FEB 1 0 1982

MEMORANDUM FOR: Chairman Palladino
Commissioner Gilinsky
Commissioner Bradford
Commissioner Ahearne
Commissioner Roberts

FROM: William J. Dircks
Executive Director for Operations

SUBJECT: TRANSPORTATION ARTICLE IN THE NEWSLETTER OF THE COUNCIL ON ECONOMIC PRIORITIES

This is in reply to a request from Commissioner Ahearne for staff comments on the recent newsletter of the Council on Economic Priorities dealing with spent fuel shipments.

Both NRC and DOT exercise control over the transport of spent fuel. Basically, NRC regulates the design, construction and use of the shipping casks, including proper loading of the casks for shipment. DOT regulates the actual transport of the material. This includes tie-downs, routing, vehicle and driver requirements, etc. DOT also prescribes the procedures to be followed in the event of a transportation accident involving radioactive materials. FEMA is the federal agency responsible for overall emergency planning and coordination.

The adequacy of NRC regulations for safe transport of radioactive material is reviewed and evaluated on a continuing basis. Most recently, in 1981, the NRC completed a comprehensive evaluation of its transportation regulations and concluded that "the present regulations provide a reasonable degree of safety and that no immediate changes in the regulations are needed to improve safety." The staff continues to believe the present regulations provide adequate protection for material moved in spent fuel casks. As part of its continuing review, the NRC has initiated several studies to consider the adequacy of the regulations and to identify possible improvements where appropriate. Enclosed is a list of various NRC studies currently underway which pertain to the safety of spent fuel shipments.

CONTACT:
C. E. MacDonald
42-74122

The article in the newsletter of the Council on Economic Priorities was apparently prompted by the new DOT regulations for routing of radioactive material shipments made by truck. Among other things, the article questions the safety conclusions in NRC studies and the standards to which spent fuel casks are licensed.

The staff reviewed the newsletter to identify the issues which were being raised. Those issues, together with the staff's comments are enclosed.

(Signed) William J. Dircks

William J. Dircks
Executive Director for Operations

Enclosures:
1. On-going Studies
2. Staff Comments

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Ongoing NRC Studies Related To Transportation of Spent Fuel

The Transportation of Radioactive Material to and from United States Nuclear Power Plants: Draft Environmental Assessment

The objective of this study is to assess the radiological impacts of transporting fresh fuel to, and spent fuel from, U.S. nuclear power plants. The assessment is for both normal and accident impacts. The report is presently in draft final form.

Modal Study of Radioactive Material Transport Safety

The purpose of this study is to develop possible package test standards representative of high severity accidents and to evaluate a range of post-test safety standards. The study will consider the types of environments that could be produced by severe accidents in each mode of transport. Various shipping containers will be physically tested to determine what level of safety standards would be feasible and practicable under these conditions. The study will also consider the risk from potential high consequence accidents, the cost-benefit of possible test standards and the effectiveness of various operational and administrative controls.

Emergency Response Guidance to the States

The objective of this program is to provide guidance to the states for developing emergency response programs for transportation accidents involving radioactive material. The project includes surveying existing emergency response capabilities, developing a model emergency response plan and providing a cost-effective guidance program to the states. The project is expected to be completed early in 1983.

Collection and Evaluation of Data on Radioactive Material Accidents and Incidents

The purpose of this program is to collect all available data on radioactive material accidents and incidents; and to prepare annual reports showing the number of incidents, to assess the radiological and economic consequences, and to provide data to states in support of their emergency response programs. The first annual report is expected in Spring 1982.

Transport of Radionuclides in Urban Environs

This effort was undertaken to assist the NPC in preparing a generic environmental impact statement on the transportation of radioactive material near, in, and through a large densely populated area. The generic environmental impact statement will consider such unique facets of the urban setting as:

(1) High population density: Heavy pedestrian traffic; diurnal variations in population; and horizontal vertical distribution.

(2) Unique transportation environment: Convergence of transportation routes; heavy traffic; many users and holders of radioactive materials; and different safeguards environment.

(3) Special effects: Effects of local and micrometeorology, and shielding effects of buildings.

Emphasis will be placed on radiological health effects, but all environmental impacts, both radiological and nonradiological, will be assessed.

