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EMPLOYEE CONCERNS

SPECIAL PROGRAM

VOLUME 2
ENGINEERING CATEGORY

SUBCATEGORY REPORT 25500
SUPPORT WELD DESIGN

UPDATED

TVA

NUCLEAR POWER

TVA EMPLOYEE CONCERNS SPECIAL PROGRAM

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1. Revised to incorporate SRP and TAS comments and CAPs.
2. Revised to incorporate SRP and TAS comments and to add Attachment C (References).
3. Revised to incorporate SRP and TAS comments.
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EXECUTIVE SUMMARY

This subcategory report summarizes and evaluates the results of 22 Employee Concern Special Program element evaluations prepared under Engineering element number series 22200 (Support Weld Design) and 21500 (Structural Steel Connection Design). The issues from employee concerns relating to pipe support weld designs were addressed in this subcategory. Welding issues other than design-related were evaluated in TVA's Welding Project Review Plan.

The element evaluations document the review of 14 issues and four peripheral findings relating to TVA's four nuclear plants: Sequoyah (SQN), Watts Bar (WBN), Browns Ferry (BFN), and Bellefonte (BLN). The issues were derived from 22 employee concerns citing perceived deficiencies in the design of pipe support welds and structural steel connection design.

The 14 issues reviewed resulted in 35 findings of which 28 require corrective actions. The corrective actions for 14 findings were initiated by TVA before the Employee Concerns Task Group evaluations; however, some did not fully address the problems. Four of the remaining 14 corrective actions were for peripheral findings related to support weld design and structural steel connection design.

The evaluation of these issues revealed a number of design deficiencies, such as incomplete weld details, incorrect weld design assumptions, minimum weld criteria not followed, weld fused to process pipe, and clamps modified without vendor approval. In some instances, the design calculations were not available for review.

Five causes dominate: "Inadequate Procedures," "Procedures Not Followed," "Inadequate Calculations," Lack of Design Detail," and "Standards Not Followed." The corrective actions in the subcategory were judged to be of significance and are summarized as follows: Evaluate box anchor rear plate weld fused to the process pipe and determine if any rework is required (WBN, BFN, BLN); qualify the modified pipe support vendor components (WBN); and analyze the welds used to replace bolts in a mixed bolted/welded connection (SQN, WBN, BFN, BLN).

The corrective action plans received by the evaluation team have been reviewed and found acceptable.

Since the corrective actions proposed by TVA for the negative findings include analysis and evaluations, they may result in hardware changes or modifications of support components. Therefore, the final significance of the corrective actions cannot be determined until the required corrective actions are completed. However, the preliminary evaluations completed to date by TVA and the verification of as-built configurations do not lead to the conclusion that support weld design/structural steel connection constitutes a significant problem to Sequoyah, Watts Bar, Browns Ferry, or Bellefonte nuclear power plants.

A review of the Nuclear Performance Plans (NPPs) by the evaluation team revealed that TVA's proposed remedial efforts will be beneficial to its nuclear program. The plant welding program, configuration control, procedure update, Design Baseline and Verification Program, training, and branch chiefs design review are the main corrective actions related to this subcategory that are being addressed in the Nuclear Performance Plans. When implemented, these programs should resolve the root causes of problems in areas such as management effectiveness and design process effectiveness observed in this subcategory.

The causes identified and other evaluation 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 t 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 evaluates the results of the ECSP element evaluations prepared under Engineering element number series 22200 (Support Weld Design) and 21500 (Structural Steel Connection Design). Welding issues other than design-related were evaluated in the TVA Welding Project Review Plan (Ref. 53).

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 determination of generic applicability
- Section 3 -- outlines the process followed for the element and 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

- o 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 14 issues have been identified. Review of these issues is presented in 22 element evaluations.

The issues reviewed under this subcategory are grouped by element and summarized, and their generic applicability determinations are addressed in the following subsections. Quality-related Corrective Action Tracking Documents (CATDs) are reviewed by the applicable site managers to identify any conditions adverse to quality (CAQ). If a CAQ report is prepared, generic applicability to all plants must be examined.

2.1 Wrong Weld Design on Box Hangers - Element 222.1

An incorrect weld was required on box hangers (box anchor rear plates). If performed as designed, the weld will fuse into the process pipe and will not allow for pipe expansion; the box anchor end plate will thus be overstressed.

This issue was evaluated for WBN, BFN, and BLN. For SQN, this issue was not considered for evaluation because the Nuclear Safety Review Staff (NSRS) concluded in its Investigation Report I-85-560-SQN that this problem does not exist at SQN.

2.2 Box Anchors with Excessive Welding - Element 222.2

Weld between process pipe and box anchor front plate is over-engineered.

This issue was evaluated for SQN and WBN and found to be invalid. There was no factual basis to consider it for other plants.

The issue of overheating due to excessive welding was addressed in Welding Project-Generic Employee Concern Report WP-15-SQN (Ref. 65).

2.3 Drawings Do Not Always Show Weld Size - Element 222.3

Pipe support drawings do not always show all details, particularly weld sizes, and welds are not detailed properly.

This issue was evaluated for the four plants (SQN, WBN, BFN, and BLN).

2.4 Modification of Clamps - Element 222.4

Proof tests were not performed to ensure that the vendor specifications were not compromised for the field-modified pipe clamps.

The issue of vendor standard components modified or fabricated by field is addressed in Construction Subcategory Report 11100.

The issue of pipe clamps designed to provide two-directional restraints was evaluated for WBN only and was found to be valid. SQN has issued Significant Condition Report (SCR) SQN CEB 8685 (B25 861126 018) to address this issue. In response to the potential generic condition evaluation request, BFN and BLN indicated that this condition does not exist at those plants.

2.5 Structural Steel Connection Design/Bolts Replaced by Welds - Element 222.5

In a mixed bolted and welded connection, the weld should be designed to carry the entire shear load.

This issue was evaluated for all four plants (SQN, WBN, BFN, and BLN).

2.6 Structural Steel Connection Design - Element 215.9

Bolts and welds are used in the same connection to transfer loads from structural steel members in concrete walls. They are not supposed to be mixed. (For Browns Ferry and Bellefonte, this issue is addressed in element 222.5.)

This issue was evaluated for all four plants (SQN, WBN, BFN, and BLN).

2.7 AISC Minimum Weld Criteria - Element 222.6

American Institute of Steel Construction (AISC) minimum weld criteria were not always followed.

This issue was not considered for evaluation for BFN and BLN because no significant findings were observed in the evaluation performed for SQN and WBN and, also, ASME code case N-413 permits weld size smaller than the minimum size required per AISC, provided appropriate design loads and allowable stresses are considered in the weld design.

2.8 Welding on Two Sides of Tubing - Element 222.7

Square tubing requires only top and bottom welds. It is implied that all-around welding should be used where possible, regardless of the loading condition.

This issue was evaluated only for WBN because of its specific reference to WBN features and was found to be invalid.

2.9 Verification of Weld Securing the Pads to the Inner Shell - Element 222.10

Weld size and supporting component size were increased, except for the welds securing the pads to the inner shell that supports the entire hanger.

This issue was evaluated only for WBN because of its specific reference to WBN features and was found to be invalid.

2.10 Undersized Weld Specified for a Support - Element 222.11

An undersized weld specified for a hanger located in unit 2 will not support the component.

