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1CAN041502

April 7, 2015

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

SUBJECT: Responses to Request for Additional Information
Update the Reactor Coolant System Pressure and Temperature and the Low Temperature Overpressure Protection System Limits
Arkansas Nuclear One, Unit 1
Docket No. 50-313
License No. DPR-51

Dear Sir or Madam:

In accordance with the provisions of Title 10 of the Code of Federal Regulations (10 CFR) Section 50.90, Entergy Operations, Inc. (Entergy) submitted a request for an amendment to the Arkansas Nuclear One, Unit 1 (ANO-1) Technical Specifications (TS) to revise the Reactor Coolant System Pressure and Temperature (P/T) Limits (TS 3.4.3); Pressurizer (TS 3.4.9); Pressurizer Safety Valves (TS 3.4.10); and Low Temperature Overpressure Protection (LTOP) System (TS 3.4.11) requirements (Reference 1). The proposed changes would extend the applicability of the limits from 31 Effective Full Power Years (EFPY) to 54 EFPY.

In the course of its review, the NRC staff has determined that additional information is required to complete its evaluation of the request (References 2, 4, 6, and 8). Entergy's response to the previous NRC's requests for additional information (RAI) (References 2, 4, and 6) were provided in References 3, 5, and 7. The response to the latest RAI (Reference 8) is included in Attachment 1 to this letter.

The attached response to RAIs 2 and 3 impacts the previously submitted changes on TS Pages 3.4.3-4 and 3.4.3-5. The changes are to the notes only. The proposed TS figures are not impacted by these changes.

In response to the remaining RAIs, the LTOP lift setpoint has been revised to a lower value compared to that previously proposed in Reference 1. This change impacts some of the previously proposed changes to TS page 3.4.11-1. Additional discussions of these changes and justification for the changes are provided in Attachment 1. The revised markup and clean TS pages are presented in Attachments 2 and 3, respectively.

The ANO-1 TS Bases for the TS that are impacted by the previously described changes to the TS will be revised in accordance with ANO-1 TS 5.5.14, "Technical Specification (TS) Bases Control Program".

With respect to the original Entergy request (Reference 1), the information contained in this submittal has been evaluated and Entergy has determined that the assessment of the no significant hazards consideration provided in Reference 1 is not invalidated by this additional information.

In accordance with 10 CFR 50.91(b)(1), a copy of this application is being provided to the designated Arkansas state official.

No new commitments have been identified in this letter.

If you have any questions or require additional information, please contact Stephenie Pyle at 479-858-4704.

I declare under penalty of perjury that the foregoing is true and correct.
Executed on April 7, 2015.

Sincerely,

ORIGINAL SIGNED BY JEREMY G. BROWNING

JGB/rwc

REFERENCES:

1. Entergy letter to NRC, “License Amendment Request Update the Reactor Coolant System Pressure and Temperature and the Low Temperature Overpressure Protection System Limits,” dated November 21, 2014 (1CAN111401) (ML14330A249)

2. NRC email to Entergy, dated January 21, 2015, “Requests for Additional Information – ANO-1 P/T and LTOP LAR to Extend P/T Curves to 54 EFPY – TAC No. MF5292

3. Entergy letter to NRC, “Responses to Request for Additional Information Update the Reactor Coolant System Pressure and Temperature and the Low Temperature Overpressure Protection System Limits,” dated February 6, 2015 (1CAN021502) (ML15041A065)

4. NRC email to Entergy dated March 4, 2015, “Request for Additional Information (2nd Round) – Arkansas Nuclear One, Unit 1 – LAR to Revise Pressure – Temperature Limits to 54 EFPY – TAC No. MF5292” (1CNA031501)

5. Entergy letter to NRC, “Responses to Request for Additional Information Update the Reactor Coolant System Pressure and Temperature and the Low Temperature Overpressure Protection System Limits,” dated March 10, 2015 (1CAN031503) (ML150701A054)

6. NRC email to Entergy dated March 20, 2015, “Arkansas Nuclear One, Unit No. 1, Request for Additional Information (2nd Round) License Amendment Request (TAC No. MF5292)”

7. Entergy letter to NRC, “Responses to Request for Additional Information Update the Reactor Coolant System Pressure and Temperature and the Low Temperature Overpressure Protection System Limits,” dated March 25, 2015 (1CAN031504) (ML15086A019)

8. NRC email to Entergy, dated April 2, 2015, “Requests for Additional Information - 4th Round - ANO-1 P/T and LTOP Limits Update to 54 EFPY License Amendment Request - MF5292” (1CNA041502)

Attachments

1. AREVA document ANP 3300Q4NP, Revision 0, “Response to Request for Additional Information on Reactor Coolant System Pressure/Temperature and Low Temperature Overpressure Protection System Limits to 54 EFPY for Arkansas Nuclear One, Unit 1”

2. Proposed Technical Specification Changes (mark-up)

3. Revised (clean) Technical Specification Pages

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Attachment 1 to

1CAN041502

AREVA document ANP 3300Q4NP, Revision 0

Response to Request for Additional Information on Reactor Coolant System Pressure/Temperature and Low Temperature Overpressure Protection System Limits to 54 EFPY for Arkansas Nuclear One, Unit 1

Response to Request for Additional Information on Reactor Coolant System Pressure/Temperature and Low Temperature Overpressure Protection System Limits to 54 EFPY for Arkansas Nuclear One, Unit 1

ANP-3300Q4-NP
Revision 0

April 2015

AREVA Inc.

Nature of Changes

Item	Section(s) or Page(s)	Description and Justification
1	All	Initial Issue

Contents

Nomenclature

Acronym	Definition
ADAMS	Agencywide Documents Access and Management system
ANO-1/ANO1	Arkansas Nuclear One, Unit 1
ART	Adjusted Reference Temperature
CD	Cooldown
COMS	Cold Overpressure Mitigating System
EFPY	Effective Full-Power Years
ERV	Electromatic Relief Valve
°F	Degree Fahrenheit
GL	Generic Letter
HU	Heatup
HTC	Heat Transfer Coefficient
ft-lb	foot-pound
ID	Inside Diameter
K_{Ia}	Crack Arrest Fracture Toughness
K_{Ic}	Plane Strain Fracture Toughness
K_{It}	Thermal Stress Intensity Factor
LAR	License Amendment Request
LTOP	Low Temperature Overpressure Protection
MU	Makeup
P/T	Pressure – Temperature
psig	Pounds per Square Inch, Gauge
RAI	Request for Additional Information
RCP	Reactor Coolant Pump
RCS	Reactor Coolant System
RPV/RV	Reactor Pressure Vessel/ Reactor Vessel
RVCH	Reactor Vessel Closure Head
TS	Technical Specifications
WEC	Westinghouse Electric Corporation

1.0 INTRODUCTION

By application dated November 21, 2014, as supplemented by letters dated February 6 and March 10, 2015 (Agencywide Documents Access and Management System (ADAMS) Accession Nos. ML14330A249, ML15041A073, and ML15071A054, respectively-References 1-3), Entergy Operations, Inc., requested changes to the Technical Specifications (TSs) for Arkansas Nuclear One, Unit No. 1 (ANO 1). The proposed changes revise TS 3.4.3, “Reactor Coolant System (RCS) Pressure and Temperature (P/T) Limits, TS 3.4.9, “Pressurizer,” TS 3.4.10, “Pressurizer Safety Valves,” and TS 3.4.11, “Low Temperature Overpressure Protection” to update the reactor coolant system (RCS) P/T and low temperature overpressure protection (LTOP) system limits to 54 effective full power years (EFPYs), the end of the current period of extended operation.

Based on the U.S. Nuclear Regulatory Commission (NRC) staff review of the information provided by Entergy (ADAMS Accession No. ML14330A249-Reference 1), the NRC staff issued Entergy requests for additional information (RAIs); Entergy responses to the RAIs are provided in References 2, 3, and 4. On March 20, 2015, the NRC issued a subsequent RAI to Entergy (Reference 4) regarding the LTOP system and the proposed revised electromatic relief valve (ERV) setpoint of 553.8 psig (Reference 4). The response to this RAI was provided to the NRC on March 25, 2015 (ANP-3300Q3P-Reference 5).

On April 2, 2015 the NRC issued four additional RAIs to Entergy (Reference 6) regarding the LTOP electromatic relief valve (ERV) setpoint of 553.8 psig and the Reactor Coolant Pump (RCP) operating restrictions specified in the notes contained in ANO-1 TSs, Figures 3.4.3-1 and 3.4.3-2. AREVA responses to these additional RAIs are provided in Sections 2.1 through 2.4 of this document. Revisions to ANP-3300, Revision 001, that incorporate responses in Sections 2.1 through 2.4 are contained in Section 2.5.

During the preparation of responses to the April 2, 2015, RAIs 2 and 3 regarding ANO-1 TS Figures 3.4.3-1 and 3.4.3-2, AREVA identified an inconsistency between the specified RCP restrictions for RCS temperatures less than or equal to 250 °F and the analytical input to the facture mechanics analyses used to develop the P/T limits. Specifically, Section 4.5 of ANP-3300, Revision 1, states that “a film coefficient of 1000 BTU/hr-ft²-ºF was used for an effective convection heat transfer film coefficient at the cladding to base metal interface for all the times during heatup and cooldown when any RCPs are in use. When no RCPs are running (i.e., when the reactor coolant temperature is 250 °F or less), a value of 430 BTU/hr-ft²-°F was used as an effective film coefficient at the cladding-to-base metal interface. The outside surface is modeled as a perfectly insulated boundary.”

