RECENT EXPERIENCE WITH THE TN-8L and TN-9 SPENT FUEL SHIPPING CASKS IN THE USA

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Abstract

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Starting in late 1983, two TN-9 and two TN-8L casks have been used in the United States of America for the transport of spent fuel and radioactive wastes between reactor, fuel storage and waste disposal facilities. These facilities include the Surry, Oyster Creek and Dresden nuclear power stations, the West Valley Demonstration Project (WVDP), the Test Area North facility at INEL and Chem-Nuclear's waste disposal facility at Barnwell, South Carolina. As of May 1986, approximately 175 metric tonnes of spent fuel and irradiated hardware have been shipped. The paper describes Transnuclear's role in this transportation campaign.

INTRODUCTION

Transnuclear provided the necessary engineering and transportation services for two spent fuel campaigns from the West Valley Demonstration Project (WVDP) to Commonwealth Edison's Dresden No. 2 and to General Public Utilities' Oyster Creek No. 1 facilities. Engineering and transportation services were also provided for compacted control rod blade shipments from Dresden to the Chem-Nuclear, Barnwell, SC, burial site. For spent fuel shipments from Virginia Power's Surry Nuclear Power Station to the United States Department of Energy's (DOE) Idaho National Engineering Laboratory, only engineering services were provided by Transnuclear and transportation services were coordinated by the DOE.

Transnuclear currently has carried out more than 95 shipments between eleven reactor stations, fuel reprocessing and storage facilities, and waste disposal sites. Table I provides an overview of this cask operating experience.*

* Table I is given on p. 174.

TRANSPORTATION CAMPAIGNS

1. West Valley, NY - Morris, IL

The movements from West Valley to Dresden represented the first transports in the United States using the TN-9 casks. This campaign consisted of 30 transports with a total of 206 assemblies being transferred. The TN-9 cask and trailer utilized for the transports were designed by Transnuclear and sold to Commonwealth Edison. The TN-9 is an overweight truck cask that holds 7 BWR assemblies.

The necessity for Commonwealth Edison, General Public Utilities, Wisconsin Electric and Rochester Gas and Electric to remove their fuel from West Valley resulted from the June 30, 1983 order of the U.S. District Court that the utilities would be liable "in trespass" unless they removed their fuel from West Valley with "reasonable dispatch".

As planning for the shipments progressed, the county of Cuyahoga, Ohio, the city of Strongsville, Ohio, and the city of Berea, Ohio filed suit in the U.S. District Court claiming that the Federal Radiological Preparedness Coordinating Committee and its several agency members had not adequately provided for assistance and guidance to various state and local governments to develop and test their emergency response plans and train and equip safety forces. On May 24, 1984 the court found that these particular Ohio political subdivisions lacked the standing necessary to pursue the suit and ordered that the shipments be allowed.

For 28 of the 30 shipments, a 7-axle vehicle consisting of the Transnuclear-designed 3-axle trailer and a 4-axle tractor was used. On the first two shipments, however, an 8-axle vehicle, consisting of the 3-axle trailer, a 3-axle tractor and a double-axle jeep supplemental or 'jo-dog' axle was used.

New York State required all overweight vehicles carrying Highway Route Controlled Quantities of material be inspected prior to being used for shipments. Therefore, a program of inspection was set up utilizing personnel from a local truck repair facility and inspectors from New York State. The vehicles were inspected prior to every shipment and periodically subjected to deceleration tests of the braking system. The deceleration tests initially were performed every 10 days but soon were lengthened to 30-day periods. The deceleration tests were conducted with the empty cask on the trailer. It is believed that the trucks used by Transnuclear and others conducting shipments from West Valley were subjected to some of the most severe routine inspections ever given to a transport campaign of any type.

New York State made its presence felt in another way. Most states in the United States recognize the time spent by a driver in the bunk of the tractor as off-duty time and, therefore, after spending a certain period of time in the bunk, a driver is again allowed to drive. New York did not recognize bunk time as off-duty time which necessitated on the return trip that the drivers stop at a motel the night before entering New York to fulfill the required off-duty time.

Because of the harsh winters normally experienced in the Buffalo, New York area, New York instituted a winter bad-weather procedure. It provided that on shipment day, prior to departure, calls would be made to designated State Police stations to check on the driving conditions. Procedures were also in place to take care of situations under which the vehicle might have to be sent back to West Valley or pulled off to the side of the road for emergency repairs.