This issue was not considered for evaluation for SQN, BFN, and BLN because no significant finding was observed in the evaluation performed for WBN.

2.11 Support Tube Distortion - Element 222.12

Testing is required to determine whether the instrument/drain lines are overstressed because of distortion in the B001-type pipe stanchions caused by the welding process.

The issue was not considered for evaluation for SQN, BFN, and BLN because there was no significant finding observed in the evaluation performed for WBN.

2.12 Summary of Subcategory Issues

The issue summaries above deal with presumed design deficiencies or inadequacies in weld design of pipe supports. More specifically, seven issues are concerned with inadequate weld designs (contained in element evaluations 222.1, 222.2, 222.3, 222.5, 215.9, 222.6, and 222.11); two issues suggest the strengthening of the weld specified on support drawings (contained in element evaluations 222.7 and 222.10); one issue requires testing to determine if the distortion caused overstressing of the instrument/drain line (contained in element evaluation 222.12); and one issue is concerned with proof tests not being performed for modified vendor pipe clamps (contained in element evaluation 222.4). In addition, four peripheral findings were uncovered during ECTG evaluation and require engineering evaluation to justify the design deficiencies.

A complete statement of each issue reviewed within the element evaluations is provided in Attachment B. This attachment also lists findings and corrective actions, which will be discussed in Sections 4 and 5 of this report.

As the following sections show, seven of the above summarized issues were found to be valid and require corrective action.

3. EVALUATION PROCESS

This subcategory report is based on the information contained in the applicable element evaluations that address the specific employee concerns related to the issues summarized in Section 2. The evaluation process consisted of the following steps (references are in Attachment C):

3.1 Wrong Weld Design on Box Anchors - Element 222.1

Watts Bar

a. Reviewed WBN standard box anchor drawings (47B100 series) (Ref. 1).

b. Reviewed Office of Engineering (OE) calculations (CEB-CAS-173) and Nonconformance Report (NCR) 6264 for box anchors (Ref. 2).

c. Reviewed TVA's corrective action plan (CAP) for CATD 222 01 WBN 01.

Browns Ferry and Bellefonte

a. Reviewed standard box anchor design drawings (for BLN) (Ref. 3).

b. Reviewed a sample of box anchor drawings to verify the rear plate weld details specified on the drawings (Refs. 4 and 5).

c. Reviewed design and construction procedures to verify rear plate welding (gap) requirements (Refs. 6, 7, 8, and 9).

d. Performed field walkdown to verify the actual welds installed (Ref. 10).

e. Reviewed TVA's CAPs for CATDs 222 01 BFN 01 and 222 01 BLN 01.

3.2 Box Anchors with Excessive Welding - Element 222.2

Sequoyah

a. Reviewed a sample of box anchor drawings for 3/4-inch- and 2-inch-diameter stainless steel pipe (Ref. 11).

b. Reviewed anchor design criteria and appropriate code requirements for welding to process pipe (Refs. 12, 13, and 48).

c. Reviewed box anchor details and their calculations for weld size calculated and specified (Ref. 14).

d. Reviewed TVA's CAP for CATD 222 02 SQN 01.

Watts Bar

a. Reviewed WBN standard box anchor 47B100 series drawings (Ref. 1).

b. Reviewed anchor design criteria and appropriate code requirements for welding to process pipe (Refs. 13 and 15).

c. Reviewed a sample of box anchor drawings for 3/4-inch- and 1-inch-diameter stainless steel pipe and for carbon steel and stainless steel pipe greater than 1 inch in diameter (Ref. 16).

d. Reviewed box anchor drawings 47A060-63-39, Rev. 0, and 47A060-62-118, Rev. 0, referred to in Concerns IN-85-316-005 and IN-85-672-001.

e. Reviewed TVA's CAP for CATD 222 02 WBN 01.

3.3 Drawings Do Not Always Show Weld Size (All Plants) - Element 222.3

a. Selected a sample of pipe support drawings for review (Ref. 17).

b. Reviewed supports selected in item a to verify completeness of the drawings.

c. Verified as-built condition if the drawings reviewed had incomplete information (for SQN and WBN) (Ref. 18).

d. Reviewed TVA procedures applicable to pipe support drawings (for BLN) (Ref. 9).

e. Reviewed TVA's CAPs for CATDs 222 03 SQN 01, 222 03 WBN 01, 222 03 BFN 01, and 222 03 BLN 01.

3.4 Modification of Clamps (Watts Bar) - Element 222.4

a. Reviewed the substitution requirements for vendor-supplied components specified in notes 49, 54, 102, and 167 of 47A050 series hanger drawings (Ref. 20).

b. Reviewed pipe support drawings 74-1RHR-R61, Rev. 904, and 47A050-3-92, Rev. 3, to verify the use of modified clamps.

c. Reviewed calculation (WBP 840127 081) to verify the qualification documentation of the modified clamp used in support 47A050-3-92, Rev. 3.

d. Reviewed TVA's CAP for CATD 222 04 WBN 01.

3.5 Structural Steel Connection Design/Bolts Replaced by Welds and Structural Steel Connection Design - Elements 222.5 and 215.9

Sequoyah and Watts Bar (222.5)

a. Reviewed 47A050 series drawing notes for mixed bolted and welded connection requirements.

b. Reviewed design criteria and applicable codes for mixed connection requirements (Ref. 21).

c. Selected pipe supports having mixed bolted/welded connections for review (Ref. 55).

d. Reviewed support calculations for design assumption and distribution of loads among bolts and weld (Ref. 22).

e. Reviewed TVA's CAPs for CATDs 222 05 SQN 01 and 222 05 WBN 01.

Sequoyah and Watts Bar (215.9)

a. Reviewed WBN problem identification report on this concern (for WBN) (Ref. 23).

b. Identified SQN investigation on this topic (for SQN) (Ref. 24).

c. Reviewed NSRS investigation (Ref. 66) (for WBN) and Civil Engineering Branch (CEB) policy memo (PM) 86-17 (841 860911 011) on this topic.

d. Selected design drawings where bearing-type bolts and welds were used in the same connections (Ref. 25).

e. Performed walkdown in Reactor Building and verified that "mixed" connections exist (for SQN) (Ref. 26).

f. Reviewed drawings and calculations for cases of "mixed" connections (Ref. 27).

g. Reviewed TVA's CAPs for CATDs 215 09 SQN 01 and 215 09 WBN 01.

Browns Ferry and Bellefonte (222.5) (Element 215.9 for BFN and BLN is addressed in this evaluation.)

a. Reviewed design criteria and 45A800 and 47B435 series drawing notes for mixed bolted and welded connection requirements (for BFN) (Ref. 29).

b. Reviewed design criteria and 4AW, 4BA, 4BB, 4DW, 4RA, 4RB, and 4RW series drawing details and notes for mixed bolted and welded connection requirements (for BLN) (Refs. 28 and 29).

c. Reviewed applicable codes (Ref. 54).

d. Selected pipe supports having mixed bolted and welded connections for review (Ref. 29).

e. Reviewed support calculations for design assumptions and distribution of loads among bolts and weld (Ref. 30).

f. Reviewed SCR BFN CEB 8621 [B41 860421 007] for these concerns and reviewed resulting BFN engineering activity.

g. Reviewed drawings and calculations for cases of mixed connections (Refs. 29 and 30).

h. Reviewed TVA's CAPs for CATDs 222 05 BFN 01 and 222 05 BLN 01.

