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DUKE POWER

April 26, 1993

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
Catawba Nuclear Station, Units 1 and 2
Docket Nos. 50-413 and 50-414
Supplement to Technical Specification Amendment
Relocation of Cycle-Specific Limits to
Core Operating Limits Report (COLR)

Dear Sir;

By a letter dated January 13, 1993, Catawba and McGuire Nuclear Stations submitted an application to amend their respective Technical Specifications (TS). The proposed amendment would relocate certain cycle-specific limits to the COLR. By a letter dated March 12, 1993, the NRC staff requested additional information and clarification regarding our application.

Accordingly, please find attached (attachment 1) our response to the questions provided by your March 12, 1993 letter. In addition, attachment 2 and 3 provides mark-ups of TS 6.9.1.9 for McGuire and Catawba Nuclear Stations, respectively. These changes are administrative in nature and do not affect the conclusions of the No Significant Hazards Consideration evaluation provided previously.

Please contact Paul Guill at (704) 875-4002 if there any questions regarding this TS amendment request.

Very truly yours,

TCMcMeekin

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ATTACHMENT 1

DUKE POWER COMPANY
MCGUIRE NUCLEAR STATION
CATAWBA NUCLEAR STATION
RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION

Request for Additional Information
Application to Transfer TS Values to COLR
for Catawba and McGuire Stations

1. Q: Identify the report providing the methodolgy for calculating the value of each of the parameters proposed to be transferred to the COLR. If the report discusses the parameter implicitly, provide a reference for the definition of each parameter and a specific discussion of how the parameter values are determined. These parameters should include τ_1, τ_2, τ_3, τ_4, τ_5, τ_6, K_1, K_2, K_3, K_4, K_5, K_6, $f_1(\Delta I)$, $f_2(\Delta I)$, the breakpoints and slopes for $f(\Delta I)$, BAST volume and concentration, RWST volume and concentration, reactor water makeup pump flow rate, and accumulator boron concentration.

A: The methodology described below is how Duke Power Company currently arrives at values for the OTΔT and OPΔT parameters. This is one of many equally valid methods for determining these parameters. Once a new preliminary set of overtemperature and overpower setpoint equation parameters is selected, they must be evaluated by reanalyzing the appropriate transient analyses with the new setpoint parameters. The transient analyses utilized to validate these new setpoints are performed using the NRC approved methodology documented in Duke Power Company topical reports DPC-NE-3002-A, "FSAR Chapter 15 System Transient Analysis Methodology," DPC-NE-3001-A, "McGuire/Catawba Nuclear Station Multidimensional Reactor Transients and Safety Analysis Physics Parameters Methodology" and DPC-NE-3000, "Thermal-Hydraulic Transient Analysis Methodology," approved by the NRC for McGuire/Catawba use in November 1991. Once the analysis is performed and the new setpoint constants demonstrate they are capable of protecting the plant during the appropriate transients, the new setpoint parameters may be used. In other words, there are many possible methods for selecting these setpoint parameters and regardless of the method used they are not considered valid parameters until they are proven capable of protecting the plant under transient conditions with the NRC approved methodology described in the topicals above.

The OPΔT parameter K_5 is not being relocated to the COLR since it currently is not calculated as part of the reload design methodology described below.

The purpose of the OTΔT trip function is to protect the reactor core against DNB and hot leg boiling for any combination of power, pressure and temperature during normal operation and transient conditions. The parameter values for K_1, K_2, K_3, K_4, K_6, and $f_1(\Delta I)$ breakpoints and slopes are calculated using as inputs the DNB core limit lines at different pressures, axial offset versus power limits, and various nominal operating condition parameters. For steady state conditions and a reference power shape these inputs are used to calculate the overtemperature and overpower ΔT setpoints based on the following constraints:

- Thermal overtemperature limits, which provide protection against DNB and hot leg boiling.
- Pressurizer low pressure and high pressure safety limits, which limit the range of pressures over which the overtemperature ΔT and overpower ΔT trips must function.

- The locus of conditions where the steam generator safety valves open, which places a limit on the primary side temperature based on the steam generator design pressure and the primary to secondary heat transfer capacity.

- Thermal overpower limit, which protects against centerline fuel melt.

