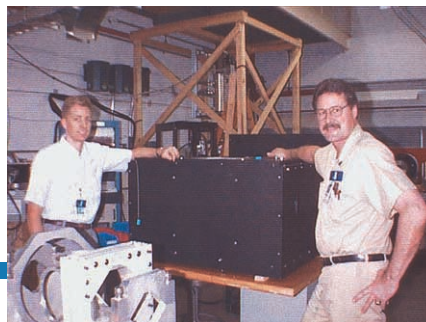
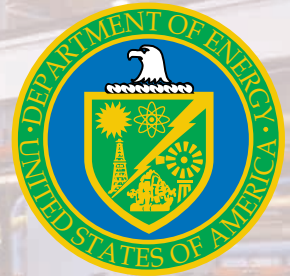


Megatons to Megawatts

Implementing HEU Transparency Measures



In February 1993, the U.S. and the Russian Federation signed a bilateral agreement for the safe and prompt disposition, for peaceful purposes, of highly enriched uranium (HEU) extracted from surplus Russian nuclear weapons—resulting from reductions in accordance with arms control and disarmament agreements. This agreement reaffirmed both governments’ commitments that nuclear materials transferred for peaceful purposes will comply with all applicable nonproliferation requirements and also allows the U.S. to purchase some of the uranium in a form suitable for use only in nuclear power reactors.

This agreement led to the signing, in January 1994, of a 20-year purchase agreement between Technabexport (Tenex) and the U.S. Enrichment Corporation (USEC) for disposing of 500 metric tons (1,100,000 pounds) of dismantled nuclear-weapon HEU. This HEU is being diluted in Russia to low-enriched uranium (LEU), which is then delivered to the U.S. for use in the manufacturing of fuel for commercial nuclear reactors. Under the purchase agreement, Russia is expected to receive about \$12 billion for the LEU. The fuel derived from the HEU weapons material will eventually generate an amount of electricity equal to that used by the entire world for almost three years.

Weapons-grade HEU is converted into LEU by a process that includes the following steps:

- The HEU-metal component is removed from a nuclear weapon.
- The component is machined into metal shavings.
- The metal shavings are heated and converted to an oxide.
- Contaminants are chemically removed from the HEU-oxide, when necessary.
- The HEU-oxide is converted, by chemical means, into uranium-hexafluoride gas.
- The HEU-hexafluoride gas is diluted with a much lower enrichment level uranium-hexafluoride gas, producing an LEU-hexafluoride gas suitable for nuclear fuel fabrication.
- The LEU-hexafluoride gas is loaded into shipping cylinders.
- The filled cylinders are shipped to USEC in the U.S.
- USEC ships the cylinders of LEU-hexafluoride gas to its customers — nuclear-fuel manufacturers — to make nuclear-reactor fuel-rod assemblies for commercial nuclear power plants.

Under the 1993 bilateral agreement, the U.S. and Russia agreed to “transparency rights.” For the U.S., transparency helps provide confidence that the LEU being delivered under the agreement with USEC is not being newly produced in Russia’s enrichment



The interior of an LEU-hexafluoride gas shipping container at UEIP is inspected for flaws.

plants, but is indeed derived from HEU.

Reciprocal transparency rights were also provided to the Russian government to ensure that the LEU being delivered by Tenex to USEC will not be used in our enrichment plants to produce weapons-grade uranium.

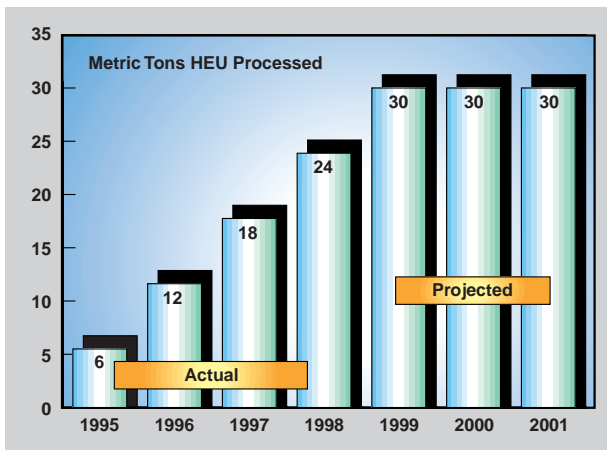
The methods used to provide the needed confidence were carefully negotiated in a Memorandum of Understanding and a Protocol with a set of Annexes, which provide the technical basis for providing confidence to each government that the other is abiding by its agreements.

