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AUG 1 1 2014

10 CFR 50.90

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

SUSQUEHANNA STEAM ELECTRIC STATION
PROPOSED AMENDMENT NO. 318 TO UNIT 1
FACILITY OPERATING LICENSE NPF-14 AND
PROPOSED AMENDMENT NO. 290 TO UNIT 2
FACILITY OPERATING LICENSE NPF-22: REVISE
TECHNICAL SPECIFICATION 3.4.10 "RCS PRESSURE
AND TEMPERATURE (P/T) LIMITS" **Docket Nos. 50-387**
PLA-7181 **and 50-388**

In accordance with the provisions of 10 CFR 50.90, PPL Susquehanna, LLC (PPL) is submitting a request for amendment to the Technical Specification (TS) 3.4.10 "RCS Pressure and Temperature (P/T) Limits" for Susquehanna Steam Electric Station (SSES) Unit 1 and Unit 2.

The enclosure to this letter contains PPL's evaluation of the proposed change. Included are a description of the proposed change, technical analysis of the change, regulatory analysis of the change (No Significant Hazards Consideration and the Applicable Regulatory Requirements), and the environmental considerations associated with the change.

Attachment 1 to this letter contains the applicable pages of the SSES Unit 1 and Unit 2 TS, marked to show the proposed change. Attachment 2 contains the marked page to the Technical Specification Bases required as a result of the proposed TS change.

There are no regulatory commitments associated with these proposed Amendments which have been reviewed by the SSES Plant Operations Review Committee and the Susquehanna Review Committee. PPL requests the NRC complete its review in order to support the startup from the SSES Unit 2 Spring 2015 Refueling Outage with the change becoming effective within 30 days of NRC approval.

If you have any questions or require additional information, please contact Mr. John L. Tripoli, Manager – Nuclear Regulatory Affairs (570) 542-3100.

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

Executed on: 8/11/2014

Sincerely,

J. A. Franke

Enclosure: PPL Susquehanna, LLC Evaluation of the Proposed Change

Attachments:

Attachment 1 - Proposed Technical Specification Change (Mark-ups)
Attachment 2 - Proposed Technical Specification Bases Change (Mark-ups)

Copy: NRC Region I
Mr. J. Greives, NRC Sr. Resident Inspector
Mr. J. Whited, NRC Project Manager
Mr. L. Winker, PA DEP/BRP

ENCLOSURE TO PLA-7181

PPL SUSQUEHANNA, LLC
EVALUATION OF PROPOSED CHANGE

UNIT 1 AND UNIT 2 CHANGES
TO TECHNICAL SPECIFICATION 3.4.10

PPL EVALUATION

Subject: UNIT 1 AND UNIT 2 CHANGE TO TECHNICAL SPECIFICATION 3.4.10

1.0 DESCRIPTION

In accordance with 10 CFR 50.90, this is a request to amend Facility Operating License Nos. NPF-14 and NPF-22 for PPL Susquehanna, LLC (PPL), Susquehanna Steam Electric Station (SSES) Unit 1 and Unit 2. The proposed changes are to the SSES Technical Specification (TS) 3.4.10, "RCS Pressure and Temperature (P/T) Limits," which are revisions to the P/T Limits curves. The primary effect of the revision is to provide P/T Limits curves that extend into the vacuum region to mitigate the risk of a level transient during startup and shutdown.

2.0 PROPOSED CHANGES

The proposed changes are to TS Figures 3.4.10-1, 3.4.10-2, and 3.4.10-3, which show the P/T Limits curves for in-service leakage and hydrostatic testing, non-nuclear heatup and cooldown, and criticality, respectively.

The proposed P/T Limits curves are valid for 35.7 EFPY for SSES Unit 1 and 30.2 EFPY for SSES Unit 2. The plotted values of the proposed curves at and above the 0 psig value for the reactor vessel top head pressure are identical to the plotted values on the present curves contained in NRC-approved amendments 232 and 209 for Unit 1 and Unit 2, respectively (Reference 7.1). The proposed change for each P/T Limits curve is to extend the curve below 0 psig to define the minimum reactor vessel metal temperature at a reactor vessel tophead pressure below 0 psig is 70 degrees F.

The marked-up TS pages are provided in Attachment 1 to this submittal. Attachment 2 contains marked-up TS Bases pages as a result of the TS changes.

3.0 BACKGROUND

As part of the Reactor Coolant System (RCS), the reactor pressure vessel (RPV) must be operated in accordance with the P/T Limits curves, as specified in TS 3.4.10, to maintain adequate margin against non-ductile failure, consistent with the 10 CFR 50 Appendix G requirements. Recently it has been identified that some plants, including SSES Units 1 and 2, can be operated in a manner such that the RPV experiences a vacuum during the early stages of startup and the latter stages of shutdown. The present P/T Limits curves do not address operation with the RPV pressure at less than 0 psig. Therefore, in order to operate within the specified P/T Limits, the RPV cannot be subjected to a vacuum.

Licensee Event Report (LER) 50-387(388)/2014-001-00, transmitted to the NRC in PLA-7146 (Reference 7.2), reported that there have been reactor startups and shutdowns at SSES during which the RPV pressure dropped below 0 psig. The analysis performed to determine the safety significance, as further detailed in Section 4.0, concluded that operation with the RPV pressure at less than 0 psig has no adverse impact on the structural integrity of the RPVs. One of the planned corrective actions for the LER is to prepare a change to the P/T Limits curves to address this issue, which is the intent of this submittal and evaluation.

