



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

SEQUOYAH NUCLEAR POWER PLANT UNITS 1 & 2  
SAFETY EVALUATION REPORT FOR EMPLOYEE CONCERNS  
ELEMENT REPORT 218.4(B), REVISION 2  
"PIPE STRESS CALCULATIONS WIDESPREAD DEFICIENCIES  
WITHIN PIPE STRESS CALCULATIONS"

I. Subject

Category: Engineering (20000)  
Subcategory: Pipe Stress Calculations (21800)  
Element: Widespread Deficiencies Within Pipe Stress Calculations (21804)  
Concerns: SQN-86-001-01, SQN-86-002-01

The basis for Element Report 218.4(B), Revision 2 are Employee Concerns SQN-86-001-01 and SQN-86-002-01 which questions TVA's evaluations of alternately analyzed piping.

II. Summary

The Employee Concerns Task Group (ECTG) report identified the following issue from the employee concerns:

1. Alternate analysis is not as detailed as it should be. Although an NCR was created to resolve all discrepancies associated with this analysis method, some discrepancies could remain unresolved beyond startup.

III. Evaluation

A technical review of Employee Concerns Element Report 218.4(B), Revision 2 was performed by NCT Engineering, Inc. under NRC Contract No. 05-86-156. The results of this review are summarized in the attached NCT technical evaluation report dated December 6, 1987 on Employee Concerns Element Report 218.4(B), Revision 2.

Element Report 218.4(B), Revision 2 found that the employee concerns were valid for Sequoyah at the time they were expressed. TVA proposed corrective actions to resolve the concerns on alternately analyzed piping at Sequoyah. The implementation of TVA's corrective actions, as modified to address ECTG comments, was found to be acceptable in an ECTG closeout verification memorandum dated May 14, 1987.

TVA's alternate analysis program has been previously reviewed by the NRC staff as part of the NRC review of the Sequoyah Nuclear Performance Plan. This previous staff review is the subject of a separate NRC safety evaluation on the alternate analysis program. The previous NRC staff review addressed specific technical issues that required evaluation prior to the restart of

Sequoyah. In addition to these restart issues, TVA committed to evaluate all alternately analyzed piping systems after the Sequoyah restart to demonstrate that all design requirements are met for these piping systems.

The NCT review of Element Report 218.4(B), Revision 2 addressed the technical issues that were not specifically addressed by the NRC's evaluation of restart issues, and the acceptability of the resolution of those issues in the TVA long term program. The NCT technical evaluation report found that TVA's proposed corrective actions for the long term program were acceptable. The staff concurs with the conclusions presented in the NCT technical evaluation report.

The NCT technical evaluation report identified one open issue. The TVA criteria for alternately analyzed piping does not require a thermal flexibility evaluation for piping systems with temperatures less than 120°F. TVA provided a technical justification for this position that was applicable to 2 inch and under diameter piping. The NCT report recommended that TVA provide additional justification for excluding the thermal analysis (for temperatures less than 120°F) of larger alternately analyzed piping sizes as part of the long term program.

#### IV. Conclusions

Based on the review of Employee Concerns Element Report 218.4(B), Revision 2 and TVA's corrective actions, the staff concludes that Employee Concerns SQN-86-001-01 and SQN-86-002-01 will be adequately addressed by TVA's alternate analysis program. TVA should provide additional justification for excluding thermal analyses of large diameter piping systems for temperatures less than 120°F in the long term (post restart) program.

SEQUOYAH NUCLEAR POWER PLANT, UNITS 1 & 2  
TECHNICAL EVALUATION REPORT FOR EMPLOYEE CONCERNS  
ELEMENT REPORT 218.4(B), REVISION 2  
"PIPE STRESS CALCULATIONS  
Wide Spread Deficiencies Within Pipe Stress Calculations"

SUBJECT: This report summarizes the NRC audit of TVA's corrective actions regarding the concern about wide spread deficiencies in the alternately analyzed piping at SQN.

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Date: December 6, 1987



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SEQUOYAH NUCLEAR POWER PLANTS UNIT 1 & 2  
TECHNICAL EVALUATION REPORT FOR EMPLOYEE CONCERNS  
ELEMENT REPORT 218.4 (B) REV. 2  
"PIPE STRESS CALCULATIONS"

I. SUBJECT

CATEGORY:	Engineering (20000)
SUBCATEGORY:	Pipe Stress Calculations (21800)
ELEMENT NO:	Wide Spread Deficiencies Within Pipe Stress Calculations (21804)
CONCERNS:	SQN-86-001-01 SQN-86-002-01

SQN-86-001-01

"During the exit interview, the CI stated that there is an Alternate Criteria NCR for the inadequacy of alternate piping. Any concerns relating to any alternate piping are put under the NCR. The concern is that this is a 'catch-all' and individual items could go unresolved beyond startup."

SQN-86-002-01

"During the exit interview the CI stated that alternate piping analysis does not get as specific as it should. Instances where the piping is not qualified gets put into a 'catch-all' NCR. This item was addressed and corrected at Watts Bar."

## II. SUMMARY OF ISSUES

The Element Report has translated the concerns into a broad issue as follows:

Alternate analysis is not as detailed as it should be. Although a Non-Conformance Report (NCR) was created to resolve all discrepancies associated with this analysis method, some discrepancies could remain unresolved beyond startup.

## III. EVALUATION

For the Sequoyah plant, TVA has generally performed piping designs by two types of analysis: Rigorous Analysis and Alternate Analysis.

