

# **THE UNITED STATES FOREIGN RESEARCH REACTOR SPENT NUCLEAR FUEL ACCEPTANCE PROGRAM: PROGRAM CONTINUATION AND CURRENT INITIATIVES**

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## **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. The policy was slated to expire May 12, 2009. On October 15, 2003, a petition requesting a program extension was delivered to the United States Secretary of Energy by a group of research reactor operators from foreign countries. In April 2004, the Secretary directed DOE to undertake an analysis, as required by the National Environmental Policy Act, to consider potential extension of the Program and to re-organize the program under the DOE National Nuclear Security Administration's (NNSA's) new Office of Global Nuclear Material Threat Reduction. Subsequently, program management transitioned to NNSA and the program was extended for an additional 10 years. This paper provides a brief update on the program, discusses program transition to NNSA, the extension of the program, and the resulting direction and initiatives.

## **Introduction**

The United States 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 establishing the Foreign Research Reactor (FRR) Spent Nuclear Fuel (SNF) Acceptance Program. The FRR SNF Acceptance Program is a critical component of U.S. nonproliferation efforts. The primary objective of the program is to reduce, and eventually eliminate, highly-enriched uranium (HEU) of U.S. origin from civil commerce worldwide. Since 1996, the FRR SNF Acceptance Program has conducted 32 shipments involving 27 countries resulting in the safe return of 6,783 spent nuclear fuel elements to the U.S. for management at DOE sites in South Carolina and Idaho, pending final disposition in a geologic repository.

The program was initially scheduled to expire in May 2009. Although the Acceptance Program has demonstrated significant progress, participation and shipping rates have not met initial expectations. By 2004 and with less than two years remaining under the program's original policy period, DOE had received only about 35 percent of the material eligible for return as estimated in the *Final Environmental Impact Statement on a Proposed Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel* [1] (*FRR SNF EIS*).

Several factors have contributed to lower than expected receipts. Some countries have burned fuel less rapidly than was expected in 1996. In addition, FRRs in at least two countries decided to process their SNF at AREVA's COGEMA facility in France, and consequently are no longer planning to return their SNF to the U.S. under the FRR SNF Acceptance Program. These countries were expected to contribute a significant percentage of the fuel elements projected for acceptance by 2009. Further, as discussed below, delays have been experienced in the development of alternative low-enriched uranium fuels suitable for replacing HEU in the research reactors.

### Low-Enriched Uranium (LEU) Fuel Development

The development and qualification of LEU fuel that can be processed is important to ensure FRRs are able to continue reactor operation and ensure proper disposition of SNF. However, administrative and technical delays have been experienced in the development of an alternate "processable" LEU fuel.

The most predominant LEU fuel being used today is uranium-silicide LEU fuel developed in the 1980s by DOE. Although processing studies concluded that the uranium-silicide fuel could be successfully processed at the SRS, disposition through a repository was chosen in lieu of processing at the SRS unless the physical condition of the fuel warranted a more immediate disposition. To date, no SNF received from the FRR SNF Acceptance Program has been dispositioned by processing in the SRS H-Canyon Separation Facility. The United Kingdom Atomic Energy Agency (UKAEA) demonstrated in laboratory scale trials [2] that uranium-silicide LEU fuel could be processed at its facility in Dounreay, Scotland. However, the capital investment in new equipment required for large-scale processing operations was determined to be uneconomical, and the facility was shutdown in 1998. COGEMA in La Hague France is the only remaining major potential processing facility. COGEMA has not processed uranium-silicide fuel on a commercial scale, and the facility may also require additional equipment for efficient processing operations. However, COGEMA is now accepting a limited quantity of uranium-silicide LEU fuel for processing, and is investigating the possibility of increasing the quantity that could be accepted for processing [3]. Additional work is underway on other alternative LEU fuel options to ensure continued reactor operation and proper spent fuel disposition in the foreseeable future.

### **Proposal to Extend the Acceptance Program**

During the DOE-sponsored Reduced Enrichment for Research and Test Reactor (RERTR) Conference in October 2003, a group of reactor operators and supporters (40 petitioners from 17 countries) prepared and delivered a petition to the U.S. Secretary of Energy. The petition requested that DOE extend the FRR SNF Acceptance Program until new LEU fuels become available, allowing reactor operators to convert to a LEU fuel type that has an identified disposition path. On February 11, 2004, in a speech to the National Defense University, the President of the United States stated, "We will help nations end the use of weapons-grade uranium in research reactors." On April 14, 2004, the Secretary of Energy directed the DOE's National Nuclear Security Administration to consolidate the U.S. FRR SNF Acceptance Program within its nonproliferation mission, further directing the appropriate offices within DOE to

initiate actions necessary to extend the FRR SNF Acceptance Program's fuel acceptance deadline. Extending the Acceptance Program ensures a back-end solution is maintained while progress continues in elimination of HEU in research reactor fuels. Consolidation of the program under the National Nuclear Security Administration (NNSA) will be discussed later in this paper.

