



U.S. Department of
ENERGY

Report on the Effect the Low Enriched Uranium Delivered Under the Highly Enriched Uranium Agreement Between the Government of the United States of America and the Government of Russian Federation had on the Domestic Uranium Mining, Conversion, and Enrichment Industries and the Operation of the Gaseous Diffusion Plant during 2009

**Report to Congress
December, 2010**

**United States Department of Energy
Washington, DC 20585**

Message from the Assistant Secretary Office for Nuclear Energy

Enclosed is a copy of the 2009 Annual Report to Congress on the effect of the U.S.-Russia Highly Enriched Uranium Agreement (HEU Agreement) on the domestic nuclear fuel industry. The report, submitted on behalf of the President, is required by section 3112(b)(10) of the United States Enrichment Corporation Privatization Act (Pub. L. No. 104-134).

Under the HEU Agreement, 382 metric tons of Russian weapons-origin highly enriched uranium has been converted to low enriched uranium between 1994 and 2009. This is equivalent to the amount of material needed for 15,293 nuclear warheads. During 2009, 30.1 metric tons of highly enriched uranium was converted into 834 metric tons of low enriched uranium. Actions taken by the Department of Energy and Congress have avoided potential adverse impacts from the HEU Agreement deliveries. The successful implementation of the HEU Agreement to date is attributable to the efforts of the U.S. and Russian Executive Agents and the U.S. nuclear fuel industry.

Successful implementation of the HEU Agreement remains a high priority of the U.S. Government and a key element of U.S. nonproliferation policy; it also serves mutual U.S. and Russian interests. The 2009 report shows that the HEU Agreement deliveries continue to be an important, stable component of supply in meeting U.S. utility needs for uranium, conversion, and enrichment. While supply stability under the HEU Agreement has reduced potential market fluctuations, the scheduled termination of the HEU Agreement during 2013 is playing a growing role in the decisions and strategies of market participants as that event approaches.

During 2009, uranium spot prices fell from \$53 per pound of uranium concentrate to \$44.50 per pound at the beginning of 2010. This price decline coincided with the continued economic slow down and follows the downward trend of the previous year. The spot price for uranium conversion services declined nearly 30 percent in 2009 with most of the decline in the first half of the year. Uranium enrichment spot prices were unchanged during 2009.

The nuclear fuel industry continues to prepare for the 2013 conclusion of the HEU Agreement. Louisiana Energy Services continued construction of its new enrichment plant in New Mexico with first production taking place in early 2010, after the period covered by the report. USEC Inc. began preparation of its Lead Cascade at Piketon, Ohio, during 2007 but slowed its activities during 2009 due to a failure to acquire a loan guarantee and financing for the project. AREVA and Global Laser Enrichment (controlled by General Electric) also clarified their plans for new U.S. enrichment facilities during 2009 with AREVA and Global Laser Enrichment submitting combined license applications to the Nuclear Regulatory Commission.

The Administration will continue to work closely with Congress and industry to monitor the implementation of the HEU Agreement and its impacts on the domestic nuclear fuel industry.

If you have any questions, please contact me or Ms. Betty Nolan, Senior Advisor, Office of Congressional and Intergovernmental Affairs, at 202-586-5450.

Sincerely,



Peter B. Lyons, Acting
Assistant Secretary
for Nuclear Energy

Pursuant to statutory requirements, this report is being provided to the following Members of Congress:

- **The Honorable David R. Obey**
Chairman, Committee on Appropriations
U.S. House of Representatives
- **The Honorable Peter J. Visclosky**
Chairman, Subcommittee on Energy and Water Development
Committee on Appropriations
U.S. House of Representatives
- **The Honorable Daniel K. Inouye**
Chairman, Committee on Appropriations
United States Senate
- **The Honorable Byron L. Dorgan**
Chairman, Subcommittee on Energy and Water Development
Committee on Appropriations
United States Senate
- **The Honorable Jeff Bingaman**
Chairman, Committee on Energy and Natural Resources
United States Senate

- **The Honorable Henry A. Waxman**
Chairman, Committee on Energy and Commerce
U.S. House of Representatives
- **The Honorable Bart Stupak**
Chairman, Subcommittee on Oversight and Investigations
Committee on Energy and Commerce
U.S. House of Representatives
- **The Honorable Edward J. Markey**
Chairman, Subcommittee on Energy and Environment
Committee on Energy and Commerce
U.S. House of Representatives
- **The Honorable Bart Gordon**
Chairman, Committee on Science and Technology
U.S. House of Representatives
- **The Honorable Brian Baird**
Chairman, Subcommittee on Energy and Environment
Committee on Science and Technology
U.S. House of Representatives

