

**PACKAGING AND TRANSPORTATION OF DERIVED ENRICHED
URANIUM FOR THE "MEGATONS TO MEGAWATTS"
USA/RUSSIA AGREEMENT**

E. Darrough (1), L. Ewing (1), and N. Ravenscroft (2)

(1) United States Enrichment Corporation, 6903 Rockledge Drive, Bethesda, Maryland, USA
(2) Edlow International Company, 1666 Connecticut Avenue, Suite 201, Washington, DC, USA

Abstract

In January 1998 the United States Enrichment Corporation (USEC) and Techsnabexport Co., Ltd. (TENEX) of Russia celebrated the fourth anniversary of the signing of the 20-year contract between these two executive agents. USEC and TENEX are responsible for implementing the Government-to-Government agreement between the United States and the Russian Federation for the purchase of uranium derived from dismantled nuclear weapons from the former Soviet Union. This program, entitled "Megatons to Megawatts," is the first time nuclear warheads have been turned into fuel, as well as the first time a commercial contract has been used to implement such a program. As of the fourth anniversary, the equivalent of almost 1,200 nuclear warheads had been converted to fuel.

USEC is responsible for making all of the arrangements to transport the Russian LEU derived from HEU--hence the term, derived enriched uranium (DEU)--from St. Petersburg, Russia to the USEC plant near Portsmouth, Ohio. Edlow International Company is working with USEC to implement the shipping campaign and is responsible for coordination of the port delivery within Russia, as well. The organization responsible for these shipments within Russia is IZOTOP.

While the program has been a major new responsibility for USEC, the early years of the program prepared all parties for the future challenges such as increased numbers of shipments, additional originating sites in Russia and witnessing requirements in Russia.

Background

On February 18, 1993, a Government-to-Government Agreement was signed by the United States of America (USA) and the Russian Federation to convert highly enriched uranium (HEU) in Soviet-era nuclear weapons into low enriched uranium (LEU) to be used as fuel for commercial nuclear power plants. The USA agreed in principle to purchase over 15,000 metric tons (MT) of LEU over a 20-year period, beginning in fiscal year 1994. The material is being produced by blending LEU with 500 MT of HEU obtained from dismantled former Soviet Union nuclear weapons. The LEU will contain about 92 million SWU and 152,000 metric tons of natural uranium. The value of this LEU is estimated to be approximately \$12 billion.

The dismantlement of the weapons and the conversion of the HEU metal into uranium hexafluoride (UF_6) and the subsequent blending to LEU UF_6 occurs in Russia before USEC takes ownership of the material.

The agreement between the USA and Russia includes provisions, i.e., "transparency measures," to provide the necessary assurances that the material purchased by USEC is derived from weapons dismantled in Russia. These "transparency" activities are implemented for the USA by the Department of Energy.

Subsequently, on January 14, 1994, USEC, acting as the USA Government's Executive Agent, signed a contract with Technabexport Co. Ltd. (TENEX), acting as the agent of the Ministry of Atomic Energy (MINATOM), Executive Agent of the Russian Federation, to purchase the LEU derived from the nuclear weapons. The contract called for the delivery of the equivalent of 10 metric tons (MT) of HEU (about 300 MT of LEU) per year for the first five years increasing to the equivalent of 30 metric tons of HEU (about 900 MT of LEU) per year for the remaining fifteen years.

Delays in implementation and subsequent contract modifications have resulted in the delivery of the LEU equivalent of 6 MT, 12 MT and 18 MT of HEU in 1995 through 1997, respectively. The current contract calls for the deliveries to increase to the equivalent of 24 MT of HEU in 1998 and 30 MT of HEU in 1999 and subsequent years.

Deliveries, 1995 through 1998

In 1995 the equivalent of six metric tons of HEU was delivered to USEC. This material was contained in 124 of the 30B cylinders and was delivered to USEC in nine shipments. USEC took delivery of the first shipment on May 30, 1995 and it subsequently arrived at the Portsmouth plant on June 23, 1995. (See Figure 1.)

Figure 1
First Russian DEU Shipment Arrives in USA



In 1996, the equivalent of 12 metric tons of HEU was delivered to USEC. The material was contained in 248 of the 30B cylinders and was delivered to USEC in 11 shipments.

In 1997, the equivalent of 18 MT of HEU was delivered to USEC. This material was contained in 321 of the 30B cylinders and was delivered to USEC in 10 shipments.

In 1998, the equivalent of 24 MT of HEU is scheduled to be delivered to USEC. This material will be contained in 482 of the 30B cylinders and will be delivered to USEC in 10 shipments.

Witnessing Services

Witnessing services at the enriching facilities and ports in Russia are provided for USEC by Edlow International, through its St. Petersburg office, Edlow East West. Witnessing services are performed at the Ekaterinburg, Krasnoyarsk and Tomsk plants and at the St. Petersburg port. This includes witnessing the filling of the 30B and sample cylinders and the placement of seals on the packaging.

