July 3, 2003

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

SUBJECT: McGUIRE NUCLEAR STATION, UNITS 1 AND 2 RE: ISSUANCE OF AMENDMENTS (TAC NOS. MB6972, MB6973, MB6974 AND MB6975)

Dear Mr. Jamil:

The Nuclear Regulatory Commission (NRC) has issued the enclosed Amendment No. 214 to Facility Operating License NPF-9 and Amendment No. 195 to Facility Operating License NPF-17 for the McGuire Nuclear Station, Units 1 and 2. The amendments consist of changes to the Technical Specifications (TS) in response to your application dated December 12, 2002, as supplemented by letters dated March 27 and April 23, 2003.

The amendments revise the TS regarding the vessel pressure-temperature limit curves and revise the low-temperature overpressure protection limits. In your application, you also requested an exemption from Title 10 of the *Code of Federal Regulations*, Section 50.60, and Appendix G to Part 50, to permit the use of American Society of Mechanical Engineers Code Case N-641 in the development of the revised TS. The NRC staff has granted the exemption and a copy is enclosed.

The licensee also requested that a change be made to TS Table 3.3.2-1, Footnote (c) to correct what was identified as an editorial error. This request was not supported by sufficient information and, as is discussed in the enclosed Safety Evaluation, is denied.

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 Nos. 50-369 and 50-370

Enclosures:
1. Amendment No. 214 to NPF-9
2. Amendment No. 195 to NPF-17
3. Safety Evaluation
4. Exemption

cc w/encls: See next page

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The amendments revise the TS regarding the vessel pressure-temperature limit curves and revise the low-temperature overpressure protection limits. In your application, you also requested an exemption from Title 10 of the *Code of Federal Regulations*, Section 50.60, and Appendix G to Part 50, to permit the use of American Society of Mechanical Engineers Code Case N-641 in the development of the revised TS. The NRC staff has granted the exemption and a copy is enclosed.

The licensee also requested that a change be made to TS Table 3.3.2-1, Footnote (c) to correct what was identified as an editorial error. This request was not supported by sufficient information and, as is discussed in the enclosed Safety Evaluation, is denied.

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Docket Nos. 50-369 and 50-370

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DATE	7/3/2003	7/3/2003	05/14/2003	7/3/2003

OFFICE	DE/EMCB/SC*	DSSA/SRXB/SC*	PDII-1/PD	DLPM/D(A)
NAME	SCoffin	JUhle	EHackett	WRuland for LMarsh
DATE	04/28/2003	06/12/2003	/ /2003	7/2/2003

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DUKE ENERGY CORPORATION

DOCKET NO. 50-369

McGUIRE NUCLEAR STATION, UNIT 1

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 214
License No. NPF-9

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

   A. The application for amendment to the McGuire Nuclear Station, Unit 1 (the facility), Facility Operating License No. NPF-9 filed by the Duke Energy Corporation (licensee) dated December 12, 2002, as supplemented by letters dated March 27 and April 23, 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. Accordingly, the license is hereby amended by page changes to the Technical Specifications as indicated in the attachment to this license amendment, and Paragraph 2.C.(2) of Facility Operating License No. NPF-9 is hereby amended to read as follows:

   (2) Technical Specifications

   The Technical Specifications contained in Appendix A, as revised through Amendment No. 214, are hereby incorporated into this license. The licensee shall operate the facility in accordance with the Technical Specifications.

3. This license amendment is effective as of its date of issuance and shall be implemented within 90 days of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

/RA/

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

Attachment:
Technical Specification
Changes

Date of Issuance: July 3, 2003

DUKE ENERGY CORPORATION

DOCKET NO. 50-370

McGUIRE NUCLEAR STATION, UNIT 2

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 195
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 December 12, 2002, as supplemented by letters dated March 27 and April 23, 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. Accordingly, the license is hereby amended by page changes to the Technical Specifications as indicated in the attachment to this license amendment, and Paragraph 2.C.(2) of Facility Operating License No. NPF-17 is hereby amended to read as follows:

   (2) Technical Specifications

   The Technical Specifications contained in Appendix A, as revised through Amendment No. 195, are hereby incorporated into this license. The licensee shall operate the facility in accordance with the Technical Specifications.

3. This license amendment is effective as of its date of issuance and shall be implemented within 90 days of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

/RA

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

Attachment:
Technical Specification
Changes

Date of Issuance: July 3, 2003

ATTACHMENT TO LICENSE AMENDMENT NO. 214

FACILITY OPERATING LICENSE NO. NPF-9

DOCKET NO. 50-369

ATTACHMENT TO LICENSE AMENDMENT NO. 195

FACILITY OPERATING LICENSE NO. NPF-17

DOCKET NO. 50-370

Replace the following pages of the Appendix A Technical Specifications and associated Bases with the attached revised pages. The revised pages are identified by amendment number and contain marginal lines indicating the areas of change.

