EMPLOYEE CONCERNS

SPECIAL PROGRAM

VOLUME 2
ENGINEERING CATEGORY

SUBCATEGORY REPORT 22100
PIPE SUPPORT DESIGN

UPDATED

TVA

NUCLEAR POWER

8902150218 890206
PDR ADOCK 05000259
P PDC

TVA EMPLOYEE CONCERNS
SPECIAL PROGRAM

REPORT NUMBER: 22100

REPORT TYPE: SUBCATEGORY REPORT FOR ENGINEERING

REVISION NUMBER: 4

TITLE: PIPE SUPPORT DESIGN

REASON FOR REVISION:

1. Revised to incorporate SRP and TAS comments.
2. Revised to incorporate TAS comments and to add Attachment C (References).
3. Revised to incorporate SRP and TAS comments.
4. Revised to incorporate TAS comments and to clarify references.

PREPARATION

PREPARED BY:

Melissa Pang Allen Peters — SIGNATURE — 12/9/87 DATE

REVIEWS

~~TEAM~~: REVIEW COMMITTEE

Karl Wiedner — SIGNATURE — 12-9-87 DATE

TAS:

James E Wardby III — SIGNATURE — 12/11/87 DATE

CONCURRENCES

		CEG-H: George R McNutt	12-11-87
		SRP: Jimmie W Cofer	12-14-87
SIGNATURE	DATE	SIGNATURE*	DATE

APPROVED BY:

James R Russell — ECSP MANAGER — 12-11-87 DATE

* SRP Secretary's signature denotes SRP concurrences are in files.

EXECUTIVE SUMMARY

This report for Subcategory 22100, Pipe Support Design, summarizes and evaluates the results of 14 Employee Concerns Special Program element evaluations. The element evaluations document the review of 24 issues (as noted in Table 1) related to TVA's four nuclear plants, Sequoyah (SQN), Watts Bar (WBN), Browns Ferry (BFN), and Bellefonte (BLN). The issues were derived from a total of 13 employee concerns that cited perceived deficiencies in pipe support design.

Of the 24 issues evaluated, 17 were found to require no corrective action. For the remainder, six corrective actions were identified to remedy the seven negative findings. One of the corrective actions was initiated by TVA before the Employee Concerns Task Group evaluations, three are new actions required to resolve the issues, and two are actions required to resolve peripheral findings identified during the evaluation.

Four of the six corrective actions for this subcategory were judged to be significant with respect to cost and plant safety. Regeneration of destroyed and missing calculations at Watts Bar is significant in terms of the time and cost to replace them. Evaluation of deficient B001 type supports at Sequoyah and Watts Bar is necessary to determine the impact on affected safety systems. Replacement of the support in the upper head injection system at Sequoyah is required to reconcile the as-constructed condition with the required design configuration.

The finding pertaining to destroyed and missing calculations is significant because it reveals shortcomings in control of the design process and communication, and inattention on the part of TVA management. Although the related issue was not evaluated for Sequoyah, the regeneration of the pipe support design calculations, which is in progress at Sequoyah, confirms the existence of a similar condition. This issue was not evaluated for Browns Ferry and Bellefonte; however, the essential calculation program covered in subcategory 24600 is designed to address missing calculations for all TVA nuclear plants.

The evaluation substantiated the concern of over-torquing the clamp bolts of B001 type supports at Sequoyah and Watts Bar. "Lack of Design Detail" and "Inadequate Calculations," as noted in Table 3, resulted in excessive torque in the clamp bolts, which requires corrective action. To resolve this finding, plant walkdown, document revision, and evaluation will be required.

An engineering error caused the discrepancy between the installation and the piping stress analysis for a support type in the upper head injection system at Sequoyah.

Thus, the employee concerns and issues evaluated for this subcategory did identify some valid problems. In the case of destroyed and missing calculations, the design adequacy of the pipe supports cannot be fully verified until the regeneration of these calculations is complete. With the exception to the above finding, examination of the overall significance of other findings and the corrective actions does not lead to the conclusion that the pipe support design constitutes a significant problem for Sequoyah, Watts Bar, Browns Ferry, or Bellefonte.

The corrective action plans received by the evaluation team have been reviewed and were found acceptable to resolve the negative findings.

A review of the Nuclear Performance Plans (NPPs) by the evaluation team revealed that the issues evaluated under this subcategory requiring corrective actions have been addressed adequately to lead to the resolution of these issues. The causes identified and other results are being reexamined from a wider perspective in 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 and reviews the results of the Employee Concerns Special Program (ECSP) element evaluations prepared under Engineering Subcategory 22100, Pipe Support Design. The element evaluations of this subcategory contain the review of the concerns related to pipe support design and its impact on the piping stress analysis. The issues evaluated include the design adequacy of pipe supports, inadequate supports and its impact on pipe stress, use of supports that are incompatible with stress analysis, and the retention of permanent records for pipe support design calculations.

The employee concerns provide the basis for the element evaluations and are listed by element number in Attachment A. The plant location where the concern was originally identified and the applicability of the concern to other TVA nuclear plants are also shown.

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 addresses the determination of generic applicability
- Section 3 -- outlines the process followed for the element and the subcategory evaluations and cites documents reviewed
- 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, 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.

  The term "Peripheral finding" in the issue column refers to a finding that occurred during the course of evaluating a concern but did not stem directly from an employee concern. These are classified as "E" in Tables 1 and 2 of this report

- Attachment C -- lists the references cited in the text

2. SUMMARY OF ISSUES/GENERIC APPLICABILITY

The employee concerns listed in Attachment A for each element and plant have been examined, and the potential problems raised by the 13 concerns have been identified as 24 separate issues. Evaluation of these issues is presented in the 14 element evaluations.

The issues summarized here deal with perceived deficiencies or inadequacies in the pipe support design. A summary of the issues evaluated under this subcategory, grouped by element, and their generic applicability is presented below.

2.1 Design Adequacy of Pipe Support Anchors and Retention of Permanent Records - Element 221.1

The pipe support design calculations have been destroyed; therefore, the potential problems in the designs cannot be identified. The procedural aspects of this issue have also been addressed in Subcategory 21200. The issue of pipe support anchor bolt design is addressed in Subcategory 10400.

The issue was derived from a concern originally identified at Watts Bar Nuclear Plant (WBN). Although this issue was evaluated only for WBN, the regeneration of the destroyed and missing pipe support design calculations at Sequoyah Nuclear Plant (SQN), which is currently in progress, confirms that the issue should have been made applicable to SQN. On the basis of the above

situation at SQN, it is believed that this issue has generic implications and should be evaluated for Browns Ferry (BFN) and Bellefonte (BLN) nuclear plants. However, the essential calculation program covered in Subcategory 24600 is designed to address the issue of missing calculations for all TVA nuclear plants.

2.2 Evaluation of Difference in Analyzed Design Loads for Pipe Supports - Element 221.2 (SQN)

The pipe support design is not adequate without considering the load due to zero period acceleration (ZPA).

The issue of addressing ZPA at SQN was evaluated and was found not to be valid. However, a corrective action was issued to finalize the preliminary reviews and studies performed to address ZPA application. In the evaluation of element 218.6 for WBN, it was found that ZPA had not been considered for rigorous analysis and some alternate analyses of the piping system. The corrective action plan for this WBN evaluation covers ZPA in future revisions to these piping analyses. Significant Condition Reports (SCR WBN CEB8631, R1 [B41 860709 021] and SCR WBN CEB8553, R1 [B41 860709 024]) for WBN require a generic applicability evaluation of this issue by TVA. This evaluation will determine the applicability of the ZPA issue to BFN and BLN.

2.3 Major Difference in Analyzed Design Loads for Similar (Unit 1 vs Unit 2) Pipe Supports - Element 221.2 (WBN)

The issue of inadequate pipe support design because of major differences in analyzed loads of similar pipe supports in units 1 and 2 is identified for the concern at WBN.

Although not specific, the issue implies a condition at WBN. Furthermore, the statement of "generic" in the concern is interpreted to mean generic to WBN. In the WBN evaluation, the issue was found not to be valid. Therefore, no further evaluation is required.

2.4 Missing or Uninstalled Pipe Supports - Element 221.3

Inadequate supports resulting from the lack of a program for tracking hanger installation will cause overstress in the pipe.

The issue, resulting from the concern identified at WBN, deals with a deficiency in the program for tracking hanger installation. The issue was found not to be valid in the evaluation at WBN. Therefore, no additional evaluation is required. In addition, the IE Bulletin 79-14 program (for details see Subcatgory Report 21200), which requires a walkdown inspection of all pipe supports, will identify any missing or uninstalled supports for all plants (SQN, WBN, BFN, and BLN).

2.5 Deletion of Supports - Element 221.4

The design of the hanger in the vicinity of undersupported HVAC piping in the Auxiliary Building (unit 2) is inadequate because kickers have been removed from the hanger.

The issue is based on a concern that describes the deficiency in pipe supports in a specific piping system and location at WBN (unit 2). The evaluation revealed that the issue is not valid, and therefore no further evaluation is required.

2.6 Pipe Support Base Plate Installed Over an Expansion Joint - Element 221.5

The pipe support is not designed to sustain the effect of interference between the support base plate and the containment wall.

The issue, resulting from the concern of an insufficient gap, is identified for WBN, unit 1. The concern specifies the exact area and location where an insufficient gap between the base plate and the containment wall may exist due to extension of the base plate over an expansion joint. The evaluation showed that the above issue is not valid. A plant walkdown (Ref. 81) revealed only an isolated case where the base plate grout extends over an expansion joint. Therefore, the issue is not generic.

2.7 Observed Bending of Pipe Clamp Ears - Element 221.6

Pipe support clamps are overstressed due to excessive torque on the clamp bolts.

The issue resulted from the concern stating that ears on small 8001 support clamps at WBN are bent. Because 8001 type supports are used at SQN and BLN, as well as at WBN, the issue is applicable to all three of these nuclear plants. TVA evaluation of generic applicability of this issue indicates that 8001 type supports are not used at BFN, and hence the issue is not applicable to BFN.

2.8 Damaged Pipe Supports - Element 221.7

The design of pipe supports found to be damaged during in-service inspection is inadequate.

The issue originated from the concern stating that support damage was found during in-service inspection at BFN. The evaluation revealed that the pipe supports were damaged due to an unanticipated loading of the piping system, and repair to the damaged supports was required. However, the issue that pipe supports required repair because of inadequate design was not substantiated.

2.9 Relief Valve Vent Line Hanger - Element 221.8

The pipe support on the relief valve vent line of chiller B is overdesigned with a very high factor of safety.

The issue is based on the concern of excessive overdesign of a pipe support at a specified location at WBN. Because the evaluation team could not identify the support specified in the concern, the supports in the vicinity of the identified area that fit the description in the concern were evaluated. The evaluation could not substantiate excessive overdesign of these supports, and hence the issue was found not to be valid.

2.10 Sharp Edge of Hanger Steel Clearance with Pipe Running Through the Hanger Steel Frame - Element 221.9

The gap between the hanger's sharp edge and the pipe is insufficient and will cause additional stress in the pipe due to interference.

The issue stems from the concern that there is interference between the support edge and the pipe at a specific location at WBN. The evaluation found the issue not to be valid. Because this issue is based on a specific support at an identified location, it is not generic.

2.11 Use of Snubber - Element 221.10

A snubber-type support is used on the vertical riser of the upper head injection system instead of a rigid-type support as required.

This issue is from a concern identified at SQN. The evaluation revealed that the issue is valid for SQN. Because the issue addresses a specific support at an identified location, it is not generic.

2.12 Heavy MOV Supports - Element 221.11

The motor operated valves (MOV) are not supported adequately. The supports on the operator of the motor-operated valves are not adequately designed.

The issues are based on the concerns identified at BLN and are specific as to the location of the supports. The evaluation revealed that the issues are not valid. Therefore, they are not generic.

3. EVALUATION PROCESS

This subcategory evaluation is based on the information contained in the applicable element evaluations prepared to address the specific employee concerns related to the issues broadly defined in Section 2. The following, in conjunction with Attachment C, outlines the evaluation process.

3.1 Design Adequacy of Pipe Support Anchors and Retention of Permanent Records - Element 221.1

a. Reviewed Problem Identification Report (PIR) WBN CEB8521 (Ref. 4), which reports the problem of miscoding the support identification into TVA's Record Information Management System (RIMS), making it irretrievable when required.

b. Reviewed Nonconformance Report (NCR) WBN CEB8418, Rev. 1, (Ref. 5), which reports the destruction of design calculations generated by EDS Nuclear, Inc. and outlines the actions taken by TVA to verify the adequacy of affected supports.

c. Spot-checked the existence of Bergen-Paterson design calculations in RIMS (Ref. 3).

d. Reviewed a sample of EDS calculations regenerated by TVA (Refs. 1 and 2).

e. Reviewed TVA's corrective action plan for CATD 212 01 WBN 01.

