

January 31, 2003

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

SUBJECT: MCGUIRE NUCLEAR STATION RE: ISSUANCE OF EXEMPTION TO 10 CFR 70.24, CRITICALITY ACCIDENT REQUIREMENTS (TAC NOS. M97863, M97864, MB5014 AND MB5015)

Dear Mr. Jamil:

The Commission is re-issuing the enclosed exemption from certain requirements of Title 10 of the *Code of Federal Regulations* (10 CFR) Section 70.24 regarding criticality accident requirements. This exemption is related to your application dated February 4, 1997, as supplemented by letter dated March 19, 1997, that requested an exemption from certain requirements of 10 CFR 70.24, "Criticality Accident Requirements." That exemption, as issued on July 31, 1997, was based in part on the finding that with no boron in the spent fuel pool water a criticality parameter of k-effective less than a value of 0.95 would be maintained. By letter dated April 18, 2002, as supplemented by letters dated August 7 and October 9, 2002, and January 15, 2003, you submitted an application for revisions to the McGuire Technical Specifications to address the spent fuel pool Boraflex degradation issues. The analysis supporting that application proposed to take partial credit for boron in the spent fuel pool water. Therefore, a part of the technical basis for the granting of the exemption from 10 CFR 70.24 on July 31, 1997, is revised. Accordingly, the exemption is being reissued to reflect the revision in the design basis assumptions for the spent fuel pool in the calculation of the limiting value of the criticality parameter, k-effective.

This exemption continues to relieve McGuire from the requirements of 10 CFR 70.24(a)(1) and (2) regarding the detection, sensitivity, and coverage capabilities of the criticality monitors, and from (a)(3) regarding emergency procedures for each area in which licensed special nuclear material is handled, used, or stored. This revised exemption is effective through December 31, 2005. The Safety Evaluation supporting this exemption provides details of the technical basis.

Dhiaa Jamil

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A copy of the Exemption and the supporting Safety Evaluation by the staff are enclosed. The Exemption is being forwarded to the Office of the Federal Register for publication.

Sincerely,

***/RA/***

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

Docket Nos. 50-369 and 50-370

Enclosures: 1. Safety Evaluation  
2. Exemption

cc w/encls: See next page

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-2-

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION  
RELATING TO REQUEST FOR EXEMPTION FROM 10 CFR 70.24 REQUIREMENTS

DUKE POWER COMPANY

MCGUIRE NUCLEAR STATION, UNITS 1 AND 2

DOCKET NOS. 50-369 AND 50-370

1.0 INTRODUCTION

Title 10 of the *Code of Federal Regulations* (10 CFR) at subsection (a) of 10 CFR 70.24, "Criticality Accident Requirements," requires that each licensee authorized to possess special nuclear material shall maintain in each area where such material is handled, used, or stored, a criticality accident monitoring system "using gamma- or neutron-sensitive radiation detectors which will energize clearly audible alarm signals if accident criticality occurs." Subsection (a)(1) and (a)(2) of 10 CFR 70.24 specify the detection, sensitivity, and coverage capabilities of the monitors required by 10 CFR 70.24(a). Subsection (a)(3) of 10 CFR 70.24 requires that the licensee shall maintain emergency procedures for each area in which this licensed special nuclear material is handled, used, or stored and provides (1) that the procedures ensure that all personnel withdraw to an area of safety upon the sounding of a criticality monitor alarm, (2) that the procedures must include drills to familiarize personnel with the evacuation plan, and (3) that the procedures designate responsible individuals for determining the cause of the alarm and placement of radiation survey instruments in accessible locations for use in such an emergency. Subsection (b)(1) requires licensees to have a means to quickly identify personnel who have received a dose of 10 rads or more. Subsection (b)(2) requires licensees to maintain personnel decontamination facilities, to maintain arrangements for a physician and other medical personnel qualified to handle radiation emergencies, and to maintain arrangements for the transportation of contaminated individuals to treatment facilities outside the site boundary. Subsection (c) exempts Part 50 licensees (such as McGuire) from the requirements of paragraph (b). Subsection (a) of 10 CFR 70.17 "Specific Exemption" states that the Commission may, upon application of any interested person or upon its own initiative, grant such exemptions from the requirements of the regulations in this part as it determines are authorized by law and will not endanger life or property or the common defense and security and are otherwise in the public interest.

