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November 16, 2000
CEOG-00-326

NRC Project 692

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

Subject: **Response to Information Request concerning CEOG Topical Report CE NPSD-683, Rev 06**

Reference: J. Cushing, NRC, to R. Bernier, CEOG, "Request for Additional Information regarding CE NPSD-683, Rev 06, "Development of a RCS Pressure and Temperature Limits Report for the Removal of P-T Limits and LTOP Requirements from the Technical Specifications," (TAC MA 9561), letter dated October 30, 2000

The purpose of this letter is to submit the attached responses as requested by the NRC in the above reference. The CEOG respectfully requests that the staff perform an expeditious review of these responses in order to support forthcoming license amendment requests from CEOG licensees.

Westinghouse and the CEOG utilities are prepared to discuss these responses and changes to the topical report and will meet with the staff, if necessary, in order to expedite this review. Please do not hesitate to call me at 623-393-5882 or Gordon Bischoff, CEOG Project Office, at 860-285-5494 if you have any questions.

Sincerely,

Richard G. Bernier

Richard Bernier
Chairman, CE Owners Group

Attachment: As Stated
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CEOG Responses to NRC

REQUEST FOR ADDITIONAL INFORMATION

J. Cushing (NRC) letter to R. Bernier (CEOG)

Dated October 30, 2000

REGARDING COMBUSTION ENGINEERING OWNERS GROUP

TOPICAL REPORT CE NPSD-683, REV. 06

"DEVELOPMENT OF A RCS PRESSURE AND TEMPERATURE LIMITS

REPORT FOR THE REMOVAL OF P-T LIMITS AND LTOP REQUIREMENTS

FROM THE TECHNICAL SPECIFICATIONS"

General G1

COMMENT: ***Please include a matrix in the methodology showing the information required to be submitted in the plant specific submittals to complete the methodology (i. e., energy addition, valve characteristics, etc).***

RESPONSE:

The following section will be added to the report:

3.5 Matrix for Plant-Specific Methodology Submittals

The following information is required to be provided in the plant-specific methodology submittals to complete the methodology description contained in this Topical Report:

(a) Description of the analytical method used in the energy addition transient analysis (Section 3.3.4);

(b) Description of the analytical method used in the mass addition transient analysis, if different from that in Section 3.3.5;

(c) Method for selection of relief valve setpoints (Section 3.3.2);

(d) Justification of use of subcooled water conditions or a steam volume in the pressurizer (ibid.);

(e) Justification of a less conservative method for the determination of decay heat contribution (ibid.);

(f) Justification for operator action time for transient mitigation or termination (Section 3.3.2);

(g) Correlations used for developing PORV discharge characteristics (Section 3.3.3.2);

(h) Spring relief valve discharge characteristic, if different from those in Sections 3.3.3.3 and 3.3.3.4.

(i) Application of reactor coolant temperature instrumentation uncertainty (Section 3.4.2);

(j) Justification for mass and energy addition transient mitigation which credit presence of nitrogen in the pressurizer. (Section 3.3.4 and Section 3.3.5);

(k) Any other deviation from the methodology included in Section 3.0.

General G2

COMMENT: ***The finite element methodology for calculating the allowable pressures due to membrane stress intensity factors was not described in the CE NSSS methodology of the topical report. Please provide a detailed description of the methodology.***

RESPONSE:

Please refer to proprietary submittal, "Technical Methodology Paper Comparing ABB/CE PT Curve to ASME Section III, Appendix G," 063-PENG-ER-096, Rev 00, dated 1/22/98 for a description of the methodology. This document was reviewed under NRC docket number 50-286, TAC NO. M99928.

Clarification C1

COMMENT: ***On page 3-3 in the third paragraph, it is stated that the LTOP system may include a combination of valves. It is not clear what is meant by this statement. Usually, one relief valve is sufficient for mitigating LTOP events. A second valve is usually required for redundancy. The statement seems to imply that some plants require more than one relief valve to mitigate LTOP events. Please explain the statement and provide examples of LTOP systems where a combination of valves is relied on for LTOP.***

RESPONSE:

A "combination of valves" means one set of LTOP valves for one portion of the LTOP temperature region and another set of LTOP valves for another portion of the LTOP temperature region. For example, in FPL St. Lucie Unit 2, two SDCS relief valves provide LTOP at low RCS temperatures, while two PORVs provide LTOP in the remainder of the LTOP temperature region. The transient analyses, of course, assume only one valve, either a SDCS relief valve or a PORV, operable, to satisfy the single failure criterion.