Remove	Insert
3.4.3-1	3.4.3-1
3.4.3-3	3.4.3-3
3.4.3-4	3.3.3-4
3.4.3-5	3.4.3-5
3.4.3-6	3.4.3-6
3.4.3-7	3.4.3-7
3.4.3-8	3.4.3-8
3.4.12-2	3.4.12-2
3.4.12-3	3.4.12-3
3.4.12-4	3.4.12-4
B 3.4.3-2	B 3.4.3-2
B 3.4.12-5	B 3.4.12-5
B 3.4.12-6	B 3.4.12-6
B 3.4.12-7	B 3.4.12-7
B 3.4.12-9	B 3.4.12-9

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 214 TO FACILITY OPERATING LICENSE NPF-9

AND AMENDMENT NO. 195 TO FACILITY OPERATING LICENSE NPF-17

DUKE ENERGY CORPORATION

MCGUIRE NUCLEAR STATION, UNITS 1 AND 2

DOCKET NOS. 50-369 AND 50-370

1.0 INTRODUCTION

By letter dated December 12, 2002, as supplemented by letters dated March 27 and April 23, 2003 (reference 1), Duke Energy Corporation, (the licensee), submitted a request for changes to the McGuire Nuclear Station, Units 1 and 2, Technical Specifications (TS). The proposed changes would revise the TS regarding the reactor vessel pressure and temperature (RPV P/T) limit curves and would revise the low-temperature overpressure protection (LTOP) limits. The proposed P/T limits would be effective through 34 effective full power years (EFPY) of facility operation. The proposed changes to the P/T limits were based, in part, on the use of American Society of Mechanical Engineers (ASME) Code Case N-641, “Alternative Pressure-Temperature Relationship and Low-Temperature Overpressure Protection (LTOP) System Requirements, Section XI, Division 1." The licensee also requested an exemption from the requirements of Appendix G to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, in order to utilize ASME Code Case N-641. Appendix G to Part 50 requires the use of Appendix G to Section XI of the ASME Code for developing RPV P/T limits.

The letters dated March 27 and April 23, 2003, provided clarifying information that did not change the scope of the December 12, 2002, application nor the initial proposed no significant hazards consideration determination.

The licensee also requested that a change be made to TS Table 3.3.2-1, Footnote (c) to correct what the licensee identified as an editorial error in the description of steam line isolation on steam line pressure negative rate-high blocking. However, the licensee's no significant hazards consideration determination did not address the editorial error as required by 10 CFR 50.91, "Notice for public comment; State consultation." As such, when the initial notice and opportunity for hearing was published in the *Federal Register* (68 FR 801), the editorial error was not included and the application for this portion of the amendment was incomplete. The editorial error clarifies an existing TS requirement, is not directly related to the other requested changes, and can be made at anytime. When this issue was identified, there was limited time to publish a new notice in the *Federal Register* and meet the licensee's needs. Because the licensee has an immediate need for the TS amendment on the P/T limits, the decision was made to proceed with the issuance of the P/T limits changes. With this in mind, the Nuclear Regulatory Commission (NRC) staff denies the editorial error changes at this time without prejudice against the licensee to seek this change in the future.

2.0 REGULATORY EVALUATION

The NRC has established requirements in 10 CFR Part 50 to protect the integrity of the reactor coolant pressure boundary in nuclear power plants. The NRC staff evaluates the P/T limit curves based on the following NRC regulations and guidance: Appendix G to 10 CFR Part 50 "Fracture Toughness Requirements"; Generic Letter (GL) 88-11 (reference 6); GL 92-01, Revision 1 (reference 7); GL 92-01, Revision 1, Supplement 1; Regulatory Guide (RG) 1.99, Revision 2 (RG 1.99, Rev. 2) (reference 8); and the Standard Review Plan (SRP) Section 5.3.2, "Pressure Temperature Limits." GL 88-11 advised licensees that the NRC staff would use RG 1.99, Rev. 2, to review P/T limit curves. RG 1.99, Rev. 2, contains methodologies for determining the increase in transition temperature and the decrease in upper-shelf energy (USE) resulting from neutron radiation. GL 92-01, Rev. 1, requested that licensees submit their RPV data for their plants to the NRC staff for review. GL 92-01, Rev. 1, Supplement 1, requested that licensees provide and assess data from other licensees that could affect their RPV integrity evaluations. These data are used by the NRC staff as the basis for the review of P/T limit curves. Appendix G to 10 CFR Part 50 requires that P/T limit curves for the RPV be at least as conservative as those obtained by applying the methodology of Appendix G to Section XI of the ASME Boiler and Pressure Vessel Code, 1995 Edition through the 1996 Addenda.

SRP Section 5.3.2 provides an acceptable method of determining the P/T limit curves for ferritic materials in the beltline of the RPV based on the linear elastic fracture mechanics methodology of Appendix G to Section XI of the ASME Code. The basic parameter of this methodology is the stress intensity factor K_I, which is a function of the stress state and flaw configuration. Appendix G requires a safety factor of 2.0 on stress intensities resulting from reactor pressure during normal and transient operating conditions, and a safety factor of 1.5 for hydrostatic testing. Appendix G also requires a safety factor of 1.0 on stress intensities resulting from thermal loads for normal and transient operating conditions as well as for hydrostatic testing. The methods of Appendix G postulate the existence of a sharp surface flaw in the RPV that is normal to the direction of the maximum stress (i.e., of axial orientation). This flaw is postulated to have a depth that is equal to 1/4 of the RPV beltline thickness and a length equal to six times its depth. The critical locations in the RPV beltline region for calculating heatup and cooldown P/T curves are the 1/4 thickness (1/4T) and 3/4 thickness (3/4T) locations, which correspond to the maximum depth of the postulated inside surface and outside surface defects, respectively. The methodology found in Appendix G to Section XI of the ASME Code requires that licensees determine the adjusted reference temperature (ART or adjusted RT_{NDT}). The ART is defined as the sum of the initial (unirradiated) reference temperature (initial RT_{NDT}), the mean value of the adjustment in reference temperature caused by irradiation (ΔRT_{NDT}), and a margin (M) term.

