INDIANA MICHIGAN POWER

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Nuclear Generation Group
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April 7, 2020

AEP-NRC-2020-01
10 CFR 50.90

Docket No.: 50-315

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555-0001

Donald C. Cook Nuclear Plant Unit 1
License Amendment Request Regarding a Change to the Reactor Coolant System Pressure and Temperature Limits and Low Temperature Overpressure Protection (LTOP) System

Pursuant to 10 CFR 50.90, Indiana Michigan Power Company (I&M), the licensee for Donald C. Cook Nuclear Plant (CNP) Unit 1, is submitting a request for an amendment to the Technical Specifications (TS) for CNP Unit 1. The proposed amendment will revise the Reactor Coolant System (RCS) heatup and cooldown curves and Low Temperature Overpressure Protection (LTOP) requirements in TS 3.4.3 and 3.4.12, respectively. The proposed changes to the LTOP requirements in TS 3.4.12 will also require changes to be made to TS 3.4.6, 3.4.7, and 3.4.10.

This application for amendment to the CNP Unit 1 TS proposes to revise TS 3.4.3, "Reactor Coolant System (RCS) Pressure and Temperature (P/T) Limits", to update Figures 3.4.3-1 "Reactor Coolant System Pressure versus Temperature Limits – Heatup Limit, Criticality Limit, and Leak Test Limit (Applicable for service period up to 32 EFPY)" and 3.4.3-2 "Reactor Coolant System Pressure versus Temperature Limits – Various Cooldown Rates Limits (Applicable for service period up to 32 EFPY)" with revised P/T limits applicable up to 48 Effective Full Power Years (EFPY).

In addition, I&M proposes to change CNP Unit 1 TS 3.4.12, "Low Temperature Overpressure Protection (LTOP) System," to align with an updated LTOP analysis. The proposed changes to the LTOP requirements in TS 3.4.12 will also require changes to be made to TS 3.4.6, 3.4.7, and 3.4.10.

Enclosure 1 to this letter provides an affirmation statement. Enclosure 2 is an evaluation of the proposed change to Section 3.4.3, 3.4.6, 3.4.7, 3.4.10, and 3.4.12 of the Unit 1 TS. Enclosure 3 contains marked up copies of the applicable Unit 1 TS pages. New Unit 1 TS pages, with proposed changes incorporated, will be provided to the Nuclear Regulatory Commission (NRC) Licensing Project Manager when requested. Enclosure 4 contains marked up copies of the applicable Unit 1 TS Bases pages, provided for information purposes. Changes to the existing TS Bases, consistent with the technical and regulatory analyses, will be implemented under TS 5.5.12 "Technical Specifications (TS) Bases Control Program."

PROPRIETARY INFORMATION
Enclosure 6 to this letter contains proprietary information.
Withhold from public disclosure under 10 CFR 2.390.
Upon removal of Enclosure 6, this Letter is decontrolled.

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Enclosure 5 contains WCAP-18455-NP, Revision 1, "D.C. Cook Unit 1 Heatup and Cooldown Limit Curves for Normal Operation," Westinghouse Electric Company (Non-Proprietary), February 2020. This report provides the methodology and results of the generation of heatup and cooldown pressure-temperature (P/T) limit curves for normal operation of the CNP Unit 1 reactor vessel.

Enclosure 6 contains LTR-SCS-19-50, Revision 0, "D.C. Cook Unit 1 Low Temperature Overpressure Protection System (LTOPS) Analysis for 48 EFPY", dated March 5, 2020, including Attachment 1 (Proprietary). This letter transmits both proprietary and non-proprietary versions of the LTOP analysis report for CNP Unit 1.

Enclosure 7 contains LTR-SCS-19-50, Revision 0, "D.C. Cook Unit 1 Low Temperature Overpressure Protection System (LTOPS) Analysis for 48 EFPY", dated March 5, 2020, Attachment 2 only. (Non-Proprietary). This enclosure contains only Attachment 2 of the letter in Enclosure 6 and the two Enclosures are separate for ease of differentiating proprietary versus non-proprietary information.

Enclosure 8 contains an affidavit from the Westinghouse Electric Company for withholding the proprietary information contained in Enclosure 6. This affidavit sets forth the basis for which the information may be withheld from public disclosure by the Commission and addresses with specificity the considerations listed in 10 CFR 2.390(b)(4). Accordingly, it is respectfully requested that the information which is proprietary to Westinghouse be withheld from public disclosure in accordance with 10 CFR 2.390.

I&M requests review and approval of this application by February 5, 2021, in order to incorporate these changes into the CNP Unit 1 TS prior to the Unit 1 reactor vessel reaching 32 EFPY. This schedule was discussed with the NRC during a public meeting on February 13, 2020 (ML20041C949). The license amendment will be implemented within 30 days of U.S. Nuclear Regulatory Commission approval.

In accordance with 10 CFR 50.91, a copy of this application, with enclosures, is being provided to the designated Michigan state officials.

There are no new regulatory commitments made in this letter. Should you have any questions, please contact Mr. Michael K. Scarpello, Regulatory Affairs Director, at (269) 466-2649.

Sincerely,

Joel P. Gebbie
Senior Vice President &
Chief Nuclear Officer

JMT/mll

PROPRIETARY INFORMATION
Enclosure 6 to this letter contains proprietary information.
Withhold from public disclosure under 10 CFR 2.390.
Upon removal of Enclosure 6, this Letter is decontrolled.

Enclosures:

1. Affirmation
2. Evaluation of Proposed Amendment to Revise Unit 1 Reactor Coolant System (RCS) Pressure and Temperature (P/T) Limits and Low Temperature Overpressure Protection (LTOP) System for Donald C. Cook Nuclear Plant Unit 1
3. Donald C. Cook Nuclear Plant Unit 1 Technical Specification Pages Marked To Show Proposed Changes
4. Donald C. Cook Nuclear Plant Unit 1 Technical Specification Bases Pages Marked To Show Proposed Changes (For Information Only)
5. WCAP-18455-NP, Revision 1, "D.C. Cook Unit 1 Heatup and Cooldown Limit Curves for Normal Operation," Westinghouse Electric Company (Non Proprietary), February 2020.
6. LTR-SCS-19-50, Revision 0, "D.C. Cook Unit 1 Low Temperature Overpressure Protection System (LTOPS) Analysis for 48 EFPY", dated March 5, 2020, including Attachment 1 (Proprietary)
7. LTR-SCS-19-50, Revision 0, "D.C. Cook Unit 1 Low Temperature Overpressure Protection System (LTOPS) Analysis for 48 EFPY", dated March 5, 2020, Attachment 2 Only (Non-Proprietary)
8. Affidavit of Withholding Pursuant to 10 CFR 2.390, Westinghouse Electric Company

c: R. J. Ancona – MPSC
EGLE – RMD/RPS
J. B. Giessner – NRC Region, III
NRC Resident Inspector
D. J. Roberts – NRC Region, III
S. P. Wall – NRC Washington, D.C.
A. J. Williamson – AEP Ft. Wayne, w/o enclosures

Enclosure 8 to AEP-NRC-2020-01

Affidavit of Withholding Pursuant to 10 CFR 2.390, Westinghouse Electric Company

AFFIDAVIT

COMMONWEALTH OF PENNSYLVANIA:
COUNTY OF BUTLER:

(1) I, Korey L. Hosack, have been specifically delegated and authorized to apply for withholding and execute this Affidavit on behalf of Westinghouse Electric Company LLC (Westinghouse).

(2) I am requesting the proprietary portions of LTR-SCS-19-50-P, Revision 0 be withheld from public disclosure under 10 CFR 2.390.

(3) I have personal knowledge of the criteria and procedures utilized by Westinghouse in designating information as a trade secret, privileged, or as confidential commercial or financial information.

(4) Pursuant to 10 CFR 2.390, the following is furnished for consideration by the Commission in determining whether the information sought to be withheld from public disclosure should be withheld.

(i) The information sought to be withheld from public disclosure is owned and has been held in confidence by Westinghouse and is not customarily disclosed to the public.

(ii) Public disclosure of this proprietary information is likely to cause substantial harm to the competitive position of Westinghouse because it would enhance the ability of competitors to provide similar technical evaluation justifications and licensing defense services for commercial power reactors without commensurate expenses. Also, public disclosure of the information would enable others to use the information to meet NRC requirements for licensing documentation without purchasing the right to use the information.

AFFIDAVIT

(5) Westinghouse has policies in place to identify proprietary information. Under that system, information is held in confidence if it falls in one or more of several types, the release of which might result in the loss of an existing or potential competitive advantage, as follows:

(a) The information reveals the distinguishing aspects of a process (or component, structure, tool, method, etc.) where prevention of its use by any of Westinghouse's competitors without license from Westinghouse constitutes a competitive economic advantage over other companies.

(b) It consists of supporting data, including test data, relative to a process (or component, structure, tool, method, etc.), the application of which data secures a competitive economic advantage (e.g., by optimization or improved marketability).

(c) Its use by a competitor would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing a similar product.

(d) It reveals cost or price information, production capacities, budget levels, or commercial strategies of Westinghouse, its customers or suppliers.

(e) It reveals aspects of past, present, or future Westinghouse or customer funded development plans and programs of potential commercial value to Westinghouse.

(f) It contains patentable ideas, for which patent protection may be desirable.

(6) The attached documents are bracketed and marked to indicate the bases for withholding. The justification for withholding is indicated in both versions by means of lower case letters (a) through (f) located as a superscript immediately following the brackets enclosing each item of information being identified as proprietary or in the margin opposite such information. These

AFFIDAVIT

lower case letters refer to the types of information Westinghouse customarily holds in confidence identified in Sections (5)(a) through (f) of this Affidavit.

I declare that the averments of fact set forth in this Affidavit are true and correct to the best of my knowledge, information, and belief.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on: 2020 03 05

Korey L. Hosack, Manager
Licensing, Analysis, & Testing

AFFIRMATION

I, Joel P. Gebbie, being duly sworn, state that I am the Senior Vice President and Chief Nuclear Officer of Indiana Michigan Power Company (I&M), that I am authorized to sign and file this request with the U. S. Nuclear Regulatory Commission on behalf of I&M, and that the statements made and the matters set forth herein pertaining to I&M are true and correct to the best of my knowledge, information, and belief.

Indiana Michigan Power Company

Joel P. Gebbie
Senior Vice President &
Chief Nuclear Officer

SWORN TO AND SUBSCRIBED BEFORE ME

THIS 7 DAY OF April, 2020

Notary Public

My Commission Expires 04-04-2024

DANIELLE BURGOYNE
Notary Public, State of Michigan
County of Berrien
My Commission Expires 04-04-2024
Acting in the County of Berrien

Enclosure 2 to AEP-NRC-2020-01

Evaluation of Proposed Amendment to Revise Unit 1 Reactor Coolant System (RCS) Pressure and Temperature (P/T) Limits and Low Temperature Overpressure Protection (LTOP) System for Donald C. Cook Nuclear Plant Unit 1

Table of Contents

1.0 SUMMARY DESCRIPTION

Indiana Michigan Power Company (I&M), licensee for Donald C. Cook Nuclear Plant (CNP) Unit 1, requests an amendment to the CNP Unit 1 Operating License DPR-58 by incorporating the proposed change for the CNP Unit 1 Technical Specifications (TS). The proposed change is a request to revise TS 3.4.3, "RCS Pressure and Temperature (P/T) Limits" and TS 3.4.12, "Low Temperature Overpressure Protection (LTOP) System" for CNP Unit 1. The proposed changes to the LTOP requirements in TS 3.4.12 will also require changes to be made to TS 3.4.6, 3.4.7, and 3.4.10. These changes are necessary to account for a service life increase from 32 Effective Full Power Years (EFPY) to an extended service life of 48 EFPY.

I&M requests review and approval of this application by February 5, 2021, in order to incorporate these changes into the CNP Unit 1 TS prior to CNP Unit 1 reaching the current TS 3.4.3 limit of 32 EFPY. The license amendment will be implemented within 30 days of the issuance of the license amendment.

2.0 DETAILED DESCRIPTION

2.1 System Design and Operation

The CNP Unit 1 Reactor Coolant System (RCS) consists of four similar heat transfer loops connected in parallel to the reactor vessel. Each loop contains a circulating pump and a steam generator (SG). The system also includes a pressurizer, connecting piping, pressurizer safety and relief valves, and relief tank, necessary for operational control.

During operation, the reactor coolant pumps (RCP) circulate pressurized water through the reactor vessel and the four reactor coolant loops. The RCS provides a boundary for containing the coolant under operating temperature and pressure conditions. During transient operation, the system's heat capacity attenuates thermal transients generated by the core or SGs.

By appropriate selection of the inertia of the RCPs, the thermal-hydraulic effects are reduced to a safe level during the pump coast down, which would result from a loss-of-flow situation. The layout of the system assures natural circulation capability following a loss-of-flow to permit decay heat removal without overheating the core. Part of the system's piping serves as part of the emergency core cooling system to deliver cooling water to the core during a loss of coolant accident.

Pressure in the system is controlled by the pressurizer, where water and steam pressure is maintained through the use of electrical heaters and sprays. Steam can either be formed by the heaters, or condensed by a pressurizer spray, to minimize pressure variations due to contraction and expansion of the coolant. Spring-loaded safety valves and power-operated relief valves are connected to the pressurizer and discharge to the pressurizer relief tank (PRT), where the discharged steam is condensed and cooled by mixing with water.

The LTOP System controls RCS pressure at low temperatures so the integrity of the reactor coolant pressure boundary (RCPB) is not compromised by violating the pressure and temperature (P/T) limits of 10 CFR 50, Appendix G. The reactor vessel is the limiting RCPB component for demonstrating such protection. TS 3.4.3, "RCS Pressure and Temperature (P/T) Limits," provides the maximum RCS pressure for the existing RCS cold leg temperature during cooldown, shutdown, and heatup to meet the Appendix G requirements during the LTOP MODES.

The current LTOP System for pressure relief consists of two power operated relief valves (PORVs), with reduced lift settings, one PORV and one residual heat removal (RHR) suction relief valve, or a depressurized RCS and an RCS vent of sufficient size. Two RCS relief valves are required for redundancy. One RCS relief valve has adequate relieving capability to prevent overpressurization for the required coolant input capability. When all RCS cold leg temperatures are ≥ 140°F and two charging pumps are capable of injecting into the RCS, the LTOP System for pressure relief includes all three RCS relief valves (two PORVs and the RHR suction relief valve). Three RCS relief valves are required for redundancy, since one PORV and one RHR suction relief valve have adequate relieving capability to prevent overpressurization at this coolant input capability.

2.2 Current Technical Specifications Requirements

The CNP Unit 1 LCO 3.4.3 "RCS Pressure and Temperature (P/T) Limits" states:

"LCO 3.4.3 *RCS pressure, RCS temperature, and RCS heatup and cooldown rates shall be maintained within the limits specified in Figures 3.4.3-1 and 3.4.3-2 with:*

a. A maximum heatup of 60°F in any one hour period;

b. A maximum cooldown of 100°F in any one hour period; and

c. A maximum temperature change of ≤ 5°F in any one hour period, during hydrostatic testing operations above system design pressure."

The RCS P/T limits LCO provides a definition of acceptable operation for prevention of non-ductile failure in accordance with 10 CFR 50, Appendix G. Although the P/T limits were developed to provide guidance for operation during heatup or cooldown (MODES 3, 4, and 5) or inservice leak and hydrostatic (ISLH) testing, their Applicability is at all times in keeping with the concern for non-ductile failure. The limits do not apply to the pressurizer.

During MODES 1 and 2, other TS provide limits for operation that can be more restrictive than or can supplement these P/T limits. LCO 3.4.1, "RCS Pressure, Temperature, and Flow Departure from Nucleate Boiling (DNB) Limits," LCO 3.4.2, "RCS Minimum Temperature for Criticality," and Safety Limit 2.1, "Safety Limits," also provide operational restrictions for pressure and temperature and maximum pressure. Furthermore, MODES 1 and 2 are above the temperature range of concern for nonductile failure, and stress analyses have been performed for normal maneuvering profiles, such as power ascension or descent.

