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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

May 18, 1979

Docket No. 50-344

Mr. Charles Goodwin, Jr.
Assistant Vice President
Portland General Electric Company
121 SW Salmon Street
Portland, Oregon 97204

Dear Mr. Goodwin:

In conducting our review of PGE-1020, "Report on Design Modifications for the Trojan Control Building" dated January 14, 1979, including Revision 1 dated March 31, 1979, we have determined that we will need the additional information identified in the enclosure to continue the review. With the exception of request No. 50, this is the same set of requests telecopied to you on May 10, 1979.

In order for us to maintain our review schedule, your response is requested by June 14, 1979. If you are unable to meet this date, you are requested to advise us, within 7 days of the date of this letter, of the schedule that you can meet. Three signed originals and forty copies are required.

Please contact us if you have any questions concerning this request.

Sincerely,

A. Schwencer

A. Schwencer, Chief
Operating Reactors Branch #1
Division of Operating Reactors

Enclosure:
Request for Additional Information

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cc w/enclosure:
See Next Page

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REQUEST FOR ADDITIONAL INFORMATION
TROJAN NUCLEAR PLANT
PROPOSED CONTROL BUILDING DESIGN MODIFICATIONS

ENGINEERING BRANCH
DIVISION OF OPERATING REACTORS

1. The footnote on page 1-7 which defines "safety related" implies that there may be a difference between this and the original definition of the term. Provide a list of any equipment, components, and piping which were originally designated as "safety related" but are no longer being considered as such and corresponding justifications for no longer considering them as "safety related."

2. Verify that closely spaced modes resulting from the modal analysis of the building complex are being considered in accordance with the criteria delineated in BC-TOP-4A. Additionally, describe what the beam elements in the STARDYNE finite element mesh represent.

3. Provide clear, detailed sketches and descriptions of the connection interfaces of the additional walls to the existing structure. Additionally, describe the methods by which the effects of concrete creep and shrinkage (causing tension in the walls and/or a reduction in assumed dead weight) have been factored into the design of these additional walls. Describe and justify in detail the design and the procedures for the connections of the new walls to the existing structure.

4. Verify that the applicable requirements of ACI 318-77 for the modifications are the same as those of ACI 349-76 as supplemented by Regulatory Guide 1.142. Identify any differences and justify the acceptability of the ACI 318-77 requirements in lieu of those contained in ACI 349-76 and Regulatory Guide 1.142.

5. Provide the basis for your determination in Section 3.2.3 of PGE-1020 that the allowance for future addition of equipment will have an insignificant effect on the seismic analysis.

6. For the "Criteria for Bolts", provide the following:

   a) A clear description of the bolt assembly and hardware arrangement.

   b) The basis for the formula to calculate the allowable shear force for the bolt including the contact area between the wall and the steel, the stress distribution at the wall/steel interface and the maximum compressive stress induced in the wall at this interface along with justification for the value.

   c) The basis for the assumed loss factor.

   d) The effect of the condition of the in-situ wall on the assumed shear capacity.

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7. For the "Criteria for Studs", provide the basis for the design value being one-half the values given in Table 15 of the Nelson Division of TRW, Inc. publication, "Design Data 10 -- Embedment Properties of Headed Studs." Include a discussion of what is indicated in this table (e.g. maximum or minimum ultimate), and the statistical variation in the testing which established these values, if appropriate.

8. Verify that all resistances and stiffnesses based upon dead load considerations considers the dead load to be reduced by the vertical earthquake component.

9. Provide a discussion of the type and the extent of the nondestructive examinations which will be performed on the plate welds, along with detailed justifications.

10. Describe the decoupling criteria for equipment, components, piping, etc. whose mass was lumped into that of the structural system and verify that it is met everywhere.

11. Provide the shear capacities of the column connections vs. the required shear resistance under the combined loadings to support your claim in Section 3.4.2.2 that the derived flexural capacities of the Trojan walls are conservative in that the building walls will not slide. Additionally, for all walls discuss the causes of (e.g. shrinkage) and the effects of the observed separation between the bottom of the steel beams and the concrete along the west wall of the Control Building and limitations on the rotational restraint of the in-situ wall on the appropriateness of using the double curvature specimen test results. Significant separation of the concrete away from the beams or tension induced in the walls where there is no separation could impact the consideration of the "box effect" or confinement as suggested by PGE thereby reducing the shear capacity assumed for the wall. Quantify the extent of and effects of this unbonded condition for all walls. Also, in addition to considering the concrete strength of 5000 psi, discuss the effects of the interfaces with 3000 psi design strength concrete.

