RECENT SPENT FUEL SHIPMENT

A CASE HISTORY

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ABSTRACT

A Burlington Northern train with a cargo of three IF-300 cask cars loaded with spent nuclear fuel arrived at the General Electric Morris facility in August of 1984. The shipment was the first intra-state use of the GE IF-300 cask system and was the largest free-world shipment of commercial spent fuel. This paper traces the hurdles and opposition road blocks that had to be overcome during the three year period prior to the shipment.

SUMMARY

In recent years, the transportation of spent nuclear fuel from power reactors has become a public issue. Opponents of shipments have often alarmed the public with allegations that these shipments could cause a serious public hazard. As a result, municipalities and states have either attempted to pass or passed laws and ordinances which severely impact spent fuel transportation. A primary target was the proposed shipment of irradiated fuel from Nebraska Public Power's (NPPD) Cooper Station to the General Electric Morris facility in Illinois. The Nuclear Industry successfully placed its story about the need for the Cooper Shipment before the public, the press and regulatory officials. After years of controversy the Cooper/Morris movement became history. After three years of detailed planning, a Burlington Northern train with a cargo of three cask cars loaded with spent nuclear fuel departed from the Cooper Nuclear Station near Brownville, Nebraska late in the evening of August 22, 1984. It arrived at its destination early in the morning of August 24. The shipment was conducted safely and without incident. It was the first intra-state use of General Electric's IF-300 cask system and was the larges free world shipment of commercial spent fuel.

BACKGROUND

In June 1981 the General Electric Company and Nebraska Public Power District reached an interim settlement of a law suit under which GE and NPPD agreed that 1056 spent fuel bundles would be removed from the Cooper Station and stored at the GE Morris, Illinois Facility. This agreement called for shipment of the spent fuel in GE's IF-300 rail cask. Current plans call for the shipment of 59 cask loads of spent fuel in 30 shipments at the rate of 6 - 9 shipments per year.

COOPER STATION

The Cooper Nuclear Station owned and operated by Nebraska Public Power District is located on the Missouri River about 80 miles south of Omaha, Nebraska. The 778 MWe GE boiling water reactor began operation on the first of July 1974. Close to 50 percent of the power from the station is sold to Iowa Power & Light.

The original capacity of the spent fuel storage pool prior to installation of high-density fuel storage racks was 740 bundles. The 13 new storage racks are now capable of storing 182 bundles each for a present capacity of 2366 bundles. By August 1984 the pool contained 848 spent fuel bundles. 548 of these spent fuel bundles are initial core bundles and are the GE 7x7 fuel design containing 49 fuel rods. The remainder of the spent fuel is the GE 8x8 fuel design with 2 water rods and 62 fuel rods.

Without any shipments of spent fuel, the Cooper fuel pool capacity of 2366 bundles would have provided adequate storage space until approximately 1991 while still retaining full core (548 bundle) discharge capability. After shipment of 1056 bundles to the GE facility in Morris, NPPD estimated Cooper Station would have had sufficient on-site spent fuel pool storage to last until the year 2000. The total cost to rate payers as a result of the fuel shipment is estimated by NPPD to be $2 million.

Another option considered by NPPD was the addition of on-site dry storage . NPPD estimated the cost to rate payers for this option to be approximately $30 million. In addition to its cost, NPPD considered the fact that on-site dry storage has never been licensed by the NRC. NPPD believed they would have to begin the design and licensing of the dry-storage facility immediately with no assurance they would have licensed storage when it was needed in 1991. The agreement with GE to ship spent fuel to Morris appeared to NPPD the most favorable option for its rate payers.

MORRIS

The Morris facility is located about 50 miles southwest of Chicago. The site encompasses 887 acres. Of that, 324 is within a fenced storage area. The site contains 9 building with about 68,000 square feet of enclosed space. The first spent fuel was stored at Morris in January 1972. As of February 1, 1985 some 304 metric tons (1229 fuel bundles) were in storage, occupying 43 percent of the present capacity. The 700 metric ton capacity expressed as uranium is equivalent to the annual fuel discharged from over 20 large nuclear steam supply systems.

