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NL-15-094

August 11, 2015

U.S. Nuclear Regulatory Commission
Document Control Desk
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Rockville, MD 20852-2738

SUBJECT: Proposed Changes to Indian Point Unit 3 Technical Specifications Regarding Reactor Vessel Heatup and Cooldown Curves and Low Temperature Overpressure Protection System Requirements
Indian Point Unit No. 3
Docket No. 50-286
License No. DPR-64

REFERENCE: Entergy Letter to NRC (NL-15-014) Regarding Proposed Changes to Indian Point Unit 3 Technical Specifications Regarding Reactor Vessel Heatup and Cooldown Curves and Low Temperature Overpressure Protection System Requirements, dated February 12, 2015.

Dear Sir or Madam:

Pursuant to 10 CFR 50.90, Entergy Nuclear Operations, Inc., (Entergy) requested a License Amendment to Operating License DPR-64, Docket No. 50-286 for Indian Point Nuclear Generating Unit No. 3 (IP3) in the referenced letter. The purpose of this letter is to provide editorial changes to the proposed Technical Specification (TS) pages and to submit additional information augmenting the technical justification. Planned Bases changes are also included for your information. These changes have been discussed with the NRC staff.

These supplements do not alter the evaluation of the proposed changes in accordance with 10 CFR 50.91 (a)(1) using the criteria of 10 CFR 50.92 (c) or the determination that the proposed changes involve no significant hazards considerations found in the referenced letter. The proposed amendment will revise the Reactor Coolant System (RCS) heatup and cooldown curves and Low Temperature Overpressure Protection (LTOP) requirements in Technical Specifications (TS) 3.4.3 and 3.4.12, respectively.

A copy of this supplement to the application and the associated attachments are being submitted to the designated New York State official in accordance with 10 CFR 50.91.

There are no new commitments being made in this submittal. If you have any questions or require additional information, please contact Mr. Robert W. Walpole, Regulatory Assurance Manager at (914) 254-6710.

A001
NRR

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

Executed on August 11, 2015.

Sincerely,

LC/sp

Attachments:

1. Supplemental information to the Analysis of Proposed Technical Specification Changes regarding Reactor Heatup and Cooldown Curves and LTOP Requirements
2. Revised Markup of Technical Specification Pages for Proposed Changes regarding Reactor Heatup and Cooldown Curves and LTOP Requirements
3. Revised Markup of Technical Specification Bases Pages for Proposed Changes regarding Reactor Heatup and Cooldown Curves and LTOP Requirements

cc: Mr. Daniel H. Dorman, Regional Administrator, NRC Region I
Mr. Douglas Pickett, NRC, Sr. Project Manager, Division of Reactor Licensing
Mr. Michael Wentzel, NRC Project Manager, Division of License Renewal
Ms. Bridget Frymire, New York State Dept. of Public Service
Mr. John B. Rhodes, President and CEO NYSERDA
NRC Resident Inspector's Office

ATTACHMENT 1 TO NL-15-094

SUPPLEMENTAL INFORMATION TO THE ANALYSIS OF PROPOSED TECHNICAL SPECIFICATION CHANGES REGARDING REACTOR HEATUP AND COOLDOWN CURVES AND LTOP REQUIREMENTS

ENTERGY NUCLEAR OPERATIONS, INC.
INDIAN POINT NUCLEAR GENERATING UNIT NO. 3
DOCKET NO. 50-286

In Entergy Nuclear Operations, Inc. (Entergy) Letter to NRC (NL-15-014), dated February 12, 2015, Entergy requested an amendment to Operating License DPR-64, Docket 50-286 for Indian Point Nuclear Generating Unit No. 3 (IP3). The proposed change would revise the Reactor Coolant System (RCS) Heatup and Cooldown limitations in IP3 Technical Specification (TS) 3.4.3, and the Low Temperature Overpressure Protection System (LTOP) requirements in TS 3.4.12. These changes are necessary to account for a service life increase from 27.2 Effective Full Power Years (EFPY) to an extended service life of 37 EFPY. In subsequent discussions with the NRC staff the need to augment the technical analysis section of evaluation of the proposed changes in accordance with 10 CFR 50.91 (a)(1). That is Section 4.0 of NL-15-014. The augmentation needs to specifically discuss several proposed changes to the TS that were not explicitly discussed.

The proposed changes were:

1. LCO 3.4.12, changed "The RCS depressurized with an RCS vent of ≥ 2.00 square inches" to "The RCS depressurized with an RCS vent of ≥ 2.00 square inches, or one blocked open PORV with its block valve disabled in the open position,"

2. Condition E.1 and F.1 of TS 3.4.12 changed "Depressurize RCS and establish RCS vent of ≥ 2.00 square inches" to "Depressurize RCS and establish RCS vent of ≥ 2.00 square inches, or one blocked open PORV with its block valve disabled in the open position,"

3. SR 3.4.12.3 changed "Verify RCS vent ≥ 2.00 square inches established" to "Verify RCS vent ≥ 2.00 square inches, or one blocked open PORV with its block valve disabled in the open position established." And

4. SR 3.4.12.9 changed "Verify each of the following conditions are satisfied prior to starting any RCP: a. Secondary side water temperature of the hottest steam generator is ≤ 64°F above the coldest RCS cold leg temperature; and" to "Verify each of the following conditions are satisfied prior to starting any RCP: a. Secondary side water temperature of the hottest steam generator is ≤ 50°F above the coldest RCS cold leg temperature; and"

The technical analysis (Section 4.0 of NL-15-014) currently states:

"The calculation for the LTOP curves uses the standard Westinghouse methodology which has been previously reviewed and approved by the NRC for other licensees. The LTOP curves in Reference 2 are based on the heatup and cooldown curves established in Reference 1. Therefore, the revised LTOP setpoints, and its family of associated curves, similarly reflect the increase in lifetime fluence for a service life of 37 EFPY. The maximum PORV opening setpoint shown in Figure 3.4.12-1 is implemented as a variable setpoint for the LTOP instrumentation. The revised LTOPS PORV setpoints meet all acceptance criteria for protecting the Appendix G limits, PORV discharge piping limits, and the RCP operation limits and provide increased operating margin compared to the current setpoints. The other curves in the LTOP family, as well as the heatup and cooldown curves in Section 3.4.3, are procedurally implemented as Operations Procedure graphs and do not relate to any automatic protection systems."

This paragraph should be supplemented by the following:

The analyses in Reference 2 support the following changes to the TS:

The TS requirements (i.e., LCO 3.4.12, TS 3.4.12 Condition E, and SR 3.4.12.3) were changed from depressurize with an RCS vent of ≥ 2.00 square inches to add allowance for depressurization with one blocked open PORV with its block valve disabled in the open position. This was based on the analysis of venting requirements. The analysis looked at the ability of the blocked open PORV with its block valve disabled open to provide the required venting for the design basis transient. Only the mass input design basis transient (start of three charging pumps) is evaluated for this event since the heat input transient from start of a RCP is not considered credible or the bounding transient. The relief capacity of a blocked open PORV with its block valve disabled in the open position relief capacity is less than the relief capacity of a 2.0 $in.^2$ vent but it is still greater than the injection capacity of the three charging pumps, the design basis mass injection. Therefore the addition of the allowance for depressurization with one blocked open PORV with its block valve disabled in the open position to LCO 3.4.14, Conditions E.1 and F.1, and SR 3.4.12.3 is acceptable. When a HHSI pump is made operable different vent requirements apply.

The RCP is not started prior to the SR 3.4.12.8 or SR 3.4.12.9 verification of conditions. The proposed TS change ("Secondary side water temperature of the hottest steam generator is ≤ 50°F above the coldest RCS cold leg temperature") is based on an analysis assuming the RCS is 290°F which is 50°F below the LTOP disarm temperature of 340°F. The start of the RCP is assumed to instantaneously flush the 50°F hotter water through the cold legs transferring heat to the primary side so that the temperature reaches the point where LTOP could disable. Note this is conservative since the actual response of the RCS would be slower than the calculated due to the time for primary side heatup and for mixing loops. The maximum pressure of the RCS (assuming a conservative starting pressure) remains well below the Appendix G limits for this analysis.

ATTACHMENT 2 TO NL-15-094

REVISED MARKUP OF TECHNICAL SPECIFICATION PAGES FOR PROPOSED CHANGES REGARDING REACTOR HEATUP AND COOLDOWN CURVES AND LTOP REQUIREMENTS

Text changes indicated by lineout for deletion and Bold/Italics for additions
Figure changes are marked with either "Replace with New Figure" or "Delete this Figure" and all new Figures are unmarked

Unit 3 Actual Affected Pages (revised pages are indicated below):
3.4.3-1
3.4.3-2
3.4.3-3 (Figure 3.4.3-1)
3.4.3-4 (Figure 3.4.3-2)
3.4.3-5(Figure 3.4.3-2)
3.4.12-1
3.4.12-2
3.4.12-4
3.4.12-5
3.4.12-8 (revised)
3.4.12-9 (Figure 3.4.12-1)
3.4.12-10 (Figure 3.4.12-2) (revised)
3.4.12-11 (Figure 3.4.12-3) (revised)
3.4.12-12 (Figure 3.4.12-4)

ENTERGY NUCLEAR OPERATIONS, INC.
INDIAN POINT NUCLEAR GENERATING UNIT NO. 3
DOCKET NO. 50-286

3.4 REACTOR COOLANT SYSTEM (RCS)

3.4.3 RCS Pressure and Temperature (P/T) Limits

LCO 3.4.3 RCS pressure, RCS temperature, and RCS heatup and cooldown rates shall be maintained within the limits specified in Figure 3.4.3-1~~,~~ ***and*** Figure 3.4.3-2~~,~~ ~~and Figure 3.4.3-3~~.

APPLICABILITY: At all times.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. ---------NOTE--------- Required Action A.2 shall be completed whenever this Condition is entered. ---------------------- Requirements of LCO not met in MODE 1, 2, 3, or 4.	A.1 Restore parameter(s) to within limits. <u>AND</u> A.2 Determine RCS is acceptable for continued operation.	30 minutes 72 hours
B. Required Action and associated Completion Time of Condition A not met.	B.1 Be in MODE 3. <u>AND</u> B.2 Be in MODE 5 with RCS pressure < 500 psig.	6 hours 36 hours

(continued)

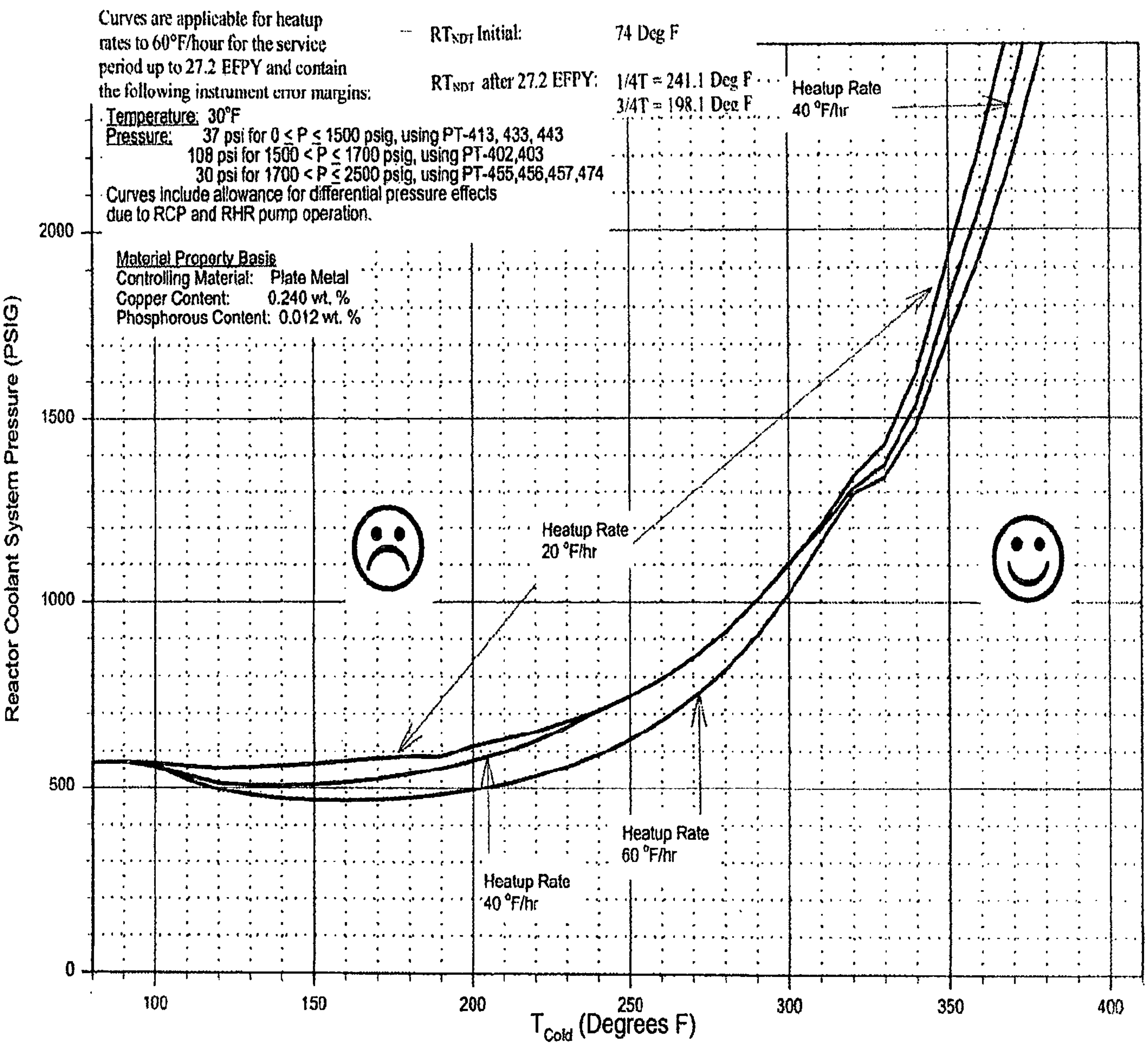
ACTIONS (continued)

