

**RERTR 2019 – 40TH INTERNATIONAL MEETING ON
REDUCED ENRICHMENT FOR RESEARCH AND TEST REACTORS**

**OCTOBER 6-9, 2019
THE WESTIN ZAGREB
ZAGREB, CROATIA**

**History of the U.S. Origin Program
and its Current End State**

Jeffrey Galan and Glen L. Jackson
NA-23 - Office of Material Management and Minimization (M3)
Savannah River Site Bldg. 730-2B, Rm 325, Aiken, SC 29802 – USA

ABSTRACT

The United States (U.S.) Department of Energy (DOE), in consultation with the Department of State, adopted the *Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel* in May 1996 which created the Foreign Research Reactor Spent Nuclear Fuel Acceptance Program (Acceptance Program). The Acceptance Program, which expired on May 12, 2019, provided Foreign Research Reactors (FRRs) an opportunity to return spent nuclear fuel (SNF) to the United States.

The goal of the Acceptance Program was to repatriate certain U.S.-origin SNF and other weapons-grade nuclear material. Managed by the National Nuclear Security Administration's Office of Material Management and Minimization, the Acceptance Program was successful in reducing the amount of highly enriched uranium (HEU) in civil commerce by returning U.S.-origin SNF to the United States for secure storage, management, and disposition. This paper provides a history of the Acceptance Program, discusses program accomplishments, and current initiatives.

1 Introduction

Under the Atoms for Peace Program in the 1950s, enriched uranium was provided to partner countries and the International Atomic Energy Agency (IAEA) for use in research reactors to support a partner country's access to special nuclear materials without establishing uranium enrichment facilities of its own. These reactors are used for conducting research in agriculture, medicine, industrial, and other scientific areas. In return, starting in the late 1950s, the United States began accepting U.S.-origin irradiated research reactor fuel from partner countries to reduce the amount of highly enriched uranium in civil commerce to prevent possible diversion of nuclear material.

The National Nuclear Security Administration (NNSA) Office of Material Management and Minimization (M³) U.S.-Origin Nuclear Material Removal Program (Acceptance Program), also known as the Foreign Research Reactor Spent Nuclear Fuel Acceptance Program (Acceptance Program), was established by the Department of Energy (DOE) and the Department of State (DOS) in 1996 with the announcement of the Record of Decision (ROD) for the *Final Environmental Impact Statement on a Proposed Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel* (61 *Federal Register* 25092). The Acceptance Program supported permanent threat reduction through the elimination of stockpiles of excess weapons-usable nuclear materials located at civilian sites throughout the world.

This paper outlines the history, recent shipments, and continuing M³ efforts to advance the goals of the Acceptance Program.

2 History

2.1.1 Initial Off-site Fuels Policy

From the advent of the first nuclear weapons, U.S. Administrations recognized that preventing the further spread of nuclear weapons must be a fundamental national security and foreign policy objective of the United States. Consequently, beginning with the "Atoms for Peace" Program in the 1950s, the United States has provided peaceful nuclear technology to partner countries in exchange for their promise to forego development of nuclear weapons. As a result of the "Atoms for Peace" Program and a major revision of the Atomic Energy Act in 1954, which provided that foreign countries receiving nuclear assistance had to accept conditions on its use, the U.S. began accepting highly enriched uranium (HEU) spent nuclear fuel (SNF) from foreign research and test reactors (FRR) in 1958.

The transfer of enriched uranium from the United States to other nations under the "Atoms for Peace" Program was initially conducted through bilateral research agreements with each foreign research reactor. Before 1964, these agreements provided for the lease of the enriched uranium, with explicit provision for the return of the SNF to the United States. After 1964, most agreements provided for the sale of the material to the foreign research reactor who subsequently returned it to the U.S. for reprocessing under a program that became known as the Off-Site Fuels Policy. This policy was implemented through a series of Federal Register Notices and was incorporated into bilateral international agreements with recipient countries.