Executive Summary

The successful implementation of the HEU Agreement remains a high priority of the U.S. Government. The agreement also serves U.S. and Russian commercial interests. HEU Agreement deliveries are an important source of supply in meeting requirements for U.S. utility uranium supply, conversion, and enrichment. With unstable spot market prices for uranium, HEU Agreement deliveries help provide an adequate uranium supply at reasonable prices. In addition, the predictability of measured uranium product deliveries under the HEU Agreement has reduced uncertainty for U.S. producers and suppliers who are moving to expand uranium mining, conversion, and enrichment capacity to meet future demands from a potential increase in domestic nuclear power generation capacity.

While initial uranium deliveries under the HEU Agreement had a limited effect on the commercial nuclear fuel markets, actions subsequently taken by the U.S. Department of Energy (DOE) and Congress to avoid an adverse material market impact from future HEU Agreement deliveries have been effective. Successful implementation of the HEU Agreement to date is also attributable to the efforts of the U.S. and Russian Executive Agents for the Government-to-Government Agreement (DOE and Rosatom, respectively), the Executive Agents for the commercial agreement (USEC and Techsnabexport), and the U.S. industry. Recognizing the vital importance of the nuclear fuel cycle to U.S. energy and national security, DOE will continue to work with Congress and industry to ensure the HEU Agreement's continued success in stabilizing increasingly tight nuclear fuels markets.



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

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I. Legislative Language

This report responds to legislative language set forth in the 1996 United States Enrichment Corporation Privatization Act (Privatization Act), Public Law 104-134 (42 U.S.C. 2297h), wherein it is stated:

"The President shall monitor the actions of the United States Executive Agent under the Russian HEU Agreement and shall report to the Congress not later than December 31 of each year on the effect the low-enriched uranium delivered under the Russian HEU Agreement is having on the domestic uranium mining, conversion, and enrichment industries, and the operation of the gaseous diffusion plants."

II. Implementation of the HEU Agreement

A contract implementing the terms of the HEU Agreement was signed on January 14, 1994, with the United States Enrichment Corporation, acting as the Executive Agent on behalf of the U.S. Government, and Techsnabexport (Tenex), as the Executive Agent for the Russian Federation. The terms provided for the sale of the enrichment component of the LEU resulting from the blended down HEU to USEC's customers. The contract also provides for the Russian Government to receive revenues from USEC based on an average of market indices for enrichment. This contract was amended in February 2009 setting terms for the remainder of the HEU Agreement period but implemented later in the year. The amendment was expected to increase the revenues received by Russia under the HEU Agreement.

The 1999 Commercial Feed Agreement (Feed Agreement) provides revenue to Russia for the natural uranium and conversion components of the LEU delivered under the HEU Agreement. The Feed Agreement establishes an allocation of the natural uranium and conversion among Tenex and the Western Consortium (Cameco, Cogema, now part of AREVA NC, and Nukem). Section 3112 of the Privatization Act sets an annual quota that restricts the total quantity of natural uranium imported into the United States for domestic end use. Natural uranium as UF₆ not purchased by Tenex or the Western Consortium is shipped to Russia. The Feed Agreement is important to the overall success of the HEU Agreement because it allows Russia to receive the full value of the LEU transactions.

Table 1 shows the estimated number of Russian warheads dismantled: HEU and LEU quantities as well as the equivalent natural uranium, conversion services, and enrichment components that have been delivered to date; and projected totals through the remaining life of the HEU Agreement. The HEU Agreement allowed for as much as 30 metric tons of uranium (MTU) of HEU to be blended down to LEU for delivery in 1999. Only 24.3 MTU (14.7 MTU in calendar

year 1999 and 6.6 MTU in 2000) of the 1999 order was actually delivered. As of December 31, 2008, 352.2 MTU of Russian HEU was converted to LEU and delivered to the United States. To reach the total goal of 500 MTU of HEU, no less than 30 MTU of deliveries are scheduled annually from 2009 through 2012. These deliveries, together with the undelivered 8.7 MTU from 1999 and a delivery of as much as 19.2 MTU in 2013, are anticipated to reach the 500 MTU of HEU at the conclusion of the HEU Agreement.

