



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 the Russian Federation had on the Domestic Uranium Mining, Conversion, and Enrichment Industries and the Operation of the Gaseous Diffusion Plant During 2010

**Report to Congress
December 31, 2011**

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

Message from the Assistant Secretary Office for Nuclear Energy

Dear Mr. Chairman:

Enclosed is the 2010 Annual Report to Congress on the effect of the U.S.-Russia Highly Enriched Uranium Agreement (HEU Agreement) on the domestic enrichment, conversion, and mining industries. The report, submitted on behalf of the President, is required by section 3112(b)(10) of the USEC Privatization Act (Pub. L. No. 104-134).

Under the HEU Agreement, over 412 metric tons of Russian weapons-origin highly enriched uranium (HEU) were converted to low enriched uranium (LEU) between 1994 and 2010. This is equivalent to the amount of material needed for 16,494 nuclear warheads. During 2010, 30.0 metric tons of HEU were converted into 858 metric tons of LEU. 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 (USEC and the State Corporation for Atomic Energy "Rosatom") 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. Uranium deliveries under the HEU Agreement continue to be an important, stable component in supplying U.S. utility needs for uranium, conversion and enrichment. U.S. producers and suppliers are moving to expand domestic uranium mining and enrichment capacity in order to meet anticipated demand following the 2013 end of the HEU Agreement.

During 2010, uranium spot prices rose from \$44.50 per pound of uranium concentrate to \$62.50 per pound at the end of 2010. This price increase reflected the anticipated rapid growth in commercial nuclear power activity, notably in Asia, and represents a recovery from a downward trend during previous years. The spot price for uranium conversion services more than doubled during 2010, with most of the increase in the second half of the year. This conversion price increase resulted primarily from a labor dispute at the United States' sole conversion facility, in Metropolis, Illinois. Uranium enrichment spot prices declined slightly during 2010.

The nuclear fuel industry continues to prepare for the 2013 expiration of the HEU Agreement. Urenco USA (formerly Louisiana Energy Services) started operation of its new enrichment plant in New Mexico in June 2010, and anticipates reaching its original target production levels during 2013. USEC Inc. continued to develop its American Centrifuge uranium enrichment plant at Piketon, Ohio, during 2010. USEC submitted a comprehensive update of its loan guarantee application for the project in September 2010. AREVA and Global Laser Enrichment (controlled by General Electric Hitachi) also moved their plans forward for additional new U.S. enrichment

facilities during 2010. The Nuclear Regulatory Commission was evaluating license applications from AREVA and Global Laser Enrichment during 2010 and AREVA had committed to pursue its project.

We 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. Patricia Temple, Office of Congressional and Intergovernmental Affairs, at 202-586-5450.

Sincerely,



Peter B. Lyons
Assistant Secretary
for Nuclear Energy

This report is being provided to the following Members of Congress:

- **The Honorable Harold Rogers**
Chairman, Committee on Appropriations
U.S. House of Representatives
- **The Honorable Rodney Frelinghuysen**
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 Dianne Feinstein**
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 Maria Cantwell**
Chairman, Subcommittee on Energy
Committee on Energy and Natural Resources
United States Senate
- **The Honorable Fred Upton**
Chairman, Committee on Energy and Commerce
U.S. House of Representatives
- **The Honorable Cliff Stearns**
Chairman, Subcommittee on Oversight and Investigations
Committee on Energy and Commerce
U.S. House of Representatives
- **The Honorable Ed Whitfield**
Chairman, Subcommittee on Energy and Power
Committee on Energy and Commerce
U.S. House of Representatives
- **The Honorable Ralph M. Hall**
Chairman, Committee on Science, Space, and Technology
U.S. House of Representatives
- **The Honorable Andy Harris**
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 HEU 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 characteristically volatile spot market prices for uranium, HEU Agreement deliveries help provide a certain supply of uranium 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 adverse effects from future HEU Agreement deliveries have been effective. Successful implementation of the HEU Agreement to date is also attributable to the efforts of the Agreement's U.S. and Russian Executive Agents (USEC and Rosatom, respectively), the U.S. and Russian Executive Agents for the commercial agreement (USEC and Techsnabexport respectively), and 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.



