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

AUG 12 1980

Docket No. 50-70

LICENSEE: General Electric Company

FACILITY: GETR

SUBJECT: SUMMARY OF JULY 30, 1980 MEETING REGARDING THE GENERAL ELECTRIC TEST REACTOR (GETR)

On July 30, 1980, we met with General Electric Company and its consultants in Bethesda to discuss the ongoing structural evaluation of the GETR. The most recent reports on this subject were submitted by GE on July 17, 1980.

A list of attendees is Attachment 1.

Significant points discussed are summarized below.

GE presented information to justify the use of the one direction loadings determined in the Phase 2 analyses as input to the finite element stress analysis of the Calaveras event. GE discussed two examples of the hand calculations referred to in EDAC-117-253.02, Rev. 1, submitted July 17, 1980, to support that the effects of the vertical earthquake component on calculated stresses in the concrete structure are insignificant. Furthermore, GE presented analytical results to show that maximum stresses determined using one horizontal direction input to the finite element analysis were nearly the same (within 10%) as those calculated using the square root of the sum of the squares of both horizontal components. Information presented is summarized in Attachments 2, 3 and 4.

GE presented a step-by-step discussion of the procedure for applying the loads determined in the linear elastic lumped mass model to the finite element model. Attachments 5, 6 and 7 summarize the information presented.

The soil pressure analyses submitted on July 17, 1980, were discussed. We requested justification for the values of shear modulus and velocity used in the analyses, as shown on Table 3-1, indicating that they may be low. GE agreed to address the question. Referring to Figure 6 "Loading vs. Capacity" of EDAC-117-253.01, Revision 1, Supplement 2, submitted July 17, 1980; we indicated that additional support for the shape of the 'conservative capacity' curve would be necessary should the "limiting combinations based on local soil pressure" curve be significantly affected by review of shear modulus and velocity values questioned above.

In addition to the discussion of the structural analyses we requested that GE provide the following:

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1. GE's calculation of radioactivity released following a design basis seismic event considering all potential sources,

2. Details to support GE's position that seismic scram actuation and subsequent control rod and equipment operation will precede significant earthquake loadings,

3. Details to support the reliability of the seismic scram and valve actuation circuitry including consideration of a single failure.

Conclusion

GE agreed to provide the information requested by the staff. We indicated that we expected to issue our SER addressing the GETR systems and structural analysis and the landslide evaluation by mid October.

Chris C. Nelson

Chris C. Nelson, Project Manager
Operating Reactors Branch #3
Division of Licensing

Attachments:
As stated

cc w/encl:
See next page

TERA

MEETING SUMMARY DISTRIBUTION

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AEOD - JHeltemes
IE-3
SShowe (PWR) or CThayer (BWR), IE

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GETR MEETING
July 30, 1980

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EDAC

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Attachment 2

EDAC

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DRAFT
25 July 1980

EFFECT OF VERTICAL EARTHQUAKE COMPONENT

PROBLEM STATEMENT:

Demonstrate by manual calculations that the effects of the vertical earthquake component on stresses in the concrete core structure of the Reactor Building are insignificant.

SUMMARY OF CALCULATIONS:

Select as an example the region between the 2nd and 3rd Floors at the location of highest stress.

fa = Axial stress due to DL = 22 psi
fv = Axial stress due to vertical EQ = -11 psi
fbnw = Flexural stress due to NW EQ = -80 psi
fbne = Flexural stress due to NE EQ = -80 psi

f = Total stress including vertical EQ
f'= Total stress excluding vertical EQ

$$f = fa - (fv^2 + fbnw^2 + fbne^2)^{1/2} = -92 \text{ psi}$$

$$f' = fa - (0 + fbnw^2 + fbne^2)^{1/2} = -91 \text{ psi}$$

DRAFT

25 JULY 1980

EFFECT OF VERTICAL EARTHQUAKE COMPONENT

continued

Select as another example the region between the 1st and 2nd Floors at the location of highest stress.

$f_a = 53$ psi

$f_v = 26$ psi

$f_{bnw} = 194$ psi

$f_{bne} = 219$ psi

$f = 241$ psi

$f' = 240$ psi

CONCLUSION:

The effects of the vertical earthquake component are insignificant.