CONDITION	REQUIRED ACTION		COMPLETION TIME
C. ---------NOTE------ Required Action C.2 shall be completed whenever this Condition is entered. ------------------- Requirements of LCO not met any time in other than MODE 1, 2, 3, or 4.	C.1	Initiate action to restore parameter(s) to within limits.	Immediately
	AND		
	C.2	Determine RCS is acceptable for continued operation.	Prior to entering MODE 4

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.4.3.1	-------------------NOTE------------- Only required to be performed during RCS heatup***, inservice leak testing,*** and cooldown operations. ~~and RCS inservice leak and hydrostatic testing.~~ ------------------------------------ Verify RCS pressure, RCS temperature, and RCS heatup and cooldown rates are within the limits specified in the following: a. Figure 3.4.3-1 during RCS heatup ***and during RCS inservice leak testing; and*** b. Figure 3.4.3-2 during RCS cooldown~~;~~ ~~and~~. ~~c. Figure 3.4.3-3 during RCS inservice leak and hydrostatic testing.~~	30 minutes

Figure 3.4.3-1:
Heatup Limitations for Reactor Coolant System



REPLACE WITH NEW FIGURE

RCS P/T

MATERIAL PROPERTY BASIS
LIMITING MATERIAL: Lower Shell Plate B-2803-3 using credible surveillance data, Position 2.1
LIMITING ART VALUES AT 37 EFPY: 1/4T, 245.0°F (Axial Flaw)
3/4T, 198.2°F (Axial Flaw)

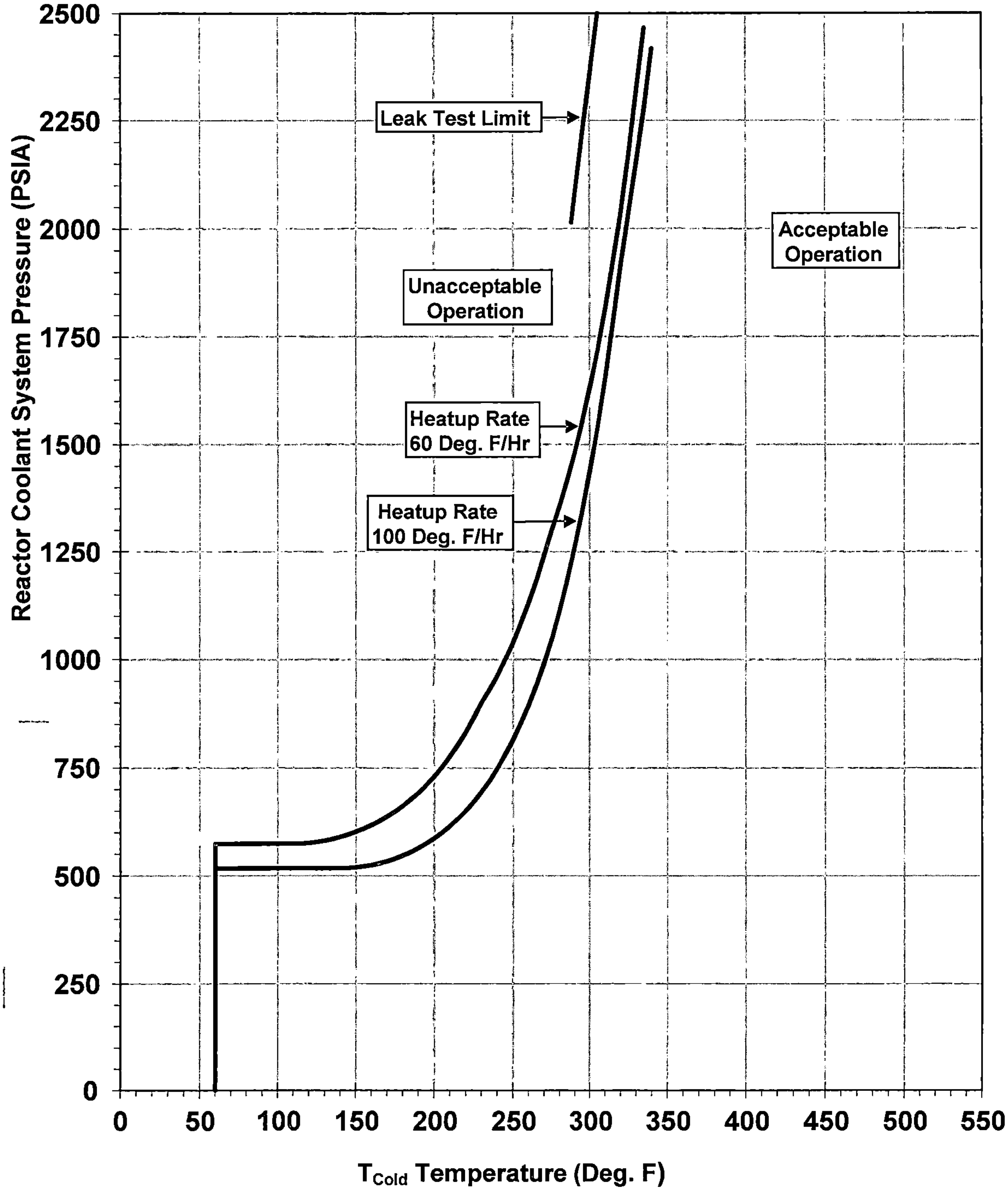


Figure 3.4.3-1:
Heatup and Inservice Leak Test Limitations for Reactor Coolant System
(Without instrument uncertainties)

REPLACE WITH NEW FIGURE

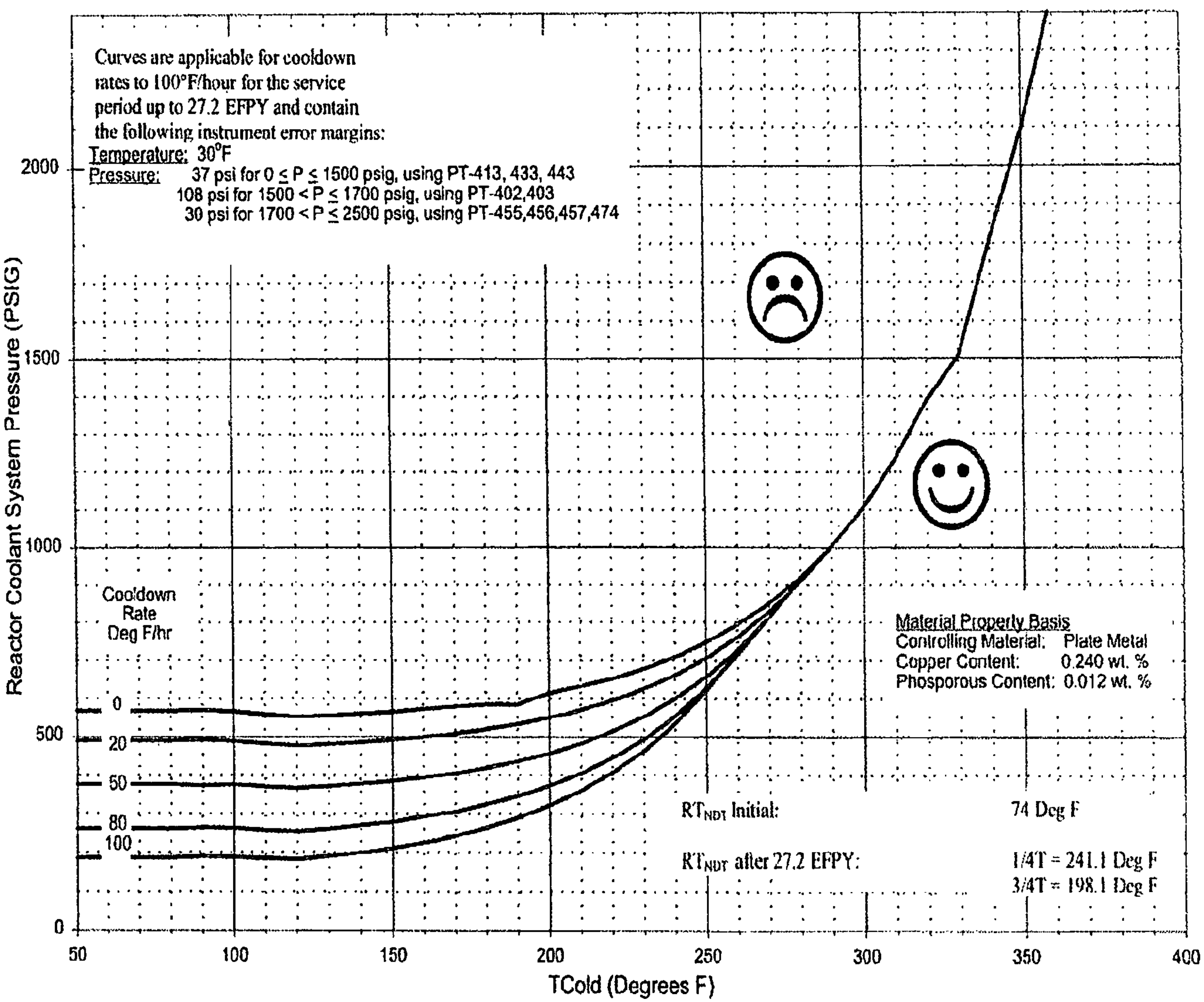


Figure 3.4.3-2:
Cooldown Limitations for Reactor Coolant System

RCS P/T Limits
3.4.3

MATERIAL PROPERTY BASIS

LIMITING MATERIAL: Lower Shell Plate B-2803-3 using credible surveillance data, Position 2.1

LIMITING ART VALUES AT 37 EFPY: 1/4T, 245.0°F (Axial Flaw)

3/4T, 198.2°F (Axial Flaw)

