TRANSPORTATION OF SPENT FUEL TO THE IDAHO NATIONAL ENGINEERING LABORATORY[a]

C. P. Gertz
Idaho National Engineering Laboratory
Department of Energy--Idaho Operations
Idaho Falls, Idaho 83402

D. H. Schoonen
Idaho National Engineering Laboratory
EG&G Idaho, Inc.
Idaho Falls, Idaho 83415

B. H. Wakeman
Virginia Power
Glen Allen, Virginia 23060

ABSTRACT

Spent fuel research and development demonstrations and associated transportation activities are being performed for the Department of Energy's (DOE) Office of Civilian Radioactive Waste Management (OCRWM) as a part of the storage cask performance testing programs at the Idaho National Engineering Laboratory (INEL). These spent fuel programs support the Nuclear Waste Policy Act (NWPA) and DOE objectives for cooperative demonstrations with the utilities, testing at Federal sites, and alternatives for viable transportation systems.

The shipment of spent fuel to the INEL from the Surry Power Station and the Nevada Test Site (NTS) required shipping plans and coordination between DOE, EG&G Idaho, Transnuclear, Inc. (the shipping cask supplier) and Virginia Power (VP) transportation personnel for the VP shipments; included Westinghouse Nevada Operations for the NTS shipments; as well as extensive communication with the corridor states. Similar extensive planning and coordination with DOE; Nuclear Regulatory Commission (NRC); General Public Utilities (GPU) Nuclear Corporation [owner and operator of Three Mile Island Unit 2 (TMI-2)]; EG&G Idaho, Inc.; two railroad companies; and state and city officials were required to initiate the shipments of core debris by railroad from TMI-2 to the INEL.

INTRODUCTION

The Spent Fuel Programs being performed and planned at the INEL for DOE are comprised of:

- Performance testing involving fuel storage casks with intact fuel or consolidated fuel
- Developing dry rod consolidation technology and prototypical equipment and testing of storage casks containing consolidated fuel rods in canisters
- Licensing and shipping of two loaded transportable/storage casks from West Valley, New York, to the INEL
- Developing a complement of prototype casks certified by the NRC for shipment of spent fuel from reactor facilities to future repository sites.

Cask performance testing and dry consolidation of spent fuel rods provide engineering data during the VP/DOE project in which the casks are tested while containing both intact and consolidated fuel. Cask performance and surveillance data will be obtained from the Nuclear Fuel Services, Inc. (NFS) transportable/storage cask project. Dry consolidation of spent fuel rods will occur during the DOE-sponsored small-scale rod consolidation activities and on a production-oriented scale during the prototypical rod consolidation project.

Research and development programs at the INEL include the testing of four different metal storage casks containing both consolidated and intact spent fuel in different cover gases and in a vacuum. These dry storage cask demonstrations support OCRWM and NWPA objectives and will establish a data base which can be used for NRC licensing by generic rule of at-reactor dry storage cask installations.

The TMI-2 reactor core debris is being shipped by railroad to the INEL for research to understand the accident sequence at TMI-2 and for temporary storage (up to 30 years) until it can be repackaged or transformed into a waste-form acceptable to either a commercial facility or a Federal repository. More than 250 canisters filled with core debris will be shipped in 35 to 40 shipments, compared with the alternative of more than 250 truck shipments.

The Test Area North (TAN) facility located at the INEL was determined to be the appropriate Federal facility in which to conduct these testing and research activities. The TAN facility has experienced staff, hot and cold test development areas, and the support needed to receive and store commercial spent fuel assemblies and the canisters containing TMI-2 core debris.

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TRANSPORTATION EXPERIENCE

The transportation experience associated with cask testing includes the handling of large empty metal spent fuel storage casks received by railroad and the shipment of 86 spent fuel assemblies in NRC certified shipping casks transported over the highways in transport vehicles having state issued special permits and meeting applicable Department of Transportation (DOT) requirements.