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25 JULY 1980

SUMMARY OF CONCLUSIONS
CALAVERAS LOAD CASE

- Based on hand calculations, the vertical earthquake component has an insignificant influence on flexural stresses.

- Based on hand calculations, the maximum flexural stress at each level is nearly the same whether the analysis is performed for the:
  - NE direction
  - NW direction
  - SRSS of NE and NW directions

- It is reasonable to expect the same results from finite element analyses.

- Therefore, it was concluded that it was necessary to perform finite element analyses for only the
  - NE direction

  and that the maximum stresses at each level would be nearly the same for the
  - NW direction
  - SRSS of NW and NE directi s

Attachment 4

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DRAFT
25 JULY 1980

COMBINATION OF COMPONENTS OF EARTHQUAKE MOTIONS

PROBLEM STATEMENT:

Demonstrate by manual calculations that the maximum stresses at a given level are in the same range for the two input cases: (1) one horizontal earthquake component, and (2) two horizontal plus vertical earthquake components.

PRELIMINARY OBSERVATION:

For a compact cross-section, the maximum stresses will be equal for the two input cases. This is illustrated for a circular cross-section in Figure 1.

The concrete core structure of the GETR Reactor Building is a compact, nearly circular cross-section as shown in Figure 2 for the first to second floor levels. For this cross section, it is reasonable to expect that the flexural stresses at locations 1 through 4 are nearly equal.

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COMBINATION OF COMPONENTS OF EARTHQUAKE MOTIONS continued

SUMMARY OF CALCULATIONS:

The stresses in the following table are flexural stresses only. Dead load and vertical earthquake load have been excluded for demonstration purposes.

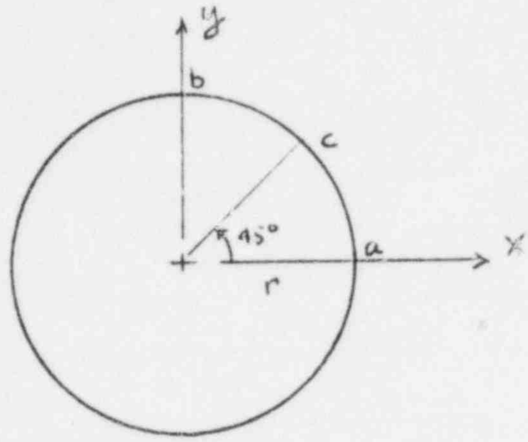
Location	fnw	fne	fsrss
1	273 psi	~0 psi	273 psi
2	194	~~281~~ 219	293
3	101	265	284
4	254	~0	254

As expected, the maximum stress computed by the SRSS method (293 psi) is nearly equal to the maximum stress obtained for one component (273 psi).

The same results are obtained if the dead load and vertical earthquake components are included. For this case, the maximum stress by the SRSS method is 241 psi and the maximum stress for one component is 220 psi.

CONCLUSION:

The maximum stresses at a given level are nearly equal for the two input cases: (1) one horizontal earthquake component, and (2) two horizontal plus vertical earthquake components.



