September 11, 2000

Mr. Ralph Phelps, Chairman
CE Owners Group
Omaha Public Power District
P.O. Box 399
Ft. Calhoun, NE 68023-0399

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION (RAI) REGARDING CE NPSD-683, REV. 05, "DEVELOPMENT OF A RCS PRESSURE AND TEMPERATURE LIMITS REPORT FOR THE REMOVAL OF P-T LIMITS AND LTOP REQUIREMENTS FROM THE TECHNICAL SPECIFICATIONS" (TAC NO. MA9561)

Dear Mr. Phelps:

By letter dated July 20, 2000, the Combustion Engineering Owners Group (CEOG) submitted Topical Report CE NPSD-683, Rev. 05, "Development of a RCS Pressure and Temperature Limits Report for the Removal of P-T Limits and LTOP Requirements from the Technical Specifications," for staff review. The contents of the report proposes a new methodology to be followed by an applicant seeking to relocate the pressure-temperature (P-T) limits and low temperature overpressure (LTOP) system setpoints from the limiting conditions for operation (LCOs) of the technical specifications (TSs) into TS-controlled pressure temperature limits report (PTLR). PTLRs of this sort are controlled under the Administrative Controls Section of the TS. The staff has determined that additional information is needed to complete its review.

The enclosed request was discussed with Mr. Paggen on August 24, 2000. A mutually agreeable target date of September 14, 2000, was established for responding to the RAI. If circumstances result in the need to revise the target date, please call me at your earliest opportunity at (301) 415-1424.

Sincerely,

/RA/

Jack Cushing, Project Manager, Section 2
Project Directorate IV & Decommissioning
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Project No. 692

Enclosure: Request for Additional Information

cc w/encl: See next page

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REQUEST FOR ADDITIONAL INFORMATION

REVIEW OF COMBUSTION ENGINEERING OWNERS GROUP

TOPICAL REPORT CE NPSD-683, REV. 05

"DEVELOPMENT OF A RCS PRESSURE AND TEMPERATURE LIMITS REPORT

FOR THE REMOVAL OF P-T LIMITS AND LTOP REQUIREMENTS

FROM THE TECHNICAL SPECIFICATIONS"

Section A, Introduction

1. Page 12, Section A.4.1. For completeness, Item 1. in the list of specific loading conditions (normal operations) should also include anticipated operational occurrences as they are referenced in Section IV.A. of 10 CFR Part 50, Appendix G, as being included among the conditions falling under the definition of normal operations.

2. The staff needs to emphasize that generic letters (GLs), in of themselves, do not constitute NRC requirements. Remove the word "requires" or "required" from any sentence in Section A of the report that could erroneously give the industry the impression that GLs are staff requirements - i.e., in the 10th line of the 1st paragraph on page 9, in the 4th line of the 1st paragraph of Section A.2 on page 10, and on the 1st sentence of the 2nd paragraph of Section A.2 on page 10.

3. Page 9, 2nd paragraph. Should refer to the correct versions of the CE methodology.

4. Does the CE NSSS P-T curve method yield P-T limit curves as conservative as those that would be generated by using Appendix G to Section XI of the American Society of Mechanical Engineers (ASME) as required by Section IV.A.2.b of 10 CFR Part 50, Appendix G? If the curves generated are less conservative then an exemption request pursuant to the requirements of 10 CFR Part 50.60(b) would need to be submitted by a licensee seeking to use this method for generating the curves.

