



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

SAFETY EVALUATION REPORT BY THE OFFICE OF SPECIAL PROJECTS

EMPLOYEE CONCERN ELEMENT REPORT 205.1(B)

"CALCULATION PREPARATION REQUIREMENTS, POLICY AND
PRACTICE SCOPE AND STANDARDS," 205.2(B), "CALCULATION

CONTROL AND INTERFACE REQUIREMENTS," 205.3(B),

"CALCULATION RECORDS RETENTION"

TENNESSEE VALLEY AUTHORITY

SEQUOYAH NUCLEAR POWER PLANT, UNITS 1 AND 2

DOCKET NOS. 50-327 AND 50-328

I. SUBJECT

Category: Engineering (20000)
Subcategory: Control of Design Calculations (20500)
Elements: Calculation preparation requirements, policy and practice,
scope and standards (20501), calculation control and interface
requirements (20502), and calculation records retention (20503)

The basis for Element Reports 205.1(B), Revision 3, dated January 14, 1987,
205.2(B), Revision 2, dated January 13, 1987 and 205.3(B), dated February 17,
1987 are employee concerns WI-85-100-043, I-85-128-NPS and IN-85-110-004 which
state:

WI-85-100-043:

"There are problems in design calculations, in that some are never prepared, some are inadequate in scope and quality, and some are not stored as quality records. There is inadequate interface and control of design calculations, which impacts traceability of design requirements. CI has no further information. Anonymous concern via letter."

I-85-128-NPS:

"An individual from Browns Ferry Nuclear Plant wrote Nuclear Safety Review Staff expressing his concern that the control and quality of the Office of Engineering's design effort is inadequate. The CI sent several pages detailing and summarizing his evaluation and conclusion of three major areas: (1) design calculation, (2) nonconformance reports, and (3) management policies."

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IN-85-110-004:

"Lack of awareness by Office of Engineering management (names given) of requirements to document the load-carrying capabilities of pipe supports for future reference. Management ignorant of requirements of ANSI N45.2.9 for retention of design calculations as permanent plant records."

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

II. SUMMARY OF ISSUES

Eight issues were defined by the licensee as applicable to this evaluation:

1. Some design calculations are never prepared.
2. Some design calculations are inadequate in scope.
3. Some design calculations are inadequate in quality.
4. There is inadequate control of design calculations.
5. There is inadequate interface coordination with design calculations (e.g., Branch/project, ONP/OF).
6. There are no procedures to maintain calculations current.
7. Some design calculations are not stored as quality records.
8. Management is not aware of the requirements of ANSI N45.2.9 for retention of design calculations as permanent plant records.

These concerns also generated issues which are addressed in other Sequoyah Element Reports:

- 201.6 Lack of control of design calculations impacts traceability of design requirements.
- 220.3 Office of Engineering management is unaware of requirements to document the load-carrying capabilities of pipe supports for future reference.

III. EVALUATION

Calculations Never Prepared

The Black & Veatch review discovered an absence of calculations for power cable ampacities. The Bellefonte electrical evaluation report identified the lack of electrical calculations for voltage drop, short circuit, etc. NRC inspection report, nos. 50-327/86-27 and 50-328/86-27 identified the lack of available calculations to support the sizing of the station batteries, vital inverters

and battery chargers. The licensee claims that these reports only establish that the calculations were missing, not that they were never prepared. The NRC staff agrees that calculations were necessary to build the plant, but many calculations were missing and their scope and quality were unknown.

Nevertheless, the licensee embarked on an extensive Design Baseline and Verification Program (DBVP) which included defining essential calculations and recalculating as necessary. In NRC inspection report nos. 50-327/87-06 and 50-328-87-06, the staff considered that the process and guidelines used to develop the list of essential mechanical engineering calculations an adequate approach to establishing a complete list of essential calculations. The nuclear engineering essential calculations list was complete and with the incorporation of enhancements recommended by the licensee's contractor, the electrical engineering's list was adequate. Since most, if not all of the design calculations have been redone, the team concluded that the activities of the electrical engineering branch were fully covered by the program.

According to the licensee's letter to the NRC dated July 31, 1987, subject: "Division of Nuclear Engineering Design Calculation Efforts," the Civil Engineering Branch (CEB) issued Policy Memorandum 86-02, "Civil Discipline Policy for Design Calculations." This memorandum defined essential calculations and contained a master calculations list that was mostly complete. Calculations identified as not retrievable are being regenerated. The Division of Nuclear Engineering (DNE) Engineering Assurance (EA) group issued a Summary Report of Follow-up Action EA Audit 87-09 on December 2, 1987. This report showed continued progress in the regeneration of CEB calculations.