The statement that the RCPs are not in use when the reactor coolant temperature is 250 F or less is not consistent with the heatup and cooldown definitions defined in ANP-3300, Revision 1, Section 4.6.2, and is not consistent with RCP operation used to apply the pressure correction factors listed in Table 6-1 of ANP-3300, Revision 1. Tables 7-5 and 7-6 to ANP-3300, Revision 1, reflect the operational restrictions used to develop pressure correction factors and were used by Entergy as the source reference for the notes in ANO-1 TS Figures 3.4.3-1 and 3.4.3-2. The impact of this inconsistency is addressed in Sections 2.2 and 2.3 and is summarized below.

Specifically, Section 4.5 of ANP-3300, Revision 1 is revised in this response to clarify that that a film coefficient of 1000 BTU/hr-ft²-°F was used for an effective convection heat transfer film coefficient at the cladding to base metal interface (all locations) for times during heatup and cooldown when three or four RCPs are in use. When two RCPs are operating, the clad to base metal film heat transfer coefficient (HTC) is reduced to 600 BTU/hr-ft²-°F for beltline locations (1,000- is retained for the outlet nozzle due to higher fluid velocities relative to the RV downcomer). When no RCPs are running, a HTC of 430 BTU/hr-ft²-°F is used at all locations.

In addition, the pressure correction factors reported in Table 6-1 of ANP-3300, Revision 1, are expanded to differentiate separate correction factors for heatup (revised Table 6-1) and cooldown (new Table 6-2). Tables 6-1 and 6-2 are used to obtain the governing adjusted pressures in ANP-3300, Revision 1, Table 7-1 and Table 7-3; Tables 7-1 and 7-3 are the pressure and temperature values reported in the ANO-1 TS Figures 3.4.3-1 and 3.4.3-2. Technical Specification, Figures 3.4.3-1 and 3.4.3-2 and ANP-3300, Revision 1, Tables 7-1 and 7-3 remain unchanged as discussed in Sections 2.2, 2.3, and 2.5 below. ANP-3300, Revision 1, Tables 7-5 and 7-6 are revised to accurately reflect the RCP operational constraints for plant heatup and cooldown that are consistent with the analytical basis for the P/T limits and associated pressure corrections.

As a result of the identification of this inconsistency AREVA opened a condition report in their corrective action program and assigned an independent internal review team to perform a Technical Quality Review. AREVA has completed a detailed review of ANP-3300, Revision 1, for all statements of fact relative to the source reference documents. No additional inconsistencies have been identified in ANP-3300, Revision 1, and associated source reference documents. In addition, ANP-3300Q1, ANP-3300Q2, and ANP-3300Q3 are not impacted by the inconsistency.

2.0 REQUEST FOR ADDITIONAL INFORMATION

Four RAIs regarding the LTOP system ERV setpoint and RCP restrictions associated with TS Figures 3.4.3-1 and 3.4.3-2 were issued to Entergy on April 2, 2015 (Reference 6). Responses to each of the RAIs are provided in Sections 2.1 through 2.4 below.

2.1 RAI 1

2.1.1 Statement of RAI 1

"The bases for the electromatic relief valve (ERV) requirements, contained in the application, stated that the ERV is signaled to open if the RCS pressure reaches a limit set in the LTOP actuation circuit. The LTOP actuation circuit monitors RCS pressure and determines when an overpressure condition is approached. When the monitored pressure meets or exceeds the setting, the ERV is signaled to open. The current LTOP-enabling ERV maximum lift setpoint is 460 pounds per square inch, gauge (psig). NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition" (ADAMS Accession No. ML070540076), Section 5.2.2, "Overpressure Protection," provides NRC staff review guidance for the application of pressure-relieving systems that function during low-temperature operation to ensure overpressure protection for the reactor coolant pressure boundary (RCPB) during low-temperature operation of the plant (startup, shutdown). Therefore, as a follow-on question to the third round RAI, the NRC staff requests that the licensee describe a limiting mass and energy addition analysis for the new LTOP ERV setpoint, at a level of detail consistent with Section 5.2.2 of NUREG-0800 (the NRC staff recognizes that ANO-1 is not an SRP plant, however, this RAI is a follow-on to the third-round RAI which did not contain a sufficient level of detail). This description should include an expanded discussion of the "standalone thermal-hydraulic model of the pressurizer" which was used to determine the rate/total increase of RCS pressure for LTOP events, as discussed on Page 16 of ANP-3300Q3P, contained in the third-round RAI response dated March 25, 2015.

2.1.2 RAI 1 Response

2.1.2.1 ERV Setpoint 31 EFPY and 54 EFPY

The ERV LTOP setpoint value was originally proposed to be revised from 460 psig at 31 EFPY to 553.8 psig at 54 EFPY. The 31 EFPY ERV LTOP setpoint was determined using the methodology contained in ASME Section XI, Appendix G, 1998 Edition, supplemented by Code Case N-514 for LTOP. Specifically, the 31 EFPY ERV setpoint of 460 psig was obtained by correcting the isothermal ASME Section XI Appendix G P/T curve multiplied by 1.10 (per Code Case N-514) and applying pressure location corrections for applicable RCP operating restrictions. The minimum pressure on the pressure corrected isothermal P/T curve, 460 psig (Reference 7), was selected as the ERV setpoint. The ERV setpoint of 460 psig exceeded the minimum permissible pressure of 348 psig from the cooldown curve (TS Figure 3.1.2-3) and 276 psig from the heatup curve (T S Figure 3.1.2-2). The ERV setpoint and P/T curves were approved by the NRC through Reference 7. Entergy requested and received an exemption to the requirements of 10 CFR 50.60 Appendix G for use of Code Case N-514 (Reference 8).

The 54 EFPY ERV LTOP setpoint was determined using ASME Section XI, Appendix G 2001 Edition through 2002 Addenda and the methodology to establish the ERV setpoint was consistent with the 31 EFPY methodology (i.e., use of isothermal P/T curves and application of pressure correction factors), with the exception that the isothermal P/T curves were not adjusted by a factor of 1.10 since Code Case N-514 was not invoked. The methods of the 2001 ASME Section XI Code, Appendix G, have been revised (e.g., use of K_{Ic}) such that Code Case N-514 is no longer required or applicable.

The 2001 ASME Section XI Code through 2002 Addenda permits the use of the higher K_{Ic} fracture toughness curve and utilizes the new methodology for calculating the stress intensity factors for pressure and radial thermal gradients. In addition, the Adjusted Reference Temperature (ART) for the limiting location at 54 EFPY is an upper shell plate material that has a value of 180 °F at the 1/4t postulated flaw depth versus a beltline weld at 31 EFPY with an ART of 212 °F at the 1/4t location (Reference 7). The use of BAW-2308 for the Linde 80 beltline resulted in the reduction of the beltline weld ART such that plate material is controlling at 54 EFPY. Although, the 31 EFPY LTOP setpoint was based on a slightly higher isothermal Appendix G curve (110% versus 100% for the 54 EFPY LTOP curves), it utilized the older ASME Section XI, Appendix G Code (1989 Edition) for calculating stress intensity factors, utilized a lower bound K_{Ia} fracture toughness curve, and included a more limiting 1/4t ART of 212 °F. Therefore, the ERV setpoint for 54 EFPY is increased relative to 31 EFPY.

2.1.2.2 Standard Review Plan 5.2.2/BTP 5-2

The original ANO-1 NSSS design did not include an automatic LTOP system. In response to NRC concerns with protection of the reactor vessel at low temperatures, a LTOP system was designed and added to ANO-1. A dual setpoint feature in the ERV control circuitry was installed in 1977. In September 1978, the NRC published NUREG 0224, “Reactor Vessel Pressure Transient Protection for Pressurized Water Reactors” (Reference 12). This NUREG in combination with Branch Technical Position 5-2 provided written guidance on the NRC LTOP requirements. NRC review of the ANO-1 LTOP system in accordance with Multiplant Issue B-04, Reactor Vessel Overpressure Protection, is documented in the NRC safety evaluation (Reference 9). NRC review of the ANO-1 LTOP system was in accordance with NUREG-0800, Section 5.2.2, Revision 1, Pages 5.2.2-7 and 5.2.2-8, July 1981. This is the current licensing basis for the ANO-1 LTOP system. The NRC SER includes an assessment of limiting mass and energy addition cases evaluated for LTOP and single failure. Applicable excerpts from the Reference 9 SER are provided below.

Section IV.B.1. Mass Input Cases

> "According to the AP&L submittals, the most limiting credible mass input transient results from failure full open of the makeup control valve."

> "For the transient that would result from the makeup valve failing full open, the most limiting single failure is a failure of the single PORV. Given this failure, the steam or nitrogen volume in the pressurizer will allow at least 10 minutes after the operator is alerted to the problem by the makeup line high flow alarm before the pressure reaches the Tech. Spec. limit."

Section IV.B.2. Heat Input Cases

The limiting heat addition event was determined to be a loss of decay heat removal system capability. The SER states the following.

> "The analysis determined that if no operator action were taken the RCS pressure would increase to the PORV setpoint in approximately 15.7 minutes. At that point, the PORV should open and limit the RCS pressure to 550 psig. Given a failure of the pressurizer PORV, the 15.7 minutes should be sufficient time to allow the operator to detect the problem and take action to correct it. The operator should be alerted to the loss of DHR capability by a flow alarm indicating either a loss of flow in the DHR system or a loss of flow in the cooling water system serving the DHR System."

