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ADDITIONAL INVESTIGATIONS TO DETERMINE EFFECTS OF VIBRATORY MOTIONS DUE TO AN EARTHQUAKE ON THE CALAVERAS FAULT

prepared for

GENERAL ELECTRIC COMPANY
Vallecitos, California

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INTRODUCTION

This document presents the results of additional investigations to determine the effects of vibratory motions due to an earthquake on the Calaveras fault. Many of the pertinent aspects of the investigations are identical to analyses which were reported previously to the NRC (Ref. 1) Therefore, in the interest of brevity and non-duplication, only the new features of the additional analyses are reported herein. This revised report supersedes the original report dated 30 April 1980. In this revision, supplementary detailed information regarding the investigations has been included. Basic procedures, results, and conclusions remain unchanged.

GROUND MOTION CRITERIA

The following ground motion parameters were selected for the evaluations (Ref. 2).

- Effective horizontal ground acceleration: 0.60g
- Effective vertical ground acceleration: 0.40g
- Response spectrum shape: Regulatory Guide 1.60

The evaluations were also performed for the following criteria specified by the USNRC (Ref. 3)

- Effective horizontal ground acceleration: 0.75g
- Effective vertical ground acceleration: 0.50g
- Response spectrum shape: Regulatory Guide 1.60

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COMPONENTS OF EARTHQUAKE VIBRATORY MOTIONS

The evaluations of the Reactor Building were based on the following matrix of percentages of effective ground acceleration values for vibratory loading:

Case	H1	H2	Vertical
1	± 100%	± 40%	± 40%
2	± 40%	± 100%	± 40%
3	± 40%	± 40%	± 100%

EVALUATION OF STRUCTURE

The Phase 2 linear elastic analyses for the GETR Reactor Building were performed for a ground acceleration of 0.8g due to a seismic event on the Calaveras fault, using a three-dimensional lumped-mass cantilever model shown in Figure 1 (Reproduced from Figure 2-5 of Reference 1). The dynamic analyses were performed for two horizontal (NE and NW) components and the vertical component independently. The stress analyses using the three-dimensional finite-element model were then performed using the NE earthquake component.

All major walls of the concrete core structure of the Reactor Building are essentially parallel either to the NE or the NW directions (Figures 2 and 3). It was found, on the basis of hand computations, that the forces due to the earthquake component in the NE direction were resisted primarily by shear walls parallel to that direction, and the stresses in the walls parallel to the NW direction due to the earthquake component in the NE direction were found to be neglegible. Similarly, the forces due to the earthquake component in the NW direction were resisted primarily by shear walls parallel to that direction, and the stresses in the walls parallel to the NE direction due to the earthquake component in the NW direction were found to be neglegible. It was also determined that the stresses in the walls parallel to the NE direction due to the earthquake component in the NE direction were similar in magnitude to the stresses in the walls parallel to the NW direction due to the earthquake component in the NW direction.

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Based on the above results, it was therefore decided to perform the Phase 2 stress analyses (Ref. 1) using the three-dimensional finite-element model with only one horizontal component of earthquake motion. The component in the NE direction was selected for this purpose. The maximum absolute accelerations at each floor level were multiplied by the tributary masses at each nodal point at that level of the finite-element model to compute the inertial forces at these nodal points. These nodal forces were then applied statically to compute the stresses in the elements of the finite element model.

After the completion of the stress analysis described above, the stresses in the NW direction in selected elements (due to the earthquake component in the NE direction) were examined, compared against the stresses in the NE direction (due to the earthquake component in the NE direction), and were found to be neglegible. This examination verified that it was appropriate to perform the stress analysis using the three-dimensional finite-element model for only one horizontal component of the earthquake motion (NE component).

The influence of the vertical component of earthquake motion on the structural response was investigated as a part of the Phase 2 Calaveras analyses (Ref. 1), as well as during the recent Verona analyses (Ref. 4). The Calaveras analyses showed that the influence of the vertical component of earthquake motion on the horizontal shears was neglegible. Also, the recent Verona analyses (performed concurrently for the three components of earthquake motion), showed that the vertical component influences the principal stresses by about 10 percent.