The ΔRT_{NDT} is a product of a chemistry factor and a fluence factor. The chemistry factor is dependent upon the amount of copper and nickel in the material and may be determined from tables in RG 1.99, Rev. 2, or from surveillance data. The fluence factor is dependent upon the neutron fluence at the maximum postulated flaw depth. The margin term is dependent upon whether the initial RT_{NDT} is a plant-specific or a generic value and whether the chemistry factor was determined using the tables in RG 1.99, Rev. 2, or surveillance data. The margin term is used to account for uncertainties in the values of the initial RT_{NDT}, the copper and nickel contents, the fluence and the calculational procedures. RG 1.99, Rev. 2, describes the methodology to be used in calculating the margin term.

The purpose of this review is to establish the acceptability of the recalculation methodology for the vessel fluence and the acceptability of the plant transients and plant conditions for the estimation of the P/T and LTOP limits. The fluence methodology requirements are described in RG 1.190 (reference 9), and are based on meeting General Design Criteria (GDC) 14, 30, and 31 (reference 10). The LTOP and P/T curve methodology, as described in WCAP-14040-NP-A (Reference 2), is also discussed below.

3.0 EVALUATION

3.1 Licensee Evaluation

The licensee requested, pursuant to 10 CFR 50.60(b), an exemption to use ASME Code Case N-641 as the basis for establishing the P/T limit curves. ASME Code Case N-641 permits application of the lower bound static initiation fracture toughness (K_{IC}) curve as the basis for establishing the P/T curves in lieu of using the lower bound crack arrest fracture toughness (K_{IA}) curve which is invoked by Appendix G to Section XI of the ASME Code. ASME Code Case N-641 further permits the use of a postulated circumferentially-oriented flaw for the evaluation of RPV circumferential welds in lieu of the axially-oriented flaw that would be required by Appendix G to Section XI of the ASME Code. The other margins involved with the ASME Section XI, Appendix G process of determining P/T limit curves remained unchanged in the licensee's evaluation.

The licensee submitted ART calculations and P/T limit curves valid for up to 34 EFPY of facility operation. Surveillance capsule data exists from McGuire Unit 1 for the intermediate shell plate B5012-1 and the intermediate shell longitudinal welds (heat # 20291/12008). Additionally, surveillance capsule weld data (heat # 21935/12008) was obtained from Diablo Canyon, Unit 2. This is the same heat as the McGuire Unit 1 lower shell longitudinal welds. The surveillance weld data from Diablo Canyon was evaluated for credibility under WCAP-15423 (reference 11). The Diablo Canyon weld data were used for determination of the limiting ART, with the full margin for ΔRT_{NDT} for McGuire, Unit 1. This data was also ratioed down to reflect the minor difference in chemistry between the Diablo Canyon, Unit 1 capsule and the McGuire, Unit 1 lower shell longitudinal weld. The licensee determined that the most limiting beltline material at the 1/4T and 3/4T locations was the lower shell longitudinal weld (seams 3-442A and C). The ART values for the lower shell longitudinal weld at the 1/4T and 3/4T locations at 34 EFPY were as follows:

	1/4T Location	3/4T Location
Fluence	1.03×10^{19}	0.366×10^{19}
ΔRT_{NDT}	196.3	140
Initial RT_{NDT}	-50	-50
Margin	56	56
ART	202	146

For McGuire, Unit 2, the licensee determined that the most limiting beltline material at the 1/4T and 3/4T locations was lower shell forging 04 (heat # 411337/11). The ART values for lower shell forging 1/4T and 3/4T locations at 34 EFPY were as follows:

	1/4T Location	3/4T Location
Fluence	1.11 X 10^{19}	0.403 X 10^{19}
ΔRT_{NDT}	119.3	86.9
Initial RT_{NDT}	-30	-30
Margin	34	34
ART	123	91

The licensee submitted information in a letter dated March 27, 2003, on the throughwall temperature gradients resulting from heatup and cooldown transients and the licensee's determination of the applied stress intensity at the tip of the postulated 1/4T and 3/4T flaws due to thermal loading (i.e., K_{IT}) to support the licensee's detailed fracture mechanics evaluations performed to establish the proposed McGuire Units 1 and 2 P/T limits. This information, along with knowledge of the applied stress intensity at the tip of the postulated 1/4T and 3/4T flaws due to pressure loads and the material property information cited above for both the limiting beltline plate and outlet nozzle forging, permitted the NRC staff to evaluate the acceptability of the proposed McGuire Units 1 and 2 P/T limit curves.

3.2 Staff Evaluation

3.2.1 LTOP and P/T Curve Methodology

WCAP-15192 and WCAP-15201 (References 3 and 4) include the calculations for the P/T curves for McGuire Units 1 and 2, respectively. The fluence values were calculated using the Westinghouse methodology, adhering to the guidance in RG 1.190, and therefore, are acceptable. The peak azimuthal fast neutron fluence (E > 1.0 MeV) at 34 EFPYs of operation for Unit 1 is 1.95×10^{19} n/cm^2. The corresponding value for Unit 2 is 1.85×10^{19} n/cm^2.

