Safety Evaluation Report

related to

SPENT FUEL STORAGE

of

OCONEE SPENT FUEL

at

McGUIRE NUCLEAR STATION - UNIT 1

SPENT FUEL POOL

DUKE POWER COMPANY

JANUARY 1979

Docket No. 70-2623

U. S. Nuclear Regulatory Commission • Office of Nuclear Material Safety and Safeguards

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SAFETY EVALUATION REPORT

BY THE

OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS

U.S. NUCLEAR REGULATORY COMMISSION

IN THE MATTER OF

DUKE POWER COMPANY

OCONEE SPENT FUEL STORAGE AT

McGUIRE NUCLEAR STATION

DOCKET NO. 70-2623

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1.0 INTRODUCTION

1.1 BACKGROUND

On March 9, 1978, Duke Power Company (the applicant) filed an application with the NRC (the Commission) for the amendment of Materials License No. SNM-1773. This application requested authority to receive and store spent nuclear fuel at the McGuire Nuclear Station, Unit 1, following its shipment from the Duke Power Oconee Nuclear Station. Duke Power Company is presently licensed under the provisions of License No. SNM-1773 to receive, possess, and store at the McGuire Facility uranium enriched in the U-235 isotope contained in unirradiated fuel assemblies. The proposed license amendment was requested in accordance with 10 CFR Part 70 prior to the issuance of an operating license to allow for the storage of Oconee spent fuel in the McGuire Unit 1 spent fuel pool.

The applicant states that as a result of delays and uncertainties experienced by Allied-General Nuclear Services (AGNS), Duke's anticipated spent fuel reprocessor, it became apparent that Oconee would run into a shortfall of spent fuel storage space. As an interim measure, Duke applied for and received approval for the expansion of Oconee's Unit 3 spent fuel pool. This increased the capacity of the pool from 216 to 474 assemblies. The Oconee Unit 1 and 2 pool, which is a shared facility, had already contained fuel and, therefore, at that time could not be increased beyond its capacity of 336 assemblies. The applicant elected to submit an application for the transfer of Oconee spent fuel to McGuire. An analysis of alternatives to the proposed action of transporting and storing Oconee spent fuel at McGuire has been considered and evaluated in the associated Environmental Impact Appraisal developed for the proposed licensing action. Duke seeks to ship Oconee spent fuel to McGuire during the first half of 1979. Duke stated in its application that failure to do so will result in the loss of full core discharge capabilities at Oconee, and subsequently jeopardize the continued power generation of the Oconee units. The maintenance of a full core reserve is a practice adopted at the discretion of the utility. It is not at present a Nuclear Regulatory Commission requirement.

This safety evaluation has been based on the information contained in the Final Safety Analysis Report (FSAR) including all amendments thereto through 59 submitted by the applicant for the McGuire Nuclear Station (Dockets 50-369 and 50-370).[1/] The review also relies on portions of the Safety Evaluation Report (SER) related to the operation of McGuire Nuclear Station Units 1 and 2 (NUREG-0422) and its supplement, dated March 1978 and May 1978 respectively.[2/] These documents are available for review at the Commission's Public Document Room at 1717 H Street, N.W., Washington, D.C., and at the Public Library of

Charlotte and Mecklenburg County, 310 North Tryon Street, Charlotte, North Carolina. The scope of this evaluation overlaps the 10 CFR Part 50 radiological Safety Evaluation Report (NUREG-0422) for the McGuire Nuclear Station since the spent fuel pool and its supporting systems are an integral portion of the reactor facility. We have based our conclusions, in part, on the evaluation of the McGuire operating license application as set forth in the 10 CFR Part 50 SER and its supplement. It should be noted that the evaluation applies only to the use of the Unit 1 spent fuel pool.

In the course of the review, the staff visited both facilities, McGuire and Oconee, and held meetings with the applicant to discuss the proposal in detail. The site visit enabled the staff to become familiar with the sites and the affected portion of the McGuire Station. A chronology of the principal actions relating to the processing of the application is attached as Appendix A to this report.

This Safety Evaluation Report examines the safety aspects of this licensing action. Descriptive details of the facility may be examined in the applicant's FSAR[1/] and the McGuire operating license SER.[2/]

1.2 SUMMARY OF PRINCIPAL REVIEW MATTERS

The staff evaluated information submitted by the applicant pursuant to the requirements of 10 CFR Part 70 as well as the information provided pursuant to 10 CFR Part 50. Since the review for a 10 CFR Part 50 operating license has not been completed, the staff evaluated and determined that several matters related to operation of the McGuire Unit 1 under an operating license have been reviewed and approved pursuant to 10 CFR Part 50 in the SER and its supplement and are not included in this report. These matters are:

1. The population density and land use characteristics of the site environs, and the physical characteristics of the site, including seismology, meteorology, geology, and hydrology.

2. The design, fabrication, construction, and testing and performance characteristics of the facility structures, systems, and components important to safety; however, those systems directly related to the safe handling and storage of spent fuel have been reevaluated and included in this report.

3. The design of the systems provided for control of radiological effluents from the plant.

4. The financial qualifications of the applicant.

The evaluation accomplished for this licensing action included a review of the information submitted by the applicant, particularly with regard to the following matters:

1. The design, fabrication, construction, and testing and performance characteristics of the McGuire spent fuel pool structure, supporting systems, and components important to safety. We have determined that they are in conformance with the Commission's General Design Criteria, quality assurance criteria, referenced regulatory guides, and other appropriate rules, codes and standards, as applicable to this portion of the facility.

2. The applicant's engineering and construction organization, plans for the conduct of plant operations, including the proposed organizations, staffing and training programs, the plans for industrial security, and the plans for emergency actions to be taken in the unlikely event of an accident that might affect the general public. We have determined that the applicant is technically qualified to safely operate that portion of the McGuire plant required to support the storage of Oconee spent fuel.

3. The expected response of the spent fuel pool and those portions of the facility required to support the operation of the pool under various anticipated operating conditions and to a spectrum of accidents associated with the receipt, handling, and storage of spent fuel. Conservative analyses of these accidents were performed by the staff to determine that the calculated potential offsite doses that might result in the unlikely event of their occurrence would not exceed the Commission's guidelines for site acceptability given in 10 CFR Part 100.