3.2 Evaluation of Difference in Analyzed Design Loads for Pipe Supports - Element 221.2 (Sequoyah)

a. Reviewed the Final Safety Analysis Report (FSAR) of the Sequoyah Nuclear Plant (Ref. 83) for specific commitment to consider ZPA effects in piping analysis.

b. Reviewed Nuclear Regulatory Commission (NRC) regulatory guide (Ref. 8) for any requirements to consider ZPA effects.

c. Reviewed available reports (Refs. 74, 75, and 82) at SQN that have addressed the issue of ZPA.

d. Performed independent review including calculations as required (Ref. 10).

e. Reviewed TVA's corrective action plan for CATD 221 02 SQN 01.

3.3 Major Difference in Analyzed Design Loads for Similar (Unit 1 vs. Unit 2) Pipe Supports - Element 221.2 (Watts Bar)

a. Obtained the load tables and isometrics for a sample of piping stress calculations (Ref. 11) for different systems on units 1 and 2, such as feedwater, Chemical Volume Control System (CVCS), Reactor Coolant System (RCS), etc., in order to study the problem.

b. Reviewed the load tables and isometrics of the selected calculations because they have similar routing, support locations, and functions for both units (Refs. 11, 12, and 13).

c. Evaluated the reasons for load variations in unit 2 and tabulated the summary of the review.

3.4 Missing or Uninstalled Pipe Supports - Element 221.3

a. Reviewed the project procedure that establishes the support design scoping (Ref. 14).

b. Reviewed the hanger tracking program and IE Bulletin 79-14 Phase I program (Refs. 17 and 18).

c. Reviewed randomly selected supports (Refs. 15 and 16) to verify the validity of the issues raised in the concern.

d. Held discussions with WBN Engineering Design (EN DES) personnel, as required.

3.5 Deletion of Supports - Element 221.4

a. Reviewed the isometric drawings of the HVAC duct (12-inch pipe) for units 1 and 2 (Refs. 21, 22, 23, and 24) to verify the location of the supports.

b. Reviewed the pipe stress calculations of HVAC duct (12-inch pipe) for unit 2 (Ref. 25) to verify compliance with ASME Code requirements.

c. Examined the design detail drawing of support 47A920-44-10 on the HVAC duct (12-inch pipe) for unit 2 (Refs. 26, 27, and 28).

d. Performed a design check to verify the adequacy of support 47A920-44-10 (Ref. 29)

3.6 Pipe Support Base Plate Installed Over an Expansion Joint - Element 221.5

a. Performed plant walkdown to identify the subject pipe support and to measure gaps between grout/base plate and the containment wall (Ref. 40).

b. Evaluated the actual displacements (Ref. 40) during a seismic event for the Containment Building and the north valve room and compared with the measured gaps in "a" above.

c. Performed a plant walkdown to determine if the subject support was an isolated case (Ref. 81).

d. Reviewed TVA's corrective action plan for CATD 221 05 WBN 01.

3.7 Observed Bending of Pipe Clamp Ears - Element 221.6 (Sequoyah and Watts Bar)

a. Evaluated torque values specified for SQN and WBN for 8001 support clamps (Refs. 43, 44, and 46).

b. Performed a calculation (Ref. 45) to determine if SQN and WBN specified torques are excessive and could cause bending of ears.

c. Determined if these clamps were modified by welding stiffeners to them to prevent them from bending.

d. Ascertained if vendor approval was obtained and documented if the clamps were modified.

e. Reviewed TVA's corrective action plans for CATDs 221 06 SQN 01 and 221 06 WBN 01.

3.8 Observed Bending of Pipe Clamps Ears - Element 221.6 (Bellefonte)

a. Obtained and reviewed sample drawings for 8001-type supports (Ref. 47).

b. Reviewed sample design calculations for 8001-type supports (Ref. 49).

c. Determined if these support clamps have been modified.

d. Determined if vendor approval has been obtained for any modifications.

3.9 Damaged Pipe Supports - Element 221.7

a. Reviewed a sampling of reportable occurrence reports for damaged pipe supports (Ref. 53).

b. Reviewed a sample of pipe supports (Refs. 51 and 52) identified from an inservice inspection as requiring repairs, modifications, or part replacements.

c. Determined if the required modifications were due to inadequate design.

3.10 Relief Valve Vent Line Hanger - Element 221.8

a. Conducted a walkdown (Ref. 84) of the area identified in the statement of concern, in order to locate the hanger in question.

b. Reviewed the design calculations (Refs. 54, 55, and 56) for two different hanger frames that fit the general description in the statement of concern, because no hanger fitting the description in the statement of concern was found in the general area indicated.

c. Established the member stress design margin for the largest size member with the highest normal stress for both of the hanger frames reviewed (Ref. 57).

3.11 Sharp Edge of Hanger Steel Clearance with Pipe Running Through the Hanger Steel Frame - Element 221.9

a. Visually inspected and photographed the subject pipe support 2-63-209 during the April 16, 1986, visit to Watts Bar unit 2 (Ref. 59).

b. Reviewed General Construction Specification G-43, Section 2.7, Rev. 8, [842 850712 505], (08/08/85).

c. Studied the magnitude and direction of calculated thermal and seismic pipe movements at the bottom location of the pipe support (Ref. 60).

3.12 Use of Snubber - Element 221.10

a. Reviewed the applicable design calculations (Refs. 63 and 64) to identify the types of supports on the vertical risers of the upper head injection system.

b. Reviewed as-constructed and as-designed pipe support detail drawings to confirm the support types (Refs. 61 and 62).

c. Reviewed TVA's corrective action plan for CATD 221 10 SQN 01.

3.13 Heavy MOV Supports - Element 221.11

a. Verified the temporary supports close to valves 1NL-IFCV-062N and -064N by plant walkdown (Ref. 76).

b. Reviewed the pipe stress calculations (Refs. 66 and 67) of the core flooding system that contains the valves in "a" (above).

c. Reviewed the support design calculations (Ref. 69) of the permanent supports near the valves in "a" (above).

d. Evaluated the results of the pipe stress calculations (Refs. 66 and 67) to verify compliance with 1974 ASME Code requirements.

e. Reviewed the support design calculation of the component cooling system hanger (Ref. 70) holding motor operated valve (MOV) 1KC-IFCV-185.

f. Reviewed the pipe stress calculation (Ref. 73) and marking on the isometric drawing (Ref. 71) to verify the support type and location of the MOV support.

g. Reviewed the MOV support design calculation (Ref. 70) to verify if the support would experience loading due to water hammer.

3.14 Subcategory Evaluation Process

For this subcategory report, the evaluation process included:

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, analyzed 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 14 element evaluations for this subcategory are contained in Attachment B. The findings are listed by element number and by plant.

The findings for each element are summarized below.

4.1 Design Adequacy of Pipe Support Anchors and Retention of Permanent Records - Element 221.1

4.1.1 Discussion

For Watts Bar, this element addressed the concern that the pipe support design calculations prepared by EDS and Bergen-Paterson have been destroyed, and, as a result, no design verification of the pipe supports can be performed. On the basis of corrective action (CATD 212 01 WBN 01) for Nonconformance Report (NCR) WBN CEB8418, Rev. 1 (Ref. 5), and Significant Condition Report (SCR) WBN CEB8531, Rev. 1, TVA committed to the NRC to regenerate a number of sample calculations and evaluate for design adequacy. The evaluation team selected and reviewed eight designs (Ref. 1) from these sample calculations. The team found these designs to be acceptable.

4.1.2 Findings

Contrary to the statement of concern, the review revealed that the design calculations prepared by Bergen-Paterson have not been destroyed. However, the review also confirmed that the original documents of the pipe support design calculations prepared by EDS were inadvertently destroyed and no copies were kept. TVA management failed to verify that it had the original, copies, or microfilm of the above calculations in its possession before authorizing their destruction by EDS. Further discussion of corrective action, causes, and significance of these findings is presented in Subcategory Reports 21200

and 24600. In addition, specific requirements of base plates and concrete anchorage bolts, which cover the concerns of element 221.1, Issue b, are addressed in Construction Subcategory Report 10400.

4.2 Evaluation of Difference in Analyzed Design Loads for Pipe Supports - Element 221.2 (SQN)

4.2.1 Discussion

For Sequoyah, this element addressed the concern that zero period acceleration (ZPA) has not been considered in the pipe stress analysis. Nuclear power plant piping systems that are important to safety must be designed to comply with applicable seismic requirements.

The usual approach is to perform the analysis within a range of frequencies (0 to 33 Hz) where the dynamic amplification occurs. This practice is based on the fact that the seismic excitation mainly contains low frequency waves, and no dynamic amplification is expected in the high frequency range. However, it has been noticed in some cases that the effects of high frequency (above 33 Hz) are significant enough to warrant consideration in the design. The contribution of these high frequency modes is known as ZPA effects. In recent years, it has become common practice in nuclear plants to consider ZPA effects in the design of components.

There are no specific commitments in the SQN FSAR to address this issue. There are also no regulatory requirements (Ref. 9) that specifically address the ZPA effects in the piping analysis. However, NRC's Standard Review Plan (SRP) Section 3.7.2 (Ref. 7) has rules that can be considered adequate to address this issue.

TVA conducted an industry survey (Ref. 85) as early as 1972 to evaluate the application of ZPA. The survey indicated that the consideration of ZPA was not a common practice at that time. In the mid 1970s, TVA introduced ZPA rigid response load case capability into the T-PIPE computer code and used this ZPA effect in the analysis of rigid piping systems (above 33 Hz). A second survey by TVA in 1982 indicated that ZPA was considered by the industry only at the client's request or to resolve identified problems.

On November 21, 1985, R. O. Barnett of TVA directed SQN to investigate the ZPA issue (Ref. 9). In response to this memo, a preliminary evaluation of ZPA effects in SQN piping systems was conducted in November and December 1985 by Impell Corporation (Ref. 74), which found that ZPA effects on the piping system would not be significant enough to require any hardware modifications. However, Impell concluded that the evaluation was based on limited information and recommended a thorough review.

A second review was completed by an outside contractor in March 1986 (Ref. 75) to examine the implementation of ZPA effects in the piping analysis of Watts Bar Nuclear Plant. The review covered a wide range of areas including NRC's Regulatory Guide requirements (Ref. 8) and common industry practice with respect to ZPA effects in piping analysis. The report recommended that a parametric study for WBN be performed to verify the design margins to cover the ZPA effects.

A more detailed evaluation (Ref. 82) was performed by TVA during March 1986 to verify the design adequacy of the components considering ZPA effects in seismically qualified piping systems at SQN. Nine problems potentially critical for ZPA loading were evaluated. The results of this preliminary evaluation revealed higher loads on some supports due to ZPA effects as compared to loads derived from the modal analysis (OBE). However, all support loads were found to satisfy the design limits.

The recommendation and findings of the above preliminary evaluations led the evaluation team to independently examine the ZPA effects on SQN piping systems. All rigorously analyzed isometric drawings (Ref. 6) were systematically reviewed to identify the areas of the piping system potentially critical for ZPA loading. A list of problems was identified through this detailed screening for further review. Based on judgment, five severe cases from the list were selected by the evaluation team for computation of ZPA loads, primarily on the equipment nozzles and restraints (Ref. 10). These ZPA loads were evaluated by comparing them with analyzed seismic (OBE) loads and allowable design limits.

The results of the review are as follows:

a. Loads due to ZPA effects for two out of five cases are higher than analyzed seismic (OBE) loads. However, for all cases reviewed, the loads are well within the design limits.

b. No hardware modification is required for any of the evaluated components.

The studies and reviews discussed above arrive at the same conclusion: the effect of ZPA on SQN piping system design is insignificant. The evaluation team concurs with the conclusion.

4.2.2 Findings

Although ZPA was addressed at Sequoyah in various studies and reviews (Refs. 9, 74, 75, and 82), the preliminary ZPA calculations were never finalized and incorporated into the piping analysis calculation packages.

4.3 Major Difference in Analyzed Design Loads for Similar (Unit 1 and Unit 2) Pipe Supports - Element 221.2 (WBN)

4.3.1 Discussion

For Watts Bar, this element addressed the concern that the support loads in unit 2 are significantly higher than similar supports in unit 1.

This concern applies only to those piping systems that have similar (if not identical) routing, support locations, and functions for both units. Because of the difficulty in trying to identify any piping system with identical features in both units, it was deemed appropriate to review unit 1 and unit 2 systems that could be considered similar enough to allow a comparison with meaningful results. Nonsimilar systems will have different responses and will generate different loads on pipe supports.

Thus, to verify the validity of this concern, a sample of 11 (Ref. 11) similar calculations from unit 1 and unit 2 systems were selected from the list of similar piping systems provided by TVA. The sample was selected from different systems, such as feedwater, CVCS, RCS, etc., to avoid systematic bias in the sample. The sample contains 12 isometrics (Ref. 12) consisting of 270 support points from each unit.