Clarification C2

COMMENT: ***On page 3-4 in the second paragraph, it is stated that according to Provision 3 of Attachment 1 to GL 96-03, "Relocation of the Pressure Temperature Limit Curves and Low Temperature Overpressure Protection System Limits," the LTOP methodology must reference ASME Code Case N-640. The GL actually suggests referencing Code Case N-514. However, depending on the plant-specific use of code cases, it may be appropriate to reference either case. A clarification of which code case to reference appears to be needed.***

RESPONSE:

The sentence will be modified to reference Code Case N-514 to be in compliance with GL 96-03.

Clarification C3

COMMENT: ***On page 5-3, the definition of "beltline" should conform to the definition stated in Section II of 10 CFR Part 50, Appendix G.***

RESPONSE:

The beginning of the last paragraph on page 5-2 starting with "10 CFR Part 50, Appendix G defines the beltline as..." will be modified as follows":

> "Per Section II of 10 CFR Part 50, Appendix G, the beltline or beltline region of reactor vessel is defined as... "

Also, the beginning of the next paragraph on page 5-3 that starts with "For the CE NSSS design, the "beltline" refers to the..." will be modified as follows:

> "Consistent with the above definition, the "beltline" for the CE NSSS design refers to the..."

In the same paragraph, the following will be inserted at the end of the second to last sentence.

> "... but does not include discontinuities, such as nozzles, ledges, etc."

Clarification C4

COMMENT: ***On page 6-3, the staff recommends adding carbon steels in addition to the ferritic steel material mentioned for the reactor coolant pressure boundary piping, pumps and valves.***

RESPONSE:

The first sentence at the top of page 6-3 will be modified as follows:

"The lowest service temperature is established based on the limiting RT_{NDT} for ferritic carbon and low alloy steel piping, pump, and valve materials in the RCPB."

Technical T1

COMMENT: ***On Page 3-7 in the last paragraph, Page 3-10 in the third paragraph, and Page 3-17 in the second paragraph, it is indicated that analyses can assume that a steam volume exists in the pressurizer if a limit on pressurizer steam volume is included in the TS. TS restrictions normally establish the amount (volume) of steam or gas that must exist in the pressurizer but do not REQUIRE that the volume consist of steam. At lower temperatures, a licensee may use nitrogen as a cover gas in the pressurizer instead of steam. The existence of nitrogen in place of steam can affect the pressurization rate. Please address such situations in your methodology. (See 10 CFR 50.72 Event Notification (EN) Number 35705 dated May 12, 1999 from Oconee.)***

RESPONSE:

Current CE Methodology does acknowledge a steam volume to minimize peak pressure in some instances to improve operating margin, with the provision that the Technical Specifications identify the assumed steam volume as an operating criterion.

The body of the report will be modified to elaborate on the potential for nitrogen and other non-condensable gasses in the pressurizer, and that this cannot be considered as part of the steam volume due to its non-conservative effect on the pressure transient.

Suggested Modified Text:

Page 3-7

An additional qualifier for the limiting events is pressurizer water level. This is one of the design bases for LTOP limitations. Each energy addition and mass addition event's definition must be supplemented by this parameter as "under water-solid conditions" or "with a pressurizer steam volume of...% (or *cu ft*)." The LTOP setpoints and limitations can be based on the transient analyses that assume a steam volume in the pressurizer only if a limit on pressurizer steam volume is in the TS. To take credit for a restriction for transient mitigation in the pressure transient analyses, this restriction must be in the TS. If there is no TS controlling the restriction (e.g., limitations on HPSI and charging pump operation or pressurizer level),

then the restriction cannot be credited in the analysis or put in the PTLR. The analysis must also account for pressurizer level (volume) instrumentation uncertainty. The uncertainty is determined using the guidance contained in Regulatory Guide 1.105 (Reference 20) and ISA Standard S67.04-1994 (Reference 13). Also, in relating the analysis assumption for steam volume to an indicated pressurizer level, consideration must also be made for the presence of potential non-condensable gas, such as nitrogen, in the apparent pressurizer steam space. The presence of gas in the vapor space can have a detrimental effect on any potential transient.

