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DUKE POWER

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U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D. C. 20555

Subject: McGuire Nuclear Station, Units 1 and 2
Docket Nos. 50-369 and 50-370
Request for Exemption - ASME Code Case N-514

Dear Sir:

Pursuant to the regulatory requirements of 10 CFR 50.12, "Specific exemptions", exemption from certain requirements of 10 CFR 50.60, "Acceptance criteria for fracture prevention measures for light water nuclear power reactors for normal operation", is hereby requested for McGuire Nuclear Station. This exemption is requested to allow the application of American Society of Mechanical Engineers (ASME) Code Case N-514, "Low Temperature Overpressure Protection", in determining the acceptable low temperature overpressure protection (LTOP) system setpoint for McGuire Units 1 and 2. Enclosed is the subject exemption with a detailed discussion of the application of the ASME Code Case N-514 to the LTOP setpoints for McGuire Nuclear Station.

In accordance with the provision of 10 CFR 50.55a, ASME Code Cases must be determined suitable for use by the NRC. NRC Regulatory Guides 1.147, 1.85 and 1.84 lists the ASME Code Cases that have been determined suitable for use by the Commission staff. The use of other Code cases may be authorized by the Director of the Office of Nuclear Reactor Regulation upon request pursuant to 10 CFR 50.55a(a)(3).

Code Case N-514 is currently not listed in the latest revisions to NRC Regulatory Guides 1.147, 1.85, and 1.84. Accordingly, pursuant to 10 CFR 50.55a(a)(3), the use of Code Case N-514 for McGuire Nuclear Station is hereby requested.

Enclosed is the subject exemption with a detailed discussion of the application of the ASME Code Case N-514 to the LTOP setpoints for McGuire Nuclear Station. This discussion also addresses the basis for NRC endorsement of the code case in accordance with the provisions of 10 CFR 50.55a(a)(3).

Please be advised that a proposed technical specification amendment request regarding Specification 3.4.9.3 (LTOP) and the pressure/temperature curves for heat up and cool down is currently in preparation. The changes to be proposed by this upcoming technical specification amendment submittal are dependent upon NRC approval of the exemption request and authorization to utilize ASME Code Case N-514 provided by this submittal.

Accordingly, timely NRC review and approval of this submittal is hereby requested. NRC approval of this submittal and of the upcoming technical specification amendment, is requested prior to the re-start of McGuire Unit 1 following the upcoming 1994 refueling outage. Approval of these submittals by the NRC is desired prior to establishing low temperature conditions for the start of McGuire Unit 1 cycle 10. Currently the anticipated date for establishing low temperature conditions for restart is the week of October 3, 1994. The NRC Project Manager for McGuire will be kept appraised of any schedule changes to the McGuire Unit 1 End-Of-Cycle 9 refueling outage.

Please contact John Washam at (704) 875-4181 if there are any questions regarding this submittal.

Very truly yours,

T. C. McMeekin

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INTRODUCTION

Title 10 CFR 50.60 states that all light water nuclear power reactors must meet the fracture toughness and material surveillance program requirements for the reactor coolant pressure boundary as set forth in Appendices G and H to 10 CFR Part 50. Appendix G of 10 CFR part 50 defines pressure/temperature (P/T) limits during any condition of normal operation, including anticipated operational occurrences and system hydrostatic tests to which the pressure boundary may be subjected over its service lifetime. Title 10 CFR 50.60 specifies that proposed alternatives to the described requirements of 10CFR Part 50 Appendices G and H may be used when an exemption is granted by the Commission under 10CFR50.12.

DISCUSSION

Pressure/Temperature (P/T) limits for low temperature overpressure (LTOP) events can be characterized by two parameters: the system enable temperature, and the minimum vessel temperature. According to current regulatory guidelines, the LTOP system must be enabled at temperatures less than of equal to RT_{NDT} + 90°F, where RT_{NDT} is the limiting adjusted reference temperature, including margin, at the one quarter thickness location. At temperatures greater than RT_{NDT} + 90°F, the overpressure protection system need not be provided. The maximum LTOP system pressure is determined based on system specific considerations, but is chosen so that the maximum pressure attained in the vessel will not exceed the P/T limit curve defined by Appendix G of ASME Section III and XI and Appendix G of 10 CFR part 50.

