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TRANSPORTING TMI-2 CORE DEBRIS TO INEL:

PUBLIC SAFETY AND PUBLIC RESPONSE[a]

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ABSTRACT

This paper describes the approach taken by the U.S. Department of Energy (DOE) to ensure that public safety is maintained during transport of core debris from the Unit-2 reactor at the Three Mile Island Nuclear Power Station near Harrisburg, PA, to the Idaho National Engineering Laboratory near Idaho Falls, ID. It provides up-to-date information about public response to the transport action and discusses DOE's position on several institutional issues. The authors advise that planners of future transport operations be prepared for a multitude of comments from all levels of federal, state, and local governments, special interest groups, and private citizens. They also advise planners to keep meticulous records concerning all informational transactions.

INTRODUCTION

Since the 1979 accident which damaged the Unit-2 reactor of the Three Mile Island Nuclear Power Station (TMI) near Harrisburg, PA, the U.S. Department of Energy (DOE), U.S. Nuclear Regulatory Commission (NRC), and General Public Utilities Nuclear Corporation (GPU Nuclear - owner/operator of TMI) have cooperated closely in planning cleanup operations within Unit-2, as well as the packaging, transport, research, and disposal of radioactive materials obtained during cleanup. In 1984, plans for removing and packaging the damaged core of Unit-2 began in earnest, culminating in July 1986 with the first shipment of seven canisters containing core debris to the Idaho National Engineering Laboratory (INEL) near Idaho Falls, ID. The canisters were transported in one of two newly designed, tested, and licensed rail casks (Fig. 1). Packaging and transporting radioactive core debris from TMI to INEL was complex, involving close cooperation and communication between several governmental organizations, a public utility, a governmental contractor, many private subcontractors, three federal research laboratories, two railroad companies, and numerous public and private organizations and citizens.

This paper describes the approach taken by DOE to ensure that public safety is maintained during transport of the core debris and provides current information on public response to one of the most thoroughly planned and executed transport operations in the history of the commercial nuclear industry. To ensure public safety, DOE authorized extra efforts in designing, fabricating, and testing two new, double containment rail casks and readying those casks for transport. Additionally, DOE followed extensive prenotification procedures to prepare the public for transportation of the core debris. However, within the United States, the public has been, and still is, apprehensive about transportation of nuclear materials, especially transcontinental transport of spent fuel and radioactive wastes. Correspondingly, the public is becoming increasingly involved in such transportational activities. DOE and its contractors have been involved in an extensive exchange of information with the public regarding all aspects of the core debris transportation program. As a result, perhaps TMI, for all its notoriety, will serve the purpose of easing public apprehension about transportation of radioactive materials. Information in this paper will be valuable, both within and without the United States, for use in planning for transportation of spent nuclear fuel or other hazardous materials and anticipating public and governmental questions.

PUBLIC CONCERNS

Notifying State and Local Governments - DOE and its contractor EG&G Idaho, Inc. fully recognized that transporting TMI core debris would be a sensitive public issue. Therefore, procedures were written outlining the methodology whereby DOE would notify involved states of the planned action to transport the debris by rail through their respective jurisdictions. Those procedures outlined the rationale used in selecting the rail route between TMI and INEL, explained the communication network used to monitor casks in transit, and described emergency communications used in case of an unplanned occurrence along the route. First-time notification was required at least 45 days before initiating the transportation campaign.

As mentioned above, DOE representatives notified officials - in most instances the governor's designee - in each state along the rail route between TMI and INEL. That was done well in advance of commencing transport of core debris from TMI. A traffic manager and public relations professional of EG&G Idaho were assigned to the program full-time, months in advance