Status of Deliveries

Table 1: Status of LEU Deliveries under the HEU Agreement

Contracted Year	Estimated Dismantled Warheads	HEU (MTU)	LEU (MTU)	Natural UF ₆ Uranium Concentrate Component (million lb U ₃ O ₈)	Natural UF ₆ Conversion Component (million kgU)	Uranium Enrichment Component (million SWU)
1995	244	6.1	186.0	4.8	1.9	Fnukem 1.1
1996	479	12.0	370.9	9.5	3.7	2.2
1997	534	13.4	358.5	10.2	3.9	2.4
1998	764	19.1	571.5	15.0	5.8	3.5
1999	970	24.2	718.7	19.0	7.3	4.5
2000	1,462	36.6	1,037.8	28.3	10.9	6.7
2001	1,201	30.0	904.3	23.7	9.1	5.5
2002	1,201	30.0	879.0	23.5	9.0	5.5
2003	1,203	30.1	906.0	23.7	9.1	5.5
2004	1,202	30.1	891.0	23.6	9.1	5.5
2005	1,206	30.1	846.0	23.3	9.0	5.5
2006	1,207	30.2	870.0	23.4	9.0	5.5
2007	1,212	30.3	840.0	23.3	9.0	5.5
2008	1,204	30.1	834.0	23.1	8.9	5.5
2009	1,204	30.1	834.0	23.1	8.9	5.5
Total Delivered Through 2009	15,293	382.3	11,048.0	297.5	114.6	69.9
Total Expected over Life of Agreement	20,000	500	15,258.6	395.8	152.2	92.1

* Based on the International Atomic Energy Agency's definition of significant quantities (1987 IAEA Safeguards Glossary).

Values are subject to rounding errors

III. Recent Events Impacting the HEU Agreement

Russia met its 2009 commitment under the HEU Agreement with deliveries to USEC of 834 MTU of down-blended LEU derived from 30.1 MTU of HEU. The following discussion provides an overview of activities that have taken place during recent years.

During late 2008 USEC and Techsnabexport (Tenex) renegotiated the pricing methodology used for transactions conducted under the HEU Agreement. Details of the agreement were announced in February 2009 and were implemented during the year. Terms reached through these negotiations will extend to the 2013 conclusion of the HEU Agreement.

The Russian Uranium Suspension Agreement (Suspension Agreement), signed October 1992, suspended the investigation by the U.S. Department of Commerce (DOC) of Russia dumping uranium products into the U.S. market. The Suspension Agreement originally provided for a price-tied quota system for Russian produced uranium product imports. The only exception to restrictions under the Suspension Agreement was uranium down-blended under the HEU Agreement. Russia can sell uranium product into the United States under the HEU Agreement only to the designated agent of the U.S. government (USEC), which sells the enrichment component (called separative work units, or SWU) to its customers and returns the uranium component to Tenex. The uranium component can then be sold subject to an annual quota in the United States. No direct Russian sale of commercial uranium or SWU in the United States was permitted. During 2006, the U.S. International Trade Commission (ITC) and DOC conducted a "sunset" review of the Suspension Agreement that recommended that the Suspension Agreement remain unchanged. On July 18, 2006 the ITC ruled that terminating the Suspension Agreement would materially injure the domestic uranium industry. Tenex and the Ad Hoc Utilities Group (a group of U.S. utilities that generate power using nuclear energy) subsequently submitted separate complaints in the Court of International Trade (CIT) appealing the ruling. On September 21, 2007, the U.S. Court of Appeals in *Eurodif v. United States*, ruled that uranium enrichment is a service and therefore not subject to U.S. antidumping laws. On September 26, 2007, CIT ruled that, based on *Eurodif*, DOC must review the Russian Uranium Suspension Agreement. This effectively removed Russian enrichment from import limits set under the Suspension Agreement and opened the possibility that Russian SWU might gain unrestricted access to U.S. markets prior to the conclusion of the HEU Agreement. The U.S. Attorney appealed this ruling to the Supreme Court which agreed to hear the case in April 2008. Arguments were subsequently heard by the Court in November 2008. In January 2009 the Court unanimously ruled in favor of the U.S. Government position that uranium enrichment is a good and not a service, for purposes of U.S. trade laws.

