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A Duke Energy Company

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September 30, 2003

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

Subject: Duke Energy Corporation
Catawba Nuclear Station, Units 1 and 2
Docket Numbers 50-413 and 50-414
Response to Request for Additional Information (RAI) for Proposed Technical Specification Amendment
TS 3.4.3 - Reactor Coolant System (RCS) Pressure and Temperature (P/T) Limits
TS 3.4.6, RCS Loops - MODE 4
TS 3.4.7, RCS Loops - MODE 5, Loops Filled
TS 3.4.10, Pressurizer Safety Valves
TS 3.4.11, Pressurizer Power Operated Relief Valves (PORVs)
TS 3.4.12, Low Temperature Overpressure Protection (LTOP) System

Reference: 1) Letter from G. R. Peterson to U.S. Nuclear Regulatory Commission dated March 24, 2003

The purpose of this letter is to docket Catawba's response to your request for additional information (RAI) dated August 18, 2003, related to the subject submittal.

In Reference 1, Duke Energy Corporation requested an amendment to the Catawba Nuclear Station Facility Operating License and Technical Specifications (TS). The proposed amendment revises various TS that are affected by the revised heatup, cooldown, critically, and inservice test pressure and temperature (P/T) limits for the reactor coolant system (RCS) of each unit.

The NRC provided a request for additional information concerning this proposed TS amendment via a letter dated August 18, 2003. The purpose of this letter is to respond to that request. This response addresses items 1, 2, 3, 4, 5, and 6 of the request for additional information.

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The items discussed in this letter and in the attachment have been reviewed against the No Significant Hazards Evaluation submitted in Reference 1. Duke has determined that the previous No Significant Hazards Evaluation still remains valid and has not been affected by any of these changes. There are no commitments contained within this letter.

Pursuant to 10 CFR 50.91, a copy of this RAI response is being sent to the appropriate State of South Carolina official.

Inquiries on this matter should be directed to R. D. Hart at (803) 831-3622.

Very truly yours,

Dhiaa M. Jamil

RDH/s

Attachments

Dhiaa M. Jamil affirms that he the person who subscribed his name to the foregoing statement and that all statements and matters set forth herein are true and correct to the best of his knowledge.

Dhiaa M. Jamil, Site Vice President

Subscribed and sworn to me: 9-30-2003
Date

Notary Public

My commission expires: 7-10-2012
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SEAL

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ATTACHMENT

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

(Throughout this attachment, the NRC request for additional information is highlighted in **bold type** and Catawba's response is shown in normal type.)

The Nuclear Regulatory Commission (NRC) staff has reviewed the licensee's submittal dated March 20, 2003, regarding proposed changes to the low temperature overpressure (LTOP) Technical Specifications (TS). The NRC staff has identified the following information that is needed to enable the continuation of its review.

NRC Question:

1. **Catawba Units 1 and 2 and McGuire Units 1 and 2 are similarly designed plants and the current LTOP TS are very similar for both stations. The proposed changes to the Catawba LTOP TS would result in differences from the McGuire LTOP TS. Identify in detail the bases for proposing a different TS format and content for the two plants' LTOP TS.**

Catawba Response:

A review of the proposed Catawba TS changes and the current McGuire TS changes identifies the following comparison.

a. Catawba proposes to allow use of the residual heat removal (RHR) suction relief valves for LTOP protection and places the requirements in the limiting condition for operation (LCO). The current McGuire TS allows use of RHR suction relief valves but places the requirements in Required Action A.2.1 and F.2. The plant protection is the same except Catawba has chosen to place the requirements in the LCO to be consistent with NUREG-1431, revision 2, Standard Technical Specifications Westinghouse Plants. This also allows use of the RHR suction valves without requiring entry into a Required Action.
b. Catawba proposes to allow use of two pumps capable of injection in LTOP operation and places the requirements in the LCO. The current McGuire TS allows operation with two pumps capable of injection but places the allowance in Condition A with five different Required Actions to support this operation. The plant operation is the same except Catawba has chosen to place the allowance in the LCO to simplify the requirements for Operations. This provides a cleaner and easier to follow TS which will prevent future errors in application. The analysis completed to support this change documents the acceptability of this operation.
c. The proposed Catawba TS moves the allowance for providing a vent path from the LCO to Required Action G.2. Current McGuire TS provides this allowance in the LCO and several Required Actions. The present Catawba TS specifies that a 4.5 square inch vent path is adequate for relieving the maximum flow rate of a single injection pump. At Catawba,

this vent path is provided by a 3 inch vent line installed on the reactor vessel head. McGuire does not have a 3 inch reactor vessel head vent. The proposed Catawba TS requires operator actions to reduce to one pump capable of injection when the specified 4.5 square inch vent path is providing LTOP. This maintains the level of conservatism within the present Catawba TS, without evaluating the vent path size required to relieve the maximum flow rate of two injection pumps.