Current LTOP system setpoints produce operational constraints by limiting the range available to the operator to heat up or cool down the plant. For example, the "operating window" through which the operator can heat up or cool down the reactor coolant system 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 LTOP system overshoot and instrument error.

The LTOP system can have a significant economic impact by restricting plant operation. Further, the narrow operating window can have adverse safety impact if it increases the possibility of unnecessary actuation of the LTOP system's power operated relief valves (PORV).

Based on information recently provided to Duke Power Company, it has been determined that the generic methodology used to determine the LTOP setpoint for McGuire did not account for the differential pressure across the reactor core during reactor coolant pump operation. The pressure input is sensed at the reactor coolant system hot leg. With all four reactor coolant pumps operating, the pressure at the reactor vessel beltline may be as much as 59 psig higher than at the pressure sensing point. Adding this differential pressure to the setpoint analyses, without substantially restricting the heatup and cooldown limits and reactor coolant pump operations, could result in the design basis transient pressure exceeding the limits of ASME Appendix G.

The present LTOP setpoint is based on a water solid condition, and mass addition from a safety injection pump. Charging/letdown flow mismatch and heat input from a hotter steam generator have also been considered. To ensure the ASME Section XI Appendix G curves are not exceeded during the limiting transient, operational restrictions have been applied to reactor coolant system heat up and cool down limits and reactor coolant pump operation. These restrictions have had a significant impact on start up of the units.

Duke Power Company evaluated lowering the LTOP system setpoint to account for this omission. The current LTOP system setpoint is 365 psig to 385 psig. Although, the Technical Specification for McGuire (TS 3.4.9.3) currently specifies a lift setting of less than or equal to 400 psig, the LTOP system setpoint (365 psig to 385 psig) is maintained and controlled by procedures. Further, a technical specification amendment will be submitted shortly to revise this setpoint to less than or equal to 385 psig. The minimum required pressure for starting a reactor coolant pump is 325 psig, which is based on maintaining a differential pressure of 200 psi across the number one seal. The existing operating window for starting a reactor coolant pump is therefore 40 psi, which is considered a minimum acceptable range necessary for plant operation.

The effect of instrumentation margin on the LTOP system setpoint calculation has also been evaluated. Instrumentation margin is included in the setpoint calculation, such that the uncertainty is added to the setpoint and pressure overshoot in determining compliance with the ASME Section XI, Appendix G limits. In addition, a modification has been initiated to reduce the instrumentation margin by installing high accuracy, low range transmitters for LTOP system actuation. Implementation of this modification is currently scheduled for the upcoming refueling outages for Units 1 and 2.

The materials data used in determining RT_{NDT} for the limiting materials has also been evaluated. Regulatory Guide 1.99 Rev. 2, position 2 (surveillance data available) has been used in determining RT_{NDT} for the limiting beltline welds and the results incorporated into the most recent P/T curves developed by Westinghouse Electric Corporation (WCAP-13949 for Unit 1 and WCAP-13516 for Unit 2).

The existing P/T curves require extension beyond the current 10 EFPY, which will require even further operational restrictions to ensure compliance with Appendix G of 10CFR50 and Appendix G of ASME Section XI. The effect of the above measures to improve LTOP system margin, in conjunction with the increased service period, is not sufficient to improve plant operational restrictions. The use of ASME Code Case N-514 was therefore evaluated.

CODE CASE N-514

ASME Code Case N-514 allows setting the LTOP actuation setpoint such that the ASME Section XI, Appendix G limits are not exceeded by more than 10%. Application of this Code Case at McGuire would allow continued operation with the present LTOP setpoint and operating window.

The ASME Working Group on Operating Plant Criteria (WGOPC) developed code guidelines to define LTOP limits that will avoid certain unnecessary operational restrictions, provide adequate margins against failure, and reduce the potential for unnecessary activation of pressure relieving devices used for LTOP. The philosophy used by the WGOPC for developing these guidelines was that administrative controls should be imposed to ensure that Technical Specification P/T limits are not exceeded, and that the physical protection system must provide adequate protection against failure of the reactor pressure vessel below the enable temperature where experience indicates these events occur.