As a result of these actions, DOE evaluated the effects of extending the FRR SNF Acceptance Program and adding the Australian Replacement Research Reactor (RRR), later referred to as OPAL (Open-Pool Australian Lightwater reactor), documented in the *Supplement Analysis for the Foreign Research Reactor Spent Nuclear Fuel Acceptance Program* [4] in accordance with the National Environmental Policy Act (NEPA) regulations. DOE and the U.S. Department of State proposed to modify the FRR SNF Acceptance Program by:

- Extending the expiration date for irradiation of eligible spent fuel either 5 or 10 years, from May 12, 2006, to May 12, 2011, or May 12, 2016;
- Extending the acceptance date for eligible spent fuel either 5 or 10 years, from May 12, 2009, to May 12, 2014, or May 12, 2019; and
- Extending eligibility to Australia's RRR reactor for participation in the Acceptance Program.

The amount of potentially eligible SNF would remain the same as identified in the original EIS, about 22,700 elements or about 20 metric tonnes of heavy metal (MTHM). The proposed program extension would not change other requirements contained in the EIS assumptions and EIS Record of Decision. However, target material and damaged spent fuel would not be eligible for acceptance beyond 2009 under the proposed extension. Target material (fuel for isotope production such as Technicium-99) and damaged spent fuel currently can only be treated in H-Canyon at SRS, and DOE plans call for the SRS H-Canyon facilities to be maintained in operable condition only through 2010, pending a review of the facility and DOE's initiatives.

The Supplement Analysis determined that an extension of the FRR SNF Acceptance Program for 5 or 10 years and inclusion of the Australian RRR would not constitute a substantial change in action relevant to the environmental concerns. Therefore, additional NEPA documentation to the *FRR SNF EIS* was not required.

The Australian RRR was added to the Supplement Analysis and subsequent Record of Decision change to accommodate the unique situation encountered by the Australian Nuclear Science and Technology Organisation (ANSTO) as the HEU-fueled High Flux Australian Reactor (HIFAR) is replaced with the LEU-fueled RRR. Conversion from HEU fuel to LEU fuel is effectively occurring as the HEU-fueled HIFAR is shutdown and the LEU-fueled RRR is brought on-line. ANSTO has participated heavily in the development of high-density uranium-molybdenum LEU fuel, serving to benefit continued development of this fuel for other FRRs. Because the uranium-molybdenum LEU fuel will not be available in the timeframe required for commissioning of the RRR, the RRR is expected to operate for a limited period of time using uranium-silicide LEU fuel. Without confirmed processing options for all of this fuel, the Australian government has requested that the fuel be accepted under DOE's FRR SNF Acceptance Program until processable uranium-molybdenum fuel becomes available.

Following DOE's determination that additional NEPA documentation to the FRR SNF EIS was not required, DOE issued a change to the FRR SNF EIS Record of Decision. The change notice to the Record of Decision allows the program to be extended for an additional 10 years and includes the participation of the Australian RRR. The issuance of a change notice to the Record of Decision also allows DOE to proceed in the development of an implementation plan and guidance for the Acceptance Program extension.

Many currently participating FRR operators will not need to change their current shipping strategies and participation and shipping schedule will continue as currently planned. However, some FRR operators may need to change their participation schedule based on specific operational needs and requirements. It is not the intent of the FRR SNF Acceptance Program or the DOE to prevent or disrupt the needed operation of a research reactor. However, repatriation of HEU is a priority function of this program and DOE's nonproliferation mission. With close coordination with the RERTR program, the FRR SNF Acceptance Program intends to assist reactor operators in conversion to LEU fuels while providing an acceptable disposition path for SNF involving uranium that was enriched in the United States. Operational strategies will be evaluated on a case-by-case basis and will take into account new emphasis on accelerating the disposition of HEU material as well as the FRR SNF Acceptance Program initiatives to extend the acceptance period, particularly for disposition of LEU uranium-silicide fuel.

### **Transition of the FRR SNF Acceptance Program to DOE's National Nuclear Security Administration**

In May 2004, the FRR Acceptance Program was incorporated as a key partner in DOE's newly established Office of Global Threat Reduction (GTR) under the DOE's NNSA. The Office of GTR's mission is to:

- accelerate and complete the repatriation of all U.S.-origin research reactor spent fuel from locations around the world;
- work in partnership with Russia to repatriate Russian-origin fresh HEU fuel;
- work to convert the cores of civilian research reactors that use HEU to use low-enriched uranium fuel; and
- work to identify other nuclear and radiological materials and related equipment that are not yet covered by existing threat reduction efforts to facilitate security when in use, storage, and disposition.

Combining these programs and missions under the Office of GTR under NNSA increases the internal communication and cooperation in achieving common interest goals and missions. The FRR SNF Acceptance Program partners closely with the RERTR Program to assist a reactor operator in conversion of their reactor and subsequently shipping their eligible SNF to the United States.

### **Office of GTR Initiatives**

The Office of GTR is developing initiatives to improve overall program implementation and performance and is continually investigating other opportunities to enhance achievement of nonproliferation goals.