d. The current Catawba TS has limits on reactor coolant pump (RCP) operation based on RCS temperature. This has been a TS requirement and is based on the analysis for Catawba. The only changes proposed for Catawba are the temperature restrictions for RCP operation.

The above discussion shows that while the location of the requirements may be different for Catawba and McGuire, the protection afforded is similar. Catawba has chosen to follow the guidelines of NUREG-1431, revision 2 as much as possible. This simplifies the TS for the plant and helps reduce any confusion that may arise during implementation.

NRC Question:

2. The Westinghouse Improved Standard Technical Specifications (ISTS), NUREG 1431, "Standard Technical Specifications, Westinghouse Plants," Revision 2, LTOP TS, Action Item A, provides a limit of 15 minutes for a condition of two charging pumps capable of injecting into the reactor coolant system (RCS) during pump swap operations. The proposed TS would allow any two pumps, either charging pumps or safety injection pumps, or any combination of two pumps with maximum flow to inject into the RCS indefinitely. This represents a deviation from the ISTS. Justify in detail why it is acceptable for two pumps in this configuration to run for a long duration and the impact of this proposed configuration on the peak pressure analyses. Also provide a discussion regarding your analysis and its termination period.

Catawba Response:

The Safety Injection and Centrifugal Charging pump flow rates have been calculated based on a conservative set of operating parameters. The flow rates selected for the LTOP analysis are based on the specific pump flow rate at the

LTOP relief valve setpoint. The pump flow rates were determined as follows:

a. The pump head curve was obtained from the applicable pump's Test Acceptance Criteria (TAC) sheets, which establishes the safety analysis minimum flow limits. Using the TAC head curves, a head curve equal to 120% of the TAC curve was developed. A review of performance test data shows the 120% TAC head curves is conservative for all Safety Injection and Centrifugal Charging pumps.

b. The system resistance (flow coefficient) was determined by obtaining the pump head and flow rate for the safety injection alignment from pump performance tests (i.e. data was obtained for the cold leg injection alignment for both Safety Injection and Centrifugal Charging pumps). The system resistance was determined using equation:

$$Cv = Q \ / \ (\Delta P \ 62.4/ \ \rho)^{0.5}$$

Where:
- ΔP = Pump Head
- Cv = Flow Coefficient
- Q = System Flow Rate
- ρ = Water Density

c. With the system resistance (flow coefficient) now known, the system resistance curve can be established for both the Safety Injection and Centrifugal Charging systems. The system resistance curves for an LTOP event are increased by an amount equal to the pump head at LTOP system pressure (normal lift setting 400 psig) adjusted for elevation changes. The system resistance curve is represented by the formula:

Safety Injection System: $HEAD = (Q/20.76)^2 + 380$ psid
Centrifugal Charging System: $HEAD = (Q/15.39)^2 + 380$ psid

d. The intersection of the system resistance curve and the 120% TAC pump curve is the conservatively determined operating point of the pump during a postulated LTOP event. The pump flow rate at that intersection is used as a conservative input to the LTOP analysis.

e. A similar process was followed for Safety Injection and Centrifugal Charging pumps operating in parallel.

- Pump performance with both pumps (2 Safety Injection pumps or 2 Centrifugal Charging pumps)

operating in parallel was conservatively assumed to be twice the TAC sheet flow rate at any given pump head. The system resistance curve remained constant. The intersection of the two-pump head curve and the original system resistance curve is the two- pump maximum flow rate. This method is conservative because when two centrifugal charging pumps operate in parallel, the combined flow passes through the same piping system, increasing the overall backpressure and decreasing the relative contribution of each pump.

- However, the combined flow of one centrifugal charging pump and one safety injection pump pass through different piping systems and do not counteract each other. Therefore the total flow is the numerical sum of the single pump flow rates.

Results of the Safety Injection and Centrifugal Charging pump / system flow analysis are tabulated below.