A special agreement between Ohio and Commonwealth Edison became necessary before transit of Ohio and the Ohio Turnpike was allowed. This agreement provided for training sessions and set instructions on travel for times surrounding holidays or on weekends of expected heavy travel. The Ohio Turnpike normally does not permit vehicles in excess of 90 000 lb gross vehicle weight to travel the road.[1] The vehicle utilized for the Commonwealth Edison shipments weighed approximately 111 500 lb loaded and approximately 109 000 lb empty. These vehicles were not only allowed to travel the Ohio Turnpike, but with police escort, were permitted to travel on a 24-hour basis.

Illinois set up a very extensive inspection program for the vehicles which included personnel from the Illinois State Police and the Illinois Department of Nuclear Safety. The Illinois program has been investigated by other states considering implementation of similar programs.

Pennsylvania and Illinois required that $1000 fees be paid for transit of spent fuel. The Illinois requirement was on a per shipment basis and the Pennsylvania requirement was on a per cask basis. Pennsylvania also required that the transports be escorted by State Police, did not permit the loaded or empty cask to remain in the state overnight and did not permit night travel. In addition to Pennsylvania, Ohio and Illinois utilized state police as escorts. In Indiana and New York, private arrangements were made to utilize off-duty policemen as escorts through urban areas.

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[1] 1 lb = 0.4536 kg.

There were objections to the routing by some local jurisdictions and in some cases by private citizens. The initially proposed route, which passed near Cleveland Ohio was changed by the NRC to pass further to the south due to objections by people in the Cleveland area. The route from West Valley to the New York State Thruway was changed during the campaign to permit use of better highways between the plant and the Thruway entrance. The New York State Thruway Authority initially had opposed use of the thruway for these shipments, but after NRC approved a route which did not include the Thruway, a request was received from New York to include the Thruway.

The first shipment left West Valley on December 8, 1983. The last shipment was delivered November 7, 1984, with major interruptions due primarily to holiday periods and delays requested by the utility due to other vital activities at Dresden.

2. West Valley, NY - Forked River, NJ

The second campaign involved the return of 226 BWR spent fuel assemblies to the Jersey Central Power and Light Co. Oyster Creek facility, located in Forked River, New Jersey. Commonwealth Edison's TN-9 cask and Transnuclear's TN-9 cask were utilized for this campaign.

The major planning task was the development of the spent fuel route. Some key considerations specific to this campaign were the following:

A. The Region. The shipment would travel through the Northeast region of the United States, including, the Northeastern New Jersey/New York City region. This is a very densely populated, high visibility area with a history of negative attitudes toward high-level radioactive shipments.

B. Three Mile Island. As a result of the 1979 accident, an increased awareness of spent fuel transports existed in Pennsylvania. Pennsylvania was willing to permit the transports to traverse the state but only to the extent necessary for the route to enter the Northwestern New Jersey interstate highway system.

C. Overnight Shutdown. The shipments would be travelling through New York, Pennsylvania and New Jersey. The route was approximately 530 miles long with an estimated transit time of 14-18 hours, which required an overnight shutdown.[2] New York was the only state that would permit a shutdown but compliance with the "bunk rule" described above, was required.

[2] 1 mile = 1.609 km.

Because of these and other considerations, several alternate routes were proposed and examined. A route was finally submitted to the USNRC and was approved, but New Jersey refused to issue a Certificate of Handling (which essentially is a transport permit for radioactive material) unless the route was changed to one with greater mileage in Pennsylvania. New Jersey cited road congestion and potential construction delays as reason for denying the NRC approved route. The impasse was finally resolved by GPU Nuclear filing suit against New Jersey and having the court rule that the Certificate of Handling should be issued for the route submitted.

Lacey Township, the township in which the Oyster Creek plant is located, also tried to prevent the shipments from occurring. The U.S. District Court for the District of New Jersey ruled that a municipality in that state could not prohibit the shipments.

The loaded shipments were escorted from origin to destination. Off-duty police officers escorted the loaded vehicle through New York State. Off-duty police officers also served as armed guards during the shutdown period. The drivers were forced to leave the vehicles during the shutdown period and check into a motel to satisfy the bunk rule of New York. Had the drivers not left the vehicle for at least 8 hours, they would have been in violation of the New York law when they started up the following morning and drove the 4 or 5 miles to the Pennsylvania border.