Multiple K_1 and K_4 pairs and corresponding K_2, K_3, and K_6s are calculated such that they meet the above constraints. Using engineering judgment and plant operating experience a set of Ks is then chosen from these allowable sets. The chosen set is then evaluated in the transient analysis using the methodology described in topical reports DPC-NE-3002-A, "FSAR Chapter 15 System Transient Analysis Methodology and DPC-NE-3000, "Thermal-Hydraulic Transient Analysis Methodology," to determine whether the K parameter values are capable of protecting the plant during the appropriate transients.

The thermal overtemperature limits described above are calculated for zero axial imbalance. Therefore, once the setpoint constants are calculated, the $f_1(\Delta I)$ trip reset function for the OTΔT equation is determined using two axial offset versus power envelopes (typically 100% and 118% power) supplied by nuclear design analyses. This function is determined as described in the technical justification using the methodology described in Chapter 4 of the NRC approved report DPC-NE-2011-P-A. A value of imbalance, ΔI, and a point on the DNB line for a given pressure which is not bounded by the exit boiling line, steam generator safety valve line , or OPΔT setpoint equation is selected. This point is compared with the OTΔT setpoint and the amount the setpoint must be lowered, if at all, to bound this point is calculated. This process is repeated for this ΔI for the other non-bounded DNB points at this and other pressures. The largest reduction in the OTΔT setpoint equation required to bound the imbalance corrected DNB points becomes the $f_1(\Delta I)$ penalty for this particular value of ΔI. This process is repeated for a range of ΔIs that will envelope all the expected skewed axial power distributions. The $f_1(\Delta I)$ breakpoints and slopes are then selected in a manner such that they bound the calculated $f_1(\Delta I)$ penalties which were determined from the two axial offset envelopes.

The purpose of the OPΔT trip function is to provide protection against fuel center-line melt (CFM) during normal operation and Condition II transients. The ΔT trip setpoint for this trip function is typically set at 118%FP and is determined as described above. The trip reset portion of this trip function, $f_2(\Delta I)$, is designed to lower the trip setpoint when measured imbalances exceed predetermined values. Since highly skewed power distributions lead to high kw/ft values, a $f_2(\Delta I)$ trip function can be developed to prevent CFM limits from being exceeded at large imbalances, or to increase the available margin to the CFM limit for highly skewed power distributions.

Current core designs do not challenge the CFM limits and therefore a $f_2(\Delta I)$ penalty is not required. However, from an operational and design standpoint, it is desirable to eliminate from consideration power distributions with high imbalances. Therefore, a $f_2(\Delta I)$ trip reset function was established to trip the reactor at high imbalances. The breakpoints and slopes of this function were arbitrarily chosen to limit the power distributions that need to be considered during the design of the reactor core and to increase the margin to the CFM limit and therefore reducing the probability of the CFM Technical Specification surveillance limits being violated.

In the event that it would to be necessary to establish a $f_2(\Delta I)$ trip reset function because CFM limits were being exceeded, one possible method of determining this trip reset function would be to develop a kw/ft versus imbalance envelope based on the analysis of Condition II transients such

that this envelope would conservatively bound expected transient peaks. This envelope would next be used to determine the $f_2(\Delta I)$ penalty as a function of imbalance by comparing the CFM kw/ft limit against the maximum expected peak for a given imbalance. The $f_2(\Delta I)$ trip reset function would then be developed such that the breakpoints and slopes bound the $f_2(\Delta I)$ penalties developed from the kw/ft versus imbalance envelope which is generated in a manner similar to the $f_1(\Delta I)$ reset function described above.

The dynamic terms (τ_1, τ_2, τ_3, τ_4, τ_5, τ_6) in the OTΔT and OPΔT setpoint equations compensate for inherent instrument delays and piping lags between the reactor core and the temperature sensors. Lead-lag and rate-lag compensations are required for the following reasons:

- To offset measured RTD instrumentation time delays.
- To ensure the protection system response time is within the limits required by the accident analyses.

In addition, the dynamic terms are used as noise filters and to decrease the likelihood of an unnecessary reactor trip following a large load rejection.