Section III. Steam Bubble

"The ANO-1 Reactor Coolant System (RCS) always operates with a steam or gas space in the pressurizer; the steam bubble is replaced with nitrogen during plant cooldown when system pressure is reduced. The vapor space in the pressurizer greatly retards the increase in RCS pressure, as compared to a water solid system, for all mass and heat input transients. Retarding the rate of pressure increase during transients provides the operator with time to recognize that a pressure transient is in progress and take action to mitigate the transient."

Section IV.C. Administrative Controls

"A number of provisions for the prevention of pressure transients are incorporated in the plant operating procedures. Some examples of these are:

1. The ANO-1 Overpressure Protection System is to be manually enabled prior to the reactor coolant system temperature dropping below 280 °F during plant cooldown. An alarm will sound in the control room if the system is not enabled or if the PORV isolation valve is not open when the RCS temperature drops below 280 °F.

2. The plant is to be operated with a steam or nitrogen blanket in the pressurizer at all times except for system hydrostatic tests. The pressurizer water level is maintained at or below the high level alarm at system pressures above 100 psig and less than the high high level alarm for pressures less than or equal to 100 psig.

3. The makeup tank water level is to be less than the high level alarm. During periods when the PORV has been removed from service, the makeup tank level will be maintained at or below the "normal" level of 73 inches.

4. The core flood tank discharge valves are closed and the circuit breakers for the motor operators are "tagged out" before the RCS pressure is decreased to 600 psig.

5. During a plant cooldown the Engineered Safeguard Actuation of the HPI System is bypassed at 1650 psig. If this function is not performed by the operator, he will receive an alarm. Prior to going below 280 °F, the circuit breakers for the four HPI motor operated valves are "locked out" with the valves in the closed position. This is accomplished by opening and tagging the selection switch in the Control Room and locking and tagging the breakers located at the Motor Control Center. The operator will receive an alarm in the Control Room if the RC temperature drops below 280 °F and any of the breakers to the four HP injection valves have not been "locked out."
6. The HPI test procedure ensures that only one (1) HPI pump is tested at a time and that no other HPI pump is operating during the test.

The administrative controls listed above are examples based on the NRC SER of the ANO-1 LTOP system in 1983. ANO-1 TS 3.4.11 and heatup, cooldown, and decay heat removal and LTOP control procedures collectively address the administrative controls, items 1-6, listed above. The LTOP TS 3.4.11 and associated administrative procedures are updated in accordance with applicable P/T submittals (15EFPY, 31 EFPY, 54 EFPY) relative to the LTOP items listed above.

The generic B&W evaluation included in the ANO-1 LTOP submittal (see list of references in Reference 9 - i.e., item 4, AP&L Letter, December 3, 1976) provides the foundation for the methodology used to develop ANO-1 LTOP P/T limits at 31 and 54 EFPY relative to mass and energy addition scenarios. As illustrated in Reference 9, limiting mass and energy addition scenarios were evaluated and the following conclusions were reached by the NRC.

> "The administrative controls and plant modifications proposed by Arkansas Power and Light Company provide protection for Arkansas Nuclear One, Unit 1 from pressure transients at low temperatures by reducing the probability of initiation of a transient and by limiting the pressure of such a transient to below the limits set by 10 CFR 50 Appendix G. We find that with the addition of Technical Specifications, as stated above, the ANO-1 overpressure protection system meets GDC 15 and 31 and that AP&L has implemented the guidelines of NUREG-0224. The ANO-1 overpressure protection system is judged to be an adequate solution to the problem of transients initiated at low pressure and temperature."

From the ANO-1 LTOP SER (Reference 9), the most limiting credible mass input transient results from failure full open of the makeup control valve. The relevant NRC review findings are as follows.

> "The DYSID Code analysis showed that, assuming no operator action, the RCS pressure would increase to 500 psig in approximately 10.5 minutes at which time the pressurizer pilot actuated relief valve would lift to reduce the system pressure. System pressure overshoot, the pressure increase after reaching the PORV setpoint of 550 psig, is almost nonexistent due to the rapid action of the electromatic PORV and the relatively slow rate of pressure increase due to the steam or nitrogen volume in the pressurizer."

> "For the transient that would result from the makeup valve failing full open, the most limiting single failure is a failure of the single PORV. Given this failure, the steam or nitrogen volume in the pressurizer will allow at least 10 minutes after the operator is alerted to the problem by the makeup line high flow alarm before the pressure reaches the Tech. Spec. limit."

As specified in ANP 3300Q3P-000, Section 2.1.2, Page 8, the limiting postulated LTOP event for a B&W plant is failure of a makeup control valve (i.e., mass addition event) that results in an RCS pressurization rate of approximately 20 to 30 psi/minute (i.e., using a RELAP5/MOD2-B&W Standalone model), depending on the pressurizer level at the start of the event. Because of restrictions that preclude water-solid operation of the pressurizer (i.e., a steam or nitrogen bubble is maintained with the reactor vessel head on), Technical Specification 3.4.11, the B&W plant design is not likely to exceed Appendix G limits due to LTOP based on review of operating data. The worst single active failure is failure of the ERV valve during the 10-minute operator action interval as discussed above. The LTOP P/T limit curves are lower than the heatup/cooldown (HU/CD) P/T curves reported in Figures 7-1 through 7-3 of ANP-3300, Revision 1, and are imposed as operating restrictions by ANO-1 during heatup and cooldown at temperatures at and below the LTOP enable temperature. Please see AREVA proprietary document 32-9220706-002 ANO-1 LTOP P/T Limits for 54 EFPY, March 2015, for details regarding the development of 54 EFPY LTOP ERV setpoint and LTOP P/T limits.

<u>Description of RELAP5/MOD2-B&WStandalone Model</u>

The RELAP5/MOD2-B&W code is used to develop expected RCS pressurization rates over a 10-minute interval after a makeup valve fails full open to simulate the limiting LTOP event identified in Reference 9. The pressurization rates are not used to establish the ERV setpoint; however, the magnitude of pressure increase over a 10-minute interval is subtracted from the ASME Section XI, Appendix G, location corrected curve (typically isothermal) to obtain the LTOP P/T limit that is imposed at ANO-1 between 60 °F and the LTOP enable temperature of 259 °F. The LTOP P/T limit ensures that the ASME Section XI, Appendix G limits are not exceeded for the limiting LTOP event over a 10-minute interval. The ERV (PORV) is assumed to be inoperable during this 10-minute interval.

RELAP5 model was developed to analyze the limiting transient identified in Reference 9 (i.e., failure of the makeup control valve full open). The model includes the volumes of the RV, pressurizer, surge line, hot leg pipe to the RCS pressure tap location, and a cold leg to provide makeup injection location; the Once-Through Steam Generators (OTSGs) are not modeled. Pressurizer heat structures are included for the cylindrical portion, lower and upper hemispherical portions. RELAP5 calculates wall condensation rate based on heat transfer to the pressurizer wall. A time dependent volume is added to represent the makeup flow. Additional modeling assumptions/considerations are as follows.

- Ambient losses and letdown are omitted (no heat loss, no letdown).
- 0% or 5% non-condensibles initially in pressurizer steam space.
- No RCPs running. If RCPs were running the ambient losses and letdown energy loss would more than compensate for added pump energy.
- No decay heat.
- One makeup pump is assumed running. Makeup flow is a function of RCS pressure and is specific to ANO-1.
- Transients are run for 10 minutes.

Description of Analyses

The RELAP5 model is initialized and run through a 10-minute uncontrolled makeup transient (based on the NRC SER-Reference 9) with steam blanket when the makeup (MU) control valve is wide open. The RCS temperature and pressure, MU temperature and pressurizer level are each set initially. Time-history results on the RCS pressure, at a selected location, are obtained through the MU transient. A parametric study is also run for a range of initial RCS conditions. As a result, a functional representation of the pressure increase is developed. Using the functional representation, a 10-minute pressure increase is calculated for each point in the heatup and cooldown limit curves. For a given temperature, the initial pressure (LTOP 10-minute limit) is determined by the heatup/cooldown limit pressure minus the pressure increase during the 10-minute run.

2.1.2.3 ERV Setpoint Revision at 54 EFPY

Entergy followed a methodology in establishing the ERV LTOP setpoint at 54 EFPY that is consistent with the current licensing basis for 31 EFPY relative to the use of isothermal P/T limits adjusted by pressure correction factors. This methodology has historically provided sufficient margin for B&W-designed plants during startup and shutdown to minimize the probably of an inadvertent actuation of the ERV at and below the LTOP enable temperature. Entergy understands that the NRC is concerned that the current and historical methodology used to establish the ERV setpoint is not in compliance with ASME Section XI, Appendix G, G-2215, Equation 1, due to the use of isothermal P/T limits versus the transient HU/CD P/T limits.

In order to expedite the review of the 54 EFPY P/T curves due to pending expiration of the ANO-1 31 EFPY P/T limits, Entergy has reduced the ERV LTOP setpoint from 553.8 psig to 508 psig (ANP-3300, Revision 1, Table 7-3 for cooldown, at 60 °F). This setpoint ensures that both isothermal (K_{It}=0.0) and transient P/T limits generated in accordance with ASME Section XI, Appendix G, G-2215, Equation 1, are protected at and below the LTOP enable temperature.