Pump / System Flow Analysis (400 psi Setpoint)	
Pump / Combination	Flow (gpm)
One Centrifugal Charging	475
Two Centrifugal Charging	660
One Safety Injection	550
Two Safety Injection	690
One Centrifugal Charging + one Safety Injection	475 + 550 = 1025

Table A (attached) provides peak pressure analysis results for the combined flow rate of one Centrifugal Charging and one Safety Injection pump. The results provided show that peak pressure does not exceed Appendix G limits for the reactor vessel beltline region at any system operating temperature. For a mass input transient with a maximum injection of 1025 gpm representing the combined flow of one Safety Injection and one Centrifugal Charging pump, the peak system pressure is 685.7 psig. This is well below the heatup and cooldown limits for the reactor vessel beltline region, which are identified on Table C and Table D (attached). Considering the steady state condition, the limiting pressures are 1141 psig and 719 psig on unit 1 and 2, respectively. Relative to overpressure protection of the reactor vessel beltline region, this supports operation during LTOP with two injection pumps configured to run for a long duration with no termination period.

Table C and D includes Appendix G limits for the reactor closure head and vessel flange region. For Catawba, the rule requires that metal temperature of the closure head region exceed a predetermined value when system pressure is greater than 621 psig (i.e., 20% of the preserves hydrostatic test pressure, 3107 psig). Based on the material unirradiated RT_{ndt} of the closure flange region, this predetermined value is 116°F and 130°F on unit 1 and 2, respectively. To ensure against exceeding the system limit when operating below the predetermined temperature limits, the number of operating reactor coolant pumps will be limited to two pumps on unit 1 and one pump on unit 2. Table A shows that operating with reactor coolant pump restrictions will limit peak system pressure to 609.5 psig and 609.6 psig on unit 1 and 2, respectively (i.e., during a mass input transient with a combined injection pump flow of 1025 gpm). Again, this supports operation during LTOP with two injection pumps configured to run for a long duration with no termination period.

NRC Question:

3. **WCAP 14040, 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, provides the methodology for pressure transient analyses using pressurizer power operated relief valves (PORVs) only. Describe and justify the method that was used to analyze the residual heat removal (RHR) suction relief valves as pressure relieving devices in this proposal. Identify any conservatism in the pressure transient analyses.**

Catawba Response:

It is desirable to take credit for the RHR (ND) suction relief valves capacity in addition to the pressurizer PORVs for compliance with LTOP specification. Doing so would provide operational, maintenance, and test flexibility for more efficient outage planning. This can be shown to be acceptable provided the RHR system suction relief valves are available to relieve the required capacity. The following is an evaluation of the specific case mentioned above.

ND-3 (RHR Train A Suction Relief) and ND-38 (RHR Train B Suction Relief) characteristics:

	Normal Operation	Cold Set Pressure
Setpoint:	450 psig @ 400°F	463 psig @ < 250°F
Capacity:	2027 gpm @ 10% Accumulation	2027 gpm @ 10% Accumulation
Accumulation:	10% of setpoint	10% of setpoint
Setpoint Tolerance:	3% of setpoint	3% of setpoint

To allow additional margin for relief valve setting drift, a setpoint tolerance of 10% will be applied to the LTOP function of the RHR suction relief valves. This increase in setpoint tolerance will be applied to the LTOP analysis for reactor vessel overpressure protection, but is not applicable to all design bases functions of the RHR suction relief valves (i.e., not applicable to RHR system overpressure protection). To this end, the proposed TS 3.4.12 LCO specifies an RHR suction relief valves with a lift setting of ≥417 psig and ≤509 psig (i.e., 463 psig +/- 10%, approximately).

The relief capacity of the RHR suction relief valves is 2027 gpm at 10% accumulation. An increase in relief pressure of 10% (46.3 psig) over the lift setting will be conservatively assumed and applied to all postulated mass and heat input transients.

Additional influences considered on the relief capacity of the RHR suction relief valves are:

- Back Pressure in discharge flow path of RHR suction relief valves (18.01 psig).
- Elevation between RHR suction relief valves and reactor vessel beltline region (6.3 psig).
- Reactor Coolant Pump induced pressure drop across Reactor Vessel (83.1 psi with 4 NCP operating, etc).

As shown on Table B (attached) the capacity of the suction relief valves, ND-3 and ND-38, (2027 gpm) is conservatively capable to relieve the combined flow rate of one Centrifugal Charging and one Safety Injection pump (1025 gpm). Again, this supports operation during LTOP with two injection pumps configured to run for a long duration with no termination period.

