

STATUS OF THE FOREIGN RESEARCH REACTOR SPENT NUCLEAR FUEL PROGRAM

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ABSTRACT

The second year of implementation of the foreign research reactor spent nuclear fuel acceptance program has been marked by significant accomplishments and achievements in supporting nuclear nonproliferation objectives. In July 1998, the Department of Energy completed its first west coast shipment of spent nuclear fuel to the Idaho National Engineering and Environmental Laboratory via the Concord Naval Weapons Station in California. This shipment, which consisted of three casks of spent nuclear fuel from two research reactors in the Republic of Korea, presented some significant technical, legal and political challenges in the United States and abroad. Lessons learned are being used in the planning and execution of our next significant milestone, the first cross country shipment of foreign research reactor spent nuclear fuel from the Charleston Naval Weapons Station in South Carolina via the Savannah River Site to the Idaho National Engineering and Environmental Laboratory (INEEL). This shipment will include transit across the United States for over 2,000 miles by truck transport. Other challenges facing the program include: resolution of issues associated with cask certification and the specific types and conditions of spent fuel proposed for transport; revisions to standard contract language in order to more clearly address unique shipping situations; and prioritization and scheduling of shipments to most effectively implement the program. As of this meeting, eight shipments, consisting of nearly 2,000 spent fuel elements from fifteen countries, have been successfully completed, and two more shipments consisting of over 460 spent fuel elements from seven countries will be completed in the near future. With the continued cooperation of State and local governments, tribal organizations, other federal agencies and the international research reactor community, we are committed to building on this success in the remaining years of the program.

INTRODUCTION

As the program nears the one-quarter completion point in the thirteen-year policy, planning activities for the third major implementation component are in full swing. The first two major components were completion of the first shipment to the Savannah River Site via the Charleston Naval Weapons Station in September 1996 and completion of the first west-coast shipment via the Concord Naval Weapons Station to the Idaho National Engineering and Environmental Laboratory in July 1998. So now, planning and preparatory activities are underway for completion of the first cross-country shipment from South Carolina to Idaho later this summer.

Additionally, several initiatives and efforts to continue the programs successes are ongoing: development of an analysis methodology to assess suitability of transportation casks for corroded spent fuel, clarification of the program policy regarding value or credit for unburned uranium,

and supplement analyses to allow more effective scheduling and transport operations. To date, eight shipments, consisting of nearly 2,000 spent fuel assemblies from fifteen countries, have been successfully completed. With the continued cooperation of the international research reactor community, we are committed to building on this success in the remaining years of the program.

PAPER

This paper describes the recent challenges and advances in the program, and discusses the Department of Energy's efforts to build on the success of the United States foreign research reactor spent nuclear fuel acceptance program.

The second year of implementation of the foreign research reactor (FRR) spent nuclear fuel (SNF) acceptance program was marked by significant challenges and achievements. The program continues to make progress toward reducing the amount of highly enriched uranium (HEU) in international civil commerce. The eight shipments successfully completed thus far represent nearly 2,000 spent fuel assemblies from fifteen countries. Contained in these spent fuel assemblies are more than 340 kilogram of weapons useable uranium, enough for nearly fourteen crude nuclear weapons.

One of the biggest achievements of the program took place in July 1998, when the Department of Energy, with help from States, tribes and other federal agencies, successfully completed the first west-coast shipment of foreign research reactor spent nuclear fuel. The shipment of Training, Research, Isotope, General Atomics (TRIGA) spent nuclear fuel originated at two storage facilities in the cities of Taejon and Seoul in the Republic of Korea (South Korea). The shipment arrived in the United States via the Concord Naval Weapons Station in California, and concluded at the Department of Energy's Spent Fuel Storage Facility at Idaho National Engineering and Environmental Laboratory (INEEL). This shipment of 299 TRIGA spent fuel rods arrived safely at INEEL on July 23, 1998, overcoming significant legal, political, and technical challenges both in the United States and abroad. The first challenge the Department of Energy overcame was a legal issue raised by local jurisdictions in the State of California. Contra Costa County and the City of Concord challenged the selection of the Concord Naval Weapons Station as the west-coast port-of-entry for the receipt of foreign spent nuclear fuel. The U.S. District Court ruled in the Department's favor on March 18, 1998, confirming that the Department's port selection was in compliance with all applicable environmental requirements and regulations.