The LTOP system controls reactor coolant system (RCS) pressure at low-temperatures to protect the integrity of the vessel through the P/T curve limit and the LTOP setpoints that are established to satisfy the requirements of Appendix G, to 10 CFR Part 50. The P/T curve limits are protected by the primary system power operated relief valves (PORV) setpoints. The PORV settings must be low enough to protect the Appendix G limits but sufficiently high to allow RCP startup without cavitation.

The thermal hydraulic conditions and vessel temperatures for several heatup and cooldown rates were calculated assuming the material properties that correspond to 34 EFPYs. The methodology is consistent with WCAP-14040-NP-A, Revision 2, (Reference 2). Both the fluence and the P/T curve calculational methodologies have been approved by the NRC staff. Thus, the proposed P/T curves are acceptable.

The LTOP limits were developed using the methodology in WCAP-14040-NP-A, Revision 2. To determine the LTOP limits, limiting mass and heat input transients are calculated. Mass input was assumed from a safety injection pump and from a centrifugal charging pump. The heat input transient was determined from a reactor coolant pump startup with temperature asymmetry between the RCS and a steam generator. The system response in these transients was determined using the Duke version of the RETRAN code described in DPC-NE-3000-PA (Reference 5). The calculation of peak pressure in these transients (setpoint plus overshoot) assumed a 2.0 second PORV stroke time. For a mass input transient the overshoot also depends on the mass input rate, the RCS volume, and PORV relief capacity as a function of

pressure. Peak transient pressures are adjusted for static and dynamic pressure effects and instrument uncertainty. Those values are then compared to Appendix G requirements to develop the P/T limits.

For both McGuire units, the calculated lift point is 385 pounds per square inch gauge (psig). This value protects the Appendix G limits but avoids RCP cavitation.

The LTOP system is enabled at a temperature that also provides protection at the high end of operating pressures by the pressurizer safety valves (PSVs). For both McGuire units the PSVs are required to relieve pressure above 2435 psig and below 2559 psig. The corresponding Appendix G pressure is 2240 psig at 275 °F and 2412 psig at 280 °F. By interpolation, it was calculated that a nominal 2485 psig PSV lift pressure would provide high-end pressure protection with the enable temperature at 282 °F (or 294 °F or higher including instrument error). The current enabling value was set at 300 °F, thus providing overpressure protection that meets the P/T limits above 300 °F for both units for operation to 34 EFPYs. This value is reflected in LCO 3.4.12 and is unchanged by this application.

For instances when two centrifugal charging pumps or two safety injection pumps or one charging and one safety injection pump are capable of injecting, additional requirements are established as set forth in the Conditions and Required Actions for TS 3.4.12. The licensee states that it is desirable to operate with one centrifugal charging pump and one safety injection pump in service for brief periods during plant heatup (i.e., for accumulator fill and check valve testing). This is acceptable pursuant to the restrictions of TS 3.4.12. The RHR relief capability is sufficient for either the charging or the safety injection pump. However, the RHR full relief capability is realized at a pressure of 560 psig, which is higher than the PORV's corresponding pressure of 524.9 psig. In TS 3.4.12, Required Actions A.2.2.1, A.2.2.2, and F.1 have been revised to reflect the new P/T limits. For McGuire Unit 1, the revised requirements are that: (1) a 100 °F/hr cooldown rate must not be used below 174 °F; and (2) a cooldown rate of < 20 °F/hr must be used between indicated temperatures of 174 °F and 74 °F. For McGuire Unit 2, the revised requirements are that: (1) a 100 °F/hr cooldown rate must not be used below 89 °F; and (2) a cooldown rate of < 60 °F/hr must be used between indicated temperatures of 89 °F and 74 °F. The NRC staff finds these revisions to Required Actions A.2 and F to be consistent with the revised P/T limit curves and, therefore, to be acceptable.

The current TS 3.4.12 LCO requires that, for a single charging pump or a single safety injection pump capable of injecting into the RCS, either two PORVs will be available or the RCS will be depressurized with an RCS vent $\geq$2.75 square inches. This recognizes that either the availability of two PORVs or the RCS vent will accommodate a single charging pump or a single safety injection pump. The licensee has proposed a new Required Action A.5 for Condition A combinations of any two charging or safety injection pumps that requires the availability of (a) two PORVs and (b) depressurization of the RCS and an RCS vent of $\geq$ 2.75 square inches. The NRC staff requires that this RCS venting requirement not be met by the provision of securing a PORV in the open position and the licensee confirms this to be the case with a revision to the TS Bases stating "(the RCS vent shall not be one of the two OPERABLE PORVs)." The licensee further states that the effective mass input rate into the RCS from any combination of two charging or safety injection pumps would be less than twice that of a single pump. On these bases, the NRC staff finds the addition of Condition A.5 to be acceptable.

In summary, the NRC staff's review of the proposed P/T curves and LTOP limits for the McGuire units indicates that the fluence calculational method adheres to the guidance in RG 1.190 and the calculational method for the limiting transient pressures has been approved in WCAP-14040-NP-A. Therefore, the proposed P/T curves and LTOP limits for both McGuire units are acceptable for operation to 34 EFPYs.

