ENCLOSURE 1

TENNESSEE VALLEY AUTHORITY
SEQUOYAH NUCLEAR PLANT (SQN)
UNITS 1 AND 2
DOCKET NOS. 327 AND 328

PROPOSED TECHNICAL SPECIFICATION (TS) CHANGE 00-14
DESCRIPTION AND EVALUATION OF THE PROPOSED CHANGE

I. DESCRIPTION OF THE PROPOSED CHANGE

The proposed amendment revises two SQN TSs (i.e., TS 3/4.4.9.1, "Pressure/Temperature Limits, Reactor Coolant System" and TS 3/4.4.12, "Low Temperature Over Pressure Protection Systems." TVA's proposed amendment for these TSs is divided into two general areas of revision:

1) Existing requirements from these TSs are relocated into a pressure temperature limit report (PTLR) format in accordance with NRC Generic Letter (GL) 96-03, "Relocation of the Pressure Temperature Limit Curves and Low Temperature Overpressure Protection System Limits."

2) These TSs are amended to upgrade to standard TS requirements for Westinghouse plants (NUREG-1431, Revision 2). In conjunction with this upgrade, TVA is proposing a change to SQN TS 3/4.4.9.2, "Pressurizer," that relocates the requirements of this TS to the SQN Technical Requirements Manual (TRM).

In accordance with the guidance with GL 96-03, TVA is submitting a formal PTLR for NRC approval. The SQN pressure-temperature (P-T) limits and low temperature overpressure protection (LTOP) setpoints are being updated to reflect the results of the latest reactor vessel surveillance program capsule "Y" analyses.

Proposed changes described above include revisions to the associated TS Index, Definition Section, Bases Section, and Administrative Controls Section.

II. REASON FOR THE PROPOSED CHANGE

The reason for TVA's proposed change is to update the SQN reactor coolant system (RCS) heatup and cooldown curves (P-T limits) to account for the analysis of the latest reactor vessel surveillance capsule "Y" specimens that were removed during SQN's Cycle 9 refueling outage for both units. The results of the "Y" capsule analyses provide extended life to SQN's current P-T limits. The life of the curves is analyzed and extended to 32 EFPYs to coincide with SQN's 40-year plant design life.

In addition, SQN TS Change 01-08 was recently approved by NRC to increase SQN's core thermal power from 3411 megawatts thermal (MWt) to 3455 MWt. As a result of increased power (neutron fluence), the applicability of the Unit 2 P-T limits decreased from 16 EFPYs to 14.5 EFPYs. Based on projected operation schedules for Unit 2, TVA anticipates 14.5 EFPYs to end in the summer of 2003. The proposed amendment extends the life of the P-T limit curves to incorporate bounding limits over 32 EFPYs and will allow continued operation of Unit 2 beyond 2003. It may be noted that the SQN Unit 1 P-T limit curves remain applicable for 16 EFPYs with the power uprate and are not as limiting as the SQN Unit 2 P-T limit curves. Accordingly, at this time, TVA is updating the P-T curves to 32 EFPYs for both units.

III. SAFETY ANALYSIS

Background:

Pressure and Temperature Limits

10 CFR 50, Appendix G, requires the establishment of P-T limits for specific material fracture toughness requirements of the reactor coolant pressure boundary (RCPB) materials. The 10 CFR 50, Appendix G establishes an adequate margin to brittle failure during normal operation, anticipated operational occurrences, and system hydrostatic tests. It mandates the use of the American Society of Mechanical Engineers (ASME) Code, Section XI, Appendix G.

The components of the RCS at SQN 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.

Each P-T limit curve defines an acceptable region for normal plant operation. The usual use of the curve is operational guidance during heatup and 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 TSs establish operating limits that provide a margin to brittle failure of the reactor vessel and piping of the RCPB. The reactor vessel and associated welds are the components most subject to brittle failure, and the TS limits apply to these components. The limits do not apply to the pressurizer, which has different design characteristics and operating functions. In the event TS 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, provides a recommended methodology for evaluating an operating event that causes an excursion outside the limits.

The reactor vessel materials have been tested to determine the initial nil ductility reference temperature (RT_{NDT}). The neutron embrittlement effect on the material toughness is reflected by increasing the RT_{NDT} as exposure to neutron fluence increases. The actual shift in the RT_{NDT} of the vessel material is established periodically by removing and evaluating irradiated reactor vessel material specimens. The operating P-T limit curves are adjusted as necessary based on evaluation of these specimens.

The P-T limit curves (heatup and cooldown 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. 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 requirement that it be ≥ 40 degrees Fahrenheit (°F) above the heatup curve or the cooldown curve, and not less than the minimum permissible temperature for inservice leak and hydrostatic testing. For SQN however, the criticality curve is not operationally limiting and a more restrictive limit is applied through SQN TS Limiting Condition of Operation (LCO) 3.1.1.4, "RCS Minimum Temperature for Criticality."

The P-T limits are not derived from SQN's Design Basis Accident (DBA) analyses. The P-T limits are prescribed for normal operation of the units.

The SQN RCS P-T heatup and cooldown curves were generated using the most limiting Adjusted Reference Temperature (ART) values and the NRC approved methodology documented in WCAP-14040-NP-A, Revision 2, "Methodology Used to Develop Cold Overpressure Mitigating System Setpoints and RCS Heatup and Cooldown Limit Curves." The exceptions to this methodology are as follows:

1. Fluence values are calculated fluence values rather than best estimate values.

2. The K_{Ic} critical stress intensities are used in place of K_{Ia} critical stress intensities based on the approved methodology in ASME Code Case N-640.

3 The reactor vessel flange pressure/temperature requirement has been eliminated consistent with the justification provided in WCAP-15315, "Reactor Vessel Closure Head/Vessel Flange Requirements Evaluation for Operating PWR and BWR Plants."

4. The 1995 edition of the ASME Code through the 1996 Addenda (instead of the 1989 version) of Appendix G to Section XI was used.

The 1995 edition of the ASME Code through the 1996 Addenda of Appendix G to Section XI is the most recent version incorporated by reference in 10 CFR 50.55a. Use of Code Case N-640 and WCAP-15315 contributes to increasing the operating window by reflecting an updated understanding of material properties and operating conditions.

SQN's updated P-T curves and the associated PTLRs are enclosed and are provided by Topical Reports WCAP-15293, Revision 1, April 2001 (Unit 1) and WCAP-15321, Revision 1, April 2001 (Unit 2). These curves are developed for normal plant operation and are applicable to 32 EFPYs. The safety analyses demonstrate that SQN's reactor vessel is adequately protected against brittle fracture when operated within these limits.

Low Temperature Overpressure Protection (LTOP)

SQN is analyzed for low temperature overpressure conditions while the plant is operating in the lower modes (i.e., Modes 4, 5, or 6 with the reactor head on). Plant transients that are capable of overpressurizing the RCS in these modes are categorized as either mass or heat input transients. These plant transients are as follows:

Mass Input Transients

a. Inadvertent safety injection; or

b. Charging/Letdown flow mismatch

Heat Input Transients

a. Inadvertent actuation of pressurizer heaters;

b. Loss of residual heat removal cooling; or

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

The following requirements ensure that mass and heat input transients do not occur in the lower plant modes:

a. Rendering all but one charging pump incapable of injection.

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

c. Disallowing start of a RCP if secondary temperature is more than 50°F above primary temperature in any one loop.

The SQN analyses demonstrate that either one power operated relief valve (PORV) or a 3 square inch RCS vent can maintain RCS pressure below limits when one charging pump is actuated. Accordingly, SQN TS for LTOP restricts plant operation to one charging pump operable while in the lower modes.

PORV Performance

The fracture mechanics analyses show that the vessel is protected when the PORVs are set to open at or below the limit shown in the SQN PTLR. The setpoints are derived by analyses that model the performance of the LTOP system, assuming the most limiting LTOP transient (i.e., one charging pump 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 P-T limits are met.

The P-T limits are periodically revised as the reactor vessel material toughness decreases due to neutron embrittlement caused by neutron irradiation. The P-T limits are determined using neutron fluence projections and the results of examinations of the reactor vessel material irradiation surveillance specimens. The PORV setpoints for LTOP are updated if the revised P-T limits conflict with the LTOP analysis limits.

RCS Vent Performance

With the RCS depressurized, analyses show a vent size of 3.0 square inches is capable of mitigating the allowed LTOP transient. The capacity of a vent this size is greater than the flow of the limiting transient for the LTOP configuration.

The RCS vent size is 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.

Justification for TS Change

TVA's proposed TS change is a two part change that;
1) relocates the current SQN RCS P-T limit curves and LTOP system limits to a PTLR in accordance with GL 96-03, and
2) amends SQN TSs to update to standard TS requirements for Westinghouse plants (NUREG-1431, Revision 2).

The first part of TVA's proposed TS change is based on NRC GL 96-03, "Relocation of the Pressure Temperature Limit Curves and Low Temperature Overpressure Protection System Limits." The GL contains guidance for preparing a license amendment request to modify the TS to relocate the P-T limit curves and LTOP system limits currently contained in the plant TSs to a PTLR or a similar document. The GL alternative is based on a change that was included in the improved standard TS (NUREG-1431) and provides a resource savings to TVA and NRC by eliminating unnecessary license amendment requests for changes to the P-T/LTOP limit curves in the TSs. While it is essential to safety to operate the plant within the bounds of P-T limits and to satisfy regulations that ensure the integrity of the RCPB, the periodic adjustment of those limits to account for time-dependent parametric changes, are considered to be acceptable in accordance with methodology approved by the NRC. Once the methodology is approved by NRC, TVA may modify figures, values, and parameters without the need for a license amendment, and without affecting nuclear safety, provided that changes are determined using the approved methodology and are consistent with all applicable limits of the plant design assumptions as stated in the Final Safety Analysis Report (FSAR). Additionally, TVA must submit a formal PTLR containing the figures, values, and parameters derived from application of the methodology approved by NRC. The PTLR reporting requirement also augments a reporting requirement that is contained in

Section III of Appendix H to 10 CFR 50 which requires a summary technical report of data relating to capsule withdrawal and specimen test results. The enclosed formal PTLR contains the capsule withdrawal and specimen tests results such that it will allow NRC to monitor status of the structural integrity of the reactor vessel. Accordingly, TVA's proposed relocation of the TS P-T limits and LTOP system limits to a PTLR is consistent with guidance in GL 96-03 and NUREG-1431.

TVA's proposed TS revisions are based on NUREG-1431, Revision 2, and include the TS improvements from the following NRC approved Industry Standard Technical Specification Task Force (TSTFs) Travelers:

TSTF-233, Revision 0 (improvements applicable to LTOP)
TSTF-243, Revision 0
TSTF-271, Revision 1
TSTF-280, Revision 1
TSTF-285, Revision 1
TSTF-352, Revision 1, (improvements applicable to LTOP)
TSTF-419, Revision 0

A more detailed basis and justification for each of the proposed TS changes is provided below:

SQN TS Section 1.0, "Definitions" is revised to incorporate a standard definition for PTLR. TVA's proposed PTLR definition is an administrative change that is consistent with NUREG-1431 and TSTF-419, Revision 0. Justification for the proposed application of TSTF-419, Revision 0 to the proposed PTLR definition is provided as follows:

> In accordance with TSTF-419, Revision 0, the standard TS definition for the PTLR is revised to omit references to the TSs that contain limits specified in the PTLR. TVA's proposed change locates the TS references associated with PTLR within SQN TS Section 6.9.1.15 (see Enclosure 2 for markup). The location of references within Section 6.9.1.15 eliminates duplication for locating the same TS references in both the definition of PTLR and Section 6.9.1.15.

SQN Specification 3/4.4.9, "Pressure/Temperature Limits," is revised in its entirety to incorporate standard titles, LCO requirements, applicability, action requirements, surveillance requirements (SRs) and notation from NUREG-1431. Justification for each change associated with 3/4.4.9 is discussed as follows:

The current TS title, "Pressure/Temperature Limits," is revised to adopt the standard title that reads: "RCS Pressure and Temperature (P/T) Limits." This change is administrative in nature and does not alter existing TS requirements.

The current LCO 3.4.9.1 is deleted and replaced with the standard LCO requirement. The current LCO reads:

> "The Reactor Coolant System (except the pressurizer) temperature and pressure shall be limited in accordance with the limit lines shown on Figures 3.4-2 and 3.4-3 during heatup, cooldown, criticality, and inservice leak and hydrostatic testing with:
>
> a. A maximum heatup of 100°F in any one hour period.
>
> b. A maximum cooldown of 100°F in any one hour period.
>
> c. A maximum temperature change of less than or equal to 5°F in any one hour period during inservice hydrostatic and leak testing operations above the heatup and cooldown limit curves."

The standard LCO reads:

> "RCS pressure, RCS temperature, and RCS heatup and cooldown rates shall be maintained within the limits specified in the PTLR."

The standard LCO simplifies the current LCO language and deletes the references to SQN TS Figures 3.4-2 and 3.4-3 (RCS heatup and cooldown limit curves). The limit curves are relocated and retained within the PTLR. The relocation of these curves is acceptable based on the guidance from NRC GL 96-03 (refer to previous discussion of GL 96-03). In addition, the RCS temperature rate-of-change limits are relocated to the PTLR. It may be noted that the temperature rate-of-change limit associated with the in-service leak and hydrostatic (ISLH) testing increases to 10°F from the current 5°F value. The 5 degree increase is justified because it is accounted for in the enclosed P-T limit analysis. The rate-of-change temperature value is an assumed parameter that provides input to the calculations for development of the P-T limits. It may be noted that the 10°F rate of change allowance is also assumed for TVA's Watts Bar Nuclear Plant and is documented in an NRC approved topical report (WCAP-14040-NP-A). In conclusion, the proposed changes to the LCO are justified based on the administrative controls for PTLR as described in GL 96-03 and previously approved methodology.

The current applicability is "at all times" and is not affected by the proposed revision. The standard LCO continues to require applicability "at all times."

The current action requirement reads:

> "With any of the above limits exceeded, restore the temperature and/or pressure to within the limit within 30 minutes; perform an engineering evaluation to determine the effects of the out-of-limit condition on the structural integrity of the Reactor Coolant System; determine that the Reactor Coolant System remains acceptable for continued operations or be in at least HOT STANBY within the next 6 hours and reduce the RCS T_{ave} and pressure to less than 200°F and 500 psig, respectively, within the following 30 hours."

The above action is revised to incorporate the standard action requirements that are broken into Actions a and b. Action a is associated with ensuring the limits are met while in Mode 1, 2, 3, and 4. Action b is associated with any time other than Mode 1, 2, 3 and 4. The standard actions provide equivalent requirements to SQN's current action by continuing to require restoration of out-of-limit parameters to within limits in 30 minutes, and performing evaluation of out-of-limit conditions for continued operation. The standard actions also include the requirement for unit shutdown in the event RCS is determined unacceptable for continued operation.

The basis for the standard actions include: (1) restoring P/T parameters to within the analyzed range, and (2) performing an evaluation to determine if RCS is acceptable for continued operation. The evaluation must verify the RCPB integrity remains acceptable and must be completed before continuing plant operation. A 72-hour action time is included for evaluating any out-of-limit condition that occurs while the unit is in Modes 1, 2, 3 or 4. The 72-hour time period is based on providing a reasonable time period for conducting an evaluation.

In addition to the standard actions, the revision to TS 3/4.4.9 includes incorporation of standard notation in the form of a footnote (*) to Actions a and b that states:

> "*The determination that the RCS is acceptable for continued operation must be completed for any entry into Action a. or b."

The footnote emphasizes the need to perform evaluation of the effects of any excursion outside the allowable limits. This is appropriate for SQN because restoration alone is insufficient. Higher than analyzed stresses may have occurred that affect the RCPB integrity.

The current SR 4.4.9.1.1 is revised to be consistent with the standard SR from NUREG-1431. The current SR states:

> "4.4.9.1.1 The Reactor Coolant System temperature and pressure shall be determined to be within the limits at least once per 30 minutes during system heatup, cooldown, and inservice leak and hydrostatic testing operations."

The proposed SR from the standard TS is stated below and includes the standard notation (footnote **):

> "Verify** RCS pressure, RCS temperature, and RCS heatup and cooldown rates are within the limits specified in the PTLR every 30 minutes."

The standard SR above is justified for use at SQN because it provides equivalent requirements to SQN's current SR 4.4.9.1.1. The footnote (**) provides clarification as to when the SR is required to be performed (i.e., during RCS heatup and cooldown operations and RCS inservice leak and hydrostatic testing). The footnote is acceptable for SQN because it is equivalent to SQN's current SR.

The current SQN SR 4.4.9.1.2 is being deleted under the proposed change. SQN SR 4.4.9.1.2 provides for removal and examination of reactor vessel material irradiation surveillance specimens in accordance with 10 CFR 50, Appendix H. The basis for deletion of this SR is the unnecessary duplication of the programmatic requirements within SQN TSs and 10 CFR 50, Appendix H. Current programmatic controls provided in 10 CFR 50, Appendix H, "Reactor Vessel Material Surveillance Program Requirements," are sufficient to govern reporting of test results for reactor vessel irradiation surveillance specimens. In addition, the PTLR provided with this TS change contains reactor vessel surveillance capsule withdrawal schedules for each unit.

SQN Specification 3.4.9.2, "Pressurizer" is deleted and relocated to the SQN TRM. SQN TSs currently provide an LCO containing temperature limits for the pressurizer during periods of RCS heatup and cooldown. In addition, the LCO includes a temperature limit for pressurizer spray water temperature differential. These temperature limits assure compatibility of operation with the pressurizer fatigue analysis performed in accordance with the ASME Code requirements. TVA has evaluated these TS requirements against the criteria of 10 CFR 50.36, "Technical Specifications." The following discussions address the applicability of the 10 CFR 50.36 criteria to SQN's pressurizer TS.

Criterion 1: Installed instrumentation that is used to detect, and indicate in the control room, a significant abnormal degradation of the reactor coolant pressure boundary.

Temperature limits are placed on SQN's pressurizer vessel to prevent non-ductile failure and assure compatibility of operation with the pressurizer fatigue analysis. The limits are consistent with structural analysis results. The limits meet the requirements provided in the ASME Boiler and Pressure Vessel Code, Section III, Appendix G. These limitations are based on the properties of the pressurizer material.

The pressurizer temperature limits are not installed instrumentation that is used to detect or indicate in the control room a significant abnormal degradation of the reactor coolant pressure boundary.

Accordingly, the SQN pressurizer temperature limits do not satisfy Criterion 1.

Criterion 2: A process variable, design feature or operating restriction that is an initial condition of a Design Basis Accident (DBA) or Transient that either assumes the failure of or presents a challenge to the integrity of a fission product barrier.

The heatup and cooldown rate limits are placed on the pressurizer to prevent non-ductile failure. The limits assure compatibility of operation with the pressurizer fatigue analysis. The limits are not initial condition assumptions of a DBA or transient. The pressurizer is not a process variable or design feature that is assumed in any initial condition of a DBA or transient that either assumes the failure of or presents a challenge to the integrity of a fission product barrier.

These limits, while they do represent operating restrictions, do not preclude unanalyzed accidents and transients. This is based on the discussion of

Criterion 2 in the NRC Final Policy Statement on TSs that specify only those operating restrictions that are required to preclude unanalyzed accidents and transients be included in the specifications. The SQN pressurizer temperature limits do not meet this test.

Accordingly, the SQN pressurizer temperature limits do not satisfy Criterion 2.

Criterion 3: A structure, system or component that is part of the primary success path and which functions or actuates to mitigate a DBA or Transient that either assumes the failure of or presents a challenge to the integrity of a fission product barrier.

SQN's pressurizer is not assumed to function in the plant safety analysis. The pressurizer is not a structure, system or component that is part of the primary success path for accident mitigation. In addition, the pressurizer does not function or actuate to mitigate a DBA or transient that either assumes the failure of or presents a challenge to the integrity of a fission product barrier. Accordingly, SQN's pressurizer does not satisfy Criterion 3.

Criterion 4: A structure, system or component, which operating experience or probabilistic safety assessment has shown to be significant to public health and safety.

The SQN pressurizer has not been identified as a significant risk contributor. Operational experience or probabilistic safety assessment have not shown the SQN pressurizer instrumentation to be significant to the public health and safety. Therefore, the pressurizer does not satisfy Criterion 4.

The proposed relocation of the pressurizer temperature requirements to the SQN TRM is acceptable based of the above discussions. In accordance with 10 CFR 50.59, the relocated requirements will be controlled to ensure changes are not implemented that would reduce the functionality or testing of SQN's pressurizer without prior NRC review.

SQN Specification 3/4.4.12, "Low Temperature Over Pressure Protection Systems," is revised to incorporate standard TS requirements from NUREG-1431. The basis and justification for each of the proposed changes to TS 3/4.4.12 is provided below:

The current TS title is revised to incorporate the standard title. This change revises the title from "Low Temperature Overpressure Protection Systems" to "Low

Temperature Overpressure Protection (LTOP) System." This change is administrative in nature and does not affect existing TS requirements.

The current LCO requirement is replaced with the standard LCO requirements. The current LCO reads as follows:

"3.4.12 At least one of the following Overpressure Protection Systems shall be OPERABLE:

a. Two power operated relief valves (PORVs) with a nominal lift setting less than or equal to that shown in Figure 3.4-4, or

b. The Reactor Coolant System (RCS) depressurized with an RCS vent of greater than or equal to 3 square inches."

The standard LCO reads as follows:

3.4.12 "An LTOP System shall be OPERABLE with a maximum of one centrifugal charging pump and no safety injection pump capable of injecting into the Reactor Coolant System (RCS) and the accumulators isolated and one of the following pressure relief capabilities:

a. Two power operated relief valves (PORVs) with lift settings within the limits specified in the PTLR, or

b. The RCS depressurized and an RCS vent $\geq$ 3 square inches."

The standard LCO provides an improvement to the current SQN TSs by including within the LCO the requirement for limiting the number of centrifugal charging and safety injection pumps capable of injecting into the RCS. Currently, SQN's TS controls that ensure isolation of these components is provided by SQN SR 4.4.12.2 and is required "once per 31 days." Incorporation of these controls within the LCO provides improved application for isolation of these pumps upon entry into the mode of applicability. The standard LCO is justified for SQN because it continues to ensure that inadvertent mass injection into the RCS does not occur from these pumps while the plant is in the LTOP mode of applicability. In addition, the standard LCO incorporates a requirement for isolation of cold leg accumulators. This change is appropriate for SQN to increase protection against mass injection from these components. A PORV or RCS vent cannot adequately relieve the pressure transient from accumulator injection. Isolation of the cold leg accumulators is accomplished by closing the accumulator isolation valves and opening the isolation valve power supply breakers. This change is considered to be an improvement over the current LCO and is acceptable for SQN. Accordingly, the standard LCO provides an improvement in the control of these components. Other features of the standard LCO requirements remain unchanged from SQN's current LCO. It may be noted that the proposed standard LCO provides for the removal of SQN's LTOP curves as contained in Figure 3.4-4, "SQN PORV Lift Settings." The removal of this LTOP figure is justified for SQN because the figure is relocated to the PTLR and is administratively controlled as part of the PTLR (refer to previous PTLR justification).

Notation associated with the LCO is provided in the form of three footnotes. The first footnote reads:

> "Two charging pumps may be made capable of injecting into the RCS for ≤ 1 hour for pump swap operations."

The above footnote provides an allowance for charging pump swap operation. This footnote provides up to one hour to complete swapping between trains of centrifugal charging pumps. Pump swap operation may be necessary to maintain continuous charging to the RCS and continuous RCP seal flow. SQN's operating procedures currently require that RCP seal flow be maintained at all times. In order to preserve seal flow, one charging pump is required to be in operation. In the event charging pump swap is necessary, procedures require starting a second charging pump and allowing it to stabilize before stopping the first pump. Once the system has stabilized, the first pump is then stopped and placed in pull-to-lock. This process ensures continuous RCP seal flow while at the same time administratively controlling charging pump alignment to prevent inadvertent mass injection to the RCS. The one-hour time period provides sufficient time to safely complete the transfer and to complete the administrative controls and surveillance associated with the swap. In addition, the one-hour time period is justified for SQN because of the low probability of an mass injection event during this brief period of time.

The second footnote reads:

> "Accumulator may be unisolated when 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 the PTLR."

The above footnote provides operational flexibility and is consistent with the provisions in NUREG-1431. Accumulator isolation is required under the LCO when accumulator pressure is greater than or equal to the maximum RCS pressure for the existing cold leg temperature allowed by the P-T limit curves specified in the PTLR. The footnote provision remains consistent with the LCO requirements to ensure appropriate administrative controls are applied to the cold leg accumulators to prevent mass injection during the lower modes of plant operation. The provision is justified for SQN because administrative controls are available to the operator for RCS pressure control to minimize the risk of injecting an unisolated cold leg accumulator.

The third footnote reads:

"For the purpose of making the required safety injection pumps and charging pump inoperable, the following time is permitted: up to 4 hours after entering MODE 4 from MODE 3, or prior to decreasing temperature on any RCS loop to below 325°F, whichever occurs first."

The above footnote is based on SQN's LTOP system design and the arming temperature contained in the PTLR. SQN's LTOP system is required to be armed at the RCS temperature of 350°F. This temperature is also the transition temperature between Mode 4 and Mode 3. During plant cooldown for transition into Mode 4 from Mode 3 (350°F), a period of time is needed to comply with provisions of the LCO that require rendering the safety injection pumps and one centrifugal charging pump incapable of RCS injection. In order to perform this activity, a footnote is included with the LCO to allow up to 4 hours to accomplish this controlled activity. A lower temperature limit of 325°F is provided in the footnote to ensure continued plant cooldown does not occur below 325°F without the pumps being rendered incapable of inadvertent RCS injection. The 4-hour time period after initial entry into Mode 4 from Mode 3, and prior to decreasing RCS below 325°F, is sufficient for completing this activity based on the low probability for inadvertent pump start during the 4 hour period. It may be noted that the proposed footnote is not included in the standard TS but is an approved provision in the Vogtle Nuclear Plant and Watts Bar Nuclear Plant TSs (plants with similar LTOP system design and arming temperatures).

The current applicability for TS 3/4.4.12 is revised to adopt the standard applicability that reads as follows:

"MODE 4 when any RCS cold leg temperature is ≤ the LTOP arming temperature specified in the PTLR,
MODE 5,
MODE 6 when the reactor vessel head is on"

The standard applicability is compatible with SQN's current TS requirements, particularly with regard to the tie between the LTOP arming temperature and the Mode 4 applicability. Referencing the "LTOP arming temperature specified in the PTLR" within the applicability will ensure the applicability remains valid for any future adjustments to SQN's LTOP arming temperature.

The current action requirements of TS 3/4.4.12 are replaced with standard actions from NUREG-1431. The standard actions are consistent with SQN's current TS action requirements with the following exceptions:

TVA proposes to delete the current Action (f) of TS 3/4.4.12, which requires submitting a special report whenever the PORVs or the RCS vent(s) are used to mitigate an RCS pressure transient. This special reporting requirement was previously deleted from the standard pressurized water reactor TSs during development of the improved standard TSs in NUREG-1431. The deletion of the reporting requirement from TSs at that time was based on duplication of reporting requirements as contained in the Administrative Controls Section of TSs (i.e., Monthly Operating Report). The SQN TSs (Section 6.9.1.10, Monthly Reactor Operating Report) currently contains reporting requirements that states - "including documentation of all challenges to the PORVs or Safety Valves shall be submitted on a monthly basis…." By letter dated March 4, 2002, TVA submitted TS change 01-03 that proposes removal of reporting information on "including documentation of all challenges to the PORVs and Safety Valves" from the SQN Monthly Reactor Operating Report. The removal of this reporting requirement is based on NRC approved TSTF-258R4 and NRC Generic Letter 97-02. These documents identify information that is required to be reported to NRC and supports the NRC Performance Indicator Program. The reporting of challenges to PORVS or Safety Valves is not specifically identified for routine reporting because this information is reported within Licensee Event Reports. Accordingly, TVA is revising Action (f) to delete the special reporting requirement.