The CNP Unit 1 LCO 3.4.6 "RCS Loops – Mode 4" states:

"LCO 3.4.6 *Two loops consisting of any combination of RCS loops and residual heat removal (RHR) loops shall be OPERABLE, and one loop shall be in operation.*

--NOTES--

1. *All reactor coolant pumps (RCPs) and RHR pumps may be removed from operation for ≤ 1 hour per 8 hour period provided:*

   a. *No operations are permitted that would cause introduction of coolant into the RCS with boron concentration less than required to meet the requirements of LCO 3.1.1, "SHUTDOWN MARGIN (SDM)"; and*

   b. *Core outlet temperature is maintained at least 10°F below saturation temperature.*

2. *Reactor coolant pumps shall not be started with one or more RCS cold leg temperatures ≤ 152°F unless the pressurizer water level is < 62% or the secondary water temperature of each steam generator is < 50°F above each of the RCS cold leg temperatures.*

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In MODE 4, this LCO ensures forced circulation of the reactor coolant to remove decay heat from the core and to provide proper boron mixing. One loop of either RCS or RHR provides sufficient circulation for these purposes. However, two loops consisting of any combination of RCS and RHR loops are required to be OPERABLE to meet single failure considerations.

The CNP Unit 1 LCO 3.4.7 "RCS Loops – Mode 5, Loops Filled" states:

"LCO 3.4.7 *One residual heat removal (RHR) loop shall be OPERABLE and in operation, and either:*

a. *One additional RHR loop shall be OPERABLE; or*

b. *The secondary side water level of at least two steam generators (SGs) shall be above the lower tap of the SG wide range level instrumentation by ≥ 420 inches.*

--NOTES--

1. *The RHR pump of the loop in operation may be removed from operation for ≤ 1 hour per 8 hour period provided:*

   a. *No operations are permitted that would cause introduction of coolant into the RCS with boron concentration less than required to meet the requirements of LCO 3.1.1, "SHUTDOWN MARGIN (SDM)"; and* *b. Core outlet temperature is maintained at least 10°F below saturation temperature.*

2. One required RHR loop may be inoperable for up to 2 hours for surveillance testing provided that the other RHR loop is OPERABLE and in operation.

3. Reactor coolant pumps shall not be started with one or more RCS cold leg temperatures ≤ 152°F unless the pressurizer water level is < 62% or the secondary water temperature of each steam generator is < 50°F above each of the RCS cold leg temperatures.

4. All RHR loops may be removed from operation during planned heatup to MODE 4 when at least one RCS loop is in operation.

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In MODE 5 with RCS loops filled, this LCO requires forced circulation of the reactor coolant to remove decay heat from the core and to provide proper boron mixing. One loop of RHR provides sufficient circulation for these purposes. However, one additional RHR loop is required to be OPERABLE, or the secondary side water level of at least two SGs is required to be above the lower tap of the SG wide range water level instrumentation by ≥ 420 inches.

<u>The CNP Unit 1 LCO 3.4.10 "Pressurizer Safety Valves" states:</u>

"LCO 3.4.10 Three pressurizer safety valves shall be OPERABLE with lift settings ≥ 2411 psig and ≤ 2559 psig."

In MODES 1, 2, and 3, and portions of MODE 4 above the LTOP arming temperature, OPERABILITY of three valves is required because the combined capacity is required to keep reactor coolant pressure below 110% of its design value during certain accidents. MODE 3 and portions of MODE 4 are conservatively included.

<u>The CNP Unit 1 LCO 3.4.12 "Low Temperature Overpressure Protection (LTOP) System" states:</u>

"LCO 3.4.12 An LTOP System shall be OPERABLE with one of the following:

A. No safety injection (SI) pump and a maximum of one charging pump capable of injecting into the RCS, except two charging pumps may be made capable of injecting into the RCS for ≤ 1 hour for pump swap operations, and the following:

1. The accumulators isolated, except an accumulator may be unisolated when the accumulator is depressurized and vented; and

2. One of the following pressure relief capabilities:

a. Two power operated relief valves (PORVs) with lift settings ≤ 435 psig;

b. *One PORV with a lift setting ≤ 435 psig and the residual heat removal (RHR) suction relief valve with a setpoint ≤ 450 psig; or*

c. *The RCS depressurized and an RCS vent of ≥ 2.0 square inches or any single PORV blocked open.*

<u>OR</u>

B. *No SI pump and both charging pumps capable of injecting into the RCS, and the following:*

1. *The accumulators isolated, except an accumulator may be unisolated when the accumulator is depressurized and vented;*

2. *Two PORVs with lift settings ≤ 435 psig;*

3. *The RHR suction relief valve with a setpoint ≤ 450 psig; and*

4. *All RCS cold leg temperatures ≥ 140°F.*

--*NOTE*--
Reactor coolant pumps shall not be started with one or more RCS cold leg temperatures ≤ 152°F unless the pressurizer water level is < 62% or the secondary water temperature of each steam generator is < 50°F above each of the RCS cold leg temperatures.
--"

This LCO provides RCS overpressure protection by having a minimum coolant input capability, limiting reactor coolant pump (RCP) startup transients, and having adequate pressure relief capacity. Limiting coolant input capability requires all safety injection (SI) pumps and all but one charging pump incapable of injection into the RCS and isolation of the accumulators. RCPs shall not be started when RCS cold leg temperature is ≤ 152°F unless certain requirements are met. The pressure relief capacity requires either two redundant RCS relief valves or a depressurized RCS and an RCS vent of sufficient size. One RCS relief valve or the open RCS vent is the overpressure protection device that is available to terminate an increasing pressure event. When all RCS cold leg temperatures are ≥ 140°F, the coolant input capability is allowed to be increased by allowing both charging pumps to be capable of injecting into the RCS. This is acceptable since requiring three RCS relief valves provides adequate pressure relief capacity under these conditions (one of the two PORVs and the RHR suction relief valve are the overpressure protection devices that are available to terminate an increasing pressure event).

2.3 Reason for the Proposed Change

Background

This License Amendment request (LAR) proposes to revise the RCS Heatup, and Cooldown curves; and the LTOP requirements, in order to allow for an increased service life. The current

TS for these curves expire at a service life of 32 EFPY, which is estimated to occur in February, 2021. Enclosure 5 contains calculations which have been performed to establish pressure versus temperature limits for all curves in TS 3.4.3 for a service life extending up to 48 EFPY, which is the accumulated burnup estimated to occur in December, 2039 during the period of extended plant operation.

As expected, the revised curves are more restrictive in some operating regions than the existing ones, due to the effects of increased neutron fluence over the life of the reactor vessel, and the associated increase in RT_{NDT} at the ¼ thickness (1/4T) and ¾ thickness (3/4T) locations. Although the revised curves are more restrictive in some operating regions, the current technical specifications are conservative for today's operation and will be from now until the amendment is approved. This would include TS 3.4.6 Note 2 and the 152°F limit on RCP operation. The new curves were developed using the standard Westinghouse methodologies which have been previously reviewed and approved by the NRC for other licensees.

TS Figures 3.4.3-1 and 3.4.3-2 provide the RCS pressure versus temperature limits for various modes of reactor operation. These curves specify safe zones of reactor operation under varying RCS P/T conditions.

The existing Unit 1 P/T limits curves required by 10 CFR 50, Appendix G and contained in TS 3.4.3 are applicable up to 32 EFPY. Enclosure 5 to this letter calculated new P/T limit curves applicable to 48 EFPY. The new P/T curves include a neutron fluence evaluation for the Unit 1 reactor vessel extended beltline region. A new LTOP analysis was performed and documented in Enclosure 6 to this letter to ensure the LTOP system prevents RCS over-pressurization for the postulated heat injection and mass injection transients. The new LTOP analysis ensures the revised P/T limits contained in TS 3.4.3 are not exceeded.

The Unit 1 TS 3.4.12 is changed to reflect the requirements of the new analysis documented in Enclosure 6 to this letter. The proposed changes to LCO 3.4.12 reflect the minimum coolant input capability, limiting reactor coolant pump (RCP) startup transient, and pressure relief capacity required by the Enclosure 6 analysis.

The proposed changes to the LTOP requirements in 3.4.12 will also require changes to be made to TS 3.4.6, 3.4.7, and 3.4.10.

2.4 Description of the Proposed Change

In the following mark ups, the deletion of text is shown by striking through the current wording and the addition of text is shown by putting the new text in boxes.

The CNP Unit 1 TS 3.4.3 "RCS Pressure and Temperature (P/T) Limits" will be revised as follows:

a. Replace the existing TS Figure 3.4.3-1 and Figure 3.4.3-2 with the proposed TS Figure 3.4.3-1 and Figure 3.4.3-2 as shown in Enclosure 3.

This change replaces the CNP Unit 1 RCS P/T curves applicable up to 32 EFPY with curves applicable up to 48 EFPY and reflects the analysis in Enclosure 5 to this letter.

The CNP Unit 1 TS 3.4.6 "RCS Loops – Mode 4" will be revised as follows:

"LCO 3.4.6 Two loops consisting of any combination of RCS loops and residual heat removal (RHR) loops shall be OPERABLE, and one loop shall be in operation.

--NOTES--

1. All reactor coolant pumps (RCPs) and RHR pumps may be removed from operation for ≤ 1 hour per 8 hour period provided:

   a. No operations are permitted that would cause introduction of coolant into the RCS with boron concentration less than required to meet the requirements of LCO 3.1.1, "SHUTDOWN MARGIN (SDM)"; and

   b. Core outlet temperature is maintained at least 10°F below saturation temperature.

2. Reactor coolant pumps shall not be started with one or more RCS cold leg temperatures ≤ ~~152~~297°F unless ~~the pressurizer water level is < 62% or~~ the secondary water temperature of each steam generator is < 50°F above each of the RCS cold leg temperatures.

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LCO Note 2 is modified to change the temperature below which RCP operation is restricted based upon delta T between the RCS and steam generators, as stated in Section 5.4 of Enclosure 6 to this letter. This restriction exists to ensure that the first RCP start is within the limits of the LTOP design limiting heat injection transient. The 297ºF limit is based on the revised LTOP enable temperature and includes RCS temperature instrument uncertainty. Above the LTOP enable temperature limit of 297ºF, LTOP restrictions on starting RCPs do not apply.

The CNP Unit 1 TS 3.4.7 "RCS Loops – Mode 5, Loops Filled" will be revised as follows:

"LCO 3.4.7 One residual heat removal (RHR) loop shall be OPERABLE and in operation, and either:

   a. One additional RHR loop shall be OPERABLE; or

b. The secondary side water level of at least two steam generators (SGs) shall be above the lower tap of the SG wide range level instrumentation by ≥ 420 inches.

---NOTES---

1. The RHR pump of the loop in operation may be removed from operation for ≤ 1 hour per 8 hour period provided:

   a. No operations are permitted that would cause introduction of coolant into the RCS with boron concentration less than required to meet the requirements of LCO 3.1.1, "SHUTDOWN MARGIN (SDM)"; and

   b. Core outlet temperature is maintained at least 10°F below saturation temperature.

2. One required RHR loop may be inoperable for up to 2 hours for surveillance testing provided that the other RHR loop is OPERABLE and in operation.

3. Reactor coolant pumps shall not be started with one or more RCS cold leg temperatures ≤ ~~152~~297°F unless the ~~pressurizer water level is < 62% or the~~ secondary water temperature of each steam generator is < 50°F above each of the RCS cold leg temperatures.

4. All RHR loops may be removed from operation during planned heatup to MODE 4 when at least one RCS loop is in operation.

---"

LCO Note 3 is modified to change the temperature below which RCP operation is restricted based upon delta T between the RCS and steam generators, as stated in Section 5.4 of Enclosure 6 to this letter. This restriction exists to ensure that the first RCP start is within the limits of the LTOP design limiting heat injection transient. The 297ºF limit is based on the revised LTOP enable temperature and includes RCS temperature instrument uncertainty. Above the LTOP enable temperature limit of 297ºF, LTOP restrictions on starting RCPs do not apply.

<u>The CNP Unit 1 TS 3.4.10 "Pressurizer Safety Valves" will be revised as follows:</u>

"LCO 3.4.10 Three pressurizer safety valves shall be OPERABLE with lift settings ≥ 2411 psig and ≤ 2559 psig.

APPLICABILITY: MODES 1, 2, and 3,
MODE 4 with all RCS cold leg temperatures > ~~266~~297°F.

---NOTE---

The lift settings are not required to be within the LCO limits during MODES 3 and 4 for the purpose of setting the pressurizer safety valves under ambient (hot) conditions. This exception is allowed for 54 hours following entry into MODE 3 provided a preliminary cold setting was made prior to heatup.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One pressurizer safety valve inoperable.	A.1 Restore valve to OPERABLE status.	15 minutes
B. Required Action and associated Completion Time not met. OR Two or more pressurizer safety valves inoperable.	B.1 Be in MODE 3. AND B.2 Be in MODE 4 with any RCS cold leg temperatures ≤ ~~266~~297°F.	6 hours 24 hours

"

1. The Applicability in Mode 4 was changed to require pressurizer safety valves to be OPERABLE above 297ºF. The 297ºF limit is based on the revised LTOP enable temperature and includes RCS temperature instrument uncertainty, as stated in Enclosure 6 to this letter. With RCS cold leg temperature ≤297ºF TS 3.4.12, Low Temperature Overpressure Protection (LTOP) System, provides RCS overpressure protection.
2. Condition B.2 was changed to reflect the new LTOP enable temperature of 297ºF. Below this temperature TS 3.4.10 does not apply.

<u>The CNP Unit 1 TS 3.4.12 "Low Temperature Overpressure Protection (LTOP) System" will be revised as follows:</u>

"LCO 3.4.12 *An LTOP System shall be OPERABLE with ~~one of~~ the following:*

A. No safety injection (SI) pump ~~and a maximum of one charging pump~~ capable of injecting into the RCS~~, except two charging pumps may be made capable of injecting into the RCS for ≤ 1 hour for pump swap operations,~~ and ~~the following:~~

1. *The accumulators isolated, except an accumulator may be unisolated when the accumulator is depressurized and vented; pressure is less than the maximum RCS pressure for the existing RCS cold leg temperature allowed by the P/T limit curves provided in TS 3.4.3;*

2. *One of the following pressure relief capabilities:*

   a. *Two power operated relief valves (PORVs) with lift settings ≤ 435 psig The residual heat removal (RHR) suction relief valve with a setpoint ≤ 450 psig and RCS cold leg temperature ≤ 150 °F;*

   b. *One PORV with a lift setting ≤ 435 psig and the residual heat removal (RHR) suction relief valve with a setpoint ≤ 450 psig; or The residual heat removal (RHR) suction relief valve with a setpoint ≤ 450 psig and at least one RCP running;*

   c. *Two PORVs with lift settings ≤ 435 psig and the residual heat removal (RHR) suction relief valve with a setpoint ≤ 450 psig;*

   d. *Two PORVs with lift settings ≤ 435 psig and RCS cold leg temperature ≥ 210 °F; or*

   ce. *The RCS depressurized and an RCS vent of ≥ 2.0 square inches or any single PORV blocked open.*

OR

B. No SI pump and both charging pumps capable of injecting into the RCS, and the following:

1. *The accumulators isolated, except an accumulator may be unisolated when the accumulator is depressurized and vented;*

2. *Two PORVs with lift settings ≤ 435 psig;*

3. *The RHR suction relief valve with a setpoint ≤ 450 psig; and*

4. *All RCS cold leg temperatures ≥ 140 °F.*

--*NOTE*--

Reactor coolant pumps shall not be started with one or more RCS cold leg temperatures ≤ 152297 °F unless the pressurizer water level is < 62% or the secondary water temperature of each steam generator is < 50 °F above each of the RCS cold leg temperatures.

APPLICABILITY: *MODE 4 when any RCS cold leg temperature is ≤ ~~266~~297 °F,*
MODE 5,
MODE 6 when the reactor vessel head is on."