Politically, the Department of Energy encountered challenges both domestically and internationally. Considerable political unrest in Indonesia during the time shipment operations were scheduled resulted in a decision by the Department of Energy, in consultation with the Department of State, not to include spent nuclear fuel from TRIGA research reactors in Bandung and Yogyakarta, Indonesia in the July 1998 west-coast shipment. We have a continuing dialogue with reactor operators in Indonesia, and are preparing to complete a shipment of Material Test Reactor (MTR) spent fuel from a research reactor in Serpong. We are currently evaluating

options for transporting the TRIGA spent fuel from Yogyakarta and Bandung, Indonesia as part of a future shipment.

In the United States, concerns were raised during the planning process for the first west-coast shipment by State and local elected officials, as well as members of the public, regarding the safe transport of spent nuclear fuel packages through local communities both at the port-of-entry (i.e. the San Francisco Bay Area) and along the transportation route to the INEEL. The Department worked closely with other federal agencies (the U.S. Nuclear Regulatory Commission (NRC), the U.S. Coast Guard and the Federal Railroad Administration in the Department of Transportation, the U.S. Navy, and the Federal Bureau of Investigation) and Tribal, State and local governments to address these concerns and to prepare for the rail transport of spent nuclear fuel from central California to southeastern Idaho. States agencies and Tribal government officials along the transportation corridor lent their expertise to the planning process. As part of the pre-shipment preparations, the Department of Energy provided radiation monitoring equipment to emergency responders along the transportation route, trained over 3,000 emergency personnel to ensure they were prepared to respond in the highly unlikely event of a radiological incident, and completed thorough inspections of the rail, locomotives, railcars and shipping containers used for the shipment.

In addition to the political and logistical challenges presented by the first west-coast shipment, the Department has encountered several technical and regulatory issues that continue to require the coordination and cooperation of cask owners and research reactor operators. One of the technical challenges involves the completion of cask certifications and approvals by the U.S. Nuclear Regulatory Commission and the U.S. Department of Transportation. In the first year of the program, the Department did not expect cask certification and transportation regulations to prohibit the shipment of damaged spent fuel. However, in preparation for the shipment from South Korea in July 1998, issues arose associated with the degraded condition of some of the fuel. Specifically, it was determined that hermetically sealed cans should be used for a small quantity of the South Korean TRIGA spent fuel in order to ensure compliance with the cask certification special requirement for inner container packaging for plutonium in excess of 20 curies (10 CFR 71.63). Similarly, several other countries have identified fuel with severe corrosion resulting in exposed fuel matrix or 'meat'. This issue has raised questions from the United States Nuclear Regulatory Commission regarding whether or not the safety analysis documentation (specifically, the containment analysis) for the transportation casks considered the dispersal of the resulting oxide that would form on these areas of corrosion during transport. The identification of spent fuel in inventory that falls into this condition category resulted in delays to spent fuel shipments in 1998.

In order to ensure that the program is not constrained to the transport of spent fuel elements with nothing more than hairline cracks or pin hole leaks, the Department has worked closely with the United States Nuclear Regulatory Commission to develop a methodology[1] for consideration of this condition in safety analyses documentation for transportation casks certification. This methodology can and is now being used by cask vendors and regulatory authorities to determine how much damaged fuel can be transported in a particular cask design. Representatives from the Savannah River Site presented the methodology to cask vendors and foreign regulatory

authorities late last year in Washington DC, Germany, and France to encourage widespread and rapid implementation. The prompt incorporation of the results of this effort into safety analysis documentation will enable us to move forward in addressing this issue and will allow us to safely ship damaged fuel on current program schedules. Given our expectation that this issue will be resolved quickly, we have rescheduled shipments previously delayed because of this issue for this year.

To avoid future cask certification issues, we encourage reactor operators to identify to Department of Energy officials early in their planning processes any fuel conditions that may need to be addressed during cask certification and conduct early fuel inspections where appropriate. Cask certification for transporting damaged fuel may require the design and manufacture of new cans, sealed containers, new baskets and more detailed technical reviews as part of the U.S. Competent Authority Certification process. This process takes time and is critical to a successful safe shipment. Cask certification by the United States Nuclear Regulatory Commission take approximately six to nine months to complete. The United States Nuclear Regulatory Commission is committed to working with us and supporting this program, but we must work with reactor operators and shippers to provide adequate time for the United States Nuclear Regulatory Commission to complete their technical reviews and evaluations. We review cask certification status and issues with the United States Nuclear Regulatory Commission on a weekly basis.