TVA proposes to retain Action (g) of TS 3/4.4.12 that provides an exemption to TS 3.0.4. This exemption is being retained as SQN current licensing basis (CLB) information and is a specific provision to allow continued operational flexibility and TS compliance under certain operational plant conditions (i.e., during unit startup and shutdown). Plant conditions may warrant the exemption to TS 3.0.4 when the plant status involves full power operation with both PORVs inoperable and incapable of RCS pressure control. Under this plant condition, SQN TS 3.4.3.2 (governing requirements for PORVs) requires entry into TS Action 3.4.3.2.c which leads to unit shutdown to Mode 4. Without the exemption to TS 3.0.4, the unit shutdown transition from Mode 3 to Mode 4 would be prohibited because SQN LTOP TS 3/4.4.12 requires PORVs to be operable in Mode 4. Without PORV operability in Mode 4, the LTOP action requirements would require opening an RCS vent path. Opening an RCS vent path would typically be accomplished following further shutdown of the unit to depressurize RCS and cooldown from Mode 4 to Mode 5. This evolution would again be prohibited without an exemption to the requirements of TS 3.0.4. Based on this example, retaining the current exemption to TS 3.0.4 is necessary for TS compliance during the transition through Modes 3 to 4 and from Modes 4 to 5.

The current SRs are revised to be consistent with standard NUREG-1431 requirements. The standard SRs remain compatible with SQN's current SRs with the following exceptions:

The proposed SRs 4.4.12.1a, 4.4.12.2, and 4.4.12.3 are consistent with standard requirements but have been adapted, as appropriate, for SQN specific application. A description and justification for each of these SRs is provided below:

SR 4.4.12.1.a contains requirements associated with performance of a Channel Functional Test of SQN's PORVs. A Channel Functional Test is defined in the SQN TS Definition Section (Section 1.0) and is being retained as CLB information. The proposed SR reads as follows:

4.4.12.1 "Each PORV shall be demonstrated OPERABLE by:

a. Performance of a CHANNEL FUNCTIONAL TEST*, but excluding valve operation, at least once per 31 days."

The standard NUREG-1431 does not define the term "Channel Functional Test." Similar definitions are provided in NUREG-1431 and include the terms Channel Operational Test (COT) and Trip Actuating Device Operational Test (TADOT). These terms are comparable to SQN's Channel Functional Test but involve slightly different testing boundaries and techniques. For this reason, TVA is retaining the term

Channel Functional Test within SR 4.4.12.1.a. This approach retains current test requirements for SQN PORVs and is preferred at this time to maintain consistency with other SRs throughout the SQN TSs that refer to a Channel Functional Test, and to minimize site procedure impacts.

The current SR 4.4.12.2 is replaced in its entirety and reads as follows:

> "All charging pumps and safety injection pumps, excluding the required OPERABLE pumps per specification 3.1.2.3 and 3.5.3, shall be verified incapable of injecting into the RCS and the cold leg accumulator discharge valves verified closed and locked out at least once per 31 days except when the reactor vessel head is removed by verifying that either the pump controls are in the pull-to-lock position, the pump motor circuit breaker(s) is tagged out or the pump(s) is isolated from the RCS by a manually closed valve or by a motor-operated valve with the valve breaker tagged out. Normal Reactor Coolant Pump seal flow can be maintained at all times."

TVA's proposed change replaces the current SR with two separate SRs (one SR for SQN's two safety injection pumps and one SR for SQN's two centrifugal charging pumps). The proposed SRs read as follows:

4.4.12.2 "Verify no safety injection pumps are capable of injecting into the RCS within 4 hours after entering MODE 4 from MODE 3 and prior to the temperature of one or more RCS cold legs decreasing below 325°F, and every 12 hours thereafter."

4.4.12.3 "Verify a maximum of one charging pump is capable of injecting into the RCS within 4 hours after entering MODE 4 from MODE 3 and prior to the temperature of one or more RCS cold legs decreasing below 325°F, and every 12 hours thereafter."

The above SRs are similar to the standard LTOP SRs that verify emergency core cooling system pumps are rendered incapable of injecting into the RCS. This verification is required to minimize the potential for an LTOP event by limiting the mass input capability. The SR frequency of within 4 hours following entry into Mode 4 from Mode 3 and prior to RCS temperature reaching 325°F is sufficient considering other indications and alarms available to the operator in the control room, to verify the required status of the equipment. It may be noted that the proposed SRs are modeled after the TS SRs approved for the Vogtle Nuclear Plant and TVA's Watts Bar Nuclear Plant TSs (plants with similar LTOP system design).

SQN Administrative Controls Section 6.9.1.15, "Reactor Coolant System (RCS) Pressure and Temperature Limits (PTLR) Report," is added as a new administrative controls section to incorporate programmatic controls for SQN's PTLR. The new specification provides a cross reference to other related specifications associated with SQN's PTLR. In addition, references are provided for the analytical methods used to determine SQN's RCS P-T limits. A reporting requirement is included for submitting the PTLR to NRC following issuance for each reactor vessel fluence period and for any revision or supplement thereto. These requirements are administrative in nature and are consistent with NRC GL 96-03 and standard NUREG-1431 requirements.

TVA's proposed change to section 6.9.1.15 includes provisions provided by TSTF-419R0. The justification for adopting the provisions of TSTF-419R0 is described as follows:

Administrative Controls Section 6.9.1.15 is revised to allow Topical Report(s) to be identified by number and title, or the NRC Safety Evaluation for a plant specific methodology by NRC letter and date. This provision allows TVA to use current Topical Reports to support limits in the SQN PTLR without having to submit an amendment to SQN TSs each time the Topical Report is revised. The SQN PTLRs (provided for each unit in enclosure 4) contain the specific information identifying the particular approved topical report(s) used to determine the SQN P/T limits or LTOP system limits.

SQN TS Bases sections that are associated with the revisions described above are modified as appropriate to incorporate the NUREG-1431 improvements.

IV. NO SIGNIFICANT HAZARDS CONSIDERATION DETERMINATION

TVA has concluded that operation of SQN Units 1 and 2 in accordance with the proposed change to the technical specifications (TSs), does not involve a significant hazards consideration. TVA's conclusion is based on its evaluation, in accordance with 10 CFR 50.91(a)(1), of the three standards set forth in 10 CFR 50.92(c).

In accordance with 10 CFR 50.36, TVA proposes to amend SQN TS 3/4.4.9.1, "Pressure/Temperature Limits, Reactor Coolant System" and TS 3/4.4.12, "Low Temperature Overpressure Protection Systems." The proposed amendment provides two changes to the these specifications as described below:

1. The proposed change relocates the information provided in these TSs into a pressure temperature limit report (PTLR) format in accordance with NRC Generic Letter (GL) 96-03, "Relocation of the Pressure Temperature Limit Curves and Low Temperature Overpressure Protection System Limits."

2. The proposed change also upgrades these TSs to the standard TS requirements for Westinghouse plants (NUREG-1431, Revision 2). In addition, TVA is proposing a change to SQN TS 3/4.4.9.2, "Pressurizer," to relocate the requirements of this TS into the SQN Technical Requirements Manual (TRM).

TVA's proposed changes to the specifications described above also include revisions to the associated TS Index, Definition Section, and Bases Section.

In accordance with the guidance of NRC GL 96-03, TVA is submitting the formal PTLR for NRC approval. The PTLR contains updated reactor coolant system (RCS) pressure-temperature (P-T) limits and low-temperature overpressure protection (LTOP) system setpoints to reflect the results of SQN's latest reactor vessel surveillance program capsule "Y" analyses. The results of the analyses extend the applicability of the SQN P-T limits to 32 Effective Full Power Years. The formal PTLR also contains LTOP arming temperatures, projected values for End of License (EOL) Reference Temperatures for Pressurized Thermal Shock, EOL Upper Shelf Energy calculations, and updated Reactor Vessel Surveillance Capsule Withdrawal Schedules. The analysis for these limits and setpoints are provided in Enclosure 5; Westinghouse Topical Reports WCAP-15293, Revision 1 (Unit 1) and WCAP-15321, Revision 1 (Unit 2).

The Westinghouse Topical Reports utilize alternative methodology from the requirements of 10 CFR 50, Appendix G, for the development of SQN's updated P-T limits. In accordance with 10 CFR 50.12, "Specific exemptions," TVA is requesting two exemptions from the methodology requirements described in 10 CFR 50, Appendix G. TVA's proposed exemption requests the use of American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section XI Code Case N-640, "Alternative Requirement Fracture Toughness for Development of P-T limit Curves for ASME Section XI, Division 1," and WCAP-15315, "Reactor Vessel Closure Head/Vessel Flange Requirements Evaluation for Operating PWR and BWR Plants," as alternates to the 10 CFR 50, Appendix G methodology.

A. <u>The proposed amendment does not involve a significant increase in the probability or consequences of an accident previously evaluated.</u>

The proposed revision does not affect plant equipment, test methods or operating practices. The modification to SQN TSs is consistent with the Standard Technical Specifications for Westinghouse Plants and continues to provide controls for safe operation within the required limits. The revised specifications provide appropriate administrative controls for the RCS P-T limits and LTOP setpoints within the PTLR for future revisions as needed. The proposed changes do not contribute to events or assumptions associated with postulated design basis accidents (DBA). The proposed revisions continue to maintain the required safety functions. Accordingly, the probability of an accident or the consequences of an accident previously evaluated is not increased.

B. The proposed amendment does not create the possibility of a new or different kind of accident from any accident previously evaluated.

The proposed revisions are not the result of changes to plant equipment, test methods, or operating practices. The proposed revision to the SQN RCS P-T limits, and LTOP setpoints continues to ensure that conservative fracture toughness margins are maintained to protect against reactor pressure vessel failure and overpressure conditions. The modified P-T limits and LTOP setpoints are based on NRC approved methodology in conjunction with alternative methods provided in ASME Code Case N-640, "Alternative Requirement Fracture Toughness for Development of P-T Limit Curves for ASME Section XI, Division 1" and WCAP-15315, "Reactor Vessel Closure Head/Vessel Flange Requirements Evaluation for Operating PWR and BWR Plants."

The proposed changes to incorporate the PTLR format is administrative in nature and provide controls for maintaining RCS P-T limits and LTOP setpoints for future revisions as needed.

The reactor vessel P-T limits and LTOP setpoints are operational limits and are not considered to be contributors to the generation of postulated accidents. The safety functions of the associated systems remain unchanged and do not affect the assumptions of DBAs. The operational limits and setpoints continue to be governed within the TSs/PTLR. Accordingly, the proposed changes do not create the possibility of a new or different kind of accident.

C. **<u>The proposed amendment does not involve a significant reduction in a margin of safety.</u>**

TVA's proposed TS amendment provides revised reactor pressure vessel P-T limits and LTOP setpoints that are within the design capabilities of the RCS Safety Structures, Systems and Components (SSC) and pressure control systems. The limits are based on conservative design margins that ensure that plant operation is within the design capacity of the reactor vessel materials. Accordingly, the function of the RCS to provide a fission product barrier is not compromised.

TVA's proposed change to include revised P-T and LTOP limits does not result in a change to system design features. The proposed change does not affect plant conditions that result in precursors to accidents or cause degradation of accident mitigation systems. The plant system safety functions are not altered by the proposed change.

The proposed changes to the P-T limits and LTOPS setpoints change the calculations and method from that described in the current TS Bases to one based on ASME Code Case N-640 and WCAP-15315. The effect of this change is to allow plant operation with different limits while continuing to retain conservative margins for assuring integrity of the reactor vessel and the RCS. Consequently, the proposed TS revisions do not significantly reduce the margin of safety.

V. ENVIRONMENTAL IMPACT CONSIDERATION

The proposed change does not involve a significant hazards consideration, a significant change in the types of or significant increase in the amounts of any effluents that may be released offsite, or a significant increase in individual or cumulative occupational radiation exposure. Therefore, the proposed change meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), an environmental assessment of the proposed change is not required.

ENCLOSURE 2

TENNESSEE VALLEY AUTHORITY
SEQUOYAH PLANT (SQN)
UNITS 1 AND 2

PROPOSED TECHNICAL SPECIFICATION (TS) CHANGE
MARKED PAGES

I. AFFECTED PAGE LIST

Unit 1	Unit 2
I, II, VI, XIII,	I, II, VI, XIII,
1-5, 1-6, 1-7	1-5, 1-6, 1-7, 1-8
3/4 4-23	3/4 4-28
3/4 4-24	3/4 4-29
3/4 4-25	3/4 4-30
3/4 4-26	3/4 4-31
3/4 4-29	3/4 4-34
3/4 4-30	3/4 4-35
3/4 4-31	3/4 4-36
B 3/4 4-6	B 3/4 4-6
B 3/4 4-7	B 3/4 4-7
B 3/4 4-8	B 3/4 4-8
B 3/4 4-9	B 3/4 4-9
B 3/4 4-10	B 3/4 4-10
B 3/4 4-11	B 3/4 4-11
B 3/4 4-12	B 3/4 4-12
B 3/4 4-13	B 3/4 4-13
	B 3/4 4-14
6-13a	6-14

II. MARKED PAGES

See attached.

SECTION

1.0 DEFINITIONS

SECTION

1.0 DEFINITIONS (Continued)

LIMITING CONDITIONS FOR OPERATION AND SURVEILLANCE REQUIREMENTS

INDEX

BASES

SECTION | PAGE

RCS PRESSURE AND TEMPERATURE (P/T) LIMITS

PRESSURE BOUNDARY LEAKAGE

INSERT A 1.22 PRESSURE BOUNDARY LEAKAGE shall be leakage (except steam generator tube leakage) through a non-isolable fault in a Reactor Coolant System component body, pipe wall or vessel wall.

24 PROCESS CONTROL PROGRAM (PCP)

1.~~23~~ DELETED

25 PURGE - PURGING

1.~~24~~ PURGE or PURGING is the controlled process of discharging air or gas from a confinement to maintain temperature, pressure, humidity, concentration or other operating condition, in such a manner that replacement air or gas is required to purify the confinement.

26 QUADRANT POWER TILT RATIO

1.~~25~~ QUADRANT POWER TILT RATIO shall be the ratio of the maximum upper excore detector calibrated output to the average of the upper excore detector calibrated outputs, or the ratio of the maximum lower excore detector calibrated output to the average of the lower excore detector calibrated outputs, whichever is greater.

27 RATED THERMAL POWER (RTP)

1.~~26~~ RATED THERMAL POWER (RTP) shall be a total reactor core heat transfer rate to the reactor coolant of 3455 MWt.

28 REACTOR TRIP SYSTEM (RTS) RESPONSE TIME

1.~~27~~ The REACTOR TRIP SYSTEM RESPONSE TIME shall be the time interval from when the monitored parameter exceeds its (RTS) trip setpoint at the channel sensor until loss of stationary gripper coil voltage. The response time may be measured by means of any series of sequential, overlapping, or total steps so that the entire response time is measured. In lieu of measurement, response time may be verified for selected components provided that the components and the methodology for verification have been previously reviewed and approved by NRC.

29 REPORTABLE EVENT

1.~~28~~ DELETED

INSERT A

PRESSURE AND TEMPERATURE LIMITS REPORT (PTLR)

1.23 The PTLR is the unit specific document that provides the reactor vessel pressure and temperature limits, including heatup and cooldown rates and the LTOP arming temperature, for the current reactor vessel fluence period. These pressure and temperature limits shall be determined for each fluence period in accordance with Specification 6.9.1.15.

30 SHIELD BUILDING INTEGRITY

1.~~29~~ SHIELD BUILDING INTEGRITY shall exist when:

a. The door in each access opening is closed except when the access opening is being used for normal transit entry and exit.

b. The emergency gas treatment system is OPERABLE.

c. The sealing mechanism associated with each penetration (e.g., welds, bellows or 0-rings) is OPERABLE.

31 SHUTDOWN MARGIN

1.~~30~~ SHUTDOWN MARGIN shall be the instantaneous amount of reactivity by which the reactor is subcritical or would be subcritical from its present condition assuming all full length rod cluster assemblies (shutdown and control) are fully inserted except for the single rod cluster assembly of highest reactivity worth which is assumed to be fully withdrawn.

32 SITE BOUNDARY

1.~~31~~ The SITE BOUNDARY shall be that line beyond which the land is not owned, leased, or otherwise controlled by the licensee (see Figure 5.1-1).

33 SOLIDIFICATION

1.~~32~~ Deleted

34 SOURCE CHECK

1.~~33~~ Deleted

35 STAGGERED TEST BASIS

1.~~34~~ A STAGGERED TEST BASIS shall consist of:

a. A test schedule for n systems, subsystems, trains or other designated components obtained by dividing the specified test interval into n equal subintervals,

b. The testing of one system, subsystem, train or other designated component at the beginning of each subinterval.

36 THERMAL POWER

1.~~35~~ THERMAL POWER shall be the total reactor core heat transfer rate to the reactor coolant.

37 UNIDENTIFIED LEAKAGE

1.~~36~~ UNIDENTIFIED LEAKAGE shall be all leakage (except reactor coolant pump seal water injection or leakoff) that is not IDENTIFIED LEAKAGE.

38 UNRESTRICTED AREA

1.~~37~~ An UNRESTRICTED AREA shall be any area, at or beyond the site boundary to which access is not controlled by the licensee for purposes of protection of individuals from exposure to radiation and radioactive materials or any area within the site boundary used for residential quarters or industrial, commerical, institutional, and/or recreational purposes.

39 VENTILATION EXHAUST TREATMENT SYSTEM

1.~~38~~ A VENTILATION EXHAUST TREATMENT SYSTEM is any system designed and installed to reduce gaseous radioiodine or radioactive material in particulate form in effluents by passing ventilation or vent exhaust gases through charcoal adsorbers and/or HEPA filters for the purpose of removing iodines or particulates from the gaseous exhaust stream prior to the release to the environment (such a system is not considered to have any effect on noble gas effluents). Engineered Safety Feature (ESF) atmospheric cleanup systems are not considered to be VENTILATION EXHAUST TREATMENT SYSTEM components.

40 VENTING

1.~~39~~ VENTING is the controlled process of discharging air or gas from a confinement to maintain temperature, pressure, humidity, concentration or other operating condition, in such a manner that replacement air or gas is not provided or required during VENTING. Vent, used in system names, does not imply a VENTING process.

DELETE PAGE 3/4 4-23

REPLACE WITH NEW PAGE 3/4 4-23

3/4.4.9 PRESSURE/TEMPERATURE LIMITS

REACTOR COOLANT SYSTEM

LIMITING CONDITION FOR OPERATION

3.4.9.1 The Reactor Coolant System (except the pressurizer) temperature and pressure shall be limited in accordance with the limit lines shown on Figures 3.4-2 and 3.4-3 during heatup, cooldown, criticality, and inservice leak and hydrostatic testing with:

a. A maximum heatup of 100°F in any one hour period.

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

c. A maximum temperature change of less than or equal to 5°F in any one hour period during inservice hydrostatic and leak testing operations above the heatup and cooldown limit curves.

APPLICABILITY: At all times.

ACTION:

With any of the above limits exceeded, restore the temperature and/or pressure to within the limit within 30 minutes; perform an engineering evaluation to determine the effects of the out-of-limit condition on the structural integrity of the Reactor Coolant System; determine that the Reactor Coolant System remains acceptable for continued operations or be in at least HOT STANDBY within the next 6 hours and reduce the RCS T_{avg} and pressure to less than 200°F and 500 psig, respectively, within the following 30 hours.

SURVEILLANCE REQUIREMENTS

4.4.9.1.1 The Reactor Coolant System temperature and pressure shall be determined to be within the limits at least once per 30 minutes during system heatup, cooldown, and inservice leak and hydrostatic testing operations.

4.4.9.1.2 The reactor vessel material irradiation surveillance specimens shall be removed and examined, to determine change in material properties, in accordance with 10 CFR 50, Appendix H. The results of these examinations shall be used to update Figures 3.4-2, 3.4-3, and 3.4-4.

REACTOR COOLANT SYSTEM

3/4.4.9 RCS PRESSURE AND TEMPERATURE (P/T) LIMITS

LIMITING CONDITION FOR OPERATION

3.4.9.1 RCS pressure, RCS temperature, and RCS heatup and cooldown rates shall be maintained within the limits specified in the PTLR.

APPLICABILITY: At all times.

ACTIONS:

a. With the requirements of the LCO not met in MODE 1, 2, 3, or 4, restore the parameter(s) to within limits in 30 minutes and determine RCS is acceptable* for continued operation within 72 hours. With the required action above not met, be in MODE 3 within the next 6 hours and in MODE 5, with RCS pressure < 500 psig, within the following 30 hours.

b. With the requirements of the LCO not met any time other than MODE 1, 2, 3, or 4, immediately initiate action to restore parameter(s) to within limits and, prior to entering MODE 4, determine RCS is acceptable* for continued operation.

SURVEILLANCE REQUIREMENTS

4.4.9.1.1 Verify** RCS pressure, RCS temperature, and RCS heatup and cooldown rates are within the limits specified in the PTLR every 30 minutes.

---

* The determination that the RCS is acceptable for continued operation must be completed for any entry into Action a. or b.

** Only required to be performed during RCS heatup and cooldown operations and RCS inservice leak and hydrostatic testing.

Delete Figure 3.4-2

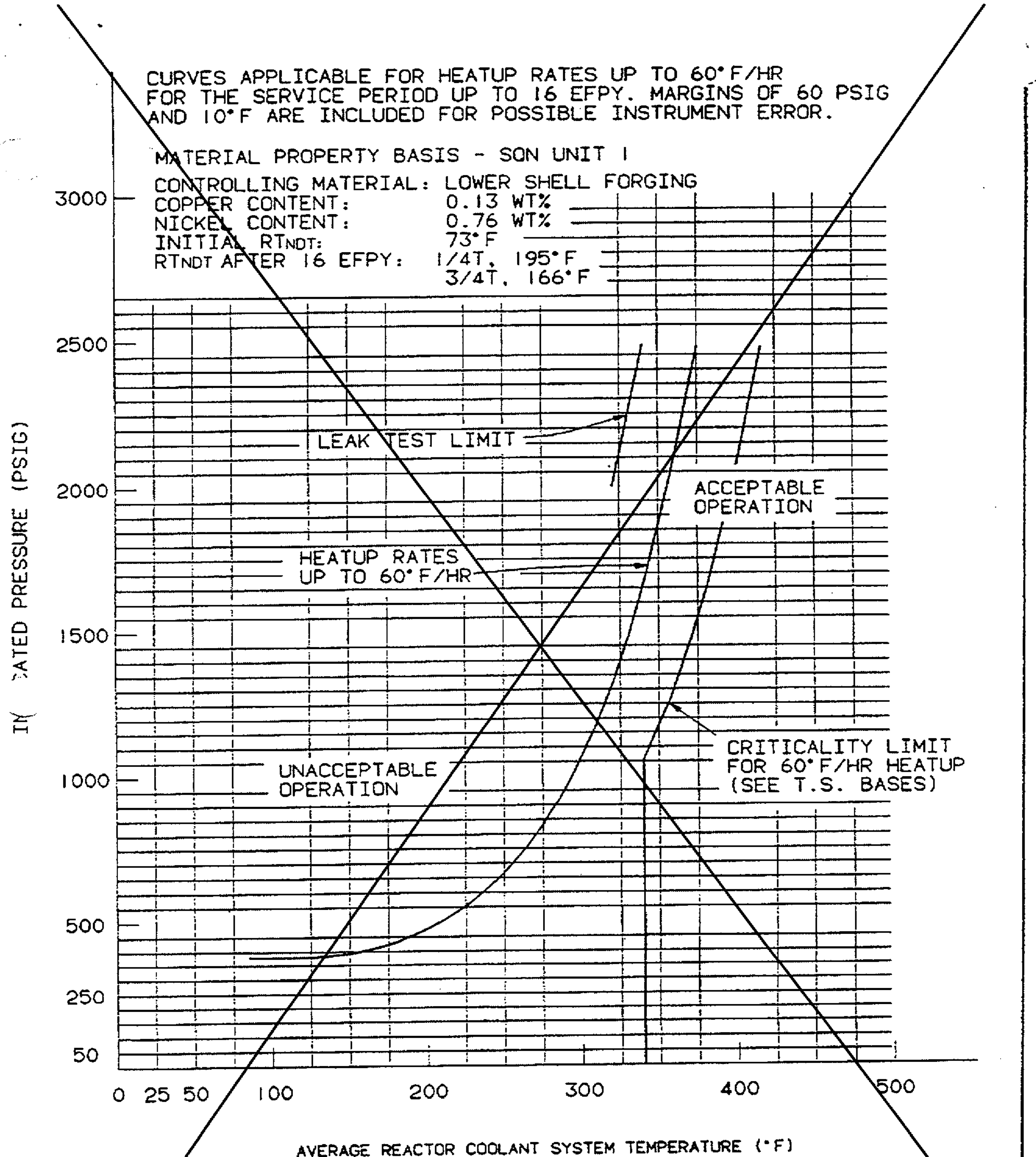


FIGURE 3.4-2 SEQUOYAH UNIT 1 REACTOR COOLANT SYSTEM HEATUP LIMITATIONS APPLICABLE UP TO 16 EFPY

R162

Amendment No. 158
March 31, 1992

Delete Figure 3.4-3

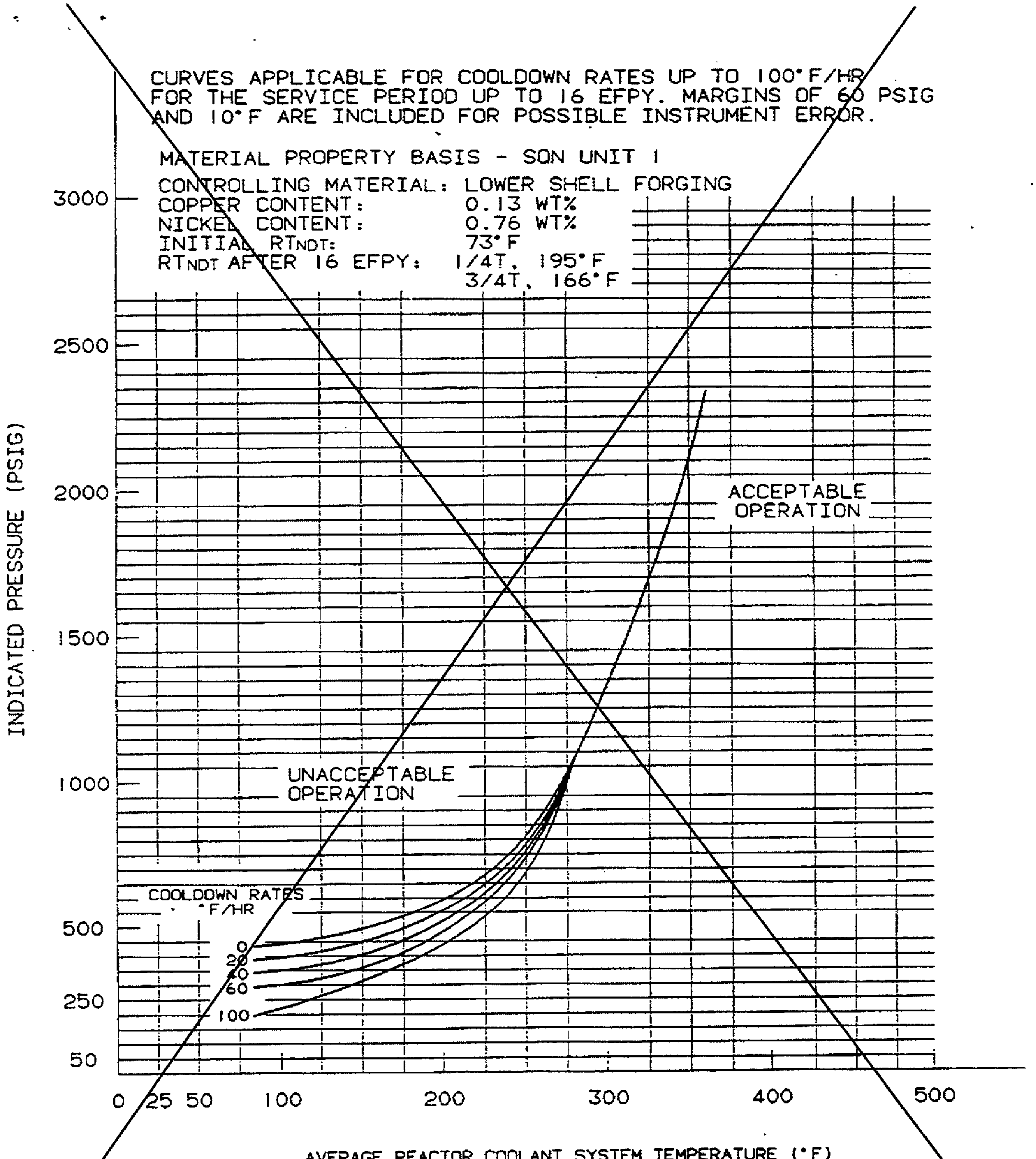


FIGURE 3.4-3 SEQUOYAH UNIT 1 REACTOR COOLANT SYSTEM COOLDOWN LIMITATIONS APPICICABLE UP TO 16 EFPY

PRESSURIZER

LIMITING CONDITION FOR OPERATION

Deleted

3.4.9.2 ~~The pressurizer temperature shall be limited to:~~

~~a. A maximum heatup of 100°F in any one hour period,~~

~~b. A maximum cooldown of 200°F in any one hour period, and~~

~~c. A maximum spray water temperature differential of 560°F.~~

~~APPLICABILITY: At all times.~~

~~ACTION:~~

~~With the pressurizer temperature limits in excess of any of the above limits, restore the temperature to within the limits within 30 minutes; perform an engineering evaluation to determine the effects of the out-of-limit condition on the structural integrity of the pressurizer; determine that the pressurizer remains acceptable for continued operation or be in at least HOT STANDBY within the next 6 hours and reduce the pressurizer pressure to less than 500 psig within the following 30 hours.~~

~~SURVEILLANCE REQUIREMENTS~~

~~4.4.9.2.1 The pressurizer temperatures shall be determined to be within the limits at least once per 30 minutes during system heatup or cooldown.~~

~~4.4.9.2.2 Any occurrence of spray operation with a differential temperature greater than 320°F shall be recorded for evaluation of the cyclic limits in Table 5.7.1.~~

DELETE PAGES 3/4 4-29,-30 AND -31

REPLACE WITH NEW PAGES 3/4 4-29 AND 3/4 4-30

3/4.4.12 LOW TEMPERATURE OVER PRESSURE PROTECTION SYSTEMS

LIMITING CONDITION FOR OPERATION

3.4.12 At least one of the following Overpressure Protection Systems shall be OPERABLE:

a. Two power operated relief valves (PORVs) with a nominal lift setting less than or equal to that shown in Figure 3.4-4, or

b. The Reactor Coolant System (RCS) depressurized with an RCS vent of greater than or equal to 3 square inches.