The reactor coolant system temperature and pressure are verified within the Technical Specification limits by the plant operators per operating procedures. The administrative heat up and cool down limits in the startup and shutdown procedures, in conjunction with the LTOP setpoint of $\leq$ 385 psig, ensures that the ASME Section XI, Appendix G limits are adhered to over the range where LTOP is enabled.

INHERENT MARGINS TO 10 CFR PART 50 APPENDIX G

There are numerous conservatism in the development of Appendix G pressure/ temperature curve calculations. These conservatisms include:

1. A factor of safety of 2.0 on the primary membrane (pressure) stresses.

2. A margin factor applied to the shift in RT_{ndt} of one or two standard deviations, by USNRC Regulatory Guide 1.99, Rev. 2

3 The use of the reference stress intensity curves (K_{IR}) by ASME Section III and XI, Appendix G, bounds the dynamic crack initiation and crack arrest toughness. Further, the use of reference stress intensity curve bounds the crack initiation fracture toughness (K_{IC}) properties by a factor of 1.2 to 2.5, depending on vessel temperature and RT_{ndt}.

4. Lower bound material properties are used in analysis. Further, increased mechanical properties of the vessel which accompanies material embrittlement is not considered (increased yield strength and flow stress).

There are numerous additional margins specific to McGuire which support the WGOPC guidelines, including:

1. The assumption of a 1/4 thickness surface flaw. No flaws exceeding the ASME Section XI allowable flaw size for volumetric examination have been detected on Unit 1 during the 10 year ISI of the reactor vessel during the end of cycle 7 refueling outage in 1991.

   For Unit 2, a flaw exceeding the ASME Section XI allowable flaw size for volumetric examination was detected during the End-of-Cycle 8 refueling outage in 1993. Although the flaw exceeded code allowable, it is significantly smaller than the assumed maximum postulated defect specified by Appendix G to ASME Section III. Further, ASME Section XI, (IWB-3122.4) allows acceptance of flaw indication by analytical evaluations in accordance with methods described in Appendix A to Section XI. The analytical evaluation that was performed concluded that the Unit 2 reactor vessel is acceptable for continued service for the licensed life of the unit. The NRC review of the information provided regarding this flaw indication is documented in a NRC letter dated August 27, 1993.

2. Instrumentation margins of 12 °F and 30 psig are included in the LTOP setpoint determination. High accuracy Rosemount pressure transmitters with instrument uncertainties that are less than 30 psig are being installed during the upcoming refueling outages for each unit.

3. Use of very conservative heat transfer coefficients (7000 Btu/ hr-ft^2-° F), and neglecting the effects of cladding conductivity in the analysis of thermal stress in the P/T curves. Further, the thermal stress is calculated for fixed and constant rates of temperature change and does not reflect the intermittent rates actually experienced by the vessel. That is, hold points for items such as crud burst cleanup during shutdown and removing residual heat removal from service during startup act as a thermal soak period and reduce the integrated effect on thermal stress.

BASIS FOR EXEMPTION

The requested exemption to the regulations is authorized by law, will not present an undue risk to public health and safety, and is consistent with the common defense and security. Duke Power believes the requested exemption meets the criteria in 10CFR 50.12(a)(2) in that special circumstances are present. These special circumstances include:

10 CFR 50.12(a)(2)(ii)
Application 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.

Basis: The basis for the LTOP setpoint is to preclude reactor coolant system pressure from exceeding the Appendix G limits when there is a potential for non-ductile failure of the vessel material. ASME Code Case N-514 recognizes the conservatism of the Appendix G curves and allows establishing a setpoint which preserves the acceptable margin of safety while maintaining operational margins for reactor coolant pump operation at low temperatures and pressures. Setpoints established in accordance with Code Case N-514 will also minimize the unnecessary actuation of protection system pressure relieving devices. Therefore, establishing the setpoint in accordance with ASME Code Case N-514 criteria satisfies the underlying purpose of the ASME Code and the NRC regulations to ensure nuclear power plants and components are operated to ensure an acceptable level of safety and environmental impact.