Development of Regulatory Guides

The staff has a continuing program to develop regulatory guides in the area of transportation. At present, three guides for spent fuel casks are in various stages of development; these are: (1) fracture toughness criteria for cask materials, (2) acceptable procedures for fabrication and construction, and (3) development of a design and construction code for spent fuel casks. The latter project is being conducted in conjunction with the ASME Boiler and Pressure Vessel Code Committee.

Staff Comments on
Council on Economic Priorities
Transportation Article

1. An accident while trucking through a city could cost thousands of lives and tens of billions of dollars.

The basis for the statement that an accident involving irradiated nuclear fuel which could cost "thousands of lives and tens of billions of dollars," is not known. The NRC environmental statement, "Transportation of Radioactive Material by Air and Other Modes," NUREG-0170, December 1977, characterizes a very severe urban accident involving an irradiated nuclear fuel truck cask as having the potential for less than 1/2 latent cancer fatality and costs of 200 million dollars. The assumed population density for the analysis was the average urban density of New York City, 15,444 people per square kilometer. The probability of such an event is listed as 2×10^{-8} per year for the spent fuel traffic expected in 1985.

The NRC/Sandia urban study, "Transportation of Radionuclides in Urban Environs: Draft Environmental Assessment," NUREG/CR-0743, July 1980, estimates one latent cancer fatality and a $2 billion dollar cost for a worst case accident involving spent fuel in New York City with an associated annual probability of about 1.4×10^{-10}.

Enclosure 2

2. New DOT regulations direct material to be transported by truck on the most direct interstate routes, even if these routes traverse metropolitan areas.

DOT regulations do not preclude shipment by modes other than truck. When shipments are made by highway, the regulations require the shipment to be routed by the most direct interstate routes. The rule also provides that large quantity shipments, including spent fuel, must be routed around a city whenever an interstate bypass or beltway is available. In addition, DOT permits states to designate alternate routes when those routes are demonstrably as safe as the routes specified in the DOT rule.

3. DOT regulations will preempt current local and state ordinances.

DOT has listed as an appendix to its routing rule those type of state and local ordinances which it considers to be inconsistent with federal regulations. This finding of inconsistency is expected to provide a basis for preemption if the state or local ordinances are challanged.

4. According to DOT, a transportation accident leading to radiation release and just one cancer fatality could occur only once every 25 million years. Is the probability this remote?

NRC studies indicate that the probability of a latent cancer fatality from accidents involving shipments of spent fuel is remote. NUREG-0170 specifies an annual probability of 4.2×10^{-4}, based on 1,500 shipments per year. This is comparable to a frequency of one latent cancer fatality in 2,400 years.

We have not been able to identify where, or if, the one in 25 million year estimate has been used by DOT.

5. A low speed accident in an urban area could unseat a valve, releasing radioactive steam and vaporizing the coolant. This would cause the fuel to heat up further and release more volatile radionuclides such as cesium.

It is possible that a relief valve could fail to reseat as a result of a low speed accident. However, the effects of such an event have been evaluated. An analysis for the potential for release of cesium from a rail cask shipment of 7 PWR fuel assemblies has been performed for an accident that exceeds the design basis accident (NUREG-0069, "Potential Releases of Cesium from Irradiated Fuel in a Transportation Accident," July 1976). The evaluation, in which the relief valve was assumed to remain open so that the cask is vented to the atmosphere, showed that potential releases of volatile fission products were consistent with estimates in the environmental survey (WASH-1238, "Environmental Survey of Transportation of Radioactive Materials to and from Nuclear Power Plants," December 1972). It was concluded that no more than 3 curies of cesium could be released, and that the potential cesium release from this postulated accident did not significantly increase the risk to public health and safety above that already estimated (14 rem from inhalation to the maximum exposed individual) in WASH-1238. It should be noted that due to weight limitations, highway casks would be limited to 3 PWR fuel assemblies. The estimate of release of cesium is also supported by a more recent study (NUREG/CR-0722) discussed in Item 16.

6. Because of a faulty valve, four GE rail shipping casks were voluntarily removed from service, June 1981.

In June 1981, the General Electric Company notified the NRC that it was voluntarily limiting the use of its four Model No. IF-300 shipping casks. Future shipments would only be made with a dry cask cavity; no coolant (water) would be present in the cavity during shipment. This was because of a problem with a relief valve.