Section 2.0, Reactor Vessel Material Surveillance Program

1. Page 30. The end of the last paragraph states that changes to a licensee's material surveillance withdrawal schedule could be performed through the 10 CFR 50.59 process if the changes were consistent with the ASTM E-185 procedure of record or with one of the editions of the procedure referenced in 10 CFR Part 50, Appendix H. On December 6, 1996, the NRC Commissioners issued Memorandum and Order CLI-96-13 in review of the Atomic Safety and Licensing Board (ASLB) decision that any change to a plant's material surveillance withdrawal schedule would need to be treated as a *"de facto"* license amendment (refer to ASLB Memorandum and Order LBP-95-17). In CLI-96-13, the Commission made the following conclusions regarding proposed changes to reactor vessel material withdrawal schedules: (1) Section II.B.3 of 10 CFR Part 50, Appendix H, "as promulgated in 1983 requires an approval or check by the staff to ensure that the

proper ASTM standard is used correctly," and (2) such approvals, however, do not constitute *"de facto"* license amendments. Thus, pursuant to CLI-96-13, the Commission found that proposed changes to reactor vessel material withdrawal schedules would have to be submitted to the staff for review and approval no matter how insignificant the changes to the schedules appeared to be. The last sentence is the last paragraph of page 30 needs to be edited to state that "*for those plants having the reactor vessel material surveillance program withdrawal schedule in a document other than the TS, any proposed changes to the program or withdrawal schedule will need to be submitted to the NRC for review and approval.*" In addition, it needs to be stated that "*Proposed changes to the surveillance capsule withdrawal schedule that are not consistent with the withdrawal criteria of the version of ASTM E-185 of record or with one of the later versions of E-185 amount to alternatives to the requirements of 10 CFR Part 50, Appendix H, and pursuant to 10 CFR 50.60(b), must be accompanied with an exemption request for their use. Such requests will be evaluated on their technical merits against the exemption acceptance criteria of 10 CFR 50.12.*"

2. Page 31, 8th line in the last paragraph and Footnote 5, page 58. RT_{NDT} should be change to *initial* RT_{NDT} .

Section 5.0, Application of Fracture Mechanics in Constructing P-T Curves

1. The report lists a number of methods for generating P-T limits - a general method in Section 5.3.1, a CE NSSS method in Section 5.3.3 of the report, and an ASME Code, Section XI, Appendix G, method in Section 5.3.4. State whether the intent of the methodology is to give the licensee for the PTLR the leeway of choosing one of these methods for generating the curves. If so, the report needs to add text to direct the licensee that they must indicate in their plant-specific PTLR submittals which method will be used as the basis for generating their curves. If not, the report needs to be condensed down to indicate a specific method for generating the curves.

2. Page 66, Section 5.2.2, Flanges. The section states that a flaw size of 0.75 inches was assumed for evaluation of the flange region and that this flaw size is smaller than the one-quarter thickness depth flaw. Discuss CE's basis for proposing separate P-T curves for the limiting material in the RPV flange. Clarify how the ability of a volumetric inspection technique to detect a flaw and how the criteria for accepting a flaw in weld materials using a radiographic inspection technique provide a sufficient basis for assuming a smaller flaw size in the P-T limit analysis of the flange region, and expand your discussion of the technical methods for generating P-T limits for the flange region. If a basis for the separate flange P-T limits (examples are provided in Figures 5.6 and 5.7) cannot be justified, the contents of Section 5.2.2 and the flange P-T curve lines in Figures 5.6 and 5.7 should be deleted from the report, and the flange limits should meet (be consistent with) the minimum temperature requirements established in Table 1 of 10 CFR Part 50, Appendix G.

3. Page 71, Section 5.3.1.4, Calculation of Allowable Pressure (in the General P-T Limits Process Description). With regard to this section:

a. An equation:

$$K_{Im} = (K_{IR} - K_{It})/2$$

is given in the middle of the page. The section should indicate that this equation is only applicable for normal operating conditions (including heatups, cooldowns, and anticipated operational occurrences), and that for pressure testing conditions (i.e., leak rate tests or hydrostatic pressure tests), the applicable equation changes to:

$$K_{Im} = (K_{IR} - K_{It})/1.5$$

List the K_{Im} equation for pressure testing conditions in addition to the K_{Im} equation for normal operations.

