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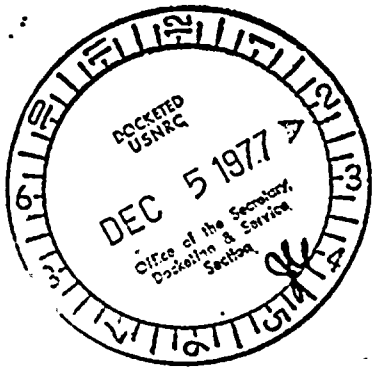
December 1, 1977

RELATED CORRESPONDENCE



Mr. John F. Stolz, Chief
Light Water Reactors Branch No. 1
Division of Project Management
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Re: Docket No. 50-275-OL
Docket No. 50-323-OL
Diablo Canyon Units 1 & 2

Dear Mr. Stolz:

Attached to this letter are our responses to the two questions on the Unit 1 structural integrity test which were enclosed in your letter of August 24, 1977.

Kindly acknowledge receipt of the above material on the enclosed copy of this letter and return it to me in the enclosed addressed envelope.

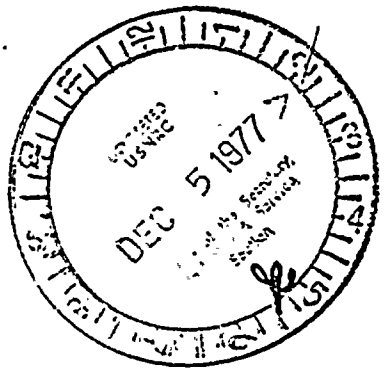
Very truly yours,

Philip A. Crane, Jr.

Enclosures
CC w/enc.: Service List

PACIFIC GAS AND ELECTRIC COMPANY
DIABLO CANYON SITE, UNIT NO. 1
CONTAINMENT STRUCTURE STRUCTURAL INTEGRITY TEST

Additional Information Requested by
USNRC Letter Dated August 24, 1977



Item 10

Your response to Item 7 did not provide any factual data from actual structural integrity tests upon which the conclusion could be drawin that the 20% margin of error for calculated displacements is indeed acceptable as you concluded. Furthermore, since your response to Item 2 suggests that the establishing of the 20% margin of error was based on a study of some data it is necessary that this data be provided to the staff to justify your conclusion. While the 20% margin of error may prove to be quite adequate you must provide an adequate basis, preferably from the structural integrity test of other containments, upon which such a margin can be established.

Response

We considered several factors affecting prediction accuracy:

a) Residual stress due to concrete shrinkage

A minimum shrinkage strain ε_s of 0.0002 inches per inch was assumed. The resulting compressive strain in reinforcing is relieved when concrete is cracked during the test, causing additional displacement Δ_s.

$$\Delta_s = \varepsilon_s R = 0.0002 \times 876 = 0.175"$$

(R = 876" = radius of hoop reinforcing)

b) Measurement Errors

The measurement accuracy is 1/32". If errors of this magnitude are made at zero and 54 psi pressure, the total error is $\Delta_e = 1/16" = 0.063"$

c) Temperature Varations

$10^{\circ}F$ temperature difference results in radial expansion of

$$\Delta_t = (\varepsilon_t)\ (t)\ (R) = 5.5 \times 10^{-6} \times 10 \times 884 = 0.049"$$

Where:

ε_t = concrete thermal expansion coefficient

t = temperature differential

R = Containment radius

d) Out of Roundness Adjustment

"As-built" deviations of the containment shell from a circular shape were a maximum of four inches. Relatively large shape adjustments were expected as the structure sought a circular configuration under pressure. We assumed the average of the six measurements at each level to represent radial displacement and deviations from the average to represent shape adjustments. But with only six measurements over a 460 foot circumference, inward and outward adjustments might not average out. Thus we felt it reasonable to allow 1/8" to account for this "out of roundness" adjustment.

The total of these factors is 0.412". This represents 44 percent of the maximum calculated radial displacement of the containment which seemed excessive. Therefore a study of other containment integrity tests was made to determine if more stringent limits might reasonably be established.

This study showed the 20% margin used on the Robert E. Ginna test was the most stringent limit successfully met. Considering that the most adverse simultaneous occurrence of all factors was unlikely it is reasonable to combine them on a square root-sum of squares basis. The maximum error in this case is 0.225" which represents a 24% margin. Taking this and the successful Ginna experience into account a 20% margin was adopted.

Item 11

In your response to Item 9 you made several statements on Page 5 in the paragraph entitled "Strains, Stresses" which need explanation:

(1) The purpose of the structural integrity test is to verify the behavior of the structure predicted by the analysis. Consequently, some acceptance standard should be set up prior to the structural integrity test being performed. Your statement that "no such standards were set for strain gage readings and no attempt was made to predict them" should be explained.

(2) You indicated that some readings were used for evaluation of the structural performance and others rejected. The report also contains a statement that the readings which have been used "appear consistent with other recorded data and credible...". This statement suggests that you are in possession of some additional information or "recorded data" which you used as an acceptance standard.

You are requested to provide the above noted specific information.

Response

(1) Our study of other tests showed only very general correlation between strain gage readings and the test variables. We observed large differences in readings of gages with theoretically identical stress and erratic stress variations with changing internal pressure. Large margins of error compromising the test objectives would be needed to allow for these discrepancies. For this reason, we concluded it was not practical to set meaningful acceptance criteria beforehand, without the benefit of a thorough evaluation and interpretation of the strain gage test data as well as consideration of the other data obtained during the test such as displacement and cracking patterns. We feel the basic objective of strain gage instrumentation - a complete evaluation of strain distribution - has been accomplished.

(2) The statement "appear consistent with other recorded data and credible..." refers to a good correlation between strains observed from two or more independent measurements and calculated values. A sample of such a correlation was given in the table on Page 7 of our response, where strain gage measurements at elevations 161 and 236 compare closely with the corresponding displacement measurements at the same elevations.

All such data is given in our test report, except that the strain gage data is given for the maximum pressure of 54 psi only. We made 23 separate strain gage data runs which provided a complete time history of readings at each gage. Malfunctioning gages could be readily identified by erratic changes of readings throughout the test and thus their credibility evaluated.