All related activities at Morris are conducted in accordance with GE safety requirements and federally imposed regulations governing spent fuel transportation and storage (Titles 10 and 49 of the Code of

Federal Regulations). Moreover, both federal and State of Illinois regulatory agencies conduct periodic inspections of the Morris facility to assure that operations conform to applicable regulations.

Some of the spent fuel stored at the Morris facility has been discharged from General Electric manufactured reactors. But much of it is from reactors supplied by other manufacturers. Currently, fuel bundles from five different nuclear power stations are stored at Morris.

Spent fuel is received at the Morris facility in special shipping casks...probably the safest containers ever built for transporting hazardous materials. These truck or railcar mounted casks may weigh from 20 to 100 tons each.

There have been 580 truck shipments of spent fuel to and from Morris and 47 rail shipments. The 627 shipments to Morris representing about 1.5 million cask miles of transportation have been accomplished without any release of radioactivity.

Upon arrival, casks are unloaded from the transport carrier by a 125-ton overhead crane. After preparation, the cask is lowered into the water-filled cask unloading pit where the fuel bundles are removed and transferred by crane to individual storage "baskets." Each loaded basket is then moved to its position in the storage pool where it is securely latched to a rugged, structural grid work. A cask is never lifted or moved over any fuel bundles. All fuel handling operations are performed under at least nine feet of water.

Fuel bundles in the Morris facility are stored in a large water-filled pool. When secured in their storage baskets, a minimum of 13 feet of water covers the tops of these bundles.

The Morris spent fuel storage pool is constructed of reinforced concrete up to four feet thick with a water-tight stainless steel liner. It contains 657,000 gallons of purified water. The water serves several functions: (1) it provides radiation shielding; (2) it removes residual heat and (3) it retains the trace amounts of radioactivity that may transfer to the water from the stored fuel. A leak detection system, radiation monitoring equipment and routine water sampling are utilized to assure that pool conditions are within established control limits.

An effective filtration system is used to maintain water clarity and remove chemical, radiochemical and particulate contamination. Pool water temperature is maintained between 75° and 95°F by a cooling system that works like an automobile radiator.

IF-300 CASK SYSTEM

General Electric's Design and Analysis Report for the IF-300 was submitted to the AEC in January 1971. Since that time, the IF-300 cask has received full Nuclear Regulatory COmmission and Department of Transportation approvals and was issued NRC Certificate of Compliance No. 9001. This document permits the licensee to deliver the loaded cask to a carrier for transportation.

The General Electric IF-300 spent fuel shipping cask is designed to ship 18 BWR (7x7 or 8x8) elements or seven PWR (14x14, 15x15, 16x16 and 17x17) fuel elements. The two fuel types (PWR, BWR) are accommodated through the use of removable fuel baskets and two different length closure heads.

The IF-300 cask inner cavity is a stainless steel cylinder, 37-1/2 inches inside diameter with a 1/2-inch thick stainless steel plate. The upper end is welded to the closure flange. Processes and procedures outlined in Section III of the ASME Code are used for guidance in the fabrication of the inner cavity.

Surrounding the inner cavity is the depleted uranium metal shielding material. This heavy metal assembly consists of annular castings, each with a 38-1/2 inch i.d. and a 4-inch thick wall. Sections are interlocked, end-to-end, using an overlapping joint which holds the stack together and prevents radiation streaming. This assembly is shrink-fitted to the inner cavity to ensure good thermal contact for heat transfer purposes. The bottom end shield is a 3-3/4 inch thick uranium metal casting.

To prevent the formation of a low melting point alloy of steel and uranium, a 5-mil thick copper diffusion barrier is provided at every uranium-steel interface. This barrier is plated or flame-sprayed on the larger pieces such as the inner and outer shells. Copper foil is used in some of the smaller areas. In welded areas, a copper-plated backup strip is used. The outer body shell is also a stainless steel cylinder with a 46-1/2 inch i.d. and a 1-1/2 inch thick wall. The outer shell is also shrink-fitted to the uranium to ensure good heat transfer characteristics.

