

Extending the Foreign Spent Fuel Acceptance Program: Policy and Implementation Issues

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ABSTRACT

The May 2006 expiration date of the Foreign Research Reactor Spent Nuclear Fuel (FRR SNF) Acceptance Program is fast approaching. In April 2004, Energy Secretary Spencer Abraham instructed the Energy Department to “initiate actions necessary to extend the fuel acceptance deadline.” However, extending the deadline may not be a simple task. The limits on the original program resulted from a delicate negotiation among many stakeholders. Any proposal to increase the duration and scope of the program will have to be considered in the context of DOE’s failure since 1996 to develop viable treatment, packaging and long-term disposal options for FRR SNF. It is also unclear whether accepting additional low-enriched uranium FRR SNF can be justified on security grounds. This paper will propose criteria for acceptance of spent fuel under an extension that are intended to minimize controversy and ensure consistency with a threat-based prioritization of homeland security expenditures.

1. Introduction

At the 25th annual Reduced Enrichment for Research and Test Reactors (RERTR) meeting in October 2003, a number of participants signed a petition to the US government requesting that the Foreign Research Reactor Spent Nuclear Fuel (FRR SNF) program be extended from its current deadline of May 2006. This request was prompted by the unexpected failure of high-density LEU uranium-molybdenum (U-Mo) dispersion fuel during irradiation tests. This setback has caused a significant delay in the development of LEU fuels that could be easily reprocessed, unlike the current generation of high-density fuels that are based on uranium silicide. Some reactor operators had hoped that U-Mo fuel would be available by the 2006 deadline, providing them with the option to ship their LEU spent fuel to a reprocessing plant once it was no longer possible to ship it to the United States for disposal. Those operators who had been counting on the reprocessing option to save them now risk being stranded without a SNF disposition path if the FRR SNF program is allowed to expire.

The Department of Energy (DOE) appeared to be sympathetic to this request, and in April 2004 Energy Secretary Spencer Abraham announced that “I have also instructed the appropriate offices within the Department to initiate actions necessary to extend the U.S. FRR SNF Acceptance Program’s fuel acceptance deadline, which will allow us to complete our work to return this U.S.-origin research reactor spent nuclear fuel.”² Secretary Abraham also announced at the time that NNSA was consolidating the FRR SNF program “within its nonproliferation mission,” that is, placing the program under the jurisdiction of the nonproliferation office of NNSA rather than DOE’s Office of Environmental Management (EM), which had previously overseen the program.

In addition to calls for extending the acceptance deadline, some observers have argued for expanding the program to include materials that are not currently included in its scope. These include experimental fuels containing US-origin HEU, and non-US origin HEU.³ Such an expansion would be consistent with the mission of the recently formed Global Threat Reduction Initiative to address all unsecured weapon-usable materials throughout the world, but would raise unique issues that would likely require additional environmental analyses under the National Environmental Policy Act (NEPA).

Any augmentation of the FRR SNF program, whether by extending the deadline, expanding the scope, or both, would pose both practical and policy challenges. Although the main US objectives of the FRR SNF program are (1) to retrieve US-origin HEU from foreign locations, and (2) to provide an incentive for research reactor operators to convert to LEU, an extension of the program deadline would paradoxically result in a large increase in the amount of LEU fuel to be returned to the United States from reactors that have already converted. While some LEU fuel from converted reactors was always included in the program --- in order not to discourage reactors from converting to LEU or to penalize those that already had --- the total quantity of LEU to be returned was limited by virtue of the finite duration of the program. An increase in this effective cap on LEU receipts could be unhelpful to the extent that it interferes with the prompt return of all US-origin HEU to the United States, for instance by using limited resources needed for HEU shipments, reinvigorating public opposition in the United States to spent fuel imports, or negatively affecting the safety of spent fuel storage operations at Savannah River Site (SRS) or Idaho National Laboratory (INL).

