August 4, 2003

Mr. Dhiaa Jamil
Vice President, McGuire Site
Duke Energy Corporation
12700 Hagers Ferry Road
Huntersville, NC 28078-8985

SUBJECT: McGUIRE NUCLEAR STATION, UNIT 2 RE: ISSUANCE OF AMENDMENTS (TAC NO. MB7536)

Dear Mr. Jamil:

The Nuclear Regulatory Commission has issued the enclosed Amendment No. 198 to Facility Operating License NPF-17 for the McGuire Nuclear Station, Unit 2. The amendment authorizes a revision to the Updated Final Safety Analysis Report in response to your application dated January 31, 2003, as supplemented by letter dated May 1, 2003.

The amendment would allow the degassing and straightening of a bent Mark-BW irradiated fuel rod in the McGuire, Unit 2 spent fuel pool.

A copy of the related Safety Evaluation is also enclosed. A Notice of Issuance will be included in the Commission's biweekly *Federal Register* notice.

Sincerely,

/RA/

Robert E. Martin, Senior Project Manager, Section 1
Project Directorate II
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-370

Enclosures:
1. Amendment No. 198 to NPF-17
2. Safety Evaluation

cc w/encls: See next page

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DUKE ENERGY CORPORATION

DOCKET NO. 50-370

McGUIRE NUCLEAR STATION, UNIT 2

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 198
License No. NPF-17

1. The Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment to the McGuire Nuclear Station, Unit 2 (the facility), Facility Operating License No. NPF-17 filed by the Duke Energy Corporation (licensee) dated January 31, 2003, as supplemented by letter dated May 1, 2003, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations as set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

   C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations set forth in 10 CFR Chapter I;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. The licensee is authorized to make changes to the McGuire Nuclear Station Updated Final Safety Analysis Report (UFSAR) to include an analysis of the process for degassing a bent irradiated fuel pin in the Unit 2 spent fuel pool, as set forth in the application dated January 31, 2003, as supplemented by letter dated May 1, 2003. These changes must be described in the next scheduled update of the UFSAR, in accordance with 10 CFR 50.71(e).

3. This license amendment is effective as of its date of issuance and shall be implemented within 30 days of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

/RA by Leonard Olshan for/

John A. Nakoski, Chief, Section 1
Project Directorate II
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Date of Issuance: August 4, 2003

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 198 TO FACILITY OPERATING LICENSE NPF-17

DUKE ENERGY CORPORATION

MCGUIRE NUCLEAR STATION, UNIT 2

DOCKET NO. 50-370

1.0 INTRODUCTION

By letter dated January 31, 2003, (Reference 1) as supplemented by letter dated May 1, 2003, (Reference 2), Duke Energy Corporation, (the licensee), proposed to revise the McGuire Nuclear Station Updated Final Safety Analysis Report (UFSAR). Specifically, the licensee proposed to revise the UFSAR by adding Section 9.1.2.5, "Degassing Bent Irradiated Fuel Pin in Unit 2 Spent Fuel Pool," to describe a process and analysis in support of degassing and straightening a bent Mark-BW irradiated fuel rod in the McGuire, Unit 2 spent fuel pool (SFP).

The licensee states that on July 21, 1993, during the reconstitution and recaging of fuel assembly V27, fuel rod number I-14 was removed from the damaged assembly and was bent while being placed into the recage assembly. Since 1993, the rod has remained in the McGuire SFP in its bent condition. The proposed amendment would allow the performance of a procedure to straighten the rod by first puncturing it to remove any rod gap gases and then removing the bend. Once straightened, the licensee will store the rod in a broken rod capsule, thereby, allowing additional storage space in the SFP.

The licensee proposed to accomplish the degassing and straightening with a remotely-operated rod manipulation work platform resting underwater, atop the spent fuel racks. This process is necessary to allow for proper long term on-site storage and eventual shipping offsite for disposal. The affected rod has decayed for approximately 10 years, and the remaining rod's plenum gases will be collected and released in a controlled manner in accordance with approved procedures.

The letter dated May 1, 2003, provided clarifying information that did not change the scope of the January 31, 2003, application or the initial proposed no significant hazards consideration determination.

