EMPLOYEE CONCERNS

SPECIAL PROGRAM

VOLUME 2
ENGINEERING CATEGORY

SUBCATEGORY REPORT 21800
PIPE STRESS CALCULATIONS

UPDATED

TVA

NUCLEAR POWER

TVA EMPLOYEE CONCERNS SPECIAL PROGRAM

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1. Revised to incorporate SRP, TAS, and Review Committee comments.
2. Revised to incorporate SRP, TAS, and Review Committee comments and add Attachment C (References).
3. Revised to incorporate SRP and TAS comment per TCOB 915.

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EXECUTIVE SUMMARY

This subcategory report addresses employee concerns pertaining to the adequacy of pipe stress analysis calculations used to demonstrate the qualification of safety-related piping to licensing commitments.

Twenty-two employee concerns were evaluated, which resulted in 28 findings requiring corrective action. Some of the more significant findings that resulted from these evaluations are interferences of pipe supports with the containment vessel during a design basis accident, time-history analysis of water-hammer loads performed to insufficient frequency limits, incorrect "seismic anchor motion" (SAM) analyses, and incorrect methods used to subdivide piping for analysis. The principal causes of the findings were "Engineering Errors" and "Inadequate Procedures." The "Engineering Errors" resulted from an apparent lack of knowledge of engineering principles in certain instances and from a lack of attention to detail. The "Inadequate Procedures" were due mostly to incomplete or inaccurate technical content, although some were due to conflicts between procedures.

Almost all of the corrective actions resulting from engineering errors noted above were applicable to Watts Bar. However, it should be noted that there were twice as many issues evaluated for Watts Bar as for any other plant. Inadequate procedures resulted in requirements for corrective actions at each plant but most applied only to Watts Bar and Browns Ferry. Some corrective actions had already been initiated by TVA before the evaluations reported here. Some of the more significant corrective actions are: modifications to pipe supports at Browns Ferry to avoid possible interference with the containment vessel, re-performance of time-history stress analyses and "seismic anchor motion" analyses at Watts Bar, and revisions of design criteria to correct the methods used to analytically subdivide piping. The corrective action plans received by the evaluation team have been reviewed and found acceptable to resolve the findings.

The results of the evaluations conducted for this subcategory reveal several significant deficiencies that have the potential to require hardware changes. The corrective actions to be completed involve further evaluations, re-performance of calculations, and revisions to criteria and procedures. However, the TVA Revised Corporate Nuclear Performance Plan describes corrective actions for improving the design control process. These include organizational changes to clarify technical responsibilities and to monitor and control technical performance. The discipline branch chiefs are to schedule and perform technical reviews on major systems throughout the design effort. Although engineering management has primary responsibility for the quality of the design product, an organization known as Engineering Assurance has been established whose responsibilities include technical audits, which will provide feedback to engineering management on technical performance. These changes, when properly implemented, should be effective in improving the technical adequacy of the piping design process.

The causes of the negative findings identified and other evaluation results are being examined from a wider perspective by the Engineering category evaluation.

Preface

This subcategory report is one of a series of reports prepared for the Employee Concerns Special Program (ECSP) of the Tennessee Valley Authority (TVA). The ECSP and the organization which carried out the program, the Employee Concerns Task Group (ECTG), were established by TVA's Manager of Nuclear Power to evaluate and report on those Office of Nuclear Power (ONP) employee concerns filed before February 1, 1986. Concerns filed after that date are handled by the ongoing ONP Employee Concerns Program (ECP).

The ECSP addressed over 5800 employee concerns. Each of the concerns was a formal, written description of a circumstance or circumstances that an employee thought was unsafe, unjust, inefficient, or inappropriate. The mission of the Employee Concerns Special Program was to thoroughly investigate all issues presented in the concerns and to report the results of those investigations in a form accessible to ONP employees, the NRC, and the general public. The results of these investigations are communicated by four levels of ECSP reports: element, subcategory, category, and final.

Element reports, the lowest reporting level, will be published only for those concerns directly affecting the restart of Sequoyah Nuclear Plant's reactor unit 2. An element consists of one or more closely related issues. An issue is a potential problem identified by ECTG during the evaluation process as having been raised in one or more concerns. For efficient handling, what appeared to be similar concerns were grouped into elements early in the program, but issue definitions emerged from the evaluation process itself. Consequently, some elements did include only one issue, but often the ECTG evaluation found more than one issue per element.

Subcategory reports summarize the evaluation of a number of elements. However, the subcategory report does more than collect element level evaluations. The subcategory level overview of element findings leads to an integration of information that cannot take place at the element level. This integration of information reveals the extent to which problems overlap more than one element and will therefore require corrective action for underlying causes not fully apparent at the element level.

To make the subcategory reports easier to understand, three items have been placed at the front of each report: a preface, a glossary of the terminology unique to ECSP reports, and a list of acronyms.

Additionally, at the end of each subcategory report will be a Subcategory Summary Table that includes the concern numbers; identifies other subcategories that share a concern; designates nuclear safety-related, safety significant, or non-safety related concerns; designates generic applicability; and briefly states each concern.

Either the Subcategory Summary Table or another attachment or a combination of the two will enable the reader to find the report section or sections in which the issue raised by the concern is evaluated.

The subcategories are themselves summarized in a series of eight category reports. Each category report reviews the major findings and collective significance of the subcategory reports in one of the following areas:

- management and personnel relations
- industrial safety
- construction
- material control
- operations
- quality assurance/quality control
- welding
- engineering

A separate report on employee concerns dealing with specific contentions of intimidation, harassment, and wrongdoing will be released by the TVA Office of the Inspector General.

Just as the subcategory reports integrate the information collected at the element level, the category reports integrate the information assembled in all the subcategory reports within the category, addressing particularly the underlying causes of those problems that run across more than one subcategory.

A final report will integrate and assess the information collected by all of the lower level reports prepared for the ECSP, including the Inspector General's report.

For more detail on the methods by which ECTG employee concerns were evaluated and reported, consult the Tennessee Valley Authority Employee Concerns Task Group Program Manual. The Manual spells out the program's objectives, scope, organization, and responsibilities. It also specifies the procedures that were followed in the investigation, reporting, and closeout of the issues raised by employee concerns.

ECSP GLOSSARY OF REPORT TERMS*

classification of evaluated issues the evaluation of an issue leads to one of the following determinations:

Class A: Issue cannot be verified as factual

Class B: Issue is factually accurate, but what is described is not a problem (i.e., not a condition requiring corrective action)

Class C: Issue is factual and identifies a problem, but corrective action for the problem was initiated before the evaluation of the issue was undertaken

Class D: Issue is factual and presents a problem for which corrective action has been, or is being, taken as a result of an evaluation

Class E: A problem, requiring corrective action, which was not identified by an employee concern, but was revealed during the ECTG evaluation of an issue raised by an employee concern.

collective significance an analysis which determines the importance and consequences of the findings in a particular ECSP report by putting those findings in the proper perspective.

concern (see "employee concern")

corrective action steps taken to fix specific deficiencies or discrepancies revealed by a negative finding and, when necessary, to correct causes in order to prevent recurrence.

criterion (plural: criteria) a basis for defining a performance, behavior, or quality which ONP imposes on itself (see also "requirement").

element or element report an optional level of ECSP report, below the subcategory level, that deals with one or more issues.

employee concern a formal, written description of a circumstance or circumstances that an employee thinks unsafe, unjust, inefficient or inappropriate; usually documented on a K-form or a form equivalent to the K-form.

evaluator(s) the individual(s) assigned the responsibility to assess a specific grouping of employee concerns.

findings includes both statements of fact and the judgments made about those facts during the evaluation process; negative findings require corrective action.

issue a potential problem, as interpreted by the ECTG during the evaluation process, raised in one or more concerns.

K-form (see "employee concern")

requirement a standard of performance, behavior, or quality on which an evaluation judgment or decision may be based.

root cause the underlying reason for a problem.

*Terms essential to the program but which require detailed definition have been defined in the ECTG Procedure Manual (e.g., generic, specific, nuclear safety-related, unreviewed safety-significant question).

Acronyms

AI	Administrative Instruction
AISC	American Institute of Steel Construction
ALARA	As Low As Reasonably Achievable
ANS	American Nuclear Society
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWS	American Welding Society
BFN	Browns Ferry Nuclear Plant
BLN	Bellefonte Nuclear Plant
CAQ	Condition Adverse to Quality
CAR	Corrective Action Report
CATD	Corrective Action Tracking Document
CCTS	Corporate Commitment Tracking System
CEG-H	Category Evaluation Group Head
CFR	Code of Federal Regulations
CI	Concerned Individual
CMTR	Certified Material Test Report
COC	Certificate of Conformance/Compliance
DCR	Design Change Request
DNC	Division of Nuclear Construction (see also NU CON)

DNE	Division of Nuclear Engineering
DNQA	Division of Nuclear Quality Assurance
DNT	Division of Nuclear Training
DOE	Department of Energy
DPO	Division Personnel Officer
DR	Discrepancy Report or Deviation Report
ECN	Engineering Change Notice
ECP	Employee Concerns Program
ECP-SR	Employee Concerns Program-Site Representative
ECSP	Employee Concerns Special Program
ECTG	Employee Concerns Task Group
EEOC	Equal Employment Opportunity Commission
EQ	Environmental Qualification
EMRT	Emergency Medical Response Team
EN DES	Engineering Design
ERT	Employee Response Team or Emergency Response Team
FCR	Field Change Request
FSAR	Final Safety Analysis Report
FY	Fiscal Year
GET	General Employee Training
HCI	Hazard Control Instruction
HVAC	Heating, Ventilating, Air Conditioning
II	Installation Instruction
INPO	Institute of Nuclear Power Operations
IRN	Inspection Rejection Notice

L/R	Labor Relations Staff
M&AI	Modifications and Additions Instruction
MI	Maintenance Instruction
MSPB	Merit Systems Protection Board
MT	Magnetic Particle Testing
NCR	Nonconforming Condition Report
NDE	Nondestructive Examination
NPP	Nuclear Performance Plan
NPS	Non-plant Specific or Nuclear Procedures System
NQAM	Nuclear Quality Assurance Manual
NRC	Nuclear Regulatory Commission
NSB	Nuclear Services Branch
NSRS	Nuclear Safety Review Staff
NU CON	Division of Nuclear Construction (obsolete abbreviation, see DNC)
NUMARC	Nuclear Utility Management and Resources Committee
OSHA	Occupational Safety and Health Administration (or Act)
ONP	Office of Nuclear Power
OWCP	Office of Workers Compensation Program
PHR	Personal History Record
PT	Liquid Penetrant Testing
QA	Quality Assurance
QAP	Quality Assurance Procedures
QC	Quality Control
QCI	Quality Control Instruction

QCP	Quality Control Procedure
QTC	Quality Technology Company
RIF	Reduction in Force
RT	Radiographic Testing
SQN	Sequoyah Nuclear Plant
SI	Surveillance Instruction
SOP	Standard Operating Procedure
SRP	Senior Review Panel
SWEC	Stone and Webster Engineering Corporation
TAS	Technical Assistance Staff
T&L	Trades and Labor
TVA	Tennessee Valley Authority
TVTLC	Tennessee Valley Trades and Labor Council
UT	Ultrasonic Testing
VT	Visual Testing
WBECSP	Watts Bar Employee Concern Special Program
WBN	Watts Bar Nuclear Plant
WR	Work Request or Work Rules
WP	Workplans

CONTENTS

TABLES

1. INTRODUCTION

This subcategory report summarizes the element evaluations performed for the Employee Concerns Special Program (ECSP) for Engineering Subcategory 21800: Pipe Stress Calculations.

Pipe stress calculations are performed as part of the design process for piping. The purpose of the calculations is to assure that the piping will maintain its pressure integrity (by demonstrating qualification to code requirements) and/or not detrimentally affect other safety-related equipment. The employee concerns in this subcategory draw into question various aspects of TVA pipe stress calculations.

The employee concern statements, as documented on TVA K-Forms upon which the evaluations of this subcategory are based, are reproduced in Attachment A.

The employee concern statements were not clear in many cases. Therefore, the evaluators have translated each concern into one or more "issues." It was these issues that were evaluated rather than the concerns themselves. The issues are presented in Attachment B.

The evaluations were performed by reviewing information provided by TVA and by visiting several of the TVA nuclear plants and engineering offices involved, as necessary. The evaluations resulted in findings and corrective actions, which are presented in Attachment B.

The evaluations are summarized in the balance of this report as follows:

- Section 2 -- summarizes, by element, the issues stated or implied in the employee concerns and the determination of generic applicability
- Section 3 -- outlines the process followed for the element and subcategory evaluations
- Section 4 -- summarizes, by element, the findings and identifies the negative findings that must be resolved
- Section 5 -- highlights the corrective actions required for resolution of the negative findings cited in Section 4 and relates them to element and to plant site
- Section 6 -- identifies causes of the negative findings
- Section 7 -- assesses the significance of the negative findings
- Attachment A -- lists, by element, each employee concern evaluated in the subcategory. The concern number is given, along with notation of any other element or category with which the concern is shared; the plant sites to which it could be applicable are noted; and the concern is quoted as received by TVA, and is characterized as safety-related, not safety-related, or safety-significant

- Attachment B -- contains a summary of the element-level evaluations. Each issue is listed, by element number and plant, opposite its corresponding findings and corrective actions. The reader may trace a concern from Attachment A to an issue in Attachment B by using the element number and applicable plant. The reader may relate a corrective action description in Attachment B to causes and significance in Table 3 by using the CATD number which appears in Attachment B in parentheses at the end of the corrective action description

- Attachment C -- contains references cited in the text

2. SUMMARY OF ISSUES/GENERIC APPLICABILITY

From the concerns, 25 issues were derived for this subcategory. Some of these issues were evaluated for more than one plant, resulting in a total of 44 issue evaluations presented in 21 element evaluations. Not all issues apply to every plant because not all of the employee concerns, from which they originate, apply to every plant. Applicablility determinations of each concern, within each element, were made early in the program, as per ECTG program manual procedure number ECTG M.1, Section 7.3, in cooperation with TVA.

The criteria for making the applicability determinations are in ECTG program manual procedure number ECTG M.1, Attachment E. The criteria clearly limit the determinations of generic applicability to circumstances where there is "reasonable factual basis (not merely speculation)" for application to additional plants.

2.1 Generic Applicability

The generic applicability assignments made are described in the following subsections.

2.1.1 Element 218.1

Concerns IN-85-038-001, IN-85-039-001 (original version), IN-85-039-002, SQN-86-002-03, and SQN-86-001-03 were evaluated for Watts Bar (WBN) and Sequoyah (SQN) only. Those concerns were not evaluated for Browns Ferry (BFN) or Bellefonte (BLN). Originally, there was no factual basis known to the evaluation team to consider those concerns for BFN or BLN. Subsequently, during the evaluation of element 218.5 for BFN, the evaluation team learned that BFN may not have had adequate operating mode definitions, as described in Concern SQN-086-002-03, established for stress analysis. However, the corrective action for CATD 218 05 BFN 01 requires definition and evaluation of thermal modes for stress analysis at BFN. Therefore, no further evaluation is warranted.

After the above evaluations were completed, TVA provided the evaluation team with revised statement of concern IN-85-039-001. That revised concern was evaluated for all four plants.

Concern SQN-86-002-04 was evaluated for WBN only because WBN was specifically referred to in the concern.

2.1.2 Elements 218.2, 218.3, 218.6, 218.8, and 218.10

Concerns IN-85-106-001, IN-85-109-005, IN-85-027-002, HI-85-107-N02, IN-85-108-001, and EX-85-131-001 were evaluated for WBN only, as the concern statements implied application to WBN. The evaluations were either not valid or, if valid, the resulting corrective action was covered by significant condition reports (SCRs) which require a generic condition evaluation. Therefore, no additional evaluation other than that required by the SCRs is necessary.

2.1.3 Elements 218.4 and 218.7

Concerns SQN-86-001-01, SQN-86-002-01, IN-85-032-001, and IN-85-039-003 were evaluated for all four plants.

2.1.4 Element 218.5

Concern HI-85-077-N03 was evaluated for BFN only, as BFN is specifically referred to in the concern.

2.1.5 Element 218.9

Concern HI-85-110-N02 was evaluated for WBN only and found to be valid. TVA generated two SCRs (SCR WBNWBP8727 and 8728) to cover the deficiencies in the site procedures. Since these SCRs are reviewed by TVA for applicability to other plants, no additional evaluation other than the generic condition evaluation required by SCR WBNWBP8727 is required.

2.1.6 Element 218.11

Concern IN-85-304-001 was evaluated for WBN only, because of the specific support cited. Concern BLN-ONE-EC-86-01 was evaluated for BLN only. Although the concern was not explicitly limited to BLN, there was no factual basis for evaluating it for other plants.

2.1.7 Element 218.12

Concern NS-85-002-N02 was evaluated for BFN only as the concern originated with BFN and implies problems occurring during a BFN plant outage.

2.1.8 Element 218.13

Concern I-85-435-BFN was evaluated for BFN only as specific BFN documents and conditions were cited. The concern was valid for BFN but not indicative of a more widespread problem. Therefore, no additional evaluation is required.

2.2 Issue Summary

A synopsis of the issues, by element, is presented below as an overview. For the unabridged text of the issues, see Attachment B.

- 218.1, Thermal Analysis of Piping Subjected to Temperatures Less than 120°F - Thermal expansion stress analyses of piping have various inadequacies (applied to all four plants).
- 218.2, Skewed Hangers and Struts - Skewed supports were not properly modeled in some stress analyses of piping (applied to Watts Bar).
- 218.3, Verification of Rigorous Computer Analysis of Piping Systems - Not all piping analyses performed by computer methods have been verified using the verification techniques of "rigorous analysis" (applied to Watts Bar).
- 218.4, Widespread Deficiencies Within Pipe Stress Calculations - "Alternate analysis" of piping is inadequate or insufficient in detail (applied to all four plants).
- 218.5, Inadequate Piping Analysis - Piping stress analyses are inadequate or undocumented (applied to Browns Ferry).
- 218.6, Piping Stress Analysis - Piping stress analyses have numerous deficiencies (applied to Watts Bar).
- 218.7, Acceptance Criteria for Overlap Areas of Calculations - No consistent policy was established as to what constituted an acceptable analytical interface between "rigorous analysis" and "alternate analysis" boundaries (applied to all four plants).
- 218.8, Potential Internal Stresses From The Tubing Adaptor Between Points 790-795 - Two pipe stress analysis problems may be unconservative due to modeling assumptions at certain locations on the piping (applied to Watts Bar).
- 218.9, Pipe Clearances in the Annulus Area - Pipe clearances in the annulus area may not be sufficient because of growth of the steel containment vessel (applied to Watts Bar).

- 218.10, Deformation of Pipe Support Stanchion - Deformation of the stanchion pipe of a particular type of pipe support could cause additional stresses in the stanchion and process pipes (applied to Watts Bar).

- 218.11, Response Spectra for Pipe Support Attached at the Interface of Shield Wall and Auxiliary Building - A pipe support has a common attachment between two structures with which different response spectra are associated (applied to Watts Bar and Bellefonte).

- 218.12, Temporary Supports, Seismic Analysis - There is inadequate control of temporary supports and inadequate consideration of the effect of such supports on seismic qualification of piping (applied to Browns Ferry).

- 218.13, Drywell Purge System Piping - An interference was identified due to pipe movement associated with thermal and pressure growth of the containment vessel during a design basis accident (applied to Browns Ferry).

3. EVALUATION PROCESS

This subcategory report is based on the information contained in the applicable element evaluations prepared to address the specific employee concerns related to the issues summarized in Section 2. The evaluation process is summarized as follows:

3.1 Element 218.1 - Watts Bar and Sequoyah

a. Reviewed appropriate design criteria and procedures (Refs. C.02.01 through C.02.21, and C.03.01 through C.03.13).

b. Requested identification of any problems where analysis proved that a design previously excluded from thermal expansion analysis was not qualified for pipe stress or support design (Refs. C.02.22 and C.03.14).

c. Reviewed excerpts of TVA calculations (Refs. C.02.23 through C.02.31, and C.03.15).

d. Reviewed TVA's corrective action plans to Corrective Action Tracking Document (CATD) 218 01 WBN 01, 218 01 WBN 02, and 218 01 SQN 01 (Refs. C.02.32 and C.03.16 through C.03.17).

3.2 Element 218.1 - Browns Ferry and Bellefonte

a. Evaluated concern IN-85-039-001 (revised version) only.

b. Reviewed design criteria (Refs. C.04.01, C.05.01, and C.05.02).

c. Reviewed TVA's corrective action plan to CATD 218 01 BFN 01 and 218 01 BLN 01.

3.3 Element 218.2 - Watts Bar

a. Reviewed skewed support designs from the main steam, low head safety injection, thermal barrier supply blowdown steam, and bypass steam systems (Refs. C.06.01 through C.06.04).

b. Reviewed Design Criteria WB-DC-40.31.9 for guidelines to proper design of skewed supports (Ref. C.06.05).

c. Reviewed WBN-RAH-208 (Watts Bar Nuclear Plant Rigorous Analysis Handbook) for guidelines to model the skewed supports into computer input as well as to indicate them on the stress isometric (Ref. C.06.06).

3.4 Element 218.3 - Watts Bar

a. Reviewed the TVA requirements for verification of piping analyses performed using computer methods (Refs. C.07.01 through C.07.13).

b. Reviewed the checklists from a sample of computer-analyzed calculations, including one time-history calculation (Refs. C.07.14 through C.07.24).

c. Reviewed TVA's corrective action plan to CATD 218 03 WBN 01 (Ref. C.07.25).

3.5 Element 218.4

3.5.1 Watts Bar

a. Reviewed the appropriate TVA design criteria and procedures (Refs. C.09.01 through C.09.13).

b. Reviewed associated NCRs, ECNs, and one PIR (Refs. C.09.14 through C.09.22).

c. Reviewed a sample of calculation reports and some of the associated computer analyses (Refs. C.09.23 through C.09.27).

d. Reviewed TVA's corrective action plan to CATD 218 04 WBN 01 and 218 04 NPS 01 (Refs. C.09.28 and C.09.29).

3.5.2 Sequoyah

a. Reviewed associated NCRs (Refs. C.08.01 through C.08.09).

b. Reviewed the Sequoyah Nuclear Plant Alternate Analysis Review Program for suitability as stand-alone qualification of "alternate analysis" piping (Refs. C.08.10 through C.08.28).

c. Reviewed TVA's corrective action plan to CATD 218 04 SQN 01 (Ref. C.08.29).

3.5.3 Browns Ferry and Bellefonte

a. Reviewed the procedures to be used to upgrade the documentation of the qualification of "alternate analysis" piping for adequacy to address the employee concerns (Refs. C.10.01 through C.10.13, C.11.01 through C.11.18).

b. Reviewed NCRs, ECNs, SCRs, PIRs, and related documents (Refs. C.11.19 through C.11.34, and C.10.14 through C.10.23).

c. Reviewed a sample of calculation reports and associated drawings (Refs. C.10.24 through C.10.40 and C.11.35 through C.11.62).

d. Reviewed TVA's corrective action plans to CATD 218 04 BFN 01 (Ref. C.10.41), CATD 218 04 BLN 01 (Ref. C.11.63), and CATD 218 04 BLN 02 (Ref. C.11.64).

3.6 Element 218.5 - Browns Ferry

a. Reviewed the requirements and procedures for upgrading the qualification documentation of safety-related piping for adequacy to address the employee concern (Refs. C.12.01 through C.12.24).

b. Reviewed a sample of calculation reports and some of the associated computer analyses (Ref. C.12.25 through C.12.45).

c. Reviewed TVA's corrective action plan to CATD 218 05 BFN 01 (Ref. C.12.46).

3.7 Element 218.6 - Watts Bar

a. Selected sample calculations of safety-related piping systems from the list of pipe stress analyses performed by rigorous and alternate methods (Refs. C.13.01 and C.13.02).

b. Reviewed the design calculations of the selected sample to study any generic deficiencies in the piping stress analysis.

c. Examined the input data of the design calculations to verify proper application of certain aspects of the piping stress analysis.

d. Reviewed TVA's corrective action plan to CATD 218 06 WBN 01 (Ref. C.13.03).

3.8 Element 218.7

3.8.1 Watts Bar, Sequoyah, and Bellefonte

a. Reviewed past and present procedures for interfacing/terminating alternate analysis piping (Refs. C.14.01 through C.14.08, C.15.01 through C.15.12, and C.17.01 through C.17.09).

b. Evaluated rigidity of alternate analysis pipe spans (Ref. C.15.13).

c. Reviewed a sample of drawings and calculations (Refs. C.15.14 through C.15.19, and C.14.09 through C.14.15).

d. Reviewed TVA's corrective action plans to CATD 218 07 WBN 01 (Ref. C.15.20), CATD 218 07 SQN 01 (Ref. C.14.16), and CATD 218 07 BLN 01 (Ref. C.17.10).

3.8.2 Browns Ferry

a. Reviewed past and present procedures for interfacing/terminating alternate analysis piping (Refs. C.16.01 through C.16.06).

b. Reviewed stress analysis isometrics for determining the types of terminations between analysis problems (Ref. C.16.07).

c. Conducted general walkdown of all three units of the plant to observe the types of termination supports (Ref. C.16.07).

d. Reviewed TVA corrective action plan to CATD 218 07 BFN 01 (Ref. C.16.08).

3.9 Element 218.8 - Watts Bar

a. Reviewed the reducer modeling and stresses in unit 1 calculation N3-68-1R and unit 2 calculation N3-68-7R (Refs. C.18.01 through C.18.04).

b. Reviewed the procedures for modeling reducers (Refs. C.18.05 through C.18.09).

c. Reviewed the reducer modeling and stresses in study analysis of unit 1 calculation N3-68-1R and in other representative calculations (Refs. C.18.03 and C.18.09).

3.10 Element 218.9 - Watts Bar

a. Reviewed criteria memoranda providing the pipe clearances required in the annulus area (Refs. C.19.01 through C.19.05).

b. Interviewed the supervisor and responsible staff members on the subject of pipe clearances in the annulus area (Ref. C.19.06).

c. Conducted general walkdown of unit 1 to observe the pipe clearances in the annulus area (Ref. C.19.06).

d. Reviewed TVA's corrective action plan to CATD 218 09 WBN 01 (Ref. C.19.07).

3.11 Element 218.10 - Watts Bar

a. Examined the 8001-type pipe supports in the plant during a walkdown of both units (Ref. C.20.01).

b. Reviewed the reports on development, testing, and use of 8001-type pipe supports (Ref. C.20.02).

c. Studied the findings of the plant walkdown and performed calculations to determine the design adequacy of stanchion pipes (Ref. C.20.03).

3.12 Element 218.11

3.12.1 Watts Bar

a. Reviewed pipe support drawing 72-1CS-R116, revisions 0 and 1 (Ref. C.21.04).

b. Reviewed piping isometric drawing 47W437-204, revision 2 and "support loads table" for analysis 7208A (Drawing 85 M 478437-428, Rev. 0) to verify the Building Zone Designation for the support in question.

c. Reviewed TVA Pipe Support Design Manual (Ref. C.21.05) to verify that enough guidelines existed for proper use of Building Zone Designation as well as for attachments to structures with different response spectra.

d. Reviewed ECN 5779 (Ref. C.21.01), which was written against the subject hanger design.

e. Reviewed drawing revisions 901 and 902 (Ref. C.21.04), which were issued to incorporate ECN 5779.

f. Reviewed Problem Identification Report (PIR) WBNCEB8603 (Ref. C.21.02), which addresses similar problems in other supports and outlines the action plan to resolve the problems identified.

g. Reviewed TVA's corrective action plan (Ref. C.21.03) to CATD 218 11 WBN 01.

3.12.2 Bellefonte

a. Reviewed TVA Significant Condition Report SCR BLNCEB8603 (Ref. C.22.01), which addresses the pipe support attachment to the building with response spectra different from the spectra used in the piping analysis.

b. Reviewed isometric drawings to locate the identified supports (Ref. C.22.02).

c. Examined the pipe support design detail drawings of the identified supports to verify the building attachments of the pipe supports (Ref. C.22.03).

d. Reviewed the pipe stress calculations (Refs. C.22.04 through C.22.11) to verify the use of appropriate response spectra in the analysis compatible with the pipe support building attachments.

e. Reviewed TVA's corrective action plan to CATD 218.11 BLN 01 (Ref. C.22.12).

3.13 Element 218.12 - Browns Ferry

a. Reviewed past and present procedures regarding temporary supports (Refs. C.23.01 and C.23.02).

b. Reviewed reports and memoranda issued on the procedures and practices applicable to temporary supports (Refs. C.23.03 through C.23.05).

c. Interviewed the supervisor and responsible staff member of Modifications group on the subject of temporary supports (Ref. C.23.06).

d. Conducted general walkdown of all three units of the plant to observe the use of temporary supports (Ref. C.23.06).

e. Reviewed TVA's corrective action plan for ECTG element 307.04, which contains the corrective action for element 218.12.