The cylindrical portion of the cask is encircled by a thin-walled, corrugated stainless steel water jacket, extending axially from the upper valve box to a point slightly above the cask bottom, thus masking the active fuel zone. Water contained in this structure functions as a neutron shield. An anti-freeze and water mixture is used when the cask is subject to cold ambient temperature conditions. The jacket surface is corrugated for heat transfer purposes. Additionally, the use of continuous corrugation provides a surface which is easily decontaminated. The jacket has a pressure rating of 200 psig and is equipped with fill, flush, and relief valves.

The cask weight when loaded is between 135,000 and 140,000 pounds, depending on the particular type of fuel being shipped. The skid and cooling system weigh approximately 45,000 pounds. Each IF-300 cask has been built to ASME Code standards and is subjected to several tests to verify construction:

a. Thermal test (temperature)
b. Hydrotesting (pressure)
c. Gamma scanning of shield
d. Leakage testing
e. Materials testing
f. Manufacturing process qualification

Before each fuel shipment several engineering tests are performed to assure that the cask has been properly loaded, assembled and has met all licensing requirements before going onto public railways.

RAILROAD AGREEMENT

Prior to the passage of the Staggers Rail Act of 1980 virtually everything that was shipped by rail in this country was shipped under a tariff published by the railroads and was subject to the approval of the Interstate Commerce Commission. Contracts between shippers and the railroads were not permitted.

The Staggers Act gave shippers the option of shipping under a published tariff or trying to negotiate a more favorable deal with the railroads.

During the early planning stages of the Cooper shipments it was decided to try and negotiate a contract with the railroads rather than ship under the published tariffs. Shipping under a contract appeared to offer several possible advantages over shipping under published tariffs: more favorable rates, the ability to specify the route and better control of the shipping schedules and in-transit times.

In addition to deciding whether to negotiate a contract or ship under a published tariff it was necessary to decide whether or not to ship by special train. The primary disadvantage to shipping by special train is cost. The round trip shipping costs of two casks increased by about 100% if a special train was used for shipment each way. However, it was felt that the advantages of having a special train at least for the loaded shipment outweighed the disadvantage of the increased cost.

The primary advantage of a special train is that it has a higher priority on the tracks than any other train except an Amtrak train. Once a special train left Cooper, it wouldn't stop, except for brief intervals for crew changes, until it reached Morris.

Because of confidentiality agreements the details of the contract cannot be discussed here other than to say it appears that the final contract offers a number of advantages to all parties versus shipping under a published tariff.

PUBLIC RELATIONS CHALLENGE

The March 1979 "Report to the President," by the Interagency Review Group on Nuclear Waste Management stressed the group's strong concern about the transportation link in nuclear waste management. The authors clearly predicted that the transportation issue would be a primary topic in future waste management policy discussions with the states. At the same time a number of local and state citizens began expressing concern about transportation accidents involving radioactive materials. During 1980 and 1981 these concerns led to a considerable body of proposed state and local restrictions including bans in certain jurisdictions.

The January 1982 "Council on Economic Priorities" newsletter was devoted to the perils of nuclear waste shipments. The council even convinced the New York Times to publish an article on spent fuel transport. The article equated the public impact of a spent fuel shipment accident at 57th Street and Broadway to the detonation of a nuclear weapon.

Public disclosure in February 1982 of the GE-NPPD plan to ship fuel by rail from Cooper to Morris drew the attention of opposition groups throughout the country. By June of 1982, the topic of the Cooper shipment had been elevated to one of major concern along the BN route in Nebraska, Iowa and Illinois. The first of many proposed ordinances began to appear.

At a public hearing held June 21, 1982, the City Council of Burlington, Iowa, defeated an ordinance to restrict rail shipments of spent fuel through their city. After hearing assurances of safety from the shipper (NPPD), carrier (Burlington Northern), General Electric and experts from the American Nuclear Society, three out of the five councilmen voted the ordinance down.