The additional steps and precautions that must be taken by plant operators in order to prevent the RPV from being subjected to a vacuum during startups and shutdowns have raised concerns. One such concern involves the increased potential of an RPV level transient due to opening the main steam isolation valves (MSIVs) with pressure in the RPV during a startup. Another concern is for potential reactivity control issues. With an emphasis on maintaining and enhancing nuclear safety, the desire is to eliminate the concerns by allowing the operators to perform reactor startups with the MSIVs open, which results in an RPV pressure at less than 0 psig. The proposed change to the P/T Limits curves is necessary to allow operation with the RPV at a vacuum.

4.0 TECHNICAL SAFETY ANALYSIS OF THE PROPOSED CHANGES

The P/T Limits curves 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 non-ductile failure of the reactor coolant pressure boundary, a condition that is unanalyzed. The operating limits for pressure and temperature are required for three categories of operation: (a) hydrostatic pressure tests and leak tests, referred to as Curve A; (b) non-nuclear heatup/cooldown and low-level physics tests, referred to as Curve B; and (c) core critical operations, referred to as Curve C.

The methodology used to develop P/T curves is described in the Bases to TS 3.4.10. There are three regions of the RPV that are evaluated: (1) the beltline region, (2) the bottom head region, and (3) the feedwater nozzle/upper vessel region. These regions bound all other regions with respect to brittle fracture.

All components in the RCS are designed to withstand the effects of cyclic loads due to system temperature and pressure changes. Normal load transients, reactor trips, and startup and shutdown operations introduce these cyclic loads. During startup and shutdown, the rates of temperature and pressure changes are limited so that the maximum specified heatup and cooldown rates are consistent with the design assumptions and satisfy the stress limits for cyclic operation.

The heatup and cooldown process for SSES Unit 1 and SSES Unit 2 is controlled by P/T Limits curves, which are developed based on fracture mechanics analysis. The present

SSES Unit 1 and SSES Unit 2 TS Figures 3.4.10-1, 3.4.10-2, and 3.4.10-3, Curves A, B, and C, respectively, represent the reactor pressure vs. minimum vessel temperature limits. These limits are developed according to Appendix G of the ASME Boiler and Pressure Vessel Code, Section XI, and incorporate a number of safety margins.

As stated in the Background section above, the present P/T Limits curves do not address operation with the RPV pressure at less than 0 psig. 10 CFR 50 Appendix G requires that operating limits on the RPV metal temperature and internal pressure be developed such that adequate margin against non-ductile failure exists for all normal operating conditions and anticipated operating occurrences. The methods of the ASME Boiler and Pressure Vessel Code, Section XI, non-mandatory Appendix G are cited in 10 CFR 50 Appendix G, as being acceptable to demonstrate the required margins against non-ductile failure. These methods require the conservative postulation of a ¼ wall thickness flaw with aspect ratio (length to depth) of 6:1. Further, only internal pressure and through-wall thermal gradients must be considered when calculating the driving force acting on the postulated flaws. Thus, the methods used to develop the P/T Limits curves do not specifically address a negative internal pressure in the RPV.

The absolute maximum vacuum is assumed to be no greater than 15 psig. This assumes the possibility of drawing a near perfect vacuum on the vessel, coupled with a 0.5 psig containment pressure. When subjected to a vacuum, the RPV will experience a uniform compressive membrane loading across the vessel wall caused by the ambient external pressure being larger than the internal pressure. Consequently, the driving force acting on the tip of a postulated flaw in any location will be reduced from that calculated for the 0 psig point on the P/T Limits curves. In other words, the applied stress intensity factor at the postulated crack tip, when the RPV experiences a vacuum, is less than the applied stress intensity factor when the RPV experiences a positive internal pressure. While it is understood that the reduction in the applied stress intensity factor is miniscule at even the maximum vacuum, the point to be made is that the applied stress intensity factor will be less at any vacuum pressure than at 0 psig. Thus, the RPV metal temperature required for an internal pressure of 0 psig is applicable and conservative for RPV operation with a vacuum.

From a structural design perspective, Article I-11, Vessels and Tubular Products under External Pressure, from the ASME Code, Section III, 1968 Edition, provides the rules to determine the acceptable external pressure on a pressure vessel. Using conservative design values for the RPV dimensions and material, it was determined that the RPV shell and head stresses remain acceptable with an external pressure in excess of 400 psig. An external pressure of 400 psig is significantly greater than the combination of any possible vacuum in the RPV and the maximum containment pressurization.

5.0 REGULATORY SAFETY ANALYSIS

5.1 No Significant Hazards Consideration

The Commission has provided standards in 10 CFR 50.92(c) for determining whether a significant hazards consideration exists. A proposed amendment to an operating license for a facility involves no significant hazards consideration if operation of the facility in accordance with the proposed amendment would not (1) involve a significant increase in the probability or consequences of an accident previously evaluated; (2) create the possibility of a new or different kind of accident from any accident previously evaluated; or (3) involve a significant reduction in a margin of safety.

PPL proposes changes to Appendix A, Technical Specifications (TS), of Facility Operating License Nos. NPF-14 and NPF-22 for the Susquehanna Steam Electric Station (SSES) Units 1 and 2, respectively.

The proposed changes revise TS Section 3.4.10, "RCS Pressure and Temperature (P/T) Limits," by adding a clarification on each of the P/T Limits curves to allow operation at an RPV pressure of less than 0 psig.

In accordance with the criteria set forth in 10 CFR 50.92, PPL has evaluated the proposed TS change and determined it does not represent a significant hazards consideration. The following is provided in support of this conclusion.

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

   No. The proposed changes request that the P/T limits curves in TS 3.4.10, "RCS Pressure and Temperature (P/T) Limits" be revised by extending each of the P/T Limits curves below 0 psig to allow operation with the RPV at a vacuum.

