

**RWE Nukem** – A German company that is a leading trader of uranium and other nuclear fuel supply materials and services in the international market. One of the members of the Western Consortium under the Uranium Feed Agreement.

**separative work units or SWU** – The unit of measurement for the effort needed to enrich uranium.

**spot market price or spot price** – In the context of this report, refers to the price paid for nuclear fuel materials and services that will be delivered soon after the contract is signed.

**tails** – Refers to depleted uranium produced during the uranium enrichment process.

**Tenex** – Joint Stock Company Technobexport – a company that is wholly owned by the Russian government and controlled by the Ministry of Atomic Energy (Minatom) that acts as Russia’s executive agent on the HEU Agreement. Also reprocesses spent fuel from reactors outside Russia and exports natural uranium, HEU, and radioisotopes.

**uranium** – A radioactive, metallic element with the atomic number 92; one of the heaviest naturally occurring elements. Uranium has 14 known isotopes, of which uranium-238 is the most abundant in nature. Uranium-235 is commonly used as a fuel for nuclear fission. (See natural uranium, enriched uranium, highly enriched uranium, and depleted uranium.)

**uranium hexafluoride or UF<sub>6</sub>** – The form of uranium that is the end product of the uranium conversion process. This compound can be easily transformed into a gaseous state at relatively low temperatures to allow the uranium to feed through a uranium enrichment process, either gaseous diffusion or gas centrifuge.

**USEC** – Currently the only enricher of uranium operating in the U.S. and operator of the Paducah Gaseous Diffusion Plant. USEC is also the U.S. executive agent on the HEU Agreement. USEC, which was formerly a wholly owned government corporation, was privatized as a result of the USEC Privatization Act of 1996.

**Western Consortium** – A group of three Western uranium suppliers (Cameco, COGEMA, RWE Nukem) that has signed an agreement with Russia to buy and then market most of the natural uranium associated with the HEU Agreement under the Commercial Feed Agreement.