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SUBJECT: Provides responses for questions one through six of RAI re TS changes for low temp overpressure protection setpoints for Units 1,2 & 3.

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December 17, 1998

U. S. Nuclear Regulatory Commission
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Washington, DC 20555

Subject: Oconee Nuclear Station
Docket Nos. 50-269, -270, -287
Proposed Revision to Technical Specifications
Pressure-Temperature Operating Curves
Technical Specification Change No. 98-06

In a letter dated October 15, 1998, Duke Energy Corporation (Duke) requested a revision to the Technical Specifications for Oconee Nuclear Station Units 1, 2, and 3. The amendment consisted of proposed changes to the pressure-temperature operating curves and associated changes to the Low Temperature Overpressure Protection (LTOP) limits. In a letter dated November 19, 1998, the NRC requested additional information about LTOP setpoints addressed in the Technical Specification amendment request.

The enclosure provides Duke's responses for questions one through six of the request for additional information. As discussed between Messrs. LN Olshan (NRC) and RC Douglas (Duke) on December 14, 1998, Duke's response to question 7 is pending NRC resolution of issues related to location and content of information which was requested to be included in the Technical Specifications.

If there any questions regarding this submittal, please contact Robert Douglas at 864-885-3073.

Very truly yours,

W. R. McCollum, Jr.
Oconee Site Vice President

Enclosure: Responses to Request for Additional Information

A001

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ENCLOSURE

RESPONSES TO RAI CONCERNING TECHNICAL SPECIFICATION CHANGES FOR LOW TEMPERATURE OVERPRESSURE PROTECTION SETPOINTS
OCONEE NUCLEAR STATION, UNITS 1, 2 AND 3

1. Question:

Provide the most limiting Appendix G pressure-temperature (P/T) limits that apply for the first 26 effective full-power years (EFPY) at Oconee Station that the proposed low temperature overpressure protection (LTOP) setpoints are meant to protect (i.e. P/T limits under steady state reactor operation, the isothermal curve).

Response:

The following tabulated information is the most restrictive 26 EFPY P/T limits based on a composite curve formed from all three Oconee Nuclear Station P/T limits analyses. The final temperature of 410°F is determined due to the pressure remaining constant at 3114 psig for all greater temperatures.

Shell Fluid Temperature °F	LTOP Press. Limits per N-514, psig	Shell Fluid Temperature °F	LTOP Press. Limits per N-514, psig	Shell Fluid Temperature °F	LTOP Press. Limits per N-514, psig
60	473	180	562	300	983
61	479	185	570	305	1026
62	481	190	579	310	1073
63	482	195	588	315	1123
64	484	200	596	320	1177
85	485	205	607	325	1235
90	488	210	618	330	1296
95	490	215	631	335	1364
100	492	220	643	340	1435
105	494	225	657	345	1511
110	497	230	671	350	1593
115	500	235	688	355	1681
120	503	240	704	360	1777
125	506	245	723	365	1878
130	510	250	684	370	1987
135	513	255	705	375	2104
140	517	260	728	380	2228
145	522	265	752	385	2355
150	526	270	778	390	2491
155	532	275	807	395	2636
160	537	280	837	400	2791
165	543	285	870	405	2955
170	548	290	905	410	3114
175	556	295	942		

2. Question:

Confirm that the power-operated relief valve (PORV) setpoint of 460 psig has been determined using proper instrumentation uncertainties incorporated.

Response:

The limiting point on the P/T limit curve provided in the response to Question 1 is the basis for the new PORV setpoint of 460 psig. Per this curve, the maximum allowed pressure at 60 °F is 473 psig. The new PORV setpoint is adjusted by -13 psi to account for the 12.9 psi instrument uncertainty associated with the RCS pressure instrumentation utilized during LTOP conditions.

3. Question:

Provide a table that lists PORV setpoint, number of operating reactor coolant pumps, transient pressure overshoot, instrumentation uncertainties, P/T limits (110 percent of Appendix G limits), and the margin that exists for various temperatures in the region where LTOP is required. These data should show that the value of the PORV setpoint plus transient pressure increase plus instrumentation uncertainties is still below the P/T limit with sufficient margin at the entire temperature range within the area of protection.