Rigorous Analysis was performed by a computer code analysis. Alternate Analysis was performed by a simplified handbook method for locating and sizing pipe supports. The ECTG report addresses TVA's alternate analysis criteria and the implementation of this criteria.

According to the ECTG report, TVA performed a review of the alternately analyzed piping designs in 1982. This review resulted in non-conformance reports (NCR, SQNSWP8215, Rev. 0 and NCR, SQNSWP8222, Rev. 0). This review had identified deficiencies in the SQN Alternate Analysis piping designs and design documentation. These deficiencies were listed as follows by the ECTG report.

1. The Alternate Analysis criteria reports may not have considered seismic response spectra for all buildings for which they may have been used.
2. Alternate Analysis piping may not have been supported to take the loads that may be imposed by adjoining deadweight supported piping which is not seismically restrained.

3. Flanges have not been evaluated for bolt stress.
4. Equipment nozzle loads have not always been evaluated.
5. Valves and other concentrated weights may not have always been supported in accordance with the design criteria.
6. Axial supports may not have always been located according to the design criteria.
7. Documentation of design data CEB 74-2 has not been verified.
8. Stress intensification factors may not have been considered in alternate criteria CEB 80-5.
9. Revision 2 Addenda to CEB 80-5 is not in MEDS (MEDS is an acronym for a TVA document control system).
10. Support loads in CEB 80-5 are significantly higher than in CEB 76-5.
11. Thermal expansion and anchor movement may sometimes have been ignored.
12. Nq documentation was found to support CEB 75-9 (SQN- and WBN- Design Data for Support of Category I stainless Steel and Copper Tubing).
13. Documentation of analyses in many cases has not been completed in enough detail to document the scope and basic assumptions used.
14. The general technical errors identified during the WBN review and documented in NCR WBNSWP8231 were also generally evident on SQN analyses that used CEB 76-5.

15. Some analyses have not been reviewed and kept current for support and piping revisions that occurred subsequent to the original design.

A two-phase program was instituted by TVA to resolve the above issues. This program was reviewed by the NRC and is a subject of the separate evaluation. Although TVA's alternate analysis program has been audited and reviewed previously by the NRC, the previous NRC evaluation did not specifically address all deficiencies cited above. This NRC evaluation reviewed the deficiencies addressed in TVA's Phase I program. These deficiencies included issues 2, 5, 6, and 11.

In the Phase II program, TVA has committed to review all seismic Category I alternate analysis piping systems to demonstrate that the licensing criteria has been met (reference SQN-AA-001). The Phase II program will be performed after the SQN re-start. According to TVA, the detail of the Phase II program implementation has not been developed yet. This evaluation will address the specific deficiencies identified above that were not directly addressed by the previous NRC review.

#### ITEM NO. 1: UNCONSERVATIVE SEISMIC RESPONSE SPECTRA

The ECTG report references the results of the WBN alternate analysis program which identified the specific design deficiencies that were shown to be significant problems. These deficiencies were evaluated during the Phase I program at SQN and are reviewed in a separate NRC report. TVA will verify the design criteria used for alternate analysis in the Phase II program. Based on review of the design documents CEB 76-5 and CEB 80-5 and the results of the WBN review, it is concluded that the criteria is sufficiently conservative to justify final verification in the Phase I program.

### ITEM NO. 3: FLANGE BOLT STRESS EVALUATIONS

ECTG report states that the SQN piping design is based on USAS B31.1.0-1967 Code. The report further states that bolts when selected in accordance with sections 104.5 and 108.5.1 of the Code are already qualified and therefore the flange bolt stresses need not be evaluated. Based on the review of USAS B31.1.0-1967 Code, it is concluded that the selection of flange bolts in accordance with section 108.5.1 eliminates the need for flange bolt stress evaluations.

### ITEM 4: EQUIPMENT NOZZLE LOADS

TVA performed equipment nozzle evaluations for the nozzles affected by the deficiencies addressed in Phase I of the program. New nozzle loads were determined and qualified by simple conservative methods. Nozzles which could not be qualified by the simple method were further evaluated by less conservative methods. According to the TVA personnel, only 5-10% of the nozzles failed the conservative criteria and none failed the less conservative calculations. This was verified by a brief review of TVA's nozzle calculations where one nozzle which failed conservative criteria shown to have met the allowables by detailed calculations. Based on this review, it is considered acceptable to complete the review of the nozzle loads in the Phase II program.

### ITEM 7: DOCUMENTATION OF CEB 74-2

According to TVA, CEB 74-2 was used in a very limited area. According to the ECTG report, CEB 74-2 is no longer used for design. Phase II of the program will evaluate all Alternate Analysis piping including those designed by CEB 74-2. Since the concern is documentation and no technical deficiencies have been identified, resolution of this issue during Phase II program is considered adequate.



ITEM 8: CEB 80-5 STRESS INTENSIFICATION FACTORS

CEB 80-5 stated, on page 15, that the stress intensification factors were considered and it provides separate tables, in Appendix B, for different fittings. Therefore, it is apparent that SIFs were considered.

ITEM 9: CEB 80-5, REV. 2 NOT IN MEDS

ECTG report states that this would be corrected by TVA in Phase II, however, during the NRC audit of employee concern, it was determined that TVA has corrected this deficiency and CEB 80-5, Rev. 2 is now in TVA's MED SYSTEM.