"ACTIONS

---NOTE---

LCO 3.0.4.b is not applicable when entering MODE 4.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or more SI pumps capable of injecting into the RCS.	*A.1 Initiate action to verify all SI pumps are not capable of injecting into the RCS.*	*Immediately*
~~*B. Two charging pumps capable of injecting into the RCS, when only one is allowed to be capable of injecting into the RCS.*~~	~~*B.1 Initiate action to verify a maximum of one charging pump is capable of injecting into the RCS.*~~	~~*Immediately*~~
~~*C*~~*B. An accumulator not isolated when the accumulator* ~~*is not depressurized and vented.*~~ *pressure is greater than or equal to the maximum RCS pressure for the existing cold leg temperature allowed by TS 3.4.3.*	~~*C*~~*B.1 Isolate affected accumulator.*	*1 hour*
~~*D*~~*C. Required Action and associated Completion Time of Condition* ~~*C*~~*B not met.*	~~*D*~~*C.1 Increase RCS cold leg temperature to > ~~266~~297 °F.* *<u>OR</u>* ~~*D*~~*C.2 Depressurize affected accumulator* ~~*and vent*~~ *to less than the maximum RCS pressure for existing cold leg temperature allowed in TS 3.4.3.*	*12 hours* *12 hours*

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
ED. One required RCS relief valve inoperable in MODE 4 while complying with LCO A.2.c or A.2.d.	*ED.1 Restore required RCS relief valve to OPERABLE status.*	*7 days*
FE. One required RCS relief valve inoperable in MODE 5 or 6 while complying with LCO A.2.c or A.2.d.	FE.1 Restore required RCS relief valve to OPERABLE status.	24 hours
F. Required RCP not running.	F.1 Do not start a RCP. AND F.2 Enter Condition G.	Immediately
G. Two or more required RCS relief valves inoperable. OR Required Action and associated Completion Time of Condition A, BC, D, E, or F not met. OR LTOP System inoperable for any reason other than Condition A, B, C, D, E, or F.	G.1 Depressurize RCS and establish RCS vent of ≥ 2.0 square inches or block open a single PORV.	12 hours

TS 3.4.12 is changed to ensure the new LTOP analysis (Enclosure 6) requirements are reflected in the LCO. The previous LTOP analysis, and TS, reflects the requirement to limit RCS mass injection capability to either one or two centrifugal charging pumps (CCP), dependent on RCS temperature and available relief capacity. The new LTOP analysis demonstrates that RCS overpressure protection is provided when the limiting mass injection transient is from two operating charging pumps for the full range of LTOP applicability. Therefore, the restriction on CCPs that may be in operation has been eliminated. Note that the LTOP TS continues to require the safety injection (SI) pumps to be incapable of injecting into the RCS for the full range of LTOP applicability.

The current LTOP TS states that accumulators must be isolated unless depressurized and vented. The proposed LTOP TS states that accumulators must be isolated unless accumulator pressure is less than the maximum RCS pressure for the existing RCS cold leg temperature allowed by the P/T limit curves provided in TS 3.4.3.

The proposed LCO 3.4.12 is structured as a series of five LCO conditions based on relief capabilities, RCS temperature limitations, and RCP status as applicable, that must be met to ensure RCS overpressure protection. Only one of the five LCO conditions must be met to meet the requirements of the LCO. The proposed LCO conditions are described below:

1. The new LTOP analysis demonstrates that the RHR suction safety can accommodate the most limiting mass injection transient for the full range of LTOP applicability, and the most limiting heat inject transient, startup of the first RCP, for RCS temperatures ≤ 150°F. Proposed LCO A.2.a reflects this required relief capability.

2. The new LTOP analysis documents that if a RCP is running then the most limiting heat injection transient cannot occur, and the remaining non-limiting heat injection transients can be accommodated by the RHR suction safety. In addition, the RHR suction safety can accommodate the most limiting mass injection transient for the full range of LTOP applicability. Therefore, the RHR suction safety can provide overpressure protection for the full range of LTOP applicability with one RCP running. Note that the most limiting heat injection transient is the start of the first RCP with temperature asymmetry between the SGs and the RCS, and the non-limiting heat injection transients are inadvertent pressurizer heater operation and loss of decay heat removal. Proposed LCO A.2.b reflects this required relief capability and RCP status.

3. The new LTOP analysis demonstrates that the RHR suction safety and one pressurizer PORV can accommodate the most limiting mass injection and heat injection transients for the full range of LTOP applicability. Two pressurizer PORVs must be OPERABLE for single failure considerations. Proposed LCO A.2.c reflects this required relief capability.

4. The new LTOP analysis demonstrates that one pressurizer PORV can accommodate the most limiting mass injection and heat injection transients if RCS temperature is ≥ 210°F. Two pressurizer PORVs must be OPERABLE for single failure considerations. Proposed LCO A.2.d reflects this required relief capability.

5. The new LTOP analysis demonstrates that a depressurized RCS with an RCS vent of ≥ 2.0 square inches or any single PORV blocked open can accommodate the most limiting

mass injection transient. Note that since a RCP cannot be intentionally started with the RCS vented, the most limiting heat injection transient is not expected to occur. Proposed LCO A.2.e reflects this required relief capability.

Other proposed changes to Unit 1 TS LCO 3.4.12 are as follows:

- The LCO 3.4.12 mode of applicability is changed to MODE 4 when any RCS cold leg temperature is ≤ 297°F.
- The LCO 3.4.12 note for RCP start was changed to add the new LTOP enable temperature (297ºF) and to delete the allowance to start RCPs if pressurizer level is < 62%.
- Condition B is deleted. This condition provided actions if two CCPs were capable of injecting into the RCS when only one was allowed.
- Condition C is relabeled Condition B and is reworded as follows:

  > "An accumulator not isolated when the accumulator pressure is greater than or equal to the maximum RCS pressure for the existing cold leg temperature allowed by TS 3.4.3."

- Condition D is relabeled Condition C. Action C.1 is reworded to reflect the new LTOP enable temperature (297ºF) and C.2 is reworded to reflect the new wording of Condition B.
- Condition E is relabeled as Condition D and is reworded as follows:

  > "One required RCS relief valve inoperable in MODE 4 while complying with LCO 2.c or 2.d."

- Condition F is relabeled as Condition E and is reworded as follows:

  > "One required RCS relief valve inoperable in MODE 5 or 6 while complying with LCO 2.c or 2.d."

- A new Condition F was added to provide actions if the required RCP was not running. The prescribed actions are to not start a RCP and to enter Condition G immediately.
- The second "OR" statement in Condition G was modified to reflect the new Condition B.

The following three TS Surveillance Requirements will be impacted by the proposed change as shown below.

SURVEILLANCE		FREQUENCY
SR 3.4.12.2	~~Verify no more than the maximum allowed number of charging pumps are capable of injecting into the RCS.~~ Verify the required RCP is running.	In accordance with the Surveillance Frequency Control Program

The current SR 3.4.12.2 was deleted. A new SR 3.4.12.2 to verify that the required RCP was running was added.

SR 3.4.12.3	-----NOTE----- Valve position may be verified by use of administrative means. ---------- Verify each accumulator that is required to be isolated is isolated.	In accordance with the Surveillance Frequency Control Program

Clarification wording was added to SR 3.4.12.3, as an accumulator is not always required to be isolated.

SURVEILLANCE		FREQUENCY
SR 3.4.12.8	-----NOTE----- Not required to be performed until 12 hours after decreasing RCS cold leg temperature to ≤ ~~266~~297 °F. ---------- Perform a COT on each required PORV, excluding actuation.	In accordance with the Surveillance Frequency Control Program

The LTOP enable temperature was changed to 297°F in the SR 3.4.12.8.

3.0 TECHNICAL EVALUATION

The basis for the proposed changes to the CNP Unit 1 TS RCS P/T Limit Curves is provided in Enclosure 5 to this letter, as described below. In addition, the basis for the proposed changes to the CNP U1 LTOP analysis is provided in Enclosure 6 to this letter, as described below.

Enclosure 5 to this letter contains WCAP-18455-NP, Revision 1, "D.C. Cook Unit 1 Heatup and Cooldown Limit Curves for Normal Operation," Westinghouse Electric Company, February 2020. (Non-Proprietary). The RCS P/T limit curves were generated using the K_{IC} methodology detailed in the 1998 Edition through the 2000 Addenda of the ASME Code, Section XI, Appendix G. This P/T limit curve generation methodology is consistent with the U.S. Nuclear Regulatory Commission (NRC) approved methodology documented in WCAP-14040-A, Revision 4 (Reference 1). The heatup and cooldown P/T limit curves utilize the Adjusted Reference Temperature (ART) values for CNP Unit 1 calculated using Regulatory Guide 1.99, Revision 2 (Reference 2).

Enclosure 6 to this letter contains LTR-SCS-19-50, Revision 0, "D.C. Cook Unit 1 Low Temperature Overpressure Protection System (LTOPS) Analysis for 48 EFPY", dated March 5, 2020", including Attachment 1 (Proprietary). The LTOP Power Operated Relief Valves (PORV) setpoints are selected in accordance with NRC approved methodology (Reference 1) such that the peak pressure during the design basis Mass Injection (MI) and Heat Injection (HI) transients will not exceed the isothermal Appendix G P/T limits.

3.1 Evaluation of Neutron Fluence Methodology

The neutron fluence analysis behind the current 32 EFPY P/T limits documented in WCAP-15878 (ML023460503) utilized the DORT discrete ordinates code Version 3.1 (WCAP-12483-NP Revision 1, provided to the NRC in ML023460493). The updated neutron fluence analysis provided in Enclosure 5 utilizes RAPTOR-M3G and FERRET, which is consistent with the NRC-approved methodology described in WCAP-18124-NP-A. This methodology was used to address both the beltline and extended beltline regions. NOTE: The NRC Safety Evaluation provided in WCAP-18124-NP-A is limited to the traditional RPV beltline region as there is currently no NRC-approved methodology to address the extended beltline region.

In 2014, I&M submitted a LAR, by letter dated April 9, 2014 (ML14101A367), to revise the P/T limits to account for vacuum refill. The NRC issued a request for additional information, by email dated July 21, 2014 (ML14217A325), which required I&M to address the non-beltline region of the current 32 EFPY P/T Limit curves. This request for additional information was addressed by I&M in letters dated August 15, 2014 (ML14230A677), and September 25, 2014 (ML14273A258), and accepted by the NRC in letter dated October 1, 2014 (ML14259A549).

The updated neutron fluence analysis evaluates the beltline and extended beltline regions to generate P/T limits up to 48 EFPY. In line with the conclusions previously provided to the NRC to address the extended beltline up to 32 EFPY, the updated P/T limits analysis provided in Enclosure 5 states that the beltline region continues to be limiting.

Both the current and the updated neutron fluence analyses utilize data from the most recent Surveillance Capsule withdrawal at CNP Unit 1 (WCAP-12483-NP Revision 1). Typically, P/T limits are updated after removing and analyzing a surveillance capsule, which allows the calculated data to be validated by the capsule data. However, the updated neutron fluence analysis does not rely on updated surveillance capsule data. By letter dated July 31, 2005 (ML052230442), I&M is obligated by NRC Regulatory Commitment, which in summary is as follows:

> I&M will pull and test one additional standby capsule for each unit between 32 EFPY and 48 EFPY to address the peak fluence expected at 60 years. A fluence update will be performed at approximately 32 EFPY when Capsules W (Unit 1) and S (Unit 2) are pulled and tested. A subsequent fluence update will be performed when the standby capsules are pulled and tested between 32 EFPY and 48 EFPY.

This LAR does not change the CNP surveillance capsule withdrawal schedule, and subsequent surveillance capsule analyses will be used to validate the updated neutron fluence values and P/T limits as described in the above NRC Regulatory Commitment.

3.2 Evaluation of the Allowance to have Both CCPs Capable of Injecting Into the RCS

The LTOP analysis contained in Enclosure 6 to this letter states that the design basis MI flowrate is due to both centrifugal charging pumps injecting into the RCS (with letdown isolated) for the full LTOP temperature range. The analysis results demonstrate that with the relief capabilities required by the LTOP analysis, the TS RCS over-pressurization will not occur. That is, the P/T limits of TS 3.4.3 will not be exceeded. Therefore, the LTOP TS allows both CCPs to be capable of injecting into the RCS at all times within the TS applicability.

3.3 Evaluation of the Change in Accumulator Pressure Requirements

The accumulators must be isolated unless accumulator pressure is less than the maximum RCS pressure for the existing RCS cold leg temperature allowed by the P/T limit curves provided in TS 3.4.3. This is a change from the current TS requirement that the accumulators must be isolated unless depressurized and vented. An accumulator that is depressurized to less than the maximum pressure allowed by the P/T limit curves cannot cause RCS over-pressurization. Depressurizing the accumulator to RCS pressure instead of fully depressurizing the accumulator would save the time and effort of fully depressurizing and subsequently pressurizing the accumulator. Therefore, the proposed LTOP TS allows an accumulator to be unisolated in this circumstance. Note that this more closely aligns the DC Cook Unit 1 LTOP TS with the NUREG 1431 Revision 4, Standard Technical Specifications Westinghouse Plants, verbiage for the LTOP LCO (3.4.12).

CNP operational procedures would be changed to ensure that proper controls were in place to support the proposed change.

3.4 Evaluation of the Change in LTOP Relief Capability Requirements

As determined in the LTOP analysis in Enclosure 6 to this letter, the RHR relief valve is a passive component and is not subject to single active failures. In accordance with the Enclosure 6 LTOP analysis the following RCS relief capabilities must be operable:

- For 60 ≤ T_{RCS} ≤ 150°F with zero through four RCPs running:
  - The RHR suction relief valve, with a setpoint ≤ 450 psig, is required to be operable and will protect against both the mass injection (MI) and heat injection (HI) transients.

- For 150 < T_{RCS} < 210°F:
  - With zero RCPs running:
    - The RHR suction relief valve, with a setpoint of ≤ 450 psig, is required to be operable and will protect against the MI transient; and
    - Two pressurizer PORVs, with lift settings ≤ 435 psig, are required to be operable and will protect against the HI transient.

  - With at least one RCP running:
    - The RHR suction relief valve, with a setpoint ≤ 450 psig, is required to be operable and will protect against both the MI and HI transients.

- For 210 ≤ T_{RCS} ≤ 297°F:
  - With zero RCPs running:
    - Two pressurizer PORVs, with lift settings ≤ 435 psig, are required to be operable and will protect against both the MI and HI transients.

  - With at least one RCP running:
    - The RHR suction relief valve, with a setpoint ≤ 450 psig, is required to be operable and will protect against both the MI and HI transients; or
    - Two pressurizer PORVs, with lift settings ≤ 435 psig, are required to be operable and will protect against both the MI and HI transients.

3.5 Evaluation of the Change for Unit 1 TS 3.4.12 LCO

The proposed LTOP TS requires one of the following relief capabilities to be operable:

1. The residual heat removal (RHR) suction relief valve with a setpoint ≤ 450 psig and RCS cold leg temperature ≤ 150°F.

   Basis: Proposed LCO A.2.a reflects the equipment availability required by the LTOP analysis contained in Enclosure 6. Per Enclosure 6, the RHR suction safety is capable of providing protection for both the LTOP mass injection and heat injection transients if RCS cold leg temperature is ≤ 150°F. Note the 150°F limit includes RCS temperature instrument uncertainty.

2. The residual heat removal (RHR) suction relief valve with a setpoint ≤ 450 psig and at least one RCP running.

   Basis: Proposed LCO A.2.b reflects the equipment availability required by the LTOP analysis contained in Enclosure 6. Per Enclosure 6, the RHR suction safety is capable of providing protection for the LTOP mass injection transient for the full range of LTOP applicability. Since the most limiting heat injection transient is the start of the first RCP, the requirement to verify that a RCP is already running ensures that the most limiting heat injection transient cannot occur. Note that Enclosure 6 performed an analysis to ensure that the RHR suction safety alone can prevent RCS over-pressurization during the non-limiting heat injection transients, i.e. inadvertent actuation of pressurizer heaters and loss of RHR cooling.
3. Two PORVs with lift settings ≤ 435 psig and the residual heat removal (RHR) suction relief valve with a setpoint ≤ 450 psig.