2.0 REGULATORY EVALUATION

Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, Appendix A, "General Design Criteria (GDC) for Nuclear Power Plants," (Reference 3), provides a list of the minimum design requirements for nuclear power plants. GDC 62, "Prevention of criticality in fuel storage and handling," requires licensees to limit the potential for criticality in the fuel handling and storage system by physical systems or processes. In addition, 10 CFR 50.68, "Criticality Accident

Requirements," requires that the licensee comply with 10 CFR 70.24, "Criticality Accident Requirements," or, in lieu of such compliance, that the licensee comply with 10 CFR 50.68(b). Section 50.68(b) requires, in part, that the SFP remain subcritical even if flooded with unborated water. The Nuclear Regulatory Commission (NRC) staff reviewed the amendment request to ensure that the licensee complies with GDC 62.

Criteria and background information used in the NRC staff's evaluation also included 10 CFR Part 20, "Standards for Protection Against Radiation"; 10 CFR 19.12, "Instruction to Workers"; Regulatory Guide 8.8, Revision 3, "Information Relevant To Ensuring That Occupational Radiation Exposure At Nuclear Power Stations Will Be As Low As Is Reasonably Achievable"; 10 CFR Part 50, Appendix I, "Numerical Guides For Design Objectives and Limiting Conditions for Operations To Meet The Criterion 'As Low As Is Reasonably Achievable' for Radioactive Material In Light-Water-Cooled Nuclear Power Reactor Effluents."

3.0 TECHNICAL EVALUATION

3.1 Degassing and Straightening Process

The NRC staff has reviewed the licensee's amendment request and responses to requests for additional information and has identified four defense-in-depth factors which significantly limit the potential for an inadvertent criticality to occur during the straightening of rod I-14 in the McGuire, Unit 2 spent fuel pool. These factors are the following:

1. The licensee performed a mechanical evaluation which demonstrates that there is a low likelihood of breaking the rod during the evolution.

2. The licensee identified provisions that limit the potential for the rod to break during the straightening process.

3. The licensee analyzed the consequences of a potential break of the rod to establish that the potential for an inadvertent criticality accident is negligible.

4. The licensee developed a test program and appropriate procedures to demonstrate that the straightening evolution can be performed safely.

In Reference 2, the licensee described the stress and strain energies which occurred during the initial bending of the fuel rod. The licensee stated that the same properties which allowed the rod to bend without breaking in 1993 would be present during straightening and should limit the potential for breakage. Additionally, the licensee provided information detailing the low clad oxide thickness, hydrogen pickup, and base metal thickness reduction. This information corroborates that the cladding is not embrittled. The NRC staff determined that the above-described information provided by the licensee suggests a low likelihood of breaking the rod during straightening.

However, since the potential for breakage does exist and cannot be neglected, the NRC staff requested, and the licensee provided, a summary of provisions that will be implemented to control the consequences of a rod breakage. The licensee identified the following provisions in Reference 2:

1. The licensee will control the speed of the rod straightening tool to prevent unintended rod behavior.

2. The licensee will provide ample underwater camera viewing to monitor all operations.

3. The licensee will employ a safety skirt to surround the rod to maintain control and accountability of rod pieces should the rod separate, and a proven rod storage capsule will be utilized for long-term rod storage within a rod storage basket once the rod is straightened.

4. Should the rod separate, the licensee will use a rod storage capsule for all of the rod segments and pieces.

The NRC staff reviewed the provisions identified by the licensee to straighten the rod. The licensee has considered the circumstances that may reasonably be expected during this process, and the NRC staff finds that the licensee has implemented adequate measures, as described above, to limit the potential for rod breakage under such circumstances, as well as to monitor the entire evolution. Additionally, should the rod break, the licensee has controls to limit dispersion of rod contents and to properly store the pieces.

To preclude the potential for an inadvertent criticality in the SFP, the licensee performed, at the request of the NRC staff, a criticality evaluation which assumes failure of the rod cladding. The licensee identified that the rod contains approximately two kilograms of uranium dioxide. In Reference 2, the licensee described previous calculations that demonstrated that an inadvertent criticality could not occur. In these previous calculations, the licensee assumed that 26.6 kilograms of unirradiated 5.0 weight percent U-235 fuel pellets (the amount contained in 10 or more fuel rods) were arranged in a spherical homogeneous mixture of uranium dioxide and unborated water. The licensee evaluated various fuel-to-water ratios and identified that the maximum effective multiplication factor (at a 95/95 threshold) was 0.9512. Additionally, the licensee confirmed that its results were consistent with the NRC published subcritical mass limits in NUREG/CR-0095, “Nuclear Safety Guide, TID-7016,” Revision 2, dated June 1978. The NRC staff reviewed the information supplied by the licensee, as discussed above, and finds that it demonstrates that substantial margin exists to preclude an inadvertent criticality event. The analysis conservatively assumed that the SFP water was unborated.