Response:

A single PORV setpoint of 460 psig is used for the entire LTOP temperature range. This maximum allowed pressure corresponds to the minimum allowed RCS temperature of 60 °F, and bounds all other pressures over the LTOP temperature range (see response to Question 1). Additional margin will exist during an LTOP event when the RCS temperature is higher than 60 °F. For temperatures greater than 60 °F, the corresponding pressure limit increases. At the upper end of the Oconee LTOP temperature region (325 °F) the maximum allowed pressure is 1235 psig, which is well above the 460 psig used for the PORV setpoint.

The P/T limits provided in the response to Question 1 include adjustments for RCP operation. The number of assumed operating RCPs is temperature dependent and is based on that allowed by Current Technical Specification Tables 3.1-1 and 3.1-2, and by Improved Technical Specification Tables 3.4.3-1 and 3.4.3-2:

	RCS Temperature °F	RCP Constraints
Heatup	T ≤ 250 °F	No more than one pump per loop
	T > 250 °F	Any
Cooldown	T > 270 °F	Any
	200 < T ≤ 270 °F	No more than one pump per loop
	T ≤ 200 °F	No more than one pump

The transient pressure response during LTOP events is relatively slow since a steam or nitrogen bubble is maintained in the pressurizer during low temperature operations. As a result of the pressurizer bubble, 10 minutes are available for operator action to mitigate LTOP events that can exceed the PORV setpoint. Since the PORV is a fast opening valve (~0.2 second stroke time), transient pressure overshoot is negligible during LTOP events. Therefore, the PORV setpoint is only adjusted for instrumentation uncertainty as discussed in the response to Question 2.

The P/T limits (110% of Appendix G limits) are provided in the response to Question 1.

4. Question:

Discuss the major assumptions used in your mass addition and energy addition transient analyses performed to support your design of the LTOP. Identify the assumptions in the analysis that are different from the restrictions specified in Oconee Technical Specifications (TS).

Response:

The mass addition and energy addition transients evaluated to support the LTOP System design are the following:

A. Erroneous actuation of the High Pressure Injection System
B. Erroneous opening of the core flood tank discharge valve
C. Erroneous addition of nitrogen to the pressurizer
D. Makeup control valve failing full open
E. Pressurizer heaters erroneously energized
F. Loss of the Decay Heat Removal System
G. Reactor Coolant Pump Start Induced Transients

Note that the above heading designations ("A", "B", etc.) for the above list are used in the following description of the administrative controls to facilitate cross referencing. For example, a "[B and D.3]" in the following description refers the

reader to all of section "B" and section "D", part 3, for the respective source(s) of the item.
The following administrative controls during LTOP conditions will ensure that the LTOP event initiators are either not credible or that 10 minutes are available for operator action:

1. RCS pressure:

    < 330 psig when RCS temperature ≤ 220 °F
    [D.2, E, F.1, and G]

    < 430 psig when RCS temperature > 220 °F and ≤ 325 °F
    [D.3, E, and G]

2. Pressurizer level is maintained within the following limits:

    a. RCS pressure is > 100 psig:

    ≤ 220 inches when RCS temperature ≤ 325 °F
    [D.2, D.3, E, F.1, and G]

    b. RCS pressure is ≤ 100 psig[1]:

    ≤ 310 inches when one or more HPI pumps are running, and when RCS temperature ≥ 150 °F and ≤ 220 °F
    [D.1 and F.2]

    ≤ 380 inches while filling or draining the RCS when RCS temperature ≤ 160 °F and no HPI pumps are running [F.3]

3. Makeup flow is restricted with the HP-120 (makeup control valve) travel stop set to ≤ 90.1 gpm for all three units.
    [D]

4. High pressure nitrogen system is administratively controlled to prevent inadvertent pressurization of the RCS. [C]

5. Three audible pressurizer level alarms at ≥ 225 inches, ≥ 260 inches, and ≥ 315 inches from the temperature compensated pressurizer level indication. [D, E, and F]

6. Two audible RCS pressure alarms at ≥ 330 psig and ≥ 430 psig. [D and F]

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[1] When the RCS pressure is ≤ 100 psig, pressurizer level is maintained ≤ 220 inches except for certain RCS evolutions. The pressurizer level limits specified here provide assurance at least 10 minutes is available for operator action during those evolutions. The identified temperature limits are used in the analyses but are based on operational limits for the evolution.