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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

On February 13, 1993, the United States and the Russian Federation signed an agreement to convert 500 metric tons (MT) of highly enriched uranium (HEU) into low enriched uranium (LEU) suitable for use in U.S. commercial nuclear reactors (HEU Agreement). The HEU was to originate from dismantled Russian nuclear warheads. A contract implementing the terms of the HEU Agreement was signed on January 14, 1994, with the United States Enrichment Corporation (USEC), 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 to USEC's customers of the enrichment component of the LEU resulting from the blended down HEU. 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 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 USEC Privatization Act sets an annual quota that restricts the total quantity of natural uranium imported into the United States by the Russian Executive Agent (Tenex) for domestic end use. Natural uranium as uranium hexafluoride (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, the resultant HEU and LEU quantities, 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, 2010, 412.4 MTU of Russian HEU was converted to LEU and delivered to the United States. To reach the total goal of 500 MTU of HEU, deliveries of no less than 30 MTU are scheduled annually during 2011 and 2012. It is anticipated that 27.6 MT of HEU would subsequently be down-blended during 2013. This will achieve the goal of 500 MT of HEU down-blended and will complete the program in 2013.

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	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
2010	1,201	30.0	858.0	23.3	9.0	5.5
Total Delivered Through 2010	16,494	412.4	11,905.7	320.8	123.6	75.4
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. Events Impacting the HEU Agreement

Russia met its 2010 commitment under the HEU Agreement with deliveries to USEC of 858 MTU of down-blended LEU derived from 30.0 MT 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 expiration 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) into Russia's alleged 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 for Federal Claims 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 scheduled expiration of the HEU

Agreement in 2013. The United States appealed this ruling to the Supreme Court which agreed in April 2008 to hear the case. Arguments were subsequently heard by the Court in November 2008. In January 2009 the Court unanimously ruled in favor of the U.S. Government's position that uranium enrichment is a good and not a service, for purposes of U.S. trade laws.

The United States and Russia 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 expiration 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 expiration 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. 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, 2010.

Uranium markets experienced a rapid withdrawal of speculative investments during the recession that started in 2008 and continued through 2009. Spot uranium prices had peaked in June 2007 partially due to these new market participants. Global economic difficulties, most evident by the latter part of 2008, led many financial investors to withdraw from the market. A substantial weakening in uranium prices occurred during 2008 with no sustained recovery during 2009. Even then, 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. A recovery in uranium prices started in July 2010 and continued through the end of the year. Uranium supplies provided under the HEU Agreement were stable for the year as they have been since before 2000. None of these price fluctuations can be associated with the HEU Agreement-based uranium supplies. The scheduled termination of the

* 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.

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.

By early 2011 at least 11 combined license applications (COLAs) were being considered by the NRC and several additional COLAs were anticipated during 2011 and afterwards. At the end of 2010 it was anticipated that combined licenses for four reactors would be issued at two sites (Vogtle and Summer) toward the end of 2011 or in early 2012. A fifth reactor remained under construction under earlier licensing at Watts Bar 2 with the targeted commercial operating date likely in 2013. Several new large commercial reactor designs have either received NRC certification or were in the process of receiving certification, while the potential for applications for smaller reactor design was becoming more likely.

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 conversion has, however, become more cautious and has been unsettled by a labor dispute at the United States' sole conversion facility in Metropolis, Illinois that continued through August 2011 as well as by earlier extended closures at Cameco's Port Hope facility in Ontario. For all nuclear power and fuel industries, there is an active sorting process now underway regarding which projects will go forward and which will not. This sorting has led to both unduly optimistic and pessimistic projections for each sub-sector of the industries.

