UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter of	)	
	)	
DUKE POWER COMPANY	)	
	)	
(Amendment to Material License SNM-1773 for Oconee Nuclear Station Spent Fuel Transportation and Storage at McGuire Nuclear Station)	)	Docket No. 70-2623

TESTIMONY OF JACK D. ROLLINS

I. Background and Experience

I am Vice President of Nuclear Assurance Corporation (NAC). I have been with NAC since 1970. In my present capacity I have management responsibility for all engineering-related services of the company. In previous positions within NAC I had overall management responsibility for the design, licensing and fabrication of the company's four NAC-1 spent-fuel shipping casks.

Prior to joining NAC I had the following experience:

--Nuclear Fuel Services, Inc., as project manager in charge of fuel reload development projects and all of the company's engineering activities on spent-fuel cask design, licensing, fabrication and transportation, as well as engineering projects for the West Valley reprocessing facility. Specifically, was responsible for design, licensing, and/or construction and testing of NFS-3, NFS-4, and NFS-5 casks. Also was in charge of engineering review of planned large rail cask designs.

514 129

369 112

--Oak Ridge National Laboratory, having overall responsibility for the lab's development program on LMFBR spent-fuel shipping casks including design and testing of all-steel shielded casks for multiple fuel assembly shipment.

--Battelle Memorial Institute as associate division chief, with management responsibility for all the division's nuclear projects including spent fuel cask design, licensing, and fabrication. Managed projects on design and licensing of PRDC-1, NFS-100, BCL 1-4, and SNAP-27 casks.

--Pratt & Whitney's Connecticut Aircraft Nuclear Engineering Laboratory (CANEL) as senior engineer in nuclear space systems.

I hold a B.S. degree from the University of Tennessee, an M.S. from Ohio State University, both in nuclear engineering, and a diploma from the Remington Rand computer school. I participate each year as a lecturer on Transportation of Radioactive Materials in Georgia Institute of Technology's Nuclear Power Safety Short Course (sponsored by the School of Nuclear Engineering). I have served for numerous years as a member of the American National Standards Institute (ANSI) N14 subcommittee on the Transportation of Fissile and Radioactive Materials. I have also served on the committee responsible for reviewing International Atomic Energy Agency regulations pertaining to transportation of radioactive materials. I have contributed on the heat transfer, shielding

and criticality sections of the "Cask Designers Guide-NSIC-68". I have also authored numerous publications and papers on spent fuel casks and related transportation.

II. Design, Fabrication, and Licensing of NAC Casks

A. NAC-1 Cask

1. History of NAC-1 Cask Development

In 1972 Nuclear Fuel Services, a fuel reprocessing company, designed and licensed a spent fuel shipping cask. This cask was designated the NFS-4. NAC acquired the design rights to the cask from NFS in 1973. Casks fabricated under the NFS quality assurance program continue to be designated as the NFS-4 whereas casks fabricated under the NAC quality assurance program are designated the NAC-1. A total of two NFS-4 casks and five NAC-1 casks have been fabricated. All of these casks except one have been put into operation. The NAC-1 casks have completed approximately 320 spent fuel shipments involving more than 800,000 miles of over-the-road travel. Additionally, these casks have been used on site at the Oconee Nuclear Station and at the Turkey Point Nuclear Plant for the transfer of some 384 fuel assemblies between fuel storage pools. Service experience has been good.

2. Description of Cask Design and Components

a. Design Configuration

The NAC-1 cask has an overall length of 214 inches, and an outer diameter of 50 inches. The internal cavity has a length of 178 inches and a diameter of 13.5 inches. The cask is classified as a Legal Weight Truck (LWT) cask in that its 50,000 pound loaded weight results in a gross vehicle weight (GVW) of less than 73,280 pounds. Basic construction consists of a 6-5/8 inch thick annular lead gamma shield enclosed inside and outside with stainless steel shells of 5/16 inch and 1-1/4 inch thickness, respectively. Outside the gamma shield is a 4-1/2 inch thick neutron shield consisting of a liquid solution of borated water and antifreeze. This shield region is bounded on the outside with a stainless steel shell. The latter shell is smooth and unfinned in that it provides sufficient surface area to dissipate the design decay heat load of 11.5 kw.