It should also be recalled that there were a number of conservatisms associated with the three-dimensional finite-element stress analyses described above. For example, the exterior wall in the basement in the region of the concrete core structure, as well as the remainder of the exterior ring wall outside of the core structure, were ignored i.e., the stiffnesses of these walls were assumed to be zero, in these analyses. A detailed discussion of the many conservatisms in the analyses is provided in Ref. 5.

It was therefore judged unnecessary to make additional stress analyses for the postulated Calaveras event for the three components of input motion as specified in the criterion (0.60g - Ref 2; and 0.75g - Ref. 3), and it was concluded that the evaluations for 0.80g described in Reference 1 adequately demonstrate that the Reactor Building is adequate to withstand motions induced by postulated seismic events on the Calaveras fault.

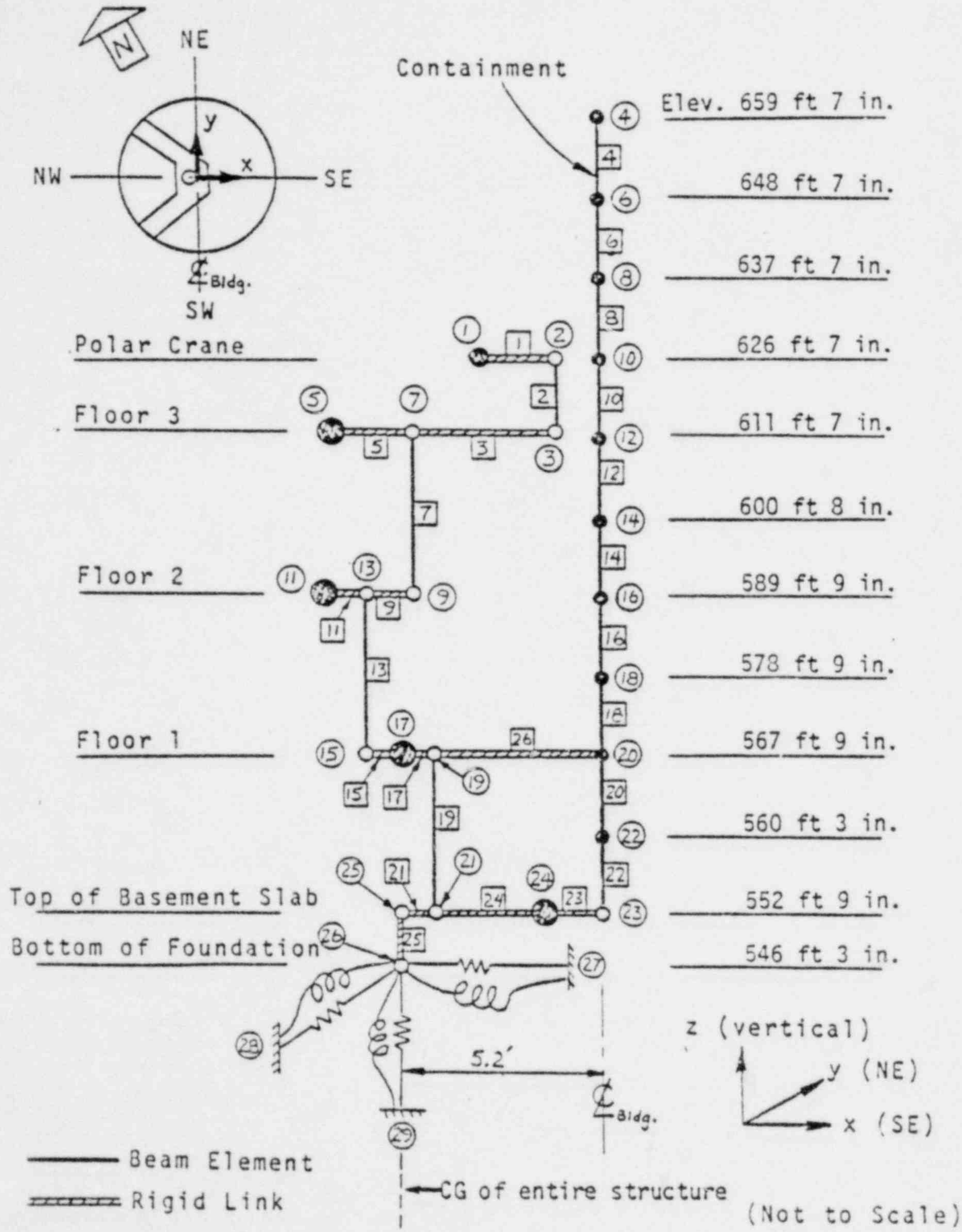

FIGURE 1. MATHEMATICAL MODEL FOR THE LINEAR ELASTIC DYNAMIC ANALYSES
(Reproduced from Figure 2-5 of Reference 1)