3.6 AISC Minimum Weld Criteria (Sequoyah and Watts Bar) - Element 222.6

a. Reviewed Pipe Support Design Criteria and Licensing Commitments regarding AISC minimum weld requirements (Ref. 32).

b. Reviewed applicable codes (Ref. 33).

c. Reviewed pipe supports and calculations to ascertain if the code requirements and commitments are met (Ref. 34).

d. Reviewed memo E44011-01 (Ref. 59) cited in the concern and associated documents (Ref. 60) (for WBN).

e. Reviewed TVA's CAPs for CATDs 222 06 SQN 01, 222 06 SQN 02, and 222 06 WBN 01.

3.7 Welding on Two Sides of Tubing (Watts Bar) - Element 222.7

a. Reviewed pipe support drawings and calculations that involve the use of square tubing (Ref. 35).

b. Reviewed Pipe Support Design Manual and Design Criteria for Analysis of Category I component supports (Refs. 13 and 36).

c. Reviewed Nuclear Safety Review Staff (NSRS) Report I-85-216-WBN.

d. Performed plant walkdown during which welded connections of various pipe supports with square tubing were inspected to verify the concern and length of side welds (Ref. 37).

e. Conducted interviews with TVA Construction and QC personnel to find the actual welding practices and/or procedures followed for square tubing (Ref. 37).

f. Held discussions with WBN Engineering Design (EN DES) personnel as required (Ref. 38).

g. Generated sample weld calculations, based on flat length of tube, for hanger 47A450-25-415, Rev. 0 (Ref. 39).

h. Reviewed TVA's CAP for CATD 222 07 WBN 01.

3.8 Verification of Weld Securing the Pads to the Inner Shell (Watts Bar) - Element 222.10

a. Reviewed original design drawing and calculations prepared by Chicago Bridge and Iron (CBI) for the supports attached to the inner shell of the dome (Ref. 40).

b. Reviewed revised design drawings and calculations performed by TVA for these supports (Ref. 41).

3.9 Undersized Weld Specified for a Support (Watts Bar) - Element 222.11

a. Reviewed Pipe Support Design Criteria and Pipe Support Design Manual (Refs. 36 and 42).

b. Reviewed 25 pipe support drawings (102 welded connections) from units 1 and 2, along with associated design calculations, to ascertain whether code requirements are met (Ref. 43).

3.10 Support Tube Distortion (Watts Bar) - Element 222.12

a. Reviewed design standards of B001 type supports (Ref. 44).

b. Performed plant walkdown during which various auxiliary feedwater (AFW) B001 type supports were visually inspected to verify the concern (06/09/86).

c. Reviewed Pipe Support Design Manual and Design Criteria for Analysis of Category I component supports (Refs. 45, 56, and 57).

d. Performed study for various branch/stanchion welded connections to evaluate the stresses in the instrument/drain line (Ref. 46).

4. FINDINGS

The findings from each of the element evaluations for this subcategory are contained in Attachment B. The findings are listed by element number and by plant. The summarized findings follow.

4.1 Wrong Weld Design on Box Hangers - Element 222.1

The employee concerns are valid for WBN, BFN, and BLN. Watts Bar (WBN) issued a nonconformance report to acknowledge the misapplication of the requirements specified on standard box anchor drawings. As a result, the WBN Office of Construction (OC) performed a walkdown to verify the as-constructed welds for all box anchors installed in units 1 and 2. The Office of Engineering (OE) evaluated all box anchors with the weld fused or with the possibility of fusion or those that were inaccessible for inspection as identified by OC. The evaluation team observed that three box anchors were not included in the OE evaluations.

The review of samples from Browns Ferry and Bellefonte box anchor drawings indicated that the gap requirements between the rear plate weld and the process pipe were not specified on the drawings. If this weld is performed as

designed for the entire length, it will run into and fuse to the process pipe. Some box anchor drawings contained a note, "no weld to pipe"; however, no installation/welding guidelines were provided to ensure "no weld to pipe" was made in such cases. There is a possibility of the rear plate being overstressed in cases where the weld is fused to the process pipe.

The issue that overheating caused by a large weld size could produce metal fatigue/in-service failure in circumferential welds is addressed in Welding Project - Generic Employee Concern Report WP-15-SQN (Ref. 65).

4.2 Box Anchors with Excessive Welding - Element 222.2

For SQN and WBN, the full penetration weld specified between the process pipe and the front plate on a sample of box anchor drawings reviewed is in compliance with the anchor design criteria and code requirements; therefore, the employee concern is not valid.

During the evaluation of this concern, a peripheral finding was identified; one SQN box anchor drawing was observed with a fillet weld specified as permitted by the anchor design criteria. However, the requirement of using the appropriate piping stress intensification factor (SIF) was not complied with in the stress analysis. The calculations for this anchor were not available to verify the adequacy of the fillet weld. This peripheral finding appears to be an isolated case and, therefore, should not be considered for other plants.

4.3 Drawings Do Not Always Show Weld Size - Element 222.3

Review of a sample of pipe support drawings for all four plants indicated that some drawings were found with missing information and incomplete details, such as no lug orientation, missing weld symbols, and welds detailed improperly. However, the actual pipe support installations at Sequoyah were verified and all were found to be installed correctly. SQN has a drawing configuration control program, and BFN has the Site Director's Program and the IE 79-14 Bulletin Program to correct missing information on pipe support drawings. WBN issued problem identification reports (PIRs) to correct this problem. At the time of evaluation, BLN did not have a program to correct weld detail related deficiencies. The employee concerns are valid for all four plants. (SQN, WBN, BFN, and BLN)

4.4 Modification of Clamps - Element 222.4

The modified pipe clamp at WBN, which is similar to the clamp identified by a Sequoyah SCR, had no documentation existing to qualify it. Evidently, no proof tests were performed following the modification to assure that vendor (Bergen-Paterson) design, fabrication, and specifications were not compromised; therefore, the employee concern is valid.

Another modified pipe clamp that was unacceptable to the vendor was accepted by TVA by documenting the engineering justification in the calculations.

4.5 Structural Steel Connection Design/Bolts Replaced by Welds and Structural Steel Connection Design - Elements 215.9/222.5

The employee concerns are valid for all four plants. At all four plants, construction was permitted to substitute fillet welds for concrete anchors when a surface-mounted plate overlaps an embedded plate. However, correct analysis assumptions were not considered in the evaluation of mixed welded/bolted connections.

A problem identification report or a significant condition report was issued by each plant to address the problem and its corrective action. However, the corrective actions were insufficient to correct the design deficiency.

In addition, a peripheral finding at BLN was discovered during the evaluation of this concern. In some areas, design calculations for pipe whip restraints under seismic out-of-plane loads need justification for results that are determined by judgment alone. The generic applicability of this peripheral finding to other plants is to be determined by TVA in the Generic Condition Evaluation required by CAQR BLF 870090 [RIMS B05 870714 301].

4.6 AISC Minimum Weld Criteria - Element 222.6

The review of a sample of pipe support drawings for SQN and WBN indicated that, in some cases, the AISC minimum weld requirements were not met as committed to in the design criteria and the FSAR. Therefore, the employee concern is valid.

In the instances where the AISC minimum weld requirements for WBN pipe supports were not met, it was found that the weld sizing was properly performed using appropriate design loads and allowable weld stresses.