4.3.2 Findings

The evaluation team examined the above sample analyses (Ref. 11) performed by TVA on similar piping systems for unit 1 and unit 2. A comparison of the pipe support loads resulting from these analyses shows that only 1 percent of the unit 2 pipe supports have loads that are greater than eight times the corresponding unit 1 support loads. The evaluation team determined that the reasons for these load increases result from differences in support configuration, flexibility, etc., of the piping systems of units 1 and 2. These load increases do not constitute any safety concern as the supports were designed for the analyzed loads.

4.4 Missing or Uninstalled Pipe Supports - Element 221.3

4.4.1 Discussion

For Watts Bar, this element addressed the concern that a long span of unsupported piping is due to missing or uninstalled hangers. TVA Project Procedure WBEP-EP 43.14, Revision 3, "Program for Hanger and Support Requirements," establishes the support design scoping activities in Section 4.0. This section of the procedure mandates the use of a Piping Analysis

Problem Review form, or its equivalent. Included in this form is a listing of each support required for a given analysis problem number, along with various descriptive items (revision number, joint number, support type, required load vs. design load, etc.) for each. The form also serves as a checklist for these items, as well as provides a means for tracking the status of actions required.

Samples (Ref. 14) of this Piping Analysis Problem Review form were selected from various systems to verify that all supports required by the applicable piping stress analysis were listed accordingly on the form. In all cases reviewed, the forms contained a complete listing of all required supports, per the latest piping stress analysis revision.

Additional steps were taken to verify that the supports listed on the forms were also listed in TVA's Hanger Tracking Program report (Ref. 18). This check assures that a design drawing exists for each support listed in the scope as defined by the Piping Analysis Problem Review form.

The documentation system of TVA treats these Piping Analysis Problem Review forms as a calculation (separate from the support design calculations themselves) which includes a cover sheet to control and document the changes in each revision.

The aforementioned procedure provides sufficient control to ensure that all supports required by the piping stress analysis will be designed and accounted for. In addition, TVA's IE Bulletin 79-14 Phase I program (Ref. 17) requires a walkdown inspection of all safety-related piping systems, thus providing added assurance that any missing or uninstalled supports will not be overlooked.

The statement of concern does not include a specific identification of the system or pipe diameter in which an unsupported 40-foot span of pipe was observed. If the piping mentioned in the statement of concern was a nonsafety-related system with a nominal diameter equal to or greater than 30 inches, then a 40-foot span of straight run pipe is possible.

In addition, the concerned individual might have observed this 40-foot span on a piping system that has not yet been finalized with respect to hanger installation. It is common to find situations where there may be an extended period from the time piping is first installed until the last engineered support for this piping is installed.

To evaluate the validity of the statement of concern, the evaluator randomly selected piping systems with various pipe sizes from the main steam, feedwater, steam generator blowdown, and auxiliary feedwater systems (Ref. 15) for review. The review was limited to verify only gravity spans for the supports in the above piping systems (Ref. 16).

4.4.2 Findings

The evaluation revealed that, in four out of six cases, the support spans satisfy ANSI B31.1 code-suggested (Ref. 19) lengths. The remaining two cases exceeded the suggested spans but were qualified by TVA using rigorous analysis. The evaluation also revealed that the reviewed supports listed on the Piping Analysis Problem Review forms (Ref. 14) were also listed in TVA's Hanger Tracking Program report (Ref. 18). Thus, a design drawing exists for each support listed in the scope as defined by the Piping Analysis Problem Review Form.

4.5 Deletion of Supports - Element 221.4

4.5.1 Discussion

For Watts Bar, the concern was that the HVAC piping (12-inch pipe, Schedule 40) in unit 2, located in the Auxiliary Building at elevation 737 feet, is not adequately supported because three hangers are deleted. To evaluate this concern, the evaluation team reviewed the piping drawings of this HVAC system for both units 1 and 2. A system drawing (Ref. 20) and the isometric drawings (Refs. 23 and 24) of the above HVAC piping system were examined to verify the support locations. As per TVA, both the unit 2 ducting of concern and the related unit 1 ducting were originally qualified by alternate criteria (span method) CEB 76-5 (Ref. 86). The support configuration based on the alternate analysis criteria was reflected in the above drawings.

The unit 2 piping was later reanalyzed by TVA using the program T-PIPE, a more accurate analysis methodology than the span method used in the alternate analysis criteria. Six supports, including three mentioned in the concern, originally placed in unit 2, were found to be unnecessary as a result of the reanalysis, and therefore were deleted. The computer analysis of this unit 2 HVAC piping reflects the support configuration as shown on the revised isometric drawings (Refs. 21 and 22). Alternate criteria CEB 76-5, originally used for this piping system, is a much more conservative approach and requires more supports than called for in the T-PIPE computer analysis. Thus, it was possible to eliminate six supports in unit 2 as the result of reanalysis by the T-PIPE computer program. The results of this T-PIPE calculation (Ref. 25) of unit 2 HVAC piping show that the system is qualified to meet the requirements of the ASME code (Ref. 30) and Watts Bar design criteria (Ref. 87).

The element also addressed the concern that the only remaining hanger attached to the ceiling is deficient in design because the hanger's kickers were removed. Of the existing hangers in unit 2 HVAC piping, the only hanger attached to the ceiling appears to be that shown on TVA drawing 47A920-44-10, Rev. 2 (Ref. 28). The review of this design detail drawing of the hanger shows that no kicker was included in the design. According to TVA, a kicker was installed at one time by Construction and was later removed (Ref. 30). Kickers were not designed or shown in the hanger detail drawings (Refs. 26 and 27) as per TVA. The review also revealed that the subject hanger was qualified (without kicker) for the computed loads calculated from the reanalysis of unit 2 HVAC piping by the T-PIPE computer program. In addition, the evaluation team reviewed this support (Ref. 29) and determined that it is adequately designed: no kicker is required.

4.5.2 Findings

The evaluation revealed that the existing support configuration, after some pipe supports are deleted, is in compliance with the requirements of the ASME code for HVAC piping (duct). The hanger is designed adequately for the computed loads without kickers.

4.6 Pipe Support Base Plate Installed Over an Expansion Joint - Element 221.5

4.6.1 Discussion

For Watts Bar, the concern was that there was an insufficient gap between the containment wall and the pipe support base plate grout that extends over an expansion joint to allow for designed movements of the containment wall.

A plant walkdown was performed by the evaluation team (Refs. 40 and 81) to review the concern. The base plate of support 47A401-9-6 (Ref. 36), situated at the location identified in the concern, does not extend over the expansion joint between the floor and the containment wall (shield wall). Consequently, further search was performed and support 1-03A-569 was found near the east door whose base plate grout (Ref. 37) extends over the expansion joint. No other pipe supports in this valve room were found with the base plates or grout extending over the expansion joints. Therefore, resolution of this concern is based on evaluation of support 1-03A-569.

The measured gaps between the shield wall and the grout and between the shield wall and the base plate are 7/8-inch and 1-7/8-inch, respectively. At elevation 729 feet, where the pipe support is located, the safe shutdown earthquake (SSE) displacements for the two structures, the Shield Building and the north valve room, are approximately 1/32-inch each. The combined

displacement (when the two structures displace toward each other) is approximately 1/16-inch (Refs. 31, 32, 33, and 40). As can be seen, the measured gaps between the shield wall and the grout/base plate are larger than the SSE displacement of the two structures. Therefore, the pipe support will not interfere with the movement of the shield wall during a seismic event.

In WBN Design Criteria WB-DC-40-31.9, paragraph 8.3.2, Rev. 5, states that special requirements are to be shown on the drawing in the form of notes. However, the pipe support 1-03A-569 detail drawing (Ref. 34) does not identify the existence of the expansion joint either in its initial design or in subsequent revisions to the design because of field change requests (Refs. 35, 38, and 39).

The evaluation team performed a unit 1 and 2 plant walkdown (Ref. 81) of floor-mounted pipe support base plates in the vicinity of expansion joints between the following structural interfaces. The purpose of this inspection was, in part, to determine whether other base plates extended over the expansion joints. None were found. The specific locations examined were:

- o North valve room to Shield Building wall at elevation 729 feet
- o South valve room to Shield Building wall at elevation 729 feet
- o Additional Equipment Building and Auxiliary Building at elevations 702 feet and 729 feet
- o Auxiliary Building and Shield Building wall at elevations 692 feet, 713 feet, 737 feet, and 757 feet

4.6.2 Findings

The review revealed an isolated case where the base plate grout extends over the expansion joint between the shield wall and the north valve room. The gap between the shield wall and the base plate grout was found to be adequate to accommodate the maximum displacements, but the existence of the expansion joint between the shield wall and the north valve room was not noted on the pipe support drawing.

4.7 Observed Bending of Pipe Clamp Ears - Element 221.6

4.7.1 Discussion

For Watts Bar, Sequoyah, and Bellefonte, the concern as stated is that over a long period of time the ears on small BOO1 support clamps will bend because of excessive torquing and that this bending will result in stressing A-36 material (of clamp) beyond its yield point.

B001 seismic Category I supports are used to support small bore (2 inches diameter and smaller) drain lines, instrument sensing lines, sampling lines, radiation monitoring lines, and test and process lines containing isolation valves. These lines are called branch lines. The B001 support consists of a stanchion pipe welded directly to the run line or to the clamp that is fastened to the run line. Similarly, the branch line is welded or clamped to the stanchion. Adequacy of the branch line and run line clamp when overtorqued is the concern addressed in this discussion.

Drawings 47B001-13 (Ref. 44) and 47B001-10 (Ref. 43) for Watts Bar and Drawings 47B001-14, 14A, and 47B001-12 (Ref. 46) for Sequoyah specify a torque value of 5 to 10 ft-lb (depending on the size of the bolt) for branch line clamps. The evaluation team found the specified torque values for the branch line clamps to be reasonable. It is not expected that the clamp ears would bend under these torque values. The aforementioned 47B001 drawings also specified a torque value of 100 ft-lb for run line clamps (regardless of clamp and bolt size). The 100 ft-lb value may have arisen from the test program CEB 77-42 (Ref. 41) that specified this value for Bergen-Paterson clamp 298 for all pipe sizes.

Drawing 47B001-10, Rev. 8 (Ref. 43) for Watts Bar, Drawing 47B001-12, Rev. 5 (Ref. 46) for Sequoyah, and CEB Report 77-42 specify torque values for the bolts, whereas CEB Report 75-18 (Ref. 42), under the tabulation of parameters for anchor clamp, specifies preload values for the bolts. To establish a relationship between preload and torque values, the evaluation team calculated torque values for clamp sizes for 2-1/2-inch to 30-inch-diameter pipe (Ref. 45).

The calculation shows that a torque value of 100 ft-lb will produce a preload almost 2-1/2 times the value indicated in CEB Report 75-18 or, alternately, the actual torque required is about 40 percent of what was specified for installation of these clamps. Therefore, it is evident that the B001 support clamps were over-stressed by over-torquing of the bolts and the ears could have been bent, especially for smaller size pipe clamps. Instead of reducing the torque value to a value compatible with the bolt preload, WBN welded stiffeners to these clamps to prevent them from bending.

The clamp manufacturer's (Bergen-Paterson's) concurrence for welding stiffeners to the clamp was not obtained (Ref. 78). The manufacturer stated that when modifications are made to the product without its prior approval, the warranty becomes void. The vendor was asked about drawing the clamp ears within 1/8 inch of each other when torqued. The manufacturer stated that it is acceptable to do so because the clamp was designed to spring back to its original configuration when the bolts are relaxed (i.e., when the torque is removed). However, because the clamps have been modified, they may not perform as intended.

Welding stiffeners to the clamps is likely to prevent bending of clamp ears, but it causes the specified preload in the bolts to be exceeded. The excessive torque value for installation of these clamps should be reduced to be compatible with the capacity of the clamps and bolts. The clamps, if damaged or determined to be ineffective for their intended function, should be replaced and installed at the lower torque value equivalent to the specified bolt preload. SQN did not weld stiffeners to the clamps.

For Bellefonte, TVA has specially engineered pipe clamps for this type of support. Each clamp is uniquely designed with a special analysis being performed by ITT Grinnell for each support. Pretorque values are calculated in the special analysis for each clamp (Ref. 47).

The evaluation team reviewed two analyses for these supports (Ref. 49). The analyses qualify the various parts of the 8001-type assembly, including the clamp, stanchion, bolts, welds, etc. Specifically, preload torque is calculated from the results of the detailed clamp analysis (Ref. 48).

Pretorque values provided by TVA for these supports differ for clamps on the same size pipe. For example, the values for 12-inch pipe vary between 43 and 215 ft-lb. These torque values are uniquely calculated in the Grinnell analysis according to the specific loading (Ref. 48).

No modifications to these clamps have been made to strengthen them against bending as the clamp and the bolt force are designed as a unit (Ref. 47).

4.7.2 Findings

For Watts Bar and SQN, the ears of the small-bore pipe branch line clamps would not be bent because the torque values specified for their installation were reasonable. Ears of the run line clamps would be bent because the torque value specified for their installation was excessive. This excessive torque could also cause overstressing and failure of clamp bolts. At Watts Bar, gussets were welded on the clamps to prevent the clamps from bending. This clamp modification was not qualified by analysis or by testing. At SQN, no modifications have been made to these clamps to prevent bending.