On the other hand, development of a more flexible policy would equip the United States with another tool to assist in its stated goal to “identify, secure, remove and/or facilitate the disposition of vulnerable nuclear and other radiological materials and equipment around the world --- as quickly and expeditiously as possible --- that pose a threat to the international community.”⁴ Thus it is certainly worthwhile to pursue changes in the policy, as NNSA has been doing since Secretary Abraham’s April announcement.

However, any changes must be fully consistent with Secretary Abraham’s instruction to NNSA “to develop a threat-based prioritization for materials to be shipped under the Acceptance program.” In addition, the new policy must be developed carefully and openly, with full involvement of all stakeholders, to avoid disrupting the delicate consensus in support of the current program that has allowed it to proceed with minimal public opposition. This would be accomplished most efficiently through the preparation of a supplement to the 1996 Final Environmental Impact Statement that would be made available for public comment, as required by law.

Given the complexities of the global situation, there is no need for NNSA to anticipate and solve every problem that may arise before it announces a new policy. However, individual requests for participation in the extended program must be evaluated on their merits in the context of a threat-based prioritization of the available resources. Thus, NNSA should reserve the right to reject any request for participation, even if it meets the criteria, if circumstances warrant such a rejection. Moreover, research reactor operators should expect that their inclusion in the extended program will be contingent upon their acceptance of additional obligations to help advance the cause of nonproliferation.

Energy Secretary Abraham has not yet made a decision on an extension of the FRR SNF acceptance program. However, some of the details of a draft Supplement Analysis prepared by DOE were outlined by Charles Messick of DOE during his presentation at the 26th RERTR International Meeting.⁵ According to this presentation, DOE proposes (1) to extend the acceptance period by ten years; (2) to require participants in the extended program to convert to LEU if they have not already done so; and (3) to accept during the extended period spent LEU fuel from the Australian Replacement Research Reactor (ARRR) slated to begin operating in 2006. DOE also concludes that these changes to the FRR SNF program do not warrant preparation of a supplement to the FRR SNF Final Environmental Impact Statement (FEIS). As the discussion below indicates, we find some aspects of this proposal to be attractive but believe that it requires further refinement.

2. A Threat-Based Prioritization

The fundamental goal underlying the 1996 FRR SNF acceptance policy was “to support the broad United States’ nuclear weapons nonproliferation policy calling for the reduction and eventual elimination of the use of highly enriched (weapons-grade) uranium in civil commerce worldwide.”⁶ This goal should continue to serve as the standard against which any proposed extension or expansion of the policy should be measured.

In developing a threat-based prioritization of materials to support an extended FRR SNF program, one possible classification is as follows, in descending order of priority:

- (a) Reactors that could fully convert to LEU with existing fuels but have not done so because they are waiting for reprocessable LEU fuel (e.g. KUR).
- (b) Reactors that cannot convert to LEU with existing fuels (e.g. BR-2).
- (c) Reactors that could convert to LEU with existing fuels but have not done so for other reasons (e.g. SAFARI).
- (d) Reactors that have converted to uranium silicide LEU fuel with the expectation that reprocessable fuels would be available by the acceptance program deadline (e.g. R2-0).
- (e) New reactors (e.g. RRR).

In considering the merits of including these reactor categories in an extension of the acceptance program, the United States should balance the desire not to penalize reactors that have participated in RERTR and converted to LEU against the need to encourage reactor operators to develop reliable arrangements for spent fuel disposition other than continued shipment to the United States.

Reactors in category (a) should be required to convert to LEU silicide fuel on an expedited schedule as a condition for acceptance in an extended program, since there would be little excuse for them not to do so. In addition, the United States should require enhanced physical protection measures for such reactors until they are successfully converted and all HEU has been removed.

Reactors in category (b) that request participation are near the top of the list, since the emphasis of the program is the retrieval of HEU. However, given that LEU fuels suitable for

this purpose may not be available for another decade, and that the post-9/11 terrorist threat is only likely to continue to increase over this time, the United States should encourage reactors in this category to consider shutdown as an alternative. In addition, the United States should require enhanced physical protection measures for such reactors. (The author is unaware of any eligible reactors in this category whose operators are likely to be interested in an extension of the US acceptance program.)