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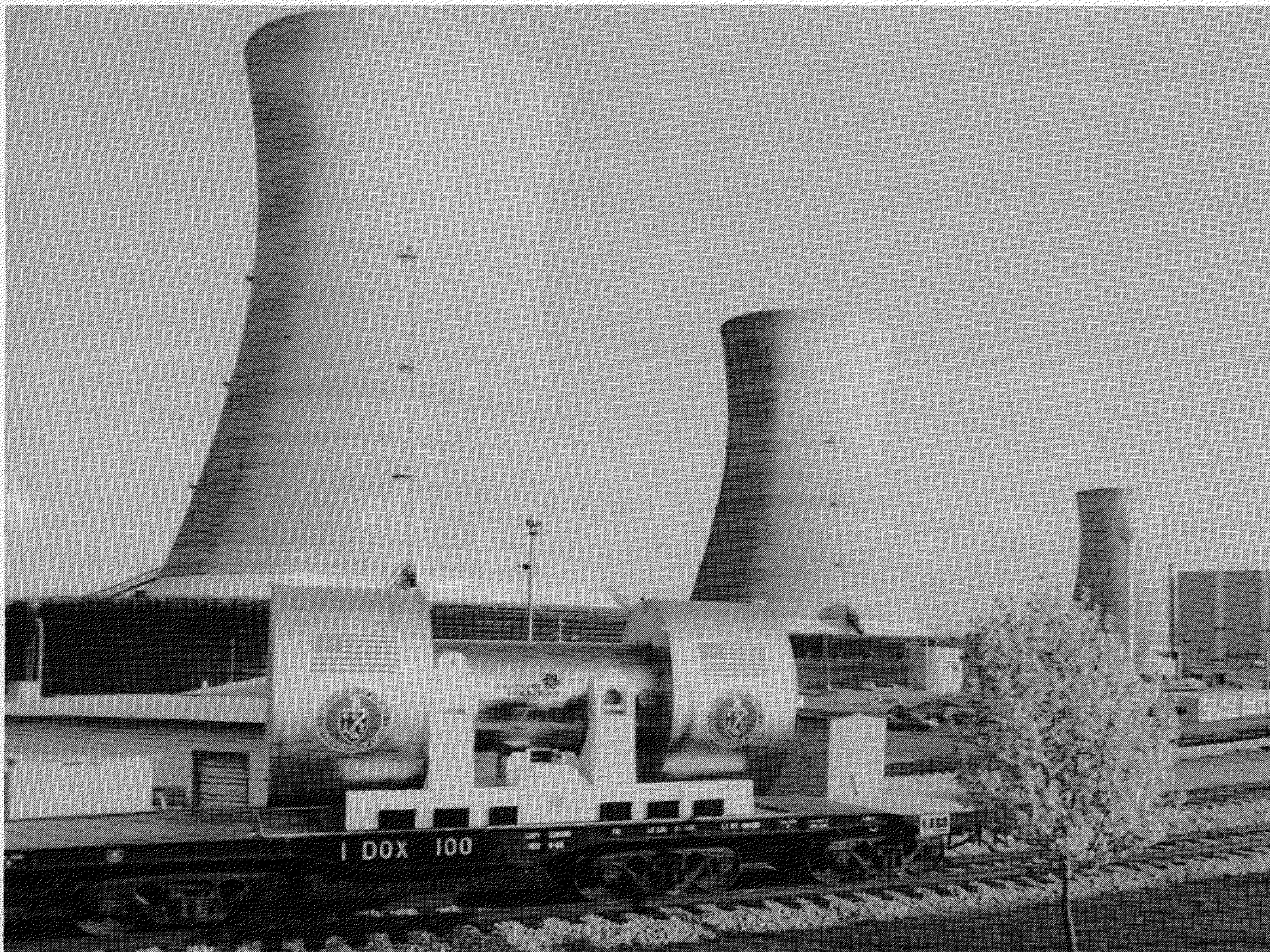

Fig. 1. Loaded NuPac 125-B Rail Cask at TMI.

of the first shipment. 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 publicly displayed scale and/or detailed models of casks and special hardware. DOE also met with some states to accommodate special inspections of the train while en route, cooperated in special audits by federal agencies responding to congressional requests, prepared and distributed videos and documentation, and conducted a special public seminar requested by a municipality along the rail route. Still, some concerned persons claimed secrecy about or inadequate notification of DOE's planned action. In reality, those complaints seem to reflect a reaction by public officials to concerns of constituents, as well as communication difficulties among federal, state, and local governments. Furthermore, the propensity of the news media to publicize sensational aspects of federal actions has not enhanced balanced dissemination of information to the public.