   The P/T curves are used as operational limits 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 P/T curves provide assurance that station operation is consistent with previously evaluated accidents. Thus, the probability of an accident or the radiological consequences of an accident previously evaluated are not significantly increased.

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

   No. The proposed changes do not change the response of any plant equipment to transient conditions. The proposed changes do not introduce any new equipment, modes of system operation, or failure mechanisms.

   Therefore, there are no new types of failures or new or different kinds of accidents or transients that could be created by these changes. The proposed changes do not create the possibility of a new or different kind of accident from any accident previously evaluated.

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

   No. The consequences of a previously evaluated accident are not increased by these proposed changes, since the Loss of Coolant Accident analyzed in the FSAR assumes a complete break of the reactor coolant pressure boundary. The proposed changes to the P/T Limits curves do not change this assumption.

   Therefore, the proposed changes do not involve a significant reduction in a margin of safety.

Conclusion:

Based upon the above responses, PPL concludes that the proposed amendment presents no significant hazards consideration under the standards set forth in 10 CFR 50.92(c), "Issuance of Amendment," and, accordingly, a finding of no significant hazards consideration is justified.

5.2 Applicable Regulatory Requirements/Criteria

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 non-ductile failure of the reactor coolant pressure boundary, a condition that is unanalyzed. Therefore, the P/T limits curves must be included in the TS in accordance with 10 CFR 50.36(c)(2)(ii), "Limiting Conditions for Operation."

The proposed P/T curves, and the methodology used to develop them, comply with the requirements for monitoring fracture toughness, minimum temperature, and performing material surveillances in accordance with 10 CFR 50 Appendix G, "Fracture Toughness Requirements, and the 1998 Edition (2000 Addenda) of ASME Code, Section XI, Appendix G."

5.3 Precedents

No specific precedent is used to support the technical evaluation of this proposal; however, and as of July 2014, the TS Task Force and NRC discussed several license amendment requests to revise the P/T Limits TS to allow RCS pressure to be less than 0 psig. The Task Force reported that plants with a Pressure and Temperature Limits Report (PTLR) already in place do not require an amendment for this issue, and as a result, there was no generic resolution identified for the issue at that time (e.g., the PTLR is a licensee-controlled document.) The NRC is currently reviewing a similar proposal to this request in which the P/T limit curves are extended into the vacuum region.

- Perry Nuclear Power Plant "Request for Licensing Action to Amend Technical Specification 3.4.11, "RCS Pressure and Temperature (P/T) Limits," dated June 23, 2014, (Accession No. ML14174A633).

Plants that have recently issued Licensee Event Reports (LERs) to describe a failure to comply with a P/T limit in their TS at the lowest pressure value in the P/T limit curve figures are currently developing their own resolutions to this issue. For many plants with PTLR curves already in place, their PTLR curves will be updated to recognize that the reactor vessel may be operated at a vacuum. The April 2014, SSES Unit 1 and 2 LER (Reference 7.2) describes similar conditions for this station, and the planned action of making this change to the P/T limit curves in the TS.

6.0 ENVIRONMENTAL CONSIDERATION

10 CFR 51.22(c)(9) identifies certain licensing and regulatory actions, which are eligible for categorical exclusion from the requirement to perform an environmental assessment. A proposed amendment to an operating license for a facility does not require an environmental assessment if operation of the facility in accordance with the proposed amendment would not (1) involve a significant hazards consideration; (2) result in a significant change in the types or significant increase in the amounts of any effluents that may be released offsite; or (3) result in a significant increase in individual or cumulative occupational radiation exposure.

PPL has evaluated the proposed change and has determined that the proposed change meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Accordingly, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment needs to be prepared in connection with issuance of the amendment. This determination, using the above criteria, is:

1. As demonstrated in the No Significant Hazards Consideration Evaluation, the proposed amendment does not involve a significant hazards consideration.

2. There is no significant change in the types or significant increase in the amounts of any effluents that may be released offsite. The proposed change does not involve any physical alteration of the plant (no new or different type of equipment will be permanently installed) or change in methods governing normal plant operation.

3. There is no significant increase in individual or cumulative occupational radiation exposure. The proposed change does not involve any physical alteration of the plant (no new or different type of equipment will be permanently installed) or change in methods governing normal plant operation.

7.0 REFERENCES

7.1 Letter from R. V. Guzman (USNRC) to B. T. McKinney (PPL), "Susquehanna Steam Electric Station, Units 1 and 2 – Issuance of Amendment Re: Revision to Technical Specification 3.4.10, Reactor Coolant System Pressure and Temperature Limits (TAC Nos. MC8646 and MC8647)," dated March 30, 2006.

7.2 PLA-7146, Mr. J. A. Franke to Document Control Desk (USNRC), "Susquehanna Steam Electric Station Licensee Event Report 50-387 (388)/2014-001-00 Unit 1 License No. NPF-14 Unit 2 License No. NPF-22," dated April 7, 2014.