Based on the above, application of the regulation in the particular circumstances is not necessary to achieve the underlying purpose of the rule.

10 CFR 50.12(a)(2)(iii)
Compliance would result in 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 by others similarly situated.

Basis: Administrative restrictions on the reactor coolant pump operation while at low reactor coolant system temperatures would result in the inability to start and vent the reactor coolant pumps at a temperature below 137 °F. Additionally, it requires considerable effort beyond what is considered reasonable to control the RCS temperature to within the acceptable heatup and cooldown limits for this condition. Duke Power Company believes that this burden is unnecessary and can be alleviated by the application of this code case. The guidelines developed by the WGOPC for LTOP setpoints provide the same range of margin against vessel failure for conditions where experience indicates these events occur, as ASME Section III and Section XI, Appendix G provides for the normal heatup and cooldown conditions. These limits do not significantly change the likelihood of vessel failure associated with the normal heatup and cool down limits. Moreover, the LTOP guidelines will reduce the potential for unnecessary activation of protection system pressure relieving devices. Consequently, the LTOP limits developed by the WGOPC provide both economic and safety benefits.

Therefore, compliance would result in undue hardship or other costs that are significantly in excess of those contemplated when the regulation was adopted.

BASIS FOR NRC ENDORSEMENT OF CODE CASE N-514

In accordance with 10 CFR 50.55a(a)(3), proposed alternatives to the requirements of this section may be used when authorized by the Director of Office of Nuclear Reactor Regulation. The regulatory requirement specifies that one of the following be demonstrated:

(i) The proposed alternatives would provide an acceptable level of quality and safety, or

(ii) Compliance with the specified requirements of this section would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety

The basis for the LTOP setpoint is to preclude reactor coolant system pressure from exceeding the Appendix G limits when there is a potential for non-ductile failure of the vessel material. ASME Code Case N-514 allows setting the LTOP actuation setpoint such that the ASME Section XI, Appendix G limits are not exceeded by more than 10%. This proposed alternative is acceptable because the code case recognizes the conservatism of Appendix G curves and allows establishing a setpoint which preserves the acceptable margin of safety while maintaining operational margins for reactor coolant pump operation at low temperatures and pressures. Setpoints established in accordance with Code Case
N-514 will also minimize the unnecessary actuation of protection system pressure relieving devices. Therefore, establishing the setpoint in accordance with ASME Code Case N-514 criteria satisfies the underlying purpose of the ASME Code and the NRC regulations to ensure nuclear power plants and components are operated at an acceptable level of quality and safety.

Administrative restrictions on the reactor coolant pump operation while at low reactor coolant system temperatures would result in the inability to start and vent the reactor coolant pumps at a temperature below 137 °F. Additionally, it requires considerable effort beyond what is considered reasonable to control the RCS temperature to within the acceptable heatup and cooldown limits for this condition. The use of current methods to calculate the LTOP setpoint will result in a LTOP setpoint that could result in normal operating pressure surges associated with starting a reactor coolant pump or the realignment of charging flow in challenging the PORVs. Duke Power Company believes that this burden is unnecessary and can be alleviated by the application of this code case. Therefore, continued compliance with current regulatory requirements could result in hardship and unusual difficulty without a compensating increase in the level of quality and safety.

CONCLUSION

ASME Code Case N-514 allows setting the LTOP actuation setpoint such that the 10CFR50 Appendix G and ASME Section XI Appendix G limits are not exceeded by more than 10%. The ASME Code Committee has concluded that the LTOP guidelines provide acceptable margin against crack initiation and failure in reactor vessels, and will reduce the potential for unnecessary activation of protection system pressure relieving devices.

Duke Power Company believes that use of Code Case N-514 provides an acceptable level of quality and safety. Without authorization to use the Code Case, Duke Power is required to comply with the currently approved code editions, addenda, and code cases of 10 CFR 50.55a and Appendix G referred to by 10 CFR 50.60. Compliance with the currently approved pressure/temperature limits would result in economic hardship to Duke Power and its customers, without a compensating increase in the level of quality or safety.