b. The section should also indicate that for areas of the RPV shell or heads with discontinuities (such as near nozzles, flanges or other geometric discontinuities), Paragraph G2222(a) of Appendix G to Section XI directs that the K_{Im} equations take into account stress intensities from applied primary and secondary bending stresses, in addition to the stress intensities from primary and secondary membrane stresses. As indicated on pages 64 and 65 of the report, the stress intensity value due to thermal stresses (K_{It} value) are treated as the only principal secondary stresses acting on the vessel; thus the K_{It} value already accounts for secondary membrane and bending stresses acting on the crack tip. Hence, for areas of the shell or head near discontinuities, primary bending stresses are the only added consideration that need to be accounted for. Thus for areas of the RPV shell or head near discontinuities, the equations listed above would have to be modified to:

$$K_{Im} = (K_{IR} - K_{It})/2 - K_{Ib} \quad \text{(Normal Operating Conditions)}$$

$$K_{Im} = (K_{IR} - K_{It})/1.5 - K_{Ib} \quad \text{(Pressure Testing Conditions)}$$

where K_{Ib} represents the primary bending stress acting on the area with the geometric discontinuity. For areas where nozzles connected to the RPV shell, Paragraph G-2223 of Appendix G to Section XI states that Appendix 5 to Welding Resource Council (WRC) Bulletin 175 provides an approximation method for taking the primary bending stress into account without a direct determination of its magnitude (i.e., the method treats a nozzle configuration as if it were a hole in a plate material), and for calculating the membrane stress (σ_m) at the nozzle from the maximum allowable stress intensity value due to membrane (hoop) stress (K_{Im} value). Provide these equations and this discussion to Section 5.3.1.4 on page 71 of the report, as being appropriate for evaluation of the RPV shell or head near discontinuities.

4. Pages 76-77, Section 5.3.3.2 Calculation of Allowable Pressure (for the CE NSSS P-T Curve Method-Section 5.3).

a. First issue is similar to that for Section 5.3.1.4 in that the K_{Im} equation for pressure testing conditions should be referenced in the section in addition to the K_{Im} equation for normal operating conditions.

b. On page 77, the following equation is given for calculating the allowable pressure:

$$\text{P-Allowable} = K_{Im} / K_{Im}^{*}$$

where K_{Im} is the allowable stress intensity factor in Ksi-inch$^{0.5}$, and K_{Im}^{*} is the pressure stress intensity factor in Ksi-inch$^{0.5}$ for a 1000 psia internal pressure as determined from a finite element model. This equation appears to be incomplete and makes no sense in that it yields a dimensionless value (i.e., it is incorrect from a dimensional analysis standpoint). With respect to this equation:

(1) Confirm that the equation is correct, and that the units for the equations are correct.

(2) State how the K_{im} and K_{im}^{*} factors used in the equation are determined and discuss the details of how the equation is used to calculate the maximum allowable pressures for the P-T curves.

(3) State whether use of this equation will yield P-T limits that are at least as conservative as would be generated if the methods of the 1995 edition of Appendix G to Section XI of the ASME Code were used to generate the curves. If use of this equation will not yield P-T limits that are at least as conservative as those that would be generated using the 1995 edition of Appendix G to Section XI, the report needs to clearly state that an exemption request needs to be submitted by the applicant, pursuant to the requirements of 10 CFR 50.60(b) and 10 CFR 50.12 to use this equation for generation of the P-T limits.

5. Page 78, Section 5.3.4. The K_{IR} equation for pressure testing (i.e., either leak rate or hydrostatic testing) conditions should be listed in addition to the K_{IR} equation for normal operations during level A and B loading conditions. (This issue is similar to the issue discussed on Section 5.3.1.4; that is, similar to RAI Issue Item 3.A. for issues with Section 5.0 of the methodology).