12. Justify the ductility limit of 4 for the outer rebar in the flexural calculations. Also, considering displacement compatibility for the entire structure using the stiffnesses indicated by the test results, what are the strains predicted in the outer rebar? Justify their acceptability in light of your assumptions. Additionally, for the flexural analysis equations justify the use of a compression zone length of 10% of the total effective length, and supply the maximum values of $E_c$ and justify the use of a linear stress-strain relationship for the concrete in compression.

13. Discuss in detail how the effects of creep and shrinkage (e.g. weight reductions, tension fields, etc.) have been factored into your consideration of the walls shear strengths and stiffnesses.

14. Discuss in detail why the dead load acting for the SSE is greater than that acting for the OBE, thereby resulting in greater shear capacities for the SSE than considered for the OBE.

15. Provide the basis for the 30% amplification factor assumed in the vertical direction.

16. Provide the basis for your calculation from the block and the beam to column connection capacities. Include a discussion of the strain compatibility of the two, and the basis for the 100 psi allowable vertical shear on the block at corners which seems to include a 1/3 increase in UBC allowable stresses which would not be appropriate nor in line with current practice.

17. Discuss in detail the effects on the in-plane wall shear capacity of any tension induced in the walls by the gross overturning moments and the "plate bending" of the walls generated by the earthquake component perpendicular to these walls.

18. In Table 3.3-1 the sum of the effective weights in the N-S direction does not add up to your indicated total. Please clarify.

19. Provide the basis for your claim that, in lieu of the test program results, there are no UBC requirements addressing the type of walls in the Trojan complex since Sec. 2417 of UBC-1963 specifies that for combinations of units, materials, or mortars, the maximum stress shall not exceed that permitted for the weakest of these. Also, provide the basis for your statement that the UBC did not envision the use of a model such as STARDYNE, therefore, higher allowables are appropriate. UBC Section 2417 merely states that forces be determined from the principles of continuity and relative rigidity, which is what STARDYNE does.

20. Provide the upper limits for the relative displacement of the Turbine and Control Buildings, considering the test results in the areas where the existing shake space is being reduced by the addition of the steel plate and verify that there is adequate clearance everywhere.

21. In Section 4.2.3 you discuss the removal of part of the concrete beam along the R line between columns 41 and 46. What was the original structural function of this beam? Verify that removal of part of the beam does not compromise its structural integrity or its structural functions. Specifically, what impact will this have on the masonry blocks supported above the beams?

22. Provide a summary of the load combinations and the maximum forces which will be developed for the bolts and the shear studs and locally in the existing elements. Indicate where the Nelson shear studs will be used. Also, discuss the shear transfer mechanism between the steel plate and existing walls in detail.

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23. Describe and justify the design criteria for the rail stop being added in the Turbine Building.

24. Explain why the finite element representation of the new wall along column line does not duplicate the wall as depicted in Figures 3.1-2 and 3.2-1.

25. In Section 4.2.3, reference is made to the tensioning of bolts after concrete has attained "adequate strength." Define "adequate strength" and describe how it will be determined.

26. Verify that the static and dynamic effects of the rigging and the steel plate on the Turbine Building above elevation 93 feet have been considered.

27. What strength concrete was used to model the new walls in the STARDYNE analysis of the modified complex? In Section 3.2.5 a concrete strength of $f'_c$ = 5000 psi at 90 days is specified for the new walls. Will the qualification of the modified complex be affected while this strength is being developed after concrete placement considering both in plane and out of plane wall loadings? Provide the basis for your response.

28. Describe the procedures used to remove the rock during relocation of the railroad spur (e.g. blasting) and verify that there will be no impact on plant safety resulting from the removal of the rock.

29. Describe in detail the modifications necessary to ensure the seismic qualification of the complex as a result of the strengthening or stiffening of the structure and the sequence in which they will be performed.

30. Provide your evaluations of the effects of the proximity or configuration of hole patterns, including the effects of any cracking which is present in the walls.

31. Summarize the details of your evaluations which determined that placement of the reinforcing steel, the forms and the concrete will not significantly degrade the seismic capability of the complex. Include a definition of significant.

32. Summarize the loads and load combinations and corresponding acceptance criteria for which the diesel generator air intake will be designed. Include a discussion of how the effects of the Turbine Building, a non-Category I structure, have been considered.

33. Provide the basis for your determination that removal of the face masonry block and a portion of the concrete core at column lines 41 and 46 on column line N' will not significantly effect the shear capacity of these walls.