   Basis: Proposed LCO A.2.c reflects the equipment availability required by the LTOP analysis contained in Enclosure 6. Per Enclosure 6, the RHR suction safety and a single Pressurizer PORV are capable of providing protection for both the LTOP mass injection and heat injection transients for the full range of LTOP applicability. Since Pressurizer PORVs are active components both PORVs are required to be operable to provide over pressure protection in the event of a failure of one PORV.

4. Two PORVs with lift settings ≤ 435 psig and RCS cold leg temperature ≥ 210°F.

   Basis: Proposed LCO A.2.d reflects the equipment availability required by the LTOP analysis contained in Enclosure 6. Per Enclosure 6, a single Pressurizer PORV is capable of providing protection for both the LTOP mass injection and heat injection transients if RCS cold leg temperature is ≥ 210°F. Since Pressurizer PORVs are active components both PORVs are required to be operable to provide over pressure protection in the event of a failure of one PORV. Note the 210°F limit includes RCS temperature instrument uncertainty.

5. The RCS depressurized and an RCS vent of ≥ 2.0 square inches or any single PORV blocked open.

   Basis: Proposed LCO A.2.e reflects the equipment availability required by the LTOP analysis contained in Enclosure 6. Per Enclosure 6, the RCS depressurized with an RCS vent of ≥ 2.0 square inches or any single PORV blocked open provides RCS over pressure protection for the full range of LTOP applicability for the mass injection transient. Note this is not a change to the existing LTOP TS requirement, this discussion is included here to confirm that the new analysis contained in Enclosure 6 demonstrated the acceptability of this relief capability.

3.6 Evaluation of the Change for Unit 1 TS 3.4.12 Conditions

- Existing Condition B is deleted in its entirety because the analysis performed in Enclosure 6 allows both charging pumps to be in service for the full range of LTOP applicability.
- Existing Condition C is relabeled as Condition B and reworded to reflect the new requirements for accumulator isolation.
- Existing Condition D is relabeled as Condition C. Action C.1 is modified for the new LTOP enable temperature. Action C.2 is reworded to reflect the new requirements for accumulator isolation. That is, that an accumulator does not need to be isolated if accumulator pressure is less than the P/T limits curve.
- Existing Condition E is relabeled as Condition D. Condition D is modified to only apply when using LCO A.2.c or A.2.d. These LCOs require multiple relief paths operable and it is appropriate to allow time to restore a redundant relief flow path in these cases since an operable relief path remains available. LCO A.2.a and A.2.b require only the RHR suction safety operable, and the appropriate Condition to enter is Condition G if the RHR suction safety is inoperable in these circumstances.
- Existing Condition F is relabeled as Condition E. Condition E is modified to only apply when using LCO A.2.c or A.2.d. These LCOs require multiple relief paths operable and it is appropriate to allow time to restore a redundant relief flow path in these cases since an operable relief path remains available. LCO A.2.a and A.2.b require only the RHR suction safety operable, and the appropriate Condition to enter is Condition G if the RHR suction safety is inoperable in these circumstances.
- A new Condition F was added to provide the actions necessary to take if the RCP required to be running by LCO A.2.b is not running. Action F.1 ensures that a RCP is not started because this could initiate a heat injection transient, and action F.2 directs entry into Condition G to restore compliance with LTOP pressure relief requirements.
- Condition G was modified to change the second "OR" statement. Failure to comply with the action requirements of Condition B requires entry into Condition C and not Condition G. Therefore, Condition B was removed from the second "OR" statement. This change reflects the renumbering of the LCO Conditions.

3.7 Evaluation of the Change for Unit 1 TS 3.4.12 Surveillances

- The existing SR 3.4.12.2 is deleted. This SR verified no more than the maximum allowed number of charging pumps are capable of injecting into the RCS. The new LTOP analysis allows both charging pumps to be capable of injecting into the RCS at all times. Therefore, this SR is no longer applicable.
- A new SR 3.4.12.2 was added to verify the required RCP is running. If LCO A.2.b is being used to comply with LTOP requirements then one RCP must be running. One RCP running ensures that the design basis limiting heat injection transient cannot occur. This SR periodically verifies the RCP required by LCO A.2.b is running. The specified frequency is in accordance with the surveillance frequency control program.
- Clarification wording was added to SR 3.4.12.3, as an accumulator is not always required to be isolated.
- The note to SR 3.4.12.8 was modified to reflect the new LTOP enable temperature of 297ºF.

4.0 REGULATORY EVALUATION

4.1 Applicable Regulatory Requirements/Criteria

Regulatory Requirements

The proposed changes were developed in accordance with the following NRC regulations and guidance:

- 10 CFR 50 Appendix G
- Regulatory Guide (RG) 1.99, Radiation Embrittlement of Reactor Vessel Materials, Rev. 2
- ASME B&PV Code Section XI Appendix G, 1998 Edition through the 2000 Addenda
- NRC Regulatory Issue Summary (RIS) 2014-11, Information on Licensing Applications for Fracture Toughness Requirements for Ferritic Reactor Coolant Pressure Boundary Components, October 14, 2014

10 CFR 50 Appendix G, by reference to ASME B&PV Code Section XI Appendix G specifies fracture toughness and testing requirements for the RCS carbon and low alloy steel materials. 10 CFR 50 Appendix G also requires prediction of the effects of neutron irradiation on vessel embrittlement by calculating the Adjusted Reference Temperature (ART) and the Charpy Upper Shelf Energy (USE). The methods provided in RG 1.99 Rev. 2 (Reference 2), defines the ART as the sum of unirradiated reference temperature, the increase of reference temperature resulting from neutron irradiation, and a margin to account for uncertainties in the prediction method.

As described in the CNP Updated Final Safety Analysis Report, Section 1.4, the Plant Specific Design Criteria (PSDC) define the principal criteria and safety objectives for the CNP design. The following PSDC are relevant to the proposed amendment:

PSDC CRITERION 33 Reactor Coolant Pressure Boundary Capability

> *The reactor coolant pressure boundary shall be capable of accommodating without rupture the static and dynamic loads imposed on any boundary component as a result of an inadvertent and sudden release of energy to the coolant. As a design reference, this sudden release shall be taken as that which would result from a sudden reactivity insertion such as rod ejection (unless prevented by positive mechanical means), rod dropout, or cold water addition.*

The proposed changes are consistent with the above regulatory requirements and criteria. Therefore, the proposed changes will assure safe operation by continuing to meet applicable regulations and requirements.

4.2 Precedent

The methodology under which the heatup and cooldown curves were created is a standard used by Westinghouse throughout the industry. The P/T limit curve generation methodology is consistent with the NRC approved methodology documented in WCAP-14040-A, Revision 4, and has been previously approved by the NRC as listed below.

1. Letter from Thomas J. Wengert, NRC, to ANO Site Vice President (Entergy Operations, Inc.), "Arkansas Nuclear One, Unit 2 - Issuance of Amendment Re: Updating the Reactor Coolant System Pressure-Temperature Limits (EPID L-2017-LLA-0396)," dated November 27, 2018, (ADAMS Accession Number ML18298A012).

2. Letter from Douglas V. Pickett, NRC, to Vice President, Operations (Entergy Nuclear Operations, Inc.), "Indian Point Nuclear Generating Unit No. 3 – Issuance of Amendment Re: Changes to Reactor Vessel Heatup and Cooldown Curves and Low Temperature Overpressure Protection system Requirements (TAC No. MF5746)," dated September 3, 2015, (ADAMS Accession Number ML15226A159).

3. Letter from Richard V. Guzman, NRC, to Scott Batson (Duke Energy Carolinas, LLC), "Oconee Nuclear Station, Units 1, 2, and 3, Issuance of Amendments Regarding Revised Pressure-Temperature Limits (TAC Nos. MF0763, MF 0764, and MF0765)," dated February 27, 2014, (ADAMS Accession Number ML14041A093).

4.3 No Significant Hazards Considenation

This LAR to the CNP Unit 1 TS proposes to revise TS 3.4.3, "Reactor Coolant System (RCS) Pressure and Temperature (P/T) Limits", to update Figures 3.4.3-1 "Reactor Coolant System Pressure versus Temperature Limits – Heatup Limit, Criticality Limit, and Leak Test Limit (Applicable for service period up to 32 EFPY)" and 3.4.3-2 "Reactor Coolant System Pressure versus Temperature Limits – Various Cooldown Rates Limits (Applicable for service period up to 32 EFPY)" with revised P/T limits applicable up to 48 Effective Full Power Years (EFPY).

In addition, I&M proposes to change CNP Unit 1 TS 3.4.12, "Low Temperature Overpressure Protection (LTOP) System," to align with an updated LTOP analysis. The proposed changes to the LTOP requirements in 3.4.12 will also require RCS temperature limit changes to be made to TS 3.4.6, 3.4.7, and 3.4.10.

TS Figures 3.4.3-1 and 3.4.3-2 provide the RCS pressure versus temperature limits for various modes of reactor operation. These curves specify safe zones of reactor operation under varying RCS pressure and temperature conditions.

As required by 10 CFR 50.91(a), the CNP analysis of the issue of no significant hazards consideration is presented below:

1. *Does the proposed amendment involve a significant increase in the probability or consequences of an accident previously evaluated?*

Response: No.

The proposed TS changes do not involve a significant increase in the probability or consequences of an accident previously evaluated. There are no physical changes to the plant being introduced by the proposed changes to the heatup and cooldown limitation curves or the LTOP analysis. The proposed changes do not modify the RCS pressure boundary. That is, there are no changes in operating pressure, materials, or seismic loading. The proposed changes do not adversely affect the integrity of the RCS pressure boundary such that its function in the control of radiological consequences is affected.

Therefore, it is concluded that the proposed amendment does not involve a significant increase in the probability or the consequences of an accident previously evaluated.

2. *Does the proposed amendment create the possibility of a new or different kind of accident from any accident previously evaluated?*

Response: No.

The proposed TS changes do not create the possibility of a new or different kind of accident from any accident previously evaluated. No new modes of operation are introduced by the proposed changes. The proposed changes will not create any failure mode not bounded by previously evaluated accidents. Further, the proposed changes to the heatup and cooldown limitation curves and LTOP analysis do not affect any activities or equipment other than the RCS pressure boundary and do not create the possibility of a new or different kind of accident from any accident previously evaluated.

Therefore, the proposed changes do not create the possibility of a new or different kind of accident, from any accident previously evaluated.

3. *Does the proposed amendment involve a significant reduction in a margin of safety?*

Response: No.

The proposed TS changes do not involve a significant reduction in the margin of safety. The proposed RCS P/T limit curves will continue to provide adequate margins of protection for the reactor coolant pressure boundary (RCPB). The methodologies used in the supporting analyses are in accordance with the criteria set forth in the applicable regulations and do not involve a significant reduction in the margin of safety. The operating limits established by the updated P/T limit curves provide margin against non-ductile failure of the RCPB per the requirements of 10 CFR 50, Appendix G.

Therefore, the proposed amendment does not involve a significant reduction in margin of safety.

4.4 Conclusions

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

5.0 ENVIRONMENTAL CONSIDERATION

I&M has evaluated the proposed amendments for environmental considerations. The review has resulted in the determination that the proposed amendment would change a requirement with respect to installation or use of a facility component located within the restricted area, as defined in 10 CFR 20. However, the proposed amendments do not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluent that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed amendments meet the eligibility criterion for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed amendments.

6.0 REFERENCES

1. WCAP-14040-A, Revision 4, "Methodology Used to Develop Cold Overpressure Mitigating System Setpoints and RCS Heatup and Cooldown Limit Curves," May 2004.

2. Regulatory Guide 1.99, "Radiation Embrittlement of Reactor Vessel Materials," Revision 2, May 1988.

Enclosure 3 to AEP-NRC-2020-01

Donald C. Cook Nuclear Plant Unit 1 Technical Specification Pages
Marked To Show Proposed Changes

3.4.3-3
3.4.3-4
3.4.6-1
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3.4.10-1
3.4.12-1
3.4.12-2
3.4.12-3
3.4.12-4
3.4.12-5

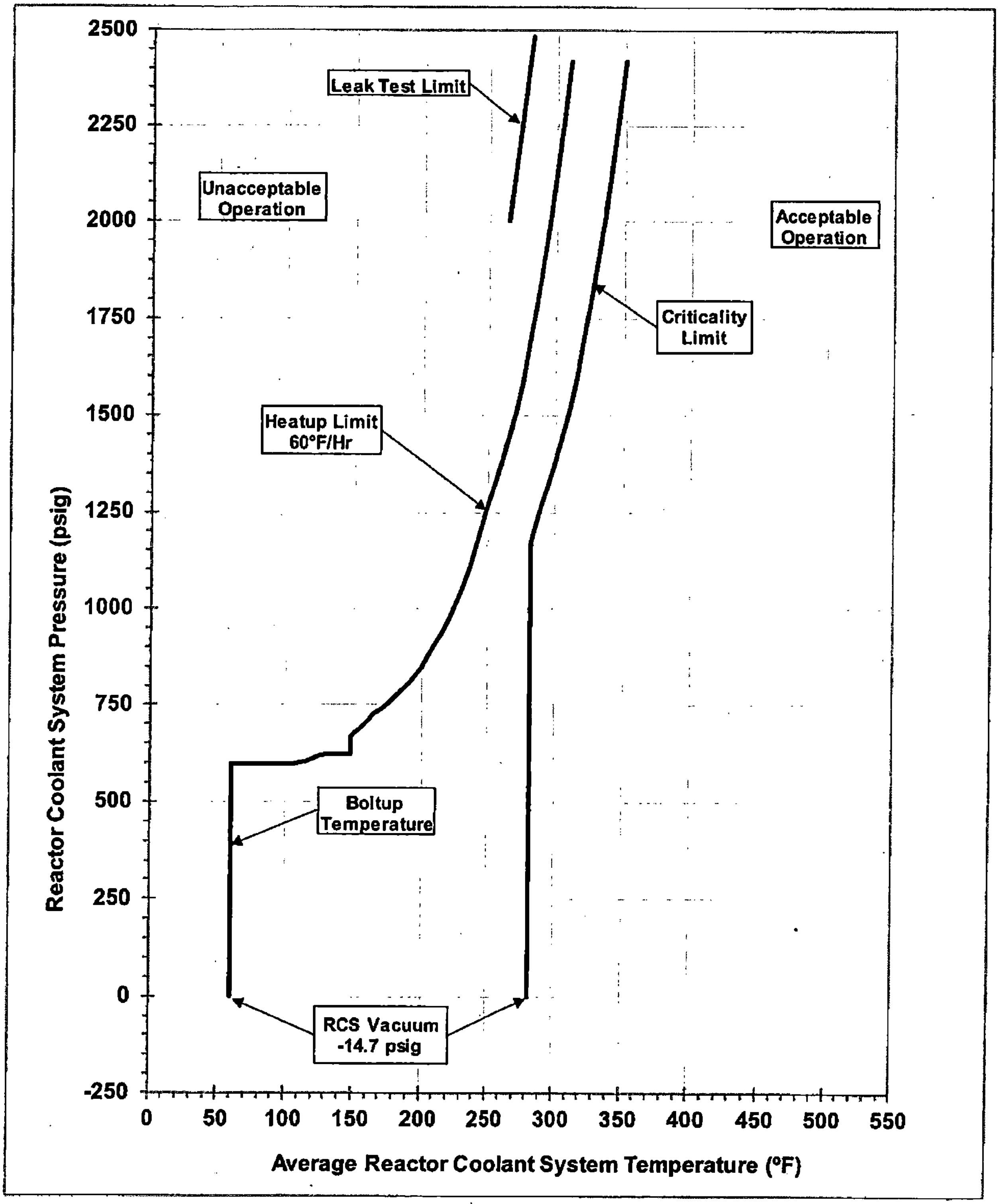

Figure 3.4.3-1 (page 1 of 1)
Reactor Coolant System Pressure versus Temperature Limits -
Heatup Limit, Criticality Limit, and Leak Test Limit
(Applicable for service period up to ~~32~~48 EFPY and during vacuum fill)

