TENNESSEE VALLEY AUTHORITY

NUCLEAR SAFETY REVIEW STAFF

NSRS INVESTIGATION REPORT NO. I-86-110-SQN

EMPLOYEE CONCERN: 00-85-005-009

SUBJECT: SEQUOYAH LOCATED ON EARTHQUAKE FAULT

DATES OF INVESTIGATION: JANUARY 24-30, 1986

INVESTIGATOR: E. F. Harwell — E. F. HARWELL — 2/28/86 — DATE

REVIEWED BY: Frederick J. Slagle — F. J. SLAGLE — 3/3/86 — DATE

APPROVED BY: W. D. Stevens — W. D. STEVENS — 3/3/86 — DATE

I. BACKGROUND

A Nuclear Safety Review Staff (NSRS) investigation was conducted to determine the validity of an expressed employee concern as received by the Quality Technology Company (QTC)/Employee Response Team (ERT). The concern of record, as summarized on the Employee Concern Assignment Request Form from QTC and identified as 00-85-005-009, stated:

> Sequoyah: Sequoyah Nuclear Plant is sited on an earthquake fault that runs from around Chattanooga to north of Knoxville. If there were an earthquake power plant structures could fail. CI has no further information. Construction Department concern.

II. SCOPE

A. The scope of the investigation was determined from the stated concern of record to be two specific issues requiring investigation:

1. Is Sequoyah Nuclear Plant (SQN) located on an earthquake fault?

2. If there were an earthquake in the area, would power plant structures fail?

B. In conducting the investigation, NSRS reviewed the SQN Final Safety Analysis Report (FSAR), NRC Safety Evaluation Report (SER), and all supplements and correspondence between the NRC and TVA concerning the seismic design margins.

III. SUMMARY OF FINDINGS

A. Requirements and Commitments

1. 10 CFR Part 100, Appendix A, "Seismic and Geologic Siting Criteria for Nuclear Power Plants"

2. Regulatory Guide 1.60, "Design Response Spectra for Seismic Design of Nuclear Power Plants"

3. Regulatory Guide 1.61, "Damping Values for Seismic Design of Nuclear Power Plants"

4. Sequoyah Final Safety Analysis Report, Section 2.5, "Geology and Seismology"

5. NUREG-75/0.87, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," Section 2.5.1, "Basic Geologic and Seismic Information"; Section 2.5.2, "Vibratory Ground Motion"; Section 2.5.3, "Surface Faulting"; and Section 3.7.1, "Seismic Input"

B. Findings

1. Section 2.5.1.5 of the FSAR states:

> The controlling features of the geologic structure at the Sequoyah plant site are the Kingston Thrust fault and a major overturned anticline which resulted from the movement along the fault. This fault lies about a mile northwest of the plant site and can be traced for 75 miles northeastward and 70 miles southwestward. The fault dips to the southeast, under the plant site, and along it steeply dipping beds of the Knox dolomite have been thrust over gently dipping strata of the Chickamauga limestone. The distance from the plant site, about one mile, and the dip of the fault, 30 degrees or more, will carry the plane of the fault at least 2000 feet below the surface at the plant site.
>
> The Missionary Ridge fault is a branch, or subsidiary, fault of the Kingston fault . . . it diverges from the Kinston fault; 3 miles southwest of the Sequoyah site, ...

2. Section 2.5.2.1 of the FSAR states, "There is no geologic evidence indicating that any of these faults could be considered to be "active" faults; that is, still undergoing movement."

3. The FSAR states that the nearest known epicenter from which an earthquake of damaging intensity (MMVII) may occur is 100 miles northeast of the SQN site. ("MM" is the Modified Mercalli Intensity Scale.) A historical view of all earthquakes near the site area has not revealed any of intensity greater than MMV-VI, which is below the damaging intensity (MMVII). Although an earthquake of the MMVIII intensity has not occurred within 250 miles of the plant site, this intensity is assumed to occur at the site for the purpose of evaluating the Safe Shutdown Earthquake (SSE). The maximum acceleration for an earthquake of this intensity is estimated to be 0.14g.

4. The FSAR states that the plant is designed so that all structures, systems, and components important to safety will remain functional when subjected to an SSE having maximum horizontal acceleration of 0.18g and maximum vertical ground acceleration of 0.12g. However, as a result of the development of the site specific response spectrum in 1979, an SSE of 0.22g was considered.

5. In the SQN SER (Ref. 2), the NRC concluded that there were no known geologic structures that would cause surface displacement or would tend to localize earthquakes in the site vicinity. The SER stated:

> In terms of actual spectral response for this period, the present design is at 0.18g while the 84th percentile (hereafter called the site-specific safe shutdown earthquake) would be at 0.28g. At periods greater than 0.35 seconds, the present design always exceeds the site-specific safe shutdown earthquake.