The transportation experience associated with transportation of TMI-2 core debris includes packaging the debris in large, specially designed shipping casks certified by NRC and handling and transporting the casks by railroad in compliance with DOT requirements and the National Environmental Policy Act of 1970.

Transportation of Spent Fuel Assemblies

Transportation experience at the INEL evolved from the activities performed or planned for the shipments indicated in Table I. The shipment of DOE owned spent fuel is a well-structured activity and is performed in accordance with DOE and DOT policies. Specific guidelines are established for the carrier, the originating facility, and the terminal point.

TABLE I

Major Spent Fuel Transportation Activities

- Shipments from Virginia Power Surry Power Station
- Shipments from Nevada Test Site
- Shipments from Battelle Columbus, West Jefferson, Ohio facility
- Shipments from West Valley, New York
- Shipments of consolidated fuel rods in canisters from Surry Power Station
- Shipments of PWR and boiling water reactor spent fuel in support of prototypical rod consolidation at INEL
- Shipments of TMI-2 fuel canisters to the INEL

In addition to invoking all applicable DOT requirements, the shipping costs and schedules were evaluated for both DOE commercial spent fuel shipments and the NRC shipping requirements. Applicable shipping forms are specified by DOT per 49CFR. In addition to the 69 fuel assemblies which were moved in 23 trips from Virginia Power Nuclear Power Plant at Surry, Virginia, to INEL, there were 17 fuel assemblies moved from the Nevada Engine Maintenance and Disassembly (E-MAD) facility to the INEL. An additional two assemblies will be moved from the Battelle, Columbus facility to the INEL. For these shipments, a unique courtesy communications system was developed and implemented in order to keep the participating states fully informed.

Communications equipment is a vital part of the transportation planning. The communications network requires a central control point and the capability to contact local emergency response organizations. The carrier calls in at specified intervals, nominally every 2 hours, to ensure that key personnel are cognizant of the location and status of each shipment and can initiate an immediate response to any unusual situation.

The drivers are DOT-licensed and trained in the transporting of highway route controlled quantities of radioactive material. Escort drivers or personnel are provided as required.

Constant surveillance of each shipment is provided by one of the drivers or escort personnel. The potential for acts of terrorism exist and a vehicle immobilization system is required.

Routes are specified in the written transportation plan which is reviewed and approved by the proper authorities. Following route approval and issuance of the transportation plan, the state over-weight permits, as required, are obtained and travel restrictions for the shipments provided to the drivers. In some cases, courtesy communication for each shipment is provided so that state patrol escorts may accompany the shipment within the state or state inspections can take place.

Before initiating the spent fuel shipments, a courtesy communication from the responsible DOE field office manager is provided to the designated representative for each affected state. The notification is provided in keeping with the spirit of consultation and cooperation described in the Nuclear Waste Policy Act of 1982. The approximate dates, duration, and number of shipments are provided. Also, the preferred routes are specified, but may be renegotiated by State officials to be in consonance with local preferences. Required courtesy notification items provided to each affected state are listed in Table II.

TABLE II

Courtesy Notification to the States

- Identifies caller as representing DOE
- Identifies shipment as program to transport nonclassified spent nuclear fuel
- Identifies number of shipments
- Identifies general time period
- Identifies method of shipment
- Identifies proposed routes
- Provides DOE office location and phone number for reporting emergencies

Major procurement activities were initiated by Virginia Power at the start of the DOE/VP/EPRI cooperative agreement in order to supply the storage casks for the program. Three storage casks were procured from different vendors and transported empty to the DOE at INEL. Also, it was necessary to procure (lease) shipping casks for the proposed spent fuel shipments. Two NRC-licensed spent fuel shipping casks as specified in Transnuclear TN-8L Certificate of Compliance USA/9015B( )F were utilized to transport the spent fuel. Each cask, with a capacity of three pressurized water reactor (PWR) fuel assemblies, was hauled on trailers supplied by Transnuclear.