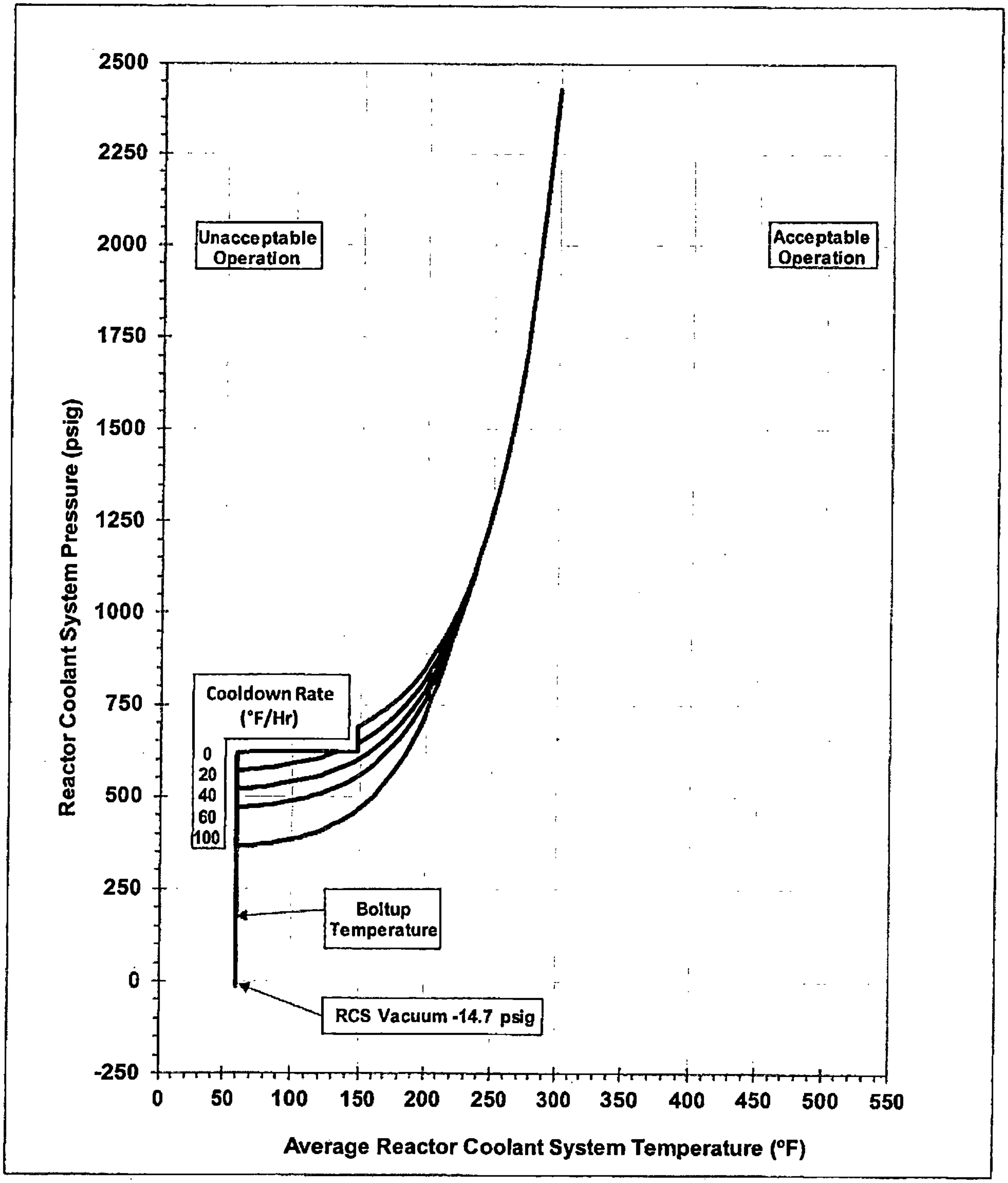

Figure 3.4.3-2 (page 1 of 1)
Reactor Coolant System Pressure versus Temperature Limits -
Various Cooldown Rates Limits
(Applicable for service period up to ~~32~~48 EFPY and during vacuum fill)

3.4 REACTOR COOLANT SYSTEM (RCS)

3.4.6 RCS Loops - MODE 4

LCO 3.4.6

Two loops consisting of any combination of RCS loops and residual heat removal (RHR) loops shall be OPERABLE, and one loop shall be in operation.

---NOTES---

1. All reactor coolant pumps (RCPs) and RHR pumps may be removed from operation for ≤ 1 hour per 8 hour period provided:

    a. No operations are permitted that would cause introduction of coolant into the RCS with boron concentration less than required to meet the requirements of LCO 3.1.1, "SHUTDOWN MARGIN (SDM)"; and

    b. Core outlet temperature is maintained at least 10°F below saturation temperature.

2. Reactor coolant pumps shall not be started with one or more RCS cold leg temperatures ≤ ~~152~~297°F unless ~~the pressurizer water level is < 62% or~~ the secondary water temperature of each steam generator is < 50°F above each of the RCS cold leg temperatures.

APPLICABILITY: MODE 4.

ACTIONS

CONDITION	REQUIRED ACTION		COMPLETION TIME
A. One required loop inoperable.	A.1	Initiate action to restore a second loop to OPERABLE status.	Immediately
	AND		
	A.2	--------------NOTE-------------- Only required if RHR loop is OPERABLE. ------------------------------------ Be in MODE 5.	24 hours

3.4 REACTOR COOLANT SYSTEM (RCS)

3.4.7 RCS Loops - MODE 5, Loops Filled

LCO 3.4.7 One residual heat removal (RHR) loop shall be OPERABLE and in operation, and either:

a. One additional RHR loop shall be OPERABLE; or

b. The secondary side water level of at least two steam generators (SGs) shall be above the lower tap of the SG wide range level instrumentation by ≥ 420 inches.

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

1. The RHR pump of the loop in operation may be removed from operation for ≤ 1 hour per 8 hour period provided:

   a. No operations are permitted that would cause introduction of coolant into the RCS with boron concentration less than required to meet the requirements of LCO 3.1.1, "SHUTDOWN MARGIN (SDM)"; and

   b. Core outlet temperature is maintained at least 10°F below saturation temperature.

2. One required RHR loop may be inoperable for up to 2 hours for surveillance testing provided that the other RHR loop is OPERABLE and in operation.

3. Reactor coolant pumps shall not be started with one or more RCS cold leg temperatures ≤ ~~152~~297°F unless the ~~pressurizer water level is < 62% or the~~ secondary water temperature of each steam generator is < 50°F above each of the RCS cold leg temperatures.

4. All RHR loops may be removed from operation during planned heatup to MODE 4 when at least one RCS loop is in operation.

APPLICABILITY: MODE 5 with RCS Loops Filled.

3.4 REACTOR COOLANT SYSTEM (RCS)

3.4.10 Pressurizer Safety Valves

LCO 3.4.10 Three pressurizer safety valves shall be OPERABLE with lift settings ≥ 2411 psig and ≤ 2559 psig.

APPLICABILITY: MODES 1, 2, and 3,
MODE 4 with all RCS cold leg temperatures > ~~266~~297°F.

-----NOTE-----
The lift settings are not required to be within the LCO limits during MODES 3 and 4 for the purpose of setting the pressurizer safety valves under ambient (hot) conditions. This exception is allowed for 54 hours following entry into MODE 3 provided a preliminary cold setting was made prior to heatup.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One pressurizer safety valve inoperable.	A.1 Restore valve to OPERABLE status.	15 minutes
B. Required Action and associated Completion Time not met. OR Two or more pressurizer safety valves inoperable.	B.1 Be in MODE 3. AND B.2 Be in MODE 4 with any RCS cold leg temperatures ≤ ~~266~~297°F.	6 hours 24 hours

3.4 REACTOR COOLANT SYSTEM (RCS)

3.4.12 Low Temperature Overpressure Protection (LTOP) System

LCO 3.4.12

An LTOP System shall be OPERABLE with ~~one of~~ the following:

A. No safety injection (SI) pump ~~and a maximum of one charging pump~~ capable of injecting into the RCS~~, except two charging pumps may be made capable of injecting into the RCS for ≤ 1 hour for pump swap operations,~~ and ~~the following~~:

1. The accumulators isolated, except an accumulator may be unisolated when the accumulator ~~is depressurized and vented;~~ pressure is less than the maximum RCS pressure for the existing RCS cold leg temperature allowed by the P/T limit curves provided in TS 3.4.3;

2. One of the following pressure relief capabilities:

   a. ~~Two power operated relief valves (PORVs) with lift settings ≤ 435 psig~~ The residual heat removal (RHR) suction relief valve with a setpoint ≤ 450 psig and RCS cold leg temperature ≤ 150°F;

   b. ~~One PORV with a lift setting ≤ 435 psig and the residual heat removal (RHR) suction relief valve with a setpoint ≤ 450 psig; or~~ The residual heat removal (RHR) suction relief valve with a setpoint ≤ 450 psig and at least one RCP running;

   c. Two PORVs with lift settings ≤ 435 psig and the residual heat removal (RHR) suction relief valve with a setpoint ≤ 450 psig;

   d. Two PORVs with lift settings ≤ 435 psig and RCS cold leg temperature ≥ 210°F; or

   ~~c~~e. The RCS depressurized and an RCS vent of ≥ 2.0 square inches or any single PORV blocked open.

~~OR~~

~~B. No SI pump and both charging pumps capable of injecting into the RCS, and the following:~~

~~1. The accumulators isolated, except an accumulator may be unisolated when the accumulator is depressurized and vented;~~

~~2. Two PORVs with lift settings ≤ 435 psig;~~

~~3. The RHR suction relief valve with a setpoint ≤ 450 psig; and~~

~~4. All RCS cold leg temperatures ≥ 140°F.~~

-----NOTE-----

Reactor coolant pumps shall not be started with one or more RCS cold leg temperatures ≤ ~~152~~297°F unless the ~~pressurizer water level is < 62% or the~~ secondary water temperature of each steam generator is < 50°F above each of the RCS cold leg temperatures.

APPLICABILITY: MODE 4 when any RCS cold leg temperature is ≤ ~~266~~297°F,
MODE 5,
MODE 6 when the reactor vessel head is on.

ACTIONS

-----NOTE-----

LCO 3.0.4.b is not applicable when entering MODE 4.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or more SI pumps capable of injecting into the RCS.	A.1 Initiate action to verify all SI pumps are not capable of injecting into the RCS.	Immediately
~~B. Two charging pumps capable of injecting into the RCS, when only one is allowed to be capable of injecting into the RCS.~~	~~B.1 Initiate action to verify a maximum of one charging pump is capable of injecting into the RCS.~~	~~Immediately~~
~~C~~B. An accumulator not isolated when the accumulator ~~is not depressurized and vented.~~ pressure is greater than or equal to the maximum RCS pressure for the existing cold leg temperature allowed by TS 3.4.3.	~~C~~B.1 Isolate affected accumulator.	1 hour

~~D~~C. Required Action and associated Completion Time of Condition ~~C~~B not met.	~~D~~C.1 Increase RCS cold leg temperature to > ~~266~~297°F. OR ~~D~~C.2 Depressurize affected accumulator ~~and vent~~ to less than the maximum RCS pressure for existing cold leg temperature allowed in TS 3.4.3.	12 hours 12 hours
~~E~~D. One required RCS relief valve inoperable in MODE 4 while complying with LCO A.2.c or A.2.d.	~~E~~D.1 Restore required RCS relief valve to OPERABLE status.	7 days
~~F~~E. One required RCS relief valve inoperable in MODE 5 or 6 while complying with LCO A.2.c or A.2.d.	~~F~~E.1 Restore required RCS relief valve to OPERABLE status.	24 hours
F. Required RCP not running.	F.1 Do not start a RCP. AND F.2 Enter Condition G.	Immediately
G. Two or more required RCS relief valves inoperable. OR Required Action and associated Completion Time of Condition A, ~~B~~C, D, E, or F not met. OR LTOP System inoperable for any reason other than Condition A, B, C, D, E, or F.	G.1 Depressurize RCS and establish RCS vent of ≥ 2.0 square inches or block open a single PORV.	12 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.4.12.1	Verify no SI pumps are capable of injecting into the RCS.	In accordance with the Surveillance Frequency Control Program
SR 3.4.12.2	~~Verify no more than the maximum allowed number of charging pumps are capable of injecting into the RCS.~~ Verify the required RCP is running.	In accordance with the Surveillance Frequency Control Program
SR 3.4.12.3	-----NOTE----- Valve position may be verified by use of administrative means. ----- Verify each accumulator that is required to be isolated is isolated.	In accordance with the Surveillance Frequency Control Program
SR 3.4.12.4	Verify RHR suction isolation valves are open for the required RHR suction relief valve.	In accordance with the Surveillance Frequency Control Program
SR 3.4.12.5	Verify required RCS vent ≥ 2.0 square inches open or a single PORV blocked open.	In accordance with the Surveillance Frequency Control Program
SR 3.4.12.6	Verify PORV block valve is open for each required PORV.	In accordance with the Surveillance Frequency Control Program
SR 3.4.12.7	Verify pressure in each required emergency air tank bank is ≥ 900 psig.	In accordance with the Surveillance Frequency Control Program

	SURVEILLANCE	FREQUENCY
SR 3.4.12.8	------------------------------NOTE------------------------------ Not required to be performed until 12 hours after decreasing RCS cold leg temperature to ≤ ~~266~~297°F. --- Perform a COT on each required PORV, excluding actuation.	In accordance with the Surveillance Frequency Control Program
SR 3.4.12.9	Perform CHANNEL CALIBRATION for each required PORV actuation channel.	In accordance with the Surveillance Frequency Control Program

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B 3.4.3-1 to B 3.4.3-6
B 3.4.6-2
B 3.4.7-2
B 3.4.10-1
B 3.4.10-3
B 3.4.12-1 to B 3.4.12-16

B 3.4 REACTOR COOLANT SYSTEM (RCS)

B 3.4.3 RCS Pressure and Temperature (P/T) Limits

BASES

BACKGROUND

All components of the RCS are designed to withstand effects of cyclic loads due to system pressure and temperature changes. These loads are introduced by startup (heatup) and shutdown (cooldown) operations, power transients, and reactor trips. This LCO limits the pressure and temperature changes during RCS heatup and cooldown, within the design assumptions and the stress limits for cyclic operation.

This LCO contains P/T limit curves for heatup, cooldown, inservice leak and hydrostatic (ISLH) testing, criticality, and data for the maximum rate of change of reactor coolant temperature (Ref. 1).

Each P/T limit curve defines an acceptable region for normal operation. The usual use of the curves is operational guidance during heatup or cooldown maneuvering, when pressure and temperature indications are monitored and compared to the applicable curve to determine that operation is within the allowable region. Vacuum fill of the RCS is performed in Mode 5 under sub-atmospheric pressure and isothermal RCS conditions. Vacuum fill is an acceptable condition since the resulting pressure/ temperature combination is reflected on the operating limits provided in Figures 3.4.3-1 and 3.4.3-2. Insert 1

The LCO establishes operating limits that provide a margin to ~~brittle~~ non-ductile failure of the ~~reactor vessel and piping of the~~ reactor coolant pressure boundary (RCPB)~~. The vessel is the component most subject to brittle failure, and the LCO limits apply mainly to the vessel. The limits do not apply to the pressurizer, which has different design characteristics and operating functions.~~ Insert 2.

10 CFR 50, Appendix G (Ref. 2), requires the establishment of P/T limits for specific material fracture toughness requirements of the RCPB materials. Reference 2 requires an adequate margin to ~~brittle~~ non-ductile failure during normal operation, anticipated operational occurrences, and system inservice hydrostatic leak tests. It mandates the use of the American Society of Mechanical Engineers (ASME) Code, Section ~~III~~ XI, Appendix G (Ref. 3).