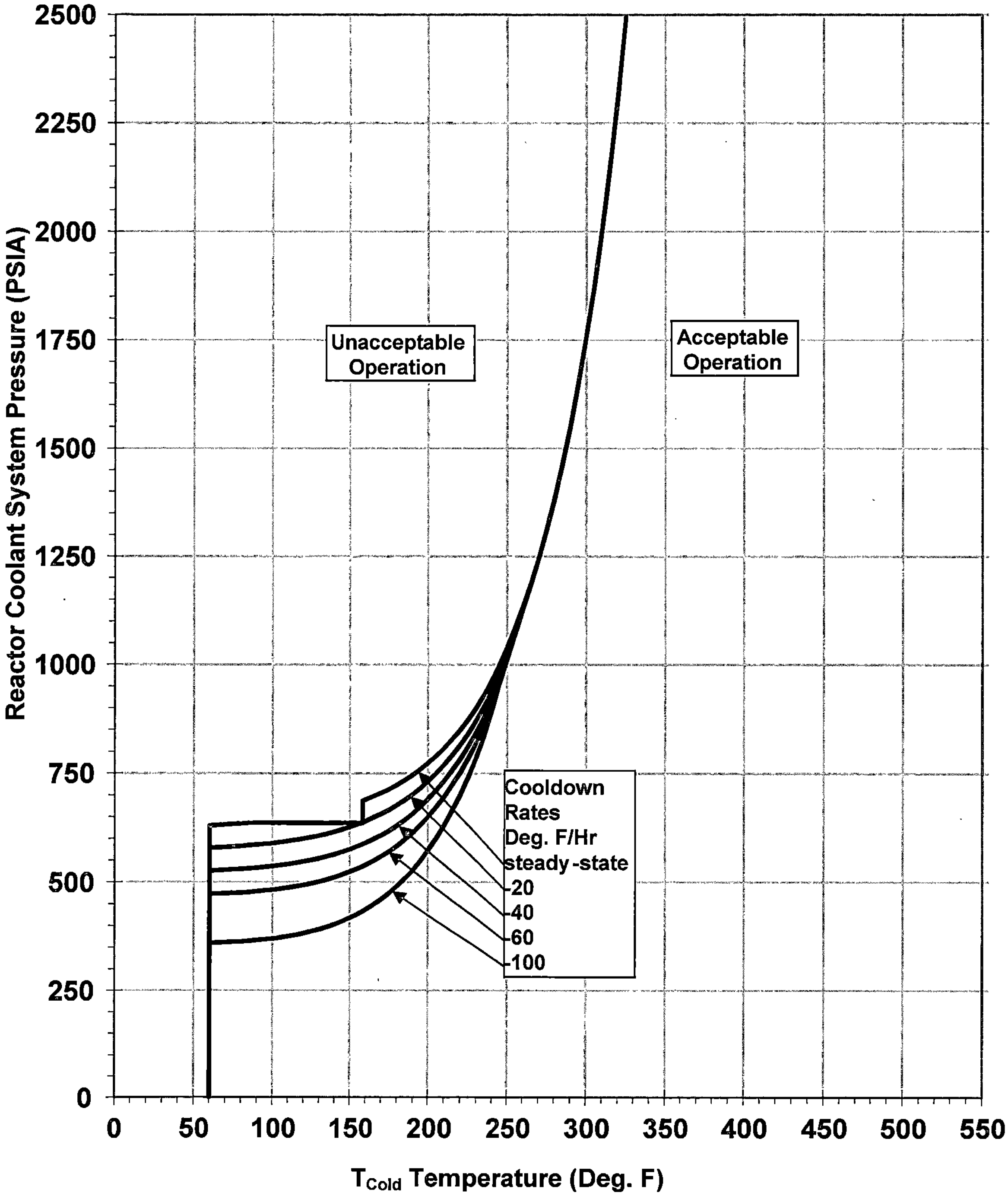
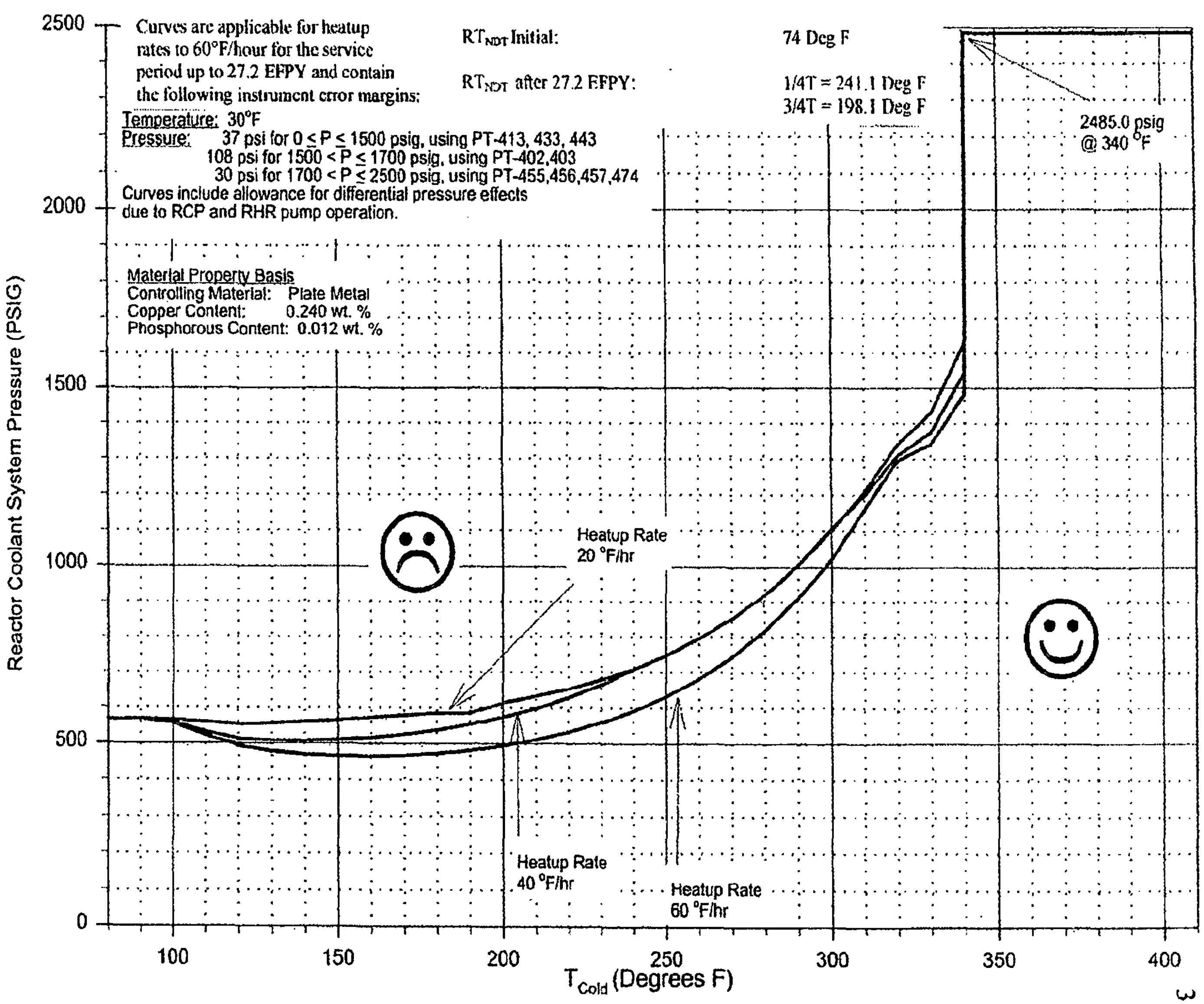


Figure 3.4.3-2:
Cooldown Limitations for Reactor Coolant System
(Without instrument uncertainties)



DELETE THIS FIGURE

Figure 3.4.3-3:
Hydrostatic and Inservice Leak Testing Limitations for Reactor Coolant System

3.4 REACTOR COOLANT SYSTEM (RCS)

3.4.12 Low Temperature Overpressure Protection (LTOP)

LCO 3.4.12

LTOP shall be OPERABLE with no high head safety injection (HHSI) pumps capable of injecting into the RCS and the accumulator discharge isolation valves closed and de-energized, and either of the following:

-------------------------------Note--------------------
LCO 3.4.12.a and LCO 3.4.12.b are not Applicable when all RCS cold leg temperatures are $> 330°F$.

----

a. The Overpressure Protection System (OPS) OPERABLE with two power operated relief valves (PORVs) with lift settings within the limit specified in Figure 3.4.12-1;

<u>OR</u>

b. The RCS depressurized with an RCS vent of ≥ 2.00 square inches***, or one blocked open PORV with its block valve disabled in the open position***.

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

1. Accumulator isolation is only required when accumulator pressure is greater than or equal to the maximum RCS pressure for the coldest existing RCS cold leg temperature allowed by the P/T limit curve in Figure 3.4.12-1.

2. One HHSI pump may be made capable of injecting into the RCS as needed to support emergency boration or to respond to a loss of RHR cooling.

3. One HHSI pump may be made capable of injecting into the RCS for pump testing for a period not to exceed 8 hours.

APPLICABILITY:

Whenever the RHR System is not isolated from the RCS,
MODE 4 when any RCS cold leg temperature is $\leq 330°F$,
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 HHSI pump(s) capable of injecting into the RCS.	A.1 Initiate action to verify no HHSI pumps are capable of injecting into the RCS.	Immediately
	~~OR~~	
	~~A.2.1 Verify RCS is vented with opening ≥ 2.00 square inches.~~	~~Immediately~~
	~~AND~~	
	~~A.2.2 Verify pressurizer level is ≤ 0%.~~	~~Immediately~~ ~~AND~~ ~~Once per 12 hours~~
	~~AND~~	
	~~A.2.3 Verify no more than two HHSI pumps are capable of injecting into the RCS.~~	~~Immediately~~ ~~AND~~ ~~Once per 12 hours~~
	OR	
	A.~~3~~**2**.1 Verify RCS is vented with opening greater than or equal to one pressurizer code safety valve flange.	Immediately
	AND	
	A.~~3~~**2**.2 Verify no more than two HHSI pumps are capable of injecting into the RCS	Immediately AND Once per 12 hours

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION		COMPLETION TIME
E. Two required PORVs inoperable. <u>OR</u> Required Action and associated Completion Time of Condition C or D not met.	E.1	Depressurize RCS and establish RCS vent of ≥ 2.00 square inches***, or one blocked open PORV with its block valve disabled in the open position***.	8 hours
	<u>OR</u>		
	E.2.1	Increase all RCS cold leg temperatures to > 330°F.	8 hours
	<u>AND</u>		
	E.2.2	Isolate the RHR System from the RCS.	8 hours
	<u>OR</u>		
	E.3	Verify pressurizer level, RCS pressure, and RCS injection capability are within limits specified in Figure 3.4.12-2 and Figure 3.4.12-3 for OPS not OPERABLE.	8 hours <u>AND</u> Once per 12 hours thereafter
F. LTOP inoperable for any reason other than Condition A, B, C, D, or E.	F.1	Depressurize RCS and establish RCS vent of ≥ 2.00 square inches***, or one blocked open PORV with its block valve disabled in the open position***.	8 hours

SURVEILLANCE REQUIREMENTS

	SURVEILLANCE	FREQUENCY
SR 3.4.12.1	Verify no HHSI pumps are capable of injecting into the RCS.	12 hours
SR 3.4.12.2	Verify each accumulator discharge isolation valve is closed and de-energized; <u>OR</u> Verify each accumulator pressure is less than the maximum RCS pressure for the coldest existing RCS cold leg temperature allowed by the P/T limit curve in Figure 3.4.12-1.	12 hours 12 hours
SR 3.4.12.3	-------------------NOTE------------------- Only required to be met when complying with LCO 3.4.12.b. -- Verify RCS vent ≥ 2.00 square inches, ***or one blocked open PORV with its block valve disabled in the open position*** established.	12 hours for unlocked open vent valve(s) <u>AND</u> 31 days for locked open vent valve(s)

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.4.12.9	------------------NOTES---------------- 1. Not required to be met when all RCS cold leg temperatures are > 330°F. 2. Not required to be met if SR 3.4.12.8 is met. -----------------------------------	
	Verify each of the following conditions are satisfied prior to starting any RCP: a. Secondary side water temperature of the hottest steam generator is ≤ ~~64~~***50***°F above the coldest RCS cold leg temperature; and b. RCS makeup is less than or equal to RCS losses; and c. Overpressure Protection System (OPS) is OPERABLE; and d. Pressurizer level is ≤ 73%; and ~~e. Coldest RCS cold leg temperature is within limits specified in Figure 3.4.12-4.~~	Within 15 minutes prior to starting any RCP