Models have been created to examine the effects of different sets of τ values used in the lead-lag, lag, and rate lag functions of the overtemperature and overpower equations. These models are the same as those given in EPRI NP-1850-CCM-A, "RETRAN-02 - A Program for Transient Thermal-Hydraulic Analysis of Complex Fluid Flow Systems." Using these models the τ values are selected in a manner such that the optimum response of the OTΔT and OPΔT setpoints to changes in plant variables is obtained while satisfying the transient analyses acceptance criteria. The acceptability of the chosen τ values is determined utilizing these same mathematical models, which are also contained in the transient analysis models described in DPC-NE-3000, "Thermal-Hydraulic Transient Analysis Methodology."

The BAST and RWST borated water volume limits are calculated using the boron concentrations required to maintain shutdown margin for the fuel cycle, as determined by the methodology documented in DPC-NE-2010-A, RCS volumes, and the minimum BAST and RWST boron concentrations. The minimum BAST and RWST concentrations are assumed values used as input to these volume calculations. The methodology used consists of the solution of a simple differential equation describing the boron mass balance during a feed and bleed operation. The calculations determine the amount of borated water volume required to maintain shutdown margin when going from hot full power (HFP) conditons to hot zero power (HZP) conditions and then HZP to cold shutdown conditions. The resulting calculated BAST and RWST borated water volumes are the volumes required to maintain the shutdown margins required by TS 3.1.1.1 and 3.1.1.2. As mentioned in the technical justification for this change, a similar change was approved for Oconee Units 1, 2, and 3, January 5, 1993 under Amendments 197, 197, and 194. The volume calculations for McGuire/Catawba are identical to those for Oconee, except that part of the coolant shrinkage makeup volume required in the Oconee calculation is neglected due to a programmed thermal contraction in the pressurizer level for McGuire/Catawba when going from HFP to HZP.

As explained in the technical justification, the accumulators and RWST minimum boron concentration limits ensure the reactor will remain subcritical during a Loss of Coolant Accident (LOCA). The accumulators and RWST minimum boron concentrations are input assumptions to

the post LOCA subcriticality analysis which is described in Section 15.6.5.2 of the McGuire and Catawba FSAR.

The reactor makeup water pump flowrates are input assumptions to the boron dilution analysis described in the NRC approved methodology,".. Supplementary Information to Topical Report BAW-10173; Boron Dilution Analysis" dated May 15, 1991 and the Catawba FSAR Section 15.4.6 given in the technical justification. Additionally, the boron dilution analysis described above has been approved in topical DPC-NE-3002-A, "FSAR Chapter 15 System Transient Analysis Methodology." The technical justification also explains how these flowrates are determined.

2. Q: The overtemperature ΔT trip setpoint is understood to be defined by the equation in Note 1 of Table 2.2-1. The identification of K_1, a constant within that overall equation, as the "overtemperature ΔT reactor trip setpoint" would therefore seem to be inappropriate. Please expand on the definition and source of the K_1 constant. Please comment similarly on the K_4 constant.

   A: The use of the "overtemperature ΔT reactor trip setpoint" and "overpower ΔT reactor trip setpoint" nomenclature for the K_1 and K_4 constants is not inconsistent with the actual definitions of K_1 and K_4, the reactor trip setpoint value at nominal, steady state conditions expressed as a fraction of full power ΔT. The nomenclature was chosen to be a short description of the parameters function/use to provide consistency between the Technical Specifications and the COLRs. These descriptions are not intended to be the precise definition of the individual parameters. This consistent nomenclature will aid an individual referring to the Technical Specification for these values since the same nomenclature is used in both documents.

3. Q: As an example of the concern expressed in 1. above, it is stated in the applications Technical Specification (pages C-66 and C-67) that the calculational methodology for about 20 parameters is described in Chapter 4 of the report DPC-NE-2011-P-A; however, this report does not explictly discuss the majority of these parameters.

   Also, it would appear that a change to the reference to DPC-NE-2011 in TS 6.9.1.9 would be appropriate to reflect its applicability to TS 2.2 methodology. No changes to 6.9.1.9 were proposed in the January 13, 1993, application.

