UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 162 TO FACILITY OPERATING LICENSE NPF-9

AND AMENDMENT NO. 144 TO FACILITY OPERATING LICENSE NPF-17

DUKE POWER COMPANY

MCGUIRE NUCLEAR STATION, UNITS 1 AND 2

DOCKET NOS. 50-369 AND 50-370

1.0 INTRODUCTION

By letter dated March 29, 1995, as supplemented by letters dated September 18 and November 16, 1995, Duke Power Company (the licensee) submitted a request for changes to the McGuire Nuclear Station, Units 1 and 2, Technical Specifications (TS). The requested changes would revise TS requirements for the Low Temperature Overpressure Protection system and update the heatup and cooldown curves for both units. The TS changes include TS 3.4.9.3 "Overpressure Protection Systems," TS 3.5.3, "ECCS subsystems - T_{avg} < 350°F," and updating of the Pressure Temperature limit curves, Figures 3.4-2, 3.4-3, 3.4-4 and 3.4-5. These proposed changes are to revise the Low Temperature Overpressure Protection (LTOP) system maximum setpoint and the minimum vent requirements, and enhance system operation and reliability. The September 18 and November 16, 1995, letters provided clarifying information that did not change the scope of the initial Federal Register notice and the initial proposed no significant hazards consideration determination.

2.0 EVALUATION

2.1 LTOP Setpoint

The purpose of the LTOP system is to control the reactor coolant system (RCS) pressure at low temperature so that the integrity of the reactor coolant pressure boundary is not compromised by violating the P-T limits of 10 CFR Part 50, Appendix G, which is based on Appendix G, Section XI of the ASME Code. Currently, the McGuire TS state that the power-operated relief valve (PORV) lift setting be less than or equal to 400 psig. The licensee is proposing to reduce the PORV lift setting to 385 psig, a more conservative setpoint that allows the PORV to open earlier during an LTOP event. ASME Code Case N-514, approved by the staff for use at McGuire by letter dated September 30, 1994, is utilized to establish the lift setpoint of the PORV for overpressure protection during low temperature conditions. As delineated in the Code Case, the LTOP system shall limit the maximum pressure in the vessel to 110% (1.1) of the pressure determined to satisfy Appendix G, Section XI of the ASME Code.

The licensee indicated that they evaluated the proposed setpoint by NRC approved methodology with three possible transients: (1) a mass input from an operable safety injection pump, (2) a mass input from an operable centrifugal charging pump, and (3) a heat input from a 50°F temperature difference between the secondary side of the steam generators and the RCS (consistent with current TS 3.4.1.3 and 3.4.1.4.1).

The licensee concluded that the PORV setpoint of 385 psig is sufficient to ensure that the peak reactor vessel beltline pressure is less than 1.1 times the ASME Section III, Appendix G, limits during anticipated pressure transients, provided appropriate limits on the heatup and cooldown rates are established. The beltline pressure includes instrument uncertainties, pressure corrections for the difference between the indicated pressure and the actual reactor beltline pressure, and the pressure corrections for the differential pressure across the reactor core. The most limiting pressure transient is the mass input from the inadvertent start of a safety injection pump with a worst case peak pressure of 537 psig. Therefore, to ensure that the reactor vessel pressure/temperature limits will not be exceeded, the licensee established limits on heatup and cooldown rates with controlled procedures for both units. The staff reviewed the limits on heatup and cooldown rates and found them acceptable.

2.2 LTOP Enable Temperature

Paragraph B.2 of the Branch Technical Position RSB 5-2, Revision 1, indicates that the LTOP System is required to be operable at a water temperature corresponding to a metal temperature of RT_{NDT} + 90°F at the beltline location that is controlling in the Appendix G limit calculations. Based on the limiting RT_{NDT} of 149.45°F (obtained from WCAP-13949) in Unit 1, the metal temperature would be 239.45°F. The LTOP enable temperature of 300°F provides a 60°F margin between the metal temperature of the vessel and the corresponding temperature of the RCS during an LTOP event. The staff agrees with the licensee that the current TS LTOP enable temperature of 300°F is conservative and therefore acceptable.

2.3 LTOP TS Changes

The licensee is proposing changes to the LTOP TS 3.4.9.3 to enhance overpressure protection during low temperature operation. The changes define additional conditions for invoking the LTOP system and the associated actions when these conditions are not met. By making these changes the licensee assures that operation and configuration of the units during low temperature operation are consistent with the LTOP event analysis.