6. Pages 79-94, Section 5.4, Typical Pressure-Temperature Limits.

Appendix G of 10 CFR Part 50 requires that the appropriate requirements for both the pressure-temperature limits and minimum temperature requirements, listed in Table 1 of the rule, must be met for all conditions. This means that with respect to the CE NSSS method used to generate sample P-T limit curves, the composite curves must be generated from the most conservative P-T combinations established by the Appendix G type P-T limits, minimum temperature requirements, minimum temperature requirement for performing the inservice hydrostatic test (applies to normal operating conditions with reactor core critical, only), and lowest service temperature for the limiting material used

to fabricate the RCS piping, pumps and valves (i.e., the CE NSSS practice from your methodology). The staff has the following issues with how the CE NSSS method is being used to generate the P-T limit curves:

a. The 5th paragraph of Section 5.4.3 (page 81) states that the minimum temperature for the inservice hydrostatic test was established to be 322°F based on a test pressure of 1.1 times normal operating pressure (i.e., 1.1 x 2250 psia = 2427 psia). With respect to this paragraph: (1) a typographical error exists in that 1.1 X 2250 psia equals 2475 psia, not 2427 psia, and (2) the practice used here for performing the hydrostatic tests is not consistent with CE stated practice for performing the tests stated in Section 5.4.1 (i.e., at 1.1 x RPV design pressure, as stated on page 80).

b. In the example given for the CE NSSS P-T limit method, for operating pressures above 20% of the preservice hydrostatic test pressure, the minimum temperature requirement for the RPV should be established at 206°F for non-critical operations (i.e., flange initial RT_{NDT} of 80°F plus 120°F plus 6°F temperature correction), and for normal operations with the core critical, at ~370°F (i.e., from the minimum temperature for performing the inservice hydrostatic test in Figure 9, which is more conservative than if the line were established from the minimum flange temperature requirement for critical operations, 246°F [80°F plus 160°F plus 6°F]); yet the minimum temperature requirement for the many of the sample P-T limit curves in Section 5.4 were established by the lowest service temperature requirement for the piping, and set at either 196°F or 156°F. This practice does not satisfy the current regulations.

7. With respect to these issues the following needs to be addressed in Section 5.4 of the report:

a. CE NSSS methodology needs to specify a single practice for performing the pressure test (i.e., either at 1.1 x RPV design pressure or 1.1 x normal operating pressure for 100 percent power), and to set the minimum temperature for performing the test accordingly. If the CE practice is to perform the test at 1.1 x RPV design pressure, then the sample P-T limit curves should be drawn, as a minimum up to 2750 psia (i.e., 1.1 x 2500 psia), and the minimum temperature listed in Paragraph 5 of Section 5.4.3 (page 81) should be somewhere on the lines of 370°F.

b. The 4th paragraph of Section 5.4.3 (page 81) needs to be corrected to state that for pressures above 20 percent of the preservice hydrostatic test pressure, the most conservative temperature of the minimum temperature-lowest requirements is 206°F.

c. Sample P-T curves should be generated from and thus applicable to only the sample reactor vessel and plant design data listed on pages 79 and 80 of Section 5.4. Figures 5.1 through 5.11 (pages 84 through 94) do not always appear to be consistent with the CE NSSS methodology listed in Section 5.3.3 of the report or with the reactor vessel and design data listed on pages 79 and 80

of Section 5.4. Any composite curves presented in Figures 5.1 through 5.11 must be drawn to ensure that they are generated from the most conservative P-T combinations established from the Appendix G type P-T limits, minimum temperature (flange) requirements, minimum temperature requirement for performing the inservice hydrostatic test (applies to normal operating conditions with reactor core critical, only), and lowest service temperature for the limiting material used to fabricate the RCS piping, pumps and valves (i.e., the CE NSSS practice from your methodology), and the curves need to encompass the pressure for performing the inservice hydrostatic test.

8. Pages 64-65, Section 5.2.1. Logical order of equations is backwards. The equation listing secondary membrane and bending stress intensity factors should be given first and then the equation listing the thermal stress intensity factor should follow with the thermal stress intensity factor substituting for the secondary membrane and bending stress intensities.