Page 3-10

- *A pressurizer steam volume can be credited in transient mitigation.*
  A steam volume in the pressurizer can be assumed, if the TS contain a limitation on a maximum pressurizer water level (or a minimum steam volume) for the LTOP temperature region, or a portion thereof. As the energy addition and mass addition transient analysis methods differ, discussions on the application of the steam volume are provided in the appropriate sections of this report (see Sections 3.3.4 and 3.3.5). In relating the analysis assumption for steam volume to an indicated pressurizer level in the TS, consideration must also be made for the presence of potential non-condensable gas, such as nitrogen, in the apparent pressurizer steam space. The presence of gas in the steam space can have a detrimental effect on any potential transient. For operating conditions where the plant will expect to have gas in the steam space of the pressurizer, the water solid transient will be bounding and the appropriate peak pressure must be addressed in the LTOP evaluation.

Page 3-17

A steam volume in the pressurizer can also be assumed in non-bounding analyses of the energy addition transient, consistent with the assumption in Section 3.3.2. With a steam volume in the pressurizer, pressurization rate prior to valve opening can be significantly reduced as compared with that in the water-solid pressurizer. This results in a reduction in the valve opening pressure, due to a smaller pressure accumulation during opening time. Such an analysis determines the peak transient pressure with relief valve mitigation and can serve as a design basis for the LTOP system, whenever a pressurizer level limitation (or steam volume) is included in the TS. In relating the analysis assumption for steam volume to an indicated pressurizer level in the TS, consideration must also be made for the presence of potential non-condensable gas, such as nitrogen, in the apparent pressurizer steam space. The presence of gas in the steam space can have a detrimental effect on any potential transient. For operating conditions where the plant will expect to have gas in the steam space of the pressurizer, the water solid transient will be bounding and the appropriate peak pressure must be addressed in the LTOP evaluation.

If a plant so chooses, an energy addition transient can be analyzed with a gas volume, but this must be addressed in the plant specific PTLR submittal as indicated in the matrix of Section 3.5.

Page 3-18/19

A pressurizer steam volume is only credited in establishing pressurization rate prior to relief valve opening, which is then used in the calculation of the pressure accumulation. The latter is added to the nominal setpoint to determine the maximum opening pressure (see Section 3.3.3). Depending on the assumed PORV opening time, a significant reduction in the maximum opening pressure on liquid can be realized, as pressurization rate on steam is much lower than on water. Note that because crediting the steam bubble is only used to improve the peak pressure at opening (and does not change the equilibrium pressure), steam bubble credit benefits those events where the peak pressure at opening (on water) exceeds the equilibrium pressure.

Whenever a pressurizer level limitation (or steam volume) is assumed in an analysis to limit peak pressure, this assumption must be included in the TS. In relating the analysis assumption for steam volume to an indicated pressurizer level in the TS, consideration must also be made for the presence of potential non-condensable gas, such as nitrogen, in the apparent pressurizer steam space. The presence of gas in the steam space can have a detrimental effect on any potential transient. For operating conditions where the plant will expect to have gas in the steam space of the pressurizer, the water solid transient will be bounding and the appropriate peak pressure must be addressed in the LTOP evaluation.

If a plant so chooses, a mass addition transient can be analyzed with a gas volume, but this must be addressed in the plant specific PTLR submittal as indicated in the matrix of Section 3.5.

Technical T2

COMMENT: ***On page 3-11 in the second full paragraph, it is stated that operator action for transient mitigation or termination can be credited 10 minutes after initiation of the event. Does "initiation of the event" refer to the start of the event (i.e., the time at which the event begins) or does it mean the time at which information (e.g., alarms, displays, indicating that an event has occurred) is available to the operator? Specifically, what operator actions are being credited to begin 10 minutes after the initiation of the event? Does the operator verify automatic plant responses before or after the 10 minutes? Are the operator actions being credited "new," or have they all been established as part of the plant's licensing basis? Have the operator actions being credited been modified from those established as part of the licensing basis?***

To fully respond to this question, reference NRC Information Notice 97-78, "Crediting Operator Actions In Place of Automatic Actions and Modifications of Operator Actions, Including Response Times," and the guidance contained in ANSI/ANS-58.8 (1984, or 1994), "Time Response Design Criteria for Safety-Related Operator Actions."