Uranium Mining

World nuclear uranium requirements during 2010 are estimated to have been about 177.1 million pounds U_3O_8 . This is an increase from an estimated 171.1 million pounds U_3O_8 in 2009. World uranium production from mines is estimated to have been 139.2 million pounds U_3O_8 during 2010, an increase of 7.2 million pounds U_3O_8 from about 132.0 million pounds U_3O_8 in 2009. Worldwide production from mines thus supplied almost 79 percent of requirements. This share has been growing in recent years. 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. The amount of such secondary sources available worldwide is declining and will become more significant with the end of the HEU Agreement in 2013.

Uranium requirements in the United States for 2010 were estimated to be 46.6 million pounds U_3O_8 equivalent compared to 49.8 million pounds U_3O_8 equivalent in 2009. Domestic uranium concentrate production increased 2.4 percent to 4.2 million pounds U_3O_8 in 2010 from 4.1 million pounds U_3O_8 in 2009. U.S. uranium production had earlier risen from 2.3 million pounds U_3O_8 in 2003 to 4.7 million pounds U_3O_8 in 2006 and has been variable in the 3.9 to 4.5 million pound U_3O_8 range since.

Spot market uranium prices began 2010 at \$44.50 per pound U_3O_8 representing a decrease from \$53 per pound U_3O_8 at the beginning of 2009. Prices remained weak through the end of July 2010 when they were still \$46.00 per pound U_3O_8 though beginning to rise. The spot price was \$62.50 by the end of December 2010 and continuing to increase. This increase followed anticipated increases in global uranium requirements as China, Russia, India, and several other nations began a rapid increase in the scale of their nuclear power sectors. Also affecting the market price was weakness of the U.S. dollar during 2010. Market anticipations have also varied regarding the impact on longer-term fuel supplies associated with the end of the HEU Agreement in 2013.

Between October 2006 and January 2011, NRC received 10 applications for in situ uranium recovery facility in Wyoming, South Dakota, and Nebraska. Six of these applications were for new facilities, three applications were for expansions, and one application for a restart. By August 2011, the NRC had approved three applications for new facilities, one expansion application, and one restart application. Additionally, three applications were being processed, and two applications were withdrawn. The NRC anticipated receiving an additional 19 applications, including two re-submittals for recovery facilities located in Wyoming, New Mexico, and Nevada through 2013. Additional projects are anticipated in other States, possibly including Texas, Utah, and Colorado. The licensing of uranium recovery operations in these latter states is subject to agreements between the NRC and the respective State governments, the agreements place the bulk of recovery facility licensing in the hands of the States. The actual timing of recovery operations depends not only on government licensing, but also on uranium market prices and local conditions. If these facilities begin production, for the most part it will be after the expiration of the HEU Agreement. Anticipated uranium mining and production expansion worldwide should also increase global uranium supplies, though the rate of this anticipated growth is uncertain.

After the initial implementation of the Commercial Feed Agreement, the measured sale of the Russian uranium to the Western Consortium by Tenex has been an important source of uranium supply for the U.S. commercial market typically amounting to around 40-50 percent of domestic requirements. In the face of a likely long-term decline in supply from many other secondary sources, the HEU Agreement deliveries have provided a stable supply at reasonable prices. The Agreement's contribution will end with its 2013 termination.

Uranium Conversion Services

World requirements for conversion services during 2010 were estimated at 64.5 million kgU as UF_6 . This compares to an estimated 59.2 million kgU as UF_6 in 2009. Conversion services demand for 2010 in the United States is estimated to be 19.9 million kgU as UF_6 , a slight increase from 19.6 million kgU as UF_6 in 2009. The sole domestic U.S. conversion facility is located in Metropolis, Illinois, and is operated by Honeywell. The Metropolis facility has an estimated annual capacity of 15.0 million kgU as UF_6 following an expansion completed in 2007. This nameplate capacity might not apply to the entire plant and annual production has averaged around 10 million kgU during the past four years. Production at Metropolis has also been hindered by a labor dispute that has continued from 2010 into 2011.