In Pennsylvania, on-duty state police escorted the loaded shipment. New Jersey State Police escorted both the loaded shipment and the empty return vehicle. In addition, while the truck was travelling on the New Jersey Turnpike or Garden State Parkway, the convoy included the state police, the transport vehicle, and Turnpike or Parkway authority police.

The campaign of 33 transports commenced in January, 1985, and was completed 27 weeks later. Only seven shipments were completed in January and February, primarily due to initially long unloading times and weather delays (a severe blizzard hit the Buffalo area in late January, effectively closing the West Valley Plant and most of the region for several days). By March, weather was no longer a major delaying factor and the schedule was accelerated to two round trips every week. One loaded cask departed West Valley on Thursday, the other cask on Sunday. Normally, overweight shipments are not permitted to travel on weekends, but New York State allowed these shipments to proceed on weekends to help accelerate the completion date. In total, the Oyster Creek campaign logged over 34 000 highway miles, 1900 hours enroute, without an in-transit delay that caused a schedule change.

TABLE I. TN-8L/9 CASK OPERATIONAL EXPERIENCE

Company:	Commonwealth Edison
Loading Facility:	West Valley Demonstration Project (WVDP)
Unloading Facility:	Dresden Nuclear Power Station
Type of Material:	205 Dresden 1 (D1) BWR Assemblies; 18 Thoria Rods
Special Requirements:	All fuel Transported in specially designed canisters 12 failed assemblies in USNRC approved canisters Thoria rods shipped in USNRC approved canister. Redundant load path, remote operated cask lift beams.
No. Shipments/Period:	30/December 1983 - November 1984
Cask Model:	One (1) TN-9
Special Equipment:	D1 Fuel Grapple (pneumatic) -Dresden D1 Canister Tool (pneumatic) -Dresden D1 Canister Lid Tool (manual)-Dresden D1 Fuel Grapple (manual) - WVDP D1 Canister Tool (manual) - WVDP D1 Canister Lid Tool (manual) - WVDP D1 Failed Fuel Canisters (20) Thoria Rod Canister Crane hook adapters: 24'-6" and 8'-8". BWR fuel spacers
Engineering Services:	Site Survey at Dresden Station and WVDP. Design and procurement of special equipment. Site specific procedure review and approval. NRC licensing. Dry run/training - Dresden and WVDP. Full time supervision-8 loadings, 6 unloadings. Operational audits. Maintenance and testing assistance.
Company:	GPU Nuclear
Loading Facility:	West Valley Demonstration Project (WVDP)
Unloading Facility:	Oyster Creek Nuclear Generating Station (OC)
Type of Material:	224 OC-1 BWR fuel assemblies
Special Requirements:	Transport 17 failed fuel assemblies in USNRC approved canisters
No. Shipments/Period:	33/January 1985 - July 1985
Cask Model:	Two (2) TN-9's
Special Equipment:	OC-1 Fuel Grapple (pneumatic) for OC OC-1 Fuel Grapple (manual) for WVDP OC-1 Canister Tool (pneumatic) for OC OC-1 Canister Tool (manual) for WVDP OC-1 Canister Removal Tool for OC OC-1 Failed Fuel Canisters (14) Cask Drop Protection System Baseplate Lid Lifting System (Oyster Creek) BWR fuel spacers
Engineering Services:	Site survey at Oyster Creek Design and Procurement of special equipment On-Site Project Management (OC) Site specific procedure review and approval Dry run training (OC) Full time supervision - 33 unloadings, 6 loadings NRC licensing for failed fuel canisters Maintenance and testing assistance

Company: Virginia Electric and Power Co.