Route Safety - In consultation with various railroads, DOE evaluated the quickest and safest rail routes between TMI and INEL, contracted independent rail routing analyses by third parties, and then reached agreements with Conrail and Union Pacific railroads for transporting the containerized core debris in NuPac 125-B Rail Casks. Announcement of the rail route between TMI and INEL initiated a flood of public inquiry. Inquiries were received from mayors, fire chiefs, the police, town meeting participants, state officials, congressmen, and senators, among others. The citizenry in several communities along the rail route voiced their desires that the TMI core debris be transported via alternate routes around their domains. Seemingly, there is public perception that rail routes can be changed here and there easily and conveniently to avoid this or that population center. The public does not seem to comprehend the fact that decisions to "avoid my town" are largely impractical. Alternate routes around cities or municipalities comprise lesser quality trackage, the use of which would increase transport time and quantitatively or qualitatively add to the risk of transporting the core debris. Also, it seems that elected officials and the public lack an understanding that the federal government cannot and will not dictate to rail companies the diversion of nuclear and/or hazardous materials from high quality, mainline trackage onto secondary trackage primarily to avoid a population center. Regulations promulgated by the U.S. Department of Transportation specifically direct railroad companies to transport such materials on high quality, mainline trackage. Hence, in the best interests of all parties involved, requests for rerouting of the TMI core debris were not approved.

The two rail companies (Conrail and Union Pacific) were selected partly because of their demonstrated safety records with hazardous wastes, partly because their combined route is one of the shortest distances between TMI and INEL, and partly because the combined route is composed of top quality trackage. That trackage (a) is certified by the U.S. Department of Transportation 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. However, it should be realized that the rail route and railroad companies selected are one combination of several routes and companies with equivalent certifications and reputations connecting those two geographical points.

Conrail agreed to provide rail service for transporting casks from TMI to East St. Louis, IL. At that point, Union Pacific assumes responsibility for transporting casks to the Scoville siding at INEL (Fig. 2). Conrail restricts the speed of the train to 35 miles per hour between TMI and East St. Louis, as a matter of corporate policy for hazardous shipments. Union Pacific has a higher speed restriction of 55 miles per hour in the open terrain portions of the route between East St. Louis and INEL. It is worth noting that the railcars procured by DOE for transporting the casks are heavy duty 8-axle cars, each capable of transporting loads 60% heavier than the 100-ton weight of a maximally loaded cask and conveying that load at speeds faster than those presently being used by the railroads.

Transportation Operations - For the first three trains transporting TMI core debris (two of which conveyed double cask shipments), DOE contracted with the railroads to move the debris via expedited service or exclusive-use trains, even though more expensive and contrary to DOE's stated policy of transporting unclassified nuclear materials by routine train service. For the single cask shipment, the flatcar carrying the cask was situated between two gondola cars. For the double cask shipments, the two casks were alternately sandwiched between three gondola cars. Both trains were limited fore and aft by a diesel locomotive and caboose, respectively. Surveillance personnel from the railroads and health physicists/observers from EG&G Idaho accompanied the casks en route. Presently, DOE and the railroad companies are negotiating the need for continuing expedited service, with all parties keenly aware of expressed desires of the states and public to maintain expedited or exclusive-use train service.

Monitoring/Communications - After the train with casks exits TMI, the engineer is required to telephone his control center once every four hours until arrival at INEL. The control center for Conrail is located in Philadelphia, while that for Union Pacific is located in Omaha. Each time the engineer telephones, he informs the dispatcher of his exact location and 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 and the Traffic Manager of EG&G Idaho, both at INEL. While the train is in motion, the control center monitors by computer the speed and location of the train, as well as the presence of nearby trains using the same track system. Scanners located at predetermined distances along the tracks automatically sense the multicolor bar codes on each railcar of the train and relay information on location, speed, time, date, and so forth 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 for the first three shipments regularly communicated by radiotelephone with surveillance personnel in the

Fig. 2. Rail route for transporting the TMI-2 core debris from Middletown, PA to the Scoville Siding of INEL, west of Idaho Falls, ID.

caboose. When the train stopped, the surveillance personnel and health physicists inspected and surveyed the train for any structural and/or radiological changes. The continued use of surveillance and health physics personnel on future shipments is another aspect being negotiated by DOE and the railroad companies.