The United States signed an agreement to amend the Suspension Agreement on February 1, 2008. The amendment allows Russian uranium product imports into the United States that are equivalent to 20 percent of the U.S. LEU product market during the period 2014-2020. This would involve the period immediately after the conclusion of the HEU Agreement. Smaller quantities of imported Russian LEU or the product equivalent would be permitted during and prior to 2013. In September 2008 the U.S. Congress amended the Privatization Act to give the Russian Federation an opportunity to sell in the U.S. market additional LEU during 2014 through 2020 based on the amount of HEU Russia down-blends after the completion of the HEU Agreement. The volume permitted would be the equivalent of an additional 5 percent share of the U.S. uranium market, over and above the 20 percent of the U.S. market permitted in the amended Suspension Agreement. Terms and conditions for distributing Russian uranium under the Suspension Agreement were negotiated during 2009 and were to be announced during the following year. The first contracts between Tenex and U.S. utilities to deliver uranium under the amended Suspension Agreement were signed during 2009.

IV. Effect of the HEU Agreement on Domestic Industries

The following sections discuss the supply and demand for the domestic uranium mining, conversion, and enrichment markets as well as prices.^{*} The period covered ended on December 31, 2009.

Uranium markets experienced a fundamental shift in supply sources during the recession that started in 2008 and which continued through 2009. Prior to the crisis, a futures market for uranium had developed and there was an increase in the volume of uranium held by financial institutions that did not process uranium. This situation contributed to fluctuating prices at many stages of the fuel supply industry. Spot uranium prices peaked in mid-2007 partially due to these new market participants. Global economic difficulties, most evident from the latter part of 2008, led many financial investors to withdraw from the market. Many financial institutions and speculators found themselves in possession of uranium inventories that were difficult to dispose of profitably. A substantial weakening in uranium prices occurred during 2008 with prices showing no sustained recovery during 2009. Nonetheless, spot uranium prices during 2008-2009 were more than twice the levels from as recently as December 2005 and well above the depressed levels that persisted for more than a decade prior to 2005. Uranium supplies provided under the HEU Agreement were stable for the year as they have been since

^{*} The reference for market prices provided in this section is the Ux Consulting Company, LLC. The reference for uranium production and demand information is Energy Resources International, Inc. and the Energy Information Administration of the U.S. Department of Energy.

before 2000. None of these price fluctuations can be associated with the HEU Agreement-based uranium supplies. The HEU Agreement has in fact provided stable supplies of uranium to the commercial market which do not vary with market price. The scheduled termination of the HEU Agreement during 2013 is affecting market decisions and strategies of market participants regarding the supply of and requirements for uranium over the next several years.

The U.S. power generation industry had indicated hopes to expand its nuclear generating capacity significantly during the later years of the 2010 decade. The U.S. Nuclear Regulatory Commission (NRC) has received 17 combined license applications for as many as 28 new reactors during the since 2007. Of the 17, applicants have suspended NRC's review of 5 applications. Several new large commercial reactor designs have either received NRC certification or are in the process of receiving certification, while the potential for additional applications for smaller reactor design is possible. Over the last several years, the U.S. uranium fuel industry has announced plans to expand its capacity in the mining, conversion, and enrichment markets in anticipation of demand and price increases for nuclear fuels. Interest in mining and conversion has, however, become more cautious with the recent declines in spot and term prices. As might be anticipated with a long list of potentially expensive proposed investments, there is an active sorting process underway in industry regarding which projects will go forward and which will not.

Uranium Mining

World nuclear uranium requirements during 2009 are estimated to have been about 165.1 million pounds U_3O_8 . World uranium production from mines is estimated to have been 131.7 million pounds U_3O_8 during 2009, an increase of 14.4 million pounds U_3O_8 from about 117.3 million pounds U_3O_8 in 2008. Worldwide production from mines thus supplied almost 80 percent of requirements. Additional uranium supply from secondary market sources such as government and commercial inventories, re-enriched uranium tails, and reprocessed uranium, as well as the natural uranium component of the HEU Agreement, met the balance of uranium requirements. Uranium requirements in the United States for 2009 were 49.8 million pounds U_3O_8 equivalent compared to 53.4 million pounds U_3O_8 equivalent in 2008. Domestic uranium concentrate production is estimated to have increased 6.9 percent to 4.1 million pounds U_3O_8 in 2009 from 3.9 million pounds U_3O_8 in 2008. The ends a decrease in domestic concentrate production over the past several years that had followed an increase of U.S. uranium production from 2.2 million pounds U_3O_8 in 2003. The Department of Energy's Energy Information Administration reports that employment in the U.S. uranium production industry declined 30 percent between 2008 and 2009 a result in part of a significant decline in drilling during 2009 in the face of lower uranium prices and a weak economy.