ITEM 10: CEB 80-5 DESIGN LOADS ARE HIGHER THAN CEB 76-5 DESIGN LOADS

Based upon discussion with TVA personnel and the review of documents CEB 80-5 and CEB 76-5, it was determined that CEB 80-5, developed for SQN, used envelop of worst spectra of different structures to determine the loads. Whereas CEB 76-5, developed later for WBN, considers specific structures and locations and thus is less conservative than CEB 80-5.

According to TVA personnel, ground acceleration for WBN and SQN are the same, however, WBN spectra are higher than SQN. However, the SQN Alternate Analysis criteria CEB 80-5 gives higher support loads than WBN criteria CEB 76-5. Since CEB 76-5 and CEB 80-5 are based on different design criteria, it would be expected that they would result in different loads. TVA has stated that these documents will be verified as part of the Phase II program. Based on the review of these documents cited in Item 1, this is considered acceptable.

ITEM 12: CEB 75-9 MAY BE UNVERIFIED

CEB 75-9 allocated allowable stresses for pressure, dead weight and seismic loads. It is a conservative approach, however, the allocated allowables add up to slightly more than  $(1.2 S_h)$  the total allowable stress (see page 6 of CEB 75-9). TVA will address this concern in Phase II program, which is acceptable in view of the overall conservatism of CEB 75-9.

ITEM 13: INCOMPLETE DOCUMENTATION

TVA's review of the application of alternate analysis at SQN found that generic documentation problems did exist. As a part of corrective action for the ECTG report, TVA revised SQN-AA-001 to require document of compliance with all aspects of Design Criteria. This will be performed as part of the Phase II effort. Since the specific technical issues that were considered the most significant were addressed in the Phase I program, the completion of the documentation for alternate analysis in the Phase II program is considered adequate.

ITEM 14: WATTS BAR REVIEW

This issue deals with the applicability of the WBN review results to SQN. As indicated in the ECTG report, the basis for the specific issues addressed in the SQN Phase I effort are based on the results of WBN evaluations. The Phase II program will require documentation of compliance with design criteria as stated in item 13. Therefore, the results of the WBN review are adequately considered in SQN alternate analysis program.

#### ITEM 15: ANALYSES NOT CURRENT

According to the ECTG report, one of the primary purposes of the Alternate Analysis review program is to address this issue. As discussed in item 13, the SQN Alternate Analysis program will require documentation of compliance with all aspects of Design Criteria. Therefore, upon completion of this program, the analyses will become current.

In addition to the items addressed above, one other item was reviewed. This item deals with the statement contained in item 11 of the ECTG report. The statement indicates that the alternately analyzed piping considers temperatures greater than 120°F for thermal expansion analysis. To address piping systems with temperatures less than 120°F, TVA provided with a qualitative justification. One document included NRC's concurrence with this practice at LaSalle Nuclear Station in a meeting on September 15, 1980. However, these justifications provided by TVA, are applicable for small-bore (up to 2" diameter) pipes whereas in some instances TVA has used Alternate Analysis for pipes much larger than 2" diameter. Therefore, large diameter piping for which no thermal expansion evaluation was performed should be reviewed or additional justification should be developed for larger pipe sizes for the Phase II program.

#### IV. CONCLUSION

The ECTG report concluded that the employees' concerns were valid at the time they were expressed and that the Alternate Analysis Review Program is adequate to resolve the employees' concerns provided that:

- a. the commitment is carried out to upgrade the program to require that documentation be developed in Phase II to demonstrate that all design requirements are met for all alternatively analyzed piping,

- b. the commitment is carried out to verify that all Alternate Analysis piping support spacings conform with all design criteria requirements by completion of Phase II.

Based on review of the specific issues addressed in this evaluation and the previous NRC review of the Alternate Analysis program, it is concluded that TVA's Phase II program is adequate to address the issues considered in this evaluation. However, it is recommended that TVA develop further justification in the Phase II program for not performing thermal analysis for larger pipe sizes having temperatures of less than 120°F.



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SEQUOYAH NUCLEAR POWER PLANT UNITS 1 & 2  
SAFETY EVALUATION REPORT FOR EMPLOYEE CONCERNS  
ELEMENT REPORT 218.7(B), REVISION 2  
"PIPE STRESS CALCULATIONS ACCEPTANCE CRITERIA  
FOR OVERLAP AREAS OF CALCULATIONS"

I. Subject

Category: Engineering (20000)  
Subcategory: Pipe Stress Calculations (21800)  
Element: Acceptance Criteria for Overlap Areas of Calculations (21807)  
Concern: IN-85-039-003

The basis for Element Report 218.7(B), Revision 2 is Employee Concern IN-85-039-003 which questions the consistency of the use of piping analysis overlap modeling techniques used for alternately analyzed piping at Watts Barr.

II. Summary of Issues

The Employee Concerns Task Group (ECTG) report identified the following two issues from the employee concern:

- a. There was no consistent policy on what constituted an acceptable lapped region at alternate analysis boundaries.
- b. The methods actually implemented interfacing alternate analysis problems may not have been sufficient.

III. Evaluation

A technical review of Employee Concerns Element Report 218.7(B), Revision 2 was performed by NCT Engineering, Inc. under NRC Contract No. 05-86-156. The results of this review are summarized in the attached NCT technical evaluation report dated November 30, 1987 on Employee Concerns Element Report 218.7(B), Revision 2.

Element Report 218.7(B), Revision 2 found that the employee concern was valid for the issue of TVA's implementation of overlap criteria at Sequoyah. TVA proposed corrective actions to address the finding in the ECTG report. The implementation of TVA's corrective actions, as modified to address ECTG comments, was found to be acceptable in an ECTG closeout verification memorandum dated July 30, 1987. The NCT review of Element Report 218.7(B), Revision 2 and TVA's corrective actions found that TVA's review of the issues were acceptable. The staff concurs with the conclusions presented in the NCT technical evaluation report.