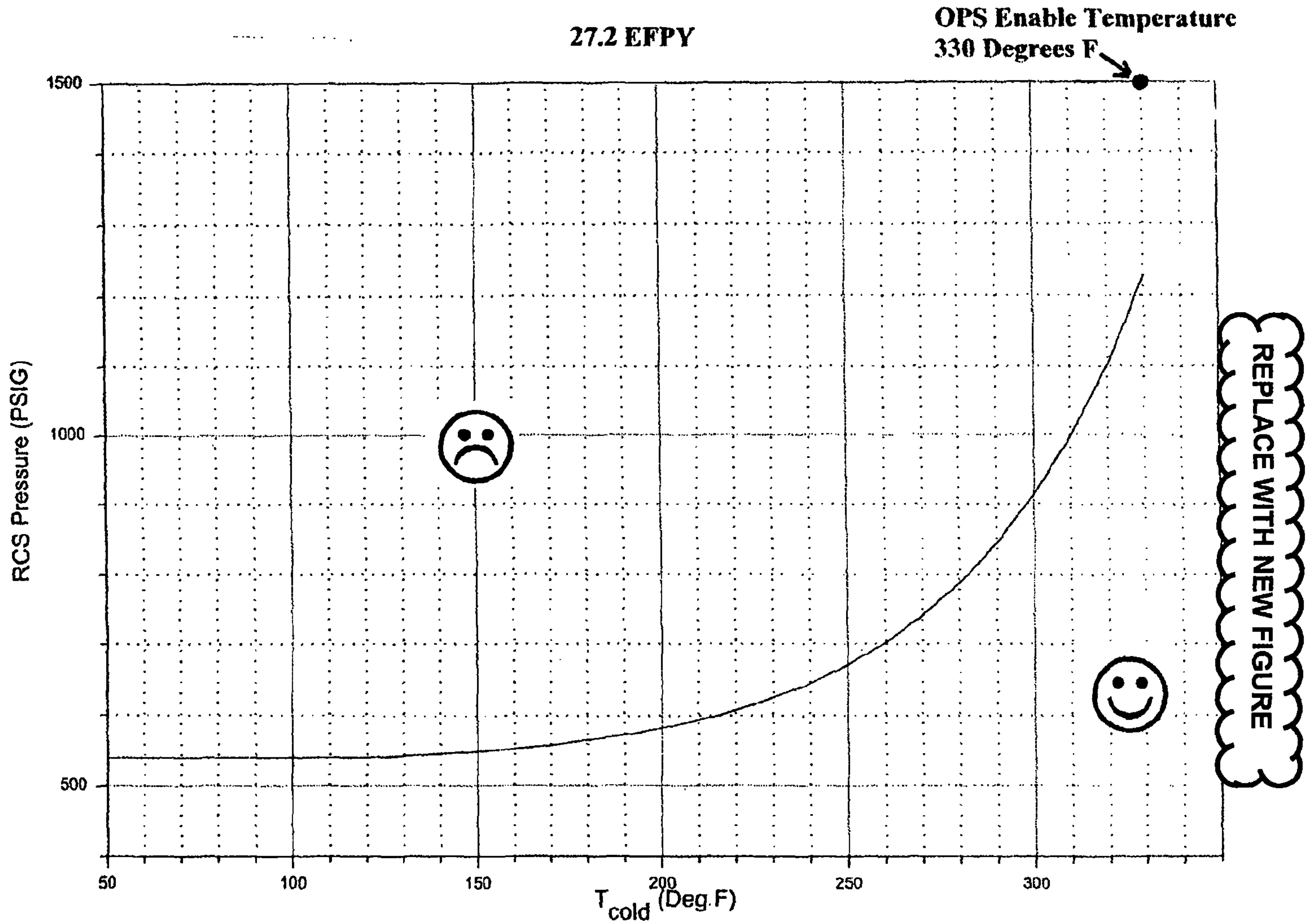


Figure 3.4.12-1: Maximum Allowable Nominal PORV Setpoint for LTOP (OPS), 27.2 EFPY

Note: OPS Enable Temperature includes an allowance of 14.4 degF for instrument uncertainty and margin.

Analytical Curve

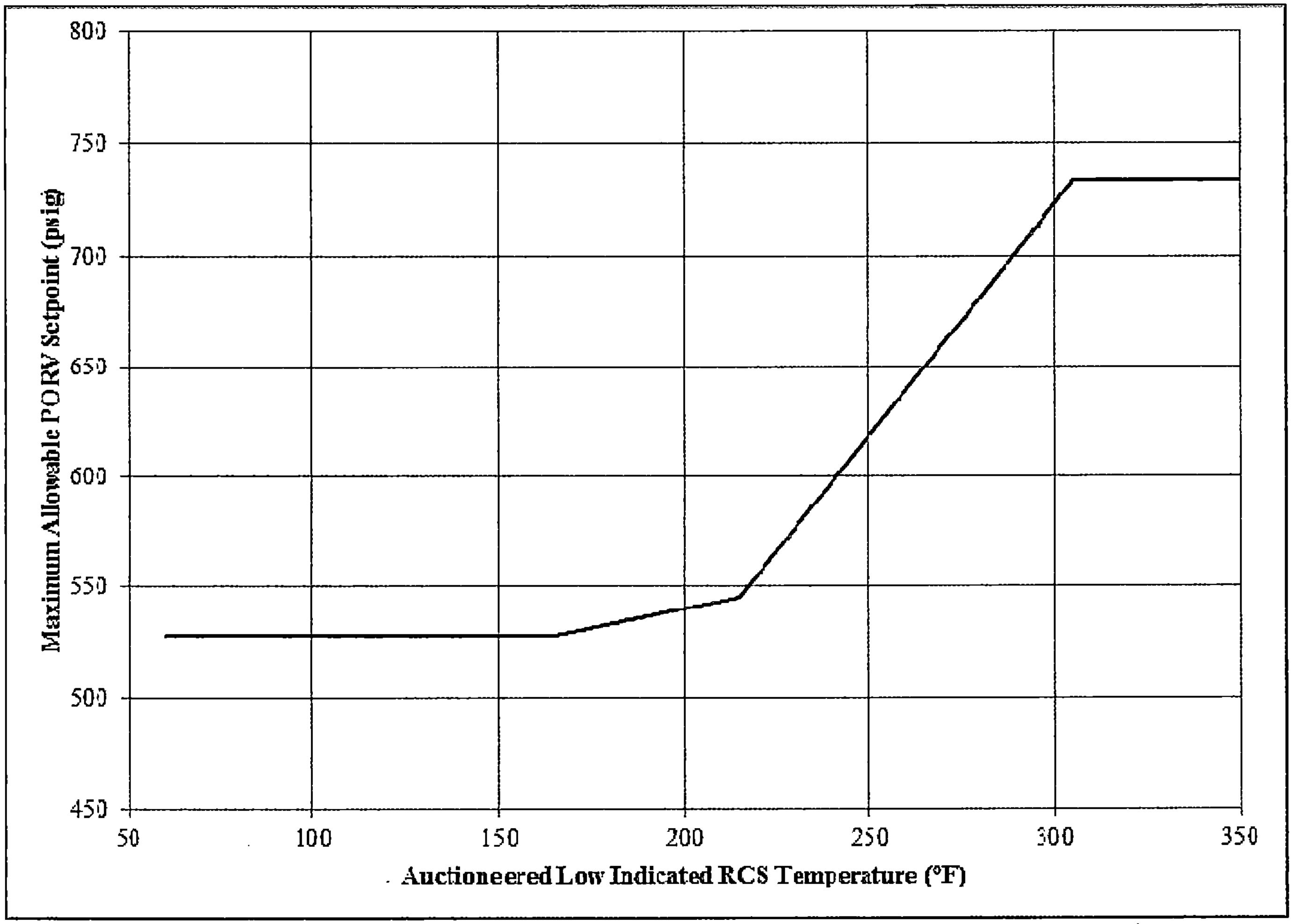


Figure 3.4.12-1: Maximum Allowable PORV Setpoint for LTOP (OPS), 37 EFPY

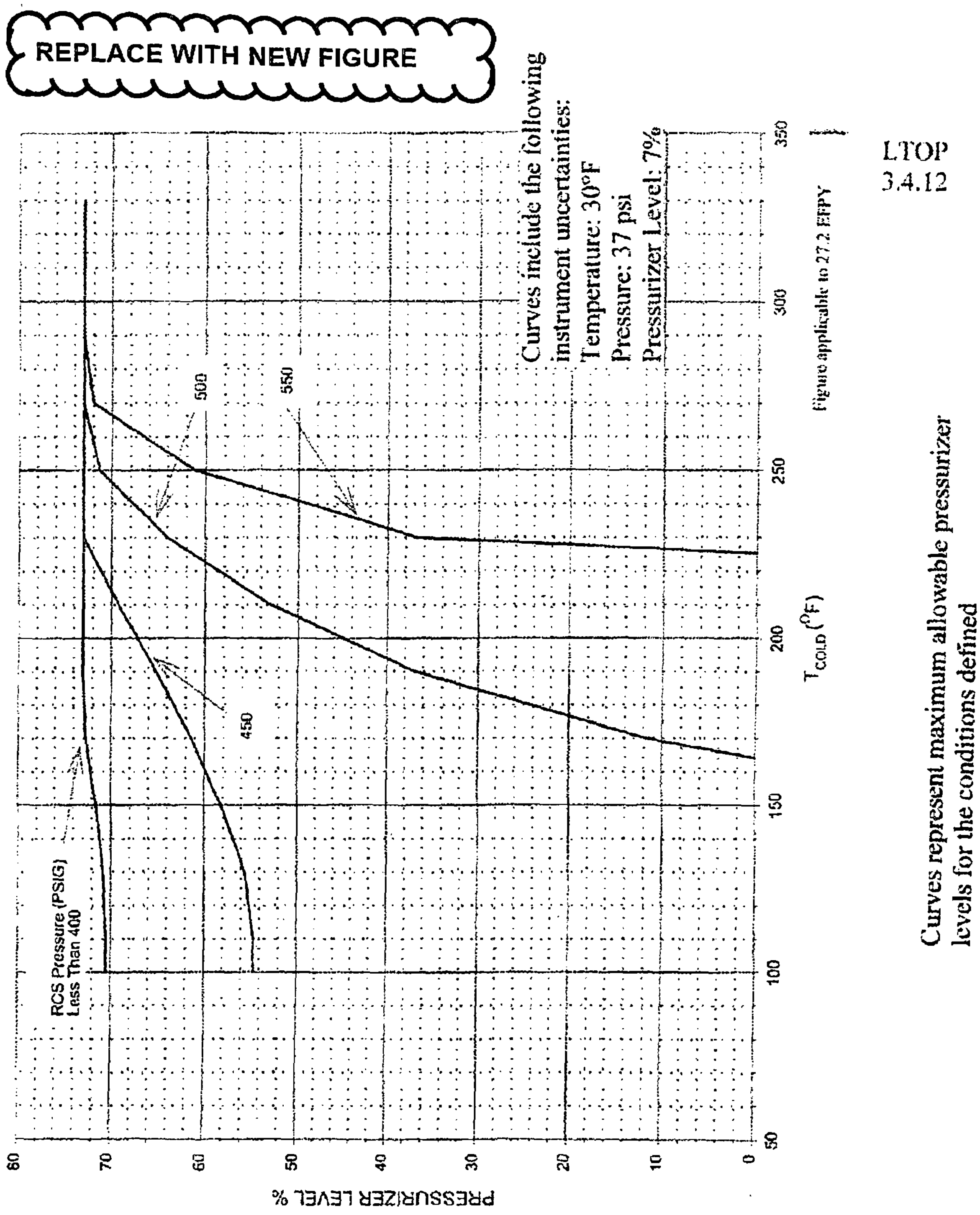


Figure 3.4.12-2: Pressurizer Limitations for OPS Inoperable, 27.2 EFPY (Up to one charging pump capable of feeding the RCS)