7. The Core Flood Tanks must be deactivated. [B]

8. Pressurizer heater bank 3 or 4 must be deactivated. [E]

9. The HPI safety injection flowpaths must be deactivated. [A]

These proposed administrative controls are based on the assumptions used in the LTOP analyses. A description of the major assumptions used in each LTOP analysis is provided below.

A. Erroneous actuation of the High Pressure Injection System

The current Oconee TSs require that both trains of the High Pressure Injection System be deactivated during LTOP conditions. This may be accomplished by deactivating the safety injection flowpaths or the HPI pumps. If a safety injection flowpath is deactivated, the associated HPI pump may still be used for normal makeup to the RCS via the charging flowpath. No change to this requirement is proposed for the new P/T limits. Therefore, a LTOP analysis is not performed for this event since it is not considered a credible LTOP initiator.

B. Erroneous opening of the core flood tank discharge valve

The current Oconee Technical Specifications require that both core flood tanks be deactivated during LTOP conditions. No change to this requirement is proposed for the new P/T limits. Therefore, a LTOP analysis is not performed for this event since it is not considered a credible LTOP initiator.

C. Erroneous addition of nitrogen to the pressurizer

The high pressure nitrogen system is currently administratively controlled to prevent inadvertent pressurization of the RCS. No change to this administrative control is proposed for the new P/T limits. Therefore, a LTOP analysis is not performed for this event since it is not considered a credible LTOP initiator.

D. Makeup control valve failing full open

The maximum makeup flow rate is limited for this event to ensure that 10 minutes are available for operator action. A mechanical device is used to limit how far the makeup control valve can stroke open. The maximum allowed makeup flowrate has been re-evaluated for the new P/T limits.

The LTOP temperature range is divided into three regions for evaluating this event. The highest allowable makeup flow rate is determined for each region. The most limiting flow rate is then used to set the makeup flow restriction. The three regions evaluated and the major assumptions made in this analysis are discussed below.

D.1 Region 1: RCS Pressure $\leq$ 100 psig and RCS Temperature $\geq$ 150 °F and $\leq$ 220 °F

The acceptance criterion for this region is that 10 minutes will be available for operator action from the time of the first alarm to the time when RCS pressure exceeds 460 psig. As discussed in the response to Question 2, this setpoint accounts for instrument uncertainty. The following initial conditions and boundary conditions are assumed for evaluating this region of operation:

a. The initial RCS pressure is 100 psig. This is the maximum pressure allowed per the proposed LTOP restrictions for this region of operation.

b. Different initial pressurizer levels ranging between 100 inches and 330 inches (this range includes a +20 inch uncertainty) are evaluated to determine the limiting initial condition. This is the range of levels permitted per the proposed LTOP restrictions for this region of operation.

c. No heat transfer occurs between the injected water and the RCS inventory. The makeup insurge flow is set to the same temperature as the initial RCS temperature. The maximum allowable flow rate is corrected to account for the differences in density that result from this assumption. The correction preserves the mass insurge rate.

d. The pressurizer PORV is assumed to be inoperable.

e. Uncertainty associated with the flow measurement instrumentation is included in the maximum allowed flowrate shown in the proposed LTOP restrictions.

f. The makeup flow rates do not vary with RCS pressure. This is conservative since the flow rate would decrease as RCS pressure increases.

g. The 460 psig P/T limit assumed in this analysis corresponds to the coldest RCS temperature on the P/T curve (60 °F).

There are two assumptions in this analysis that are different from those assumed in the analyses supporting the current LTOP restrictions in Oconee TSs. The first is that a 25 psi RCS pressure uncertainty was previously used while a 13 psi RCS pressure uncertainty is used in the new analysis. The second different assumption is that the RCS pressure limit used for the new analysis is 460 psig, whereas the current analysis assumed 480 psig.