In response to increasing U.S. congressional and public concern about the potential diversion of HEU, the Department of Energy (DOE) initiated the Reduced Enrichment for Research and Test Reactors (RERTR) program in 1978. The RERTR program was aimed at reducing the use of HEU in civilian programs by promoting the conversion of foreign research reactors from HEU fuel to low enriched uranium (LEU) fuel. As a part of the RERTR program, DOE developed LEU fuels and worked with foreign research reactor operators to modify their reactors to run on the new fuels. The foreign research reactor operators who converted to LEU fuel did so in support of nuclear weapons nonproliferation objectives, even though the conversions could be expensive and sometimes affected the capabilities of the reactors.

From the beginning of the RERTR program, foreign research reactor operators indicated their willingness to convert their research reactors to LEU fuel was contingent upon the continued acceptance of SNF by DOE for disposition in the United States. In 1986, to further encourage foreign research reactor operators to convert to LEU fuel, the DOE Off-Site Fuels Policy was extended to include the acceptance of SNF containing LEU enriched in the United States. This policy expired on December 31, 1988 for HEU fuels and on December 31, 1992 for LEU fuels.

2.1.2 Spent Fuel Acceptance Policy

Several years of discussions about the renewal of the Offsite Fuels Policy ensued between DOE and partner governments. In July 1993, the Secretary of Energy directed DOE to prepare both an Environmental Assessment (EA) addressing short-term "urgent-relief" shipments from selected foreign research reactors and a full Environmental Impact Statement (EIS) addressing all qualified irradiated research reactor fuels and target material containing uranium of U.S. origin. The EA was completed in April 1994 and the EIS was completed in February 1996, *Final Environmental Impact Statement on a Proposed Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel (FRR SNF EIS DOE 1996)*.

The original Acceptance Program allowed irradiation of eligible materials for 10 years with an additional 3 year window for its return. Under the Acceptance Program, the United States accepted eligible spent fuel and target material containing uranium of U.S.-origin. DOE and DOS detailed the types of material accepted in the ROD published on May 19, 1996.

Significant amounts of HEU remained in civil commerce so in 2004 DOE and DOS extended the Acceptance Program for an additional 10 years for both irradiation and receipt. In 2009, the Acceptance Program was expanded to include non-U.S. origin uranium, and FRR SNF that DOE had not previously included. This expansion is referred to as the Gap Removal Program.

The first extension of the Acceptance Program officially concluded on May 12, 2016. The Acceptance Program allowed an additional 3-year window for transportation of SNF elements. The end of this shipping window was May 12, 2019 and the original Acceptance Program has ended.

2.2 Acceptance Program Accomplishments

The Acceptance Program, now in its twenty-third year, has successfully completed 212 shipments to date, safely and securely. Thirty-one (31) countries and Taiwan have participated, returning a total of 10,606 spent nuclear fuel elements to the U.S. for management at DOE sites in South Carolina and Idaho. Ten shipments consisted of Training, Research, Isotopes-General Atomics (TRIGA) type fuel went to Idaho National Laboratory (INL). The remaining shipments went to the Savannah River Site (SRS) in South Carolina. As of September 2019, M³ has removed or confirmed the disposition of over 7,166 kilograms of weapons-usable material, enough for approximately 321 nuclear weapons.

3 Recent Removals

3.1.1 Jamaica

In 2015 the Caribbean was made HEU free when the reactor core was removed from Jamaica's "Safe Low-Power Kritical Experiment" (SLOWPOKE-2) research reactor. The reactor, located at the University of the West Indies, International Centre for Environmental and Nuclear Science (ICENS) is primarily used for materials research which has informed environmental, agricultural and health related studies as well as mineral exploration, and contributed to increased food safety, food security and water and air quality in Jamaica. To ensure this important research continues, ICENS and the M³ Office of Conversion and Office of Nuclear Material Removal worked together to convert the reactor to run on LEU fuel.

3.1.2 Perú

In 2017 U.S.-origin LEU SNF was removed from the RP-10 reactor in Perú. The RP-10 reactor is operated by the Instituto Peruano de Energía Nuclear (IPEN) and was constructed primarily to support neutron radiography, neutron activation analysis, medical isotope production, and research. Removing the SNF allows IPEN to continue to provide these vital services for Perú and surrounding countries.