Emergency Preparedness/Response - Emergency preparedness and response was, and is, a common concern among local government officials and the public. Local groups asked what should they do in the event of a train accident involving the NuPac 125-B Rail Casks. Likewise, state emergency organizations pondered their roles in similar situations. In all situations, the principal function of local and state emergency response organizations - be they fire departments, municipal police, state police, or whatever - is to isolate the incident until assistance arrives. The railroad has responsibility for the cask while in transit and prime responsibility for recovery from non-radiological aspects of an accident. DOE has emergency response plans which divide the United States into eight regionally located offices. Each office has Radiological Assistance Program (RAP) teams trained in responding to and recovering from any radiological emergency. In all, there are 26 such teams strategically located around the country, each of which is capable of mobilizing within two hours and reaching the site of the emergency within six to eight hours. Once on the scene, the RAP team, assisted by a specially trained team from the railroad company, assumes responsibility for controlling, confining, and cleaning up radioactive material. At INEL, DOE has identified a special TMI transportation response team which can reach any point along the rail route within hours and assist the RAP team, if the situation so warrants. Regardless of how many and what types of emergency response organizations there are, the public still seems to be apprehensive and local governments concerned about responsibilities in case of a radiological emergency.

Technological Considerations of the Rail Cask - Besides emergency preparedness, public concern increasingly has focused on the safety of transport packages for spent nuclear fuel, as evidenced by penetrating questions about the TMI transport package. DOE has responded to those questions with information describing (a) how the NuPac 125-B Rail Cask is designed, fabricated, and tested per regulatory requirements; (b) how those requirements encompass all conditions expected in the most severe rail accidents; (c) how the possibility of a breach of cask integrity during a rail accident is extremely remote; and (d) how more than 35 years of transportation experience with Type B packaging in general has not resulted in either loss of containment of any cask or death attributable to radiological consequences. In some cases, the public has claimed that certification of the NuPac 125-B Rail Cask was "the swiftest and most incomplete licensing since the days of the old Atomic Energy Commission." Whereas the licensing process for the NuPac 125-B Rail Cask may have been "swift," it nonetheless was as detailed as that given any new cask.

The NuPac 125-B Rail Cask is a spent nuclear fuel cask certified for use by the Transportation Certification Branch of NRC. The cask was certified by NRC only after complete review of the application for certification, which included the Safety Analysis Report for the cask, data from drop tests using a one-quarter scale cask model, data from drop tests of full-sized fuel and knockout canisters, and resolution of many design- and test-related questions from NRC. Before the application was submitted to NRC for review and approval, it was subjected to one of the most intensive reviews in the history of transporting radioactive materials. Reviewers included personnel from DOE National Laboratories, EG&G Idaho, GPU Nuclear, and several subcontractors. The scrutiny and analysis expended on the application by NRC were as thorough as given any application for any rail, or truck, spent fuel cask. The "rapidity" with which NRC accomplished the review and certified the NuPac 125-B Rail Cask was made possible by (a) DOE contracting with a highly qualified cask vendor (Nuclear Packaging, Inc.), (b) DOE willing to expend extra effort and money to resolve issues, (c) DOE electing to implement suggestions in 10 CFR 71, Subpart F, regarding drop testing a model of the cask and combining data therefrom with analytical data in the Safety Analysis Report; and (d) extensive reviews of the application already discussed. From the first meeting with NRC on cask certification (August 1984), until issuance of the Certificate of Compliance by NRC (April 1986), about 20 months passed and countless man-years of effort were expended in preparing, evaluating, and analyzing the application.

The approach used in designing the NuPac 125-B Rail Cask assumes the following: (a) worst-case loadings of core debris in each of the seven canisters (i.e., maximum quantity of radioactive material per canister and maximum concentration of radioactive isotopes available in the core at the time each canister is filled) to calculate the minimum shielding required in the cask; (b) the worst-case geometrical configuration of canisters and contents during a severe train accident (for criticality analyses from induced mechanical deformation); and (c) the worst-case train accident for mechanical and thermal shock to the transport package [to evaluate resistance of the cask to mechanical deformation during an accident and provide data on the ability of the transport package to withstand the maximum hypothetical fire outlined in 10 CFR 71.73 c(3)]. Moreover, because canisters containing core debris are not considered a level of containment for plutonium (as specified in 10 CFR 71) the two levels of containment required by NRC for transporting nuclear fuel are provided by the cask. That is, the NuPac 125-B Rail Cask is composed of a leak-tight vessel (inner containment vessel) within a leak-tight vessel (outer containment vessel) as shown in Fig. 3. Leak tight is defined in the regulations as 10^{-7}atm-cm^3/s.