The LTOP P/T limit curves have been generated using an ERV LTOP setpoint of 508 psig adjusted for pressure correction factors and the postulated limiting mass addition event (makeup valve full open) as described in ANP 3300Q3P-000 (Reference 5). Entergy .has determined that although operating margin has been reduced, the ERV setpoint of 508 psig will not result in operational restrictions at low temperatures relative to net positive suction head (NPSH) requirements that would preclude heatup and cooldown. However, the reduction in ERV setpoint from 553.8 psig to 508 psig, at and below the LTOP enable temperature, reduces the margin relative to inadvertent ERV actuation for a low temperature over pressurization event that has never occurred at ANO-1 and is unlikely to occur at a B&W operating plant (Reference 14, Pages ES-1and ES-2).

Entergy understands that the following provisions in Generic Letter (GL) 88-11, “NRC Position on Radiation Embrittlement of Reactor Vessel Materials and its Impact on Plant Operations,” (Reference 13) may be exercised should the margin and restrictions due to the reduced ERV setpoint result in operational restraints at low temperatures. Entergy did exercise provisions of GL 88-11 for the 15 EFPY P/T limits (Reference 10).

> “As plants age, it is expected that the operating window will continue to narrow and startup operations will become more difficult. Revision 2 accelerates this narrowing of the operating window. Licensees are encouraged to review system hardware and operating procedures to determine what changes could be made to reduce the likelihood of LTOP challenges. If changes can be implemented to demonstrate that the frequency of an LTOP event that would exceed Appendix G limits is expected to be much less than one per reactor lifetime, then the staff would consider alternatives to Appendix G LTOP set points with appropriate justification of adequate safety from the standpoint of fracture prevention.”

2.1.2.4 SRP 5.2.2 (March 2007-Reference 11)

The following additional information was requested from the NRC relative to review guidance provided in NUREG-0800, SRP 5.2.2, March 2007, Section III., C, items iii. and iv.

iii. The reviewer identifies the capacities, setpoints, and setpoint tolerances for all primary and secondary SRVs or other overpressure protection system devices. The reviewer verifies that these constraints are adequate to provide overpressure protection to the RCPB at critical values of pressure and temperature based on RCPB material parameters.

<u>Item iii Response</u>

The ERV setpoint, as noted above, is revised from 553.8 psig to 508 psig. Capacities and tolerances of the ERV are reported in the original ANO-1 LTOP submittal and associated NRC safety evaluation (Reference 9).

> "The pilot actuated relief valve is an electromatic valve that uses system pressure for its operation. The pilot valve is normally held closed by a spring. It is opened by an electric solenoid. Characteristics of this PORV at the lower setpoint are:"
>
> - Open setpoint 550 psig
> - Close setpoint 500 psig
> - Steam Capacity at 550 psig 25,985 lb/hr
> - Equivalent liquid insurge rate 2,650 gpm
> - Liquid capacity at 550 psig 500 gpm
> - Nitrogen capacity at 550 psig 32,420 lb/hr
> - Equivalent liquid insurge rate 2,350 gpm/hr

iv. Relevant industry codes and classifications applied to the system analysis for low-temperature operation should be clearly identified as specified in RIS 2004-04. Assumptions used in the analysis, including the initial plant conditions and system parameters, should also be identified and justified. The reviewer should identify studies that show the sensitivity of the system's performance to variations in these conditions, parameters, and characteristics. The reviewer should consult Section 5.2.2 of the FSAR for new plant designs to obtain insight on the overpressure protection methodology.

Item iv. Response

The 2001 ASME Section XI Code through 2002 Addenda was used to generate 54 EFPY P/T limits. The provisions of ASME Code Cases N-588, N-640, and N-641 that are applicable to P/T limit curve development were incorporated into ASME Code Section XI, Appendix G in the 1998 Edition through 2000. Therefore, the ANO-1 54 EFPY P/T curves are in compliance with the guidance provided in Regulatory Issue Summary (RIS) 2004-04 relative to developing reactor pressure vessel pressure-temperature limits using ASME Section XI, Appendix G. The analysis and corresponding assumptions that supports the ANO-1 LTOP system is described in Reference 9 as supplemented by the discussion in Section 2.1.2.2 above.

2.2 RAI 2

2.2.1 Statement of RAI 2

"In proposed new TS Figure 3.4.3-1, the reactor coolant pump (RCP) restrictions were modified from no RCPs allowed to be operating at < 84 deg F, ≤ 2 between 84 and 225 deg F and ≤ 3 between 225 deg F and 300 deg F to ≤ 3 between 100 deg F and 300 deg F and no RCPs allowed to be operating at < 100 deg F. Please provide a justification for this change, including any impacts on the limiting mass and energy analysis."

2.2.2 RAI 2 Response

The RCP restrictions were revised for operational considerations, not technical concerns. The revised restrictions are inputs into the supporting analyses.

Revisions to Notes 3 and 4 of the proposed TS, Figure 3.4.3-1 (RCS Heatup Limitations to 54 EFPY) are based on ANP-3300, Revision 1, Section 4.6.1, and Table 7-5. The RCP restrictions and allowable heatup rates in Notes 3 and 4 reflect the analytical input used to develop the heatup P/T curves in accordance with ASME Section XI, Appendix G, G-2215, Equation 1. As discussed in Section 1.0 above, there is an inconsistency between the description of film heat transfer coefficients used in the fracture mechanics evaluation (ANP-3300, Revision 1, Section 4.5) and the operational constraints for heatup presented in Table 7-5 (basis is limiting location pressure corrections). The inconsistency in the application of the film heat transfer coefficient was revised to accurately reflect the operational restrictions of the plant during heatup, which are correctly captured in the Note 3 and 4 definitions at 31 EFPY (TS, Figure 3.4.3-1).

The inconsistencies with ANP-3300, Revision 1 have been amended (See Section 2.5 below) such that the operating restrictions for heatup at 54 EFPY (Notes 3 and 4) are identical to the operating restrictions at 31 EFPY (Notes 3 and 4). The heatup P/T limits reported in Table 7-1 of ANP-3300, Revision 1, are not impacted by the amendment to operational restrictions. Therefore, the 54 EFPY heatup P/T limits reported in Figure 3.4.3-1 (all heatup rates) remain unchanged; Notes 3 and 4 for 54 EFPY are revised to be identical to Notes 3 and 4 for 31 EFPY as shown below. Sections 4.5, 6.0, 7.0, and Table 7-5 to ANP-3300, Revision 1 are amended to support this revision.

3. RCP Operating Restrictions:

RCS TEMP	RCP RESTRICTIONS
T > 300 °F	None
300 °F ≥T ≥ 225 °F	≤ 3
225 °F > T ≥ 84 °F	≤ 2
T < 84 °F	No RCPs operating

4. Allowable Heatup Rates:

RCS TEMP	H/U RATE
60 °F < T ≤ 84 °F	≤ 15 °F/HR
T > 84 °F	As allowed by applicable curve

With respect to the above note changes, the LTOP P/T limits and the ERV setpoint and enable temperature are not impacted since they were generated using conservative RCP operating restrictions relative to those defined in Note 3 above. There are no changes to the limiting mass addition analysis described in Section 2.1.2.2 above.

2.3 RAI 3

2.3.1 Statement of RAI 3

"In proposed new TS Figure 3.4.3-2, RCP restrictions were modified form no RCPs allowed to be operating at < 150 deg F, ≤ 2 RCPs operating between 150 deg F and 255 deg F, to no RCPs operating at < 100 deg F and ≤ 2 RCPs operating between 100 deg F and 250 deg F. In addition, Note 5 to the figure, which restricted cooldown rate to 30 deg F in 15 hours in the temperature range of 150-180 deg F was removed. Please provide a justification for these changes, including any impacts on the limiting mass and energy analysis."

2.3.2 RAI 3 Response

The RCP restrictions were revised for operational considerations, not technical concerns. The revised restrictions are inputs into the supporting analyses.

Revisions to Notes 3 and 4 of the proposed TS, Figure3.4.3-2 (RCS Cooldown Limits to 54 EFPY) are based on ANP-3300, Revision 1, Section 4.6.2 and Table 7-6. The RCP restrictions and allowable cooldownrates in Notes 3 and 4 reflect the analytical input used to develop the cooldownP/T curves in accordance with ASME Section XI, Appendix G, G-2215, Equation 1. As discussed in Section 1.0 above, there is an inconsistency between the description of film heat transfer coefficients used in the fracture mechanics evaluation (ANP-3300, Revision 1, Section 4.5) and the operational constraints for cooldown presented in Table 7-6 (basis is limiting location pressure corrections). The inconsistency in the application of the film heat transfer coefficient was revised to accurately reflect the operational restrictions of the plant during cooldown, which are correctly captured in the Note 3 and 4 definitions at 31 EFPY (TS, Figure 3.4.3-2).

The inconsistencies with ANP-3300, Revision 1 have been amended (See Section 2.5 below) such that the operating restrictions for cooldown at 54 EFPY (Notes 3 and 4) are identical to the operating restrictions at 31 EFPY (Notes 3 and 4). The cooldown P/T limits reported in Table 7-3 of ANP-3300, Revision 1, are not impacted by the amendment to operational restrictions. Therefore, the 54 EFPY cooldown P/T limits reported in Figure 3.4.3-2 remain unchanged, with the exception of the elimination of Note 5.

Note 5 was included for 31 EFPY to cover the acid reducing phase cooldown transient where the last RCPs are assumed operating at temperatures below 200 °F. For this cooldown case, the supporting P/T limit analysis was performed such that the RCS cooldown between 150 °F and 180 °F is assumed to occur over 15 hours. Note 5 is eliminated for the updated 54 EFPY P/T limit analysis since for the last RCP trip cases analyzed in the supporting analysis, the cooldown ramp rates and step changes as defined in the TS under allowable cooldown rates is being maintained over the entire temperature range of the normal cooldown. See Section 2.5 below and the revisions to ANP-3300, Revision 1, Section 4.6.2 for further information.