2.0 SPENT FUEL POOL

2.1 DESIGN CONSIDERATIONS

The design of the spent fuel pool was reviewed using General Design Criterion 61, "Fuel Storage and Handling Criteria for Nuclear Power Plants," of Appendix A to 10 CFR Part 50, "General Design Criteria for Nuclear Power Plants." In addition, the pool design was evaluated using Regulatory Guide 1.13, "Spent Fuel Storage Facility Design Basis;" Regulatory Guide 3.24, "Guidance on the Licensing Application, Siting, Design, and Plant Protection for an Independent Spent Fuel Storage Installation;" and ANSI Standard N210, "Design Objectives for Light Water Reactor Spent Fuel Storage Facilities at Nuclear Power Stations."[3/]

The systems necessary to assure safe handling and adequate cooling of the spent fuel include: the spent fuel pool; the spent fuel cooling and purification system; the fuel handling system; and portions of the fuel building ventilation system. A detailed description of each of these systems is included in Chapter 9 of the McGuire Final Safety Analysis Report.[1/] Other auxiliary systems, both mechanical and electrical, which may be indirectly related to the storage of spent fuel were also reviewed.

Each unit of the McGuire Nuclear Station has a separate spent fuel pool. The pool in Unit 1, located in the Auxiliary Building, is housed in a concrete and steel superstructure designed to seismic Category 1 requirements. The north end of the building however, is enclosed by a steel structure. This end of the building houses the fuel receiving area and new fuel storage vault.

The McGuire plant systems or portions of systems needed to support the storage of Oconee spent fuel will be complete and operational prior to shipment of Oconee spent fuel to McGuire Unit 1. A total of 300 Oconee assemblies will be required to decay for a minimum of 270 days before shipment to McGuire. Sufficient space will remain after the storage of Oconee spent fuel in the McGuire Unit 1 storage pool for an unloading of the McGuire Unit 1 core.

2.2 Spent Fuel Cooling

The spent fuel cooling system is designed to remove decay heat generated by the spent fuel assemblies and maintain the pool water temperature within acceptable limits. Each McGuire spent fuel pool has a separate spent fuel cooling system with redundant active components, which comprise two cooling trains. Under normal conditions, with a fuel inventory of 1-1/3 cores (maintaining a full core reserve), either cooling train can maintain the pool water temperature at 52° C. (125° F) or less. Conditions could result in off loading McGuire Unit 1, thereby resulting in 2-1/3 cores being stored in the McGuire Unit 1 spent fuel pool. Under this condition, both cooling trains will operate to limit the pool water temperature to less than 65.5° C. (150° F). The storage of Oconee fuel will not impact the spent fuel cooling system beyond normal conditions due to limitations that will require the Oconee fuel to decay for a minimum decay period of 270 days.

2.3 Fuel Handling

The pool is designed to store 500 assemblies in a safe configuration. The fuel handling equipment is designed to handle the fuel elements and cask loading and unloading operations underwater. The fuel handling system is designed in accordance with Regulatory Guide 1.13 which conforms to General Design Criterion 61. This criterion requires the design of the fuel storage and handling systems to assure adequate safety under normal and postulated accident conditions. Crane interlocks are provided to preclude the movement of heavy objects over or near the storage of spent fuel.

The Oconee fuel assemblies are accommodated within the McGuire fuel storage rack by the placement of 14 cm (5 1/2 in.) spacers in those locations designated to hold Oconee fuel. The spacers are necessary to permit handling of the Oconee fuel assemblies with the Oconee fuel handling tool in the McGuire storage rack. Each spacer has a 161 sq. cm. (25 sq. in.) opening to allow adequate coolant flow.

The staff has evaluated the location and method of attaching the spacers to McGuire's spent fuel rack. They will not nullify the seismic Category 1 design of McGuire's fuel rack. The spacers are not rigidly attached to the fuel rack but rather simply rest on the support plate due to gravity and are contained within the rack due to the fuel assembly guides. On this basis, the staff concludes that they have only negligible structural effects on the rack and structural support system. The mass of the spacer is very small compared to the mass of fuel rack and fuel assemblies, therefore, the structural impact due to this increase in mass is considered to be negligible.

Storage of Oconee spent fuel assemblies at McGuire when set on a 14-cm (5.5-in.) spacer will provide a clearance between stored fuel assemblies and those being transferred of 46 cm (18 in.). The minimum clearance may result from the storage of an assembly containing a control rod which will then reduce that clearance to 33 cm (13 in.). Since the fuel handling equipment interlocks prevent lateral movements except when the fuel hoist is in the fully withdrawn position, inteference due to assembly clearance is not considered a problem.

We have reviewed the possibility of adverse consequences by inadvertently storing Oconee fuel assemblies in locations which are designated for McGuire fuel or vice versa, and concluded that such an event is implausible as the fuel handling tool design will preclude inadvertent storage of Oconee spent fuel assemblies in locations reserved for McGuire fuel or vice versa. In addition, the placement of spacers will be administratively controlled such that one spacer will be installed when an Oconee fuel assembly is received at McGuire for storage.

To accommodate the special handling tool for Oconee fuel, an auxiliary hoist has been mounted on the fuel handling bridge. This hoist is provided with the same safety features and interlocks as the McGuire fuel handling bridge crane. The hoist used to handle Oconee spent fuel has a load capacity of 1814 kgs (4000 lbs) with an overload interlock set at 1315 kgs (2900 lbs) which is well below the maximum uplift capacity of the storage racks.

The staff concludes that the designs of the spent fuel storage facility and the fuel handling system meet General Design Criterion 61 of Appendix A to 10 CFR Part 50, and the positions of Regulatory Guide 1.13, "Fuel Storage Facility Design Basis," and 1.29, "Seismic Design Classification," including seismic design and missile protection guidelines (see Section 5.0).

The design and operating provisions also conform to Regulatory Guide 8.8, "Information Relevant to Maintaining Occupational Radiation Exposure As Low As Reasonably Achievable," and is therefore acceptable.

2.4 Fire Protection

The spent fuel pool area is constructed of fire resistive and non-combustible materials. The pool is enclosed in a heavy reinforced concrete and steel structure. The general method of construction for the Auxiliary Building which includes the spent fuel area, employs the use of approved non-combustible, heat resistant, fire retardant or non-flame propagating materials.

Requirements for spent fuel pool per Appendix A to Branch Technical Position APCSB 9.5-1, "Guidelines for Fire Protection for Nuclear Power Plants Docketed Prior to July 1976," and Regulatory Guide 1.120, "Fire Protection Guidelines for Nuclear Power Plants," require protection in the spent fuel pool area by provision of local hose stations and portable extinquishers. Additionally, automatic fire detection must be provided to alarm and annunciate in the control room and to alarm locally. Duke Power Company has submitted a fire protection program which complies with these provisions.[4/]

A fire outside the perimeter of the spent fuel pool will not endanger the storage of the fuel assemblies. In the event cooling and/or ventilation services are disrupted due to other fire emergencies outside the pool area, the Oconee fuel, due to its age of decay, will not pose any immediate danger in a static pool of water. (Section 5.0 examines an accident condition assuming the loss of power and cooling.)