D.2 Region 2: RCS Pressure > 100 psig and ≤ 330 psig when RCS Temperature ≤ 220 °F

The acceptance criterion for this region is that 10 minutes will be available for operator action from the time of the first alarm to the time when RCS pressure exceeds 460 psig. As discussed in the response to Question 2, this setpoint accounts for instrument uncertainty. The following initial conditions and boundary conditions are assumed for evaluating this region of operation:

a. Initial RCS pressures as high as 330 psig (corresponding to the proposed maximum RCS pressure for this range of RCS temperatures) are evaluated.

b. An initial pressurizer level of 240 inches is assumed which includes a +20 inch instrument uncertainty. This corresponds to the proposed maximum pressurizer level of 220 inches when RCS pressure is > 100 psig.

c. No heat transfer occurs between the injected water and the RCS inventory. The makeup insurge flow is set to the same temperature as the initial RCS temperature. The maximum allowable flow rate is corrected to account for the differences in density that result from this assumption. The correction preserves the mass insurge rate.

d. The pressurizer PORV is assumed to be inoperable.

e. Uncertainty associated with the flow measurement instrumentation is included in the maximum allowed flowrate.

f. The makeup flow rates do not vary with RCS pressure. This is conservative since the flow rate would decrease as RCS pressure increases.

g. The 460 psig P/T limit assumed in this analysis corresponds to the coldest RCS temperature on the P/T curve (60 °F).

There are four assumptions in this analysis that are different from those assumed in the analyses supporting the current LTOP restrictions. The first is that a 25 psi RCS pressure uncertainty was previously used while a 13 psi RCS pressure uncertainty is used in the new analysis. The second different assumption is that the current LTOP restrictions allow for pressurizer level to be as high as 260 inches when RCS pressure is > 100 psig and RCS temperature is >220 °F and ≤ 325 °F. The proposed LTOP restrictions for the new P/T limits require that pressurizer level be ≤ 220 inches when RCS temperature is ≤ 325 °F and RCS pressure is > 100 psig. The third different assumption in the proposed LTOP restrictions is that RCS pressure must be < 330 psig in this region of operation, whereas the current LTOP restrictions allow RCS pressure to be < 345 psig. The fourth different assumption is that the RCS pressure limit used for the new analysis is 460 psig, whereas the current analysis assumed 480 psig.

D.3 Region 3: RCS Pressure ≤ 430 psig and RCS Temperature ≥ 220 °F but ≤ 325 °F

The acceptance criterion for this region is that 10 minutes will be available for operator action from the time of the first alarm to the time when RCS pressure exceeds 601 psig. This setpoint is the P/T limit associated with a 220 °F RCS temperature including instrument uncertainty. The following initial conditions and boundary conditions are assumed for evaluating this region of operation:

a. An initial RCS pressure of 430 psig is assumed. This pressure corresponds to the proposed maximum RCS pressure for this range of RCS temperatures.

b. An initial pressurizer level of 240 inches is assumed which includes a +20 inch instrument uncertainty. This corresponds to the proposed maximum pressurizer level of 220 inches when RCS pressure is > 100 psig.

c. No heat transfer occurs between the injected water and the RCS inventory. The makeup insurge flow is set to the same temperature as the initial RCS temperature. The maximum allowable flow rate is corrected to account for the differences in density that result from this assumption. The correction preserves the mass insurge rate.

d. The pressurizer PORV is assumed to be inoperable.

e. Uncertainty associated with the flow measurement instrumentation is included in the maximum allowed flowrate.

f. The makeup flow rates do not vary with RCS pressure. This is conservative since the flow rate would decrease as RCS pressure increases.

g. The 601 psig P/T limit assumed in this analysis corresponds to a 220 °F RCS temperature on the P/T curve.

There are four assumptions in this analysis that are different from those assumed in the analyses supporting the current LTOP restrictions. The first is that a 25 psi RCS pressure uncertainty was previously used while a 13 psi RCS pressure uncertainty is used in the new analysis. The second different assumption is that the current LTOP restrictions allow for pressurizer level to be as high as 260 inches when RCS pressure is > 100 psig and RCS temperature is > 220 °F and ≤ 325 °F. The proposed LTOP restrictions for the new P/T limits require that pressurizer level be ≤ 220 inches when RCS temperature is ≤ 325 °F and RCS pressure is > 100 PSIG. The third different assumption in the proposed LTOP restrictions is that RCS pressure must be < 430 psig in this region of operation, whereas the current LTOP restrictions allow RCS pressure to be < 450 psig. The fourth different assumption is that the RCS pressure limit of 601 psig is used for the new analysis (the prior limit was 650 psig). This reflects the new P/T limit at a RCS temperature of 220 F.