The neutron embrittlement effect on the material toughness is reflected by increasing the nil ductility reference temperature (RT_{NDT}) as exposure to neutron fluence increases.

The actual shift in the RT_{NDT} of the vessel material will be established periodically using the methodology provided in Regulatory Guide 1.99, Revision 2. These calculated values are periodically confirmed by removing and evaluating the irradiated reactor vessel material specimens, in accordance with ASTM E 185 (Ref. 4) and Appendix H of 10 CFR 50

(Ref. 5). The operating P/T limit curves will be adjusted, as necessary, based on the evaluation findings ~~and the recommendations of Regulatory Guide 1.99 (Ref. 6)~~ using the methodology provided in Appendix G to the ASME Section XI Code (Ref 2).

The P/T limit curves are composite curves established by superimposing limits derived from stress analyses of those portions of the reactor vessel and head that are the most restrictive. At any specific pressure, temperature, and temperature rate of change, one location within the reactor vessel will dictate the most restrictive limit. Across the span of the P/T limit curves, different locations are more restrictive, and, thus, the curves are composites of the most restrictive regions.

The heatup curve represents a different set of restrictions than the cooldown curve because the directions of the thermal gradients through the vessel wall are reversed. The thermal gradient reversal alters the location of the tensile stress between the outer and inner walls.

The criticality limit curve includes the Reference 2 requirement that it be ≥ 40°F above the heatup curve or the cooldown curve, and not less than the minimum permissible temperature for ISLH testing. However, the criticality curve is not operationally limiting; a more restrictive limit exists in LCO 3.4.2, "RCS Minimum Temperature for Criticality."

The consequence of violating the LCO limits is that the RCS has been operated under conditions that can ~~result in brittle~~ challenge the margins against non-ductile failure of the RCPB, possibly leading to a nonisolable leak or loss of coolant accident. In the event these limits are exceeded, an evaluation must be performed to determine the effect on the structural integrity of the RCPB components. The ASME Code, Section XI, Appendix E (Ref. 7), provides a recommended methodology for evaluating an operating event that causes an excursion outside the limits.

APPLICABLE SAFETY ANALYSES

The P/T limits are not derived from Design Basis Accident (DBA) analyses. They are prescribed during normal operation to avoid encountering pressure, temperature, and temperature rate of change conditions that might cause undetected flaws to propagate and cause nonductile failure of the RCPB, an unanalyzed condition. ~~Reference 1 establishes the methodology for determining the P/T limits.~~ Although the P/T limits are not derived from any DBA, the P/T limits are acceptance limits since they preclude operation in an unanalyzed condition.

RCS P/T limits satisfy Criterion 2 of 10 CFR 50.36(c)(2)(ii).

LCO

The two elements of this LCO are:

a. The limit curves for heatup, cooldown, criticality, and ISLH testing; and

b. Limits on the rate of change of temperature.

BASES

LCO (continued)

The LCO limits apply to all components of the RCS, except the pressurizer. Because the pressurizer is subjected to insurges and outsurges and it is used to control RCS pressure, it experiences higher heatup and cooldown rates which have been analyzed separately. ~~These limits define allowable operating regions and permit a large number of operating cycles while providing a wide margin to nonductile failure.~~

The limits for the rate of change of temperature control the thermal gradient through the vessel wall and are used as inputs for calculating the heatup, cooldown, and ISLH testing P/T limit curves. Thus, the LCO for the rate of change of temperature restricts stresses caused by thermal gradients and also ensures the validity of the P/T limit curves.

Violating the LCO limits places the reactor vessel outside of the bounds of the ~~stress~~ analyses and can increase stresses in other RCPB components. The consequences depend on several factors, as follow:

a. The severity of the departure from the allowable operating P/T regime or the severity of the rate of change of temperature;

b. The length of time the limits were violated (longer violations allow the temperature gradient in the thick vessel walls to become more pronounced); and

c. The existences, sizes, and orientations of flaws in the vessel material.

APPLICABILITY

The RCS P/T limits LCO provides a definition of acceptable operation for prevention of nonductile failure in accordance with 10 CFR 50, Appendix G (Ref. 2). Although the P/T limits were developed ~~to provide guidance~~ for operation during heatup or cooldown (MODES 3, 4, and 5) or ISLH testing, their Applicability is at all times in keeping with the concern for nonductile failure~~. The limits do not apply to the pressurizer~~.

During MODES 1 and 2, other Technical Specifications provide limits for operation that can be more restrictive than or can supplement these P/T limits. LCO 3.4.1, "RCS Pressure, Temperature, and Flow Departure from Nucleate Boiling (DNB) Limits," LCO 3.4.2, "RCS Minimum Temperature for Criticality," and Safety Limit 2.1, "Safety Limits," also provide operational restrictions for ~~pressure and~~ temperature and maximum pressure. Furthermore, MODES 1 and 2 are above the temperature range of concern for nonductile failure, and ~~stress~~ analyses have been performed for normal maneuvering profiles, such as power ascension or descent.

BASES

ACTIONS

A.1 and A.2

Operation outside the P/T limits during MODE 1, 2, 3, or 4 must be corrected so that the RCPB is returned to a condition that has been verified by ~~stress~~ analyses.

The 30 minute Completion Time reflects the urgency of restoring the parameters to within the analyzed range. Most violations will not be severe, and the activity can be accomplished in this time in a controlled manner.

Besides restoring operation within limits, an evaluation is required to determine if RCS operation can continue. The evaluation must verify the RCPB integrity remains acceptable and must be completed within 72 hours. The evaluation must include an analysis to determine the effects of the out-of-limit condition on the fracture toughness properties of the RCS. Several methods may be used, including comparison with pre-analyzed ~~transients~~ conditions in the ~~stress~~ analyses, new analyses, or inspection of the components.

ASME Code, Section XI, Appendix E (Ref. 7), may be used to support the evaluation. However, its use is restricted to evaluation of the vessel beltline.

The 72 hour Completion Time is reasonable to accomplish the evaluation. The evaluation for a mild violation is possible within this time, but more severe violations may require special, event specific stress analyses or inspections.

Condition A is modified by a Note requiring Required Action A.2 to be completed whenever the Condition is entered. The Note emphasizes the need to perform the evaluation of the effects of the excursion outside the allowable limits. Restoration alone per Required Action A.1 is insufficient because higher than analyzed stresses may have occurred and may have affected the RCPB integrity.

B.1 and B.2

If any Required Action and associated Completion Time of Condition A is not met, the unit must be placed in a lower MODE because either the RCS remained in an unacceptable P/T region for an extended period of time or a sufficiently severe event resulted in a determination that the RCS is or may be unacceptable for continued operation. Either possibility indicates a need for more careful examination of the event, best accomplished with the RCS at reduced pressure and temperature. In reduced pressure and temperature conditions, the possibility of propagation ~~with~~ of undetected flaws is decreased.

BASES

ACTIONS (continued)

If the required restoration activity cannot be accomplished within 30 minutes, Required Action B.1 and Required Action B.2 must be implemented to reduce pressure and temperature.

If the required evaluation for continued operation cannot be accomplished within 72 hours or the results are indeterminate or unfavorable, action must proceed to reduce pressure and temperature as specified in Required Action B.1 and Required Action B.2. A favorable evaluation must be completed and documented before returning to operating pressure and temperature conditions.

Pressure and temperature are reduced by bringing the unit to MODE 3 within 6 hours and to MODE 5 with RCS pressure < 500 psig within 36 hours.

The allowed Completion Times are reasonable, based on operating experience, to reach the required unit conditions from full power conditions in an orderly manner and without challenging unit systems.

C.1 and C.2

Actions must be initiated immediately to correct operation outside of the P/T limits at times other than when in MODE 1, 2, 3, or 4, so that the RCPB is returned to a condition that has been verified by stress analysis.

The immediate Completion Time reflects the urgency of initiating action to restore the parameters to within the analyzed range. Most violations will not be severe, and the activity can be accomplished in this time in a controlled manner.

Besides restoring operation within limits, an evaluation is required to determine if RCS operation can continue. The evaluation must verify that the RCPB integrity remains acceptable and must be completed prior to entry into MODE 4. The evaluation must include an analysis to determine the effects of the out-of-limit condition on the fracture toughness properties of the RCS. Several methods may be used, including comparison with pre-analyzed ~~transients~~conditions in the ~~stress~~ analyses, or inspection of the components.

ASME Code, Section XI, Appendix E (Ref. 7), may be used to support the evaluation. However, its use is restricted to evaluation of the vessel beltline.

BASES

ACTIONS (continued)

Condition C is modified by a Note requiring Required Action C.2 to be completed whenever the Condition is entered. The Note emphasizes the need to perform the evaluation of the effects of the excursion outside the allowable limits. Restoration alone per Required Action C.1 is insufficient because higher than analyzed stresses may have occurred and may have affected the RCPB integrity.

SURVEILLANCE REQUIREMENTS

SR 3.4.3.1

Verification that operation is within limits is required when RCS pressure and temperature conditions are undergoing planned changes. The Surveillance Frequency is controlled under the Surveillance Frequency Control Program.

Surveillance for heatup, cooldown, or ISLH testing may be discontinued when the definition given in the relevant plant procedure for ending the activity is satisfied.

This SR is modified by a Note that only requires this SR to be performed during system heatup, cooldown, and ISLH testing. No SR is given for criticality operations because LCO 3.4.2 contains a more restrictive requirement.

REFERENCES

1. ~~WCAP-15878, Rev. 0, dated December 2002.~~ WCAP-18455-NP, Rev. 1, dated February 2020

2. 10 CFR 50, Appendix G.

3. ASME, Boiler and Pressure Vessel Code, Section ~~III~~ XI, Appendix G.

4. ASTM E 185-82, July 1982.

5. 10 CFR 50, Appendix H.

6. Regulatory Guide 1.99, Revision 2, May 1988.

7. ASME, Boiler and Pressure Vessel Code, Section XI, Appendix E.

Insert 1

Operation is permitted in the region located to the right and below the curves provided in Figures 3.4.3-1 and 3.4.3-2. Conversely, operation in the region located to the left and above the curves is not permitted. These curves were developed without allowance for instrumentation uncertainties. The curves in the plant operating procedures are adjusted to account for the instrumentation uncertainties associated with the actual instruments used to implement these curves.

Insert 2

components fabricated from low alloy steel. The reactor vessel is the most limiting RCPB component subjected to neutron irradiation embrittlement. However, the remainder of the RCPB components fabricated from low alloy steel (e.g., steam generators, pressurizer, etc.) have also been considered in the analysis. These components were analyzed to the applicable ASME Code Section III Editions and met the requirements at the time of construction.

BASES

LCO (continued)

Utilization of the Note is permitted provided the following conditions are met:

a. No operations are permitted that would dilute the RCS boron concentration with coolant with boron concentrations less than required to meet the requirements of LCO 3.1.1, "SHUTDOWN MARGIN (SDM)," therefore maintaining the margin to criticality. Boron reduction with coolant at boron concentrations less than required to assure SDM is maintained is prohibited because a uniform concentration distribution throughout the RCS cannot be ensured when in natural circulation; and

b. Core outlet temperature is maintained at least 10°F below saturation temperature, so that no vapor bubble may form and possibly cause a natural circulation flow obstruction.

Note 2 requires that the secondary side water temperature of each SG be < 50°F above each of the RCS cold leg temperatures ~~or the pressurizer water level be < 62%~~ before the start of an RCP with any RCS cold leg temperature ≤ ~~152~~297°F. This restraint is to prevent a low temperature overpressure event due to a thermal transient when an RCP is started.

An OPERABLE RCS loop comprises an OPERABLE RCP and an OPERABLE SG, which has the minimum water level specified in SR 3.4.6.2.

Similarly for the RHR System, an OPERABLE RHR loop comprises an OPERABLE RHR pump (either the east or west) capable of providing forced flow to an OPERABLE RHR heat exchanger. RCPs and RHR pumps are OPERABLE if they are capable of being powered and are able to provide forced flow if required. Management of gas voids is important to RHR System OPERABILITY.

APPLICABILITY

In MODE 4, this LCO ensures forced circulation of the reactor coolant to remove decay heat from the core and to provide proper boron mixing. One loop of either RCS or RHR provides sufficient circulation for these purposes. However, two loops consisting of any combination of RCS and RHR loops are required to be OPERABLE to meet single failure considerations.

Operation in other MODES is covered by:

LCO 3.4.4, "RCS Loops - MODES 1 and 2";
LCO 3.4.5, "RCS Loops - MODE 3";
LCO 3.4.7, "RCS Loops - MODE 5, Loops Filled";
LCO 3.4.8, "RCS Loops - MODE 5, Loops Not Filled";

BASES

LCO

The purpose of this LCO is to require that at least one of the RHR loops be OPERABLE and in operation with an additional RHR loop OPERABLE or two SGs with secondary side water level above the lower tap of the SG wide range level instrumentation by ≥ 420 inches. One RHR loop provides sufficient forced circulation to perform the safety functions of the reactor coolant under these conditions. An additional RHR loop is required to be OPERABLE to meet single failure considerations. However, if the standby RHR loop is not OPERABLE, an acceptable alternate method is two SGs with their secondary side water levels above the lower tap of the SG wide range level instrumentation by ≥ 420 inches. Should the operating RHR loop fail, the SGs could be used to remove the decay heat via natural circulation.

Note 1 permits all RHR pumps to be removed from operation ≤ 1 hour per 8 hour period. The purpose of the Note is to permit the RHR pump to be removed from operation when switching operation from one RHR loop or flowpath to another. The 1 hour time period is adequate to switch the RHR loops, and operating experience has shown that boron stratification is not likely during this short period with no forced flow.

Utilization of Note 1 is permitted provided the following conditions are met:

a. No operations are permitted that would dilute the RCS boron concentration with coolant with boron concentrations less than required to meet the requirements of LCO 3.1.1, "SHUTDOWN MARGIN (SDM)," therefore maintaining the margin to criticality. Boron reduction with coolant at boron concentrations less than required to assure SDM is maintained is prohibited because a uniform concentration distribution throughout the RCS cannot be ensured when in natural circulation; and

b. Core outlet temperature is maintained at least 10°F below saturation temperature, so that no vapor bubble may form and possibly cause a natural circulation flow obstruction.

Note 2 allows one RHR loop to be inoperable for a period of up to 2 hours, provided that the other RHR loop is OPERABLE and in operation. This permits periodic surveillance tests to be performed on the inoperable loop during the only time when such testing is safe and possible.

Note 3 requires that the secondary side water temperature of each SG be < 50°F above each of the RCS cold leg temperatures ~~or the pressurizer water level be < 62%~~ before the start of a~~n~~ reactor coolant pump (RCP) with an RCS cold leg temperature < ~~152~~297°F. This restriction

B 3.4 REACTOR COOLANT SYSTEM (RCS)

B 3.4.10 Pressurizer Safety Valves

BASES

BACKGROUND

The pressurizer safety valves provide, in conjunction with the Reactor Trip System, overpressure protection for the RCS. The pressurizer safety valves are totally enclosed pop type, spring loaded, self actuated valves with backpressure compensation. The safety valves are designed to prevent the system pressure from exceeding the system Safety Limit (SL), 2735 psig, which is 110% of the design pressure.

Because the safety valves are totally enclosed and self actuating, they are considered independent components. The relief capacity for each valve, 420,000 lb/hr, is based on postulated overpressure transient conditions resulting from a complete loss of steam flow to the turbine. This event results in the maximum surge rate into the pressurizer, which specifies the minimum relief capacity for the safety valves. The discharge flow from the pressurizer safety valves is directed to the pressurizer relief tank. An acoustic flow monitor and a temperature indicator on each valve discharge alerts the operator to the passage of steam due to leakage or valve lifting.

Overpressure protection is required in MODES 1, 2, 3, 4, and 5; however, in MODE 4, with one or more RCS cold leg temperatures ≤ ~~266~~297°F, and MODE 5 and MODE 6 with the reactor vessel head on, overpressure protection is provided by operating procedures and by meeting the requirements of LCO 3.4.12, "Low Temperature Overpressure Protection (LTOP) System."

