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

SEP 13 1985

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MEMORANDUM FOR: [redacted]
Licensing Branch No. 3
Division of Licensing

FROM: George Lear, Chief
Structural and Geotechnical Engineering Branch
Division of Engineering

SUBJECT: DIABLO CANYON ALLEGATION 163

Allegation 163 was partially addressed in SSER 28 and required additional work in order to reach a resolution. This work has now been completed and summarized in the enclosure. The result of the work has shown that the allegation can be closed and that no modifications to the structure are required. Should you have any questions contact Harold Polk of the SGEB on ext. 28426.

George Lear

George Lear, Chief
Structural and Geotechnical
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Division of Engineering

Enclosure: As stated

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Review of Allegation 163

1.0 Characterization of Allegation

The subject of this allegation is the effect of differential temperatures, throughout the annulus steel and between the annulus steel and the crane wall concrete, on member stresses in the annulus steel. Specifically three questions were raised:

a. Temperature differentials that occur in the transient condition during plant startup and shutdown.

b. Local temperature differentials in supporting structural members of the framing system caused by the thermal environment in the supported pipe.

c. Local temperature effects due to jet impingement.

2.0 Implied Significance

The first part of the allegation (see a. above) is significant in that the concrete changes temperature slower than the steel as the ambient temperature in the annulus region changes during startup or shutdown. Since the annulus steel is particularly constrained by the concrete in the crane wall, differential temperatures between the steel and concrete will induce thermal stresses in the steel.

The second and third parts of the allegation (see b. and c. above) deal with local temperature differentials in the steel framing itself caused by heat from either pipe supports or jet impingement loads from a pipe break. In either case the result would be differential axial expansion of the steel members and bowing of the members due to the induced thermal gradient across the thickness of the members. Both effects will introduce stresses in the members because of the member constraints.

The potential thermal stresses were not included by PG & E in the original evlauation of the annulus steel members. The objective of the audits performed by the staff were to evaluate the significance of these stresses.

3.0 Assessment of Safety Significance

The statement was made in SSER 28 that PG & E should consider the thermal stresses induced into the annulus steel by a maximum thermal gradient of 40°F which could exist between the steel and crane wall concrete during shutdown.

This issue was addressed by PG & E in a letter DCL-84-133 dated April 5, 1984. It was shown that the maximum thermal stress in the steel is 7.54 ksi for the conservative assumption that the concrete wall completely constrains the steel. Most codes (e.g., ASME, ANSI) permit an increase of allowable stresses of at least 1/3 when transient thermal stresses are considered. The minimum allowable stress is 21.6 ksi for the cases when thermal stresses are included. Since the 1/3 increase in the allowable stress (7.2 ksi) is almost equal to the thermal stress for the completely confined steel (7.56 ksi), it was argued that the factor of safety for load combinations including the transient thermal loadings will be equal to or greater than the factor of safety for load combinations already considered. The inclusion of the concrete flexibility in the thermal analysis would significantly reduce the 7.56 ksi stress. The same analysis applied to both Units 1 and 2. The staff agrees with this assessment and considers this part of the issue is closed for both Units 1 and 2.

The second issue raised in SSER 28 concerns the thermal gradients introduced in the annulus steel thru the pipe supports. This issue was also addressed in PG & E letter DCL-84-133 dated April 5, 1984.

An attachment to the letter contained temperature distribution data measured on five different types of Grinnell engineered pipe supports. In all cases the pipe contained steam at about 900°F while the ambient temperature was about 90°F and a 4 inch thick combination insulation was placed around the pipe. Thermocouples were placed at various locations of the pipe supports. The support temperature approached ambient at distances of 1 to 2 feet from the pipe. Main structural steel would not be within these ranges. PG&E concluded that pipe supports would not produce thermal gradients in the primary structural steel. The staff agrees with this conclusion. It should be noted that the response applied equally to Units 1 and 2.

The third issue raised in SSER 28 concerns local thermal gradient which could be caused by a pipe break. This issued was addressed for Unit 1 in PG & E letter DCL-84-133 dated April 5, 1984 in which two potential pipe breaks were identified. One at column line 8 was located so that the maximum surface temperature reached 170°F at a localized region. The second at column line 6 resulted in a peak surface temperature of 500°F. There is little restraint to prevent the column from expanding vertically so that no increase in column axial stress can develop. However because of the temperature gradient

across the thickness of the column, there will be a bending moment introduced into the column. The stresses due to bending are low enough so that the functionality of the column is not impaired.

During the May 30, 1985 audit the staff raised the question as to whether the axial expansion of the column would adversely effect the floor slab at Elevation 140. PG & E responded to this question in letter DCL-85-213 dated June 14, 1985 and stated that the moments and shears introduced in the slab by the expansion of column 4 were within allowable limits.

PG & E also responded to the Unit 2 jet impingement issue in letter DCL-85-213 dated June 14, 1985. As in Unit 1, columns 6 and 8 are two locations in Unit 2 where a pipe break could result in a jet impingement on a column. The conditions are the same as for Unit 2 so the above discussion applies to Unit 2.

The staff accepts these responses and considers the issues closed.

4.0 Staff Position

The staff considers the issues associated with Allegation 163 closed.

5.0 Action Required

None.