9. Section 5.3.1.3 on page 70 of the report. The reference for the lower bound crack arrest (K_{Ia}) equation and the lower bound static crack initiation (K_{Ic}) equation is Reference 10, which is listed on page 101 of the report as "ASME Boiler and Pressure Vessel Code, 1995 Edition and addenda through 1996 Addenda, Section XI, Appendix A, ‘Analysis of Flaws,’" and Appendix G, "Fracture Toughness Criteria for Protection Against Failure."

   a. Separate Reference 10 on page 101 into two separate references: Reference 10a, "ASME Boiler and Pressure Vessel Code, 1995 Edition and addenda through 1996 Addenda, Section XI, Appendix G, ‘Fracture Toughness Criteria for Protection Against Failure,’" and Reference 10b, "ASME Boiler and Pressure Vessel Code, 1995 Edition and addenda through 1996 Addenda, Section XI, Appendix A, ‘Analysis of Flaws.’"

   b. Change the reference number for the K_{Ia} equation listed on page 70 to Reference 10a and the reference number for the K_{Ic} equation listed on page 70 to Reference 10b.

   c. In addition, the staff recommends that a footnote be added to the K_{Ic} value equation to link the equation to the Note at the bottom of page 70.

10. The report includes statements that state that the report does not consider undershoot or the minimum pressure resulting during the transient. At some plants, undershoot can potentially damage the RCP seals. Therefore, this consideration must be included to ensure that an LTOP event does not result in a more serious event, i.e., LOCA due to RCP seal failure.

    a. Please modify your methodology to address this concern or describe in detail the design and operation of the RCP seal design that is not affected by low RCS pressure and provide sufficient information to show how the RCP seal is not affected by the low pressure.

b. Please revise the applicability of the methodology to those plants with the RCP seal design described in Part a.

11. You describe the LTOP range as the range of temperatures from the LTOP enable temperature down to the point where an adequate RCS vent is established. This is not accurate. The LTOP range is any temperature below the enable temperature. Establishing an adequate vent is one method of LTOP protection and is recognized by the TS as such. Please revise the report to clarify this description. Section 3.4.3 provides a similar description and should also be revised.

12. The 1st paragraph on page 3 needs to be more definitive in terms of what is required. For example the first paragraph includes the statement that the LTOP-related limitations are usually contained in the TS. This should say that these limitations must be included in the TS. Another example is the statement that every time the P-T limits change, the TS may need to be changed. This should say that the TS must be changed. Also, a specific statement regarding a required evaluation of the LTOP limits and the required incorporation of any such changes into the TS should be included.

13. Section 3.2.1 states that any analysis supporting LTOP must be quality assured. This statement should be modified to specify that analyses must be quality assured by the 10 CFR Part 50, Appendix B quality assurance program.

14. With regard to the LTOP limits:

    a. Please describe how restricting the heatup and/or cooldown rates would help in LTOP analyses.

    b. How are the different P-T limits curves (steady state, heatup, cooldown) required to be used in the LTOP analyses? Does the methodology allow the use of the steady state P-T limits for the whole LTOP range?

15. It is not clear what is intended to be allowed by the 3 items under Section 3.2.2, Item 3. For example, it appears that the first item would allow the licensee to redesign the LTOP system. This can be interpreted as allowing a plant that relies on pressurizer relief valves to start relying on SDC valves. This should not be allowed by this methodology. Such a change would require prior NRC review and approval. The reason for the LTOP evaluation under this report (methodology) is covered by Item b under Section 3.2.2, Item 3. The other items are confusing and should be deleted.