Spot market uranium prices began 2009 at \$53 per pound U_3O_8 representing an increase from the end of 2002 when prices were just over \$10 per pound U_3O_8 . The beginning 2009 spot price was, however, down from a \$136 per pound U_3O_8 peak in June 2007. Spot prices closed 2009 at \$44.50 per pound U_3O_8 representing the general downward trend during the year. Most of the drop followed a level of \$52 per pound U_3O_8 at midyear. The price decline reflects the

recent slowdown of the global economy, the reduced role of institutional investors in the uranium market, the growth of foreign uranium suppliers, and uncertainties in the market due to varying perceptions regarding longer-term fuel supplies associated with the end of the HEU Agreement in 2013. Also affecting spot uranium prices was the global recession.

In early October 2007, NRC received an application for an in situ uranium recovery facility in Wyoming. This was the first application for a new uranium recovery facility that NRC had received since 1988, though applications for facility expansion and restarts had been received during the period. By January 2010 the NRC had received five applications for new facilities to be located in Wyoming and South Dakota. At that time the NRC anticipated receiving nine additional applications for new facilities during 2010-2012 located in Wyoming, Arizona, and New Mexico with expansion applications for facilities in Nebraska as well. Additional projects are likely in other States, notably Texas, Utah, and Colorado. One stimulus for the new mining ventures had been the high prices of uranium during 2007 and early 2008. As noted, prices have since fallen resulting in some projects being deferred. Rapid anticipated uranium mining and production expansion worldwide should also increase global uranium supplies at an uncertain rate compared to demand.

Following the initial implementation of the Feed Agreement, the measured sale of the Russian uranium to the Western Consortium by Tenex has been an important source of uranium supply for U.S. commercial market amounting to almost half of domestic requirements. In spite of declining supply availability from other secondary sources, the HEU Agreement deliveries have provided a stable supply at reasonable prices.

Uranium Conversion Services

World requirements for UF₆ conversion during 2009 are estimated to have been 62.6 million kgU as UF₆. This compares to 60.4 million kgU as UF₆ in 2008. Conversion services demand for 2009 in the United States is estimated to be 19.6 million kgU as UF₆. The sole domestic U.S. conversion company, ConverDyn (Honeywell, General Atomics) in Metropolis, Illinois has an estimated annual capacity of 15.0 million kgU as UF₆ following an expansion completed in 2007. Conversion is an international business with customers often not required to buy from the nation of origin. The net gap in volume between domestic production and demand during 2009 was made up by a combination of the conversion services equivalent contained in the feed component of the uranium under the HEU Agreement and other commercial UF₆ sources located outside of the United States. Cameco's Port Hope, Ontario conversion facility had experienced a series of extended shut downs starting in 2007 but is back in operation. AREVA intends to replace its Comurhex conversion facility in Pierrelatte, France with a unit that is anticipated to reach full production in 2012. The only other large conversion facilities worldwide are located in Russia. The replacement of facilities in France is the principal ongoing international investment in the global uranium conversion business.

From a market perspective, the conversion component of the HEU Agreement is equivalent to almost 9 million kgU per year of production capacity, which is somewhat smaller in size than the larger existing conversion production facilities worldwide. Because the Privatization Act

does not restrict the sale of Russian conversion services entering the United States, the unfettered introduction of the 9 million kgU of conversion from HEU Agreement deliveries into the market initially impacted the conversion services market leading to the closure of a second facility in Gore, Oklahoma. However, with an existing shortfall in production, the HEU Agreement has become an essential source of conversion supply, with the issue becoming replacing the supply after the conclusion of the HEU Agreement imports during 2013.

Spot conversion increased 322 percent from a low of \$2.25 per kgU as UF₆ in July 2000 to \$9.50 per kgU as UF₆ at the end of 2007. The North American spot market price for conversion services declined during 2009 to \$6.00 per kgU as UF₆ at the end of 2008 compared to \$8.50 per kgU at the beginning of the year. This was a drop of 29.4 percent over the year. Prices were \$6.50 per kgU at midyear 2009 indicating that sources of the decline might include both the economic slowdown and the anticipated influx of new material following the restart of the Port Hope, Ontario facility. Term prices for conversion were \$11.00 per kgU as UF₆ at the conclusion of 2009, considerably above spot prices.