Finally, in response to the NRC staff’s request for information in Reference 4, the licensee provided a summary of its full-scale mockup testing program, to be performed by Framatome ANP, as well as a copy of the draft procedures to be used during the evolution. The licensee stated that the mockup testing program would be used to conduct process and cooling qualification and to support personnel training and qualification prior to onsite implementation. The mockup program will consist of several cladding samples that will parallel the shape and physical properties of the irradiated bent fuel rod. The licensee will repeat the sample straightening process several times to study the behavioral characteristics of the rod and the straightening process and to allow functional operation of the process by the technicians who will execute the task on the irradiated rod. The NRC staff has reviewed the mockup program details proposed by the licensee as well as the draft procedure, which will be finalized based on lessons learned during the mockup program. The mockup program addresses all of the important steps in the straightening procedure, and, therefore, the NRC staff finds that the

licensee has an adequate plan to ensure sufficient training and understanding of the evolution by those who will perform the work.

As set forth above, the NRC staff determined the following: (1) the likelihood of rod breakage is low, (2) adequate controls will be in place should breakage occur, (3) the potential for an inadvertent criticality is negligible, and (4) the licensee has a full-scale mockup program for testing and training. Accordingly, the NRC staff concludes that the licensee has performed an acceptable engineering analysis to demonstrate that the straightening of fuel rod I-14 can be performed safely. Additionally, the NRC staff has determined that upon issuance of this amendment and inclusion of the new Section 9.1.2.5 in the UFSAR, the licensee will still comply with GDC 62. Therefore, the NRC staff finds the licensee's amendment to be acceptable.

3.2 Occupational Radiation Exposure

The NRC staff has reviewed the licensee's plan and procedures for the bent rod modification and storage with respect to occupational radiation exposure. The fuel rod was bent in July 1993, during fuel reconstitution and re-caging operations. The licensee plans to use a contractor, Framatome, for the proposed rod activities, including Framatome's specialized equipment and procedures to degas and collect the fuel rod plenum gases. After the gas collection, the rod will be straightened to facilitate onsite in-pool storage and future shipment for disposal. Release of the collected gas will have no measurable dose impact on the public. All rod manipulations will be performed remotely, from above the pool. No underwater worker diving operations are planned.

All of the rod manipulation operations will be governed by procedures, with the rod residing under about 23 feet of water. Considering this shielding, from an occupational exposure perspective, external radiation level increases above the pool are expected only as equipment is raised to the surface. These procedures were prepared with full consideration of as low as reasonably achievable (ALARA) principles, consistent with the requirements of 10 CFR Part 20. The radiation protection (RP) department will prepare a job coverage plan (JCP) covering pertinent phases of the project. The JCP will include a detailed description of the work evolutions, and will include pre-job briefing checklists. Additionally, the JCP will describe the provisions for radiological work coverage and radiation work permits (RWP), including work hold points for the various jobs associated with the in-pool and out-of-pool operations. Based on the predetermined dose rate and individual worker electronic dosimeter dose set points, RP hold points will be established.

Station radiation protection technicians (RCT) will provide continuous coverage for all work evolutions, including fuel rod movement, degassing, straightening, and post-work job site and equipment decontamination. They will be involved in all pertinent aspects of pre-job briefings and planning. All items removed from the pool will be monitored by the RCT, as the material breaks the water surface, and these items will be sprayed down to reduce the potential for creating an airborne radioactive material problem and to minimize the likelihood of spreading contamination (including discrete radioactive (hot) particles). Representative work site air samples will include assessment for beta, gamma and alpha emitters, as well as tritium, and the installed SFP ventilation system monitors will be online. The RWP and supporting job procedures establish provisions for timely external radiation and airborne surveys, personal protective clothing and equipment, individual monitoring devices, and other access and work controls consistent with good radiation protection practices and 10 CFR Part 20 requirements.

RP supervisors and at least one RCT will observe a mockup demonstration at the vendor's facility. Lessons learned from this demonstration, as well as any other pertinent operational experience, will used in the development of the RP job coverage plan. Each member of the project team will receive radiation protection training on the rod operations, consistent with the requirements of 10 CFR Part 19. RCT training will include irradiated component and hot particle hazards, and impacts of degassing the rod (noble gas release). The pre-job briefings will be used to inform workers and RCT of job scope and pertinent ALARA techniques.