Calculations Inadequate in Scope

"Inadequate in scope" means a failure to address the essential parameters required by the calculations. This issue is substantiated by NRC inspection report nos. 50-327/86-27 and 50-328/86-27. Some of the inadequate scopes for calculations were shown as failures to consider:

- a. Friction forces caused by thermal displacements,
- b. torsional stresses due to an unsymmetrical configuration,
- c. ratings of the components of the emergency power system to verify that the installed equipment is adequate to meet the increased horsepower demand,
- d. ambient temperature and aging for sizing station batteries,
- e. diesel generator load sequence to verify that the drop and recovery of the output voltage and frequency were within design limits,
- f. magnetizing in-rush current on the voltage and the frequency analysis of the sequencer zero block loading.

The corrective actions are contained in the previous section on calculation preparation.

Calculations Inadequate in Quality

"Inadequate quality" refers to failure to comply with procedures. Incorrect calculations are covered in other element reports. The licensee's audit D51-A-84-0006 identified the failure to update and revise electrical calculations to support design changes. This issue is also substantiated by NRC inspection report nos. 50-327/86-27 and 50-328/86-27. Some of the failures to comply with procedures are:

- a. Use of the wrong load rate for the top tray in the design of a cable tray support,
- b. use of the rigid base design approach after the licensee's standard was changed to consider plate flexibility,
- c. not revising sizing calculations for station batteries after numerous plant changes,
- d. not specifying a hydrostatic pressure test following seismic qualification tests for certain instruments,
- e. inconsistency in specifying quality assurance and seismic requirements for safety-related design modifications.

Many calculations have been regenerated and this program has been subject to several inspections by the NRC staff. In NRC inspection report nos. 50-327/87-14 and 50-328/87-14, the staff concluded that CEB had generally analyzed design modifications to safety-related piping, equipment and structures in accordance with FSAR commitments and CEB's general design criteria. In NRC inspection report nos. 50-327/87-27 and 50-328/87-27, the staff reviewed the condition adverse to quality reports (CAQR) generated by the mechanical, electrical, nuclear and civil engineering branches and found the generic consideration of these reports to be adequate. In the Summary Report of Follow-up Actions to DNE EA Audit 87-09. It was noted that the Electrical Engineering Branch (EEB) had issued instruction EEB-CI-4, "Preparation, Review and Approval of Calculations." The corrective actions are programmatically acceptable.

Inadequate Control of Calculations

NSRS report no. I-85-992-SQN documented discrepancies in the management and control of AC and DC electrical load margins and interfaces. The licensee's evaluation team found that some calculations prepared during the design phase of the Sequoyah plant were not treated by the design engineers as permanent project/plant support documents equally as important as design input or design output documents. Consequently, they were not controlled in the same degree and manner as design input/design output documents. This issue was substantiated.

In NRC inspection report nos. 50-327/87-27 and 50-328/87-27, the staff reviewed the mechanical engineering branch (MEB) instructions regarding the

identification memorandum for controlling calculations. Additionally, MEB has reviewed and verified the classification of all MEB calculations. The team reviewed these memorandums which are typical of instruction and verification memos issued for each plant system assigned to MEB and found them to be acceptable. In correspondence identified as TCAB-099 dated July 14, 1987, the licensee committed to the implementation of Sequoyah engineering procedure (SQEP) Administrative Instruction 10, "Processing and Control of Calculations," as the means to enforcement of requirements for the retention, storage, and retrieval of design calculations. The DNE EA follow-up to audit 87-09 found that each electrical lead engineer is required to establish and maintain electrical calculation logs according to DNE procedures. This corrective action is programmatically acceptable.

Inadequate Interface Coordination

The licensee's evaluation team found a lack of adequate coordination between branch and project for electrical design changes which resulted in inadequately prepared and controlled electrical load calculations. Audit Deviation Report D51-A-84-0006 identified a failure to establish an adequate system to ensure that calculations and studies performed by the electrical engineering branch are updated and revised to support the design as changes are made after plant operation begins. NSRS report no. I-85-132-/SQN reviewed the maintenance of load calculations for diesel generators and identified an instance where the electrical engineering branch was not notified of a load change during the engineering change notice (ECN) review cycle. This issue was substantiated.

The licensee has implemented corrective actions through procedural control. SQEP-13, "Procedure for Transitional Design Change Control" controls new design changes and ECNs. The procedure contains several opportunities for system interfaces to be identified and reviewed. For example, the lead engineer coordinates a meeting to determine the scope of the ECNs, the project planning and scheduling section reviews the scope of work and the nuclear engineering branch (NEB) performs a preliminary assessment of the proposed modification to assess the potential for an unreviewed safety question (USQD). This assessment is concerned with the effect of the ECN on the safety margin of other systems, structures and components. Then the task engineer identifies the disciplines involved into ECN and the lead engineers and responsible engineers review the ECN for Appendix R, environmental qualification, FSAR, seismic and electrical system impact. The lead engineers are specifically directed to assign reviewers or checkers to perform an interface review. NEB performs an USQD for modifications to the facility as described in the FSAR for both original and revised ECNs. SQEP-60, "Handling of Modifications Using Design Change Notices," controls minor and emergency modifications and interface coordination is handled in a similar manner. The NRC staff finds the corrective action to be programmatically acceptable.