The valve is designed to open in the event of an accident and, after relieving internal pressure within the cask, to reseat and reseal. The problem with the valve centered upon whether it would meet specified leakage limits after reseating.

When liquid coolant is excluded from the cavity (i.e., dry shipment), the internal pressures would not be sufficient to cause the relief valve to open and thus its reseating performance is not important to safety. Liquid coolants will not be used in the cask until NRC agrees the problem has been satisfactorily resolved.

This potential problem is not generic to other spent fuel casks because no other cask is equipped with a valve which is intended to reseat.

7. Government reports show that a 1/2-hour, 1850°F fire could cause the seal and pressure relief valve to fail, causing release of coolant and radioactive material.

Casks are permitted to release water coolant under accident conditions if the activity of the coolant is within federally allowed limits. The case in which the cask is vented to the atmosphere is discussed in Item 5, above. Fire temperatures are discussed in Item 22.

8. Failure of relief valves was not considered by DOT. NRC studied the less likely possibility of actually breaking the cask.

The DOT did not specifically consider failure of relief valves in the routing rule but it did consider packaging standards. The NRC considers possible failure of relief valves in licensing evaluations of specific casks. The NRC has also considered loss of coolant, as would occur in the event of valve failure or malfunction, in generic environmental studies (NUREG/CR-0743, WASH-1238 and its supplement NUREG-0069, see Item 5).

9. The study accepted by NRC for truck accident speeds based its data on phone calls to three city police departments.

The study referred to, NUREG/CR-0743, July 1980, is a contractor's draft report prepared to assist the NRC staff in formulating a draft environmental impact statement on the transport of radionuclides in urban environs. This report is now under staff review and has not yet been accepted by NRC. The contractor's draft report uses an accident severity categorization scheme developed in NUREG-0170, which is based upon a detailed statistical study of accident severities and probabilities (SLA-74-0001, September 1976). The accident severity categorization scheme was supplemented by additional data including information obtained by phone calls to three city police departments in high density urban areas. The collection and statistical treatment of accident data upon which the report is based represents the state-of-the-art for estimating accident speeds and conditions and is not based solely or principally on the phone calls as noted in the CEP Report.

10. Routing shipments along interstates through urban areas will increase the probability and consequences of an accident. 76% of all truck accidents occur in urban areas and the urban accident rate is about 30 times the national average for all truck accidents.

The staff agrees that about 76% of all truck accidents occur in cities. Further, our figures seem to show that the urban accident rate is about 15 times higher than the overall accident rate. Nevertheless, the statement "routing shipments along interstates through urban areas will increase the probability and consequences of an accident" does not follow from available facts. The probabilities of some accidents may increase, but others will decrease. Also in those accidents for which consequences increase, probabilities decrease. The severities of the accidents in cities is generally less than elsewhere. Although about 3/4 of the truck accidents occur in cities, one study (Heavy Trucks, Fatal Accident Reporting System, NHTSA, USGPO, 1977) shows that only 1/4 of fatal truck accidents occur in cities. The frequency of accidents on interstate highways is less than on other types of roads. Only 5% of fatal accidents occurred on urban portions of interstate roads, while 19% occurred on urban portions of other road types. Because of differences in population density and property values, the consequences of a given accident will usually be higher in an urban area than in a rural area, but the likelihood of a severe accident in an urban area is much less than in rural areas.

11. CEP predicts four nuclear transport accidents per year in the 1990's and 17 accidents per year by the turn of the century. Three a year will occur in cities in the 1900's and rise to 13 annually by the year 2000.

Based upon a projected 1.43×10^6 shipment-miles of spent fuel in 1990 and 6.68×10^6 shipment-miles in 2000, the estimate of 17 traffic accidents per year appears plausible. The large majority of these will be relatively minor traffic accidents which would not challenge the integrity of spent fuel casks (see Item 19). NUREG/CR-0743 estimates 94% of urban truck accidents involving spent fuel cause no release of radioactive material. The risk from severe accidents having a potential to cause release is estimated to be small.

12. Of all transport options, NRC considers barge transport to be the safest, yet this is precluded by DOT regulations.

The NRC has not established barge transport as the safest mode. DOT regulations, including the new routing rule, do not preclude the use of barge transport. Both NRC and DOT consider barge, as well as other modes of transport, to be adequately safe for radioactive material.