For Bellefonte, the 8001-type clamps are uniquely designed with an analysis performed by ITT Grinnell to qualify each assembly.

4.8 Damaged Pipe Supports - Element 221.7

4.8.1 Discussion

For Browns Ferry, this element addressed the concern that inadequate pipe support design caused damage to the supports found during in-service inspection. Pipe supports are required to be designed for loadings resulting from anticipated system behavior. If a system undergoes unanticipated behavior or misoperation, additional loading may be induced on the system causing damage to the pipe supports. Such an occurrence should not be considered an inadequacy of pipe support design. Such instances are reported to the NRC in the form of reportable occurrence reports. Corrective action is taken to restore the system to operational condition. If necessary, modifications to the system are implemented to ensure that there will be no recurrence of such behavior. Examples of reportable occurrences selected by the evaluation team from a conditions adverse to quality (CAQ) data base frequency report (Ref. 53) where pipe supports that were damaged at BFN were reviewed.

The above reports stated that the occurrences did not present a safety concern. No damage to equipment was noted. These damaged supports are indications that the piping and supports were undergoing an unanticipated loading condition. Investigation of these supports led to modification of the system to prevent recurrence.

There are various BFN programs in place to identify pipe supports which require repair, modification, or replacement. One such program is inservice inspection (ISI) (Ref. 51), which this concern makes reference to. Inservice inspection is required by ASME Section XI to be performed during each 10-year interval of commercial service. ASME Code equivalency has been established for BFN inservice inspection purposes. (BFN was originally designed to ANSI/ASME 831.1 Code requirements.)

Pipe supports requiring repair found during an ISI are reported in Part I, Finding, of a Notification of Indication (NOI) in accordance with procedure BFNP SI-4.6.G, "Inservice Inspection Program" (Ref. 51). Appropriate action to be taken is noted in Part II, Disposition, of the NOI. Part III, Verification of the NOI, is completed after the repair work is done. The evaluation team reviewed a sample of six NOIs (Ref. 52). Four NOIs (NOIs U2/C5B-20, -22, -24, -61) dealt with loose bolt connections, and one (NOI U2/C5B-39) dealt with a broken tack weld between the process pipe and insulation saddle. These NOIs are instances of normal maintenance for an operating plant. The sixth NOI (NOI U2/C5B-29) dealt with an inadequate weld between the pipe and lugs. This weld deficiency was due to the lack of fusion as stated in the NOI.

Replacement of parts or entire supports is not necessarily an indication that the original design was inadequate or that parts were damaged. Support additions, deletions, and modifications due to pipe stress reanalysis are not uncommon occurrences. Pipe supports can be damaged from transportation and installation of other commodities. In these cases, the damaged parts would be replaced. Pipe supports can also be damaged by system misoperation or unanticipated system behavior. Support discrepancies are identified through various plant walkdowns such as those required for normal maintenance. Any discrepancy (both physical and documentative) may be identified by a discrepancy report (DR) in accordance with Site Director Standard Practice SDSP 3.1, "Corrective Action Program" (Ref. 50). A DR may be generated by non-QA personnel; however, the DR is processed through QA for review and appropriate corrective action.

4.8.2 Findings

The review of the sample damaged pipe supports reported to the NRC revealed that the supports were damaged by unanticipated loading on the piping system. The support modifications were required because of pipe stress reanalysis, installation difficulties, and the necessity of minimizing any recurrence of such unanticipated loading. No support design deficiencies were noticed.

4.9 Relief Valve Vent Line Hanger - Element 221.8

4.9.1 Discussion

For WBN, the statement of concern implies that the relief valve vent line hanger cited by the concerned individual has a design margin of at least 10.0.

Although the design margin concept can be applied to various aspects of any hanger design (member stress, weld stress, stiffness, deflection, etc.), the evaluation team elected to address the concern in terms of member stress, which is the deciding factor in almost all cases of member size determination, since the concerned individual is apparently questioning the choice of member size utilized in the observed hanger design.

Since the hanger described in the statement of concern was not specifically identified, the evaluation team visually inspected supports in the unit 2 Auxiliary Building (Ref. 84) located near column lines "A13" and "U" at elevation 737 feet. No vent line was found at or near this location.

However, two supports utilizing tube steel were identified in the adjacent chiller room. One is a pipe support (SVS-H-53-174-1984) that utilizes a 6 x 6 x 1/2 inch square tube as its largest member size. The other is a cable

tray support (MK420) with a pipe support (47A920-38-3) attached to it. The largest member size in this cable tray/pipe support frame is an 8 x 8 x 3/8 inch square tube, which is actually a primary member of the cable tray support frame MK420.

The structural analysis calculations (Refs. 54, 55, and 56) for both supports were reviewed by the evaluation team with the objective of establishing a member stress design margin for the heaviest loaded member of largest size in the entire frame. For the purpose of this review, the member stress design margin is defined as the inverse of the AISC interaction value. This interaction value is the sum of three actual vs. allowable stress ratios for axial compression stress, as well as bending stresses in both directions of bending.

A calculation was performed by the evaluation team (Ref. 57) to find the member stress design margin for the 6 x 6 x 1/2-inch structural tube for support SVS-H-53-174-1984 and 8 x 8 x 3/8-inch structural tube for support MK420.

4.9.2 Findings

The member stress design margin was found to be approximately 3 for pipe support SVS-H-53-174-1984 (Ref. 55) and 2 for cable tray support MK 420.

On the basis of a review of the structural analysis calculations for both the aforementioned support frames, the member stress design margins of 3 and 2 are reasonable.

Particularly from the standpoint of member size selection, there is no evidence that either of the supports reviewed was overdesigned.

4.10 Sharp Edge of Hanger Steel Clearance with Pipe Running Through the Hanger Steel Frame - Element 221.9

4.10.1 Discussion

For Watts Bar, the statement of concern implies that the pipe will hit the sharp edge of structural steel and be damaged if its movement in the unrestrained direction in any mode of plant operation is greater than the clearance available.

Visual inspection of the support (Ref. 59) revealed a structural tube used as a shim to achieve the required horizontal clearance specified in the design drawing (Ref. 58). The edge closest to the pipe in the direction in question is the round corner of this structural tube.

A study of calculated thermal and seismic pipe movements (Ref. 60) at the subject hanger location revealed that the pipe will move away from the edge of the structural tube in question as it goes from a cold to hot condition.

The minimum gap of 1/8 inch (-0 inch) specified in the design sketch is greater than the calculated maximum seismic pipe displacement of ±0.0243 inch at the hanger location for the worst case safe shutdown earthquake (SSE).

General Construction Specification G-43, Section 2.7, Rev. 8, states that the tolerances specified in the design drawing govern over construction tolerances permitted in the specification.

4.10.2 Findings

The evaluation concluded that the clearance between the support and the pipe is adequate to avoid interference in any plant event and hence acceptable.

4.11 Use of Snubber - Element 221.10

4.11.1 Discussion

For SQN, the concern was that a snubber-type support was installed on the vertical riser of the upper head injection system instead of a rigid-type support as analyzed. The evaluation team reviewed the supports on the vertical riser portion of the loop for both units (units 1 and 2), (Refs. 61 and 62).

The results of the review show that a rigid-type support at node point 44A is specified in the piping analysis problem 15-01 (units 1 and 2) (Ref. 65), while as-constructed support detail drawings (1-H45-9, Ref. 61, and 2-H45-9, Ref. 62) identify a snubber-type support at this location. In March 1986, this discrepancy was identified by TVA in Significant Condition Report SCR SQN CEB 8615 (Section 2.0) [B41 860306 043]. On August 24, 1986, TVA performed a study calculation for the analysis problem 15-01 (Ref. 65) specifying a snubber-type support at node point 44A to reflect the as-constructed condition. The results of the TVA analysis demonstrate that no failure of the upper head injection system will result from this deficiency. The evaluation team agrees with TVA's conclusion since the change from a rigid-type support to a snubber-type support will have no impact on the seismic stress levels, and the thermal stress levels will be generally lower due to the added flexibility of the system.

Irrespective of the study calculation results, TVA has decided to replace the installed snubber-type support with the rigid-type support before restart of SQN unit 2.

4.11.2 Findings

The review revealed that a snubber-type support was installed on the vertical riser of the upper head injection system instead of a rigid-type support as analyzed. This discrepancy was identified by TVA before the ECTG evaluation.

4.12 Heavy MOV Supports - Element 221.11

4.12.1 Discussion

For Bellefonte, this element addressed the concerns that the valves will not be supported properly when the temporary supports are removed and that the supports on the heavy motor operated valves (MOV) are not effectively designed to sustain plant operating conditions.

To evaluate the validity of the concern of temporary supports, the evaluation team performed a plant walkdown (Ref. 76) in the Reactor Building, unit 1. The following observations were made during the walkdown:

- o No temporary supports were found in the vicinity of valves 1NL-IFCV-062N and -064N in the core flooding system.
- o The installation of permanent supports next to the above valves was noticed.

To verify the adequacy of the support configuration on the piping system, the pipe stress calculations of the core flooding system were reviewed (Refs. 66 and 67). The review revealed the following:

- o The supports next to the valves, observed during the plant walkdown, are included appropriately in the mathematical model of the piping analysis (Ref. 68).
- o The above supports are designed adequately to sustain the computed loads (Ref. 69).
- o The results of the piping stress analyses comply with the requirements of the 1974 ASME code.

To evaluate a specific support holding an MOV in the component cooling system (KC), the evaluation team examined KC system isometric drawings to identify all MOVs attached to 3-inch piping on the north side of the Reactor Building, unit 1, at elevation 622 feet (Ref. 71). The examination revealed that only one MOV (1KC-IFCV-185) out of a total of four in this area, had a support on

the operator. Further examination of this operator support design drawing (Ref. 70) showed that the support attachment was not at the ceiling; hence, the situation did not match that described in the concern. The above finding led the evaluation team to evaluate MOV supports in the identified location.

A plant walkdown was conducted by the evaluation team (Ref. 77) in the unit 1 Reactor Building, elevation 622 feet, to identify the supports on MOVs. The following observations were made during the plant walkdown:

- o Thirty-four MOVs were identified in seven systems.
- o Of the 34 MOVs, three were identified as having support on the operator.

The evaluation of the supports on the above MOVs revealed the following:

- o The support on MOV 1NL-IFCV-076A appeared to be a temporary construction support. Therefore, no further evaluation was performed on this support.
- o The support on MOV 1KC-IFCV-207B consisted of a rectangular frame placed around the operator yoke and attached to the ceiling beam. It was noticed that there were gaps larger than 1/8-inch between the frame and the operator yoke and that the frame was not supporting the MOV. Further examination revealed that this rectangular frame is neither marked on the isometric drawing nor considered in the pipe stress calculation as a support on the MOV (Ref. 71). The review of the support design drawing of this rectangular frame showed that this support was deleted (Ref. 72). It was further confirmed by TVA that the construction of this support was left incomplete after the deletion of the support was transmitted to construction. TVA agreed to remove this frame (Ref. 79).
- o The identified support on MOV 1KC-IFCV-185 was found to be a snubber (support 1KC-MPHG-0884). The evaluation of the design calculation (Ref. 70) indicated that the support design is adequate to sustain the computed loads for all plant events. According to TVA, no water hammer is experienced in this piping system (problem N4-1KC-G) during plant operation. Therefore, load combinations of this support do not contain the water hammer loading (Ref. 73).

4.12.2 Findings

The evaluation revealed that the existing support configuration is adequate to support the valves. The motor-operated valve supports are designed adequately, and the supports are marked appropriately on the isometric drawings (Ref. 71).

4.13 Summary of Subcategory Findings

The classified findings are summarized in Table 1. Class A and B findings indicate 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.

Findings are summarized by classification in Table 2. Where more than one corrective action is identified in Table 1 for a single finding (e.g., element 221.6, Finding a), Table 2 counts only a single classification. Thus Table 2 identifies one finding for each issue evaluated. Of the 24 findings identified by a classification in Table 1, 17 require no corrective action. Of the remaining, one issue had corrective actions initiated before the ECTG evaluation, four required new corrective actions to be identified, and two were peripheral issues uncovered during the ECTG evaluation. From this table it can be seen that at Watts Bar, where most of the issues were originated, four out of a total of 12 issues were found to be valid and require corrective action, and one of these four issues had corrective action initiated before the ECTG evaluation.

5. CORRECTIVE ACTIONS

The corrective actions that are required for the elements reviewed for this subcategory are described in detail in Attachment B. The following is a brief description of the corrective actions by element and applicable plant.

- 221.1, Design Adequacy of Pipe Support Anchors and Retention of Permanent Records - For Watts Bar, the review confirmed that the pipe support design calculations prepared by EDS were destroyed and no copies were kept. TVA is committed to regenerate all missing pipe support design calculations and the destroyed EDS calculations before fuel load. TVA also plans to review all pipe support design calculations to ensure their completeness.