Assume $M_{xx} \cong M_{yy} = M$

$I_{xx} \cong I_{yy} = I$

1. EQ in x-dir only

$f_a = \frac{Mr}{I}$ $\quad f_b = 0$ $\quad f_c = \frac{Mr}{I\sqrt{2}}$

2. EQ in y dir only

$f_a = 0$ $\quad f_b = \frac{Mr}{I}$ $\quad f_c = \frac{Mr}{I\sqrt{2}}$

3. SRSS of stresses

$f_a = \frac{Mr}{I}$ $\quad f_b = \frac{Mr}{I}$ $\quad f_c = \frac{Mr}{I}$

FIGURE 1 COMPACT (CIRCULAR) CROSS SECTION

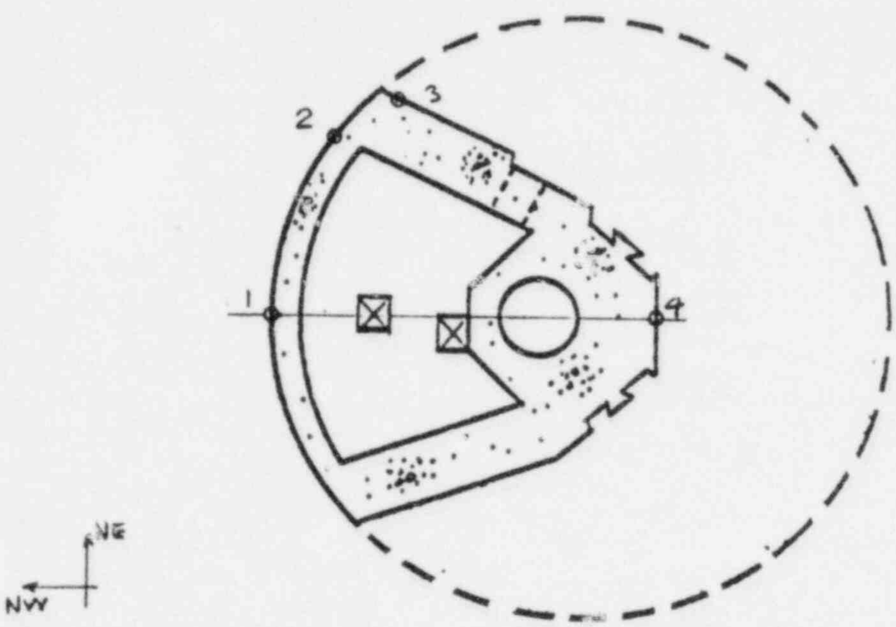


FIGURE 2 CONCRETE CORE STRUCTURE
CROSS SECTION 1^{st} - 2^{nd} FLRS

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STEP-BY-STEP PROCEDURES TO DETERMINE EQUIVALENT STATIC NODAL LOADS IN THE FINITE ELEMENT MODEL

1. A linear elastic lumped mass model of the Reactor Building was developed as shown in Figure 2-5 of the Phase 2 report. Masses Mi at each level were calculated and included concrete and equipment.

2. An earthquake time history dynamic analysis was performed for the peak ground acceleration of 0.6g using the modal superposition method.

3. The instances at which the maximum base moment and base shear occurred were examined and moments and shears at these instances were scaled by 0.8/0.6 = 1.33 to obtain values for 0.8g case.

   Accelerations at t = 10.35 sec. were then obtained from the output and scaled by 1.33 to obtain accelerations for the 0.8g case.

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STEP-BY-STEP PROCEDURES TO DETERMINE EQUIVALENT STATIC NODAL LOADS IN THE FINITE ELEMENT MODEL

continued

4. A finite element model (FEM) was developed as shown in Figures A-1 to A-10, Phase 2 Report. It was decided, for simplification, to apply the nodal loads only at the elements at the floor levels of the FEM, rather than to distribute loads throughout the entire height of the concrete core structure.

   - The total lateral (or vertical) force F_i at level i was obtained by calculating $F_i = M_i a_i$, where M_i is the total mass at level i, and a_i is the acceleration at level i.

   - The story shears and overturning moments were then calculated based on the forces F_i, and checked against the values from step 3 to assure that they were conservative.

   - The total concrete volume V_i at each floor level i was then calculated.

   - The concrete volume $V_{i,j}$ tributary to node j at level i was then calculated.

   - The lateral (or vertical) force $f_{i,j}$ at node j at level i was calculated from $f_{i,j} = F_i(V_{i,j}/V_i)$

Attachment 6

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25 JULY 1980

STEPS IN STRESS ANALYSIS OF FINITE ELEMENT MODEL

1. Select ground accelerations and unsupported length for analysis.

2. Select scale factor for inertia forces (0.3g/0.8g).

3. Develop matrix of 24 load cases based on 1.0/0.4/0.4 matrix.

4. Perform computer analyses for three separate basic cases H1, H2, V, and obtain 6 stress components in each element (in the global axes) for each basic case.

5. For each of the 24 cases, combine the stresses for each element in principle thus:

$$DL + C_1H1 + C_2H2 + C_3V$$

Actually thus:

$$C_1H1 + C_2H2 + V(1 + C_3)$$

Now have 24 sets of combined stresses.

6. For each of the 24 load cases, calculate principle stresses in center of each element, and calculate stress ratios for principle tensile stresses.