13. Following an accident, the temperature of irradiated fuel will determine the extent to which volatiles would be released. "It is quite possible that irradiated fuel will reach temperatures greater than 670°F causing more cesium to be released with the steam and hot air."

Following an accident, fuel temperatures could exceed 670°F; however, this does not mean that significant amounts of cesium would be released. It is possible that the fuel cladding could potentially fail as a result of an accident. However, clad failure alone does not lead to cesium release. As indicated in Item 16, the fractional release for cesium is 0.3%. Because the cask interior is at a much lower temperature than the central fuel pins, most of the cesium released from the fuel pins is expected to plate-out and be contained within the spent fuel cask. The possible release for a breached containment vessel has been considered for a rail shipment of 7 PWR fuel assemblies, and the maximum release was estimated to be less than 3 curies of cesium (NUREG-0069, see Item 5).

14. Under calm meteorlogical conditions, with a 10% release of cesium, hundreds to thousands of early deaths could occur within 1/4 mile of the accident. Outside the 1/4 mile area, delayed cancer fatalities would result if anyone remained in the area. Assuming 100,000 people per square mile did stay, 50,000 latent cancers would develop. An area of 1/2 square mile would be off limits to people for several hundred years.

In NUREG/CR-0743, a sabotage event in a city considered a 0.28% respirable release from a 15KCi cesium source (a respirable release of 0.042KCi). This compares well with a 10% release (0.052KCi) from a typical truck cask, as assumed in the CEP analysis. This study found no early fatalities or injuries and 5 to 9 latent cancer fatalities; this estimate is consistent with NRC staff estimates. Without more detail on how an estimate of "hundreds to thousands of early deaths" was obtained, we cannot explain this CEP estimate. However, the NRC staff believes the CEP estimate to be excessively high. Furthermore the NRC staff believes, as documented in a May 2, 1980 letter* to Dr. Resnikoff, that a 10% release of cesium from the cask inventory is excessively high. The basis for the CEP assumption that a 1/2 square mile area would be off limits for several hundred years is not given. Even if a release of this magnitude were to occur it is not clear why decontamination procedures could not be performed.

*A copy of the May 2, 1980 letter from the staff to Dr. Resnikoff is attached.

15. Based on the assessed value of Manhattan property, damages could reach billions of dollars. No private property is insured against this loss. An NRC study put the maximum economic consequences on the order of $2 billion, a gross underestimate.

NUREG/CR-0743, the draft environmental assessment on urban transport prepared by an NRC contractor does estimate $2 billion costs from a severe spent fuel accident in Manhattan. The NRC staff has been evaluating this cost estimate and has found instances of great overestimation as well as large uncertainties. Although large uncertainties do surround this NRC contractor cost estimate, the NRC staff has no reason to believe that it is a gross underestimate.

16. The NRC questions whether a 10% release of cesium is realistic. However, in light of observations at TMI, a 10% release of cesium in a highway accident is conservative.

As detailed in the letter of May 2, 1980 from the NRC staff to Dr. Resnikoff, the observations at TMI, specifically the occurrence of a clad-steam chemical reaction, do not appear to be relevant to the far lower temperatures, smaller masses, and different configuration involved in a spent fuel transportation accident. A February 1980 study by ORNL "Fission Product Release from Highly Irradiated Fuel," (NUREG/CR-0722) based on a series of experiments on irradiated fuel, simulating a cask loss of coolant accident, finds a fractional release of 0.3% for cesium. This is the release from the fuel elements, not from the cask. The amount released from the cask is expected to be much less, because of plate-out on the interior of the cask. In summary, the NRC staff, for the reasons cited in the staff letter to Dr. Resnikoff and on the basis of the new, experimental data in NUREG/CR-0722, believes a 10% release fraction for cesium is excessively high.

17. Local departments of health and fire and police departments are not trained or equipped to cope with emergencies of this magnitude. Also, local communities are not prenotified of shipments.

The federal agencies responsible for developing guidance and planning for transportation accidents involving radioactive material are DOT and FEMA. Both agencies have ongoing programs directed towards improving emergency response capabilities. This includes training of state and local emergency response personnel. In addition, DOE maintains a radiological assistance team which is available to advise and assist local authorities at the scene of an accident.

With regard to prenotification, NRC regulations were recently amended to require licensees to provide advance notification of spent fuel and nuclear waste shipments to state governors or their designees. This requirement becomes effective in July 1982.