- 221.2, Evaluation of Difference in Analyzed Design Loads for Pipe Supports - Although ZPA was addressed at Sequoyah, the ZPA study calculations were not finalized. Lack of proper documentation of ZPA calculations was the primary reason to initiate the corrective action. TVA plans to finalize the preliminary reviews and studies performed on ZPA.

- 221.5, Pipe Support Base Plate Installed Over an Expansion Joint - At Watts Bar, the review revealed an isolated case of base plate grout extending over the expansion joint between the shield wall and the north valve room. This case prompted the corrective action to incorporate notes on the above identified support detail drawing to clarify the existence of the expansion joint. TVA also plans to inform pipe support designers by memo on the above incident to avoid recurrence of this problem.

- 221.6, Observed Bending of Pipe Clamp Ears - For Sequoyah and Watts Bar, the review revealed that an excessive torque value has been specified for installation of the bolts on the run line of B001 type supports. As corrective action, TVA is committed to revise drawings 47B001-12 (SQN) and 47B001-10 (WBN) to provide appropriate torque values for the above bolts. TVA also plans to perform a plant walkdown to identify and evaluate deficient B001 type supports. For Watts Bar, TVA is also committed to qualify the clamps that are modified by welding gusset plates.

- 221.10, Use of Snubber - For Sequoyah, the review identified an installed snubber-type support on the vertical riser of the upper head injection system instead of a rigid-type support as analyzed. TVA plans to remove the snubber and install a rigid support at the identified location.

A review of the corrective actions described above for this subcategory reveals that each requires some documentation changes. Evaluation and analysis are needed as corrective action for the clamps and the associated bolts of B001 type supports. A need for plant modification is apparent in the case of replacement of a snubber by a rigid support in the upper head injection system.

Table 2 identifies seven findings that require corrective action. The corrective actions, along with their finding/corrective action classifications, are summarized in Table 3. The description of the corrective actions in Table 3 is a condensation of the more detailed corrective action

information provided in Attachment B. The plant or plants to which a corrective action is applicable are shown in the Corrective Action Tracking Document (CATD) column, and are identified by the CATD number.

The CATD column in Table 3 shows that, in most cases, a particular corrective action is applicable to only a single plant. The corrective action for element 221.6, which involves clamp bolt torque calculations, is the only corrective action applicable to more than one plant.

In all cases, the evaluation team found the corrective action plans to be acceptable to resolve the findings.

6. CAUSES

Table 3 identifies one or more causes for each finding requiring corrective action. For each corrective action, the most important cause is identified using the judgment of the evaluation team. In some instances, it is judged that the finding resulted from a combination of causes, and, therefore, more than one cause is identified.

The bases for identifying the causes for each corrective action described in Table 3 and the linkage with the negative findings are as follows:

- 221.1, Design Adequacy of Pipe Support Anchors and Retention of Permanent Records - Inadvertent destruction of the pipe support design calculations prepared by EDS was caused by a misunderstanding due to poor communication of the status of calculations held by TVA. This might have been prevented if the manager responsible for the decision had been more attentive. The other cause, inadequate quality training, resulted in a lack of understanding by the responsible engineers of the need to control and maintain the design documents.

- 221.2, Evaluation of Difference in Analyzed Design Loads for Pipe Supports - Although ZPA calculations were performed in a study, no attempt was made to finalize those calculations. Failure to act on this peripheral item resulted from lack of attention on the part of the first-line supervisor to establish and implement an effective design process for ZPA loading.

- 221.5, Pipe Support Base Plate Installed Over an Expansion Joint - Procedures to show special requirements on the drawings were not followed in the case of the omission of an expansion joint in the support design detail drawing.

- o 221.6, Observed Bending of Pipe Clamp Ears

  - Over-torquing of the clamp bolts was the result of a design error that could have been prevented by performing adequate calculations. In addition, there was a lack of design detail to establish the relationship between preload values and torque values for the bolts, which led to higher torque values when the bolts were installed.

  - Inadequate calculations resulted in the use of unqualified clamps modified by welding gusset plates at WBN. This oversight was an engineering error. Failure to obtain approval from the pipe clamp manufacturer for the modification of the clamp resulted from the lack of management attention and inadequate communication.

- o 221.10, Use of Snubber - Installation of a snubber instead of a rigid support as analyzed was due to an engineering error. In addition, as-built reconciliation was deficient as it did not identify this problem.

7. COLLECTIVE SIGNIFICANCE

The last three columns of Table 3 show the significance of the corrective actions that resulted from the evaluation of the concerns under this subcategory. Significance is judged by the evaluation team and is rated in accordance with the type or types of changes that may be expected to result from the corrective action.

The 24 issues evaluated in this subcategory resulted in seven corrective actions. Six of the seven are judged to be significant for the expected changes, as indicated in the last three columns of Table 3.

Although the corrective actions require some changes in documentation, the volume of documents required to be regenerated for destroyed and missing calculations is most significant in terms of the time and cost to replace. Furthermore, the regeneration of the pipe support design calculations may potentially lead to hardware modifications and also may result in changes in design margin. This particular concern of destroyed and missing pipe support design calculations was evaluated by ECTG only for Watts Bar. However, the process of regenerating the destroyed and missing pipe support design calculations at Sequoyah, now in progress, confirms the existence of a similar

condition. The retrievability of design calculations for Browns Ferry and Bellefonte was not evaluated in this subcategory but is addressed in Subcategory 24600.

The corrective action that resulted from the excessive torque applied to the clamp bolts to 8001 type supports for Sequoyah and Watts Bar was considered significant for the protection of systems required for plant safety. The evaluation of these clamps may lead to potential hardware modifications. However, the magnitude of the problem can be assessed only after the plant walkdown and evaluation is complete.

The other three significant corrective actions resulted from isolated events and are applicable to individual plants.

An evaluation of the types of corrective actions resulting from the findings indicates a need for better document control than existed when the issues arose. The collective significance of the causes reveals a lack of effectiveness in management of the design process. However, with the exception of the issue about the destroyed calculations, the evaluation of the other issues reveals that the pipe support design for the four TVA plants does not represent a significant technical problem in the area of design adequacy.

TVA's nuclear performance plans (NPPs) (Ref. 88) for Sequoyah and Watts Bar were reviewed regarding the issues evaluated in this subcategory requiring corrective actions. On the basis of this review, it can be concluded that these issues have been addressed adequately in the NPPs. The causes identified and other evaluation results are being examined from a wider perspective in the Engineering category evaluation.

TABLE 1

CLASSIFICATION OF FINDINGS AND CORRECTIVE ACTIONS

	Element	Issue/ Finding**	Finding/Corrective Action Class* SQN	WBN	BFN	BLN
221.1	Design Adequacy of Pipe Support Anchors and Retention of Permanent Records	a	-	C3	-	-
		b	-	***	-	-
221.2	Major Difference in Analyzed Design Loads for Similar (unit 1 vs unit 2) Pipe Supports (WBN), and Evaluation of Difference in Analyzed Design Loads for Pipe Supports (SQN)	a	A	A	-	-
		b	A	-	-	-
		c	E3	-	-	-
221.3	Missing or Uninstalled Pipe Supports	a	-	A	-	-
		b	-	A	-	-
221.4	Deletion of Supports	a	-	B	-	-
		b	-	A	-	-
221.5	Pipe Support Base Plate Installed Over an Expansion Joint	a	-	A	-	-
		b	-	E3	-	-
221.6	Observed Bending of Pipe Clamp Ears	a	D3	D3	-	A
			D6	D6	-	-
		b	A	D5	-	A

*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 for each plant in Attachment B.
***Addressed in Subcategory 10400.

TABLE 1 (Cont'd)

	Element	Issue/ Finding**	Finding/Corrective Action Class*			
			SQN	WBN	BFN	BLN
221.7	Damaged Pipe Supports	a	-	-	A	-
221.8	Relief Valve Vent Line Hanger	a	-	A	-	-
221.9	Sharp Edge of Hanger Steel Clearance with Pipe Running Through the Hanger Steel Frame	a	-	A	-	-
221.10	Use of Snubber	a	01	-	-	-
221.11	Heavy MOV Supports	a	-	-	-	A
		b	-	-	-	A
		c	-	-	-	A

*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 for each plant in Attachment B.

TABLE 2

FINDINGS SUMMARY

Classification of Findings	Plant SQN	WBN	BFN	BLN	Total
A. Issue not valid. No corrective action required.	3	7	1	5	16
B. Issue valid but consequences acceptable. No corrective action required.	0	1	0	0	1
C. Issue valid. Corrective action initiated before ECTG evaluation.	0	1	0	0	1
D. Issue valid. Corrective action taken as a result of ECTG evaluation.	2	2	0	0	4
E. Peripheral issue uncovered during ECTG evaluation. Corrective action required.	1	1	0	0	2
Total.	6	12	1	5	24

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
221.1	C3	Regenerate all destroyed and missing calculations prior to fuel load.	WBN 01		X			X		X											A	P	P
221.2	E3	Finalize preliminary reviews and studies for Zero Period Acceleration (ZPA).	SQN 01							X											A	-	-
221.5	E3	Incorporate notes on the pipe support 1-03A-569 detail drawing and issue memo to avoid recurrence of this problem.	WBN 01				X							X							-	-	-
221.6	D3	Revise drawing 478001 to provide appropriate torque values.	SQN 01 WBN 01									X X		X X					X X		A	-	-
	D6	Perform plant walkdown to identify and evaluate deficient B001 type supports.	SQN 01 WBN 01									X X		X X					X X		A	-	P
	D5	Qualify the clamps modified by welding gusset plates.	WBN 01					X		X		X							X		A	-	P
221.10	D1	Remove snubber and install a rigid type support on the vertical riser of the upper head injection system.	SQN 01										X						X		A	-	A
			TOTALS		1		1	2		3		5	1	5					6				

* 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 - The evaluation team's judgment as to the significance of the corrective actions listed in Table 3 is indicated in the last three columns of the table. Significance is rated in accordance with the type or types of changes that may be expected to result from the corrective action. Changes are categorized as:

- 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 requirements 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 action 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 22100

Attachment A -- lists, by element, each employee concern evaluated in the subcategory. The concern's 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 the concern characterized as safety related, not safety related, or safety significant.

ELEMENT	CONCERN NUMBER	PLANT LOCATION	APPLICABILITY SQN	WBN	BFN	BLN	CONCERN DESCRIPTION*
221.1	IN-85-110-001 (shared with 10400 and 20500)	WBN		X			"Potential for failure of concrete anchors supporting critical pipe supports of primary safety systems inside the Primary Containment (e.g.: Safety Injection System, Component Cooling System, Main Steam System, etc.). In WBNP Unit 1, due to lack of proper evaluation and documentation (design calcs.) of their load carrying capabilities. Design calculations for most engineered pipe supports from Bergen-Paterson and EDS have been intentionally destroyed per TVA direction." (SR)
221.2	EX-85-002-001	WBN		X			"Major differences between support analysis on Unit 1 vs. Unit 2. The loads on Unit 2 went up 8-10 times what was required on Unit 1. This is generic concern. CI has no further specific information." (SR)
	SQN-85-002-05	SQN	X				"During the exit interview the CI stated that Zero Period Acceleration (ZPA) has not been addressed at SQN. ZPA has been discussed but management does not want to bring up any new items to Power which might affect startup." (SS)
221.3	WI-85-091-008	WBN		X			"Missing or uninstalled hangers were found. These hangers had never been designed as being part of a specific system yet when a forty foot span of pipe occurs with no support it is obvious there is a design error. CI has no further information. Construction Dept. concern." (SR)
221.4	EX-85-151-002	WBN		X			"Unit 2, auxiliary building, elev. 737' at LRB & A11, 12" HVAC sch 40 pipe. CI stated there was (is) a horizontal to vertical to horizontal run that has 3 hangers deleted (approx. 4 mos. ago) that left more than 20' between hangers. The only hanger left (ceiling) had its "kickers" removed. CI has no additional information. Construction dept. concern." (SR)
221.5	IN-85-246-001	WBN		X			"WBNP, Unit #1, North valve room, 2" feedwater pipe behind structural steel member as you enter west door, hanger base plate welded to the floor extends 'over' an expansion joint between the base plate and the wall (approx. 3/8") is insufficient to allow 'designed' movement." (SR)

* 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 A

EMPLOYEE CONCERNS FOR SUBCATEGORY 22100

ELEMENT	CONCERN NUMBER	PLANT LOCATION	APPLICABILITY SQN	WBN	BFN	BLN	CONCERN DESCRIPTION*
221.6	IN-85-305-001	WBN	X	X		X	"Over a period of time the bending of ears on small B001 support clamps will cause the A-36 material to yield beyond its yield point. Clamps are installed in both units. (WBNP)." (SR)
221.7	XX-85-102-N13	BFN			X		"NRC identified the following concern from review of QTC files. 'Pipe hangers are routinely found damaged during ISI inspections. May be indicative of inadequate pipe support design.'" (SR)
221.8	IN-85-772-002	WBN		X			"Hanger, on relief valve vent line room control room chiller B, is overdesigned at least 10 times. This hanger, 8 x 8 tube steel, is for supporting relief valve vent line vapor pressure. Location: A13 and U line elev. 737' aux. bldg Unit 2 side. Control room chiller B. CI has no further information. NUC Power Department concern." (NO)
221.9	IN-85-947-007	WBN		X			"Hanger 2-63-209 (elevation 720, Unit 2 containment) is designed with too little clearance between its sharp edges and the 1" to 1-1/2" stainless steel line that runs through it. During plant operation, vibration and/or shock loading could cause the hanger to damage the stainless pipe. Construction dept. concern. CI has no further information." (SR)
221.10	SQN-86-001-002	SQN	X				"During the exit interview, the CI stated that the Upper Head Injection System vertical riser just outside reactor vessel (Units 1 and 2) require a rigid support, but instead a snubber was used." (SS)
221.11	BNP-QCP-10.35-8-33	BLN				X	CI was concerned about actual specifications used on heavy MOV supports. Specific concern was on a KC system hanger holding an MOV which was attached to a 3-inch pipe located on the ceiling, north side of RB1, elevation 622. Marking on ISO of MOV supports were not addressed by OE, and discussions with OE indicated that retrofit probably would take place. CI felt this problem could cause failure of MOV as a result of water hammer or other stress fatigue. (SR)
	BNP-QCP-10.35-22	BLN				X	Valves INL-1FCV-064N, -062N, etc will not be properly supported once the temporary supports are removed. (SR)
221.12			-	-	DELETED		
221.13			-	-	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 B

SUMMARY OF ISSUES, FINDINGS, AND
CORRECTIVE ACTIONS FOR
SUBCATEGORY 22100

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 that appears in Attachment B.