The upper and lower pressure limits are based on the ± 3% tolerance requirement (Ref. 1) for lifting pressures above 1000 psig. The lift setting is for the ambient conditions associated with MODES 1, 2, and 3. This requires either that the valves be set hot or that a correlation between hot and cold settings be established.

The pressurizer safety valves are part of the primary success path and mitigate the effects of postulated accidents. OPERABILITY of the safety valves ensures that the RCS pressure will be limited to 110% of design pressure. The consequences of exceeding the American Society of Mechanical Engineers (ASME) pressure limit (Ref. 1) could include damage to RCS components, increased leakage, or a requirement to perform additional stress analyses prior to resumption of reactor operation.

BASES

APPLICABILITY (continued)

The LCO is not applicable in MODE 4 when any RCS cold leg temperatures are ≤ ~~266~~297°F or in MODE 5 because LTOP is provided. Overpressure protection is not required in MODE 6 with reactor vessel head removed.

The Note allows entry into MODES 3 and 4 with the lift settings outside the LCO limits. This permits testing and examination of the safety valves at high pressure and temperature near their normal operating range, but only after the valves have had a preliminary cold setting. The cold setting gives assurance that the valves are OPERABLE near their design condition. Only one valve at a time will be removed from service for testing. The 54 hour exception is based on 18 hour outage time for each of the three valves. The 18 hour period is derived from operating experience that hot testing can be performed in this timeframe.

ACTIONS

A.1

With one pressurizer safety valve inoperable, restoration must take place within 15 minutes. The Completion Time of 15 minutes reflects the importance of maintaining the RCS Overpressure Protection System. An inoperable safety valve coincident with an RCS overpressure event could challenge the integrity of the pressure boundary.

B.1 and B.2

If Required Action A.1 and associated Completion Time is not met or if two or more pressurizer safety valves are inoperable, the unit must be brought to a MODE in which the requirement does not apply. To achieve this status, the unit must be brought to at least MODE 3 within 6 hours and to MODE 4 with any RCS cold leg temperatures ≤ ~~266~~297°F within 24 hours. The allowed Completion Times are reasonable, based on operating experience, to reach the required unit conditions from full power conditions in an orderly manner and without challenging unit systems. With any RCS cold leg temperatures at or below ~~266~~297°F, overpressure protection is provided by the LTOP System. The change from MODE 1, 2, or 3 to MODE 4 reduces the RCS energy (core power and pressure), lowers the potential for large pressurizer insurges, and thereby removes the need for overpressure protection by three pressurizer safety valves.

B 3.4 REACTOR COOLANT SYSTEM (RCS)

B 3.4.12 Low Temperature Overpressure Protection (LTOP) System

BASES

BACKGROUND

The LTOP System controls RCS pressure at low temperatures so the integrity of the reactor coolant pressure boundary (RCPB) is not compromised by violating the pressure and temperature (P/T) limits of 10 CFR 50, Appendix G (Ref. 1). The reactor vessel is the limiting RCPB component for demonstrating such protection. ITS 3.4.3, "RCS Pressure and Temperature (P/T) Limits," provides the maximum RCS pressure for the existing RCS cold leg temperature during cooldown, shutdown, and heatup to meet the Reference 1 requirements during the LTOP MODES.

The reactor vessel material is less tough at low temperatures than at normal operating temperature. As the vessel neutron exposure accumulates, the material toughness decreases and becomes less resistant to pressure stress at low temperatures (Ref. 2). RCS pressure, therefore, is maintained low at low temperatures and is increased only as temperature is increased.

The potential for vessel overpressurization is most acute when the RCS is water solid, occurring only while shutdown; a pressure fluctuation can occur more quickly than an operator can react to relieve the condition. Exceeding the RCS P/T limits by a significant amount could cause brittle cracking of the reactor vessel. LCO 3.4.3 requires administrative control of RCS pressure and temperature during heatup and cooldown to prevent exceeding the P/T limits.

This LCO provides RCS overpressure protection by having a minimum coolant input capability, limiting reactor coolant pump (RCP) startup transients, and having adequate pressure relief capacity. Limiting coolant input capability requires all safety injection (SI) pumps ~~and all but one charging pump~~ incapable of injection into the RCS and isolation of the accumulators. RCPs shall not be started when RCS cold leg temperature is ≤ ~~152~~297°F unless certain requirements are met. The pressure relief capacity requires adequate capacity available ~~either two redundant RCS relief valves~~ or a depressurized RCS and an RCS vent of sufficient size. ~~One~~ Sufficient RCS relief capacity ~~valve~~ or the open RCS vent is the overpressure protection ~~device~~ that is available to terminate an increasing pressure event. ~~When all RCS cold leg temperatures are ≥ 140°F, the coolant input capability is allowed to be increased by allowing both charging pumps to be capable of injecting into the RCS. This is acceptable since requiring three RCS relief valves provides adequate pressure relief capacity under these conditions (one of the two PORVs and the RHR suction relief valve are the overpressure protection devices that are available to terminate an increasing pressure event).~~

BASES

BACKGROUND (continued)

With minimum coolant input capability, the ability to provide core coolant addition is restricted. The LCO does not specifically require the makeup control system deactivated or the SI actuation circuits blocked. Due to the lower pressures in the LTOP MODES and the expected core decay heat levels, the makeup system can provide adequate flow via the makeup control valve. If conditions require the use of ~~more than one charging pump or~~ an SI pump for makeup in the event of loss of inventory, then pumps can be made available through manual actions.

The LTOP System for pressure relief consists of one of the following: ~~two power operated relief valves (PORVs), with reduced lift settings, one PORV and one RHR suction relief valve, or a depressurized RCS and an RCS vent of sufficient size. Two RCS relief valves are required for redundancy. One RCS relief valve has adequate relieving capability to prevent overpressurization for the required coolant input capability. When all RCS cold leg temperatures are ≥ 140°F and two charging pumps are capable of injecting into the RCS, the LTOP System for pressure relief includes all three RCS relief valves (two PORVs and the RHR suction relief valve). Three RCS relief valves are required for redundancy, since one PORV and one RHR suction relief valve have adequate relieving capability to prevent overpressurization at this coolant input capability.~~

1. The RHR suction relief valve with RCS temperature ≤ 150°F;
2. The RHR suction relief valve with one RCP running;
3. Two power operated relief valves (PORVs), with reduced lift settings, and the RHR suction relief valve;
4. Two power operated relief valves (PORVs), with reduced lift settings, with RCS temperature ≥ 210°F; or
5. The RCS depressurized and an RCS vent of ≥ 2.0 square inches or any single PORV blocked open.

Note that the temperatures used above include allowances for RCS temperature instrument uncertainties.

<u>PORV Requirements</u>

When the RCS temperature is below the LTOP enable temperature, a safeguards circuit can be ~~is~~ manually armed which allows the PORVs to open in the event of a low temperature overpressurization transient. RCS pressure is monitored by two wide range pressure instruments with each instrument providing an opening signal to one PORV.

BASES

BACKGROUND (continued)

The LTOP setpoints for both PORVs are the same. Having the setpoints of both valves within the limit ensures that the Reference 1 limits will not be exceeded in any analyzed event.

When a PORV is opened in an increasing pressure transient, the release of coolant will cause the pressure increase to slow and reverse. As the PORV releases coolant, the RCS pressure decreases until a reset pressure is reached and the valve is signaled to close. The pressure continues to decrease below the reset pressure as the valve closes.

RHR Suction Relief Valve Requirements

During LTOP MODES, the RHR System is operated for decay heat removal and low pressure letdown control. Therefore, the RHR suction isolation valves are open in the piping from the RCS hot legs to the inlets of the RHR pumps. While these valves are open, the RHR suction relief valve is exposed to the RCS and is able to relieve pressure transients in the RCS.

The RHR suction isolation valves must be open to make the RHR suction relief valve OPERABLE for RCS overpressure mitigation. The RHR suction relief valve is a spring loaded, bellows type water relief valve with pressure tolerances and accumulation limits established by Section III of the American Society of Mechanical Engineers (ASME) Code (Ref. 3) for Class 2 relief valves.

RCS Vent Requirements

Once the RCS is depressurized, a vent exposed to the containment atmosphere will maintain ~~the~~RCS pressure within limits ~~at containment ambient pressure~~ in an RCS overpressure transient, if the relieving requirements of the transient do not exceed the capabilities of the vent. Thus, the vent path must be capable of relieving the flow resulting from the limiting LTOP mass or heat input transient, and maintaining pressure below the P/T limits. The required vent capacity may be provided by one or more vent paths.

For an RCS vent to meet the flow capacity requirement, it requires removing a pressurizer safety valve, blocking open any one of the three PORVs, and disabling its block valve in the open position, or similarly establishing a vent by opening sufficient RCS vent valves to provide a 2.0 square inch vent path. The vent path(s) must be above the level of reactor coolant, so as not to drain the RCS when open.

BASES

APPLICABLE SAFETY ANALYSES

Safety analyses (Ref. 4) demonstrate that the reactor vessel is adequately protected against exceeding the Reference 1 P/T limits. In MODES 1, 2, and 3, and in MODE 4 with RCS cold leg temperature exceeding ~~266~~297°F, the pressurizer safety valves will prevent RCS pressure from exceeding the Reference 1 limits. At ~~266~~297°F and below, overpressure prevention is provided by one of the RCS relief paths required by this LCO. ~~falls to two OPERABLE RCS relief valves (or three RCS relief valves when all RCS cold leg temperatures are ≥ 140°F and two charging pumps are capable of injecting into the RCS) or to a depressurized RCS and a sufficient sized RCS vent.~~ Each of these means has a limited overpressure relief capability.

The actual temperature at which the pressure in the P/T limit curve falls below the pressurizer safety valve setpoint increases as the reactor vessel material toughness decreases due to neutron embrittlement. Each time the P/T limit curves are revised, the LTOP System must be re-evaluated to ensure its functional requirements can still be met. ~~using the RCS relief valve method or the depressurized and vented RCS condition~~.

The LCO contains the acceptance limits that define the LTOP requirements. Any change to the RCS must be evaluated against the Reference 4 analyses to determine the impact of the change on the LTOP acceptance limits.

Transients that are capable of overpressurizing the RCS are categorized as either mass or heat input transients, examples of which follow:

Mass Input Type Transients

a. Inadvertent safety injection; or

b. Charging/letdown flow mismatch.

Heat Input Type Transients

a. Inadvertent actuation of pressurizer heaters;

b. Loss of RHR cooling; or

c. Reactor coolant pump (RCP) startup with temperature asymmetry within the RCS or between the RCS and steam generators.

The following are required during the LTOP MODES to ensure that mass and heat input transients do not occur~~, which either of~~ that the LTOP overpressure protection means cannot handle:

a. Rendering all SI pumps ~~and all but one charging pump~~ incapable of injection~~, unless all RCS cold leg temperatures are ≥ 140°F, and~~

BASES

APPLICABLE SAFETY ANALYSES (continued)

three RCS relief valves are OPERABLE, then only all of the SI pumps must be rendered incapable of injection;

b. Deactivating the accumulator discharge isolation valves in their closed positions; and

c. Disallowing a startup of an RCP with one or more RCS cold leg temperatures ≤ 297 152°F, unless the pressurizer water level is < 62% or the secondary water temperature of each steam generator is < 50°F above each of the RCS cold leg temperatures.

The Reference 4 analyses demonstrate the following:

1. The RHR suction safety can accommodate the most limiting mass injection transient for the full range of LTOP applicability, and the most limiting heat injection transient, startup of the first RCP, for RCS temperatures ≤ 150°F.
2. If a RCP is running then the most limiting heat injection transient cannot occur, and the remaining non-limiting heat injection transients and the limiting mass injection transient can be accommodated by the RHR suction safety. Therefore, the RHR suction safety can provide overpressure protection for the full range of LTOP applicability with one or more RCPs running.
3. The RHR suction safety and one pressurizer PORV can accommodate the most limiting mass injection and heat injection transients for the full range of LTOP applicability. Two pressurizer PORVs must be OPERABLE for single failure considerations.
4. One pressurizer PORV can accommodate the most limiting mass injection and heat injection transients if RCS temperature is ≥ 210°F. Two pressurizer PORVs must be OPERABLE for single failure considerations.
5. A depressurized RCS with an RCS vent of ≥ 2.0 square inches or any single PORV blocked open can accommodate the most limiting mass injection and heat injection transients. Note that since a RCP cannot be intentionally started with the RCS vented, the most limiting heat injection transient is not expected to occur.

either one RCS relief valve or the depressurized RCS and RCS vent can maintain RCS pressure below limits when only one charging pump is actuated. Thus, the LCO allows only one charging pump to be capable of injecting into the RCS during the LTOP MODES. Since neither one RCS relief valve nor the RCS vent The LTOP analysis does not analyze handle the pressure transient need from accumulator injection , when RCS temperature is low,. Therefore, the LCO also requires the accumulators isolation when the accumulators are not depressurized to below the P/T limits curve for the given RCS temperature. and vented.

BASES

APPLICABLE SAFETY ANALYSES (continued)

~~The analyses also demonstrate that one PORV and one RHR suction relief valve can maintain RCS pressure below limits when both charging pumps are actuated, all RCS cold leg temperatures are ≥ 140°F. Thus, the LCO allows two charging pumps to be capable of injecting into the RCS under these conditions.~~

The isolated accumulators must have their discharge valves closed and the valve power supply breakers fixed in their open positions.

Fracture mechanics analyses established the temperature of LTOP Applicability at ≤ ~~266~~ 297°F. This value includes RCS temperature instrument uncertainty.

PORV Performance

The fracture mechanics analyses show that the vessel is protected when the PORVs are set to open at or below the specified setpoint. The setpoints are derived by analyses that model the performance of the LTOP System~~, assuming the mass addition transient of one or two charging pumps injecting into the RCS or the limiting heat input transient of an RCP startup with temperature asymmetry within the RCS or between the RCS and steam generators of 50°F above each of the RCS cold leg temperatures~~. A single PORV can provide protection for the most severe heat injection transient for the full range of LTOP applicability, and can provide protection for the most severe mass injection transient if RCS temperature is ≥ 210°F. These analyses consider pressure overshoot and undershoot beyond the PORV opening and closing, resulting from signal processing and valve stroke times. The PORV setpoints at or below the derived limit ensures the Reference 1 P/T limits will be met.

The PORV setpoints will be updated, as necessary, when the P/T limits are revised. The P/T limits are periodically modified as the reactor vessel material toughness decreases due to neutron embrittlement caused by neutron irradiation. Revised limits are determined using neutron fluence projections and the results of examinations of the reactor vessel material irradiation surveillance specimens. The Bases for LCO 3.4.3, "RCS Pressure and Temperature (P/T) Limits," discuss these examinations.

The PORVs are considered active components. Thus, the failure of one PORV is assumed to represent the worst case, single active failure.

BASES

APPLICABLE SAFETY ANALYSES (continued)

RHR Suction Relief Valve Performance

Analyses show that the RHR suction relief valve with a setpoint ≤ 450 psig ~~will pass flow greater than that required for the mass addition transient of one charging pump injecting into the RCS while maintaining RCS pressure less than the P/T limit curve. Assuming all relief flow requirements during the mass addition event, The RHR suction relief valve~~ will maintain RCS pressure to within the Appendix G limit curves and 110% of the RHR System design pressure (660 psig) during the most severe mass injection transient, and the most severe heat injection transient if RCS temperature is ≤ 150°F. ~~When all RCS cold leg temperatures are ≥ 140°F and two charging pumps are capable of injecting into the RCS, the RHR suction relief valve and one PORV, in combination, will maintain RCS pressure less than the P/T limit curve.~~

If at least one RCP is running then the most limiting heat injection transient cannot occur. Analysis show that the RHR suction safety is capable of maintaining RCS pressure within the Appendix G limit curves during the non-limiting heat injection transients for the full range of LTOP applicability. Therefore, the RHR suction safety will maintain RCS pressure to within the Appendix G limit curves and 110% of the RHR System design pressure (660 psig) during the most severe mass injection transient, and the applicable heat injection transients for the full LTOP temperature range if at least one RCP is running.