The applicant has designed and constructed the McGuire spent fuel pool and associated area of the Auxiliary Building to minimize structural damage from fire. Duke Power has an acceptable program to minimize the potential for, and the unfavorable consequences from, fire occurring.

The fire protection plan submitted pursuant to 10 CFR Part 50, complies with the applicable regulations and guidelines, and will be implemented prior to issuance of the proposed amendment to Materials License No. SNM-1773.

3.0 NUCLEAR CRITICALITY SAFETY ANALYSIS

3.1 Introduction

The potential for accidental nuclear criticality has been considered in the storage of irradiated Oconee fuel in the spent fuel storage pool at the McGuire Nuclear Station. There is no fuel at the Oconee Nuclear Station having an enrichment (prior to irradiation) greater than 3.5% ^{235}U.[5/] In the absence of a neutron moderator, an infinite number of these fuel assemblies cannot be made critical. Although a small number of assemblies could become critical if placed in the proper configuration and moderated with water, such a configuration is not possible when the assemblies are stored in the McGuire Unit 1 spent fuel pool because of the design of the McGuire storage racks.

The spent fuel storage pool at each of the two McGuire station units has a capacity for 500 fuel assemblies. Fuel assemblies are held in position by racks having a nominal center-to-center spacing of 39.37 cm (15.5 in.). The inside dimension of each rack is 24.13 cm (9.5 in.) square (the space within which an assembly is held). The minimum distance from the center line of the racks to the nearest concrete wall is 41.9 cm (16.5 in.). Each Oconee fuel assembly consists of a 15 x 15 array of fuel pins with 208 of the locations containing the fuel.

3.2 Nuclear Criticality Safety Study

The staff made an independent evaluation of the nuclear criticality safety of the storage array for the Oconee fuel. The following assumptions were made in the analysis:

1. The fuel enrichment is 3.5% ^{235}U.

2. There is no fuel burnup.

3. Each of the 225 positions within a fuel assembly contained a fuel rod (92.4% of the positions actually contain fuel).

4. Theoretical fuel rod density was assumed (actual maximum density of new fuel in each Oconee core is 93.5% of theoretical).

5. The fuel rods are infinitely long (active fuel length is 3.66 meters (12 feet)).

6. All pool walls are 41.9 cm (16.5 in.) from the center line of the nearest storage rack (actual distance varies from 41.9 cm to 52.1 cm (16.5 in. to 20.5 in.)).

7. The pool water is not borated.

The following variables were considered in the analysis:

1. Center-to-center spacing between adjacent storage racks.

2. Pool water temperature.

3. Pool concrete floor thickness.

4. Location of a fuel assembly between the storage racks and the pool concrete wall (accident condition).

The staff analysis employed the NITAWL-XSDRN-KENO Monte Carlo computer programs, using the 123-group resonance corrected GAM-THERMOS neutron cross section library.

Table 3-1 summarizes the results of analyses for infinite storage arrays in the spent fuel pool at 20° C (68° F) as a function of center-to-center spacing between storage racks. Analyses made at higher temperatures indicate lower infinite multiplication constants for the spacings of interest between fuel assemblies.

TABLE 3-1

INFINITE MULTIPLICATION CONSTANT (k_∞) VS
FUEL ASSEMBLY SPACING

Center-to center spacing (cm)	(in.)	K
30.48	(12)	1.046 ± .006
35.56	(14)	0.928 ± .006
39.37	(15.5)	0.899 ± .005

The nominal center-to center spacing between fuel racks is 39.37 ± 0.32 cm (15.5 in. ± .125 in.). The minimum center-to-center spacing between fuel assemblies is 36.45 cm (14.35 in.). The maximum infinite multiplication constant at this spacing is approximately 0.92 with the pool water at 20° C. (68° F). Calculations indicate the k_∞ decreases with increase in water temperature at these spacings.

Within the limits of error in the calculations, there is no significant change in k_∞ with increase in concrete floor thickness from 40.6 cm to 121.9 cm (16 in. to 48 in.).

An accident condition was considered in which a fuel assembly was placed against a storage rack between the rack and the nearest concrete wall. A 25 x 25 array (625 assemblies on 39.37 cm (15.5 in.) centers) surrounded by four concrete walls and a concrete floor was considered. This is conservative since each storage pool has a capacity for only 500 assemblies. Under these conditions, the maximum effective multiplication constant (k_{eff}) for the array is 0.932 ± .005 compared to 0.905 ± .005 with no assembly between the racks and concrete wall.

The licensee has precluded this postulated accident condition by attaching steel strips to the structural support members between the fuel storage racks and the pool wall. It is physically impossible to insert a fuel assembly between the racks and the adjacent concrete wall.

Mixed arrays of McGuire and Oconee fuel assemblies in the storage pool were also considered. Since the infinite multiplication constant of either type array by itself does not exceed 0.95, a mixed array of both type assemblies in the storage pool cannot be made critical.

3.3 Administrative Controls

Qualified individuals from the McGuire Nuclear Station supervisory staff review procedures associated with nuclear safety. These procedures must be approved by the station manager. The specific locations for all fuel assemblies are approved by the reactor engineer prior to moving an assembly. He is adequately qualified and is part of the McGuire Nuclear Station organization that functions independently from that part of the organization responsible for the day-to-day operations of the station.[1/]

3.4 Engineered Criticality Safety

The cask handling crane in the fuel handling area is designed to preclude moving the spent fuel shipping cask over the spent fuel pool. This design will prevent the dropping of a shipping cask into the spent fuel pool.

Only one fuel assembly can be manipulated at one time and the fuel storage racks are designed to preclude insertion of fuel between assemblies within the spent fuel storage pool and between the racks and adjacent concrete walls. Closer spacing between assemblies than that considered in the nuclear criticality safety analysis is not possible.

3.5 Safety Conclusion

A nuclear criticality safety review of the storage of Oconee fuel at the McGuire Nuclear Station has been completed. The design of the storage racks, engineered criticality safety, and administrative controls to operate the fuel storage facility are adequate to protect it against inadvertent criticality.