The term "Peripheral finding" in the issue column refers to a finding that occurred during the course of evaluating a concern but did not stem directly from an employee concern. These are classified as "E" in Tables 1 and 2 of this report.

Issues	Findings	Corrective Actions
********** Element 221.1 - Design Adequacy of Pipe Support Anchors and Retention of Permanent Records **********		
SQN (Not to be evaluated)	SQN	SQN
WBN	WBN	WBN
a. Design calculations for pipe supports that were prepared by Bergen-Paterson and EDS have been destroyed and are no longer in TVA's possession. Therefore, it will not be possible to identify potential failures in the designs unless the calculations are regenerated.	a. Contrary to the statement of concern, design calculations prepared by Bergen-Paterson have not been destroyed. However, design calculations prepared by EDS were inadvertently destroyed, as discussed in Subcategory Reports 21200 (WBN element 212.1) and 20500 (WBN element 205.1). TVA demonstrated the design adequacy of the affected EDS designs by regenerating a sample of the destroyed calculations. The evaluation team selected eight designs from that sample and verified that the supports were adequate for the design loads. The NRC concurred with TVA's conclusion that the extent of the sampling program was sufficient to demonstrate the adequacy of all EDS designs. Nevertheless, the NRC directed TVA to regenerate all affected calculations by the date of first refueling for Watts Bar Unit 1, and by the date of initial fuel load for Watts Bar Unit 2. TVA's commitment to regenerate these calculations is outlined in its nonconformance report (NCR) WBNCEB8418, R1 and Significant Condition Report (SCR) WBNCEB8531, R1. TVA plans to complete this action for each unit prior to the unit's fuel load.	a. Nonconformance Report WBNCEB8418 R1 addressed the destroyed EDS calculations for both units. This NCR action was completed by November 30, 1984 (memorandum from R. O. Barrett to J. C. Standifer, CEB 841130 003) and determined that all unit 2 supports will be reviewed by TVA as a part of that unit's design process. Thus, acceptability of these supports will be ensured. Significant Condition Report SCRWBNCEB8531 R1 was issued on January 14, 1986 to take corrective action for all missing pipe supports, in addition to the destroyed EDS calculations, for unit 1. This corrective action is as follows: 1. Review all calculations for basic completeness. 2. Ensure that all calculations are in the Records and Information Management System (RIMS). 3. Prepare, issue, and document calculations for all missing and incomplete calculation packages and those not meeting requirements of 1. and 2. above. The above corrective action will be implemented by the Hanger and Analysis Update Program and will be completed prior to unit 1 fuel load.

Issues	Findings	Corrective Actions
Element 221.1 - WBN (Continued)		
		The above TVA commitment is per its corrective action plan (TCAB-212, 02/25/87) for CATD 212 01 WBN 01. NOTE: No further corrective action is required beyond responding to above corrective action for CATD 212 01 WBN 01.
b. The rated load capacities of assemblies have not been properly evaluated against the actual loads (being addressed by Construction in Subcategory 10400). Note: Similar issues are also addressed in Subcategory Reports 21200 (WBN element 212.1, titled Retention of Calculation Records), and 20500 (WBN element 205.1, titled Control of Design Calculations).	b. TVA's Subcategory Report 10400 is the main document that addresses all items related to base plates and anchor bolts in full detail. However, TVA's commitment to the NRC's IE Bulletin 79-02 base plate program will ensure that all pipe support designs that include base plates attached to the building structure with concrete expansion bolts will be reassessed to incorporate all necessary requirements.	b. Corrective action is addressed by Construction Subcategory Report 10400.
BFN (Not to be evaluated)	BFN	BFN
BLN (Not to be evaluated)	BLN	BLN

Issues	Findings	Corrective Actions
********** Element 221.2 - Evaluation of Difference in Analyzed Design Loads for Pipe Supports (SQN) ********** - Major Difference in Analyzed Design Loads for Similar (Unit 1 vs Unit 2) Pipe Supports (WBN)		
SQN	SQN	SQN
a. In certain piping configurations, Zero Period Acceleration (ZPA) loads may be greater than the low frequency seismic excitation loads.	a. The concern that ZPA was not addressed at SQN is not valid based on the results of sample independent studies and reviews performed to evaluate the effect of ZPA on the piping systems.	a. No corrective action is required.
b. Management does not want to discuss the ZPA issue as it may delay the startup.	b. There is no evidence that TVA management did not want to discuss the ZPA issue. On the contrary, they commissioned the studies and reviews discussed above.	b. No corrective action is required.
c. Peripheral finding.	c. A final closure of this ZPA issue is required.	c. In its corrective action plan (TCAB 004, 11/07/86) for CATD 221 02 SQN 01, TVA commits to finalize preliminary reviews and studies for ZPA. This CAP will furnish adequate documentation to close the issue of ZPA.

Issues	Findings	Corrective Actions
Element 221.2 - WBN	WBN	WBN
a. Analyzed pipe support design loads on Unit 2 are significantly higher than the the analyzed loads of similar pipe supports on Unit 1.	a. The evaluation team examined a sample of 11 analyses performed by TVA on fairly similar Unit 1 and Unit 2 piping systems. A comparison of the pipe support loads resulting from these analyses shows that only 1 percent of the Unit 2 pipe supports have loads that are greater than 8 times the corresponding Unit 1 support loads. The evaluation team determined that the reasons for these load increases result from differences in support configuration, difference in flexibility, etc., of Unit 1 and 2 piping systems. These load increases do not constitute any safety concern as the supports were designed for the analyzed loads.	a. No corrective action is required.
BFN	BFN	BFN
(Not to be evaluated)		
BLN	BLN	BLN
(Not to be evaluated)		
********** Element 221.3 - Missing or Uninstalled Pipe Supports **********		
SQN	SQN	SQN
(Not to be evaluated)		

Issues	Findings	Corrective Actions
Element 221.3 - WBN	WBN	WBN
a. An unsupported 40-foot span of piping is an indication of a missing hanger due to design error that may cause an over-stressed condition in the pipe. Note: This issue is limited to gravity supports on nonseismic pipe.	a. The aforementioned review of randomly selected piping systems indicated that four out of six cases were within ANSI B31.1 code-suggested spans and that the remaining two cases exceeded the suggested spans, but were qualified by TVA using rigorous analysis. If the piping mentioned in the statement of concern was a nonsafety-related system with a nominal diameter greater than or equal to 30 inches, then a 40-foot span of straight run pipe is acceptable. In addition, the concerned individual might have observed this 40-foot span on a piping system that has not yet been finalized with respect to hanger installation.	a. No corrective action is required.
b. TVA's program for tracking hanger installation status lacks sufficient controls to prevent inadvertent omission of supports required by the piping analysis. Note: This issue covers the concern as it may relate to seismic piping and spans.	b. As regards the hanger tracking program, the evaluation team verified that the supports listed on the Piping Analysis Problem Review forms (App. A, b.a) were also listed in TVA's Hanger Tracking Program report. Thus, a design drawing exists for each support listed in the scope as defined by the Piping Analysis Problem Review form. In addition to these procedural controls, TVA's IE Bulletin 79-14 Phase I program (discussed in Subcategory Report 21200) requires a walkdown inspection of all safety-related piping systems that will identify any missing or uninstalled supports.	b. No corrective action is required.

Issues	Findings	Corrective Actions
Element 221.3 - BFN	BFN	BFN
(Not to be evaluated)		
BLN	BLN	BLN
(Not to be evaluated)		
********** Element 221.4 - Deletion of Supports **********		
SQN	SQN	SQN
(Not to be evaluated)		
WBN	WBN	WBN
a. The piping system is undersupported over a longer span because hangers were deleted.	a. The evaluation team reviewed the piping stress analysis of the HVAC duct (12-inch pipe). Some hangers, including the three hangers stated in the employee concern, were deleted in this computer analysis. This analysis shows that the system is qualified to meet the requirements of ASME Code and satisfies the design span (28 feet).	a. No corrective action is required.
b. The only hanger left, which is attached to the ceiling, is deficient because the hanger's "kickers" were removed. Note: A "kicker" is a brace supporting a column or a beam.	b. The evaluation team examined the subject hanger detail drawing (47A920-44-10) and determined that the original support design did not contain any "kickers." The subject hanger was qualified (without kicker) for the computed loads derived from the piping stress analysis.	b. No corrective action is required.

Issues	Findings	Corrective Actions
Element 221.4 - BFN	BFN	BFN
(Not to be evaluated)		
BLN	BLN	BLN
(Not to be evaluated)		
********** Element 221.5 - Pipe Support Baseplate Installed Over an Expansion Joint **********		
SQN	SQN	SQN
(Not to be evaluated)		
WBN	WBN	WBN
a. A pipe support base plate in the north valve room is installed over the expansion joint between the floor and the containment wall. The gap between base plate and the containment wall is insufficient and will interfere with the seismic displacement of the containment (Shield Building) wall.	a. The actual gaps between the shield wall and grout/base plate of pipe support 1-03A-569 are larger than the maximum combined SSE displacement of the Shield Building and the north valve room.	a. No corrective action is required.
b. Peripheral finding.	b. The existence of the expansion joint between the shield wall and the north valve room is not noted on the pipe support 1-03A-569 drawing. A walkdown in units 1 and 2 to inspect floor-mounted base plates, in the vicinity of expansion joints, did not identify any other base plates that extended over the expansion joints.	b. In its corrective action plan (CAP), for CATD 221 05 WBN 01 (TCAB-220, 2/27/87), TVA commits to revise the drawing for the unit 1 pipe support 1-03A-569 during the implementation of the hanger and analysis update program for unit 1. The Bechtel and TVA plant walkdowns of units 1 and 2, in the vicinity of building expansion joints, have demonstrated that this was an isolated case.

Issues	Findings	Corrective Actions
Element 221.5 - WBN (Continued)		
		To avoid a recurrence of this problem, Watts Bar pipe support designers will be made aware of this problem by memorandum.
BFN	BFN	BFN
(Not to be evaluated)		
BLN	BLN	BLN
(Not to be evaluated)		
********** Element 221.6 - Observed Bending of Pipe Clamp Ears **********		
SQN	SQN	SQN
a. Excessive torque on bolts caused bending of clamp ears.	a. There could be no bending of ears for the small bore pipe branch line clamps because the torque values specified for their installation were [illegible] There would be bending of ears for the run line clamps because an excessive torque value was specified for their installation. This excessive torque could also cause over-stressing and failure of clamp bolts.	a. In its corrective action plan (TCAB-002, 11/05/86) for CAIU 221 UU SQN 01, TVA initial revised drawing 47B001-3 to provide [illegible] torque values for the clamps listed. A plant survey will be performed to identify and evaluate B001 type supports that may have been installed with excessive torque applied to the clamp bolts.
b. Clamps were modified to prevent this bending but the clamp manufacturer's concurrence was not obtained.	b. SQN did not modify pipe clamps to prevent them from bending.	b. No corrective action is required.

