UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

SAFETY EVALUATION BY THE OFFICE OF SPECIAL PROJECTS

FOR EMPLOYEE CONCERNS

SEQUOYAH NUCLEAR POWER PLANT UNITS 1 AND 2

ELEMENT REPORT EN 215.1(B) "CIVIL/STRUCTURAL DESIGN-SEISMIC CRITERIA"

I. SUBJECT

Category: Engineering

Subcategory: Civil/Structural Design

Element: Seismic Criteria

Concern: 00-85-005-009

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.

II. SUMMARY OF ISSUE

1. Sequoyah plant is on an earthquake fault that runs from Chattanooga to Knoxville.

2. Plant structures could fail in an earthquake.

III. EVALUATION

As discussed in the Subject Element Report and the SER issued in March 1979 (Reference 1), the nearest regional fault to both the Sequoyah and Watts Bar Nuclear Power Plant is the Kingston Fault, which lies about one mile to the northwest of the plant at its closest approach. This fault is about 150 miles long, strikes northeast and dips at least 30° to the southeast. Projection along the dip of the fault would place it at least 2000 feet beneath both plant sites.

The Kingston Fault is one of numerous low angle thrust faults that characterize the Southern Valley and Ridge Tectonic Province. These faults range in length from several tens of miles to more than 100 miles. They were formed during the Applachian Orogeny in the late Paleozoic Era (more that 250 million year ago). There is no evidence that these faults have been active since that time, however, outcrops that expose cross-cutting relationships between the faults and overlying younger strata are rare. The following are the bases presented

in the Clinch River SER (Reference 2) to support the staff's conclusion that these faults are not capable in the meaning of Appendix A, 10 CFR Part 100:

1. Extensive filed research has been conducted in the region with the intent of finding evidence for recent displacement along these faults to explain current seismicity, and none has been found.

2. Triassic dikes mapped in Virginia penetrate Valley and Ridge Province structures without being offset.

3. In Alabama where Coastal Plain deposits overlie the southern part of the Valley and Ridge Province structure there is no evidence of offset.

4. Where subsidiary faults of the major thrust faults have been mapped in relation to overlying ancient terrace deposits, those terraces have not been offset (i.e., Phipps Bend and Watts Bar site fault investigation; TVA, 1975; TVA, 1974).

5. Radiometric age dating of gouge taken from the Copper Creek Fault, which is similar to the Kingston Fault and strikes parallel to it several miles to the east, indicates an age of at least 280 million years before present.

Seismological studies of instrumentally recorded earthquakes in eastern Tennessee and some of their aftershock sequences indicate that their hypocenters occur predominantly in the Precambrian basement well below the Paleozoic thrust faults. Fault plane solutions of these events suggest that the earthquake source mechanisms are inconsistent with the structural trends and the sense of predominant displacement on these low angle thrust faults that are characteristic of Valley and Ridge. On the other hand, trends and senses of motion of these earthquake are consistent with structures imaged in geophysical data taken within the Precambriam basement.

IV. CONCLUSION

For the reasons stated above, the staff reaffirms its conclusions made in previous licensing activities regarding sites in eastern Tennessee, specifically Sequoyah and Watts Bar, that the regional low angle thrust faults, including the Kingston Fault, do not represent a ground displacement or seismic hazard to nuclear power plants in that region and concurs with the conclusion drawn in the subject element report.

V. REFERENCES

1. NUREG-0011, "Safety Evaluation Report Related to Operation of Sequoyah Nuclear Plant, Units 1 and 2" dated March 1979.

2. NUREG-0968, "Safety Evaluation Report Related to Construction of Clinch River Breeder Reactor Plant" dated March 1983.