ATTACHMENT 1 TO PLA-7181

PPL SUSQUEHANNA, LLC

PROPOSED TECHNICAL SPECIFICATION CHANGE (MARKUPS)

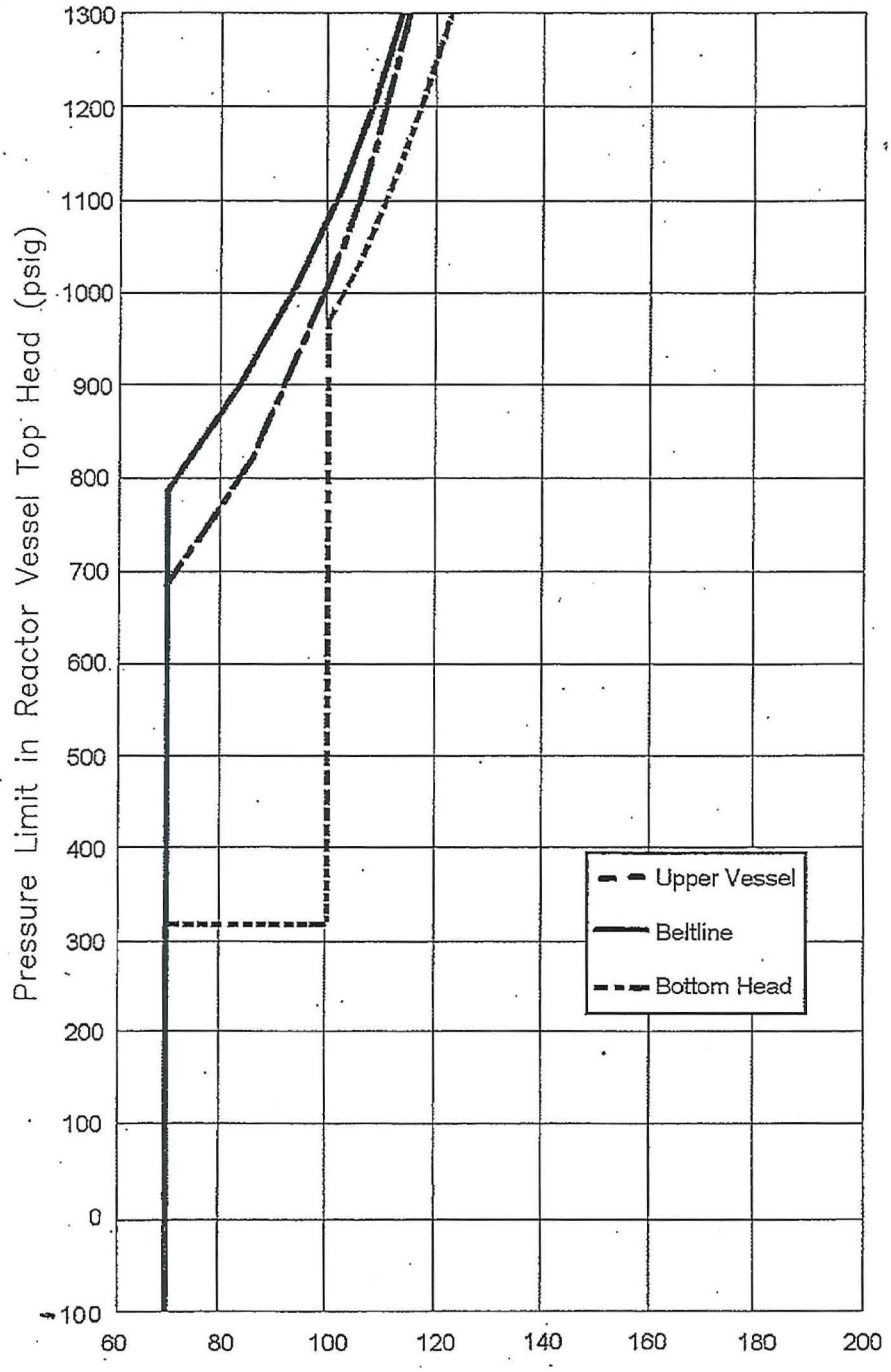

FIGURE 3.4.10–1
System Hydrotest Limit with Fuel in Vessel for 35.7 EFPY
(Curve A)