In addition, design calculations for 12 SQN pipe supports whose welds do not meet minimum sizes were not available for review to verify that appropriate design loads and allowable stresses are considered in weld designs.

4.7 Welding on Two Sides of Tubing - Element 222.7

For WBN, the adequacy of top and bottom welds for structural tubing was evaluated and found to be qualified, either by analysis or by documented engineering judgment. Therefore, the utilization of an all-around weld as stated by the CI is not required.

During the evaluation of this concern, a peripheral finding was discovered: one weld connection for the top and bottom sides of structural tubings was calculated based on the entire lengths (i.e., including the curve surface). However, the evaluation team noted that Construction provided a weld for the flat lengths only (i.e., did not include the curve surface). The generic applicability of this peripheral finding to other plants is to be determined by TVA in the Generic Condition Evaluation required by CAQR BLF 870098 [RIMS B05 870612 318].

4.8 Verification of Weld Securing the Pads to the Inner Shell - Element 222.10

The evaluation team reviewed the original WBN weld calculations prepared by Chicago Bridge and Iron and the revised calculations prepared by TVA for the supports attached to the pads. An increase in weld size is not necessary.

4.9 Undersized Weld Specified for a Support - Element 222.11

The review of a WBN sample of pipe supports indicated that, in all cases, the specified weld sizes were larger than the calculated weld sizes. Therefore, the employee concern that undersized welds are specified on support drawings is not valid.

4.10 Support Tube Distortion - Element 222.12

A note on a WBN 8001 sketch from an expurgated file indicated a 5/16-inch distortion in a pipe stanchion. Distortions of this magnitude were not observed by the evaluation team during the visual inspection of several 8001 stanchions. Further, the calculations performed by the evaluation team indicate that axial stresses would not result in a fatigue-induced pipe failure during the expected operating life of the plant. Additional testing is not required because the concern is not substantiated.

4.11 Summary of Subcategory Findings

Each of the detailed findings in Attachment B has been classified. A summary of the classified findings is provided in Table 1. Class A and B findings indicate that there is no problem and that corrective action is not required. Class C, D, and E findings require corrective action. The corrective action class, defined in the Glossary Supplement, is identified in the table by the numeral combined with the finding class.

The summary of findings by classification is given in Table 2. Where more than one finding/corrective action classification is listed in Table 1 for a single issue/finding, Table 2 counts only a single classification. For element 222.1, the "C6" classification would be chosen over the "C2." Therefore, Table 2 identifies only one finding/corrective action classification for each issue evaluated.

Of the 35 findings identified by a classification in Table 2, seven require no corrective action. Of the remaining 28, 14 findings had corrective actions initiated before the ECTG evaluation, 10 findings had new corrective actions identified, and four were peripheral findings identified during the ECTG evaluation. From this table, it can be seen that at Watts Bar, where most of the issues originated, 8 out of a total of 13 findings were found to be valid and require corrective action. Also at Watts Bar, there was one peripheral finding requiring corrective action.

5. CORRECTIVE ACTIONS

The corrective actions, along with their finding/corrective action classifications, are summarized in Table 3. The corrective action descriptions in the table are a condensation of the more detailed corrective action information provided in Attachment 8. The table indicates the plant or plants to which a corrective action is applicable by the Corrective Action Tracking Document (CATD) column, where the applicable plant is identified by the CATD number. Summaries of the corrective action plans are as follows:

5.1 Wrong Weld Designed on Box Hangers - Element 222.1

Three box anchors will be evaluated that were not included in an earlier WBN evaluation. WBN box anchor 478100 series drawings have been revised to specify gap requirements between the rear plate weld and the process pipe.

BFN has reviewed box anchors installed in 1980 or later and found 12 box anchors drawings that do not provide for a gap between the rear plate and the process pipe. The 12 box anchors will be evaluated/reinspected for weld fusion to the process pipe. Box anchors installed before 1980 will be evaluated under the IE Bulletin 79-14 program, small bore program and class II over class I program. BFN design criteria will be revised to add gap requirements.

BLN will reinspect and evaluate all installed box anchors for weld fusion to the process pipe and will also revise the general note on the standard box anchor drawing to specify the gap requirement between the rear plate weld and the process pipe.

Box anchors found unacceptable by the evaluation will be reworked to remove the fused weld (WBN, BFN, BLN).

5.2 Box Anchors with Excessive Welding - Element 222.2

The adequacy of 1/4-inch fillet weld used for anchor 1-H20-330, Rev. 5, will be verified. To establish this occurrence as an isolated case, a random sample of box anchors will be examined to verify the as-constructed weld (SQN). (No corrective action is required for WBN.)

5.3 Drawings Do Not Always Show Weld Size - Element 222.3

Sequoyah commits to documenting modifications to supports on configuration control drawings. Watts Bar safety-related pipe supports will be revised under the existing PIRs to show missing information.

BFN pipe support drawing discrepancies for the supports installed before 1980 will be verified under IE.Bulletin 79-14 program, small bore piping program, and class II over class I program. Support drawings installed after 1980 will be verified for missing information by examining a random sample.

BLN will review a randomly selected sample of weld connections specified with 2 sides/3 sides symbol in support drawings. The as-constructed weld configuration will be verified against the calculated configuration. Design criteria will be revised to follow AWS welding symbols for the future designs.

5.4 Modification of Clamps - Element 222.4

All safety-related pipe support designs will be evaluated to qualify the modified vendor components (WBN).

The support design manual will be revised to require any modification to vendor supplied standard support components to be qualified by the vendor or any appropriate qualified TVA designer (WBN).

5.5 Structural Steel Connection Design/Bolts Replaced by Weld and Structural Steel Connection Design - Elements 215.9/222.5

TVA commits to select a random sample of surface-mounted plates with mixed welded/bolted connections from various commodities. The sample will be analyzed by distributing all shear forces applied on the base plate to the weld. The sample will be expanded, if required, to achieve a 95 percent confidence level in 95 percent conformance. The connections that are found deficient will be strengthened. A policy memorandum was issued to prevent recurrence in the future (SQN, WBN, BFN, BLN).

The calculations for jet impingement barriers will be reviewed and revised to address seismic out-of-plane loads and to justify the inadequate engineering judgement made in the the calculations. Deficient structures will be modified as required (BLN).

5.6 AISC Minimum Weld Criteria - Element 222.6

Applicable design criteria and FSAR sections will be revised to reflect the use of welds smaller than the AISC minimum (SQN, WBN). In addition, Sequoyah will qualify by analysis the 12 supports whose welds do not meet minimum sizes.

5.7 Welding on Two Sides of Tubing - Element 222.7

All engineered pipe supports with tubes welded on two opposite sides will be reviewed under the hanger and analysis update programs. All required support and calculation revisions will be performed under these programs (WBN).

5.8 Summary of Subcategory Corrective Actions

From the Finding/Corrective Action Classification column in Table 3, it can be seen that of the 16 corrective actions identified, eight involve additional evaluation/analysis to meet design commitments and may require hardware changes or physical modification, six require revision of support design criteria and reinstruction of designers to prevent recurrence, one requires verification of appropriate design loads and allowable stresses used in weld designs, and the remaining one requires documentation of missing information on support drawings.

In addition, the CATD column in Table 3 shows that, in most cases, a similar corrective action is applicable to all plants. The corrective action plans are found to be acceptable by the evaluation team to resolve the findings.