34. Provide the capacity assumed for the dowels used to perform the wall modifications and the basis for this assumed capacity.

35. Provide the basis for your determination that the connection of the guide columns between the Control and Turbine Buildings will not significantly effect the behavior of either structure during a seismic event.

36. Provide the basis for your determination that removal of portions of the Turbine Building will not effect the analysis referred to in Section 2 nor significantly affects its seismic capability.

37. Provide the correlation, wall for wall between the test specimens and the actual walls, and justification for the applicability of the test specimen results to the actual wall including a discussion of the similarities of such items as reinforcing steel ratio and continuity, encasement, material strengths, joint preparation (especially where drypack was used), etc. With regard to the drypack, refer to the article by Kahn and Hanson entitled, "Infilled Walls for Earthquake Strengthening" in the February 1979 ASCE Journal of the Structural Division. This article describes a "brittle" failure of a test specimen with a drypack joint. Discuss the implications of this with respect to the walls in the Trojan complex with the drypack joints and the applicability of the test results from specimens without drypack joints.

38. Discuss the behavior of the test walls vs. those of the actual walls considering the large differences in the H/T and L/T ratios. Provide the basis for your response.

39. Define "representative" as used in defining the struts used in specimens E1, F2 and H2. Include a discussion of the similarity between the way in which the struts were anchored into the bulkheads, thus encasing the wall vs. the way the walls are encased in the frame formed by the columns and beams in the actual structure. Expand this to include a similar discussion for specimens L1 and L2. Also, discuss the similarities between the horizontal steel anchorage at the edges of the test specimens vs. that of the actual walls interrupted by openings, and those which intersect cross walls (e.g. the wall intersection at the intersection of column lines R and 55.)

40. Provide the relationships between stiffness and load degradation vs. the number of stress cycles at the stress levels to which the walls are loaded to substantiate that the structure will withstand several OBE's followed by an SSE. Indicate the number of full stress reversal cycles considered for each event and the number of OBE's considered for evaluation purposes, and the basis for each choice.

41. Discuss in detail the error band associated with each of the test results (e.g., stiffnesses, strengths, degradation, etc.). Explain and justify how these were factored into your evaluation of the complex.

42. Discuss the bases for your statements regarding the strength differences between L1 and L2 in more detail. Include further discussion of the effects of the shear studs in L1 since they were only at the base as indicated in Figure A3-2. For all specimens, indicate the reinforcement anchorage details in the upper and lower beams.

43. Describe in detail how the constant bending moment applied to the test specimens via the auxiliary loading system in conjunction with the main loading system compares to that which would exist due to end restraint in the actual Trojan walls, to justify the applicability to the test specimens results directly to the actual walls.

44. Provide the relative displacement profiles between the complex and other structures, along with the allowable, at the computed OBE stress levels in the walls and the factored OBE stress levels in the walls considering the test data results.

45. Considering the strength of the column connections for the actual walls, demonstrate that they are capable of resisting the axial forces indicated by those results for the columns inspecimens L1 and L2. Justify any exceedences of the beam/column connection capacity.

46. Provide the secant modulus derived for each of the test specimens vs. stress level; a comparison of the experimental initial elastic modulus for the test specimens vs. that calculated using the formula in Section 2.2.1.3.2 of Appendix G; the error bands, and their deviation, for the curves representing stiffness reduction as a function of stress level; and the stresses in each of the walls resulting from incorporation of the stiffness reduction factors in the STARDYNE model along with the associated stiffness reduction factors assumed in the analysis. Since the stiffness reduction factors are not linear with stress level discuss the effect of transverse gross overturning moments and transverse inertial wall loadings, plus the effects of creep and shrinkage on the stiffness in a given direction. Discuss the effects of the embedded steel framing and how it was incorporated into your analyses. Also, indicate why the results of the specimens with struts were not incorporated into your stiffness considerations.

47. Provide the detailed bases for each of the variations assumed in Table B-2 in the calculations of the peak broadening percentage.

48. Provide the SSE and the OBE floor response spectra for all elevations in the complex.

49. Compare the slopes of the sides of the peaks in floor response spectra for the complex frequency shift vs. stress (therefore, ground acceleration) level as derived from the test data results to verify that the floor response spectra are conservative for all earthquake levels for both the OBE and the SSE spectra. Justify any non-conservative deviations.

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50. Verify that the original FSAR pipe break criteria are not impacted by the new analyses.

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