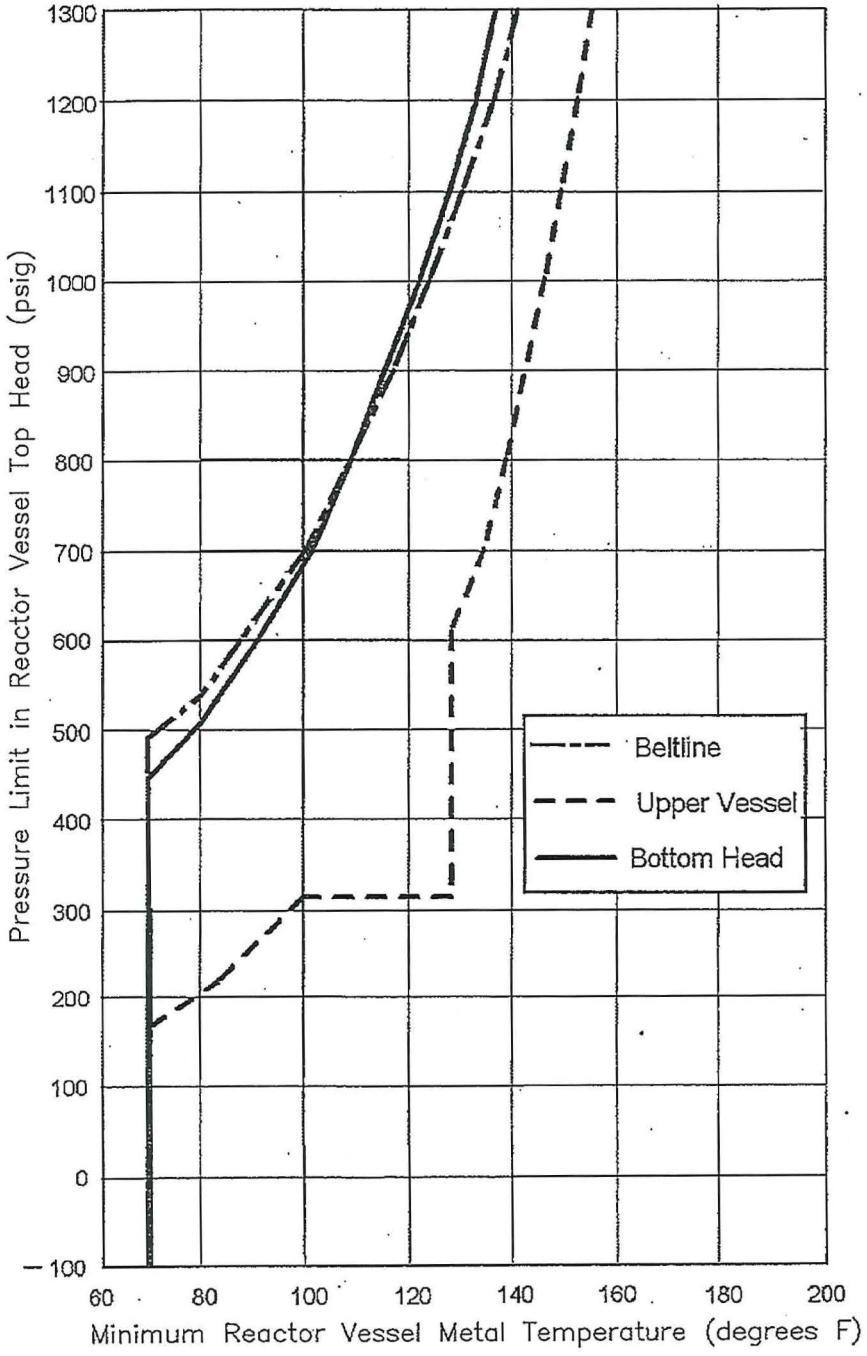

FIGURE 3.4.10–2
Non–Nuclear Heating Limit for 35.7 EFPY
(Curve B)

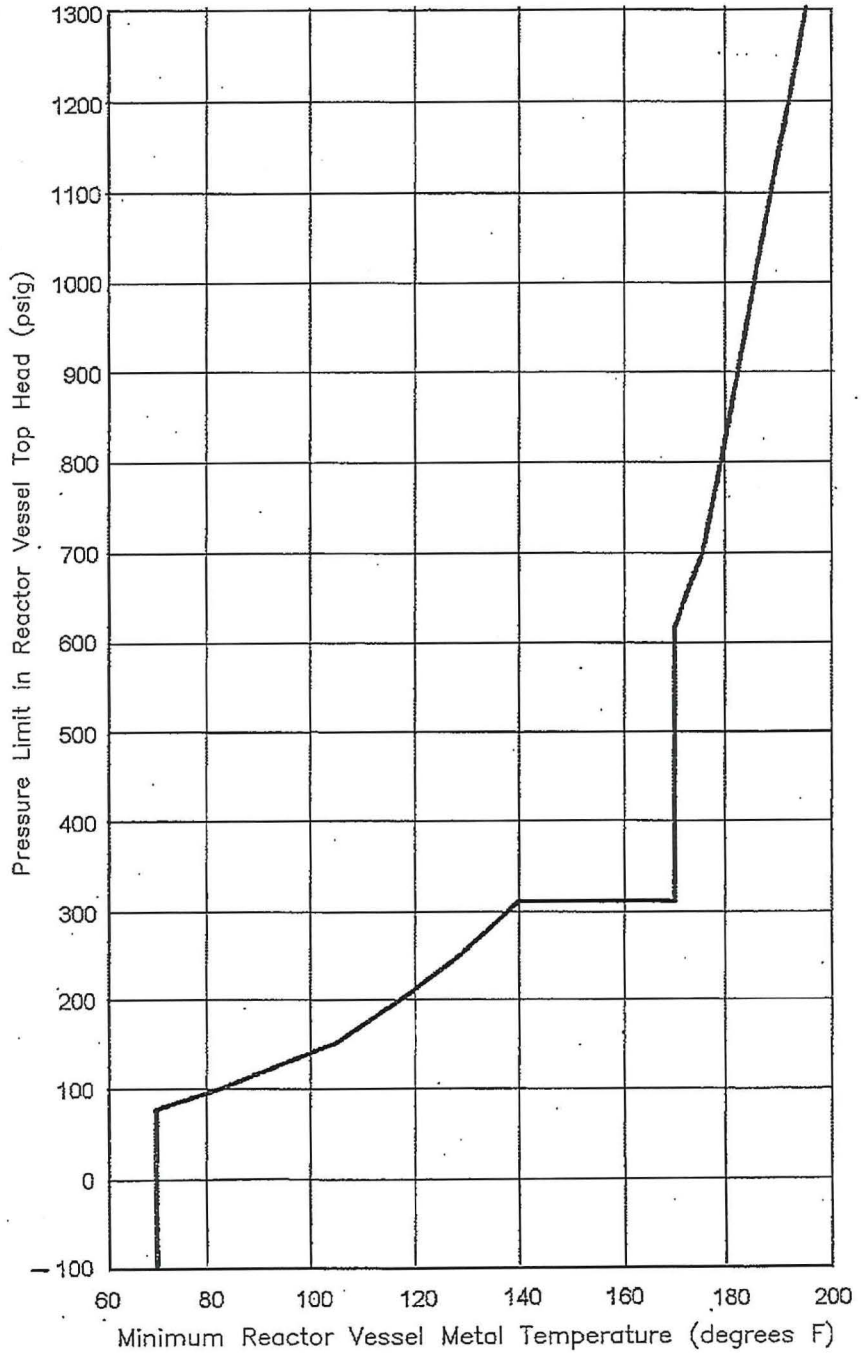

FIGURE 3.4.10–3
Nuclear (Core Critical) Limit for 35.7 EFPY
(Curve C)