3.2.2 Technical Specification Changes

The NRC staff reviewed the TS markup in Attachment 1 to the submittal. McGuire Unit 1 TS Figure 3.4.3-1, "RCS Heatup Limitations," was replaced with Figures 3.4.3-1 and 3.4.3-2 (separating the hydrostatic test limit); McGuire Unit 2 TS Figure 3.4.3-1, "RCS Heatup Limitations," was replaced with Figures 3.4.3-3 and 3.4.3-4; McGuire Unit 1 TS Figure 3.4.3-2 "RCS Cooldown Limitations," was replaced with Figure 3.4.3-5; and McGuire Unit 2 TS Figure 3.4.3-2, "RCS Cooldown Limitations," was replaced with Figure 3.4.3-6. The NRC staff finds that the proposed TS changes correctly reflect the proposed changes and thus, are acceptable. The changes to TS 3.4.12 for the LTOP were found to be acceptable, as discussed above.

3.2.3 Use of ASME Code Case N-641

As mentioned above, the licensee requested an exemption to allow the use of ASME Code Case N-641 as the basis for establishing the P/T limit curves. Use of the K_{IC} curve in determining the lower bound fracture toughness curve in the development of P/T operating limits is technically correct. The K_{IC} curve appropriately implements the use of static initiation fracture toughness behavior to evaluate the controlled heatup and cooldown process of an RPV. The NRC staff concluded that P/T curves based on the K_{IC} fracture toughness curve as referenced by ASME Code Case N-641 will enhance overall plant safety by expanding the P/T operating window with the greatest safety benefit in the region of low temperature operation. The operating window through which the operator heats up and cools down the RCS is determined by the difference between the maximum allowable pressure determined by Appendix G of ASME Section XI, and the minimum required pressure for the reactor coolant pump seals adjusted for instrument uncertainties. A narrow operating window could potentially have an adverse safety impact by increasing the possibility of inadvertent overpressure protection system actuation due to pressure surges associated with normal plant evolutions such as RCS pump starts and swapping operating charging pumps with the RCS in a water-solid condition. In addition, implementation of the proposed P/T curves, as defined by the technical basis supported by ASME Code Case N-641, does not significantly reduce the margin of safety.

The NRC staff performed an independent calculation of the ART values for the limiting material using the methodology in RG 1.99, Rev. 2. Based on these calculations, the NRC staff verified that the licensee's limiting beltline material for McGuire, Unit 1 is the lower shell longitudinal weld (seams 3-442A and 3-442C) and for McGuire, Unit 2 it is the lower shell forging (heat # 411337/11). The NRC staff's calculated ART values for the limiting material agreed with the licensee's calculated ART values.

The NRC staff evaluated the licensee's P/T limit curves for acceptability by performing a finite set of check calculations based on information submitted by the licensee using the methodologies referenced in the ASME Code (as indicated by SRP 5.3.2) and in Welding Research Council Bulletin 175, "PVRC Recommendations on Toughness Requirements for

Ferritic Materials," August 1972. The NRC staff's calculations confirmed the licensee's determination that the limiting RPV beltline materials and the closure head flange and vessel flange contributed to the definition of the McGuire, Unit 1 P/T limit curves. For McGuire, Unit 2, the NRC staff's calculation confirmed that both the limiting RPV beltline materials and the closure head flange contributed to the definition of the McGuire, Unit 2 P/T limit curves. The NRC staff verified that the licensee's proposed P/T limits satisfy the requirements in Paragraph IV.A.2 of Appendix G of 10 CFR Part 50. Specifically, the NRC staff concluded that the P/T limit curves submitted by the licensee appropriately accounted for the limiting conditions defined by the material properties of the limiting beltline materials (plates and welds) and were as conservative as those that would be generated by the NRC staff's application of the methodology specified in Appendix G to Section XI of the ASME Code, as modified by ASME Code Case N-641. Therefore, the NRC staff determined that the licensee's proposed P/T limit curves were acceptable for operation of the McGuire, Units 1 and 2 RPVs through 34 EFPY of operation.

In addition, Appendix G of 10 CFR Part 50 also imposes a minimum temperature at the closure head flange based on the reference temperature for the flange material. Section IV.A.2 of Appendix G states that when the pressure exceeds 20 percent of the preservice system hydrostatic test pressure, the temperature of the closure flange regions highly stressed by the bolt preload must exceed the reference temperature of the material in those regions by at least 160 °F for core critical operation, 120 °F for normal, non-critical core operation, and by 90 °F for hydrostatic pressure tests and leak tests. The Charpy V-notch tests for the Unit 1 RPV and closure head flanges were re-evaluated by the licensee using the material certifications from Bethlehem Steel Corporation. This re-evaluation has concluded that the initial RT_{NDT} values for the RPV and closure head flanges should be 10 °F. Based on the limiting flange RT_{NDT} of 10 °F for McGuire Unit 1 and RT_{NDT} of 1 °F for McGuire, Unit 2, the NRC staff has determined that the proposed P/T limits have satisfied the requirement for the closure flange region during all modes of normal operation and for hydrostatic pressure and leak testing.

4.0 SUMMARY

The NRC staff reviewed the information submitted by the licensee to support TS changes related to revision of the P/T curves and the LTOP limits applicable out to 34 EFPYs. Specifically, the NRC staff reviewed the vessel fluence methodology and the peak transient pressure methodology for the estimation of the LTOP limits. The NRC staff concluded that: (1) the methodology used for the fluence evaluation conforms with the guidance in RG 1.190 and is acceptable, (2) the P/T and LTOP limit estimation was performed using a staff-approved methodology and is acceptable, and (3) the TS changes correctly reflect the proposed changes, and thus are acceptable.

