

Edson G. Case

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1114 CIVIL ENGINEERING BUILDING

URBANA, ILLINOIS 61801

30 June 1971

Mr. Edson G. Case, Director
Division of Reactor Standards
U.S. Atomic Energy Commission
Washington, D.C. 20545



Re: Contract No. AT(49-5)-2667
Three Mile Island Nuclear Station - Unit 1
Metropolitan-Edison Company and
Jersey Central Power and Light Company
AEC Docket No. 50-289

Dear Mr. Case:

Dr. W. J. Hall and I have reviewed the Final Safety Analysis Report for Three Mile Island Nuclear Station - Unit 1. We are attaching herewith our Commentary which forms the basis of our separate final report on this facility, a draft of which is sent separately.

Sincerely yours,

N M Newmark

N. M. Newmark

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Enclosures

cc: W. J. Hall (2)

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COMMENTARY
ON
FINAL SAFETY ANALYSIS REPORT
FOR
THREE MILE ISLAND NUCLEAR STATION -- UNIT 1
METROPOLITAN-EDISON COMPANY AND JERSEY CENTRAL POWER AND LIGHT COMPANY
AEC Docket No. 50-289
by
N. M. Newmark and W. J. Hall

1. Seismic Design Criteria

Earthquake Hazard --

The seismic design for the plant was carried out for a Design Basis Earthquake characterized by 0.12g maximum horizontal ground acceleration to the extent of insuring containment and safe shutdown; also, the design was made for an Operating Basis Earthquake characterized by a maximum horizontal ground acceleration of 0.06g. As noted in our report on the PSAR (Ref. 4), we concur in these design levels for use in the seismic design of this plant.

Buried Piping --

The description of the approach followed by the applicant for buried piping is given on pages 5-76a and 5-76b. Further information is included in Amendment 20 where it is indicated that a typical detail for the egress or ingress of a concrete pipe into a building is through a bell and spigot joint. Steel pipe is rigidly anchored. Relative motions are calculated and the stresses in steel

piping where relative motions may be a problem are kept at 8000 psi or less. Subgrade reactions are considered in arriving at the evaluation of relative motions and piping forces. Also, the length of the pipe run versus possible seismic ground wave length is considered, but in the Three-Mile Island plant the applicant advises that there are no "long" pipe runs. For example, between the make-up water plant and the pumphouse, the piping follows an irregular path that provides considerable flexibility and ductility. On the basis of the information we have been supplied, we believe this design can be considered satisfactory for the seismic risk involved.

Reactor Internals --

The analysis used in the design of the reactor internals, as described on page 3-46 of the FSAR, is that given in Babcock and Wilcox topical report BAW-10008, Part I, Revision 1 (Ref. 3). The approach followed therein for the analysis of the reactor internals is acceptable to us. It was made for higher levels of base ground acceleration than those for the current plant design. The second topical report, BAW 10008, Part II, Revision 1 refers to the fuel assemblies stress deflection analyses for loss of coolant accident and seismic excitation (Ref. 3(b)). According to Appendix 4A, the analysis was made for values of earthquake excitation corresponding to the design criteria for the plant. We believe the procedures are adequate.

Building Analysis --

The seismic design approach adopted for the buildings is summarized on pages 5-18 and thereafter in the FSAR. It is indicated that the vertical and horizontal seismic components at any point in the shell were added by summing the absolute values of the response (that is, stress, shear, moment, or deflections) of each contributing mode due to the vertical motion to the corresponding absolute values of the response of each contributing mode to the horizontal motion. We believe the approach is satisfactory. In general, the approach adopted for the

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seismic analysis of the shell follows classical methods and the materials presented in the FSAR appear to be acceptable.

Design Stresses --

The applicant states in Section 5.2.3 that the design of the prestressed reactor building was made so as to have a low strain elastic response for all design loads. The stresses presented in Table 5-3 for various load combinations appear acceptable. The stresses for loading conditions 31 and 32, which are for the Design Basis Earthquake, do not control the design, according to information presented in Amendment 20. The stresses indicated appear reasonable.