By letter dated February 4, 1997, as supplemented March 19, 1997, Duke Power Company (the licensee) requested an exemption for all its nuclear plants from the requirements of 10 CFR 70.24. The staff reviewed the licensee's submittal and determined that procedures and design features made an inadvertent criticality in special nuclear materials handling or storage at McGuire unlikely, in accordance with General Design Criterion 62, and on that basis, granted an Exemption on July 31, 1997. Part of the basis for that conclusion was that the criticality parameter of  $k_{\text{eff}}$  would remain less than or equal to 0.95 when the spent fuel pool was filled with unborated water. By letter dated April 18, 2002, as supplemented on August 7 and October 9, 2002, and January 15, 2003, the licensee submitted an application for revisions

to the McGuire Technical Specifications to address the spent fuel pool Boraflex degradation issues. The analysis supporting this application proposed to take partial credit for boron in the spent fuel pool water. Therefore, a part of the technical basis for which the 10 CFR 70.24 exemption was granted has changed. The staff has reviewed the licensee's application and has reissued a temporary exemption based on criteria similar to the criteria in 10 CFR 50.68. This exemption will be valid until December 31, 2005.

## 2.0 EVALUATION

Special nuclear material, as nuclear fuel, is stored in the spent fuel pool and the new fuel storage vault. The spent fuel pool is used to store irradiated fuel under water after its discharge from the reactor, and new fuel prior to loading into the reactor. New fuel is stored dry (in air) in the new fuel storage vault.

Special nuclear material is also present in the form of fissile material incorporated into nuclear instrumentation. The small quantity of special nuclear material present in these items precludes an inadvertent criticality.

### 2.1 Requirements of 10 CFR 70.24(a)(1) and (2)

Each McGuire unit has its own spent fuel pool. When the 10 CFR 70.24 exemption was granted on July 31, 1997, the spent fuel pool was designed to store the fuel in a geometric array that precluded criticality. At that time, Section 5.6 of the units' Technical Specifications required that the spent fuel racks be designed and maintained such that the effective neutron multiplication factor,  $k_{\text{eff}}$ , would remain less than or equal to 0.95 under all normal and accident conditions for fuel of maximum nominal enrichment of 4.75 weight percent (wt%) U-235. The staff found this design acceptable when granting the exemption in 1997.

An application dated April 18, 2002, as supplemented on August 7 and October 9, 2002, and January 15, 2003, proposed changes to spent fuel storage requirements in the facility Technical Specifications that result in a change to the design basis criticality analysis assumptions that would now allow partial credit for soluble boron in the pool water. Section 4.3.1.1(b) of both units' Technical Specifications requires that  $k_{\text{eff}}$  be less than 1.0 if fully flooded with unborated water, which includes an allowance for uncertainties. The proposed TS amendment would revise TS Section 4.3.1.1(c) such that it would require that  $k_{\text{eff}}$  be less than or equal to 0.95 if fully flooded with water borated to 850 ppm, which includes an allowance for uncertainties.

Reactivity uncertainties associated with taking credit for burnup and integral fuel burnable absorber (IFBA) rods are accounted for, using boron credit. Since these uncertainties are not accounted for in the unborated case, the  $k_{\text{eff}}$  of the spent fuel pool in unborated water could be greater than 1.0 when accounting for the uncertainties. This is outside the criticality requirement in 10 CFR 50.68(b)(4), which states that  $k_{\text{eff}}$  must remain below 1.0 without any soluble boron present in the spent fuel pool. However, the staff does not consider this a safety risk on the basis discussed below.

There are considerable safeguards to prevent and mitigate the boron dilution event. The licensee calculated that it would take at least 8.83 hours to dilute the spent fuel pool from an initial concentration of 2,675 ppm to 850 ppm. The 850 ppm value is the concentration of boron (290 ppm) that provides a 5 percent reactivity margin plus the concentration (560 ppm) required

to account for uncertainties in Region 2A. This region in the spent fuel pool required the maximum total soluble boron out of the four spent fuel pool regions. The minimum concentration of boron required in the spent fuel pool that would prevent  $k_{\text{eff}}$  from reaching a value of 1.0 during normal conditions is 570 ppm. This is the amount of boron required to account for reactivity uncertainties in Region 2B, which was the region that required the most compensation for uncertainties. Diluting the pool to 570 ppm of boron would take approximately 13 hours. In addition to spent fuel pool level being monitored in the control room, plant procedures require personnel to make two rounds through the spent fuel pool area every 12-hour shift. Thus, plant personnel would be aware of and would respond to the dilution event well before the concentration of boron in the spent fuel pool reached 570 ppm. The licensee confirmed these procedures in its letter dated January 15, 2003. The staff finds that the dilution event would be detected and mitigated prior to any possible criticality and that dilution of the spent fuel pool to 570 ppm boron is highly unlikely.