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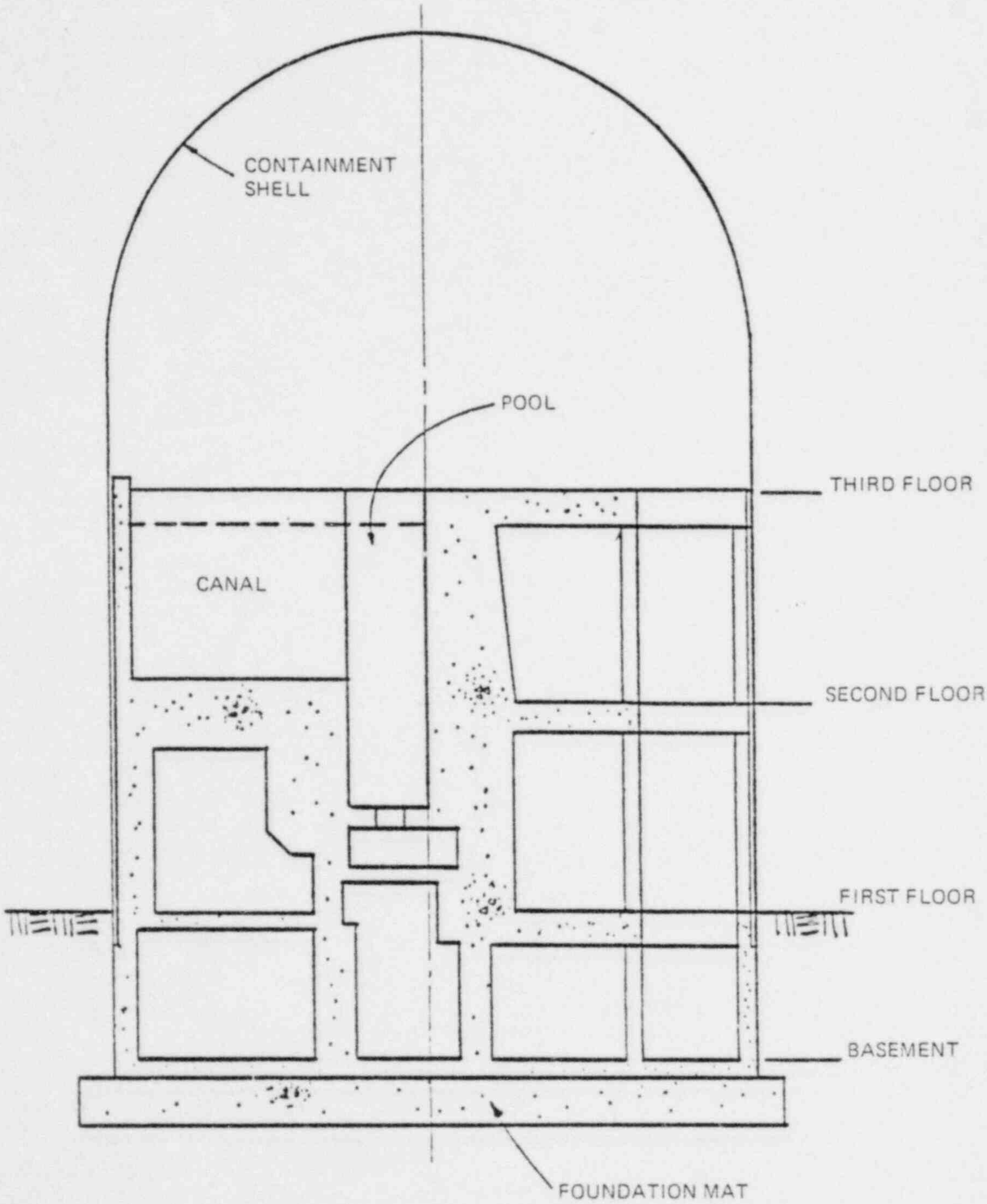