Packaging and Transportation

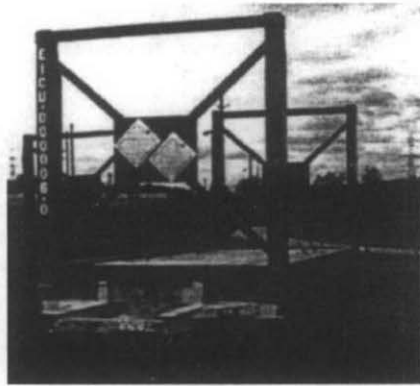
The challenges inherent in this effort have been the procurement of packaging, its delivery to Russia, and the scheduling, logistics, and coordination with external groups in making the shipments and importing the material. The conditions of the agreement require USEC to provide and ship cylinders, overpacks, sample containers, and other hardware to Russia; the Russians to fill the cylinders and sample containers; and USEC to analyze the samples, accept the material, and provide transportation services from St. Petersburg, Russia, to the USEC Portsmouth plant.

The agreement for these transports stipulates that various types of sample cylinders may be used but it specifies the use of a model 30B UF₆ product cylinder. Each 30B cylinder contains about 1,500 kilograms of LEU. All cylinders supplied to the Russians for this program must be clean, dry and pressurized with nitrogen. Sample cylinders are shipped in small drums and transported by air. The product cylinders are shipped in overpacks which are secured to 20-foot ocean containers. These ocean containers have been either modified or specially constructed (See Figure 2) to accommodate the shipment of UF₆ packages with no intermediate handling at the ocean ports.

All packaging is fabricated and tested in accordance with national and international standards and regulations. All packages and ocean containers are marked, labeled and placarded in accordance with the standards and regulations of the International Atomic Energy Agency and the U. S. Department of Transportation (DOT).

As mentioned above, TENEX is the marketing organization for fuel cycle materials in Russia. The Russian organization responsible for transporting material on behalf of TENEX is IZOTOP. Shipments of radioactive material to or from Russia are managed by IZOTOP, which has been successfully managing radioactive material shipments for over thirty years. In addition to their expertise in transportation matters, IZOTOP operates a secure facility in which they can either store material or maintain it in a secure staging area while awaiting import, export or internal distribution. IZOTOP operates a fleet of trucks and has direct rail service to/from their facility.

Figure 2
Customized Ocean Container Used for DEU Shipments



Upon delivery of the empty packaging to St. Petersburg, IZOTOP transports the sample and product cylinders to either the Ural Electrochemical Integrated Plant near Ekaterinburg, the Electrochemical Plant in Krasnoyarsk or the Siberian Chemical Integrated Plant in Tomsk. The cylinders are filled at these plants, then shipped by rail to the IZOTOP facility in St. Petersburg, Russia. It is in St. Petersburg where USEC takes ownership of the material upon its loading onto a ship. The sample containers are shipped from St. Petersburg by air to the USA. As described in the environmental assessment (EA) developed for the program, the transportation modes for the product material include ship voyage from St. Petersburg, Russia to the USA and truck shipments from the port to the USEC Portsmouth plant in Piketon, Ohio. Most ocean voyages with this material go directly from St. Petersburg to the USA without intermediate ports of call. The vessels travel routine shipping lanes through the Gulf of Finland, the Baltic and North Seas, and then into the Atlantic Ocean. The EA included most of the major ports on the East and Gulf Coasts as ports of entry into the USA. These ports are in the states of Georgia, Maryland, New Jersey, New York, Pennsylvania, Texas and Virginia. (Figure 3 shows the DEU implementation sites.)

Ports on the East and Gulf Coasts were selected for the shipments because the distance a ship would travel from St. Petersburg to the West Coast and the distance a truck would travel from the West Coast to Ohio are greater than the distances and costs associated with the East or Gulf Coast ports.

When transporting radioactive material internationally, one must consider the requirements of the country of origin, destination and intermediate countries. These requirements may include items such as special nuclear liability insurance, package validations and transit permits. In some cases, it is economically impossible to satisfy the nuclear liability requirements of intermediate countries and it may take weeks or months to get transit authorization. The foreign nuclear liability insurance amount of \$100 million provided under the Price Anderson Act falls short of the requirements for

many countries. It has therefore been our policy to ship directly, without intermediate ports of call, whenever possible.

Figure 3
DEU Implementation Sites



If one were to look at the selection of ocean carriers offering service between the USA and Russia it would appear that there is unlimited service. However, due to steamship line corporate policy, charter agreements, nuclear liability insurance requirements and the endless requirements for transit authorizations only two or three of these carriers will accept this material for ocean transportation.

Because the outer surface of the overpacks is subject to damage from handling equipment at the ports, a decision was made to ship this material on a "house-to-house" basis. This means that the shipping packages are secured to 20-foot ocean containers and remain there between the IZOTOP and USEC facilities. Only the ocean container is handled at the transfer points.

When the material arrives at the port, an Edlow representative inspects the ocean containers and shipping packages. This policy has been established because the packages occasionally arrive at the port with missing labels or placards. (Although the packages are properly labeled and placarded at the St. Petersburg port, harsh weather conditions in Russia and the North Atlantic create conditions for their loss.) The primary purpose of this inspection is to ensure that these consignments meet the DOT's requirements for marking, labeling and placarding before being offered for transportation.