The NRC concluded that the difference in seismic hazard between the present design at SQN and the site-specific response spectrum is not substantiated. The report also stated:

> In addition, because of such factors in the plant design as usage of lower-bound material properties, conservative analysis methods, and loading combinations that include low-occurrence-probability secondary events, a substantial additional margin to resist seismic loading exists in the plant's structures and equipment. Based on all the above, we conclude that the present design basis for the Sequoyah Nuclear Plant is adequate to withstand the effects of earthquakes without loss of capability to perform the required safety functions.

However, because the design spectra did fall below the site-specific spectra, the NRC requested verification and qualification of the additional margins of selected critical sections of the reactor building and auxiliary building.

6. In reference 3, the NRC stated that they had ascertained that the limiting design of the steel containment was not seismic loads, but loss-of-coolant pressure loads. As a result of their review, the NRC concluded that the seismic Category I structures are acceptable for seismic loadings calculated on the basis of the 84th percentile site-specific response spectra when used in conjunction with the damping values recommended by Regulatory Guide 1.61.

7. In December 1979, the ACRS recommended that TVA continue and expand the study of the seismic design margins for the SSE. In May 1980, TVA described by letter (Ref. 5) the details of the expanded seismic design margin investigation. In reference 4, the NRC concluded that completion of the expanded design margin program within the next 18 months was acceptable and that operation at full power need not be delayed pending completion of the reanalysis.

8. TVA presented the results of the expanded design margin study to the NRC on March 29 and 30, 1982, in Knoxville and the NRC reviewer did not disagree with TVA conclusions.

IV. CONCLUSIONS AND RECOMMENDATIONS

A. Conclusion

The concern of record as stated was not substantiated because:

1. The SQN is not located directly on the earthquake fault.

2. The seismic analysis performed by TVA and accepted by the NRC concluded that adequate design margins exist for all critical components and structures to withstand the anticipated earthquake loads without losing their capability to perform their required safety functions.

B. Recommendations

None

DOCUMENTS REVIEWED IN INVESTIGATION I-86-110-SQN
AND REFERENCES

1. Sequoyah Final Safety Analysis Report R2, Section 2.5, "Geology and Seismology"

2. Sequoyah Safety Evaluation Report, NUREG-0011, March 1979, Docket Nos. 50-327 and 50-328

3. Sequoyah SER, NUREG 0011, Supplement 1, dated February 1980

4. Sequoyah SER, NUREG 0011, Supplement 2, dated August 1980

5. TVA letter from L. M. Mills to A. Schwencer of NRC dated May 5, 1981 (A27 810505 028)

6. TVA letter from L. M. Mills to E. Adensam of NRC dated March 1, 1982 (A27 820301 002)

7. 10 CFR Part 100, Appendix A, "Seismic and Geologic Siting Criteria for Nuclear Power Plants"

8. Regulatory Guide 1.60 R1, "Design Response Spectra for Seismic Design of Nuclear Power Plants"

9. Regulatory Guide 1.61, "Damping Values for Seismic Design of Nuclear Power Plants"

10. NUREG-75/087, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants"

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TVA 64 (09-65) (OP-WP-5-85)

UNITED STATES GOVERNMENT

Memorandum

TENNESSEE VALLEY AUTHORITY

To NRC

TO: H. L. Abercrombie, Site Director, Sequoyah Nuclear Plant

FROM: K. W. Whitt, Director of Nuclear Safety Review Staff, E3A8 C-K

DATE: MAR 06 1986

SUBJECT: NUCLEAR SAFETY REVIEW STAFF INVESTIGATION REPORT TRANSMITTAL

Transmitted herein is NSRS Report No. I-86-129-SQN

Subject SECOND FOLLOW-UP OF QEB RECORDS INVESTIGATION I-83-13-NPS

Concern No. SQP-6-002-001

The attached report contains one Priority 3 [P3] recommendation which in this case requires you to continue corrective action as indicated in the report. No formal response is required for this report unless you disagree with the proposed action. Please notify us if actions taken have been completed sooner. Should you have any questions, please contact W. D. Stevens at telephone 6231-K.

Recommend Reportability Determination: Yes ____ No X

Director, NSRS/Designee

WDS:GDM
Attachment
cc (Attachment):
W. C. Bibb, BFN
W. T. Cottle, WBN
James P. Darling, BLN
R. P. Denise, LP6N40A-C
G. B. Kirk, SQN
D. R. Nichols, E10A14 C-K
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