RECENT EXPERIENCE IN PLANNING, PACKAGING, AND PREPARING NON-COMMERCIAL SPENT FUEL FOR SHIPMENT WITHIN THE UNITED STATES

P. E. Johnson
Oak Ridge National Laboratory
Oak Ridge, Tennessee 37831-6495
(423) 574-7450

L. B. Shappert
Oak Ridge National Laboratory
Oak Ridge, Tennessee 37831-6495
(423) 576-2066

D. W. Turner
Lockheed Martin Energy Systems
Oak Ridge, Tennessee 37831-6060
(423) 576-2017

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Oak Ridge, Tennessee 37831-6495
Managed by
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ABSTRACT

The U.S. Department of Energy - Headquarters (DOE-HQ) has issued a Record of Decision (ROD) which identified the plan to be followed in storing spent nuclear fuel belonging to the Department. As a result, the aluminum-clad fuels now stored at the Oak Ridge National Laboratory (ORNL) will be shipped to the Savannah River Site (SRS). A number of activities had to be carried out in order to ready the fuel for shipping, including choosing a cask capable of transporting the fuel, repackaging the fuel, developing a transportation plan, identifying the appropriate routes, and carrying out a readiness self-assessment. These tasks have been successfully completed and are discussed herein.

I. INTRODUCTION

The U.S. Department of Energy (DOE) is committed to the safe, efficient, and cost-effective transportation of all materials that support its various waste programs and activities. The Department strives to ensure that its radioactive materials, hazardous substances, and hazardous and mixed wastes are handled and transported in compliance with all applicable federal, state, tribal, and local rules and regulations. It does this through the development of a transportation plan, the application of a readiness assessment, an analysis of the routes to be used, and the use of proper equipment.

DOE Headquarters (DOE-HQ) has issued a Record of Decision (ROD) (60 FR 28680) on the DOE Programmatic SNF (Spent Nuclear Fuel) Management Environmental Impact Statement (DOE/EIS-0203-F, April 1995) which selected the alternative of regional storage of SNF by cladding type. This ROD has resulted in plans for DOE-owned, aluminum-clad SNF to be transferred to and stored at the Savannah River Site (SRS). Most of the other types of SNF will be transported to and stored at the Idaho National Engineering Laboratory (INEL).

The Oak Ridge National Laboratory (ORNL) has been a center of nuclear research for over 50 years. During this time, experiments have been carried out on a number of fuel types, including those whose cladding and internal structure were aluminum-based. The State of Tennessee has reviewed and commented on the ROD and has been supportive of ORNL's efforts in planning to ship the SNF covered by the ROD, thus removing from long-term storage the SNF no longer needed for research projects at ORNL.

Recently, ORNL committed to packaging and shipping to the SRS for disposition pieces of aluminum-clad SNF which had been used in a wide variety of research programs in the past and have been in storage since that time. The pieces in question contained both low-enriched and high-enriched fuel. The burnup of these pieces varied widely (some up to 75%), and most have been in storage from 10 to 20 years; consequently their radiation levels have decreased significantly. Much of
this fuel is small dimensionally and must be packaged to allow it to be handled efficiently. However, some fuel plates exist that are as much as 80 cm in length.

In the planning stage, a number of activities were carried out in parallel. One of the first activities that needed to be carried out was to determine if there was a shipping cask whose certificate permitted the shipment of this type of fuel and in the form in which it existed. A second activity was to get on the receiving schedule at the SRS. The third was to determine what routes between Oak Ridge, Tennessee, and the SRS met federal routing requirements, and the fourth activity was to interact with state authorities who will be involved with the shipments.

II. THE BMI-1 CASK

After examining and comparing a number of Certificates of Compliance, it was apparent that the BMI-1 cask was best suited to transport off-site the aluminum-clad SNF from dry storage at ORNL. The cask is approved for the type of aluminum-clad fuel that needs to be shipped, has adequate shielding, and has a cavity large enough to accept the fuel pieces. In addition, the cask belongs to the DOE and is used primarily to ship Materials Test Reactor (MTR)-type fuel from research reactors located at a number of universities around the United States to the SRS, which has scheduled a time window during which to accept the planned shipments. No operational problems are expected at SRS because the facility has had a great deal of experience in handling this cask in the past.

Operationally, the cask is considered a good match for the shipping needs of this SNF from ORNL. However, during the planning period, the cask came up for its annual inspection, which is required by its Safety Analysis Report for the Packaging (SARP). The cask cannot be used for off-site shipments unless the inspection is carried out in a timely fashion according to the requirements identified in the SARP. This inspection was performed by ORNL while the cask was there for practice loading and readiness preparations.

III. REPACKAGING

The fuel acceptance criteria from the SRS indicated that the fuel would have to be packaged for handling purposes. In addition, it became apparent that to transfer the fuel into and out of the cask, the fuel would also need to have certain handling characteristics which could be provided by canisters designed for the purpose. The canisters would have to be fabricated from aluminum and need to fit into a specially designed BMI-1 can, which, in turn, would be placed in the cask cavity.

The fuel pieces destined for the SRS had been stored in small containers in dry storage at ORNL. Some of the cans had been stored for more than 20 years, and the accuracy of the records that identified their contents was unknown. It was necessary that the storage cans be transferred to a hot cell, opened, the contents examined and then packaged in the appropriate canisters for shipping. Plans were for the fuel to be transferred to a second facility where the canisters could be loaded into the BMI-1 cask for off-site shipment.