Responses Resulting from Vertical Motions --

The statements in the FSAR indicate that appropriate amplification was taken into account in the design of the structures and piping. Amendment 20 documents the fact that the piping mounted on walls of main supporting elements to the structure, or on floors close to such walls, was designed for vertical amplification corresponding to the input motions. This approach is satisfactory. Amendment 20 also indicates that when the piping support is on a floor, if upon examination of the support, which includes the floor and the pipe support system, the frequency is less than 30 Hertz, a dynamic analysis will be carried out to reflect the amplification arising from the support; if the frequency is greater than 30 Hertz, the support arrangement is considered as rigid. This approach is satisfactory.

Further explanation is presented in Amendment 20 concerning the design of equipment. The applicant indicates that for equipment without a significant mass, the equipment is modeled with the piping when the piping is analyzed. For equipment with a significant mass, the analysis is made with a pseudo floor response spectrum applicable to the piping system at the nozzle point of the equipment. In this way, feedback between the mounted equipment and the piping

is taken into account. The applicant also advises that if the equipment is flexibly supported, this fact is taken into account in arriving at the forces on the equipment as well as the input forces into the piping, and in the feedback analysis. This approach appears satisfactory.

Piping Analyses --

The general description of the method of dynamic analysis followed for piping systems is given on pages 5-76a and 5-76b. Further amplification is given in the topical report by Gilbert and Associates (Ref. 2), which indicates that the method of Biggs and Roesset was employed for the analyses. The floor response spectra that were used in the piping analyses are presented in Amendment 20, and appear to be adequate.

2. Class I Items of Equipment in Class II Structures

The applicant advises that there are no Class I equipment items located within Class II structures.

3. Critical Items of Control and Instrumentation

The adequacy of critical controls and instrumentation is documented in report BAW 10003, "Qualification Testing of Protection System Instrumentation", Ref. 3(c). These items are satisfactory.

4. Aircraft Impact Design

The applicant addresses this question in Appendix 5a. The revised loadings used to determine stresses and deflections in this Appendix, in Amendment 19, appear reasonably conservative for Cases A and B (which correspond to impact of isolated objects such as engine pods) and Case D (which corresponds to impact radially or normally of a 200,000 lb. aircraft) all at 200 knots velocity. The heavier aircraft impact of Case C was not considered as a design basis, and was not reviewed by us.

The stresses and deflections were computed by methods which are appropriately conservative, both for the reactor building and for the flat roof and wall surfaces of other buildings designed to resist aircraft impact. In our opinion, based on our examination of the applicant's presentation and supplemented by considerations of response into the inelastic range, we believe that the stresses and deflections resulting from aircraft impact of aircraft weighing less than 200,000 lb. gross, impacting at velocities of less than 200 knots, will not cause impairment of the safe shutdown capability of the facility.

REFERENCES

1. "Final Safety Analysis Report -- Vol. I through IV, including Amendments 14, 17 and 19", Metropolitan-Edison Company and Jersey Central Power and Light Company, AEC Docket No. 50-289, 1970 and 1971.
2. "Dynamic Analyses of Vital Piping Systems Subjected to Seismic Motion", Gilbert and Associates, Inc., Topical Report No. 1729, 20 May 1970.
3. (a) "Reactor Internal Stress and Deflection due to Loss-of-Coolant Accident and Maximum Hypothetical Earthquake", Babcock and Wilcox Report BAW-10008, Part I, Revision 1, June 1970.
- (b) "Fuel Assembly Stress and Deflection Analysis for Loss-of-Coolant Accident in Seismic Excitation", Babcock and Wilcox Report BAW-10008, Part II, Revision 1, June 1970 (Proprietary).
- (c) "Qualification Testing of Protection System Instrumentation", Babcock and Wilcox Report BAW-10003, March 1971 (Proprietary).
4. "Adequacy of the Structural Criteria for Three-Mile Island Nuclear Station Unit 1", Metropolitan-Edison Company (AEC Docket 50-289), Report to AEC Regulatory Staff by N. M. Newmark and W. J. Hall, December 1967.

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