RESPONSE:

The documents cited in the NRC comment have not been a part of the Westinghouse CE LTOP methodology. The assumption for operator action is proposed to remain in the report, although modified, deferring the justification to those plant-specific PTLR methodologies that use this assumption. This requirement is included in the matrix in the Response to Comment G1 under item f. The write-up in the report will be modified to read as follows:

> "*Operator action time*
>
> Those plants that use operator action for transient mitigation or termination as the first line of defense for LTOP must provide in the plant-specific methodologies justification of operator action time. NRC Information Notice 97-78, "Crediting Operator Actions In Place of Automatic Actions and Modifications of Operator Actions, Including Response Times," and the guidance contained in ANSI/ANS-58.8 (1994), "Time Response Design Criteria for Safety-Related Operator Actions" should be consulted for the operator action time determination."

Technical T3

COMMENT: ***On the bottom of page 3-13, it is stated that pressurization rate is determined for each applicable transient via an analysis that produces a pressure vs. time function for <u>discharge from a water solid pressurizer</u>. This statement appears to be in regard to calculating the pressurization rate during accumulation. Consistent with the assumption regarding valve operation, which is stated earlier as "during the opening time period, the PORV remains closed and then opens instantaneously" it would be inappropriate to assume that the valve is open and discharging when calculating the pressurization rate during accumulation. Please justify your statement that the pressurization rate is determined for each applicable transient via an analysis that produces a pressure vs. time function for <u>discharge</u> from a water solid pressurizer. In addition, your statement on page 3-13 implies that you will calculate the pressurization rate (for purposes of accumulation) based on a water solid pressurizer. With certain restrictions, the report allows the use of an assumption that a steam volume exists in the pressurizer. This allowance is included to reduce the pressurization rate. Please explain how the pressurization rate is calculated for purposes of calculating accumulation for plants that are allowed to assume that a steam volume exists. Would such a plant assume <u>water solid pressurizer</u> for that calculation?***

RESPONSE:

The cited statement will be modified to read: "Pressurization rate, in psi/sec, is determined for each applicable transient in a closed RCS, i. e., without pressure relief, via an analysis that produces a pressure vs. time function."

Technical T4

COMMENT: ***The discussion under Sections 3.3.3.3 and 3.3.3.4 for the SDC Relief Valves and Pressurizer Relief Valves is lacking in detail when compared to the discussion under Section 3.3.3.2 for Power-Operated Relief Valves. For example, the discussion under the SDC Relief Valves and Pressurizer Relief Valves does not include consideration of flashing at the valve outlet. In addition, although it is stated in the report that the peak transient pressure could be higher than the lift pressure for the valve + the accumulation, no mention of valve curves is made. Also, although it is stated that for these valves, the ASME Code requires that the valves start opening at 3 percent accumulation above the set pressure and reach rated flow position at 10 percent accumulation, no discussion is provided on how the calculation of the resulting pressure increase during accumulation will be performed. Please address these items in the discussion under Sections 3.3.3.3 and 3.3.3.4.***

RESPONSE:

The SDCS relief valves pass subcooled water. A degree of subcooling at the valve inlet during discharge is sufficiently high to result in a discharge coefficient that is essentially independent of subcooling. Accordingly, flashing at the outlet is not an issue for these valves. The rated flow rate at 10% accumulation for the pressurizer relief valve, which is used for LTOP in only one Westinghouse CE NSSS, is determined using equations in the manufacturer's valve manual that account for flashing at the valve outlet.

The Westinghouse CE LTOP methodology assumes the following discharge characteristic for the SDCS and pressurizer relief valves used for LTOP. During a transient, the valve remains closed until inlet pressure reaches 3% above the nominal set pressure. The 3% accumulation is actually the set pressure tolerance, per the ASME Code Article NB-7513.1, which mandates the initiation of the valve opening at no greater than 3% above the set pressure. Should the valve manufacturer specify a higher than 3% value, the manufacturer's value should be used in the developing the discharge model in the plant-specific PTLR methodologies.