6. CAUSES

Table 3 identifies one or more causes for each problem requiring corrective action. An attempt was made to identify the most important cause for each corrective action; however, in some instances, the problem may have resulted from a combination of causes. Therefore, more than one cause is identified for some of the corrective actions. However, whenever there was direct evidence linking a cause with a corrective action requirement, such evidence was taken into account.

6.1 Bases for Identifying Causes

The bases for identifying specific causes for each corrective action description in Table 3 and the negative findings are as follows:

6.1.1 Wrong Weld Designs on Box Hangers - Element 222.1

Installation procedures and standard box anchor drawings did not specify the gap requirements between the rear plate weld and the process pipe and detail on the drawings was not clear causing welds to be fused to the process pipe. Adequate procedures should have prevented this deficiency.

6.1.2 Box Anchors With Excessive Welding - Element 222.2

Design criteria require the stress intensification factor (SIF) to be used when a fillet weld is used between the front plate of a box anchor and the process pipe. Calculations were not performed to adhere to the design requirements. The oversight was an engineering error.

6.1.3 Drawings Do Not Always Show Weld Sizes - Element 222.3

Pipe support drawings were missing design details. Wrong weld symbols were specified on support drawings because AWS Weld Standards were not followed.

6.1.4 Modification of Clamps - Element 222.4

Calculations performed were inadequate and engineering judgment was not documented to justify the modification of vendor components.

6.1.5 Structural Steel Connection Design/Bolts Replaced by Welds and Structural Steel Connection Design - Elements 215.9 and 222.5

Assumptions used in the calculations of mixed connections were unconservative. Welds should have been designed considering the total shear load and a portion of tension loads, in accordance with the requirements provided in the design criteria and procedures.

6.1.6 AISC Minimum Weld Criteria - Element 222.6

Design criteria and the FSAR have commitments to follow the AISC minimum weld requirements. However, the calculations performed did not consider the minimum weld requirements.

6.1.7 Welding on Two Sides of Tubing - Element 222.7

Weld calculations performed for two sides of structural tubing were inadequate. Only the straight portions of structural tubing should have been considered in sizing the weld. Design criteria did not provide guidelines for designing such welds. The oversight was an engineering error.

6.2 Groups of Causes

The causes in Table 3 are assigned to broader groups as follows: management effectiveness, design process effectiveness, and technical adequacy. Using these groups, the totals from Table 3 show that 10 causes are in the management effectiveness group, 12 are in the design process effectiveness group, and 5 are in the technical adequacy group.

6.2.1 Management Effectivenss

The pattern of "Inadequate Procedures" and "Procedures not Followed," which was encountered in the findings related to box anchor weld fused to process pipe, modification of pipe clamps, analysis of mixed bolted/welded connections, and welding on two sides of tubing, indicates there is insufficient involvement on the part of engineering supervision in providing adequate procedures and assuring that they are followed.

TVA has committed in its NPPs (Ref. 52) to update procedures and provide adequate training in procedure implementation. These steps, when properly implemented, will correct the observed deficiencies.

6.2.2 Design Process Effectiveness

The greatest number of causes fall in the area of design process effectiveness and were primarily attributed to "Inadequate Calculations" and "Lack of Design Detail." Design calculations were either incomplete, i.e., did not cover all components, or the design assumptions were not properly followed. The "Inadequate Calculations" were also a result of "Procedures Not Followed" or "Inadequate Procedures." These causes indicate a lack of attention to documenting calculations adequately.

The programs addressed in the NPPs, such as the hanger and analysis update program, design baseline and verification, regeneration of calculations, configuration control, and technical audits, should correct the deficiencies identified above. Action by line management to upgrade the design review process should reduce the number of errors and deficiencies in design output in the future.

6.2.3 Technical Adequacy

The dominating cause of technical inadequacies was that the design standards were not correctly followed. Pipe support drawings had missing information. This missing information was minor, except at BLN where welds were not properly specified.

7. COLLECTIVE SIGNIFICANCE

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. Eight of the 16 corrective actions for this subcategory are judged to be significant.

On the basis of the judgment of the evaluation team, the overall significance of the negative findings and corrective actions of all four plants can be collectively summarized as follows:

- o If the box anchor rear plate welds are made as shown in the drawings, they will fuse into the process pipe and may not meet code requirements. WBN evaluated all box anchors and found that three needed to be reworked to remove the fused weld. SQN reviewed all installed box anchors (NSRS Investigation Report I-85-560-SQN) and did not find a similar condition.

- o Missing information on pipe support drawings is judged to be of negligible importance except for Bellefonte. Some welds shown in Bellefonte pipe support drawings were not detailed properly and could be misinterpreted by Construction, causing wrong welds to be installed. The type of welds in question were not used in a majority of cases. However, BLN will evaluate all such cases to determine any needed modification.

- o Where bolts were replaced by welds for the base plate overlapping the embedment, the analysis to be performed to evaluate the adequacy of the changes may result in a hardware change or a physical modification. SQN has completed the evaluation of mixed welded/bolted connections as proposed in the corrective action plan and observed no deficiency.

- o The stress intensification factor (SIF) not considered in the analysis of the piping system at SQN could cause loads to be increased and could result in higher stresses that might not meet code allowable stresses. This was an isolated case observed during the SQN evaluation and appears to be insignificant. However, SQN will examine a random sample of box anchors to establish that this is an isolated case.

- o The modification of pipe clamps and reduction in weld lengths at WBN would result in higher stresses that may not meet code allowable stresses. However, a sample of welds evaluated, considering that length, were found adequate.

TVA's corrective action plans to address the negative findings may result in additional hardware changes or modifications of support components. Therefore, the final significance of the corrective actions cannot be determined until the required evaluations are completed. However, the preliminary evaluations completed to date by TVA and the verification of as-built configurations do not lead to the conclusion that support weld design/structural steel connection constitutes a significant problem to Sequoyah, Watts Bar, Browns Ferry, or Bellefonte nuclear power plants.

The type of corrective actions resulting from these findings does indicate a need to develop better procedures/criteria and follow them effectively in the design process. The corrective actions, such as correcting deficiencies in procedures/criteria and training to implement procedures/criteria properly, will minimize the deficiencies in the design process.

The TVA Nuclear Performance Plans (NPPs), outlined in the reference section of this report, should correct programmatic, management, and design-related deficiencies. The Corporate NPP describes the measures that TVA has taken and currently intends to take to improve the corporate-level management of its nuclear activities and to correct the problems that have occurred in this area. The corporate NPP has also identified the need for strengthening TVA's Engineering organization. This need is based, in part, on deficiencies in design process effectiveness, which are partially illustrated by the cause discussion in Section 6. It also is based on past implementation of the TVA Quality Assurance program. Thus, the need for strengthening the Engineering organization, as indicated by the NPPs, is primarily accomplished through additional training and augmentation of the design review process by the Engineering Assurance (EA) organization.

Under the restructured organization, the Branch Chief provides engineers and technical direction for the Project Engineer; the Branch Chief also assesses the need for technical reviews, develops a document review and approval matrix, and schedules reviews as required. These programs, when fully implemented, would minimize the deficiencies in design process effectiveness. An independent audit on the effectiveness of the implementation of the total Quality Assurance program is instituted by Engineering management, as a management tool, to additionally ensure that management policy is being enforced. This audit function is provided by the Engineering Assurance (EA) organization.

