

# HEU REMOVAL FROM POLAND

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## ABSTRACT

In September 2016 the final amount of highly enriched uranium (HEU) was removed from Poland. It was the 11<sup>th</sup> shipment from two Polish research reactors (Ewa – decommissioned, Maria – operational). Total amount of HEU removed from Poland was over 700 kilograms (1,500 pounds) – the largest amount of HEU material to be shipped from any participating country in the Russian-origin Remove Program. Unlike the previous shipments of spent HEU fuel from Poland, which were done by sea to the Russian port of Murmansk, the final shipment was conducted by air using the An-124 cargo plane. This shipment cleaned out all HEU from Poland, making it the 31<sup>st</sup> country to be HEU-free.

### 1. Introduction

In 1999 the U.S. Department of Energy together with the IAEA and Rosatom, Russian Federation agreed to start a new nuclear non-proliferation initiative to return the Russian/Soviet-origin highly enriched uranium (HEU) back to the country of origin. This initiative was based on the success of the Foreign Research Reactor Spent Nuclear Fuel Acceptance program, which removes eligible U.S.-origin research reactor fuel to the United States for management and disposition. Trilateral discussions among the U.S., the Russian Federation, and the IAEA

identified more than 20 research reactors in 17 countries (Belarus, Bulgaria, China, Czech Republic, DPRK, Egypt, Germany, Hungary, Kazakhstan, Latvia, Libya, Poland, Romania, Serbia, Ukraine, Uzbekistan, and Vietnam) that have Russian/Soviet-origin HEU. In 2000 the IAEA Director General sent a letter to 15 countries asking for their willingness to return spent HEU fuel to the Russian Federation. Fourteen countries responded positively to the Director General's letter.

The primary goal of the NNSA Russian Research Reactor Fuel Return (RRRFR) program is to advance nuclear nonproliferation objectives encouraging eligible countries to convert their research reactors from HEU to low-enriched uranium (LEU) fuel and to eliminate stockpiles of HEU.

In May 2004, the United States and the Russian Federation signed a Government-to-Government Agreement concerning cooperation for the transfer of Russian-produced research reactor nuclear fuel to the Russian Federation. This agreement established the legal framework necessary for cooperation between the United States and the Russian Federation for the return of Russian-supplied research/test reactor fuel from eligible countries.

To date, the RRRFR program has completed sixty three successful operations to repatriate to Russia almost 2,300 kg of Russian-origin HEU fresh and spent fuel. All Russian-origin HEU has been completely removed from 12 countries: Bulgaria, the Czech Republic, Hungary, Georgia, Latvia, Libya, Poland, Romania, Serbia, Ukraine, Uzbekistan, and Vietnam.

## **2. HEU Removal from Poland**

The largest amount of HEU under the RRRFR program was removed from two Polish research reactors: Ewa (shut-down) and Maria (operational, converted to LEU fuel). During ten years the RRRFR program conducted eleven shipments to return more than 700 kg of fresh and spent HEU back to the Russian Federation, which is enough material for 28 nuclear bombs.

The first shipment of fresh HEU was conducted in August 2006. In two days 39.8 kg of fresh HEU fuel were loaded into five TK-S15 transportation containers and shipped to Russia by air using the An-12 cargo plane.



Figure 1. Loading of HEU assembly into TK-S15

The removal of spent HEU fuel started in September 2009. In five shipments from September 2009 until September 2010, 454.9 kg of spent HEU were removed to Russia in complex operations. The spent fuel assemblies were loaded into spent fuel casks and shipped to the railroad station in Warsaw by trucks. At the railroad station the spent fuel casks were reloaded onto the railroad platform and shipped by rail to the Polish sea port of Gdynia. In Gdynia the spent fuel casks were loaded into a special vessel and then shipped by sea to the Russian port of Murmansk where they were reloaded on the railroad platform and shipped to the Mayak facility for final disposition. One shipment usually took about 6 weeks.