4.0 RADIOLOGICAL SAFETY: EFFECT OF TRANSSHIPMENT ON CONSTRUCTION FORCE AND OTHER NON-OPERATIONS STATION PERSONNEL

4.1 Shipping Cask

Duke Power Company currently owns one NFS-4 (also designated NAC-1) truck shipping cask, and is purchasing a second to be used to transship the spent fuel from Oconee to McGuire. These casks bear NRC Certificate of Compliance No. 6698, and are designed to hold one PWR or two BWR fuel elements with a decay heat load of 11.5 KW (3.9 x 10^4 BTU/hr) and a minimum decay time of 120 days without exceeding the Department of Transportation (DOT) specifications for dose rates in 49 CFR 173.393. The regulations require that the dose rate at the outside surface of the package (including thermal shield) not exceed 200 mrem/hr and at two meters (six feet) from the package not exceed 10 mrem/hr.

Since the fuel to be shipped will be required to have 270 days minimum cooling time, the dose rates outside the cask will be significantly lower than that of the cask design basis fuel. In connection with some fuel transfers at Oconee, Duke Power measured actual dose rates outside the cask containing fuel with approximately 20,000 MWD/MT and decay times of 170 to 410 days. The contact readings were made without a thermal shield in place. None exceeded 60 mrem/hr gamma. The two meter (six feet) readings averaged about 5 mrem/hr gamma. Neutron dose expected to be significant. The staff concludes that the two meter (six feet) dose rates could be as high as the DOT limit of 10 mrem/hr. However, based on the decay time to be imposed by a license condition and the measurements taken by the applicant, 5 mrem/hr at two meters (six feet) from the cask is a reasonable value to assume for consideration of dose rates from the cask.

4.2 Transshipment Routing and Schedules

The distance from Oconee to McGuire is approximately 270 kilometers (170 miles). Thus, transshipment would be accomplished without stops in about five hours. Arrival of the cask could be expected at any hour of the day or night, but the projected schedule of one receipt per day at a particular time could be achieved after a routine is established. Although the most likely time of arrival is during the evening (second shift), for evaluation purposes the staff has assumed that arrival will be during the day when the bulk of the approximately 2000 person construction force and station personnel are on site. Some shipments can be expected to arrive during this time regardless of ideal scheduling.

At the McGuire site, the shipment will enter the Duke Power Company road off of N.C. Route 73, travelling 0.5 Km (0.3 mi.) then pass through the split parking lot and stop at the Security Gate to gain admission to the Station protected area. The shipment would then move directly north past the warehouse, turbine building, four trailers used as temporary offices, then turn east to the north end of the auxiliary building where the spent fuel storage pool is located. See Figure 4-1.

Initial checks for surface contamination will be made in the yard. A cask wash down facility, for removing road dirt, is located just outside the entrance to the pool. After wash down, the cask will be moved into the building where subsequent operations will be performed by station personnel. The cask with truck can be stored in the receiving bay of the building if desired.

4.3 Description of Personnel Locations and Barriers

- Administration Building - About 100 employees work in the Administration Building, a corner of which is 100 meters (325 feet) from the nearest passage of the shipment as it enters the station. It is conceivable that some employees could be in the parking lot as the truck passes through some 10 meters (30 feet) away.

- Security Gate - Two or more guards will be located at the Security Gate where the shipment and drivers will be checked before being permitted to enter the Protected Area. This is estimated to take about 10 minutes, during which time the guards could remain in the vicinity of the cask.

- Temporary Offices - Four trailers serving as temporary offices for about 60 Station personnel are located as near as 6 meters (20 feet) from the route of the cask as it heads toward the spent fuel storage area.

- Turbine Building - The nearest side of the Turbine Building where construction activities will be essentially complete is 20 meters (65 feet) from the route of the cask.

- Yard - Duke has indicated no other offices, trailers or other occupied structures that will be located in the vicinity of the cask where it will be stopped, examined, cleaned or stored in the yard outside the spent fuel storage pool.

- Construction Areas - Construction will be continued during the transshipment activities, but only at Unit 2. A system of security fences and gates, patrolling and posted guards, existing walls, temporary barriers, and alarms will be used to prevent unauthorized access of the construction force into Unit 1 operating areas, including the spent fuel storage pool area and yard. The nearest point of unshielded access to the parked cask is at the East Security Gate, about 60 meters (200 feet) away. Other points may be equidistant but are shielded by concrete walls and/or earthen berm. Duke Power Company has indicated that any construction/vendor personnel who must gain access to any area where there would be exposure above background doses will be under direct supervision of the McGuire Health Physicist. The temporary barrier system described by the Applicant and which is part of the Security Plan has been reviewed by the staff and found acceptable.

4.4 Radiation Dose

Duke Power Company has concluded that the total doses to construction or vendor personnel due to spent fuel shipping, handling and storage at McGuire will be negligible. Based upon our review of the transshipment schedule and routing within the station areas, the low dose rates measured and expected, the exclusion distances provided and controls that will be exerted, we agree with this conclusion. This holds true for other non-operations station personnel as well. Doses received by the drivers of the trucks are not included herein, but have been evaluated in the associated Environmental Impact Appraisal dated December, 1978.

Guards who work at the South Security Gate may be in the vicinity of the cask for several minutes while a shipment is being checked and could receive measureable doses. We estimate that a guard could receive a maximum dose of about 200 mrem per year if he were present at the time of each receipt. However, we have calculated that the maximum expected dose is approximately 70 mrem per year, based on rotating shifts and transshipment schedules. Duke will provide guards with personnel dosimetry.