   A: See response to question 1 above. A change to the reference to DPC-NE-2011 in TS 6.9.1.9 would be appropriate and will be marked up to include its applicability to TS 2.2.

4. Q: The Technical Justification discusses several checks wherein thermal margin calculations are performed pursuant to DPC-NE-2011 and physics parameter calculations pursuant to DPC-NE-3001 are performed to ensure that previously existing analysis results remain valid. The discussion states that, if the TS amendment tranferring these values to the COLR is approved and these checks fail but acceptable reanalysis can be performed, "...no Technical Specification change would be necessary." This is confusing since, if the parameter has been relocated to the COLR, a change to the TS is no longer necessary to change its value. Please clarify.

   A: The statement was meant to indicate that no Technical Specification change will be required after the values are relocated to the COLR. For example, currently the "K", "T" and $f(\Delta I)$ values are located in the Technical Specifications. If the failure of one of the safety analysis physics

parameter checks requires a reanalysis with different "K", "τ", and/or f(ΔI) values to obtain acceptable results, these new values would currently require a Technical Specification change submittal. However, if this Technical Specification change is approved and the values for "K", "τ" and f(ΔI) are relocated to the COLR, the values would be changed in the COLR and would not require a Technical Specification change submittal.

5. **Q:** Clarify whether the report DPC-NE-2004 is intended as a methodology report for the parameters to be relocated to the COLR. If so, it should also be included in a revised TS 6.9.1.9.

   A: The topical report DPC-NE-2004 was not intended to be a methodology report for the parameters being relocated to the COLR. It was included to indicate where a discussion of the relationship between the ΔT reactor trip setpoints and the core safety limits could be found.

6. **Q:** Please clarify the applicability of the limits on minimum volume and boron concentration for the BAST and the RWST to providing an adequate shutdown margin.

   A: The minimum borated water volumes and boron concentrations for the BAST and the RWST are based on the calculations described in the response to question number 1. The volume limits consist of the calculated volumes required to maintain the shutdown margins as required by TS 3.1.1.1 and 3.1.1.2, plus unusable volumes, instrument uncertainties, and additional margin as shown in the current Catawba and proposed McGuire TS bases. Therefore, the minimum borated water volumes and boron concentrations will provide adequate shutdown margin at all times during a given fuel cycle.

7. **Q:** One of the references cited in support of the reactor makeup pump flowrate limits has not yet been approved by the NRC staff review processes. In the event of its approval, as part of the subject amendment application, it should also be included in TS 6.9.1.9.

   A: An SER for topical report BAW-10173 P, Revision 2, dated February 20, 1991 was received by Duke Power Company on February 25, 1991. Section 3 of this SER gave 5 conditions for referencing this topical for future reload cycles with Mark-BW fuel. Condition 4 required that a boron dilution analysis be provided in the first reload analysis report. Responses to this and the four other conditions of the SER were provided in letters dated March 14, 1991 and April 25, 1991. A letter dated May 15, 1991, "... Supplementary Information Relative to Topical Report BAW-10173; Boron Dilution Analysis," was provided to correct reactor coolant system volume assumptions for the boron dilution analysis provided in the previous responses. The first reload to use Mark-BW fuel was Catawba 1 Cycle 6 and contained references to topical report BAW-10173 P. An SER for the Catawba 1 Cycle 6 reload, dated May 31, 1991 was received by Duke Power Company on June 5, 1991. Therefore, the supplementary information relative to the above topical report was approved by the NRC and Catawba 1 Cycle 6 was allowed to start up. Subsequent to the above process the boron dilution analysis was approved in topical DPC-NE-3002-A, "FSAR Chapter 15 System Transient Analysis Methodology."

8. **Q:** The markup to the FSAR, enclosed with the application, proposes to replace the term f($\Delta\phi$) with either $f_1(\Delta\phi)$ or $f_2(\Delta\phi)$. However, the definition of the term remains unchanged. Please comment on the significance of the change in terminology.

   A: The terms were changed in the FSAR to identify that there now exists two distinct functions of f($\Delta\phi$), one applied to the OTΔT setpoint and the second applied to the OPΔT setpoint. The basic

definition of the function has not changed, the addition of the subscripts serve to distinguish the similar functions which contain different parameters (slopes and breakpoints).