FIGURE 2. REACTOR BUILDING VERTICAL SECTION
(Reproduced from Figure 3-5 of Reference 1)

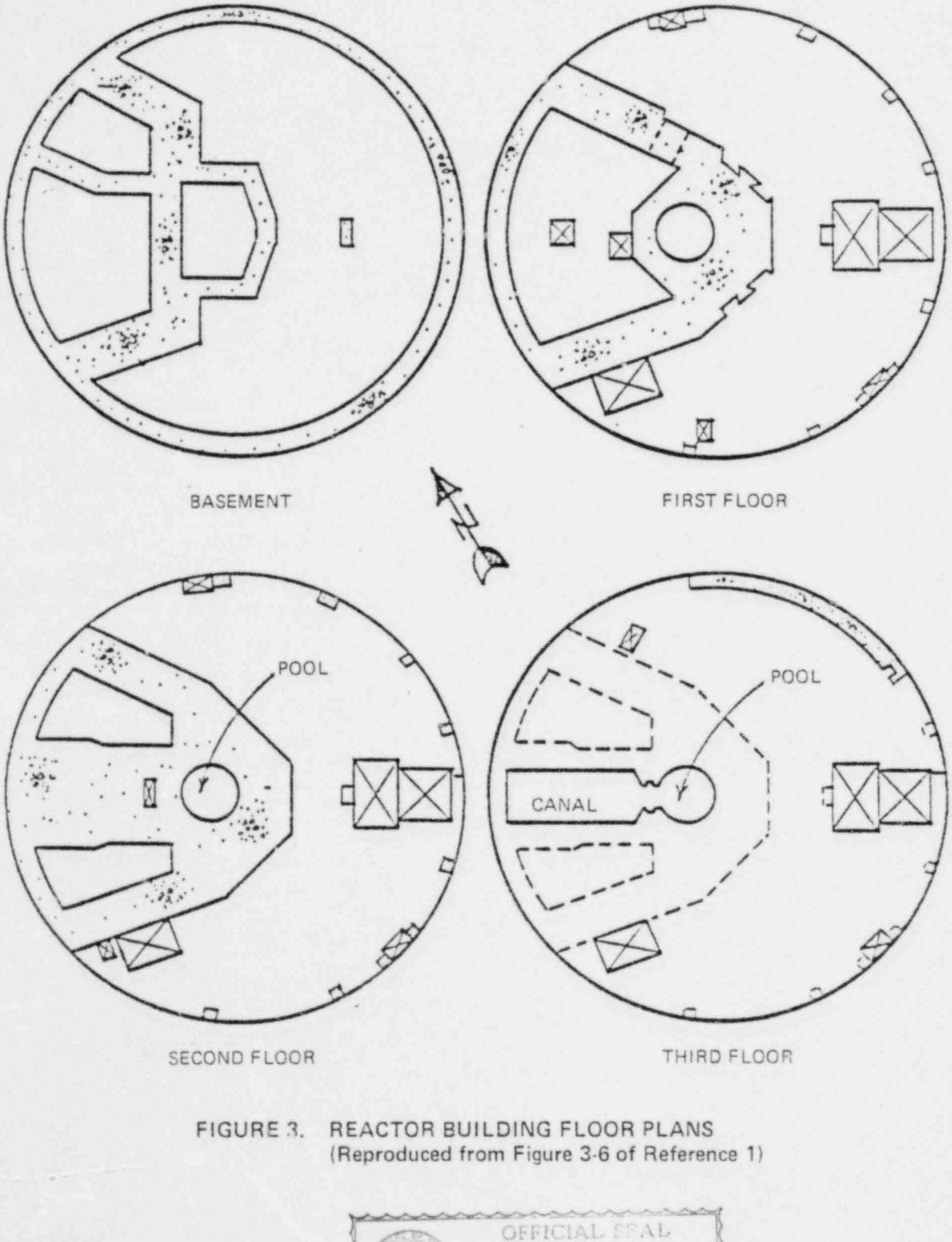

FIGURE 3. REACTOR BUILDING FLOOR PLANS
(Reproduced from Figure 3-6 of Reference 1)

REFERENCES

REFERENCES

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