The United States should use participation in an extended acceptance program as an incentive to encourage reactors in category (c) to convert to LEU as soon as feasible. However, since many of these reactors were eligible for the original program yet did not commit to conversion, it is not clear that US acceptance of spent fuel under an extended program would provide sufficient incentive to convert.

For reactors in category (d), additional criteria should be considered. First, a distinction should be made between those reactors that are in imminent jeopardy of shutdown because of a lack of sufficient spent fuel storage capacity, and those that may have sufficient near-term capacity but are required to provide advance spent fuel management planning to regulatory authorities. Second, a distinction should be made between countries with and without an extensive nuclear power infrastructure.

Those reactors in imminent jeopardy of shutdown should be allowed to file “urgent relief” acceptance requests similar to those that took place during the period from 1988-1996 when the United States policy on off-site HEU fuel receipts had lapsed. The United States should give such requests favorable consideration.

However, it is more difficult for the United States to justify accepting spent fuel from reactors merely so that they will be able to comply with a regulatory requirement. It is unclear why the burden should be on the United States to modify its policies substantially to accommodate these reactors when their own national regulatory authorities appear unwilling to modify their policies. Similarly, it is hard to understand why countries with extensive nuclear power infrastructures, in some cases including interim storage facilities for power reactor spent fuel and high-level radioactive waste, cannot find domestic solutions for managing the spent fuel from their research reactors. These reactors should be given a low priority in an extended acceptance program. However, if there is a credible threat that a reactor in this category may convert back to HEU fuel from LEU to facilitate spent fuel management, the United States should take that into account.

Reactors in category (e) are discussed below in section 5.

3. Policy Duration

In establishing the original 10-year duration of the acceptance policy, DOE argued that a 5-year extension would be “unlikely to provide sufficient time for the reactor operators to arrange for alternative spent fuel disposal mechanisms,” yet an indefinite extension “would be unlikely to provide sufficient incentive for other countries to proceed expeditiously with development of alternative arrangements for disposal not involving the United States.”⁷

The United States again faces the same dilemma in deciding on an appropriate duration for an extension of the policy. However, the difference today is that reactor operators have already had ten years to “proceed expeditiously with development of alternative arrangements.” For many operators, this meant focusing exclusively on the hope that U-Mo dispersion fuel would

be available in time, even though they surely must have been aware that the development and qualification process for experimental fuels is a risky endeavor and that extensive delays should be anticipated. The United States cannot always be relied on to come to the rescue of reactor operators who have made poor decisions. For this reason, a ten-year extension of the policy, as DOE is proposing, would seem to be too generous and could well lead to a repetition of the current situation ten years from now.

Instead, the program should be extended in three three-year intervals. Reactors operators should be put on notice that the acceptance policy is not going to be extended beyond nine years, and that they must develop other management options for the future.

After the first interval, the United States should assess the progress of operators in converting the remaining HEU-fueled reactors and in developing reliable alternative arrangements for spent fuel disposition. Only those who are determined to be making good-faith efforts in these two areas should be considered for participation during the next interval. This level of supervision should increase public confidence that an extension of the FRR SNF acceptance program will advance United States policy goals.

4. A Word on Radiological Threats

Some observers have argued that retrieval by the United States of LEU spent fuel from foreign research reactors has a direct security benefit in that the spent fuel could be stolen by terrorists and used in a radiological dispersal device (i.e., a “dirty bomb”). Given the low activity of much research reactor spent fuel, the difficulty of effective dispersal, and the vast array of unsecured radiological sources in the world, this does not seem to be a compelling argument.

However, there is one radiological threat that LEU research reactor fuel presents that merits consideration. The possibility that terrorists could construct a potent neutron source from a small quantity of LEU with U-235 concentrations in the 10 to 20% range, is of great concern. Such a device has the potential to cause many near-term casualties from acute neutron radiation exposure --- an outcome that “dirty bombs” are typically not able to achieve. This threat may warrant greater controls on LEU than are currently in place, and may provide another rationale for the United States to take back and secure LEU-based research reactor spent fuel.