In the U.S., the Department of Energy (DOE) is responsible for developing and implementing the transparency requirements of the February 1993 bilateral agreement. DOE and its counterpart in Russia, the Ministry of Atomic Energy (Minatom), work closely together to develop and implement transparency measures acceptable to both countries.

At DOE, the Office of Nonproliferation and National Security is responsible for developing, participating in negotiations on, and implementing transparency measures in our bilateral agreements. DOE’s site offices also support transparency measures with such work as in-country logistical agreements, which the Oakland Operations Office manages.



Russian museum display of nuclear weapons.



The actual quantity of HEU already processed and the amounts projected for processing by 2001. To date, sixty (60) metric tons of HEU from dismantled Russian nuclear weapons have been downblended to LEU. According to the IAEA's definition of a significant quantity (1987 IAEA safeguards glossary), this would be enough to make approximately 2,400 nuclear explosive devices.

For the U.S., transparency measures consist of on-site document reviews and on-site monitoring at four Russian nuclear facilities. Portable nondestructive assay (NDA) instruments measure uranium enrichment at various stages of the conversion process. Together, these activities are being used to acquire the information necessary to help confirm that the nonproliferation goals of this program are being achieved.

For the Russians, transparency measures consist of on-site document reviews and monitoring at five American fuel fabricators, thereby providing confidence that the LEU is being used only for peaceful purposes as nuclear-reactor fuel.

DOE's transparency activity also supports a "Permanent Presence Office," at Novouralsk in the Russian Federation. Novouralsk is home to the Ural Electrochemical Integrated Plant (UEIP), where HEU and low assay LEU-hexafluoride gases are mixed to dilute (blend down) the HEU into an LEU product. At UEIP, up to four permanent presence monitors are provided with daily access, the year round, to the facilities and material related to

the conversion process. Special monitors are also sent to the other Russian plants participating in this activity, up to six times per year, to conduct similar monitoring activities for periods of five days.

The Russians have established a Permanent Presence Office at USEC's Gaseous Diffusion Plant, in Portsmouth, Ohio, where LEU is received after being shipped from Russia. The Russians also have the

right to visit the fuel fabricators where this LEU is processed into fuel assemblies. In addition, the Russians have the right to review all the relevant documents used to track this LEU through the U.S. to its eventual destination at a commercial nuclear power plant.

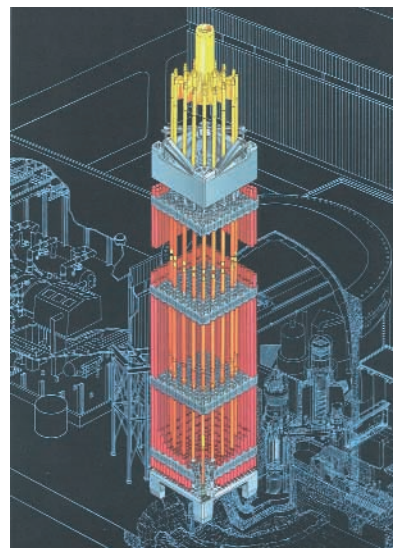
Benefits of the HEU Transparency Activities

DOE's HEU transparency activities are producing significant results and benefits. These are:

- Removing 500 metric tons (1,100,000 pounds) of weapons-grade HEU from global supplies.
- Reducing the number of nuclear weapons stockpiled in the Russian Federation, thus improving the situation with respect to the security of its remaining nuclear materials.
- Reducing the availability of HEU materials to potential proliferant nations and terrorists.
- Stimulating commercial development and economic diversity in the closed cities of the Russian nuclear weapons complex,

thereby helping to diversify the work available to Russian nuclear scientists, engineers, and technicians.

- Converting former weapons-grade nuclear material to a peaceful purpose—generating electric power in commercial nuclear reactors.



Artists' concept of a fuel rod assembly being installed in a nuclear power reactor.

Participants in the HEU Transparency Activities

DOE has leveraged its national laboratories' expertise to support implementing the HEU transparency activities. The national laboratories provide technical expertise, specialized equipment, and support, as needed. The participants include DOE operations offices and Argonne, Brookhaven, Lawrence Livermore, Los Alamos, New Brunswick, Oak Ridge, and Sandia National Laboratories.

The transparency activities are conducted with the cooperation of the Department of State, the Nuclear Regulatory Commission, and USEC.

Key Accomplishments

Key accomplishments of the HEU transparency activities include:

- Establishing and maintaining a Permanent Presence Office at UEIP in Novouralsk.
- Supporting the Russians in establishing their Permanent Presence Office at USEC's Gaseous Diffusion Plant in Portsmouth, Ohio.
- Conducting special monitoring visits to each of the Russian HEU processing facilities: the Siberian Chemical Enterprise (SChE) at Seversk; the Electrochemical Plant (ECP) at Zelenogorsk; the Ural Electrochemical Integrated

Plant (UEIP) at Novouralsk; and the Mayak Production Association (MPA) at Ozersk.