All of the lessons learned from the first eight successful shipments under this program will be used in planning and executing our next significant program milestone, the cross-country transportation of FRR SNF. The United States will receive TRIGA spent fuel from research reactors in Europe via the Charleston Naval Weapons Station and then transport the fuel overland by truck in the United States for approximately 2,000 miles to INEEL. This first cross-country shipment is planned for the summer of 1999 and will consist of an estimated five casks of spent fuel from research reactors in Romania, Slovenia, Germany, and Italy. (see Table 1.) Contracts with reactor operators are currently being completed, and the domestic transportation planning effort began in late 1998. The transportation planning effort will continue for the next several months, concluding when the shipment is completed this summer. The Department of Energy is working with the Western Governor's Association, the Southern States Energy Board, the Council of State Governments-Midwestern Office and Tribal governments on the preparations for the cross-country transportation of the an estimated 830 rods of TRIGA spent fuel. Table 2. provides list of potentially impacted states and tribes. A Cross-Country Transportation Working Group has been formed to work with the Department of Energy as well as other federal agencies to conduct transportation planning, which includes routing, security and emergency preparedness. Additionally, safeguards and security, notifications, inspections, weather precautions, contingency planning, and safe havens are being addressed as part of the transportation planning process.

Table 1. TRIGA Spent Fuel in First Cross-Country FRR SNF Shipment

Country		Spent Fuel Rod SizeCladding	Location	Number of Rods
Romania	0.5 inch Diameter	Incoloy	Pitesti	400

Slovenia	1.5 inch Diameter	aluminum, and stainless steel	Ljubljana	128
Italy	1.5 inch Diameter		Rome	140
Germany	1.5 inch Diameter		Hannover	76

The first meeting of the Cross-Country Transportation Working Group was held to begin the transportation planning process. A draft transportation plan was introduced and Cross-Country Transportation Working Group members input and comments were solicited. Breakout sessions were held to give States and tribes an opportunity to discuss issues concerning transportation, safeguards and security, and emergency preparedness. Proposed transportation routes were introduced and are currently under evaluation. The proposed routes are consistent and in compliance with the highway routing requirements in 49 CFR 397, and minimize transportation time and distance while also considering the accident rate history. In February of this year, a draft Transportation Plan was completed and States/Tribes began training as necessary. In March, a second, Cross-Country Transportation Working Group planning meeting will be held in Chicago, Illinois with a final meeting and table-top exercise meeting tentatively scheduled in May or June 1999.

At present the Department estimates about forty casks of TRIGA spent fuel from research reactors in Europe, Africa and South America will be received at the Charleston Naval Weapons Station for overland transport to INEEL over the remaining eleven years of the program. This represents about one to two shipments per year.

Table 2. Potentially Affected States and Tribes in First Cross-Country FRR SNF Shipment

Southern States Energy Board	Council of State Governments-Midwest	Western Governors Association	Tribes
			Northwestern Band of the Shoshoni Nation
Georgia	Iowa	Colorado	
Kentucky	Illinois	Idaho	
North Carolina	Indiana	Nebraska	Fort Hall Shoshone-Bannock
South Carolina	Kansas	Utah	
Tennessee	Missouri	Wyoming	

In addition to planning and executing shipments of spent nuclear fuel under the acceptance program over the past year, the Department of Energy also clarified its implementation of the acceptance policy in several important areas, and has addressed a number of implementation questions from reactor operators. One such example regards the types of fuel eligible for acceptance under the policy. It should be noted that the *Final Environmental Impact Statement on a Proposed Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel (DOE/EIS-0218, February 1996) (FEIS)* clearly defines the types of fuel eligible for shipment (TRIGA and aluminum-clad MTR fuels and target material containing U.S.-origin enriched uranium) and also specifically excludes fuel elements containing U.S.-origin

enriched uranium from other types of reactors (fast reactors, thermal research reactors, thermal homogeneous liquid and solid fueled reactors and other special purpose reactors). The spent fuel types excluded by the FEIS are fuels that were not eligible for acceptance by the United States under the previous "Off-Site Fuels Policy" which expired in 1988. The Department will continue to consistently implement this eligibility policy as described in the FEIS.

