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SUBJECT:
RESPONSE TO NRC"S LTR DTD 11/10/77 CONSISTING OF INFO CONCERNING MATHEMATICAL MODEL OF REACTOR INTERNALS AND RESPONSE TO INFORMAL QUESTION ON STEAM GENERATOR AND PRESSURIZER ASYMMETRIC PRESSURIZATION FROM MEETING OF 01/05/78.

PLANT NAME: DIABLO CANYON - UNIT 1
DIABLO CANYON - UNIT 2

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February 14, 1978

RECEIVED FEB 28 1978 U.S. NUCLEAR REGULATORY COMMISSION Mail Section

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:

Enclosed are 40 copies of our response to question 3.115 (Mathematical model of reactor internals) of your letter of November 10, 1977, and our response to the informal question on Steam Generator and Pressurizer Asymmetric Pressurization from the meeting in Bethesda on January 5, 1978.

Five copies of this submittal have been sent directly to Mr. Dennis Allison.

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
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Diablo Canyon Units 1 & 2
Request for Additional Information

Question 3.115:

The mathematical model of the reactor internals used for seismic analysis was different from that for the loss of coolant accident (LOCA) analysis (specifically referring to the core barrel upper support condition). Justify the adequacy of each of these two different mathematical models for the same structure.

Answer:

The modeling of the core barrel for the seismic evaluation of the internals (reported in Amendment 50 of the Diablo Canyon FSAR) and for the blowdown evaluation of the internals in MULTIFLEX and DARI-WOSTAS (reported in WCAP 9421) is different in the upper core barrel support modeling. In the seismic analysis, the upper support of the core barrel was assumed to be fixed against translation and rotation. In the blowdown analysis, the upper support of the core barrel is restrained by a lateral stiffness and a rotational stiffness. The modeling of this support in the blowdown analysis is representative of the flexibility present in the actual structure. The modeling of this location as fixed in the seismic analysis is an approximation which has been shown by comparison to more realistic seismic models to be conservative, as will be discussed.

The modeling used for the seismic analysis used a fixed representation for the core barrel upper support. This analysis was a response spectra analysis and contained several conservative analytical techniques. This is the model discussed in Amendment 50. A second seismic model was developed in which the upper core barrel support representation was similar to the representation used in the blowdown analysis. The translation stiffness was identical and the rotational stiffness varied slightly. It has been shown, however, that the rotational stiffness of this structure is so great that variations like those between the second seismic model and the blowdown model are insignificant. A time-history analysis of the second seismic model was performed for the DDE and the resulting stresses at the most critical location in the core barrel were compared to those from the response spectra analysis with the fixed boundary condition. The response spectra analysis gave slightly higher results indicating the adequacy of that model.

The modeling of the upper core barrel for the blowdown model is representative of the actual structure. The seismic model, although assumed to be rigid, has been shown to be acceptable on this basis of comparisons to seismic analyses using realistic modeling techniques.

Diablo Canyon Steam Generator and Pressurizer Asymmetric Pressurization

The containment structure immediately surrounding the Diablo Canyon steam generator is open and therefore not conducive to the development of asymmetric pressurization loads on the steam generator. The steam line exits the steam generator area at an elevation above the steam generator, goes behind a secondary shield wall and does not pass along the side of an enclosed steam generator as in some plant designs. Consequently, a rupture in the vertical run parallel to the steam generator would be on the opposite side of the secondary shield wall and would cause no steam generator asymmetric pressurization. A rupture in the steam line at the steam nozzle on the steam generator would cause steam to flow into the upper containment. Because this containment volume is large, the rupture would cause essentially no asymmetric pressures on the steam generator. A rupture in the primary loop outside the primary shield wall will also vent into a large compartment and also would not be expected to cause any significant asymmetric pressurization. Rupture of a steam line at the top of the steam generator or in the primary loop will exert very small vertical forces on the steam generator.

Steam line break pressurization loads were calculated for a plant that, unlike Diablo Canyon, had a tight concrete enclosure surrounding the steam generator and attached steam line. The steam generator and the steam line were enclosed in a single compartment with the steam line running parallel to the steam generator. The asymmetric loads corresponding to this plant design were conservatively used to verify the adequacy of the Diablo Canyon steam generator supports. The peak horizontal asymmetric pressurization loads were approximately 1000 kips for a break in the steam line next to the steam generator in the enclosed compartment and approximately 100 kips for the steam line break at the top of the steam generator. The 1000 kips corresponds to a peak differential pressure of less than 10 psi if the load is assumed to be uniformly distributed over one side of the steam generator. The peak vertical load, due to the break at the top, was calculated to be approximately 800 kips. This is equivalent to a peak differential pressure of approximately 30 psi. These loads are much greater than those which would be expected in an open design such as Diablo Canyon and would conservatively envelope all potential break locations.

In order to demonstrate the adequacy of the Diablo Canyon steam generator supports for the effect of asymmetric pressurization, these conservative loads were applied to the system. The worst steam line break thrust loads result from the break at the top of the steam generator. If the "tight compartment" loads corresponding to that break (100 kips) are combined with the thrust loads, the steam generator supports will not be overstressed. This break has the most impact on the steam generator upper support loads. The postulated primary loop breaks outside the primary shield wall in the loop which cause the highest forces on the steam generator supports are the steam generator inlet and outlet nozzle breaks. The "tight compartment" loads which conservatively envelope this break will be those loads resulting from a pipe break adjacent to the steam generator in a closed compartment (1000 kips). If this load is split between the upper and lower support and combined with the load resulting from the primary loop breaks, the supports will not be overstressed. The above statements regarding the satisfactory nature of the stresses in the support is true for both the LOCA or Steam Line Break (SLB) occurring alone, or for the most conservative combination of LOCA loads or SLB loads combined with the seismic loads.

The evaluation performed for the potential effect of asymmetric pressurization on the steam generator support is extremely conservative. The loads used were calculated from a tight compartment analysis while the Diablo Canyon compartment is essentially open. Even in the severe loading case the Diablo Canyon supports were shown to be adequate.

The effects of asymmetric pressure within the pressurizer enclosure have been evaluated. The peak calculated differential pressure from the subcompartment analysis described in Section 6.2 of the Diablo Canyon FSAR was assumed for the evaluation. The peak differential pressure 7.8 psid was assumed to act over the projected area of the pressurizer vessel insulation envelope above the elevation 140 foot deck. The asymmetric pressure loading on the pressurizer upper seismic supports was calculated to be 140 kips per support lug. The asymmetric pressure load was combined with the peak seismic (DDE) load of 150 kips resulting in a maximum 290 kip load on the most highly loaded support lug. The original upper support evaluation was based on a design load of 260 kips. This evaluation demonstrated that the upper supports were adequate for the design loads. A subsequent review of the evaluation indicates that there is sufficient additional load capacity available to absorb the increased loading.