THIS ITEM PARTIALLY COMPLETED
BY SQN DATE 12-4-88

Issues	Findings	Corrective Actions
Element 221.6 - WBN	WBN	WBN
a. Excessive torque on bolts caused bending of clamp ears.	a. Ears of the small-bore pipe branch line clamps would not be bent, because the torque values specified for their installation were reasonable. Ears of the run line clamps would be bent because the torque value specified for their installation was excessive. This excessive torque could also cause overstressing and failure of clamp bolts.	a. In its CAP for CATD 221 06 WBN 01 (TCAB-003-WBN) and subsequent TVA/Bechtel telecon (IUM 659, 02/18/87), TVA commits to perform a field walkdown on units 1 and 2 to identify all 47B001 type supports with bent clamp ears and/or deformed bolts. The deficiencies found in this walkdown will be corrected. Drawing 47B001-10 will be revised to change the presently specified 100 ft-lb (minimum) torque value to appropriate torque values. These revised torque values will be based on the pipe size, bolt preload, any tests performed, etc. This corrective action will be initiated and tracked by Problem Identification Reports PIR WBN CEB8693 for unit 1 and PIR-WBNCEB8698 for unit 2.
b. Clamps were modified to prevent this bending but the clamp manufacturer's concurrence was not obtained.	b. To prevent the pipe clamp ears from bending, gussets were welded to them at Watts Bar. The pipe clamp manufacturer's approval for this modification was not obtained. As a result, the manufacturer would not honor the original warranty for this product. Watts Bar did not qualify the modified pipe clamps either by analysis or by testing.	b. In its CAP for CATD 221 06 WBN 01 (TCAB-003-WBN), TVA commits to qualify the clamps (that were modified by welding gusset plates) and associated bolts. This corrective action will be initiated and tracked by Problem Identification Reports PIR WBN CEB8693 for unit 1 and PIR WBN CEB8698 for unit 2.
BFN	BFN	BFN
(Not to be evaluated)		
BLN	BLN	BLN
a. Excessive torque on bolts caused bending of clamp ears.	a. The B001-type clamps are uniquely designed with an analysis performed by ITT Grinnell to qualify each assembly. The analysis performed specifically qualifies the clamp for the pretorque forces applied to the bolts.	a. None required.
b. Clamps were modified to prevent this bending but the clamp manufacturer's concurrence was not obtained.	b. No modifications have been made to these clamps to prevent bending.	b. None required.

Issues	Findings	Corrective Actions
********** Element 221.7 - Damaged Pipe Supports **********		
SQN	SQN	SQN
(Not to be evaluated)		
WBN	WBN	WBN
(Not to be evaluated)		
BFN	BFN	BFN
a. Damaged pipe supports found during inservice inspections may indicate inadequate pipe support design.	a. The evaluation team's review of reportable occurrence reports (to the NRC) for damaged pipe supports revealed that the supports were subjected to unanticipated loading of the system. From the evaluation team's review of design documents for pipe supports from an ISI repair summary report, it was determined that support modifications were required due to pipe stress reanalysis and installation difficulties. The evaluation team's review of NOIs revealed that the pipe supports required repair of loosened parts (normal maintenance for an operating plant) and rework of an inadequately performed weld. There was no evidence that pipe supports required repair because of inadequate design. BFN has various programs in place to identify and provide maintenance or repair of pipe supports. These include reportable occurrence reports, inservice inspection, NOIs, the 79-14/79-02 program, and DRs.	a. No corrective action is required.
BLN	BLN	BLN
(Not to be evaluated)		

Issues	Findings	Corrective Actions
********** Element 221.8 - Relief Valve Vent Line Hanger **********		
SQN	SQN	SQN
(Not to be evaluated)		
WBN	WBN	WBN
a. A pipe support on the relief valve vent line of chiller B is over-designed by at least a factor of 10.0.	a. The member stress design margin was found to be approximately 3 for pipe support SVS-H-53-174-1984 and 2 for cable tray support MK 420. On the basis of a review of the structural analysis calculations for both the aforementioned support frames, the member stress design margins of 3 and 2 are reasonable. Particularly from the standpoint of member size selection, there is no evidence that either of the supports reviewed was overdesigned.	a. No corrective action is required.
BFN	BFN	BFN
(Not to be evaluated)		
BLN	BLN	BFN
(Not to be evaluated)		

Issues	Findings	Corrective Actions
********** Element 221.9 - Sharp Edge of Hanger Steel Clearance with Pipe Running Through the Hanger Steel Frame **********		
SQN (Not to be evaluated)	SQN	SQN
WBN a. If the stainless steel pipe that runs through the hanger moves and contacts the hanger's sharp edge,* an additional unanticipated component of stress may develop in the pipe. This phenomenon could damage the pipe, especially if it were to accelerate towards the sharp edge, as a result of operational vibration or shock (seismic) loading. * There is only one edge.	WBN a. The so-called sharp edge consists of a round corner of a square structural tube utilized as a shim. The round corner of the structural tube cannot be considered a "sharp edge" in the context of the stated concern. Magnitudes and directions of all analyzed thermal and seismic pipe movements at the location of the subject support reveal the following: o The pipe will actually move away from the shim as it travels from its cold to hot position. o The existing 1/8-inch gap between the pipe in its cold position and the shim is greater than the seismic displacement (0.0243-inch) for the "worst case" safe shutdown earthquake analysis. o Restraints (snubbers) located on both sides of the support in question will limit the amplitude of horizontal vibration during operation, thus providing added assurance that the pipe will not make contact with the shim.	WBN a. No corrective action is required.

Issues	Findings	Corrective Actions
Element 221.9 - BFN	BFN	BFN
(Not to be evaluated)		
BLN	BLN	BLN
(Not to be evaluated)		
********** Element 221.10 - Use of Snubber **********		
SQN	SQN	SQN
a. Upper head injection system vertical riser has a snubber type support instead of a rigid type support as required.	a. A snubber type support instead of the rigid type support shown on the drawing exists on the vertical riser of the Upper Head Injection System on both units. This has also been identified in TVA's report SCR SQN CEB 8615.	a. In its corrective action plan (TCAB-009, 11/24/88) for CAT [illegible] 221 14 SQN 01, TVA commits to remove the snubber and install a rigid type support in this location before the restart of the plant.
WBN	WBN	WBN
(Not to be evaluated)		
BFN	BFN	BFN
(Not to be evaluated)		
BLN	BLN	BFN
(Not to be evaluated)		

ITEM COMPLETED
DATE: 7-11-88

Issues	Findings	Corrective Actions
********** Element 221.11 - Heavy MOV Supports **********		
SQN	SQN	SQN
(Not to be evaluated)		
WBN	WBN	WBN
(Not to be evaluated)		
BFN	BFN	BFN
(Not to be evaluated)		
BLN	BLN	BLN
a. Valves are undersupported due to lack of adequate permanent supports.	a. On the basis of the results of the stress analyses, the existing permanent support configuration is adequate to support the valves.	a. None required.
b. The hangers supporting the heavy motor operated valves (MOVs) are not adequately designed.	b. No MOV supports in the KC system match the description provided by the concerned individual. The design review of MOV supports in the KC and other systems indicates that the supports are designed adequately.	b. None required.
c. The supports for the MOVs are not marked on the isometric drawings.	c. All reviewed MOV supports are shown and marked appropriately on the isometric drawings.	c. None required.

ATTACHMENT C

REFERENCES

1. Calculations and design drawings for the following WBN pipe supports, which were taken from the sample of regenerated calculations originally prepared by EDS:

Support, Rev.	Calculation RIMS Number
1-03A-586, R901	WBP 841109 006
1-62A-328, R1	WBP 841114 115
47A435-10-21, R3	WBP 841123 001
1-63-320, R2	WBP 841108 005
1-68-131, R904	WBP 841109 025
1-70-005, R1	WBP 841029 403
1-70-867, R901	WBP 841123 002
1-87-068, R906	WBP 840725 019

2. Calculations and design drawings for the following WBN pipe supports, which are attached to common framing with the supports listed above in 1:

Support, Rev.	Calculation RIMS Number
1-70-034, R1	WBP 841029 405
1-68-132, R901	WBP 841123 023
1-68-135, R0	WBP 841123 025
47A435-17-13A, R1	WBP 840719 048
47A435-17-13B, R1	WBP 840719 048
1-87-069, R905	WBP 841128 049

3. Microfilms of calculations prepared by Bergen-Paterson for the following WBN pipe supports:

Support, Rev.	Calculation RIMS Number
74-1RHR-R164, R1	WBP 830421 053
67-1ERCW-R198, R0	WBP 830506 023
70-1CC-R155, R3	WBP 830513 021
62-1LCV-R214, R1	WBP 830421 050

4. Problem Identification Report (PIR) WBN CEB8521 [B41 850816 021]

5. Nonconformance Report (NCR) WBN CEB8418, R1 [CEB 841130 004]

6. TVA, Sequoyah Nuclear Plant design isometric drawings of rigorously analyzed piping systems (copies controlled on 06/25/86):

   47K400-50 through 47K406-137
   47K427-50 through 47K450-59
   47K450-60 through 47K464-59
   47K464-60 through 47K465-50
   47K465-51 through 47K555-62
   47K555-63 through 47K1110-13

7. U.S. NRC Standard Review Plan (SRP) Section 3.7.2, (07/81)

8. NRC (formerly U.S. Atomic Energy Commission) Regulatory Guide 1.60, R1, (12/73)

9. Memo from R. O. Barnett to C. N. Johnson, "Potential Generic Condition Evaluation - PIR WBN CEB 8553," [841 851121 028/24], (11/21/85)

10. ZPA calculations on SQN by Bechtel, calculation PD-221.2SQN-01, R0, (09/16/86)

11. Load Tables and isometrics for the identified WBN piping stress calculations:

    o Calculations 200-02-04 (unit 1) and 250-02-04 (unit 2)

47W401-211/R5	47W401-226/R1
47B401-406/R2	47B401-454/R0
47B401-407/R2	47B401-455/R0

    o Calculations 200-04-09 (unit 1) and 250-04-09 (unit 2)

200-04-09/R908	47W464-251/R0
47B464-629/R0	47B464-809/R0
47B464-631/R0	47B464-810/R0
47B464-630/R0	47B464-812/R0
47B464-633/R1	47B464-813/R0
47B464-634/R1	47B464-814/R0

    o Calculations 200-08-18 (unit 1) and 250-08-18 (unit 2)

0600200-08-18/R906	47W406-371/R1
47B406-591/R1	47B406-868/R0
47B406-592/R1	47B406-869/R0
47B406-495/R2	47B406-506/R1

- Calculations 200-09-02 (unit 1) and 250-09-02 (unit 2)

47W435-220/R5	47W435-267/R2
47W435-222/R2	47W435-273/R2
47B435-484/R1	47B435-653/R1
47B435-485/R3	47B435-654/R1
47B435-486/R2	47B435-655/R1
47B435-487/R1	47B435-656/R1
47B435-488/R1	47B435-657/R1
47B435-489/R2	47B435-658/R1
47B435-491/R2	47B435-659/R1
47B435-492/R2	47B435-662/R1
47B435-494/R3	47B435-663/R1
47B435-652/R1	47B435-665/R1

- Calculations 200-13-10 (unit 1) and 250-13-10 (unit 2)

47W465-219/R4	47B465-429/R0
47B465-389/R1	47B465-438/R0
47B465-390/R1	47B465-439/R0
47B465-391/R1	47B465-440/R0
47W465-218/R1	47B465-397/R3

- Calculations N3-3-3A (unit 1) and N3-3-15A (unit 2)

47W427-200/R1	47W427-208/R5
47B427-466/R0	47B427-407/R2
47B427-467/R0	47B427-412/R5
47B427-465/R0	47B427-462/R2
47B427-373/R4	47B427-463/R2
47B427-374/R3	47B427-464/R2
47B427-380/R4	47B427-489/R1
47B427-382/R4	47B427-491/R0

- Calculations N3-3-11A (unit 1) and N3-3-18A (unit 2)

47W427-202/R11	47W427-216/R6
47W427-215/R4	47W427-217/R5
47B427-471/R2	47B427-453/R2
47B427-472/R0	47B427-454/R1
47B427-473/R2	47B427-455/R1
47B427-474/R2	47B427-456/R1
47B427-377/R7	47B427-417/R4
47B427-383/R6	47B427-451/R1

- Calculations N3-62-12A (unit 1) and N3-62-18A (unit 2)

47W555-207/R8	47W555-208/R2
47B555-379/R2	47B555-409/R3
47B555-385/R3	47B555-386/R3
47B555-464/R0	47B555-381/R3

- Calculations N3-62-14A (unit 1) and N3-62-19A (unit 2)

47W555-207/R8	47W555-208/R12
47B555-380/R2	47B555-382/R2
47B555-384/R1	47B555-387/R2
47B555-368/R3	47B555-421/R2
47B555-465/R0	47B555-466/R1

- Calculations N3-70-31A (unit 1) and N3-70-39A (unit 2)

47W464-225/R7	47W464-227/R4
47B464-456/R5	47B464-462/R3

- Calculations N3-70-32A (unit 1) and N3-70-38A (unit 2)

47W464-225/R7	47W464-227/R4
47B464-459/R2	47B464-461/R2

12. Bechtel Calculation PD-221-03, R0, (06/02/86)

13. TVA T-Pipe analysis for WBN Piping Stress Analyses N3-62-19A, (08/10/76), and N3-62-14A, [no RIMS number], (08/12/76)