The NRC staff concludes that the proposed P/T limit curves for each of the pressure test, core-not-critical and core-critical conditions satisfy the requirements in Appendix G to Section XI of the ASME Code, as modified by Code Case N-641, and Appendix G of 10 CFR Part 50. The proposed P/T limits also satisfy GL 88-11, because the method in RG 1.99, Rev. 2, was used to calculate the ART. Hence, the proposed P/T limit curves may be incorporated into the McGuire, Units 1 and 2 TS and shall be valid until 34 EFPY of operation.

5.0 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.

6.0 ENVIRONMENTAL CONSIDERATION

The amendments change requirements with respect to installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20 and change surveillance requirements. The NRC staff has determined that the amendments involve 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 amendments involve no significant hazards consideration, and there has been no public comment on such finding (68 FR 801). 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.

7.0 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.

8.0 REFERENCES

1. Letter from D.M. Jamil to the U.S. Nuclear Regulatory Commission, "McGuire Units 1 and 2 License Amendment Request Technical Specification Changes (TS) TS 3.3.2 Engineered Safety Feature Actuation System (ESFAS) Instrumentation TS 3.4.3 Reactor Coolant System (RCS) Pressure and Temperature Limits (P/T) Limits TS 3.4.12 Low Temperature Overpressure Protection (LTOP) System," dated December 12, 2002, as supplemented on March 27 and April 23, 2003.

2. WCAP-14040-NP-A, Revision 2, "Methodology Used to Develop Cold Overpressure Mitigating System Setpoints and RCS Heatup and Cooldown Limit Curves," Westinghouse Electric Company LLC dated January, 1996.

3. WCAP-15192, "McGuire Unit 1 Heatup and Cooldown Limit Curves for Normal Operation," by T.J. Laubham, Westinghouse Electric Company LLC, September 2002.

4. WCAP-15201, "McGuire Unit 2 Heatup and Cooldown Limit Curves for Normal Operation," by T.J. Laubham, Westinghouse Electric Company LLC, September 2002.

5. DPC-NE-3000, "Thermal-Hydraulic Transient Analysis Methodology" Duke Power Company, June 2002.

6. Generic Letter 88-11, “Radiation Embrittlement of Reactor Vessel Materials.”

7. NRC Generic Letter 92-01, “Reactor Vessel Structural Integrity.”

8. Regulatory Guide 1.99, “Effects of Residual Elements on Predicted Radiation Damage to Reactor Vessel Materials.”

9. Regulatory Guide 1.190, “Calculational and Dosimetry Methods for Determining Pressure Vessel Neutron Fluence.”

10. GDC 14, “Reactor Coolant Pressure Boundary,” GDC 30, “Quality of Reactor Coolant Pressure Boundary,” GDC 31, “Fracture Prevention of Reactor Coolant Pressure Boundary.”

11. WCAP-15423, “Analysis of Capsule V from Pacific Gas and Electric Company Diablo Canyon Unit 2 Reactor Vessel Radiation Surveillance Program,” B. Burgos, et al., September 2000.

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Date: July 3, 2003

7590-01-P

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

Duke Power Company (the licensee) is the holder of Facility Operating License Nos. NPF-9 and NPF-17 that authorizes operation of the McGuire Nuclear Station, Units 1 and 2 (McGuire). The license provides, among other things, that the facility is subject to all rules, regulations, and orders of the U.S. Nuclear Regulatory Commission (NRC, the Commission) now or hereafter in effect.

The facility consists of two pressurized water reactors located in Mecklenburg County, North Carolina.

2.0 REQUEST/ACTION

Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.60(a), requires that the fracture toughness and material surveillance requirements of Appendix G to Part 50 must be met for the reactor coolant pressure boundary. Appendix G to Part 50 requires that pressure and temperature (P/T) limits be established for reactor pressure vessels (RPVs) during normal operating and hydrostatic or leak rate testing conditions. Specifically, Section IV.A.2.a of Appendix G to 10 CFR Part 50 states that “The appropriate requirements on both the pressure-temperature limits and the minimum permissible temperature must be met for all conditions.” Further, Section IV.A.2.b of Appendix G to 10 CFR Part 50 requires that these P/T

limits must be at least as conservative as limits obtained by following the methods of analysis and the margins of safety of Appendix G to Section XI of the American Society of Mechanical Engineers (ASME) *Boiler and Pressure Vessel Code* (Code). The current ASME Code of Record for McGuire is the 1995 edition through 1996 addenda of the ASME Code. The McGuire Code of Record does not incorporate the provisions of ASME Code Case N-641. Although the provisions of ASME Code case N-641 were incorporated into Appendix G to Section XI of the ASME Code in the 1998 edition through 2000 addenda, which is the latest edition and addenda codified in 10 CFR 50.55a, McGuire has not adopted this edition and consequently must meet its Code of Record to comply with Appendix G to Part 50. Therefore, in this case, the licensee is still required to obtain an exemption to apply Code Case N-641.

