

THE UNITED STATES FOREIGN RESEARCH REACTOR SPENT NUCLEAR FUEL ACCEPTANCE PROGRAM: PROPOSAL TO MODIFY THE PROGRAM

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ABSTRACT

The United States Department of Energy (DOE), in consultation with the Department of State (DOS), adopted the *Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel* in May 1996. The policy was slated to expire in May 2009. However, in October 2003, a petition requesting a program extension was delivered to the United States Secretary of Energy from a group of research reactor operators from foreign countries. In April 2004, the Secretary directed DOE undertake an analysis, as required by the National Environmental Policy Act (NEPA), to consider potential extension of the Program. On December 1, 2004, a Federal Register Notice was issued approving the program extension. This paper discusses the findings from the NEPA analysis and the potential changes in the program that may result from implementation of the proposed changes.

1. Introduction

DOE, in consultation with the Department of State (DOS), adopted the Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel in May 1996. The program was scheduled to expire in May 2009. The Foreign Research Reactor (FRR) Spent Nuclear Fuel (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 nuclear applications worldwide. Since 1996, the Acceptance Program has conducted 31 shipments involving 27 countries in the safe return of 6,445 spent nuclear fuel elements to the United States for management at Department of Energy (DOE) sites in South Carolina and Idaho, pending final disposition in a geologic repository.

2. Global Threat Reduction Initiative

In May 2004, the FRR SNF Acceptance Program was incorporated as a key element in DOE's newly established Global Threat Reduction Initiative (GTRI). GTRI's mission is to identify, secure, remove or facilitate the disposition of vulnerable, high-risk nuclear and other radiological materials around the world --as quickly and expeditiously as possible--that pose a threat to the United States and the international community. GTRI objectives include to:

- accelerate and complete the repatriation of U.S.-origin research reactor spent HEU fuel from locations around the world;
- work in partnership with Russia to repatriate Russian-origin HEU fuel from Russian-supplied research reactors;
- work to convert the cores of civilian research reactors that use HEU to use low-enriched uranium (LEU) fuel; and
- work to identify other nuclear and radiological materials and related equipment that are not yet covered by existing threat reduction efforts and rapidly address the most vulnerable facilities.

The National Nuclear Security Administration (NNSA) has made remarkable progress since this new initiative was launched last year. Representatives from approximately 100 countries attended the successful Global Threat Reduction Initiative International Partners' Conference last September. In addition, under GTRI and the Russian Research Reactor Fuel Return program, NNSA has worked closely with the IAEA, the Russian Federation, and other countries to repatriate fresh HEU from Uzbekistan and the Czech Republic to Russia over the past 6 months. More than 10 other joint projects under GTRI are in the planning stages.

Although the Acceptance Program has demonstrated significant progress, participation and shipping rates have not met initial expectations. As of the beginning of FY2005, 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. Several countries have burned fuel less rapidly than was expected in 1996. In addition, two countries (Belgium and France) decided to process their SNF at the COGEMA facility in France, and consequently have not participated in the program. These two countries were expected to contribute a significant percentage of the fuel elements projected for acceptance by 2009. However, it is deemed appropriate and acceptable to process SNF to LEU material. Finally, as discussed below, delays have been experienced in the development of alternative fuels. Under the GTRI, NNSA is working to overcome these obstacles by accelerating the development of higher-density LEU fuels, and accelerating the return of eligible U.S.-origin HEU spent nuclear fuel from research reactors.

3. Low-Enriched Uranium (LEU) fuel development

The international community has experienced technical delays in the development of an alternate "processable" LEU fuel. The development and qualification of LEU fuel that can be processed is important to ensure FRRs are able to continue reactor operation in the foreseeable future and ensure proper disposition of SNF. Extending the Acceptance Program ensures a backend solution is maintained while progress continues in eliminating HEU in research reactor fuels.

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 Savannah River Site (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 would 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].

4. Proposal to modify the acceptance program

During the DOE-sponsored Reduced Enrichment for Research and Test Reactors (RERTR) Conference in Chicago 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 (NNSA) 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.

As a result of these actions, DOE conducted an evaluation on the effects of extending the FRR SNF Acceptance Program and adding the Open Pool Australian Lightwater (OPAL) Reactor (formerly referred to as the Australian Replacement Research 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 Replacement Research Reactor (RRR) for participation in the Acceptance Program.

The amount of 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 (fuel for isotope production such as Technetium-99) and damaged spent fuel currently can only be treated in H-Canyon at SRS. Current DOE plans call for the SRS H-Canyon facilities to be maintained in operable condition through 2010 pending a review of the facility and DOE’s initiatives. Therefore, target material and damaged spent fuel would not be eligible for acceptance beyond 2009 under the proposed extension.

