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COMMENTARY

ON

FINAL SAFETY ANALYSIS REPORT

FOR

ARKANSAS NUCLEAR ONE -- UNIT 1

ARKANSAS POWER AND LIGHT COMPANY

AEC Docket No. 50-313

by

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1. Seismic Design Criteria

Earthquake Hazard --

The FSAR indicates that the seismic design for the plant was carried out for a Design Basis Earthquake characterized by 0.20g maximum horizontal ground acceleration so as to insure containment and safe shutdown. Also, the design was made for an Operating Basis Earthquake characterized by a maximum horizontal ground acceleration of 0.10g. As noted in our report concerning the PSAR review (Ref. 3), we concur in the use of these design levels.

Site Foundations --

The description in the FSAR in Section 2.6.7, Site Foundation Evaluation, indicates that the foundations of all Class I structures will be on shale; the indications were that the foundation materials would be expected to be excellent. Some statement as to the actual adequacy of the foundation materials, as revealed during construction, should be provided by the applicant.

The stability of the intake and discharge canal slopes was the subject of a special review (Ref. 4) and in some manner the adequacy of this aspect of the design, as reflected by the applicant's evaluation, should be presented.

Dynamic Analysis --

Reactor Building. In Section 5.1.1.2.5, a general statement is made that a dynamic analysis was used to determine the equivalent static loads for the design. The seismic analysis of the reactor building is described in Section 5.1.1.5.6 and it appears that the analysis was handled by a response spectrum procedure. The damping values employed for the reactor building were noted to be 5 percent for the OBE and 2 percent for the DBE; we concur in the use of these damping values.

In order to gain a better understanding of the analysis that was actually carried out for the reactor building, it will be necessary to have further details as to the manner in which the reactor building was modeled and a summary of the calculations. This request is not meant to imply that the procedure employed will not give reasonable results, but little can be said about the adequacy of the design without having some indication of the nature of the results. Also, for example, it is indicated that the several modal contributions are combined to give the final response of the structure, but there is no indication as to how the values were combined. Thus, in summary, for the reactor building analysis, we need more details on the model of the structure, the nature of the calculations carried out, and the results.

Other Structures. Reference to page 5.A-1 indicates that there were a number of other Class I structures (the auxiliary building, portions of the intake structure housing the service water pumps, supports for Class I system components, and emergency reservoir and pipelines) that were analyzed for seismic loading as well. The only statement covering the analysis of these structures is that on page 5.A-5 wherein the following is stated: "Earthquake analyses of the Class I structures, systems and equipment are accomplished, where applicable, using the spectrum response or time history approaches, which utilizes the natural period, mode shapes, and appropriate damping values of the particular system". For evaluation purposes we need further details for the types of analyses that were carried out as well as the results.

The damping values given on page 5.A-5 for both the OBE and DBE are acceptable.

Piping. It would appear from the presentation in Appendix 5A, particularly that on page 5.A-5, that the general statement concerning dynamic analysis applies to piping as well. A special section on piping is presented in Appendix A, and the seismic design procedures are outlined in Section A.5. It is indicated that piping is classified as rigid if it has a fundamental frequency greater than 30 cycles per second and that piping is analyzed for the static loads corresponding to the acceleration in the rigid range of the spectrum curves. Immediately thereafter it is stated that the dynamic analysis of flexible Class I seismic piping systems for seismic loads is performed by using the spectrum response method. It goes on to say that the percentage of critical damping for all modes is 0.5 percent for the OBE and DBE. Further on, it states that in lieu of the above procedures, some Class I seismic piping is analyzed for static loads equivalent to the peak of the spectrum curve for the applicable floor elevation; and, that the horizontal acceleration spectrum curves applied to the piping systems are developed as a part of the seismic analysis for the building.

If indeed the procedure employed for the reactor building, as described earlier herein, was a response spectrum procedure, it is not clear how additional spectrum curves could be developed at the various floor levels of the reactor building. Perhaps the reactor building was analyzed in several ways. If so, this should be clarified. In any event, the various Class I piping runs should be identified specifically or broken down into groups, the precise details of the method of dynamic analysis employed described, and typical stress results presented indicating the magnitude of the seismic stresses and other applicable stresses. A summary of this type is required before any further evaluation can be undertaken of this aspect of the design.