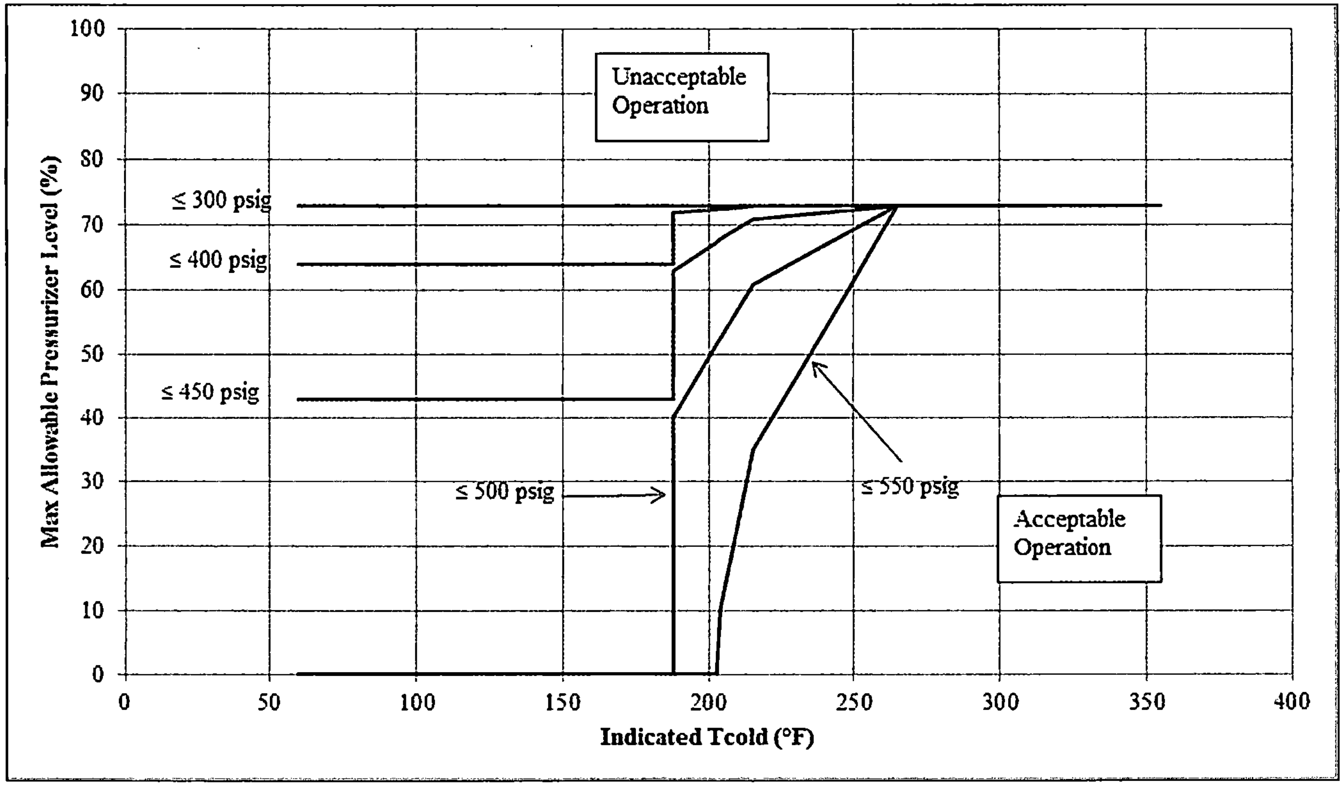


Figure 3.4.12-2: Maximum Allowable Pressurizer Level for LTOPS Inoperable with 1 Charging Pump Capable of Injecting, 37 EFPY

REPLACE WITH NEW FIGURE

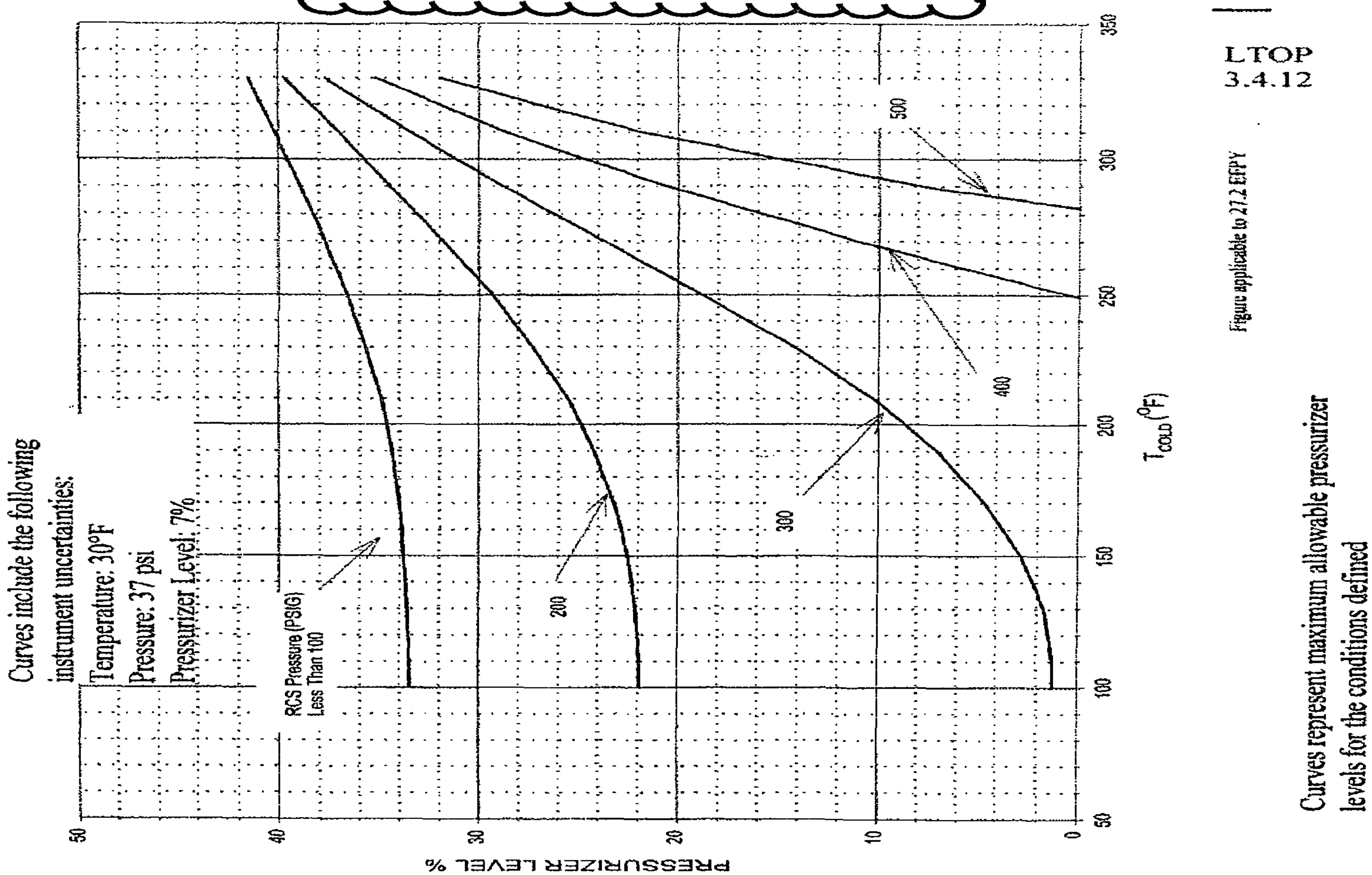


Figure 3.4.12-3: Pressurizer Limitations for OPS Inoperable, 27.2 EFPY (Up to three charging pumps and/or one safety injection pump capable of feeding the RCS)

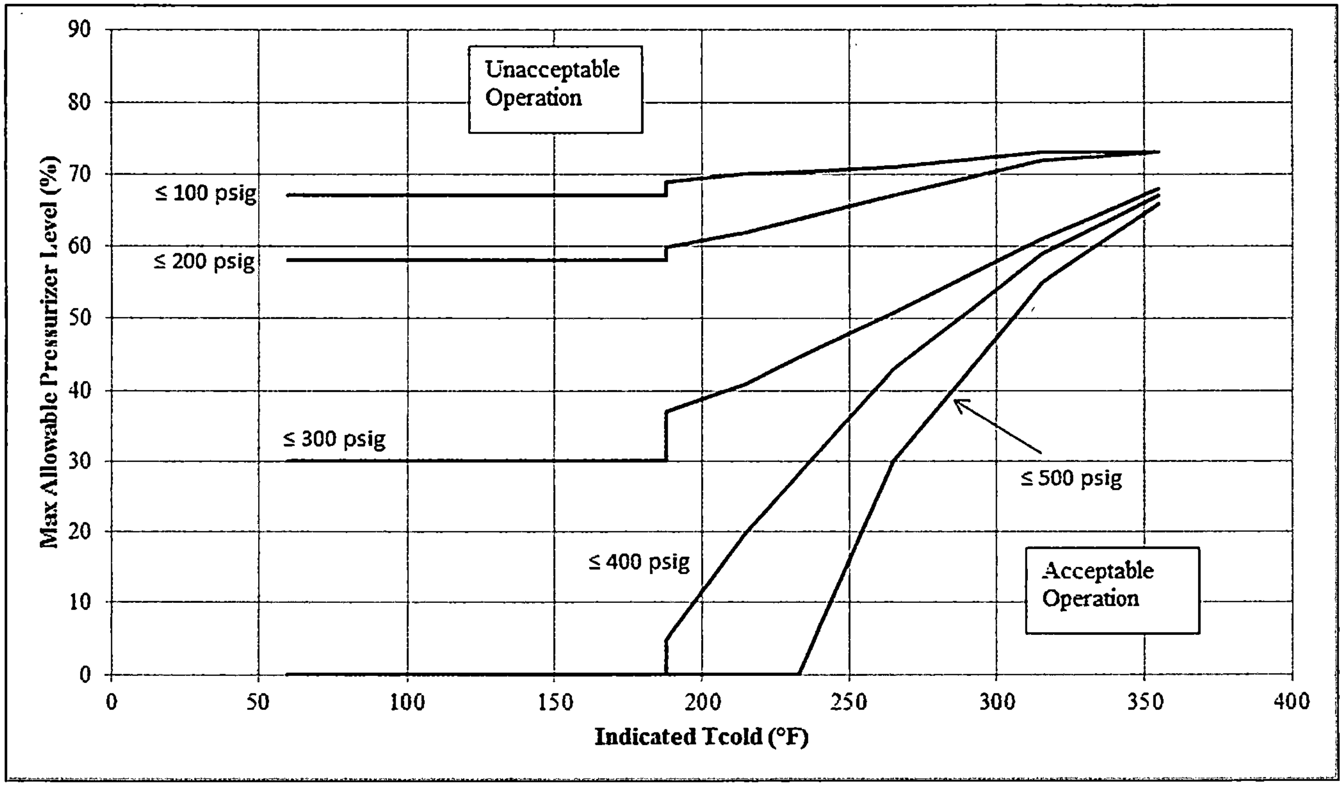


Figure 3.4.12-3: Maximum Allowable Pressurizer Level for LTOPS Inoperable with 3 Charging Pumps Capable of Injecting, 37 EFPY

LTOP
3.4.12

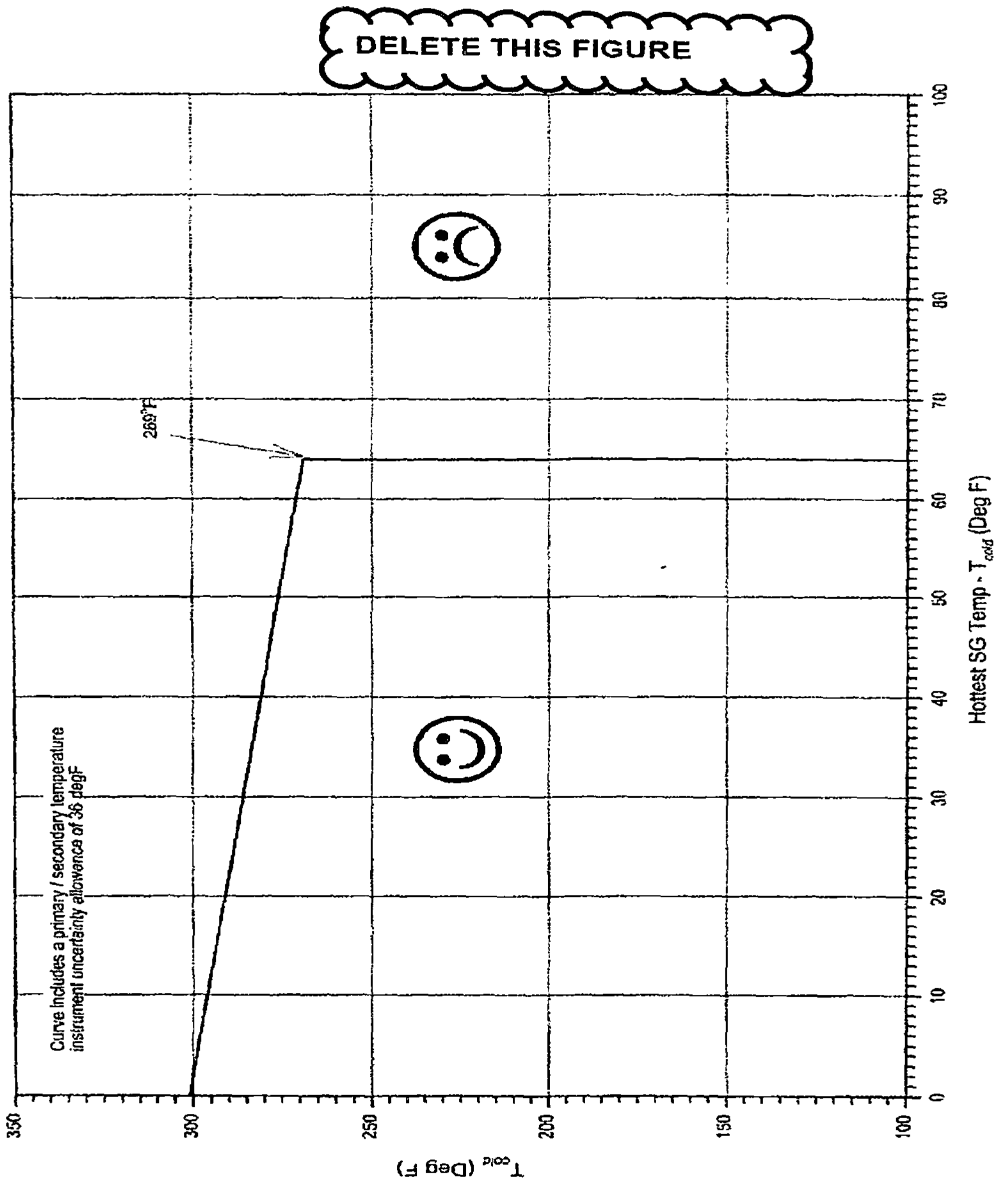


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Figure 3.4.12-4: Secondary Side Limitations for RCP Start with Secondary Side Hotter than Primary Side, 27.2 EFPY