5. NEPA Considerations For an Extended FRR SNF Program

It is essential for the future of the FRR SNF Program that DOE thoroughly assess both the nonproliferation implications and the environmental impacts of any contemplated extension by preparing a supplement to the FRR SNF Final Environmental Impact Statement (FEIS). This is because the current policy is the result of a delicate balancing act between the global security interests of the US government and the more parochial interests of stakeholders at the local level. The 1996 reinstatement of the FRR SNF program ultimately survived multiple lawsuits by the state of South Carolina because of the thoroughness and depth of the FRR SNF FEIS. In addition, the SNF acceptance program was not challenged in the courts by some national environmental groups because they came to agree that the nonproliferation benefits of a carefully constrained program outweighed the environmental risks associated with importing additional radioactive waste into the United States.

South Carolina, where the bulk of the returned material was to be received, sued DOE because it was opposed to the receipt of spent fuel for indefinite interim wet storage at SRS,

and argued that DOE had neither analyzed the environmental impacts of such storage nor presented a credible alternative. However, DOE was protected from this charge to some extent by its commitment in the 1996 Record of Decision (ROD) to “avoid indefinite storage of this spent nuclear fuel in a form that is unsuitable for disposal.” To this end, DOE further committed to “aggressively pursue one or more new [treatment or packaging] technologies that would put foreign research reactor spent fuel in a form or container that is eligible for direct disposal in a geologic repository.” (This decision itself was an attempt to find a compromise between South Carolina representatives, who favored conventional reprocessing of FRR SNF in one of the SRS canyons, and some national nonproliferation groups who favored a non-reprocessing alternative that did not raise the safeguards concerns associated with production of separated HEU.) While the FEIS evaluated wet storage of FRR SNF at SRS for up to 40 years, the ROD can be read as a reasonably firm commitment to aggressively move from wet to dry storage within a few years.

Subsequently, in DOE’s 2000 ROD on SRS SNF Management, DOE decided to implement a technology known as “melt-and-dilute” to manage most of the aluminum-clad SNF at SRS, from both foreign and domestic sources. This non-aqueous process would convert HEU SNF to LEU metallic ingots without separating HEU from fission products, thereby reducing the safeguards and security burden posed by HEU SNF in interim storage prior to disposition in a repository.

NNSA’s current proposal to amend the 1996 FRR SNF ROD has the potential to upset the consensus that allowed the program to go forward with little objection from national environmental groups. Stakeholders who tolerated the import of HEU FRR SNF may feel differently about the import of additional quantities of LEU SNF, which would not have a direct nonproliferation benefit.

But an even greater risk may result from the possibility that revisiting the FRR SNF ROD will focus attention on DOE’s utter failure to fulfill its legal commitments to “aggressively pursue” and implement a new processing technology --- namely, melt-and-dilute. Although the melt-and-dilute program was progressing on schedule and under budget to a demonstration at an experimental facility at L-Reactor, DOE abruptly cancelled the program in 2002 without proposing an alternative. While DOE maintains that it is giving serious consideration to direct disposal of RR SNF in a geologic repository, it has not made a decision, and does not appear to be aggressively pursuing development of an appropriate packaging technology, as it was required to do under the 1996 ROD. Moreover, the recent D.C. Court of Appeals ruling ordering the Environmental Protection Agency to develop new safety standards for the proposed Yucca Mountain repository calls into doubt any RR SNF management alternative that anticipates shipments of spent fuel to Yucca Mountain will occur within a predictable time frame.

Under DOE’s NEPA implementing regulations, a supplement to a Final Environmental Impact Statement (EIS) is required if “the agency makes substantial changes to the proposed action that are relevant to environmental concerns, or if “there are significant new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts.” In order to evaluate whether a particular change to a program meets this standard, DOE must perform a Supplement Analysis. According to Charles Messick’s presentation at the 26th RERTR meeting, DOE’s draft Supplement Analysis concludes that a supplement to the FEIS is not necessary for an extension of the FRR SNF program along the lines that DOE is proposing.