Together Table A and B show that a single PORV or a single RHR suction relief valve is adequate to mitigate the pressure increase from the worst case transient (combined mass input from one Safety Injection and one Centrifugal Charging pump). Since the limiting case is bounded, it

naturally follows that all other combinations of injection pumps or heat addition events are bounded as well. Reactor Coolant Pump operating restrictions are required to protect the Reactor Vessel / Closure Head Region. The overpressure protection provided by the LTOP system is:

	PORV System Peak Pressure	RHR Suction Relief Peak Pressure	Steady State Limit*
Unit 1: 2 NCP (NCS ≤ 126°F) 4 NCP (NCS > 126°F)	 609.5 psig 667.2 psig	 605.3 psig 663.0 psig	 621 psig (<116°F) 2220 psig (>116°F)
Unit 2: 1 NCP (NCS ≤ 140°F) 4 NCP (NCS > 140°F)	 609.6 psig 685.7 psig	 586.9 psig 663.0 psig	 621 psig (<130°F) 1062 psig (>130°F)

*Actual temperature without adjustment for instrument uncertainty

NRC Question:

4. Attachment 2, Page 2-10, discusses the PORV and RHR suction relief valves setpoints and the respective peak pressures and pressure-temperature (P/T) limits. In your analyses, if the upper limit is used for the PORV (425 pounds per square inch gauge (psig)) and the RHR suction relief valves (509 psig), what is the impact on the peak pressure calculation? Provide two separate tables identifying the following parameters for the PORV and RHR suction relief valves for heatup and cooldown limiting cases for both units. The tables should reflect the enable temperature range versus the PORV setpoint, the uncertainty, the transient pressure, the peak pressure and P/T limit from the revised P/T curves. Also provide the details of limitations on operation of the reactor coolant pump when the LTOP system is in service based on the revised heatup and cooldown curves for both Catawba units.

Catawba Response:

The attached Table A and B summarizes the peak vessel pressure and pressure corrections for the pressurizer PORV and RHR Suction Relief Valve's response during the postulated LTOP event. Table C and D provides the Catawba 1 and 2 allowable heatup and cooldown limits from WCAP -15203

and -15285, adjusted to include assumed temperature offset of +10 F. The peak pressures (Table A and B) is compared to the allowable limits (Table C and D) to verify the assumed pressurizer PORV lift setting (normal 400 psig) and the RHR Suction Relief lift setting (cold 463 psig) are adequate.

Per ASME Code Case 641, "Alternative Pressure - Temperature Relationship and Low Temperature Overpressure Protection System Requirements - Section XI, Division 1" January 17, 2000, the LTOP systems shall be effective below the temperature calculated ($T_{enable} = RT_{ndt} + 40°F$) to ensure against nonductile failure of the reactor pressure vessel. For Catawba Unit 1, the limiting RT_{ndt} at 34 EFPY is 42°F. For Catawba Unit 2, the limiting RT_{ndt} at 34 EFPY is 121°F. With the calculated temperatures well below the Code Case allowed minimum of 200°F, an LTOP enable temperature of 210°F (which includes instrument uncertainty) has been established for both Catawba Unit 1 and 2.

Using the instrumentation margin calculation by Duke Power Company/Catawba Engineering, the instrumentation uncertainty of the pressurizer PORV actuation signal is +/- 51.8 psi and +/- 7.1 °F. This instrument uncertainty includes an allowable drift of 25 psi, allowing a TS 3.4.12 LCO normal left setting of 400 psig (as left calibrated) and allowable value ≤ 425 psig (as found). For the LTOP peak pressure analysis, a left setting of 400 psig is conservatively applied, because it produces a greater pressure increase (i.e., a greater pressurizer PORV Accumulation in Table A). Instrumentation uncertainty is then conservatively applied use ±60 psi and ±10 °F. The 60 psig uncertainly is included in Table A. Table C and D have been adjusted to include an uncertainty of 10°F.

For the pressurizer PORV actuation signal, the remaining uncertainty to be addressed is the static pressure between the lowest point in the beltline and the location of the pressure transmitters. The instruments are calibrated to the inside bottom of the hot legs. The elevation difference between the inside bottom of the hot leg and the bottom of the beltline region is approximately 126.3 inches, for which the equivalent pressure increase is 4.6 psig. This is included in Table A.