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ATTACHMENT 3 TO NL-13-014

MARKUP OF TECHNICAL SPECIFICATION BASES PAGES FOR PROPOSED CHANGES REGARDING REACTOR HEATUP AND COOLDOWN CURVES AND LTOP REQUIREMENTS

Text changes indicated by lineout for deletion and Bold/Italics for additions

Unit 3 Actual Affected Pages:
B 3.4.3-1 to B 3.4.3-9
B 3.4.12-1
B 3.4.12-3 to -14
B 3.4.12-17 to -19

A revision to the FONT has changed page numbering

ENTERGY NUCLEAR OPERATIONS, INC.
INDIAN POINT NUCLEAR GENERATING UNIT NO. 3
DOCKET NO. 50-286

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.~~ ***10CFR50, Appendix G (Ref 1) establishes the requirements for pressure and temperature limitations to prevent non-ductile failure of the ferrite steel components which are part of the reactor coolant pressure boundary (RCPB). These components include the reactor vessel, the steam generators and the pressurizer. The remainder of the RCPB components are fabricated from either stainless steel or from Nickel alloy materials and therefore are not susceptible to non-ductile fracture in the range of normal operating temperatures. This LCO implements the requirements of 10CFR50, Appendix G.***

LCO 3.4.3, Figure 3.4.3-1, Heatup ***and Inservice Leak Test*** Limitations for the Reactor Coolant System~~,~~ ***and*** Figure, 3.4.3-2, Cooldown Limitations for the Reactor Coolant System~~, and Figure 3.4.3-3, Hydrostatic and Inservice Leak Testing Limitations for the Reactor Coolant System,~~ contain P/T limit curves for heatup, ***and inservice leak test, and*** cooldown, ~~and inservice leak and hydrostatic (ISLH) testing,~~ respectively ~~(Ref. 1)~~. ***These P/T limits were developed in Reference 7.***

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. ~~The happy face icon shown on Figure 3.4.3-1, Figure, 3.4.3-2, and Figure 3.4.3-3, indicates the side of the curve in which operation is permissible. Conversely, the sad face icon indicates the side of the curve in which operation is prohibited. Vacuum fill of the RCS is performed in Mode 5 under sub-atmospheric pressure and isothermal conditions. Vacuum fill is an acceptable condition since the resulting pressure / temperature combination is located on the happy face region to the right and below the operating limits provided in Figures 3.4.3-1, 3.4.3-2 and 3.4.3-3.~~ ***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.***

The LCO establishes operating limits that provide a margin to ~~brittle~~ ***non-ductile*** failure of the ***ferritic portions of the*** ~~reactor vessel and piping of the~~

(continued)

BASES

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.~~ ***Since the reactor vessel is the only RCPB component which is subjected to neutron irradiation embrittlement, it is the most limiting RCS component. However, the remainder of the RCPB components fabricated from ferritic steel (i.e. Steam Generators and Pressurizer) have also been considered in the analysis and were found to be bounded by the beltline region of the reactor vessel.***

10 CFR 50, Appendix G (Ref. ***1*** ~~2~~), requires the establishment of P/T limits for specific material fracture toughness requirements of the RCPB materials. Reference ***1*** ~~2~~ requires an adequate margin to brittle failure during normal operation, anticipated operational occurrences, and system ~~hydrostatic~~ ***inservice leak*** tests. It mandates the use of the American Society of Mechanical Engineers (ASME) Code, Section ~~III~~***XI***, Appendix G (Ref.***2*** ~~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 (Ref. 5). These calculated values are periodically confirmed*** by removing and evaluating the irradiated reactor vessel material specimens, in accordance with ASTM E 185 (Ref. 4***3***) and Appendix H of 10 CFR 50 (Ref. ~~5~~***4***). 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.

(continued)

BASES

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~~***6***), 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.

LCO

The two elements of this LCO are:

a. The limit curves for heatup, ***and inservice leak test, and*** cooldown~~, and ISLH testing~~; and

b. Limits on the rate of change of temperature.

Figure 3.4.3-1, Heatup ***and Inservice Leak Test*** Limitations for the Reactor Coolant System~~,~~ ***and*** Figure, 3.4.3-2, Cooldown Limitations for the Reactor Coolant System, ~~and Figure 3.4.3-3, Hydrostatic and Inservice Leak Testing Limitations for the Reactor Coolant System,~~ contain P/T limit curves for heatup, ***and inservice leak test, and*** cooldown~~, and inservice leak and hydrostatic (ISLH) testing~~, respectively. These figures specify the maximum RCS pressure for various heatup and cooldown rates at any given reactor coolant temperature. The figures provide the limiting RCS pressure and reactor coolant temperature combination for reactor coolant temperature heatup ***and cooldown*** rates up to ~~60°F~~***100°F*** /hr ~~***and reactor coolant temperature cooldown rates up to 100°F/hr***~~. Therefore, heatup ***or cooldown*** rates that exceed ~~60°F /hr and cooldown rates that exceed~~ 100°F/hr are ~~considered~~ not ***considered to be*** within the limits of this LCO.

(continued)

BASES

The LCO limits apply to all components of the RCS pressure boundary, 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~~,~~ ***and*** 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. Heatup and cooldown limits are specified in hourly increments (i.e., the heatup and cooldown limits are based on the temperature change averaged over a one hour period). Limit lines for cooldown rates between those presented may be obtained by interpolation.

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 follows:

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 existence, size, and orientation 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~~***1***). Although the P/T limits were developed ~~to provide guidance~~ for operation during heatup***, Inservice Leak test*** 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

(continued)

BASES

for nonductile failure, and ~~stress~~ analyses have been performed for normal maneuvering profiles, such as power ascension or descent.

~~Figures 3.4.3-1 and 3.4.3-2 are applicable for 34EFPY at 3216 MWt. Both figures are labeled applicable for 27.2 EFPY solely for the low temperature over pressure protection system arming temperature.~~

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 before continuing operation. 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~~***6***), 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. A favorable evaluation must be completed before continuing to operate.

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 a Required Action and associated Completion Time of Condition A are not met, the plant must be placed in a lower MODE because either the RCS

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remained in an unacceptable P/T region for an extended period of increased stress or a sufficiently severe event caused entry into an unacceptable region. 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.

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 plant to MODE 3 within 6 hours and to MODE 5 with RCS pressure < 500 psig within 36 hours. Note that LCO 3.4.12, Low Temperature Overpressure Protection (LTOP), will also apply and may require limits for operation that are more restrictive than or supplement this limit.

The allowed Completion Times are reasonable, based on operating experience, to reach the required plant conditions from full power conditions in an orderly manner and without challenging plant 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. Several methods may be used, including comparison with pre-analyzed ~~transients~~ ***conditions*** in the ~~stress~~ analyses, or inspection of the components.

(continued)

BASES

ASME Code, Section XI, Appendix E (Ref. ~~7~~***6***), may be used to support the evaluation. However, its use is restricted to evaluation of the vessel beltline. 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 the P/T limits is required every 30 minutes when RCS pressure and temperature conditions are undergoing planned changes. This Frequency is considered reasonable in view of the control room indication available to monitor RCS status. Heatup and cooldown limits are specified in hourly increments (i.e., the heatup and cooldown limits are based on the temperature change averaged over a one hour period). Also, since temperature rate of change limits are specified in hourly increments, 30 minutes permits assessment and correction for minor deviations within a reasonable time.

Surveillance for heatup, ***Inservice Leak test and*** 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, ***Inservice Leak test and*** cooldown~~, and ISLH testing~~. No SR is given for criticality operations because LCO 3.4.2 contains a more restrictive requirement.

REFERENCES

~~1. WCAP-7924-A, July 1972.~~

1~~2~~. 10 CFR 50, Appendix G.

2~~3~~. ASME, Boiler and Pressure Vessel Code, Section ~~III~~***XI***, Appendix G.

3~~4~~. ASTM E 185~~-70~~.

4~~5~~. 10 CFR 50, Appendix H.

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5 ~~6~~. Regulatory Guide 1.99, Revision 2, May 1988.

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

~~8. WCAP – 16212P, Indian Point Nuclear Power Generating Unit No. 3 Stretch Power Uprate NSSS and BOP Licensing Report, June 2004.~~

7. WCAP-17954-P, Rev 0, "Indian Point 3 Heatup and Cooldown Limit Curves for Normal Operation," December 2014.

BASES

BACKGROUND

LTOP is established to limit 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. LCO 3.4.12, Figure 3.4.12-1 provides the maximum allowable nominal actuation logic setpoints for the power operated relief valves (PORVs) and the maximum RCS pressure for the coldest 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 because 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~~***non-ductile failure*** of the reactor vessel. LCO 3.4.3, "RCS Pressure and Temperature (P/T) Limits," requires administrative control of RCS pressure and temperature during heatup and cooldown to prevent exceeding the limits ~~in Figure 3.4.12-1~~ ***of Reference 1***.

When the RHR System is isolated from the RCS, the RHR System is protected from overpressure by two spring loaded relief valves (SI-733A and SI-733B). When the RHR System is not isolated from the RCS, the RHR System is protected from overpressure by ***a*** spring loaded relief valve (i.e., AC-1836) which has sufficient capacity to accommodate all 3 charging pumps. However, this relief valve does not have sufficient capacity to ensure that the RHR system does not exceed design pressure limits during a mass addition resulting from an inadvertent injection of one or more high head safety injection (HHSI) pumps. Therefore, LTOP requirements are used to protect the RHR System whenever the RHR System is not isolated from the RCS.

This LCO provides RCS overpressure protection by limiting maximum coolant input capability and having adequate pressure relief capacity. Limiting coolant input capability is achieved by not permitting any High Head Safety Injection (HHSI) pumps to be capable of injection into the RCS and isolating the accumulators. The pressure relief capacity requires either two redundant power operated relief valves (PORVs) or a depressurized RCS and an RCS vent of sufficient size. One PORV or the open RCS vent is sufficient to provide overpressure protection to terminate an increasing

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pressure event. Alternately, if redundant PORVs are not Operable or an RCS vent cannot be established, LTOP protection may be established by limiting the pressurizer level to within limits specified in Figure 3.4.12-2 and Figure 3.4.12-3 consistent with the number of charging pumps and number of high head safety injection (HHSI) pumps capable of injecting into the RCS. This approach is acceptable because pressurizer level can be maintained such that it will either accommodate any anticipated pressure surge or allow operators time to react to any unanticipated pressure surge. When pressurizer level is used to satisfy LTOP requirements, operator action is assumed to terminate the unplanned HHSI pump injection within 10 minutes.

With high pressure coolant input capability limited, the ability to create an overpressure condition by coolant addition is restricted. The LCO does not require the makeup control system deactivated or the safety injection (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. There is no restriction on the status of charging pumps when LTOP is established using either a PORV or an RCS vent. If conditions require the use of more than one HHSI pump for makeup in the event of loss of inventory, then pumps can be made available through manual actions. Charging pumps and low pressure injection systems are available to provide makeup even when LTOP requirements are applicable.

When configured to provide low temperature overpressure protection, the PORVs are part of the Overpressure Protection System (OPS).

LTOP for pressure relief can consist of either the OPS (two PORVs with reduced lift settings), or a depressurized RCS and an RCS vent of sufficient size. Two PORVs are required for redundancy. One PORV has adequate relieving capability to keep from overpressurization for the required coolant input capability.