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The NCT technical evaluation report identified one open issue. TVA's evaluation of Nonconformance Report No. SQNCEB8303 identified 16 rigorous/alternate boundaries that were found to be unacceptable and required further review. TVA's proposed resolution of these 16 interface problems is to address these problems in the post restart portion of the alternate analysis program. The alternate analysis program has been previously audited by the NRC and a separate NRC safety evaluation report on the Sequoyah Nuclear Performance Plan has addressed the technical issues that were determined to be prerestart items. The issues addressed in the prerestart portion of the alternate analysis program were based on an evaluation of alternate analysis piping deficiencies and the identification of those deficiencies which could adversely affect the piping system integrity. The prerestart evaluation included a review of rigorous/alternate boundaries for the effects of anchor movements. This review provided adequate assurance of the acceptability of rigorous/alternate interfaces for the prerestart program. The post restart portion of the alternate analysis program will review all alternately analyzed piping for conformance to the design criteria. Therefore, TVA's resolution of the 16 interface problems identified by SQNCEB8303 in the post restart portion of the alternate analysis program is considered acceptable to the staff.

#### IV. Conclusions

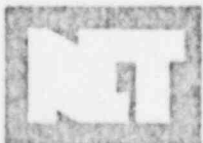
Based on the review of Employee Concerns Element Report 218.7(B), Revision 2 and TVA's corrective actions, the staff concludes that Employee Concern IN-85-039-003 has been adequately addressed.

SEQUOYAH NUCLEAR POWER PLANT, UNIT 2  
TECHNICAL EVALUATION REPORT FOR EMPLOYEE CONCERNS  
ELEMENT REPORT 218.7(B), REVISION 2  
"PIPE STRESS CALCULATIONS  
Acceptance Criteria for Overlap Areas of Calculations"

SUBJECT: This report summarizes the NRC audit of TVA  
investigation of SQN structural modeling at piping  
analysis interfaces (overlap) concerns.

By: Robert E. Serb  
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Date: November 30, 1987



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SEQUOYAH NUCLEAR POWER PLANT, UNITS 1 & 2  
TECHNICAL EVALUATION REPORT FOR EMPLOYEE CONCERNS  
ELEMENT REPORT 218.7(B), REVISION 2  
"PIPE STRESS CALCULATIONS  
Acceptance Criteria for Overlap Areas of Calculations"

I. Subject

Category: Engineering (20000)  
Subcategory: Pipe Stress Calculations (21800)  
Element: Acceptance Criteria for Overlap Areas of  
Calculations (21807)  
Concern: IN-85-039-003

The basis for Element Report 21807 is Employee Concern IN-85-039-003 which questions the consistency of methods employed at Watts Bar Nuclear Plant (WBN) for structural modeling of alternate analysis problems at their interfaces with other piping analysis problems.

II. Summary of Issue

Although the concern was noted relative to WBN, the ECTG report has addressed it relative to Sequoyah Nuclear Plant (SQN) and translated it into the following two issues:

- a. There was no consistent policy on what constituted an acceptable lapped region at alternate analysis boundaries.
- b. The methods actually implemented for interfacing alternate analysis problems may not have been sufficient.

Specific examples of improper interface were alleged in the Employee Concern. The examples are apparently WBN piping problems and as such were not addressed as part of the SQN ECTG program. Likewise, they were not reviewed during this audit of TVA response to the concern.

Discussion here is limited to concern regarding interfaces



between alternate and rigorously analyzed piping. Interfaces between gravity and alternately analyzed piping is one subject of the technical evaluation report for Element Report 21804.

### III. Evaluation

#### Issue "a"

To investigate concern regarding the consistency of rigorous to alternate analysis interface requirements, the ECTG reviewed applicable past and present procedures. The Procedure for Detailed Analysis of Category 1 Piping Performed by TVA, Document Number DED-EP-21.10, was issued in 1975. Section 8.2.5.2 of that procedure defined rigorous to alternate piping interface requirements which were typical of industry requirements in that time frame. The procedure required the interface boundary to be specified at an anchor or an effective "3-way restraint." Overlapping was not a method included in the procedure. After the USNRC publication of "Dynamic Analysis of Piping Using the Structural Overlap Method," NUREG/CR-1980, TVA expanded rigorous to alternate interface requirements in 1983 via Section SQN-RAH-206 of their Rigorous Analysis Handbook (RAH). The adequacy of these procedures was addressed by the ECTG and is discussed under Issue "b" below.

The ECTG report notes that 3 alternate analysis procedures have been applied for SQN piping design. One of these, TVA Document CEB 76-5, did inappropriately include rigorous to alternate interface recommendations. During the NRC audit of the TVA employee concerns program, ECTG personnel noted that although the procedure should have deferred to rigorous analysis procedures for interface requirements, it is reasonable to expect experienced analysts not to have been confused and to have applied the rigorous analysis procedural requirements.