Uranium Enrichment

World demand for enrichment during 2009 is estimated to have been 45.8 million SWU, an increase over the 2008 level of 45.6 million SWU. Overall world enrichment production and world demand for enrichment, including the LEU resulting from the HEU Agreement, are in very close balance. Technical considerations favor enrichment facilities to enter into supply contracts to ensure that centrifuges operate at nearly 100 percent capacity. The enrichment market is thus expected to have little or no excess supply capacity over the coming years as gas centrifuge capacity increases in proportion to demand and as gaseous diffusion based capacity is retired. An exception to this absence of excess capacity might be enrichment capacity in Russia, whose enrichment exports to North America and Europe are restricted by policy and international agreements.

Demand for enrichment in the United States during 2009 is estimated at 17.2 million SWU, up from the 12.6 million SWU in 2008.¹ The low enrichment levels in 2008 were a statistical anomaly. During 2009 the Paducah Gaseous Diffusion Plant, managed by USEC, was the only domestic enrichment facility operating in the United States. (Domestic enrichment-equivalent services are also provided through the National Nuclear Security Administration through the down-blending of domestic-origin HEU to reactor-grade LEU.) Paducah produced about 6.3 million SWU in 2009 though nominal production capacity is estimated to be about 8.0 million SWU. The international character of the enrichment market is such that some of Paducah's enrichment is exported and additional enrichment is imported into the United States. The enrichment component of the HEU Agreement provides the equivalent of 5.5 million SWU per year, approximately 32 percent of domestic enrichment demand. Most of the SWU purchased by USEC under the HEU Agreement are used to meet U.S. demand. The Energy Information

¹ We believe that 2008 enrichment is unusually low and 2009 enrichment is unusually high. Thus both statistics do not well represent longer term enrichment market trends.

Administration reports that about 76 percent of the enrichment consumed in the United States in 2009 was imported.

Spot prices for enrichment have increased noticeably since 2006. The spot price began in 2006 was \$114 per SWU and increased 40.4 percent to \$160 per SWU at the beginning of 2009. Spot prices were still \$160 per SWU at the end of December 2009 though they had varied slightly during the year.

Plans for new enrichment technology deployment in the United States continued to develop during 2009. Louisiana Energy Services (LES) continued to build its National Enrichment Facility in Eunice, New Mexico. The 3 million SWU per year first phase of the enrichment plant uses the Enrichment Technology Company's (ETC) gas centrifuge technology. The plant was expected to begin initial production in early 2010 following final NRC clearances. This phase of the LES facility is expected to reach full capacity around 2013, approximately the time of the conclusion of the HEU Agreement. LES indicated in November 2008 that it intends to nearly double the size of the facility to 5.9 million SWU per year by the end of 2015. The ETC technology is the same technology used in many of Urenco's European facilities. ETC is a 50-50 joint venture of AREVA NC and Urenco. Urenco is owned equally the parties: the government of the United Kingdom, the government of the Netherlands, and by a collection of German utilities. There are discussions ongoing regarding privatizing some of the government holdings.

USEC has a license from the NRC to build and operate its American Centrifuge Plant (ACP) in Piketon, Ohio. USEC planned to deploy a 3.8 million SWU per year gas centrifuge enrichment plant by 2012 based on an updated version of DOE's gas centrifuge technology developed in the 1980s. NRC granted USEC its commercial license in April 2007. USEC initiated operations at its demonstration Lead Cascade facility at Piketon in late 2007. Development of the Lead Cascade continued through 2009 and USEC applied to the Department of Energy for a loan guarantee for the plant. During 2009 USEC and the Department of Energy agreed to defer review of the loan guarantee application for the proposed ACP as USEC endeavors to demonstrate the technical and financial viability of the project. The rate of USEC's investment activities at ACP has slowed with the opening date of the new facility now uncertain and many activities delayed. The ACP is intended to eventually replace the Paducah Gaseous Diffusion Plant.

In December 2008, AREVA Enrichment Services (AES) submitted an application for a combined license to build and operate a 3 million SWU per year gas centrifuge enrichment facility at Eagle Rock near Idaho Falls, Idaho. The AREVA plant would use ETC technology. Construction might begin in 2011. Initial production would be attained as early as 2014 with full capacity targeted for as early as 2017. During 2009 AES revised its license application to request that capacity might later be expanded to a total of 6 million SWE per year capacity.