<u>PORV Requirements</u>

The Overpressure Protection System (OPS) provides the low temperature overpressure protection by controlling the Power Operated Relief Valves (PORVs) and their associated block valves with pressure setpoints that vary with RCS cold leg temperature. Specifically, cold leg temperature signals from three RCS loops are supplied to three associated function generators that calculate the maximum RCS pressures allowed at those temperatures. The maximum RCS pressure limits at any RCS temperature correspond to the 10 CFR 50, Appendix G, limit curve ~~maintained in the Pressure and Temperature Limits Report~~ and are used as the OPS pressure setpoint. Having the setpoints of both valves within the limits in Figure 3.4.12-1

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ensures that the Reference 1 limits will not be exceeded in any analyzed event.

In addition to generating the OPS pressure setpoint, the same cold leg temperature signals are used to "arm" the OPS when RCS temperature falls below the temperature at which low temperature overpressure protection is required (330°F). This temperature includes an allowance of 14.4°F for instrument uncertainty and margin. Each PORV opens when a two-out-of-two (temperature and pressure) coincidence logic is satisfied. OPS is "armed" when RCS temperature falls below the temperature that satisfies one half of the two-out-of-two (temperature-pressure) coincidence logic. When OPS is enabled, the PORVs will open if RCS pressure exceeds the calculated pressure setpoint that varies with RCS temperature.

The PORV block valves open when the RCS temperature falls below the OPS arming temperature. Note that the control switches for the PORV and PORV block valves must be in the AUTO position and the OPS states links closed for OPS signals to actuate the PORVs.

Three channels of RCS cold leg temperature are used in the two-out-of-three coincidence logic to satisfy the temperature portion of the two-out-of-two (temperature and pressure) coincidence logic for each PORV. Three channels of RCS pressure are used in a two-out-of-three coincidence logic to satisfy the pressure portion of the two-out-of-two (temperature-pressure) coincidence logic for each PORV. Use of a two-out-of-three coincidence logic for pressure and for temperature ensures that a single failure will not cause or prevent an OPS actuation. Use of two PORVs, each with adequate relieving capability to prevent overpressurization, ensures that a single failure will not prevent an OPS actuation.

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.

RCS Vent Requirements

Once the RCS is depressurized, a vent exposed to the containment atmosphere will maintain the RCS 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.

(continued)

BASES

Multiple methods exist for establishing the required RCS vent capacity including removing or blocking open a PORV and disabling its block valve in the open position. An RCS vent of ≥ 2.00 square inches ***or by a blocked open PORV*** when no HHSI pump is capable of injecting into the RCS; or, an RCS vent with opening greater than or equal to one pressurizer code safety valve flange and up to two HHSI pumps capable of injecting into the RCS will satisfy LTOP requirements because either configuration ensures pressure limits are not exceed during a transient. ***Two (2) PORVs open on nitrogen with the associated block valves open and disabled is equivalent to a blocked open PORV with its block valve open and disabled.*** ~~Alternately, an RCS vent of ≥ 2.00 square inches coupled with a pressurizer level ≤ 0% and up to two HHSI pumps capable of injecting into the RCS will satisfy LTOP requirements because it ensures a minimum of 10 minutes for operator action before pressure limits are exceeded during a transient.~~ The vent path(s) must be above the level of reactor coolant, so as not to drain the RCS when open.

APPLICABLE SAFETY ANALYSES

Safety analyses ~~(Ref. 3)~~ demonstrate that the reactor vessel is adequately protected against exceeding the Reference ***6*** ~~1~~ P/T limits. In MODES 1, 2, and 3, with RCS cold leg temperature exceeding ~~380°F~~***330°F***, the pressurizer safety valves will prevent RCS pressure from exceeding the Reference ***6*** ~~1~~ limits. At 330 °F and below, overpressure prevention falls to two OPERABLE PORVs in conjunction with the Overpressure Protection System (OPS) or to a depressurized RCS and a sufficient sized RCS vent. Each of these means has a limited overpressure relief capability. Alternately, if redundant PORVs are not Operable, Low Temperature Overpressure protection may be maintained by limiting the pressurizer level to within limits specified in Figure 3.4.12-2 and Figure 3.4.12-3 consistent with the number of charging pumps and ~~number of~~ ***no*** high head safety injection (HHSI) pumps capable of injecting into the RCS. This approach is acceptable because pressurizer level can be established to either accommodate any anticipated pressure surge or allow operators time to react to any unanticipated pressure surge.

When the RCS temperature is greater than the LTOP arming temperature ~~(i.e., ≥330°F)~~ but below the minimum temperature at which the pressurizer safety valves lift prior to violation of the 10 CFR 50, Appendix G, limits ~~(i.e., ≤ 380°F)~~, administrative controls in the Technical Requirements Manual (TRM) (Ref. ***3***~~4~~) are used to limit the potential for exceeding 10 CFR 50, Appendix G, limits. These administrative controls may include operating with a bubble in the pressurizer and/or otherwise limiting plant time or activities when the RCS temperature is in the specified range. The use of administrative controls to govern operation above the LTOP arming temperature but below the minimum temperature at which the pressurizer safety valves lift prior to

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violation of the 10 CFR 50, Appendix G, limits is consistent with the guidance provided in Generic Letter 88-011, NRC Position on Radiation Embrittlement of Reactor Vessel Materials and its Impact on Plant Operations (Ref.2). GL 88-011 states that automatic, or passive, protection of the P-T limits will not be required but administratively controlled when in the upper end of the 10 CFR 50, Appendix G, temperature range.

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 Figure 3.4.12-1 curves are revised, LTOP must be re-evaluated to ensure its functional requirements can still be met using the OPS (PORVs) method or the depressurized and vented RCS condition.

Figure 3.4.12-1 contains the acceptance limits that define the LTOP requirements. Any change to the RCS must be evaluated ~~against the Ref. 3 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:

<u>Mass Input Type Transients</u>

a. Inadvertent safety injection; or

b. Charging/letdown flow mismatch.

<u>Heat Input Type Transients</u>

a. Inadvertent actuation of pressurizer heaters;

b. Loss of RHR cooling; or

c. Reactor coolant pump (RCP) startup with ***Steam Generator secondary side*** temperature ***up to 50^0 F higher than the RCS primary side 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. This is accomplished by the following:

a. Rendering all HHSI pumps incapable of injection;

b. Deactivating the accumulator discharge isolation valves in their closed positions or maintaining accumulator pressure less than the maximum

BASES

RCS pressure for the coldest existing RCS cold leg temperature allowed by the P/T limit curves provided in Figure 3.4.12-1; and

c. Disallowing start of an RCP unless conditions are established that ensure a RCP pump start will not cause a pressure excursion that will exceed LTOP limits. Required conditions for starting a RCP when LTOP is required include a combination of primary and secondary water temperature differences and Overpressure Protection System (OPS) status or pressurizer level. Meeting the LTOP RCP starting surveillances ensures that theses conditions are satisfied prior to a RCP pump start.

The ~~Ref. 3~~ analyses demonstrate that either one PORV or the depressurized RCS and RCS vent can maintain RCS pressure below limits when no HHSI pump is capable of injecting into the RCS. This assumes an RCS vent of ≥ 2.00 square inches ***or by a blocked open PORV. Two (2) PORVs open on nitrogen with the associated block valves open and disabled is equivalent to a blocked open PORV with its block valve open and disabled.*** The same protection can be provided when up to two HHSI pumps are capable of injecting into the RCS assuming an RCS vent with opening greater than or equal to one code pressurizer safety valve flange. Alternately, LTOP requirements can be satisfied by various combinations of pressurizer level, RCS pressure, and RCS injection capability (i.e., maximum number of ~~HHSI pumps and/or~~ charging pumps ***and no HHSI pumps***) shown in Figure 3.4.12-2 and 3.4.12-3. These combinations of pressurizer level, RCS pressure, and RCS injection capability satisfy LTOP requirements by ensuring a minimum of 10 minutes for operator action to terminate an unplanned event prior to exceeding maximum allowable RCS pressure. None of the analyses addressed the pressure transient need from accumulator injection, therefore, when RCS temperature is low, the LCO also requires the accumulator isolation when accumulator pressure is greater than or equal to the maximum RCS pressure for the coldest existing RCS cold leg temperature allowed in Figure 3.4.12-1.

If the accumulators are isolated and not depressurized, then the 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 330°F.~~

The consequences of a loss of coolant accident (LOCA) in LTOP MODE 4 conform to 10 CFR 50.46 and 10 CFR 50, Appendix K (Refs. ~~5~~***4*** and ~~6~~5) requirements by having ECCS OPERABLE in accordance with requirements in LCO 3.5.3, ECCS-Shutdown.

PORV Performance

(continued)

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~~The fracture mechanics a~~***A***nalyses show that the vessel is protected when the PORVs are set to open at or below the limit shown in Figure 3.4.12-1. The setpoints are derived by analyses that model the performance of the LTOP System, assuming the limiting LTOP transient with HHSI not injecting into the RCS. 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 OPS setpoint is based on a***n*** ~~comparative~~ analysis ~~of Reference 3~~, with allowances for metal/fluid temperature differences, static head due to elevation differences, and dynamic head from the operation of the reactor coolant pumps and RHR pumps ***(Ref. 7).***

~~The PORV setpoints in Figure 3.4.12-1 will be updated when the revised P/T limits conflict with the LTOP analysis limits.~~ 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~~ ***testing*** 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.

RCS Vent Performance

With the RCS depressurized, analyses show ~~a vent size of 1.4 square inches~~ ***that one blocked open PORV with its block valve disabled in the open position (note that a 2 square inches vent path is more conservative than one blocked open PORV)*** is capable of mitigating the allowed LTOP overpressure transient assuming no HHSI pump and no accumulator injects into the RCS. ***Two (2) PORVs open on nitrogen with the associated block valves open and disabled is equivalent to a blocked open PORV with its block valve open and disabled.*** ~~The LCO limit for an RCS vent is conservatively established at 2.00 square inches.~~ The capacity of a vent this size is greater than the flow of the limiting transient for the LTOP configuration, maintaining RCS pressure less than the maximum pressure on the P/T limit curve. An RCS vent with opening greater than or equal to one pressurizer code safety valve flange and up to two HHSI pumps capable of injecting into the RCS will satisfy LTOP requirements because it ensures pressure limits are not exceede***d*** during a transient. ~~An RCS vent of ≥ 2.00 square inches coupled with a pressurizer level ≤ 0% and up to two HHSI pumps capable of injecting into the RCS will satisfy LTOP requirements because it ensures a minimum of 10 minutes for operator action before pressure limits are exceeded during a transient.~~

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BASES

~~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.

LTOP satisfies Criterion 2 of 10 CFR 50.36.

LCO

This LCO requires that LTOP is OPERABLE. LTOP 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, the LCO requires that no HHSI pumps be capable of injecting into the RCS and all accumulator discharge isolation valves ***be*** closed and de-energized if accumulator pressure is greater than or equal to the maximum RCS pressure for the existing RCS cold leg temperature allowed in Figure 3.4.12-1~~, Maximum Allowable Nominal PORV Setpoint for LTOP (OPS)~~.

The elements of the LCO that provide low temperature overpressure mitigation through pressure relief are:

a. Two OPERABLE PORVs configured as part of an OPERABLE Overpressure Protection System (OPS); or

b. A depressurized RCS and an RCS vent.

A PORV is OPERABLE for LTOP when its block valve is open, its lift setpoint is set to the limit required by Figure 3.4.12-1 and testing proves its ability to open at this setpoint, and motive power is available to the two valves and their control circuits.

The OPS is OPERABLE for LTOP when there are three OPERABLE RCS pressure channels and three OPERABLE RCS temperature channels. The OPS is still OPERABLE when an inoperable RCS pressure or temperature channel is in the tripped condition. OPS is considered OPERABLE for meeting LCO 3.4.12 requirements even if one or two RCS cold leg temperatures is above the LTOP Applicability limit.

An RCS vent is OPERABLE when open with an area of ≥ 2.00 square inches ***or by a blocked open PORV with its block valve disabled in the open position. Two (2) PORVs open on nitrogen with the associated block valves open and disabled is equivalent to a blocked open PORV with its block valve open and disabled.***

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

APPLICABILITY

This LCO is applicable whenever the RHR System is not isolated from the RCS to protect the RHR system piping. When all RCS cold leg temperatures are < 330 °F, RHR system piping is adequately protected by making the accumulators and all HHSI pumps incapable of injecting into the RCS. Therefore, a Note in the LCO specifies that requirements for the OPS System and/or an RCS vent are not Applicable when all RCS cold leg temperatures are > 330 °F.