At 3% accumulation, the valve is assumed to reach 30% of rated flow. Rated flow is reached at 10% accumulation above the nominal set pressure. The discharge model assumes that between 3% accumulation and 10% accumulation, discharge flow rate changes linearly with inlet pressure. It should be noted that in a typical overpressure protection case, only the valve rated flow at 10% accumulation (full flow position) is relevant for transient analyses, as this parameter should ensure that system pressure does not exceed 110% of the design pressure. A similar approach can also be used for LTOP transients, providing conservative results. However, knowing (or assuming) a certain valve behavior between the opening and full flow position and using it in a transient analysis may lead to the determination of the peak transient (or equilibrium) pressure between the opening pressure and 10% accumulation, i. e., at a less than the full open position. A lower peak pressure would allow utilizing a higher heatup and/or cooldown rate.

As either valve is a direct-acting relief valve, no instrumentation uncertainty and corresponding opening delay is applied, as in the case of PORVs.

This model is used in the analyses of mass and energy addition transients that are mitigated by either relief valve. A different relief valve discharge model and/or a valve discharge model above 10% accumulation must be addressed in the plant-specific PTLR methodologies.

Based on the above discussion, the following statement will be added after the 3rd sentence in Section 3.3.3.3 and after the 4th sentence in Section 3.3.3.4:

> "At 3% accumulation, the valve reaches 30% of rated flow. Rated flow is reached at 10% accumulation above the nominal set pressure. Between 3% accumulation and 10% accumulation discharge flow rate changes linearly with inlet pressure. If the discharge model is different and/or a discharge characteristic above 10% accumulation is needed, these must be included in the plant-specific PTLR methodologies, as indicated in the matrix Section 3.5."

Technical T5

COMMENT: ***On Page 3-16, it is stated that the analytical model uses equations for calculating heat transfer in the heated portions of the steam generator tubes from the secondary SG inventory to the reactor coolant. Please explain what is meant by "heated portions." In addition, please explain how the methodology will treat plugged steam generator tubes and how the number of plugged tubes will be determined for use in the analyses. Justify your answers.***

RESPONSE:

The heated portions of SG tubes include active tubes where heat is transferred from the secondary SG inventory outside the tube to the passing primary coolant inside the tube. The active tubes with respect to the LTOP energy addition transient analysis imply portions of the open (not plugged) tubes beyond the tube sheet. Each plant keeps an updated number of plugged SG tubes. Subtracting this number from the total number of SG tubes gives the number of the open tubes. That number is used to determine; (1) the convective heat transfer coefficient inside the tubes and (2) the SG heat transfer area.

Technical T6

COMMENT: ***On the top of page 3-18, it is not clear if the assumptions for pump flow rates provide bounding analysis inputs. For example, it is stated that for both pumps maximized performance is typically based on inservice test acceptance criteria. Inservice test acceptance criteria will likely establish the minimum flow rate required to be delivered by the pumps. For LTOP analyses, it is expected that maximum flow rates be assumed. In addition, the basis for the additional 3-10 percent for HPSI pumps is not presented. Also, the requirement for assuming the maximum flow measured for charging pumps does not address instrumentation uncertainty. Please address these points.***

RESPONSE:

On the presumption that the basis for any utility Inservice Test program is the ASME O&M Code, the current code requirements stipulate that pump performance testing establish the acceptable flow rate measurement range as plus or minus 10% of the established reference point. Thus, the plant may have a performance criteria that allows the pump to deliver as much as 10% more than design, or even more if the reference value (though not expected) is above nominal design. It is also acceptable within the Code requirements for the IST acceptable range to be narrower than the prescribed 10%.

The text of the report will be modified to improve the discussion. The point that the text is meant to acknowledge is that in acknowledging HPSI and charging pump flow in the mass addition event, that a maximized delivery value must be considered; that industry criteria could allow as much as 10% over design flow, and that for some instances the IST program can provide a referenceable maximized flow assumption.

The text will be enhanced to note that when relying upon test acceptance criteria, that measurement uncertainty assumptions must be considered and that also, the current Safety Analysis of record may have already established potential HPSI and charging system maximized delivery.