Conversion is an international business, with customers often buying from international suppliers. The gap in volume between domestic production and demand during 2010 was made up by a net 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 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 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 HEU Agreement did not restrict the sale of Russian conversion services entering the United States, the introduction of the 9 million kgU of conversion from HEU Agreement deliveries into the market initially did lead to the 1976 closure of a second facility in Gore, Oklahoma. However, with an existing shortfall in production, the HEU Agreement has subsequently become an essential source of conversion supply. This raises the potential issue of replacing this conversion 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 by the end of 2009 compared to \$12.50 per kgU at the end of 2010. This 108.3 percent increase in spot prices over the year has been subsequent to the labor dispute at Metropolis with almost all of the increase coming since July 2010. Over the longer term, some industry analysts are concerned regarding the adequacy of conversion industry capacity. Prior to the recent price increases, analysts argued that conversion prices were inadequate to stimulate needed industry investment for any rapid rise in nuclear power capacity. Some independent participants in the conversion industry also face a situation where some nuclear fuel transactions include the bundling of conversion and enrichment as a single product.

Uranium Enrichment

World requirements for enrichment during 2010 are estimated at 45.3 million SWU, a 1.1 percent decrease from estimated 2009 requirements of 45.8 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 situations in which enrichment facilities enter into supply contracts to ensure that centrifuges operate at nearly 100 percent capacity. It is anticipated that the enrichment market will 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 2010 is estimated at 13.8 million SWU, down from the 17.2 million SWU in 2009. The high enrichment level in 2009 was statistically high following unusually low levels during the preceding year (2008). As of 2010 the Paducah Gaseous Diffusion Plant, operated by USEC, is no longer the only commercial domestic enrichment facility operating in the United States. On June 11, 2010, Urenco USA, formerly known as Louisiana Energy Services (LES), began production at a gas centrifuge uranium enrichment facility in Eunice, New Mexico. (A domestic supply of enrichment is also provided through the National Nuclear Security Administration-sponsored down-blending of domestic-origin HEU to reactor-grade LEU.)

The Energy Information Administration reports that about 84 percent of the enrichment consumed in the United States in 2009 was imported. Paducah produced about 6.3 million SWU in 2010 though nominal production capacity is estimated to be about 8.0 million SWU. The competitive character of the international 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 40 percent of domestic enrichment demand. Most of the SWU purchased by USEC under the HEU Agreement are used to meet U.S. demand.

Spot prices for enrichment have increased noticeably since 2006. The spot price began 2006 at \$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 2009 though they had varied slightly during the year. By the end of 2010 spot SWU prices had dropped slightly, to \$155 per SWU.

The adequacy of the international market for enrichment will depend on new gas centrifuge and laser uranium enrichment facilities and on the retirement schedules for existing gaseous diffusion uranium enrichment plants. While such facilities are also located in Europe, eastern Asia, and a very small number of additional locations, U.S.-based facilities represent a significant portion of the anticipated capacity shift. The impending end of the HEU agreement and its supplies of enriched nuclear fuel have played a major role in the development of these changes in uranium enrichment capacity. Generally, gas centrifuge enrichment facilities can be expanded more rapidly than new commercial power facilities; thus enrichment capacity can normally be adequate for market demand.

HEU Agreement deliveries remain important to the U.S. enrichment market because they account for nearly 40 percent 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 coupled with limits through 2020 of Russian imports of uranium under the amended Suspension Agreement have permitted potential uranium enrichment suppliers to target their proposed investments within the United States.

Plans for new enrichment technology deployment in the United States continued to develop during 2010. Urenco USA started operations at its National Enrichment Facility in Eunice, New Mexico. This facility uses the Enrichment Technology Company's (ETC) gas centrifuge technology that is currently used by Urenco in Western Europe. ETC is a 50-50 joint venture of AREVA and Urenco. The plant production will probably not reach full 3 million SWU initial annual capacity anticipated around 2013, approximately the time of the conclusion of the HEU Agreement. Urenco USA 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. Urenco shares are equally divided among the government of the United Kingdom; the government of the Netherlands; and a collection of German utilities.