Passage of the Burlington ordinance was to have been the centerpiece of a MacNeil/Lehrer broadcast, but was displaced by an analysis of the Hinckley acquittal when it was voted down.

Throughout the rest of 1982, 1983 and 1984 the opposition continued to keep the topic of the proposed Cooper shipments one of major concern. Pamphlets such as "The Cooper Station Special May Be Coming Through Your Town" distributed to various groups raised undue public concern. The contention that a shipment of irradiated fuel could go awry and create a serious public hazard alarmed the public sector. The opposition cultivated a fear of accidents by reinforcing the public's misconception that the fuel is in the form of a liquid or powder which could be easily dispersed in the atmosphere. Taking advantage of this fear, the opposition continued to push for the passage of ordinances in local communities such as Lincoln, Nebraska, Galesburg, Illinois and Aurora, Illinois.

The Illinois legislature focused on the transportation issue and a great deal of effort was expended over several years to pass restrictive legislation at the state level. In 1980 the Illinois legislature passed a law which in effect prohibited the shipment of spent fuel into the state. The governor vetoed the bill. In his veto message the governor stated he believed the bill was unconstitutional and the bill was also bad public policy. The legislature overrode the governor's veto. GE and Southern California Edison sued the state in federal court to over turn the law. The U.S. District Court ruled it unconstitutional and the decision was upheld by the U.S. Court of Appeals.

The first shipment from Cooper to Morris was completed August 24, 1984 successfully and uneventfully because of detailed planning that covered about three years. GE and Nebraska Public Power District successfully placed their story before the public, county and state officials and the media. The Cooper shipment project was successful not only because the GE-NPPD team was able to alleviate public concern but also because it was able to obtain the cooperation of federal and state agencies involved with the project.

REGULATORY AGENCIES

Spent fuel shipments are under the jurisdiction of the Nuclear Regulatory Commission (NRC) and the U.S. Department of Transportation (DOT). The NRC imposes security requirements and certifies the shipping casks which are used to transport the spent fuel. DOT regulations establish the requirements for radiation safety and highway safety.

DOT regulations (49CFR71-177 inclusive) require:

- Establishing comprehensive shipping procedures that include marking, labeling, placarding, notifications, seals, etc.
- Establishment of standards and criteria for shipping containers (casks):
  - Defining type of container required (Type B for spent fuel).
  - Imposing limits on radiation dose rates in normal use of the cask.

- Assuring that design is such that casks will not release radioactive material or lose their ability to control radiation dose rates in the event of the most severe accidents.

- Imposing limits on levels of surface contamination for casks in normal use.

o Regulation of routes - either interstate or state designated highways or direct rail lines.

o Establishment of training requirements for truck and train crews.

o Audits of shipments to assure requirements are met.

The NRC is responsible for:

o Licensing all spent fuel transportation packages to assure that DOT requirements have been met.

o Licensing of the operators of facilities that may handle and transport spent fuel.

o Approving Quality Assurance, operating, and training procedures.

o Inspecting and reviewing licensee's performance.

o Establishing safeguards requirements and approving licensee's safeguards plan.

o Requiring licensees to establish plans for emergency response to all accidents including transportation accidents.

o Auditing licensee's paperwork and overall performance.

Additional surveillance is also provided by some states. Illinois, for example, is responsible for:

o Providing the Illinois Spent Fuel Transportation Accident Plan, a comprehensive response guide for State and local emergency organizations.

o Enforcing all U.S. Department of Transportation regulations pertaining to hazardous material shipments including shipments of spent fuel. This included:

  - Assuring, by measurement, that the shipper performed properly and that all radiation and contamination control requirements of the Federal Regulations were met. (Department of Nuclear Safety)

  - Assuring that drivers were properly trained and training was current. (Department of Nuclear Safety)

  - Assuring that all paperwork required for control of the shipment was in place. (Illinois Department of Nuclear Safety and Illinois State Police)

  - Assuring by inspection that the vehicles -- tractor and trailer or train -- were road worthy.

o Notifying appropriate local law enforcement and emergency response personnel along the transit route when shipments are scheduled.