3.14 Element 218.13 - Browns Ferry

a. Reviewed reports and memoranda issued on the drywell purge system interference problem (Refs. C.24.01 through C.24.03).

b. Reviewed physical drawings (area drawings) - mechanical heating and ventilating plans and sections for the drywell purge system piping (Ref. C.24.04).

c. Reviewed drywell purge piping system sketches for ECN P0384 (Ref. C.24.05).

d. Reviewed TVA's NRC IE Bulletin 79-14 program - Phase I inspection packages concerning the drywell purge system (Ref. C.24.07).

e. Reviewed TVA's corrective action plan to CATD 218 13 BFN 01 (Ref. C.24.06).

3.15 Subcategory Report 21800

a. Tabulated issues, findings, and corrective actions from the element evaluations in a plant-by-plant arrangement (see Attachment B).

b. Prepared Tables 1, 2, and 3 to permit comparison and identification of common and unique issues, findings, and corrective actions among the four plants.

c. Classified the findings and corrective actions from the element evaluations using the ECSP definitions.

d. On the basis of ECSP guidelines, derived the collective significance and causes of the findings from the element evaluations.

e. Evaluated defined corrective actions to determine if additional actions are required as a result of causes found in step d.

f. Provided additional judgment or information that may not be apparent at the element level.

4. FINDINGS

The findings from each of the 21 element evaluations for this subcategory are contained in Attachment B. A synopsis of the findings for each element and plant follows.

4.1 Thermal Analysis of Piping Subjected to Temperatures Less Than 120°F - Element 218.1

The employee concerns were valid, in part, for all four plants. "Alternate analysis" piping was generally not evaluated for thermal expansion, where the operating temperatures fell exclusively between 20°F and 120°F. Some TVA procedures were contradictory as to the requirements for qualification of piping limited to operation between 20°F and 120°F. TVA has used one type of pipe support that may experience high thermal expansion reaction loads never considered because of the above-described lack of stress analyses. The adequacy of thermal operating modes used at Watts Bar was validated by a sampling program accepted by the NRC. Watts Bar procedures allowed the acceptance of increased operating temperatures of up to 20°F, or 10 percent,

without further evaluation. TVA had at one time determined that Watts Bar pipe stress calculations did not contain "current, valid" operating mode data. The Watts Bar FSAR required an evaluation of "one time secondary stress" that was not performed. Watts Bar procedures did not require that operating mode data be issued in document form. TVA has committed to consider "normal" and "upset" service limit environmental temperatures for reanalysis under the Hanger and Analysis Update Program. The environmental temperature (150°F) for the annulus cited by the CI is invalid. The existing procedures did not require transmittal of operating mode data to piping stress analysts in a controlled manner. "Alternate analysis" design criteria at all four plants did not consider the range of stresses for thermal expansion and/or thermal "anchor movements." The "alternate analysis" criteria allow the omission of "anchor movements" parallel to branch piping at the branch line attachment point.

4.2 Skewed Hangers and Struts - Element 218.2

The employee concern was not valid. Skewed supports were properly designed for skewing effects, and the skewed supports were properly modeled in the stress analysis.

4.3 Verification of Rigorous Computer Analysis of Piping Systems - Element 218.3

The employee concern was valid for Watts Bar. While not all piping analyses performed by computer have been verified using the verification techniques of "rigorous analysis," there is no reason that they should be. However, it was found that a verification checklist used for time-history dynamic analyses did not address the analysis parameters specific to time-history analyses. Review of one example calculation identified a significant deficiency in the area of calculation cut-off frequency that could have been prevented by an adequate checklist. TVA had already identified inadequacies in time-history analyses before this review. TVA has implemented a checklist for "simplified analysis." One procedure was found to contain redundant instructions for "alternate analysis" by TPIPE.

4.4 Widespread Deficiencies Within Pipe Stress Calculations - Element 218.4

The employee concern was factual and valid for all four plants. TVA had recognized deficiencies in the qualification documentation of some "alternate analysis" piping and design criteria before completion of the evaluation. Programs have been committed to or are under way to address these deficiencies. In addition, TVA design criteria for the analysis of some free-ended vent and drain lines do not properly address the seismic qualification of these lines. Some design criteria or procedures applicable to all four plants were inadequate because they provide for analytically decoupling branch lines by the "inertia-ratio" method without excluding short, open-ended, flexible piping.

4.5 Inadequate Piping Analysis - Element 218.5

The employee concerns, which applied to Browns Ferry only, were factual and valid. Calculations are not presently available that document the qualification of all Browns Ferry piping. Deficiencies were found in sample calculations reviewed, some of which resulted from a lack of formally defined thermal operating modes.

4.6 Piping Stress Analysis - Element 218.6

The employee concern was valid for Watts Bar only. Some analyses were found to be deficient as follows: lumped masses of pipe supports were not included, the effects of zero period acceleration (ZPA) were not considered, structural seismic displacements at pipe supports were not considered, and documentation was not complete.

4.7 Acceptance Criteria for Overlap Areas of Calculations - Element 218.7

The employee concerns were valid for all four plants. There were no established procedures for structural overlapping for Browns Ferry. The procedures in use for Sequoyah, Watts Bar, and Bellefonte were deficient in the justification of the use of a three-way restraint as an analysis boundary and, at WBN and BLN, they were not consistent in their requirements.

4.8 Potential Internal Stresses from the Tubing Adaptor Between Points 790-795 - Element 218.8

The employee concern was valid for Watts Bar unit 1 only. Reanalysis using conservative modeling of the "tubing adaptor" (reducer-insert) for unit 1 demonstrated that the analysis of record was unconservative. The conservative reanalysis demonstrated that the piping was qualified, however. The concern was not factual for unit 2.

4.9 Pipe Clearances in the Annulus Area - Element 218.9

The employee concern was valid for Watts Bar only. The containment vessel thermal movements were established, but there was no coordinated program to assure sufficient clearances. Walkdowns actually performed were not properly documented.

The evaluators performed a partial walkdown in the annulus area and found instances where sufficient clearances were not maintained. A similar condition of insufficient clearances can occur inside the containment vessel as well as in the annulus because of inward movement of the steel containment.

4.10 Deformation of Pipe Support Stanchion - Element 218.10

The employee concern was not valid. The evaluators performed a walkdown at Watts Bar, and the only deformation of stanchions observed was slight ovality at the free ends. This slight deformation is insignificant to the adequacy of the supports and piping.

4.11 Response Spectra for Pipe Support Attached at the Interface of Shield Wall and Auxiliary Building - Element 218.11

The employee concern, applicable only to Watts Bar and Bellefonte, was valid. For Watts Bar, although the evaluators found no evidence, from the information reviewed, that the subject support was ever designed with a "common attachment between the shield wall and the Auxiliary Building," they did find that the support was attached to a building other than the one specified in the piping analysis. TVA has issued a problem identification report to review other pipe supports that may be affected. The evaluators observed that the consideration of proper building attachment was not emphasized in sufficient detail in TVA's Pipe Support Design Manual.

For Bellefonte, a support was found with an attachment between two buildings, the relative motion of the two buildings was not considered for the design of the piping or the support, and the envelope response spectra applicable to both buildings was not used in the piping analysis.

4.12 Temporary Support Seismic Analysis - Element 218.12

The employee concern was valid, in part, for Browns Ferry. During the unit 3 outage in 1983, there were no programmatic controls or documentation for the installation and removal of temporary supports. The current procedures provide adequate controls for tracking temporary supports during outages. However, current procedures do not establish any requirements for the qualification of piping systems during the time when seismic supports are removed.

4.13 Drywell Purge System Piping Interference in DBA - Element 218.13

The employee concern is valid for Browns Ferry. On unit 2, there is a potential interference between a pipe support and a pipe. The interference would occur as a result of pressure and thermal growth of the containment during a design basis accident. On units 2 and 3, the box-frame-type pipe supports do not provide sufficient clearances for the upward movement of the 18-inch drywell purge system pipes that would occur because of pressure and thermal growth of the containment during a design basis accident.

4.14 Summary of Findings

The findings have been classified as shown in Table 1. Class A and B findings indicate there is no problem and that corrective action is not required. Class C, D, and E findings require corrective actions. The corrective action class, defined in the Glossary Supplement, is identified in the table by the numeral combined with the finding class. For example, the designation D1 in Table 1 indicates that the evaluated issue was found to be valid (finding Class D) and that a corrective action involving some type of hardware or plant modification is required (corrective action Class 1).

Where more than one "finding/corrective action" classification is listed in Table 1 for a single "issue/finding," Table 2 counts only one: the most significant of any of the definitions presented at the end of Table 1 that are applicable to that "issue/finding."

5. CORRECTIVE ACTIONS

Synopses of the corrective actions applicable to each element within this subcategory are presented in the following subsections. TVA corrective actions are described in detail in Attachment 8 to this subcategory report.

5.1 Thermal Analysis of Piping Subjected to Temperatures Less Than 120°F - Element 218.1

For Watts Bar, revise piping analysis design criteria to address thermal analysis for temperatures from 20 to 120°F. Revise documents (e.g., Rigorous Analysis Handbook) to remove universal exemptions from requirements for requalification. Revise all applicable TVA documents, as necessary, to remove inconsistencies between licensing basis and design. Require operating mode definitions to be issued in calculation form for the complete reanalysis to be required by the Hanger and Analysis Update Program. Revise a procedure to allow calculations to be used to transfer design data. For all plants, "alternate analysis" design criteria will be revised to clearly require evaluation and documentation of the secondary stress range. Existing calculations will be conformed to the revised criteria.

5.2 Verification of Rigorous Computer Analysis of Piping Systems - Element 218.3

For Watts Bar, revise a procedure to delete redundant instructions for "alternate analysis" by TPIPE. Revise another procedure to no-longer-require a checklist for verification of complex analyses. Re-perform time-history stress analyses using the "direct-integration" method.

5.3 Widespread Deficiencies Within Pipe Stress Calculations - Element 218.4

For Sequoyah, revise a procedure to require that documentation be developed in Phase II of the Alternate Analysis Review Program to demonstrate that all design requirements are met for all alternately analyzed piping and to require that support spacings meet design requirements. The evaluation team has verified the completion of this corrective action (see BLT-209, 05/11/87).

For Watts Bar, revise a procedure to delete redundant instructions for "alternate analysis" by TPIPE and to clarify valve qualification requirements. Revise analysis handbook to include instructions for documenting discrepancies in dates of analyses verifications. Revise applicable documents to assure that transient mechanical loadings are properly evaluated. Review all "alternate analysis" calculations to assure that the

dates of verification documentation do not predate their respective subject calculations. "Address" (i.e., properly perform) water-hammer analyses when all analyses are re-performed as part of the Hanger and Analysis Update Program.

For Browns Ferry, revise the design criteria for seismic class I piping less than 2-1/2 inches in diameter; perform a walkdown and evaluation of a sample of such piping; qualify and document existing seismic class II piping less than 2-1/2 inches in diameter as per a significant condition report; revise the "Torus Integrity Long-Term Program, Plant Unique Analysis Report"; review torus-attached piping analyses to identify all cases of calculated overstress and correct.

For Bellefonte, revise design criteria; revise an NCR; revise "alternate analysis" calculations to eliminate axial snubbers in-line with rigid restraints; evaluate for pipe break any "high energy" piping greater than 1 inch in diameter currently classified as "alternate"; modify tubing drawings to show seismic classifications; requalify any tubing not previously qualified to the correct seismic classification; incorporate lug stress evaluations into "alternate analysis" calculations; issue three design criteria documents.

For all plants, revise design criteria to provide acceptable techniques for dynamic analysis of flexible, open-ended, branch lines.

5.4 Inadequate Piping Analysis - Element 218.5

For Browns Ferry, generate calculations demonstrating the qualification of all safety-related piping less than 2-1/2 inches in diameter; revise one calculation to "clarify and justify" the thermal analysis; revise design criteria; formally define and document thermal modes for all safety-related piping qualified by a program for "as-built" reconciliation; review piping outside the scope of that program for conformance with the new thermal modes.

5.5 Piping Stress Analysis - Element 218.6

For Watts Bar, revise design criteria and Rigorous Analysis Handbook to show how to account for zero period acceleration (ZPA). Revise design documents to assure that support weights are considered in future analyses. Incorporate pipe support component weights, where applicable, in reanalyses to be performed under Hanger and Analysis Update Program.

Perform seismic anchor motion analyses as per the Rigorous Analysis Handbook during the Hanger and Analysis Update Program. Evaluate analysis to include the effects of ZPA. Revise and reissue pipe support designs.

5.6 Acceptance Criteria for Overlap Areas of Calculations - Element 218.7

For Sequoyah, revise Rigorous Analysis Handbook to require "rigorous"/"alternate" interfaces to be anchored unless otherwise approved by the technical supervisor. Evaluate selected "worst case" problems. If

significant increases in stress levels are revealed, evaluate any problems with low stress margins that may be affected. The evaluation team has verified completion of this corrective action (see BLT-343, 07/24/87).

For Watts Bar, revise criteria documents to require termination of "rigorous analysis" by either (1) anchor, (2) inertia ratio of 25 for decoupled piping of adequate flexibility, (3) overlapping, or (4) flexible hose. Reanalyze problems not terminated by one of the four methods described above.

For Browns Ferry, "add a section to the Rigorous Analysis Handbook defining structural overlap requirements at analysis problem boundaries"; perform structural overlapping for the purposes of a program for as-built reconciliation as per the new section to be added to the Rigorous Analysis Handbook as above.

For Bellefonte, revise design criteria; review and revise rigorous analysis interfaces to revised criteria; revise two NCRs and a problem identification report.

5.7 Pipe Clearances in the Annulus Area - Element 218.9

For Watts Bar, determine, evaluate, and resolve potential interferences to growth of steel containment vessel.

5.8 Response Spectra for Pipe Support Attached at the Interface of Shield Wall and Auxiliary Building - Element 218.11

For Watts Bar, revise the Pipe Support Design Manual to emphasize that it is the responsibility of the pipe support designers and checkers to assure that pipe supports are attached to the correct structure. Review all pipe supports close to two or more seismic response spectra zones. If any supports are attached to the wrong structures, revise the piping analysis or modify the supports accordingly.

For Bellefonte, review pipe supports in close proximity to two or more seismic zones; revise Pipe Support Design Manual.

5.9 Temporary Support Seismic Analysis - Element 218.12

TVA elected to assume responsibility for preparation of the corrective action tracking documents (CATDs) and corrective action plans (CAPs) for element 218.12(C). TVA requested (Ref. C.23.07) that the evaluators include the TVA CAP for element 307.04 in the element evaluation for element 218.12(C). It is quoted below for reference purposes only.

CATD 307 04 BFN 01

"A. Determine enveloping pipe support configurations which may have existed during the 1983 outage of unit 3 RHR Loop I.

"B. Evaluate configurations identified in (A.) above for pipe stress, support loads, and nozzle loads.

"C. Determine additional corrective action, if required, based on results of (B.) above. Additional corrective action may include inspections and/or modifications.

"This work should be completed prior to unit 3 startup.

"Note: A similar situation exists on unit 1 and is being handled under ECP Investigation Report Concern ECP 86-8F-566-001."

CATD 307 04 BFN 02

"Modifications will initiate a corrective action report (CAR) identifying the above [on CATD 307 04 BFN 02] adverse condition. Modifications shall propose, as a corrective action, that a walkdown of the RHR system be performed to verify the removal of all temporary supports."

"During the close out process ensure that a CAQR is initiated."

CATD 307 04 BFN 03.

"(A) MAI-23 is being revised to include [a] precaution statement for installing, removing, and/or modifying supports on operating systems (in approval cycle).

"(B) The USQD is part of the ECN, therefore, it is included in the workplan that removes the support, if the system is inoperable. If removal on operable system precaution statement requires a specific USQD [incomplete sentence].

"(C) Temporary supports have 2nd party verification of installation and removal in a PORC approved instruction (MAI-23), therefore, a TACF is not applicable as long as MAI-23 is the referenced document."

5.10 Drywell Purge System Piping Interference in OBA - Element 218.13

For Browns Ferry, remove two pipe supports and requalify the piping.

5.11 Summary of Subcategory Corrective Actions

These corrective actions also appear in Table 3, along with their corresponding finding/corrective action classifications. The table indicates the plant or plants to which a corrective action is applicable by the Corrective Action Tracking Document (CATD) number in the CATD column. The table also identifies which corrective actions are significant, what effect may result from them (viz., change in documentation, hardware, or design margin), and whether they are already known to be required (classified "actual") or only may be required depending on the outcome of further TVA evaluations (classified "potential").

Fifty-nine corrective actions are associated with this subcategory. Of the 13 elements in this subcategory, three require no corrective action (218.2, 218.8, and 218.10). The element requiring the largest number of corrective actions is 218.1, "Thermal Analysis of Piping Subjected to Temperature Less Than 120°F," which has 16.

The evaluation team found the corrective action plans received and summarized in Attachment B, excluding those for BFN element 218.12, which are to be addressed by TVA under element 307.4, to be acceptable to resolve the findings.

6. CAUSES

Table 3 identifies a cause of the finding underlying each corrective action. The most important cause of negative findings in this subcategory is "Engineering Error." This cause is followed closely by "Inadequate Procedures." Less frequent causes were "Inadequate Calculations," "Inadequate Design Bases," "Inadequate Communication," and "Failure to Follow Procedures."

The causes have been divided into three groups: management effectiveness, design process effectiveness, and technical adequacy. Thirty causes are in the management effectiveness category, 12 are in the design process category, and 19 are in the technical adequacy category.

Most of the negative findings in the management effectiveness category resulted from "Inadequate Procedures." TVA has originated and implemented many procedural documents, some called "criteria" by TVA, applicable to the design of safety-related piping systems. Such "criteria" documents were counted as "procedures" for the purposes of Table 3.

The negative findings in the design process effectiveness category resulted equally from "Inadequate Design Bases" and "Inadequate Calculations." Examples of "Inadequate Design Bases" are design criteria and procedures that allow universal exemptions from licensing requirements (e.g., see Attachment B, element 218.1 for Watts Bar, issue "d," findings and corrective actions) and design criteria and procedures that contain invalid analysis techniques (e.g., see Attachment B, element 218.7 for Sequoyah, issue "b," findings and corrective actions).

The negative findings in the technical adequacy category resulted exclusively from "Engineering Errors." These errors were caused, in part, by instances of an apparent lack of knowledge of engineering principles as follows: (a) lack of proper application of the principles of dynamics used to establish analysis parameters critical to time-history stress analyses such as for water hammer loading (element 218.3, WBN), (b) invalid application of engineering principles used to reduce calculated expansion stresses (element 218.5 BFN), (c) performance of "seismic anchor motion" (SAM) analyses using improper magnitude and phasing of pipe support and attachment motions (element 218.6 WBN).

Some engineering errors resulted from a lack of attention to detail (see also Attachment B, element 218.4 for Watts Bar, findings, paragraph 4, and corrective actions, paragraph 3) as follows: (a) failure to include all "normal" and "upset" service limit thermal operating modes in the determination of maximum range of moments for secondary stress evaluations (element 218.5 BFN), (b) failure to prevent interferences that could have resulted from expansion of the steel containment vessel during a design basis accident (element 218.9 WBN), and (c) design of pipe supports for attachment to a different seismic zone than that considered in the piping analysis (element 218.11 WBN, BLN).

7. COLLECTIVE SIGNIFICANCE

The results of the evaluations conducted for this subcategory reveal significant deficiencies, many with the potential for hardware changes. These deficiencies were generally caused by failure to adequately or competently plan and perform pipe stress analyses.

The corrective actions to be completed involve further evaluations, re-performance of calculations, and revisions to criteria and procedures. The majority of corrective actions apply to Watts Bar. However, it should be noted that twice as many issues were evaluated for Watts Bar as for any other plant. Nearly all of the corrective actions resulting from engineering errors are required for Watts Bar. The more significant engineering errors were: failure to perform time-history analyses to a sufficient high-frequency limit; inappropriately excluding branch piping from a time-history analysis; neglecting "rigid-region" (i.e., frequencies above the amplified portion of the seismic response spectra) seismic response; incorrectly performing analysis of relative support motions due to earthquake; terminating computer models of piping at a 3-way support where piping extends beyond such support; failure to assure clearances between piping and supports attached to different building structures; and the existence of supports attached to structures in the wrong seismic zone. Any of these engineering errors could result in the underprediction of pipe stress and support loads. The evaluation team's judgement as to the significance of individual corrective actions is listed in the last three columns of Table 3.

The TVA Revised Corporate Nuclear Performance Plan (RCNPP; Ref. C.01.04) describes corrective actions for problems in the design control and configuration control areas. Correction of these problems includes organizational changes that clearly define the technical responsibilities of the project engineer and of the discipline branch chief engineers to monitor and control technical performance. The discipline branch chiefs are responsible for conducting technical reviews of the design parameters of the major plant systems to evaluate the quality, technical accuracy and adequacy, and the economy of the products and services for which they are responsible.

These reviews are scheduled by the branch chief at a point when an area in the design nears completion and before approval for use. The RCNPP describes a new organization, Engineering Assurance (EA), that is established within ONE and reports to Nuclear Quality Assurance for Quality Assurance related matters. One function of EA is to "conduct in-depth technical audits, utilizing engineering expertise outside EA as necessary to assess the technical adequacy of the work." Such audits will provide feedback to engineering management on technical performance for further action, as necessary. When circumstances warrant it, EA has the authority to order a work stoppage.

The organizational changes being made to clarify technical responsibilities to monitor and control technical performance should improve the quality of the piping design process. In addition, the establishment of EA should result in greater probability of adequate design quality.

The findings of this subcategory, along with the observation made on engineering errors for Watts Bar, are combined with the findings of other subcategory reports and broadly evaluated in the Engineering category report.

TABLE 1

CLASSIFICATION OF FINDINGS AND CORRECTIVE ACTIONS

	Element	Issue/ Finding**	Finding/Corrective Action Class* SQN	WBN	BFN	BLN
218.1	Thermal Analysis of Piping Subjected to Temperatures Less Than 120°F	a	A	D2	D2***	D2***
			-	D6	D6***	D6***
			-	C2	-	-
		b	A	B	-	-
		c	A	A	-	-
		d	A	D2	-	-
			-	C6	-	-
		e	A	D2	-	-
		f	A	D2	-	-
		g	D2	A	-	-
		h	-	D2	-	-
			-	D6	-	-
218.2	Skewed Hangers and Struts	a	-	A	-	-
218.3	Verification of Rigorous Computer Analysis of Piping Systems	a	-	C2	-	-
			-	D2	-	-
			-	C5	-	-
218.4	Widespread Deficiencies Within Pipe Stress Calculations	a	D2	D2	D2	D2
			-	D6	D6	D6
			-	D5	-	-
218.5	Inadequate Piping Analysis	a	-	-	C3	-
		b	-	-	D6	-
			-	-	D2	-
218.6	Piping Stress Analysis	a	-	D6	-	-
			-	D2	-	-
			-	C6	-	-
			-	C5	-	-
			-	D5	-	-

TABLE 1 (Cont'd)

	Element	Issue/ Finding**	Finding/Corrective Action Class* SQN	WBN	BFN	BLN
218.7	Acceptance Criteria for Overlap Areas of Calculation	a	A	B	D2	D2
		b	D2	D2	D2	D2
			D6	D5	D6	D6
		c	-	A	-	-
218.8	Potential Internal Stresses From The Tubing Adaptor Between Points 790-795	a	-	B	-	-
		b	-	A	-	-
218.9	Pipe Clearances in the Annulus Area	a	-	D6	-	-
218.10	Deformation of Pipe Support Stanchion	a	-	A	-	-
218.11	Response Spectra for Pipe Support Attached at the Interface of Shield Wall and Auxiliary Building	a	-	D2	-	C6
			-	D6	-	-
218.12	Temporary Supports, Seismic Analysis	a	-	-	D3	-
			-	-	D2	-
		b	-	-	D6	-
218.13	Drywell Purge System Piping	a	-	-	D6	-

*Classification of Findings and Corrective Actions

A. Issue not valid. No corrective action required.
B. Issue valid but consequences acceptable. No corrective action required.
C. Issue valid. Corrective action initiated before ECTG evaluation.
D. Issue valid. Corrective action taken as a result of ECTG evaluation.
E. Peripheral issue uncovered during ECTG evaluation. Corrective action required.

1. Hardware
2. Procedure
3. Documentation
4. Training
5. Analysis
6. Evaluation
7. Other

**Defined in Attachment B.

*** Revised version of concern IN-85-039-001

TABLE 2

FINDINGS SUMMARY

Classification of Findings	Plant SQN	WBN	BFN	BLN	Total
A. Issue not valid. No corrective action required.	7	6	0	0	13
B. Issue valid but consequences acceptable. No corrective action required.	0	3	0	0	3
C. Issue valid. Corrective action initiated before ECTG evaluation.	0	0	1	1	2
D. Issue valid. Corrective action taken as a result of ECTG evaluation.	3	11	8	4	26
E. Peripheral issue uncovered during ECTG evaluation. Corrective action required.	0	0	0	0	0
Total	10	20	9	5	44

ELEM	FINDING/ CORRECTIVE ACTION CLASS.**	CORRECTIVE ACTION	CATD	CAUSES OF NEGATIVE FINDINGS * — MANAGEMENT EFFECTIVENESS							DESIGN PROCESS EFFECTIVENESS							TECHNICAL ADEQUACY			Significance of Corrective Actions*		
				1 Fragmented Organization	2 Inadequate Q-trng	3 Inadequate Procedures	4 Procedures Not Followed	5 Inadequate Communication	6 Untimely Res of Issues	7 Lack of Mgt Atten	8 Inadequate Design Bases	9 Inadequate Calcs	10 Inadequate As-blt Reconcil.	11 Lack of Design Detail	12 Engrg Judgmt not Documented	13 Design Crit/ Commit Not Met	14 Insuf. Verif Documentation	15 Stds Not Followed	16 Engrg Error	17 Vendor Error	D	M	H
218.1	D2	Include requirements for stress range evaluations in Phase II of the AARP.	SQN 01			X															A	P	P
	D2	Issue a CAQR to ensure existing calculations consider stress range.	SQN 01			X															A	P	P
	D2	Revise piping analysis design criteria to address thermal analysis for temperatures from 20°F to 120°F.	WBN 01			X															A	P	P
	D6	Conform calculations to revised design criteria.	WBN 01			X															P	P	P
	C2	Retired superseded procedural document.	WBN 01			X															-	-	-
	D2	Revise documents (e.g., Rigorous Analysis Handbook) to remove universal exemptions from requirements for requalification.	WBN 01								X										A	P	P
	C6	Conducted a sampling program which verified adequacy of existing operating modes.	WBN 01									X									-	-	-
	D2	Revise all TVA documents, as necessary, to remove inconsistencies between licensing basis and design.	WBN 01				X														A	P	P
	D2	Require operating mode definitions to be issued in calculation form for the complete reanalysis to be required by the Hanger and Analysis Update Program.	WBN 01					X													A	P	P

* Defined in the Glossary Supplement.

** Defined in Table 1.

ELEM	FINDING/ CORRECTIVE ACTION CLASS.**	CORRECTIVE ACTION	LATD	CAUSES OF NEGATIVE FINDINGS *																	Significance of Corrective Actions*		
				MANAGEMENT EFFECTIVENESS							DESIGN PROCESS EFFECTIVENESS							TECHNICAL ADEQUACY					
				1 Fragmented Organization	2 Inadequate Utrng	3 Inadequate Procedures	4 Procedures Not Followed	5 Inadequate Communication	6 Untimely Res of Issues	7 Lack of Mgt Atten	8 Inadequate Design Bases	9 Inadequate Calcs	10 Inadequate As-blt Reconcil.	11 Lack of Design Detail	12 Engrg Judgmt not Documented	13 Design Crit/ Commit Met	14 Insuf. Verif Documentation	15 Stds Not Followed	16 Engrg Error	17 Vendor Error	D	M	H
218.1	D2	Revise NEP 3.1 to allow calculations to be used to transfer design data.	WBN 01			X															A	-	-
	D6	Issue a CAQR to ensure that existing calculations consider stress range.	WBN 02			X															P	P	P
	D2	"Alternate analysis" criteria will be revised to consider stress range, if "alternate analysis" is used in the future.	WBN 02			X															P	P	P
	D2	Revise design criteria to consider stress range.	BFN 01			X															A	P	-
	D6	Conform calculations to revised criteria.	BFN 01			X															P	P	P
	D2	Revise design criteria to consider stress range.	BLN 01			X															A	P	-
	D6	Conform calculations to revised criteria.	BLN 01			X															P	P	P
218.3	C2	Implemented checklist for "simplified analysis"	WBN 01			X															A	-	-
	D2	Revise WBEP-EP 43.21 to delete redundant instructions for "alternate analysis" by IPIPE.	WBN 01			X															A	-	-
	D2	Revise CEB-EP 21.42 to no-longer-require a checklist for verification of complex analyses.	WBN 01			X															A	-	-
	C5	Re-perform time-history stress analyses using the "direct-integration" method.	WBN 01																X		A	A	P

* Defined in the Glossary Supplement.