In October 2006, GE Hitachi submitted a letter of intent to NRC indicating that GE Hitachi's affiliate Global Laser Enrichment (GLE) planned to build a demonstration laser enrichment facility. Cameco joined the project as an investor in 2008. A test loop at the facility began

operation in July 2009 and an application for a commercial scale facility was submitted in June 2009. GLE has set an initial target capacity of 3.5 million to 6 million SWU per year. If the laser enrichment technologies show promised efficiencies, successful implementation of the facility could have major implications for the enrichment and uranium supply industries worldwide.

By the end of 2009 Urenco expanded capacity at its three European enrichment facilities to a total of 12.2 million SWU per year. The company expects to bring its capacity in Europe to 15 million SWU per year by 2015. AREVA has moved forward on announced plans to replace its existing gaseous diffusion enrichment plant in France. It would have 7.5 million SWU per year initial capacity and would use ETC's gas centrifuge technology. The new plant, named Georges Besse II began operation late in 2009 and could achieve full production by 2016. The site of the new plant would be at AREVA's existing gaseous diffusion enrichment site in Tricastin, France.

The importation of enrichment from the Russian Federation into the United States is limited by the HEU Agreement. A 2009 decision by the Supreme Court, the February 2008 amendment to the Suspension Agreement, and a law signed in September 2008 effectively permit some importation of Russian enrichment after the conclusion of the HEU Agreement, though under strictly defined terms and quantities during 2013-2020. Russia has announced it will not extend the current HEU Agreement past 2013, though U.S. law now would permit the negotiation of a similar agreement covering 2013 through 2020.

Enrichment buyers have been concerned about potential supply shortfalls after the conclusion of the 2013 HEU Agreement, but the pending conclusion has encouraged new enrichment facility investments that seem to have been countered these concerns. The HEU Agreement deliveries remain important to the U.S. enrichment market because they account for nearly half of U.S. demand and have given U.S. uranium markets a stable source of supply during the period covered by the HEU Agreement. The likely conclusion of the HEU Agreement in 2013 has permitted potential enrichment suppliers to target their proposed investments within the United States.

V. Actions Taken to Avoid Potential Adverse Impacts to the Nuclear Fuel Industry

Recognizing the vital importance of the nuclear fuel cycle to U.S. energy markets and national security, Congress, DOE, and industry have worked diligently to help avoid any adverse material impacts of the HEU Agreement deliveries upon commercial nuclear fuel markets. Historically, actions taken include:

- Congress provided, under the United States Enrichment Corporation Privatization Act, a graduated level of quotas that allowed the natural uranium component of the HEU Agreement to enter into the U.S. market in a measured and stable manner.

- The United States Enrichment Corporation Privatization Act also provided for the purchase and transfer of the 1995 and 1996 natural uranium component of the HEU Agreement deliveries to DOE. DOE has responsibly managed the uranium to avoid an adverse material impact to the market.
- Congress provided the authority and funding for DOE to purchase and hold until March 24, 2009, the 1997 and 1998 natural uranium component of the HEU Agreement deliveries to avoid over supplying the uranium and conversion markets.
- Russia and the Western Consortium have successfully implemented the Feed Agreement to ensure the reliable and stable supply of uranium and conversion into the market.
- USEC has ensured the successful introduction of the enrichment component of the HEU into the U.S. market under existing contracts to avoid adverse material market impacts.
- The U.S. and Russian Governments have actively monitored the progress of the HEU Agreement and the Feed Agreement as well as proposed amendments to help ensure avoidance of adverse market impacts.
- The HEU Agreement has been the only avenue for the entry of Russian uranium into U.S. markets. The Agreement will end during 2013. An amendment to the Suspension Agreement was signed by the United States and Russia in February 2008 that extends limits on Russian uranium product imports to 20 percent of the U.S. market during 2014-2020. Much smaller quantities of additional Russian uranium product would be permitted into the United States under the agreement during 2011-2013. This agreement thus allows for some continuity of Russian-origin uranium supplies beyond the termination of the HEU Agreement.

While the initial uranium deliveries under the HEU Agreement had a limited effect on the commercial nuclear fuel markets, mitigating actions subsequently taken by DOE and Congress to avoid an adverse market impact from future HEU Agreement deliveries have been effective. The successful implementation of the HEU Agreement to date is also attributable to the efforts of the U.S. and Russian Executive Agents for the Government-to-Government Agreement, the designated Executive Agents for the commercial arrangement, and the U.S. industry. Recognizing the vital importance of the nuclear fuel cycle to U.S. energy markets and national security, DOE will continue to work with Congress and industry to ensure the HEU Agreement's continued success.

Glossary

Blending or down-blend – The term used to describe the process whereby HEU is mixed with depleted, natural, or low enriched uranium to create LEU.