Each McGuire unit has its own new fuel storage vault. The new fuel storage vault is used to receive and store new fuel in a dry condition upon arrival on site and prior to loading in the reactor or spent fuel pool. Although the new fuel storage area is prevented by design from flooding (there is no piping which could rupture and flood this area, there is a drainage system, and there is no hydrogenous fire fighting equipment in the area), the spacing between new fuel assemblies in the vault is sufficient to maintain the array in a subcritical condition even under accident conditions assuming the presence of neutron moderator. The maximum nominal enrichment of 4.75 wt% U-235 for the new fuel assemblies results in a maximum  $k_{\text{eff}}$  of less than 0.95 under conditions of accidental flooding by unborated water, and  $k_{\text{eff}}$  less than 0.98 under conditions of low-density optimum moderation. The staff has found the design of the licensee's new fuel storage vault to be adequate to store fuel enriched to 4.75 wt% U-235.

Nuclear fuel is moved between the shipping container (two assemblies in each container), the new fuel storage vault, the reactor vessel, and the spent fuel pool to accommodate refueling operations. In all cases, fuel movements are procedurally controlled and designed to preclude conditions involving criticality concerns. Only one new fuel assembly is handled at any one time in any area of the fuel building. Upon removal from the shipping container, the assembly is inspected and transferred by the crane to the new fuel storage vault or the spent fuel pool for storage. All valves that could allow water into the area of the spent fuel operating deck are administratively controlled, and remain shut during fuel handling operations.

The licensee's procedures and controls are designed to prevent an inadvertent criticality during fuel handling; nevertheless, radiation monitoring, as required by General Design Criterion 63, is provided for handling new fuel prior to being placed into the spent fuel pool. In addition, handling of fuel in the spent fuel pool is monitored by required radiation monitors on the fuel handling bridges (Section 16.7.6 "Radiation Monitoring for Plant Operators" in the Selected Licensee Commitments Manual). These required radiation monitors have associated alarm response procedures, that provide instructions to the operators upon receipt of alarms.

On the basis of the above, the licensee has met the intent of 10 CFR 70.24 by the existing facility design, the extremely low probability of criticality, and operating procedures. Literal compliance with the requirements of 10 CFR 70.24(a)(1) and (2) would not increase the margin of safety.

## 2.2 Requirements of 10 CFR 70.24(a)(3)

The purpose of 10 CFR 70.24 is to ensure that, if a criticality were to occur during the handling of special nuclear material, personnel would be alerted to that fact and would take appropriate action. The staff has discussed above that reasonable and satisfactory precautions exist to preclude a nuclear criticality accident, thereby meeting the requirements of General Design Criterion 62. In addition, the licensee has installed radiation monitors, as required by General Design Criterion 63, in fuel storage and handling areas. These monitors will alert personnel to excessive radiation levels and allow them to initiate appropriate safety actions.

The licensee provides radiation alarm training in the general employee plant access training that each employee receives before being badged for unescorted access at the plant. This training identifies the types of alarms that are used, the types of alarm signals emitted, and the expected employee response. An exemption to 10 CFR 70.24(a)(3) would not decrease personnel's ability to identify and respond to radiation alarms in areas involving fresh fuel as long as the licensee's general procedures described in its submittals are in effect.

## 2.3 Requirements of 10 CFR 70.24(b) and (c)

The requirements of 10 CFR 70.24(c) exempt holders of Part 50 operating licenses (e.g., McGuire) from the requirements of 10 CFR 70.24(b)(1) and (2) regarding decontamination facilities, arrangements for physician and other medical personnel qualified to handle radiation emergencies, and arrangements for the transportation of contaminated individuals to treatment facilities outside the site boundary. Thus, there is no need for the staff to take any action on 10 CFR 70.24(b) and (c) for McGuire.

## 3.0 CONCLUSION

In accordance with 10 CFR 70.17(a), the licensee has demonstrated that it wishes to remain subject to an exemption from the requirements of 10 CFR 70.24 and has demonstrated that the existing facility design and operating procedures ensure extremely low probability of criticality, and that the existing emergency procedure provides for notification and evacuation of personnel. The life, property or common defense and security of the public will not be endangered. Literal compliance with the requirements of 10 CFR 70.24(a)(1), (2) and (3) would not increase the margin of safety, and, therefore, in accordance with the provisions in 10 CFR 70.17(a), the licensee is allowed to remain covered by the exemption until December 31, 2005.