#### Issue "b"

ECTG investigation of concern regarding rigorous to alternate interface methodology included review of a TVA study and follow-up evaluation conducted in response to TVA Nonconformance Report (NCR) SQNCEB8303. The NCR which was written in 1983 identified deficient rigorous to alternate analysis interfaces for analyses performed prior to issuance of RAH Section SQN-RAH-206. Results of the study are contained in the TVA report "Finding of the Design Study of Analysis Lapping and Termination Techniques (NCR SQNCEB8303) for Sequoyah Nuclear Plant dated January 11, 1985. The study included review of 358 analyses for adequate interface definitions. Thirty-eight (38) rigorous to alternate interfaces were found not to terminate at anchors or 3-way (or effective 3-way supports) as was required by the procedure applicable prior to 1983 (TVA Document No. DED-EP-21.10). The improper interfaces appear to have resulted

in part from the lack of detailed instructions provided by that TVA procedure. Subsequently, the improper interfaces were evaluated by TVA via the OE Calculation "Review of Piping Analysis for Adequate Termination - SDR - S048" dated February 27, 1986. For interfaces which comply with the intent of the DED-EP 21.10 procedure and an associated informal handout dated August 14, 1975, TVA states in that calculation that: "these procedures provided piping boundary conditions which prevented significant problem interaction and provided either conservative stresses and support loads or stresses and support loads representative of an encompassing analysis." On that basis TVA found all but 16 of the identified discrepant interfaces to be acceptable. During the NRC audit it was determined that the SQN Alternate Analysis Review Program, TVA Document SQN-AA-001 dated March 30, 1987, identifies evaluation of these 16 problems as a post restart effort.

During the NRC audit ECTG personnel noted that their investigation included review and evaluation of SQN rigorous to alternate analysis interface structural modeling methods. Their review resulted in discussion with TVA regarding the adequacy of terminating rigorous analyses at interfaces with alternate analysis scope piping at 3-way, or effective 3-way supports. TVA noted that since alternate analysis scope piping is supported such that piping dynamic response is limited to the rigid range (i.e., > 33 hertz), a 3-way support is adequate to isolate the alternate analysis piping response. However, the ECTG has demonstrated that alternate analysis piping is not always rigidly supported. This matter was not resolved at the time the ECTG report was issued and was the subject of further review and discussion between the ECTG and TVA. Resolution to the satisfaction of the ECTG is addressed in the ECTG verification closeout checklist for the subject element report, CATD No. 218 07 SQN 01 dated July 24, 1987 which was also reviewed during the NRC audit of the TVA employee concerns program.

The ECTG verification closeout checklist summarizes corrective actions taken which meet the TVA corrective action plan requirements and which include additional actions identified by the ECTG subsequent to issuance of that plan. Initially, TVA screened all SQN rigorous analysis problems for critical examples of rigorous to alternate interfaces at 3-way restraints. Eight example interfaces based on pipe size and span, branch pipe locations, pipe routing, support types and locations, and concentrated weights and locations were selected for reanalysis. Subsequently, TVA screened all such interfaces at the request of the ECTG to identify analyses for which in the vicinity of the subject interfaces, small increases in stress over the then current analysis results would result in exceeding stress allowables. TVA identified twelve worst cases of this low stress margin condition. The ECTG evaluated the twelve problems and identified one for inclusion in the critical interface sample. The nine problems were reanalyzed by TVA. The results of these reanalyses met plant design criteria.

The ECTG verification closeout checklist also summarizes

changes made to the RAH to avoid future problems with analysis interface locations. Section SQN-RAH-206 of the handbook now prohibits interfaces defined at other than structural anchor locations without technical supervisory approval. For cases in which anchors are not feasible, rigid region and overlap guidelines are specified.

Based on the reanalysis results and RAH revision discussed above, and the understanding that additional systems will be evaluated as part of the TVA Alternate Analysis Review Program the ECTG concluded that concern regarding rigorous to alternate interfaces and, in particular, the adequacy of using of 3-way restraints at rigorous to alternate interfaces had been adequately addressed.

#### IV. Conclusions

##### Issue "a"

Alternate to rigorous piping analysis interface modeling and evaluation instructions have been available for use by SQN analysts. The failure of one of the alternate analysis criteria documents to defer to the rigorous procedure for interface requirements is not likely to have resulted in confusion to an experienced analyst. The NCR and employee concerns program corrective actions which are addressed in this report relative to Issue "b" and the TVA alternate analysis review program (TVA Document NO. SQN-AA-001) assure that this issue does not pose a safety concern. Therefore, TVA investigation of this issue is considered adequate and resolution as described in Element Report 218.7(B), Revision 2, is acceptable.

##### Issue "b"

The resolution of discrepant interfaces identified via NCR 8303 has been adequately addressed provided designating evaluation of the 16 "unacceptable" interfaces as a post restart function is confirmed to be acceptable. Concern regarding rigorous to alternate analysis interface procedure is resolved based on the corrective actions summarized in the ECTG verification closeout checklist and discussed in Section III of this evaluation. Therefore, TVA investigation of concerns regarding this issue is acceptable provided post restart evaluation of the noted 16 interfaces is confirmed to be acceptable by the NRC. Review of the SQN alternate analysis review program (TVA Document SQN-AA-001), including designation of requirements as pre or post restart, is the subject of a separate NRC evaluation.



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SAFETY EVALUATION REPORT BY THE OFFICE OF SPECIAL PROJECTS

EMPLOYEE CONCERN ELEMENT REPORT 220.1(B)

"A SERIES DRAWINGS AND 050 NOTES"

TENNESSEE VALLEY AUTHORITY

SEQUOYAH NUCLEAR POWER PLANT, UNITS 1 AND 2

DOCKET NOS. 50-327 AND 50-328

I. SUBJECT

Category: Engineering (20000)  
Subcategory: Support Design General (22000)  
Element: "A" Series Drawings and "050" Notes (22001)

The basis for Element Report 220.1(B) Revision 1, dated January 8, 1987 is Employee Concern IN-85-024-001 which states:

"A series hanger drawings and 050 notes are contradictory and allow hangers or box anchors or structural features to be acceptable, even when they do not conform to the requirements of drawing details. The 050 series notes are misinterpreted by all those who utilize them."