18. It is often unclear who has the authority and responsibility for cleanup and protecting public health and safety in an emergency, a confusion which compounds the hazard.

In the event of a transportation accident involving radioactive material, those aspects of the accident which do not involve radioactivity (e.g., traffic control, fire fighting, etc.) are the responsibility of the state or local agency normally responsible for those occurrences. The radiological aspects to protect the health and safety of the public are the responsibility of state government.

19. Shipping casks should be designed to withstand all likely accidents. The present standards are unchanged since 1961 and are inadequate.

Shipping casks are designed to criteria which make the casks resistant to all likely accidents and most unlikely accidents as well. A Sandia Laboratories Study, SAND 77-0001, "Severities of Transportation Accidents Involving Large Packages," dated May 1978 supports the view that the present test standards provide protection for large, heavy, spent fuel casks against a high percentage of road and rail accidents. An ongoing Commission study, referred to as the Modal Study, is identifying the characteristics of transportation accidents at the upper end of the severity scale to determine whether NRC standards should require protection against very severe accidents on a cost-effective basis.

20. The 30-foot drop test is equivalent to a 30-mph crash into an unyielding barrier. According to NRC's own statistics, fewer than 1/4 of truck accidents occur at less than 32 mph.

It is not valid to compare a 30 mph impact of a spent fuel cask into an unyielding surface with the crash of a vehicle carrying that cask at the same speed. The crushing of the truck cab, and the energy absorbed in the trailer, in breaking the tiedown devices, in rotary motion, and in demolishing most of the objects in the path of the cask, all serve to reduce the amount of energy available to damage the cask. With the very few objects available which would represent an unyielding surface to a spent fuel cask, the impacting surface in most accidents will yield considerably. While these considerations do not provide absolute assurance of cask survival in all accidents, they serve to make cask failure in an accident unlikely.

21. Government documents show that if a shipping cask were to strike a bridge abutment sideways at 12.5 mph, the cask would lose coolant and radioactivity.

This apparently refers to a 1978 report, PNL-2588, prepared for the Department of Energy by Pacific Northwest Laboratory. In that report, various failure thresholds were estimated for a generic "reference" cask. One case considered in the report was side-on impact of the reference cask into a column, such as a bridge support. The report estimated the failure threshold could be as low as 12.5 mph for the worst case of geometric alignment between the cask and the column.

The estimate, made as part of a risk analysis, was based upon several conservative assumptions. Principal among these was assuming the column to be perfectly rigid and capable of developing the very high forces required to fail a cask without the column itself being subject to failure or deformation. The report also neglected other possible sources of energy dissipation such as crushing of the tractor-trailer equipment.

The report notes the estimates are less than the actual strength of the cask if tests to failure had been performed. The report also notes the failure threshold estimate should not be used as an assessment of cask integrity for purposes other than performing a risk analysis.

This type of impact is not directly covered in the present cask test standards. The extent (if any) to which the standards should reflect this type load will be considered in the Modal Study of Transport Safety currently being conducted by the NRC. (The Modal Study is described in the staff comments in Item 19.)

22. Shipping casks are designed to withstand a fire of 1/2 hour at 1475°F, yet the average temperature of a fire, according to government reports is 1850°F and many burn considerably hotter and longer.

The regulatory design test is a 1/2-hour exposure to a thermal radiation source of 1475°F, having an emissivity of 0.9. The effect of this test is equivalent to a seemingly hotter 1/2-hour hydrocarbon fuel fire (e.g., gasoline, kerosene). A real fire would not be uniformly at 1850°F, it would exhibit a temperature distribution with a peak temperature averaging around 1850°F. The local temperatures depend on ventilation (i.e., available oxygen) and the presence of massive cooling surfaces (i.e., heat sinks). Ventilation would tend to increase flame temperatures; massive cooling surfaces would absorb heat and tend to decrease flame temperatures. A large fire surrounding a cask would have a peak temperature some distance away from the massive cask. The fire would have to be large to engulf the cask, making ventilation poor. It has been shown that packages respond to the regulatory 1475°F fire about the same as they do to real hydrocarbon fires (Bader, B.E., "Heat Transfer in Liquid Hydrocarbon Fuel Fires," Proceedings International Symposium for Packaging and Transportation of Radioactive Materials, January 12-15, 1965).