** Defined in Table 1.

ELEM	FINDING/ CORRECTIVE ACTION CLASS.**	CORRECTIVE ACTION	LATD	CAUSES OF NEGATIVE FINDINGS *																	Significance of Corrective Actions*		
				MANAGEMENT EFFECTIVENESS							DESIGN PROCESS EFFECTIVENESS							TECHNICAL ADEQUACY					
				1 Fragmented Organization	2 Inadequate Q-trng	3 Inadequate Procedures	4 Procedures Not Followed	5 Inadequate Communication	6 Untimely Res of Issues	7 Lack of Mgt Atten	8 Inadequate Design Bases	9 Inadequate Calcs	10 Inadequate As-blt Reconcil.	11 Lack of Design Detail	12 Engrg Judgmt not Documented	13 Design Crit/ Commit Not Met	14 Insuf. Verif Documentation	15 Stds Not Followed	16 Engrg Error	17 Vendor Error	D	M	H
	C2	Revise design criteria and analysis handbook to provide instructions on how to account for high frequency modes in time-history analysis.	WBN UI																X		A	-	-
218.4	D2	Revise SQN-AA-UUI to require that documentation be developed in Phase II of the Alternate Analysis Review Program to demonstrate that all design requirements are met for all alternately analyzed piping and to require that support spacings meet design requirements.	SQN UI			X															A	-	-
	D2	Revise WBEP-EP 43.21 to delete redundant instructions for "alternate analysis" by IPIPE.	WBN UI			X															A	-	-
	D2	Revise WBEP-EP 43.21 to clarify valve qualification requirements.	WBN UI			X															A	P	P
	D6	Review all "alternate analysis" calculations to assure the dates of verification documentation do not predate their respective subject calculations.	WBN UI																X		A	P	-
	D2	Revise analysis handbook to include instructions for documenting discrepancies in dates of analyses verifications.	WBN UI																X		A	-	-
	D5	"Address" (i.e., properly perform) water hammer analyses when all analyses are re-performed as part of the Hanger and Analysis Update Program.	WBN UI																X		A	P	P

* Defined in the Glossary Supplement.

** Defined in Table 1.

ELEM	FINDING/ CORRECTIVE ACTION CLASS.**	CORRECTIVE ACTION	CAID	CAUSES OF NEGATIVE FINDINGS *																	Significance of Corrective Actions*		
				MANAGEMENT EFFECTIVENESS							DESIGN PROCESS EFFECTIVENESS							TECHNICAL ADEQUACY					
				1 Fragmented Organization	2 Inadequate Q-trng	3 Inadequate Procedures	4 Procedures Not Followed	5 Inadequate Communication	6 Untimely Res of Issues	7 Lack of Mgt Atten	8 Inadequate Design Bases	9 Inadequate Calcs	10 Inadequate As-blt Reconcil.	11 Lack of Design Detail	12 Engrg Judgmt not Documented	13 Design Crit/ Commit Not Met	14 Insuf. Verif Documentation	15 Stds Not Followed	16 Engrg Error	17 Vendor Error	D	M	H
	D2	Revise applicable documents to assure transient mechanical loadings are properly evaluated.	WBN 01																X		A	P	P
	D2	Revise design criteria.	BFN 01			X															A	P	P
	D6	Perform walkdown and evaluation of a sample of piping and supports less than 2-1/2 inches in diameter.	BFN 01									X									A	P	P
	D6	Review and revise design criteria documents, evaluate alternate analysis calculations and revise if required to correct deficiencies in the alternate analysis piping calculations.	BLN 01									X									A	P	P
	D2	Issue and implement three criteria documents.	BLN 02			X															A	P	P
	D2	Revise design criteria to properly address amplified response of branch lines due to run line dynamic motion.	NPS 01			X															A	P	P
	D6	Issue a CAQR due to lack of consideration of amplified seismic response in one branch line analysis.	NPS 01			X															P	P	P

* Defined in the Glossary Supplement.

** Defined in Table 1.

TABLE 3
MATRIX OF ELEMENTS, CORRECTIVE ACTIONS, AND CAUSES
SUBCATEGORY 21800

ELEM	FINDING/ CORRECTIVE ACTION CLASS.**	CORRECTIVE ACTION	CATD	CAUSES OF NEGATIVE FINDINGS * — MANAGEMENT EFFECTIVENESS 1 Fragmented Organization	2 Inadequate Q-trng	3 Inadequate Procedures	4 Procedures Not Followed	5 Inadequate Communication	6 Untimely Res of Issues	7 Lack of Mgt Atten	DESIGN PROCESS EFFECTIVENESS 8 Inadequate Design Bases	9 Inadequate Calcs	10 Inadequate As-blt Reconcil.	11 Lack of Design Detail	12 Engrg Judgmt not Documented	13 Design Crit/ Comalt Not Met	14 Insuf. Verif Documentation	TECHNICAL ADEQUACY 15 Stds Not Followed	16 Engrg Error	17 Vendor Error	Significance of Corrective Actions* D	M	H
218.5	C3	Calculations for safety-related piping less than 2-1/2 inches in diameter are being created.	BFN UI									X									A	P	P
	D6	A 25.8% overstress in one calculation will be resolved by the corrective action plan for BFN element 218.4.	BFN UI																X		A	P	P
	D6	A calculation with a deleted thermal mode will be revised. All thermal modes for the core spray system will be formally defined.	BFN UI																X		A	P	P
	D2	Revise design criteria. Formally define thermal operating modes for all safety-related piping.	BFN UI			X															A	P	P
218.6	D6	Incorporate pipe support component weights in reanalyses to be performed under Hanger and Analysis Update Program.	WBN UI																X		A	P	P
	D2	Revise design documents to assure support weights are considered in future analyses.	WBN UI																X		A	-	-
	C6	Perform a parametric study to establish procedures for ZPA analysis.	WBN UI																X		-	-	-
	C6	Evaluate analysis to include the effects of ZPA.	WBN UI																X		A	P	P
	C5	Revise and reissue pipe support designs.	WBN UI																X		A	P	P

* Defined in the Glossary Supplement.

** Defined in Table 1.

ELEM	FINDING/ CORRECTIVE ACTION CLASS.**	CORRECTIVE ACTION	LAIU	CAUSES OF NEGATIVE FINDINGS *																	Significance of Corrective Actions*		
				MANAGEMENT EFFECTIVENESS							DESIGN PROCESS EFFECTIVENESS							TECHNICAL ADEQUACY					
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17			
				Fragmented Organization	Inadequate Q-trng	Inadequate Procedures	Procedures Not Followed	Inadequate Communication	Untimely Res of Issues	Lack of Mgt Atten	Inadequate Design Bases	Inadequate Calcs	Inadequate As-blt Reconcil.	Lack of Design Detail	Engrg Judgmt not Documented	Design Crit/ Commit Not Met	Insuf. Verif Documentation	Stds Not Followed	Engrg Error	Vendor Error	D	M	H
	D2	Revise design criteria and Rigorous Analysis Handbook to show how to account for ZPA.	WBN U1								X										A	-	-
	D5	Perform seismic anchor motion analyses as per the Rigorous Analysis Handbook during the Hanger and Analysis Update Program.	WBN U1																X		A	P	P
218.7	D6	Evaluate selected "worst case" problems.	SQN U1								X										P	P	P
	D2	Revise Rigorous Analysis Handbook to require "rigorous"/"alternate" interfaces to be anchored except by approval of technical supervisor.	SQN U1								X										A	-	-
	D5	Reanalyze problems not terminated by one of the four methods described immediately below.	WBN U1								X										P	P	P
	D2	Revise criteria documents to require termination of "rigorous analysis" by either (1) anchor, (2) inertia ratio of 25 for decoupled piping of adequate flexibility, (3) overlapping, and (4) flexible hose.	WBN U1								X										A	-	-
	D2	Revise design criteria.	WBN U1			X															A	P	P

* Defined in the Glossary Supplement.

** Defined in Table 1.

ELEM	FINDING/ CORRECTIVE ACTION CLASS.**	CORRECTIVE ACTION	CATD	CAUSES OF NEGATIVE FINDINGS *																	Significance of Corrective Actions*		
				MANAGEMENT EFFECTIVENESS							DESIGN PROCESS EFFECTIVENESS							TECHNICAL ADEQUACY					
				1 Fragmented Organization	2 Inadequate Q-trng	3 Inadequate Procedures	4 Procedures Not Followed	5 Inadequate Communication	6 Untimely Res of Issues	7 Lack of Mgt Atten	8 Inadequate Design Bases	9 Inadequate Calcs	10 Inadequate As-blt Reconcil.	11 Lack of Design Detail	12 Engrg Judgmt not Documented	13 Design Crit/ Commit Not Met	14 Insuf. Verif Documentation	15 Stds Not Followed	16 Engrg Error	17 Vendor Error	D	M	H
	D6	Overlapping will be performed as per the revision to the rigorous analysis handbook required by SCRBFNCE8861b, RO for the analyses required by Phase II of the BFEP-PI 80-05 program.	BFN 01									X									A	P	P
	D2	Revise design criteria.	BLN 01			X															A	P	P
	D6	Revise design criteria and conform calculations.	BLN 01									X									A	P	P
218.9	D6	Determine, evaluate, and resolve potential interferences to growth of steel containment vessel.	WBN 01																X		A	P	P
218.11	D2	Revise Pipe Support Design Manual to emphasize that it is the responsibility of the pipe support designer to assure support attachment to the correct structure.	WBN 01																X		A	-	-
	D6	Review all pipe supports in close proximity to two or more seismic response spectra zones. If any supports are found to be attached to the wrong structures, revise the piping analysis or modify the supports accordingly.	WBN 01																X		P	P	P
	C6	Evaluate existing designs, reanalyze and, if necessary, modify supports. Add seismic zone information to pipe stress isometrics. Revise pipe supports design manual.	BLN 01																X		P	P	P

* Defined in the Glossary Supplement.

** Defined in Table 1.

TABLE 3
MATRIX OF ELEMENTS, CORRECTIVE ACTIONS, AND CAUSES
SUBCATEGORY 21800

ELEM	FINDING/ CORRECTIVE ACTION CLASS.**	CORRECTIVE ACTION	CATD	CAUSES OF NEGATIVE FINDINGS *																Significance of Corrective Actions*		
				MANAGEMENT EFFECTIVENESS							DESIGN PROCESS EFFECTIVENESS							TECHNICAL ADEQUACY					
				1 Fragmented Organization	2 Inadequate Q-trng	3 Inadequate Procedures	4 Procedures Not Followed	5 Inadequate Communication	6 Untimely Res of Issues	7 Lack of Mgt Atten	8 Inadequate Design Bases	9 Inadequate Calcs	10 Inadequate As-blt Reconcil.	11 Lack of Design Detail	12 Engrg Judgmt not Documented	13 Design Crit/ Commit Not Met	14 Insuf. Verif Documentation	15 Stds Not Followed	16 Engrg Error	17 Vendor Error	D	M	H
218.12	D6	Corrective actions for this	BFN 01			X															P	P	P
	D3	element are to be presented	BFN 02			X															P	-	-
	D2	in TVA ECTG evaluation 307.04.	BFN 03			X															P	-	-
218.13	D6	Remove two pipe supports. Reanalyze.	BFN 01																X		P	P	P
			TOTALS			28	1	1			6	6							19				

* Defined in the Glossary Supplement.

** Defined in Table 1.

GLOSSARY SUPPLEMENT
FOR THE ENGINEERING CATEGORY

Causes of Negative Findings - the causes for findings that require corrective action are categorized as follows:

1. Fragmented organization - Lines of authority, responsibility, and accountability were not clearly defined.

2. Inadequate quality (Q) training - Personnel were not fully trained in the procedures established for design process control and in the maintenance of design documents, including audits.

3. Inadequate procedures - Design and modification control methods and procedures were deficient in establishing requirements and did not ensure an effective design control program in some areas.

4. Procedures not followed - Existing procedures controlling the design process were not fully adhered to.

5. Inadequate communications - Communication, coordination, and cooperation were not fully effective in supplying needed information within plants, between plants and organizations (e.g., Engineering, Construction, Licensing, and Operations), and between interorganizational disciplines and departments.

6. Untimely resolution of issues - Problems were not resolved in a timely manner, and their resolution was not aggressively pursued.

7. Lack of management attention - There was a lack of management attention in ensuring that programs required for an effective design process were established and implemented.

8. Inadequate design bases - Design bases were lacking, vague, or incomplete for design execution and verification and for design change evaluation.

9. Inadequate calculations - Design calculations were incomplete, used incorrect input or assumptions, or otherwise failed to fully demonstrate compliance with design requirements or support design output documents.

10. Inadequate as-built reconciliation - Reconciliation of design and licensing documents with plant as-built condition was lacking or incomplete.

11. Lack of design detail - Detail in design output documents was insufficient to ensure compliance with design requirements.

12. Failure to document engineering judgments - Documentation justifying engineering judgments used in the design process was lacking or incomplete.

13. Design criteria/commitments not met - Design criteria or licensing commitments were not met.

14. Insufficient verification documentation - Documentation (Q) was insufficient to audit the adequacy of design and installation.

15. Standards not followed - Code or industry standards and practices were not complied with.

16. Engineering error - There were errors or oversights in the assumptions, methodology, or judgments used in the design process.

17. Vendor error - Vendor design or supplied items were deficient for the intended purpose.

Classification of Corrective Actions - corrective actions are classified as belonging to one or more of the following groups:

1. Hardware - physical plant changes

2. Procedure - changed or generated a procedure

3. Documentation - affected QA records

4. Training - required personnel education

5. Analysis - required design calculations, etc., to resolve

6. Evaluation - initial corrective action plan indicated a need to evaluate the issue before a definitive plan could be established. Therefore, all hardware, procedure, etc., changes are not yet known

7. Other - items not listed above

Peripheral Finding (Issue) - A negative finding that does not result directly from an employee concern but that was uncovered during the process of evaluating an employee concern. By definition, peripheral findings (issues) require corrective action.

Significance of Corrective Actions - Significance is rated in Table 3 in accordance with the type or types of changes that may be expected to result from the corrective actions. Changes are categorized as follows:

- Documentation change (D) - This is a change to any design input or output document (e.g., drawing, specification, calculation, or procedure) that does not result in a significant reduction in design margin.

- Change in design margin (M) - This is a change in design interpretation (minimum requirement vs actual capability) that results in a significant (outside normal limits of expected accuracy) change in the design margin. All designs include margins to allow for error and unforeseeable events. Changes in design margins are a normal and acceptable part of the design and construction process as long as the final design margins satisfy regulatory requirements and applicable codes and standards.

- Change of hardware (H) - This is a physical change to an existing plant structure or component that results from a change in the design basis, or that is required to correct an initially inadequate design or design error.

If the change resulting from the corrective actions is judged to be significant, either an "A" for actual or "P" for potential is entered into the appropriate column of Table 3. Actual is distinguished from potential because corrective actions are not complete and, consequently, the scope of required changes may not be known. Corrective actions are judged to be significant if the resultant changes affect the overall quality, performance, or margin of a safety-related structure, system, or component.

ATTACHMENT A

EMPLOYEE CONCERNS
FOR SUBCATEGORY 21800

Attachment A -- lists, by element, each employee concern evaluated in the subcategory. The concern number is given along with notation of any other element or category with which the concern is shared, the plant sites to which it could be applicable are noted, the concern is quoted as received by TVA, and is characterized as safety related, not safety related, or safety significant.

ELEMENT	CONCERN NUMBER	PLANT LOCATION	APPLICABILITY SQN	WBN	BFN	BLN	CONCERN DESCRIPTION*
218.1	IN-85-038-001	WBN	X	X			"The CI stated that large bore pipe is analyzed by 'SAGS' without considering thermal effects. The 'T-PIPE' (A tee connection between small & large bore pipe) considered thermal effects. The CI feels the entire large bore analysis should consider the thermal effect in order to be compatible with bore [sic] 'T-PIPE' analysis." (SR)
	IN-85-039-001	WBN	X	X			Original Version: "In violation of ASME, thermal stress was not a consideration on all piping systems for WBNP Unit #1." (SR)
			X	X	X	X	Revised Version "On Watts Bar unit 1 thermal stress (for range of thermal moments) for class 2&3 (ASME) was not consistently done in accordance with code requirements. Piping system alternate analyses CEB 76-5 & SCT 82-18 were used however, they do not address the range of thermal moments caused by thermal stress. For unit 2 analysis the "T" pipe stress program is being utilized which addresses a range of thermal moments thru evaluation" (SR)
	IN-85-039-002	WBN	X	X			"Watts Bar Unit 1, thermal analysis design (pipe stress) of some systems have yielded stress and support loading problems. Several packages for which thermal analysis has been written off completely for temperatures between 40 DG. F-120 DG. F." (SR)
	SQN-86-001-03	SQN	X	X			"During the exit interview, the CI stated that the procedure for operational mode (for piping analysis) does not require an evaluation for thermal condition changes. These should be evaluated on a case-by-case basis. The procedure should be revised as needed." (SS)
	SQN-86-002-03	SQN	X	X			"During the exit interview the CI stated that Operating Mode Drawings have not been looked at for all subsequent analysis. Site group not allowed to evaluate impact of the correct 'Op Mode' in the record analysis. In the annulus area, the temperature can go to 150°, however, the site group was not allowed to evaluate effects on other lines." (SS)
	SQN-86-002-04	SQN		X			"During the exit interview the CI requested an answer to the following question: 'was the 150 degree annulus temperature transmitted to the Watts Bar Group?'" (SS)

* SR/NO/SS indicates safety related, not safety related, or safety significant per determination criteria in the ECTG Program manual and applied by TVA before evaluations.

ELEMENT	CONCERN NUMBER	PLANT LOCATION	APPLICABILITY SQN	WBN	BFN	BLN	CONCERN DESCRIPTION*
218.2	IN-85-106-001	WBN		X			"On the main steam system (Unit 1) some hangers were designed so that they put forces/moments back into the pipe to be taken out by supports adjacent to them. The adjacent supports were not evaluated for these increases in loads." (SR)
	IN-85-109-005	WBN		X			"Induced moments or axial loads back into the piping due to skewed struts: Question as to what happens to the axial component and thermal growth loads. These are not taken into account. Why? No example." (SR)
218.3	IN-85-027-002	WBN		X			"Piping system design performed by computer analysis not subjected to Rigorous Analysis verification." (SR)
218.4	IN-85-032-001	WBN		X			"Past piping calculations were not adequately analyzed. Recontact has determined that calculations are being reviewed and the individual wishes to drop this concern." (SR)
	SQN-86-001-01	SQN	X	X	X	X	"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." (SS)
	SQN-86-002-01	SQN	X	X	X	X	"During the exit interview the CI stated that alternate piping analysis does not get as specific as it should. Instances where this piping is not qualified gets put into a 'catch-all' NCR. This item was addressed and corrected at Watts Bar." (SS)
218.5	HI-85-077-N03	BFN			X		"NRC identified the following concern from review of the QTC file: 'Inadequate/undocumented piping analysis at Browns Ferry.'" (SR)
218.6	HI-85-107-N02	WBN		X			"Numerous concerns identified in the rigorous analysis and alternate analysis according to piping stress analysis at Watts Bar." (SR)

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ELEMENT	CONCERN NUMBER	PLANT LOCATION	APPLICABILITY SQN	WBN	BFN	BLN	CONCERN DESCRIPTION*
218.7	IN-85-039-003	WBN	X	X	X	X	"There are various 'alternately analyzed' problems on Watts Bar Unit 1 and Unit 2, which have lapped region boundaries rather than anchor terminations. The concern is 'there was no consistant policy on what constituted an acceptable lapped region'. The following method and/or combinations were employed: a). Terminate at a 3-way support between problems. b). Establish a rigid region between problems. c). Eliminate torsion & bending by introducing additional supports. Problem area example: Root line N3-26-A42A, branch line 26238, 26234, 26227, 26007, 26228. There are many more examples available in file." (SS)
218.8	IN-85-108-001	WBN		X			"With reference to piping problem analysis inputting (IPIPE), N3-68-1R-reactor vessel flange monitoring piping, during analysis condition '4' the tubing adapter (ie reducer) between points 790-795 could cause rigidity due to potential internal stresses because the tubing and the adapter have same thickness. Refer to isometric: #47W465-200. This potential problem should be evaluated for WBNP Units 1&2." (SR)
218.9	NI-85-110-N02	WBN		X			"Clearances of pipes in the annulus area possibly decreasing due to thermal expansion of the shield wall (steel) - (K-form says not safety-related)." (SR)
218.10	EX-85-131-001	WBN		X			"Deformation of B001 pipe support stanchion pipes should be studied in Units 1 and 2, WBNP, and tested for stresses in the pipes." (SR)
218.11	IN-85-304-001	WBN		X			"The support (72-1CS-R116) for a 10" dia. containment spray line approximately at the 745-750 elev. has a common attachment between the shield wall and the auxiliary building. Since the response spectra are different for these two structures the common (rigid) attachment could cause a problem in the event of a seismic occurrence Unit 1 construction concern. CI could provide no additional information." (SR)
	BLN-ONE-EC-86-01	BLN				X	It is possible for a pipe support to be attached to a different building than analyzed. (SS)

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ELEMENT	CONCERN NUMBER	PLANT LOCATION	APPLICABILITY SQN	WBN	BFN	BLN	CONCERN DESCRIPTION*
218.12	NS-85-002-N02 (shared with 30700)	BFN			X		NRC identified the following concern from QTC Report NS-85-002-001. "Although the investigation discusses control of temporary supports during the outage, and inadequate tracking to determine if supports were removed, no mention of any seismic analysis, or the effect of the temporary supports on existing seismic criteria." (SR)
218.13	I-85-435-BFN	BFN			X		"A. General background: an interference to movement of two-inch-diameter pipe during a design basis accident (DBA) was identified which could cause a rupture in dry well purge system piping just outside containment. The condition developed on Brown's Ferry unit 2 due to a reroute of piping required by ECN-PD384 [ECN-P0384]. The interference was identified and was to be corrected by fielde [field] change request (FCR) although it was felt at the time that the standby gas treatment system could handle the assumed br [break]." (SS)
218.14			-	-	DELETED		
218.15			-	-	DELETED		
218.16			-	-	DELETED		

* SR/NO/SS indicates safety related, not safety related, or safety significant per determination criteria in the ECTG Program manual and applied by TVA before evaluations.

ATTACHMENT 8

SUMMARY OF ISSUES, FINDINGS, AND
CORRECTIVE ACTIONS FOR
SUBCATEGORY 21800

Attachment 8 -- contains a summary of the element-level evaluations. Each issue is listed, by element number and by plant, opposite its corresponding findings and corrective actions. The reader may trace a concern from Attachment A to an issue in Attachment 8 by using the element number and applicable plant. The reader may relate a corrective action description in Attachment 8 to causes and significance in Table 3 by using the CATD number which appears in Attachment 8 in parentheses at the end of the corrective action description.

Issues	Findings	Corrective Actions
Element 218.1 - Thermal Analysis of Piping Subjected to Temperatures Less Than 120°F		
SQN	SQN	SQN
a. Current operating mode drawings were not used for all subsequent analyses.	a. Five calculations (Refs. C.01.25 through C.01.30) were reviewed for incorporation of thermal operating mode data. Of these, one revised calculation (Ref. C.01.29) was reviewed to verify that the information on the current operating mode drawing was actually incorporated into the calculation. The verification was successful.	a. None required.
b. Site group stress analysts were not allowed to evaluate the significance of the current operating mode definitions in the analysis of record.	b. Four site group stress analysts were confidentially interviewed. All four indicated that they were not aware of any instance where anyone may have been instructed not to use up-to-date thermal operating mode drawings.	b. None required.
c. The environmental temperature in the annulus area may reach 150°F but site group stress analysts were not allowed to evaluate the effect of the environmental temperature on piping in that area.	c. The highest environmental temperature in the annulus applicable to pipe stress analysis is 120°F, the "maximum abnormal" temperature (Ref. b), not 150°F as claimed by the concerned individual.	c. None required.
d. The operational mode procedure does not require evaluation of previously performed thermal analyses when thermal conditions change.	d. The current means of distributing and controlling operating mode data is through the use of operating mode drawings. These drawings are official design documents which are required to be kept current. This means of distributing and controlling operating mode data is adequate. While there was no formal means of distributing and controlling operating mode data prior to the institution of operating mode drawings, the operating modes considered in analyses were frequently written on the piping isometric drawings which were signed by, among others, a member of the Mechanical Engineering Branch (MEB) which is the branch responsible for defining operating modes. Where it was implemented, this procedure would have provided reasonable assurance that correct operating mode data were used for analysis. A sampling program was conducted at the Watts Bar plant to verify the adequacy of thermal operating modes used in analysis. The results of that program are applicable to the Sequoyah plant, because the designs at Sequoyah and Watts Bar were performed by a joint SQN/WBN project until about April 1983, and indicate that thermal operating modes used for analysis are adequate.	d. None required.

Issues	Findings	Corrective Actions
Element 218.1 - SQN (Continued)		
e. Not all stress-analyzed piping included a code-required evaluation of thermal expansion.	e. It is known that TVA excludes piping with operating temperatures below 120°F from analysis for Alternate Analysis piping. However, any concern related to Alternate Analysis piping is addressed in Sequoyah Element Report 218.4. It is believed that this exclusion was the basis of the employee concern. TVA has stated (e.g., TVA reply to Bechtel RFI-512) that Rigorous Analysis piping does not exclude consideration of piping operating below 120°F, and TVA procedures are consistent with that statement.	e. None required.
f. Excessive levels of pipe support loads and pipe stress due to thermal expansion have been observed for some piping where the system operating temperatures were between 40°F and 120°F and no thermal expansion evaluation was performed.	f. Issue "f" relates only to Alternate Analysis piping since a thermal expansion evaluation was performed for all Rigorous Analysis piping. The adequacy of Alternate Analysis piping, including consideration of pipe stress and support loads, is addressed by the TVA Alternate Analysis Review Program reviewed under SQN element 218.4.	f. None required.
g. Alternate analysis utilizing CEB-76-5 and OE-SEP 82-18 does not consider secondary stress range at Watts Bar unit 1, as required by the piping code.	g. "Alternate analysis" criteria (CEB 76-5) in use when Concern IN-85-039-001 (both versions) was voiced (1985) did not appear to consider stress ranges for either thermal expansion or "anchor movements." The "alternate analysis" design criteria, as above, allow omission of "anchor movements" for movements parallel to branch lines in the secondary stress evaluation of the branch lines. The procedure (Ref. (C.08.18) in use for the Alternate Analysis Review Program appears to require consideration of stress ranges only for anchor movement evaluations, not for thermal expansion. One sample "alternate analysis" problem reviewed as part of the verification of corrective actions for Element Report 205.1(B) (no. N2-70-A-324A, R0 [B25 870123 807]) was found to neglect stress range considerations both for thermal expansion and anchor movement evaluations.	g. TVA in its corrective action plan (CAQ-102, 12/08/87) has said: "The alternate analysis procedures and instructions to be developed for Phase II of the Alternate Analysis Review Program (AARP) and any subsequent alternate analysis instructions will clearly require evaluation and documentation of the maximum stress range associated with system operating temperatures and anchor movements.* "The alternate analysis procedures and instructions to be developed for Phase II of the AARP and any subsequent alternate analysis instructions will include instruction for evaluating anchor movements parallel to a branch line in the branch line analysis. ______ "* Evaluation of thermal expansion is not required for systems whose operating temperatures are exclusively within the 120°F - 20°F range."