This concern was evaluated by the licensee as potentially nuclear safety-related and potentially applicable to Sequoyah (generic).

II. SUMMARY OF ISSUES

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

1. 47A050 notes are contradictory to "A" series hanger drawings. They allow hangers, box anchors, and structural shapes to be accepted even though they do not conform to the design requirements.
2. 47A050 notes are written in such a way that they can be misinterpreted.
3. There are discrepancies between 47A050 notes and other installation documents.

III. EVALUATION

The licensee's evaluation team reviewed the employee concern in the latter part of 1986 and concluded that there were not any conflicts between the "A" series hanger drawings and the 47A050 notes. The notes were found to be concise, clear and easy to interpret.

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However, the Nuclear Safety Review Staff report (I-85-110-WBN-01) on the same concern in 1985 resulted in numerous findings. There were 74 pages of drawing notes and the Office of Engineering personnel were making about five changes per week. Several contradictory notes were found and the conclusion was that the notes caused considerable confusion and multiple interpretations. In addition, Finding QP.3-1 of the Institute of Nuclear Power Operations evaluation of Watts Bar construction specifically mentioned the 47A050 notes as being a contributing factor in the high rejection rate. Since both Sequoyah and Watts Bar drawing notes were written by the same engineering office at about the same time, the employee concern is substantiated.

Since the INPO finding and other employee concerns such as those found in Element Reports 215.9(B) and 222.5(B), the licensee performed a general review and improvement of the drawing notes. Most of these revisions took place in the first half of 1986. The NRC staff reviewed the present drawing notes for Sequoyah and found the notes to be clear and non-contradictory. Several notes contain engineering decisions that should be discussed in the future, but these notes are also clear and understandable.

The staff also reviewed several Watts Bar drawings. It is not known if these drawings have been updated.

47A050-1N Revision 9, dated September 10, 1985, "Seismic Category I Structures, Mechanical Hanger Drawing Notes" Note 51 - "Where the weld symbol for a specific weld is not applicable to the actual configuration, the appropriate type of weld of the same size is authorized."

47A050-1N Revision 9, dated September 18, 1985, "Seismic Category I Structures, Mechanical Hanger Drawing Notes" Note 81 - "Lugs shown fastened to pipe by flare bevel welds shall be attached with full penetration welds on all category supports."

47A050-1N2 Revision 4, dated March 31, 1986 "Seismic Category I Structures, Mechanical Hanger Drawing General Notes" Note 130 - "When improper welds are specified..."

Note 51 essentially requires the inspector to look at the weld and make an engineering judgment as to the type of weld required. Note 81 is not physically possible in all configurations. Note 130 also requires an engineering judgment. These type of notes were not found on Sequoyah drawings.

#### IV. CONCLUSION

The Element Report did not thoroughly evaluate the employee concern. The NRC staff reviewed the concern and the corrective action for the Sequoyah Nuclear Plant is acceptable. The employee concern is substantiated.



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NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D. C. 20555

SEQUOYAH NUCLEAR POWER PLANT UNITS 1 & 2  
SAFETY EVALUATION REPORT FOR EMPLOYEE CONCERNS  
ELEMENT REPORT 220.3(B), REVISION 2  
"SUPPORT DESIGN GENERAL DESIGN OF SUPPORTS"

I. Subject

Category: Engineering (20000)  
Subcategory: Support Design General (22000)  
Element: Acceptance Criteria for Overlap Areas of Calculations (22003)  
Concerns: 00-85-005-008, IN-85-886-001

The basis for Element Report 220.3(B), Revision 2 are Employee Concerns 00-85-005-008 and IN-85-886-001 which question TVA's design and construction of supports.

II. Summary of Issues

The Employee Concerns Task Group (ECTG) report identified the following four issues from the employee concerns:

1. Seismic supports are designed inadequately.
2. They are too rigid and will break loose during a seismic event and will fall on other equipment and damage it.
3. Pipe support designs are not constructible.
4. Seismic support design criteria are non existent.

In addition to these four issues, the ECTG report identified two additional issues which were addressed in Element Reports 204.4 and 201.3.

III. Evaluation

A technical review of Employee Concerns Element Report 220.3(B), Revision 2 was performed by NCT Engineering, Inc. under NRC Contract No. 05-86-156. The results of this review are summarized in the attached NCT technical evaluation report dated December 6, 1987 on Employee Concerns Element Report 220.3(B), Revision 2.

Element Report 220.3(B), Revision 2 found that the employees concerns were only valid for the issue of implementation of design criteria at Sequoyah. This finding was based on the review of a sample of pipe support calculations at Sequoyah. TVA's proposed corrective action to the ECTG report finding was to perform calculations for the observations noted in the ECTG report for nine pipe supports. This corrective action was determined to be a non restart item by TVA and, therefore, final verification of TVA's corrective action by ECTG had not been performed. The ECTG report also stated that issue 3, constructibility of pipe supports, had been addressed in Element Report 222.3. Element Report 222.3 is the subject of a separate NRC safety evaluation.