As the RCS P/T limits are decreased to reflect the loss of toughness in the reactor vessel materials due to neutron embrittlement, the RHR suction relief valve must be analyzed to still accommodate the design basis transients for LTOP.

The RHR suction relief valve is a passive component and is not subject to active failure.

RCS Vent Performance

With the RCS depressurized, analyses show a vent size of 2.0 square inches or a single blocked open PORV is capable of mitigating the allowed LTOP overpressure transients. The capacity of a vent this size is greater than the flow of the mass addition transient for the LTOP configuration of ~~one~~ two charging pumps OPERABLE, maintaining RCS pressure less than the maximum pressure on the P/T limit curve.

BASES

APPLICABLE SAFETY ANALYSES (continued)

The RCS vent size will be re-evaluated for compliance each time the P/T limit curves are revised based on the results of the vessel material surveillance.

The RCS vent is passive and is not subject to active failure.

The LTOP System satisfies Criterion 2 of 10 CFR 50.36(c)(2)(ii).

LCO

This LCO requires that the LTOP System is OPERABLE. The LTOP System is OPERABLE when the minimum coolant input and pressure relief capabilities are OPERABLE. Violation of this LCO could lead to the loss of low temperature overpressure mitigation and violation of the Reference 1 limits as a result of an operational transient.

~~To limit the coolant input capability,~~ T~~t~~he LCO restricts coolant injection capability to two charging pumps, i.e. the safety injection pumps must be incapable of injection into the RCS. In addition, all accumulators must be isolated, or depressurized to below the P/T limits curve value for the given RCS temperature.~~provides two options. The first option requires that no SI pumps and a maximum of one charging pump be capable of injecting into the RCS, and all accumulators isolated (i.e., the discharge isolation valves closed and deactivated).~~

~~The first option, however, allows two charging pumps to be made capable of injecting into the RCS for ≤ 1 hour during pump swap operations. One hour provides sufficient time to safely complete the actual transfer and to complete the administrative controls and Surveillance Requirements associated with the swap. The intent is to minimize the actual time that more than one charging pump is physically capable of injection.~~ In addition, an accumulator may be unisolated when the accumulator pressure is less than the maximum RCS pressure for the existing RCS cold leg temperature allowed by the P/T limit curves provided in TS 3.4.3~~is depressurized and vented~~. This permits the accumulator discharge isolation valve Surveillance to be performed only when ~~under these~~ the pressure and temperature limits of the P/T limit curve are not exceeded ~~conditions~~.

Furthermore, the ~~first~~ LCO options requires ~~one of~~ the ~~three~~ following pressure relief capabilities, as applicable:

a. Two OPERABLE PORVs;

   A PORV is OPERABLE for LTOP when its block valve is open, its lift setpoint is set to the specified limit required by the LCO and testing

BASES

LCO (continued)

proves its ability to open at this setpoint, and motive power is available to the two valves and their control circuits. Motive power for the PORVs is through the use of air. Normally this air is supplied by the plant control air source. To assure OPERABILITY of the PORVs in the event of a loss of control air, a backup air supply is provided. The backup air supply consists of compressed air bottles (the emergency air tank bank), piping, and valves. The backup air supply contains enough air to support PORV operation for 10 minutes with no operator action upon a loss of control air. Only two of the three PORVs have a backup air supply, therefore they are the only PORVs that can be used to meet the LCO requirements.

b. ~~One OPERABLE PORV and one~~ An OPERABLE RHR suction relief valve; ~~or~~

   An RHR suction relief valve is OPERABLE for LTOP when its RHR suction isolation valves are open, its setpoint is ≤ 450 psig, and testing has proven its ability to open at this setpoint.

c. A depressurized RCS and an RCS vent.

   An RCS vent is OPERABLE when open with an area of ≥ 2.0 square inches or a single blocked open PORV.

~~Each of these methods of overpressure prevention is capable of mitigating the limiting LTOP transient.~~

~~Consistent with the first option, the second option requires that no SI pumps be capable of injecting into the RCS and that the accumulators are isolated, except an accumulator may be unisolated when it is depressurized and vented. However, the second option allows both charging pumps to be capable of injecting into the RCS, provided all RCS cold leg temperatures are ≥ 140°F and all three of the relief valves (two PORVs and one RHR suction relief valve) described in the first option are OPERABLE.~~

BASES

LCO (continued)

The Both LCO options are modified by a Note that places restrictions on RCP startups. This is necessary to ensure the limiting heat input transient is maintained within the analyses assumptions. Therefore, the Note states that reactor coolant pumps shall not be started with one or more RCS cold leg temperatures ≤ 297 152°F unless the pressurizer water level is < 62% or the secondary water temperature of each steam generator is < 50°F above each of the RCS cold leg temperatures.

APPLICABILITY

This LCO is applicable in MODE 4 when any RCS cold leg temperature is ≤ 266 297°F, in MODE 5, and in MODE 6 when the reactor vessel head is on. The pressurizer safety valves provide overpressure protection that meets the Reference 1 P/T limits with all RCS cold leg temperatures > 266 297°F. When the reactor vessel head is off, overpressurization cannot occur.

LCO 3.4.3 provides the operational P/T limits for all MODES. LCO 3.4.10, "Pressurizer Safety Valves," requires the OPERABILITY of the pressurizer safety valves that provide overpressure protection during MODES 1, 2, and 3, and MODE 4 with all RCS cold leg temperatures > 266 297°F.

Low temperature overpressure prevention is most critical during shutdown when the RCS is water solid, and a mass or heat input transient can cause a very rapid increase in RCS pressure resulting in little or no time available to allow operator action to mitigate the event.

ACTIONS

A Note prohibits the application of LCO 3.0.4.b to an inoperable LTOP system when entering MODE 4. There is an increased risk associated with entering MODE 4 from MODE 5 with LTOP inoperable and the provisions of LCO 3.0.4.b, which allow entry into a MODE or other specified condition in the Applicability with the LCO not met after performance of a risk assessment addressing inoperable systems and components, should not be applied in this circumstance.

A.1 and B.1

With one or more SI pumps capable of injecting into the RCS, RCS overpressurization is possible. In addition, when only one charging pump is allowed to be capable of injecting into the RCS and both charging pumps are actually capable, RCS overpressurization is possible.

BASES

ACTIONS (continued)

To immediately initiate action to restore restricted coolant input capability to the RCS reflects the urgency of removing the RCS from this condition.

B~~C~~.1, C~~D~~.1, and C~~D~~.2

An unisolated accumulator requires isolation within 1 hour. This is only required when the accumulator is not depressurized to less than the maximum RCS pressure for existing cold leg temperature allowed in TS 3.4.3 ~~and vented~~.

If isolation is needed and cannot be accomplished in 1 hour, Required Action C~~D~~.1 and Required Action C~~D~~.2 provide two options, either of which must be performed in the next 12 hours. By increasing the RCS temperature to > ~~266~~297°F, an accumulator pressure of 658 psig cannot exceed the LTOP limits if the accumulators are fully injected. Depressurizing the accumulator to less than the maximum RCS pressure for the existing cold leg temperature allowed in TS 3.4.3~~and venting the affected accumulators~~ also gives this protection.

The Completion Times are based on operating experience that these activities can be accomplished in these time periods and on engineering evaluations indicating that an event requiring LTOP is not likely in the allowed times.

~~E~~D.1

In MODE 4 when any RCS cold leg temperature is ≤ ~~266~~297°F and while complying with LCO A.2.c or A.2.d, with one required RCS relief valve inoperable, the RCS relief valve must be restored to OPERABLE status within a Completion Time of 7 days. Two or three RCS relief valves ~~(depending upon the condition of the charging pumps) in any combination of the PORVs and the RHR suction relief valve~~ are required to provide low temperature overpressure mitigation while withstanding a single failure of an active component.

This condition can be used only while complying with LCO A.2.c or A.2.d when more than one relief valve is required to be OPERABLE. At least one additional relief valve is OPERABLE. Therefore, it is appropriate to allow some time to restore an inoperable relief valve to operable status.

The Completion Time considers the facts that only one or two of the RCS relief valves (depending upon RCS temperature ~~the condition of the charging pumps~~) are required to mitigate an overpressure transient and that the likelihood of a single active failure of the remaining valve path(s) during this time period is very low.

BASES

ACTIONS (continued)

~~F~~E.1

The consequences of operational events that will overpressurize the RCS are more severe at lower temperature (Ref. 7). Thus, with one ~~of the two~~ RCS relief valves inoperable in MODE 5 or in MODE 6 with the head on, the Completion Time to restore the required valve to OPERABLE status is 24 hours.

This condition can be used only while complying with LCO A.2.c or A.2.d when more than one relief valve is required to be OPERABLE. At least one additional relief valve is OPERABLE. Therefore, it is appropriate to allow some time to restore an inoperable relief valve to operable status.

The Completion Time represents a reasonable time to investigate and repair several types of relief valve failures without exposure to a lengthy period with only the minimum OPERABLE RCS relief valve(s) required to protect against overpressure events.

F.1 and F.2

If the RCP required by LCO A.2.b is not running the RHR suction safety may not be able to provide overpressure protection for a heat injection transient. RCS flow should not be re-initiated since it could cause a heat injection transient. Since the LTOP system may not be able to provide overpressure protection for the heat injection transient in this condition it is appropriate to immediately enter Condition G.

G.1

The RCS must be depressurized and a vent must be established within 12 hours when:

a. Two or more required RCS relief valves are inoperable;

b. A Required Action and associated Completion Time of Condition A, ~~B~~C, D, E, or F is not met; or

The LTOP System is inoperable for any reason other than Condition A, B, C, D, E, or F (e.g., when an RCP is started without meeting the requirements of the Note to LCO 3.4.12.

BASES

ACTIONS (continued)

In addition, if complying with LCO A.2.a or A.2.b only the RHR suction safety valve is required to be operable. If the RHR suction safety valve becomes inoperable when it is the only RCS relief valve available the appropriate condition to enter is Condition G.

The vent must be sized ≥ 2.0 square inches or the vent must be a blocked open PORV to ensure that the flow capacity is greater than that required for the worst case mass input transient reasonable during the applicable MODES. This action is needed to protect the RCPB from a low temperature overpressure event and a possible brittle failure of the reactor vessel.

The Completion Time considers the time required to place the unit in this Condition and the relatively low probability of an overpressure event during this time period due to increased operator awareness of administrative control requirements.

SURVEILLANCE REQUIREMENTS

SR 3.4.12.1~~, SR 3.4.12.2,~~ and SR 3.4.12.3

To minimize the potential for a low temperature overpressure event by limiting the mass input capability, no SI pumps ~~and a maximum of one or two charging pumps (depending upon whether the LCO Option A or B is being used)~~ are verified capable of injecting into the RCS and the accumulator discharge isolation valves are verified closed and deactivated. The SI pump(s) ~~and charging pump~~ are rendered incapable of injecting into the RCS through removing the power from the pumps by racking the breakers out under administrative control. An alternate method of LTOP control may be employed using at least two independent means to prevent RCS injection such that a single failure or single action will not result in an injection into the RCS. This may be accomplished through the pump control switch being placed in pull to lock and at least one valve in the discharge flow path being closed, or at least one valve in the discharge flow path being closed and sealed or locked.

In addition, SR 3.4.12.3 is modified by a Note that allows the accumulator discharge isolation valve position to be verified by administrative means. This is acceptable since the valve position was verified prior to deactivating the valve, access to the containment is restricted, and valves are only operated under strict procedural control.

The Surveillance Frequency is controlled under the Surveillance Frequency Control Program.

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.4.12.2

This SR requires verification that the required RCP is in operation and circulating reactor coolant. This surveillance is only required if complying with LCO 3.4.12.A.2.b. Verification includes flow rate, temperature, or pump status monitoring, which help ensure RCS forced flow. The existence of forced flow from at least one RCP ensures that the limiting heat injection transient, startup of the first RCP, cannot occur. The Surveillance Frequency is controlled under the Surveillance Frequency Control Program.

SR 3.4.12.4

The required RHR suction relief valve shall be demonstrated OPERABLE by verifying the RHR suction isolation valves are open. This Surveillance is only required to be performed if the RHR suction relief valve is being used to meet this LCO.

The RHR suction isolation valves are verified to be opened. The Surveillance Frequency is controlled under the Surveillance Frequency Control Program.

SR 3.4.12.5

The RCS vent of ≥ 2.0 square inches or a blocked open PORV is proven OPERABLE by verifying its open condition. The Surveillance Frequency is controlled under the Surveillance Frequency Control Program.

The passive vent path arrangement must only be open if the vent is being used to satisfy the pressure relief requirements of LCO 3.4.12.A.2.~~e~~c.

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.4.12.6

The PORV block valve must be verified open to provide the flow path for each required PORV to perform its function when actuated. The valve must be remotely verified open in the main control room. This Surveillance is performed if ~~one or more~~ PORVs are required to satisfy the LCO.

The block valve is a remotely controlled, motor operated valve. The power to the valve operator is not required removed, and the manual operator is not required locked in the inactive position. Thus, the block valve can be closed in the event the PORV develops excessive leakage or does not close (sticks open) after relieving an overpressure situation.

The Surveillance Frequency is controlled under the Surveillance Frequency Control Program.

SR 3.4.12.7

Verification that each required emergency air tank bank's pressure is ≥ 900 psig assures adequate air pressure for reliable PORV operation. With the emergency air supply at ≥ 900 psig, there will be enough air to support PORV operation for 10 minutes with no operator action upon a loss of control air. The Surveillance Frequency is controlled under the Surveillance Frequency Control Program.

SR 3.4.12.8

Performance of a COT is required on each required PORV to verify and, as necessary, adjust its lift setpoint. A successful test of the required contact(s) of a channel relay may be performed by the verification of the change of state of a single contact of the relay. This clarifies what is an acceptable COT of a relay. This is acceptable because all of the other required contacts of the relay are verified by other Technical Specifications and non-Technical Specifications tests at least once per refueling interval with applicable extensions. The COT will verify the setpoint is within the LCO limit. PORV actuation could depressurize the RCS and is not required.

BASES

SURVEILLANCE REQUIREMENTS (continued)

A Note has been added indicating that this SR is not required to be performed until 12 hours after decreasing RCS cold leg temperature to ≤ ~~266~~ 297°F. The COT cannot be performed until in the LTOP MODES when the PORV lift setpoint can be reduced to the LTOP setting. The test must be performed within 12 hours after entering the LTOP MODES if PORVs are required. The Surveillance Frequency is controlled under the Surveillance Frequency Control Program.

SR 3.4.12.9

Performance of a CHANNEL CALIBRATION on each required PORV actuation channel is required to adjust the whole channel so that it responds and the valve opens within the required range and accuracy to known input. The Surveillance Frequency is controlled under the Surveillance Frequency Control Program.

REFERENCES

1. 10 CFR 50, Appendix G.
2. Generic Letter 88-11.
3. ASME, Boiler and Pressure Vessel Code, Section III.
4. ~~WCAP-13235, "Donald C. Cook Units 1 & 2, Analysis of Low Temperature Overpressurization Mass Injection Events with Pressurizer Steam Bubble and RHR Relief Valve, March 1992; "WCAP-12483 Revision 1, "Analysis of Capsule U From the American Electric Power Company D. C. Cook Unit 1 Reactor Vessel Radiation Surveillance Program, December 2002;" and WCAP-13515, Revision 1, "Analysis of Capsule U From Indiana Michigan Power Company D. C. Cook Unit 2 Reactor Vessel Radiation Surveillance Program, May 2002."~~ Westinghouse Letter LTR-SCS-19-50, D.C. Cook Unit 1 Low Temperature Overpressure Protection System (LTOPS) Analysis for 48 EFPY, Revision 0
5. 10 CFR 50, Section 50.46.
6. 10 CFR 50, Appendix K.
7. Generic Letter 90-06.