The site-specific nuclear performance plans for SQN, WBN, and BFN provide a complete account of the actions TVA is taking to improve its nuclear program at the respective plants, and the Corporate NPP encompasses BLN nuclear activities.

One of the programs addressed in the NPP is TVA's welding project review. Two separate phases were used by the welding project to evaluate TVA's welding program. The first phase verified the adequacy of existing welding procedures to meet the FSAR/Code commitments; the second phase verified that the TVA welding procedures are adequately implemented by construction, welds in the plants are suitable for service, and welding-related employee concerns have no detrimental effect on the adequacy of hardware.

The results of this subcategory evaluation are being combined with the other subcategory evaluations and reassessed in the Engineering category evaluation.

TABLE 1

CLASSIFICATION OF FINDINGS AND CORRECTIVE ACTIONS

	Element	Issue/ Finding**	Finding/Corrective Action Class* SQN	WBN	BFN	BLN
222.1	Wrong Weld Designed on Box Hanger. Weld Will Run Into Pipe.	a	-	C6	C6	D6
			-	C2	D2	D2
		b	-	C6	C6	D6
222.2	Box Anchors With Excessive Welding	a	A	A	-	-
		b	E5	-	-	-
			E6	-	-	-
222.3	Drawings Do Not Always Show Weld Size	a	C3	D3	C3	A
		b	C3	D3	C3	D6
			-	D4	D4	D4
222.4	Modification of Clamps	a	-	D2	-	-
			-	D6	-	-
222.5	Structural Steel Connection Design/Bolts Replaced By Welds	a	C4	C4	C4	C4
			D6	C6	C6	C6
		b	***	***	C4	C4
			-	-	C6	C6
		c	-	-	-	E6
215.9	Structural Steel Connection Design	a	C4	C4	****	****
			D6	C6	-	-

*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 Element 215.9.
****Addressed in Element 222.5.

TABLE 1 (Cont'd)

	Element	Issue/ Finding**	Finding/Corrective Action Class* SQN	WBN	BFN	BLN
222.6	AISC Minimum Weld Criteria	a	D2	D2	-	-
		b	E5	-	-	-
222.7	Welding on Two Sides of Tubing	a	-	A	-	-
		b	-	E6	-	-
			-	E2	-	-
222.10	Verification of Weld Securing the Pads to the Inner Shell	a	-	A	-	-
222.11	Undersized Weld Specified for a Support	a	-	A	-	-
222.12	Support Tube Distortion	a	-	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.	1	5	0	1	7
B. Issue valid but consequences acceptable. No corrective action required.	0	0	0	0	0
C. Issue valid. Corrective action initiated before ECTG evaluation.	2	4	6	2	14
D. Issue valid. Corrective action taken as a result of ECTG evaluation.	3	4	0	3	10
E. Peripheral issue uncovered during ECSP evaluation. Corrective action required.	2	1	0	1	4
Total	8	14	6	7	35

TABLE 3
MATRIX OF ELEMENTS, CORRECTIVE ACTIONS, AND CAUSES
SUBCATEGORY 25500

ELEM	FINDING/ CORRECTIVE ACTION CLASS.**	CORRECTIVE ACTION	CATD	CAUSES OF NEGATIVE FINDINGS *																	Significance of Corrective Actions*		
				MANAGEMENT EFFECTIVENESS							DESIGN PROCESS EFFECTIVENESS							TECHNICAL ADEQUACY					
				1 Fragmented Organization	2 Inadequate Q-trng	3 Inadequate Procedures	4 Procedures Not Followed	5 Inadequate Communication	6 Untimely Res of Issues	7 Lack of Mgt Atten	8 Inadequate Design Bases	9 Inadequate Calcs	10 Inadequate As-blt Reconcil.	11 Lack of Design Detail	12 Engrg Judgmt not Documented	13 Design Crit/ Commit Not Met	14 Insuf. Verif Documentation	15 Stds Not Followed	16 Engrg Error	17 Vendor Error	D	H	N
222.1	D6, C6	Evaluate all installed box anchors and repair if required.	WBN 01 BFN 01 BLN 01			X								X							A	P	P
	D2, C2	Revise applicable design criteria/installation documents.	WBN 01 BFN 01 BLN 01			X								X							A	-	-
222.2	E5	Verify the adequacy of 1/4-inch fillet weld used for anchor I-H20-330.	SQN 01				X					X							X		A	P	P
	E6	To establish this occurrence as an isolated case, examine a random sample of box anchors to verify the as-constructed weld.	SQN 01									X									A	P	P
222.3	D3, C3	Document missing information on pipe support drawings.	SQN 01 WBN 01 BFN 01											X				X			A	-	-
	D6	Evaluate weld connections specified with 2S/3S symbols on pipe support drawings.	BLN 01											X				X			A	P	P
	D4	Reinstruct support designers to prevent recurrence.	WBN 01 BFN 01 BLN 01															X			A	-	-
222.4	D6	Evaluate all safety-related pipe support designs to qualify the modified vendor components.	WBN 01									X			X						A	P	P

* Defined in the Glossary Supplement.

** Defined in Table 1.

TABLE 3
MATRIX OF ELEMENTS, CORRECTIVE ACTIONS, AND CAUSES
SUBCATEGORY 2550O

ELEM	FINDING/ CORRECTIVE ACTION CLASS.**	CORRECTIVE ACTION	CATD	CAUSES OF NEGATIVE FINDINGS *																	Significance of Corrective Actions*		
				MANAGEMENT EFFECTIVENESS							DESIGN PROCESS EFFECTIVENESS							TECHNICAL ADEQUACY					
				1 Fragmented Organization	2 Inadequate Q-trng	3 Inadequate Procedures	4 Procedures Not Followed	5 Inadequate Communication	6 Untimely Res of Issues	7 Lack of Mgt Atten	8 Inadequate Design Bases	9 Inadequate Calcs	10 Inadequate As-blt Reconcil.	11 Lack of Design Detail	12 Engrg Judgmt not Documented	13 Design Crit/ Commit Not Met	14 Insuf. Verif Documentation	15 Stds Not Followed	16 Engrg Error	17 Vendor Error	D	M	H
	D2	Revise the support design manual to require any modification to vendor-supplied standard support components to be qualified by the vendor or by appropriate qualified TVA designers.	WBN 01			X															A	-	-
222.5/ 215.9	D6, C6	Evaluate surface-mounted plates with mixed welded/bolted connections.	SQN 01 (222) SQN 01 (215) WBN 01 (222) WBN 01 (215) BFN 01 (222) BLN 01 (222)				X					X									A	P	P
	C4	Provide instructions for designing mixed bolted/welded connections.	SQN 01 WBN 01 BFN 01 BLN 01				X														A	-	-
	E6	Review/evaluate jet impingement calculations.	BLN 01				X					X									A	P	P
222.6	D2	Revise applicable design criteria and licensing commitments.	SQN 01 WBN 01				X														A	-	-
	E5	Perform analytical verification of twelve supports whose welds do not meet minimum size.	SQN 02									X									A	-	-
222.7	E6	Evaluate welds on two opposite sides of structural tubing.	WBN 01			X						X									A	P	P
	E2	Revise pipe support manual to consider flat lengths in weld design.	WBN 01			X													X		A	-	-
			TOTALS			5	5					7		4	1			3	2				

* 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 25500

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 characterized as safety related, not safety related, or safety significant.