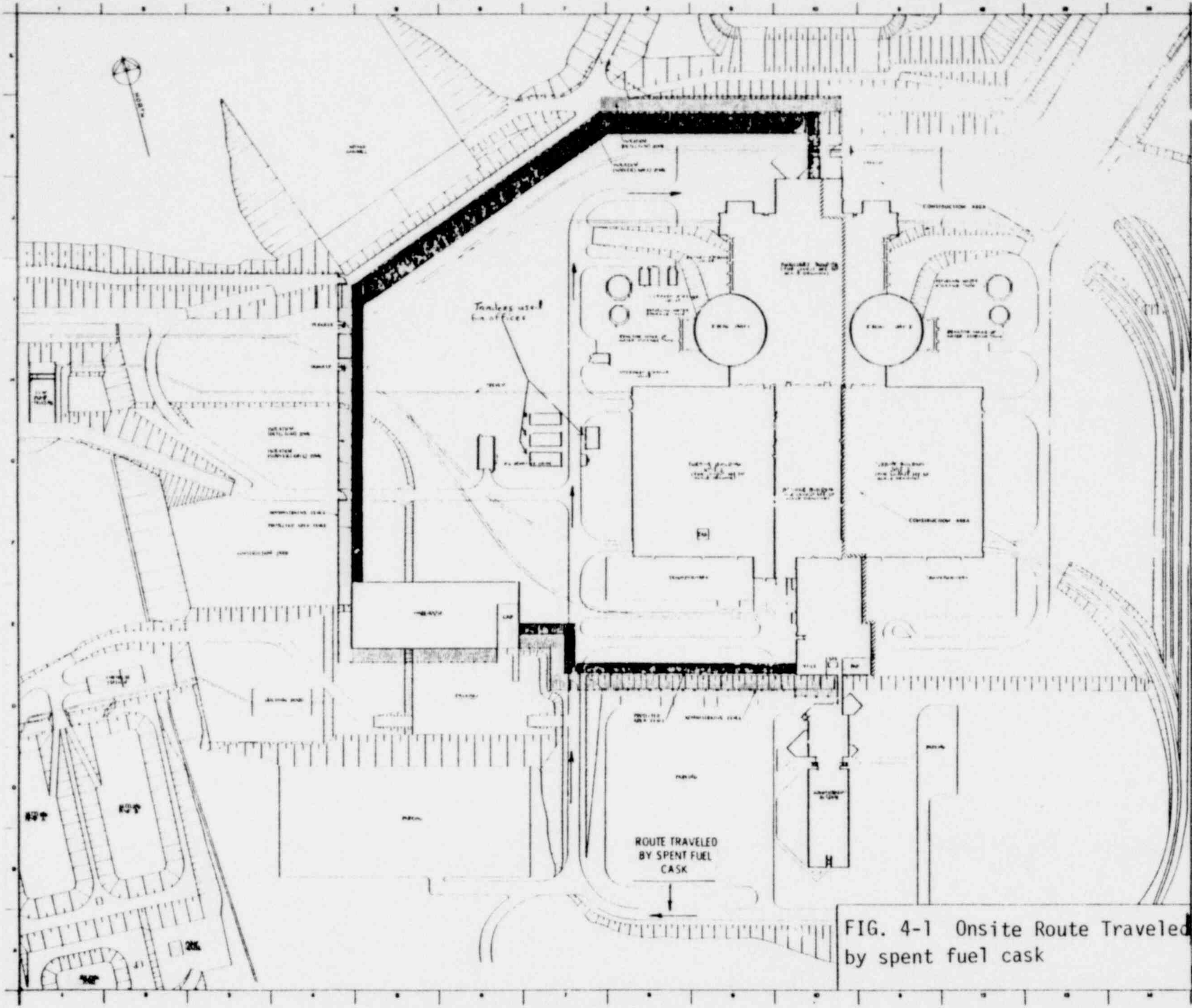

FIG. 4-1 Onsite Route Traveled by spent fuel cask

5.0 ACCIDENT ANALYSIS

A limited number of accidents involving spent fuel conceivably could occur that may cause a potential for release of radioactivity. These accidents, which are not expected to take place due to procedural and administrative controls as well as physical limitations, are postulated to insure that there exists a reasonable assurance that the health and safety of the public will not be endangered.

The accidents considered in this review include; 1) a fuel handling accident, 2) a cask drop, and 3) the loss of power resulting in a loss of cooling. Other accidents, such as loss of ventilation or purification have not been addressed since they have been reviewed and found acceptable for the McGuire operating license. The parameters of such accidents will not change the results found during that review due to the 270 day decay period imposed on the Oconee fuel. Missile trajectories have also been examined as part of the review for McGuire's operating license and the design of the building has been accepted. Impacts resulting from the storage of Oconee fuel will be less significant than those for the approved McGuire fuel. A nuclear criticality safety analysis has been performed for a normal and an accident condition. This analysis has been presented and evaluated by the staff in Section 3.0. The design of the racks, and safety and administrative controls are adequate to protect the pool against inadvertent criticality.

5.1 Fuel Handling Accident

The staff has evaluated the consequences of dropping an Oconee fuel assembly and concludes that the consequences of such an event are acceptable. These consequences are less severe than the dropping of a McGuire assembly in which the radiological consequences have been evaluated and determined to be well within 10 CFR Part 100 guidelines. The McGuire fuel drop accident has been evaluated and found to be acceptable as part of the McGuire operating license review. The basis for determining that the impacts from dropping Oconee fuel is less significant is derived from: 1) the Oconee fuel will be required to decay for a minimum period of 270 days prior to shipment and will consistently contain less stored radioactivity; 2) the fuel enrichment by weight is generally of a lower percent (for a 12 month fuel cycle, the average enrichment is 2.8% and 3.11% U^{235} for Oconee and McGuire respectively, although both facilities have been reviewed and accepted for a maximum of 3.5% U^{235}); and 3) the fuel pin density (expressed in % of theoretical) is a maximum of 93.5% for Unit I at Oconee and 92.5% for Units II and III as compared to 95.0% for McGuire Unit I.

During fuel handling operations at McGuire, the fuel handling ventilation exhaust subsystem is required to be in operation. This system is comprised of two 100 percent capacity fans, duct work, bypass and filters. Sufficient redundancy is included in this system to assure proper operation with one active exhaust fan out of service. The operation of this system continuously purges the fuel pool area of heat, humidity, gaseous, and/or particulate matter.

Should a fuel handling accident occur, the fuel handling ventilation exhaust subsystem would reduce dose consequences. Should this system become inoperable, fuel handling would be terminated.

5.2 Cask Drop Accident

The fuel handling bridge crane which is used for handling the spent fuel in it shipping cask is rated at 125 tons. The crane and associated equipment (hooks, wire rope, lugs, etc.) have been previously evaluated to be designed with a sufficient degree of redundancy and safety interlocks to insure the adequate handling of a loaded spent fuel cask. Additionally, mechanical stops are installed to prevent the cask from being moved into the fuel pool area. The cask loading and unloading area is separated from the spent fuel pool by a three foot reinforced concrete wall with a gated slot for fuel handling.

The spent fuel pool including the cask unloading area has been designed to withstand an accidental cask drop. The pool is constructed of 1.2 meter (4 foot) reinforced concrete walls lined with .5 cm (3/16 inch) stainless steel. The stainless steel liner has a leak chase system that provides a method of continuous testing for leaks. The foundation of the Auxiliary Building, which houses the spent fuel pool, consists of a 1.2 meter (4 foot) thick reinforced concrete slab, based on sound rock.