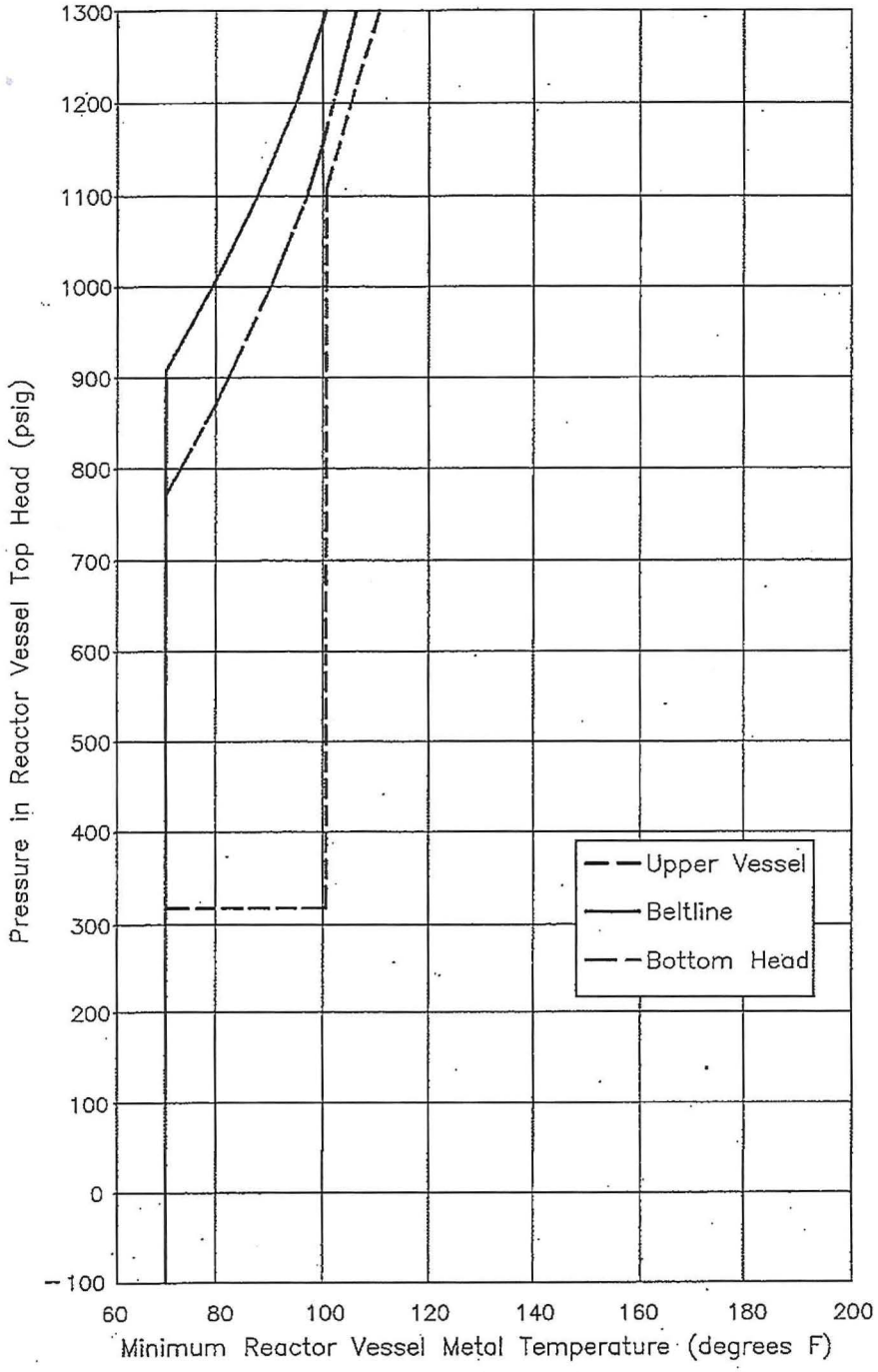

Figure 3.4.10–1
System Hydrotest Limit with Fuel in Vessel for 30.2 EFPY
(Curve A)