Notes 3 and 4 for 54 EFPY are revised to be identical to Notes 3 and 4 for 31 EFPY as shown below, with the exception of elimination of Note 5. Sections 4.5, 4.6.2, 6.0, 7.0, and Table 7-6 to ANP-3300, Revision 1 are amended in Section 2.4 below to support this revision.

3. RCP Operating Restrictions:

RCS TEMP	RCP RESTRICTIONS
T > 255 °F	None
150 °F ≤ T ≤ 255 °F	≤ 2 ~~(See Note 5)~~
T < 150 °F	No RCPs operating

4. Allowable Cooldown Rates:

RCS TEMP	C/D RATE	STEP CHANGE
T ≥ 280 °F	100 °F/HR	≤ 50 °F in any 1/2 HR
280 °F > T ≥ 150 °F	50 °F/HR ~~(Note 5)~~	≤ 25 °F in any 1/2 HR
T < 150 °F	25 °F/HR	≤ 25 °F in any 1 HR

~~5. If RCPs are operated < 200°F, then the RCS cooldown rate from 150°F < T < 180°F is reduced to 30°F in 15 hours.~~

With respect to the above noted changes, the LTOP P/T limits, ERV setpoint and enable temperature are not impacted since they were generated using conservative RCP operating restrictions relative to those defined in Note 3 above.

2.4 RAI 4

2.4.1 Statement of RAI 4

ASME Code, Section XI, Nonmandatory Appendix G, "Fracture Toughness Criteria for Protection Against Failure," Paragraph G-2215 states, "LTOP systems shall limit the maximum pressure in the vessel to 100% of the pressure determined to satisfy Eq. (1)." Figure 1 of the licensee's March 25, 2015 RAI response shows the licensee's proposed P/T limits calculated in accordance with Eq. (1) of G-2215 along with the LTOP setpoint curve. Explain how the proposed LTOP setpoint "limits the maximum pressure in the vessel to 100% of the pressure determined to satisfy Eq. (1)" since the LTOP pressure setpoint, as shown in Figure 1, is higher that the cooldown limits calculated in accordance with Eq. (1) of G-2215.

2.4.2 RAI 4 Response

Please see the response to Additional RAI 1, Section 2.1.2.

2.5 *Revisions to ANP-3300, Revision 1*

The following revisions are made to ANP-3300, Revision 1 to provide clarification relative to the operational restrictions discussed in Sections 2.2 and 2.3 above. Items highlighted in yellow are revisions to ANP-3300, Revision 1.

Section 4.5 (Convection Film Coefficient) is replaced with the following text

A value of 1000 BTU/hr-ft^2-°F was used for an effective convection heat transfer film coefficient (beltline and RV outlet nozzle) at the cladding to base metal interface for all the times during heatup and cooldown when 3 or 4 Reactor Coolant Pumps (RCP) are in use. That is, when RCS temperatures are > 255 °F during cooldown and when RCS temperatures ≥ 225 °F during heatup.

A value of 600 BTU/hr-ft²-ºF was used for an effective convection heat transfer film coefficient (all locations with the exception of the outlet nozzles where 1,000 BTU/hr-ft²-°F was retained due to velocity in the nozzle) at the cladding to base metal interface for all the times during heatup and cooldown when 2 Reactor Coolant Pumps (RCP) are in use; that is, when RCS temperatures are 225 °F > T ≥ 84 °F during heatup and when RCS temperatures are 150 °F ≤ T ≤ 255 °F during cooldown.

When no reactor coolant pumps are running (i.e., when RCS temperature are T < 84 °F for heatup and T < 150 °F for cooldown) or immediately following last RCP trip temperature, a value of 430 BTU/hr-ft²-°F was used as an effective film coefficient at the cladding-to-base metal interface.

Section 4.6 Reactor Coolant Temperature-Time Histories

Section 4.6.1 is not changed

Section 4.6.2 Cooldown Transients is revised as follows.

For the analysis of the normal cooldown P/T limits, the cooldown transients were analyzed for a step transient as well as a ramp transient.

Initiation of the decay heat removal system (DHRS) occurs at a reactor coolant temperature of 270 °F. DHRS initiation was modeled as a step change from 270 °F to 249 °F, with a hold at 249 °F for one minute, followed by a step temperature increase to 263 °F.

The cooldown transients were analyzed with the last Reactor Coolant Pump (RCP) tripping at three different temperatures (at 255 ºF, at 200 ºF, and at 150 ~~175~~ °F). For each of these transient cases, the fourth RCP trip was simulated by a 25 °F temperature decrease in 20 seconds. This 25 °F change in temperature, at the time of the fourth RCP trip, occurs as the reactor coolant transitions from a state of RCP forced flow to one controlled by the DHRS.

<u>Cooldown with last RCP Trip at 255 °F:</u>

The step cooldown transient is defined as follows:

- 570 °F - 280 °F: 50 °F steps with 30 minute hold periods or equivalent
- 280 °F - 150 °F: 25 °F steps with 30 minute hold periods or equivalent
  at 270 °F: DHRS initiation as described above
  at 255 °F: 25 ºF ramp in 20 seconds
- 150 °F - 60 °F: 25 °F steps with 60 minute hold periods or equivalent

The ramp cooldown transient is defined as follows:

- 570 °F - 280 °F: 100 °F/hr ramp
- 280 °F - 150 °F: 50 °F/hr ramp
  at 270 °F: DHRS initiation as described above
  at 255 °F: 25 °F ramp in 20 seconds (to simulate the tripping of the fourth RCP), with a 30 minute hold
- 150 °F - 60 °F: 25 °F/hr ramp
- Cooldown with last RCP trip at 200 °F:

The 200 ºF value was selected as an intermediate value between 255 °F and 150 ~~175~~ °F. Similar to the above transient, the fourth RCP trip was modeled by a 25 °F ramp in 20 seconds.

Acid Reducing Phase Cooldown with last RCP trip at 150 ~~175~~ °F:

The purpose of this low temperature pump operation is to provide circulation throughout the RCS for acid reduction and control of water chemistry prior to completion of shutdown. For this special cooldown case involving an Acid Reducing Phase (last RCP trip at 150 ~~175~~ °F), the cooldown transients are similar to the RCP trip at 255 °F. At 150 ~~175~~ °F the fourth RCP trip is simulated by a 25 °F ramp in 20 seconds. ~~followed by a hold at 150 °F for 2 hours~~.

Section 6.0 Pressure Corrections

The uncorrected P/T limits are calculated at the required locations or components in the RCS for heatup and cooldown. Although both wide and low range pressure taps are located in the hot legs, they are both modeled at the same node in the thermal hydraulics model, and, therefore, only one set of location corrections is used. The uncorrected P/T limits are corrected to this single location. Location correction factors were determined for various temperatures and pump combinations. The limiting correction factors at various temperature ranges were then determined for beltline, nozzle, and closure head locations, as tabulated individually in Table 6 1 for heatup and 6-2 for cooldown.

~~Table 6-1: Limiting Location Pressure Corrections Factors for ANO-1~~

~~Temperature Range, °F~~	~~50-99~~		~~100-249~~		~~250-349~~		~~350-449~~		~~450-532¹~~	
	~~ΔP, psi~~	~~RCP2~~	~~ΔP, psi~~	~~RCP2~~	~~ΔP, psi~~	~~RCP2~~	~~ΔP, psi~~	~~RCP2~~	~~ΔP, psi~~	~~RCP2~~
~~Beltline~~	~~22~~	~~0/0~~	~~109~~	~~2/1~~	~~122~~	~~2/2~~	~~116~~	~~2/2~~	~~108~~	~~2/2~~
~~Outlet Nozzle~~	~~17~~	~~0/0~~	~~71~~	~~2/0~~	~~69~~	~~2/0~~	~~47~~	~~2/2~~	~~44~~	~~2/2~~
~~RVCH~~	~~14~~	~~0/0~~	~~67~~	~~2/0~~	~~66~~	~~2/0~~	~~N/A~~	~~-~~	~~N/A~~	~~-~~
~~Core Flood Nozzle~~	~~17~~	~~0/0~~	~~106~~	~~2/1~~	~~122~~	~~2/2~~	~~116~~	~~2/2~~	~~107~~	~~2/2~~

~~1) The correction factor is used for temperatures above 532 ºF since the values are bounding for higher temperatures~~
~~2) The definition of RCP combinations used here are as follows: 0/0 - no pumps operating; 2/2 - all pumps operating; 2/0 - both pumps of loop A operating, both pumps of loop B are turned off; 2/1 - two pumps of loop A and one pump of loop B operating, one pump of loop B turned off.~~

Table 6-1: Heatup Limiting Location Corrections for P/T Limits

Temp Range, °F	50-83		84-224		225-300		301-532	
	ΔP, psi	RCP	ΔP, psi	RCP	ΔP, psi	RCP	ΔP, psi	RCP
Beltline	22	0/0	89	2/0	108	2/1	119	2/2
Outlet Nozzle	17	0/0	71	2/0	65	2/1	49	2/2
RVCH	14	0/0	67	2/0	60	2/1	48	2/2
Core Flood Nozzle	17	0/0	82	2/0	105	2/1	119	2/2

Table 6-2: Cooldown Limiting Location Corrections for P/T Limits

Temp Range, °F	0-149		150-255		256-532	
	ΔP, psi	RCP	ΔP, psi	RCP	ΔP, psi	RCP
Beltline	22	0/0	88	2/0	122	2/2
Outlet Nozzle	17	0/0	71	2/0	50	2/2
RVCH	14	0/0	67	2/0	49	2/2
Core Flood Nozzle	17	0/0	82	2/0	122	2/2

Section 7.0 Conclusions

The following is a summary of results for the ANO-1 P/T limits at 54 EFPY. The allowable pressures are corrected for location only. Correction due to instrument uncertainty is not included.