In order to address provisions of amendments to the McGuire Technical Specification (TS) P/T limit curves, the licensee requested in its submittal dated December 12, 2002, as supplemented by letters dated March 27 and April 23, 2003, that the NRC staff exempt McGuire from application of specific requirements of 10 CFR 50.60 and Appendix G to 10 CFR Part 50, and substitute the use of ASME Code Case N-641. ASME Code Case N-641 permits the use of an alternate reference fracture toughness curve for RPV materials and permits the postulation of a circumferentially-oriented flaw for the evaluation of circumferential RPV welds when determining the P/T limits. The proposed exemption request is consistent with, and is needed to support, the McGuire TS amendment that was contained in the same submittal. The proposed McGuire TS amendment will revise the P/T limits for heatup, cooldown, and inservice test limitations for the reactor coolant system (RCS) through 34 effective full power years of operation.

Code Case N-641

The licensee has proposed an exemption to allow the use of ASME Code Case N-641 in conjunction with Appendix G to ASME Section XI, 10 CFR 50.60(a) and 10 CFR Part 50, Appendix G, to establish the P/T limits for the McGuire, Units 1 and 2 RPVs.

The proposed TS amendment to revise the P/T limits for McGuire, Units 1 and 2, relies in part, on the requested exemption. These revised P/T limits have been developed using the lower bound K_{IC} fracture toughness curve shown in ASME, Section XI, Appendix A, Figure A-2200-1, in lieu of the lower bound K_{IA} fracture toughness curve of ASME, Section XI, Appendix G, Figure G-2210-1, as the basis fracture toughness curve for defining the McGuire P/T limits. In addition, the revised P/T limits have been developed based on the use of a postulated circumferentially-oriented flaw for the evaluation of RPV circumferential welds in lieu of the axially-oriented flaw that would be required by Appendix G to Section XI of the ASME Code. The other margins involved with the ASME Section XI, Appendix G, process of determining P/T limit curves remain unchanged.

Use of the K_{IC} curve as the basis fracture toughness curve for the development of P/T operating limits is technically correct. The K_{IC} curve appropriately implements the use of a relationship based on static initiation fracture toughness behavior to evaluate the controlled heatup and cooldown process of a RPV, whereas the K_{IA} fracture toughness curve codified into Appendix G to Section XI of the ASME Code was developed from more conservative crack arrest and dynamic fracture toughness test data. The application of the K_{IA} fracture toughness curve was initially codified in Appendix G to Section XI of the ASME Code in 1974 to provide a conservative representation of RPV material fracture toughness. This initial conservatism was necessary due to the limited knowledge of RPV material behavior in 1974. However, additional knowledge has been gained about RPV materials that demonstrates the lower bound on

fracture toughness provided by the K_{IA} fracture toughness curve is well beyond the margin of safety required to protect the public health and safety from potential RPV failure.

Likewise, the use of a postulated circumferentially-oriented flaw in lieu of an axially-oriented one for the evaluation of a circumferential RPV weld is more technically correct. The size of flaw required to be postulated for P/T limit determination has a depth of one-quarter of the RPV wall thickness and a length six times the depth. Based on the direction of welding during the fabrication process, the only technically reasonable orientation for such a large flaw is for the plane of the flaw to be circumferentially-oriented (i.e., parallel to the direction of welding). Prior to the development of ASME Code Case N-641 (and the similar ASME Code Case N-588), the required postulation of an axially-oriented flaw for the evaluation of a circumferential RPV weld has provided an additional, unnecessary level of conservatism to the overall evaluation.

In addition, P/T limit curves based on the K_{IC} fracture toughness curve and postulation of a circumferentially-oriented flaw for the evaluation of RPV circumferential welds will enhance overall plant safety by expanding the P/T operating window with the greatest safety benefit being in the region of low temperature operations. The operating window through which the operator heats up and cools down the RCS is determined by the difference between the maximum allowable pressure determined by Appendix G of ASME Section XI, and the minimum required pressure for the reactor coolant pump seals adjusted for instrument uncertainties. A narrow operating window could potentially have an adverse safety impact by increasing the possibility of inadvertent overpressure protection system actuation due to pressure surges associated with normal plant evolutions such as RCS pump starts and swapping operating charging pumps with the RCS in a water-solid condition.

Since application of ASME Code Case N-641 provides appropriate procedures to establish maximum postulated defects and to evaluate those defects in the context of

establishing RPV P/T limits, this application of the Code Case maintains an adequate margin of safety for protecting RPV materials from brittle failure. The NRC staff has reviewed the exemption request submitted by the licensee and has concluded that an exemption should be granted from the requirements of 10 CFR 50.60 and Section IV.A.2.b of Appendix G to 10 CFR Part 50 to permit the licensee to use the provisions of ASME Code Case N-641 for the purpose of developing the McGuire Units 1 and 2 RPV P/T limit curves. However, the NRC staff does not agree with the special circumstances cited by the licensee in its December 12, 2002, application regarding the basis for granting the exemption. The NRC staff did not conclude that the circumstances cited above constitute "undue hardship or other costs that are significantly in excess of those contemplated when the regulation was adopted, or that are significantly in excess of those incurred by others similarly situated," pursuant to 10 CFR 50.12(a)(2)(iii). Rather, the NRC staff concluded that the application of the technical provisions of ASME Code Case N-641 provided sufficient margin in the development of RPV P/T limit curves such that the underlying purpose of the regulations, Appendix G to 10 CFR Part 50, will continue to be met and that the specific conditions required by the regulations (i.e., use of all provisions in Appendix G to Section XI of the ASME Code) were not necessary. Therefore, the NRC staff grants the requested exemption to the licensee based on the special circumstances of 10 CFR 50.12(a)(2)(ii), "[a]pplication of the regulation in the particular circumstances would not serve the underlying purpose of the rule or is not necessary to achieve the underlying purpose of the rule."