Once the LEU arrives at one of the ports of entry and is cleared by the U. S. Customs Service, it is transported via local transportation routes to the nearest interstate highway. This practice is in keeping with DOT routing regulations which require that the interstate highway system be used to the maximum extent possible. The interstate highway is used until it connects with a state highway leading to the USEC Portsmouth plant.

Planning and Coordination

Planning and implementing the shipments from Russia were at first a challenge but as more shipments have occurred, the effort has become manageable, if not routine. The working document for the TENEX/USEC agreement laid the framework for the shipping campaign by stipulating equipment needs, delivery schedules, marking and sealing requirements, and documentation to be included with the shipments. To facilitate the planning, USEC established communication mechanisms between the Portsmouth plant and the USEC shipping agent. Integrated planning schedules were developed by the plant, which help track the key elements of each shipment, determine whether the inventories are adequate, efficiently use the hardware, and keep updated as to the status of the overall program.

Close coordination between USEC and the Department of Commerce (DOC) and the U.S. Customs Service at the incoming port has been necessary, to fulfill DOC's import clearances and documentation requirements and the Customs offices' import accountability. Additional documentation requirements of the DOC are associated with the particulars of the Suspension Agreement. Typically, once the details of a shipment are known, USEC must notify the DOC of the shipment and include information on the port, exporter and importer names, date and time of arrival, and name of carrier. Official documents which must be submitted include the export certificate, bill of lading, shipping specification/packing list, country of origin, and a certification that the material being imported does not circumvent the Suspension Agreement.

When the material arrives at the port of entry, it is held at the port until the U. S. Customs office issues a release order. The Customs office, in turn, must await clearance from the DOC. Once the DOC has reviewed and accepted the information USEC has provided, they notify the U.S. Customs Headquarters office of their approval to release the shipment and they, in turn, notify the Customs office at the port. USEC and Edlow use a customs broker at the port to expedite the process at each port. The local Customs office issues an entry number, which is relayed back to the DOC for their records. Before the shipment can depart the port for delivery to the USEC facility, the U. S. Customs office must release it for formal entry into USA commerce. At times, the Customs office will release the cargo without a physical inspection. On occasion, however, the Customs office will require an "intensive inspection." This does not usually include the opening of packages. However, it might include the weighing of a package to confirm weight values stated in the import documentation. Once cleared by Customs, an Edlow representative arranges to get the material on a truck bound for the USEC plant.

International Interactions

In August 1996, to ensure continued success and to facilitate enhanced coordination for these shipments, Edlow and IZOTOP sponsored a week-long conference in St. Petersburg. A special

emphasis of the conference was on the requirements for documentation, marking and labeling of UF₆ shipments. The conference was attended by representatives of USEC and various Russian regulatory agencies and facility personnel. The conference was successful in establishing a forum for an exchange of ideas relating to international shipping programs and regulations.

The conference was repeated in 1997 and was expanded to include European companies. In addition to those attending the 1996 conference, new participants included British Nuclear Fuels, Nuclear Cargo Services and URENCO. Representatives of various technical and regulatory bodies in Russia, Kazakstan, Uzbekistan and Belarus were in attendance, as were Russian port and customs officials, as well as freight forwarders, fuel fabricators and enrichers from Germany, Russia, Sweden, the United Kingdom and the United States. The 1997 conference focused on physical protection and emergency response measures, in accordance with standards of the International Atomic Energy Agency, as they apply to shipments of radioactive materials.

Specialized Equipment

To support the hardware requirements of the program, USEC to date has purchased about 1,000 new cylinders, 250 new overpacks and 250 1S sample containers. Both the DOT-21PF-1 overpacks and the UX-30 overpacks are used for shipments of the 30B cylinders. Additional purchases will be made as needed to support the delivery of the material to the USEC plant.

Chances of loss or damage to shipments are greatest when they are exposed to repeated handling. To avoid intermediate handling and its associated risks, Edlow International has purchased customized ocean containers which have been fabricated, tested and certified to accommodate weight concentrated loads such as those experienced with UF₆ shipments. Specialized equipment such as this ensures enhanced safety during transportation. Additionally, these ocean containers have been specially outfitted to allow rapid securement of either natural UF₆ cylinder cradles or enriched UF₆ cylinders in overpacks.

Summary

USEC is responsible for implementing the agreement between the United States and the Russian Federation for the purchase of uranium derived from dismantled nuclear weapons from the former Soviet Union. Edlow International Company is working with USEC to conduct the shipping campaign for this material. Nine shipments of the LEU were delivered to USEC in calendar year 1995, 11 shipments in 1996, 10 shipments in 1997 and 10 are scheduled for 1998. The quantity of material delivered has increased by almost a factor of four since 1995. The shipping campaign has required the procurement and certification of packaging, its delivery to Russia, and the scheduling, logistics and coordination with both domestic and international groups in conducting the shipments and importing the material.