This LCO is applicable to provide protection for the RCS pressure boundary in MODE 4 when any RCS cold leg temperature is ≤ 330 °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 above 330 °F. When the reactor vessel head is off, overpressurization cannot occur. Although LTOP is not A***applicable*** when the RCS temperature is greater than the LTOP arming temperature (i.e., ≥ 330 °F) ~~but below the minimum temperature at which the pressurizer safety valves lift prior to violation of the 10 CFR 50, Appendix G, limits (i.e., ≤ 380 °F)~~, administrative controls in the Technical Requirements Manual (TRM) (Ref. 4***3***) are used to limit the potential for exceeding 10 CFR 50, Appendix G, limits. 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 above 330 °F when the RHR system is isolated from the RCS.

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 when little or no time allows operator action to mitigate the event.

The Applicability is modified by three Notes,. Note 1 states that accumulator isolation is only required when the accumulator pressure is more than the maximum RCS pressure for the existing temperature, as allowed by the P/T limit curves. This Note permits the accumulator discharge isolation valve Surveillance to be performed only under these pressure and temperature conditions.

Note 2 ensures that LCO 3.4.12 will not prohibit a HHSI pump being energized and aligned to the RCS as needed to support emergency boration or to respond to a loss of RHR cooling.

(continued)

BASES

Note 3 specifies that one HHSI pump may be made capable of injecting into the RCS for a period not to exceed 8 hours to perform pump testing. During testing, administrative controls are used to ensure that HHSI testing will not result in exceeding RCS or RHR system pressure limits.

ACTIONS

A Note prohibits the application of LCO 3.0.4.b to an inoperable LTOP system. 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, A.2.1~~,~~ ***and*** A.2.2~~, A.2.3, A.3.1 and A.3.2~~

When one or more HHSI pumps are capable of injecting into the RCS, LTOP assumptions regarding limits on mass input capability may not be met. Therefore, immediate action is required to limit injection capability consistent with the LTOP analysis assumptions and the existing combination of pressurizer level and RCS venting capacity. Required Action A.1 requires restoration with LCO requirements. Required Action~~s~~ A.2 ~~and A.3~~ require*s* verification and periodic re-verification that alternate LTOP configurations are met. The Completion Times of immediately reflects the urgency that one of the acceptable LTOP configurations is established as soon as possible.

B.1, C.1 and C.2

To be considered isolated, an accumulator must have its discharge valves closed and the valve power supply breakers fixed in the open position.

An unisolated accumulator requires isolation within 1 hour. This is only required when the accumulator pressure is at or more than the maximum RCS pressure for the existing temperature allowed by the P/T limit curves.

If isolation is needed and cannot be accomplished in 1 hour, Required Action C.1 and Required Action C.2 provide two options, either of which must be performed in the next 12 hours. By increasing the RCS temperature to > 330 °F, an accumulator pressure of 700 psig cannot exceed the LTOP limits if the accumulators are injected. Isolating the RHR system from the RCS ensures that the RHR system is not subjected to accumulator pressure. Depressurizing the accumulators below the LTOP limit from Figure 3.4.12-1 also gives this protection. Additionally, the RHR System must be isolated from the RCS to protect RHR piping from a potential mass addition event.

The Completion Times are based on operating experience that these activities can be accomplished in these time periods and on engineering

(continued)

evaluations indicating that an event requiring LTOP is not likely in the allowed times.

D.1

When any RCS cold leg temperature is ≤ 330 °F, with one required PORV inoperable, the PORV must be restored to OPERABLE status within a Completion Time of 7 days. Two PORVs are required to provide low temperature overpressure mitigation while withstanding a single failure of an active component.

The Completion Time considers the facts that only one of the PORVs is required to mitigate an overpressure transient and that the likelihood of an active failure of the remaining valve path during this time period is very low.

E.1

When both required PORVs are inoperable or the Required Action and associated Completion Time of Condition C or D is not met, an alternate method of low temperature overpressure protection must be established within 8 hours. The acceptable alternate methods of LTOP include the following:

a. Depressurize the RCS and establish an RCS vent path; or

b. Increase all RCS cold leg temperatures to > 330°F and isolate the RHR system from the RCS; or

If the option selected is to depressurize the RCS and establish an RCS vent path, the vent must be sized ≥ 2.00 square inches ***or by a blocked open PORV with its block valve disabled in the open positio***n to ensure that the flow capacity is greater than that required for the worst case mass input transient reasonable during the applicable MODES. ***Two (2) PORVs open on nitrogen with the associated block valves open and disabled is equivalent to a blocked open PORV with its block valve open and disabled.*** This action is needed to protect the RCPB from a low temperature overpressure event and a possible ~~brittle~~ ***non-ductile*** failure of the reactor vessel.

The Completion Time considers the time required to place the plant 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.

F.1

BASES

If LTOP requirements are not met for reasons other than Conditions A, B, C, D or E, LTOP requirements must be re-established by depressurizing the RCS and establishing an RCS vent of ≥ 2.00 square inches ***or by a blocked open PORV*** with its block valve disabled in the open position within 8 hours. ***Two (2) PORVs open on nitrogen with the associated block valves open and disabled is equivalent to a blocked open PORV with its block valve open and disabled.***

SURVEILLANCE REQUIREMENTS

SR 3.4.12.1 and SR 3.4.12.2

To minimize the potential for a low temperature overpressure event by limiting the mass input capability, all HHSI pumps are verified incapable of injecting into the RCS. Additionally, the accumulator discharge isolation valves are verified closed and locked out or the accumulator pressure less than the maximum RCS pressure for the existing RCS cold leg temperature allowed by the P/T limit curves provided in Figure 3.4.12-1.

The HHSI pumps are rendered incapable of injecting into the RCS either through removing the power from the pumps by racking the breakers out or by providing isolation of the injection path with the valve de-energized or locked closed under administrative control. Other methods may be employed using at least two independent means to prevent a pump 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 Trip Pullout and at least one valve in the discharge flow path being closed or by one valve in the discharge flow path being locked or de-energized closed.

The Frequency of 12 hours is sufficient, considering other indications and alarms available to the operator in the control room, to verify the required status of the equipment.

SR 3.4.12.3

The RCS vent of ≥ 2.00 square inches ***or by a blocked open PORV with its block valve disabled in the open position*** is proven OPERABLE by verifying its open condition either:

a. Once every 12 hours for a valve that is not locked.

b. Once every 31 days for a valve that is locked, sealed, or secured in position. A removed pressurizer safety valve, PORV, or Manway Cover fits this category.

(continued)

BASES

The passive vent arrangement must only be open to be OPERABLE. This Surveillance is required to be performed if the vent is being used to satisfy the pressure relief requirements of the LCO 3.4.12.b.

SR 3.4.12.4

Performance of the CHANNEL CHECK of the Overpressure Protection System (OPS) RCS pressure and temperature channels every 24 hours ensures that gross failure of instrumentation has not occurred. A CHANNEL CHECK is normally a comparison of the parameter indicated on one channel to a similar parameter on other channels. It is based on the assumption that instrument channels monitoring the same parameter should read approximately the same value. Significant deviations between the two instrument channels could be an indication of excessive instrument drift in one of the channels or of something even more serious. A CHANNEL CHECK will detect gross channel failure; thus, it is key to verifying that the instrumentation continues to operate properly between each CHANNEL CALIBRATION.

Agreement criteria are determined by the unit staff based on a combination of the channel instrument uncertainties, including indication and readability. If a channel is outside the criteria, it may be an indication that the sensor or the signal processing equipment has drifted outside its limit.

The Frequency is based on operating experience that demonstrates channel failure is rare. The CHANNEL CHECK supplements less formal, but more frequent, checks of channels during normal operational use of the displays associated with the LCO required channels. This SR is required only when LCO 3.4.12.a is used to establish LTOP protection.

SR 3.4.12.5

The PORV block valve opens automatically when RCS cold leg temperature is below the OPS arming temperature; however, the valves must be verified open every 72 hours to provide the flow path for each required PORV to perform its function when actuated. The valve may be remotely verified open in the control room. This Surveillance is performed only if the PORV is being used to satisfy LCO 3.4.12.a.

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. If closed, the block valve must be de-energized to prevent the valve from re-opening automatically.

(continued)

BASES

The 72 hour Frequency is considered adequate because the PORV block valves are opened automatically by the OPS when below the OPS arming temperature if the valve control is positioned to auto and other administrative controls available to the operator in the control room, such as valve position indication, that verify that the PORV block valve remains open.

SR 3.4.12.6

Performance of a COT is required within 12 hours after decreasing all RCS temperatures to ≤ 330 °F and every 31 days 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 appplicable extensions. The COT will verify the setpoint is within the allowed maximum limits in Figure 3.4.12-1. PORV actuation could depressurize the RCS and is not required.

The 24 month Frequency considers the demonstrated reliability of the Overpressure Protection System and the PORVs.

A Note has been added indicating that this SR is required to be met within 12 hours after decreasing RCS cold leg temperature to ≤ 330°F. The 12 hour allowance considers the unlikelihood of a low temperature overpressure event during this time.

SR 3.4.12.7

Performance of a CHANNEL CALIBRATION on each required PORV actuation channel is required every 18 months. Performance of a CHANNEL CALIBRATION of RCS pressure and temperature instruments that support the Overpressure Protection System is required every 24 months. These calibrations verify both the OPS and PORV function and ensure the OPERABILITY of the whole channel so that it responds and the valve opens within the required range and accuracy to known input.

SR 3.4.12.8 and SR 3.4.12.9

The RCP starting prerequisites must be satisfied prior to starting or jogging any reactor coolant pump (RCP) when low temperature overpressure protection is required. The RCP starting prerequisites prevent an overpressure event due to thermal transients when an RCP is started. Plant conditions prior to the RCP start determines whether SR 3.4.12.8 or SR 3.4.12.9 must be satisfied prior to starting any RCP.

(continued)

BASES

The principal contributor to an RCP start induced thermal and pressure transient is the difference between RCS cold leg temperatures and secondary side water temperature of any SG prior to the start of an RCP. The RCP starting prerequisites vary depending on plant conditions but include the following: reactor coolant temperature relative to the LTOP enable temperature; secondary side water temperature of the hottest SG relative to the temperature of the coldest RCS cold leg temperature; and, status of the Overpressure Protection System (OPS). When the OPS is inoperable, additional compensatory requirements are required including limits for the pressurizer level and RCS pressure and temperature. When a pressurizer level is specified as a requirement, the level specified is sufficient to prevent the RCS from going water solid for 10 minutes which is sufficient time for operator action to terminate the pressure transient.

SR 3.4.12.8 is used if secondary side water temperature of the hottest steam generator (SG) is less than or equal to the coldest RCS cold leg temperature. SR 3.4.12.9 is more restrictive and is used if the secondary side water temperature of the hottest steam generator is ≤ ***50***~~6~~4 °F above the coldest RCS cold leg temperature.

RCP starting is prohibited if the hottest steam generator is > ***50***~~6~~4 °F above RCS cold leg temperature or if neither of the RCP starting prerequisites SRs can be satisfied. The steam generator temperature may be measured using the Control Room instrumentation or, as a backup, from a contact reading off the steam generator's shells. Pressurizer level may be determined using control room instrumentation or alternate methods.

The FREQUENCY of the RCP starting prerequisites SRs is Within 15 minutes prior to starting any RCP. This means that each of the required verifications must be performed within 15 minutes prior to the pump start and must be met at the time of the pump start.

SR 3.4.12.8 and SR 3.4.12.9 are each modified by two Notes. Note 1 specifies that these SRs are required as a condition for pump starting only when the RCS is below the LTOP arming temperature. Note 2 specifies that meeting either SR 3.4.12.8 or SR 3.4.12.9 ensures that pump starting prerequisites are met.

REFERENCES

1. 10 CFR 50, Appendix G.

2. Generic Letter 88-011, NRC Position on Radiation Embrittlement of Reactor Vessel Materials and its Impact on Plant Operations.

~~3. IP3 Low Temperature Overpressurization System Analysis Final Report, August 24, 1984, in conjunction with ASME Code Case N-514, Low Temperature Overpressure Protection, February 12, 1992.~~

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3~~4~~. IP3 Technical Requirements Manual.

4~~5~~. 10 CFR 50, Section 50.46.

5. 10 CFR 50, Appendix K.

6. ~~WCAP-16037 Revision 1, "Final Report on Pressure-Temperature Limits for Indian Point Unit 3 NPP," Westinghouse Electric Company, May 2003.~~***WCAP-17954-P, "Indian Point 3 Heatup and Cooldown Limit Curves for Normal Operation", December 2014***

7. LTR-PCSA-15-16, Revision 1, Indian Point Unit 3: Low Temperature Overpressure Protection (LTOP) Report