APPLICABILITY: MODE 4, MODE 5 and MODE 6 with the reactor vessel head on.

ACTION:

a. With one PORV inoperable, in MODE 4 either:

   1. Restore the inoperable PORV to operable status within 7 days, or

   2. Depressurize and vent the RCS through at least a 3 square inch vent within the next 8 hours, or

   3. Ensure pressurizer level is maintained less than or equal to 30 percent.

b. With one PORV inoperable in MODES 5 or 6, either (1) restore the PORV to operable status within 24 hours, or (2) complete depressurization and venting of the RCS through at least a 3 square inch vent within a total of 32 hours.

c. With both PORVs inoperable, depressurize and vent the RCS through at least a 3 square inch vent within 8 hours.

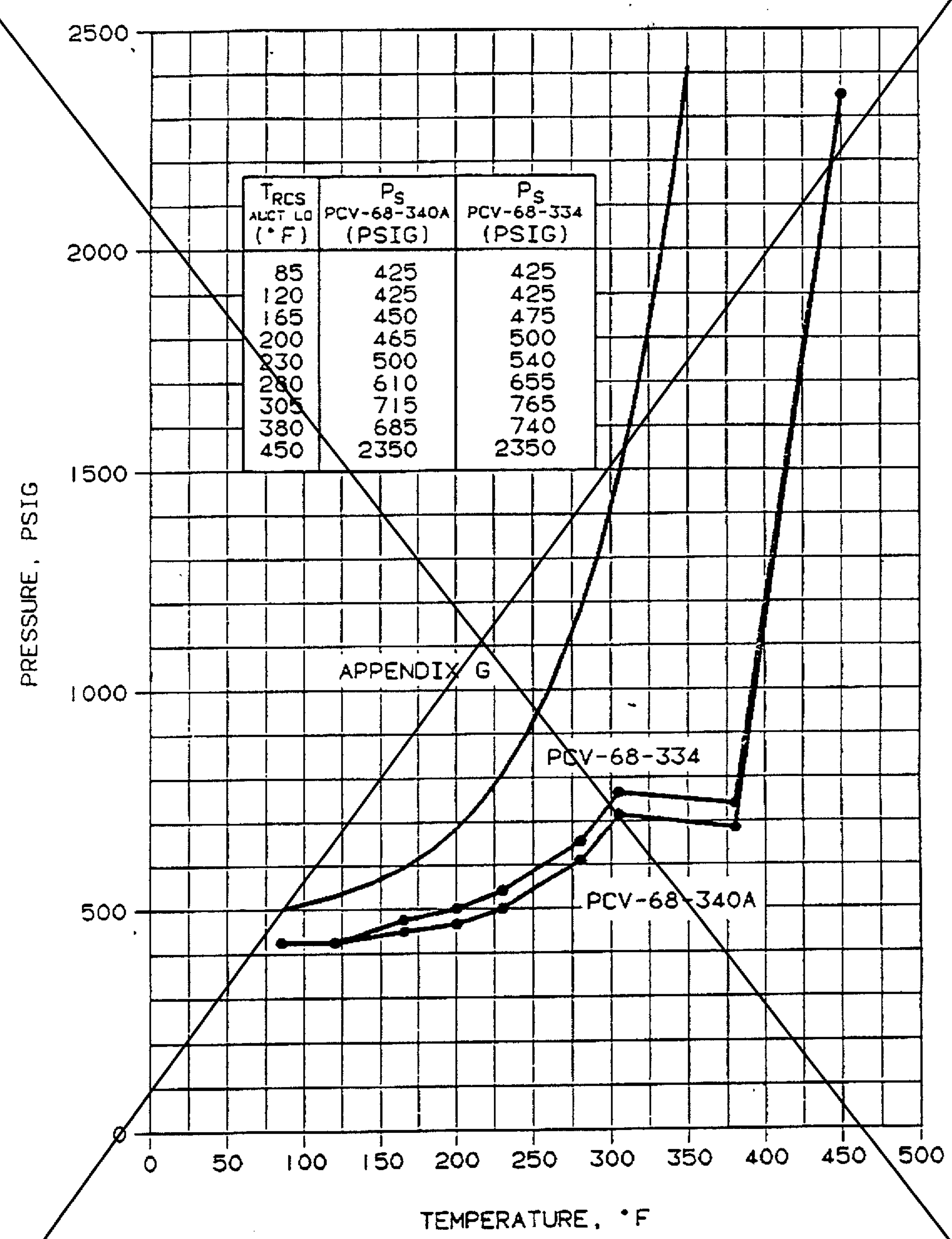
d. With the RCS vented per ACTIONS a, b, or c, verify the vent pathway at least once per 31 days when the pathway is provided by a valve(s) that is locked, sealed, or otherwise secured in the open position; otherwise, verify the vent path every 12 hours.

e. When RCS temperature is less than 350° F, both safety injection pumps and one centrifugal charging pump shall be made incapable of automatic injection into the RCS. Should any of these pumps be found actually capable of automatic injection, return the pump(s) to incapable status within 12 hours or depressurize and vent RCS through at least a 3 square inch vent within the next 8 hours.

f. In the event either the PORVs or the RCS vent(s) are used to mitigate an RCS pressure transient, a Special Report shall be prepared and submitted to the Commission pursuant to Specification 6.9.2 within 30 days. The report shall describe the circumstances initiating the transient, the effect of the PORVs or RCS vent(s) on the transient, and any corrective action necessary to prevent recurrence.

g. The provisions of Specification 3.0.4 are not applicable.

Delete Figure 3.4-4



T_{RCS} ALCT LO (°F)	P_S PCV-68-340A (PSIG)	P_S PCV-68-334 (PSIG)
85	425	425
120	425	425
165	450	475
200	465	500
230	500	540
280	610	655
305	715	765
380	685	740
450	2350	2350

PORV NOMINAL LIFT SETTINGS - APPLICABLE UP TO 16 EFPY

FIGURE 3.4-4

SURVEILLANCE REQUIREMENTS

4.4.12.1 Each PORV shall be demonstrated OPERABLE by:

a. Performance of a CHANNEL FUNCTIONAL TEST, but excluding valve operation, at least once per 31 days;

b. Performance of a CHANNEL CALIBRATION on each required PORV actuation channel at least once per 18 months; and

c. Verifying the PORV isolation valve is open at least once per 72 hours. when the PORV is being used for overpressure protection.

4.4.12.2 All charging pumps and safety injection pumps, excluding the required OPERABLE pumps per specification 3.1.2.3 and 3.5.3, shall be verified incapable of injecting into the RCS and the cold leg accumulator discharge valves verified closed and locked out at least once per 31 days except when the reactor vessel head is removed by verifying that either the pump controls are in the pull-to-lock position, the pump motor circuit breaker(s) is tagged our or the pump(s) is isolated from the RCS by a manually closed valve or by a motor-operated valve with the valve breaker tagged out. Normal Reactor Coolant Pump seal flow can be maintained at all times.

3/4.4.12 LOW TEMPERATURE OVER PRESSURE PROTECTION (LTOP) SYSTEM

LIMITING CONDITION FOR OPERATION

3.4.12* An LTOP System shall be OPERABLE with a maximum of one centrifugal charging pump and no safety injection pump capable of injecting into the Reactor Coolant System (RCS) and the accumulators isolated and one of the following pressure relief capabilities:

a. Two power operated relief valves (PORVs) with lift settings within the limits specified in the PTLR, or

b. The RCS depressurized and an RCS vent ≥ 3 square inches.

APPLICABILITY: MODE 4 when any RCS cold leg temperature is ≤ the LTOP arming temperature specified in the PTLR,
MODE 5,
MODE 6 when the reactor vessel head is on.

ACTION:

a. Should one or more safety injection pumps or more than one charging pump be found capable of injecting into the RCS, immediately initiate action to verify a maximum of one centrifugal charging pump and no safety injection pumps are capable of injecting into the RCS.

b. With an accumulator not isolated when the accumulator pressure is greater than or equal to the maximum RCS pressure for existing cold leg temperature allowed in the PTLR, isolate the affected accumulator within 1 hour, or either;

   1. Increase RCS cold leg temperature to >the LTOP arming temperature specified in the PTLR within 12 hours, or

   2. Depressurize the affected accumulator to less than the maximum RCS pressure for existing cold leg temperature allowed in the PTLR within 12 hours.

c. With one required PORV inoperable in MODE 4, restore the required PORV to OPERABLE status within 7 days.

d. With one required PORV inoperable in MODE 5 or 6, restore the required PORV to OPERABLE status within 24 hours.

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* 1) Two charging pumps may be made capable of injecting into the RCS for ≤ 1 hour for pump swap operations.

2) Accumulator may be unisolated when 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 the PTLR.

3) For the purpose of making the required safety injection pumps and charging pump inoperable, the following time is permitted: up to 4 hours after entering MODE 4 from MODE 3, or prior to decreasing temperature on any RCS loop to below 325°F, whichever occurs first.

ACTION (Continued)

e. With two required PORVs inoperable, or the Actions (a), (b), (c) , or (d) not met, or the LTOP System inoperable for any reason other than (a), (b), (c), or (d), depressurize the RCS and establish RCS vent of ≥ 3.0 square inches within 12 hours.

f. The provisions of Specification 3.0.4 are not applicable

SURVEILLANCE REQUIREMENTS

4.4.12.1 Each PORV shall be demonstrated OPERABLE by:

a. Performance of a CHANNEL FUNCTIONAL TEST*, but excluding valve operation, at least once per 31 days;

b. Performance of a CHANNEL CALIBRATION on each required PORV actuation channel at least once per 18 months; and

c. Verifying the PORV block valve is open for each required PORV at least once per 72 hours.

4.4.12.2 Verify no safety injection pumps are capable of injecting into the RCS within 4 hours after entering MODE 4 from MODE 3 and prior to the temperature of one or more RCS cold legs decreasing below 325°F, and every 12 hours thereafter.

4.4.12.3 Verify a maximum of one charging pump is capable of injecting into the RCS within 4 hours after entering MODE 4 from MODE 3 and prior to the temperature of one or more RCS cold legs decreasing below 325°F, and every 12 hours thereafter.

4.4.12.4 Verify each accumulator is isolated at least once per 12 hours

4.4.12.5 Verify# required RCS vent ≥ 3.0 square inches open at least:

a. Once every 12 hours for unlocked open vent valve(s) and,

b. Once every 31 days for other vent path(s)

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* Not required to be performed until 12 hours after decreasing RCS cold leg temperatures to ≤ the LTOP arming temperature in the PTLR.

Only required to be met when complying with LCO 3.4.12.b.

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3/4.4.9 PRESSURE/TEMPERATURE LIMITS

The temperature and pressure changes during heatup and cooldown are limited to be consistent with the requirements given in the ASME Boiler and Pressure Vessel Code, Section III, Appendix G.

1) The reactor coolant temperature and pressure and system heatup and cooldown rates (with the exception of the pressurizer) shall be limited in accordance with Figures 3.4-2 and 3.4-3 for the first full-power service period.

   a) Allowable combinations of pressure and temperature for specific temperature change rates are below and to the right of the limit lines shown. Limit lines for cooldown rates between those presented may be obtained by interpolation.

   b) Figures 3.4-2 and 3.4-3 define limits to assure prevention of non-ductile failure only. For normal operation, other inherent plant characteristics, e.g., pump heat addition and pressurizer heater capacity, may limit the heatup and cooldown rates that can be achieved over certain pressure-temperature ranges.

2) These limit lines shall be calculated periodically using methods provided below.

3) The secondary side of the steam generator must not be pressurized above 200 psig if the temperature of the steam generator is below 70°F.

4) The pressurizer heatup and cooldown rates shall not exceed 100°F/hr and 200°F/hr respectively. The spray shall not be used if the temperature difference between the pressurizer and the spray fluid is greater than 560°F.

5) System preservice hydrotests and in-service leak and hydrotests shall be performed at pressures in accordance with the requirements of ASME Boiler and Pressure Vessel Code, Section XI.

10 CFR 50, Appendix G, addresses metal temperature of the close head flange and vessel regions. Appendix G states that the minimum metal temperature of the closure flange region should be at least 120 degrees Fahrenheit (F) higher than the limiting RT_{NDT} for this region when the pressure exceeds 20 percent of the preservice hydrostatic test pressure (561 pounds per square inch gauge (psig) for Westinghouse Electric Corporation plants). For SQN, Unit 1, the minimum temperature of the closure flange and vessel flange regions is 90 degrees F since the limiting initial RT_{NDT} for the closure head flange is -40 degrees F (see Table B 3/4.4-1). These numbers (561 psig and 90 degrees F) include a margin for instrumentation error of 10 degrees F and 60 psig. The SQN Unit 1 heat up and cooldown curves shown in Figures 3.4-2 and 3.4-3 are not impacted by this regulation.

The fracture toughness properties of the ferritic materials in the reactor vessel are determined in accordance with the NRC Standard Review Plan, and ASTM E185-82, and in accordance with additional reactor vessel requirements. These properties are then evaluated in accordance with Appendix G to 10 CFR 50 and Appendix G of the 1986 ASME Boiler and Pressure Vessel Code, Section III, Division 1 and the calculation methods described in WCAP-7924-A, "Basis for Heatup and Cooldown Limit Curves, April 1975."

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Heatup and cooldown limit curves are calculated using the most limiting value of the nil-ductility reference temperature, RT_{NDT}, at the end of 16 effective full power years of service life. The 16 EFPY service life period is chosen such that the limiting RT_{NDT} at the 1/4T location in the core region is greater than the RT_{NDT} of the limiting unirradiated material. The selection of such a limiting RT_{NDT} assures that all components in the Reactor Coolant System will be operated conservatively in accordance with applicable Code requirements

The reactor vessel materials have been tested to determine their initial RT_{NDT} ; the results of these tests are shown in Table B 3/4.4-1. Reactor operation and resultant fast neutron (E greater than 1 MEV) irradiation can cause an increase in the RT_{NDT}. Therefore, an adjusted reference temperature, based upon the fluence of the material in question, has been predicted using Regulatory Guide 1.99, Revision 2 and a peak surface fluence of 1.94×10^{19} n/cm^2 for 16 effective full power years (Reference WCAP 12970, "Heatup and Cooldown Limit Curves for Normal Operation," June 1991). The heatup and cooldown limit curves of Figures 3.4-2 and 3.4-3 include predicted adjustments for this shift in RT_{NDT} at the end of 16 EFPY, as well as adjustments for possible errors in the pressure and temperature sensing instruments.

Values of delta RT_{NDT} determined in this manner may be used until the results from the material surveillance program, evaluated according to ASTM El85, are available. The first capsule was removed at the end of the first core cycle. Successive capsules will be removed in accordance with the requirements of ASTM E185-73 and l0 CFR 50, Appendix H. The heatup and cooldown curves and the low temperature overpressure protection setpoints must be recalculated when the delta RT_{NDT} determined from the surveillance capsule exceeds the calculated delta RT_{NDT} for the equivalent capsule radiation exposure.

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TABLE B 3/4.4-1 is relocated to the end of the Pressure/Temperature Limits BASES Section (End of Insert C).

TABLE B 3/4.4-1

SEQUOYAH-UNIT 1 REACTOR VESSEL TOUGHNESS DATA

COMPONENT	HEAT NO.	MATERIAL GRADE	Cu (%)	Ni (%)	NDT (°F)	MINIMUM 50 ft-lb/35 mil temp. TEMP.(°F) PMWD1	NMWD2	RT_{NDT} (°F)	AVERAGE UPPER SHELF ENERGY (ft-lb) PMWD1	NMWD2
Clos Hd. Dome	52841-1	A533B,C1.1	-	-	-40	+14	+34	-26	104[a]	-
Clos Hd. Ring	(D75600)	A508,C1.2	-	-	+ 5	+36	+56*	+5	125[a]	-
Hd Flange	4842	A508,C1.2	-	-	-40	-24	-4*	-40	131[a]	-
Vessel Flange	4866	A508,C1.2	-	-	-49	-47	-27	-49	158[a]	-
Inlet Nozzle	4846	A508,C1.2	-	-	-58	+25	+45	-15	94.5[a]	-
Inlet Nozzle	4949	A508,C1.2	-	-	-40	+39	+59*	-1	93[a]	-
Inlet Nozzle	4863	A508,C1.2	-	-	-22	+16	+36*	-22	118[a]	-
Inlet Nozzle	4865	A508,C1.2	-	-	-67	+ 9	+29*	-31	94[a]	-
Outlet Nozzle	4845	A508,C1.2	-	-	-49	+21	+41*	-19	94[a]	-
Outlet Nozzle	4850	A508,C1.2	-	-	-58	+30	+50*	-10	79.5[a]	-
Outlet Nozzle	4862	A508,C1.2	-	-	-58	+16	+36*	-24	103[a]	-
Outlet Nozzle	4864	A508,C1.2	-	-	-49	0	+20	-40	126[a]	-
Upper Shell	4841	A508,C1.2	-	-	-40	+43	+83	+23	83[a]	113[b]
Inter Shell	4829	A508,C1.2	0.15	0.86	-4	+10	+100	+40	116	73[b,c]
Lower Shell	4836	A508,C1.2	0.13	0.76	+5	+28	+133	+73	109	70[b]
Trans. Ring	4879	A508,C1.2	-	-	+5	+27	+47*	+ 5	98[a]	-
Bot. Hd. Rim	52703/2-1	A533B,C1.1	-	-	-31	+23	+43*	-17	104[a]	-
Bot. Hd. Rim	52703/2-2	A533B,C1.1	-	-	-13	+36	+56*	-4	63[a]	
Bot. Hd. Rim	52704/2	A533B,C1.1	-	-	-49	-24	-4*	-49	114[a]	
Bot. Hd. Rim	52703/2-2	A533B,C1.1	-	-	-31	+43	+63*	+3	86[a]	
Bot. Hd. Rim	52704/2	A533B,C1.1	-	-	-58	-13	+4	-53	120[a]	
Bot. Hd.	52704/11	A533B,C1.1	-	-	-58	-47	-27*	-58	139[a]	
Weld	-	Weld	0.33	.017	-40	-	-4	-40	-	116[b]
HAZ	-	Weld	-	-	-22	-	+41	-19	-	86[b]

1-Paralled to Major Working Direction

2-Normal to Major Working Direction

a-%Shear Not reported

b-Minimum upper shelf energies

c-Minimum upper shelf energy decreased to 51 at a test temperature of 300°F. This anomaly will be reevaluted when the results of Generic task A-11 are available.

* Estimate based on USAEC Regulatory Standard Review Plan, Section 5.3.2 MTEB

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Allowable pressure -temperature relationships for various heatup and cooldown rates are calculated using methods derived from Appendix G in Section III of the ASME Boiler and Pressure Vessel Code as required by Appendix G to 10 CFR Part 50 and these methods are discussed in detail in WCAP-7924-A.

The general method for calculating heatup and cooldown limit curves is based upon the principles of the linear elastic fracture mechanics (LEFM) technology. In the calculation procedures a semi-elliptical surface defect with a depth of one quarter of the wall thickness, T, and a length of 3/2T is assumed to exist at the inside of the vessel wall as well as at the outside of the vessel wall. The dimensions of this postulated crack, referred to in Appendix G of ASME III as the reference flaw, amply exceed the current capabilities of inservice inspection techniques. Therefore, the reactor operation limit curves developed for this reference crack are conservative and provide sufficient safety margins for protection against non-ductile failure. To assure that the radiation embrittlement effects are accounted for in the calculation of the limit curves, the most limiting value of the nil ductility reference temperature, RT_{NDT}, is used and this includes the radiation induced shift, delta RT_{NDT}, corresponding to the end of the period for which heatup and cooldown curves are generated.

The ASME approach for calculating the allowable limit curves for various heatup and cooldown rates specifies that the total stress intensity factor, K_I, for the combined thermal and pressure stresses at any time during heatup or cooldown cannot be greater than the reference stress intensity factor, K_{IR}, for the metal temperature at that time. K_{IR}, is obtained from the reference fracture toughness curve, defined in Appendix G to the ASME Code. The K_{IR}, curve is given by the equation:

$$K_{IR} = 26.78 + 1.223 \exp [0.0145(T-RT_{NDT} + 160)] \qquad (1)$$

where K_{IR} is the reference stress intensity factor as a function of the metal temperature T and the metal nil ductility reference temperature RT_{NDT}. Thus, the governing equation for the heatup-cooldown analysis is defined in Appendix G of the ASME Code as follows:

$$C\,K_{IM} + K_{It} \leq K_{IR} \qquad (2)$$

Where, K_{IM} is the stress intensity factor caused by membrane (pressure) stress.

K_{IT} is the stress intensity factor caused by the thermal gradients.

K_{IR} is provided by the code as a function of temperature relative to the RT_{NDT} of the material.

C = 2.0 for level A and B service limits, and

C = l.5 for inservice hydrostatic and leak test operations.

At any time during the heatup or cooldown transient, K_{IR} is determined by the metal temperature at the tip of the postulated flaw, the appropriate value for RT_{NDT}, and the reference fracture toughness curve. The thermal stresses resulting from temperature gradients through the vessel wall are calculated and then the corresponding (thermal) stress intensity factors, K_{IT}, for the reference flaw are computed. From Equation (2) the pressure stress intensity factors are obtained and from these the allowable pressures are calculated.

COOLDOWN

For the calculation of the allowable pressure versus coolant temperature during cooldown, the Code reference flaw is assumed to exist at the inside of the vessel wall. During cooldown, the controlling location of the flaw is always at the inside of the wall because the thermal gradients produce tensile

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stresses at the inside, which increase with increasing cooldown rates. Allowable pressure-temperature relations are generated for both steady-state and finite cooldown rate situations. From these relations composite limit curves are constructed for each cooldown rate of interest.

The use of the composite curve in the cooldown analysis is necessary because control of the cooldown procedure is based on measurement of reactor coolant temperature, whereas the limiting pressure is actually dependent on the material temperature at the tip of the assumed flaw. During cooldown, the 1/4T vessel location is at a higher temperature than the fluid adjacent to the vessel ID. This condition, of course, is not true for the steady-state situation. It follows that at any given reactor coolant temperature, the delta T developed during cooldown results in a higher value of K_{IR} at the 1/4T location for finite cooldown rates than for steady-state operation. Furthermore, if conditions exist such that the increase in K_{IR} exceeds K_{IT}, the calculated allowable pressure during cooldown will be greater than the steady-state value.

The above procedures are needed because there is no direct control on temperature at the 1/4T location; therefore, allowable pressures may unknowingly be violated if the rate of cooling is decreased at various intervals along a cooldown ramp. The use of the composite curve eliminates this problem and assures conservative operation of the system for the entire cooldown period.

HEATUP

Three separate calculations are required to determine the limit curves for finite heatup rates. As is done in the cooldown analysis, allowable pressure-temperature relationships are developed for steady-state conditions as well as finite heatup rate conditions assuming the presence of a 1/4T defect at the inside of the vessel wall. The thermal gradients during heatup produce compressive stresses at the inside of the wall that alleviate the tensile stresses produced by internal pressure. The metal temperature at the crack tip lags the coolant temperature; therefore, the K_{IR} for the 1/4T crack during heatup is lower than the K_{IR} for the 1/4T crack during steady-state conditions at the same coolant temperature. During heatup, especially at the end of the transient, conditions may exist such that the effects of compressive

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thermal stresses and different K_{IR}'s for steady-state and finite heatup rates do not offset each other and the pressure-temperature curve based on steady-state conditions no longer represents a lower bound of all similar curves for finite heatup rates when the 1/4T flaw is considered. Therefore, both cases have to be analyzed in order to assure that at any coolant temperature the lower value of the allowable pressure calculated for steady-state and finite heatup rates is obtained.

The second portion of the heatup analysis concerns the calculation of pressure-temperature limitations for the case in which a 1/4T deep outside surface flaw is assumed. Unlike the situation at the vessel inside surface, the thermal gradients established at the outside surface during heatup produce stresses which are tensile in nature and thus tend to reinforce any pressure stresses present. These thermal stresses, of course, are dependent on both the rate of heatup and the time (or coolant temperature) along the heatup ramp. Furthermore, since the thermal stresses, at the outside are tensile and increase with increasing heatup rate, a lower bound curve cannot be defined. Rather, each heatup rate of interest must be analyzed on an individual basis.

Following the generation of pressure-temperature curves for both the steady-state and finite heatup rate situations, the final limit curves are produced as follows. A composite curve is constructed based on a point-by-point comparison of the steady-state and finite heatup rate data. At any given temperature, the allowable pressure is taken to be the lesser of the three values taken from the curves under consideration.

The use of the composite curve is necessary to set conservative heatup limitations because it is possible for conditions to exist such that over the course of the heatup ramp the controlling condition switches from the inside to the outside and the pressure limit must at all times be based on analysis of the most critical criterion.

The leak test limit curve shown on Figure 3.4-2 represents the minimum temperature requirements at the leak test pressure specified by applicable codes. The leak test limit curve was determined by methods of Branch Technical Position MTEB 5-2 and 10 CFR 50, Appendix G.

The criticality limit curve shown in Figure 3.4-2 specifies pressure-temperature limits for core operation to provide additional margin during actual power production. The pressure-temperature limits for core operation (except for low power physics tests) require the reactor vessel to be at a temperature equal to or higher than the minimum temperature required for the in-service hydrostatic test, and at least 40 degrees F higher than the minimum pressure-temperature curve for heatup and cooldown. The maximum temperature for the in-service hydrostatic test for the SQN Unit 1 reactor vessel is 327 degrees F. A vertical line at 327 degrees F on the pressure-temperature curve, intersecting a curve 40 degrees F higher than the pressure-temperature limit curve, constitutes the limit for core operation for the reactor vessel.

Finally, the composite curves for the heatup rate data and the cooldown rate data are adjusted for possible errors in the pressure and temperature sensing instruments by the values indicated on the respective curves.

Although the pressurizer operates in temperature ranges above those for which there is reason for concern of non-ductile failure, operating limits are provided to assure compatibility of operation with the fatigue analysis performed in accordance with the ASME Code requirements.