The spent fuel shipping casks, transported by highway from both loading sites to the INEL, utilized

diesel units supplied by a shipping contractor, Tri-State Motor Transit Company, licensed by the Interstate Commerce Commission (ICC). Overweight permits for the 50,803 kg (112,000 lbs) combined units were required. An over-the-highway cask transportation unit is shown in Fig. 1. The shipments followed the state preferred highway routes as specified in the Transportation Plan.

Cask loading and transporter activities at both the Surry Power Station (SPS) and Nevada Test Site (NTS) facility were performed in accordance with applicable transportation and safety regulations. The documentation for each shipment was prepared, reviewed, and approved in accordance with 49CFR. Prior to each shipment leaving a loading site, a DOE-ID/EG&G Idaho, Inc., representative reviewed and signed the paperwork accepting title to the fuel and shipment responsibility.

Notifications for each shipment were made by the DOE-ID/EG&G Idaho, Inc., traffic representative to the INEL receiving facility and the DOE Transportation Manager in Washington, D.C.

Meetings with state officials in the originating states were conducted to apprise them of the intended shipments and key facts associated with the shipments. Periodic review meetings were also held with the carrier, shipping cask representatives, and DOE/EG&G Idaho/VP traffic personnel to discuss overall transport equipment readiness, procedures for driver activities, tractor/trailer permits, backup equipment, route conditions, and the handling of shipping papers/permits. The results of this planning and attention to details for all aspects of shipping are graphically displayed in Fig. 2.

For the shipments from the SPS to the INEL, estimates of average round-trip times ranged from 12 to 14 days, depending upon the travel route used. Actual experience for the three shipping campaigns was 17 days for Campaign 1, 13 days for Campaign 2, and 11 days for Campaign 3. The reduction in the approximately 8206-km (5100-mile) round-trip times resulted from optimization of the travel route, changing to back-to-back shipments, and reduced handling times at SPS and INEL as workers became more familiar with their tasks. At SPS in particular, cask loading times were reduced from 30 hours to 15 hours. The trip from the SPS to the INEL averaged 3 days during Campaign 3. The shipping routes are shown in Fig. 3.

A substantial effort was made to ensure the readiness of the tractor and trailer prior to each shipment from SPS. A local contractor was retained to provide inspections and maintenance and repairs, if necessary. SPS quality control personnel performed incoming and outgoing inspections, and Virginia State Police hazardous material personnel performed outgoing inspections. Similar arrangements were established for the shipments from the NTS. The route for the shipments from the Nevada Test Site is shown in Fig. 4.

Fig. 1. Over-the-Highway Cask Transportation Unit.