In addition to these enforcement activities, State agencies undertook other actions to assure safety of the shipments.

o Escorting the cask with radio equipped personnel trained in radiological safety so that response capability, in event of accident, is only minutes away.

o Escorting the cask with law enforcement people (State Police) so that response to accident, vandalism, or sabotage is almost immediate.

o Providing the use of the State emergency network for continuous communication with ESOA and other agencies.

DESCRIPTION OF SHIPMENT

The first shipment contained three cask cars loaded with spent nuclear fuel because General Electric needed 52 spent fuel bundles for use in a DOE funded study of the viability of a system of "dry cask" spent nuclear fuel storage. 52 fuel bundles (three casks worth) had to be shipped from Cooper before the plant was shut down for a nine month outage to replace reactor piping.

Under the special train service, the train cargo contained only the three cask cars. The eight car train utilized empty gondola cars as the buffer cars required by NRC regulation and there were two cabooses, one for the escort personnel required by NRC regulations and one for the train crews.

Many features of the shipping plan went beyond federal regulations to alleviate the concern of some people along the route about the safety of the shipment. Included were the special train service, limited speed and the escort vehicle.

The Burlington Northern train left the Nebraska Public Power District plant about 9:00 p.m. on the 637-mile journey.

The train was met by few protesters and passed unnoticed through most communities along the route.

CONCLUSION

The public and political problems associated with the shipment of spent nuclear fuel require intense attention to the smallest details. The parties to such shipments are dealing with media, public and local officials far removed from their territory and with whom they have no established close contact or credibility. Advance preparation prior to the plan becoming public is a must.

Once the shipping route has been identified and publicly announced, the following steps are required:

o Contact major utilities along the route to discuss the proposed shipment. They can be invaluable in providing information about local conditions, political personalities and media contacts. Ask the major utilities in each state to supply you with their clipping service starting with the announcement of your shipment.

- o Identify the major state elected officials of each state through which the shipment will pass. Have they taken a position on this issue or nuclear power in general?
- o Identify which state agency has authority over state response. Is there a state emergency response plan? What is the experience of others in dealing with this agency?
- o Prepare a mailing list of elected officials along the route: state governor, state police commander, head of state emergency response agency, state senators and representatives for districts on the route, U.S. congressmen for districts on the route, U.S. senators for each state, county board members for each county on the route and the mayor and city council members for any city through which the shipment will pass.
- o Prepare a list of all law enforcement agencies who have jurisdiction for the shipment.
- o Travel the route to identify potential problem areas: Are there any bridges on the route which are locally thought to be unsafe? Is there a hospital or school immediately adjacent to the highway or rail line? Has there been a hazardous material accident or an evacuation in the recent past?
- o Prepare a mailing list of all the major media along the route.
- o Designate a single media spokesman for the project capable of representing all the principles involved in the shipment.
- o Prepare information packets for use with elected officials. Having an adequate supply in advance will save a lot of headaches later.
- o Prepare media information packets, basically the same as above but also include a copy of 10 CFR 73.37, which covers the safeguarding of shipping schedules.
- o Have extra copies of a video tape version of the Sandia crash test film ("Accident Testing", 12 minutes).
- o If you don't have a good working relationship with your regional NRC public affairs officer, establish one.
- o Be prepared to address the federal preemption -- local jurisdiction issue.

The 80's is the era of instant information. Legislators, local officials and citizens are able to follow news events as they happen from locations thousands of miles away. How boldly and creatively the nuclear establishment participates in the communications revolution will determine in great measure the success of future spent fuel shipment programs whether they be local, national or international. Messages and techniques of public communication must be as contemporary as today's information transmission technologies.

Our experience in addressing the spent fuel transportation issue in Nebraska, Iowa and Illinois convinces us that the principles involved in any future shipment must seize the communications initiative at every opportunity.

ACKNOWLEDGEMENTS

C. E. King
E. E. Voiland