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B 3/4.4 REACTOR COOLANT SYSTEM

B 3/4.4.9 Reactor Coolant System 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.

The PTLR contains P/T limit curves for heatup, cooldown, inservice leak and hydrostatic (ISLH) testing, 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.

The LCO establishes operating limits that provide a margin to brittle 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. The reactor vessel materials have been tested to determine their initial RT_{NDT} and the results of these tests are shown on Table B 3/4.4-1.

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 failure during normal operation, anticipated operational occurrences, and system hydrostatic tests. It mandates the use of the American Society of Mechanical Engineers (ASME) Code, Section III, 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 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).

BASES

BACKGROUND (continued)

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 3.1.1.4, "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 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 (Continued) 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, 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. 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. Specification 3/4.2.5, "DNB Parameters," Specification 3.1.1.4, 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.

ACTIONS

Action a

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.

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ACTIONS (continued)

The 30 minute action 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 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 action 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.

Action (a) is modified by a footnote requiring an evaluation of RCS acceptability to be completed whenever the action is entered. The footnote emphasizes the need to perform the evaluation of the effects of the excursion outside the allowable limits. Restoration alone is insufficient because higher than analyzed stresses may have occurred and may have affected the RCPB integrity.

If Action (a) is not met, the plant must be placed in a lower MODE because either the RCS 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 undetected flaws is decreased.

If the required restoration activity cannot be accomplished within 30 minutes, the action 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. 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.

The allowed action 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.

BASES

ACTIONS (continued)

Action b

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 action 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 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.

Action b is modified by a footnote requiring an evaluation of RCS acceptability to be completed whenever the action is entered. The footnote emphasizes the need to perform the evaluation of the effects of the excursion outside the allowable limits. Restoration alone is insufficient because higher than analyzed stresses may have occurred and may have affected the RCPB integrity.

SURVEILLANCE REQUIREMENTS

4.4.9.1.1

Verification that operation is within the PTLR 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. 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, 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 footnote that only requires this SR to be performed during system heatup, cooldown, and ISLH testing. No SR is given for criticality operations because LCO 3.1.1.4 contains a more restrictive requirement.

REFERENCES:

1. WCAP-7924-A,April 1975
2. 10 CFR 50, Appendix G.
3. ASME, Boiler and Pressure Vessel Code, Section III, 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.
8. WCAP-15293, "Sequoyah Unit 1 Heatup and Cooldown Limit Curves for Normal Operation and PTLR Support Documentation," T. J. Laubham, dated April 2001.

Insert Table B 3/4 4-1 on this page.

3/4.4.10 DELETED

3/4.4.11 REACTOR COOLANT SYSTEM HEAD VENTS

INSERT D

The function of the RCS head vents is to remove non-condensables or steam from the reactor vessel head. This system is designed to mitigate a possible condition of inadequate core cooling, inadequate natural circulation, or inability to depressurize the RHR System initiated conditions resulting from the accumulation of non-condensable gases in the Reactor Coolant System. The reactor vessel head vent is designed with redundant safety grade vent paths.

3/4.4.12 OVERPRESSURE PROTECTION SYSTEM

The operability of two PORVs or an RCS vent opening of at least three square inches ensures that the RCS will be protected from pressure transients which could exceed the limits of Appendix G to 10 CFR 50 when one or more of the RCS cold legs are less than or equal to 350 degrees F. Either PORV has adequate relieving capability to protect the RCS from overpressurization when the transient is limited to either: (1) the start of an idle RCP with a water-solid RCS and the secondary water temperature of the steam generator is less than or equal to 50 degrees F above the RCS cold leg temperatures, or (2) the start of a charging pump and its injection into the RCS with letdown isolated.

The maximum allowed PORV setpoint for the low temperature overpressure protection (LTOP) system is derived by analysis which models the performance of the LTOP system assuming various mass input and heat input transients. Operation with the PORV setpoint less than or equal to the maximum setpoint ensures that Appendix G criteria will not be violated with consideration for a maximum pressure overshoot beyond the PORV setpoint which can occur as a result of time delays in signal processing and valve opening, instrument uncertainties, and signal failure. To ensure that mass and heat input transients more severe than those assumed cannot occur, technical specifications require tagout or isolation of all but one centrifugal charging pump while in modes 4, 5, and 6 with the reactor vessel head installed and disallow restart of an RCP if a steam bubble does not exist in the pressurizer.

The LTOP system setpoints include a 50 degree F allowance for instrument accuracy. An 800 psig pressure limit protects the PORV piping from the consequences of a possible water hammer caused by the rapid opening times associated with the PORVs.

B 3/4.4 REACTOR COOLANT SYSTEM

B 3/4.4.12 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. The PTLR provides the maximum allowable actuation logic setpoints for the power operated relief valves (PORVs) and 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 3.4.9.1, "RCS Pressure and Temperature (P/T) Limits," requires administrative control of RCS pressure and temperature during heatup and cooldown to prevent exceeding the PTLR limits.

This LCO provides RCS overpressure protection by having a minimum coolant input capability and having adequate pressure relief capacity. Limiting coolant input capability requires all but one charging pump incapable of injection into the RCS and isolating the accumulators. The pressure relief capacity requires either two redundant PORVs or a depressurized RCS and an RCS vent of sufficient size. One PORV or the open RCS vent is the overpressure protection device that acts to terminate an increasing pressure event.

With minimum coolant input capability, the ability to provide core 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. If conditions require the use of more than one charging 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 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.

INSERT D
(Continued)

BASES
Background (continued)

PORV Requirements

As designed for the LTOP System, each PORV is signaled to open if the RCS pressure approaches a limit determined by the LTOP actuation logic. The LTOP actuation logic monitors both RCS temperature and RCS pressure and determines when a condition not acceptable in the PTLR limits is approached. The wide range RCS temperature indications are auctioneered to select the lowest temperature signal.

The lowest temperature signal is processed through a function generator that calculates a pressure limit for that temperature. The calculated pressure limit is then compared with the indicated RCS pressure from a wide range pressure channel. If the indicated pressure meets or exceeds the calculated value, a PORV is signaled to open.

The PTLR presents the PORV setpoints for LTOP. The setpoints are normally staggered so only one valve opens during a low temperature overpressure transient. Having the setpoints of both valves within the limits in the PTLR 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.

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.

For an RCS vent to meet the flow capacity requirement, it requires an RCS vent opening of at least three square inches. This may be accomplished by removing a pressurizer safety valve, removing a PORV's internals, and disabling its block valve in the open position. 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. 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 the LTOP arming temperature specified in the PTLR , the pressurizer safety valves will prevent RCS pressure from exceeding the Reference 1 limits.

APPLICABLE SAFETY ANALYSES

At about the LTOP arming temperature specified in the PTLR, and below, overpressure prevention falls to two OPERABLE PORVs 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 PTLR curves are revised, the LTOP System must be re-evaluated to ensure its functional requirements can still be met using the PORV method or the depressurized and vented RCS condition.

The PTLR 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:

<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 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 the LTOP overpressure protection means cannot handle:

a. Rendering all but one charging pump incapable of injection;

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

c. Disallowing start of an RCP unless a steam bubble exits in the pressurizer. LCO 3.4.1.3, “Reactor Coolant System - Hot Shutdown” provides this protection.

BASES

APPLICABLE SAFETY ANALYSES (continued)

The Reference 4 analyses demonstrate that either one PORV 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 OPERABLE during the LTOP MODES. Since neither one PORV nor the RCS vent can handle the pressure transient need from accumulator injection, when RCS temperature is low, the LCO also requires the accumulators isolated when accumulator pressure is greater than or equal to the maximum RCS pressure for the existing RCS cold leg temperature allowed in the PTLR.

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

Fracture mechanics analyses establish the temperature of LTOP Applicability at the LTOP arming temperature specified in the PTLR.

The consequences of a small break loss of coolant accident (LOCA) in LTOP MODE 4 conform to 10 CFR 50.46 and 10 CFR 50, Appendix K (Refs. 5 and 6), requirements by having a maximum of one charging pump OPERABLE and SI actuation enabled.

<u>PORV Performance</u>

The fracture mechanics analyses show that the vessel is protected when the PORVs are set to open at or below the limit shown in the PTLR. The setpoints are derived by analyses that model the performance of the LTOP System, assuming the limiting LTOP transient is one charging pump 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 PORV setpoints in the PTLR 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 of the reactor vessel material irradiation surveillance specimens. The Bases for LCO 3.4.9.1 "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)

RCS Vent Performance

With the RCS depressurized, analyses show a vent size of 3.0 square inches is capable of mitigating the allowed LTOP overpressure transient. The capacity of a vent this size is greater than the flow of the limiting transient for the LTOP configuration, one charging pump OPERABLE, maintaining RCS pressure less than the maximum pressure on the P/T limit curve.

The RCS vent size will be re-evaluated for compliance each time the P/T SAFETY 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, the LCO requires that a maximum of one charging pump be capable of injecting into the RCS, and all accumulator discharge isolation valves be closed and immobilized when accumulator pressure is greater than or equal to the maximum RCS pressure for the existing RCS cold leg temperature allowed in the PTLR.

The LCO is modified by three footnotes. The first footnote allows two charging pumps to be made capable of injecting 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. The second footnote states that 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 the PTLR. This footnote permits the accumulator discharge isolation valve surveillance to be performed only under these pressure and temperature conditions. The third footnote allows a 4-hour maximum time period for rendering both safety injection pumps and one centrifugal charging pump inoperable after entry to MODE 4 from MODE 3. RCS temperature must remain above 325°F until the pumps are rendered incapable of inadvertent injection. The 4-hour time period is sufficient for completing this activity and is based on the low probability for inadvertent pump start.

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

LCO (continued)

a. Two OPERABLE PORVs,

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

b. A depressurized RCS and an RCS vent.

An RCS vent is OPERABLE when open with an area of ≥3.0 square inches.

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

APPLICABILITY

This LCO is applicable in MODE 4 when any RCS cold leg temperature is ≤ the LTOP arming temperature specified in the PTLR, 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 the LTOP arming temperature specified in the PTLR. When the reactor vessel head is off, overpressurization cannot occur.

LCO 3.4.9.1 provides the operational P/T limits for all MODES.
LCO 3.4.3.1, "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 above the LTOP arming temperature specified in the PTLR.

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.

ACTIONS

Action a

With two or more centrifugal charging pumps capable of injecting into the RCS, RCS overpressurization is possible.

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

Action b

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.

BASES

ACTIONS (continued)

If isolation is needed and cannot be accomplished in 1 hour, two options are provided either of which must be performed in the next 12 hours. By increasing the RCS temperature to > LTOP arming temperature specified in the PTLR, an accumulator pressure of 600 psig cannot exceed the LTOP limits if the accumulators are fully injected. Depressurizing the accumulators below the LTOP limit from the PTLR also gives this protection.

The action 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.

Action c

In MODE 4 when any RCS cold leg temperature is ≤ the LTOP arming temperature specified in the PTLR, with one required PORV inoperable, the required PORV must be restored to OPERABLE status within 7 days. Two PORVs are required to provide low temperature overpressure mitigation while withstanding a single failure of an active component.

The action 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.

Action d

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

The action time represents a reasonable time to investigate and repair several types of PORV failures without exposure to a lengthy period with only one OPERABLE PORV to protect against overpressure events.

Action e

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

a. Both required PORVs are inoperable;

b. Actions a, c, or d are not completed in the allowable times; or

c. The LTOP System is inoperable for any reason other than Actions a, b, c or d.

BASES

ACTIONS (continued)

The vent must be sized ≥ 3.0 square inches 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 action 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.

SURVEILLANCE REQUIREMENTS

4.4.12.1.a

Performance of a CHANNEL FUNCTIONAL TEST is required within 12 hours after decreasing RCS cold leg temperature to ≤ LTOP arming temperature specified in the PTLR and every 31 days on each required PORV to verify and, as necessary, adjust its lift setpoint. The CHANNEL FUNCTIONAL TEST will verify the setpoint is within the PTLR allowed maximum limits in the PTLR. PORV actuation could depressurize the RCS and is not required.

The 12 hour frequency considers the unlikelihood of a low temperature overpressure event during this time.

A footnote* has been added indicating that this SR is required to be performed 12 hours after decreasing RCS cold leg temperature to ≤ LTOP arming temperature specified in the PTLR. The CHANNEL FUNCTIONAL TEST 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.

4.4.12.1.b

Performance of a CHANNEL CALIBRATION on each required PORV actuation channel is required every 18 months to adjust the whole channel so that it responds and the valve opens within the required range and accuracy to known input.

4.4.12.1.c

The PORV block valve must be verified open every 72 hours 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.

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.

BASES

SURVIELLANCE REQUIREMENTS (continued)

The 72 hour frequency is considered adequate in view of 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.

4.4.12.2 and 4.4.12.3

To minimize the potential for a low temperature overpressure event by limiting the mass input capability, all safety injection pumps and all but one charging pump are verified incapable of injecting into the RCS and the accumulator discharge isolation valves are verified closed and locked out The safety injection pumps and charging pumps 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 a pump start 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.

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.

4.4.12.4

The accumulator discharge isolation valves are verified closed and locked out at least once per 12 hours. 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.

4.4.12.5

The RCS vent of ≥ 3.0 square inches is proven OPERABLE by verifying its open condition either:

a. Once every12 hours for a valve that is not locked. (valves that are sealed or secured in the open position are considered "locked" in this context).

b. Once every 31 days for other vent path(s) (e.g., a vent valve that is locked, sealed, or secured in position or a removed pressurizer safety valve or open manway also fits this category.

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

INSERT D
(Continued)

BASES

REFERENCES

1. 10 CFR 50, Appendix G
2. Generic Letter 88-11.
3. ASME, Boiler and Pressure Vessel Code, Section III.
4. FSAR, Chapter 15
5. 10 CFR 50, Section 50.46.
6. 10 CFR 50, Appendix K.
7. Generic Letter 90-06.
8. ASME, Boiler and Pressure Vessel Code, Section XI.

CORE OPERATING LIMITS REPORT (continued)

6. WCAP-10054-P-A, Westinghouse Small Break ECCS Evaluation Model Using the NOTRUMP Code, August 1985, (W Proprietary)
   (Methodology for Specification 3/4.2.2 - Heat Flux Hot Channel Factor)

7. WCAP-10266-P-A, Rev. 2, "THE 1981 REVISION OF WESTINGHOUSE EVALUATION MODEL USING BASH CODE", March 1987, (W Proprietary).
   (Methodology for Specification 3.2.2 - Heat Flux Hot Channel Factor).

8. BAW-10227P-A, "Evaluation of Advance Cladding and Structural Material (M5) in PWR Reactor Fuel," February 2000, (FCF Proprietary)
   (Methodology for Specification 3/4.2.2 - Heat Flux Hot Channel Factor)

6.9.1.14.b The core operating limits shall be determined so that all applicable limits (e.g., fuel thermal-mechanical limits, core thermal-hydraulic limits, ECCS limits, nuclear limits such as shutdown margin, and transient and accident analysis limits) of the safety analysis are met.

6.9.1.14.c THE CORE OPERATING LIMITS REPORT shall be provided within 30 days after cycle start-up (Mode 2) for each reload cycle or within 30 days of issuance of any midcycle revision of the NRC Document Control Desk with copies to the Regional Administrator and Resident Inspector.

INSERT B

SPECIAL REPORTS

6.9.2.1 Special reports shall be submitted within the time period specified for each report, in accordance with 10 CFR 50.4.

6.9.2.2 This specification has been deleted.

INSERT B

REACTOR COOLANT SYSTEM (RCS) PRESSURE AND TEMPERATURE LIMITS (PTLR) REPORT

6.9.1.15 RCS pressure and temperature limits for heatup, cooldown, low temperature operation, criticality, and hydrostatic testing, LTOP arming, and PORV lift settings as well as heatup and cooldown rates shall be established and documented in the PTLR for the following:

Specification 3.4.9.1, "RCS Pressure and Temperature (P/T) Limits"

Specification 3.4.12, "Low Temperature Over Pressure Protection (LTOP) System"

6.9.1.15.a The analytical methods used to determine the RCS pressure and temperature limits shall be those previously reviewed and approved by the NRC, specifically those described in the following documents:

1. Westinghouse Topical Report WCAP-14040-NP-A, Revision 2, "Methodology used to Develop Cold Overpressure Mitigating System Setpoints and RCS Heatup and Cooldown Limit Curves, January 1996.

2. Westinghouse Topical Report WCAP-15293, Revision 1, "Sequoyah Unit 1 Heatup and Cooldown Limit Curves for Normal Operation and PTLR Support Documentation," April 2001.

6.9.1.15.b The PTLR shall be provided to the NRC within 30 days of issuance of any revision or supplement thereto.

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1.0 DEFINITIONS (Continued)

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LIMITING CONDITIONS FOR OPERATION AND SURVEILLANCE REQUIREMENTS

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BASES

OPERATIONAL MODE - MODE

1.20 An OPERATIONAL MODE (i.e., MODE) shall correspond to any one inclusive combination of core reactivity condition, power level and average reactor coolant temperature specified in Table 1.1.

PHYSICS TESTS

1.21 PHYSICS TESTS shall be those tests performed to measure the fundamental nuclear characteristics of the reactor core and related instrumentation and 1) described in Chapter 14.0 of the FSAR, 2) authorized under the provisions of 10 CFR 50.59, or 3) otherwise approved by the Commission.

PRESSURE BOUNDARY LEAKAGE

1.22 PRESSURE BOUNDARY LEAKAGE shall be leakage (except steam generator tube leakage) through a non-isolable fault in a Reactor Coolant System component body, pipe wall or vessel wall.

INSERT A

24 PROCESS CONTROL PROGRAM (PCP)

1.~~23~~ DELETED

PURGE - PURGING

25 1.~~24~~ PURGE or PURGING is the controlled process of discharging air or gas from a confinement to maintain temperature, pressure, humidity, concentration or other operating condition, in such a manner that replacement air or gas is required to purify the confinement.

QUADRANT POWER TILT RATIO

26 1.~~25~~ QUADRANT POWER TILT RATIO shall be the ratio of the maximum upper excore detector calibrated output to the average of the upper excore detector calibrated outputs, or the ratio of the maximum lower excore detector calibrated output to the average of the lower excore detector calibrated outputs, which-ever is greater.

INSERT A

PRESSURE AND TEMPERATURE LIMITS REPORT (PTLR)

1.23 The PTLR is the unit specific document that provides the reactor vessel pressure and temperature limits, including heatup and cooldown rates and the LTOP arming temperature, for the current reactor vessel fluence period. These pressure and temperature limits shall be determined for each fluence period in accordance with Specification 6.9.1.15.

27 <u>RATED THERMAL POWER (RTP)</u>

1.~~26~~ RATED THERMAL POWER (RTP) shall be a total reactor core heat transfer rate to the reactor coolant of 3455 MWt.

28 <u>REACTOR TRIP SYSTEM (RTS) RESPONSE TIME</u>

1.~~27~~ The REACTOR TRIP SYSTEM RESPONSE TIME shall be the time interval from when the monitored parameter exceeds its (RTS) trip setpoint at the channel sensor until loss of stationary gripper coil voltage. The response time may be measured by means of any series of sequential, overlapping, or total steps so that the entire response time is measured. In lieu of measurement, response time may be verified for selected components provided that the components and the methodology for verification have been previously reviewed and approved by NRC.

29 <u>REPORTABLE EVENT</u>

1.~~28~~ DELETED

30 <u>SHIELD BUILDING INTEGRITY</u>

1.~~29~~ SHIELD BUILDING INTEGRITY shall exist when:

a. The door in each access opening is closed except when the access opening is being used for normal transit entry and exit.

b. The emergency gas treatment system is OPERABLE.

c. The sealing mechanism associated with each penetration (e.g., welds, bellows or O-rings) is OPERABLE.

<u>SHUTDOWN MARGIN</u>

31 1.~~30~~ SHUTDOWN MARGIN shall be the instantaneous amount of reactivity by which the reactor is subcritical or would be subcritical from its present condition assuming all full length rod cluster assemblies (shutdown and control) are fully inserted except for the single rod cluster assembly of highest reactivity worth which is assumed to be fully withdrawn.

<u>SITE BOUNDARY</u>

32 1.~~31~~ The SITE BOUNDARY shall be that line beyond which the land is not owned, leased, or otherwise controlled by the licensee (see figure 5.1-1).

SOLIDIFICATION

33 1.~~32~~ Deleted.

SOURCE CHECK

34 1.~~33~~ Deleted.

STAGGERED TEST BASIS

35 1.~~34~~ A STAGGERED TEST BASIS shall consist of:

a. A test schedule for n systems, subsystems, trains or other designated components obtained by dividing the specified test interval into n equal subintervals,

b. The testing of one system, subsystem, train or other designated component at the beginning of each subinterval.

THERMAL POWER

36 1.~~35~~ THERMAL POWER shall be the total reactor core heat transfer rate to the reactor coolant.

UNIDENTIFIED LEAKAGE

37 1.~~36~~ UNIDENTIFIED LEAKAGE shall be all leakage (except reactor coolant pump seal water injection or leakoff) that is not IDENTIFIED LEAKAGE.

UNRESTRICTED AREA

38 1.~~37~~ An UNRESTRICTED AREA shall be any area, at or beyond the site boundary to which access is not controlled by the licensee for purposes of protection of individuals from exposure to radiation and radioactive materials or any area within the site boundary used for residential quarters or industrial, commercial, institutional, and/or recreational purposes.

VENTILATION EXHAUST TREATMENT SYSTEM

39 1.~~38~~ A VENTILATION EXHAUST TREATMENT SYSTEM is any system designed and installed to reduce gaseous radioiodine or radioactive material in particulate form in effluents by passing ventilation or vent exhaust gases through charcoal adsorbers and/or HEPA filters for the purpose of removing iodines or particulates from the gaseous exhaust stream prior to the release to the environment (such a system is not considered to have any effect on noble gas effluents). Engineered Safety Feature (ESF) atmospheric cleanup systems are not considered to be VENTILATION EXHAUST TREATMENT SYSTEM components.

40 VENTING

1.~~39~~ VENTING is the controlled process of discharging air or gas from a confinement to maintain temperature, pressure, humidity, concentration or other operating condition, in such a manner that replacement air or gas is not provided or required during VENTING. Vent, used in system names, does not imply a VENTING process.

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Replace with new Page 3/4 4-28

3/4.4.9 PRESSURE/TEMPERATURE LIMITS

LIMITING CONDITION FOR OPERATION

3.4.9.1 The Reactor Coolant System (except the pressurizer) temperature and pressure shall be limited in accordance with the limit lines shown on Figures 3.4-2 and 3.4-3 during heatup, cooldown, criticality, and inservice leak and hydrostatic testing with:

a. A maximum heatup of 100°F in any one hour period.

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

c. A maximum temperature change of less than or equal to 5°F in any one hour period during inservice hydrostatic and leak testing operations above the heatup and cooldown limit curves.

APPLICABILITY: At all times.

ACTION:

With any of the above limits exceeded, restore the temperature and/or pressure to within the limit within 30 minutes; perform an engineering evaluation to determine the effects of the out-of-limit condition on the structural integrity of the Reactor Coolant System; determine that the Reactor Coolant System remains acceptable for continued operation or be in at least HOT STANDBY within the next 6 hours and reduce the RCS T_{avg} and pressure to less than 200°F and 500 psig, respectively, within the following 30 hours.

SURVEILLANCE REQUIREMENTS

4.4.9.1.1 The Reactor Coolant System temperature and pressure shall be determined to be within the limits at least once per 30 minutes during system heatup, cooldown, and inservice leak and hydrostatic testing operations.

4.4.9.1.2 The reactor vessel material irradiation surveillance specimens shall be removed and examined, to determine changes in material properties in accordance with 10 CFR 50, Appendix H. The results of these examinations shall be used to update Figures 3.4-2, 3.4-3, and 3.4-4.

3/4.4.9 RCS PRESSURE AND TEMPERATURE (P/T) LIMITS

LIMITING CONDITION FOR OPERATION

3.4.9.1 RCS pressure, RCS temperature, and RCS heatup and cooldown rates shall be maintained within the limits specified in the PTLR.

APPLICABILITY: At all times.

ACTIONS:

a. With the requirements of the LCO not met in MODE 1, 2, 3, or 4, restore the parameter(s) to within limits in 30 minutes and determine RCS is acceptable* for continued operation within 72 hours. With the required action above not met, be in MODE 3 within the next 6 hours and in MODE 5, with RCS pressure < 500 psig, within the following 30 hours.

b. With the requirements of the LCO not met any time other than MODE 1, 2, 3, or 4, immediately initiate action to restore parameter(s) to within limits and, prior to entering MODE 4, determine RCS is acceptable* for continued operation.

SURVEILLANCE REQUIREMENTS

4.4.9.1.1 Verify** RCS pressure, RCS temperature, and RCS heatup and cooldown rates are within the limits specified in the PTLR every 30 minutes.

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* The determination that the RCS is acceptable for continued operation must be completed for any entry into Action a. or b.

** Only required to be performed during RCS heatup and cooldown operations and RCS inservice leak and hydrostatic testing.

DELETE FIGURE 3.4-2

CURVES APPLICABLE FOR HEATUP RATES UP TO 60°F/HR FOR THE SERVICE PERIOD UP TO 14.5 EFPY. MARGINS OF 60 PSIG AND 10°F ARE INCLUDED FOR POSSIBLE INSTRUMENT ERRORS.

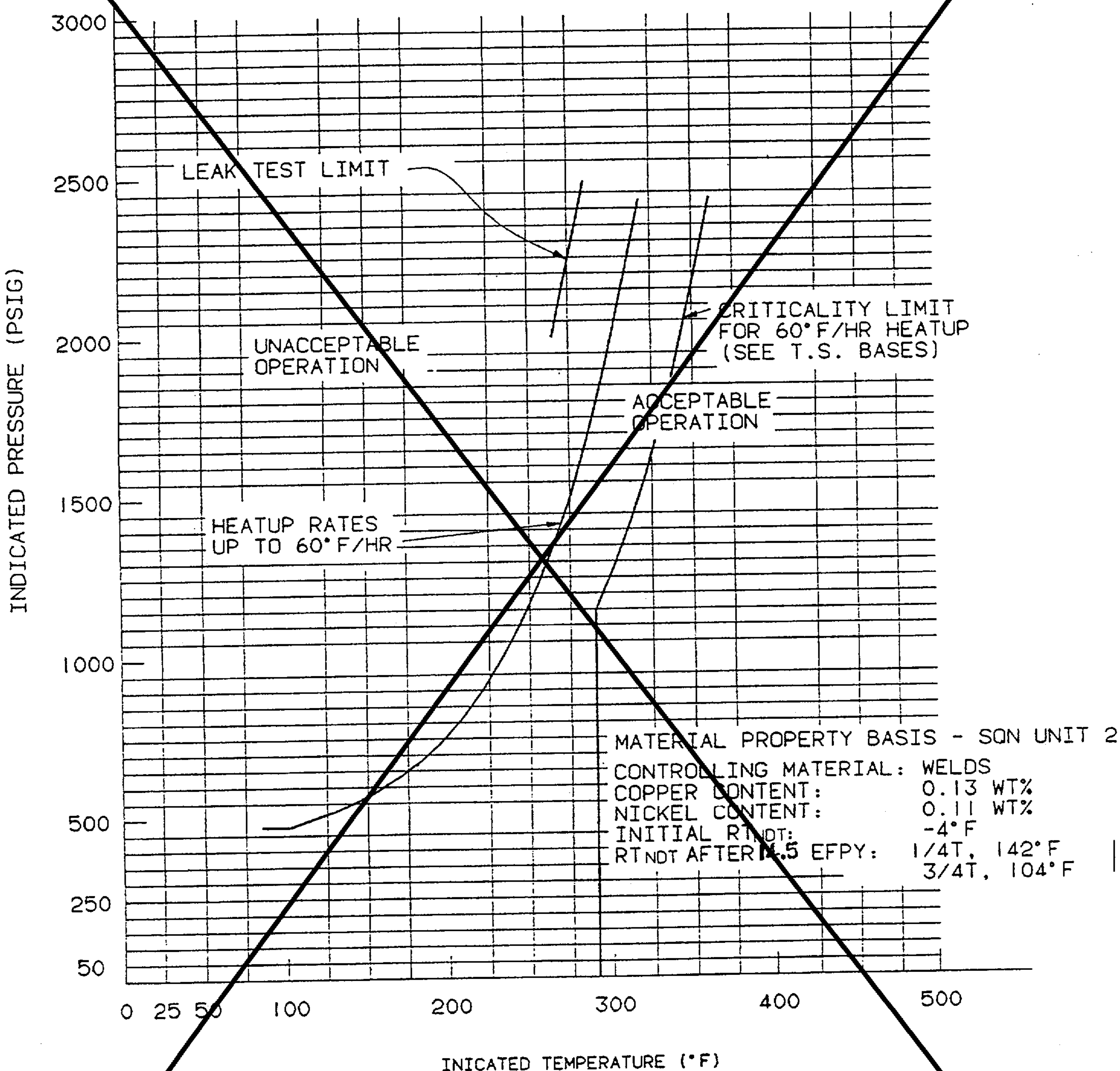


FIGURE 3.4-2 SEQUOYAH UNIT 2 REACTOR COOLANT SYSTEM HEATUP LIMITATIONS APPLICABLE UP TO 14.5 EFPY

DELETE FIGURE 3.4-3

CURVES APPLICABLE FOR COOLDOWN RATES UP TO 100°F/HR FOR THE SERVICE PERIOD UP TO 14.5 EFPY. MARGINS OF 60 PSIG AND 10°F ARE INCLUDED FOR POSSIBLE INSTRUMENT ERRORS.