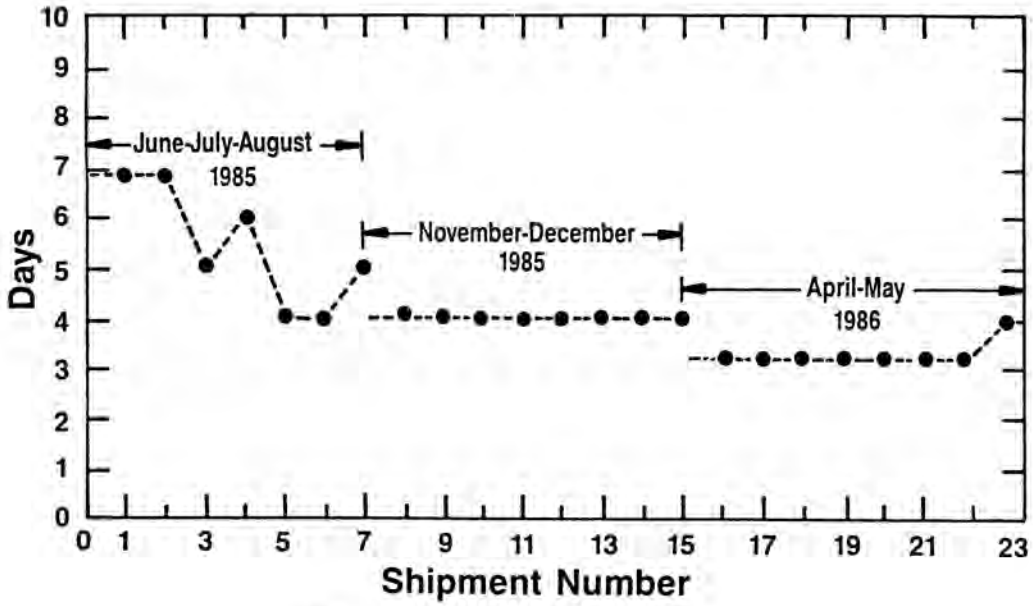

Fig. 2. Spent Fuel Shipment Data.

Fig. 3. Routes from Surry, Virginia, to Scoville, Idaho.

Fig. 4. Route from Nevada Test Site to Scoville, Idaho.

Transportation of TMI-2 Core Debris

The shipments of more than 250 canisters filled with TMI-2 core debris were started in July 1986 over the Conrail and Union Pacific railroads from Middletown, Pennsylvania, to the INEL. As of January 1987, 35 canisters have been transported to the INEL on three trains. The shipping program is expected to last approximately 2 years and include 35 to 40 shipments.

The canisters are transported in NuPac 125B rail casks developed by Nuclear Packaging, Incorporated. Each cask can contain seven canisters in a double containment configuration. That is, the canisters are loaded in a leak-tight vessel within a leak-tight vessel. Each vessel has a lid and seals and is leak tested before each shipment. The casks are certified by the Transportation Certification Branch of the NRC to comply with or exceed requirements in 10 CFR, Part 71 for Type B transport packages.

The railcars procured by DOE to transport the casks are heavy-duty eight-axle cars. The cars are capable of transporting loads 60% heavier than the 90,718-kg (100-ton) weight of a maximally loaded cask and of conveying that load at speeds faster than those being used presently by the railroads. Figure 5 shows the rail cask secured on the railcar and ready for transport from TMI to the INEL.

The Conrail and Union Pacific railroad routes shown in Fig. 6 were selected for transporting the TMI-2 core debris from TMI to the INEL. These routes were selected because of their demonstrated safety records with hazardous wastes and because the combined route is one of the shortest distances between TMI and INEL. Also, the combined route is comprised of top quality trackage - trackage that (a) is certified by the DOT for use in transporting hazardous wastes, (b) has the highest inspection standards, (c) has the highest level of automatic tracking systems, and (d) is inspected and certified independently by the Federal Railroad Administration at the request of DOE.

The DOE notified officials (in most instances the governor or his designee) in each state along the rail route between TMI and INEL at least 45 days before initiating the transportation campaign. A traffic manager and a public relations professional were assigned to the program full time, months in advance of the first transport. DOE made many public announcements, hosted a news media day at TMI, met with public and state officials, displayed a rail cask at TMI and in the Idaho Falls area, and put on public displays of scale and/or detail models of casks and special hardware. DOE also met with some states to accommodate special inspections of the train while enroute, cooperated in special audits by Federal agencies responding to congressional requests, prepared and distributed videos and documentation, and conducted special public seminars requested by some municipalities along the rail route.