All workers will be provided with appropriate personal dosimeters and protective clothing for out-of-pool work activities. Periodic radiation surveys will be conducted for external radiation, hot particles and loose surface contamination levels, as appropriate and in accordance with the governing RWP. Previous historical experience during large-scale fuel pool reracking shows that radioactive airborne material levels in the above-pool work area have been negligible; given the much narrower scope of this single rod project, radioactive airborne levels should be negligible. However, the licensee has performed bounding (worst case) worker dose calculations for an accidental, sudden release of the rod plenum gases. All calculated pool-side worker doses (thyroid, whole body and shallow dose) are very small fractions of the applicable Part 20 annual occupational radiation dose limits.

An underwater vacuum and washing system will be available to reduce contamination levels of material before they are removed from the pool, so that radiation and contamination levels (including hot particles) can be reduced. The licensee will use the existing SFP filtration system during the current fuel rack installation to maintain water clarity in the SFP. In the unlikely event of fuel rod rupture, a safety tray will be provided to catch any solid debris, thereby reducing the potential dispersal of fuel pellets and debris throughout the pool. These engineering controls and cleaning procedures will help minimize the spread of contamination (e.g., hot particles), while maintaining worker doses ALARA. Appropriate hot particle zones will be established in above-pool work areas. After fuel rod straightening, the rod will be placed and stored in a failed rod capsule, which is stored in a failed rod basket in the SFP.

On the basis of the NRC staff's review of the licensee's proposal and for the reasons set forth above, the NRC staff concludes that the rod degassing and straightening activities can be performed in a manner that will ensure that doses to workers will be maintained ALARA. As further set forth above, the NRC staff finds that the plans for pre-job training and briefings, including the use of vendor mockups, detailed procedures and radiation protection coverage activities, meet the Part 20 ALARA requirements for controlling worker doses. Therefore, the NRC staff finds the licensee's plans to be acceptable for maintaining worker doses ALARA.

3.3 Radiological Impact Assessment

Radiation protection personnel will monitor the doses to the workers during the fuel rod straightening project, and all work will be in accordance with radiation work permits and implementing procedures. The work will be performed remotely from pool-side. The total occupational dose to plant workers as a result of the rod operations is expected to be minimal; a very small fraction of the Unit 2 rolling 3-year annual average worker collective dose of 88 person-rem. The project will follow detailed procedures prepared with full consideration of ALARA principles, consistent with the requirements of 10 CFR Part 20.

On the basis of the NRC staff's review of the licensee's proposal, and for the reasons set forth above, the NRC staff concludes that the McGuire, Unit 2 rod straightening project can be performed in a manner that will ensure that doses to workers will be maintained ALARA and is, therefore, acceptable.

4.0 STATE CONSULTATION

In accordance with the Commission's regulations, the North Carolina State official was notified of the proposed issuance of the amendments. The State official had no comments.

5.0 ENVIRONMENTAL CONSIDERATION

The amendment changes a requirement with respect to installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20. The NRC staff has determined that the amendment involves no significant increase in the amounts and no significant change in the types of any effluents that may be released offsite and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that the amendment involves no significant hazards consideration, and there has been no public comment on such finding [68 FR 18274]. Accordingly, the amendments meet the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendments.

6.0 CONCLUSION

The Commission has concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendments will not be inimical to the common defense and security or to the health and safety of the public.

7.0 REFERENCES

1. Letter from D.M. Jamil (DEC) to U.S. Nuclear Regulatory Commission, "Request for License Amendment, Procedure for Straightening and Irradiated Mark-BW Fuel Rod," dated January 31, 2003, ADAMS Accession No. ML030420365.

2. Letter from D.M. Jamil (DEC) to U.S. Nuclear Regulatory Commission, "Request for Additional Information (RAI); Procedure for Straightening an Irradiated Fuel Rod (TAC No. MB7536)," dated May 1, 2003, ADAMS Accession No. ML031330616.

3. Title10 of the Code of Federal Regulations, Part 50 Appendix A, General Design Criteria 62, "Prevention of criticality in fuel storage and handling."

4. Letter from R.E. Martin (NRC) to D.M. Jamil (DEC), "William B. McGuire Nuclear Station, Unit 2 Re: Procedure for Straightening an Irradiated Fuel Rod (TAC No. MB7536)," dated April 4, 2003, ADAMS Accession No. ML030940679.

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Date: August 4, 2003

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