Quality Assurance/Control - The quality assurance/control programs under which both casks and canisters were procured were approved by NRC and subjected to intense review by DOE. In addition, NRC conducted a comprehensive quality audit of the cask vendor (Nuclear Packaging, Inc.) in which one hundred percent of the nondestructive examination records of cask components were examined. In short, the design of the NuPac 125-B Rail Cask, as certified by NRC, complies with or exceeds requirements in 10 CFR 71 for Type B transport packages.

Core Debris Canisters - Segments of the public have quizzed DOE about canister issues, loading of canisters with core debris, preparation of canisters for transport, preparations to load canisters into casks, and preparations of casks for transport to INEL. DOE has provided answers in the form of detailed descriptions of the entire operational sequence, including filling canisters with core debris; sealing, leak-testing, monitoring gas generation, and certifying each canister; weighing each canister to verify required internal void volumes; confirming performance of catalysts used to recombine gases generated by radiolysis of residual water in canisters; and calculating a safe "transport window" (contained within the timeframe between canister dewatering at TMI and refilling at INEL) for each

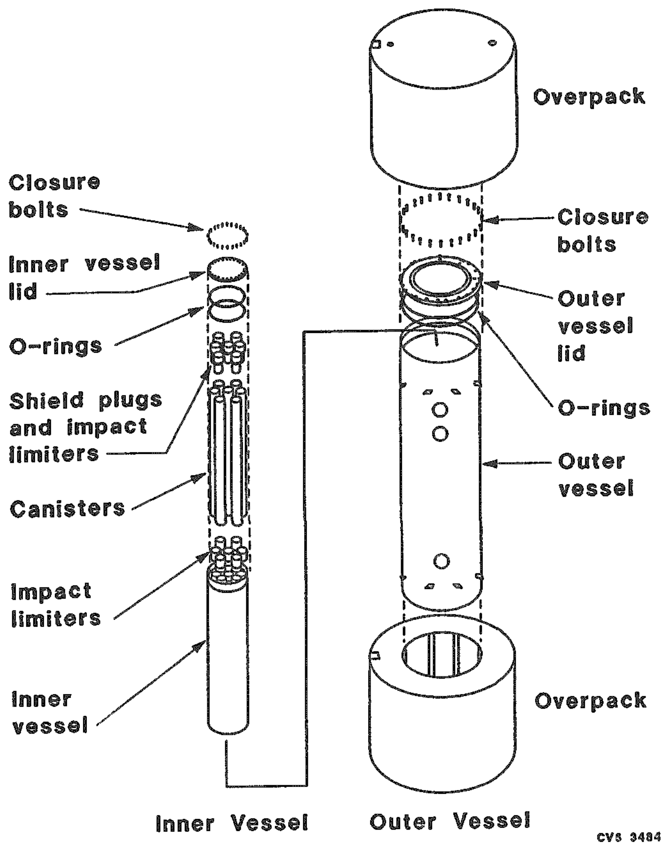

Fig. 3. Disassembled view of NuPac 125-B Rail Cask.

canister. DOE also described the sequence of loading each cask and certifying that the transport package was ready for conveyance to INEL.