Suggested Modified Text:

Page 3-17/18

A mass addition event can take place whenever a HPSI and/or charging pump is aligned to the RCS. An inadvertent SIAS is assumed to initiate mass injection to the RCS from all the aligned pumps. The relief valve behavior in a mass addition event is similar to that described for an energy addition event (Section 3.3.4). As a different number of HPSI pumps and/or charging pumps may be operable in a particular temperature region, each pump combination represents an analytical case and should be analyzed, rather than postulating the worst possible combination over the entire LTOP temperature range. Mass addition is assumed to take place at the cold leg centerline and adjustments can be made to the pressurizer. HPSI and charging pump flow in the mass addition event must be a maximized delivery value. Either of the following means can be used as a source for maximized flow. Industry criteria can allow actual flow as much as 10% over design flow. In some instances the plant's IST program can provide a referenceable maximized flow assumption. Alternately, the current assumptions in some of the plant's Safety Analyses may have established potential HPSI and charging system-maximized delivery. When relying upon test acceptance criteria, measurement uncertainty assumptions must be considered.

Technical T7

COMMENT: ***On page 3-18 at the end of the second paragraph, it is stated that the equilibrium pressure is determined for liquid input and discharge. Earlier, under Section 3.3.3.2, it is stated that the PORVs may pass subcooled water, saturated water, and/or steam depending on the pressurizer conditions during***

the transient. It is further stated that especially important is accounting for discharge flow reduction due to flashing at the valve outlet when the discharged water has a low degree of subcooling. Please explain how the degree of subcooling of the discharged water is handled when determining the equilibrium pressure based on liquid discharge.

RESPONSE:

In the development of PORV discharge characteristics, it is always assumed that the pressurizer is water-solid at the saturation conditions. In order to develop a characteristic, i. e., a function of discharge flow rate vs. inlet pressure, a number of the inlet pressures above the initial pressure are assumed. Each assumed inlet pressure is associated with a degree of subcooling at the valve inlet, based on the initial saturation pressure. The greater the assumed pressure, the greater is the flow rate, not just because of the increase in inlet pressure, but, also, due to a greater discharge coefficient, which increases with subcooling. The discharge coefficient vs. subcooling functions and correction factors that are applied to conservatively reduce discharge flow rate are based on the test data that was obtained during the EPRI testing of the PORVs in the early 1980's. The tests performed for various PORVs and initial conditions yielded PORV flow rates that account for flashing in the valve.
Independent of what a PORV discharges at any given moment during a transient, the equilibrium pressure is always determined for liquid discharge. In the case of a water-solid pressurizer, the PORV starts discharging subcooled water immediately upon opening. Again, the degree of subcooling depends on the difference between the initial saturation pressure and pressure at the valve inlet.

When a steam volume is present in the pressurizer, the PORV opens on steam, but is assumed to eventually start discharging subcooled water. As a significantly greater amount of energy is removed from the RCS when steam is discharged, as compared with water, the equilibrium pressure during liquid discharge is greater than during steam discharge. Thus the determination of the equilibrium pressure in a transient with a steam volume in the pressurizer and initial steam discharge is essentially similar to that in a transient with a water-solid pressurizer and initial liquid discharge.

Technical T8

COMMENT: ***On top of Page 3-19 it is stated that accumulation is added to the nominal setpoint to determine the maximum opening pressure. This appears incomplete because it appears to neglect instrumentation uncertainty. Please modify your writeup to include instrumentation uncertainty.***

RESPONSE:

The statement will be modified to read as follows: "The latter is added to the opening pressure (which is the nominal setpoint corrected for uncertainty) to determine the maximum opening pressure (see Section 3.3.3.2)."

Technical T9

COMMENT: ***On Page 3-19 in the second paragraph, it is stated that mass input from the pumps into the RCS determines the decrease in the pressurizer steam volume each time step. This appears incomplete because it does not account for the energy inputs which were converted into equivalent flow rates.***

RESPONSE:

The statement will be modified to read as follows: "Mass input from the pumps into the RCS, supplemented with additional energy inputs, that is converted into an equivalent flow rate, determines the decrease in the pressurizer steam volume at each time increment."