THIS ITEM COMPLETED AT SQN
DATE: 2-19-88

Issues	Findings	Corrective Actions
Element 218.1 - SQN (Continued)		THIS ITEM PARTIALLY COMPLETED AT SQN DATE: 2/22/88 A CAQR will be issued to address the neglect of stress range both for thermal expansion and anchor movement and to address the generic application of this condition to other AARP Unit 2 and Unit 1 pipe stress calculation packages. The evaluation team concurs with the above corrective action plan (CATD 218 01 SQN 01).
Element 218.1 - WBN a. Not all piping requiring analysis has been qualified by analysis for the effects of thermal expansion.	WBN a. TVA has excluded Alternate Analysis piping operating exclusively at temperatures between 20°F and 120°F from detailed thermal evaluations (see TVA reply to RFI 115 and OE-SEP 82-18 [Ref. C.03.05], Att. 7, sec. 3.14). According to TVA's preliminary description of its "Hanger and Analysis Update Program," TVA intends to exclude all categories of piping from thermal expansion analysis where the operating temperature range falls exclusively between 20°F and 120°F (reply to RFI 151, p. 25 of telecopy, Technical Issue 5). TVA has stated that, despite the above, no such exclusion was made for "rigorous analysis" piping (telecon, 02/13/87). TVA procedures were contradictory as to whether any steps were required to be taken to assure adequate flexibility of "alternate analysis" piping not formally designed for thermal expansion and as to what those steps were (see OE-SEP 82-18, Rev. 3, Att. 7, sec. 3.14 versus OE-SEP 82-18, Rev. 3, Att. 7, App. H versus OE-SEP 82-18, Rev. 3, Att. 10). Some standard pipe support designs at Watts Bar (e.g., see drawing 4/A053-10A, Rev. 9) provide axial restraint with zero clearance. Such supports could develop unanticipatedly high loads for piping not analyzed for thermal expansion. Six sets of "alternate analysis" piping drawings (problems 26030, 67019, N3-67-A1BA, 31023, N3-40-A11C, N3-59-A01C, see reply to RFI 69) for piping limited in operation to 20°F to 120°F were reviewed by the evaluators. For each calculation, thermal expansion stresses were computed by the evaluation team either by simplified methods or by computer analysis. The piping for all six calculations was found to be qualified.	WBN a. Concerning the finding that TVA procedures were contradictory as to requirements for qualification of piping limited to 20°F to 120°F, TVA, in its corrective action plan (TCAB-247, 03/09/87), has said: "The Piping Analysis Design Criteria will be revised to address the thermal analysis for temperatures from 20°F to 120°F. Adequate justification and any restrictions of it's [sic] use will be documented." TVA has also informed the evaluators (telecon, 03/12/87) that if such revisions require any evaluations of such piping, then the existing calculations will be conformed to the revised criteria under the "Hanger and Analysis Update Program." The document (OE-SEP 82-18) which contained the contradictory procedures has been retired. This fact coupled with the corrective action described above should clearly establish the requirements for evaluation of thermal expansion effects for piping limited to operation between 20°F and 120°F. (CATD 218 01 WBN 01)

Issues	Findings	Corrective Actions
Element 218.1 - WBN (Continued)		
b. Excessive levels of pipe support loads and stress, due to thermal expansion, have been observed for some piping which was not qualified by analysis for thermal expansion.	b. Multiple in-line axial restraints with zero clearance (e.g., see drawing 47A053-1UA, Rev. 9) were used at Watts Bar. Such supports could develop unanticipatedly high loads for piping not analyzed for thermal expansion. TVA, under the Program for Alternate Analysis Fix (OE-SEP 82-18) performed thermal expansion evaluations on systems previously not qualified by analysis for thermal expansion. Modifications were necessary to correct pipe support problems on multiple in-line axial restraints. Concern IN-85-039-002 does not name specific examples of "stress and support loading problems." The evaluators reviewed six piping stress calculations (same as for issue [a] above) that did not include a thermal expansion analysis. An evaluation was performed by the evaluation team for each problem to determine the adequacy of the piping for thermal expansion. No deficiencies were found.	b. None required.
c. Current operating mode drawings were not used for all subsequent analyses.	c. Operating mode drawings are not used at WBN. Related to this issue, TVA had, at one time, determined that thermal operating mode data used in piping analyses are "not in all cases identified as being current, valid data." (See NCR WBNCEB8215, prep. 05/05/82, CEB 820507 007, reply to RFI SQN 677, item 1.) This concern was addressed by a sampling program (EN DES-SEP 82-15, R2, p. 1, reply to RFI 207) designed to determine whether or not the "operational mode data," however issued and controlled, are "acceptable." The conclusion of the sampling program was that "the validity of the operational modes data used on WBN has been established" (CEB-84-02, R1, p. 15, reply to RFI 667, item 4). The NRC has accepted that conclusion (Report Nos. 50-390/84-52 and 50-391/84-41, U.S. NRC, Atlanta, GA, reply to RFI 743).	c. None required.

Issues	Findings	Corrective Actions
Element 218.1 - WBN (Continued)		
d. Site group stress analysts were not allowed to evaluate the significance of the current operating mode definitions in the analysis of record.	d. Nonmandatory rules for evaluating the significance of changes in operating mode definitions were issued as part of the Rigorous Analysis Handbook (WBN-RAH-603, 12/20/85). These rules allow the acceptance of temperature increases ". . .less than or equal to the larger of 20°F or ten percent of the old temperature minus 70[°F]." Greater increases are also permitted when based upon "engineering judgment." The evaluation team considers it conceivable, therefore, that such nonmandatory rules were made mandatory by individual supervisors.	d. Concerning the finding that TVA procedures (e.g., WBN-RAH-603) allow the acceptance of temperature increases ". . . less than or equal to the larger of 20°F or ten percent of the old temperature minus 70[°F]," TVA, in its corrective action plan (TCAB-247, 03/09/87), has committed to revise TVA documents to remove any ". . . generic [i.e., universal] exemptions from requirements for requalification." The evaluators believe such revisions will assure that all future changes to operating mode definitions will be adequately addressed. A sampling program (Ref. C.02.17) was conducted at WBN which demonstrated the adequacy of the operating mode definitions used in existing pipe stress calculations. (CAID 218 01 WBN 01)
e. The environmental temperature in the annulus area may reach 150°F, but site group stress analysts were not allowed to evaluate the effect of the environmental temperature on piping in that area.	e. TVA has said that environmental temperatures "were not considered in all types of analyses (alternate type in particular)" (reply to RFI 151, p. 26 of telecopy, Technical Issue 6.a). TVA will consider the environmental temperatures, for "normal" and "upset" service conditions, for the planned reanalysis under the "Hanger and Analysis Update Program" (reply to RFI 151, p. 26 of telecopy, Technical Issue 6a). The Watts Bar FSAR (Table 3.9-9) requires an evaluation of "one time secondary stress," which includes "faulted" service condition loading, for piping which penetrates or which is supported by the steel containment vessel. Such evaluations were not actually performed in all cases where required (see telecon of 02/13/87 [Bechtel 104 650]). The maximum temperature of the annulus for all service conditions is postulated by TVA to be 133.7°F (Drawing 47E235-44, R1, ITB 243-5). However, revision 1 of this drawing was issued after the employee concern was received by TVA. Revision 0 of the drawing reflected the 150°F temperature claimed in the statement of concern.	e. Concerning the finding that the Watts Bar FSAR requires an evaluation of a "faulted" service limit loading for secondary stress not likewise required by the "Hanger and Analysis Update Program," TVA, in its corrective action plan (TCAB-247, 03/09/87), said that: "All TVA documents (FSAR, Design Specification, etc.) will be reviewed and revised for inconsistencies . . . under the 'Hanger and Analysis Update Program.'" The evaluators understand this commitment to mean that TVA will delete the requirement for the "faulted" secondary stress evaluation from the FSAR. The evaluators believe that this corrective action will conform both current and future TVA calculations to its licensing commitments. (CAID 218 01 WBN 01)

Issues	Findings	Corrective Actions
Element 218.1 - WBN (Continued)		
f. The operational mode procedure does not require evaluation of previously performed thermal analyses when thermal conditions change.	f. TVA had, at one time, determined that: "No engineering procedure exists to control revisions to [thermal design] data, i.e., assurance that the analysis is still valid for current operating conditions." (See NCR WBNCEB8215, prep. 05/05/82, CEB 820507 007, reply to RFI SQN 667, item 1.) The current procedure for defining operating mode data for piping analysis is "Mechanical Design Guide DG-M5.1.1," original issue, 08/11/76. "Mechanical Design Guide DG-M5.1.1" does not require that operating mode data be issued in document form. The Rigorous Analysis Checklist (see reply to RFI 184, ITB 232-4) requires the analysis verifier to "Check Table of Design Modes and Operating Conditions and ensure all modes are entered and that operational modes have been squad checked through WPB mechanical group" (WBN-RAH-400, II.B.1.a, reply to RFI 184) and to check that "The operational modes match those on the operational modes squad check or the mechanical operational modes calculation packages" (WBN-RAH-400, II.B.2.b.1, reply to RFI 184). NEP 5.2 requires an interface review of design input documents, design output documents, and calculations. TVA has informed the evaluators (telecon 01/28/87, IOM 583) that operating mode data have been issued in the form of calculation packages for the past 3 or 4 years. No documents have been received by the evaluators that show that such calculation packages are required, however. NEP 5.1 defines "Design Output Documents" to be documents of a particular nature issued for use by organizations outside the Division of Nuclear Engineering (DNE). Therefore, NEP 5.1 does not require that thermal operating mode data derived by the WBLP mechanical group be issued to the WBLP Civil (piping analysis) group as "Design Output Documents" since such documents are not necessarily or ordinarily issued for use external to DNE.	f. Concerning the finding that there is no document that formally requires that operating mode data is to be issued in document form, TVA, in its corrective action plan (TCAB-247, 03/09/87), has committed to require that operating mode definitions be issued in the form of calculations by the "Hanger and Analysis Update Program." NEP-3.1 will also be revised to allow calculations to be used to transfer such information from the Mechanical Engineering Branch (MEB) to the Civil Engineering Branch (CEB). The evaluators believe that this corrective action will assure that changes to operating mode definitions instituted by MEB will be issued to CEB and issued as a controlled document. A sampling program (Ref. C.02.17) was conducted at WBN which demonstrated the adequacy of the operating mode definitions used in existing pipe stress calculations. The evaluators concur with the above described TVA corrective action plan. (CATD 218 01 WBN 01)

Issues	Findings	Corrective Actions
Element 218.1 - WBN (Continued)		
g. A temperature of 150°F was established, by an unnamed entity, applicable to the annulus area, but never transmitted to the Watts Bar Engineering Project.	g. The concerned individual did not name the source of the alleged 150°F annulus temperature. TVA Drawing 47E235-44, R1, 09/09/86 indicates that the maximum temperature of the annulus environment is 133.7°F. A TVA memo (reply to RFI 254, no RIMS number) from L. Klaer of the Mechanical Engineering Branch Staff to H. Manlman (02/20/87) gives some indication that the environmental temperature data were made available to the Watts Bar Engineering Project, particularly the mechanical group. (See also, issue "e" above for related discussion.)	g. None required.
h. Alternate analysis utilizing CEB-76-5 and OE-SEP 82-18 does not consider secondary stress range at Watts Bar unit 1, as required by the piping code.	h. Alternately analyzed piping at Watts Bar unit 1 did not consider the range of stresses in the evaluation of secondary piping stresses for both thermal expansion (telecon, 10/23/87 [Bechtel IOM 1905]) and anchor movements. The alternate analysis design criteria (Refs. C.03.05 and C.03.08) allow the omission of anchor movements parallel to the axis of the pipe in the evaluation of secondary piping stresses.	h. TVA, in it corrective action plan (TCAB-375, 12/08/87) states: "1. A CAQR will be issued to address the neglect of stress range for both thermal expansion and anchor movements in WBN alternately analyzed piping. "2. If alternate analysis is used in the future, the alternate analysis procedures and instructions (e.g., CEB 76-5) will be revised to explicitly require the evaluation and documentation of both the maximum secondary stress range associated with system operating temperatures and anchor movements, including anchor point movements parallel to branch line in the branch line analysis. "3. Existing alternate analysis calculations will be reviewed and conformed to maximum stress range requirements associated with systems operating temperatures and anchor movements." The evaluation team concurs with the above corrective action plan (CAID 218 01 WBN 02).

Issues	Findings	Corrective Actions
Element 218.1 - BFN	BFN	BFN
a. Alternate analysis utilizing CEB-7b-5 and OE-SEP 82-18 does not consider secondary stress range at Watts Bar unit 1, as required by the piping code.	a. TVA "alternate analysis" design criteria (e.g., Ref. C.03.08) do not require stress range evaluation for either thermal expansion or thermal anchor movement stresses. Some TVA "alternate analysis" design criteria (e.g., Ref. C.03.08) do not always clearly address run-line "anchor movements" axial to branch lines for the secondary stress evaluations of branch lines.	a. The following is quoted from TCAB-494, 12/23/87: "I. Attachment B of Design Criteria BFN-50-C-7103 will be revised to add the following: A. A requirement and procedure for evaluation of the maximum stress range resulting from the system operating temperatures* and anchor movements. B. A requirement and procedure for evaluating anchor movements parallel to the piping being analyzed. "II. The following will be reevaluated and documented using the new design criteria requirements or will be rigorously analyzed using Attachment A of BFN-50-C-7103**: A. All seismic class I piping less than or equal to 2" in diameter with thermal operating modes outside the range of 20°F to 120°F. B. All seismic class I piping less than or equal to 2" in diameter which may experience thermal or seismic anchor point movements. C. All seismic class I piping greater than 2" in diameter. " * A thermal evaluation will not be required if all operating temperatures for the piping are within the range of 20°F to 120°F. "** This work will be performed as part of the Small Bore Piping Reconciliation Program and the NRC OIE Bulletin 79-14 Program."

Issues	Findings	Corrective Actions
Element 218.1 - BFN (Continued)		
		The evaluation team concurs with this CAP (CATD 218 01 BFN 01).
Element 218.1 - BLN	BLN	BLN
a. Alternate analysis utilizing CEB-7o-5 and UE-SEP 82-18 does not consider secondary stress range at Watts Bar unit 1, as required by the piping code.	a. TVA "alternate analysis" design criteria (e.g., Refs. C.05.01 and .02) do not require that the range of thermal anchor movements be evaluated. Some TVA "alternate analysis" design criteria (e.g., Refs. C.05.01 and .02) do not always clearly address run-line "anchor movements" axial to branch lines for the secondary stress evaluations of branch lines.	a. The following is quoted from TCAB-649, 11/20/87: "I. A. All design criteria applicable to "alternate analysis" will be identified. B. All of the above identified criteria will be revised to explicitly require the consideration of the range of 'anchor movements' where the piping to be qualified is subjected to more than one set of thermal 'anchor movements.' "II. All TVA design criteria identified in I.A. above will be revised to provide explicit instructions for evaluation and documentation of 'anchor movements' parallel with branch lines at points of analytical decoupling with run lines that impose such 'anchor movements.' "III. All 'alternate analysis' calculations will be reviewed and conformed to the design criteria revisions described above where applicable."

Issues	Findings	Corrective Actions
********** Element 218.2 - Skewed Hangers and Struts **********		
SQN	SQN	SQN
(N/A)	(N/A)	(N/A)
WBN	WBN	WBN
a. Some hangers on the main steam system were skewed with respect to the piping and thereby introduced forces and moments on adjacent supports which were not evaluated. In addition, axial components and thermal growth loads imposed on the piping due to skewed struts were not taken into account.	a. The evaluation team's review indicates that all skewed supports were properly designed. The review of samples* of the associated piping stress analyses input (thermal and seismic) showed that the skewed supports within those samples were all properly modeled. Therefore, any additional load components resulting from the supports being skewed were factored into the piping stress analysis. This step ensures that the additional loads (thermal and seismic) imposed upon the piping and the supports adjacent to the skewed supports are included in the design process. Also, the design and installation of skewed hangers and restraints is common industry practice.	a. None required.
BFN	BFN	BFN
(N/A)	(N/A)	(N/A)
BLN	BLN	BLN
(N/A)	(N/A)	(N/A)

* Problem 600-200-06-01 for node point 77, (03/10/83); Problem 600-200-09-02 for node points C98 through 113, R7; Problem 600-250-09-02 for node points 119 through 370, R0; Problem 600-200-07-02 for node points F19 through 180, (12/14/82); Problem 600-200-07-01 for node points 23 through 6, (12/82); Problem 600-250-07-02 for node points N2 through 29C, R1; Problem 600-250-07-04 for node points 5 through V83, (12/84).

Issues	Findings	Corrective Actions
********** Element 218.3 - Verification of Rigorous Computer Analysis of Piping Systems **********		
SQN (N/A) WBN	SQN (N/A) WBN	SQN (N/A) WBN
a. Not all piping analyses performed using computer methods have been verified using the verification techniques of "rigorous analysis."	a. Not all piping analyses performed using computer methods were verified using Rigorous Analysis verification techniques; however, not all types of analyses performed using computer methods are required to be verified using Rigorous Analysis techniques. This is because not all piping is classified "rigorous." There was no consistent method in use for verification of Simplified Analysis. However, the calculation checklists examined were found to be reasonably complete and adequate. A checklist is required by CEB-EP 21.42 for all Rigorous Analyses; however, the checklist used for verification of time-history dynamic analyses does not address the analysis parameters of importance to time-history dynamic analysis. One time-history analysis (Ref. C.07.20) was reviewed and it was found to have been performed to an insufficiently high frequency limit. Corrective action is required on SCR WBNCEB8553, R1 to assure that time-history dynamic analyses are being or have been performed to a sufficiently high frequency limit.	a. Concerning the finding related to the uniformity of Simplified Analysis checklists, TVA, in its corrective action plan (TCAB-239, 03/06/87), notes that it has implemented a checklist specifically for Simplified Analysis. In addition, TVA has committed (under Watts Bar element 218.4) to revise WBEP-EP 43.21 to delete instructions, including a checklist, for performing Alternate Analysis using the computer program TPIPE. The evaluators believe these steps will assure that consistent verification procedures will be applied to Simplified Analysis in the future. No deficiencies were found in the checklists reviewed by the evaluators; therefore, the evaluators believe that the verification performed for existing Simplified Analysis is adequate. Concerning the finding that a checklist has not been implemented for time-history stress analysis, TVA, in its corrective action plan (TCAB-239, 03/06/87), has committed to revise CEB-EP 21.42, and other documents, " . . . to not require the use of a checklist for time-history, Class I, and other complex analysis." There is no absolute (i.e., external to TVA) requirement for use of checklists for verification of time-history stress analysis of piping. The TVA corrective action will conform TVA procedures to the

Issues	Findings	Corrective Actions
Element 218.3 - WBN (Continued)		existing calculations which do not include checklists for time-history analyses. It will also conform the procedures to TVA current practice. Concerning the finding that some TVA time history analyses were performed to an insufficiently high cut-off frequency, TVA, in its corrective action plan (TCAB-239, 03/06/87), states that "SCR WBNCEB8553 and SCR WBNCEB8631 are being addressed and corrective action will be taken prior to fuel loading." These SCRs require that all model-superposition time-history analyses of piping be reanalyzed using the direct-integration method. The evaluators believe that this corrective action will resolve this issue as it pertains to existing analyses. The SCRs also require that the design criteria and analysis handbook be revised to address how to account for the higher frequency modes in time-history analysis. The evaluators believe this corrective action will prevent recurrence. The evaluators concur with the TVA corrective actions described above. (CATD 218 03 WBN 01)
BFN (N/A)	BFN (N/A)	BFN (N/A)
BLN (N/A)	BLN (N/A)	BLN (N/A)

Issues	Findings	Corrective Actions
********** Element 218.4 - Widespread Deficiencies within Pipe Stress Calculations **********		
SQN	SQN	SQN
a. Alternate analysis is not as detailed as it should be. There is a nonconformance report (NCR) that is created for resolving all discrepancies with this analysis method, but some discrepancies could remain unresolved after start up.	a. At the time the employees' concerns were stated, documentation assuring the qualification of some Alternate Analysis piping was incomplete. TVA issued NCR SQNCEB8215 to address a group of problem areas related to piping analysis. This was followed by additional NCRs (SQNSWP8222, SQNCEB8613, SQNCEB8614). Then, TVA instituted the Alternate Analysis Review Program to upgrade the design and associated documentation of Alternate Analysis piping to meet all design criteria requirements. This program is intended to address, prior to restart (i.e., during Phase I), potential deficiencies which could cause FSAR chapter 15 type events or prevent the safe shutdown of the plant. The Alternate Analysis Review Program is being revised to require documentation to show that all Alternate Analysis piping is qualified to all design requirements by the second refueling outage following restart for Unit #1 and by the third refueling outage following restart for Unit #2 (i.e., by completion of Phase II). Thermal expansion evaluation for piping 200°F and less is postponed to Phase II. The program is being revised to include a general evaluation of the conformance of Alternate Analysis piping to the design criteria for gravity and seismic loading. Qualification of integral (i.e., welded) attachments to Alternate Analysis piping is included as part of the Alternate Analysis Review Program.	a. TVA has submitted a corrective action plan (TCAP-034, 12/18/86) which includes commitments to: (a) revise SQN-AA-001 ". . . to require that documentation be developed in Phase I to demonstrate that all design requirements are met for all alternately analyzed piping . . ." and (b) revise SQN-AA-001 ". . . to require verification in Phase I that support spacings for alternately analyzed piping are such that design requirements are satisfied." This corrective action is satisfactory to the evaluation team. In addition, the evaluation team has verified (see BLI-200, 05/11/87) completion of the corrective actions defined by the CAP. (CAT 218.04 - SQN-01)

Issues	Findings	Corrective Actions
Element 218.4 - WBN a. 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.	WBN a. Significant deficiencies in "alternate analysis" calculations have been identified by TVA and documented in NCR WBNSWP8252 and others (WBNSWP8238, WBNSWP8231, WBNSWP8220, WBNSWP8160, WBNCEB8218, WBNCEB8216, 4164R) related to this problem. Those NCRs have been closed. The Simplified Analysis Handbook and WBEP-EP-43.21 conflict in scope. Both provide rules for performing "alternate analysis" using TPIPE. WBEP-EP 43.21, Att. 10, does not provide an example of valve qualification, contrary to section 3.3(e)(6)(b), and the requirements for valve qualification are not specified. The checklist for one calculation (03021) was signed off prior to the analysis it is supposed to verify. Water hammer loadings were neglected for a small branch pipe with only 9.9 percent of allowable stress remaining from other load cases. The seismic analysis (03021) of a small branch pipe was invalid because the lowest natural frequency of the branch pipe is not above the highest frequency of amplified response of the building structure to seismic ground motion while the analysis neglected amplified response to the piping the branch pipe was connected to. Some design criteria or procedures (e.g., C.09.02, .03, .04, .07, .08, .11, .12, .13; C.10.04, .07, .08; C.11.01, .02, .10, .11) applicable to all four nuclear plants are inadequate because they provide for analytically decoupling branch lines by the inertia ratio method without excluding short, open-ended, flexible piping. A finding unrelated to the issue was discovered: that the seismic anchor motion analysis of one rigorously analyzed piping system was invalid. Necessary corrective action for this finding is committed to in CATD 218 06 WBN 01.	WBN a. Concerning the finding that WBEP-EP 43.21 and the Simplified Analysis Handbook conflict in scope, TVA, in its corrective action plan (TCAB 265, 03/12/87), states: "WBEP-EP 43.21 will be revised to delete the instructions on the use of TPIPE in performing Alternate Analysis. . . ." The evaluators believe that this corrective action will assure that the verification procedure intended for use with "simplified analysis" will be consistently implemented. Concerning the finding that the requirements for qualification of valves were not specified in SWP- and WBEP-EP 43.21, TVA, in its corrective action plan (TCAB 265, 03/12/87), has committed to revise WBEP-EP 43.21 to clarify the WBN valve qualification requirements. The evaluators believe that this corrective action will ensure that stress analysts will be informed of the WBN valve qualification requirements. Concerning the finding that the checklist for one calculation predates the computer analysis it is supposed to represent, TVA, in its corrective action plan (TCAB 265, 03/12/87), has committed to review all "alternate analysis" calculation packages for this discrepancy as part of the "Unit 1 Hanger and Analysis Update Program" (and a similar program to be established for Unit 2) and to take appropriate corrective action if necessary. In addition, TVA has committed to revise the "analysis handbook" to include instructions for documenting such discrepancies in calculation packages.

Issues	Findings	Corrective Actions
Element 218.4 - WBN (Continued)		Concerning the finding that water hammer loadings were neglected for a small branch pipe that was already computed to be stressed close to the allowable limit for other loadings, TVA, in its corrective action plan (ICAB 265, 03/12/87), notes that it has committed to address the issue of water hammer in its forthcoming "Unit 1 Hanger and Analysis Update Program" (and a similar program to be established for Unit 2). It has also committed to revise all applicable documents to assure that such loadings are properly evaluated in the future. The evaluators concur with the above described TVA corrective action plan. (CAID 218 04 WBN 01) Concerning the finding that the seismic analysis of a small branch pipe was invalid, TVA, in its corrective action plan (ICAB-374, 11/13/87), has committed to issue a CAQR on that finding. The CAQR addresses related findings that water hammer loadings were not adequately considered, that the decoupling criteria used did not account for the amplified response caused by the run pipe, and that the design criteria did not address decoupling adequately for the type of branch pipe involved. Concerning the finding that some design criteria for all four nuclear plants are inadequate because they provide for analytically decoupling branch lines by the inertia ratio method without excluding short, open-ended, flexible piping, TVA, in its corrective action plan (ICAB-374, 11/13/87), has committed to revise all applicable design

Issues	Findings	Corrective Actions
Element 218.4 - WUN (Continued)		criteria and procedures to provide acceptable techniques for dynamic analysis of flexible, open-ended branch lines, such as: o Coupling the branch line with the run line o Modifying the geometry and/or support configuration of open-ended flexible branch lines to make them effectively rigid o Analyzing the branch line for the effects of dynamic inertia by including response spectra generated from the run line at the location of the branch line attachment o Locating supports on the run line such that the run line does not amplify the building response at the point where the branch line is attached The evaluators concur with the above-described TVA corrective action plan. (CAID 218 04 NPS 01)

Issues	Findings	Corrective Actions
Element 218.4 - BFN	BFN	BFN
a. Alternate analysis is not as detailed as it should be. There is a nonconformance report (NCR) that is created for resolving all discrepancies with this analysis method, but some discrepancies could remain unresolved after start up.	a. The concerns are, in part, factually correct for application to Browns Ferry: there are essentially no calculations on file that demonstrate the qualification of "alternate analysis" piping to code requirements other than that for torus-attached and certain control rod drive piping. TVA is conducting several programs to upgrade the design and design qualification documentation of piping, including "alternate analysis" piping. TVA has committed to qualify all "alternate analysis" piping greater than 2 inches in diameter as part of its NRC-OIE 79-02/79-14 Bulletin program. This program is described and evaluated in Subcategory 21200. The details of the small-bore piping program are presently in development so the qualification of piping less than 2-1/2 inches in diameter remains to be established. The detailed design criteria for analysis of torus-attached piping under the Long-Term Torus Integrity Program (LTTIP) could be interpreted to allow the acceptance of stresses which may be calculated to exceed certain licensing commitments (ASME Boiler and Pressure Vessel Code, Section III, Subsections NC and ND-3650) by up to 5 percent. Those provisions of the design criteria are not in agreement with the PUAR (Ref. C.10.10). It was observed in two (Refs. C.10.33, C.10.3b) out of six (Refs. C.10.33 through .38) example problems that calculated stresses believed by the originators to be in excess of licensing commitments were accepted. In these particular cases, reanalysis has shown that allowable stresses were not exceeded. The reanalyses of control rod drive piping under ECNs P0392, P0859, P0880, and P0881 are complete and the criteria and procedures under which such analyses were performed are adequate.	The following is quoted from TCAB-490 (08/13/87): a. "Existing seismic Class I piping less than 2-1/2" and supports will be evaluated/qualified and documented per the corrective action required by SCRBFNCEB8520 R0; as follows: 1. Revise Design Criteria BFN-50-712 to delete typical support details and the reference designed and checked supporting calculations or a new criteria as appropriate. 2. Perform a walkdown and an evaluation of a comprehensive sample, (a statistically valid sample of 64 randomly selected Class I supports and associated piping based on the Multiple Sampling Plan included in NCIG-02, Sampling Plan for Visual Reinspection of Welds), to determine seismic qualification of existing Seismic Class I Piping less than 2-1/2" and supports. The acceptance criteria for the piping analysis will be in accordance with design criteria BFN-50-712 or BFN-50-707. The acceptance criteria for the pipe support design will be in accordance with design criteria BFN-50-724. The concrete expansion anchor inspection will be evaluated in accordance with the NRC OIE Bulletin 79-02. If any of the piping, supports, or expansion anchors do not meet the aforementioned criteria, an interim qualification criteria may be applied. For interim qualification the total support system need only be sufficient to assure that the pipe will perform its intended function for all required load cases. If the sample evaluation is found to be acceptable only if the interim qualification criteria is applied, the entire population will be considered

Issues	Findings	Corrective Actions
Element 218.4 - BFN (Continued)		to be interim qualified only and further evaluation will be required to achieve long-term acceptance. The interim and long term qualification will be reviewed and approved by the NRC. 3. If required by the sample, (as required by the Multiple Sampling Plan included in NCIG-02, Sampling Plan for Visual Reinspection of Welds) (Attachment E), perform a 100 percent walkdown/evaluation and qualification of all Seismic Class I piping less than 2-1/2" and supports. Interim qualification criteria stated in A2 may be applied, pending NRC approval. 4. Obtain a DCR from the plant to allow DNE to issue design documents required for modifications. "Existing Seismic Class II Piping less than 2-1/2" and supports will be evaluated/qualified and documented per the corrective action required by SCRBFNME88605 R0. "The BFN 'Torus Integrity Long-Term Program, Plant Unique Analysis Report' (PUAR) will be revised to describe and provide justification for the current allowance of a 5 percent operating temperature increase without reanalysis or a 5 percent calculated thermal overstress. Revision 2 of the PUAR has been approved by NRC in May, 1985. The justifications will be included in Revision 3 to the PUAR, which will be submitted to NRC for review and approval. The BFN-50-D711 criteria will be revised to make clear that use of the 5 percent temperature increase or 5 percent calculated overstress is applicable for 'emergency' and 'faulted' secondary stress evaluations only.