Procedures to Keep Calculations Current

Both past and current engineering procedures require a review of calculations that may be affected by changes in design output documents and the concern is not substantiated. For example, EP 3.03, "Design Calculations" states that

modifications must be accompanied by a review of associated calculations for possible updating and configuration changes must be reconciled with the associated calculations. However, it is documented in NRC staff reports that the licensee was not keeping the calculations current.

In NRC inspection report nos. 50-327/86-38 and 50-328/86-38, the staff found that, if properly implemented, the engineering assurance (EA) oversight review plan should confirm the adequacy of the procedures and the design drawings and calculations. In NRC inspection report nos. 50-327/87-31 and 50-328/87-31, the staff found that the EA oversight was competent and effective and produced satisfactory resolutions in the areas of operations, mechanical engineering, nuclear engineering and instrumentation and control. In the civil/structural area, the review by the staff showed that the punchlist items from the EA observations are being closed properly. In the electric power area, the staff found the EA approach for identification, resolution, and/or closure of the action items and observations to be acceptable.

As described above in the section on interface coordination, the procedures for ECNs and DCNs require an examination of related systems and by implication, a review of the adequacy of the existing calculations. The staff attended the first lecture given to DNE engineers on SQEP-13 which lasted 2-3 hours. The lecture was found to be comprehensive and well-prepared. The staff reviewed the plan for the second training on SQEP-13. It covers DNE commitment, root causes of past problems, improvements implemented with SQEP-13, importance of interdivisional communication and coordination, and latest reviews to the procedure. The corrective actions are acceptable.

Design Calculations not Stored as Quality Records

The licensee's evaluation team showed that design calculations were collected, filed, and stored and retained in an inconsistent and contradictory manner. Procedure SQN-QAP-III-1.2, "Preparation, Review, and Records of Design Calculations" issued in 1970, left the record collection and filing decisions to the individual design engineers and supervisors. When these engineers went to another assignment, they often took their records with them. This procedure did not provide direction on handling and storing calculations prior to indexing. This procedure did not provide guidance on microfilming.

EP 3.03, "Design Calculations" and EP 1.14, "Engineering Records" issued in 1974, detailed the record requirements. However, EP 1.14 required biweekly microfilming of all active calculations in any state of preparation, while EP 3.03 only suggested microfilming critical calculations that were in preparation. The biweekly microfilming was deleted in 1976, but other differences remained. It is possible that many calculations were not microfilmed as a part of the permanent design record.

EP 3.03 was revised in 1978 to improve the means of retrieving calculations while EP 1.14 did not change. In 1979, EP 3.03 required that calculations be approved and microfilmed before or during the issuance of design drawings, but this change was not reflected in EP 1.14 until 1983. EP 3.03 was also changed

in 1983 to require microfilming of calculations within 30 days of their approval.

In 1985, these procedures were replaced by OEP-07, "Calculations" and OEP-16, "Design Records Control." The procedures for preparation and handling of calculations were now found in several other procedures and specific directions about storage or the maximum time to microfilm records were not found. In 1986, these procedures were replaced by NEP-3.1, "Calculations" and NEP-1.3, "Records Control." The licensee's evaluation team concluded that these new procedures are consistent with each other and have specific instructions concerning microfilming and records management.

Although retention requirements for final calculations were reflected in various procedures, the absence of some calculations and the difficulties in retrieving others show that the record programs were ineffective.

In correspondence TCAB-085 dated April 2, 1987, the licensee committed to writing an administrative instruction that would address collection, filing and storage requirements for completed or approved calculations, routine microfilming of approved calculations and provide a definition of the "final calculation." AI-10, "Processing and Control of Calculations" has been written and is being implemented.

ANSI N45.2.9 Quality Assurance Records

Engineering record procedures reference N45.2.9 from when it was first published in 1974 in EP 1.14, "Engineering Records - Retention and Storage" to the present. The concern that management is not aware of the requirements for the collection, storage and maintenance of quality assurance records for nuclear power plants is not substantiated. However, recurring problems in the calculation records show that the management awareness is not being transformed into clearly understood and implemented procedures. For example, the contradictions between procedures EP 1.14 and EP 3.03 mentioned in the previous section on storage of records.

Administrative Instruction, AI-10, "Processing and Control of Calculations," has been written and is being implemented. In correspondence TCAB-099 dated July 14, 1987, the licensee committed to provide training on the use of this instruction in accordance with Nuclear Engineering Procedure 1.2, "Training." The licensee also committed to having the Engineering Assurance group audit the effectiveness of AI-10.

IV. CONCLUSIONS

The licensee's element reports 205.1(B) Revision 3, 205.2(B) Revision 2 and 205.3(B) divided the concerns into eight issues. The licensee felt that five were substantiated and three were not, and the NRC staff agrees with that conclusion. However, all of the issues identified shortcomings in the licensee's existing procedures; and corrective actions were planned, implemented and in most cases, completed. The NRC staff finds the corrective actions to be

programmatically acceptable. The adequacy of the improvements in the calculations program will be monitored through inspections and audits.