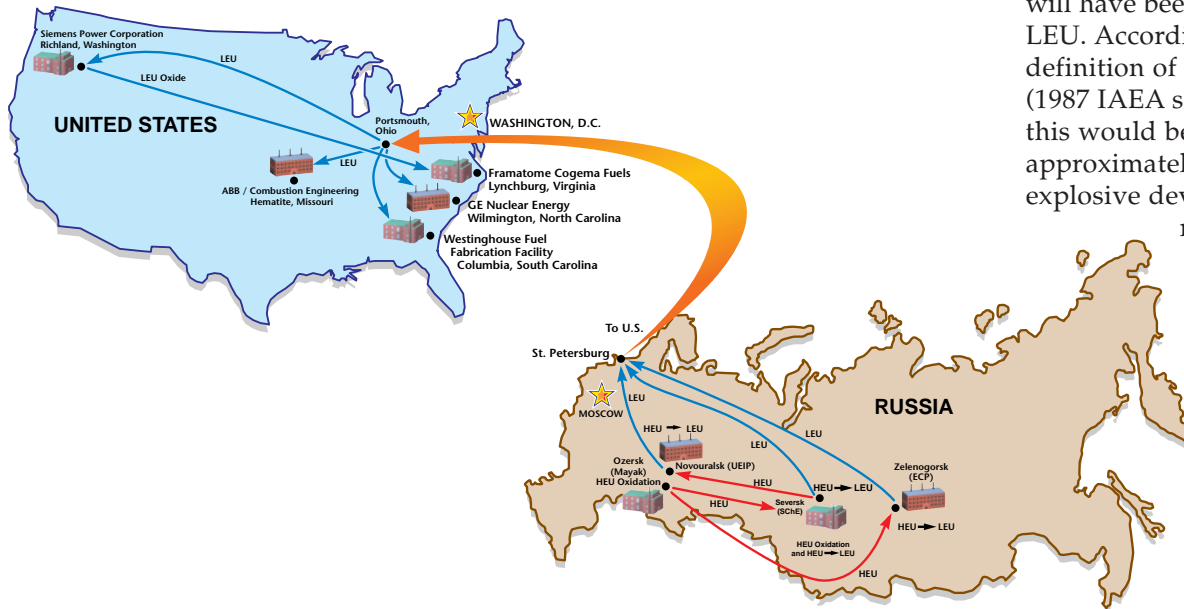
- Receiving LEU materials at USEC's Gaseous Diffusion Plant in Portsmouth, Ohio.
- Installing the Blend Down Monitoring System at UEIP to measure the flow and enrichment level of uranium-hexafluoride gas moving through the pipes and to confirm the blending down of HEU to LEU. Similar equipment will be installed at ECP and SChE.
- Developing and using portable, nondestructive, assay instruments—to detect the presence or absence of HEU material in closed containers.

Impact of HEU Transparency

The DOE's nonproliferation and arms control work is of central importance to our national and global security. HEU transparency activities are an important part of efforts to reduce the amount of weapons-grade uranium, through its conversion to LEU for use as commercial-sector fuel. These activities, which draw on the expertise of many national laboratories and other government agencies, ensure that all parts of the bilateral agreement with respect to the conversion of surplus Russian HEU weapons components and the sale to USEC of the LEU derived from them, are being met.

By the end of the 20-year contract, 500 metric tons of HEU from dismantled Russian nuclear weapons will have been downblended to LEU. According to the IAEA's definition of a significant quantity (1987 IAEA safeguards glossary), this would be enough to make approximately 20,000 nuclear explosive devices. Megatons to

megawatts—an arrangement in which both governments and the world are winners.



Illustrating the HEU and LEU flow from Russia to the U.S.

For further information, please contact:

Edward F. Mastal,
HEU Transparency Implementation Program Director,
U.S. Department of Energy, Office
of International Nuclear Safety and Cooperation
19901 Germantown Road
Germantown, MD 20874
(301) 903-3197
Email: edward.mastal@hq.doe.gov

Andrew J. Bieniawski,
Deputy Chief HEU Transparency Negotiator,
U.S. Department of Energy, Office of Nonproliferation
and National Security
International Policy and National Analysis Division
1000 Independence Avenue, S.W.
Washington, D.C. 20585
(202) 586-1685
Email: andrew.bieniawski@hq.doe.gov