Issues	Findings	Corrective Actions
Element 218.4 - BFN (Continued)		
		"LTTIP piping analysis will be reviewed to identify all cases of calculated overstress. For such cases the justification given in the calculation will be reviewed for adequacy. If the justification does not demonstrate that the piping actually meets allowable stresses (as stated in the PUAR and Design Criteria BFN-50-D711), or if there is no justification; then the calculation will be revised to demonstrate that the piping actually meets code allowables." The evaluation team concurs with this corrective action plan (CATD 218 04 BFN 01).
BLN	BLN	BLN
a. Alternate analysis is not as detailed as it should be. There is a nonconformance report (NCR) that is created for resolving all discrepancies with this analysis method, but some discrepancies could remain unresolved after start up.	a. Qualification of flanges remains to be proven for "alternate analysis" piping (Ref. C.11.33). TVA has added an Appendix G in its draft revision 3 of CEB 76-11 which includes instructions for flange evaluations. The above "Program for Alternate Analysis Fix . . ." (PAAF) includes flange evaluations within its scope (Sec. 4.4.5. and Att. 7). Completion of the PAAF should allow closure of NCR BLNCEB8205 and fully resolve this issue. (no CATD) Qualification of pipe supports for corrected pipe movement data for "alternate analysis" piping remains to be performed (Ref. C.11.31). TVA has defined appropriate corrective action for this issue, but it remains to be completed. (no CATD) Qualification of components with associated stress intensifications plus welded attachments remains to be proven (Ref. C.11.32). TVA has defined appropriate corrective action for this issue, but it remains to be completed. (no CATD)	a. The following is quoted from TCAB-643 (08/13/87): "The following nine corrective actions correspond to the nine findings listed in section 6 of [the first CATD]: o Review and revise as necessary TVA Design Criteria documents N4-50-D711, N4-50-D717, N4-50-D720, N4-50-D725, and CEB-EP-21.12, CEB-76-11, and CEB-75-17. These documents will be reviewed and revised for the following: A. Delete requirements outside the scope of the documents as titled. B. Delete requirements which overlap with requirements in other design criteria documents as necessary for consistency. C. Add or revise applicability definition statements to the above documents to indicate the scope of activities covered by that specific document (i.e., "This document covers the following scope of activities:", Then list the activities.)

Issues	Findings	Corrective Actions
Element 218.4 - BLN (Continued)		
	Qualification of "alternate analysis" piping and supports for relief valve thrust loads remains to be proven (Ref. C.11.20) and CEB 76-11 remains to be revised to include instructions for evaluation of relief valve thrust loads. TVA has incorporated this issue within the scope of the PAAF, which includes instructions as Attachment 6, for evaluation of relief valve thrust loads. No instructions for evaluation of such loads are included in the draft Revision 3 to CEB 76-11, however. The corrective action described in SCR BLNCEB8509 is adequate, however. (no CATD)	o Review and revise as necessary all corrective action items on NCRBLNCEB8423. The items which presently read "Where support design loads are increased more than 10 percent over the previous design load . . ." will be changed to read "Where support design loads are increased over the previous design load . . . ."
	Criteria for performing "alternate analysis" using IPIPE (viz., Simplified Analysis Handbook) needs to be formally issued and other criteria and procedures conformed. TVA has defined appropriate corrective action, but it remains to be completed. (no CATD)	o A. Review all alternate analysis calculation packages to determine if snubbers are located on the same axial runs as rigid axial restraints. B. Revise alternate analysis calculation packages to delete redundant snubbers as per 3A and recalculate axial support loads. Supports that are not in line axial support will be considered to be "effective" axial support if they are positioned within the proximity requirements of sections 5.1.3 (B), 5.2.1.1, and 5.2.1.2 of CEB report 76-11 R3. C. Revise affected support design calculations as needed. D. Add to checklist of BLEP-20 and BLEP-06 requirements for justification and approval of snubber installation.
	Documentation of "alternate analysis" piping support locations remains to be completed (Ref. C.11.21). TVA has incorporated this issue within the scope of PAAF, which remains to be completed. (no CATD)	
	One calculation (Ref. C.11.61) reviewed excluded consideration of thermal expansion yet part of the related piping operated at 170°F with supports that may not have been intended to include gaps and that were oriented such that thermal expansion would be resisted. This concern should be resolved by completion of the PAAF. (CATD 02)	o A. Revise BLEP-06, BLEP-20, CEB Report 76-11, and CEB Report 78-11 to include specific requirements for the evaluation of post LOCA containment pressurization. B. NCR BLNCEB8423 will be revised to delete the last sentence of the No. 6 corrective action.
	In the same calculation (Ref. C.11.61) reviewed, some "free end" piping was not adequately supported. Lack of adequate support of "free end" piping is identified by NCR BLNCEB8423. (no CATD)	

Issues	Findings	Corrective Actions
Element 218.4 - BLN (Continued)		
	In three calculations (Refs. C.11.3o through .38) reviewed, thermal qualification was through the use of the computer program IPIPE yet no criteria had been established to qualify "alternate analysis" piping through the use of IPIPE. TVA has defined appropriate corrective action (Ref. C.11.22 and BLN "Simplified Analysis Handbook"), but it remains to be completed. (no CAID)	o NCRBLNCEB8423 will be revised to delete the third sentence of corrective action No. 7.
	In one calculation (Ref. C.11.36) the second of two sheets of the "Final Analysis Input Data Verification Sheet" was not signed by the checker. (CAID 02)	o A. CEB Report 76-11 does not include high energy pipes within the scope of the report. All alternately analyzed piping will be reviewed under ECN 3380 (unit 1) and 3381 (unit 2). Any alternate analysis calculation packages found to have high energy piping greater than 1-inch diameter will be reanalyzed rigorously. This pipe will be evaluated for pipe rupture. See Bellefonte Design Criteria N4-50-D720. B. Revise corrective action step 8 of NCR BLNCEB8423 to include reanalysis of piping rigorously.
	In one calculation reviewed (Ref. C.11.37), a formula was used for nozzle load qualification that was not presented in the design criteria (Ref. C.11.11). This issue was identified by the RAAB (Section 4.D.3), where it was concluded that it should not be necessary to revise the existing calculations. The evaluators disagree with that conclusion. However, nozzle load evaluations should be incorporated in all calculations by completion of the program described in Bellefonte Engineering Project, Project Manual: Program for Alternate Analysis Fix . . ., BLEP-20, unissued copy. (CAID 02)	
	In two calculations reviewed (Refs. C.11.37 and .38), thermal expansion analyses were not performed for the correct operating temperatures. Thermal expansion qualification should be established upon completion of the PAAF. (CAID 02)	o A. The tubing for BLN has been designated as Category I by an asterisk on the 5GB0925-10-series and the tubing without an asterisk is considered as not Category I. QCP 4.6 is used to inspect all lines that are not Category I. The revision of 5GB0925-10-01 will add these additional notes: (9) For tubing and supports designated as seismic Category I (see drawings 5GB0925-10-57, note 11 and 5GB0925-10-94, note 5). (10) for all tubing and supports not designated as seismic Category I, but installed in safety-related civil structures, the tubing and supports shall be considered seismic Category I(L). This tubing is to be reviewed to assure it is qualified to the requirements applicable to the clarified seismic classification designations to be placed on the 5GB0925-10 drawing series.
	In one calculation reviewed (Ref. C.11.38), the dates on the revision log do not conform with the dates on the calculation cover sheet which, in turn, do not conform to the dates on the verification cover sheets. (CAID 02)	
	In the same calculation reviewed (Ref. C.11.38), the verification cover sheets are not endorsed by all responsible individuals for every revision of the calculation. (CAID 02)	

Issues	Findings	Corrective Actions
Element 218.4 - BLN (Continued)		
	In one calculation (Ref. C.11.38) reviewed, superseded thermal displacements were not deleted from a drawing (Ref. C.11.38, p. 29). (CAID 02)	o A. Revise BLEP-06 and BLEP-20 to include requirements for lug stress evaluation. B. Revise CEB-Report 76-11 to include requirements for lug stress evaluation. C. Revise corrective action of NCR BLNCEB8405 to include a review for lug stress evaluation. D. Review and revise as necessary alternate analysis calculation packages to include lug stress evaluations. E. Revise as necessary support design calculations to incorporate changes made from D above.
	TVA has identified concerns related to field supported piping (Refs. C.11.17 and .66). Related criteria (Refs. C.11.35, .62, and .66) are in the process of change. (no CAID)	o NCR 8423 will be revised to delete the fourth sentence of corrective action No. 1." The evaluation team concurs with this corrective action plan (CAID 218 04 BLN 01).
	Some TVA design criteria documents (Refs. C.11.01 and .02) were found to provide requirements outside the scope of the documents as titled or to provide overlapping requirements with other design criteria documents. (CAID 01)	The following is quoted from ICAB-635, 08/06/87: "Corrective action for [the second CAID] will be accomplished with the issuance and implementation of the following three documents. o Program for Alternate Analysis Fix, Reviewing, Verifying, and Documenting (Bellefonte Engineering Procedure BLEP-20). o Component Supports - Analysis, Design Procurement, Fabrication, and Installation (Bellefonte Engineering Procedure BLEP-06).
	Axial support requirements of CEB 76-11 may not be met (Ref. C.11.65). This concern should be resolved by completion of the PAAF. (CAID 02)	
	Incorrect anchor movement data was used for one analysis interface (Refs. C.11.28 and .31), and the validity of other analysis interfaces without a "Branch Line Data Sheet" are questionable. TVA has addressed this issue in the PAAF (Section 4.4.1), which remains to be completed. (CAID 02)	
	TVA corrective action for NCR BLNCEB8423, as it pertains to "free end" piping, is inadequate due to permitted arbitrary acceptances of support load increases of up to 10 percent without further investigations. (CAID 01)	
	"Alternate analysis" calculations lack documentation of nozzle load qualifications. This issue was identified by the RAAB (Section 4.0.3), where it was concluded that it should not be necessary to revise the existing calculations. The evaluators disagree with that conclusion. However, nozzle load evaluations should be incorporated in all calculations by completion of the program described in Bellefonte Engineering Project, Project Manual: Program for Alternate Analysis Fix . . ., BLEP-20, unissued copy. (CAID 02)	
	Qualification of "alternate analysis" support loads for nonsymmetrically located concentrated weights remains to be proven (Ref. C.11.65). This concern should be resolved by the PAAF, which requires that all alternate	

Issues	Findings	Corrective Actions
Element 218.4 - BLN (Continued)		
	analysis calculations include support loads calculated according to BLEP-6 (Section 3.2 (k), note 1). BLEP-6 (draft) requires that, for "alternate analysis," support loads be computed as per CEB 76-11. Revision 3 (draft) of CEB 76-11 provides instructions for evaluating nonsymmetric located concentrated weights. (CATD 02) On the basis of a review by the evaluation team, CEB 76-11 does not adequately account for the load on axial supports from piping adjacent to the axial run (see also, C.11.65). (CATD 01) Snubbers have been used as axial supports in-line with rigid supports (Ref. C.11.65). (CATD 01) Active valve qualification remains to be completed for "alternate analysis" piping (Refs. C.11.26, and .65). TVA has incorporated instructions for active valve qualification in a draft Revision 3 to CEB 76-11. The draft PAAF indicates (Section 4.4.3) that the calculations of record will be conformed to the draft Revision 3 to CEB 76-11. The corrective action in NCR BLNCEB8423 is adequate. (no CATD) Revised insulation weights have not been evaluated for all existing analyses (Ref. C.11.26). This concern should be resolved by completion of the PAAF. (CATD 02) TVA corrective actions to address post-LOCA containment expansion are inadequate because NCR BLNCEB8423 (CEB 841207 011) permits arbitrary acceptance of support load increases of up to ten percent. (CATD 01) TVA corrective action to address wind loading is inadequate because NCR BLNCEB8423 (CEB 841207 011) permits arbitrary acceptance of support load increases of up to ten percent. (CATD 01)	o Alternate Criteria for Piping Analysis and Support (CEB Report 76-11 R3)." The evaluation team concurs with this corrective action plan (CATD 218 04 BLN 02).

Issues	Findings	Corrective Actions
Element 218.4 - BLN (Continued)		
	Postulated pipe break evaluations have not been completed for high energy "alternate analysis" piping greater than one inch in diameter (Refs. C.11.26 and .65). (CATD 01)	
	Tubing has not been properly classified and may not all be properly qualified (Refs. C.11.26 and .65). (CATD 01)	
	Damping values used for tubing analyses may be incorrect (Ref. C.11.65). This issue is deferred to subcategory 22800. (no CATD)	
	TVA has determined the limits of elevations in primary and secondary containment and interior structure that the tubing supports described in the 5680925-10 drawing series are qualified for. That drawing series has been updated to show these limitations. (no CATD)	
	A testing program (Ref. C.11.44) has been conducted to determine acceptable design loads for tubing clamps. (no CATD)	
	Some "alternate analysis" lateral support spacings implemented may violate criteria requirements (Ref. C.11.65). (CATD 01)	
	Lug stress evaluations may be inadequate (Ref. C.11.65). (CATD 01)	
	The TVA corrective action for analysis interfaces is inadequate (Ref. C.11.26). (CATD 01)	

Issues	Findings	Corrective Actions
********** Element 218.5 - Inadequate Piping Analysis **********		
SQN	SQN	SQN
(N/A)	(N/A)	(N/A)
WBN	WBN	WBN
(N/A)	(N/A)	(N/A)
BFN	BFN	BFN
		The following is quoted from TCAB-460 (07/26/87):
a. Piping stress analyses performed for Browns Ferry are not documented [related element: BFN 205.1 in subcategory 24600].	a. Calculations are not presently available that document the qualification of all Browns Ferry piping. Programs are currently in progress or complete to create calculations that should document the qualification of all safety-related piping (Refs. C.12.03; telecon, R. Cutsinger [TVA] to R. C. Wilkinson [Bechtel], Bechtel IOM 856, 04/07/87). Retention of design calculations is now a TVA requirement (OEP-07).	a. "Calculations demonstrating qualification of all safety-related piping less than 2-1/2 inches in diameter will be generated by the Small Bore Piping Reconciliation Program as previously committed to in CAID number 21804 BFN 01. Upon completion of the NRC OIE Bulletin 79-14 Program, documented calculations will exist showing qualification of all other safety related piping. This was committed to in CAID number 21807 BFN 01.
b. Piping stress analyses performed for Browns Ferry are inadequate [related BFN elements: 218.4, 218.7].	b. The adequacy of Browns Ferry safety-related piping generally could not be determined due to the lack of documentation addressed under Issue "a." TVA has instituted programs to assure the technical adequacy of Browns Ferry piping (see BFN element 218.4 above). In Calculation NI-175-IRA, a calculated stress exceeded the allowable stress by 25.8 percent. The overstress was accepted on the basis of invalid reasoning. In a later revision of the calculation discussed above, a 35°F thermal mode was improperly deleted from part of the thermal expansion analysis and the report text was not revised to reveal the deletion. The possible qualification of the piping to Equation 11 limits remains to be adequately demonstrated in the calculation report.	b. "The findings related to calculated overstress were previously identified in ECTG Evaluation 218.4 for BFN and will be resolved under the corrective action plan associated with that report. "Piping analysis calculation NI-175-IRA will be revised to add documentation which will both clarify and justify the thermal analysis approach used. In conjunction with revising calculation NI-175-IRA, all thermal modes for the Core Spray System will be formally defined. Based on these thermal modes it will be shown that all the seismic Class I piping included in analysis NI-175-IRA meets code equation 11 stress allowables when considering the maximum theoretical stress range for all operating conditions, including

Issues	Findings	Corrective Actions

Element 218.5 - BFN (Continued)

The criteria in Design Criteria BFN-50-D707 are inadequate for "alternate analysis" because they require the use of Report 0600002 for qualification of "alternate analysis" piping greater than 2 incnes in diameter while Report 0600002 includes no requirements for thermal expansion qualification. The criteria are adequate for "rigorous analysis." TVA has said (telecon E. Fre[v]old et al., [TVA] to R. Wilkinson, [Bechtel], Bechtel IOM 759, 03/11/87; RFI 1125, 03/19/87; telecon, R. T. Deal et al., [TVA] to R. C. Wilkinson [Bechtel], Bechtel IOM 779, 03/20/87) that all Class I piping greater than 2 incnes in diameter will be requalified using "rigorous analysis" techniques. Similarly, TVA has said that future qualification of such piping will be by "rigorous analysis" exclusively. That commitment has not yet been formally established.

faulted. Additionally all seismic Class II piping will be shown to meet code secondary stress requirements for normal and upset conditions. This revision to calculation MI-175-IRA will therefore demonstrate that the current thermal stress analysis meets all licensing commitments.

"Design Criteria BFN-50-D707 will be revised to eliminate the option to use Report 0600002 for alternate analysis. Since there are no documented analyses which use this report no additional corrective action is needed.

"The generic implications of CATD item "3" will be resolved as follows:

1. Thermal modes will be formally defined and documented for all BFN safety-related piping systems. (TVA contract No. TV-72164a initiates this effort).

2. The thermal modes described above will be incorporated in the analysis of piping qualified by the NRC OIE Bulletin 79-14 Program (BFEP PI 86-05) and the Small Bore Piping Reconciliation Program (BFEP PI 87-40).

3. All BFN piping analysis calculations not included in (2) above will be reviewed with respect to the formally defined thermal modes described in (1) above. For any calculations found that evaluate a smaller thermal stress range than that which would be produced by the new thermal modes, an evaluation based on the new

Issues	Findings	Corrective Actions
Element 218.5 - BFN (Continued)		thermal modes will be performed. If the evaluation shows that the piping remains qualified, the calculation will be revised to document this evaluation of the new thermal modes. If the evalution determines that the piping is not qualified, corrective action will be taken in accordance with NEP 9.1. The evaluation team concurs with this corrective action plan. (CATD 218 05 BFN 01)
BLN (N/A)	BLN (N/A)	BLN (N/A)
********** Element 218.6 - Piping Stress Analysis **********		
SQN (N/A)	SQN (N/A)	SQN (N/A)
WBN a. Piping stress analysis performed by rigorous and alternate methods has numerous deficiencies.	WBN a. The following findings are determined from the review of 20 sample calculations (Ref. C.13.02 and .06): o The calculations are performed in accordance with the Watts Bar design criteria (Refs. C.13.04 and .05), and the pipe stress evaluations are performed to satisfy the requirements prescribed in ASME Code. o In the mathematical model of the piping stress analysis, lumped masses of the valves, SIFs, enveloped seismic response spectra, and pipe support types are considered appropriately. o Lumped masses of the pipe support components are not included in the mathematical model for the dynamic and gravity analyses. o Rigid-range seismic response is not considered in all piping analyses. o Structural seismic displacements at the pipe support attachments are not included in the mathematical model.	WBN a. In its corrective action plan (CAP) (TCAB-240, 03/06/87) and Bechtel/TVA telecon (IOM 749, 03/09/87), TVA commits to perform the following: Under the Hanger and Analysis Update Program (HAAUP), all affected piping analysis problems for unit 1 will be evaluated to include the pipe support component weights where applicable. The corresponding design documents will be revised to prevent recurrence of this problem. A program similar to HAAUP will be implemented for unit 2. Significant Condition Reports (SCRs) SCR WBNCEB 8553 R1 and SCR WBNCEB 8631 R1 were issued on 06/24/86, to address the ZPA [zero period acceleration] issue for unit 1 and unit 2, respectively. The corrective action taken per these SCRs

Issues	Findings	Corrective Actions
Element 218.6 - WBN (Continued)		
	o The alternate analyses performed by the span method have used the criteria prescribed in CEB-76-5 appropriately. o In alternately analyzed calculation N3-67-A27R, the documentation of the flange calculation to qualify the flange is not included in the calculation package. This is not a concern since the only flanges in this problem are connected to flexible hoses. Therefore, they will not be subjected to significant loads. o In the calculation N3-67-A10A analyzed by the alternate method, the documentation for the SAM movements check is not included in the calculation package. However, it is stated in the assumptions that "[t]he seismic anchor movements from CEB 80-10 were investigated & found to have negligible affects [sic] on this problem." This is the minimum acceptable documentation. However, the documentation in calculation N3-67-A27R for the identical circumstances, which describes the magnitudes of the SAM movements, is preferable.	was to perform a parametric study to establish the procedures to be used, to include the load contribution due to modes greater than 33 Hz (ZPA effects) for response spectra analysis. On the basis of this study, an evaluation of all affected response spectra analyses will be performed to include the effects of ZPA. As required, pipe support designs will be revised and reissued. This action will be taken as a part of the HAAUP for unit 1 and as part of a similar program to HAAUP for unit 2. The design criteria and the Rigorous Analysis Handbook will be revised to indicate how to account for the ZPA effects in both response spectra and time history analysis. This should prevent recurrence of this problem. Structural seismic displacements at pipe supports located in different seismic structures must be considered in the seismic anchor movement (SAM) analysis in accordance with the Rigorous Analysis Handbook (RAH 206, 10/30/85). All rigorous analysis problems will be reanalyzed under the HAAUP. Any discrepancy discovered in the SAM analysis of structural displacements at pipe support locations will be corrected. There are explicit instructions in RAH 206 on how to consider these structural displacements at the pipe support locations. This should prevent recurrence of the problem. A program similar to HAAUP will be implemented for unit 2 and will address this deficiency. The evaluation team concurs with this CAP. (CAID 218 06 WBN 01)

Issues	Findings	Corrective Actions
Element 218.6 - BFN	BFN	BFN
(N/A)	(N/A)	(N/A)
BLN	BLN	BLN
(N/A)	(N/A)	(N/A)
********** Element 218.7 - Acceptance Criteria for Overlap Areas of Calculations **********		
SQN	SQN	SQN
a. There was no consistent policy on what constituted an acceptable lapped region at alternate analysis boundaries.	a. There were consistent procedures (Ref. C.14.07 and .08) for interfacing computer-analyzed rigorous analysis piping with non-computer-analyzed alternate analysis piping. As per procedure, there is no need for lapped region at alternate analysis boundaries. ("Terminating at points where alternate analysis begins requires less isolation, since the system will be supported rigidly from that point on.")	a. None required.
b. The methods actually implemented for interfacing alternate analysis problems may not have been sufficient.	b. There is no justification for use of a 3-way restraint, without overlap, at the interface of rigorous analysis piping with alternate analysis piping where the alternate analysis piping is not rigidly supported.	b. In its Corrective Action Plan (CAP) (TCAB-068, 01/26/87), TVA commits to establish a program to resolve the adequacy of using a 3-way restraint to terminate rigorous analysis problems which interface with alternate analysis problems and to assure compliance with FSAR commitments. TVA will review all the rigorous analysis problems for Units 1 and 2 which interface with alternate analysis problems at 3-way restraints or effective 3-way restraint interfaces. The worst case interface problems will be selected on the basis of the following parameters: pipe sizes and spans, branch line locations, pipe configurations, support types, and the location of concentrated weights. The selected worst cases will be reanalyzed to include the rigorous analysis problems along with an adequate portion of the alternate analysis problems on the other side of 3-way restraint interfaces. If significant increases in stress levels are revealed, TVA will review all the

Issues	Findings	Corrective Actions
Element 218.7 - SQN (Continued)		problems and further evaluate any problems with low stress margins which might be affected. If any inadequacies are found, TVA will take steps to assure FSAR compliance either by more sophisticated analysis or by actual field modifications. In order to avoid recurrence, TVA will revise Sequoyah Rigorous Analysis Handbook to state that the rigorous/alternate analyses interfaces are to be terminated with an anchor, and any exceptions will be approved by the technical supervision. The evaluation team concurs with this CAP. In addition, the evaluation team has verified (see BLT-343, 07/24/87) completion of the corrective actions defined by the CAP. (CATD 218 07 SQN 01)
WBN	WBN	WBN
a. There was no consistent policy on what constituted an acceptable lapped region at alternate analysis boundaries.	a. There were procedures (Refs. C.15.03 and .21) for interfacing computer-analyzed rigorous analysis piping with non-computer-analyzed alternate analysis piping. The procedures explained the acceptable methods of overlap between the various interfaces.	a. None required.
b. The methods actually implemented for interfacing alternate analysis problems may not have been sufficient.	b. There is no justification for use of a 3-way restraint, without overlap, at the interface of rigorous analysis piping with alternate analysis piping where the alternate analysis piping is not rigidly supported.	b. In its corrective action plan (CAP) (TCAB-209, 02/25/87) and TVA/Bechtel telecon (02/17/87), TVA commits to implementing a "Hanger and Analysis Update Program" for Watts Bar Nuclear Plant, unit 1. This program will identify all rigorous analysis problems interfacing with alternate analysis problems where the analysis boundaries were not adequately considered in the qualification of piping. All analysis problems that are not terminated in accordance with one of the following criteria will be reanalyzed: 1) anchor, 2) decoupling with inertia ratio of 25 and with adequate flexibility for decoupled piping, 3) overlapping, and 4) flex hose.

Issues	Findings	Corrective Actions
Element 218.7 - WBN (Continued)		
		This corrective action will be initiated and tracked by Problem Identification Report PIR WBNCEB8682 for both units. The criteria documents will be revised appropriately to avoid recurrence. The evaluation team concurs with this CAP. (CATD 218 07 WBN 01)
c. Various methods of overlap were used in the specific examples cited.	c. The examples cited in the employee concern were reviewed by the evaluation team. It was found that different methods of interface were used between the analysis problems. However, the use of different methods of interface between problems does not preclude achieving acceptable results.	c. None required.
BFN	BFN	BFN The following is quoted from TCAB-433 (07/15/87):
a. There was no consistent policy on what constituted an acceptable lapped region at alternate analysis boundaries.	a. There are no established criteria or procedures at BFN for structural overlapping at analysis problem boundaries.	a. "The proposed corrective action for Issue 'A' is identical with the action required to prevent recurrence (ARPR) for SCRBFNCEB8616 R0, which is to 'add a section to the rigorous analysis handbook defining structural overlap requirements at analysis problem boundaries.' This section will define overlap requirements for the following cases: o Rigorous analysis interfacing with another rigorous analysis. o Rigorous analysis interfacing with alternate analysis (including alternate analysis piping which is not rigidly supported). o Rigorous analysis interfacing with deadweight analysis.

Issues	Findings	Corrective Actions
Element 218.7 - BFN (Continued)		
b. The methods actually implemented for interfacing alternate analysis problems may not have been sufficient.	b. BFN has 3-way and 2-way restraints as separation between analysis problems. There is no generic technical justification for use of such restraints, without overlap, at the interface of rigorous analysis piping with alternate analysis piping where the alternate analysis piping is not rigidly supported.	b. "For a large portion of BFN Seismic Class I piping, no retrievable analysis documentation exists. For this piping, the issue of structural overlapping at analysis problem boundaries will be adequately addressed under the NRC-OIE Bulletin 79-14 Program and the Small Bore Piping Reconciliation Program (SBPRP). "TVA's program to resolve NRC-OIE Bulletin 79-14 applies to all BFN Seismic Class I piping 2-1/2" in diameter and greater and all safety-related piping regardless of size which was dynamically analyzed by computer. Under the Phase I portion of the 79-14 Program, this piping received a review to assure adequate configuration. Any configuration which was deemed potentially inadequate was evaluated for interim approval using existing or new analyses. The extent of overlap considered was determined on an individual basis by the analysis evaluator. "Under the Phase II portion of the 79-14 Program, a code compliance analysis will be generated for all piping under the bulletin. This commitment is found in BFEP-PI 86-05 (NRC-OIE Bulletin 79-02 and 79-14 Program Document) and the Nuclear Performance Plan Vol. 3. Overlapping will be in accordance with the rigorous analysis handbook section described above. "The BFN SBPRP is being implemented to resolve SCRBFNCEB8520. This program will establish the long term acceptability of Seismic Class I small bore piping (2" in diameter and less) which was originally alternately analyzed. Commitments regarding this program are found in

Issues	Findings	Corrective Actions

Element 218.7 - BFN (Continued)

BFEP-PI 87-40 (SBPRP) and the Nuclear Performance Plan Vol. 3. Overlapping will be in accordance with either the rigorous analysis handbook section described above or with acceptance criteria developed specifically for the SBPRP. Overlapping acceptance criteria developed specifically for the SBPRP will be reviewed to assure consistency with the rigorous analysis handbook section.

"For Seismic Class I piping for which retrievable analysis documentation exists, the following corrective action is recommended:

1. Review analysis documentation to identify rigorous analysis which has been terminated at 3-way/2-way support without an overlap region.

2. Evaluate the termination methods of the analysis identified above on a case-by-case basis for adequacy in the areas of piping stress, support loads, and equipment qualification."