ELEMENT	CONCERN NUMBER	PLANT LOCATION	APPLICABILITY SQN	WBN	BFN	BLN	CONCERN DESCRIPTION*
215.9	IN-85-297-003	WBN	X	X	X(1)	X(1)	"Structual steel connections (I-beams to embed plates) are both welded and bolted. One method is for vibration and the other method is for dead loads. Both type connections are being used on the same I-Beam and these 'are not supposed to be mixed'. Construction Dept. concern. CI declined to provide further information." (SR)
222.1	EX-85-039-003 (shared with Subcategory 50300)	WBN		X	X	X	"Watts Bar: A design deficiency has a 'wrong weld' required on box hangers which, if performed per design, causes the weld to run into the pipe (SS or carbon steel code pipe). Const. Dept. concern. CI has no further information." (SR)
	IN-85-405-001 (shared with Subcategory 50300) (shared with Element 222.2)	WBN		X	X	X	"Possibility of metal fatigue/in-service failure in circumferential welds. Connecting ss pipe to 'box' hangers. Production pressure to meet weekly quotas causes welding continuously rather than allowing weldment to cool. This might encourage using excessive amperage and larger weld rod. Many of these hangers have excessive weld metal (eg 1" weld for 6" pipe). Hanger design doesn't allow for pipe expansion. Both units Reactor Bldg, Aux, and 'raceway'." (SS)
	IN-85-634-001	WBN		X			"Box anchor end plants may be stressed due to extended welding. Example may be found at el. 687' in tunnel of #2 pipe chase." (SR)
	XX-85-086-002	BLN		X	X	X	"Bellefonte: A design deficiency has a 'wrong weld' required on box hangers which, if performed per design, causes the weld to run into the pipe (SS or carbon steel code pipe). Const. Dept. concern. CI has no further information." (SR)
	XX-85-086-003 (shared with Subcategory 50300)	SQN		X	X	X	"Sequoyah: A design deficiency has a 'wrong weld' required on box hangers which, if performed per design, causes the weld to run into the pipe (SS or carbon steel code pipe). Const. Dept. concern. CI has no further information." (SR)
	XX-85-086-004	BFN		X	X	X	"Browns Ferry: A design deficiency has a 'wrong weld' required on box hangers which, if performed per design, causes the weld to run into the pipe (SS or carbon steel code pipe). Const. Dept. concern. CI has no further information." (SR)

(1) Addressed in Element 222.5

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

ELEMENT	CONCERN NUMBER	PLANT LOCATION	APPLICABILITY SQN	WBN	BFN	BLN	CONCERN DESCRIPTION*
222.2	IN-85-316-005	WBN		X			"Pipe support design by ENDES puts excessive heat and weld on circumferentially restrained small bore pipe (1" fillet). Design concern; one example: RB2, Accumulator #1, 716' ele. pipe, support 47A-060-63-39. CI has no further information Dept. concern." (SR)
	IN-85-405-001 (shared with Subcategory 50300) (Shared with Element 222.1)	WBN		X			"Possibility of metal fatigue/ in-service failure in circumferential welds. Connecting ss pipe to 'box' hangers. Production pressure to meet weekly quotas causes welding continuously rather than allowing weldment to cool. This might encourage using excessive amperage and larger weld rod. Many of these hangers have excessive weld metal (eg 1" weld for 6" pipe). Hanger design doesn't allow for pipe expansion. Both units Reactor Bldg, Aux, and 'raceway'." (SS)
	IN-85-613-001 (shared with Subcategory 50300)	WBN		X			"Thermal stress caused by 1/2"- 1" circumferential weld on pipe to install box hanger. (generic concern)" (SR)
	IN-85-672-001	WBN		X			"Box anchors on stainless pipe requires extreme heat to complete the welding process. This weld generated heat is applied for extended periods. The pipe could be weakened in these areas. This condition exists through out both units. However examples may be found in Unit #2 reactor at el. 692" inside reactor area door." (SR)
	OW-85-003-001	WBN	X	X			"The box anchors on the 3/4" and 1" stainless pipe (no further location details known) are over-engineered. CI is concerned that when, 'all that metal is welded on', the pipe has to get so hot that it could adversely affect the pipe material. CI has no further information." (SR)
	WBP-86-007-001 (shared with Subcategory 50300)	WBN		X			"Box anchors are improperly designed plant-wide. The design requires an excessive amount of weld metal to be applied which could result in overheating of the material and resultantly weaken the material. Construction Department concern. CI has no further information." (SR)
222.3	EX-85-061-004 (shared with Subcategory 20400)	WBN	X	X	X	X	"Drawings do not always show complete details, i.e., specific weld size. Construction concern. CI has no additional detail." (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.

ELEMENT	CONCERN NUMBER	PLANT LOCATION	APPLICABILITY SQN	WBN	BFN	BLN	CONCERN DESCRIPTION*
222.3 (Cont'd)	OE-QMS-8 (shared with Subcategory 10400)	NPS	X	X	X	X	"Two areas regarding design methods for pipe supports are not receiving proper consideration: o Effect of baseplate flexibility on anchor loads. o Detailing methods for welds." (SS)
222.4	IN-85-305-N02	WBN		X			NRC identified the following concern from QTC Report IN-85-305-001. "Proof test not performed following field modification of clamps to assure that vendor design specifications were not compromised as a result to field modification." (SR)
222.5	IN-85-109-002	WBN	X	X	X	X	"Bolts replaced by welding to embedded plates. The CI is of the opinion that the weld should be analyzed for carrying the entire load. (Aux. Building, Elev. 747' or 757', Unit 1 & 2) Two internal memos (correspond ence known) describe this condition. Time frame was July 1983." (SR)
222.6	IN-85-109-003	WBN	X	X			"AISC Minimum Weld Criteria is violated by Memo E44011-01. Names are known." (SR)
222.7	IN-85-541-001	WBN		X			"Concern: Work package requires welding top and bottom only on square tubing welds even though there is no interference from other installations. This required welding on only two sides of tubing exists throughout the site. Example: Reactor #2, raceway, 709' elev., AZ 270, 3" tubing." (SR)
222.10	IN-85-670-001	WBN		X			"Concern: Reactor #2, inner shell of dome. The requirements changed, after installation - from 3"x3"x1/4" angle to 4"x4"x1/2" angle and weld sizes were increased accordingly except for the welds securing the pads to the inner shell which supports the entire hanger/piping configuration. Hangers support 2 10" Ø lines and 2 8" Ø lines. June 1985 (still inprocess work). A rough sketch is available." (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.