However, even if the environmental impacts of the proposed extension are bounded by the impacts of the program evaluated in the FRR SNF EIS, there are clearly aspects of an extended program that constitute “significant new circumstances or information relevant to environmental concerns.” Perhaps most important is the changed context for long-term SNF management at SRS since the FRR SNF ROD was issued, due both to the failure of DOE to implement a new treatment or packaging technology for the FRR SNF returned during the current policy period, and to the greatly diminished prospects for the Yucca Mountain repository and geologic disposal within the United States in general. Both these considerations appear to be relevant to DOE’s commitment to avoid “indefinite storage of this spent nuclear fuel in a form that is unsuitable for disposal.”

In addition, at least one proposed expansion of the policy appears to directly conflict with the criteria in the FRR SNF ROD and would appear to warrant the performance of a supplemental EIS. The FRR SNF ROD explicitly states that “spent nuclear fuel (HEU and/or LEU) would not be accepted from new research reactors starting operation after the date of implementation of the policy.” It is clear that this language would exclude acceptance of the LEU silicide fuel from the Australian Replacement Research Reactor (ARR), which by current estimates will not be fully operational until June 2006. While one may split hairs as to whether or not the word “operation” in the ROD means “full-scale operation,” the intent of this restriction was plainly meant to discourage new research reactors from starting up with the expectation that the United States would take their spent fuel off their hands.

It seems, however, that Australia has undertaken construction of the ARR with exactly such an expectation in mind. The reactor, which was designed to use LEU silicide fuel, apparently has no spent fuel management option available to it other than participation in an extended FRR SNF program, and no plan for spent fuel management even after an extension would expire. But the fact that this is a new reactor, designed and constructed at a time when the limitations and uncertainties of research reactor SNF management were well-known, raises the question as to why the designers did not provide adequate long-term SNF storage capacity as a contingency. In any event, even if U-Mo dispersion fuel were available on schedule and could be reprocessed overseas, Australia would still have to develop a domestic high-level waste disposal capability for the returned high-level reprocessing waste. In fact, because some HEU spent fuel from the HIFAR reactor has been sent to Europe for reprocessing, Australia already is in the position of having to develop such a waste disposal capability.

Acceptance of ARR LEU SNF by the United States under an extended program would merely reward Australia for poor spent fuel management planning, and would be far removed from the initial policy goal of supporting “a U.S. nuclear weapons nonproliferation policy that seeks to reduce, and eventually eliminate, the use of highly enriched ... uranium in civil programs worldwide.” For that reason alone, preparation of a supplement to the FRR SNF FEIS is clearly warranted.

6. Conclusions

A limited extension of the FRR SNF program is justified for some research reactors. However, the extension should be carefully crafted to ensure that it is consistent with the nonproliferation goals of the program and limits environmental impacts in the United States to an acceptable level. To maximize the likelihood of public acceptance, DOE should prepare a supplement to the FRR SNF FEIS and fully address the public comment it receives.

And to avoid the potential for legal action, DOE should begin now to seriously address the long-term management of FRR SNF, as it is legally obligated to do.

References

¹ E-mail: elyman@ucsusa.org.

² US DOE, "Department Refocuses Threat Reduction Efforts to Return Nuclear Research Reactor Fuel," press release, April 14, 2004.

³ J. Edlow and G. Gruber, "A Global Cleanout Project," 8th International Topical Meeting on Research Reactor Fuel Management, March 21-24, 2004, Munich, Germany.

⁴ Energy Secretary Spencer Abraham, remarks at the IAEA 48th General Conference, September 20, 2004.

⁵ Charles Messick et al., "The United States Foreign Research Reactor Spent Nuclear Fuel Acceptance Program: Current Progress," this conference.

⁶ US Department of Energy, *Record of Decision for the Final Environmental Impact Statement on a Proposed Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel*, May 17, 1996.

⁷ Ibid.