The remaining question is the fire duration. The probability of exceeding the 1/2-hour fire in an accident has been studied and found to be small (WASH-1238, December 1972). In addition, casks are massive and generally insensitive to a fire's total heat.

23. Not all accidents are modeled in NRC standards (e.g., crush loads and torch fires).

It is not necessary to model all accidents in the regulatory package standards, as long as the standards result in packages which will survive most transportation accidents. Accident crush forces are a good example since there is no specific regulatory accident crush test. An NRC sponsored study of accidental crush forces "Potential Crush Loading of Radioactive Material Packages in Highway, Rail, and Marine Accidents," NUREG/CR-1588, dated October 1980, concludes that for packages such as spent fuel casks the regulatory impact test assures a level of protection against accidental crush forces at least as high as the level of protection provided against accident impact and puncture forces. Adequate crush resistance is therefore provided without the need for a specific crush test.

The potential for torching fires and fires involving materials other than hydrocarbons are well known. Because of the relative infrequency of heat sources with temperatures higher than large hydrocarbon fires, the small probability of such localized heat sources interacting with a spent fuel cask, and the relative ineffectiveness of a local heat source on a massive spent fuel cask, local torching fires are not directly represented in NRC standards, but will be considered by the ongoing NRC Modal Study for inclusion in the standards on a cost-effective basis.

24. No casks moving on the highways or rails have actually been physically tested. Reliance on computer analysis rather than physical testing presents problems because of the simplifying assumptions which must be made.

The report is accurate in that full-scale physical tests have not been conducted on casks that are presently being used. However, the NRC does require applicants to demonstrate that proposed cask designs meet NRC safety standards. This demonstration may be by means of full-scale testing, scale model testing, engineering analysis, or a combination of these methods.

The use of engineering analysis techniques, including computer modeling, is a well established and verified engineering practice. A number of computer programs are available and have been used by engineers to accurately model a variety of different systems and to successfully predict their performance under specified conditions. Simplifying assumptions of a conservative or bounding nature are routinely used to reduce the amount of analysis required to obtain necessary results.

Although casks in current use have not been subjected to full-scale physical tests, a number of obsolete casks have been tested by DOE. In one test, a truck carrying a cask was deliberately placed in the path of a speeding locomotive. The 120-ton locomotive struck the cask at a

speed of 80 miles per hour. In another test, a cask aboard a truck moving at about 80 miles per hour was deliberately crashed into an immovable concrete structure. Subsequent examination in both tests indicated that no radioactive material would have been released if the casks had been loaded with spent fuel. In addition, the observed test results were in good agreement with the engineering evaluations made before the tests were conducted.

25. The industry quality control and NRC inspection programs have been highly inadequate.

Since 1979, the NRC has required its licensees to apply quality assurance (QA) programs to the design, fabrication and use of shipping containers. Design and fabrication of shipping containers after the effective date of the rule must be in accordance with an NRC approved QA program. NRC licensees are required to maintain and use radioactive material containers in accordance with an NRC approved QA program. This has resulted in increased inspections by both the NRC and users of the packages. Several deficiencies in package construction have been found and corrected.

26. There is reason to believe that the Model No. NFS-4 casks have faulty welds and wrong metals (copper) and have bowed or slumped in the middle and had to be reinforced with copper plates which were installed without NRC review and permission.

In 1979, Nuclear Assurance Corporation informed the NRC that one of its casks deviated from the design approved by the NRC. The deviations consisted of a small region of reduced lead shielding and the inner shell being bowed along its length so that it was outside the straightness limit specified on the drawings. Copper plates had been welded to the outer shell of the cask to provide additional shielding to compensate for the region of reduced lead shielding, not to provide additional strength.

Upon receiving this information, the NRC ordered all casks of this design withdrawn from service until it could be determined that the casks were fabricated properly and met NRC requirements. Subsequently, the inner shells of three other Model No. NFS-4 casks were found to be outside the straightness limit specified on the drawings.

The casks whose shells did conform to the drawing specifications were returned to service with restrictions placed upon their contents and operating conditions. Those casks whose shells do not conform to the drawings remain out of service pending a demonstration of adequacy by the licensee.

