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December 12, 1979

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Office of Nuclear Reactor Regulation

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION ON GE REPORT NEDO-23652

REFERENCE: Letter to G.A. Esswein from R.J. Bosnak dated October 30, 1979 on above subject.

The following answers are provided in accordance with your request for added information on the analysis of GE's BWR-6 Standard Plant main steam head fitting analysis documentation.

Responses to Questions on GE NEDO-23652

1. (a) Are loads on head fitting constant throughout each thermal transient?

Associated with each of the thermal transients, there are mechanical loads arising from the thermal expansion of the process piping. These loads are in the form of axial, shear, moment and torsional loads on the head fitting and are considered as externally applied concentrated forces and moments on head fitting. These loads are not considered constant for each thermal transient.

(b) How are the loads derived?

Loads for thermal transient 1 were derived from GE's M.S. Piping Stress Report for BWR/6 Standard Plants of sizes 218, 238 and 251. From the stress diagram appropriate joint number of head fitting was selected first; forces and moments for three thermal cases were evaluated; highest values of forces and moments were selected to which a factor of 20% was added to give the final forces and moments that appeared in the topical report. Prorating these values by a thermal expansion factor, $\frac{T_{TRANSIENT} - T_{70}}{T_{OPERATING} - T_{70}}$, forces and moments for thermal transients 2,3,4 and 5 were derived.

(c) Are the loads always positive or is OBE applied in both directions?

The loads may be positive or negative. The OBE stress is added to a worst case stress range.

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1. (Continued)

   (d) Are the OBE stresses then added in the worst possible manner to the thermal transient stresses of each pair?

   The worst stress range between any two thermal transient events was found. Then the OBE stress (½ of the OBE stress range) was added directly to this stress range to determine the larger stress range of thermal transient plus seismic loadings. This stress range was then conservatively assumed to act for 60 cycles (maximum number of OBE cycles) for the fatique evaluation.

2. At what times are the stresses evaluated for the various thermal events?

   A time history analysis was done to determine worst thermal gradients. The time at which stresses were maximum was based on an estimation from these results.

3. Does GE presume that the reference to general, not local, thermal stress in NB 3222.2 means element not surface stresses are o.k.?

   We assume that this question has a reference to the results reported on Table 2-14C in the topical report. Only maximum element stresses are reported on Tables 2-13 thru 2-18. Stresses were calculated for several critical locations on the head fitting other than those reported. Result reported on Table 2-14C is at element number 230. It is considered adequate to represent surface stresses using stresses from finite elements if the elements are sufficiently small and the transient gradients are reasonable as in the case of this analysis.

4. Are loads on inside and outside surfaces of the assembly always taken to act in the same direction?

   The load directions were taken to give equilibrium for the analysed system. This may result in the same or opposite directions.

5. Does GE add an axial load due to pressure to the tabulated mechanical loads on the piping?

   Yes.

6. Does GE assume that a stress intensity range below the stress limit at 10^6 cycles in Figure I-9.0 causes no fatigue damage?

   Fatigue evaluation was performed by using Nutech's program COSTAR which complies with the requirements of NB 3222.4. As code requires, this program assumes a linear damage relation to evaluate the effect of alternating stresses of varying amplitudes per requirements of NB 3222.4(e)4. This analysis assume that stress ranges giving greater than 10^6 cycles do not contribute to fatigue damage.

7. Have the stress intensity range values been increased by the ratio of room temperature to design temperatures elastic moduli as required by NB 3222.4(e)4. before entering Figure I-9.0?

   Yes.

8. When the NB 3222.2 limit is exceeded and the limit of NB 3228.3(a) is checked.

   a) Is the element checked necessarily the same as in the NB 3222.2 check?

      Element checked for NB 3222.2 and NB 3228.3(a) is the same in this case and the results are reported in Table 2-14C. As stated earlier, only the maximum stresses are reported. However, different elements were checked for NB 3222.2 and NB 3228.3(a) at other critical locations and the results were not reported on Table 2-14C as these were not maximum stresses.

   b) Is the load set necessarily the same as in the NB 3222.2 check?

      Yes.

   c) Is NB 3228.3(b) followed in the cumulative fatigue damage evaluation?

      Yes.

9. Since OBE loads are larger on the outside containment side of the head fitting than the inside, how can the stresses for LC18-LC19 be larger inside?

   Initially, it was thought that the thermal gradient contribution was much larger than the OBE loads and that these stresses were higher on the inside of the head fitting overshadowing seismic stresses. However, upon review with the engineering firm who performed the analysis, it was found that the seismic loads on the inside of the head fitting were increased to the same values as used on the outside of the head fitting. This conservative assumption was not originally discussed with Roland Dix of ITT a few months ago and does explain why their results were so different than ours. However this assumption used in our analysis is conservative and is the major reason why the combined thermal plus seismic stresses are as high as they are in GE's report.

We hope these responses fully address the questions that Argonne has submitted to your staff. Please contact us if additional clarification is required.

Bhaskar Deb

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Approved by: G.A. Esswein

G.A. Esswein, Manager
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cc: DRF B21-17
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