Technical T10

COMMENT: ***On page 3-23 in the last paragraph, it is stated that the flow induced pressure drop depends on the RV flow rate, which is a function of the number of operating RCPs. While not as large, flow from SDC pumps can also have an impact on the pressure drop. Please include the effect of the SDC pumps.***

RESPONSE:

Flow rate from a LPSI pump in the CEOG plants ranges from 1500 to 5000 gpm, whereas a single RCP produces flow rate of the order of 100,000 gpm. As a pressure drop is proportional to flow rate squared, a pressure drop value at 5,000 gpm is only a tiny fraction of the pressure drop at 100,000 gpm. Specifically, $\Delta P_{3000} = (5{,}000/100{,}000)^2\ \Delta P_{100000} \approx 0.0025\Delta P_{100000}$. Disregarding the LPSI pump contribution is inconsequential with respect to the flow induced pressure drop and pressure correction factors.

Technical T11

COMMENT: ***On Page 3-24 in the second paragraph, it is stated the for the LTOP systems that use large capacity (over 1500 gpm) relieve valves connected to the pressurizer, an adjustment must be made to account for the pressure differential between the RV and the pressurizer due to flow induced losses in the surge line. Please justify the value of 1500 gpm.***

RESPONSE:

Liquid flow through a surge line occurs when a relief valve connected to the pressurizer discharges pressurizer inventory during mitigation of an LTOP pressure transient. In the CEOG member plants, the LTOP relief valves connected to the pressurizer are mostly PORVs with relatively small orifices. A typical LTOP analysis for these plants does not account for the surge line pressure drop, as these PORVs pass a relatively small flow, which results in an insignificant surge line pressure drop.

Only one plant has a relatively large LTOP relief valve connected to the pressurizer. For this plant, pressure drop in the surge line was accounted for by adding the value to the peak transient pressure in the pressurizer to arrive at the design peak pressure. Specifically, at a flow rate of 2,000 gpm, the pressure drop was calculated to be 2.2 psid. The value of 1,500 gpm was selected as the appropriate threshold for accounting for this pressure drop. At 1,500 gpm, that pressure drop would be $2.2 \times (1{,}500/2000)^2 = 1.2$ psid. Lower flow rates will yield smaller pressure drops, which can be disregarded, due to conservatism in the calculations of the P-T limits and peak transient pressures.

Editorial E1

COMMENT: ***On Page 3-5 in the second full paragraph it is stated that the LTOP methodology of the report for CE-NSSS designs is consistent with BTP RSB 5-12. The reference should be to BTP RSB 5-2 not 5-12.***

RESPONSE:

The typo in the report will be corrected.

Editorial E2

COMMENT: ***In several places (e.g., third paragraph on page 3-8, second paragraph on page 3-10, first full paragraph on page 3-11, first paragraph on page 3-13, second paragraph on page 3-16), the methodology states that further justification/explanation must be included in plant-specific PTLRs. This should state that the justifications must be included in plant-specific PTLR methodologies.***

RESPONSE:

The report will be modified to read "plant-specific PTLR methodologies" instead of "plant-specific PTLRs" where applicable.

Editorial E3

COMMENT: ***On Page 3-11 in the first full paragraph, it is stated that an acceptable alternate method is to determine decay heat rates separately for heatup and cooldown, recognizing the fact that the times after reactor shutdown to reach the same temperature during cooldown and heatup differ. It is also stated that decay heat input may not have to be included at all during cooldown or isothermal conditions. Please remove the word "acceptable" since the staff is not reviewing this portion of the method for acceptance at this time.***

RESPONSE:

The word "acceptable" will be removed from the statement.

Editorial E4

COMMENT: ***On Page 3-14, the first paragraph states that the function of peak pressure vs. setpoint "could" be developed using results from the analyses of both mass addition and energy addition transients performed for a number of setpoints. The word "could" should be replaced with the word "must".***

RESPONSE:

The word "could" refers to the development of the function. The development of the function is optional and is not required, as it is only intended to facilitate a selection of an optimal setpoint. If the function is deemed to be useful, it must be based on both mass addition and energy addition transients. To add clarity, the 2nd statement in the last paragraph of Section 3.3.3.2 will be modified to read:

"If developed, this function must be based on results of the analyses of both mass addition and energy addition transients performed for a number of setpoints".

Editorial E5

COMMENT: ***On Page 3-25 in the last paragraph, it is stated that the resulting enable temperatures are then corrected for instrumentation uncertainty, as applicable. Please explain what is meant by as applicable. When would instrumentation uncertainty not be applicable?***

RESPONSE:

The words "as applicable" will be deleted from the last paragraph of Section 3.4.3.