SEQUOYAH NUCLEAR POWER PLANT, UNITS 1 & 2
SAFETY EVALUATION REPORT FOR EMPLOYEE CONCERNS
ELEMENT REPORT 215.2-SQN
"CIVIL/STRUCTURAL DESIGN, CUT REBAR CONTROL"

I. Subject

Category: Engineering

Subcategory: Civil/Structural

Element: Civil/Structural Design, Cut Rebar Control

Concerns: IN-85-297-005, IN-85-868-004

The bases for Element Report 215.2-SQN, Rev. 1, dated January 27, 1987, are Sequoyah Employee Concerns IN-85-297-005 and IN-85-868-004 which questioned the structural integrity of the containment and the crane walls inside the reactor building because of over 2000 known releases for core drills due to penetrations of ducts, conduits and pipes.

These concerns were evaluated by TVA as potentially nuclear safety-related and potentially applicable to Sequoyah (generic).

II. Summary of Issues

The stated concerns as defined by TVA are: (a) cutting of rebar in the reactor containment and the crane walls inside the reactor building could have weakened the structure; (b) there are over 2000 known releases for core drills; and (c) procedural control/assessment of cut rebar to ensure structural integrity of concrete is in question.

III. Evaluation

Investigations by TVA personnel and consultants found that all three issues were valid and that there was a lack of procedural controls and adequate assessment of the cumulative effect of cut rebars. The NRC staff reviewed TVA's investigations and concurred with their findings. To resolve the three issues, TVA developed a corrective action plan (CAP) that included three pre-restart and three post-restart action items. The pre-restart CAP was to (1) revise existing plant procedures to ensure coordination between plant operations and TVA's Division of Nuclear Engineering, and develop a new procedure for documenting and controlling future rebar cuts, (2) develop a baseline map of cut rebars that ocurred in the reactor building during the construction phase, and assess the structural integrity of the shield wall and crane wall for the cumulative effect of both cut rebars and hanger loads (see Element Report 215.6-SQN for employee concern on hanger loads), and (3) assess the structural integrity of the most critically affected concrete elements in the auxiliary building - slabs at Elev. 714', 734' and 749', U-line wall, and other critical shield walls - for the cumulative effect of both cut rebars and hanger loads. The percentage of cut rebar was assumed to be the same as the worst percentage of cut rebar developed from the data for the corresponding concrete elements of the auxiliary building at the Watts Bar Nuclear Plant (WBN) because the concrete design is similar for the two plants and because such plant specific data for the SQN auxiliary building were not available. The assessments were done on the basis of the ultimate strength method as specified in design criteria SQN-DC-V-1.3.3.1, and the combination of dead, live, and FSAR OBE or SSE loads was considered.

TVA has completed the implementation of the pre-restart CAP. To assess the adequacy of the scope and implementation of the pre-restart CAP, the NRC staff performed a walkdown of the plant and audited a representative sample of the results of TVA's implementation. In addition, TVA was requested to compare the percentage of cut rebars between the SQN and WBN reactor buildings based on the available data from both plants. The comparison showed that the percentage of cut rebars in the reactor building was similar between the two plants, and the NRC staff accepted TVA's assumption for pre-restart CAP item (3) regarding the similarity in percentage of cut rebars between the SQN and WBN auxiliary buildings. TVA was also requested to verify that the structural assessments, which considered the seismic loads from the FSAR OBE and SSE, provided sufficient safety margins with respect to the seismic loads from the site-specific (84-percentile) SSE by evaluating the two most critically stressed locations of the slab in the auxiliary building at Elev. 714'. The evaluation results obtained by TVA demonstrated that the floor does possess sufficient margin to withstand the 84-percentile SSE. Based on the above evaluations, the NRC staff found the scope and implementation of the pre-restart CAP to be acceptable.

For the post-restart CAP, TVA will (1) develop a plant-specific baseline of cut rebars for all Category I concrete structures at SQN to facilitate the long term assessment of the cumulative effect of cut rebar and hanger loads, and also review the WBN cut rebar data and evaluations in detail because they were already complete, (2) revise Section 3.8 of the Sequoyah FSAR to clarify the use of the ultimate strength method as specified in design criteria SQN-DC-V-1.3.3.1 for the evaluation of the reactor building and auxiliary building because the ACI working stress

method was the original FSAR criteria for the design of concrete for these two buildings, and (3) evaluate and document future cut rebar requests based on procedures developed from the pre-restart CAP. The NRC staff found the scope of the post-restart CAP to be sufficient.

