HARD LESSONS AND NEW OPPORTUNITIES FOR US-RUSSIAN NUCLEAR COOPERATION
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Megatons to Megawatts is a unique program in the history of nuclear disarmament, nuclear energy and U.S.-Russia relations. As its name implies, it has enabled the conversion of megatons of destructive power to megawatts of electricity. This was achieved by turning 500 tons of highly enriched uranium from Russian nuclear warheads dismantled as part of disarmament initiatives into fuel for U.S. nuclear power plants.

The program has set a precedent of a nuclear disarmament initiative being implemented using commercial mechanisms. The amount of weapons-grade material disposed of as part of the program would have been sufficient to make 20,000 nuclear warheads. That material was turned instead into enough nuclear fuel to provide electricity for our whole planet for five months, the United States for two years, or Russia for seven years. The program has been the biggest single step in the history of irreversible nuclear arms reduction. It has also helped the Russian nuclear industry to become fully integrated into the global nuclear market. The program has generated an estimated $17 billion in revenue for the Russian state. Taking into account its indirect positive effects on the Russian nuclear industry, the figure is probably well above $20 billion.

In November 2013 the last batch of low enriched uranium (LEU) recycled from Russian nuclear bombs arrived in the United States, and the Megatons to Megawatts program came to an end. It is already being replaced by deliveries of Russian low-enriched uranium on the basis of commercial contracts that are currently worth over $11.5 billion.

In this report, a group of Russian and U.S. researchers – including those who were directly involved in drawing up and implementing the program – look at the origins of the program; the difficulties encountered during its implementation; the economic and political effects of the program; and the prospects for using the Megatons to Megawatts experience and expertise in future Russian-U.S. cooperation projects, specifically in the area of irreversible nuclear disarmament and nuclear energy.
TIMELINE OF HEU AGREEMENT AND RELATED EVENTS

**HEU Agreement milestones**
- The Soviet Union and the United States sign the Strategic Arms Reduction Treaty (START I)

**HEU Agreement-related events**
- Russia and the United States sign the HEU Agreement
- Russia’s Technoexport and United States Enrichment Corporation (USEC), designated as executive agents, sign a contract for the supply of LEU made by downblending HEU
- Kazakhstan joins the Nuclear Non-Proliferation Treaty (NPT) as a non-nuclear weapon state
- Ukraine joins the NPT as a non-nuclear weapon state, The HEU Purchase Agreement allowed to provide the funds for compensating Ukraine and Kazakhstan for the removal of HEU contained in nuclear ammunition
- Technoexport and a Group of Western Companies (Canada’s Cameco, French Cogema, and the American-German company Nukem) sign a contract for the purchase of some of the Russia-owned natural uranium, stockpiled on U.S. territory (Feed Component Implementing Contract)

**Key principles of the HEU Contract agreed at a Russian-U.S. Summit in Vancouver**
- 04.06.1993
- 14.01.1994
- 18.02.1995
- 05.05.1996
- 24.08.1999
- 24.03.1999
- 26.04.1996
- 31.05.1995
- 11.01.2013

**First shipment of LEU dispatched from the St. Petersburg sea port; the size of the batch is equivalent to 750 kilos of HEU**

**The annual volume of HEU downblending reaches 30 metric tonnes in 2000, and stays there until the end of the program in 2013**

**The last LEU batch is shipped from the St. Petersburg sea port. The total amount of material supplied under the HEU deal reaches an equivalent of 500 metric tonnes of HEU**

**3.01.2014**

As of January 1, 2014, the Russian enrichment industry contracts portfolio includes 20 commercial contracts for exports of enrichment services to the United States, worth a total of about $11.5 billion. The overall export contracts portfolio is worth over $25 billion.
POLICY RECOMMENDATIONS

BY ANTON KHLOPKOV

1. Use the experience and expertise Russia and the United States have gained during the HEU deal to pursue closer bilateral cooperation in the peaceful use of nuclear technologies. Their bilateral nuclear cooperation, hitherto dominated by nonproliferation initiatives, should shift its focus towards joint commercial projects between the Russian and U.S. nuclear industries. This shift should be reflected in the agenda of the Nuclear Energy and Nuclear Security Working Group under the Russian-U.S. Bilateral Presidential Commission.

2. Consider the possibility of the Rosatom State Nuclear Energy Corporation and the U.S. Department of Energy preparing a collective publication (or two separate ones) on the legal, technological, financial and other aspects of the HEU Agreement’s implementation. The release of such a book could be timed to coincide with the 20th anniversary of the first batch of HEU-derived LEU being shipped to the United States in May 1995. The book could also include documents related to the HEU deal.

3. Consider the possibility of creating a U.S. LEU reserve with the participation of the Russian enrichment industry. This will give U.S. energy utilities assured access to a supply of low enriched uranium fuel during a transitional period now that the Megatons to Megawatts program has ended, and pending the construction of the American Centrifuge Plant and the GE Laser Enrichment Facility. The Transitional Supply Contract which USEC and Techsnabexport signed in March 2011 could be used as the legal framework for supplying Russian uranium for the U.S. reserve.

4. Consider the possibility of downblending new and equal quantities of excess Russian and American HEU for use as LEU fuel in each country’s own power reactors. The new program could include the downblending of HEU previously used for non-weapons purposes. The planning of such an initiative should take into account the situation on the uranium market and the interests of the Russian and U.S. producers of natural uranium. Russia could help the United States downblend its new quantities of HEU by supplying the blendstock produced from the depleted uranium tails.

5. Take additional steps to implement the Russian-U.S. Plutonium Management and Disposition Agreement (PMDA), under which each country is to dispose of 34 tons of plutonium declared as being surplus to its defense requirements. To that end, the two countries could make use of commercial mechanisms, including those previously used for the HEU Agreement.

6. Consider the possibility of Rosatom and the U.S. Department of Energy developing an alternative option for disposing of excess weapons-grade plutonium stockpiles by adding small amounts of that plutonium to uranium fuel used in light-water reactors (1 percent of the fissile material by mass). As a first step, this option for WPu disposal could be tried at one of Russia’s VVER reactors as part of a joint Russian-U.S. R&D project. If the trial is successful the technology can be used for U.S. reactors and perhaps other Western-designed reactors in other countries.

7. Step up R&D cooperation between Rosatom and the U.S. Department of Energy, and flesh out the bilateral Agreement on Cooperation in Nuclear- and Energy-Related Scientific Research and Development signed in September 2013. The priorities of such cooperation could include fast reactors and managing spent nuclear fuel.

8. The taking of practical steps by Rosatom and the U.S. Department of Energy to stimulate bilateral cooperation in nuclear medicine. The top priority for such cooperation is stabilizing the global supply of the Mo-99 isotope, which is widely used in the diagnostics of cancer and heart disease. This would help to avoid a repeat of the 2010 crisis, when millions of patients could not undergo the required procedures because of a Mo-99 shortage. Such cooperation would also create commercial incentives for a transition to Mo-99 production technologies not requiring the use of HEU, when economically and technologically feasible.