Maintaining the reactor coolant system pressure below the upper limit of the pressure-temperature limit curves ensures protection against non-ductile failure. Acceptable pressure and temperature combinations for reactor vessel operation are below and to the right of the applicable P/T limit curves. These P/T limit curves have been adjusted based on the pressure differential between point of system pressure measurement and the point in the reactor vessel that establishes the controlling unadjusted pressure limit. The P/T limit curves provided in Figure 7-1 through Figure 7-3 have not been corrected for instrument error. The reactor is not permitted to be critical until the pressure-temperature combinations are, as a minimum, to the right of the criticality curve. The numerical values for the Technical Specification P/T curves provided in Figure 7-1 through Figure 7-3 are shown in Table 7-1 through Table 7-4. These P/T limit curves are developed based on the pressure correction factors ~~summarized~~ in Table 6-1 and Table 6-2. The ~~LTOP pressure limits are derived considering the~~ RCP operational constraints for plant heatup and cooldown ~~as~~ are provided in Tables 7-5 and 7-6, respectively. Tables 7-5 and 7-6 represent the most conservative RCP operational constraints by which both the P/T limits and the LTOP limits remain valid. These Technical Specification P/T curves meet all the pressure and temperature requirements for the reactor pressure vessel listed in Table 1 of 10CFR Part 50, Appendix G[1].

The TS P/T limits for normal heatup for ANO Unit 1 are shown in Table 7-1. The TS P/T limits for normal cooldown for ANO-1 are determined by the limiting allowable pressure at every calculated temperature, as shown in Table 7-3. The TS P/T limits for ISLH heatup are shown in Table 7-4. The criticality limit temperature corresponding to a pressure of 2500 psig is determined through interpolation of the ISLH heatup data in Table 7-4. As shown in Table 7-2(a), the criticality limit temperatures for ANO-1, is 272 °F. The criticality-limit P/T limits are shown in Table 7-2 (b).

In BAW-10046A Rev. 2 [4], the RCS piping and control rod drive motor tube (both parts of the RCS pressure boundary) are qualified by establishing Lowest Service Temperature (LST) requirements in lieu of Appendix G analysis. The maximum allowable pressure for RCS piping during normal operation for temperatures up to 150 °F is 20% of pre-service hydro-test minus the pressure correction factor [4]. It has been demonstrated that the limiting component at low temperature is the RVCH which removes the requirement to include the LST of RCS piping in the P/T limits [4]. It has also been demonstrated that a LST of 40 °F for the control rod drive mechanism motor tube satisfies the ASME Code and 10 CFR Appendix G requirements.

The LTOP enable temperature for 54 EFPY is determined as 259 °F plus any instrument/measurement uncertainty. This is 3 °F lower than the current (32 EFPY) LTOP enable temperature of 262 °F.

The LTOP pressure limit is determined as 508 psig ~~553.8~~ psig. This value, after adjustment for measurement and opening uncertainty, is to be used for the ERV (Electronic Relief Valve) setpoint whenever the RCS temperature is below the LTOP enable temperature.

No changes to Tables 7-1, 7-2, 7-3, and 7-4. Tables 7-5 and 7-6 are revised as follows.

Table 7-5: Operational Constraints for Plant Heatup

CONSTRAINT	RC TEMPERATURE	HEATUP RATE	RCP RESTRICTIONS
RC Temperature	T < 84°F	≤ 15°F in any 1 hr period	NA
	T ≥ 84°F	≤ 50°F, 70°F or 90°F in any 1 hr period	NA
RC Pumps	T > 300°F	NA	None
	300 °F ≥ T ≥ 225 °F	NA	≤ 3 pumps
	225°F >T ≥84°F	NA	≤ 2 pumps
	T < ~~100~~ 84 °F		No RCPs operating

Table 7-6: Operational Constraints for Plant Cooldown

CONSTRAINT	RC TEMPERATURE	COOLDOWN RATE	RCP RESTRICTIONS
RC Temperature	T ≥ 280°F	≤ 50°F in any 1/2 hr period	NA
	280°F > T ≥ 150°F	≤ 25°F in any 1/2 hr period	NA
	T<150°F	≤ 25°F in any 1 hr period	NA
RC Pumps	T ≥ 255°F	N/A	None
	150°F ≤ T ≤ 255°F	N/A	≤ 2 pumps
	T < 150°F	N/A	No pumps operating

3.0 REFERENCES

1. License Amendment Request Update the Reactor Coolant System Pressure and Temperature and the Low Temperature Overpressure Protection System Limits, Arkansas Nuclear One, Unit 1, Docket No. 50-313, License No. DPR-51, Adams Accession Numbers ML14330A246, ML14330A249, ML14330A250, November 21, 2014
2. Responses to Request for Additional Information Update the Reactor Coolant System Pressure and Temperature and the Low Temperature Overpressure Protection System Limits, Adams Accession Number ML15041A073, February 6, 2015
3. Responses to Request for Additional Information Update the Reactor Coolant System Pressure and Temperature and the Low Temperature Overpressure Protection System Limits Arkansas Nuclear One, Adams Accession Number ML15071A054, March 10, 2015
4. E-mail from NRC Singal, Balwant to Bob Clark, March 20, 2015, 11:57 a.m., FW: Arkansas Nuclear One, Unit No. 1, Request for Additional Information (Second Round) - License Amendment Request (TAC MF5292)
5. AREVA Document ANP-3300Q3P and ANP-3300Q3NP, Response to Request for Additional Revision Information on Reactor Coolant System Pressure/Temperature and Low Temperature Overpressure Protection System Limits to 54 EFPY for Arkansas Nuclear One, Unit 1(ADAMS accession number ML15086A024)
6. E-mail from Andrea George, NRC, to David Bice, Entergy, Request for Additional Information - ANO-1 P/T and LTOP Limits Update to 54 EFPY License Amendment Request, MF5292, April 2, 2015, Adams Accession Number ML15093A006

7. ANO-1 32 EFPY P/T Submittal, "Proposed Technical Specification Change To The Reactor Coolant System Pressure And Temperature Curves," Entergy Letter 1CAN119608, November 26, 1996

8. NRC SER, ISSUANCE OF AMENDMENT NO. 188 TO FACILITY OPERATING LICENSE NO. DPR-51 - ARKANSAS NUCLEAR ONE, UNIT NO. 1 (TAC NO. M97529), March 14, 1997

9. NRC letter from John F. Stolz to Mr. John M. Griffin, NRC review of the low temperature overpressure mitigating systems for Arkansas Nuclear One, Unit No. 1. SER of ANO-1 LTOP, May 5, 1983

10. NRC letter from Thomas W. Alexion to Mr. Neil S. Carns, ISSUANCE OF AMENDMENT NO. 154 TO FACILITY OPERATING LICENSE NO. DPR-51 SER of 15 EFPY P/T Limits, 1CNA119103, November 14, 1991

11. NUREG 0800, SRP 5.2.2, March 2007

12. Zech, G; Reactor Vessel Pressure Transient Protection for Pressurized Water Reactors; U.S. NRC NUREG-0224; September 1978.

13. NRC Generic Letter 88-11, NRC Position on Radiation Embrittlement of Reactor Vessel Materials and Its Impact on Plant Operations, July 12, 1988