The evaluation team concurs with this corrective action plan. (CAID 218 07 BFN 01)

Issues	Findings	Corrective Actions
Element 218.7 - BLN	BLN	BLN The following is quoted from TCAB-636 (08/06/87):
a. There was no consistent policy on what constituted an acceptable lapped region at alternate analysis boundaries.	a. The current procedures for interfacing rigorous analysis piping with alternate analysis piping are inconsistent. The procedures in the Rigorous Analysis Handbook differ from those in CEB 76-11, which does not refer to the appropriate section of the Rigorous Analysis Handbook.	a. "Revise BLN alternate analysis criteria (CEB Rep. 76-11) section 5.5.2 to refer to BLN Rigorous Analysis Handbook.
b. The methods actually implemented for interfacing alternate analysis problems may not have been sufficient.	b. There is no justification in the currently issued Rigorous Analysis Handbook for the use of a three-way support, or effective three-way support, without overlap, at the interface of rigorous analysis piping with alternate analysis piping where the alternate analysis piping is not rigidly supported. The method provided in the currently issued Rigorous Analysis Handbook for overlapping a rigorous analysis with an alternate analysis (i.e., include in the rigorous model a segment of the alternately analyzed line, which contains at least one support in each direction and one change in direction) is not an adequate structural overlap.	b. "Revise section BLN-RAH-204 to delete the use of 3-way (or effective 3-way) support to terminate an analysis. "Revise section BLN-RAH-204 to delete this method. In addition to the above actions, the following will be performed. 1) Revise the Rigorous Analysis Handbook (section BLN-RAH-204) to clarify the following requirements on interface which will meet the requirements of NUREG/CR-1980. (a) Rigorous to rigorous interface (b) Rigorous to alternate interface (to include all alternate analysis pipe sizes greater than 3/8" in diameter) (c) Rigorous to simplified analysis interface (d) Rigorous to deadweight interface 2) Review and revise BLEP-06, BLEP-20, and BLN Simplified Analysis Handbook (SAH) to be consistent with the rigorous analysis handbook (BLEP-20 and BLN-SAH are in draft form). 3) Review and revise all rigorous analysis interfaces to the requirements of Item 1).

Issues	Findings	Corrective Actions
Element 218.7 - BLN (Continued)		4) Revise corrective actions of NCR BLNCEB8412R1 to be consistent with the above items 1) and through 3). 5) The following will be added as corrective actions to NCR BLNCEB8423. (a) Add a section (e.g., 5.5.3) to BLN alternate analysis (AA) criteria to cover alternate to simplified analysis interfaces which will make reference to the BLN Simplified Analysis Handbook (SAH). (b) Revise BLN AA criteria section 5.5.1 to refer to BLEP-06 or BLEP-20. (c) Add a section(e.g., 5.5.4) to BLN AA criteria to cover alternate to alternate analysis interfaces which will make reference to BLEP-06 or BLEP-20. (d) Revise BLN AA criteria section 5.5.2 to refer to BLN Rigorous Analysis Handbook. (e) Review and revise, accordingly, all AA interfaces and all deadweight analysis interfaces to the requirements of BLEP-06 or BLEP-20. 6) A corrective action will be added to PIR BLNCEB8626 to include: Review and revise, accordingly, all simplified analysis interfaces to the requirements of the BLN Simplified Analysis Handbook.

Issues	Findings	Corrective Actions
Element 218.7 - BLN (Continued)		7) BLN AA criteria, BLN-RAH, BLN-SAH, BLEP-06, and BLEP-20 will be issued to the requirements of the above corrective action plan by July 31, 1988." The evaluation team concurs with this corrective action plan. (CATD 218 07 BLN 01)
********** Element 218.8 - Potential Internal Stresses from the Tubing Adapter Between Points 790-795 **********		
SQN (N/A) WBN a. Unit 1 piping analysis NJ-68-1R may be unconservative due to modelling assumptions between data points 790-795.	SQN (N/A) WBN a. The unit 1 socket-welding reducer-insert of concern was originally modeled with the outside diameter and wall thickness of the mating tubing. The stresses computed by a later IVA study analysis (Ref. C.18.03) where the reducer-insert was modeled with estimated outside diameter and wall thickness of the reducer-insert itself, were significantly higher than those in the original analysis. However, the study analysis demonstrated that the unit 1 piping of concern was qualified to applicable code stress limits. The original unit 1 analysis (Ref. C.18.02) modeled a second socket-welding reducer-insert in the same manner as that specifically identified within the statement of concern. In the study analysis, this reducer modeling was unchanged. However, it appears that there is a sufficient margin of allowable stress remaining to accommodate an increase in calculated stress at this second reducer-insert, were it to be modeled conservatively. The piping of concern was unusually sensitive to the choice of outside diameter and wall thickness used to model the reducer-insert because a pipe support was attached to the tubing unusually close to the reducer insert. The proximity of a support on tubing near the juncture of tubing with piping, through a socket-welding reducer-insert, was determined to be essentially an isolated case.	SQN (N/A) WBN a. None required.

Issues	Findings	Corrective Actions
Element 218.8 - WBN (Continued)		
b. The corresponding Unit 2 piping analysis may also be unconservative for similar reasons.	b. The unit 2 socket-welding reducer-insert of concern was modelled (Ref. C.18.02) with outside diameter and wall thickness estimated for the reducer-insert itself, a conservative modelling approach, and stresses were within allowable limits.	b. None required.
BFN	BFN	BFN
(N/A)	(N/A)	(N/A)
BLN	BLN	BLN
(N/A)	(N/A)	(N/A)
********** Element 218.9 - Pipe Clearance in the Annulus Area **********		
SQN	SQN	SQN
(N/A)	(N/A)	(N/A)
WBN	WBN	WBN
a. Pipe clearances in the annulus area may not be sufficient due to growth of the steel containment vessel.	a. There is a lack of control procedures to ensure that all components in close proximity to the steel containment vessel have sufficient clearances. There is a lack of proper documentation of walkdowns conducted in the annulus area. Sufficient clearances were not maintained in the annulus area between the steel containment vessel and pipes (including pipe supports) in its proximity. The issue of insufficient clearance in the annulus area between the steel containment vessel and components in close proximity is not limited to pipes and pipe supports.	a. In its corrective action plan (CAP) (TCAB-223, 03/04/87), TVA commits to establish a program on units 1 and 2 for determining, evaluating, and resolving potential interferences both inside and outside the steel containment vessel resulting from growth of the vessel. This corrective action will be initiated and tracked by Significant Condition Reports SCR WBNWBP8727 for unit 1 and SCR WBNWBP8728 for unit 2. The corrective action will involve Division of Nuclear Engineering (DNE) to define the program (including clearance requirements) and Division of Nuclear Construction (DNC) to implement the program. Also, DNC will ensure that clearance requirements are maintained and controlled during any future field work. The evaluation team concurs with this CAP. (CAID 218 09 WBN 01)

Issues	Findings	Corrective Actions
Element 218.9 - WBN (Continued)		
	The evaluation team conducted a brief walkdown (BLI-126, dated 02/17/87) of the annulus area of unit 1 and found instances where sufficient clearances were not maintained between the pipes (including pipe supports) and the steel containment vessel (e.g., core spray pipe supports attached to containment vessel and fire protection pipe attached to shield wall at location: azimuth 300-305 and elevation 801; air duct pipe supports attacned to shield wall and steel containment vessel at location: azimuth 140 and elevation 811; and air duct pipe support attached to shield wall and steel containment vessel at location: azimuth 230 and elevation 811). While conducting the walkdown, the evaluation team noticed numerous interferences involving cable trays, conduits, platforms, etc., that are outside the scope of this element consisting of only pipe clearances. Although this evaluation pertains to the annulus area, similar interference problems could exist inside the containment vessel because of inward (negative) radial movements of the vessel [memo from Chief, Civil Engineering Branch, to Sequoyah and Watts Bar Project Manager, dated September 18, 1979, provides envelope radial movements by elevation for both outward (positive) and inward (negative) movements].	
BFN	BFN	BFN
(N/A)	(N/A)	(N/A)
BLN	BLN	BLN
(N/A)	(N/A)	(N/A)

Issues	Findings	Corrective Actions
********** Element 218.10 - Deformation of Pipe Support Stanchion **********		
SQN	SQN	SQN
(N/A)	(N/A)	(N/A)
WBN	WBN	WBN
a. Deformation of the stanchion pipe of a B001-type pipe support could cause additional stresses in the stanchion and process pipes.	a. The evaluation team examined the B001-type pipe supports at various locations in the plant during a plant walkdown for both units. The inspection revealed no deformation in the stanchion pipe within the region between the process pipe and the branch pipe. However, a slight ovality of the stanchion pipe at the free end was observed during this inspection. This slight deformation does not affect the load-carrying capacity of the support and would not induce any significant stresses in the process line. In addition, the static load tests conducted by TVA (CEB Report 77-42) on the B001-type pipe supports have demonstrated the design adequacy of the stanchion pipes. All B001-type supports are also required to be inspected for implementation of the IE Bulletin 79-14 to ensure their functionality.	a. None required.
BFN	BFN	BFN
(N/A)	(N/A)	(N/A)
BLN	BLN	BLN
(N/A)	(N/A)	(N/A)
********** Element 218.11 - Response Spectra for Pipe Support Attached at the Interface of Shield Wall ********** and Auxiliary Building		
SQN	SQN	SQN
(N/A)	(N/A)	(N/A)

Issues	Findings	Corrective Actions
Element 218.11 - WBN a. Attaching a pipe support to a building other than the one specified in the Building Zone Designation may invalidate the piping stress analysis.	WBN a. Contrary to the statement of concern, the evaluation team found no evidence that the subject support was ever designed with a "common attachment between the shield wall and the auxiliary building." However, the general concern of the employee was valid, in the sense that the subject support was attached to a building other than the one specified in the piping analysis. The piping analysis (stress isometric drawing and support load table for calculation 7208A) requires that the subject support be attached to the auxiliary building only and not to the wall of the shield building. The proper building for pipe support attachment (referred to by TVA as the "Building Zone Designation") is identified in both the support loads table and the piping isometric drawing (calculation 7208A) . Apparently, this key design input information was overlooked by the pipe support designer and the checker. Per ECN 5779 the subject pipe support drawing was revised to illustrate proper attachment to the auxiliary building. The support was then installed in conformance with the revised drawing. TVA discovered that this problem related to proper building attachment was not isolated to the support identified in the statement of concern. As a result, TVA issued a Problem Identification Report PIR WBNCEB8603/R2 which requires that all pipe supports for safety-related piping with detailed analyses for piping close to an interface between two or more seismic response spectra zones will be reviewed, and if any supports are attached to an incorrect seismic structure, appropriate revisions will be made to the supports or to the analysis. The pipe support cited in the statement of concern was designed by Bergen-Paterson, but another support identified as having the same problem was designed by TVA. The evaluation team observed that the proper building attachment consideration was not emphasized in sufficient detail by TVA's Pipe Support Design Manual.	WBN a. In its corrective action plan (CAP) (TCAB-221, 03/02/87) and subsequent TVA/Bechtel telecon (IOM 721, 03/02/87), TVA commits to review all pipe supports in close proximity to an interface between two or more seismic response spectra zones. These pipe supports are from the piping analyzed with detailed (computer) analysis. If this review identifies any pipe supports that are attached to an incorrect seismic structure, the supports or the piping analysis will be revised in accordance with Engineering Change Notice (ECN) 6208. Problem Identification Report (PIR) PIR WBNCEB 8603, R2, was issued on September 11, 1986, to initiate this corrective action. Typical (standard) supports on lines, designed to span rules, are not included in this corrective action as these support designs are based on the envelope of all response spectra. The Pipe Support Design Manual (PSDM) will be revised in sufficient detail to emphasize that it is the responsibility of the pipe support designers and checkers to ensure that pipe support design considers attachment to the correct seismic structure. This will prevent the problem from recurring. The evaluation team concurs with this CAP. (CATD 218 11 WBN 01)
BFN (N/A)	BFN (N/A)	BFN (N/A)

Issues	Findings	Corrective Actions
Element 218.11 - BLN a. Attaching a pipe support to a building with response spectra different from the spectra used in the seismic analysis would invalidate the piping stress analysis.	BLN a. The findings of the investigation are as follows: o For the attachment of pipe support 2CA-MPHG-0060, the enveloped response spectra of the Containment and Auxiliary Buildings at this support location are not used in the piping seismic analysis (Ref. C.22.05). o Evaluation for the pipe stress and the support design due to SAM at the above support location is not documented in design calculation package N4-2CA-B. o For ONM-MPHG-0439 and ONM-MPHG-0623, the pipe supports are attached to a building that is not compatible with the response spectra used in the piping stress analysis. This finding is covered by TVA's Significant Condition Report SCR BLNCEB8603. o Detailed review is not performed by TVA to verify proper support attachments compatible with response spectra used in the analysis for all pipe supports located at the vicinity of two or more seismic response spectra zones. This finding is covered by TVA's SCR BLNCEB8603 and a telecon between Bechtel and TVA, (07/08/87).	BLN a. The following is quoted from TCAB-637 (08/06/87): "1. Determine the spectra zone interfaces which require review. "2. Walkdown or review of the drawings to determine all support attachments for large and small bore pipes at the spectra zone interfaces that are not compatible with response spectra used in the analysis. "3. For supports that are incompatible with response spectra used in the analysis, redesign and attach the supports to the structures with spectra zones compatible with analysis or reanalyze the piping system with revised response spectra to reflect the existing support attachments. Consider enveloping of spectra or multiple zone spectra methods to generate the revised response spectra. "4. Add information to the pipe analysis isometric or load tables to define seismic zone attaching requirements for the pipe. "5. For any support that is attached to multi-structure, redesign to modify the support attachment to one structure. "6. Revise the Bellefonte Pipe Support Design Manual to provide guidelines for handling support attachment to spectra zones. (The Bellefonte Rigorous Analysis Handbook [BLN-RAH-402] was revised 7-29-85 [Revision 1] to require the addition of notes to the isometrics defining support attaching requirements in seismic zones. [See 3.1.18])" The evaluation team concurs with this corrective action plan (CATD 218 11 BLN 01)

Issues	Findings	Corrective Actions

****
Element 218.12 - Temporary Support Seismic Analysis
****

SQN

(N/A)

WBN

(N/A)

BFN

TVA elected to assume responsibility for preparation of the corrective action tracking documents (CATDs) and corrective action plans (CAPs) for element 218.12(C). TVA requested (Ref. C.23.07) that the evaluators include the TVA CAP for element 307.04 in the element evaluation for element 218.12(C). It is quoted below for reference purposes only.

SQN

(N/A)

WBN

(N/A)

BFN

SQN

(N/A)

WBN

(N/A)

BFN

The following corrective actions for this element are presented in TVA ECTG evaluation 307.04:

"A. Determine enveloping pipe support configurations which may have existed during the 1983 outage of unit 3 RHR Loop I.

"B. Evaluate configurations identified in (A.) above for pipe stress, support loads, and nozzle loads.

"C. Determine additional corrective action, if required, based on results of (B.) above. Additional corrective action may include inspections and/or modifications. This work should be completed prior to unit 3 startup.

"Note: A similar situation exists on unit 1 and is being handled under ECP Investigation Report Concern No. ECP 86-BF-566-001." (CATD 307 04 BFN 01)

"Modifications will initiate a corrective action report (CAR) identifying the above [i.e., CATD 307 04 BFN 02] adverse condition. Modifications shall propose, as

Issues	Findings	Corrective Actions
Element 218.12 - BFN (Continued)		
		a corrective action, that a walkdown of the RHR system be performed to verify the removal of all temporary supports." "During the close out process ensure that a CAQR is initiated." (CATD 307 04 BFN 02) "(A) MAI-23 is being revised to include precaution statement for installing, removing, and/or modifying supports on operating systems (in approval cycle). "(B) The USQD is part of the ECN, therefore, it is included in the workplan that removes the support, if the system is inoperable. If removal on operable system precaution statement requires a specific USQD [incomplete sentence]. "(C) Temporary supports have second party verification of installation and removal in a PORC approved instruction (MAI-23), therefore, a TACF is not applicable as long as MAI-23 is the referenced document." (CATD 307 04 BFN 03)
a. Inadequate control and tracking of temporary supports during the outage.	a. During the unit 3 outage in 1983, there were no programmatic controls or documentation for the installation and removal of temporary supports. The current version of Modifications and Additions Instruction MAI-23, Attachment B, provides adequate controls for tracking temporary supports during outages. Mechanical Maintenance Instruction MMI-164 provides stringent requirements for the removal and reinstallation of pipe supports.	
b. The effects of temporary supports on the seismic qualification of piping systems have not been addressed.	b. The current version of MAI-23 does not include any requirements for the seismic qualification of piping systems when seismic supports are removed.	
BLN (N/A)	BLN (N/A)	BLN (N/A)

Issues	Findings	Corrective Actions
********** Element 218.13 - Drywell Purge System Piping Interference in DBA **********		
SQN	SQN	SQN
(N/A)	(N/A)	(N/A)
WBN	WBN	WBN
(N/A)	(N/A)	(N/A)
BFN	BFN	BFN
a. Drywell purge system piping - interference was identified to pipe movement as a result of thermal and pressure growth of containment during a design basis accident (DBA), which could cause rupture of the piping.	a. On unit 2 during a DBA, there is an interference (Ref. C.24.01) with the brace of the pipe support frame obstructing the pipe movement of the 2-inch drywell purge pipe as a result of the pressure and thermal growth of the containment. On units 2 and 3 during a DBA, the box frame type pipe supports do not provide sufficient clearances (Ref. C.24.01) for the upward movement of the 18-inch drywell purge system pipes because of the pressure and thermal growth of the containment.	a. The following is quoted from TCAB-461 (07/26/87): "In the event of a LOCA, the unit 2 support (H87 at elevation 629'-9") will fail, and the adjacent rod hanger (H89) will be subjected to compression. The unit 3 support (H33) will fail, and the adjacent rod hanger (H32) will be subjected to compression. The piping has been evaluated under 79-14 with supports H87 and H33 removed from the analysis and is still qualified for interim operation. In order to prevent support failure, the corrective action will be to remove support H87 in unit 2 and support H33 in unit 3. Attached [to the corrective action plan] are copies of the appropriate inspection data. (CATD 218 13 BFN 01) "Long term qualification of the 18" piping and supports will be accomplished under Phase II of the 79-14 program. The 2" piping will be evaluated for clearance and interference under the Small Bore Pipe Reconciliation Program." The evaluation team concurs with this corrective action plan. (CATD 218 13 BFN 01)
BLN	BLN	BLN
(N/A)	(N/A)	(N/A)

ATTACHMENT C

REFERENCES

C.01 General

1. Sequoyah Element Report 218.01, "Thermal Analysis of Piping Subjected to Temperatures Less Than 120°F," Rev. 1 (12/04/86)

2. Sequoyah Element Report 218.04, "Widespread Deficiencies Within Pipe Stress Calculations," Rev. 2 (01/06/87)

3. Sequoyah Element Report 218.07, "Acceptance Criteria for Overlap Areas of Calculations," Rev. 2 (01/27/87)

4. Revised Corporate Nuclear Performance Plan (TVA), Rev. 4 (03/87)

5. Nuclear Performance Plan (TVA), Volume 4, Watts Bar Nuclear Plant (draft for comment by 03/27/87)

C.02 Element 218.1 SQN

1. TVA, Sequoyah Nuclear Plant, Detailed Design Criteria for Detailed Analysis of Category I Piping Systems, SQN-DC-V-13.3, R0, (03/10/75) R3 (08/13/84) |

2. TVA, Sequoyah Nuclear Plant, Detailed Design Criteria for Analyzing Pipes with Rigid Attachments to the Containment Vessel, SQN-DC-V-13.3.1, R0, (07/26/79), R2 (12/27/83) |

3. TVA, Sequoyah Nuclear Plant, Detailed Design Criteria for Alternate Piping Analyses and Support Criteria for Category I Piping Systems, SQN-DC-V-13.7, R0, (04/01/73), R2 (10/04/84) |

4. EDS Nuclear, Sequoyah Nuclear Plant, Alternate Criteria for Piping Analysis and Support, R1 (06/75)

5. TVA, Sequoyah Nuclear Plant, Earthquake and Dead Load Design Data for Small Diameter Carbon Steel and Aluminum Piping, [8007018005I], (05/18/74) |

6. TVA, Sequoyah Nuclear Plant, Alternate Analysis Manual, Documentation of Alternate Analysis Packages, SQN-AA-002, R0 (06/28/86)

7. Mechanical Design Guide DG-M5.1.1, pages 1-8, original issue, (08/11/76) |

8. Engineering Procedure EN DES-EP 4.02: Engineering Change Notices - Handling, R13 (06/07/83)

9. Nuclear Engineering Procedure, NEP-5.1, R0: Design Output (07/01/86)

10. Sequoyah Rigorous Analysis Handbook, SQN-RAH-207, R1: Operating and Design Modes (09/18/86)

11. TVA memo from R. O. Barnett to C. A. Chandley [B41 850605 015]: Sequoyah Nuclear Plant - Operating Modes - Mechanical Design Guide MS.1.1 and NCR SQN CEB 8501 (06/05/85, NCR attached)

12. Office of Engineering, OEP-11, Change Control, R0, (04/26/85)

13. Nuclear Engineering Procedure NEP-6.1, R0: Change Control (07/01/86)

14. Sequoyah Rigorous Analysis Handbook, SQN-RAH-401, R1: Analysis Checklist (11/15/85)

15. Alternate Analysis Review Program, Program Description, SQN-AA-001, R0 (07/07/86)

16. USA Standard Code for Pressure Piping, USAS B31.1.0-1967, ASME

17. Watts Bar Nuclear Plant, Sampling Program for Review of Operational Modes Data Used in Rigorously Analyzed Piping, EN DES-SEP 82-15, R2 (05/31/84)

18. Review of Operational Modes Data Used in [Watts Bar] Piping Analysis, TVA Report CEB-84-02, R0, (02/17/84), R1 (03/08/84)

19. (Deleted duplicate of C.02.17)

20. SQN-AA-002, "Sequoyah Nuclear Plant, Alternate Analysis Manual, Documentation of Alternate Analysis Packages," R1, [B25 870331 012], (reply, RFI 866), (03/27/87)

21. SQN-AA-005, "Sequoyah Nuclear Plant, Units 1 and 2, Alternate Analysis Review Program, Evaluation of Piping for Anchor Movement and Thermal Expansion Load Cases," R1, TTB-523-1, [B25 870407 013], (04/06/87)

22. RFI SQN 664 (10/28/86)

23. TVA, examples of Alternate Analysis typical support drawings provided in reply to RFI SQN-512, Item 9

24. Problem N2-62-3A, 4A, and 5A, R1 excerpts, [no RIMS number], (01/26/86)

25. TVA Calculation N2-62-3A through 5A, R3 (11/12/82)

26. TVA Calculation N2-70-R2, R3 (05/05/86)

27. TVA Calculation N2-78-5A, R1 (10/30/85)

28. TVA Calculation N2-70-20A, R0 (02/17/81)

29. TVA Calculation N2-67-4R, R2 (10/17/84)

30. TVA Calculation N2-26-A-301A, R0 (09/14/86)

31. N2-70-A-324A, R0, TVA Calculation (TTB 516-3, Vol. 4), [825 860915 806], (09/12/86)

32. TCAB 102, (12/08/87)

C.03 Element 218.1 WBN

1. TVA NEP-3.1, "Calculations," R0, TTB 61, [805 860701 003], (07/10/86)

2. TVA NEP-5.1, "Design Output," R0, TTB 61, [no RIMS number], (07/01/86)

3. TVA NEP-1.3, "Records Control," R0, TTB 61, [no RIMS number], (07/01/86)

4. Construction Specification N3C-912 "Support and Installation of Piping Systems in Category I Structures," TTB 2, [ESB 841005 202], R1, (12/03/82), R3, (10/31/84)

5. OE-SEP 82-18, TVA, WBN, "Program for Alternate Analysis Fix - Coordinating, Documenting, and Verifying," R3, TTB 11-3, [no RIMS number], (no date), [R2, 826 850503 001, 05/03/85]

6. EN DES-SEP 82-15, TVA, WBN, "Sampling Program for Review of Operational Modes Data Used in Rigorously Analyzed Piping," R2, (reply to RFI 207), [CEB 840531 006], (05/31/84)

7. WBN-RAH-603, TVA, WBN, Rigorous Analysis Handbook, "Evaluation for Changes in Temperature," R0, (reply to RFI 78), [841 851220 004], (12/20/85)

8. CEB-76-5, TVA, WBN, "Alternate Criteria for Piping Analysis and Support," R3, [CEB 830613 026], (06/13/83)

9. CEB-84-02, TVA, "Review of Operational Modes Data Used in Piping Analysis," R1, (reply to RFI SQN-667), [CEB 840308 002], (03/08/84)

10. WBN-RAH-400, TVA, WBN, Rigorous Analysis Handbook, "Watts Bar Nuclear Plant Rigorous Analysis Checklist," (reply to RFI-184), TTB-232-4, [no RIMS number], (no date)

11. EN DES-EP 4.04, TVA, "Squadcheck Process," R9, [ESB 840426 217], (04/24/84)

12. Mechanical Design Guide DG-M5.1.1, "Operational Modes Analysis for Piping Systems," Original Issue, [no RIMS number], (08/11/76)

13. TVA NEP-5.2, "Review," R0, TTB-61, [no RIMS number], (07/01/86)

14. Bechtel RFI WBN-149, (01/22/87)

15. Calculation, TVA, "CVCS Operating Modes for Problem 0600200-08-06" (partial reply to RFI-160), TTB-482-7, [B26 850520 034], (05/20/85)

16. TCAB-247, (03/09/87)

17. TCAB-375, (12/08/87)

C.04 Element 218.1 BFN

1. BFN-50-712, TVA, "Detailed Design Criteria, Seismically Qualifying Field Run Piping (sizes 1/2 through 2 inches)" (TTB 178, Vol. 2, B42 860103 505), R0, (11/29/72), R4, (11/27/85)

C.05 Element 218.1 BLN

1. CEB 76-11-C-R3, "CEB Report: Bellefonte Nuclear Plant Alternate Criteria for Piping Analysis and Support," (proposed revision) (TTB 327-5, Vols. 5 and 6), [no RIMS number], (no date)

2. BLEP-20, "Bellefonte Engineering Project, Project Manual: Program for Alternate Analysis Fix: Reviewing, Verifying and Documenting," (TTB 472-2), [no RIMS number], (not issued).