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The issue of pipe support design criteria has been addressed by the NRC staff as part of the staff's review of TVA's Sequoyah Nuclear Performance Plan. As a result of the staff's review, TVA is currently evaluating all rigorously analyzed pipe supports to a single design criteria document. Based on the previous review of the pipe support calculations, the staff considers part of the employee concern with TVA's design criteria for pipe supports to be valid. The staff's evaluation of the current TVA pipe support calculation effort will be addressed in a separate evaluation of TVA's calculation program.

The NCT technical evaluation report addresses the remaining issues in Element Report 220.3(B), Revision 2 including TVA's corrective action on the support deficiencies identified in the element report. The NCT review of Element Report 220.3(B), Revision 2 and TVA's recently generated calculations concludes that ECTG's review of those issues and TVA's corrective actions are adequate. The staff concurs with the conclusions presented in the NCT technical evaluation report.

#### IV. Conclusions

Based on the review of Employee Concerns Element Report 220.3(B), Revision 2 and TVA's current program to evaluate piping supports at Sequoyah, the staff concludes that Employee Concerns 00-85-005-008 and IN-85-886-001 have been adequately addressed. The issue of pipe support constructibility is the subject of a separate staff evaluation on Element Report 222.3. TVA's current program to evaluate piping supports will be the subject of a separate NRC evaluation on the Sequoyah Nuclear Performance Plan.

#### V. Addendum

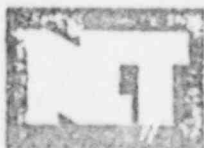
The safety evaluation for this element report specified the completion of the NRC's review of the piping support evaluation as an open restart issue. The review of regenerated pipe support calculations was completed during an inspection during the week of February 15, 1988. This review did not identify any open restart issues on pipe supports. Therefore, the staff has completed its restart evaluation of the regenerated pipe support calculations.

SEQUOYAH NUCLEAR POWER PLANT, UNITS 1 & 2  
TECHNICAL EVALUATION REPORT FOR EMPLOYEE CONCERNS  
ELEMENT REPORT 220.3(B), REVISION 2  
"SUPPORT DESIGN GENERAL  
Design of Supports"

SUBJECT: This report summarizes the NRC audit of TVA's corrective actions regarding SQN pipe support design concerns.

By: Mohammad K. Tai  
Consultant  
NCT Engineering, Inc.

Date: December 6, 1987



NCT ENGINEERING, INC.

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SEQUOYAH NUCLEAR POWER PLANTS UNIT 1 & 2  
TECHNICAL EVALUATION REPORT FOR EMPLOYEE CONCERNS  
ELEMENT REPORT 220.3 (B) REV. 2  
"SUPPORT DESIGN GENERAL"

I. SUBJECT

CATEGORY: Engineering (20000)  
SUBCATEGORY: Support Design General (22000)  
ELEMENT NO: Design of Supports (22003)  
CONCERNS: 00-85-005-008  
IN-85-886-001

00-85-005-008

"Sequoyah seismic supports are not designed properly. They are rigid and will break loose during a seismic event, and will fall down and damage other equipment, as well as failing to support their respective components. CI has no further information. Construction Department Concern."

IN-85-886-001

"TVA designs were not developed well enough to be constructible. 1) Design changes are still being instituted in areas where there should have been minimal changes, especially in areas of conflicts between TVA and vendor drawings. 2) Engineering Design Criteria is often non-existent, particularly for Seismic Hanger design. Many design criteria or acceptance criteria are still being changed. This is generic concern. Any further information would divulge confidentiality. Construction Department concern. CI has no further information."

## II. SUMMARY OF ISSUES

The ECTG report has translated the concerns into the following four issues:

1. Seismic supports are designed inadequately.
2. They are too rigid and will break loose during a seismic event and will fall on other equipment and damage it.
3. Pipe support designs are not constructible.
4. Seismic support design criteria are non-existent.

The ECTG report also identified the following two issues, which are addressed in other element reports.

Design changes take place in areas of conflict between TVA and vendor drawings (see SQN Element Report 204.4).

Design and Acceptance criteria are still being changed (see SQN Element Report 201.3).

## III. EVALUATION

According to the ECTG report, NFRS Investigation Report I-86-131-SQN addresses this concern and indicates that this concern is for pipe supports. Therefore, only the pipe supports were the subject of this evaluation.

In order to determine the validity of issue 1, ECTG conducted a review program which included review of pipe support criteria and fifteen randomly selected seismic support calculations. ECTG evaluation concluded that only six of the fifteen calculations thus reviewed were acceptable, and seismic design requirements were properly addressed. The other nine support calculations were either inadequate or incomplete. Based on this review, the ECTG report concluded that the

seismic design criteria for pipe supports are adequate, but the implementation could not be verified.

Six of the nine calculations belonged to unit 2. TVA has recently regenerated calculations for the six unit 2 supports as part of the pipe support calculation program. These supports were 2MSH-315, 2MSH-348, 2RCH-302, 2SGBH-290, 2RHRH-449, and 2CSH-05. These were reviewed during this audit at TVA site. The calculations for these supports were very extensive and adequate and were performed based on the design criteria SQN-DC-V-24.2 which contains the seismic design requirements. The criteria SQN-DC-V-24.2 are currently being reviewed by NRC. One of the six support calculations called for modification to the existing support. Documentation for the completion of this modification were not reviewed. TVA has committed to regenerate calculations for all the seismic supports based on SQN-DC-V-24.2.