    Bechtel Calculation PD-221-04, R0, (05/30/86)

14. WBN Piping Analysis Problem Review forms (scoping documents) for the following piping system calculations:

    N3-70-31A [CEB 850114 905], (01/15/85)
    N3-70-32A [CEB 850114 905], (01/15/85)
    N3-62-12A [WBP 840816 041], (06/13/84)
    N3-62-14A [WBP 840816 041], (06/13/84)
    N3-3-15A [841 851211 951], (12/12/85)

15. WBN Piping Analysis Isometrics:

47W400-222/R2
47W401-211/R5
47W400-232/R1
47W427-202/R11
47W427-217/R5
47W400-208/R7

16. Bechtel Calculation PD-221-06, R0, (06/10/86)

17. EN DES-SEP 82-13, "Program for NRC-OIE Bulletin 79-14, Phase I Inspection at Watts Bar Nuclear Plant, Unit 1," [CEB 831222 010], R4, (12/22/83)

18. WBN Hanger Tracking Program Report for Units 1 and 2, (03/06/86), response to request for information (RFI) 020

19. ANSI/ASME B31.1, 1983 Edition, "Design of Pipe Supporting Elements"

20. TVA, Watts Bar Nuclear Plant, HVAC system drawing 47W920-44, R11, (04/18/86)

21. TVA, Watts Bar Nuclear Plant, simplified analysis N3-31-A52A, Isometric sheet 1 of 2, R1, (07/11/85)

22. TVA, Watts Bar Nuclear Plant, simplified analysis N3-31-A52A, Isometric Sheet 2 of 2, R2, (09/26/85)

23. TVA, Watts Bar Nuclear Plant, simplified analysis N3-31-A52A, R0 (Page 10 of 14), Isometric sketch, (12/16/82)

24. TVA, Watts Bar Nuclear Plant, design calculation N3-31-A51A, R0 (Page 10 of 14), Isometric sketch, (12/16/82)

25. TVA, Watts Bar Nuclear Plant design calculation N3-31-A52A, R1 (Computer output), (07/11/85)

26. TVA, Watts Bar Nuclear Plant support design detail drawing 47A920-44-10, R0, (04/26/85)

27. TVA, Watts Bar Nuclear Plant support design detail drawing 47A920-44-10, R1, (04/26/85)

28. TVA, Watts Bar Nuclear Plant support design detail drawing 47A920-44-10, R2, (08/14/85)

29. Bechtel design-check calculation for WBN support 47A920-44-10, PD-221-12, R0, (07/10/86)

30. Watts Bar Nuclear Plant, Response from TVA on employee concern EX-85-151-002, Element 221.4, Response to RFI 019

31. CEB-75-8, "Dynamic Earthquake and Static Wind - Tornado Analysis of the Shield Building," Cover Sheet and Figure B-2, [B41 860411 009], R2, (04/14/86), R0, (03/10/75)

32. CEB-75-23, "Dynamic Earthquake Analysis of the North Valve Room and Response Spectra for Attached Equipment," Cover Sheet and Figure A-2, [CEB 830812 077], R1, (08/12/83), R0, (07/14/75)

33. CEB-80-26, "Dynamic Earthquake Analysis of the Interior Concrete Structure and Response Spectra for Attached Equipment," Cover Sheet and Figure B-1, [B41 851216 001], R1, (12/16/85), R0, (01/30/74)

34. Drawing for WBN Pipe Support 1-03A-569, R903, (10/20/83)

35. For WBN Pipe Support 1-03A-569:

    Calculation Cover Sheet, R0 and R1 [WBP 830922 023], (08/31/83)

    Calculation Summary Sheets 1 through 5 for revision 903 of the support, (09/07/83)

    Calculation Summary Sheet 1 for revision 0 of the support, (11/22/81)

    Field Change Request reply memorandum for FCR H-6885, [WBN 820119 320], (01/04/82)

    Field Change Request reply memorandum for FCR H-6555, [WBN 811214 301], (11/23/81)

36. Drawing for Pipe Support 47A401-9-6, R1 (03/05/84)

37. Sketch of Base Plate/Grout for WBN Pipe Support 1-03A-569, (06/07/86)

38. FCR H-7049, [WBN 820203 323], (01/18/82)

39. FCR H-7100, [WBN 820209 351], (01/28/82)

40. Bechtel calculation PD-221-01, R0, (04/28/86) - includes WBN walkdown information (gap measurements) for support 1-03A-569

41. CEB-77-42, "Static Pipe Support Tests and Development, Sequoyah Nuclear Plants 1 and 2," [CEB 801030 012], R0, (10/25/77)

42. CEB-75-18, "Small Line Attachment Details to Class 2 and 3 Piping Equal to or Larger than 2-1/2-inch Diameter," [CEB 840522 001], R3, (05/22/84); R1 (07/01/77)

43. WBN Drawing 47B001-10, "Mechanical Branch Valve Connection Seismic Support," R0, (11/09/77); R8, (07/06/84)

44. WBN Drawing 47B001-13, "Mechanical Branch Valve Conn. Seismic Support," R0, (10/13/79); R3, (11/13/85)

45. Bechtel Calculation PD-221-14, R0, (09/04/86)

46. SQN 47B001 series drawings "Mechanical Branch Valve Connection Seismic Support. Seismic Class I Structures"

Drawing	Rev	Drawing	Rev
47B001-1	3	47B001-10	1
47B001-2	2	47B001-11	4
47B001-3	3	47B001-12	5
47B001-4	3	47B001-13	4
47B001-5	1	47B001-13A	3
47B001-6	1	47B001-14	4
47B001-7	1	47B001-14A	1
47B001-8	5	47B001-15	2
47B001-9	2	47B001-16	0
47B001-9A	1	47B001-17	1
47B001-9B	0		

47. Memo, A. K. Jeffries, TVA, to A. Peters, Bechtel, in response to Request for Information (RFI) BLN-1705, (06/18/87)

48. Memo, A. K. Jeffries, TVA, to A. Peters, Bechtel, in response to RFI BLN-1699, (06/18/87)

49. ITT Grinnell calculations SA-3236-11 Rev. A and SA-3236-13 Rev. A for pipe supports ISM-MPGH-0453 and ISM-MPGH-0461, (06/28/87)

50. BFN Site Director Standard Practice SDSP 3.1, "Corrective Action Program," R0, (04/30/85), R7 (12/04/86)

51. BFN Procedure BFNP SI4.6.G, "Inservice Inspection Program," R0, (12/23/86)

52. BFN Notification of Indication (NOI) Reports:

NOI U2/C5B-20, (10/08/86)
NOI U2/C5B-22, (10/08/86)
NOI U2/C5B-24, (11/18/86)
NOI U2/C5B-29, (12/31/86)
NOI U2/C5B-39, (12/31/86)
NOI U2/C5B-61, (01/12/87)

53. "OE Conditions Adverse to Quality (CAQ) Data Base Frequency Report - 67 - Browns Ferry - By Identifiers," [no RIMS number], (04/02/87)

54. TVA WBN Design Calculation 47A920-38-3, R1, [WBP 831216 003], (12/30/83)

55. TVA WBN Design Calculation H-53-174-1984, sheets 1 through 9, R0, [WBP 841026 904], (10/29/84)

56. TVA WBN Design Calculation MK420, R1 [B41 860106 956], (12/20/85)

57. Bechtel Calculation PD-221-15, R0, 06/25/87

58. EDS Nuclear Inc., WBN Pipe Support Drawing 2-63-209, R902

59. Photograph of Watts Bar support 2-63-209 taken by the evaluation team on 04/16/86 during a visit to the plant

60. Thermal and SSE Seismic Displacement Problem 0600250-09-06, Node 25, computed by R. Singh, [no RIMS number], (04/17/86), response to RFI WBN-025

61. Pipe support detail drawings of SQN Problem 0600104-15-01, Unit 1:

Dwg. No.	Rev.	Dwg. No.	Rev.	Dwg. No.	Rev.
1-H45-18	906	1-H45-41	908	1-H45-32	902
1-H45-19	909	1-H45-42	908	1-H45-33	902
1-H45-22	907	1-H45-45	908	1-H45-9	2
1-H45-23	907	1-H45-46	906	1-H45-10	902
				1-H45-11	902

62. Pipe support detail drawings of SQN Problem 0600154-15-01, Unit 2:

Dwg. No.	Rev.	Dwg. No.	Rev.	Dwg. No.	Rev.
2-H45-18	3	2-H45-41	908	2-H45-9	2
2-H45-19	904	2-H45-42	908	2-H45-10	2
2-H45-22	905	2-H45-45	907	2-H45-11	1
2-H45-23	3	2-H45-46	910	2-H45-32	1
				2-H45-33	1

63. EDS Nuclear Inc., piping analysis calculation 0600104-15-01, R6, Unit 1, [no RIMS number], response to RFI SQN-625

64. EDS Nuclear Inc., piping analysis calculation 0600154-15-01, R5, Unit 2, [no RIMS number], response to RFI SQN-625

65. TVA, Summary of Analysis of SQN Problem 0600104-15-01, R7, Unit 1, [B25 860716 803]

66. TVA Bellefonte Nuclear Plant piping analysis design calculation N4-1NL-A, R2, [B21 850531 201], (05/31/85)

67. TVA, Bellefonte Nuclear Plant piping analysis design calculation N4-1NL-B, R2, [B21 850619 208], (06/14/85)

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

Drawing Number	Revision	Date
SK-1NL-MPHG-0093	R2	10/26/83
SK-1NL-MPHG-0094	R2	10/26/83
SK-1NL-MPHG-0105	R1	12/15/83
SK-1NL-MPHG-0106	R2	12/15/83

69. TVA, Bellefonte Nuclear Plant design calculation for pipe supports, 2-inch diameter and under, calculation 4B-XO-166A, R1, [BLP 841003 401], (10/04/84)

70. TVA, Bellefonte Nuclear Plant pipe support design calculation, Support 1KC-MPHG-0884 for MOV 1KC-IFCV-185, R0, [B21 870403 200], (04/03/87)

71. TVA, Bellefonte Nuclear Plant isometric drawings:

Drawing Number	Revision	Date
1RW1456-KC-G1	R6	12/08/77
1RW1456-KC-G2	R7	12/08/77
1RW1456-KC-G3	R7	12/08/77
1RW1456-KC-H1	R5	01/11/78
1RW1456-KC-H2	R5	01/11/78
1RW1456-KC-H3	R4	01/11/78

72. TVA, Bellefonte Nuclear Plant support design detail drawing 1KC-MPHG-0482 for MOV 1KC-IFCV-207B, R3, (12/17/80)

73. TVA, Bellefonte Nuclear Plant, code analysis load combinations of the piping analysis problem N4-1KC-G, R1, (04/08/85)

74. Memo from C. N. Johnson, SQN, to R. O. Barnett, TVA, "Reply to Potential Generic Evaluation - PIR WBNCEB8553 [B41 851121 028/24] for SQN," [B25 851216 300], (12/16/85)

75. Letter from R. Dunham, Bechtel, to R. O. Barnett, TVA, "Review of Implementation of ZPA Effects in Watts Bar's Piping Analysis," [no RIMS number], (03/26/86)

76. Results of Bechtel walkdown at BLN to verify existence of temporary supports in vicinity of valves 1NL-1FCV-062N and -064N, IOM 2051, (05/18/87)

77. Results of Bechtel walkdown at BLN to identify supports on MOVs, IOM 2049, (05/29/87)

78. Quality Technology Company (QTC) Employee Response Team (ERT) Investigation Report for Concern IN-85-305-001, (WBN), (03/26/86)

79. Bechtel/TVA telecon, BLN Element 221.11 - deleted support 1KC-MPHG-0482, IOM 2056, (05/22/87)

80. TVA BLN design calculations for MOV supports:

1CF-0285, R0, [B44 851205 474], (12/05/85)
1CF-0270, R0, [B44 850529 466], (05/29/85)

81. Results of WBN Plant Walkdown - base plates extending over expansion joints of certain buildings, IOM 2060, (05/21/86)

82. TVA status summary of preliminary review of ZPA at SQN, [no RIMS number], (03/86)

83. SQN FSAR Section 3.7 - ZPA commitments, Amendment 3 (05/05/86)

84. Letter from G. Parkinson, Bechtel, to G. McNutt, TVA, "Meeting Minutes May 20-22, 1986," BLT 018, 06/09/86 (Attachment 1, page 4)

85. Bechtel/TVA telecon, SQN Element 221.2 - History of ZPA issue, IOM 276, (09/25/86)

Preliminary Paper on Zero Period Acceleration (ZPA), RFI 598, (08/07/86)

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

87. WB-DC-40-31.7, "Detailed Design Criteria for the Analysis of Category I and I(L) Piping Systems," [B42 860129 501], R7, (02/21/86)

88. TVA Nuclear Performance Plans (NPPS):

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

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

Nuclear Performance Plan (TVA), Volume 2, Sequoyah Nuclear Plant, [L44 860714 800], R1, (07/14/86)