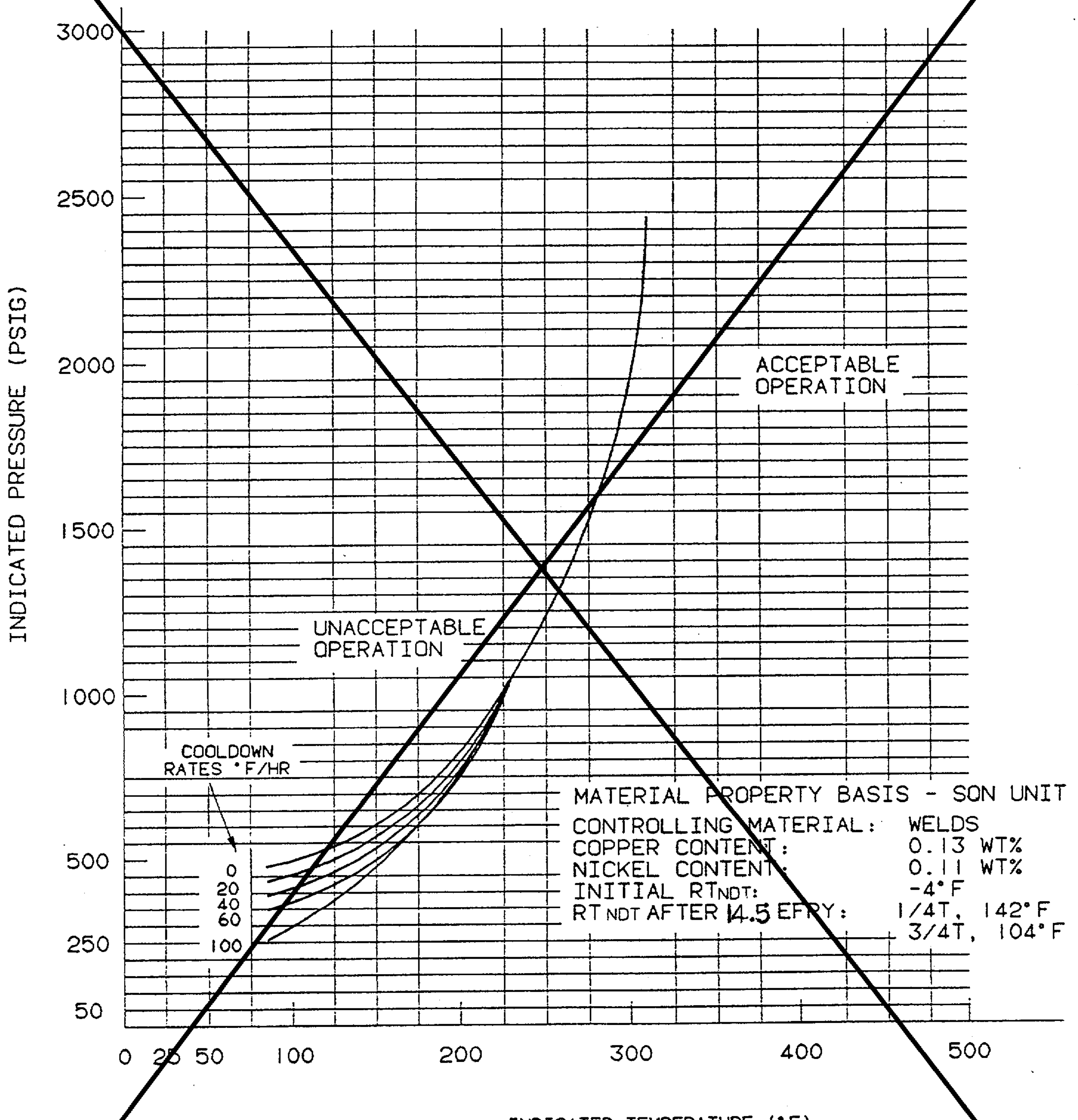


FIGURE 3.4-3 SEQUOYAH UNIT 2 REACTOR COOLANT SYSTEM COOLDOWN LIMITATIONS APPLICABLE UP TO 14.5 EFPY

LIMITING CONDITION FOR OPERATION

3.4.9.2 The pressurizer temperature shall be limited to: Deleted

a. A maximum heatup of 100°F in any one hour period,

b. A maximum cooldown of 200°F in any one hour period, and

c. A maximum spray water temperature differential of 560°F.

APPLICABILITY: At all times.

ACTION:

With the pressurizer temperature limits in excess of any of the above limits, restore the temperature to within the limits within 30 minutes; perform an engineering evaluation to determine the effects of the out-of-limit condition on the structural integrity of the pressurizer; determine that the pressurizer remains acceptable for continued operation or be in at least HOT STANDBY within the next 6 hours and reduce the pressurizer pressure to less than 500 psig within the following 30 hours.

SURVEILLANCE REQUIREMENTS

4.4.9.2.1 The pressurizer temperatures shall be determined to be within the limits at least once per 30 minutes during system heatup or cooldown.

4.4.9.2.2 Any occurrence of spray operation with a differential temperature greater than 320°F shall be recorded for evaluation of the cyclic limits in Table 5.7.1.

DELETE PAGES 3/4 4-34, -35 AND -36

REPLACE WITH NEW PAGES 3/4 4-34 AND 3/4 4-35

3/4.4.12 LOW TEMPERATURE OVER PRESSURE PROTECTION SYSTEMS

LIMITING CONDITION FOR OPERATION

3.4.12 At least one of the following Overpressure Protection Systems shall be OPERABLE:

a. Two power operated relief valves (PORVs) with a nominal lift setting less than or equal to that shown in Figure 3.4-4, or

b. The Reactor Coolant System (RCS) depressurized with an RCS vent of greater than or equal to 3 square inches.

APPLICABILITY: MODE 4, MODE 5, and MODE 6 with the reactor vessel head on.

ACTION:

a. With one PORV inoperable, in MODE 4 either:

1. Restore the inoperable PORV to operable status within 7 days, or

2. Depressurize and vent the RCS through at least a 3 square inch vent within the next 8 hours, or

3. Ensure pressurizer level is maintained less than or equal to 30 percent.

b. With one PORV inoperable in MODES 5 or 6, either (1) restore the PORV to operable status within 24 hours, or (2) complete depressurization and venting of the RCS through at least a 3 square inch vent within a total of 32 hours.

c. With both PORVs inoperable, depressurize and vent the RCS through at least a 3 square inch vent within 8 hours.

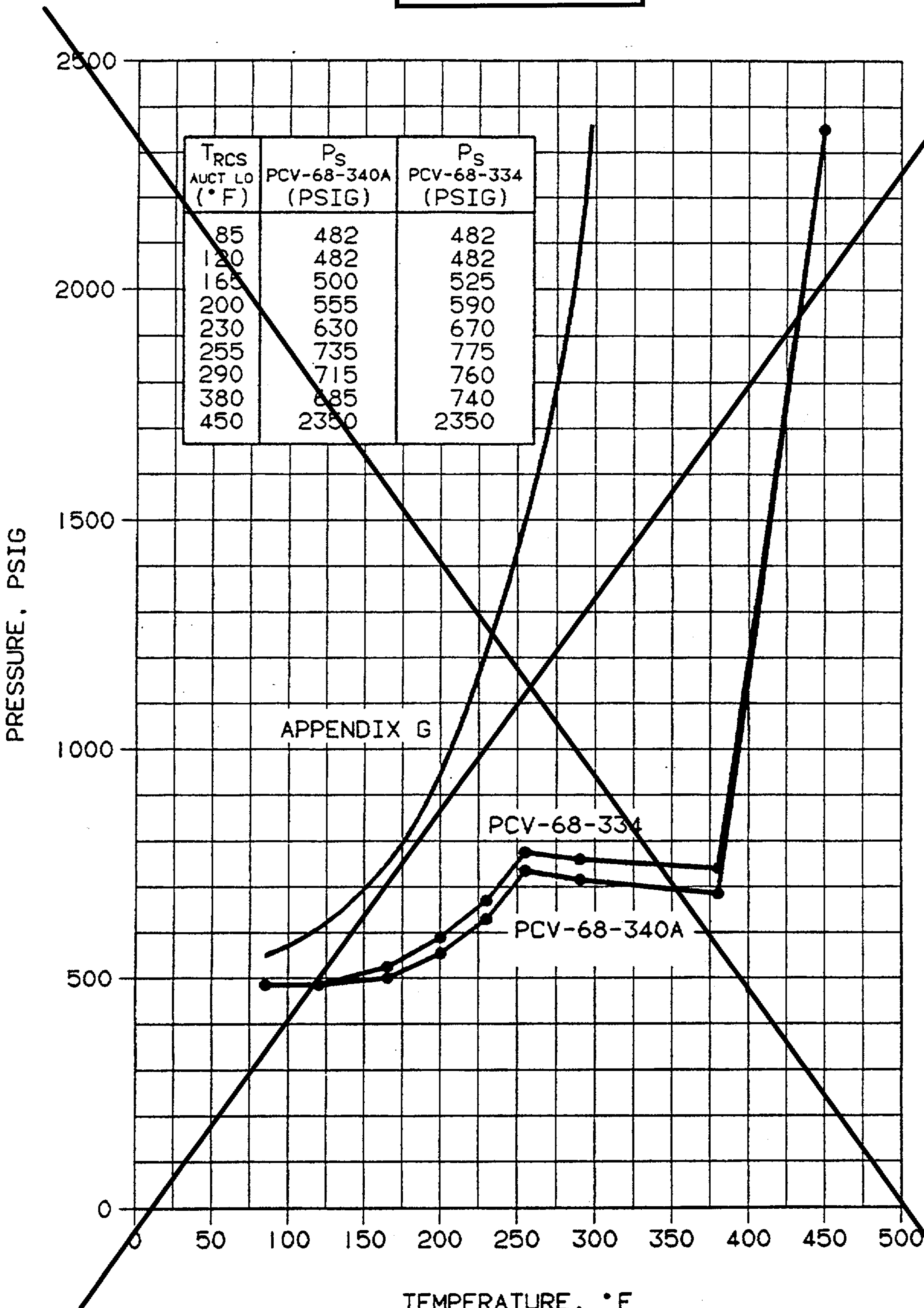
d. With the RCS vented per ACTIONS a, b, or c, verify the vent pathway at least once per 31 days when the pathway is provided by a valve(s) that is locked, sealed, or otherwise secured in the open position; otherwise, verify the vent path every 12 hours.

e. When RCS temperature is less than 350° F, both safety injection pumps and one centrifugal charging pump shall be made incapable of automatic injection into the RCS. Should any of these pumps be found actually capable of automatic injection, return the pump(s) to incapable status within 12 hours or depressurize and vent RCS through at least a 3 square inch vent within the next 8 hours.

f. In the event either the PORVs or the RCS vent(s) are used to mitigate an RCS pressure transient, a Special Report shall be prepared and submitted to the Commission pursuant to Specification 6.9.2 within 30 days. The report shall describe the circumstances initiating the transient, the effect of the PORVs or RCS vent(s) on the transient, and any corrective action necessary to prevent recurrence.

g. The provisions of Specification 3.0.4 are not applicable.

DELETE FIGURE 3.4-4



T_{RCS} AUCT LO (°F)	P_S PCV-68-340A (PSIG)	P_S PCV-68-334 (PSIG)
85	482	482
120	482	482
165	500	525
200	555	590
230	630	670
255	735	775
290	715	760
380	685	740
450	2350	2350

PORV NOMINAL LIFT SETTINGS - APPLICABLE UP TO 14.5 EFPY
FIGURE 3.4-4

SURVEILLANCE REQUIREMENTS

4.4.12.1 Each PORV shall be demonstrated OPERABLE by:

a. Performance of a CHANNEL FUNCTIONAL TEST, but excluding valve operation, at least once per 31 days;

b. Performance of a CHANNEL CALIBRATION on the PORV actuation channel at least once per 18 months; and

c. Verifying the PORV isolation valve is open at least once per 72 hours when the PORV is being used for overpressure protection.

4.4.12.2 All charging pumps and safety injection pumps, excluding the required OPERABLE pumps per specification 3.1.2.3 and 3.5.3, shall be demonstrated inoperable at least once per 31 days except when the reactor vessel head is removed by verifying that either the pump controls are in the pull-to-lock position, the pump motor circuit breaker(s) is tagged our or the pump(s) is isolated from the RCS by a manually closed valve or by a motor-operated valve with the valve breaker tagged out. Normal Reactor Coolant Pump seal flow can be maintained at all times.

REACTOR COOLANT SYSTEM

3/4.4.12 LOW TEMPERATURE OVER PRESSURE PROTECTION (LTOP) SYSTEM

LIMITING CONDITION FOR OPERATION

3.4.12* An LTOP System shall be OPERABLE with a maximum of one centrifugal charging pump and no safety injection pump capable of injecting into the Reactor Coolant System (RCS) and the accumulators isolated and one of the following pressure relief capabilities:

a. Two power operated relief valves (PORVs) with lift settings within the limits specified in the PTLR, or

b. The RCS depressurized and an RCS vent ≥ 3 square inches.

APPLICABILITY: MODE 4 when any RCS cold leg temperature is ≤ the LTOP arming temperature specified in the PTLR,
MODE 5,
MODE 6 when the reactor vessel head is on.

ACTION:

a. Should any safety injection pump or more than one charging pump be found capable of injecting into the RCS, immediately initiate action to verify a maximum of one centrifugal charging pump is capable of injecting into the RCS.

b. With an accumulator not isolated when the accumulator pressure is greater than or equal to the maximum RCS pressure for existing cold leg temperature allowed in the PTLR, isolate the affected accumulator within 1 hour, or either;

   1. Increase RCS cold leg temperature to > the LTOP arming temperature specified in the PTLR within 12 hours, or

   2. Depressurize the affected accumulator to less than the maximum RCS pressure for existing cold leg temperature allowed in the PTLR within 12 hours.

c. With one required PORV inoperable in MODE 4, restore the required PORV to OPERABLE status within 7 days.

d. With one required PORV inoperable in MODE 5 or 6, restore the required PORV to OPERABLE status within 24 hours.

---

* 1) Two charging pumps may be made capable of injecting into the RCS for ≤ 1 hour for pump swap operations.

2) Accumulator may be unisolated when 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 the PTLR.

3) For the purpose of making the required safety injection pumps and charging pump inoperable, the following time is permitted: up to 4 hours after entering MODE 4 from MODE 3, or prior to decreasing temperature on any RCS loop to below 325°F, whichever occurs first.

ACTION (Continued)

e. With two required PORVs inoperable, or the Actions (a), (b), (c) , or (d) not met, or the LTOP System inoperable for any reason other than (a), (b), (c), or (d), depressurize the RCS and establish RCS vent of ≥ 3.0 square inches within 12 hours.

f. The provisions of Specification 3.0.4 are not applicable

SURVEILLANCE REQUIREMENTS

4.4.12.1 Each PORV shall be demonstrated OPERABLE by:

a. Performance of a CHANNEL FUNCTIONAL TEST*, but excluding valve operation, at least once per 31 days;

b. Performance of a CHANNEL CALIBRATION on each required PORV actuation channel at least once per 18 months; and

c. Verifying the PORV block valve is open for each required PORV at least once per 72 hours.

4.4.12.2 Verify no safety injection pumps are capable of injecting into the RCS within 4 hours after entering MODE 4 from MODE 3 and prior to the temperature of one or more RCS cold legs decreasing below 325°F, and every 12 hours thereafter.

4.4.12.3 Verify a maximum of one charging pump is capable of injecting into the RCS within 4 hours after entering MODE 4 from MODE 3 and prior to the temperature of one or more RCS cold legs decreasing below 325°F, and every 12 hours thereafter.

4.4.12.4 Verify each accumulator is isolated at least once per 12 hours

4.4.12.5 Verify# required RCS vent ≥ 3.0 square inches open at least:

a. Once every 12 hours for unlocked open vent valve(s) and,

b. Once every 31 days for other vent path(s)

---

* Not required to be performed until 12 hours after decreasing RCS cold leg temperatures to ≤ the LTOP arming temperature in the PTLR.

\# Only required to be met when complying with LCO 3.4.12.b.

SPECIFIC ACTIVITY (Continued)

Reducing T_{avg} to less than 500°F prevents the release of activity should a steam generator tube rupture since the saturation pressure of the primary coolant is below the lift pressure of the atmospheric steam relief valves. The surveillance requirements provide adequate assurance that excessive specific activity levels in the primary coolant will be detected in sufficient time to take corrective action. Information obtained on iodine spiking will be used to assess the parameters associated with spiking phenomena. A reduction in frequency of isotopic analyses following power changes may be permissible if justified by the data obtained.

INSERT C

3/4.4.9 PRESSURE/TEMPERATURE LIMITS

The temperature and pressure changes during heatup and cooldown are limited to be consistent with the requirements given in the ASME Boiler and Pressure Vessel Code, Section III, Appendix G.

1) The reactor coolant temperature and pressure and system heatup and cooldown rates (with the exception of the pressurizer) shall be limited in accordance with Figures 3.4-2 and 3.4-3 for the first full-power service period.

   a) Allowable combinations of pressure and temperature for specific temperature change rates are below and to the right of the limit lines shown. Limit lines for cooldown rates between those presented may be obtained by interpolation.

   b) Figures 3.4-2 and 3.4-3 define limits to assure prevention of non-ductile failure only. For normal operation, other inherent plant characteristics, e.g., pump heat addition and pressurizer heater capacity, may limit the heatup and cooldown rates that can be achieved over certain pressure-temperature ranges.

2) These limit lines shall be calculated periodically using methods provided below.

3) The secondary side of the steam generator must not be pressurized above 200 psig if the temperature of the steam generator is below 70°F.

4) The pressurizer heatup and cooldown rates shall not exceed 100°F/ hr and 200°/hr respectively. The spray shall not be used if the temperature difference between the pressurizer and the spray fluid is greater than 560°F.

INSERT C

PRESSURE/TEMPERATURE LIMITS (Continued)

5) System preservice hydrotests and in-service leak and hydrotests shall be performed at pressures in accordance with the requirements of ASME Boiler and Pressure Vessel Code, Section XI.

10 CFR 50, Appendix G, addresses metal temperature of the closure head flange and vessel regions. Appendix G states that the minimum metal temperature of the closure flange region should be at least 120 degrees Fahrenheit (F) higher than the limiting RT_{NDT} for this region when the pressure exceeds 20 percent of the preservice hydrostatic test pressure (561 pounds per square inch gauge (psig) for Westinghouse Electric Corporation plants). For SQN, Unit 2, the minimum temperature of the closure flange and vessel flange regions is 117 degrees F since the limiting initial RT_{NDT} for the closure head flange is -13 degrees F (see Table B 3/4.4-1). These numbers (561 psig and 117 degrees F) include a margin for instrumentation error of 10 degrees F and 60 psig. The SQN Unit 2 heat up and cooldown curves shown in Figures 3.4-2 and 3.4-3 are not impacted by this regulation.

The fracture toughness properties of the ferritic materials in the reactor vessel are determined in accordance with the NRC Standard Review Plan, and ASTM E185-82, and in accordance with additional reactor vessel requirements. These properties are then evaluated in accordance with Appendix G to 10 CFR 50 and Appendix G of the 1986 ASME Boiler and Pressure Vessel Code, Section III, Division 1 and the calculation methods described in WCAP-7924-A, "Basis for Heatup and Cooldown Limit Curves, April 1975."

Heatup and cooldown limit curves are calculated using the most limiting value of the nil-ductility reference temperature, RT_{NDT} at the end of 16 effective full power years of service life. The 16 EFPY service life period is chosen such that the limiting RT_{NDT} at the 1/4T location in the core region is greater than the RT_{NDT} of the limiting unirradiated material. The selection of such a limiting RT_{NDT} assures that all components in the Reactor Coolant System will be operated conservatively in accordance with applicable Code requirements.

The reactor vessel materials have been tested to determine their initial RT_{NDT}; the results of these tests are shown in Table B 3/4.4-1. Reactor operation and resultant fast neutron (E greater than 1 MEV) irradiation can cause an increase in the RT_{NDT}. Therefore, an adjusted reference temperature, based upon the fluence of the material in question, has been predicted using Regulatory Guide 1.99, Revision 2 and a peak surface fluence of 0.864×10^{19} n/cm^2 for 16 effective full power years (Reference WCAP 12971, "Heatup and Cooldown Limit Curves for Normal Operation," June 1991. The heatup and cooldown limit curves of Figures 3.4-2 and 3.4-3 include predicted adjustments for this shift in RT_{NDT} at the end of 16 EFPY, as well as adjustments for possible errors in the pressure and temperature sensing instruments. The heatup and cooldown limits in WCAP-12971 were based on a core thermal power of 3411 MWt. The curves have been evaluated in WCAP-15725 to be effective for operation through the end of 14.5 EFPY for the uprated core thermal power of 3455 MWt.

INSERT C

PRESSURE/TEMPERATURE LIMITS (Continued)

Values of ΔRT_{NDT} determined in this manner may be used until the results from the material surveillance program, evaluated according to ASTM E185, are available. The first capsule will be removed at the end of the first core cycle. Successive capsules will be removed in accordance with the requirements of ASTM E185-82 and 10 CFR 50, Appendix H. The heatup and cooldown curves and the low temperature overpressure protection setpoints must be recalculated when the ΔRT_{NDT} determined from the surveillance capsule exceeds the calculated ΔRT_{NDT} for the equivalent capsule radiation exposure.

Allowable pressure-temperature relationships for various heatup and cooldown rates are calculated using methods derived from Appendix G in Section III of the ASME Boiler and Pressure Vessel Code as required by Appendix G to 10 CFR Part 50 and these methods are discussed in detail in WCAP-7924-A.

The general method for calculating heatup and cooldown limit curves is based upon the principles of the linear elastic fracture mechanics (LEFM) technology. In the calculation procedures a semi-elliptical surface defect with a depth of one-quarter of the wall thickness, T, and a length of 3/2T is assumed to exist at the inside of the vessel wall as well as at the outside of the vessel wall. The dimenstions of this postulated crack, referred to in Appendix G of ASME III as the reference flaw, amply exceed the current capabilities of inservice inspection techniques. Therefore, the reactor operation limit curves developed for this reference crack are conservative and provide sufficient safety margins for protection against non-ductile failure. To assure that the radiation embrittlement effects are accounted for in the calculation of the limit curves, the most limiting value of the nil ductility reference temperature, RT_{NDT}, is used and this includes the radiation induced shift, ΔRT_{NDT}, corresponding to the end of the period for which heatup and cooldown curves are generated.

TABLE B 3/4 4-1 is relocated to the end of the Pressure/Temperature Limits BASES Section (End of INSERT C).

TABLE B 3/4.4-1

SEQUOYAH-UNIT 2 REACTOR VESSEL TOUGHNESS DATA

COMPONENT	HEAT NO.	MATERIAL GRADE	CU %	Ni %	NDTT °F	MINIMUM 50 FT-LB/35 MIL TEMP °F PMWD[1]	NMWD[2]	RT_{NDT} °F	AVERAGE UPPER SHELF FTLB PMWD[1]	NMWD[2]
CL Hd. Dome	52899-1	A533BCL1	-	-	-13	28	48*	-12	75[a]	
CL Hd. Ring	-	A508CL2	-	-	5	34	54*	5	125.5[a]	
Hd Flange	4890	A508CL2	-	-	-13	<-67*	<-67	-13	141.[a]	
Vessel Flange	4832	A508CL2	-	-	-22	-47	-27	-22	155.5[a]	
Inlet Nozzle	4868	A508CL2	-	-	-22	41	61*	1	79[a]	
Inlet Nozzle	4872	A508CL2	-	-	-22	12	32*	-22	108[a]	
Inlet Nozzle	4877	A508CL2	-	-	-31	1	21*	-31	113[a]	
Inlet Nozzle	4886	A508CL2	-	-	-31	-52	-32*	28	138[a]	
Outlet Nozzle	4867	A508CL2	-	-	-31	19	39*	-21	85[a]	
Outlet Nozzle	4873	A508CL2	-	-	-22	21	41*	-19	76[a]	
Outlet Nozzle	4878	A508CL2	-	-	-40	-6	14*	-40	105[a]	
Outlet Nozzle	4887	A508CL2	-	-	-22	-11	9*	-22	143.5[a]	
Upper Shell	4885	A508CL2	-	-	5	25	45*	5	104[a]	
Inter Shell	4853	A508CL2	0.13	0.74	-22	19	70	10	138	93
Lower Shell	4994	A508CL2	0.14	0.76	-40	8	38	-22	140.5	100
Trans. Ring	4879	A508CL2	-	-	5	27	47*	5	98[a]	
Bot. Hd. Rim	52835-1B	A533BCL1	-	-	-4	48	68*	8	81[a]	
Bot. Hd. Rim	52835-1B	A533BCL1	-	-	-22	25	45*	-15	81[a]	
Bot. Hd. Rim	52899-2	A533BCL1	-	-	-13	39	59*	-1	62[a]	
Bot. Hd.	5297-1	A533BCL1	-	-	-31	14	34*	-26	99.5[a]	
Weld	-	Weld	0.13	0.11	-4	-	14	-4	-	101
HAZ	-	HAZ	-	-	-13	-	17	-13	-	120

[1] Paralled to Major Working Direction
[2] Normal to Major Working Direction
* Estimate based on USAEC Regulatory Standard Review Plan, Section 5.3.2 MTEB 5-2
[a] % Shear not reported

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INSERT C

BASES

PRESSURE/TEMPERATURE LIMITS (Continued)

The ASME approach for calculating the allowable limit curves for various heatup and cooldown rates specifies that the total stress intensity factor, K_I, for the combined thermal and pressure stresses at any time during heatup or cooldown cannot be greater than the reference stress intensity factor, K_{IR}, for the metal temperature at that time. K_{IR} is obtained from the reference fracture toughness curve, defined in Appendix G to the ASME Code. The K_{IR} curve is given by the equation:

$$K_{IR} = 26.78 + 1.223 \exp [0.0145(T-RT_{NDT} + 160)] \quad (1)$$

where K_{IR} is the reference stress intensity factor as a function of the metal temperature T and the metal nil ductility reference temperature RT_{NDT}. Thus, the governing equation for the heatup-cooldown analysis is defined in Appendix G of the ASME Code as follows:

$$C\,K_{IM} + K_{It} \leq K_{IR} \quad (2)$$

Where, K_{IM} is the stress intensity factor caused by membrane (pressure) stress.

K_{It} is the stress intensity factor caused by the thermal gradients.

K_{IR} is provided by the code as a function of temperature relative to the RT_{NDT} of the material.

C = 2.0 for level A and B service limits, and

C = 1.5 for inservice hydrostatic and leak test operations.

INSERT C

PRESSURE/TEMPERATURE LIMITS (Continued)

At any time during the heautp or cooldown transient, K_{IR} is determined by the metal temperature at the tip of the postulated flaw, the appropriate value for RT_{NDT}, and the reference fracture toughness curve. The thermal stresses resulting from temperature gradients through the vessel wall are calculated and then the corresponding (thermal) stress intensity factors, K_{IT}, for the reference flaw are computed. From Equation (2) the pressure stress intensity factors are obtained and from these the allowable pressures are calculated.