Loading Facility:	Surry Power Station
Unloading Facilities:	Test Area North (TAN) Idaho National Engineering Lab; North Anna Power Station (tentative 8/86)
Type of Material:	64 to 114 Surry PWR fuel assemblies
Special Requirements:	Fuel unloaded dry/remote
No. Shipments/Period:	23 done (15 tentative)/July 1985 - May 1986
Cask Model:	Two (2) TN-8L's
Special Equipment:	Crane Hook Sleeve Adapter (3) Crane Hook Adapter - 19"-1" in. Lid Lifting Systems (2) for Surry and North Anna Horizontal Lift Beam (2) with tilting frames
Engineering Services:	Site Survey at Surry, North Anna and TAN. Design and procurement of special equipment. Site specific procedure review and approval. Dry run training - Surry, TAN, North Anna Full time supervision: - 11 loadings, 11 unloadings Maintenance and testing assistance

Company: WasteChem Corporation

Loading Facilities:	Dresden Nuclear Power Station Nine Mile Point Station Brunswick Nuclear Power Station
Unloading Facilities:	Chem-Nuclear, Barnwell SC Facility US Ecology, Hanford WA Facility
Type of Material:	Compacted, non-fuel bearing, irradiated hardware
Special Requirements:	Liners loaded horizontally in pool Cask unloading performed dry/horizontal at Barnwell; dry/vertical at Hanford
No. Shipments/Period:	9/September and October 1985, March 1986
Cask Model:	One (1) TN-8L
Special Equipment:	Horizontal handling equipment for Barnwell Side Loading Liners Liner In-pool Cradle and Liner Handling Tools Vertical handling equipment for Hanford
Engineering Services:	Site surveys at loading and unloading sites Design and procurement of special equipment NRC licensing Dry run/training - Barnwell, Hanford Full time supervision - 4 loadings, 4 unloadings

Company: EG&G Idaho

Loading Facility:	E-MAD Facility at the Nevada Test Site
Unloading Facility:	TAN Facility at Idaho National Engineering Laboratory
Type of Material:	17 PWR fuel assemblies
Special Requirements:	Cask loaded and unloaded remotely dry/vertical
Period/No. of Shipments:	Begun May, 1986/6
Cask Model:	Two (2) TN-8L's
Engineering Services:	Site survey - E-MAD Dry run/training at E-MAD Site specific procedure preparation and approval Full time supervision-2 loadings, 1 unloading.

TABLE I. (cont.)

Company:	Duke Power
Loading Facility:	Oconee Nuclear Station
Unloading Facility:	McGuire Nuclear Station
Type of Material:	Up to 230 Oconee B&W PWR fuel assemblies
Special Requirements:	Design, license, procure TN-8L Configuration X lid for longer fuel
No. Shipments/Period:	80/Scheduled to begin July, 1986
Cask Model:	One (1) TN-8L with Configuration X lid
Special Equipment:	Configuration X lid B&W fuel tool (pneumatic)-Oconee B&W fuel tool (manual)-McGuire Crane hook adapters: 19'-4" and 19'-11"
Engineering Services:	Site Survey at Oconee and McGuire NRC licensing Configuration X lid (Received 5/86) Design and procurement of special equipment Site specific procedure development

Note: 1 ft = 0.3048 m.
1 in = 25.4 mm.

CASK OPERATIONS AND ENGINEERING

Transnuclear uses a total program approach to provide cask operations and engineering services. As a number of the loading and unloading facilities had never shipped spent fuel previously and none had ever used the TN-8/9 series of casks, Transnuclear began engineering activities from six to twelve months prior to the first scheduled shipment.

Early in the planning phase, a facility and site survey was performed by one or more Transnuclear cask operations engineers. Using a prepared checklist, a walk-through of the on-site routing and cask handling path was performed. Measurements of the building access openings, decontamination areas, and the fuel pool and storage areas were made. Also, the elevations, dimensions and capacities of the cranes to be used for cask and fuel handling were noted. The loading/unloading sequence was reviewed with station personnel to determine what special equipment might be required to safely and efficiently operate the cask.

A site-survey report was then prepared, which reviewed the operations to be performed in each area of the plant and identified what special equipment was required. After concurrence of the client, the design and procurement of needed special interface equipment was initiated by Transnuclear.

Standard auxiliary equipment requirements are also reviewed to determine if changes are necessary for operation of the cask. This includes requirements for electrical power, compressed air and clean water, as well as lay-down areas. Normally, Transnuclear supplies the auxiliary equipment which was designed and built to our specification. This includes the cask lift beams, lid lifting systems, cask fill, drain and cool-down systems, a vacuum drying system, skirt fill systems and leak testing systems. Some facilities have built-in systems which can be substituted and this is determined from the site survey.