The proposed TS changes, although consistent with NUREG-1431, have been justified for plant-specific use by the licensee. The changes, which establish the operability of the LTOP system, include:

(1) limiting the number of pumps capable of injecting into the RCS to one,

(2) isolating all the accumulators,

(3) a reduction in the RCS vent size,

(4) the action that if the PORV is inoperable, terminate any activities that could lead to a water-solid pressurizer within 24 hours, or use the RHR suction relief valve if the RCS temperature is >167°F, or depressurize and vent the RCS within 8 hours, and

(5) the action that if the LTOP is inoperable, depressurize and vent the RCS within 8 hours.

As noted above, the basis for all these changes is to enhance the overpressure protection during low temperature operation. Because these changes will lead to an acceptable depressurization process, the changes will ensure safer reactor operation.

The reduction in RCS vent size and the use of residual heat removal (RHR) suction relief valve for LTOP are discussed in greater detail in Sections 2.4 and 2.5 below. For the remaining proposed changes listed above, the licensee stated that these changes are more restrictive than the current LTOP TS.

The licensee also proposed changes to the TS surveillances that are additional to the current LTOP TS surveillances. The additional TS surveillances verify the accumulators have been isolated, the RHR suction isolation valves are open when the suction relief valves are being used for overpressure protection, and the block valve associated with the PORV providing LTOP protection is open. The staff agrees with the licensee's assessment that these changes are more restrictive and add more assurance that the depressurization process will take place when needed; therefore, the staff finds the changes acceptable.

2.4 Reduction of RCS Vent Size

In the event that a PORV is not available, the licensee is directed by its TS to make a vent available. Currently, that vent is specified as 4.5 square inches. This vent size appeared as overly conservative to the licensee. The licensee proposed to reduce the required vent size from 4.5 to 2.75 square inches. The licensee indicated that they completed an analysis, using NRC-approved methods, that verifies that the 2.75 square-inch vent is more than adequate for overpressure protection during an LTOP event. Also, by reducing the vent size in the TS, the licensee indicated that they are providing consistency in establishing the required vent based on the required relief flowrate. The licensee calculation of the vent size by NRC-approved methodology is acceptable.

2.5 RHR Suction Relief Valve

The main purpose of the RHR system is to remove decay heat during low temperature conditions. After the reactor coolant temperature and pressure have been reduced to approximately 350°F and 385 psig, the RHR system is placed into operation. While the RHR system is in service, the RHR suction relief valve is exposed to the RCS and is able to relieve RCS overpressure transients.

The licensee indicated that the current TS does not define how to use the RHR suction relief valve for overpressure protection during low temperature conditions. The proposed change to the TS defines the specific conditions under which the RHR suction relief valve can be used: (1) to enable a second emergency core cooling system (ECCS) pump to inject into the RCS; or (2) when one PORV is inoperable while in Modes 5 or 6, if the RCS temperature is greater than 167°F, and the RHR suction isolation valves are open. The first option, to use the RHR suction relief valve to enable a second ECCS pump to inject, is permitted at RCS temperatures below 167°F with additional restrictions: the RCS temperature must be greater than 107°F, the unit is being shut down, and the rate of the cooldown is less than 20°F per hour.

The licensee indicated that the capacity of the RHR suction relief valve is 902 gpm, which is adequate to relieve the full flow of either pump (565 gpm or 660 gpm) not both. Therefore, in situations where two pumps are capable of injecting into the RCS, both PORVs and the RHR suction relief valve are required to be operable.

When the RCS temperature is below 167°F and an LTOP event is mitigated by the RHR suction relief valve, the resultant peak pressure could exceed the allowable pressure for a cooldown rate of 100°F/hour. To avoid exceeding the 570 psig pressure limit on the 100°F/hour cooldown rate, the licensee proposes to restrict the use of the RHR suction relief valve below an RCS temperature of 167°F. The RHR suction relief valve can be used between RCS temperatures 107°F and 167°F provided the cooldown rate is limited to 20°F/hour or less. The associated allowable pressure is approximately 562 psig at 107°F. Since the resultant peak pressure of an LTOP event mitigated by the RHR suction relief valve, when the RCS temperature is below 107°F, could exceed the allowable pressure for a cooldown rate of 20°F/hour or less, the licensee proposes to prohibit the use of the RHR suction relief valve, as the means of LTOP, below an RCS temperature of 107°F. In this case, proposed TS 3.4.9.3 requires that two PORVs are secured in the open position for LTOP.