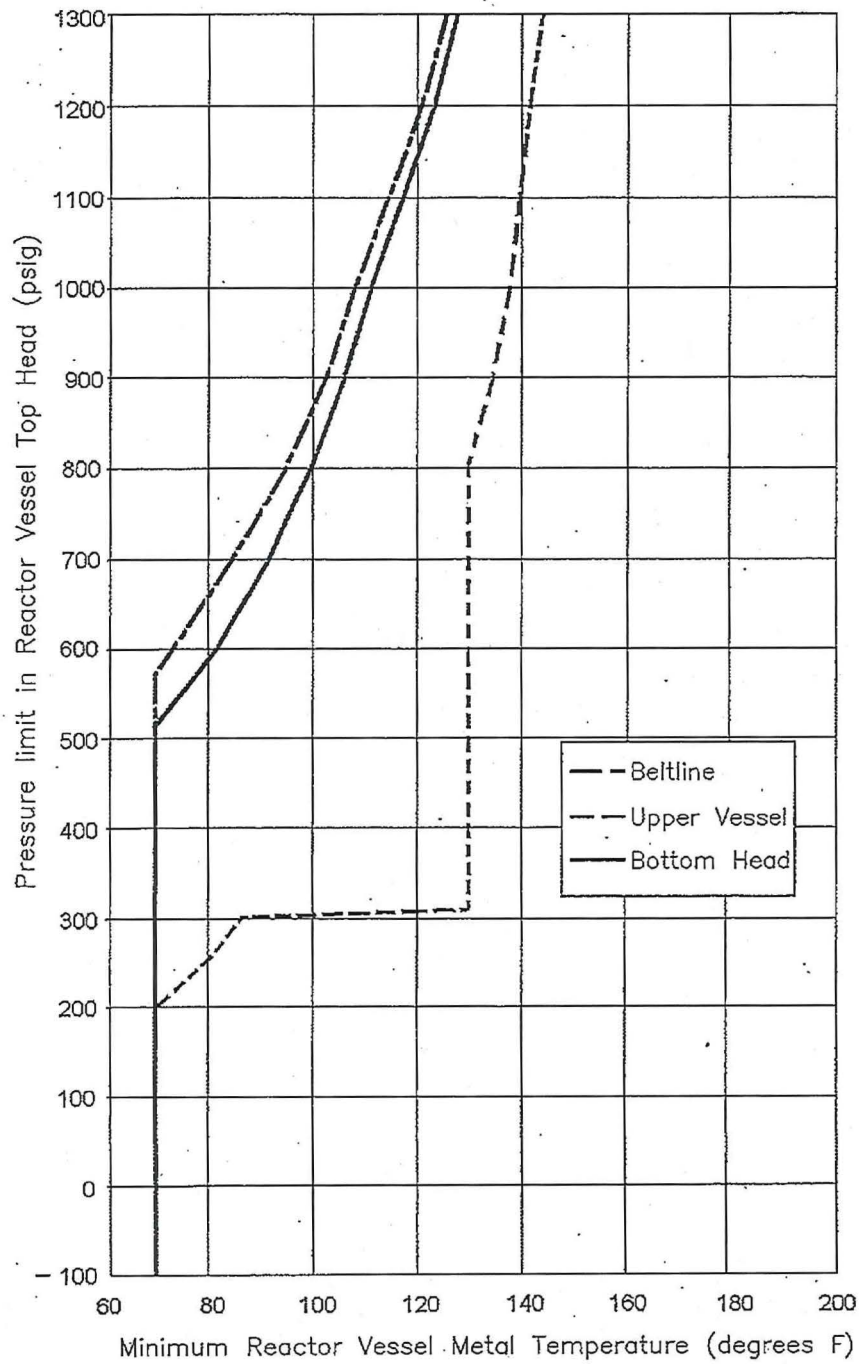

Figure 3.4.10–2
Non–Nuclear Heating Limit for 30.2 EFPY
(Curve B)

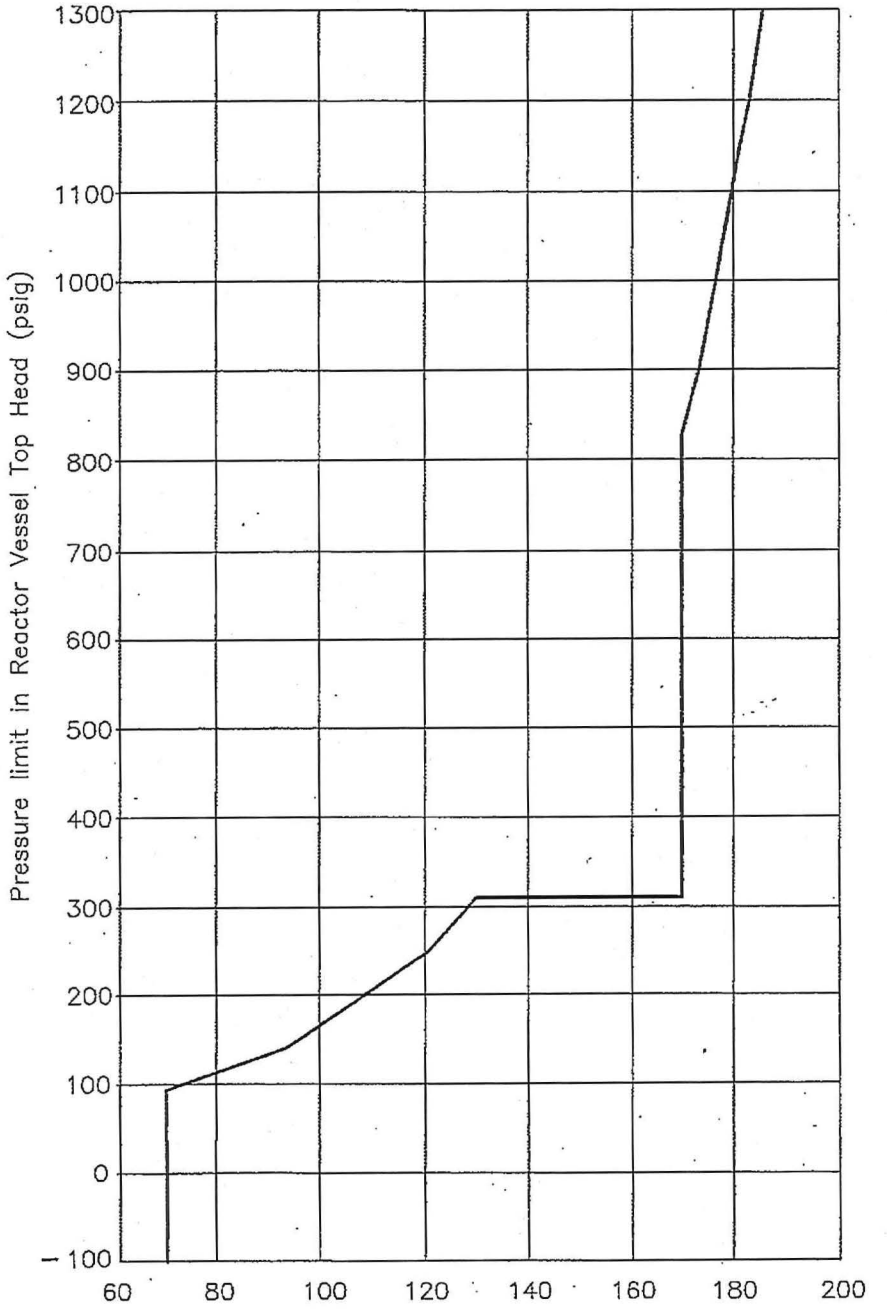

FIGURE 3.4.10–3
Nuclear (Core Critical) Limit for 30.2 EFPY
(Curve C)