In summary, the ASME Section XI, Appendix G, procedure was conservatively developed based on the level of knowledge existing in 1974 concerning reactor coolant pressure boundary materials and the estimated effects of operation. Since 1974, the level of knowledge about the fracture mechanics behavior of RCS materials has been greatly expanded, especially regarding the effects of radiation embrittlement and the understanding of fracture toughness properties

under static and dynamic loading conditions. The NRC staff concurs that this increased knowledge permits relaxation of the ASME Section XI, Appendix G requirements by application of ASME Code Case N-641, while maintaining, pursuant to 10 CFR 50.12(a)(2)(ii), the underlying purpose of the ASME Code and the NRC regulations to ensure an acceptable margin of safety against brittle failure of the RPV.

The NRC staff has reviewed the exemption request submitted by the licensee and has concluded that an exemption should be granted from the requirements of 10 CFR 50.60(a) and Section IV.A.2.b of Appendix G to 10 CFR Part 50 to permit the licensee to utilize the provisions of ASME Code Case N-641 for the purpose of developing McGuire Units 1 and 2 RPV P/T limit curves.

3.0 DISCUSSION

Pursuant to 10 CFR 50.12, the Commission may, upon application by any interested person or upon its own initiative, grant exemptions from the requirements of 10 CFR Part 50 when (1) the exemptions are authorized by law, will not present an undue risk to public health or safety, and are consistent with the common defense and security; and (2) when special circumstances are present.

Special circumstances, pursuant to 10 CFR 50.12(a)(2)(ii), are present in that continued operation of McGuire, Units 1 and 2, pursuant to the requirements of 10 CFR 50.60 and Section IV.A.2.b of Appendix G to 10 CFR Part 50, using P/T curves developed in accordance with ASME Section XI, Appendix G, without the relief provided by ASME Code Case N-641, is not necessary to achieve the underlying purpose of 10 CFR 50.60 and Appendix G to 10 CFR Part 50. Application of ASME Code Case N-641 in lieu of the requirements of ASME Code Section XI, Appendix G, provides an acceptable alternate methodology that will continue to meet the underlying purpose of 10 CFR 50.60 and Appendix G to 10 CFR Part 50. The underlying purpose of the regulations in 10 CFR 50.60 and Appendix G to 10 CFR Part 50 is to

provide an acceptable margin of safety against brittle failure of the RCS during any condition of normal operation to which the pressure boundary may be subjected over its service lifetime.

The NRC staff examined the licensee's rationale to support the exemption request, and accepts the licensee's determination that an exemption would be required to approve the use of Code Case N-641. The NRC staff agrees that the use of ASME Code Case N-641 would meet the underlying intent of 10 CFR 50.60 and Appendix G to 10 CFR Part 50. The NRC staff concludes that the application of the technical provisions of ASME Code Case N-641 provides sufficient margin in the development of RPV P/T limit curves such that the underlying purpose of the regulations (10 CFR 50.60 and Appendix G to 10 CFR Part 50) continues to be met and that the specific conditions required by the regulations (i.e., use of all provisions in Appendix G to Section XI of the ASME Code) were not necessary. Therefore, the NRC staff concludes that the exemption requested by the licensee is justified based on the special circumstances of 10 CFR Part 50(a)(2)(ii), "[a]pplication of the regulation in the particular circumstances would not serve the underlying purpose of the rule or is not necessary to achieve the underlying purpose of the rule."

Based upon a consideration of the conservatism that is explicitly incorporated into the methodologies of Appendix G to 10 CFR Part 50; Appendix G to Section XI of the ASME Code; and Regulatory Guide 1.99, Revision 2; the NRC staff concludes that application of ASME Code Case N-641, as described, will provide an adequate margin of safety against brittle failure of the RPV. This conclusion is also consistent with the determination that the NRC staff has reached for other licensees under similar conditions based on the same considerations. Therefore, the NRC staff concludes that granting the exemption under the special circumstances of 10 CFR 50.12(a)(2)(ii) is appropriate, and that the methodology of Code Case N-641 may be used to revise the P/T limits for the McGuire, Unit 1 and 2 RPVs.

4.0 CONCLUSION

Accordingly, the Commission has determined that, pursuant to 10 CFR 50.12(a), the exemption is authorized by law, will not present an undue risk to the public health and safety, and is consistent with the common defense and security. Also, special circumstances are present. Therefore, the Commission hereby grants the licensee an exemption from the requirements of 10 CFR 50.60(a), and 10 CFR Part 50, Appendix G, Section IV.A.2.b, to allow application of ASME Code Case N-641 in establishing TS requirements for the RPV limits for McGuire, Units 1 and 2.

Pursuant to 10 CFR 51.32, the Commission has determined that the granting of this exemption will not have a significant effect on the quality of the human environment (68 FR 31735).

This exemption is effective upon issuance.

Dated at Rockville, Maryland, this 3rd day of July 2003.

FOR THE NUCLEAR REGULATORY COMMISSION

/RA/

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