E. <u>Pressurizer heaters erroneously energized</u>

The acceptance criterion for this region is that 10 minutes will be available for operator action from the time of the first alarm to the time that RCS pressure exceeds 460 psig. As discussed in the response to Question 2, this setpoint accounts for instrument uncertainty. The following initial conditions and boundary conditions are assumed for evaluating this scenario:

a. A range of initial RCS pressures allowed during LTOP conditions are evaluated to determine the limiting initial condition.

b. An initial pressurizer level of 80 inches is assumed which includes a +20 inch instrument uncertainty. This corresponds to a minimum pressurizer level of 100 inches. Previous analyses have shown that a low initial pressurizer level results in a more rapid pressurization rate for this event. Procedural guidance requires operators to maintain a

pressurizer level of at least 100 inches to ensure that the heaters remain covered.

c. Pressurizer heater Banks 1, 2, and either 3 or 4 are assumed to be simultaneously energized at the beginning of this event. The new proposed LTOP restrictions require that either Bank 3 or 4 be deactivated prior to entering LTOP conditions. The rated power of Banks 3 and 4 are identical, thus the total heat input will be the same when either is assumed to be operable and available during this transient.

d. The pressurizer PORV is assumed to be inoperable.

e. The 460 psig P/T limit assumed in this analysis corresponds to the coldest RCS temperature on the P/T curve (60 °F).

There are three assumptions in this analysis that are different from those assumed in the analyses supporting the current LTOP restrictions. The first is that a 25 psi RCS pressure uncertainty was previously used while a 13 psi RCS pressure uncertainty is used in the new analysis. The second different assumption is that the RCS pressure limit used for the new analysis is 460 psig, whereas the current analysis assumed 480 psig. The third different assumption is that either pressurizer heater Bank 3 or 4 is deactivated before entering LTOP conditions to ensure that 10 minutes will be available for operator action in the event that the operable heater banks are simultaneously energized.

F. <u>Loss of the Decay Heat Removal System</u>

The LTOP analyses evaluate three loss of decay heat removal events. The first case evaluates the scenario where a rapid cooldown to decay heat removal system conditions has been performed and the decay heat removal system is placed into service. End-of-cycle decay heat is assumed along with the maximum number of running RCPs such that the RCS heat load is maximized. A loss of decay heat removal is then simulated to verify that 10 minutes are available for operator action from the time of the first alarm to the time at which the P/T limit is exceeded. This case is referred to as Case 1 in this discussion.

The second case evaluates the scenario where a pressurizer cooldown is in progress when this event occurs. During these activities the LTOP restrictions allow pressurizer level to be as high as 310 inches with an HPI pump in operation provided RCS pressure is $\leq$ 100 psig. This case was not previously evaluated, but has been performed in support of the current and proposed

LTOP restrictions. A loss of the decay heat removal system is simulated from this initial condition to verify that 10 minutes are available for operator action from the time of the first alarm to the time at which the P/T limit is exceeded. This case is referred to as Case 2 in this discussion.

The third case evaluates the scenario where RCS fill/drain activities are in progress when this event occurs. During these activities the LTOP restrictions allow pressurizer level to be as high as 380 inches, provided no HPI pumps are running and RCS pressure is $\leq$ 100 psig. A loss of the decay heat removal system is simulated from this initial condition to verify that 10 minutes are available for operator action from the time of the first alarm to the time at which the P/T limit is exceeded. This case is referred to as Case 3 in this discussion.

The major assumptions used in the three cases are discussed below.