The types of interface equipment which Transnuclear has designed and procured for its clients include horizontal lift beams, crane hook adapters, BWR and PWR manual and pneumatic fuel tools, failed fuel shipping canisters, irradiated waste shipping canisters, horizontal and vertical lid lifting systems, horizontal unloading equipment and cask drop protection components. A listing of the special equipment designed for each client is provided in Table I. All safety related interface equipment was designed in compliance with the quality assurance criteria of 10CFR71, Subpart H [1].

Depending on the type and condition of the fuel assemblies and waste forms transported, a revision to the USNRC Certificate of Compliance (COC) for the packaging may be required. During the last several years, amendments to the TN-8/8L/9 Safety Analysis Report (SAR) have been prepared and submitted to the NRC for approval for several types of changes.

The first major change to the COC was initiated as a result of a new requirement to apply for specific authorization to transport known or suspected failed fuel assemblies and fuel with cladding defects greater than pin holes and hairline cracks. This requirement went into effect in April 1984 in the middle of the West Valley to Dresden campaign. As it was known that up to 20 of the 205 fuel assemblies in storage at West Valley were failed or had cladding defects, design and licensing activities for a failed fuel canister compatible with TN-9 cask were begun.

The Transnuclear design was based on using a closed stainless steel canister provided with a fine (approximately 60 micron opening) wire mesh screen at the top and bottom of the canister. The canister lid was sealed against the body of the canister by multiple layers of viton sheets. The canister was designed to provide confinement rather than containment. NRC approval of the Transnuclear designed D-1 failed fuel canister was received in August 1984 and the failed fuel shipments were completed by October 1984. Transnuclear also designed and obtained a license for a modification to the basic D-1 canister

to allow the transport of 18 individual thoria rods from West Valley to Dresden.

A failed fuel canister of similar design was also designed and procured for the Oyster Creek (OC-1) BWR failed fuel assemblies during the GPU Nuclear campaign in 1985. Changes to the D-1 design were required to accommodate the larger OC-1 fuel. Much closer tolerances had to be maintained and the canister tool had to be redesigned.

Another major design modification which recently received NRC approval, is the TN-8L Configuration X lid. This lid was designed to provide an increased cavity length to allow the transport of B&W PWR fuel with burnable poison rod assemblies installed. The new lid was designed to be within the as-built dimensions of the two TN-8L packagings without any changes to the cask body or to the removable front shock absorbing cover.

Several months prior to the start of a campaign, Transuclear provided assistance in the preparation and approval of the site specific cask handling and loading/unloading procedures. The generic procedures for the operation and maintenance of the cask system, including the cask, lift beams, vacuum drying and leakage testing systems, and trailers, which are included in Transnuclear's operation and maintenance manuals, were modified to meet site specific needs.

At each site, prior to the facility dry run and training program, Transnuclear delivered the interface and ancillary equipment to the facility and assisted in the receipt inspection, set-up and check-out of the equipment.

Prior to dry run cask operations, a classroom training program was presented to the cask handling, health physics and QA/QC personnel. This program provided an overview of the cask design and operating conditions, a review of the cask operational sequence and a question and answer period. Special attention was given to operational requirements critical to the safety of the workers, the general public during transit, and the cask and ancillary equipment.

Following the classroom training, a dry run of the complete cask turnaround cycle was performed to ensure that all equipment functioned and interfaced properly and to verify the acceptability of the facility operations procedure. Transnuclear cask operations engineers provided technical guidance and assistance during the dry run. Following the dry run, equipment and procedure corrections were made, as necessary, to ensure that the cask would be operated safely and efficiently.

During the first several cask loading and unloading operations, and as needed during each campaign, Transnuclear cask operations engineers provide technical assistance to the facility's cask operators and perform periodic inspections and maintenance. In addition, QA audits of cask operations are made periodically to ensure compliance with the procedures and regulatory requirements. Close communication is maintained with the appropriate client personnel to ensure that operational problems are properly identified and resolved and that each campaign is completed safely and in full compliance with the applicable USNRC and USDOT regulations. Lastly, appropriate records generated by the cask user and by Transnuclear for all cask operations, maintenance, repairs and test activities are retained for the lifetime of each cask and for all safety related ancillary equipment.

REFERENCE

[1] Title 10 Code of Federal Regulations January 1, 1985 Edition with amendments through April 12, 1986 Regulations Management Corporation