C.06 Element 218.2 WBN

1. Pipe supports from the following isometrics:
   47W464-251/R0 0600200-04-09/R908
   47W435-222/R2 47W435-267/R2
   47W435-220/R5 47W435-273/R2

2. Stress analysis input information for:
   - o Problem 600-200-06-01 for node point 7Z, [no RIMS number], (03/10/83)
   - o Problem 600-200-09-02 for node points C98 through 113, R7, [no RIMS number]
   - o Problem 600-250-09-02 for node points 119 through 370, R0, [no RIMS number]
   - o Problem 600-200-07-02 for node points F19 through 186, (12/14/82), [no RIMS number]
   - o Problem 600-200-07-01 for node points 23 through 6, (12/82), [no RIMS number]
   - o Problem 600-250-07-02 for node points N2 through 29C, R1, [no RIMS number]
   - o Problem 600-250-07-04 for node points 5 through V83, 12/84, [no RIMS number]

3. Bechtel calculation PD-218-08, R0 (06/10/86)

4. Pipe support calculations:
   - o 47A400-6-97 R1, [WBP 845010 016], (05/11/84)
   - o 47A400-1-31 R0, [B41 850417 951], (04/17/85)

5. "Detailed Design Criteria for Location and Design of Piping Supports and Supplemental Steel in Category 1 Structures," WB-DC-40-31.9, R5, (04/09/84)

6. Watts Bar Nuclear Plant Rigorous Analysis Handbook, WBN-RAH-208, R0, (09/19/85)

C.07 Element 218.3 WBN

1. WB-DC-40-31.7, "Watts Bar Nuclear Plant, Detailed Design Criteria, Analysis of Category I and I(L) Piping systems," R7, [B42 860129 501], (01/21/86)

2. CEB-EP-21.43, "Documentation of ASME Class 2 and Class 3 Rigorous Piping Analysis," R1, [B42 851219 503], (12/13/85)

3. ANSI N45.2.11-1974, "Quality Assurance Requirements for the Design of Nuclear Power Plants"

4. OEP-07, "Office of Engineering: Calculations," R0, (TTB 2), (01/15/86)

5. OEP-10, "Office of Engineering: Review," R0, (TTB 2), (08/30/85)

6. WB-DC-40-31.3, "Watts Bar Nuclear Plant, Detailed Design Criteria for Assignment of Responsibility for Analysis, Support, and Fabrication of Piping Systems," (TTB 2), R2, [ESB 841012 201], (10/04/84)

7. WBN-RAH-400, "Watts Bar Nuclear Plant, Rigorous Analysis Handbook, Class 2 and 3 Analysis: Watts Bar Nuclear Plant Rigorous Analysis Checklist," (TTB 5), R3, [B41 851113 020], (11/13/85)

8. WBN-SAH-400, "Watts Bar Nuclear Plant, Simplified Analysis Handbook, Class 2 and 3 Analysis, Watts Bar Simplified Analysis Checklist," (TTB 5), R1, [B41 860314 012], (03/14/86)

9. OEP-SEP 82-18, "Special Engineering Procedure, Watts Bar Nuclear Plant, Program for Alternate Analysis Fix - Coordinating, Documenting, and Verifying," (TTB 11), R3, [85051400032], (no date)

10. EN DES-EP 3.03, "Engineering Procedure, Design Calculations," (TTB 2), [ESB 840426 210], (04/24/84)

11. CEB-EP 21.12, "Class 2 and 3 Piping Analysis," R3, [ESB 831205 201], (12/01/83)

12. CEB-EP 21.42, "Piping Analysis Verification for ASME Class 1, 2, and 3 (Rigorous or Alternate)," R1, [B42 851219 502], (12/13/85)

13. WBEP-EP 43.21, "Alternate Analysis of Piping Systems - Documenting and Verifying," (TTB 2), R0, (01/09/86)

14. Calculation 26109 Checklist (WBN-RAH-400), (TTB 22), [no RIMS number], (12/01/83)

15. Calculation 0317 Checklist (WBN-RAH-400), (TTB 22), [no RIMS number], (05/23/84)

16. Calculation N3-31-A45A Checklist (SAGS/DAGS), (TTB 22), [no RIMS number], (12/10/83)

17. Calculation 0600200-02-01 Checklist (source not identified), [no RIMS number], (12/07/81), (Reply to RFI 058)

18. Calculation 6801 Checklist (WBN-RAH-400), [no RIMS number], (Reply to RFI 061)

19. Calculation N3-33-R07 Checklist (OEP 82-18), (Reply to RFI 061)

20. Calculation 0600200-02-01, R8, [CEB 840320 007], (03/20/84)

21. TPIPE Computer Output, TVA Calculation 0600200-02-01, R8, (TTB 235-6)

22. Listing, TPIPE Computer Model Input, TVA Calculation 0600200-02-01, R6, (TTB 67-7)

23. Calculation 7729 Checklist (SAGS/DAGS), (TTB 22), [no RIMS number], (02/26/83)

24. Calculation 6214 Checklist (SAGS/DAGS), (TTB 22), [no RIMS number], (03/01/83)

25. TCAB 239, 03/06/87

C.08 Element 218.4 SQN

1. TVA memo from D. W. Wilson to J. A. Raulston, Chief Nuclear Engineer, [B25 860514 015], (05/14/86): SCR-SQNCEB8613 (SCR attached)

2. Engineering Report, Rev. 1, [SO1 860509 977], (05/09/86): SCR SQNCEB8613 RO

3. TVA memo from K. L. Mogg to Dave Wilson, [no RIMS number], (04/29/86): SCR [SQN]CEB8613 and 8614

4. TVA memo from K. L. Mogg to T. C. Cruise, [no RIMS number], (04/17/86): SCR SQNCEB8613 and 8614

5. Engineering Report, Rev. 1 (not approved): SQNSWP8215 RO

6. Nonconformance Report, SQNSWP8222, [SWP (82?)1221 023], (revision not shown), (12/21/82)

7. TVA memo from John A. Raulston to T. G. Campbell, [RIMS number not legible], (11/26/82, attached: SQNSWP8215 and failure evaluation)

8. TVA memo from W. B. West to Dave Wilson et al., [no RIMS number] (05/23/86, attached: Engineering Report, Rev. 1, not approved, prepared 05/22/86)

9. TVA NCR WBNSWP8231, [SWP 820616 006], (06/16/82)

10. Alternate Analysis Review Program, Alternate Analysis Manual, SQN-AA-001 (preliminary copy of RO) (06/25/86)

11. Alternate Analysis Review Program, Evaluation of Piping for Phase I Issues, SQN-AA-006 (06/25/86, not approved)

12. Alternate Analysis Review Program, General Guildelines [SIC] for Case-by-Case Evaluation of Piping for Deadweight and Seismic Load Cases, Rev. 0, (06/18/86)

13. Alternately Analyzed Piping Review Program, Phase I, Pipe Stress and Support Design - Load Combinations, Allowable Stress and Allowable Loads (06/20/86, not approved)

14. Alternate Analysis Review Program, Instruction Index (no date)

15. Alternate Analysis Review Program - Program Description - SQN-AA-001, RO, (07/01/86)

16. Alternate Analysis Review Program, Pipe Stress and Support Design Screening and Evaluation, Load Combinations, Allowable Stress and Allowable Loads, SQN-AA-003, RO, (07/09/86)

17. Sequoyah Nuclear Plant, [TVA reply to] NRC Technical Information Request on Interim Acceptance Criteria, Civil Engineering Programs [S10 860812 831], (transmitted 08/12/86)

18. Alternate Analysis Review Program, Evaluation of Piping for Anchor Movement Load Cases, SQN-AA-005, Rev. 0 (06/30/86)

19. Alternate Analysis Review Program, Instructions for Pipe Support Design, SQN-AA-009, Rev. 1 (08/9/86)

20. Alternate Analysis Review Program, Program Description, SQN-AA-001, Rev. 0 (7/7/86)

21. Alternate Analysis Manual, Documentation of Alternate Analysis Packages, SQN-AA-002, Rev. 0 (06/28/86)

22. Alternate Analysis Review Program, General Guidelines for Case-by-Case Evaluation of Piping for Deadweight and Seismic Load Cases, SQN-AA-004, [B25 860708 013], (06/18/86)

23. Alternate Analysis Review Program, Evaluation of Piping for Anchor Movement Load Cases, SQN-AA-005, R0, (06/30/86)

24. Alternate Analysis Review Program, Evaluation of Piping for Phase I Issues, SQN-AA-006, Rev. 0 (07/04/86)

25. Alternate Analysis Review Program, Procedure for Scoping, SQN-AA-007, Rev. 0 (07/04/86)

26. Alternate Analysis Information Bulletin No. SQN-AABU-010, Rev. 0 (07/12/86): Evaluation of Spacing Violations and Embedded Plates

27. Alternate Analysis Information Bulletin No. SQN-AABU-013, Rev. 0 (07/12/86): Rigid Response

28. Alternate Analysis Information Bulletin No. SQN-AABU-14, Rev. 0, [B25 860712 011], (07/12/86): Seismic and Thermal Anchor Movement

29. TCAB-034, Corrective Action Plan (CAP) for Element 218.4 (B), (12/18/86)

C.09 Element 218.4 WBN

1. OE-SEP 82-18, "Program for Alternate Analysis Fix - Coordinating, Documenting, and Verifying," (TTB 011) [850514 D0032], (R0: 09/17/82; R3: no date)

2. SWP-EP 43.21, "Alternate Analysis of Piping Systems - Documenting and Verifying," (superseded by C.09.03) (TTB 263-4) [ESB 830103 210 as per IOM 623], R0, (01/13/83)

3. WBEP-EP 43.21, "Alternate Analysis of Piping Systems - Documenting and Verifying," (reply, RFI 068) (TTB 37), [no RIMS number], R0, (01/09/86)

4. CEB 76-5, "Alternate Criteria for Piping Analysis and Support," R3 [CEB 830613 026], (06/13/83)

5. WBN-SAH-400, (TTB-5) [B41 860314 012] (R0: 12/27/84; R1: 03/14/86)

6. WBN-SAH-100, Watts Bar Nuclear Plant, Simplified Analysis Handbook, title: General Handbook Policy (TTB 263-4) R0, [CEB 841207 012], (12/07/84)

7 CEB-EP 21.12, "Class 2 and 3 Piping Analysis," (TTB 5) [ESB 831205 201] R3, (12/01/83)

8. WB-DC-40-31.7, "Design Criteria for Analysis of Category I and I(L) Piping Systems," (TTB 2) [B42 860129 501], (01/21/86)

9. (Deleted duplicate of C.09.11)

10. CEB-75-18, R3, "Small Line Attachment Details to Class 2 and 3 Piping Equal to or Larger than 2-1/2 Inch Diameter," [CEB 840522 001], (05/22/84)

11. WBN-RAH-202, R0, "Analysis Boundaries and Decoupling Criteria," (TTB 5) [B41 850920 001], (09/20/85)

12. WB-DC-40-31.7, R7, "Analysis of Category I and I(L) Piping Systems," (TTB 2) [B42 860129 501], (01/21/86)

13. CEB-EP 21.12, R4, "Class 2 and 3 Piping Analysis," (TTB 327-5, Vol. 2) [B42 851219 501] (12/13/85)

14. NCR WBNSWP8231 (reply, RFI 064) [SWP 820616 006], (prep. 06/16/82)

15. NCR WBNSWP8220 (reply, RFI 064) [SWP 820512 001], (prep. 05/12/82)

16. NCR WBNSWP8160 (reply, RFI 064) [SWP 811113 085], (prep. 11/13/81)

17. NCR 4164R (TTB 219-3) [WBN 820615 110], (initiated 06/11/82)

18. NCR WBNSWP8252, R2 (for R3, see 21) (reply, RFI 066) [WBP 830919 019], (prep. 09/15/83)

19. ECN 3213 (TTB 219-3) [SWP 830120 526], (01/20/83)

20. ECN 4807 (TTB 219-3) [WBP 840510 518], (05/03/84)

21. NCR WBNSWP8252, R3 (for R2, see 18) (reply, RFI 066), (prep. 04/18/85)

22. PIRWBNCEB8646, "Problem Identification Report" (reply, RFI 391) [B41 860411 035], (approved 04/11/86)

23. TVA calculation 74202, R0, (TTB 241) [CEB 850206 956], (02/06/85)

24. TVA calculation 7203, R0, (TTB 241), [WBP 840710 020], (07/09/84)

25. TVA calculation 03021, R0, (TTB 241), [B41 851021 958], (10/21/85)

26. TVA calculation N3-62-A20R, R0, (TTB 241), [WBP 831025 040], (10/25/83)

27. 0600200-02-01, R8, TVA calculation, (TTB-235), [CEB 840320 007], (03/20/84)

28. TCAB 265, 03/12/87

29. TCAB 374, 11/13/87

C.10 Element 218.4 BFN

1. Bechtel (North American) Power Corporation, Job 16985-007, "Browns Ferry Nuclear Power Plant, Report on Technical Review of TVA Program to Implement NRC Bulletin 79-14" (TTB 176-2[2], B41 860107 008), (12/85)

2. BFEP-PI 85-01, TVA, "Implementation of NRC-OIE Bulletins 79-02/79-14 for Browns Ferry Nuclear Plant," R1 (draft) (TTB 176-2[6], no RIMS number), (01/06/86)

3. BFEP-PI 86-05, TVA, BFN, "NRC-OIE Bulletin 79-02/79-14 Program Document for Browns Ferry Nuclear Plant," (TTB 176-2[9], B22 860805 011), (07/29/86)

4. BFN-50-D707, TVA, "Detailed Design Criteria for Analysis of As-Built Piping Systems" (TTB 178, Vol.1, B42 850501 501), R0, (08/11/80), R3, (04/17/85)

5. BF MMI-99, TVA, BFN, "Instructions for the Implementation of [hand marked "Phase I"] NRC IE Bulletin 79-14, Units 1, 2, and 3" (TTB 176-2[7], no RIMS number), (hand-marked copy of 11/15/85 issue)

6. BFEP-PI-86-06, TVA, "Implementation of NRC-OIE Bulletin 79-14 Phase II Verification for Browns Ferry Nuclear Plant," (TTB 176-2[10], no RIMS number), (no date)

7. BFN-50-D711, TVA, BFN, "Detailed Design Criteria for Analysis of Torus Attached Piping (Long-Term Torus Integrity Program)" (TTB 178, Vol. 1, B42 850719 502), R0, (07/27/82), R2, (07/12/85)

8. BFN-50-712, TVA, "Detailed Design Criteria, Seismically Qualifying Field Run Piping (sizes 1/2 through 2 inches)" (TTB 178, Vol. 2, B42 860103 505), R0, (11/29/72), R4, (11/27/85)

9. EN DES-SEP 81-02, TVA, BFN, "Special Engineering Procedure, Implementation of NRC-OIE Bulletin 79-14 for [BFN]" (TTB 208, Vol. 6, CEB 811221 014), (12/21/81)

10. CEB 83-34, TVA, "[BFN] Torus Integrity Long-Term Program, Plant Unique Analysis Report" (TTB 208, Vol.5, CEB 841210 008), R0, (12/21/83), R2, (12/10/84)

11. BFN-50-D706, TVA, "General Design Criteria for the Torus Integrity Long-Term Program" (TTB 178, Vol. 1, ESB 840621 205), R0, (07/24/80), R1, (06/20/84)

12. DIM-BFN-50-D707-3, TVA, "Design Input Memorandum Analysis of As-Built Piping Systems, BFN-50-D707" (TTB 178, Vol.1, B41 861124 017), (11/24/86)

13. DIM-BFN-50-712-1, TVA, "Design Input Memorandum for Seismically Qualifying Field Run Piping (sizes 1/2 through 2 inches), BFN-50-712" (TTB 178, Vol. 2, B41 861124 008), (11/24/86)

14. Engineering Report, re SCRBFNCEB8520, R0, (TTB 204-3, 860106 00531), [B25 8512?? ???], (approved 12/24/85)

15. Significant Condition Report SCRBFNMEB8605, (TTB 204-3, B44 860703 007), (07/01/86)

16. ECN P0392 (TTB 208-5, TDP 811009 500), (02/26/81)

17. ECN P0880 (preliminary) (TTB 208-5, no RIMS number), (04/29/86)

18. ECN P0881 (preliminary) (TTB 208-5, no RIMS number), (04/29/86)

19. ECN P0859 (TTB 208-5, B22 860625 500), (prepared 02/05/86)

20. TVA, "Failure Evaluation/Engineering report" (re NCR BFNNEB8401, R1), [NEB 840814 267], (08/14/84)

21. BFNNEB8401, TVA, "Nonconformance Report," (TTB-359-4) [CEB 840605 011], R2, (05/30/84)

22. "Nonconformance Report Completion Verification Sheet" (re NCR BFNNEB8401, R2), (TTB 359-4) [no RIMS number], (08/03/84)

23. SCRBFNCEB8520, Significant Condition Report (reply to RFI 1104, telecopied 03/16/87 08:45) (no TTB number, B41 851112 016), (11/06/85)

24. 67 M 47W458-211, R1, TVA, Drawing [no RIMS number] (reply, RFI 1226) (06/11/82)

25. 67 M 47W403-206, R2, TVA, Drawing [no RIMS number] (reply, RFI 1226) (07/17/84)

26. 67 M 47W403-207, R2, TVA, Drawing [no RIMS number] (reply, RFI 1226) (07/17/84)

27. 67 M 47W403-208, R3, TVA, Drawing [no RIMS number] (reply, RFI 1226) (02/21/85)

28. 67 M 47W403-209, R3, TVA, Drawing [no RIMS number] (reply, RFI 1226) (09/05/84)

29. 67 M 47W403-210, R2, TVA, Drawing [no RIMS number] (reply, RFI 1226) (07/17/84)

30. 67 M 47W456-211, R2, TVA, Drawing [no RIMS number] (reply, RFI 1226) (12/16/85)

31. 67 M 47W455-206, R1, TVA, Drawing [no RIMS number] (reply, RFI 1226) (12/22/86)

32. 67 M 47W920-207, R1, TVA, Drawing [no RIMS number] (reply, RFI 1226) (07/25/84)

33. N1-373-5R, TVA, calculation (TTB 312-17), [BWP 840817 102], R3, two volumes (08/17/84)

34. N1-064-6R, TVA, calculation (TTB 312-17), [CEB 841227 759], R3 (12/21/84)

35. N1-264-4R, TVA, calculation (TTB 312-17), [B22 861112 104], R5 (11/12/86)

36. N1-175-1RA, TVA, calculation (TTB 312-17), [B22 851231 102], R8, (12/31/85)

37. N1-371-3R, TVA, calculation (TTB 312-17), [CEB 841227 765], R1 (12/21/84)

38. N1-273-2R, TVA, calculation (TTB 312-17), [B22 861219 152], R3 (12/19/86)

39. 67 M 47W458-209, R3, TVA, Drawing [no RIMS number] (reply, RFI 1226) (03/10/86)

40. 67 M 47W458-210, R3, TVA, Drawing [no RIMS number] (reply, RFI 1226) (08/09/86)

41. TCAB-490, 08/13/87

C.11 Element 218.4 BLN

1. DC-N4-50-D717, "General Design Criteria, Bellefonte Nuclear Plant: Design of Safety-Related Piping Supports and Supplemental Steel," (TTB 327-5, Vol. 2), [B42 851112 525], R4, (10/22/85)

2. DC-N4-50-D725, "Bellefonte Nuclear Plant, General Design Criteria for Assignment, Support, and Fabrication of Piping Systems," (TTB 327-5, Vol. 2), [ESB 831115 217], (R0, 01/27/76; R1, 11/09/83)

3. "Fragnet for FY 87 Milestone and Alternate Analysis Fix," sheet 1, (attached to Ref. C.11.01 above), [no RIMS number], (no date)

4. CEB-EP 21.42, "Piping Analyses Verification for ASME Class 1, 2, and 3 (Rigorous or Alternate)," (TTB 327-5, Vol. 2), R1, [B42 851219 503], (12/13/85)

5. CEB-EP 21.43, "Documentation of ASME Class 2 and Class 3 Rigorous Piping Analysis," (TTB 327-5, Vol. 2), R1, [B42 851219 503], (12/13/85)

6. CEB-EP 21.12, "Class 2 and 3 Piping Analysis," (TTB 327-5, Vol. 2), R4, [B42 851219 501], (12/13/85)

7. BLP-EP 44.76 "Bellefonte Design Project, Engineering Procedure: Component Supports - Analyses, Design, Procurement, Fabrication, and Installation," (TTB 327-5, Vol. 2), [ESB 831019 205], (R0, 01/09/79; R3, 11/01/83)

8. CEB 76-11, "CEB Report: Bellefonte Nuclear Plant Alternate Criteria for Piping Analysis and Support," (TTB 327-5, Vol. 3), R2, [CEB 840106 027], (01/06/84) (See also Ref. C.11.11 below.)

9. BLEP-06, "Bellefonte Engineering Project, Project Manual: Component Supports - Analyses, Design, Procurement, Fabrication, and Installation," (proposed revision to Ref. C.11.7) (TTB 327-5, Vol. 4), R0, [no RIMS number], (09/30/85)

10. BLEP-20, "Bellefonte Engineering Project, Project Manual: Program for Alternate Analysis Fix: Reviewing, Verifying and Documenting," (TTB 327-5, Vol. 4), [no RIMS number], (not issued) (see also Ref. C.11.17)

11. CEB 76-11-C-R3, "CEB Report: Bellefonte Nuclear Plant Alternate Criteria for Piping Analysis and Support," (proposed revision to Ref. C.11.08) (TTB 327-5, Vols. 5 and 6), [no RIMS number], (no date) (See also Ref. C.11.8 above.)

12. BLEP-08, "Engineering Procedure, Bellefonte Engineering Project, Verification of As-Constructed Input Information for Nonrigorous Seismic Analyses of Safety-Related Piping Systems," (R1 supercedes BLP-EP 44.78, R0), (TTB 347-3), [B42 850411 500], (R0: 11/21/80, R1: 04/24/85)

13. N4-50-D754, "Bellefonte Nuclear Plant, General Design Criteria for the Classification of Piping, Pumps, Valves, and Vessels," (TTB 347-2, Vol. 6) [ESB 840927 203] (R0: 07/18/77, R1: 09/17/84) (duplicated at Ref. C.11.18)

14. N4-50-D744, "Bellefonte Nuclear Plant, General Design Criteria for Identification of Mechanical Safety-Related Systems and Components," (TTB 347-2, Vol. 6) [ESB 840927 202] (R0: 11/30/77, R1: 09/17/84)

15. N4-WE-D740, R2, Detailed Design Criteria, "Equipment and Floor Drainage System" (TTB 347-2, Vol. 5), [B05 861219 501], (12/18/86)

16. N4-50-D711, General Design Criteria, Bellefonte Nuclear Plant, "Detailed Analysis and Seismic Qualification of Category I and I(L) Piping Systems" (TTB 347-2, Vol. 1) [B42 851112 524], original issue, (08/08/75), R3, (10/17/85)

17. BLEP-20, "Bellefonte Engineering Project, Project Manual: Program for Alternate Analysis Fix: Reviewing, Verifying and Documenting," (TTB 472-2), [no RIMS number], (not issued) (a later version of that provided as C.11.10 above)

18. N4-50-D754, "Bellefonte Nuclear Plant, General Design Criteria for the Classification of Piping, Pumps, Valves, and Vessels," (TTB 381-6), [ESB 840927 203], (R0: 07/18/77; R1: 09/17/84) (duplicated at Ref. C.11.13)

19. ECN 2487, "Engineering Change Notice, Cover Sheet," (TTB 383-5), [BLP 830825 013], (08/31/83)

20. SCRBLNCEB8509, "Significant Condition Report," (TTB 375-4) [B41 851018 007] (10/18/85)

21. PIRBLNCEB8631, "Problem Identification Report," (TTB 375-4) [B41 861025 002] (09/22/86)

22. PIRBLNCEB8626, "Problem Identification Report," concerns: ". . . analysis problems were issued without a documented procedure . . .," (TTB 402-17), [B41 860805 008] (approved 08/05/86)

23. Engineering Change Notice (ECN) 3380, Bellefonte unit 1, description of change: "review analysis and revise drawings as required for corrective action to NCR BLNCEB8423," (reply, RFI 1721) [B21 860530 815], (prep. 02/04/86)

24. ECN 3381, Bellefonte unit 2, description of change: "review analyses to incorporate changes as required per NCR BLNCEB8423," (reply, RFI 1721) [B21 860530 823], (prep. 02/04/86)

25. NCR BLNCEB8307, "Nonconformance Report," concerns: thermal modes, (TTB 470-1) [CEB 831205 007] (prepared 11/2[?]/83)

26. NCR BLNCEB8423, "Nonconformance Report," concerns: "Lack of Experience and Training," (TTB 327-5, Vol. 8) [CEB 841207 011], (Branch/Chief: 12/07/84)

27. PIRWBNCEB8573, "Problem Identification Report," concerns: "substitution of fillet weld in place of concrete anchors when a surface mounted plate overlaps an embedded plate . . . ," (TTB 327-5, Vol. 8), [B41 851220 016], (approved 12/20/85)

28. PIRBLNCEB8626, "Problem Identification Report," concerns: ". . . analysis problems were issued without a documented procedure . . .," (TTB 327-5, Vol. 8), [B41 860805 008], (approved 08/05/86) (Partial copy, see also Ref. C.11.22)

29. BLNBLP8231, "Nonconformance Report," concerns: CEB 76-11 excludes from its scope components not listed in App. E that are, nevertheless, within one CEB 76-11 calculation, (TTB 381-7), [BLP 821112 023], (11/09/82)

30. BLNCEB8411, "Nonconformance Report" concerns: welded attachments to intensified components in violation of CEB 76-11, (TTB 381-7), [CEB 840731 012], (07/25/84)

31. BLNBLP8403, "Nonconformance Report" concerns: wrong pipe movement data, (TTB 381-7), [CEB 840412 015], (03/23/84)

32. BLNCEB8405, "Nonconformance Report" concerns: wrong allowable lug stress, (TTB 381-7), [CEB 840409 007], (04/09/84)

33. BLNCEB8205, "Nonconformance Report" concerns: no flange evaluations, (TTB 383-5), [CEB 820521 001], (05/13/82)

34. Memo, to J. P. Wooten, from W. A. English, "Bellefonte Nuclear Plant - NCR BLNBLP8404 - Failure to Ensure Thermal Gap Requirements in Support Designs, "(TTB 383-5), [BLP 840621 015], (06/18/84)

35. 88 M 3GB0054-00 (series of drawings, proposed revisions to C.11.67), "Seismic Cat. I Structures, Mechanical, Seismic Support, Process Pipe 2-1/2 [inches] through 6 [inches] Dia, Requirements and Guidelines for Locating and Designing Seismic Supports for Cat. I & I(L)A Piping Systems 2-1/2 [inches] thru [sic] 6 [inches] Dia in Category I Structures," (TTB 327-5, Vol. 4), [no RIMS number], (dates and revision number vary from sheet to sheet)

36. BLN-NB-D054-19, R8, calculation, "Chemical Addition & Boron Recovery System," (TTB 391-5) [BLP 850218 240] (no date)

37. BLN-NS-D053-09, R2, calculation, "Reactor Bldg. Spray (NS) Piping Analysis, NaOH Tank Loop Seal, Unit 2, " (TTB 391-5) [BLP 840214 245] (02/14/84)

38. BLN-KC-D053-28, R5, calculation, "Alternate Analysis - Component Cooling System, Waste Gas Compressor Discharge," (TTB 391-5) [BLP 850221 207] (02/21/85) (for p. 27, see Ref. C.11.39)

39. Page 27 of calculation BLN-KC-D053-28 (TTB 403-2) [no RIMS no.], (R0, 11/24/78, R5, 02/12/85) (see also Ref. C.11.38)

40. S K 0478-NB-11G, R2, drawing, "Reactor Bldg. Unit 1, Chemical Addition & Boron Recovery System Elev. 622'0 [inches]," (TTB 391-5) [no RIMS number] (08/31/82)

41. S K 0455-KD-03F, drawing, "Aux. Bldg., Mechanical, Control Rod Drive Cooling System," (TTB 391-5) [no RIMS number] (02/28/83)

42. S K 0455-KD-04F, drawing, "Aux. Bldg., Mechanical, Control Rod Drive Cooling System," (TTB 391-5) [no RIMS number] (02/28/83)

43. 88 M 3AH0478-NB-81F, R0, drawing, "Reactor Bldg. Unit 1, Chem. Add. & Boron Rec. Sys., El. 622'-0 [inches], Table of Support Loads," (TTB 391-5) [no RIMS number] (06/30/82)

44. Calculation, TVA, Bellefonte units 1 and 2, "Instrument Line Tubing Supports - Allowable Loads," (TTB-475-3) [B21 850809 422], (10/09/85)

45. 88 M 3BH0455-KD-02F, R0, drawing, "Aux. Bldg., Mechanical - Control Rod Drive Cooling System, Table of Support Loads, " (TTB 391-5) [no RIMS number] (04/14/83)

46. 88 M 3BH0419-NV-38, R8, drawing, "Alternate Analysis, Units 1 and 2, Makeup and Purification System, Table of Support Loads," (TTB 391-5) [no RIMS number] (02/21/79)

47. 88 M 3BH0419-NV-39, R4, drawing, "Alternate Analysis, Units 1 and 2, Makeup and Purification System, Table of Support Loads," (TTB 391-5) [no RIMS number] (07/14/87)

48. List of alternate analysis problem numbers (in two parts) (TTB 327-5, Vol. 8) [no RIMS number], (04/03/87)

49. 88 M 3BH0419-NV-40, R2, drawing, "Alternate Analysis, Units 1 and 2, Makeup and Purification System, Table of Support Loads," (TTB 391-5) [no RIMS number] (11/03/84)

50. "List of Field-Analyzed Problems," (TTB 327-5, Vol. 8), [no RIMS number], (02/19/87)

51. 88 M 3BH0419-NV-54, R5, drawing, "Alternative Analysis, Unit 2, Makeup and Purification System, Table of Support Loads," (TTB 391-5) [no RIMS number] (07/18/85)

52. 88 M 3BH0419-NV-79, R1, drawing, "Units 1 & 2, Makeup and Purification System, Table of Support Loads," (TTB 391-5) [no RIMS number] (09/12/85)

53. 88M 3AH0478-NB-18,R9, drawing, "Auxiliary Building, Units 1 and 2, Mechanical, Chemical Addition and Boron Recovery System, Table of Support Loads, " (TTB 391-5) [no RIMS number] (03/14/85)

54. 88 M 3AH0478-NB-19, R12, drawing, "Auxiliary Building, Units 1 and 2, Mechanical, Chemical Addition and Boron Recovery System, Table of Support Loads, " (TTB 391-5) [no RIMS number] (08/14/85)

55. 88 M 3AH0478-NB-20, R8, drawing, "Auxiliary Building, Units 1 and 2, Mechanical, Chemical Addition and Boron Recovery System," (TTB 391-5) [no RIMS number] (10/06/86)

56. 88 M 3AH0478-NB-21, R5, drawing, "Auxiliary Building, Units 1 and 2, Mechanical, Chemical Addition and Boron Recovery System, Table of Support Loads, " (TTB 391-5) [no RIMS number] (10/31/84)

57. 88 M 3BH0416-NS-02, R3, "Auxiliary Building, Unit 2, Reactor Bldg. Spray, Table of Support Loads," (TTB 391-5) [no RIMS number] (03/06/84)

58. 88 M 3BH0456-KC-14, R5, drawing, "Units 1 and 2, Component Cooling System, Table of Support Loads," (TTB 391-5) [no RIMS number] (11/03/84)

59. 88 M 3BH0456-KC-15, R5, drawing, "Units 1 and 2, Component Cooling System, Table of Support Loads," (TTB 391-5) [no RIMS number] (11/03/84)

60. 88 M 3BH0456-KC-16, R9, drawing, "Units 1 and 2, Component Cooling System, Table of Support Loads," (TTB 391-5) [no RIMS number] (date illegible)

61. BLN-NV-D053-15, R2, calculation, "Alternate Analysis, Makeup and Purification System," (TTB 391-5) [no RIMS number] (03/28/85)