b. Functional Components

Closure of the cask is effected by means of a shielded lid that is retained by high strength bolts. The lid is doubly grooved to accommodate two teflon o-rings which provide sealing of the internal cask cavity when the lid is attached to the main cask body. Multiple valve-type drain closures are incorporated to facilitate flushing during cask handling. Drop protection is provided

by disc-shaped, stainless steel sheathed, balsa impact limiters at the upper and lower extremities of the cask. These components, the upper of which is removable to provide access to the lid, are designed to crush on impact, thereby absorbing large amounts of kinetic energy. Positioning and support of the fuel within the cask is accomplished by means of an internal stainless steel basket.

3. Description of Fabrication

a. General Procedures and Methods Used.

Fabrication of the casks was performed at a qualified facility using certified materials, written manufacturing procedures, ASME code-qualified welders and non-destructive testing inspections and examinations. Extensive acceptance testing was performed on each cask following completion of fabrication. The acceptance tests included a gamma scan of the cask shielding, helium leak tests of the cask cavity, the neutron shield tanks and the impact limiters followed by hydrostatic tests of the cavity, the neutron shield tanks and the closure o-ring seals. Each cask was subjected to a thermal test using a heat source equivalent to the rated decay heat capacity of the cask. The cask lifting trunnions were load tested to twice their design static load. Acceptance criteria required satisfactory completion of each test under the specified test conditions.

b. Quality Assurance (Q.A.) Considerations

All cask fabrication was performed in accordance with the then AEC approved Q.A. program designed to comply with the applicable regulatory documents, 10CFR50, Appendix B and the at-that-time proposed 10CFR71, Appendix E. Manufacturing, inspection and test programs were established in accordance with the provisions of the Q.A. program. Manufacturing procedures, material certifications and inspection results were documented and maintained in the fabrication records. Q.A. Audits were performed by NAC and by the NRC during cask fabrication as independent checks

4. Licensing

A formalized procedure exists whereby the safety of a given cask design such as the NAC-1 may be validated. This procedure consists of preparation by the license applicant of a detailed safety analysis report (SAR) followed by submittal to and review by the USNRC and, where successful, ending in the issuance of a certificate of compliance (license) for the cask. Compliance in this case denotes that the design has met the requirements of Title 10 of the Code of Federal Regulations, Part 71, in accordance with which the safety analysis was performed and the Regulatory review conducted. The salient parts of 10CFR71 wherein the regulatory requirements are delineated include specifically: Appendix A, Normal Conditions of Transport; Appendix B, Hypothetical Accident Conditions; and Appendix E, Quality Assurance Criteria. Consideration of the latter (QA) criteria is given in 3(b) above and will not be further discussed here. However, a listing of the normal and accident conditions to which the cask has to be subjected (under test or analysis) is essential to appreciating the degree to which the safety of the cask is evaluated. Accordingly, the following excerpts from Appendix A and B of 10CFR71 are noted, respectively:

Normal Conditions - The cask is subjected separately to conditions of heat (130° F), cold (-40° F), pressure (0.5 times atmospheric pressure), vibration, water spray, free drop (1 ft.) corner drop (1 ft.), penetration (projectile impact), and compression to determine damage effects.

Hypothetical Accident Conditions - Conditions applied sequentially, in the order indicated, to determine their cumulative effect on the cask are a free drop from 30 feet onto an unyielding horizontal surface (in position of maximum damage occurrence), a 40-inch drop puncture test onto a 6-inch diameter bar, exposure to a (thermal) radiation environment of 1475° F for 30 minutes, followed by immersion in 3 feet of water for at least 8 hours.

Certificate of Compliance Number 6698 is evidence that the NAC-1 cask is fully compliant with the applicable 10CFR71 regulations which means that its performance under subjection to the aforementioned conditions has been officially recognized and approved.

369 ~~119~~

514 136

III. Radiation Levels Resulting from Normal Transportation of Oconee Fuel Using the NAC-1 Cask

A. Overview and conclusions

The NAC-1 cask is designed to meet the dose rate restrictions of 49CFR 173.393. Actual measurements on hundreds of fuel shipments indicate that the regulations are adequately met.