The staff has reviewed the licensee's intended use of the RHR suction relief valve and agrees that by defining how the RHR suction relief valve is to be used for LTOP, the licensee has ensured the integrity of the cooldown limits. The proposed TS changes also impose increased restrictions on the licensee and therefore the staff finds these changes acceptable.

2.6 Relocation of Instrument Error

Currently, the instrument uncertainty is included in the heatup and cooldown curves as 10°F and 60 psig margins. The proposed TS change is to move the instrument uncertainties to controlling procedures for unit operations and into the LTOP system setpoint selection calculations. The staff endorses the relocation of the heatup and cooldown curves from the TS, in their entirety, to controlled document, "Pressure Temperature Limit Report" (PTLR). The staff's endorsement is reflected in the new Standard Technical Specifications for Westinghouse Plants, NUREG-1431. The licensee is proposing to relocate only the instrument uncertainties, while maintaining the curves in the TS. The uncertainties were developed by the NRC-approved Westinghouse Reactor Protection and Engineered Safeguards Setpoint Methodology and ISA SP67.15, Draft 10. The licensee has committed to incorporating the uncertainties into the Operating Procedures. Based on the licensee's conformance to the standards set forth in NUREG-1431 and their commitment to place the uncertainties in the Operating Procedures, the staff finds the proposed change to relocate the uncertainties to the PTLR acceptable.

The margins associated with the relocation of the uncertainties are 12°F and 30 psig. The licensee indicated that the increase in the temperature margins is for added assurance with no modification to the existing instrumentation. However, the reduction in the pressure margin from 60 psig to 30 psig, reflects the replacement of the wide range RCS transmitters with a narrow range pressure transmitter. The licensee used approved methods to verify the total instrument loop uncertainty for the RCS narrow range pressure instrumentation and its associated LTOP function. The worst case total loop uncertainty was calculated as ± 21 psig. The staff reviewed the calculation and found it acceptable; therefore, the use of 30 psig margin is acceptable.

2.7 Pressure-Temperature Limit Curves

The staff evaluates Pressure-Temperature (P-T) limits based on the following NRC regulations and guidance: Appendix G to 10 CFR Part 50; Generic Letters (GL) 88-11 and 92-01; Regulatory Guide (RG) 1.99, Rev. 2; and Standard Review Plan (SRP) Section 5.3.2. Appendix G to 10 CFR Part 50 requires that P-T limits for the reactor vessel must be at least as conservative as those obtained by Appendix G to Section III of the ASME Code. GL 88-11 informs licensees to use the methods in RG 1.99, Rev. 2, to predict the effect of neutron irradiation by calculating adjusted reference temperature (ART) of reactor vessel materials. The ART is defined as the sum of initial nil-ductility transition reference temperature (RT_{ndt}) of the material, the increase in RT_{ndt} caused by neutron irradiation, and a margin to account for uncertainties in the prediction method. The increase in RT_{ndt} is calculated from the product of a chemistry factor and a fluence factor. The chemistry factor may be calculated using credible surveillance data, obtained by the licensee's surveillance program, as directed by Position 2 of RG 1.99, Rev. 2. If credible surveillance data is not available, the chemistry factor is calculated depending upon the amount of copper and nickel in the vessel material as specified in Table 1 of RG 1.99, Rev. 2. GL 92-01 indicated that licensees should submit reactor vessel materials data, which the staff used in the review of the P-T limits submittals.

For the McGuire Unit 1 reactor vessel, the licensee determined two different limiting materials at the 1/4T and 3/4T locations. The licensee determined that the lower shell longitudinal weld material, 3-442 A&C, is the limiting material for the 1/4T location. Using integrated surveillance data, the licensee calculated an ART of 149.45°F at the 1/4T location at 16 effective full-power years (EFPY). The integrated surveillance data used for this material is based on the Diablo Canyon Unit 2 surveillance data. The staff approved use of Diablo Canyon Unit 2 surveillance data for McGuire Unit 1 in a letter to the licensee dated July 17, 1995. The licensee determined that the lower shell plate material, B5013-2, is the limiting material for the 3/4T location. Using the chemistry data of plate B5013-2 (the material was not included in the integrated surveillance program), the licensee calculated an ART of 102.03°F at the 3/4T location at 16 EFPY. The neutron fluence used in the ART calculation was 4.348×10^{18} n/cm^2 at the 1/4T location and 2.134×10^{18} n/cm^2 at the 3/4T location. The initial RT_{NDT} values for weld 3-442 A&C and plate B5013-2 were -50°F and 30°F, respectively. The margin terms used in calculating the ART for weld 3-442 A&C and plate B5013-2 were 28°F and 34°F, respectively.