Principal Contributors: Veronica Klein  
Robert Martin

Date: January 31, 2003

UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION  
DUKE POWER COMPANY  
MCGUIRE NUCLEAR STATION, UNITS 1 AND 2  
DOCKET NOS. 50-369 AND 50-370  
EXEMPTION

1.0 BACKGROUND

The Duke power Company (the licensee) is the holder of Facility Operating License Nos. NPF-9 and NPF-17, for the McGuire Nuclear Station, Units 1 and 2. The licenses provide, among other things, that the licensee is subject to all rules, regulations, and orders of the Commission now or hereafter in effect.

These facilities consist of two pressurized water reactors located at the licensee's site in Mecklenburg County, North Carolina.

2.0 REQUEST/ACTION

Title 10 of the *Code of Federal Regulations* (10 CFR) at subsection (a) of 10 CFR 70.24, "Criticality Accident Requirements," requires that each licensee authorized to possess special nuclear material shall maintain in each area where such material is handled, used, or stored, a criticality accident monitoring system "using gamma- or neutron-sensitive radiation detectors which will energize clearly audible alarm signals if accident criticality occurs." Subsection (a)(1) and (a)(2) of 10 CFR 70.24 specify the detection, sensitivity, and coverage capabilities of the monitors required by 10 CFR 70.24(a). Subsection (a)(3) of 10 CFR 70.24 requires that the licensee shall maintain emergency procedures for each area in which this licensed special nuclear material is handled, used, or stored and provides (1) that the procedures ensure that all personnel withdraw to an area of safety upon the sounding of a criticality monitor alarm, (2) that



the procedures must include drills to familiarize personnel with the evacuation plan, and (3) that the procedures designate responsible individuals for determining the cause of the alarm and placement of radiation survey instruments in accessible locations for use in such an emergency. Subsection (b)(1) requires licensees to have a means to quickly identify personnel who have received a dose of 10 rads or more. Subsection (b)(2) requires licensees to maintain personnel decontamination facilities, to maintain arrangements for a physician and other medical personnel qualified to handle radiation emergencies, and to maintain arrangements for the transportation of contaminated individuals to treatment facilities outside the site boundary. Subsection (c) exempts Part 50 licensees (such as McGuire) from the requirements of paragraph (b).

By letter dated February 4, 1997, as supplemented March 19, 1997, Duke Power Company (the licensee) requested an exemption for all its nuclear plants from the requirements of 10 CFR 70.24. The staff reviewed the licensee's submittal and determined that procedures and design features made an inadvertent criticality in special nuclear materials handling or storage at McGuire unlikely, in accordance with General Design Criterion 62. Accordingly, the staff granted an Exemption on July 31, 1997. Part of the basis for that exemption was that the criticality parameter of k-effective ( $k_{\text{eff}}$ ) would remain less than or equal to 0.95 when the spent fuel pool was filled with unborated water. By letter dated April 18, 2002, as supplemented on August 7 and October 9, 2002, and January 15, 2003, the licensee submitted an application for revisions to the McGuire Technical Specifications to address the spent fuel pool Boraflex degradation issues. The analysis supporting this application proposed to take partial credit for boron in the spent fuel pool water. Therefore, a part of the technical basis for which the 10 CFR 70.24 exemption was granted on July 31, 1997, has changed. The staff has reviewed the licensee's application and continues to find that existing procedures and design features make an inadvertent criticality in special nuclear materials handling or storage at McGuire unlikely.

### 3.0 DISCUSSION

Pursuant to Section 70.17 of 10 CFR, "Specific exemptions," the Commission may, upon application by any interested person or upon its own initiative, grant such exemptions from the requirements of the regulations in this part as it determines are authorized by law and will not endanger life or property or the common defense and security and are otherwise in the public interest.

The staff concludes, on the basis provided above, that the licensee has thus met the intent of 10 CFR 70.24 by the low probability of an inadvertent criticality in areas where fresh fuel could be present, by the licensee's adherence to General Design Criterion 63 regarding radiation monitoring, and by provisions for personnel training and evacuation.

### 4.0 CONCLUSION

Accordingly, the Commission has determined that, pursuant to 10 CFR 70.17, the exemption is authorized by law and will not endanger life or property or the common defense and security and is otherwise in the public interest. Therefore, the Commission hereby grants Duke Power Company an exemption from the requirements of 10 CFR 70.24(a)(1), (2), and (3) for McGuire, Units 1 and 2, on the bases as stated in Section II above.

Pursuant to 10 CFR 51.32, the Commission has determined that granting of this exemption will not have a significant effect on the quality of the human environment (68 FR 5054).

This exemption is effective upon issuance and shall expire on December 31, 2005.

Dated at Rockville, Maryland, this 31st day of January.

FOR THE NUCLEAR REGULATORY COMMISSION

*/RA/*

John A. Zwolinski, Director  
Division of Licensing Project Management  
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McGuire Nuclear Station

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