The status and location of the trains carrying the shipments are continually monitored and reported. The engineer telephones the control center every 4 hours to inform the dispatcher of the trains exact location and relays information about any unusual occurrence. In turn, the control center relays the same information on the same schedule by telephone to the Warning Communication Center of DOE at INEL and Traffic Manager of EG&G Idaho, Inc. While the train is in motion, the control center monitors with computers the speed and location of the train, as well as nearby trains using the same track system. Scanners located at predetermined distances along the tracks automatically sense the multicolor bar codes on each railcar in the train and relay information on location, speed, time, date, etc., to the control center. The control center thus knows the location of the train at any particular point in time. Besides talking with the control center, the engineer regularly

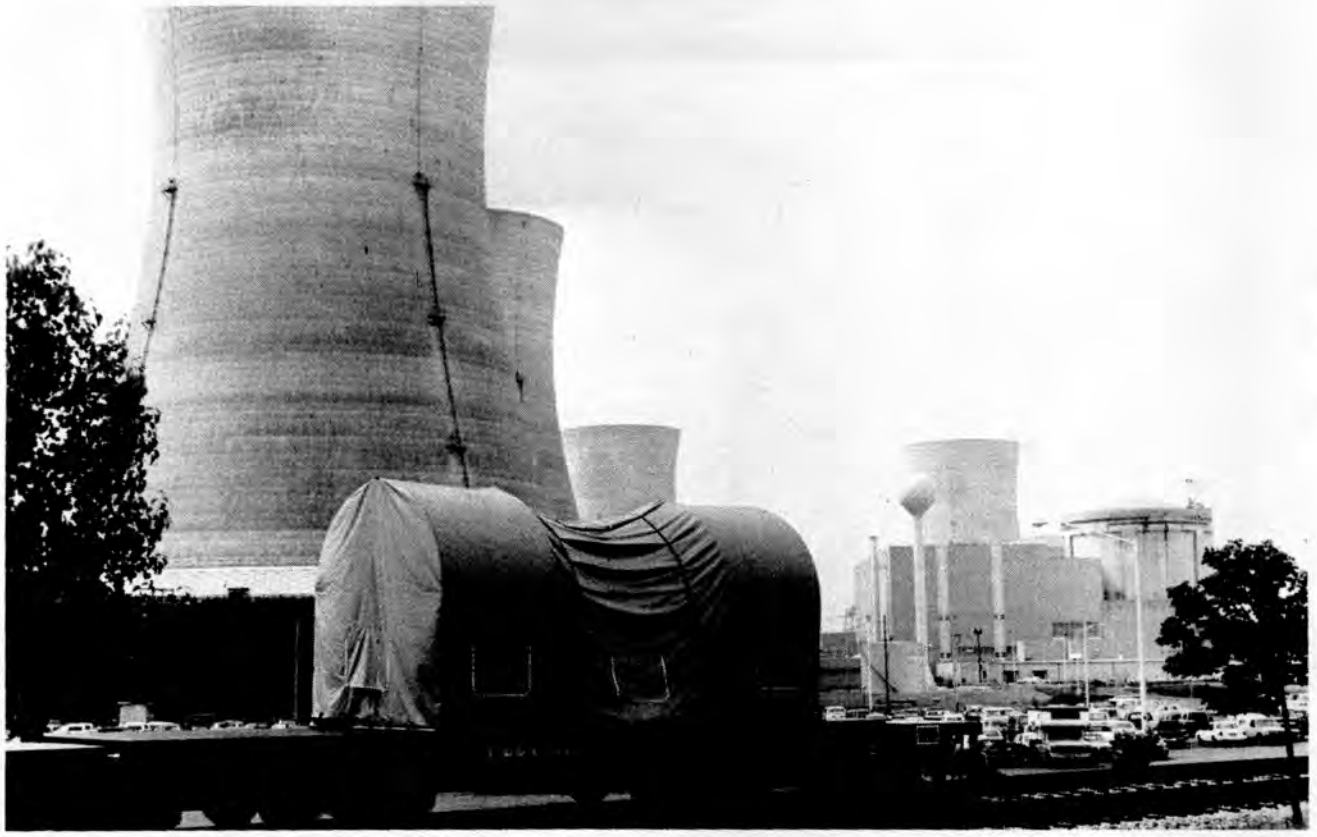

Fig. 5. Rail Cask and Railcar Ready for Transport at TMI.