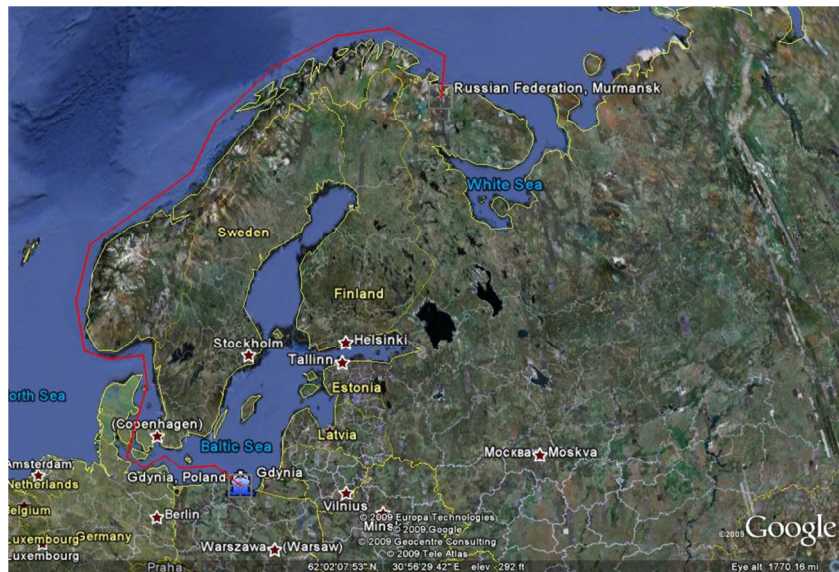
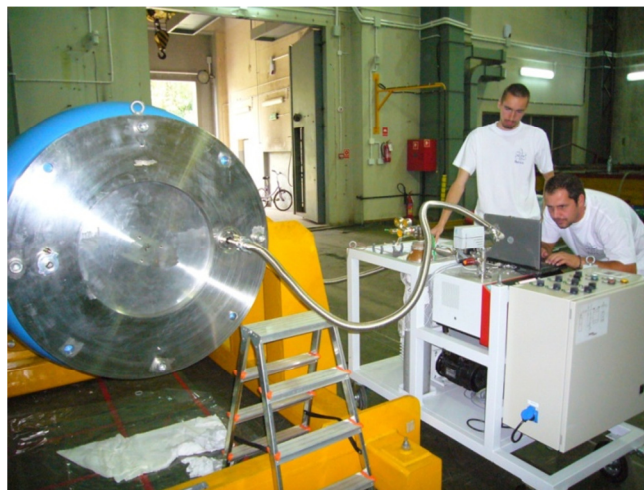


Figure 2. Transportation map

During the first spent fuel shipment, 856 WWR type fuel assemblies from Ewa research reactor were shipped to Russia using 16 Skoda VPVR/M transportation casks.



*Figure 3. VPVR/M cask drying/leak testing*

During the second shipment, 348 WWR type assemblies from Ewa reactor in 16 Skoda casks and 80 MR-6 type assemblies from Maria reactor in 20 TUK-19 casks were shipped to Russia. It was a unique shipment when Skoda and TUK-19 casks were used together for the first time. To make the reloading operation more efficient, all TUK-19 and Skoda casks were loaded into ISO containers.



*Figure 4. TUK-19 casks in ISO container*

During shipment #6 in August 2012, 60 MR-6 HEU fuel assemblies were shipped in 15 TUK-19 casks along with 90 EK-10 fuel assemblies in three Skoda VPVR/M casks.



*Figure 5. The train with spent HEU fuel at the Gdynia port*

The last shipment by truck-rail-sea-rail transportation mode from Poland to Russia was conducted in August 2014. During this shipment 44 MR-6 fuel assemblies were shipped to Russia in 11 TUK-19 casks using modernized vessel “Michael Dudin”.



*Figure 6. Loading of ISO containers with HEU fuel into vessel cargo hold*

In 2014 Maria research reactor was successfully converted to LEU fuel. The last HEU fuel was discharged from the reactor in August 2014 and after appropriate cooling time could be shipped back to Russia.

Transportation of the spent HEU fuel for long distance by truck, rail, and sea was not considered a viable option for safety and security reasons. In order to increase security during transportation of HEU for the last shipment of spent fuel assemblies from Poland to Russia, it was proposed to use an air shipment. Under the RRRFR program spent HEU fuel was first-time shipped by air from Romania to Russia in June 2009 using the TUK-19 cask. Then in December 2009, the spent HEU fuel assemblies were shipped from Libya to Russia, also by air using the same cask. And in 2014 spent fuel from WWR-K reactor in Kazakhstan was also shipped to Russia by air using the TUK-19 cask.

It took almost two years for the specialists from Russia and Poland to prove the safety of the air shipment of Maria spent fuel in the TUK-19 cask. In September 2016, 51 MR-6 fuel assemblies were loaded in 17 TUK-19 casks and then in ISO containers, and were shipped to the Gdansk International Airport. At the airport six ISO containers were loaded into the An-124 cargo plane and transported to Russia. The whole operation took less than two days.

This shipment cleaned out all HEU from Poland, making it the 31<sup>st</sup> country to be HEU-free.



*Figure 7. Loading of ISO containers with HEU fuel into An-124 cargo plane*

### **3. Conclusions**

The HEU removal from Poland was the largest removal operation conducted under the NNSA Russian Research Reactor Fuel Return program. During 10 years, more than 700 kg of fresh and spent HEU were shipped to Russia. In order to increase security during transportation, the last shipment of HEU from Poland was conducted by air which allowed to shorten the duration of transit from 6 weeks to two days.