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9 September 1968

Dr. Peter A. Morris, Director
Division of Reactor Licensing
U. S. Atomic Energy Commission
Washington, D.C. 20545

Re: Contract No. AT(49-5)-2667
Dresden Nuclear Power Station Units 2 & 3
AEC Docket Nos. 50-237 and 50-249

Dear Dr. Morris:

In reply to the questions contained in our letters regarding the above project dated 16 May and 31 May 1968, your office transmitted to us, for information only, informal copies of seismic analysis reports identified as follows:

(a) "Dresden Units 2 & 3 Nuclear Plant, Earthquake Analysis, Ventilation Stack," by John A. Blume and Associates, undated, but transmitted with a letter dated May 25, 1967.

(b) "Dresden Units 2 & 3 Nuclear Plant, Earthquake Analysis: Drywell," by John A. Blume & Associates, undated, but transmitted with a letter dated January 24, 1967.

(c) "Dresden Units 2 & 3 Nuclear Plant, Earthquake Analysis: Reactor-Turbine Building," by John A. Blume & Associates, undated, but transmitted with a letter dated January 19, 1967.

We have reviewed these reports in some detail and find that they are not responsible to the questions raised in our letters referred to earlier. The description of the method of analysis given is not complete enough, nor are the assumptions on which the methods are based described in enough

detail to permit us to make an independent judgment of the accuracy and adequacy of the analyses. Therefore we are transmitting to you herewith additional questions which are divided into two parts: (1) General questions which refer to the methods used and are applicable to all three of the reports cited; and (2) specific questions concerning the details of the analysis given in each of the reports.

(1) General Questions and Comments

The method of analysis described in the first part of each of the reports is the same. The method appears to be a standard one. It is based on a time-history input of earthquake motion. The following questions concern primarily the input data and the method of handling it, and except for an explanation of one of the items of the nomenclature, do not concern the method of analysis, which is adequate provided that the proper data are used and the results properly interpreted.

1. In the reports the symbol R_n is not defined. We assume that it is the product of the unit vector by the mass matrix and by the mode shape factor for the nth mode. However, we need assurance that this is the definition that was actually used.

2. No information is given regarding the time history of ground motions (or actually ground acceleration) which was used in the analysis. Without such information we can not judge either the accuracy or adequacy of the results given. The only description of the input indicates that it had a maximum acceleration of 0.10g. It would be desirable, as a minimum, to have a diagram showing the specific time history input, including its duration as used in the analysis, and preferably the response spectrum calculated from that time input, in order that we can judge the adequacy of the results. However, we can make the calculation of the response spectrum ourselves if the applicant

is not able to give us these data. For this, however, we do need an accurate description of the specific time history input used. This is indeed a critical matter.

3. Although the reports give the natural period of vibration of the calculated modes, no other information is given concerning the modes. If these data were made available to us, we could very quickly estimate the accuracy of the computations. For this purpose, we would need to have the mode shapes for each of the modes used, or at least the first and second mode, and the values of R_n and M_n, or the ratio, R_n/M_n for each mode in order that we can determine the participation factor for that mode.

A much more complete checking of the calculations could be obtained if the maximum shear and maximum moment diagrams for these modes were also given. However, it is possible that these were not computed for the individual modes.

4. Although the statement is made in the various descriptions in the reports that "the effects of axial and shear deformation are included in the formation of the stiffness matrix," and it is also indicated that "the structural member input data for the program is in the form of member moments of inertias, areas, and effective shear areas," the effective shear areas are not tabulated nor is information given in any of the reports as to how they were computed. Hence, we can make no estimate of the adequacy of the physical constants used in the analysis. Tabulations are given, however, of area of cross section and gross moment of inertia of cross section, but these alone are not sufficient to define the effective shear areas. It is necessary to have, at the least, a statement as to how the effective shear area was determined.

5. The calculations reported give only the maximum response and it is indicated that this maximum was obtained by summing at each time instant the sum of the responses for each of the modes considered. However, only the maximum value is given, and no indication is given of the number of times a near-maximum value was obtained from which one could obtain a measure of possible oscillations in the response. It is likely that no other information was made available from the computer program, but if it is possible that there is a typical time history of a particular response, it would be most helpful in judging the adequacy of the time history of input used.