In April 2007, NRC granted USEC its commercial license to build and operate its American Centrifuge Plant (ACP) in Piketon, Ohio. USEC plans to begin commercial operations at ACP in 2013 eventually expanding to 3.8 million SWU per year using gas centrifuges based on an updated version of DOE technology developed in the 1980s. USEC initiated operations at its demonstration Lead Cascade facility at Piketon in late 2007. Development of the Lead Cascade continued through 2010. USEC has also applied to DOE for a loan guarantee for the plant at that time. DOE's technical and financial review indicated that the project was not ready to move to commercial scale operations at that time and USEC's application would not likely meet statutory requirements. The Department offered to reconsider USEC's application in the future. On August 3, 2010, USEC announced that it had submitted a comprehensive update to its application with DOE. The ACP is intended to eventually replace much of the production capacity at the Paducah Gaseous Diffusion Plant.

In December 2008, AREVA Enrichment Services (AES) submitted an application to the NRC 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. On December 13, 2011, AREVA announced that, while designs and planning for the project continue, construction activities for the Eagle Rock Enrichment Facility are on hold until AREVA resolves funding for construction. The Eagle Rock plant would use ETC technology. The license was issued on October 12, 2011 with initial production estimated as early as 2014 and 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 SWU per year capacity.

GE Hitachi's affiliate Global Laser Enrichment (GLE) announced plans in 2006 to build a demonstration laser enrichment facility. Cameco joined the project as an investor in 2008. A test loop facility has been in operation since July 2009 and an application for a commercial scale facility was submitted in June 2009. Licensing activities, including some application revisions, continued through 2011. Approval of the license application and issuance of the license could come as early as the third quarter of 2012, after which GLE would decide whether to proceed further. GLE is requesting a capacity of 6 million SWU per year. If the laser enrichment technologies realize promised efficiencies, successful implementation of the facility could have major implications for the enrichment and uranium supply industries worldwide.

By December 2010, 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 total nameplate capacity to 18 million SWU per year by 2015, including nearly 6 million SWU at Eunice, New Mexico, and the remainder in Europe. 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, was anticipated to begin operation during 2011 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. During 2011 AREVA announced its intention to continue operating its older gaseous diffusion uranium enrichment, Georges Besse I, at reduced capacity, at least until 2012.

The importation of enriched material from the Russian Federation into the United States has been limited by the HEU Agreement. The Supreme Court's *Eurodif* decision, the February 2008 amendment to the Suspension Agreement, and a law signed in September 2008 effectively permits some minor additional importation of Russian enriched material prior to the expiration of the Agreement with additional imports after the conclusion of the HEU Agreement 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 permits additional uranium (including enrichment imports) during 2013 through 2020 over and above limitations set under the amended Suspension Agreement.

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 in an effort to avoid any adverse effects of the HEU Agreement deliveries upon commercial nuclear fuel markets. Historically, actions taken 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. market 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 of the HEU Agreement deliveries to DOE. DOE has responsibly managed the uranium to avoid an adverse material impact to the market.
- 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 since its establishment. 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 are permitted into the United States under the amended agreement during 2011-2013. This agreement thus allows for some continuity in limits of Russian-origin uranium supplies beyond the expiration 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 HEU Agreement, the designated Executive Agents for the commercial arrangement, and U.S. industry. The HEU Agreement has also added to uranium market stability within the United States. Anticipating the end of the HEU Agreement in 2013, the international nuclear fuel industry has embarked on adding new capacity and utilizing excess capacity to fulfill the requirements of both the current reactor fleet and anticipated new nuclear power reactors worldwide. Foreign suppliers will continue to be the major source of fuel for our nation's reactors after the end of the HEU Agreement. With the planned start-up of new enrichment plants, U.S.-sourced enriched uranium is anticipated to increase its share of the U.S. market and provide some export potential, and could counterbalance subsequent Russian competitive access to U.S. markets. 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.

Global Laser Enrichment (GLE) – An subsidiary of General Electric Hitachi that was created to commercialize laser technology for the enrichment of uranium. The Canadian firm Cameco also owns the 24% of GLE not owned by GEH.

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 .

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.

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

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.