Cameco – A Canadian company that is the world's largest supplier of uranium and one of the largest suppliers of uranium conversion services. Cameco is one of the three members of the Western Consortium under the 1999 Commercial Feed Agreement.

AREVA – AREVA, includes the enrichment firm formerly known as Cogema. AREVA is active in all phases of the nuclear fuel cycle including uranium, conversion, and enrichment services. AREVA (through its Cogema origins) is one of the members of the Western Consortium under the 1999 Commercial Feed Agreement.

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 United States are subject to quotas set forth in the United States Enrichment Corporation Privatization Act.

Conversion – The process whereby natural uranium in the form of an oxide is converted to UF₆.

Depleted uranium – Uranium containing less than the 0.71 percent ²³⁵U. Found in natural uranium.

Enrichment Technology Company (ETC) – A 50-50 joint venture of Urenco and AREVA NC that develops and builds gas centrifuges used to enrich uranium.

Enriched uranium – Uranium that is greater than the 0.71 percent ²³⁵U. (See uranium, natural uranium, and highly enriched uranium.)

Executive Agent – These are the commercial companies responsible for implementing the HEU Agreement on behalf of the Governments of the United States (USEC) and Russia (Tenex).

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

Gas centrifuge - A uranium enrichment process that uses centrifuges to spin UF₆ as a gas at high speeds to separate ²³⁵U isotopes from the ²³⁸U isotopes based on their difference in atomic weight.

Gaseous diffusion – A uranium enrichment process where UF₆ as a gas is compressed through a series of membranes to increase the concentration of ²³⁵U isotopes.

General Electric Hitachi (GEH) – An affiliate of General Electric (60 percent in the United States) and Hitachi (40 percent in the United States) that manages the nuclear power activities formerly held by the companies General Electric (United States) and Japan. This includes plans to develop laser-based enrichment facilities in the United States.

Highly enriched uranium (HEU) – HEU is uranium having greater than 20 percent ^{235}U . (See natural uranium component, enriched uranium, and depleted uranium.)

Kilogram of uranium (kgU) as UF_6 – Equal to 2.6 pounds of U_3O_8 .

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 (LEU) – Uranium that is greater than 0.71 percent ^{235}U but less than 20 percent. Most nuclear power reactor fuel contains LEU having three to five percent ^{235}U .

Louisiana Energy Services (LES) – An affiliate of the European enrichment joint venture Urenco. LES is building a three million SWU gas centrifuge uranium enrichment plant in Eunice, New Mexico.

Metric ton of uranium (MTU) – One thousand kilograms 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.

Nuclear Regulatory Commission (NRC) – The Federal agency that is responsible for the licensing and regulation of nuclear safety, safeguards, and security of commercial nuclear facilities.

Nukem – A company that provides uranium and services in the international nuclear fuel market. Nukem is one of the members of the Western Consortium under the 1999 Commercial Feed Agreement.

Paducah Gaseous Diffusion Plant – Was the only operating uranium enrichment plant in the United States, located in Paducah, Kentucky during 2009.

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

Separative work units (SWU) – A unit of measurement used in the enrichment of ^{235}U .

Spot market price or spot price – In the context of this report, refers to the price paid for nuclear fuel materials and services delivered within one year of the purchase date.

Tails – UF_6 depleted in ^{235}U produced during the uranium enrichment process.

Techsnabexport (Tenex) – A company wholly owned by the Russian Government and controlled by the Federal Atomic Energy Agency, Russian Federation. Tenex acts as Russia's Executive Agent on the HEU Agreement.

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

Uranium hexafluoride (UF_6) – Uranium oxide (U_3O_8) is converted to UF_6 which can then be fed through a uranium enrichment process, traditionally gaseous diffusion or gas centrifuge.

USEC Inc. – During 2009 the only domestic supplier of uranium enrichment located in the United States and operator of the Paducah Gaseous Diffusion Plant. USEC is also the U.S. Executive Agent on the HEU Agreement. The United States Enrichment Corporation, a formerly wholly owned government corporation, was privatized as a result of the United States Enrichment Corporation Privatization Act of 1996. USEC is developing the American Centrifuge Plant.

Western Consortium – A group of three Western uranium suppliers (Cameco, COGEMA, Nukem) that signed the 1999 Commercial Feed Agreement with Russia to buy and then market the natural uranium that remains in the United States under the HEU Agreement. Cogema is now a portion of the company AREVA NC.