The RHR Suction Relief Valves are not dependant on system pressure instrumentation for actuation. Therefore, Table B does not include a value for instrumentation uncertainty related to an actuation signal. The elevation difference between the RHR Suction Relief Valves and the bottom of the

vessel beltline region is considered, for which 6.3 psig is included in Table B.

Limitations on Operation of Reactor Coolant Pumps:

The LTOP actuation signal originates from pressure transmitters located off the hot legs of the reactor coolant system. During startup and shutdown, reactor coolant pumps are operating and the induced flows create a pressure drop across the reactor vessel core. This pressure drop along with the difference in elevation between the beltline region and the instrumentation locations must be added to the indicated pressure to determine an accurate pressure for the reactor vessel beltline region.

All four reactor coolant pumps create a differential pressure across the reactor vessel known to be 47.5 psi at a flow rate of 359,627 gpm and temperature of 561 °F. In determining the reactor core pressure drop influence on LTOP peak pressure, conservatism is added by considering a maximum reactor coolant system flow of 400,000 gpm and by adding 6600 gpm for normal two train RHR flow.

Number of Operating Reactor Coolant Pumps	4 pumps	3 pumps	2 pumps	1 pump
Pressure Drop Across Reactor Vessel Core	83.1 psid	53.0 psid	25.4 psid	7.0 psid

For no reactor coolant pumps running there is virtually no pressure drop across the reactor vessel due to RHR pump flow, so 1 psid is used for conservatism.

NRC Question:

5. **The Updated Final Safety Analysis Report Section 5.2.2 provides only a general discussion regarding the LTOP system. It does not provide any information regarding mass input and heat input transient analyses. Provide a detailed discussion of the mass input and heat input transient analyses, including the results of the analyses and the computer code used.**

Catawba Response:

In general, the methodology presented in "Pressure Mitigation Systems Transient Analysis Results, Westinghouse

Electric Corporation for Reactor Coolant Overpressurization", July 1977 and Supplement September 1977, were employed for Catawba's Low Temperature Overpressure Protection Systems. The peak pressure (setpoint plus overshoot) is combined with corrections to convert indicated pressure and temperature to actual conditions, including instrumentation margins and calculated Reactor Vessel (RV) differential pressure. Both the pressurizer PORVs and the RHR System suction line relief valves are evaluated in response to bounding mass and energy addition transients. Also, corrections for S/G tube plugging were considered, and determined not required. The PORV setpoint is verified acceptable by comparison to the Pressure/Temperature (P/T) curves of WCAP-15203, Catawba 1 Heatup and Cooldown Limit Curves for Normal Operation Using Code Case N-640, August 1999, and WCAP 15285, Catawba 2 Heatup and Cooldown Limit Curves for Normal Operation Using Code Case N-640, October 1999. Acceptable heatup and cooldown limits are determined based on comparison of peak pressure and P/T curve limits.

The LTOP Setpoint is verified acceptable as follows:

a. First the reactor coolant system pressure overshoot (relief valve accumulation) is calculated for limiting transients (inadvertent start of any combination of charging/safety injection pumps, charging letdown mismatch, and overheating from a steam generator due to inadvertent RCP startup). This is done for both the D5 S/Gs (Unit 2) and the BWI S/Gs (Unit 1).

    1. For the BWI S/Gs (Unit 1) the S/G heat transfer surface area exceeds the maximum used in "Pressure Mitigation Systems Transient Analysis Results" for the heat input transient. Therefore, this specific transient has been evaluated by Duke Safety Analysis using a RETRAN-2 model with the same basic assumptions employed in the LTOP calculation.

b. The difference between the indicated pressure (signal actuating pressurizer PORV's) and the actual reactor vessel belt line pressure is calculated. This includes elevation differences between the reactor vessel belt line and the reactor coolant pressure transmitters and the differential pressure across the reactor core due to hydraulic losses. The transmitters actuating the PORV's are on the hot legs, while the reactor vessel belt line is on the cold leg side of the core.

c. Then the impact of Steam Generator tube plugging on the Pressure Overshoot Margin is evaluated [At the present time Catawba does not have a significant number of steam generator tubes plug].

d. The instrument error for the pressure and temperature instrumentation associated with LTOP is calculated by Duke Power Company/Catawba Engineering.

e. The information gathered in steps 1, 2, 3, and 4 is then combined. Table A summarizes the peak vessel pressure, pressure corrections and instrument uncertainties, for a 3.0 second PORV opening time.

f. The heatup and cooldown limits were calculated by Westinghouse based on the use of Code Case N-640 and are summarized on Table C and D. Table C represents WCAP-15203 (Unit 1). Table D represents WCAP-15285 (Unit 2).

g. The peak pressures calculated on Tables A and B are compared to the Appendix G limits from Table C and D (as calculated using CC-640 methodology).