Based on inspections performed by IE, there are no indications that structural materials other than those approved by the NRC were used to fabricate the casks. The copper plates are a shielding material and are not used for a structural purpose. Also, the cask welds were inspected following accepted procedures and there are no indications that the welds are faulty.

27. Standards for cask construction have not yet been set down by ASME. For lack of specific standards, ASME boiler standards are used.

ASME standards for pressure vessels, including nuclear reactor vessels, are contained in the "ASME Boiler and Pressure Vessel Code." Design criteria for spent fuel casks are given in Regulatory Guide 7.6. The criteria in this document were adapted from Section III of the ASME Code for Class I nuclear vessels. Section III is being used by a newly formed ASME Committee to develop specific standards for spent fuel casks.

28. DOT has no special requirements for trucks and drivers. Neither NRC nor DOT inspect the vehicles and tie-downs holding shipping casks.

DOT has extensive safety requirements applicable to vehicles and drivers of hazardous material shipments, including shipments of spent fuel. Specific requirements for emergency response training of drivers of vehicles carrying large quantities of radioactive materials were included in the DOT routing rule. DOT has a nationwide field inspection force charged, among other things, with inspection of drivers and vehicles.

29. NRC studies (NUREG-0194) underestimate the number of early fatalities because people within 1/4 mile are not considered and 90% of persons within 10 miles are assumed to be evacuated within 4 hours. Granting these assumptions, a rail accident in New York City still projects up to 4,100 early deaths and 680,000 latent cancer fatalities.

The source term used in the CEP evaluation is unrealistically large for a transportation accident, since it assumes 100% release of cesium (see response to Item 16, above). The CEP evaluation is also based upon an improper extrapolation of consequence estimates to the high population densities in a city.

The model used to estimate public health consequence in NUREG-0194, which is essentially the same as that used in the Reactor Safety Study, does make the assumptions described by CEP. However, these assumptions do not substantially effect the consequence estimate in that report and do not invalidate its conclusions. For extrapolation to urban areas, however, the cautionary language in the Addenda to NUREG-0194 is important: "The population environment is modeled by a uniform population density. The value of 100 people/mi^2 chosen for these calculations slightly overestimates the average density in the conterminous United States; radiological consequences for different values of population density may be estimated by linear scaling provided that caution is applied for urban densities. These calculations do not include considerations of release kinetics, buildings, evacuation, or decontamination, all of which are important for urban situations and which presumably tend to decrease the calculated consequences."

In NUREG/CR-0743, near field effects not treated in NUREG-0194 were considered. But even in the case of a sabotage event involving a sizeable cesium source term (see response to Item 14), no early fatalities were estimated.

30. Another NRC study, the TRUE study, uses unrealistically low estimates for radiation release and assumes only corrosion products will be released along with gaseous radionuclides, but no cesium.

The release estimates made in NUREG/CR-0743 (i.e., the "TRUE" Study), attempt to be realistic but are probably conservative, based upon physical test data and engineering analysis. Several sources of evidence, including an explicit analysis in NUREG/CR-0743, indicate that the addition of an appropriately small amount of cesium (such as 0.3% - see response to Item 16) would not effect consequences in a detectable manner.

References Cited in Staff Comments

WASH-1238	"Environmental Survey of Transportation of Radioactive Materials To and From Nuclear Power Plants," December 1972
NUREG-0069	"Potential Releases of Cesium from Irradiated Fuel in a Transportation Accident," July 1976
NUREG-0170	"Final Environmental Statement on the Transportation of Radioactive Material by Air and Other Modes," December 1977
NUREG-0194	"Calculations of Radiological Consequences From Sabotage of Shipping Casks for Spent Fuel and High-Level Waste," February 1977
NUREG/CR-0743	"Transportation of Radionuclides in Urban Environs: Draft Environmental Assessment," July 1980
NUREG/CR-1588	"Potential Crush Loading of Radioactive Material Packages in Highway, Rail, and Marine Accidents," October 1980
NUREG/CR-0722	"Fission Product Release From Highly Irradiated LWR Fuel," February 1980
NRC Regulatory Guide 7.6, Rev.1	"Design Criteria for the Structural Analysis of Shipping Cask Containment Vessels," March 1978
SLA-74-0001	"Severities of Transportation Accidents," Change 1, September 1976.
SAND 77-0001	"Severities of Transportation Accidents Involving Large Packages," May 1978
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