### Receipt Facility Improvements

The FRR SNF Acceptance Program is improving spent nuclear fuel receipt capabilities at SRS to allow more shipment capability. The L-Area Storage Facility at SRS is being modified for the receipt of tubular type material test reactor (MTR) fuel in a NAC-LWT transport package (work is scheduled to be completed in early 2006). Other modifications have been made to DOE's receiving facilities to improve receipt capabilities, the latest modification in L-Area continue DOE's efforts to ensure versatility in U.S. capabilities to receive FRR SNF Acceptance Program fuel.

### Program Acceleration

The FRR SNF Acceptance Program is attempting to accelerate the program to the extent possible. Particular concentration is directed toward the repatriation of HEU fuel. The Office of GTR is evaluating all potential participants working in conjunction with all available programs that may be used to benefit the FRR operator while meeting the individual program's mission. For example, the FRR SNF Acceptance Program is coordinating closely with the RERTR Program to establish a single major project to provide conversion, fuel fabrication, and shipping assistance enabling joint assistance for the overall project. This overall project package is expected to provide a more integrated approach as well as combining efforts and minimizing overall costs to the reactor operator and DOE.

### Fee Policy Update

The FRR SNF Acceptance Program is developing a revision to the program's fee policy charged for FRRs in countries with high income economies as identified in the current World Bank. There has been no change in the DOE management fee since the initiation of the program provided in the U.S. Federal register Notice on the *Establishment of the Fee Policy for Acceptance of Foreign Research reactor Spent Nuclear Fuel* [5]. The fee was established in part no higher than \$4,500 per kilogram of total mass for aluminum-based spent fuel containing HEU and TRIGA (Training, Research, Isotope, General Atomics) spent fuel, and no higher than \$3,750 per kilogram of total mass for aluminum-based spent fuel containing LEU. A subsequent notice regarding handling of fees for FRRs in other-than-high income economies and the transition from an other-than-high income economy status to a high-income economy status in accordance with the World Bank or vice-versa was issued in the *Office of Environmental Management - Foreign Research Reactor Spent Nuclear Fuel Fee Policy* [6].

At the time of the 2005 International RERTR Meeting, DOE is developing the fee policy revision and conceptual plans have not yet been validated. FRR operators and other affected organizations are strongly encouraged to provide feedback on the proposed fee policy. The current basis of the fee policy change is conceptual in nature and is intended to provide an incentive for the FRR to establish a firm shipping schedule as well as provide a firm planning

basis for the allocation of DOE resources needed to support receipt of the SNF. For FRRs that can commit to a specific DOE approved shipping schedule, DOE acceptance fees will not change. For FRR operators that cannot commit to a specific schedule at this time, or are currently not program participants, fees will modestly increase based on inflation from 1996 to 2002. FRRs missing this opportunity to lock in lower fees will have another chance in 2009, at which time another incremental adjustment is planned based on inflation to 2007.

Detailed shipment scheduling is most important in the two years preceding a shipment. Therefore, the requirement for a detailed schedule is expected to ensure that the FRR identifies the shipment month for shipments within the next two U.S. Fiscal Years (01 October through 30 September), including the number of SNF assemblies. Out-year schedules may require only the estimated number of SNF assemblies in a particular year. For example, shipments initially requiring detailed scheduling will consist of any shipment planned by the end of the U.S. Fiscal Year 2007 (30 September 2007). Prior to 01 October 2006 (the beginning of Fiscal Year 2007), a detailed schedule must be in place for shipments to be conducted through the end of Fiscal Year 2008, and so on.

## **CONCLUSION**

The United States remains committed to supporting worldwide nonproliferation goals, including those for which the FRR SNF Acceptance Program was designed, and accepting eligible fuel now rather than later remains a primary focus. The DOE actively seeks to work with all remaining eligible research reactors to plan for shipments of eligible spent fuel, and continues to support research reactor operators' needs and shared nonproliferation goals. We welcome your feedback and look forward to continued interactions with interested parties to further discuss the program and participation options.

## **References**

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[3] Auziere, P., 2004, "UMo Spent Fuel Acceptance Treatment at La Hague Plant." Transactions of the 8<sup>th</sup> Topical Meeting on Research Reactor Fuel Management, Munich, Germany, March 21-24, p. 131, COGEMA, La Hague, France.

[4] Department of Energy, Supplement Analysis for the Foreign Research Reactor Spent Nuclear Fuel Acceptance Program, DOE/EIS-0218-SA-3, November 2004

[5] U. S. Federal Register Notice, Vol 61, No 103, Tuesday, May 28, 1996, Page 26507-26508, Establishment of the Fee Policy for Acceptance of Foreign Research Reactor Spent Nuclear Fuel

[6] U. S. Federal Register Notice, Vol 64, No 70, Tuesday, April 13, 1999, Page 18006-18007, Office of Environmental Management - Foreign Research Reactor Spent Nuclear Fuel Fee Policy