3.1.3 Greece/Portugal

In March 2019 U.S.-origin LEU SNF was received from Greece and Portugal in a joint shipment. The material in Greece was returned by The National Centre for Scientific Research, referred to as Demokritos, which operated the Greek Research Reactor (GRR-1). The material in Portugal was returned by The Instituto Superior Técnico in Portugal, which operated the Reactor Português de Investigação (RPI). Both reactors previously returned U.S.-origin HEU SNF. These are the final shipments of U.S.-origin SNF from these countries and the GRR-1 and RPI reactors are being permanently decommissioned.

3.1.4 Canada

Canada and the United States have an extensive history of cooperation in nonproliferation matters. Atomic Energy of Canada, Ltd. (AECL) and M³ are currently undertaking two large shipping campaigns to return U.S.-origin HEU contained in National Research Universal (NRU) reactor and National Research Experimental (NRX) reactor SNF as well as HEU contained in Target Residue Material generated during medical isotope production.

In April of 2019, the McMaster University Nuclear Reactor completed a LEU spent fuel shipment. This was the last return shipment under the original Acceptance Program.

3.1.5 Material Disposition

The DOE Office of Environmental Management is currently reviewing final disposition options for repatriated nuclear materials. M³ transports all aluminum clad spent fuel to DOE's SRS for

interim storage, while stainless steel-clad fuel, such as TRIGA fuel, is transported to INL. However, INL is currently unable to receive TRIGA fuel with the possibility that the prohibition will continue for the foreseeable future.

4 End State of the Acceptance Program

The Acceptance Program has achieved its goal of reducing the amount of HEU in civil commerce by returning U.S.-origin SNF and target material to the United States for secure storage, management, and disposition. Although the original Acceptance Program officially concluded in May of 2019, M³ remains committed to providing safe removal and disposition options to reactor operators or facilities with eligible HEU materials.

4.1 Policy on Exemptions

To demonstrate continued commitment to nonproliferation goals, the NNSA Administrator signed the Policy on Exemptions to the Acceptance Program ("Policy on Exemptions") on December 22, 2016. This extended a portion of the Acceptance Program through May 12, 2029. Proposed receipts will be considered on a case-by-case basis. NNSA will grant exemptions from the May 2019 end date only for cases where there is clear justification to do so. All other previously established Acceptance Program requirements continue to apply.

4.2 Exemption Criteria

The Policy on Exemptions provides three examples of factors NNSA will consider when deciding whether to grant an exemption:

1. An HEU research reactor is shutdown or converted to operate with LEU;
2. A clear nonproliferation justification exists, including the removal of a significant amount of HEU and/or separated plutonium from a nuclear facility; or
3. A facility meets the criteria of the Acceptance Program prior to the deadline in 2019 but is unable to complete the shipping campaign for reasons outside of its control.

NNSA will base the length of an exemption, if granted, on the commitment of the country involved to the goals of the Acceptance Program, technical issues related to any reactor conversion to LEU fuel or shutdown, and logistical issues such as transportation and U.S. storage availability. The exemption will be commensurate with the amount, purity, and vulnerability of the material involved. Options for ultimate disposition of the material will also be a factor in determining whether to grant an exemption. NNSA will consult closely with DOE's Office of Environmental Management, which manages FRR SNF storage facilities and other disposition capabilities at SRS and INL, when deciding whether to grant an exemption. NNSA will only grant exemptions for FRR SNF eligible for return under the Acceptance Program, including material described in the ROD for the *FRR SNF EIS* and the 2009 amended ROD for Gap Material-Spent Nuclear Fuel.

5 Conclusion

M³ remains committed to supporting U.S. and international nonproliferation goals while helping the world benefit from the safe use of modern nuclear technology. The M³ Nuclear Material Removal Program aims to accept all eligible HEU nuclear materials and strongly encourages reactor operators to work closely with technical points-of-contact. M³ supports the needs of the foreign research reactor community and is available to meet with interested parties to discuss disposition options.

6 References

- [1] Final Environmental Impact Statement on a Proposed Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel (61 Federal Register 25092).
- [2] J. E. Matos, “Relationship between the RERTR Program and U.S. Spent Fuel Acceptance Policy”, Proceedings from Waste Management Symposium, Tucson, Arizona, March 1-5, 1998.