NRC Question:

6. **Clarify whether the term "RCS relief valves" in TS 3.4.12 means "RHR suction relief valves."**

Catawba Response:

The term "RCS relief valves" can mean either or both "RHR suction relief valves" and pressurizer power operated relief valves. The term "RCS relief valves" was used based on the use and terminology that is currently used in revision 2 to NUREG-1431, Standard Technical Specifications Westinghouse Plants. This is also described in the TS Bases Background section and Condition E.1.

Table A:
Peak Reactor Coolant System Pressure (3.0 second PORV Stroke Time)

Transient Description		PORV Set-point	PORV Accumulation Unit 1 (3 sec)	PORV Accumulation Unit 2 (3 sec)	Trans-mitter Elev.	RCP Press. Diff.	S/G Plug	Inst. Uncer-tanity (psi)	Peak Pressure BWI S/G (psig) Unit 1	Peak Pressure D5 S/G (psig) Unit 2
Combined Injection Flow (1025 gpm)	0 RCPs	400	119.5	138	4.6	1	N/A	60	585.1	603.6
	1 RCP	400	119.5	138	4.6	7.0	N/A	60	591.1	609.6
	2 RCPs	400	119.5	138	4.6	25.4	N/A	60	609.5	628.0
	3 RCPs	400	119.5	138	4.6	53.0	N/A	60	637.1	655.6
	4 RCPs	400	119.5	138	4.6	83.1	N/A	60	667.2	685.7
Safety Injection (550 gpm)	0 RCPs	400	64.7	74.7	4.6	1	N/A	60	530.3	540.3
	1 RCP	400	64.7	74.7	4.6	7.0	N/A	60	536.3	546.3
	2 RCPs	400	64.7	74.7	4.6	25.4	N/A	60	554.7	564.7
	3 RCPs	400	64.7	74.7	4.6	53.0	N/A	60	582.3	592.3
	4 RCPs	400	64.7	74.7	4.6	83.1	N/A	60	612.4	622.4
Charging / Letdown Mismatch (475 gpm)	0 RCPs	400	55.4	64.0	4.6	1	N/A	60	521.0	529.6
	1 RCP	400	55.4	64.0	4.6	7.0	N/A	60	527.0	535.6
	2 RCPs	400	55.4	64.0	4.6	25.4	N/A	60	545.4	554.0
	3 RCPs	400	55.4	64.0	4.6	53.0	N/A	60	573.0	581.6
	4 RCPs	400	55.4	64.0	4.6	83.1	N/A	60	603.1	611.7
Heat Input (<100 F)	1 RCP	400	34.0	20.3	4.6	7.0	N/A	60	511.6	491.9
Heat Input (100- 180 F)	1 RCP	400	77.0	55.3	4.6	7.0	N/A	60	572.6	526.9
Heat Input (180- 250 F)	1 RCP	400	110	80.3	4.6	7.0	N/A	60	560.9	551.9

Table B:
Peak Reactor Coolant System Pressure (RHR Suction Relief)