With spent fuel eligibility policy clearly established, the Department has addressed several questions during the past year regarding more precise spent fuel inventories at specific storage facilities. Since publishing the FEIS in February 1996, and in the course of implementing the policy, the Department has received more detailed information regarding exact locations and quantities of eligible spent fuel elements from research reactors which intend to ship fuel in the future. In some cases, spent fuel or target material eligible for acceptance under the policy has been identified in countries listed in the FEIS, but at eligible research reactors not specifically mentioned in the FEIS. Additionally, as we gather more detailed information from reactor operators on the exact spent fuel inventories in storage facilities that are available for a shipment, the estimates included in the FEIS are being refined. This past year, the Department completed an analysis to confirm that refinement of these estimates is within the potential impacts analyzed in the FEIS as long as the total number of elements shipped to the United States does not exceed the FEIS total estimate of 22,700 spent fuel elements in 837 shipping casks. As a result, we are working with reactor operators to ensure that all of their eligible spent fuel is considered in shipment planning. The current estimate of spent fuel expected to be transported to the United States is approximately 17,500 spent fuel elements in approximately 680 shipping casks.

In addition to more refined information on spent fuel inventories, the Department of Energy has obtained updated information on the inventory of spent fuel casks available to support the program. When the FEIS was prepared, eight casks on a vessel was assumed to be the maximum number of casks that would be available for any one shipment. This assumption was then incorporated into the assessment of potential environmental impacts. The worldwide supply of spent fuel casks has now increased such that more than eight casks could be made available for a single shipment. The Department has confirmed that increasing the number of casks per vessel from eight-per-ship up to sixteen-per-ship is within the bounds of the analysis presented in the FEIS and within all regulatory requirements. This policy change to sixteen casks-per-ship will enable both the Department and the reactor operators to be more efficient in their transportation and shipment planning and will help reduce the cost of transporting spent fuel to the United States.

The Department has also addressed other questions posed by the research reactor community concerning the Foreign Research Reactor Spent Nuclear Fuel program as they have arisen. Several reactor operators who have fuel eligible for acceptance have requested that the Department give "credit" for the value of the uranium in unirradiated fuel being shipped back to the United States. As is clearly stated in the FEIS and the Record of Decision [2], the Department treats unirradiated fuel and spent fuel for purposes of the acceptance program and does not give any value to this material. The Department of Energy is not accepting spent fuel from foreign research reactors in order to recover uranium, but is instead accepting the fuel as an important nuclear nonproliferation initiative to reduce the use of highly enriched uranium in civil

commerce worldwide. From the reactor community's viewpoint, we continue to strongly believe that this program offers significant economic advantages over other management and disposition options available to reactor operators. The United States has demonstrated its commitment to the program by subsidizing shipment from "other-than-high-income economy" countries and by charging fees that are less than full cost recover to "high-income economy" countries (i.e. the United States is not recovering enough in fees to cover the life cycle cost of spent fuel management). While implementation of the policy will cost U. S. taxpayers money, it is a cost that the Department believes fairly balances nuclear nonproliferation goals with fairness to taxpayers.

Finally, it is important to emphasize that the program will end on May 12, 2009. A great deal of spent fuel eligible for acceptance by the United States still remains in reactor facilities and is not yet scheduled for shipment to the United States. We continue to encourage all reactor operators who are eligible to decide as soon as possible to participate in the program. We look forward to learning the results of PETTEN's ongoing study on the conversion of their reactor and hope to work with them on a shipment in the near future, should they decide to convert to low enriched uranium bearing fuel. Additionally, we anticipate working more closely with several other countries which will make their first shipments under the policy this year.

It has become very clear over the past 2 ½ years that each country and each reactor present unique challenges. The ongoing success of the program shows the commitment and ability of the Department to resolve these challenges. We hope to continue to bring other eligible countries into the program and are interested in continuing dialogue on any and all aspects of the program with reactor operators. It has been another exciting and challenging year. We remain fully committed to the successful implementation of the Foreign Research Reactor Spent Nuclear Fuel Acceptance Program. The new Secretary of Energy, Bill Richardson, has given his full support to this important nuclear Nonproliferation initiative. We look forward to another successful year and the opportunity to continue working with reactor operators.

REFERENCES

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- II. Record of Decision for the final Environmental Impact statement of a Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel, May 1996, U.S. Department of Energy