Two levels of aluminum packaging were selected for use. The inner cans are used to contain the pieces for handling in the cell. The small cans have a capacity of about 400 cm³ and are equipped with a screw top. These cans could efficiently contain the small fuel pieces and were easy to handle individually in the hot cell; the filled cans could then be stacked in the aluminum canister that was designed for loading the SNF out of the hot cell. This aluminum canister was sized to fit in the on-site carrier, in the BMI-1 can, and in the planned storage location at the SRS. It was also designed with the appropriate lifting bail for underwater handling operations at the SRS.

The aluminum canisters are 12 cm in diameter, are 99 cm long, and are designed to be closed with a freeze plug. The freeze-plug closure was an attractive choice because the canister was not to be introduced into the cell, but to remain clean, outside, with the bottom of the canister butted up to the opening in the cell wall. In this condition, only the inside of the canister was exposed to the cell atmosphere. The bottom plug was placed into the cell and cooled with liquid nitrogen. Once the canister was loaded, the plug was removed from the coolant and placed into the bottom of the canister, where it expanded and sealed. This closure was tested and found to be gastight and capable of holding, a payload of over 450 kg, far exceeding the planned weight of SNF.

IV. TRANSPORTATION PLAN

For off-site shipments of SNF, a Transportation Plan is prepared by the traffic manager in cooperation with the organization originating the shipment. This plan is submitted to DOE for its review and approval.
The plan identifies responsibilities, requirements, and procedures to ensure the successful movement of SNF from ORNL in Oak Ridge, Tennessee, to the SRS in Aiken, South Carolina. The plan summarizes transportation activities, organizational responsibilities, and emergency preparedness guidelines and discusses the specific materials to be shipped, the proposed routes to be taken, a description of the shipping cask to be used, the communication plan, and a recovery plan in case of accidents.

V. ROUTING

The Transportation Routing Analysis Geographic Information System (TRAGIS) was used to examine routes for the transportation plan of ORNL aluminum-clad SNF to the SRS. TRAGIS was developed to provide DOE a user-friendly geographic information system (GIS) for road, rail, and waterway routing analysis efforts. This work has been sponsored by the DOE Transportation Management Division (EM-76).

The shipments of the BMI-1 cask from Oak Ridge to SRS must follow U.S. Department of Transportation (DOT) regulations for the shipment of radioactive materials. These regulations are specified in 49 CFR 397.101 and essentially state that highway-route-controlled quantities (HRCQs) of radioactive material must use the quickest route on Interstate highways; Interstate beltways around metropolitan areas, where such beltways exist; and state-designated preferred routes. Pickup and delivery locations normally are not on Interstate highways; for these cases, the shortest route to and from the nearest Interstate should be used. TRAGIS includes the capability to calculate such routes and to identify the expected time to travel each route. Another feature of TRAGIS is its capability to calculate alternative routes. In many instances, an alternative route may exist that does not involve a significant increase in both mileage and driving time. For the shipment of the aluminum-clad fuel to the SRS, two routes were determined to be feasible. The two routes will be discussed as Route A and Route B.

Route A is 362 miles long and has a travel time of nearly 7 h. This route proceeds from ORNL to I-40, heads east and uses the I-640 bypass around Knoxville, and then continues on I-40 into North Carolina. Near Asheville, the route changes to I-26 and proceeds into South Carolina. Near Columbia, the route changes to I-20 and continues southwestward to State Route 19 to access SRS.

Route B is 390 miles long and has a travel time of 7 h. The route proceeds from ORNL to access I-75 and then follows I-75 to the Atlanta area. I-285 is used around the northeastern portion of the Atlanta area and then the route follows I-20 through Georgia and into South Carolina. State Route 19 is used from I-20 to access SRS.

Both routes are very similar, but Route A is 28 miles shorter and would take approximately 10 min less to drive. Because Route A presents several potential problems, Route B is the preferred route. Potential problems along Route A include transport through a mountainous area of North Carolina, including tunnels. This portion of I-40 is currently undergoing numerous road maintenance projects which could result in major traffic delays. Because of this road work, the State of North Carolina has requested that the BMI-1 shipments use a different route. Route B will be used for the shipments. An exception will take place if shipments are to be made during the Olympic Games being held in Atlanta in July 1996. An agreement has been reached with the affected States that if the shipping occurs during the Olympic Games, Route A will be used in lieu of Route B.

VI. READINESS SELF-ASSESSMENT

Because of the complexity of preparing for these SNF shipments, ORNL decided to carry out a readiness self-assessment and create a team to identify and review the activities that needed to be addressed. These activities included bringing the SNF to the hot cell from its storage location, inspecting and packaging it, transferring it to another facility for loading into the BMI-1 shipping cask, and shipping it out of the Laboratory. The team was made up of staff members from several different organizations. The organizations responsible for each activity identified the proposed criteria to demonstrate readiness for each phase of the activity, and the assessment team reviewed the criteria. Each responsible organization then documented that its facilities, equipment, personnel, training, and documentation were ready, and the team verified that readiness.

VII. CONCLUSIONS

This paper identifies the actions that have been carried out in anticipation of shipping radioactive SNF currently stored at ORNL to the SRS in a safe and uneventful manner. These shipments will be carried out in accordance with all U.S. Nuclear Regulatory
Commission, DOE, U.S. Department of Transportation, and state regulations for the shipment of SNF.

REFERENCES