62. 88 M 3GB0053-00 (series of drawings, proposed revisions to C.11.68), "Seismic Cat. I Structures, Mechanical, Seismic Support, Process Pipe 2 [inches] Dia & Less, Requirements and Guidelines for the Design and Installation of Seismic Supports for Cat. I & I(L)A Piping 2 [inches] & Less in Category I Structures," (TTB 327-5, Vol. 4), [no RIMS number], (dates and revision number vary from sheet to sheet)

63. TCAB-643, 08/13/87

64. TCAB-635, 08/06/87

65. McMahan, S. D., Rasbury, E. W., Consumo, N. F. (TVA), "Review of Alternate Analysis for Bellefonte Nuclear Plant," [no RIMS number], (10/17/84)

66. TVA written reply to Bechtel RFI 1501, (03/30/87)

67. 88 M 3GB0054-00 (series of drawings), "Seismic Cat. I Structures, Mechanical, Seismic Support, Process Pipe 2-1/2 [inches] through 6 [inches] Dia, Requirements and Guidelines for Locating and Designing Seismic Supports for Cat. I & I(L)A Piping Systems 2-1/2 [inches] thru [sic] 6 [inches] Dia in Category I Structures," (TTB 327-5, Vol. 2), [no RIMS number], (dates and revision numbers vary from sheet to sheet)

68. 88 M 3GB0053-00 (series of drawings), "Seismic Category I Structures, Mechancial, Seismic Support, Process Pipe 2 [inches] Dia & Less, Requirements and Guidelines for the Design and Installation of Seismic Support for Cat. I and I(L)A Piping 2 [inches] & Less in Category I Structures," (TTB 327-5, Vol. 2), [no RIMS number], (dates and revision numbers vary from sheet to sheet)

C.12 Element 218.5 BFN

1. Bechtel (North American) Power Corporation, Job 16985-007, "Browns Ferry Nuclear Power Plant, Report on Technical Review of TVA Program to Implement NRC Bulletin 79-14" (TTB 176-2[2]), [B41 860107 008], (12/85)

2. TVA memo from J. P Stapleton, Project Engineer, (BFEP, DNE) to W. R. Brown, Programs Manager (ECTG, WBN, ONP), "Nuclear Manager's Review Group (NMRG) Report I-84-33-BFN - Investigation of BFN Piping and Support Design" (TTB 176-2[4]), [B22 860912 201], (09/12/86)

3. BFEP-PI 85-01, TVA, "Implementation of NRC-OIE Bulletins 79-02/79-14 for Browns Ferry Nuclear Plant," R1 (draft) (TTB 176-2[6]), [no RIMS number], (01/06/86)

4. BFEP-PI 86-05, TVA, BFN, "NRC-OIE Bulletin 79-02/79-14 Program Document for Browns Ferry Nuclear Plant," (TTB 176-2[9]), [B22 860805 011], (07/29/86)

5. BFN-50-D707, TVA, "Detailed Design Criteria for Analysis of As-Built Piping Systems" (TTB 178, Vol.1), [B42 850501 501], R0, (08/11/80), R3, (04/17/85)

6. BF MMI-99, TVA, BFN, "Instructions for the Implementation of [hand marked "Phase I"] NRC IE Bulletin 79-14, Units 1, 2, and 3" (TTB 176-2[7]), [no RIMS number], (hand marked copy of 11/15/85 issue)

7. BFEP-PI 86-06, TVA, "Implementation of NRC-OIE Bulletin 79-14 Phase II Verification for Browns Ferry Nuclear Plant," (no revision number) (TTB 176-2[10]), [no RIMS number], (no date)

8. BFN-50-D711, TVA, BFN, "Detailed Design Criteria for Analysis of Torus Attached Piping (Long-Term Torus Integrity Program)" (TTB 178, Vol. 1), [B42 850719 502], R0, (07/27/82), R2, (07/12/85)

9. BFN-50-712, TVA, "Detailed Design Criteria, Seismically Qualifying Field Run Piping (sizes 1/2 through 2 inches)" (TTB 178, Vol. 2), [B42 860103 505], R0, (11/29/72), R4, (11/25/85)

10. Report 0600002, "Browns Ferry Nuclear Power Station, Earthquake and Dead Load Criteria for Small Diameter Piping," Engineering Data Systems, San Francisco, CA (TTB 204-3), [no RIMS number], (01/10/70)

11. TVA Corporate Plan for Browns Ferry (draft), (TTB 176-2[1]), (12/16/86)

12. BFN-50-713, TVA, "Detailed Design Criteria for Seismically Qualifying Field-Run Tubing (sizes 1/4 through 1-1/2 inches)" (TTB 178, Vol. 2), [ESB 840829 202], R0, (11/17/81), R2, (08/27/84)

13. EN DES-SEP 81-02, TVA, BFN, "Special Engineering Procedure, Implementation of NRC-OIE Bulletin 79-14 for [BFN]" (TTB 208, Vol. 6), [CEB 811221 014], (12/21/81)

14. CEB-83-34, TVA, "[BFN] Torus Integrity Long-Term Program, Plant Unique Analysis Report" (TTB 208, Vol.5), [CEB 841210 008], R0, (12/21/83), R2, (12/10/84)

15. BFN-50-D706, TVA, "General Design Criteria for the Torus Integrity Long-Term Program" (TTB 178, Vol. 1), [ESB 840621 205], R0, (07/24/80), R1, (06/20/84)

16. DIM-BFN-50-D707-3, TVA, "Design Input Memorandum Analysis of As-Built Piping Systems, BFN-50-D707" (TTB 178, Vol.1), [841 861124 017], (11/24/86)

17. DIM-BFN-50-712-1, TVA, "Design Input Memorandum for Seismically Qualifying Field Run Piping (sizes 1/2 through 2 inches), BFN-50-712" (TTB 178, Vol. 2), [B41 861124 008], (11/24/86)

18. CEB-84-20, TVA, "Stress Intensification Factors for Browns Ferry, Sequoyah, Watts Bar, Bellefonte," originated by G. C. Slagis Associates (reply, RFI 1150, telecopied 03/27/87 14:17) [CEB 840906 002], (09/06/84)

19. TVA, "Browns Ferry Nuclear Plant, Rigorous Analysis Handbook," (TTB 204-04[2]), [no RIMS number], (no date)

20. OEP-7, TVA, Office of Engineering, Engineering Program Directive, "Calculations" (TTB 2) [no RIMS number], R0, (04/26/87)

21. OEP-16, TVA, Office of Engineering, Engineering Program Directive, "Design Records Control" (TTB 2) [no RIMS number], R0, (04/26/87)

22. NEP 3.1 (was OEP-07), TVA Division of Nuclear Engineering, Nuclear Engineering Procedure, "Calculations" (TTB 61 4) [B05 860701 003], R0, (07/01/86)

23. NEP 1.3 (was OEP-16), TVA Division of Nuclear Engineering, Nuclear Engineering Procedure, "Records Control" (TTB 61 4) [no RIMS number], R0, (07/01/86)

24. MPR-751, MPR Associates, "Mark I Containment Program Augmented Class 2/3 Fatigue Evaluation Method and Results for Typical Torus Attached and S/RV Piping Systems," [no RIMS number], (11/82)

25. N1-373-5R, TVA, calculation (TTB 312-17), [BWP 340817 102], two volumes, R3, (08/17/84)

26. N1-064-6R, TVA, calculation (TTB 312-17), [CEB 841227 759], R3, (12/21/84)

27. N1-264-4R, TVA, calculation (TTB 312-17), [B22 861112 104], R5, (11/12/86)

28. N1-175-1RA, TVA, calculation (TTB 312-17), [B22 851231 102], R8, (12/31/85)

29. N1-371-3R, TVA, calculation (TTB 312-17), [CEB 841227 765], R1, (12/21/84)

30. N1-273-2R, TVA, calculation (TTB 312-17), [B22 861219 152], R3, (12/19/86)

31. Computer output for TVA calculation NI-64-6R, TVA microfilm roll 50407 (reply, RFI 1234) [no RIMS number], (no date)

32. Computer analysis for Calculation N1-064-6R (reply, RFI 1234)

33. Computer analysis for Calculation N1-175-1RA (TTB 351)

34. 67 M 47W458-209, R3, TVA, drawing [no RIMS number] (reply, RFI 1226) (03/10/86)

35. 67 M 47W458-210, R3, TVA, drawing [no RIMS number] (reply, RFI 1226) (08/09/86)

36. 67 M 47W458-211, R1, TVA, drawing [no RIMS number] (reply, RFI 1226) (06/11/82)

37. 67 M 47W403-206, R2, TVA, drawing [no RIMS number] (reply, RFI 1226) (07/17/84)

38. 67 M 47W403-207, R2, TVA, drawing [no RIMS number] (reply, RFI 1226) (07/17/84)

39. 67 M 47W403-208, R3, TVA, drawing [no RIMS number] (reply, RFI 1226) (02/21/85)

40. 67 M 47W403-209, R3, TVA, drawing [no RIMS number] (reply, RFI 1226) (09/05/84)

41. 67 M 47W403-210, R2, TVA, drawing [no RIMS number] (reply, RFI 1226) (07/17/84)

42. 67 M 47W456-211, R2, TVA, drawing [no RIMS number] (reply, RFI 1226) (12/16/85)

43. 67 M 47W455-206, R1, TVA, drawing [no RIMS number] (reply, RFI 1226) (12/22/86)

44. 67 M 47W920-207, R1, TVA, drawing [no RIMS number] (reply, RFI 1226) (07/25/84)

45. 67 M 47B458-114, R2, TVA, drawing [no RIMS number] (reply, RFI 1290)

46 TCAB-460, 07/26/87

C.13 Element 218.6 WBN

1. List, Rigorous and Alternate analysis piping problems, TVA-WBN, (TTB 220), [no RIMS number], (01/27/87)

2. TVA, Watts Bar Nuclear Plant rigorous piping analysis design calculations:

Problem No.	Revision	Date	RIMS Accession Number	TTB
250-03-01	R4	06/03/86	B41 860603 950	237
200-13-03	R10	02/08/85	CEB 850208 935	237
N3-62-2A	R4	06/04/84	CEB 840604 012	237
N3-70-2R	R1	06/19/85	B41 850619 975	237
N3-74-1A	R12	05/13/85	B41 850513 965	237
200-08-02	R9	11/29/83	WBP 831129 408	237
200-03-01	R14	09/20/85	B41 850920 959	237
N3-63-3A	R5	01/30/85	CEB 850130 914	237
200-02-01	R8	03/20/84	CEB 840320 007	237
CLI-250-03-01	R1	06/30/86	B41 860904 009	237

3. TCAB 240, 03/06/87

4. TVA, WBN Design Criteria WB-DC-40-31.7,R7, (TTB 2), [B42 860129 501], (01/21/86)

5. TVA, WBN FSAR, Sections 3.0, Volume 4,(TTB 2), [no RIMS number], (no amendment number, no date)

6. TVA, Watts Bar Nuclear Plant alternate piping analysis design calculations:

Problem No.	Revision	Date	MEDS Accession Number	TTB
74202	0	02/06/85	CEB 850206 956	241
N3-67-A10A	R1	08/04/86	B41 860804 951	241
63201	R0	02/16/85	CEB 350222 919	241
N3-67-A27R	R1	05/18/84	WBP 840514 007	241
N3-62-A20R	R0	10/25/83	WBP 831025 040	241
7203	R0	07/09/84	WBP 840710 020	241
N3-63-A11R	R0	12/21/83	WBP 831221 053	241
N3-70-R06A	R2	10/02/84	CEB 841002 907	241
N3-62-02A	R0	12/21/83	WBP 8311221 060	241
03021	R0	10/21/85	B41 851021 958	241

C.14 Element 218.7 SQN

1. TVA, Sequoyah Nuclear Plant, Rigorous Analysis Handbook, Section SQN-RAH-206, Rev. 0, (Att. 1 to reply to RFI 509, CEB 830825 008) (08/25/83)

2. TVA, "Review of Piping Analysis for Adequate Termination," SDR S048, (Att. 2 to reply to RFI 509, B41 860227 003) (02/27/86)

3. TVA, Sequoyah Nuclear Plant, Alternate Analysis Review Program, "Program Description," SQN-AA-001, (Att. 4 to reply to RFI 509, B25 860708 008) (07/01/86)

4. TVA, Sequoyah Nuclear Plant, Rigorous Analysis Handbook, Section SQN-RAH-401, Rev. 1, (Att. 5 to reply to RFI 509, B25 851115 001) (11/15/85)

5. U.S. NRC, NUREG/CR-1980, BNL-NUREG 51357: "Dynamic Analysis of Piping Using the Structural Overlap Method," 02/81

6. U.S. NRC, Standard Review Plan

7. TVA, Sequoyah Nuclear Plant, "Procedure for Detailed Analysis of Category I Piping Performed by TVA, DED-EP 21.10, Rev. 0," (TTB 212-8, no RIMS #, replacement copy), (10/30/75)

8. TVA, "Alternate Piping Analyses and Support Criteria for Category I Piping Systems, Design Criteria No. SQN-DC-V-13-7, 4-1-73, Rev. 2," (Reply to RFI 559[7], ESB 841012 203) (10/04/84)

9. TVA Drawing No. 47K435-60, R2 (04/22/81) (Reply to RFI 570, no RIMS #)

10. TVA Drawing No. 0600102-09-01, R8 (Reply to RFI 570, no RIMS #) (04/10/84)

11. TVA Drawing No. 47K435-58, R0 (02/27/78) (Reply to RFI 570, no RIMS #)

12. TVA Drawing No. 47K435-53, R6 (07/05/84) (Reply to RFI 570, no RIMS #)

13. TVA Drawing No. 47K432-50, R8 (07/05/84) (Reply to RFI 570, no RIMS #)

14. TVA Drawing No. 47K406-57, R5 (11/04/80) (Reply to RFI 570, no RIMS #)

15. TVA Drawing No. 0600152-09-02, R5 (05/15/81) (Reply to RFI 570, no RIMS #)

16. TCAB-68, Corrective Action Plan (CAP) for Element 218.7(B), (01/26/87)

C.15 Element 218.7 WBN

1. TVA, Watts Bar Nuclear Plant Rigorous Analysis Handbook, Section WBN-RAH-202: "Analysis Boundaries and Decoupling Criteria," R0, [B41 850920 001], (09/20/85)

2. CEB-EP 21.12, "Procedure for a Detail Analysis of Category I and I(L) Piping Systems," R0, (TTB-452-3), (12/12/78)

3. CEB-EP 21.12, "Class 2 and 3 Piping Analysis," R3, [ESB 831205 201], (12/01/83)

4. WB-DC-40-31.7, "Analysis of Category I and I(L) Piping Systems," R7, [B42 860129 501], (01/21/86)

5. Letter, R. Baer, Chief, Light Water Reactors Branch No. 2, Division of Project Management, US NRC, to William O. Parker, Jr., Vice-President, Steam Production, Duke Power Co., "Criteria for Piping Modeling Technique - Structural Overlapping (McGuire Nuclear Station, Units 1 and 2)," (10/03/78)

6. CEB-76-5, "Alternate Criteria for Piping Analysis and Support," R3, [CEB 830613 026], (06/13/83)

7. TVA Clarification of RAH-202 Philosophy (reply to RFI-048), (TTB-473-12) (05/06/86)

8. OE-SEP 82-18, "Program for Alternate Analysis Fix - Coordinating, Documenting, and Verifying," R3, [No RIMS number], (no date), (R2, B26 B50503 001, 05/03/85)

9. WBEP-EP 43.21, "Alternate Analysis of Piping Systems - Documenting and Verifying," R0, (TTB-2), (01/09/86)

10. Rigorous Analysis Handbook Policy Statement 1, [CEB 830425 024], (04/25/83)

11. Rigorous Analysis Handbook Policy Statement 2, [CEB 830218 013], (01/08/83)

12. TVA, Watts Bar Nuclear Plant, Rigorous Analysis Handbook, Section WBN-RAH-400, "Watts Bar Nuclear Plant Rigorous Analysis Checklist," R3, [B41 851113 020], (11/13/85)

13. Bechtel Plant Design Calculation Number PD-218-02, R0, Job Number 16985-026, (06/02/86)

14. EN DES Calculations, Piping Analysis Package Problem Number N3-26-A42A, R2, [CEB 850209 884], (02/08/85)

15. EN DES Calculations, Alternate Analysis Problem Number 26238, R0, [CEB 850209 883], (TTB-220), (02/14/85)

16. EN DES Calculations, Alternate Analysis Problem Number 26234, R0, [CEB 850214 818], (TTB-220), (01/31/85)

17. EN DES Calculations, Alternate Analysis Problem Number 26227, R0, [CEB 850209 899], (TTB-220), (01/02/85)

18. EN DES Calculations, Alternate Analysis Problem Number 26228, R0, [CEB 850214 822], (TTB-220), (02/14/85)

19. EN DES Calculations, "Alternate Analysis for System 26I, Drawing H-491-3, Sheet 22 2607," R1, [CEB 850209 837], (TTB-220), (01/03/85)

20. TCAB-209, 02/25/87

21. TVA, Watts Bar Nuclear Plant, Rigorous Analysis Handbook, Section WBN-RAH-202, "Analysis Boundaries and Decoupling Criteria," R0, [B41 850920 001], (09/20/85)

C.16 Element 218.7 BFN

1. Report No. 0600002, "Browns Ferry Nuclear Power Station, Earthquake and Dead Load Criteria for Small Diameter Piping," Engineering Data Systems, San Francisco, CA (TTB 204-3), [no RIMS number], (01/10/70)

2. BFN-50-712, TVA, "Detailed Design Criteria, Seismically Qualifying Field Run Piping (sizes 1/2 through 2 inches)" (TTB 178, Vol. 2,) [B42 860103 505], R0, (11/29/72), R4, (11/27/85)

3. BFN-50-D706, TVA, "General Design Criteria for the Torus Integrity Long-Term Program," (TTB 178, Vol. 1), [ESB 840621 205], R0, (07/24/80), R1, (06/20/84)

4. BFN-50-D707, TVA, "Detailed Design Criteria for Analysis of As-Built Piping Systems" (TTB 178, Vol. 1), [B42 850501 501], R0, (08/11/80), R3, (04/17/85)

5. BFN-50-D711, TVA, BFN, "Detailed Design Criteria for Analysis of Torus Attached Piping (Long-Term Torus Integrity Program)" (TTB 178, Vol. 1), [B42 850719 502], R0, (07/27/82), R2 (07/12/85)

6. BFN-RAH-100 through 501, "[BFN] Rigorous Analysis Handbook Class 2 and 3 Analysis," (TTB 204-4 [2]), (09/29/83 through 09/11/86)

7. Trip Report - Browns Ferry Nuclear Plant from March 16 to March 19, 1987, BLT-166, (03/27/87)

8. TCAB-433, 07/15/87

C.17 Element 218.7 BLN

1. "Bellefonte Nuclear Plant, Rigorous Analysis Handbook, Class 2 & 3 Analysis, Section BLN-RAH-204: Geometry Modeling Conventions," (TTB 357), R2, [B41 860603 019], (06/03/86)

2. CEB 76-11, "CEB Report: Bellefonte Nuclear Plant Alternate Criteria for Piping Analysis and Support," (TTB 327-5, Vol. 3), R2, [CEB 840106 027], (01/06/84)

3. DC-N4-50-D711, "General Design Criteria, Bellefonte Nuclear Plant, Detailed Analysis and Seismic Qualification of Category I and I(L) Piping Systems," (TTB 347-2, Vol. 1), R3 [B42 851112 524], (10/17/85)

4. McMahan, S.D., Rasbury, E.W., Consumo, N.F., "Review of Alternate Analysis for Bellefonte Nuclear Plant," (TTB 327-5, Vol. 8), [no RIMS number], (10/17/84)

5. "Bellefonte Nuclear Plant, Rigorous Analysis Handbook, Class 2 & 3 Analysis, Section BLN-RAH-204: Geometry Modeling Conventions," (TTB 453-5), R0, [CEB 840305 011], (03/05/84)

6. "Bellefonte Nuclear Plant, Rigorous Analysis Handbook, Class 2 & 3 Analysis, Section BLN-RAH-204: Geometry Modeling Conventions, Policy Statement No. 12," (TTB 453-5), [CEB 841030 003], (10/30/84)

7. "Bellefonte Nuclear Plant, Rigorous Analysis Handbook, Class 2 & 3 Analysis, Section BLN-RAH-204: Geometry Modeling Conventions," (TTB 453-5), proposed revision to [C.17.01 above], [no RIMS number], (not issued)

8. BLEP-20, "Bellefonte Engineering Project, Project Manual: Program for Alternate Analysis Fix: Reviewing, Verifying and Documenting," (TTB 327-5, Vol. 4), [no RIMS number], [not issued]

9. BLN-SAH-206, "Bellefonte Nuclear Plant, Simplified Analysis Handbook, Class 2 and 3 and Category I(L) Analysis: Problem Boundary Definitions," (TTB 327-5, Vol. 7), [no RIMS number], (not issued)

10. TCAB-636, 08/06/87

C18. Element 218.8 WBN

1. Drawing 85 M 47W465-200, R6, (TTB 16-7), (05/02/84)

2. Computer Model Input, Calculations N3-68-1R, (12/13/83), (unit 1), N3-68-7R, (03/04/85), (unit 2), (TTB 16-7)

3. Study Reanalysis of Calculation N3-68-1R, (04/25/86), (TTB 25)

4. Drawings defining arrangement and support of instrument tubing near attachment to monitored piping (Reply to RFI 060)

5. WBN-RAH-203, "Watts Bar Nuclear Plant, Rigorous Analysis Handbook, Class 2 and 3 Analysis: Physical Data," R0, (TTB 5), [B41 850805 006], (08/05/85)

6. CEB-EP 21.12, "Class 2 and 3 Piping Analysis," (TTB 5), R3, [ESB 831205 201], (12/01/83)

7. Memorandum from J. McCord to Rigorous Analysis Section, [no RIMS number], (07/02/86), (Reply to RFI 127)

8. Excerpts from CASD Modeling Data Bases Reference Manual, [CEB 831207 500], (12/02/83) and Condensed Input Processor (CIP), Version 2.0, User's Manual, [no RIMS number], (04/19/85), (Reply to RFI 179)

9. Bechtel Review of Reducer Modeling - selected problems, S. Chitnis, (04/17/86) (IOM 2206)

C.19 Element 218.9 WBN

1. TVA memo, R. G. Domer to R. M. Pierce, "Sequoyah and Watts Bar Nuclear Plants Units 1 and 2 - Allowable Clearance Between Containment Vessel and External System Appurtenances," [CEB 770603 006], (06/03/77)

2. TVA memo, R. G. Domer to R. M. Pierce, "Watts Bar Nuclear Plant, Units 1 and 2 - Contract 73C61-75320, N3S-1 - Containment Vessel Movements," [CEB 790817 016], (08/17/79)

3. TVA memo, R. G. Domer to R. M. Pierce, "Watts Bar Nuclear Plant Units 1 and 2 - Contract 73C61-75320, N3S-1 - Containment Vessel Movements," [CEB 790918 014], (09/18/79)

4. TVA memo, R. M. Pierce to T. B. Northern, Jr., "Watts Bar Nuclear Plant Units 1 and 2 - Allowable Clearance Between Containment Vessel and System Appurtenances - WBN-96," [SWP 790926 005], (09/25/79)

5. TVA informal memo, E. Cole to A. Jonsson, "Watts Bar Nuclear Plant - Movement of the Steel Containment Vessel (SCV)," (TTB-473-9), (08/05/85)

6. Letter, G. L. Parkinson, Bechtel, to G. R. McNutt, TVA, Trip Report, BLT-126, (02/17/87)

7. TCAB 223, 03/04/87

C.20 Element 218.10 WBN

1. Plant Walkdown Report by S. S. Chitnis and A. M. Bree, BLT 018, (06/09/86)

2. TVA, CEB-77-42, Static Pipe Support Tests and Development, Sequoyah Nuclear Plant units 1 and 2, (TTB12), [CEB 801030 012], (10/25/77)

3. Bechtel, Project Calculation PD-218-07, B001-Type Supports - WBN, R0, (07/10/86)

C.21 Element 218.11 WBN

1. ECN 5779, [B26 850621 508], (06/20/85)

2. PIR WBN CEB8603, R2, [B26 861010 014], (09/11/86)

3. TCAB-221, 03/02/87

4. Revision 0, 1, 901, and 902 of hanger drawing 72-1CS-R116

5. TVA Pipe Support Design Manual, Volume 2

C.22 Element 218.11 BLN

1. TVA, Bellefonte Nuclear Plant, Significant Condition Report SCR BLN CEB8603, (TTB 320), [B41 860124 009], (01/17/86)

2. TVA, Bellefonte Nuclear Plant design isometric drawings:

Drawing Number	Revision	Date	TTB	RIMS Number
1AW1453-KE-HI	R10	05/11/77	357	None
1AW2418-CA-B1	R5	05/11/79	357	None
1AW2418-CA-B2	R3	05/11/79	357	None
1AW0454-NM-W2	R5	01/25/80	357	None

3. TVA, Bellefonte Nuclear Plant support design detail drawings:

Drawing Number	Revision	Date	TTB	RIMS Number
1KE-MPHG-1537	R1	11/08/84	357	None
2CA-MPHG-0060	R3	12/30/85	357	None
ONM-MPHG-0439	R2	09/27/82	357	None
ONM-MPHG-0623	R6	07/18/84	357	None

4. TVA, Bellefonte Nuclear Plant piping analysis design calculations N4-1KE-G and N4-1KE-H, R5, (TTB 357), [B21 860402 200], (04/02/86)

5. TVA, Bellefonte Nuclear Plant piping analysis design calculation N4-2CA-B, R1, (TTB 357), [B21.851226 200], (12/26/85)

6. TVA, Bellefonte Nuclear Plant piping analysis design calculation N4-1NM-X, R2, (TTB 357), [B21 861208 200], (12/16/86)

7. TVA, Bellefonte Nuclear Plant pipe support design calculation 1KE-1537, R2, (TTB 357), [B21 851231 402], (12/31/85)

8. TVA, Bellefonte Nuclear Plant pipe support design calculation 2CA-0060, R0, (TTB 357), [B44 860121 482], (01/21/86)

9. TVA, Bellefonte Nuclear Plant pipe support design calculation ONM-0439, R1, (TTB 357), [BLP 850211 253], (02/11/85)

10. TVA, Bellefonte Nuclear Plant pipe support design calculation ONM-0623, R0, (TTB 357), [MEB 840719 450], (07/19/84)

11. TVA, Bellefonte Nuclear Plant support design load drawing 1AB-1453-KE-H2, R7, (TTB 357), [no RIMS number], (05/11/87)

12. TCAB 637, 08/06/87

C.23 Element 218.12 BFN

1. Procedure Number MAI-23, TVA, BFN, "Support and Installation of Piping Systems in Category I Structures," (08/17/83), R1, (02/06/87)

2. Procedure Number MMI-164, TVA, BFN, "Temporary Removal and Reinstallation of Pipe Supports," R0, (05/24/86), R2, (01/30/87)

3. Memorandum, TVA, "Browns Ferry Nuclear Plant (BFN) Unit 2 - Torus Integrity Long-Term Program - Minimum Hanger Configuration During Performance of Torus Attached Piping Modifications," [BFP 841114 004], (11/08/84)

4. Memorandum, TVA, "Browns Ferry Nuclear Plant (BFN) Unit 2 - Torus Integrity Long-Term Program - Minimum Hanger Configuration During Performance of Torus Attached Piping Modifications," [BFP 850222 011], (02/22/85)

5. Memorandum, TVA, "Browns Ferry Nuclear Plant - Unit 3 - P0361, P0362, and P0392 - Minimum Hanger Requirements During Repair of Piping Support Discrepancies for Supports Modified During Cycle 5 Outage," [822 850801 006], (08/01/85)

6. Trip Report, Browns Ferry Nuclear Plant from March 16 to March 19, 1987, BLT-166, (03/27/87)

7. Telecon, R. T. Deal (TVA) to M. H. Malkani (Bechtel), IOM 935, (04/20/87)

C.24 Element 218.13 BFN

1. Report, TVA, Nuclear Safety Review Staff Investigation Report I-85-435-BFN, attachment to Memo from K. W. Whitt, Director of NSRS, E3A8 C-K to W. C. Bibb, Plant Manager, BFN, (01/10/86)

2. Memo, TVA, "RE: NSRS Report I-85-435-BFN," from W. C. Bibb, Site Director, BFN to K. W. Whitt, Director of NSRS, E3A8 C-K, (02/20/86)

3. Memo, TVA, "BFN - Drywell Purge Line Interference," from R. L. Lewis, Plant Manager, BFN to E. P. Schlinger, Manager, Engineering and Modifications, BFN, [R35 860116 873]], (01/23/86)

4. Drawing, TVA, Mechanical Heating and Ventilating Plans and Sections, drawing number 47W 920-8, R0, (10/14/86), R21, (01/16/87)

5. Sketches, TVA, "2-Inch Pipe Re-routed for ECN P0384," from H. Miller, BFN to N. R. Beasley, 6206 MIB-F, [no RIMS number], (03/09/83)

6. TCAB-461, 07/26/87

7. Trip Report, Browns Ferry Nuclear Plant, March 16 through 19, 1987, BLT-166, (03/27/87)