F.1 **Case 1** - Loss of Decay Heat Removal With Concurrent RCP Operation:

The following initial conditions and boundary conditions are assumed for this case:

a. A range of initial RCS pressures allowed by the LTOP restrictions for this region of operation are evaluated to determine the limiting initial condition.

b. An initial pressurizer level of 240 inches is assumed which includes a +20 inch instrument uncertainty. This is the maximum level allowed by the LTOP restrictions for this region of operation.

c. The pressurizer PORV is assumed to be inoperable.

d. End-of-cycle decay heat is assumed to maximize the heat load in the RCS.

e. One RCP per loop is in operation. This is the maximum number of RCPs allowed per Technical Specifications for this region of operation.

f. The secondary side of the steam generators are not modeled.

g. The 460 psig P/T limit assumed in this analysis corresponds to the coldest RCS temperature on the P/T curve (60 °F).

There are four assumptions in this analysis that are different from those assumed in the analyses supporting the current LTOP restrictions. The first is that a 25 psi RCS pressure uncertainty was previously used while a 13 psi RCS pressure uncertainty is used in the new analysis. The second different assumption in the proposed LTOP restrictions is that RCS pressure must be < 330 psig in this region of operation, whereas the current LTOP restrictions allow RCS pressure to be < 345 psig. The third different assumption is that the RCS pressure limit for the new analysis is 460 psig, whereas the current analysis assumed 480 psig. The fourth different assumption is the decay heat load modeled in the new analysis. The current analyses assume an overly conservative short time to reach decay heat removal system conditions following a reactor shutdown. It was assumed that a trip from full power occurred, followed immediately by a plant cooldown at the maximum cooldown rates allowed by Technical Specifications. The new analysis includes an additional 30 minutes to account for other activities that must be performed during a unit shutdown. Some of these typical delays are:

I. Post-trip system response evaluation
II. Performing CRD trip time tests
III. Completing the hot shutdown checklist
IV. Shutdown boron concentration sampling and RCS boration as needed
V. Maintaining the RCS at 350 °F - 330 °F until LTOP requirements are met
VI. Alignment of the decay heat removal system

This additional time results in an ~3% decrease in the assumed decay heat relative to that used in the current LTOP analyses.

F.2 **Case 2** - Loss of Decay Heat Removal with RCS pressure ≤ 100 psig and HPI makeup available:

The following initial conditions and boundary conditions are assumed for this case:

a. An initial RCS pressure of 100 psig is assumed. This is the maximum pressure allowed per the proposed LTOP restrictions for this region of operation.

b. An initial pressurizer level of 330 inches is assumed which includes a +20 inch instrument uncertainty. This is the maximum level allowed by the proposed LTOP restrictions for this region of operation.

c. The pressurizer PORV is assumed to be inoperable.

d. End-of-cycle decay heat is assumed to maximize the heat load in the RCS.

e. No RCPs are in operation since the RCS pressure is below that required for NPSH.

f. The secondary side of the steam generators are not modeled.

g. The 460 psig P/T limit assumed in this analysis corresponds to the coldest RCS temperature on the P/T curve (60 °F).

As mentioned before, this case was not previously analyzed. The selected initial conditions reflect the allowable operating conditions defined in the new proposed LTOP restrictions.

F.3 **Case 3** - Loss of Decay Heat Removal with RCS pressure ≤ 100 psig and no HPI pumps:

The following initial conditions and boundary conditions are assumed for this case:

a. An initial RCS pressure of 100 psig is assumed. This is the maximum pressure allowed per the proposed LTOP restrictions for this region of operation.

b. An initial pressurizer level of 240 inches is assumed which includes a +20 inch instrument uncertainty.

c. The pressurizer PORV is assumed to be inoperable.

d. End-of-cycle decay heat is assumed to maximize the heat load in the RCS.

e. No RCPs are in operation since the RCS pressure is below that required for NPSH.

f. The secondary side of the steam generators are not modeled.

g. The 460 psig P/T limit assumed in this analysis corresponds to the coldest RCS temperature on the P/T curve (60 °F).

There are four assumptions in this analysis that are different from those assumed in the analyses supporting the current LTOP restrictions. The first is that a 25 psi RCS pressure uncertainty was previously used while a 13 psi RCS pressure uncertainty is used in the new analysis. The second different

assumption is that the RCS pressure limit used for the new analysis is 460 psig, whereas the current analysis assumed 480 psig. The third different assumption is the decay heat load modeled in the new analysis. As was done for Case 1, an additional 30 minutes is added to the length of time following a reactor shutdown in determining the decay heat load used in the analysis.