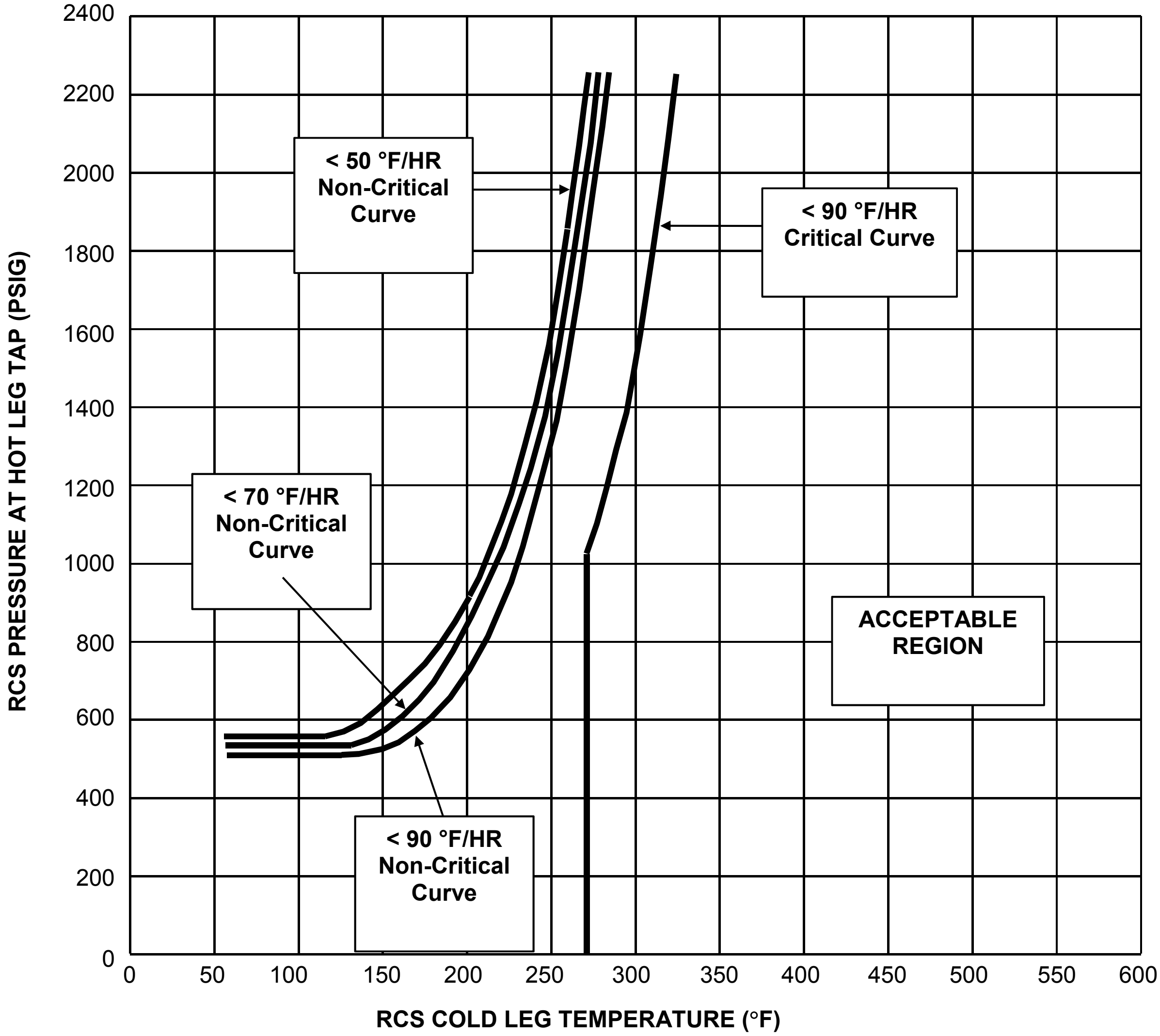
14. NUREG-1326, Regulatory Analysis for the Resolution of Generic Issue 94, Additional Low-Temperature Overpressure Protection for Light-Water Reactors, December 1989

Attachment 2 to

1CAN041502

Proposed Technical Specification Changes (mark-up)

FIGURE 3.4.3-1
RCS Heatup Limitations to 54~~31~~ EFPY



Notes:

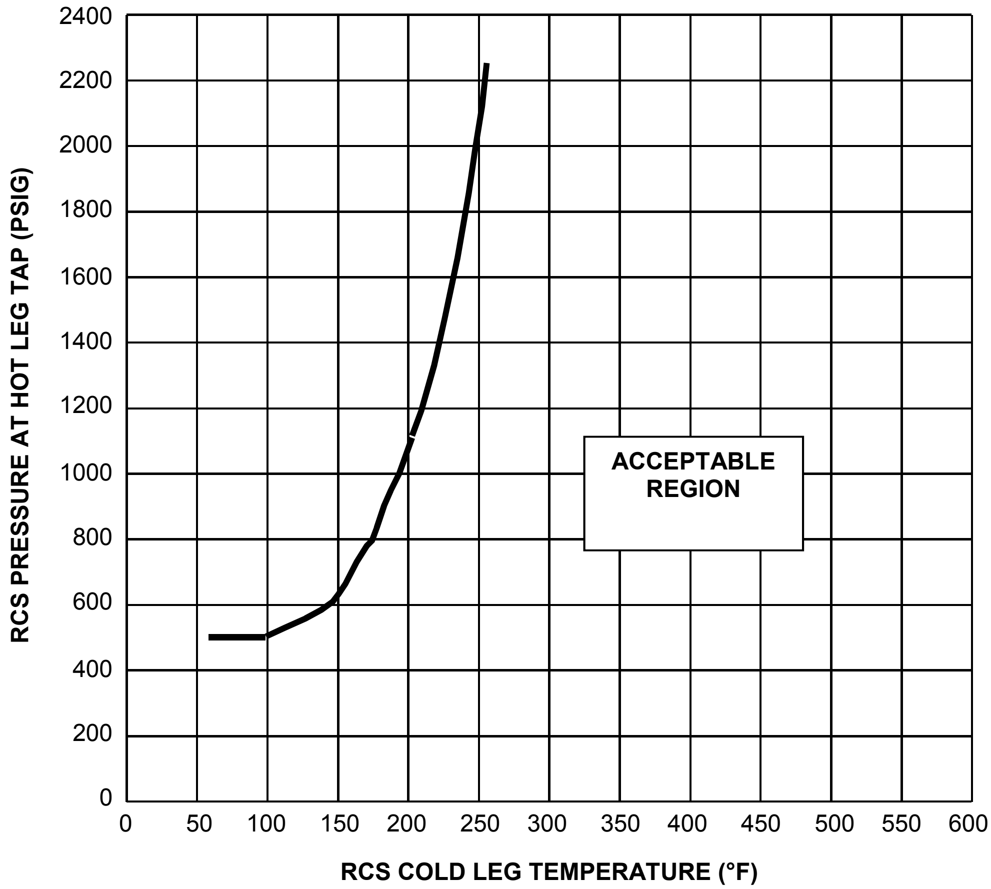
1. These curves are not adjusted for instrument error and shall not be used for operation.
2. When DHR is in operation with no RCPs operating, the DHR system return temperature shall be used.
3. RCP Operating Restrictions:

RCS TEMP	RCP RESTRICTIONS
T > 300 °F	None
300 °F ≥ T ≥ 225 °F	≤ 3
225 °F > T ≥ 84 °F	≤ 2
T < 84 °F	No RCPs operating

4. Allowable Heatup Rates:

RCS TEMP	H/U RATE
60 °F < T ≤ 84 °F	≤ 15 °F/HR
T > 84 °F	As allowed by applicable curve

FIGURE 3.4.3-2
RCS Cooldown Limits to 54~~31~~ EFPY



Notes:

1. This curve is not adjusted for instrument error and shall not be used for operation.
2. A maximum step temperature change of 25 °F is allowable when securing all RCPs with the DHR system in operation. This change is defined as the RCS temperature prior to securing all the RCPs minus the DHR return temperature after the RCPs are secured. When DHR is in operation with no RCPs operating, the DHR system return temperature shall be used.
3. RCP Operating Restrictions:

RCS TEMP	RCP RESTRICTIONS
T > 255 °F	None
150 °F ≤ T ≤ 255 °F	≤ 2 ~~(See Note 5)~~
T < 150 °F	No RCPs operating

4. Allowable Cooldown Rates:

RCS TEMP	C/D RATE	STEP CHANGE
T ≥ 280 °F	100 °F/HR	≤ 50 °F in any 1/2 HR
280 °F > T ≥ 150 °F	50 °F/HR ~~(Note 5)~~	≤ 25 °F in any 1/2 HR
T < 150 °F	25 °F/HR	≤ 25 °F in any 1 HR

~~5. If RCPs are operated < 200 °F, then the RCS cooldown rate from 150 °F ≤ T ≤ 180 °F is reduced to 30 °F in 15 hours.~~

3.4 REACTOR COOLANT SYSTEM (RCS)

3.4.11 Low Temperature Overpressure Protection (LTOP) System

LCO 3.4.11 An LTOP System shall be OPERABLE with high pressure injection (HPI) deactivated and the core flood tanks (CFTs) isolated and:

--NOTES--

1. HPI deactivation and CFT isolation not applicable during ASME Section XI testing.
2. HPI deactivation not applicable during fill and vent of the RCS.
3. HPI deactivation not applicable during emergency RCS makeup.
4. HPI deactivation not applicable during valve maintenance.
5. CFT isolation is only required when CFT pressure is greater than or equal to the maximum RCS pressure for the existing RCS temperature allowed by the pressure and temperature curves provided in LCO 3.4.3, "RCS Pressure and Temperature (P/T) Limits."

----

a. Pressurizer level such that the unit is not in a water solid condition and an OPERABLE electromatic relief valve (ERV) with a setpoint of ≤ ~~460~~508.0 psig; or

---NOTES---------------------------------------

1. Pressurizer level not applicable as allowed by Emergency Operating Procedures.

2. Pressurizer level not applicable during system hydrotest.

----

b. The RCS depressurized and the RCS open.