COOLDOWN

For the calculation of the allowable pressure versus coolant temperature during cooldown, the Code reference flaw is assumed to exist at the inside of the vessel wall. During cooldown, the controlling location of the flaw is always at the inside of the wall because the thermal gradients produce tensile stresses at the inside, which increase with increasing cooldown rates. Allowable pressure-temperature relations are generated for both steady-state and finite cooldown rate situations. From these relations composite limit curves are constructed for each cooldown rate of interest.

The use of the composite curve in the cooldown analysis is necessary because control of the cooldown procedure is based on measurement of reactor coolant temperature, whereas the limiting pressure is actually dependent on the material temperature at the tip of the assumed flaw. During cooldown, the 1/4T vessel location is at a higher temperature than the fluid adjacent to the vessel ID. This condition, of course, is not true for the steady-state situation. It follows that at any given reactor coolant temperature, the delta T developed during cooldown results in a higher value of K_{IR} at the 1/4T location for finite cooldown rates than for steady-state operation. Furthermore, if conditions exist such that the increase in K_{IR} exceeds K_{IT}, the calculated allowable pressure during cooldown will be greater than the steady-state value.

INSERT C

PRESSURE/TEMPERATURE LIMITS (Continued)

The above procedures are needed because there is no direct control on temperature at the 1/4T location; therefore, allowable pressures may unknowingly be violated if the rate of cooling is decreased at various intervals along a cooldown ramp. The use of the composite curve eliminates this problem and assures conservative operation of the system for the entire cooldown period.

HEATUP

Three separate calculations are required to determine the limit curves for finite heatup rates. As is done in the cooldown analysis, allowable pressure-temperature relationships are developed for steady-state conditions as well as finite heatup rate conditions assuming the presence of a 1/4T defect at the inside of the vessel wall. The thermal gradients during heatup produce compressive stresses at the inside of the wall that alleviate the tensile stresses produced by internal pressure. The metal temperature at the crack tip lags the coolant temperature; therefore, the K_{IR} for the 1/4T crack during heatup is lower than the K_{IR} for the 1/4T crack during steady-state conditions at the same coolant temperature. During heatup, especially at the end of the transient, conditions may exist such that the effects of compressive thermal stresses and different K_{IR}'s for steady-state and finite heatup rates do not offset each other and the pressure-temperature curve based on steady-state conditions no longer represents a lower bound of all similar curves for finite heatup rates when the 1/4T flaw is considered. Therefore, both cases have to be analyzed in order to assure that at any coolant temperature the lower value of the allowable pressure calculated for steady-state and finite heatup rates is obtained.

The second portion of the heatup analysis concerns the calculation of pressure-temperature limitations for the case in which a 1/4T deep outside surface flaw is assumed. Unlike the situation at the vessel inside surface, the thermal gradients established at the outside surface during heatup produce stresses which are tensile in nature and thus tend to reinforce any pressure stresses present. These thermal stresses, of course, are dependent on both the rate of heatup and the time (or coolant temperature) along the heatup ramp. Furthermore, since the thermal stresses, at the outside are tensile and increase with increasing heatup rate, a lower bound curve cannot be defined. Rather, each heatup rate of interest must be analyzed on an individual basis.

INSERT C

PRESSURE/TEMPERATURE LIMITS (Continued)

Following the generation of pressure-temperature curves for both the steady-state and finite heatup rate situations, the final limit curves are produced as follows. A composite curve is constructed based on a point-by-point comparison of the steady-state and finite heatup rate data. At any given temperature, the allowable pressure is taken to be the lesser of the three values taken from the curves under consideration.

The use of the composite curve is necessary to set conservative heatup limitations because it is possible for conditions to exist such that over the course of the heatup ramp the controlling condition switches from the inside to the outside and the pressure limit must at all times be based on analysis of the most critical criterion.

The leak test limit curve shown on Figure 3.4-2 represents the minimum temperature requirements at the leak test pressure specified by applicable codes. The leak test limit curve was determined by methods of Branch Technical Position MTEB 5-2 and 10 CFR 50, Appendix G.

The criticality limit curve shown in Figure 3.4-2 specifies pressure-temperature limits for core operation to provide additional margin during actual power production. The pressure-temperature limits for core operation (except for low power physics tests) require the reactor vessel to be at a temperature equal to or higher than the minimum temperature required for the in-service hydrostatic test, and at least 40 degrees F higher than the minimum pressure-temperature curve for heatup and cooldown. The maximum temperature for the in-service hydrostatic test for the SQN Unit 2 reactor vessel is 274 degrees F. A vertical line at 274 degrees F on the pressure-temperature curve, intersecting a curve 40 degrees F higher than the pressure-temperature limit curve, constitutes the limit for core operation for the reactor vessel.

Finally, the composite curves for the heatup rate data and the cooldown rate data are adjusted for possible errors in the pressure and temperature sensing instruments by the values indicated on the respective curves.

Although the pressurizer operates in temperature ranges above those for which there is reason for concern of non-ductile failure, operating limits are provided to assure compatibility of operation with the fatigue analysis performed in accordance with the ASME Code requirements.

3/4.4.10 DELETED

Move Section 3/4.4.10 to Bases page B 3/4 4-15.

B 3/4.4 REACTOR COOLANT SYSTEM

B 3/4.4.9 Reactor Coolant System 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.

The PTLR contains P/T limit curves for heatup, cooldown, inservice leak and hydrostatic (ISLH) testing, 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.

The LCO establishes operating limits that provide a margin to brittle 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. The reactor vessel materials have been tested to determine their initial RT_{NDT} and the results of these tests are shown on Table B 3/4.4-1.

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 failure during normal operation, anticipated operational occurrences, and system hydrostatic tests. It mandates the use of the American Society of Mechanical Engineers (ASME) Code, Section III, 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 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).

B 3/4.4 REACTOR COOLANT SYSTEM

B 3/4.4.9 Reactor Coolant System Pressure and Temperature (P/T) Limits

BASES

BACKGROUND (Continued)

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).

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 Reference2 requirement that it be ≥ 40°F above the heatup curve or the cooldown curve, and not less than the minimum permissible temperature forISLH testing. However, the criticality curve is not operationally limiting; a more restrictive limit exists in LCO 3.1.1.4, "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 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.

INSERT C (Continued)

B 3/4.4 REACTOR COOLANT SYSTEM

B 3/4.4.9 Reactor Coolant System Pressure and Temperature (P/T) Limits

BASES

APPLICABLE SAFETY ANALYSIS (Continued)

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, and ISLH testing; and

b. Limits on the rate of change of temperature.

The LCO limits apply to all components of the RCS, except the pressurizer. 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.

INSERT C (Continued)

B 3/4.4 REACTOR COOLANT SYSTEM

B 3/4.4.9 Reactor Coolant System Pressure and Temperature (P/T) Limits

BASES

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. Specification 3/4.2.5, "DNB Parameters," Specification 3.1.1.4, 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.

ACTIONS

ACTION (a)

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 action 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 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.

B 3/4.4 REACTOR COOLANT SYSTEM

B 3/4.4.9 Reactor Coolant System Pressure and Temperature (P/T) Limits

BASES

ACTIONS (Continued)

The 72 hour action 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.

Action (a) is modified by a footnote requiring an evaluation of RCS acceptability to be completed whenever the action is entered. The footnote emphasizes the need to perform the evaluation of the effects of the excursion outside the allowable limits. Restoration alone is insufficient because higher than analyzed stresses may have occurred and may have affected the RCPB integrity.

If Action (a) is not met, the plant must be placed in a lower MODE because either the RCS 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 undetected flaws is decreased.

If the required restoration activity cannot be accomplished within 30 minutes, the action 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. 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 MODE3 within 6 hours and to MODE 5 with RCS pressure < 500 psig within 36 hours.

The allowed action 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.

B 3/4.4 REACTOR COOLANT SYSTEM

B 3/4.4.9 Reactor Coolant System Pressure and Temperature (P/T) Limits

BASES

ACTIONS (CONTINUED)

ACTION (b)

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 action 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 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.

Action (b) is modified by a footnote requiring an evaluation of RCS acceptability to be completed whenever the action is entered. The footnote emphasizes the need to perform the evaluation of the effects of the excursion outside the allowable limits. Restoration alone is insufficient because higher than analyzed stresses may have occurred and may have affected the RCPB integrity.

SURVEILLANCE REQUIREMENTS

SR 4.4.9.1.1

Verification that operation is within the PTLR 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. 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, cooldown, or ISLH testing may be discontinued when the definition given in the relevant plant procedure for ending the activity is satisfied.

B 3/4.4 REACTOR COOLANT SYSTEM

B 3/4.4.9 Reactor Coolant System Pressure and Temperature (P/T) Limits

BASES

SURVEILLANCE REQUIREMENTS (Continued)	This SR is modified by a footnote that only requires this SR to be performed during system heatup, cooldown, and ISLH testing. No SR is given for criticality operations because LCO3.1.1.4 contains a more restrictive requirement.

REFERENCES

1. WCAP-7924-A,April 1975
2. 10 CFR 50, Appendix G.
3. ASME, Boiler and Pressure Vessel Code, Section III, 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.
8. WCAP-15321, “Sequoyah Unit 2 Heatup and Cooldown Limit Curves for Normal Operation and PTLR Support Documentation,” T. J. Laubham, dated April 2001.

INSERT

Table B 3/4.4-1

3/4.4.10 DELETED

REACTOR COOLANT SYSTEM

BASES

3/4.4.11 REACTOR COOLANT SYSTEM HEAD VENTS

The function of the RCS head vents is to remove non-condensables or steam from the reactor vessel head. This system is designed to mitigate a possible condition of inadequate core cooling, inadequate natural circulation, or inability to depressurize the RHR System initiated conditions resulting from the accumulation of non-condensible gases in the Reactor Coolant System. The reactor vessel head vent is designed with redundant safety grade vent paths.

INSERT D

3/4.4.12 OVERPRESSURE PROTECTION SYSTEM

The operability of two PORVs or an RCS vent opening of at least three square inches ensures that the RCS will be protected from pressure transients which could exceed the limits of Appendix G to 10 CFR Part 50 when one or more of the RCS cold legs are less than or equal to 350 degrees F. Either PORV has adequate relieving capability to protect the RCS from overpressurization when the transient is limited to either: (1) the start of an idle RCP with a water-solid RCS and the secondary water temperature of the steam generator is less than or equal to 50 degrees F above the RCS cold leg temperatures, or (2) the start of a charging pump and its injection into the RCS with letdown isolated.

The maximum allowed PORV setpoint for the low temperature overpressure protection (LTOP) system is derived by analysis which models the performance of the LTOP system assuming various mass input and heat input transients. Operation with the PORV setpoint less than or equal to the maximum setpoint ensures that Appendix G criteria will not be violated with consideration for a maximum pressure overshoot beyond the PORV setpoint which can occur as a result of time delays in signal processing and valve opening, instrument uncertainties, and signal failure. To ensure that mass and heat input transients more severe than those assumed cannot occur, technical specifications require tagout or isolation of all but one centrifugal charging pump while in modes 4, 5, and 6 with the reactor vessel head installed and disallow restart of an RCP if a steam bubble does not exist in the pressurizer.

The LTOP system setpoints include a 50 degree F allowance for heat transport effects and a 27 degree F allowance for instrument accuracy. An 800 psig pressure limit protects the PORV piping from the consequences of a possible water hammer caused by the rapid opening times associated with the PORVs.

INSERT D

B 3/4.4 REACTOR COOLANT SYSTEM

B 3/4.4.12 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. The PTLR provides the maximum allowable actuation logic setpoints for the power operated relief valves (PORVs) and 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. LCO3.4.9.1, "RCS Pressure and Temperature (P/T) Limits," requires administrative control of RCS pressure and temperature during heatup and cooldown to prevent exceeding the PTLR limits.

This LCO provides RCS overpressure protection by having a minimum coolant input capability and having adequate pressure relief capacity. Limiting coolant input capability requires all but one charging pump incapable of injection into the RCS and isolating the accumulators. The pressure relief capacity requires either two redundant PORVs or a depressurized RCS and an RCS vent of sufficient size. One PORV or the open RCS vent is the overpressure protection device that acts to terminate an increasing pressure event.

B 3/4.4 REACTOR COOLANT SYSTEM

B 3/4.4.12 Low Temperature OverPressure Protection (LTOP) System

BASES

BACKGROUND (Continued)

With minimum coolant input capability, the ability to provide core 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. If conditions require the use of more than one charging 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 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.

PORV Requirements

As designed for the LTOP System, each PORV is signaled to open if the RCS pressure approaches a limit determined by the LTOP actuation logic. The LTOP actuation logic monitors both RCS temperature and RCS pressure and determines when a condition not acceptable in the PTLR limits is approached. The wide range RCS temperature indications are auctioneered to select the lowest temperature signal.

The lowest temperature signal is processed through a function generator that calculates a pressure limit for that temperature. The calculated pressure limit is then compared with the indicated RCS pressure from a wide range pressure channel. If the indicated pressure meets or exceeds the calculated value, a PORV is signaled to open.

The PTLR presents the PORV setpoints for LTOP. The setpoints are normally staggered so only one valve opens during a low temperature overpressure transient. Having the setpoints of both valves within the limits in the PTLR ensures that the Reference 1 limits will not be exceeded in any analyzed event.

B 3/4.4 REACTOR COOLANT SYSTEM

B 3/4.4.12 Low Temperature OverPressure Protection (LTOP) System

BASES

BACKGROUND (Continued)

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.

For an RCS vent to meet the flow capacity requirement, it requires an RCS vent opening of at least three square inches. This may be accomplished by removing a pressurizer safety valve, removing aPORV's internals, and disabling its block valve in the open position. 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. 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 the LTOP arming temperature specified in the PTLR, the pressurizer safety valves will prevent RCS pressure from exceeding the Reference 1 limits. At about the LTOP arming temperature specified in the PTLR and below, overpressure prevention falls to two OPERABLE PORVs or to a depressurized RCS and a sufficient sized RCS vent. Each of these means has a limited overpressure relief capability.

B 3/4.4 REACTOR COOLANT SYSTEM

B 3/4.4.12 Low Temperature OverPressure Protection (LTOP) System

BASES

APPLICABLE SAFETY ANALYSES (Continued)

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 PTLR curves are revised, the LTOP System must be re-evaluated to ensure its functional requirements can still be met using the PORV method or the depressurized and vented RCS condition.

The PTLR 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.

B 3/4.4 REACTOR COOLANT SYSTEM

B 3/4.4.12 Low Temperature OverPressure Protection (LTOP) System

BASES

APPLICABLE SAFETY ANALYSES (Continued)

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

a. Rendering all but one charging pump incapable of injection;

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

c. Disallowing start of an RCP unless a steam bubble exists in the pressurizer. LCO 3.4.1.3, "Reactor Coolant System - Shutdown," provides this protection.

The Reference 4 analyses demonstrate that either one PORV 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 OPERABLE during the LTOP MODES. Since neither one PORV nor the RCS vent can handle the pressure transient need from accumulator injection, when RCS temperature is low, the LCO also requires the accumulators isolated when accumulator pressure is greater than or equal to the maximum RCS pressure for the existing RCS cold leg temperature allowed in the PTLR.

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

Fracture mechanics analyses establish the temperature of LTOP Applicability at the LTOP arming temperature specified in the PTLR

The consequences of a small break loss of coolant accident (LOCA) in LTOP MODE 4 conform to 10 CFR 50.46 and 10 CFR 50, Appendix K (Refs. 5 and 6), requirements by having a maximum of one charging pump OPERABLE and SI actuation enabled.

INSERT D (Continued)

B 3/4.4 REACTOR COOLANT SYSTEM

B 3/4.4.12 Low Temperature OverPressure Protection (LTOP) System

BASES

APPLICABLE SAFETY ANALYSES (Continued)

PORV Performance

The fracture mechanics analyses show that the vessel is protected when the PORVs are set to open at or below the limit shown in the PTLR. The setpoints are derived by analyses that model the performance of the LTOP System, assuming the limiting LTOP transient is one charging pump 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 PORV setpoints in the PTLR 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 of the reactor vessel material irradiation surveillance specimens. The Bases for LCO 3.4.9.1 "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 3.0square inches is capable of mitigating the allowed LTOP overpressure transient. The capacity of a vent this size is greater than the flow of the limiting transient for the LTOP configuration, one charging pump OPERABLE, maintaining RCS pressure less than the maximum pressure on the P/T limit curve.

B 3/4.4 REACTOR COOLANT SYSTEM

B 3/4.4.12 Low Temperature OverPressure Protection (LTOP) System

BASES

APPLICABLE SAFETY ANALYSES

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, the LCO requiresthat a maximum of one charging pump and no safety injection pumps becapable of injecting into the RCS, and all accumulator discharge isolation valves be closed and immobilized (when accumulator pressure is greater than or equal to the maximum RCS pressure for the existing RCS cold leg temperature allowed in the PTLR).

The LCO is modified by three footnotes. The first footnote allows two charging pumps to be made capable of injecting 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. The second footnote states that 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 the PTLR. This footnote permits the accumulator discharge isolation valve surveillance to be performed only under these pressure and temperature conditions. The third footnote allows a 4-hour maximum time period for rendering both safety injection pumps and one centrifugal charging pump inoperable after entry to MODE 4 from MODE 3. RCS temperature must remain above 325°F until the pumps are rendered incapable of inadvertent injection. The 4-hour time period is sufficient for completing this activity and is based on the low probability for inadvertent pump start.

B 3/4.4 REACTOR COOLANT SYSTEM

B 3/4.4.12 Low Temperature OverPressure Protection (LTOP) System

BASES

LCO (Continued)

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

a. Two OPERABLE PORVs,

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

b. A depressurized RCS and an RCS vent.

An RCS vent is OPERABLE when open with an area of ≥ 3.0 square inches.

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

APPLICABILITY

This LCO is applicable in MODE 4 when any RCS cold leg temperature is ≤ the LTOP arming temperature specified in the PTLR, 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 the LTOP arming temperature specified in the PTLR. When the reactor vessel head is off, overpressurization cannot occur.

LCO 3.4.9.1 provides the operational P/T limits for all MODES. LCO 3.4.3.1, "Pressurizer Safety Valves," requires the OPERABILITY of the pressurizer safety valves that provide overpressure protection during MODES 1, 2, and 3.

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.

B 3/4.4 REACTOR COOLANT SYSTEM

B 3/4.4.12 Low Temperature OverPressure Protection (LTOP) System

BASES

ACTIONS

ACTION (a)

With any safety injection pump or more than one centrifugal charging pump capable of injecting into the RCS, RCS overpressurization is possible.

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

ACTION (b)

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, two options are provided either of which must be performed in the next 12 hours. By increasing the RCS temperature to > LTOP arming temperature specified in the PTLR, an accumulator pressure of 600 psig cannot exceed the LTOP limits if the accumulators are fully injected. Depressurizing the accumulators below the LTOP limit from the PTLR also gives this protection.

The action 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.

B 3/4.4 REACTOR COOLANT SYSTEM

B 3/4.4.12 Low Temperature OverPressure Protection (LTOP) System

BASES

ACTIONS (Continued)

ACTION (c)

In MODE 4 when any RCS cold leg temperature is≤ the LTOP arming temperature specified in the PTLR, with one required PORV inoperable, the required PORV must be restored to OPERABLE status within 7days. Two PORVs are required to provide low temperature overpressure mitigation while withstanding a single failure of an active component.

The action 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.

ACTION (d)

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

The action time represents a reasonable time to investigate and repair several types of PORV failures without exposure to a lengthy period with only one OPERABLE PORV to protect against overpressure events.

ACTION (e)

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

a. Both required PORVs are inoperable;

b. Actions (a), (c), or (d) are not completed in the allowable times; or

c. The LTOP System is inoperable for any reason other than Actions (a), (b), (c) or (d).

B 3/4.4 REACTOR COOLANT SYSTEM

B 3/4.4.12 Low Temperature OverPressure Protection (LTOP) System

BASES

ACTIONS (Continued)

The vent must be sized ≥ 3.0 square inches 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 action 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.

SURVEILLANCE REQUIREMENTS

SR 4.4.12.1.a

Performance of a CHANNEL FUNCTIONAL TEST is required within 12 hours after decreasing RCS cold leg temperature to ≤ LTOP arming temperature specified in the PTLR and every 31 days on each required PORV to verify and, as necessary, adjust its liftsetpoint. The CHANNEL FUNCTIONAL TEST will verify the setpoint is within the PTLR allowed maximum limits in the PTLR. PORV actuation could depressurize the RCS and is not required.

The 12 hour frequency considers the unlikelihood of a low temperature overpressure event during this time.

A footnote* has been added indicating that this SR is required to be performed 12 hours after decreasing RCS cold leg temperature to ≤ LTOP arming temperature specified in the PTLR. The CHANNEL FUNCTIONAL TEST 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.

SR 4.4.12.1.b

Performance of a CHANNEL CALIBRATION on each required PORV actuation channel is required every 18 months to adjust the whole channel so that it responds and the valve opens within the required range and accuracy to known input.

SURVEILLANCE REQUIREMENTS (Continued)

SR 4.4.12.1.c

The PORV block valve must be verified open every 72 hours 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.

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 72 hour frequency is considered adequate in view of 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 4.4.12.2 and SR 4.4.12.3

To minimize the potential for a low temperature overpressure event by limiting the mass input capability, all safety injection pumps and all but one charging pump are verified incapable of injecting into the RCS and the accumulator discharge isolation valves are verified closed and locked out The safety injection pumps and charging pumps 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 a pump start 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.

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.

B 3/4.4 REACTOR COOLANT SYSTEM

B 3/4.4.12 Low Temperature OverPressure Protection (LTOP) System

BASES

SURVEILLANCE REQUIREMENTS (Continued)

SR 4.4.12.4

The accumulator discharge isolation valves are verified closed and locked out at least once per 12 hours. 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 4.4.12.5

The RCS vent of ≥ 3.0 square inches is proven OPERABLE by verifying its open condition either:

a. Once every12 hours for a valve that is not locked. (valves that are sealed or secured in the open position are considered "locked" in this context).

b. Once every 31 days for other vent path(s) (e.g., a vent valve that is locked, sealed, or secured in position or a removed pressurizer safety valve or open manway also fits this category.

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

B 3/4.4 REACTOR COOLANT SYSTEM

B 3/4.4.12 Low Temperature OverPressure Protection (LTOP) System

BASES

REFERENCES

1. 10 CFR 50, Appendix G
2. Generic Letter 88-11.
3. ASME, Boiler and Pressure Vessel Code, Section III.
4. FSAR, Chapter 15
5. 10 CFR 50, Section 50.46.
6. 10 CFR 50, Appendix K.
7. Generic Letter 90-06.
8. ASME, Boiler and Pressure Vessel Code, Section XI.

CORE OPERATING LIMITS REPORT (continued)

6. WCAP-10054-P-A, Westinghouse Small Break ECCS Evaluation Model Using the NOTRUMP Code, August 1985, (W Proprietary)
   (Methodology for Specification 3/4.2.2 - Heat Flux Hot Channel Factor)

7. WCAP-10266-P-A, Rev. 2, "THE 1981 REVISION OF WESTINGHOUSE EVALUATION MODEL USING BASH CODE", March 1987, (W Proprietary).
   (Methodology for Specification 3.2.2 - Heat Flux Hot Channel Factor).

8. BAW-10227P-A, "Evaluation of Advance Cladding and Structural Material (M5) in PWR Reactor Fuel," February 2000, (FCF Proprietary)
   (Methodology for Specification 3/4.2.2 - Heat Flux Hot Channel Factor)

6.9.1.14.b The core operating limits shall be determined so that all applicable limits (e.g., fuel thermal-mechanical limits, core thermal-hydraulic limits, ECCS limits, nuclear limits such as shutdown margin, and transient and accident analysis limits) of the safety analysis are met.

6.9.1.14.c THE CORE OPERATING LIMITS REPORT shall be provided within 30 days after cycle start-up (Mode 2) for each reload cycle or within 30 days of issuance of any midcycle revision of the NRC Document Control Desk with copies to the Regional Administrator and Resident Inspector.

INSERT B

SPECIAL REPORTS

6.9.2.1 Special reports shall be submitted within the time period specified for each report, in accordance with 10 CFR 50.4.

6.9.2.2 This specification has been deleted.

INSERT B

REACTOR COOLANT SYSTEM (RCS) PRESSURE AND TEMPERATURE LIMITS (PTLR) REPORT

6.9.1.15 RCS pressure and temperature limits for heatup, cooldown, low temperature operation, criticality, and hydrostatic testing, LTOP arming, and PORV lift settings as well as heatup and cooldown rates shall be established and documented in the PTLR for the following:

Specification 3.4.9.1, "RCS Pressure and Temperature (P/T) Limits"

Specification 3.4.12, "Low Temperature Over Pressure Protection (LTOP) System"

6.9.1.15.a The analytical methods used to determine the RCS pressure and temperature limits shall be those previously reviewed and approved by the NRC, specifically those described in the following documents:

1. Westinghouse Topical Report WCAP-14040-NP-A, Revision 2, "Methodology used to Develop Cold Overpressure Mitigating System Setpoints and RCS Heatup and Cooldown Limit Curves, January 1996.

2. Westinghouse Topical Report WCAP-15321, Revision 1, "Sequoyah Unit 2 Heatup and Cooldown Limit Curves for Normal Operation and PTLR Support Documentation," April 2001.

6.9.1.15.b The PTLR shall be provided to the NRC within 30 days of issuance of any revision or supplement thereto.

ENCLOSURE 3

TENNESSEE VALLEY AUTHORITY
SEQUOYAH NUCLEAR PLANT (SQN)
UNITS 1 AND 2

PROPOSED TECHNICAL SPECIFICATION (TS) CHANGE
REVISED PAGES

Unit 1	Unit 2
I, II, VI, XIII,	I, II, VI, XIII,
1-5, 1-6, 1-7	1-5, 1-6, 1-7, 1-8
3/4 4-23	3/4 4-28
3/4 4-24	3/4 4-29
3/4 4-25	3/4 4-30
3/4 4-26	3/4 4-31
3/4 4-29	3/4 4-34
3/4 4-30	3/4 4-35
B 3/4 4-6	B 3/4 4-6
B 3/4 4-7	B 3/4 4-7
B 3/4 4-8	B 3/4 4-8
B 3/4 4-9	B 3/4 4-9
B 3/4 4-10	B 3/4 4-10
B 3/4 4-11	B 3/4 4-11
B 3/4 4-12	B 3/4 4-12
B 3/4 4-13	B 3/4 4-13
B 3/4 4-14	B 3/4 4-14
B 3/4 4-15	B 3/4 4-15
B 3/4 4-16	B 3/4 4-16
B 3/4 4-17	B 3/4 4-17
B 3/4 4-18	B 3/4 4-18
B 3/4 4-19	B 3/4 4-19
B 3/4 4-20	B 3/4 4-20
B 3/4 4-21	B 3/4 4-21
B 3/4 4-22	B 3/4 4-22
B 3/4 4-23	B 3/4 4-23
	B 3/4 4-24
6-13a	6-14

REVISED PAGES

See attached.

SECTION

1.0 DEFINITIONS

SECTION

1.0 DEFINITIONS (Continued)

LIMITING CONDITIONS FOR OPERATION AND SURVEILLANCE REQUIREMENTS

SECTION | PAGE

3/4.4 REACTOR COOLANT SYSTEM

INDEX

BASES

SECTION		PAGE

PRESSURE BOUNDARY LEAKAGE

1.22 PRESSURE BOUNDARY LEAKAGE shall be leakage (except steam generator tube leakage) through a non-isolable fault in a Reactor Coolant System component body, pipe wall or vessel wall.

PRESSURE AND TEMPERATURE LIMITS REPORT (PTLR)

1.23 The PTLR is the unit specific document that provides the reactor vessel pressure and temperature limits, including heatup and cooldown rates and the LTOP arming temperature, for the current reactor vessel fluence period. These pressure and temperature limits shall be determined for each fluence period in accordance with Specification 6.9.1.15.