The fourth assumption that is different from that previously assumed is the initial pressurizer level. Previously, a level of 380 inches with a +20 inch uncertainty was assumed with both RCS loops in a water solid condition. A review of plant operating procedures shows that both RCS loops are never in a water solid condition when pressurizer level is allowed to be 380 inches during unit startup and shutdown. When RCS pressure is less than 100 psig, pressurizer level is maintained between 80 inches and 130 inches. An indicated pressurizer level of 380 inches is seen for short periods of time during filling and draining of the RCS, but only coincident with coexisting gas volumes in the upper region of the hot legs. Operators are procedurally instructed during the drain down mode to limit pressurizer level to $\leq$ 120 inches before opening the high point vents to drop the hot leg water levels. The resultant insurge into the pressurizer results in the pressurizer level increasing to between 300 inches and 370 inches. During RCS filling and venting activities, operators are instructed to raise the pressurizer level to 350-370 inches before opening the hot leg high point vents, increasing the pressurizer gas volume pressure, and filling the hot legs. The resultant pressurizer level after this activity is typically ~100 inches. Based on this, the gas volume present in the RCS during filling and draining activities is at least equivalent to that present in the pressurizer when pressurizer level is at 120 inches. Thus, the previous analysis was overly conservative in using an initial pressurizer level of 380 inches with the RCS loops in a water solid condition. The new analysis assumes that the initial pressurizer level is 240 inches (this includes a +20 inch uncertainty) which bounds the equivalent gas volume present in the RCS during filling and draining operations.

G. <u>Reactor Coolant Pump Start-Induced Transients</u>

Two types of RCP induced LTOP transients are evaluated in Letter, William O. Parker, Jr. (Duke) to Benard C. Rusche (NRC), Oconee Nuclear Station Docket Nos. 50-269, -270, -287, dated October 14, 1976. The first transient is filling of the OTSG secondary side with hot water followed by starting of an RCP. The second transient is the restart of an RCP during heatup following a period of stagnant (no flow) conditions. The results discussed

in the above letter showed a peak RCS pressure increase of ~130 psi for the first transient, and a peak RCS pressure increase of ~75 psi for the second transient. The initial conditions and assumptions assumed in the above letter were evaluated with regard to the current LTOP restrictions to ensure that they remained bounding. This is done again with the new proposed LTOP restrictions. The initial conditions for the first transient were:

1. RCS pressure = 300 psig
2. RCS temperature = 140 °F
3. Initial pressurizer level = 315 inches
4. Steam generator temperature = 420 °F

All but one of these conditions (RCS pressure) is bounding relative to the new proposed restrictions and plant operating procedures. The new P/T limits are most restrictive at RCS temperatures $\leq$ 220 °F. The new maximum allowable operating pressure at these temperatures is 330 psig, which is only slightly higher than that assumed in the referenced analysis. The change in thermodynamic properties between 300 psig and 330 psig is negligible, thus the same magnitude of RCS pressurization (130 psig) would be expected from either initial condition during this transient. This would result in a peak RCS pressure of 330 + 130 = 460 psig which is within the new P/T limits. The pressurizer level is now also limited to 220 inch for RCS temperatures $\leq$ 220 °F, which is considerably lower than the 315 inch assumed in the referenced analysis.

The second RCP start-induced transient involves the circulation of a very cool mass of water through a heated RCS upon the start of an idle RCP. The RCS initial conditions assumed in the analyses described in the above letter were 450 psig and 275 °F. The resulting pressure increase was seen to be self-limiting, with a peak pressure increase of ~75 psi. Per the new operational limits and restrictions, the maximum allowable operating pressure for RCS temperatures between 220 °F and 325 °F is 430 psig. This would result in a maximum RCS pressure of 505 psig for this event, which does not exceed the new P/T limits (601 psig) for this temperature range. For RCS temperatures below 220 °F, a smaller RCS pressurization will be seen due to the smaller change in temperature between the hot RCS inventory and the cooler mass. The new LTOP restrictions allow RCS pressure to be 330 psig for RCS temperatures $\leq$ 220 °F. Conservatively assuming a 75 psi increase for this case results in a peak RCS pressure of 405 psig, which is well below the P/T limit of 460 psig for this temperature range.