For the McGuire Unit 2 reactor vessel, the licensee determined that the lower shell forging 04 is the limiting material for both the 1/4T and 3/4T locations. Using the chemistry data of the forging (the material was not included in the surveillance program), the licensee calculated an ART of 104°F at the 1/4T location and 73°F at the 3/4T location at 16 EFPY. The neutron fluence used in the ART calculation was 6.138×10^{18} n/cm^2 at the 1/4T location and 2.222×10^{18} n/cm^2 at the 3/4T location. The initial RT_{NDT} and margin term were -30°F and 34°F, respectively.

For the McGuire Unit 2 reactor vessel, the licensee also calculated the ART values using surveillance data for the intermediate shell 05 and the intermediate/lower shell weld. The ART values calculated for both materials were less than the ART value of shell forging 04; therefore, the licensee concluded the shell forging 04 is limiting.

The staff verified for McGuire Units 1 and 2 that the copper and nickel content and initial RT_{NDT} agreed with the NRC reactor vessel material database as reported by the licensee in response to GL 92-01. The staff used the material properties to perform an independent calculation of the ART values for the limiting materials using RG 1.99, Revision 2. In addition, the staff used the surveillance data, as submitted in previous reports to the NRC, to perform an independent calculation of the ART values for the surveillance materials using Position 2 of RG 1.99, Revision 2. Based on the staff's calculation, the staff verified that the licensee's limiting material for McGuire Unit 1 is the lower shell longitudinal weld material, 3-442 A&C, at the 1/4T location and the lower shell plate material, B5013-2, at the 3/4T location. The staff also verified that the limiting material for McGuire Unit 2 is shell forging 04 at both the 1/4T and 3/4T locations. The staff's calculated ART values for the limiting materials agreed with the licensee's calculated ART values.

Substituting the ART values for McGuire Units 1 and 2 into equations in SRP 5.3.2, the staff verified that the proposed P-T limits for heatup, cooldown, criticality, and inservice hydrostatic test satisfy the requirements in Paragraphs IV.A.2 and IV.A.3 of Appendix G of 10 CFR Part 50.

In addition to beltline materials, 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% 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 120°F for normal operation and by 90°F for hydrostatic pressure tests and leak tests. Based on the flange RT_{ndt} of 40°F for Unit 1 and 1°F for Unit 2, provided by the licensee, the staff has determined that the proposed P-T limits have satisfied the requirement for the closure flange region during normal operation, hydrostatic pressure test, and leak test.

3.0 STAFF CONCLUSION

The staff's review of the licensee's proposed changes to the LTOP TS 3.4.9.3, the LTOP setpoint, the LTOP enable temperature, the reduction in vent size, the use of the RHR suction relief valve for LTOP mitigation, and the relocation of the instrument error finds these changes acceptable because they (1) have been analyzed by approved methods, (2) are more restrictive than the current TS, and (3) conform to NUREG-1431, Westinghouse Standard Technical Specifications.

The staff has performed an independent analysis to verify the licensee's proposed P-T limits. The staff concludes that the proposed P-T limits for heatup, cooldown, inservice hydrostatic test, and criticality are valid for 16 EFPY because: 1) the limits meet the requirements of Appendix G of 10 CFR Part 50 and conform to GL 88-11; 2) the material properties and chemistry used in calculating the P-T limits are consistent with data submitted under GL 92-01; and 3) the surveillance data used in calculating the P-T limits are consistent with data in surveillance reports submitted to the staff. Therefore, the proposed P-T limits may be incorporated in the McGuire Units 1 and 2 TS. In addition, the proposed editorial changes in the Bases section of the TS are consistent with the P-T limits changes; therefore, they are acceptable.

4.0 STATE CONSULTATION

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

5.0 ENVIRONMENTAL CONSIDERATION

The 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 (60 FR 49933 dated September 27, 1995). Accordingly, the amendments meet the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b) no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendments.

6.0 CONCLUSION

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

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