PROCESS CONTROL PROGRAM (PCP)

1.24 DELETED

PURGE - PURGING

1.25 PURGE or PURGING is the controlled process of discharging air or gas from a confinement to maintain temperature, pressure, humidity, concentration or other operating condition, in such a manner that replacement air or gas is required to purify the confinement.

QUADRANT POWER TILT RATIO

1.26 QUADRANT POWER TILT RATIO shall be the ratio of the maximum upper excore detector calibrated output to the average of the upper excore detector calibrated outputs, or the ratio of the maximum lower excore detector calibrated output to the average of the lower excore detector calibrated outputs, whichever is greater.

RATED THERMAL POWER (RTP)

1.27 RATED THERMAL POWER (RTP) shall be a total reactor core heat transfer rate to the reactor coolant of 3455 MWt.

REACTOR TRIP SYSTEM (RTS) RESPONSE TIME

1.28 The REACTOR TRIP SYSTEM RESPONSE TIME shall be the time interval from when the monitored parameter exceeds its (RTS) trip setpoint at the channel sensor until loss of stationary gripper coil voltage. The response time may be measured by means of any series of sequential, overlapping, or total steps so that the entire response time is measured. In lieu of measurement, response time may be verified for selected components provided that the components and the methodology for verification have been previously reviewed and approved by NRC.

REPORTABLE EVENT

1.29 DELETED

SHIELD BUILDING INTEGRITY

1.30 SHIELD BUILDING INTEGRITY shall exist when:

a. The door in each access opening is closed except when the access opening is being used for normal transit entry and exit.

b. The emergency gas treatment system is OPERABLE.

c. The sealing mechanism associated with each penetration (e.g., welds, bellows or 0-rings) is OPERABLE.

SHUTDOWN MARGIN

1.31 SHUTDOWN MARGIN shall be the instantaneous amount of reactivity by which the reactor is subcritical or would be subcritical from its present condition assuming all full length rod cluster assemblies (shutdown and control) are fully inserted except for the single rod cluster assembly of highest reactivity worth which is assumed to be fully withdrawn.

SITE BOUNDARY

1.32 The SITE BOUNDARY shall be that line beyond which the land is not owned, leased, or otherwise controlled by the licensee (see Figure 5.1-1).

SOLIDIFICATION

1.33 Deleted

SOURCE CHECK

1.34 Deleted

STAGGERED TEST BASIS

1.35 A STAGGERED TEST BASIS shall consist of:

a. A test schedule for n systems, subsystems, trains or other designated components obtained by dividing the specified test interval into n equal subintervals,

b. The testing of one system, subsystem, train or other designated component at the beginning of each subinterval.

THERMAL POWER

1.36 THERMAL POWER shall be the total reactor core heat transfer rate to the reactor coolant.

UNIDENTIFIED LEAKAGE

1.37 UNIDENTIFIED LEAKAGE shall be all leakage (except reactor coolant pump seal water injection or leakoff) that is not IDENTIFIED LEAKAGE.

UNRESTRICTED AREA

1.38 An UNRESTRICTED AREA shall be any area, at or beyond the site boundary to which access is not controlled by the licensee for purposes of protection of individuals from exposure to radiation and radioactive materials or any area within the site boundary used for residential quarters or industrial, commerical, institutional, and/or recreational purposes.

VENTILATION EXHAUST TREATMENT SYSTEM

1.39 A VENTILATION EXHAUST TREATMENT SYSTEM is any system designed and installed to reduce gaseous radioiodine or radioactive material in particulate form in effluents by passing ventilation or vent exhaust gases through charcoal adsorbers and/or HEPA filters for the purpose of removing iodines or particulates from the gaseous exhaust stream prior to the release to the environment (such a system is not considered to have any effect on noble gas effluents). Engineered Safety Feature (ESF) atmospheric cleanup systems are not considered to be VENTILATION EXHAUST TREATMENT SYSTEM components.

VENTING

1.40 VENTING is the controlled process of discharging air or gas from a confinement to maintain temperature, pressure, humidity, concentration or other operating condition, in such a manner that replacement air or gas is not provided or required during VENTING. Vent, used in system names, does not imply a VENTING process.

3/4.4.9 RCS PRESSURE AND TEMPERATURE (P/T) LIMITS

LIMITING CONDITION FOR OPERATION

3.4.9.1 RCS pressure, RCS temperature, and RCS heatup and cooldown rates shall be maintained within the limits specified in the PTLR.

APPLICABILITY: At all times.

ACTIONS:

a. With the requirements of the LCO not met in MODE 1, 2, 3, or 4, restore the parameter(s) to within limits in 30 minutes and determine RCS is acceptable* for continued operation within 72 hours. With the required action above not met, be in MODE 3 within the next 6 hours and in MODE 5, with RCS pressure < 500 psig, within the following 30 hours.

b. With the requirements of the LCO not met any time other than MODE 1, 2, 3, or 4, immediately initiate action to restore parameter(s) to within limits and, prior to entering MODE 4, determine RCS is acceptable* for continued operation.

SURVEILLANCE REQUIREMENTS

4.4.9.1.1 Verify** RCS pressure, RCS temperature, and RCS heatup and cooldown rates are within the limits specified in the PTLR every 30 minutes.

* The determination that the RCS is acceptable for continued operation must be completed for any entry into Action (a) or (b).

** Only required to be performed during RCS heatup and cooldown operations and RCS inservice leak and hydrostatic testing.

FIGURE 3.4-2 - DELETED

SEQUOYAH UNIT 1 REACTOR COOLANT SYSTEM HEATUP LIMINATIONS
APPLICABLE UP TO 16 EFPY

FIGURE 3.4-3 - DELETED

SEQUOYAH UNIT 1 REACTOR COOLANT SYSTEM COOLDOWN LIMITATIONS
APPLICABLE UP TO 16 EFPY

LIMITING CONDITION FOR OPERATION

3.4.9.2 DELETED.

3/4.4.12 LOW TEMPERATURE OVER PRESSURE PROTECTION (LTOP) SYSTEM

LIMITING CONDITION FOR OPERATION

3.4.12* An LTOP System shall be OPERABLE with a maximum of one centrifugal charging pump capable of injecting into the Reactor Coolant System (RCS) and the accumulators isolated and one of the following pressure relief capabilities:

a. Two power operated relief valves (PORVs) with lift settings within the limits specified in the PTLR, or

b. The RCS depressurized and an RCS vent ≥ 3 square inches.

APPLICABILITY: MODE 4 when any RCS cold leg temperature is ≤ the LTOP arming temperature specified in the PTLR,
MODE 5,
MODE 6 when the reactor vessel head is on.

ACTION:

a. Should any safety injection pump or more than one charging pump be found capable of injecting into the RCS, immediately initiate action to verify a maximum of one centrifugal charging pump is capable of injecting into the RCS.

b. With an accumulator not isolated when the accumulator pressure is greater than or equal to the maximum RCS pressure for existing cold leg temperature allowed in the PTLR, isolate the affected accumulator within 1 hour, or either;

   1. Increase RCS cold leg temperature to >the LTOP arming temperature specified in the PTLR within 12 hours, or

   2 Depressurize the affected accumulator to less than the maximum RCS pressure for existing cold leg temperature allowed in the PTLR within 12 hours.

c. With one required PORV inoperable in MODE 4, restore the required PORV to OPERABLE status within 7 days.

D With one required PORV inoperable in MODE 5 or 6, restore the required PORV to OPERABLE status within 24 hours.

---

* 1) Two charging pumps may be made capable of injecting into the RCS for ≤ 1 hour for pump swap operations.

2) Accumulator may be unisolated when 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 the PTLR.

3) For the purpose of making the required safety injection pumps and charging pump inoperable, the following time is permitted: up to 4 hours after entering MODE 4 from MODE 3, or prior to decreasing temperature on any RCS loop to below 325°F, whichever occurs first.

ACTION (Continued)

e. With two required PORVs inoperable, or the Actions (a), (b), (c) , or (d) not met, or the LTOP System inoperable for any reason other than (a), (b), (c), or (d), depressurize the RCS and establish RCS vent of ≥ 3.0 square inches within 12 hours.

f. The provisions of Specification 3.0.4 are not applicable

SURVEILLANCE REQUIREMENTS

4.4.12.1 Each PORV shall be demonstrated OPERABLE by:

a. Performance of a CHANNEL FUNCTIONAL TEST*, but excluding valve operation,at least once per 31 days;

b. Performance of a CHANNEL CALIBRATION on each required PORV actuation channel at least once per 18 months; and

c. Verifying the PORV block valve is open for each required PORV at least once per 72 hours.

4.4.12.2 Verify no safety injection pumps are capable of injecting into the RCS within 4 hours after entering MODE 4 from MODE 3 prior to the temperature of one or more RCS cold legs decreasing below 325°F, and every 12 hours thereafter.

4.4.12.3 Verify a maximum of one charging pump is capable of injecting into the RCS within 4 hours after entering MODE 4 from MODE 3 prior to the temperature of one or more RCS cold legs decreasing below 325°F, and every 12 hours thereafter.

4.4.12.4 Verify each accumulator is isolated at least once per 12 hours

4.4.12.5 Verify# required RCS vent ≥ 3.0 square inches open at least:

a. Once every 12 hours for unlocked open vent valve(s) and,

b. Once every 31 days for other vent path(s)

* Not required to be performed until 12 hours after decreasing RCS cold leg temperatures to ≤ the LTOP arming temperature in the PTLR.

Only required to be met when complying with LCO 3.4.12.b.

B 3/4.4 REACTOR COOLANT SYSTEM

B 3/4 4.9 Reactor Coolant System 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.

The PTLR contains P/T limit curves for heatup, cooldown, inservice leak and hydrostatic (ISLH) testing, 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.

The LCO establishes operating limits that provide a margin to brittle 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. The reactor vessel materials have been tested to determine their initial RT_{NDT} and the results of these tests are shown on Table B 3/4.4-1.

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 failure during normal operation, anticipated operational occurrences, and system hydrostatic tests. It mandates the use of the American Society of Mechanical Engineers (ASME) Code, Section III, 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 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).

BASES

BACKGROUND (continued)

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 3.1.1.4, "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 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, 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. 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. Specification 3/4.2.5, "DNB Parameters," Specification 3.1.1.4, 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.

ACTIONS

Action a

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.

BASES

ACTIONS (continued)

The 30 minute action 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 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 action 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.

Action (a) is modified by a footnote requiring an evaluation of RCS acceptability to be completed whenever the action is entered. The footnote emphasizes the need to perform the evaluation of the effects of the excursion outside the allowable limits. Restoration alone is insufficient because higher than analyzed stresses may have occurred and may have affected the RCPB integrity.

If Action (a) is not met, the plant must be placed in a lower MODE because either the RCS 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 undetected flaws is decreased.

If the required restoration activity cannot be accomplished within 30 minutes, the action 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. 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.

The allowed action 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.

BASES

ACTIONS (continued)

Action b

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 action 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 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.

Action b is modified by a footnote requiring an evaluation of RCS acceptability to be completed whenever the action is entered. The footnote emphasizes the need to perform the evaluation of the effects of the excursion outside the allowable limits. Restoration alone is insufficient because higher than analyzed stresses may have occurred and may have affected the RCPB integrity.

SURVEILLANCE REQUIREMENTS

4.4.9.1.1

Verification that operation is within the PTLR 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. 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, 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 footnote that only requires this SR to be performed during system heatup, cooldown, and ISLH testing. No SR is given for criticality operations because LCO 3.1.1.4 contains a more restrictive requirement.

BASES

REFERENCES:

1. WCAP-7924-A,April 1975
2. 10 CFR 50, Appendix G.
3. ASME, Boiler and Pressure Vessel Code, Section III, 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.
8. WCAP-15293, "Sequoyah Unit 1 Heatup and Cooldown Limit Curves for Normal Operation and PTLR Support Documentation," T. J. Laubham, dated April 2001.

TABLE B 3/4.4-1

SEQUOYAH-UNIT 1 REACTOR VESSEL TOUGHNESS DATA

COMPONENT	HEAT NO.	MATERIAL GRADE	Cu (%)	Ni (%)	NDT (°F)	MINIMUM 50 ft-lb/35 mil temp. TEMP.(°F)		RT_{NDT} (°F)	AVERAGE UPPER SHELF ENERGY (ft-lb)	
						PMWD1	NMWD2		PMWD1	NMWD2
Clos Hd. Dome	52841-1	A533B,C1.1	-	-	-40	+14	+34	-26	104[a]	-
Clos Hd. Ring	(D75600)	A508,C1.2	-	-	+ 5	+36	+56*	+5	125[a]	-
Hd Flange	4842	A508,C1.2	-	-	-40	-24	-4*	-40	131[a]	-
Vessel Flange	4866	A508,C1.2	-	-	-49	-47	-27	-49	158[a]	-
Inlet Nozzle	4846	A508,C1.2	-	-	-58	+25	+45	-15	94.5[a]	-
Inlet Nozzle	4949	A508,C1.2	-	-	-40	+39	+59*	-1	93[a]	-
Inlet Nozzle	4863	A508,C1.2	-	-	-22	+16	+36*	-22	118[a]	-
Inlet Nozzle	4865	A508,C1.2	-	-	-67	+ 9	+29*	-31	94[a]	-
Outlet Nozzle	4845	A508,C1.2	-	-	-49	+21	+41*	-19	94[a]	-
Outlet Nozzle	4850	A508,C1.2	-	-	-58	+30	+50*	-10	79.5[a]	-
Outlet Nozzle	4862	A508,C1.2	-	-	-58	+16	+36*	-24	103[a]	-
Outlet Nozzle	4864	A508,C1.2	-	-	-49	0	+20	-40	126[a]	-
Upper Shell	4841	A508,C1.2	-	-	-40	+43	+83	+23	83[a]	113[b]
Inter Shell	4829	A508,C1.2	0.15	0.86	-4	+10	+100	+40	116	73[b,c]
Lower Shell	4836	A508,C1.2	0.13	0.76	+5	+28	+133	+73	109	70[b]
Trans. Ring	4879	A508,C1.2	-	-	+5	+27	+47*	+ 5	98[a]	-
Bot. Hd. Rim	52703/2-1	A533B,C1.1	-	-	-31	+23	+43*	-17	104[a]	-
Bot. Hd. Rim	52703/2-2	A533B,C1.1	-	-	-13	+36	+56*	-4	63[a]	
Bot. Hd. Rim	52704/2	A533B,C1.1	-	-	-49	-24	-4*	-49	114[a]	
Bot. Hd. Rim	52703/2-2	A533B,C1.1	-	-	-31	+43	+63*	+3	86[a]	
Bot. Hd. Rim	52704/2	A533B,C1.1	-	-	-58	-13	+4	-53	120[a]	
Bot. Hd.	52704/11	A533B,C1.1	-	-	-58	-47	-27*	-58	139[a]	
Weld	-	Weld	0.33	.017	-40	-	-4	-40	-	116[b]
HAZ	-	Weld	-	-	-22	-	+41	-19	-	86[b]

1-Paralled to Major Working Direction

2-Normal to Major Working Direction

a-%Shear Not reported

b-Minimum upper shelf energies

c-Minimum upper shelf energy decreased to 51 at a test temperature of 300°F. This anomaly will be reevaluted when the results of Generic task A-11 are available.

* Estimate based on USAEC Regulatory Standard Review Plan, Section 5.3.2 MTEB

3/4.4.10 DELETED

3/4.4.11 REACTOR COOLANT SYSTEM HEAD VENTS

The function of the RCS head vents is to remove non-condensables or steam from the reactor vessel head. This system is designed to mitigate a possible condition of inadequate core cooling, inadequate natural circulation, or inability to depressurize the RHR System initiated conditions resulting from the accumulation of non-condensable gases in the Reactor Coolant System. The reactor vessel head vent is designed with redundant safety grade vent paths.

B 3/4.4 REACTOR COOLANT SYSTEM

B 3/4.4.12 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. The PTLR provides the maximum allowable actuation logic setpoints for the power operated relief valves (PORVs) and 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 3.4.9.1, "RCS Pressure and Temperature (P/T) Limits," requires administrative control of RCS pressure and temperature during heatup and cooldown to prevent exceeding the PTLR limits.

This LCO provides RCS overpressure protection by having a minimum coolant input capability and having adequate pressure relief capacity. Limiting coolant input capability requires all but one charging pump incapable of injection into the RCS and isolating the accumulators. The pressure relief capacity requires either two redundant PORVs or a depressurized RCS and an RCS vent of sufficient size. One PORV or the open RCS vent is the overpressure protection device that acts to terminate an increasing pressure event.

With minimum coolant input capability, the ability to provide core 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. If conditions require the use of more than one charging 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 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.

BASES

Background (continued)

PORV Requirements

As designed for the LTOP System, each PORV is signaled to open if the RCS pressure approaches a limit determined by the LTOP actuation logic. The LTOP actuation logic monitors both RCS temperature and RCS pressure and determines when a condition not acceptable in the PTLR limits is approached. The wide range RCS temperature indications are auctioneered to select the lowest temperature signal.

The lowest temperature signal is processed through a function generator that calculates a pressure limit for that temperature. The calculated pressure limit is then compared with the indicated RCS pressure from a wide range pressure channel. If the indicated pressure meets or exceeds the calculated value, a PORV is signaled to open.

The PTLR presents the PORV setpoints for LTOP. The setpoints are normally staggered so only one valve opens during a low temperature overpressure transient. Having the setpoints of both valves within the limits in the PTLR 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.

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.

For an RCS vent to meet the flow capacity requirement, it requires an RCS vent opening of at least three square inches. This may be accomplished by removing a pressurizer safety valve, removing a PORV's internals, and disabling its block valve in the open position. 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. 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 the LTOP arming temperature specified in the PTLR , the pressurizer safety valves will prevent RCS pressure from exceeding the Reference 1 limits.

BASES

APPLICABLE SAFETY ANALYSES

At about the LTOP arming temperature specified in the PTLR and below, overpressure prevention falls to two OPERABLE PORVs 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 PTLR curves are revised, the LTOP System must be re-evaluated to ensure its functional requirements can still be met using the PORV method or the depressurized and vented RCS condition.

The PTLR 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 the LTOP overpressure protection means cannot handle:

a. Rendering all but one charging pump incapable of injection;

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

c. Disallowing start of an RCP unless a steam bubble exists in the pressurizer. LCO 3.4.1.3, "Reactor Coolant System- Hot Shutdown," provides this protection.

BASES

APPLICABLE SAFETY ANALYSES (continued)

The Reference 4 analyses demonstrate that either one PORV 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 OPERABLE during the LTOP MODES. Since neither one PORV nor the RCS vent can handle the pressure transient need from accumulator injection, when RCS temperature is low, the LCO also requires the accumulators isolated when accumulator pressure is greater than or equal to the maximum RCS pressure for the existing RCS cold leg temperature allowed in the PTLR.

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

Fracture mechanics analyses establish the temperature of LTOP Applicability at the LTOP arming temperature specified in the PTLR.

The consequences of a small break loss of coolant accident (LOCA) in LTOP MODE 4 conform to 10 CFR 50.46 and 10 CFR 50, Appendix K (Refs. 5 and 6), requirements by having a maximum of one charging pump OPERABLE and SI actuation enabled.

PORV Performance

The fracture mechanics analyses show that the vessel is protected when the PORVs are set to open at or below the limit shown in the PTLR. The setpoints are derived by analyses that model the performance of the LTOP System, assuming the limiting LTOP transient is one charging pump 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 PORV setpoints in the PTLR 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 of the reactor vessel material irradiation surveillance specimens. The Bases for LCO 3.4.9.1 "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)

RCS Vent Performance

With the RCS depressurized, analyses show a vent size of 3.0 square inches is capable of mitigating the allowed LTOP overpressure transient. The capacity of a vent this size is greater than the flow of the limiting transient for the LTOP configuration, one charging pump OPERABLE, maintaining RCS pressure less than the maximum pressure on the P/T limit curve.

The RCS vent size will be re-evaluated for compliance each time the P/T SAFETY 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, the LCO requires that a maximum of one charging pump and no safety injection pumps be capable of injecting into the RCS, and all accumulator discharge isolation valves be closed and immobilized when accumulator pressure is greater than or equal to the maximum RCS pressure for the existing RCS cold leg temperature allowed in the PTLR.

The LCO is modified by three footnotes. The first footnote allows two charging pumps to be made capable of injecting 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. The second footnote states that 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 the PTLR. This footnote permits the accumulator discharge isolation valve surveillance to be performed only under these pressure and temperature conditions. The third footnote allows a 4-hour maximum time period for rendering both safety injection pumps and one centrifugal charging pump inoperable after entry to MODE 4 from MODE 3. RCS temperature must remain above 325°F until the pumps are rendered incapable of inadvertent injection. The 4-hour time period is sufficient for completing this activity and is based on the low probability for inadvertent pump start.

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

BASES

LCO (continued)

a. Two OPERABLE PORVs,

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

b. A depressurized RCS and an RCS vent.

An RCS vent is OPERABLE when open with an area of ≥3.0 square inches.

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

APPLICABILITY

This LCO is applicable in MODE 4 when any RCS cold leg temperature is ≤ the LTOP arming temperature specified in the PTLR, 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 the LTOP arming temperature specified in the PTLR. When the reactor vessel head is off, overpressurization cannot occur.

LCO 3.4.9.1 provides the operational P/T limits for all MODES.
LCO 3.4.3.1, "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 above the LTOP arming temperature specified in the PTLR.

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.

ACTIONS

Action a

With any safety injection pump or more than one centrifugal charging pumps capable of injecting into the RCS, RCS overpressurization is possible.

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

Action b

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.

BASES

ACTIONS (continued)

If isolation is needed and cannot be accomplished in 1 hour, two options are provided either of which must be performed in the next 12 hours. By increasing the RCS temperature to > LTOP arming temperature specified in the PTLR, an accumulator pressure of 600 psig cannot exceed the LTOP limits if the accumulators are fully injected. Depressurizing the accumulators below the LTOP limit from the PTLR also gives this protection.

The action 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.

Action c

In MODE 4 when any RCS cold leg temperature is ≤ the LTOP arming temperature specified in the PTLR, with one required PORV inoperable, the required PORV must be restored to OPERABLE status within 7 days. Two PORVs are required to provide low temperature overpressure mitigation while withstanding a single failure of an active component.

The action 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.

Action d

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

The action time represents a reasonable time to investigate and repair several types of PORV failures without exposure to a lengthy period with only one OPERABLE PORV to protect against overpressure events.

Action e

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

a. Both required PORVs are inoperable;

b. Actions a, c, or d are not completed in the allowable times; or

c. The LTOP System is inoperable for any reason other than Actions a, b, c or d.

BASES

ACTIONS (continued)

The vent must be sized ≥ 3.0 square inches 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 action 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.

SURVEILLANCE REQUIREMENTS

4.4.12.1.a

Performance of a CHANNEL FUNCTIONAL TEST is required within 12 hours after decreasing RCS cold leg temperature to ≤ LTOP arming temperature specified in the PTLR and every 31 days on each required PORV to verify and, as necessary, adjust its lift setpoint. The CHANNEL FUNCTIONAL TEST will verify the setpoint is within the PTLR allowed maximum limits in the PTLR. PORV actuation could depressurize the RCS and is not required.

The 12 hour frequency considers the unlikelihood of a low temperature overpressure event during this time.

A footnote* has been added indicating that this SR is required to be performed 12 hours after decreasing RCS cold leg temperature to ≤ LTOP arming temperature specified in the PTLR. The CHANNEL FUNCTIONAL TEST 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.

4.4.12.1.b

Performance of a CHANNEL CALIBRATION on each required PORV actuation channel is required every 18 months to adjust the whole channel so that it responds and the valve opens within the required range and accuracy to known input.

4.4.12.1.c

The PORV block valve must be verified open every 72 hours 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.

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.

BASES

SURVEILLANCE REQUIREMENTS (continued)

The 72 hour frequency is considered adequate in view of 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.

4.4.12.2 and 4.4.12.3

To minimize the potential for a low temperature overpressure event by limiting the mass input capability, all safety injection pumps and all but one charging pump are verified incapable of injecting into the RCS and the accumulator discharge isolation valves are verified closed and locked out The safety injection pumps and charging pumps 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 a pump start 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.

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.

4.4.12.4

The accumulator discharge isolation valves are verified closed and locked out at least once per 12 hours. 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.

4.4.12.5

The RCS vent of ≥ 3.0 square inches is proven OPERABLE by verifying its open condition either:

a. Once every12 hours for a valve that is not locked. (valves that are sealed or secured in the open position are considered "locked" in this context).

b. Once every 31 days for other vent path(s) (e.g., a vent valve that is locked, sealed, or secured in position or a removed pressurizer safety valve or open manway also fits this category.

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

BASES

REFERENCES		
	1.	10 CFR 50, Appendix G
	2.	Generic Letter 88-11.
	3.	ASME, Boiler and Pressure Vessel Code, Section III.
	4.	FSAR, Chapter 15
	5.	10 CFR 50, Section 50.46.
	6.	10 CFR 50, Appendix K.
	7.	Generic Letter 90-06.
	8.	ASME, Boiler and Pressure Vessel Code, Section XI.

CORE OPERATING LIMITS REPORT (continued)

6. WCAP-10054-P-A, Westinghouse Small Break ECCS Evaluation Model Using the NOTRUMP Code, August 1985, (W Proprietary)
   (Methodology for Specification 3/4.2.2 - Heat Flux Hot Channel Factor)

7. WCAP-10266-P-A, Rev. 2, "THE 1981 REVISION OF WESTINGHOUSE EVALUATION MODEL USING BASH CODE", March 1987, (W Proprietary).
   (Methodology for Specification 3.2.2 - Heat Flux Hot Channel Factor).

8. BAW-10227P-A, "Evaluation of Advance Cladding and Structural Material (M5) in PWR Reactor Fuel," February 2000, (FCF Proprietary)
   (Methodology for Specification 3/4.2.2 - Heat Flux Hot Channel Factor)

6.9.1.14.b The core operating limits shall be determined so that all applicable limits (e.g., fuel thermal-mechanical limits, core thermal-hydraulic limits, ECCS limits, nuclear limits such as shutdown margin, and transient and accident analysis limits) of the safety analysis are met.

6.9.1.14.c THE CORE OPERATING LIMITS REPORT shall be provided within 30 days after cycle start-up (Mode 2) for each reload cycle or within 30 days of issuance of any midcycle revision of the NRC Document Control Desk with copies to the Regional Administrator and Resident Inspector.

REACTOR COOLANT SYSTEM (RCS) PRESSURE AND TEMPERATURE LIMITS (PTLR) REPORT

6.9.1.15 RCS pressure and temperature limits for heatup, cooldown, low temperature operation, criticality, and hydrostatic testing, LTOP arming, and PORV lift settings as well as heatup and cooldown rates shall be established and documented in the PTLR for the following:

Specification 3.4.9.1, "RCS Pressure and Temperature (P/T) Limits"

Specification 3.4.12, "Low Temperature Over Pressure Protection (LTOP) System"

6.9.1.15.a The analytical methods used to determine the RCS pressure and temperature limits shall be those previously reviewed and approved by the NRC, specifically those described in the following documents:

1. Westinghouse Topical Report WCAP-14040-NP-A, Revision 2, "Methodology used to Develop Cold Overpressure Mitigating System Setpoints and RCS Heatup and Cooldown Limit Curves, January 1996.
2. Westinghouse Topical Report WCAP-15293, Revision 1, "Sequoyah Unit 1 Heatup and Cooldown Limit Curves for Normal Operation and PTLR Support Documentation," April 2001.

6.9.1.15.b The PTLR shall be provided to the NRC within 30 days of issuance of any revision or supplement thereto.

SPECIAL REPORTS

6.9.2.1 Special reports shall be submitted within the time period specified for each report, in accordance with 10 CFR 50.4.

6.9.2.2 This specification has been deleted.

DEFINITIONS

SECTION PAGE

1.0 DEFINITIONS

SECTION PAGE

1.0 DEFINITIONS (Continued)

LIMITING CONDITIONS FOR OPERATION AND SURVEILLANCE REQUIREMENTS

OPERATIONAL MODE - MODE

1.20 An OPERATIONAL MODE (i.e., MODE) shall correspond to any one inclusive combination of core reactivity condition, power level and average reactor coolant temperature specified in Table 1.1.

PHYSICS TESTS

1.21 PHYSICS TESTS shall be those tests performed to measure the fundamental nuclear characteristics of the reactor core and related instrumentation and 1) described in Chapter 14.0 of the FSAR, 2) authorized under the provisions of 10 CFR 50.59, or 3) otherwise approved by the Commission.