6. We have some minor questions regarding terminology, but these are probably very easily resolved. We should like to be sure that the values of "maximum absolute displacement" are in fact the maximum displacement relative to the base of the particular structure or structural element considered, and not the maximum displacement in space. We should like also to be sure that the assumption is made that the bases of all of the elements that are connected together move in precisely the same way.

(2) Questions and Comments Regarding Specific Reports

The following questions refer to the specific reports identified earlier in this letter. Report (a) refers to the ventilation stack, Report (b) refers to the drywell, and Report (c) refers to the reactor-turbine building.

1. The statement is made that the analysis for the stack, Report (a), was made on the assumption that the stack is fixed at its base. Because of the weight of the stack and the size of the base, it appears that some overturning or rotational effect might be important. What studies were made to eliminate this as a possibility?

2. Report (b). How was the drywell supported at Elevation 575'-2"? Specifically, we inquire whether the drywell was assumed to be attached

rigidly to the reactor turbine building, with exactly the same deflection as the latter at the point of connection, or whether some flexibility in the connection was assumed, and if so, what flexibility? We assume that the connection is rigid since the displacements at Elevation 575'-2" given in Report (b) in Figs. 6 and 10 are about the same, as nearly as we are able to judge from the drawings, as the deflections shown in Figs. 7 and 11 of Report (c). The reports imply that the calculations for the drywell and the reactor turbine building were made as if they were a single unit, but because of the separation in the reporting, there is a question as to whether this is in fact so, or whether some approximation was used to represent the parts of the confined structure which act with the particular element analyzed in the separate reports.

3. In Report (b) the actual masses of the drywell are not shown anywhere. Not even the total mass is given. The mass distribution is essential in interpreting the results of the analysis. It seems likely that the mass of the drywell is not negligible compared with the mass of the reactor-turbine building. Hence it should have an important effect on the reactor turbine building. There is evidence in Report (b) that the reactor turbine building has an important effect on the drywell, as indicated by the relatively large shears shown at the point of support at Elevation 575'-2", ranging from 100 to 400 kips depending on the direction and the state of emptiness of the drywell.

4. There is no indication of a force acting on the reactor building due to the force from the drywell, comparable to the change in shear acting on the drywell, at Elevation 575'-2". Figs. 5 and 9 of Report (c) show no force at all at that elevation, which is not consistent with the

influence that the reactor building has on the drywell as indicated in Report (b).

5. The sketch of the reactor turbine building shown in Fig. 1 of Report (c) does not indicate the value of the spring constant connecting the reactor building and the turbine building at the elevation near the top in the north-south direction. No spring is shown in Fig. 2 for the east-west direction. Presumably there is no connection in the east-west direction at the upper elevation.

At the 561'-6" elevation apparently a rigid connection is indicated between the two buildings in both directions. However, the deflections shown in Fig. 7 and Fig. 11 for the two directions, north-south and east-west, respectively, do not indicate that the deflections are the same at this elevation in each of the directions. Some explanation of the way in which these deflections can differ, although the buildings are connected rigidly together and their bases presumably move the same, would have to be given in order to explain this apparent discrepancy.

(3) General Comments

We assume that a part of our function is to report on the adequacy of the seismic analyses for the earthquake hazards considered reasonable in the design of specific nuclear reactor power plants. We do not feel comfortable when such a report must be based entirely on judgment without recourse to analysis and calculations. Where analyses are available, and reported in sufficient detail for us to make an independent judgment of their accuracy and adequacy, then we can perform our function most effectively. However, where insufficient information is given, without enough data to permit us to make a check both of the assumptions used in the calculations and of the accuracy

of the calculations themselves, we are not willing merely to accept numbers for design values given without explanation. Hence, we have raised certain questions in this letter in the hope that we can obtain sufficient additional information to make an independent judgment of the adequacy of the numerical values reported.

Very truly yours,

N. M. Newmark

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bjw
cc: W. J. Hall
W. H. Walker