According to the ECTG report, Issue 2 is addressed in NSRS Report I-86-131-SQN. Many of the piping analysis programs used in the nuclear industry assumes pipe supports to be rigid compared to the piping, i.e., zero deflection at the support points is assumed in the calculation of pipe support loads. This assumption is used to simplify piping analysis and in order to support this assumption, the pipe support design criteria SQN-DC-V-24.2 limits the deflection of pipe supports to 1/16" and 1/8" under the design loads. Therefore, there is no technical concern of supports breaking loose provided they are designed adequately for the imposed pipe loads.

Issue 3 is addressed partly in the SQN Element Report 222.03. In addition to the issues addressed in Report 222.03, ECTG evaluated the constructibility of the original design by reviewing drawings of five supports. ECTG review identified one support that had to be modified, however, the ECTG report determined that the support designs in general were constructible.

According to the ECTG report, Issue 4 concerning seismic design criteria being non-existent is not valid because the seismic design requirements did exist, however, they existed in several documents. Nevertheless, TVA has issued new criteria SQN-DC-V-24.2, which contains the seismic requirements for support design. Although seismic design criteria did exist at SQN, the criteria used for support designs were not consistent. This is, currently, being corrected by TVA's evaluation of all pipe supports to this new criteria.

#### IV. CONCLUSION

1. The ECTG report concluded that the SQN design criteria were adequate for seismic design, however, there was a valid concern with the implementation of the design criteria. TVA is currently evaluating all pipe supports to the design criteria SQN-DC-V-24.2. Based on review of six regenerated pipe support calculations, TVA's corrective action is adequate.
2. ECTG report concluded that the supports being too rigid does not cause excessive loading on them, and hence, will not fail. ECTG conclusion is based on valid technical considerations and is adequate.
3. ECTG report concluded that the SQN pipe supports are constructible. The constructibility of pipe supports will be addressed in the NRC review of SQN Element Report 222.03.
4. ECTG report concluded that the seismic design criteria have existed for SQN, but in the form of several documents. However, TVA has recently issued one document, SQN-DC-V-24.2, where the seismic design requirements are included along with other design requirements. TVA's evaluation of all pipe supports to this single criteria document is acceptable.



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SEQUOYAH NUCLEAR POWER PLANT UNITS 1 & 2  
SAFETY EVALUATION REPORT FOR EMPLOYEE CONCERNS  
ELEMENT REPORT 220.11(B), REVISION 2

"SUPPORT DESIGN GENERAL TEMPERATURE VARIATION CONSIDERATION"

I. Subject

Category: Engineering (20000)  
Subcategory: Pipe Design General (22000)  
Element: Temperature Variation Consideration (22011)  
Concern: IN-85-103-002

The basis for Element Report 220.11(B), Revision 2 is Employee Concern IN-85-039-003 which questioned the pipe/hanger calculation consideration of temperature variations in the thermal analysis.

II. Summary of Issues

The Employee Concerns Task Group (ECTG) report identified the following two issues for the employee concern.

1. The expansion of structural members restrained between two rigid points (such as concrete surfaces) will cause additional loading on members.
2. The thermal expansion of pipe will impose loads on the pipe supports.

III. Evaluation

A technical review of Employee Concerns Element Report 220.11(B), Revision 2 was performed by NCT Engineering, Inc. under NRC Contract No. 05-86-156. The results of this review are summarized in the attached NCT technical evaluation report dated December 8, 1987 on Employee Concerns Element Report 220.11(B), Revision 2.

Element Report 220.11(B), Revision 2 found that the employee concern was valid for the issue of thermal expansion of restrained structural members at Sequoyah. TVA proposed corrective actions to address the finding in the ECTG report. The final verification of TVA's corrective actions has not been completed by the ECTG.

The NCT review of Element Report 220.11(B), Revision 2 and TVA's completed corrective actions found that TVA's review of the issues were acceptable, however, TVA had not completed all of the corrective actions at the time of the review. The NCT report also references Element Reports 218.1 and 218.4 for additional discussions on piping system thermal analysis. The staff

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concur with the conclusions presented in the NCT technical evaluation report. In addition to the review of pipe supports, the staff is reviewing the issue of restrained thermal expansion for other structural members as part of the review of the Sequoyah Nuclear Performance Plan. This review will be the subject of a separate staff evaluation.

The NCT technical evaluation report identified two open issues. Based on discussions with ECTG, a concern was identified by ECTG with the implementation of the field modifications. The report recommends review of the final resolution of the ECTG concern with TVA's implementation of field modifications. Additionally, the NCT report recommends review of the four calculations that were to be completed by TVA as a part of the corrective action plan.

#### IV. Conclusions

Based on the review of Employee Concerns Element Report 220.11(B), Revision 2 and TVA's completed corrective actions, the staff finds that TVA's review of Employee Concern IN-85-103-002 will be adequately addressed when the ECTG verification effort is complete. TVA's completion of the corrective action calculations and the final ECTG verification resolution should be reviewed by the staff prior to restart of Sequoyah. Additional review of piping thermal analysis is contained in the staff's evaluation of Element Reports 218.1 and 218.4. Review of restrained thermal expansion of structural members other than pipe supports will be the subject of a separate staff safety evaluation.

#### V. Addendum

The safety evaluation report for this element report contained two restart open issues. The first issue involved the receipt of the completed employee concerns element verification report. This report has been received and reviewed by the staff. The second open issue involved TVA's completion of their evaluation of the four pipe supports prior to restart. These pipe supports evaluations were reviewed during an inspection on the week of February 15, 1988. Based on the review of the completed actions, the open restart items are considered resolved.