PRESSURE BOUNDARY LEAKAGE

1.22 PRESSURE BOUNDARY LEAKAGE shall be leakage (except steam generator tube leakage) through a non-isolable fault in a Reactor Coolant System component body, pipe wall or vessel wall.

PRESSURE AND TEMPERATURE LIMITS REPORT (PTLR)

1.23 The PTLR is the unit specific document that provides the reactor vessel pressure and temperature limits, including heatup and cooldown rates and the LTOP arming temperature, for the current reactor vessel fluence period. These pressure and temperature limits shall be determined for each fluence period in accordance with Specification 6.9.1.15.

PROCESS CONTROL PROGRAM (PCP)

1.24 DELETED

PURGE - PURGING

1.25 PURGE or PURGING is the controlled process of discharging air or gas from a confinement to maintain temperature, pressure, humidity, concentration or other operating condition, in such a manner that replacement air or gas is required to purify the confinement.

QUADRANT POWER TILT RATIO

1.26 QUADRANT POWER TILT RATIO shall be the ratio of the maximum upper excore detector calibrated output to the average of the upper excore detector calibrated outputs, or the ratio of the maximum lower excore detector calibrated output to the average of the lower excore detector calibrated outputs, which-ever is greater.

RATED THERMAL POWER (RTP)

1.27 RATED THERMAL POWER (RTP) shall be a total reactor core heat transfer rate to the reactor coolant of 3455 MWt.

REACTOR TRIP SYSTEM (RTS) RESPONSE TIME

1.28 The REACTOR TRIP SYSTEM RESPONSE TIME shall be the time interval from when the monitored parameter exceeds its (RTS) trip setpoint at the channel sensor until loss of stationary gripper coil voltage. The response time may be measured by means of any series of sequential, overlapping, or total steps so that the entire response time is measured. In lieu of measurement, response time may be verified for selected components provided that the components and the methodology for verification have been previously reviewed and approved by NRC.

REPORTABLE EVENT

1.29 DELETED

SHIELD BUILDING INTEGRITY

1.30 SHIELD BUILDING INTEGRITY shall exist when:

a. The door in each access opening is closed except when the access opening is being used for normal transit entry and exit.

b. The emergency gas treatment system is OPERABLE.

c. The sealing mechanism associated with each penetration (e.g., welds, bellows or O-rings) is OPERABLE.

SHUTDOWN MARGIN

1.31 SHUTDOWN MARGIN shall be the instantaneous amount of reactivity by which the reactor is subcritical or would be subcritical from its present condition assuming all full length rod cluster assemblies (shutdown and control) are fully inserted except for the single rod cluster assembly of highest reactivity worth which is assumed to be fully withdrawn.

SITE BOUNDARY

1.32 The SITE BOUNDARY shall be that line beyond which the land is not owned, leased, or otherwise controlled by the licensee (see figure 5.1-1).

SOLIDIFICATION

1.33 Deleted.

SOURCE CHECK

1.34 Deleted.

STAGGERED TEST BASIS

1.35 A STAGGERED TEST BASIS shall consist of:

a. A test schedule for n systems, subsystems, trains or other designated components obtained by dividing the specified test interval into n equal subintervals,

b. The testing of one system, subsystem, train or other designated component at the beginning of each subinterval.

THERMAL POWER

1.36 THERMAL POWER shall be the total reactor core heat transfer rate to the reactor coolant.

UNIDENTIFIED LEAKAGE

1.37 UNIDENTIFIED LEAKAGE shall be all leakage (except reactor coolant pump seal water injection or leakoff) that is not IDENTIFIED LEAKAGE.

UNRESTRICTED AREA

1.38 An UNRESTRICTED AREA shall be any area, at or beyond the site boundary to which access is not controlled by the licensee for purposes of protection of individuals from exposure to radiation and radioactive materials or any area within the site boundary used for residential quarters or industrial, commercial, institutional, and/or recreational purposes.

VENTILATION EXHAUST TREATMENT SYSTEM

1.39 A VENTILATION EXHAUST TREATMENT SYSTEM is any system designed and installed to reduce gaseous radioiodine or radioactive material in particulate form in effluents by passing ventilation or vent exhaust gases through charcoal adsorbers and/or HEPA filters for the purpose of removing iodines or particulates from the gaseous exhaust stream prior to the release to the environment (such a system is not considered to have any effect on noble gas effluents). Engineered Safety Feature (ESF) atmospheric cleanup systems are not considered to be VENTILATION EXHAUST TREATMENT SYSTEM components.

VENTING

1.40 VENTING is the controlled process of discharging air or gas from a confinement to maintain temperature, pressure, humidity, concentration or other operating condition, in such a manner that replacement air or gas is not provided or required during VENTING. Vent, used in system names, does not imply a VENTING process.

3/4.4.9 RCS PRESSURE/TEMPERATURE (P/T) LIMITS

LIMITING CONDITION FOR OPERATION

3.4.9.1 RCS pressure, RCS temperature, and RCS heatup and cooldown rates shall be maintained within the limits specified in the PTLR.

APPLICABILITY: At all times.

ACTIONS:

a. With the requirements of the LCO not met in MODE 1, 2, 3, or 4, restore the parameter(s) to within limits in 30 minutes and determine RCS is acceptable* for continued operation within 72 hours. With the required action above not met, be in MODE 3 within the next 6 hours and in MODE 5, with RCS pressure < 500 psig, within the following 30 hours.

b. With the requirements of the LCO not met any time other than MODE 1, 2, 3, or 4, immediately initiate action to restore parameter(s) to within limits and, prior to entering MODE 4, determine RCS is acceptable* for continued operation.

SURVEILLANCE REQUIREMENTS

4.4.9.1.1 Verify** RCS pressure, RCS temperature, and RCS heatup and cooldown rates are within the limits specified in the PTLR every 30 minutes.

* The determination that the RCS is acceptable for continued operation must be completed for any entry into Action (a) or (b).

** Only required to be performed during RCS heatup and cooldown operations and RCS inservice leak and hydrostatic testing.

FIGURE 3.4-2 - DELETED

SEQUOYAH UNIT 2 REACTOR COOLANT SYSTEM HEATUP LIMINATIONS
APPLICABLE UP TO 14.5 EFPY

FIGURE 3.4-3 - DELETED

SEQUOYAH UNIT 2 REACTOR COOLANT SYSTEM COOLDOWN LIMITATIONS
APPLICABLE UP TO 14.5 EFPY

LIMITING CONDITION FOR OPERATION

3.4.9.2 DELETED.

3/4.4.12 LOW TEMPERATURE OVER PRESSURE PROTECTION (LTOP) SYSTEM

LIMITING CONDITION FOR OPERATION

3.4.12* An LTOP System shall be OPERABLE with a maximum of one centrifugal charging pump capable of injecting into the Reactor Coolant System (RCS) and the accumulators isolated and one of the following pressure relief capabilities:

a. Two power operated relief valves (PORVs) with lift settings within the limits specified in the PTLR, or

b. The RCS depressurized and an RCS vent ≥ 3 square inches.

APPLICABILITY: MODE 4 when any RCS cold leg temperature is ≤ the LTOP arming temperature specified in the PTLR,
MODE 5,
MODE 6 when the reactor vessel head is on.

ACTION:

a. Should any safety injection pump or more than one charging pump be found capable of injecting into the RCS, immediately initiate action to verify a maximum of one centrifugal charging pump is capable of injecting into the RCS.

b. With an accumulator not isolated when the accumulator pressure is greater than or equal to the maximum RCS pressure for existing cold leg temperature allowed in the PTLR, isolate the affected accumulator within 1 hour, or either;

   1. Increase RCS cold leg temperature to >the LTOP arming temperature specified in the PTLR within 12 hours, or

   2 Depressurize the affected accumulator to less than the maximum RCS pressure for existing cold leg temperature allowed in the PTLR within 12 hours.

c. With one required PORV inoperable in MODE 4, restore the required PORV to OPERABLE status within 7 days.

D With one required PORV inoperable in MODE 5 or 6, restore the required PORV to OPERABLE status within 24 hours.

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* 1) Two charging pumps may be made capable of injecting into the RCS for ≤ 1 hour for pump swap operations.

2) Accumulator may be unisolated when 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 the PTLR.

3) For the purpose of making the required safety injection pumps and charging pump inoperable, the following time is permitted: up to 4 hours after entering MODE 4 from MODE 3, or prior to decreasing temperature on any RCS loop to below 325°F, whichever occurs first.

ACTION (Continued)

e. With two required PORVs inoperable, or the Actions (a), (b), (c) , or (d) not met, or the LTOP System inoperable for any reason other than (a), (b), (c), or (d), depressurize the RCS and establish RCS vent of ≥ 3.0 square inches within 12 hours.

f. The provisions of Specification 3.0.4 are not applicable

SURVEILLANCE REQUIREMENTS

4.4.12.1 Each PORV shall be demonstrated OPERABLE by:

a. Performance of a CHANNEL FUNCTIONAL TEST*, but excluding valve operation,at least once per 31 days;

b. Performance of a CHANNEL CALIBRATION on each required PORV actuation channel at least once per 18 months; and

c. Verifying the PORV block valve is open for each required PORV at least once per 72 hours.

4.4.12.2 Verify no safety injection pumps are capable of injecting into the RCS within 4 hours after entering MODE 4 from MODE 3 and prior to the temperature of one or more RCS cold legs decreasing below 325°F, and every 12 hours thereafter.

4.4.12.3 Verify a maximum of one charging pump is capable of injecting into the RCS within 4 hours after entering MODE 4 from MODE 3 and prior to the temperature of one or more RCS cold legs decreasing below 325°F, and every 12 hours thereafter.

4.4.12.4 Verify each accumulator is isolated at least once per 12 hours

4.4.12.5 Verify# required RCS vent ≥ 3.0 square inches open at least:

a. Once every 12 hours for unlocked open vent valve(s) and,

b. Once every 31 days for other vent path(s)

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* Not required to be performed until 12 hours after decreasing RCS cold leg temperatures to ≤ the LTOP arming temperature in the PTLR.

\# Only required to be met when complying with LCO 3.4.12.b.

SPECIFIC ACTIVITY (Continued)

Reducing T_{avg} to less than 500°F prevents the release of activity should a steam generator tube rupture since the saturation pressure of the primary coolant is below the lift pressure of the atmospheric steam relief valves. The surveillance requirements provide adequate assurance that excessive specific activity levels in the primary coolant will be detected in sufficient time to take corrective action. Information obtained on iodine spiking will be used to assess the parameters associated with spiking phenomena. A reduction in frequency of isotopic analyses following power changes may be permissible if justified by the data obtained.

B 3/4.4 REACTOR COOLANT SYSTEM

B 3/4.4.9 Reactor Coolant System 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.

The PTLR contains P/T limit curves for heatup, cooldown, inservice leak and hydrostatic (ISLH) testing, 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.

The LCO establishes operating limits that provide a margin to brittle 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. The reactor vessel materials have been tested to determine their initial RT_{NDT} and the results of these tests are shown on Table B 3/4.4-1.

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 failure during normal operation, anticipated operational occurrences, and system hydrostatic tests. It mandates the use of the American Society of Mechanical Engineers (ASME) Code, Section III, 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 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).

BASES

BACKGROUND (continued)

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 3.1.1.4, "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 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, 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. 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. Specification 3/4.2.5, "DNB Parameters," Specification 3.1.1.4, 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.

ACTIONS

Action a

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.

BASES
ACTIONS (continued)

The 30 minute action 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 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 action 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.

Action (a) is modified by a footnote requiring an evaluation of RCS acceptability to be completed whenever the action is entered. The footnote emphasizes the need to perform the evaluation of the effects of the excursion outside the allowable limits. Restoration alone is insufficient because higher than analyzed stresses may have occurred and may have affected the RCPB integrity.

If Action (a) is not met, the plant must be placed in a lower MODE because either the RCS 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 undetected flaws is decreased.

If the required restoration activity cannot be accomplished within 30 minutes, the action 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. 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.

The allowed action 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.

BASES

ACTIONS (continued)

Action b

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 action 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 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.

Action b is modified by a footnote requiring an evaluation of RCS acceptability to be completed whenever the action is entered. The footnote emphasizes the need to perform the evaluation of the effects of the excursion outside the allowable limits. Restoration alone is insufficient because higher than analyzed stresses may have occurred and may have affected the RCPB integrity.

SURVEILLANCE REQUIREMENTS

4.4.9.1.1

Verification that operation is within the PTLR 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. 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, 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 footnote that only requires this SR to be performed during system heatup, cooldown, and ISLH testing. No SR is given for criticality operations because LCO 3.1.1.4 contains a more restrictive requirement.

BASES

REFERENCES:

1. WCAP-7924-A,April 1975
2. 10 CFR 50, Appendix G.
3. ASME, Boiler and Pressure Vessel Code, Section III, 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.
8. WCAP-15321, "Sequoyah Unit 2 Heatup and Cooldown Limit Curves for Normal Operation and PTLR Support Documentation," T. J. Laubham, dated April 2001.

TABLE B 3/4.4-1

SEQUOYAH-UNIT 2 REACTOR VESSEL TOUGHNESS DATA

						MINIMUM 50 FT-LB/35 MIL TEMP °F			AVERAGE UPPER SHELF FTLB	
COMPONENT	HEAT NO.	MATERIAL GRADE	CU %	Ni %	NDTT °F	$PMWD_1$	$NMWD_2$	RT_{NDT} °F	PMWD[1]	NMWD[2]
CL Hd. Dome	52899-1	A533BCL1	-	-	-13	28	48*	-12	75[a]	
CL Hd. Ring	-	A508CL2	-	-	5	34	54*	5	125.5[a]	
Hd Flange	4890	A508CL2	-	-	-13	<-67*	<-67	-13	141.[a]	
Vessel Flange	4832	A508CL2	-	-	-22	-47	-27	-22	155.5[a]	
Inlet Nozzle	4868	A508CL2	-	-	-22	41	61*	1	79[a]	
Inlet Nozzle	4872	A508CL2	-	-	-22	12	32*	-22	108[a]	
Inlet Nozzle	4877	A508CL2	-	-	-31	1	21*	-31	113[a]	
Inlet Nozzle	4886	A508CL2	-	-	-31	-52	-32*	28	138[a]	
Outlet Nozzle	4867	A508CL2	-	-	-31	19	39*	-21	85[a]	
Outlet Nozzle	4873	A508CL2	-	-	-22	21	41*	-19	76[a]	
Outlet Nozzle	4878	A508CL2	-	-	-40	-6	14*	-40	105[a]	
Outlet Nozzle	4887	A508CL2	-	-	-22	-11	9*	-22	143.5[a]	
Upper Shell	4885	A508CL2	-	-	5	25	45*	5	104[a]	
Inter Shell	4853	A508CL2	0.13	0.74	-22	19	70	10	138	93
Lower Shell	4994	A508CL2	0.14	0.76	-40	8	38	-22	140.5[a]	100
Trans. Ring	4879	A508CL2	-	-	5	27	47*	5	98[a]	
Bot. Hd. Rim	52835-1B	A533BCL1	-	-	-4	48	68*	8	81[a]	
Bot. Hd. Rim	52835-1B	A533BCL1	-	-	-22	25	45*	-15	81[a]	
Bot. Hd. Rim	52899-2	A533BCL1	-	-	-13	39	59*	-1	62[a]	
Bot. Hd.	5297-1	A533BCL1	-	-	-31	14	34*	-26	99.5[a]	
Weld	-	Weld	0.13	0.11	-4	-	14	-4	-	101
HAZ	-	HAZ	-	-	-13	-	17	-13	-	120

[1] Paralled to Major Working Direction
[2] Normal to Major Working Direction
* Estimate based on USAEC Regulatory Standard Review Plan, Section 5.3.2 MTEB 5-2
[a] % Shear not reported

3/4.4.10 DELETED

3/4.4.11 REACTOR COOLANT SYSTEM HEAD VENTS

The function of the RCS head vents is to remove non-condensables or steam from the reactor vessel head. This system is designed to mitigate a possible condition of inadequate core cooling, inadequate natural circulation, or inability to depressurize the RHR System initiated conditions resulting from the accumulation of non-condensable gases in the Reactor Coolant System. The reactor vessel head vent is designed with redundant safety grade vent paths.

B 3/4.4 REACTOR COOLANT SYSTEM

B 3/4.4.12 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. The PTLR provides the maximum allowable actuation logic setpoints for the power operated relief valves (PORVs) and 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 3.4.9.1, "RCS Pressure and Temperature (P/T) Limits," requires administrative control of RCS pressure and temperature during heatup and cooldown to prevent exceeding the PTLR limits.

This LCO provides RCS overpressure protection by having a minimum coolant input capability and having adequate pressure relief capacity. Limiting coolant input capability requires all but one charging pump incapable of injection into the RCS and isolating the accumulators. The pressure relief capacity requires either two redundant PORVs or a depressurized RCS and an RCS vent of sufficient size. One PORV or the open RCS vent is the overpressure protection device that acts to terminate an increasing pressure event.

With minimum coolant input capability, the ability to provide core 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. If conditions require the use of more than one charging 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 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.

BASES

Background (continued)

PORV Requirements

As designed for the LTOP System, each PORV is signaled to open if the RCS pressure approaches a limit determined by the LTOP actuation logic. The LTOP actuation logic monitors both RCS temperature and RCS pressure and determines when a condition not acceptable in the PTLR limits is approached. The wide range RCS temperature indications are auctioneered to select the lowest temperature signal.

The lowest temperature signal is processed through a function generator that calculates a pressure limit for that temperature. The calculated pressure limit is then compared with the indicated RCS pressure from a wide range pressure channel. If the indicated pressure meets or exceeds the calculated value, a PORV is signaled to open.

The PTLR presents the PORV setpoints for LTOP. The setpoints are normally staggered so only one valve opens during a low temperature overpressure transient. Having the setpoints of both valves within the limits in the PTLR 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.

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.

For an RCS vent to meet the flow capacity requirement, it requires an RCS vent opening of at least three square inches. This may be accomplished by removing a pressurizer safety valve, removing a PORV's internals, and disabling its block valve in the open position. 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. 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 the LTOP arming temperature specified in the PTLR , the pressurizer safety valves will prevent RCS pressure from exceeding the Reference 1 limits.

BASES

APPLICABLE SAFETY ANALYSES

At about the LTOP arming temperature specified in the PTLR and below, overpressure prevention falls to two OPERABLE PORVs 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 PTLR curves are revised, the LTOP System must be re-evaluated to ensure its functional requirements can still be met using the PORV method or the depressurized and vented RCS condition.

The PTLR 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 without a steam bubble in the pressurizer.

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

a. Rendering all but one charging pump incapable of injection;

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

c. Disallowing start of an RCP unless a steam bubble exists in the pressurizer. LCO 3.4.1.3, "Reactor Coolant System - Hot Shutdown" provides this protection.

BASES

APPLICABLE SAFETY ANALYSES (continued)

The Reference 4 analyses demonstrate that either one PORV 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 OPERABLE during the LTOP MODES. Since neither one PORV nor the RCS vent can handle the pressure transient need from accumulator injection, when RCS temperature is low, the LCO also requires the accumulators isolated when accumulator pressure is greater than or equal to the maximum RCS pressure for the existing RCS cold leg temperature allowed in the PTLR.

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

Fracture mechanics analyses establish the temperature of LTOP Applicability at the LTOP arming temperature specified in the PTLR.

The consequences of a small break loss of coolant accident (LOCA) in LTOP MODE 4 conform to 10 CFR 50.46 and 10 CFR 50, Appendix K (Refs. 5 and 6), requirements by having a maximum of one charging pump OPERABLE and SI actuation enabled.

PORV Performance

The fracture mechanics analyses show that the vessel is protected when the PORVs are set to open at or below the limit shown in the PTLR. The setpoints are derived by analyses that model the performance of the LTOP System, assuming the limiting LTOP transient is one charging pump 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 PORV setpoints in the PTLR 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 of the reactor vessel material irradiation surveillance specimens. The Bases for LCO 3.4.9.1 "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)

RCS Vent Performance

With the RCS depressurized, analyses show a vent size of 3.0 square inches is capable of mitigating the allowed LTOP overpressure transient. The capacity of a vent this size is greater than the flow of the limiting transient for the LTOP configuration, one charging pump OPERABLE, maintaining RCS pressure less than the maximum pressure on the P/T limit curve.

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, the LCO requires that a maximum of one charging pump and no safety injection pumps be capable of injecting into the RCS, and all accumulator discharge isolation valves be closed and immobilized (when accumulator pressure is greater than or equal to the maximum RCS pressure for the existing RCS cold leg temperature allowed in the PTLR).

The LCO is modified by three footnotes. The first footnote allows two charging pumps to be made capable of injecting 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. The second footnote states that 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 the PTLR. This footnote permits the accumulator discharge isolation valve surveillance to be performed only under these pressure and temperature conditions. The third footnote allows a 4-hour maximum time period for rendering both safety injection pumps and one centrifugal charging pump inoperable after entry to MODE 4 from MODE 3. RCS temperature must remain above 325°F until the pumps are rendered incapable of inadvertent injection. The 4-hour time period is sufficient for completing this activity and is based on the low probability for inadvertent pump start.

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

BASES

LCO (continued)

a. Two OPERABLE PORVs,

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

b. A depressurized RCS and an RCS vent.

An RCS vent is OPERABLE when open with an area of ≥3.0 square inches.

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

APPLICABILITY

This LCO is applicable in MODE 4 when any RCS cold leg temperature is ≤ the LTOP arming temperature specified in the PTLR, 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 the LTOP arming temperature specified in the PTLR. When the reactor vessel head is off, overpressurization cannot occur.

LCO 3.4.9.1 provides the operational P/T limits for all MODES.
LCO 3.4.3.1, "Pressurizer Safety Valves," requires the OPERABILITY of the pressurizer safety valves that provide overpressure protection during MODES 1, 2, and 3.

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.

ACTIONS

Action a

With any safety injection pump or more than one centrifugal charging pumps capable of injecting into the RCS, RCS overpressurization is possible.

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

Action b

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.

BASES

ACTIONS (continued)

If isolation is needed and cannot be accomplished in 1 hour, two options are provided either of which must be performed in the next 12 hours. By increasing the RCS temperature to > LTOP arming temperature specified in the PTLR, an accumulator pressure of 600 psig cannot exceed the LTOP limits if the accumulators are fully injected. Depressurizing the accumulators below the LTOP limit from the PTLR also gives this protection.

The action 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.

Action c

In MODE 4 when any RCS cold leg temperature is ≤ the LTOP arming temperature specified in the PTLR, with one required PORV inoperable, the required PORV must be restored to OPERABLE status within 7 days. Two PORVs are required to provide low temperature overpressure mitigation while withstanding a single failure of an active component.

The action 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.

Action d

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

The action time represents a reasonable time to investigate and repair several types of PORV failures without exposure to a lengthy period with only one OPERABLE PORV to protect against overpressure events.

Action e

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

a. Both required PORVs are inoperable;

b. Actions a, c, or d are not completed in the allowable times; or

c. The LTOP System is inoperable for any reason other than Actions a, b, c or d.

BASES

ACTIONS (continued)

The vent must be sized ≥ 3.0 square inches 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 action 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.

SURVEILLANCE REQUIREMENTS

4.4.12.1.a

Performance of a CHANNEL FUNCTIONAL TEST is required within 12 hours after decreasing RCS cold leg temperature to ≤ LTOP arming temperature specified in the PTLR and every 31 days on each required PORV to verify and, as necessary, adjust its lift setpoint. The CHANNEL FUNCTIONAL TEST will verify the setpoint is within the PTLR allowed maximum limits in the PTLR. PORV actuation could depressurize the RCS and is not required.

The 12 hour frequency considers the unlikelihood of a low temperature overpressure event during this time.

A footnote* has been added indicating that this SR is required to be performed 12 hours after decreasing RCS cold leg temperature to ≤ LTOP arming temperature specified in the PTLR. The CHANNEL FUNCTIONAL TEST 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.

4.4.12.1.b

Performance of a CHANNEL CALIBRATION on each required PORV actuation channel is required every 18 months to adjust the whole channel so that it responds and the valve opens within the required range and accuracy to known input.

4.4.12.1.c

The PORV block valve must be verified open every 72 hours 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.

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.

BASES

SURVEILLANCE REQUIREMENTS (continued)

The 72 hour frequency is considered adequate in view of 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.

4.4.12.2 and 4.4.12.3

To minimize the potential for a low temperature overpressure event by limiting the mass input capability, all safety injection pumps and all but one charging pump are verified incapable of injecting into the RCS and the accumulator discharge isolation valves are verified closed and locked out The safety injection pumps and charging pumps 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 a pump start 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.

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.

4.4.12.4

The accumulator discharge isolation valves are verified closed and locked out at least once per 12 hours. 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.

4.4.12.5

The RCS vent of ≥ 3.0 square inches is proven OPERABLE by verifying its open condition either:

a. Once every12 hours for a valve that is not locked. (valves that are sealed or secured in the open position are considered "locked" in this context).

b. Once every 31 days for other vent path(s) (e.g., a vent valve that is locked, sealed, or secured in position or a removed pressurizer safety valve or open manway also fits this category.

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

BASES

REFERENCES

1. 10 CFR 50, Appendix G
2. Generic Letter 88-11.
3. ASME, Boiler and Pressure Vessel Code, Section III.
4. FSAR, Chapter 15
5. 10 CFR 50, Section 50.46.
6. 10 CFR 50, Appendix K.
7. Generic Letter 90-06.
8. ASME, Boiler and Pressure Vessel Code, Section XI.

CORE OPERATING LIMITS REPORT (continued)

6. WCAP-10054-P-A, Westinghouse Small Break ECCS Evaluation Model Using the NOTRUMP Code, August 1985, (W Proprietary)
   (Methodology for Specification 3/4.2.2 - Heat Flux Hot Channel Factor)

7. WCAP-10266-P-A, Rev. 2, "THE 1981 REVISION OF WESTINGHOUSE EVALUATION MODEL USING BASH CODE", March 1987, (W Proprietary).
   (Methodology for Specification 3.2.2 - Heat Flux Hot Channel Factor).

8. BAW-10227P-A, "Evaluation of Advance Cladding and Structural Material (M5) in PWR Reactor Fuel," February 2000, (FCF Proprietary)
   (Methodology for Specification 3/4.2.2 - Heat Flux Hot Channel Factor)

6.9.1.14.b The core operating limits shall be determined so that all applicable limits (e.g., fuel thermal-mechanical limits, core thermal-hydraulic limits, ECCS limits, nuclear limits such as shutdown margin, and transient and accident analysis limits) of the safety analysis are met.

6.9.1.14.c THE CORE OPERATING LIMITS REPORT shall be provided within 30 days after cycle start-up (Mode 2) for each reload cycle or within 30 days of issuance of any midcycle revision of the NRC Document Control Desk with copies to the Regional Administrator and Resident Inspector.

REACTOR COOLANT SYSTEM (RCS) PRESSURE AND TEMPERATURE LIMITS (PTLR) REPORT

6.9.1.15 RCS pressure and temperature limits for heatup, cooldown, low temperature operation, criticality, and hydrostatic testing, LTOP arming, and PORV lift settings as well as heatup and cooldown rates shall be established and documented in the PTLR for the following:

Specification 3.4.9.1, "RCS Pressure and Temperature (P/T) Limits"

Specification 3.4.12, "Low Temperature Over Pressure Protection (LTOP) System"

6.9.1.15.a The analytical methods used to determine the RCS pressure and temperature limits shall be those previously reviewed and approved by the NRC, specifically those described in the following documents:

1. Westinghouse Topical Report WCAP-14040-NP-A, Revision 2, "Methodology used to Develop Cold Overpressure Mitigating System Setpoints and RCS Heatup and Cooldown Limit Curves, January 1996.

2. Westinghouse Topical Report WCAP-15321, Revision 1, "Sequoyah Unit 2 Heatup and Cooldown Limit Curves for Normal Operation and PTLR Support Documentation," April 2001.

6.9.1.15.b The PTLR shall be provided to the NRC within 30 days of issuance of any revision or supplement thereto.

SPECIAL REPORTS

6.9.2.1 Special reports shall be submitted within the time period specified for each report, in accordance with 10 CFR 50.4.

6.9.2.2 This specification has been deleted.