B. Radiation Levels on Contact and Other Locations

Dose rates normally are taken at the surface of the vehicle and at six feet from the vehicle. These dose rates have to comply with the respective limits of 200 millirem per hour and 10 millirem per hour as specified in 49CFR 173.393. Corresponding does rates as measured at the Oconee Nuclear Station were of the order of 20 to 40 millirem per hour at the surface of the cask and 2.5 to 3 millirem per hour at six feet from the truck. Although the dose rates vary with fuel burnup and cooldown time, readings taken on fuel shipments from other stations are consistent with the values from Oconee.

Dose rates at other distances from the cask may be calculated based on a distance ratio relationship.

IV. Analysis of NAC-1 Cask During Accident Conditions

A. Overview and Results of NAC

In accordance with USNRC licensing requirements (see Section II.A.4 above) the NAC-1 cask has been fully analyzed for performance under hypothetical

accident conditions (as defined in 10CFR71, Appendix B). The above conditions represent the performance criteria to which all casks that are candidates for a license have to be subjected. These are not meant to represent actual conditions encountered in transport but rather represent conditions under which cask survival would indicate the likelihood of success under actual conditions. They represent a safety standard whereby all casks of varying design features can be compared.

B. Application of Sandia "Crash Tests" to NAC-1 Cask

1. Comparison of Casks used in Test with NAC-1

The truck casks used in the Sandia tests were basically similar in construction to that of the NAC-1. However, the NAC-1 casks were subjected to a more stringent quality assurance program.

2. Improvement in Design in NAC-1 Generation Cask with Ones Used in Sandia Tests

The main design improvement is in the use of impact limiters which, of course, were added to the Sandia casks to better represent the NAC-1 generation of casks. This is not to imply that the actual casks tested were less safe but rather represents the evolution in cask design technology based on additional accumulation of experience.

V. Current Developments

NRC Show Cause Order

During an internal quality assurance audit for four-year-old cask manufacturing records, NAC found that during fabrication of one of the NAC-1 casks (NAC-1A), a manufacturing deviation from the approved design had occurred. A manufacturing modification had been made to rectify the deviation but approval of the modification by the then AEC regulatory group was not obtained. NAC reported this information to the USNRC on March 29, 1979 and immediately commenced an evaluation of the deviation. At that same time, NAC-1A cask was withheld from public transportation service.

Subsequently, on April 6, 1979, the NRC's Office of Nuclear Materials Safety and Safeguards issued an order suspending the operating license of all NFS-4/NAC-1 casks until the quality assurance records for all casks were reviewed, the interior cavities of all the casks of this design were remeasured and it was demonstrated that each cask was in compliance with the design approved.

569 122

Fully complying with the NRC order, all casks were removed from service. A meeting was held with the NRC to discuss their concerns and to review with their personnel the actions NAC proposed to take in response to their order. The quality assurance review which had been initiated earlier was continued covering all records both in-house and at the cask manufacturer's plant. A gaging system was developed and detailed measurements were

514 139

taken of the cavity inner shell for all the casks. Structural calculations of the characteristics of the casks were initiated by NAC with the assistance of an independent engineering consulting firm to ascertain that the casks would meet all regulatory requirements for both normal and accident conditions.

At the time of this writing the results of the investigation have not been finalized. Each cask is being separately analyzed based upon the quality assurance review and the specific measurements obtained, although no cask will be returned to public transportation service until all aspects of the NRC order and NAC's internal reviews are fully satisfied, preliminary results indicate that a number of the casks are in full compliance and hopefully will receive an NRC release for service at an early date. Any casks that have a manufacturing deviation, such as NAC-1A, will not be considered for release until the structural analysis is complete and it is demonstrated that there is no reduction in the effectiveness of the cask.

369 123

It is emphasized that previous operations of cask NAC-1A or any of the other casks, has not in any resulted in overexposure to radiation of the workers or the public. The radiation shielding provided assured that dose rates met regulatory requirements and radiation surveys of casks are made prior to the release of every fuel shipment and the documented results verify that the specified dose rates were never exceeded.

514 140