In the unlikely event of a cask drop accident, the cask will fall into the cask unloading area. The path traversed by the cask to and from the truck bed and the unloading area will not cross any safety related system. The cask is designed to survive, leak tight, a drop from the maximum height in the unloading area. Structural deformation of the foundation may occur, and a tear in the liner may also occur. However, any leakage would be limited to the unloading area due to the separation from the spent fuel by the concrete wall and gate which assures that the fuel remains flooded.

5.3 Loss of Power Accident

In the event of a loss of offsite power, the spent fuel pool cooling system and associated systems would be deenergized. The spent fuel pool cooling system is designed to remove the decay heat generated by the stored spent fuel assemblies, and maintain the water temperature within acceptable limits during normal and abnormal operating conditions. During a loss of power emergency, the power will be supplied by onsite power sources. The capability of onsite power is provided by two redundant power trains, each with two diesel generators. There are also redundant components within the diesel generator system to avoid losing onsite power. The probability of losing both diesel generator trains in addition to losing offsite power is extremely small. As a result of power supplied by the generators, the operation of the spent fuel cooling system will be restored within one hour. Redundant active components are provided in the cooling system to preclude its failure when power is supplied.

Independent calculations have been performed to analyze the resulting heat up rate, assuming a loss of cooling. A summary of these calculations are provided below.

Assumptions for this calculation were made to maximize the results, and subsequently yield values higher than would be expected to occur. Realistic thermal loads were used in the Environmental Impact Appraisal. The assumptions made for this analysis were:

i) burnup = 36,000 MWD

ii) reactor operation = 100% uptime

iii) 300 Oconee assemblies, all shipped consecutively using the minimum 270 day decay time.

Thermal values for assemblies were taken from the computer program Origen-S.

Variables used in the calculations include:

i) volume of pool water = 1242 m^3 (43,860 ft^3)

ii) displacement of fuel assemblies = .17 m^3/assy (6.05 ft^3/assy)

iii) displacement of storage racks = 43 m^3 (1,525 ft^3)

Postulated conditions at time of power loss:

1) 300 Oconee assemblies only in the McGuire pool would yield a heat load of 6.0 x 10^3MJ (5.68 x 10^6 BTU/hr). Assuming no heat loss from the pool, and a water capacity in the pool of 1.14 x 10^6 kg (2.51 x 10^6 lb mass), the resulting heat up rate would be 1.25° C/hr (2.26° F/hr). With the presumption that one cooling train had been operating and maintained a steady state temperature of 52° C (125° F), it would take 38.5 hrs to reach 100° C (212° F).

2) 300 Oconee assemblies and a full core off load of the McGuire Unit 1 (assuming an irradiation period of 1 year, and a decay period of 7 days) are examined in this case. The resulting heat load in the pool would be 4.0 x 10^4 MJ (3.8 x 10^7 BTU/hr) (15% of this load is attributable to Oconee fuel). Assuming the same parameters as above,

and a water capacity of 1.1×10^6 kg (2.42×10^6 lb mass), the resulting heat up rate would be 8.67° C/hr (15.6° F/hr). Assuming both cooling trains had been operational prior to the power failure, and pool water temperature was 65.5° C (150° F), it would take 4.0 hrs to reach 100° C (212° F).

Based on the staff's evaluation ample time exists in the event of a power failure to restore cooling to the spent fuel pool.

6.0 QUALITY ASSURANCE

The description of the quality assurance (QA) program to be applied to the spent fuel storage pool is referenced in Section 17 of the Duke Power Company's McGuire Nuclear Station FSAR[1/] and contained in Topical Report, "Quality Assurance Program, Duke-1."[6/] Our evaluation of the quality assurance program applicable to operations at the storage pool is based upon review of the topical report and information provided by the applicant to determine compliance with the requirements of Appendix B to 10 CFR Part 50.

6.1 Organization

The Executive Vice President is the corporate executive responsible for defining Duke Power's QA policies, goals and objectives. The responsibility for development and maintenance of the QA programs is delegated to the corporate QA manager. A senior QA engineer who reports to the corporate QA manager, through the manager of QA operations, is resident at the nuclear station. He is responsible for all QA activities at the spent fuel storage pool, and has delegated written authority and organizational freedom to: identify quality problems, recommend or initiate remedial action and verify implementation of corrective action. The QA organization for operations engage in all QA and quality control (QC) activities including placing and approving QA requirements on procurement documents, administration of ir ervice inspections, maintenance of quality records, su~veillance, assuring QA requirements are placed in inspection and test procedures, performing special processes, dispositioning nonconforming items and conducting quality-related audits.

6.2 Quality Assurance Program

The QA operational program utilized to meet the requirements of Appendix B to 10 CFR 50 is described in various company manuals containing policies, procedures and instructions. The structures, systems and components that are subject to this program are identified in Tables 3.2.1-1, 3.2.2-2, and 3.2.3-1 of the FSAR.

Training programs are established to assure persons involved in quality-related activities are knowledgeable in QA procedures and requirements. The program is formulated to provide the required training based upon individual employee experience and to assure safe and reliable operation of the storage pool. Periodic retraining is planned to assure personnel engaged in quality-related activities remain proficient.

The QA organization conducts comprehensive audits in all phases of operations. All organizational components performing quality-related functions are audited with a system of three levels of audit:

a) Level 1 consists of surveillance and continual review of procedures and records;

b) Level 2 involves periodic audits of special processes such as welding and certain QC inspections; and

c) Level 3 consists of periodic corporate management reviews of the entire QA program to ascertain its effective implementation.

The frequency of all audits is based upon the status and safety importance of the activities being performed and upon work history. Significant audit findings are discussed with management of the audited function and included in periodic reports to top management.

6.3 Implementation

The Office of Inspection and Enforcement (I&E) has performed an inspection to confirm implementation of the committed QA program for operations. No deviations or nonconformances were found. I&E made a finding that the QA program applicable to operations of the storage pool was being implemented consistent with the applicable QA requirements.

6.4 Quality Assurance Conclusions

Our review of Duke Power Company's QA program for operations at McGuire Nuclear Station spent fuel storage pool as described in Topical Report, "Quality Assurance Program, Duke-1," has established that all applicable requirements of Appendix B to 10 CFR 50, "QA Requirements for Nuclear Power Plants and Reprocessing Plants," are met. Further, this review assures that the designated QA organization is structured such that it can effectively carry out responsibilities related to quality with sufficient authority and independence from influences of cost and schedule, and has sufficient access to management at a level necessary to report and resolve quality problems.