ATTACHMENT 2 TO PLA-7181

PPL SUSQUEHANNA, LLC

PROPOSED TECHNICAL SPECIFICATION BASES CHANGE (MARKUPS)

BASES

LCO (continued)

Curve A must be used for any ASME Section III Design Hydrostatic Tests performed at unsaturated reactor conditions. Curve A may also be used for ASME Section XI inservice leakage and hydrostatic testing when heatup and cooldown rates can be limited to 20°F in a one-hour period. Curve A is based on pressure stresses only. Thermal stresses are assumed to be insignificant. Therefore, heatup and cooldown rates are limited to 20°F in a one-hour period when using Curve A to ensure minimal thermal stresses. The recirculation loop suction line temperatures should be monitored to determine the temperature change rate.

Curves B and C are to be used for non-nuclear and nuclear heatup and cooldown, respectively. In addition, Curve B may be used for ASME Section XI inservice leakage and hydrostatic testing, but not for ASME Section III Design Hydrostatic Tests performed at unsaturated reactor conditions. Heatup and cooldown rates are limited to 100°F in a one-hour period when using Curves B and C. This limits the thermal gradient through the vessel wall, which is used to calculate the thermal stresses in the vessel wall. Thus, the LCO for the rate of coolant temperature change limits the thermal stresses and ensures the validity of the P/T curves. The vessel beltline fracture analysis assumes a 100°F/hr coolant heatup or cooldown rate in the beltline area. The 100°F limit in a one-hour period applies to the coolant in the beltline region, and takes into account the thermal inertia of the vessel wall. Steam dome saturation temperature (T_{SAT}), as derived from steam dome pressure, should be monitored to determine the beltline temperature change rate at temperatures above 212°F. At temperatures below 212°F, the recirculation loop suction line temperatures should be monitored.

During heatups and cooldowns, the reactor vessel could experience a vacuum (negative pressure) at low temperatures (unsaturated conditions) and low rates of temperature change. Under a vacuum, the vessel wall would experience a uniform compressive loading, which would counteract the tensile stress due to any thermal gradients through the vessel wall. To ensure the margin to brittle fracture is no less than at any other pressure, Curves A, B, and C require a minimum vessel metal temperature of 70°F when the reactor vessel is at a negative pressure.

Violation of the limits places the reactor vessel outside of the bounds of the stress analyses and can increase stresses in other RCS components. The consequences depend on several factors, as follows:

a. The severity of the departure from the allowable operating pressure temperature 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 potential for violating a P/T limit exists at all times. For example, P/T limit violations could result from ambient temperature conditions that result in the reactor vessel metal temperature being less than the minimum allowed temperature for boltup. Therefore, this LCO is applicable even when fuel is not loaded in the core.

(continued)

BASES

LCO (continued)

Curve A must be used for any ASME Section III Design Hydrostatic Tests performed at unsaturated reactor conditions. Curve A may also be used for ASME Section XI inservice leakage and hydrostatic testing when heatup and cooldown rates can be limited to 20°F in a one-hour period. Curve A is based on pressure stresses only. Thermal stresses are assumed to be insignificant. Therefore, heatup and cooldown rates are limited to 20°F in a one-hour period when using Curve A to ensure minimal thermal stresses. The recirculation loop suction line temperatures should be monitored to determine the temperature change rate.

Curves B and C are to be used for non-nuclear and nuclear heatup and cooldown, respectively. In addition, Curve B may be used for ASME Section XI inservice leakage and hydrostatic testing, but not for ASME Section III Design Hydrostatic Tests performed at unsaturated reactor conditions. Heatup and cooldown rates are limited to 100°F in a one-hour period when using Curves B and C. This limits the thermal gradient through the vessel wall, which is used to calculate the thermal stresses in the vessel wall. Thus, the LCO for the rate of coolant temperature change limits the thermal stresses and ensures the validity of the P/T curves. The vessel belt-line fracture analysis assumes a 100°F/hr coolant heatup or cooldown rate in the beltline area. The 100°F limit in a one-hour period applies to the coolant in the beltline region, and takes into account the thermal inertia of the vessel wall. Steam dome saturation temperature (T_{SAT}), as derived from steam dome pressure, should be monitored to determine the beltline temperature change rate at temperatures above 212°F. At temperatures below 212°F, the recirculation loop suction line temperatures should be monitored.

During heatups and cooldowns, the reactor vessel could experience a vacuum (negative pressure) at low temperatures (unsaturated conditions) and low rates of temperature change. Under a vacuum, the vessel wall would experience a uniform compressive loading, which would counteract the tensile stress due to any thermal gradients through the vessel wall. To ensure the margin to brittle fracture is no less than at any other pressure, Curves A, B, and C require a minimum vessel metal temperature of 70°F when the reactor vessel is at a negative pressure.

Violation of the limits places the reactor vessel outside of the bounds of the stress analyses and can increase stresses in other RCS components. The consequences depend on several factors, as follows:

a. The severity of the departure from the allowable operating pressure temperature 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 potential for violating a P/T limit exists at all times. For example, P/T limit violations could result from ambient temperature conditions that result in the reactor vessel metal temperature being less than the minimum allowed temperature for boltup. Therefore, this LCO is applicable even when fuel is not loaded in the core.

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