Transient Description*		RHR Suction Relief Setpoint	RHR Suction Relief Accumulation	RHR Suction Relief Setpoint Drift	RHR Relief Back-pressure	Reactor Vessel Beltline Elev.	S/G Plug	RCP Press Diff.	Peak Press (psig) Unit 1&2
Combined Injection Flow (1025 gpm)	0 RCP	463	46.3	46.3	18.01	6.3	N/A	1	580.9
	1 RCP	463	46.3	46.3	18.01	6.3	N/A	7.0	586.9
	2 RCPs	463	46.3	46.3	18.01	6.3	N/A	25.4	605.3
	3 RCPs	463	46.3	46.3	18.01	6.3	N/A	53.0	632.9
	4 RCPs	463	46.3	46.3	18.01	6.3	N/A	83.1	663.0
Safety Injection (550 gpm)	0 RCP	463	46.3	46.3	18.01	6.3	N/A	1	580.9
	1 RCP	463	46.3	46.3	18.01	6.3	N/A	7.0	586.9
	2 RCPs	463	46.3	46.3	18.01	6.3	N/A	25.4	605.3
	3 RCPs	463	46.3	46.3	18.01	6.3	N/A	53.0	632.9
	4 RCPs	463	46.3	46.3	18.01	6.3	N/A	83.1	663.0
Charging / Letdown Mismatch (475 gpm)	0 RCP	463	46.3	46.3	18.01	6.3	N/A	1	580.9
	1 RCP	463	46.3	46.3	18.01	6.3	N/A	7.0	586.9
	2 RCPs	463	46.3	46.3	18.01	6.3	N/A	25.4	605.3
	3 RCPs	463	46.3	46.3	18.01	6.3	N/A	53.0	632.9
	4 RCPs	463	46.3	46.3	18.01	6.3	N/A	83.1	663.0
Heat Input (<100 F)	1 RCP	463	46.3	46.3	18.01	6.3	N/A	7.0	586.9
Heat Input (100- 180 F)	1 RCP	463	46.3	46.3	18.01	6.3	N/A	7.0	586.9
Heat Input (180- 250 F)	1 RCP	463	46.3	46.3	18.01	6.3	N/A	7.0	586.9

* All transients assume 2027 gpm at 10% accumulation through the RHR suction relief valve.

Table C:
Catawba Unit 1 Allowable Heatup and Cooldown Limits for 34 EFPY from WCAP-15203, Tables 11 and 14

Temperature		Closure Head / Vessel Flange Region	Allowable Pressure per WCAP-15203 No Margin					
Actual	Indicated (w/ 10 F margin)		Steady State	CD 20 F/Hr	CD 40 F/Hr	CD 60 F/Hr	CD 100 F/Hr	HU 60 F/Hr
60	70	621	0	0	0	0	0	0
60	70	621	1141	1141	1141	1141	1141	1141
65	75	621	1197	1197	1197	1197	1197	1197
70	80	621	1260	1260	1260	1260	1260	1260
75	85	621	1329	1329	1329	1329	1329	1329
80	90	621	1406	1406	1406	1406	1406	1406
85	95	621	1490	1490	1490	1490	1490	1467
90	100	621	1583	1583	1583	1583	1583	1493
95	105	621	1687	1687	1687	1687	1687	1532
100	110	621	1801	1801	1801	1801	1801	1585
105	115	621	1927	1927	1927	1927	1927	1652
110	120	621	2066	2066	2066	2066	2066	1731
115	125	621	2220	2220	2220	2220	2220	1824
120	130		2391	2391	2391	2391	2391	1931
125	135							2053
130	140							2190
135	145							2344
140	150							
145	155							
150	160							
155	165							
160	170							
165	175							
170	180							
175	185							
180	190							
185	195							
190	200							

Table D
Catawba Unit 2 Allowable Heatup and Cooldown Limits for 34 EFPY from WCAP-15285, Tables 17 and 18

Temperature		Closure Head / Vessel Flange Region	Allowable Pressure per WCAP-15285 No Margin					
Actual	Indicated (w/ 10 F margin)		Steady State	CD 20 °F/Hr	CD 40 °F/Hr	CD 60 °F/Hr	CD 100 °F/Hr	HU 60 °F/Hr
60	70	621	0	0	0	0	0	0
60	70	621	719	678	637	596	514	719
65	75	621	731	691	651	611	533	731
70	80	621	744	705	666	628	553	744
75	85	621	759	721	683	647	576	759
80	90	621	775	738	702	667	601	775
85	95	621	792	757	723	690	629	776
90	100	621	812	778	747	716	660	776
95	105	621	833	802	772	744	695	776
100	110	621	857	828	801	776	734	780
105	115	621	883	857	832	811	777	789
110	120	621	912	888	867	849	824	801
115	125	621	944	924	906	892	877	817
120	130	621	979	963	949	940	936	837
125	135	621	1018	1006	997	992	1001	861
130	140	621	1062	1053	1049	1050		888
135	145		1109	1106	1107			920
140	150		1162					956
145	155		1221					997
150	160		1285					1042
155	165		1356					1093
160	170		1435					1150
165	175		1522					1213
170	180		1618					1283
175	185		1725					1361
180	190		1842					1447
185	195		1972					1542
190	200		2116					1647
195	205		2274					1763
200	210		2449					1891
205	215							2033
210	220							2190
215	225							2363
220	230							