7.0 CONDUCT OF OPERATIONS

7.1 Emergency Planning

Plans for coping with emergencies were submitted by the applicant pursuant to Section 50.34(b)(6)(v) of 10 CFR Part 50. Duke Power Company will implement its "Proposed Emergency Plan for McGuire Nuclear Station," dated February 1976,[7/] prior to receipt of the proposed amendment to Materials License No. SNM-1773. This plan describes the actions to be taken in the event of a radiological accident where the health and safety of station personnel and the general public may be involved. The Emergency Plan also makes provisions for other general industrial emergency and accident conditions such as fire, vehicular accidents, natural disasters, medical injury or illness, and industrial security.

In this specific case involving the shipment of aged fuel (270 days minimum), the possiblility of significant offsite releases is remote. Onsite accidents are also improbable. The Emergency Plan which was submitted by Duke Power has been reviewed and accepted by the staff for the operation of the McGuire units. The Plan is summarized below:

The normal operating staff is composed of the shift supervisor, assistant shift supervisor, control operators, utility and assistant utility operators, a health physics technician, and other technical-services and maintenance personnel as necessary. The normal operating crew is staffed and qualified to perform all actions that are necessary to institute immediate protective measures and to implement the Emergency Plan. Additional emergency assistance from the Steam Production Department general office staff (Health Physics, Operations, Maintenance, etc.) and other departments within the Company, as well as the full resources of Duke Power and backup from corporate management are available to the station.

All emergencies at McGuire Nuclear Station are handled by the shift supervisor on duty. He is informed immediately of all emergencies and assumes control of the Station. He then alerts and warns Station personnel and others, takes necessary onsite remedial action, obtains necessary outside aid, and notifies management. The shift supervisor continues in this capacity until relieved by the Emergency Coordinator, who then coordinates with outside agencies, enabling the shift supervisor to devote full attention to remedial measures within the Station.

In case of a major emergency, an Emergency Control Center is established in the Steam Production Department general office in Charlotte, N.C. This center provides emergency backup and support to the Station. The Steam Production Department operations and maintenance group at the Emergency Control Center will coordinate directly with the Station Emergency Coordinator.

The Emergency Plan establishes and provides emergency-action procedures for five classifications of emergencies:

1) Personnel Emergency
2) Emergency Alert
3) Plant/Unit Emergency
4) Site/Station Emergency
5) General Emergency

The shift supervisor, by being aware of the normal operating mode, is able to classify an emergency at any time that conditions warrant.

Agreements have been made with local, state and federal authorities for coordination of activities in the event of an emergency.

Written agreements have been made with the following agencies:

North Carolina Department of Human Resources

Department of Energy Savannah River Operations Office

Charlotte Memorial Hospital

Gaston Memorial Hospital

North Carolina State Highway Patrol

Mecklenburg County Police

Mecklenburg County Sheriff Department

Mecklenburg County Health Department

Gilead Volunteer Fire Department

Charlotte City/Mecklenburg County Fire Department

North Mecklenburg Ambulance and Rescue Squad

Mecklenburg County Civil Preparedness Agency

Lincoln County Civil Preparedness Agency

Iredell County Civil Preparedness Agency

Gaston County Civil Preparedness Agency

The North Carolina Department of Human Resources, Division of Facility Services, Radiation Protection Branch, is the principal state agency responsible for coping with radiological emergencies.

Multiple internal and external communication systems are available throughout the course of an emergency. All systems are available in the Control Room (onsite) and at the offsite Emergency Control Center.

All Station personnel receive copies of the Emergency Plan and are trained to be familiar with the plan and their role in handling an emergency. Personnel on each shift are trained in radiation monitoring and exposure control, first aid, and fire fighting. Quarterly drills are conducted to develop and maintain the proficiency of operating personnel in handling emergency situations. Medical support, rescue, and local fire department personnel are given special training by Duke Power health physics personnel.

The Emergency Plan and associated equipment are maintained in a current viable fashion by provisions for an annual review of the Plan, quarterly drills and monthly surveys.

Following any major emergency, detailed plans would be developed to return the McGuire Nuclear Station to normal conditions. Coordination planning will involve Duke Power Company management, the Commission, the Radiation Protection Branch of the North Carolina Department of Human Resources, and the Mecklenburg County Health Department.

The staff has reviewed the information submitted by the applicant, including the proposed emergency plan for the McGuire Nuclear Station, and response to several staff questions, and finds that it meets the requirements of the regulations and Regulatory Guide 3.24, "Guidance on the

License Application, Siting, Design, and Plant Protection for an Independent Spent Fuel Storage Installation," and is responsive to the specific requirements of the staff. The staff, therefore, concludes that the applicant has provided bases for an acceptable state of emergency preparedness.

7.2 Physical Security

The Commission's requirements for physical security are set forth in 10 CFR Part 73. These comprehensive requirements provide for a system of protection measures including armed guards, multiple barriers, intrusion alarms, access controls, communications, and liaison with local police authorities. The applicant prepared and submitted for our review a security plan describing how these requirements would be met.[8/] The commitments made in this plan, when implemented (prior to the issuance of the proposed license amendment), will provide the level of protection required by Part 73.

The staff has concluded that the plan is satisfactory and that the protection provided by the applicant will be adequate to deter and defend the McGuire Nuclear Station spent fuel pool from acts of radiological sab[illegible] directed within or outside the facility and the[illegible]re meets the Commission's requirements. Accordingly, the staff concludes that the security plan will ensure that the health and safety of the public will not be endangered.

8.0 COMMON DEFENSE AND SECURITY

The applicant states that the activities to be conducted will be within the jurisdiction of the United States and that all the directors and principal officers of the applicant are citizens of the United States.

The applicant is not owned, dominated or controlled by an alien, a foreign corporation or a foreign government. The activities to be conducted do not involve any restricted data, but the applicant has agreed to safeguard any such data that might become involved in accordance with the requirements of 10 CFR Parts 50 and 70. The transit to and storage of spent fuel at the McGuire Nuclear Station are being accomplished in accordance with the Commission's regulations. For these reasons, and in the absence of any information to the contrary, we have found that the activities to be performed will not be inimical to the common defense and security.