There are three assumptions in this analysis that are different from those assumed in the analyses supporting the current LTOP restrictions. The first is that a 25 psi RCS pressure uncertainty was previously used while a 13 psi RCS pressure uncertainty is used in the new analysis. The second different assumption in the proposed LTOP restrictions is that RCS pressure must be < 330 psig when RCS temperature is ≤ 220 °F, and <430 psig when RCS temperature is > 220 °F and ≤ 325 °F. The current LTOP restrictions allow RCS pressure to be < 345 psig and < 450 psig, respectively, for the corresponding temperature ranges. The third different assumption is that the RCS pressure limit of 601 psig is used for the new analysis (the prior limit was 650 psig). This reflects the new P/T limit at a RCS temperature of 220 °F.

5. Question:

ASME Code Case N-514 states that LTOP systems shall be effective at coolant temperature less than 200 °F or at the coolant temperature corresponding to a reactor vessel metal temperature less than nil-ductility reference temperature (RTndt) + 50 °F, whichever is greater. The vessel metal temperature is the temperature at distance one-fourth of the vessel section thickness from the inside surface in the vessel beltline region. Provide values of the RTndt, the temperature difference between the reactor coolant and the metal at 1/4T, and instrumentation uncertainties assumed in calculating the proposed enable temperature of 325 °F.

Response:

An LTOP event is normally characterized as a slow moving transient with no sudden temperature or pressure changes. It is noted the LTOP transient typically occurs under steady-state conditions where the resultant water temperature and 1/4T metal temperature gradient is approximately 0°F. Oconee Nuclear Station is employing CC N-514 which was conservatively developed under the supervision of the ASME Section XI Operating Plant Criteria working group using 110% of the Appendix G steady-state curve. Therefore, the primary response to Question 5 would not include a thermal gradient term. However, to ensure a conservative response to this RAI, the following table is assembled based on a maximum rate heatup transient at the enable temperature of 325°F.

In order to provide the most conservative response to this RAI, a review was performed to determine the worst case scenario and

bounding transient during normal plant operation heatup and cooldown cases. It was decided the most limiting case would be a maximum rate heatup transient at the upper-most point of the LTOP conditions (i.e., where the maximum allowable heatup ramp changes from 50°F/hour at 280°F to 100°F/hour up to 325°F). At 325°F, the maximum temperature gradient occurs between the water (fluid) and the reactor vessel 1/4T location metal temperature during normal heatup. The fluid temperature is 325°F during this heatup transient, while the resultant metal temperature at the 1/4T location is 298.6°F; therefore, the maximum temperature differential is 26.4°F (Reference FTI Doc. 32-5000576-00).

The maximum controlling RT_{NDT} values given in the following table -may be located in the Duke Energy Corporation Pressure-Temperature Operating Curves Technical Specification submittal, dated October 15, 1998, in Tables 1, 2, and 3. The instrumentation uncertainty value of 11.6°F given in the following table was obtained from a Duke Energy Corporation uncertainty calculation.

Unit	RT_{NDT}	Instrumentation Uncertainty	Maximum Temperature Gradient	CC N-514	Total
1	194.3	11.6	26.4	50	282.3
2	236.4	11.6	26.4	50	324.4
3	202.1	11.6	26.4	50	290.1

6. Question:

Discuss the standard used for determining the instrumentation uncertainties applied in the design of LTOP setpoints.

Response:

Duke Energy Corporation has developed an engineering directive that outlines the requirements for performing instrument uncertainty and setpoint calculations. The primary purpose of this directive is to provide a consistent methodology based on standard industry practices for performing instrument uncertainty and setpoint calculations. The calculation methodology is consistent with the intent of ISA-67.04, Part II, "Methodologies for the Determination of Setpoints for Nuclear Safety-Related Instrumentation."

In brief, the methodology conservatively accounts for the typical uncertainty terms such as reference accuracy, drift, temperature

effect, calibration effects (which include measurement and test equipment uncertainty, calibration tolerance and resolution), etc. The random-independent uncertainty terms are combined via the "square-root-sum-of-the-square" (SRSS) technique, whereas the random-dependent and bias uncertainty terms are combined via a combination of SRSS and/or algebraic techniques.