Vertical Earthquake Excitation. On page 5-3 of the FSAR, in Section 5.1.1.2.5, it is indicated that a simultaneous vertical component two-thirds of the magnitude of the horizontal acceleration was applied. The applicant should indicate whether a constant coefficient was employed in all cases, or whether amplified response values (just as for the horizontal excitation) were used. The information supplied should refer to building structures, piping, and equipment.

Buried Piping. If Class I buried piping is located in the facility, the special steps taken to insure its integrity under earthquake excitation should be described.

2. Stress Limits

The discussion of the design stress basis in Appendix 5A, Section 5.A.3.1 indicates that the upper limit of elastic behavior against which the designs were checked corresponded to yield strength of steel and the yield strength for reinforced concrete structures as related to the element resisting capacity given in the ACI-318-63 Code. These limits are acceptable in the sense of defining essentially elastic response, but we should like the applicant to indicate whether there were any special conditions under which these yield limits were exceeded. This point is raised because in the latter portion of the same section, it is indicated that limited yielding is allowed; the question then arises as to what check was made to insure that excessive deformation would not lead to loss of function for the particular structure or item. Further information from the applicant is required concerning the details of the items for which this criterion was applicable and the manner in which the calculations were carried out to insure their adequacy.

3. Class I Equipment in Class II Structures

The application should indicate whether there are any Class I equipment items in Class II structures. If so, the provisions taken to insure their functional adequacy should be described.

4. Reactor Internals

The discussion in Section 4.1.2.5.1, under Reactor Coolant Systems, refers to Report BAW-10008, Part 1, Rev 1, and Part 2, Rev 1. Also, Refs. 3(a) and 3(b) are referenced in Section 3 on reactors. The approach followed in these reports for the analysis of reactor internals is acceptable to us.

5. Critical Items of Control and Instrumentation

The adequacy of [illegible]cal items of control and instrumentation is documented in Report BAW-10003, "Qualification Testing of Protection System Instrumentation". These items appear satisfactory.

6. Equipment Openings

The design approach followed in analyzing large penetrations, as for example equipment openings, is described in Section 5.1.1.5.5 and appears satisfactory. It is indicated on page 5-27 that the seismic loads are taken into account in the analysis. The point in question then is whether in the analysis it was perceived that the deformations associated with the seismic loading could cause any difficulties with the proper operation or sealing of the doors in these large penetrations. We should like confirmation from the applicant that this aspect of the design was considered.

7. Reactor Lining

The analysis procedures followed in designing the reactor lining are described in Appendix 5K; also presented there is a summary of liner plate anchor tests. In order to gain some appreciation for the ductility of the system under consideration, it would be helpful if the applicant could supply examples of the test results, including some of the results for those elements that showed less loading capability than predicted (Appendix 5.K-6) in order that we can evaluate the nature of the results.

<u>Summary</u>

Topics for which additional information is required are as follows:

a. Confirmation of adequacy of foundation materials.

b. Stability of intake and discharge slopes.

c. Additional details of reactor building analyses, model used, technique employed, and typical results.

d. Seismic analysis techniques for other buildings.

e. Details of analysis techniques employed for piping.

f. Techniques employed for handling the vertical earthquake excitation.

g. Approach used for buried piping.

h. Design criteria where yielding can occur.

i. Class I items in Class II structures.

j. Penetration deformation associated with seismic loading.

k. Additional information on liner anchor test results.

REFERENCES

1. "Final Safety Analysis Report -- Vol. I through Vol. III (Amendment 19)", Arkansas Power and Light Company, AEC Docket No. 50-313, 1971.

2. (a) "Reactor Internals Stress and Deflection Due to Loss-of-Coolant Accident and Maximum Hypothetical Earthquake", Babcock & Wilcox Report BAW-10008, Part I, Rev 1, June 1970.

   (b) "Fuel Assembly Stress and Deflection Analysis for Loss-of-Coolant Accident and Seismic Excitation", Babcock & Wilcox Report BAW-10008, Part 2, Rev 1, June 1970 (Proprietary).

   (c) "Qualification and Testing of Protective System Instrumentation", Babcock & Wilcox Report BAW-10003, March 1971 (Proprietary).

3. Newmark, N. M., W. J. Hall, and W. H. Walker, "Report to AEC Regulatory Staff -- Adequacy of the Structural Criteria for the Russellville Nuclear Unit -- Arkansas Power and Light Company", AEC Docket No. 50-313, August 1968.

4. Newmark, N. M., "Stability of Intake and Discharge Canal Slopes, Russellville Nuclear Station", Memorandum forwarded to AEC/DRL on 19 September 1968.