9.0 FINANCIAL PROTECTION AND INDEMNITY REQUIREMENTS

Pursuant to the financial protection and indemnification provisions of the Atomic Energy Act of 1954, as amended (Section 170 and related sections), the Commission has issued regulations in 10 CFR Part 140. The Commission's regulations in Part 140 require that each holder of a construction permit under 10 CFR Part 50, who is also the holder of a license under 10 CFR Part 70 authorizing the ownership and possession for storage only of special nuclear material at the reactor site, shall, during the interim storage period prior to licensed operation, have and maintain financial protection in the amount of $1,000,000 and execute an indemnity agreement with the Commission. Proof of financial protection is to be furnished prior to, and the indemnity agreement executed as of, the effective date of the 10 CFR Part 70 license.

Materials License No. SNM-1773 was issued on February 28, 1978. Also on that date an indemnity agreement (No. B-83) was signed between Duke Power Company and the Nuclear Regulatory Commission.

In Duke Power Company's application for the amendment of Materials License No. SNM-1773, the Applicant requested that the Commission exercise its discretionary authority to extend Price-Anderson indemnification and publish in the Federal Register a notice pursuant to 10 CFR § 140.9 indicating its intent to modify McGuire's indemnity agreement to allow for the indemnification of the proposed storage of Oconee spent fuel.

The staff has considered this request and prepared and presented a paper to the Commission with regard to this issue.[9/] The Commission has decided to publish a Federal Register Notice proposing to extend Price-Anderson indemnification and offering an opportunity for public comment on this action before it is taken.

The extension of Price-Anderson indemnification is not a prerequisite for reaching a decision on the proposed action.

10.0 CONCLUSIONS

Based on its evaluation of the application as set forth in the preceding chapters, the staff concludes that:

1. The issuance of the license amendment would not be inimical to the common defense and security and would not constitute an unreasonable risk to health and safety of the public.

2. The Applicant meets the requirements of the Atomic Energy Act of 1954, as amended (Act), and the regulations of the Commission. Specifically the Applicant meets the provisions of 10 CFR § 70.23(a) in that:

   a. The special nuclear material is to be used in activities licensed by the Commission under Section 103 or 104 of the Act;

   b. The Applicant is qualified by reason of training and experience to use the material for the purpose requested in accordance with the regulations in Title 10 of the Code of Federal Regulations;

   c. The Applicant's proposed equipment and facilities are adequate to protect health and minimize danger to life or property; and

   d. The Applicant's proposed procedures to protect health and to minimize danger to life or property are adequate.

APPENDIX A

CHRONOLOGY OF RADIOLOGICAL REVIEW

OF WILLIAM B. MCGUIRE NUCLEAR STATION, UNITS 1 AND 2

_ NT FUEL POOL

NOTE: Documents referenced in this chronology are available for public inspection and copying for a fee at the NRC Public Document Room, 1717 "H" Street, N.W., Washington, D. C.; and at the Public Library of Charlotte and Mecklenburg County, 310 North Tryon Street, Charlotte, North Carolina 28202; and at the Oconee County Library, 201 South Spring Street, Walhalla, South Carolina 29691.

March 9, 1978	Letter from applicant transmitting application for review (received March 14, 1978)
March 27, 1978	Letter from applicant transmitting copies of final safety analysis report and environmental report
March 30, 1978	Application docketed
April 25, 1978	Site visit and meeting with applicant at McGuire Facility for familiarization with spent fuel pool and support systems
April 26, 1978	Site visit and meeting with applicant at Oconee Facility for familiarization with spent fuel pool and handling procedures
April 27, 1978	Meeting with applicant to discuss decay age of fuel to be considered for transshipment
May 3, 1978	Memorandum from applicant transmitting location of stored components in Oconee Units 1 & 2 and Unit 3 pools
May 19, 1978	Letter to applicant transmitting request for additional information
May 26, 1978	Letter from applicant requesting clarification of requirements in 10 CFR Parts 70 and 73
June 2, 1978	Meeting with applicant to establish minimum decay period of fuel to be shipped

June 5, 1978	Letter from applicant confirming decision to ship fuel which has decayed for a period of 9 months, and notification that response to request for additional information will be forthcoming by June 16, 1978
June 14, 1978	Letter to applicant in response to May 26, 1978 request for clarification of 10 CFR Parts 70 and 73
June 16, 1978	Letter from applicant in response to May 19, 1978 request for additional information
July 21, 1978	Letter to applicant transmitting request for additional information
August 2, 1978	Letter to applicant transmitting schedule for review
August 7, 1978	Letter from applicant transmitting copy of McGuire Modified Amended Security Plan
August 23, 1978	Letter from applicant in response to July 21, 1978 request for information
September 5, 1978	Letter from applicant transmitting 1 page of proprietary information inadvertently deleted from August 23, 1978 letter
October [illegible] 1978	Letter to applicant transmitting request for additional information on the alternative of reracking Oconee Units 1 & 2 pool
October 18, 1978	Letter from applicant in response to October 12, 1978 request for information
October 20, 1978	Letter from applicant in response to verbal request for information from Brett Spitalny on October 4 and 5, 1978
November 27, 1978	Letter from applicant forwarding transportation cost estimates
December 22, 1978	Letter to applicant transmitting Environmental Impact Appraisal and Negative Declaration

APPENDIX B

REFERENCES

1. Duke Power Company, Final Safety Analysis Report on McGuire Nuclear Station, Units 1 and 2. Docket Nos. 50-369 and 50-370, 1974.

2. U.S. Nuclear Regulatory Commission, Safety Evaluation Report Related to Operation of McGuire Nuclear Station, Units 1 and 2. NUREG-0422. Docket Nos. 50-369 and 50-370, March 1978.

3. American National Standard N210, ANS-57.2 Working Group, Design Objectives for Light Water Reactor Spent Fuel Storage Facilities at Nuclear Power Stations. American Nuclear Society, Hinsdale, Illinois, April 1976.

4. Duke Power Company, McGuire Nuclear Station Fire Protection Review. September 1977.

5. Duke Power Company, Final Safety Analysis Report for Oconee Nuclear Stations 1, 2 and 3. Docket Nos. 50-269, 50-270 and 50-287, 1969.

6. Duke Power Company Topical Report, Quality Assurance Program, Duke 1. 1974.

7. Duke Power Company, Proposed Emergency Plan for McGuire Nuclear Station. February 1976.

8. Duke Power Company, Modified Amended Security Plan. July 1978.

9. U.S. Nuclear Regulatory Commission Paper, SECY-78-607, Two Requests to Transfer and Store Spent Fuel at Reactor Sites Other Than the Sites Where the Fuel Was Irradiated, and to Have Such Storage Indemnified. November 1978.