5. Analysis of the proposed action

The Supplement Analysis discusses the impact of the proposed action on the shipment schedule projected and analyzed in the FRR SNF EIS, and compares the likely effects that the proposed action would have on environmental resources to those analyzed in the EIS. The comparison focuses primarily on the radiological effects on human health and safety. Human health and safety is considered to be the most important resource, and radiological considerations are the most likely variables, to be affected by the proposed action. The Supplement Analysis also discusses the most significant assumptions used in the FRR SNF EIS to analyze the radiological effects on human health and safety, the conservatism of these assumptions based on experience gained from actual shipments to date, and assumptions that need to be changed because of the proposed action or because of new information available since the publication of the FRR SNF EIS in 1996. Key considerations evaluated in the Supplement Analysis include shipping schedules; normal and accident radiological consequences for marine, port, and ground transportation situations; and impacts to the management sites. A summary of these considerations is provided below:

Shipment schedule: The Supplement Analysis determined that shipment schedule projected over the extended period is expected to remain substantially lower than the constant shipping rate assumed in the FRR SNF EIS.

Normal and Accident Radiological Consequences: The Supplement Analysis discusses the conservatism built into the original EIS radiological impact analysis and analyzed changed assumptions and actual conditions since the EIS. The evaluation of the normal and accident radiological consequences included bounding SNF fission product activity, transport packages used in the program, projected change in population density over the extended period, actual

transport package external dose rate from experience derived since the program's inception, and the effect of receipt of the OPAL SNF. These factors were applied to analysis of marine transport, port activity, and ground transportation impacts. Accident and incident-free impacts of marine transport, port activity, and ground transportation activities were considered. The study found no significant increase in risk to marine shipping crews, port workers, or ground transportation workers as a result of the proposed program extension. The study found the proposed extension could increase the radiological risk to the general public near the port of entry or along ground transportation routes primarily due to population increases since 1996, but the risk remained within or slightly above the low risk calculated in the FRR SNF EIS.

Impacts at SRS and the Idaho National Engineering and Environmental Laboratory: The Supplement Analysis determined that the proposed extension would not impact the total quantity of candidate SNF and that the SNF mass and receipt schedules would remain within DOE site-specific limits. The study also determined that the risk to workers and the general public from the addition of the Australian's OPAL Reactor fuel assemblies would be too small to impact existing environmental impact calculations.

6. Conclusion

The Supplement Analysis determined that an extension of the FRR SNF Acceptance Program for 5 or 10 years and inclusion of the Australian's OPAL Reactor would not constitute a substantial change in action relevant to environmental concerns. Therefore, additional NEPA documentation to the FRR SNF EIS would not be required. The program extension was approved within DOE on November 23, 2004 and a formal issuance of an extension of the program occurred by the issuance of a Federal Register Notice [5] on December 1, 2004.

The OPAL Reactor was added to the Supplement Analysis and the subsequent Record of Decision changed to accommodate a unique situation encountered by the Australian Nuclear Science and Technology Organization (ANSTO) as the HEU-fueled High Flux Australian Reactor (HIFAR) is replaced with the LEU fueled OPAL. Conversion from HEU fuel to LEU fuel is effectively occurring as the HEU fueled HIFAR is shutdown and the LEU fueled OPAL 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 OPAL it 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.

Subsequent to DOE's determination that additional NEPA documentation to the FRR SNF EIS would not be 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's OPAL Reactor. The issuance of a change notice to the Record of Decision also allows DOE to proceed in development of an implementation plan and guidance for the Acceptance Program extension. This information will be shared with FRR participants and other interested parties.

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 GTRI mission to prevent or disrupt the needed operation of a research reactor. The 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. In accordance with the objectives of GTRI and the allowances provided in the FRR SNF Acceptance Program extension, it is expected that FRRs that are currently

using HEU fuel will convert to use LEU fuel as soon as possible with the understanding that SNF with uranium enriched in the United States can be dispositioned in the United States until May 13, 2019 provided the fuel is not irradiated after May 13, 2016. Operational strategies will be evaluated on a case-by-case basis based on these new considerations.

As a result of these new GTRI activities, DOE is evaluating the FRR SNF Acceptance Program Fee Policy to determine how to accelerate and solidify shipment schedules.

The United States remains committed to supporting worldwide nonproliferation goals such as those for which this program was designed. Accepting eligible fuel now rather than later remains a primary focus of that commitment. The United States hopes to work with all remaining eligible research reactors to plan for shipments of their eligible spent fuel, and DOE continues to support research reactor operators' needs and seeks to meet any interested parties to further discuss the program

7. References

[1] Department of Energy, Final Environmental Impact Statement on a Proposed Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel, DOE/EIS-0218F, February 1996

[2] Cartwright, P., 1996, "Reprocessing of LEU Silicide Fuel at Dounreay." Proceedings of the 19th International Meeting on Reduced Enrichment for Research and Test Reactors, Seoul, Korea, October 7-10, p. 418, United Kingdom Atomic Energy Agency, Dounreay, Scotland.

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

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

[5] Federal Register Notice, Volume 69, No 230, Wednesday, December 1, 2004, Pages 69901 – 69903, Revision of the Record of Decision for a Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel.