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Enclosure 1

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

STRUCTURAL AND GEOSCIENCES BRANCH

SEISMIC ANALYSIS OF BUILDING 10 AND WALKOVER STRUCTURE

FORT ST. VRAIN NUCLEAR GENERATING STATION

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1.0 INTRODUCTION

Public Service Company of Colorado (PSC) added two new seismic safety-related structures to the Fort St. Vrain Nuclear Generating Station. The new structures are Building 10 (designed by Stone and Webster) and the Walkover Structure (designed by PSC) which connects Building 10 and the Turbine Building. Since the methods used for the seismic analyses performed on these structures are different from those contained in the FSAR, a review of the methods used is required.

2.0 EVALUATION

Building 10 is a reinforced concrete frame structure 34 feet by 45 feet in plan and about 60 feet high. The building is founded on 6 caissons, each 4 feet in diameter, and extending about 60 feet to bedrock. The soil consists of 4 layers each having different shear wave velocities. The structural model used to perform the seismic analysis was a stick model with masses lumped at each of the six floor elevations. Soil-structure interaction effects were modeled with springs attached to the foundaton of the structure. The spring constants were evaluated based upon the stiffness characteristics of the caissons. The methods in Ref. 1 were used to evaluate the stiffnesses of a uniform soil layer. The PILAY2 computer program (Ref. 2) was used to determine horizontal interaction spring constants using the actual layered soil configuration. Damping values of 7% for the SSE* and 4% for the OBE were used for all modes. The input to the model consisted of a Reg. Guide 1.60 spectrum anchored at 0.05g and 0.10g for the OBE and SSE respectively. Spectral plots are made to compare the 5% (damping) OBE R.G.1.60 spectrum for Building 10 with the 2% OBE FSAR spectrum and the 7% SSE R.G.1.60 spectrum for Building 10 with the 5% DBE FSAR spectrum. The Building 10 spectra envelope the FSAR spectra in both cases. A time history analysis is performed and the results are used to evaluate stresses in the structural members of Building 10 and to determine the response spectra for each mass point in the Building 10 model.

*Safe Shutdown Earthquake (SSE) and Design Basis Earthquake (DBE) have the same meaning. The latter term has been used in the FSAR of Fort St. Vrain.

The Walkover Structure is a braced steel frame structure providing a walkway between the various levels of Building 10 and the Turbine Building. It is about 19 feet by 6 feet in plan and 54 feet tall. It is founded on a reinforced concrete footing varying between 4 feet and 6 feet in thickness. A lumped mass cantilever model was used to evaluate the seismic response of the Walkover Structure. Since the structure is very light, soil-structure interaction (SSI) effects are omitted and the same seismic input motions used for Building 10 are input directly to the foundation. Reg. Guide 1.60 spectra were used as input to the structural model. These spectra are conservative relative to the FSAR design spectra and therefore considered to be acceptable.

The effect of structure-structure interaction were specifically considered. Since the masses of the new buildings are small and their fundamental frequencies are high as compared with those of the Turbine Building, the motion of the Turbine Building would not be affected by the new buildings. However, on the other hand, the Turbine Building response may affect the horizontal motion of Building 10 and the Walkover Structure. Inputting the Turbine Building basement motion directly to the mat of Building 10 and the Walkover Structure would provide bounds of this effect. In view of the relative masses of the structures this approach is acceptable.

The isolated peak E-W DBE displacements of the three buildings are:

Turbine Building	0.096 inches
Building 10	0.210 inches
Walkover Structure	0.858 inches

The maximum relative displacements between the Turbine Building/Walkover Structure and the Building 10/Walkover Structure are 0.954 inches and 1.068 inches respectively. Both of these are less than the available 2 inch gap. There is a ½ inch gap between the checker plates and the Turbine Building, and it is shown that the bolts holding the checker plates will fail at an applied load of 334 pounds per foot which will not have a significant effect on the impact on the Turbine Building. This is because of the fact that the load is small, and that the nature of the bolt shear failure is such that once impact occurs the bolts will fail and the checker plates cannot be involved in further impacts.

There is a 1-inch gap between Building 10 and the step on the Walkover Structure. This clearance exceeds the calculated relative motion of 0.414 inches and is therefore adequate.

3.0 CONCLUSION

The seismic analysis methods used for Building 10 and the Walkover Structure have been found to be conservative relative to the FSAR. The gaps provided are found to adequately accommodate relative motions which occur between these two structures and between the Walkover Structure and the Turbine Building.

References:

1. J. P. Singh, N.C. Donovan, and A.C. Jobsis, "Design of Machine Foundation on Piles", ASCE Journals of the Geotechnical Engineering Division, August 1977.

2. Systems Analysis Control and Design Activity (SACDA), User Manual, PILAY2, A Computer Program for Calculation of Stiffness and Damping of Piles in Layered Media. The University of Western Ontario, London, Ontario, Canada, January 1981. Enclosure 2

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