16. The last paragraph on page 38 and the 2nd and 4th major assumptions on page 40 need to be clarified to address the following:

    a. The type of gas used in the analyses of the pressurizer steam volume should bound allowed plant operations. For example, steam and nitrogen would result in different pressurization rates and the analyses should be performed to bound the plant configurations allowed with regard to the type of gas that could be present.

b. The two assumptions contradict each other. In addition, the descriptions under the two assumptions contradict the assumption statements. For example one assumption states that a water solid pressurizer must be assumed while the description allows for the use of a steam volume.

17. The description under the major assumption for decay heat is not clear. For example, it is stated that an acceptable method is to determine decay heat rates separately for heatup and cooldown. How will this be implemented and how will this account for outages of different lengths? In addition, while the assumption would require analysis with no decay heat removal capability, an allowance for decay heat removal capability is discussed in the descriptions. The description appears to contradict the assumption its describing.

18. Under Section 3.3.2, it is stated that a number of setpoints must be analyzed for a variable setpoint arrangement. A similar statement is also included on page 48. Please provide the number of setpoints that must be analyzed. You should also specify that both mass and energy addition transients must be analyzed at these points to ensure that the bounding case is used for establishing the valve setpoints.

19. Under 3.3.3.2, it is stated that appropriate correlations must be used for development of the PORV discharge charactistics. No correlations are provided in the methodology. Please provide the correlations to be used in your proposed methodology.

20. The first full paragraph on page 44 includes the wrong reference number for the footnote on the previous page. Please fix this error.

21. The last paragraph under Section 3.3.3.2 allows the calculation of a new setpoint based on energy addition transient analyses alone. While energy addition will be more limiting for some temperatures within the LTOP range, mass addition transients will be more limiting for others. Therefore, it is important to ensure that the calculation of new setpoints is based on analyses of both mass addition and energy addition. Please either revise the text to require that both energy and mass addition transients be analyzed or explain why excluding the mass addition should be accepted.

22. Under 3.3.3.3, it is stated that "typically" the SDC relief valves are assumed to start opening at 3 percent accumulation and reach rated flow at 10 percent accumulation. This statement needs to be more definitive. It should require that the analysis assume the 3 percent and 10 percent instead of saying that this is typical. In addition, it appears that Section 3.3.3.4 should include the same statements regarding the 3 percent and 10 percent accumulation. Please include these statements or justify your reasons for excluding them.

23. Section 3.3.4 includes a statement to specify that in the case of the pressurizer relief valve, the pressure obtained at the valve inlet needs to be adjusted to the pressurizer by adding the inlet piping pressure drop. Why is this statement limited to the case of the pressurizer relief valve?

24. For the energy addition transient analysis, no temperature difference between the primary and secondary is specified for the methodology. Please include a temperature difference to be used by the methodology or explain how a temperature difference would be determined for use in plant specific analyses.

25. The five node system used to model the RCS for the energy addition does not appear to include the entire RCS volume (e.g., RCP and loop volumes). Please describe how the entire RCS volume is modeled or justify any exclusions.

26. In the description of the energy addition calculation, it is stated that the SG heat transfer area includes the surface area of the "active" portions of the tubes, with no tubes plugged. Is this equivalent to the total surface area of the tubes or is active being used to justify a smaller area?

27. On page 48 it is stated that other computer codes or hand calculations can be utilized for the energy addition transient. This should not be allowed by the methodology unless the specific methods are described for approval. This statement should be deleted. In addition, it is not clear why the last paragraph is included in Section 3.3.4 when the report states that the method described in the paragraph may not be used as a method for demonstrating adequate LTOP protection. Please provide your reasons for including this paragraph as part of your methodology.

28. Section 3.4.2 is missing a discussion of the static head. Please include static head in the pressure correction factor discussion or explain why it does not have to be included.

29. The 2nd to last paragraph on page 54 states that temperature instrument uncertainty needs to be considered. This should be strengthened to say that it must be included.

30. Under Section 3.4.4, for items that must be included in the TS, it would be helpful to include closing of SIT valves, pressurizer level, and pressurizer pressure.