7. Search stress ratios for maximum values.

8. Prepare stress ratio summary sheets for all load cases, and evaluate results.

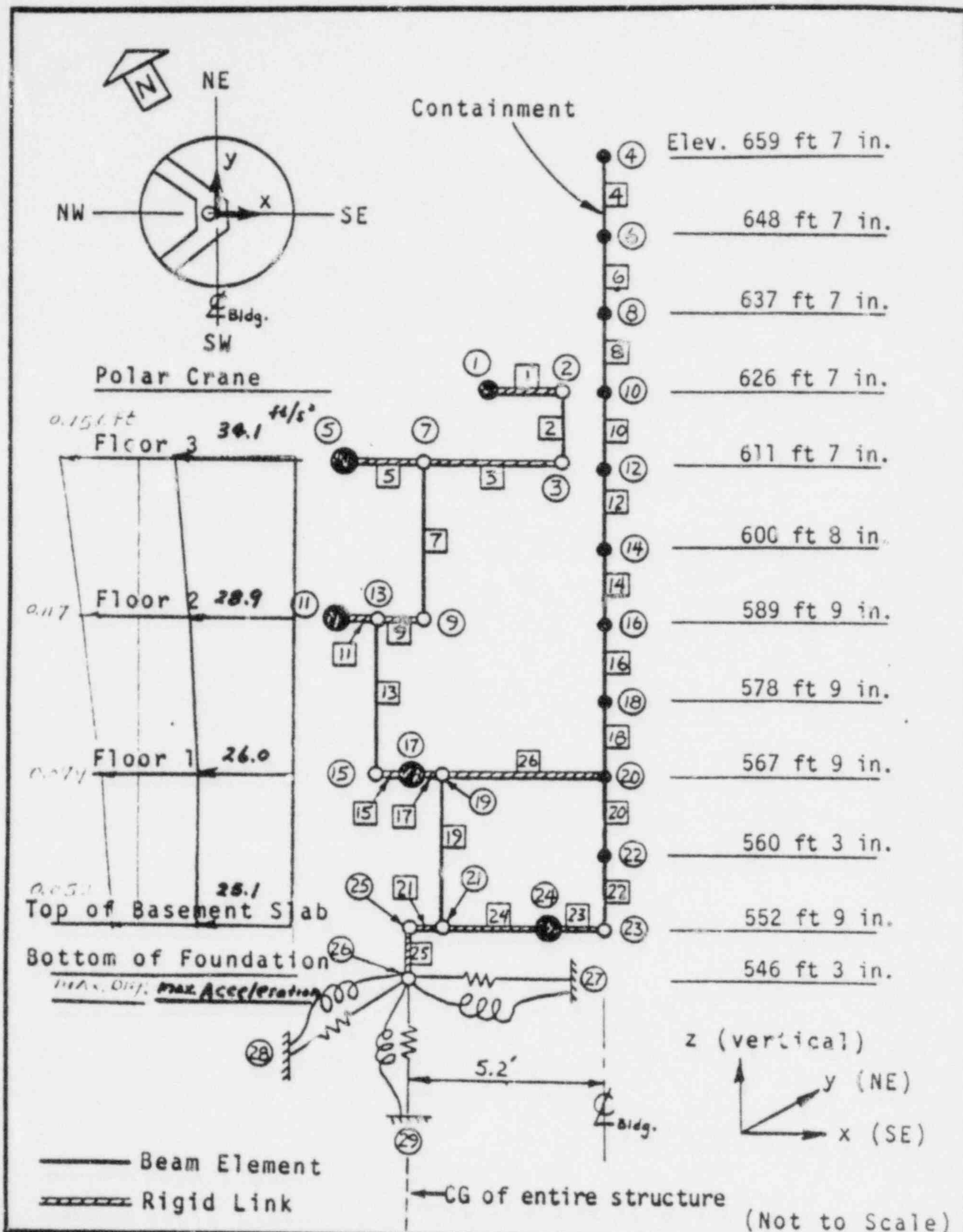

FIGURE 2-5 MATHEMATICAL MODEL FOR THE LINEAR ELASTIC DYNAMIC ANALYSES