APPLICABILITY: MODE 4 with RCS temperature ≤ ~~262~~259 °F,
MODE 5,
MODE 6 when the reactor vessel head is on.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Pressurizer level not within required limits.	A.1 Restore pressurizer level to within required limits.	1 hour

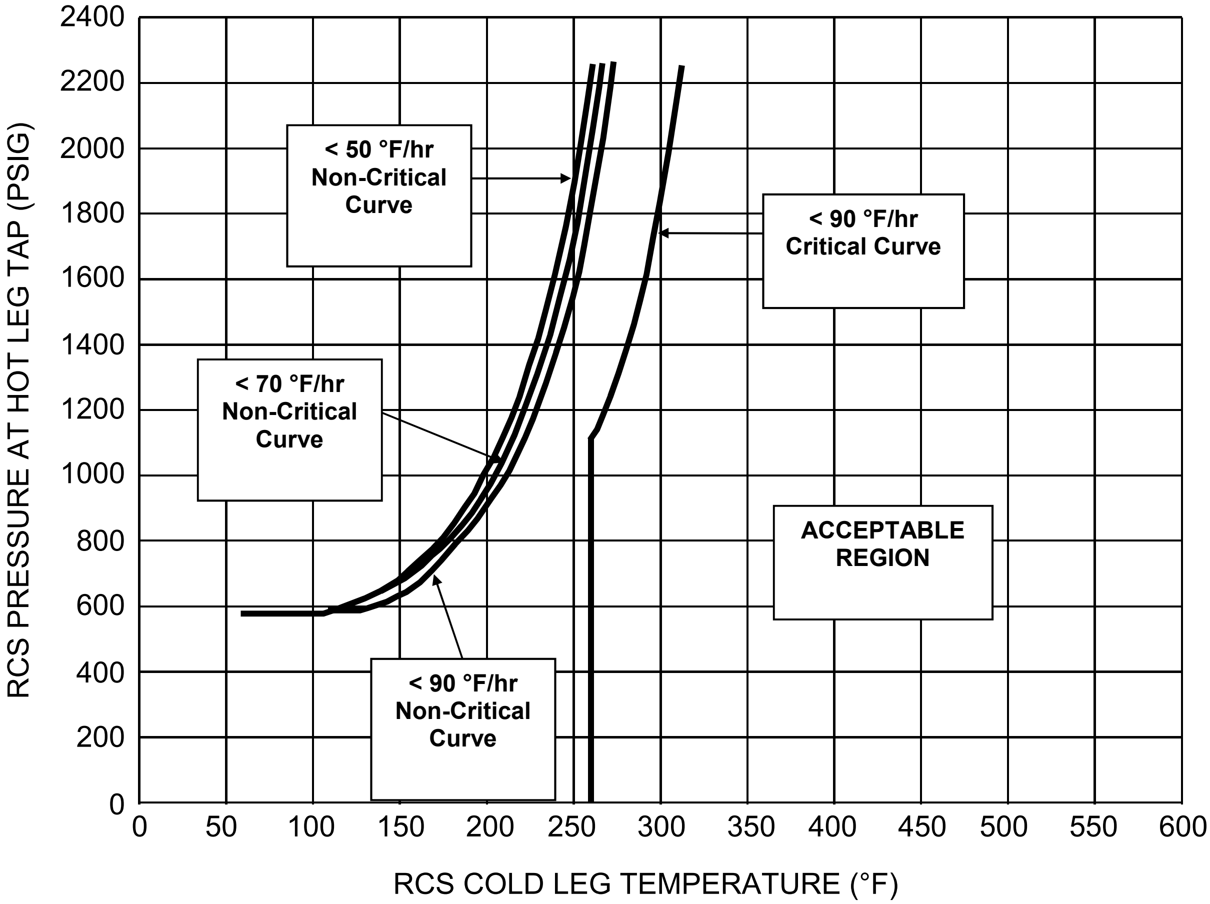
Attachment 3 to

1CAN041502

Revised (clean) Technical Specification Pages

FIGURE 3.4.3-1

RCS Heatup Limitations to 54 EFPY



Notes:

1. These curves are not adjusted for instrument error and shall not be used for operation.
2. When DHR is in operation with no RCPs operating, the DHR system return temperature shall be used.
3. RCP Operating Restrictions:

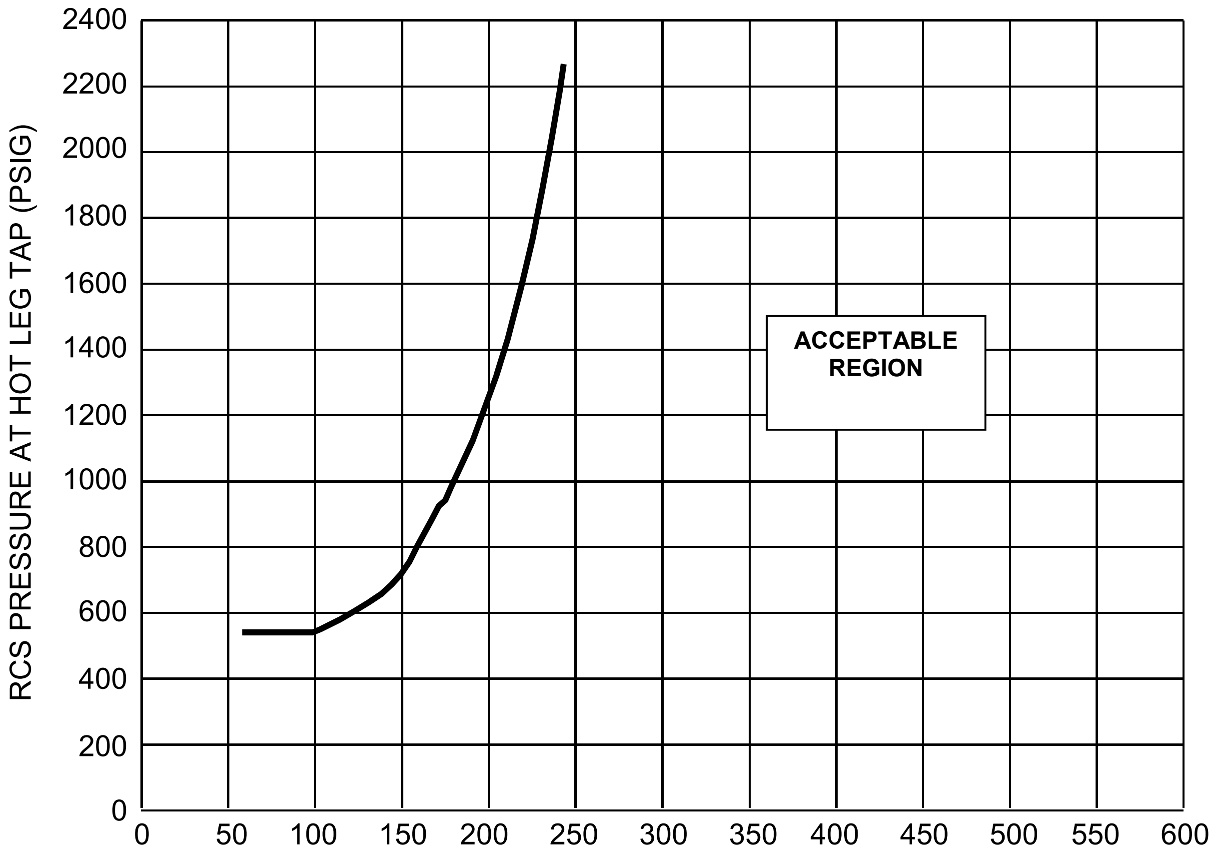
RCS TEMP	RCP RESTRICTIONS
T > 300 °F	None
300 °F ≥ T ≥ 225 °F	≤ 3
225 °F > T ≥ 84 °F	≤ 2
T < 84 °F	No RCPs operating

4. Allowable Heatup Rates:

RCS TEMP	H/U RATE
60 °F < T ≤ 84 °F	≤ 15 °F/HR
T > 84 °F	As allowed by applicable curve

FIGURE 3.4.3-2

RCS Cooldown Limits to 54 EFPY



Notes:

1. This curve is not adjusted for instrument error and shall not be used for operation.
2. A maximum step temperature change of 25 °F is allowable when securing all RCPs with the DHR system in operation. This change is defined as the RCS temperature prior to securing all the RCPs minus the DHR return temperature after the RCPs are secured. When DHR is in operation with no RCPs operating, the DHR system return temperature shall be used.
3. RCP Operating Restrictions:

RCS TEMP	RCP RESTRICTIONS
T > 255 °F	None
150°F ≤ T ≤ 255 °F	≤ 2
T < 150 °F	No RCPs operating

4. Allowable Cooldown Rates:

RCS TEMP	C/D RATE	STEP CHANGE
T ≥ 280 °F	100 °F/hr	≤ 50 °F in any 1/2 hr
280°F > T ≥ 150 °F	50 °F/hr	≤ 25 °F in any 1/2 hr
T < 150 °F	25 °F/hr	≤ 25 °F in any 1 hr

3.4 REACTOR COOLANT SYSTEM (RCS)

3.4.11 Low Temperature Overpressure Protection (LTOP) System

LCO 3.4.11 An LTOP System shall be OPERABLE with high pressure injection (HPI) deactivated and the core flood tanks (CFTs) isolated and:

---NOTES---

1. HPI deactivation and CFT isolation not applicable during ASME Section XI testing.
2. HPI deactivation not applicable during fill and vent of the RCS.
3. HPI deactivation not applicable during emergency RCS makeup.
4. HPI deactivation not applicable during valve maintenance.
5. CFT isolation is only required when CFT pressure is greater than or equal to the maximum RCS pressure for the existing RCS temperature allowed by the pressure and temperature curves provided in LCO 3.4.3, "RCS Pressure and Temperature (P/T) Limits."

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a. Pressurizer level such that the unit is not in a water solid condition and an OPERABLE electromatic relief valve (ERV) with a setpoint of ≤ 508 psig; or

---NOTES---

1. Pressurizer level not applicable as allowed by Emergency Operating Procedures.

2. Pressurizer level not applicable during system hydrotest.

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b. The RCS depressurized and the RCS open.

APPLICABILITY: MODE 4 with RCS temperature ≤ 259 °F,
MODE 5,
MODE 6 when the reactor vessel head is on.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Pressurizer level not within required limits.	A.1 Restore pressurizer level to within required limits.	1 hour