NATHAN M. NEWMARK
CONSULTING ENGINEERING SERVICES

8004300 695

1114 CIVIL ENGINEERING BUILDING
URBANA, ILLINOIS 61801

21 February 1973

COMMENTARY

ON

FINAL SAFETY ANALYSIS REPORT

FOR

ARKANSAS NUCLEAR ONE -- UNIT 1

ARKANSAS POWER AND LIGHT COMPANY

AEC Docket No. 50-313

by

N. M. Newmark and W. J. Hall

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, and that the foundation materials were found to be as anticipated with no unusual problems encountered during excavation.

The stability of the intake and discharge canal slopes was the subject of a special review (Ref. 4). A brief summary of the stability analyses carried out is presented in Section 2.6.7.1 of the FSAR and in the answer to Question 9.5, and the tabulations presented therein indicate the design to be adequate.

Dynamic Analysis --

Reactor Building and Other Class I Structures. The seismic analysis of structures is described in Section 5.1.1.5.6; the analysis was handled by a response spectrum approach, and includes soil-structure interaction as described in the answer to several questions. The approach described is satisfactory.

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.

Piping. 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. It is noted that the dynamic analysis of flexible Class I seismic piping systems for seismic loads is performed by using the spectrum response method. 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. Additional information on this aspect of the seismic design approach is presented on page 5-28b, and it appears that time-history analyses were made to ascertain floor response spectras for the Class I structures. These floor motions were subsequently used in the analyses for piping, equipment and other Class I systems. The approach appears acceptable to us. However, it would be our recommendation that stress summaries for critical runs of piping be requested of the applicant and reviewed.

Vertical Earthquake Excitation. In Section 5.1.1.2.6, it is indicated that a vertical component amounting to two-thirds of the magnitude of the horizontal acceleration was applied, and the horizontal and vertical effects combined simultaneously as appropriate. This approach was applicable to structures, equipment and other Class I systems. We concur in the approach adopted.

Buried Piping. The general approach employed for buried piping, and as presented on pages A-4 and A-4a, is acceptable.

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. Other information on stress limits in Class I structures is presented in the answers to Questions 5.40 and 5.74. These limits and tabulations are acceptable in the sense of defining essentially elastic response. The applicant advises that limited yielding may be permitted under missile forces, but has been checked in design to help assure that the yielding allowed is limited and reasonable. We concur in this approach.

3. Class I Equipment in Class II Structures

The application indicates on page 5A-4 that all Class I equipment is housed in Class I structures. We concur in this approach.

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 critical items of control and instrumentation is documented in Report BAW-10003, "Qualification Testing of Protection System Instrumentation". The answer to Question 8.8 on battery racks and batteries describes the provisions taken to insure the adequacy of these items under seismic excitation. These items appear satisfactory.

6. Penetrations

The design approach followed in analyzing large penetrations, as for example equipment openings, is described in Section 5.1.2.1.3 and appears satisfactory. It is indicated on page 5-31, as well as in Appendix 5A, that the seismic loads are taken into account in the analysis and that the deformations of the equipment hatch associated with the seismic loading will not cause any difficulties with the proper operation or sealing of the door. The approach employed appears satisfactory.

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. The test results summarized on pages 5K-6 and 5K-7 indicate that the liner anchors, as designed, possess significant deformation capacity and indicate the anchorage design to be adequate.

REFERENCES

1. "Final Safety Analysis Report -- Vol. I through Vol. III (Amendments 19 and 21-29)", 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 1, 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.