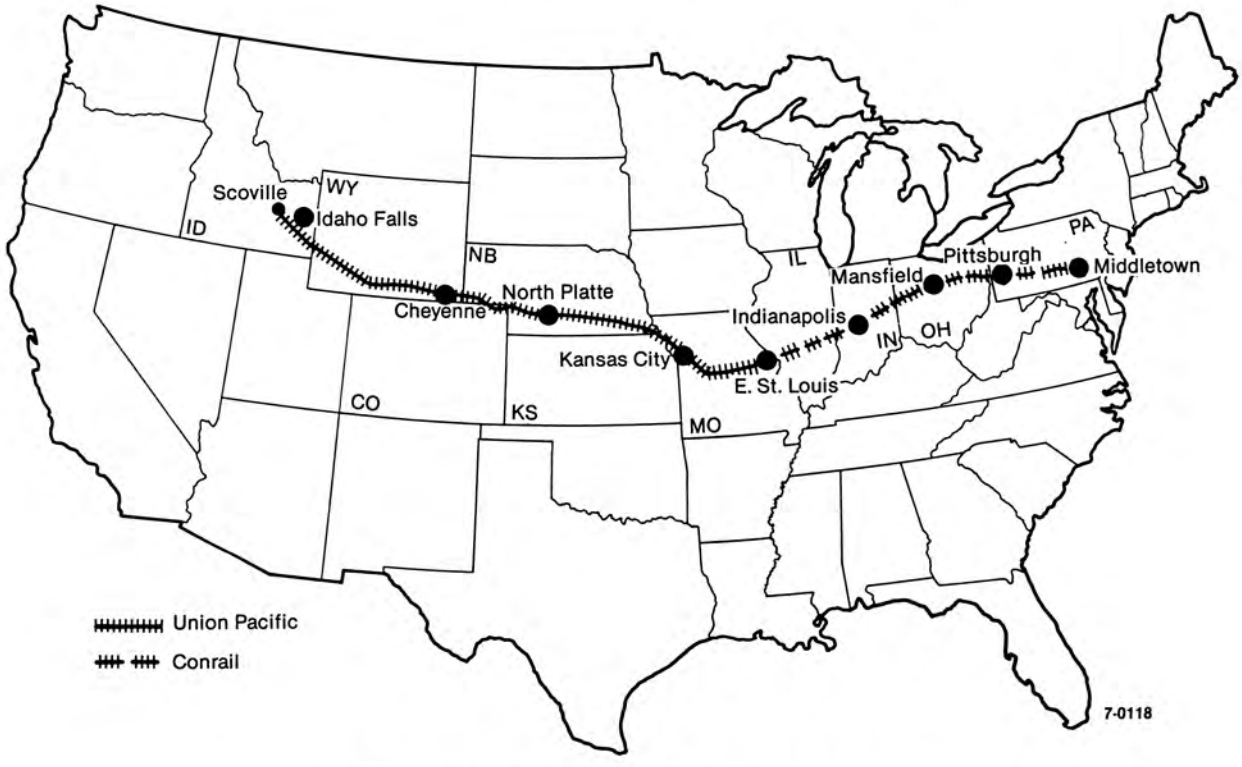

Fig. 6. Railroad Route from TMI to Scoville, Idaho.

communicates by radiotelephone with surveillance personnel in the caboose. When the train stops, surveillance personnel and health physicists inspect and survey the train for any change in structural and radiological conditions.

CONCLUSIONS

The comprehensive planning, attention to details, communications networks, and compliance with established requirements resulted in a relatively trouble-free series of shipping campaigns with 86 spent fuel assemblies and, as of January 1987, 35 canisters filled with core debris from TMI-2 received at the INEL.

The long-distance transportation of a large number of spent fuel assemblies from the SPS and NTS as well as canisters filled with core debris from TMI-2 is considered a success story. The evaluation and implementation of applicable requirements, industry perspective, and extensive planning all contributed to this achievement.