IV. Conclusions

The NRC staff reviewed TVA's investigation of the employee concerns and the CAP developed by TVA to resolve such concerns, and found they were adequate. TVA's implementation of the pre-restart CAP was also found acceptable. The NRC staff therefore believes TVA's resolution for the concerns as described in Element Report 215.2-SQN, Rev. 1, is acceptable.

SEQUOYAH NUCLEAR POWER PLANT, UNITS 1 & 2
SAFETY EVALUATION REPORT FOR EMPLOYEE CONCERNS
ELEMENT REPORT 215.6-SQN
"CIVIL/STRUCTURAL DESIGN, HANGER LOADS ON STRUCTURES"

I. Subject

Category: Engineering

Subcategory: Civil/Structural

Element: Civil/Structural Design, Hanger Loads on Structures.

Concerns: IN-85-220-003, IN-86-173-001

The bases for Element Report 215.6-SQN, Rev. 1, dated January 27, 1987, are Sequoyah Employee Concerns IN-85-220-003 and IN-86-173-001 which questioned the structural integrity of the supporting walls/floors in the Unit 2 reactor building annulus areas in particular, and in other concrete structures in general, due to the weight of an excessive number of hanger attachments.

These concerns were evaluated by TVA as potentially nuclear safety-related and potentially applicable to Sequoyah (generic).

II. Summary of Issues

The stated concerns as defined by TVA are: (a) structural integrity of concrete walls/slabs in the annulus area of the Unit 2 reactor building is questionable due to excessive number of hangers; and (b) design calculations have not evaluated individual and cumulative effects of hangers on concrete walls/slabs.

III. Evaluation

Investigations by TVA personnel found both issues to be valid and identified one additional deficiency, i.e., lack of control and documentation for hanger loads. The NRC staff concurred with the findings from TVA's investigations. To resolve the employee conerns and the related deficiency, TVA developed a corrective action plan (CAP) which consisted of both pre- and post-restart corrective actions. The pre-restart CAP was to (1) perform live load evaluation of all Category I structure concrete slabs, (2) perform evaluation for two worst case shield walls, the reactor building shield wall, and the auxiliary building U-line wall, and (3) revise DNE and plant procedures to control approval for all future hanger attachments, and develop a program plan for the long term evaluation of remaining Category I concrete walls not covered by the pre-restart evaluation. For the concrete elements in the reactor and auxiliary building, the cumulative effects of both hanger loads and cut rebar were considered simultaneously in the evaluations, as was discussed also in Element Report 215.2-SQN, Rev. 1. The implementation of the pre-restart CAP is complete, and the assessment of concrete structural elements was based on the ultimate strength method specified in design criteria SQN-DC-V-1.3.3.1, considering the combination of dead, live and FSAR OBE or SSE seismic loads. The NRC staff's evaluation included a walkdown of the plant and an audit of representative samples of TVA's implementation results. The scope and implementation of the pre-restart CAP items were found acceptable. The assumption regarding the similarity in percentage of cut rebar between the SQN and WBN auxiliary buildings and the assessment of the concrete structural elements were found acceptable as discussed in the staff safety evaluation for Element Report 215.2-SQN, Revision 1.

Regarding the post-restart CAP, TVA has committed to (1) revise Section 3.8 of Sequoyah FSAR to clarify the use of the ultimate strength method from design criteria SQN-DC-V-1.3.3.1 for the structural integrity assessment of the reactor building and auxiliary building, and (2) perform the long term evaluation of Category I concrete walls not included in the pre-restart assessments, based on the program plan developed in pre-restart CAP item (3). The NRC staff found the scope of the the post-restart CAP to be sufficient.

IV. Conclusions

The NRC staff reviewed TVA's investigation of the employee concerns and the CAP developed by TVA to resolve such concerns, and found they were adequate. TVA's implementation of the pre-restart CAP was also acceptable. The NRC staff therefore believes TVA's resolution for the concerns as described in Element Report 215.6-SQN, Rev. 1, is acceptable.