Compliance with NEPA - Questions were directed to DOE concerning compliance with provisions of the National Environmental Policy Act (NEPA) of 1969 (PL 90-190) and also the necessity/logic of transporting TMI core debris to INEL for storage, research, and ultimate disposition at a federal repository. DOE is required (by PL 90-190) to consider the environmental impacts of its actions, including transporting TMI-2 core debris to INEL. DOE reviews such actions in accordance with regulations for implementing the procedural provisions of PL 90-190 published by the Council on Environmental Quality in the Federal Register [Vol. 43 (No. 230): 55978-56007] and DOE guidelines for compliance with PL 90-190 published in the Federal Register [Vol. 45 (No. 62):20694-20701], as amended. DOE concluded that transporting core debris from TMI falls within a categorical exclusion in DOE guidelines, which stipulates "Actions that are substantially the same as other actions for which the environmental effects have already been assessed in a NEPA document and determined by DOE to be clearly insignificant and where such assessment is currently valid." In reaching that conclusion, DOE considered (a) previous environmental analyses of irradiated fuel routinely transported by DOE via various transportation modes and (b) analysis of environmental effects and risks of transporting spent nuclear fuel by various modes discussed in the "Final Environmental Statement on the Transportation of Radioactive Materials by Air and Other Modes" (NUREG-0170) written and issued by NRC. NUREG-0170 also was used by the U.S. Department of Transportation and upheld by the courts to support a uniform national routing regulation for transporting radioactive materials (Highway Routing of Radioactive Materials, Docket No. HM-164). The U.S. Department of Transportation concurred with NRC that transportation of radioactive materials is a low-risk activity, by any level of comparison.

The "Final Programmatic Environmental Impact Statement on TMI-2" (NUREG-0683) by NRC indicated that TMI was unsuited environmentally for long-term storage and/or disposition of wastes (including the core) generated during the cleanup of Unit-2. The same document concluded that those wastes not acceptable for disposal at a commercial disposal facility should be sent to a federal installation for storage and research until repackaged or transformed into a waste form acceptable for either a commercial facility or federal repository, depending upon whether the waste form is low-level or high-level waste. Because DOE was, and is, the only agency of the federal government with installations suitable for handling, researching, and storing such radioactive wastes, it became the designee alluded to in NUREG-0683. Because INEL is one installation of DOE actively engaged in management and research of nuclear waste, as well as the only installation specifically dedicated to reactor behavior/safety research, it logically was targeted to receive the radioactive materials from TMI not suitable for disposal at a commercial disposal facility. Thus, DOE entered into contractual agreement with GPU Nuclear to receive, transport, research, store and/or dispose of certain, specified wastes from TMI. NRC, as regulator of the utility, was included de facto as a third party, although remaining free of any contractual obligations. The core debris canisters from TMI were designed for storage in a pool for as long as 30 years. After the federal repository is built and becomes operational, the core debris from Unit-2 will be transformed into a waste form acceptable to the repository.

At INEL, DOE has experimented with and studied the effects of loss-of-coolant accidents on numerous test reactors in order to understand reactor behavior during severe accidents. The incident at TMI was a severe accident; therefore, it was logical to assign INEL the responsibility of studying the core debris from Unit-2 and comparing it with smaller but similarly damaged cores at the laboratory. Results from the research will be used at INEL to refine safety computer codes and by national and international regulatory authorities in operating commercial nuclear reactors.

CONCLUSION

Despite all the the safety features designed and built into each transport package, multiple inspections of both the packages and trackage between TMI and INEL, attention to safety issues, and extensive prenotification to the states and public of DOE's planned actions, the official and public reaction to transporting the TMI core debris has been overwhelming. For those planning similar actions in the future, the lesson learned is this: It is not enough to materially and physically inform the populace before implementing such an action - resilience and dedication are required to weather the "storm of skepticism." Moreover, preparations for implementing the action should be above reproach. State and local governments are concerned about and actively involved in ensuring the safe transportation of radioactive and/or hazardous materials through their political jurisdictions, and rightly so. Moreover, both are sometimes ill-prepared to deal effectively with the public on how an emergency situation would be accommodated should one arise. That, combined with a generalized mistrust of governmental institutions, increases public apprehension. Consequently, before initiating a transportation campaign such as developed for the TMI core debris, a comprehensive educational effort involving state and local officials, news media, and public at large is mandatory.

Meticulous records of all informational transactions should be kept, and preparations must be in place for managing the large volume of official, public, and private inquiries that will follow announcement and commencement of a planned transportation campaign involving nuclear materials. After the exchange of information begins, there is a tendency by some more informed elements of the public to probe, via questioning, for indefensible or "soft spots" in the plans and regulatory compliance of the transport activity. Such probing has been ineffective in disrupting the transportation of core debris from TMI. The authors believe that the amount of information exchanged concerning transportation of the TMI core debris was as large as or larger than any exchanged previously on the subject of transport packaging (of radioactive materials). We also believe that some progress has been achieved to increase public confidence on transporting nuclear materials by rail.