ELEMENT	CONCERN NUMBER	PLANT LOCATION	APPLICABILITY SQN	WBN	BFN	BLN	CONCERN DESCRIPTION*
222.11	IN-86-003-001	WBN		X			"CI has the concern that the weld specified for a hanger is undersized and will not support component. Details known to QTC, withheld due to confidentiality. Hanger located in Unit 2. Construction Dept. concern. CI has no further information." (SR)
222.12	WBM-86-002-001	WBN		X			"B-001 type pipe support on safety-related system (Ex. AFW, SIS) have a welding-caused condition which produces an elliptical shape in the support tube. Testing needs to be done to determine if the distortion of the support tube caused overstressing in instrument/drain line it supports. Nuclear Power concern. CI has no further information." (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 B

SUMMARY OF ISSUES, FINDINGS, AND
CORRECTIVE ACTIONS FOR
SUBCATEGORY 25500

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 222.1 - Wrong Weld Design on Box Hangers **********		
SQN (N/A)	SQN	SQN
WBN a. Wrong weld required on box hangers (anchor plate). If performed as designed, weld will run into process pipe.	WBN a. WBN issued nonconformance report (NCR) 6264 in 08/85 to acknowledge the misapplication of the requirements specified in drawings 47B100-2 and 47B100-3. Construction attempted to make a weld for the entire length (extending up to the process pipe) of the box anchor rear plate. This resulted in the weld actually fusing to the process pipe. Watts Bar Office of Construction (OC) performed a walkdown of 466 box anchors that do not show gap requirements between the rear plate and the process pipe, and found 146 as-constructed box anchors with the possibility of weld fused to the process pipe. Of the 146 anchors identified, 24 had fused welds, 78 had the possibility of fused welds, and 44 were inaccessible for verification. Office of Engineering (OE) evaluated (Ref. 2) 142 of the 146 box anchors identified by OC. Two box anchors (2-70-219 and 2-70-359) were not acceptable and required field rework to remove the fused welds. Furthermore, OC volunteered to rework box anchor 47A060-67-81, but the remaining three box anchors, 47A060-82-3, 47A060-82-4, and 47A060-82-5, were not evaluated. Subsequently, box anchor 47B100 series drawings were revised to incorporate weld gap requirements where both the rear plate of the box anchor and the process pipe are of the same material.	WBN a. In its corrective action plan (CAP) (TCA8-232, 03/05/87) in CAID 222 01 WBN 01, TVA commits to evaluate the remaining three box anchors (47A060-82-3, -4, and -5) and include this evaluation in the box anchor evaluation calculations (CEB-CAS-173). This corrective action will be tracked by problem identification report (PIR) WBN WBP 8750, R0. Three box anchors (2-70-219, 2-70-359, and 47A060-67-81) have been reworked to remove the fused weld per construction work packages J070D34, J070D02, and J067G36. Box anchor 47B100 series drawings were revised to specify gap requirements between the rear plate weld and the outer surface of the process pipe. This should prevent recurrence of the problem. The evaluation team concurs with the CAP.

Issues	Findings	Corrective Actions
Element 222.1 - WBN (Continued)		
b. Box anchor designs do not allow for pipe expansion due to extended welding to the process pipe and may overstress box anchor end plate. NOTE: The following issue from Employee Concern IN-85-405-001 is addressed in Welding Project - Generic Employee Concern Report WP-15-SQN: The overheating caused by a large weld size could produce metal fatigue/in-service failure in circumferential welds.	b. There is a possibility of the rear plate being overstressed in cases where the weld is fused to the process pipe.	b. Corrective action "a" will also evaluate the overstress issue.
BFN a. Wrong weld required on box hangers (anchor plate). If performed as designed, weld will run into the process pipe.	BFN a. Of the 24 anchor drawings (Ref. 4) reviewed by the evaluation team, five do not specify a weld gap or a "no weld to pipe" note. They are 47B1349-31/R0, 47B1349-35/R1, 47B2349-17/R0, 47B3349-27/R1, and 47B3349-29/R2. Similar findings were observed in the NSRS report (Ref. 47) and in the BFN response (Ref. 64) to potential generic condition evaluation (NCR6264). BFN stated that it reviewed all (38) anchor drawings in torus attached, rigorously analyzed, 6-inch and less diameter piping systems. However, two torus attached piping anchors (47B452-83/R1 and 47B452-168/R1) were not included in the review. During the plant walkdown, the evaluation team observed the possibility of weld fusion for two anchors, 47B452-149/R3 and 47B452-150/R2 (with "no weld to pipe" notes on these anchor drawings). A box anchor rear plate weld specified with a "no weld to pipe" note is difficult to accomplish for the entire length without fusion to the pipe. However, two BFN construction personnel indicated in the interviews (TVA response to NCR 6264) that rear plate welds were accomplished without fusion to the pipe.	BFN a. In its corrective action plan (CAP) (TCAB-491) in CATD 222 01 BFN 01, TVA commits to take the following actions: An engineering evaluation of 12 box anchors and affected piping will be performed assuming localized weld fusion to pipe. These 12 box anchors were identified in BFN's review of the 40 box anchors from all BFN plants whose design drawings are available and include two box anchors (47B 452-83 and 47B 452-168) that were omitted from the previous generic condition review. If the engineering evaluation cannot confirm the acceptability of localized weld fusion, a field walkdown will be performed to ascertain whether weld fusion actually exists in that support. If the walkdown cannot show that there is no weld fusion, the support will be disassembled and modified as necessary.

Issues	Findings	Corrective Actions
Element 222.1 - BFN (Continued)		
	The evaluation team reviewed BFN installation procedures (Refs. 6, 8, and 9) to determine whether they provided Construction with guidance when anchor drawings did not specify gap or "no weld to pipe" note for rear plate weld. The team found that the documents did not provide any such guidance.	Pipe supports for seismic class 1 piping 2-1/2 inches in diameter and larger issued before 1980, whose drawings are not available, will be evaluated under the NRC OIE Bulletin 79-14 program. Supports for seismic class 1 piping less than 2-1/2 inches in diameter and supports for class 2 over class 1 piping will be evaluated under the small bore program and class 2 over class 1 program. Box anchors identified during the walkdown performed in these programs will be evaluated and dispositioned as described above. Pipe support design personnel at BFN have been made aware of the potential implications of this drawing detailing deficiency. In addition, to ensure future uniform and proper design of box anchors at BFN, Design Criteria BFN-50-725 and the Pipe Support Design Handbook for BFN are also under review. These actions will be sufficient to prevent recurrence of this deficiency. The evaluation team concurs with the CAP.
b. Box anchor designs do not allow for pipe expansion due to extended welding to the process pipe and may overstress box anchor end plate. NOTE: The following issue from Employee Concern IN-85-405-001 is addressed in Welding Project - Generic Employee Concern Report WP-15-SQN: The overheating caused by a large weld size could produce metal fatigue/in-service failure in circumferential welds.	b. There is a possibility of the rear plate being overstressed in cases where the weld is fused to the process pipe.	b. Corrective action "a" will also evaluate the overstress issue.

Issues	Findings	Corrective Actions
Element 222.1 - BLN	BLN	BLN
a. Wrong weld required on box hangers (anchor plate). If performed as designed, weld will run into the process pipe.	a. The 30 box anchor drawings (Ref. 5) reviewed by the evaluation team did not specify a weld gap or a "no weld to pipe" note between the rear plate and the process pipe. In response to the WBN potential generic condition evaluation (for NCR 6264) [B21 851220 001], BLN indicated that this condition does not exist. Four anchors were observed to have a gap of 1/32-inch or less between the rear plate weld and the process pipe. No fused welds were evident from the walkdown performed by the evaluation team. However, general note 26 on drawing 3GB0067-00-3, R6 states "the weld joining the rear plates may be terminated 3/8 inch from the surface of the pipe," indicating an option for Construction. Thus, the possibility of weld fused to the process pipe exists. The evaluation team reviewed BLN installation procedures (Refs. 7, 8, and 9) to determine whether they provided Construction with guidance when anchor drawings did not specify a "no weld to pipe" note for rear plate weld. The team found that the documents did not provide any such guidance.	a. In its corrective action plan (CAP) (TCAB-617) in CATD 222 01 BLN 01, TVA commits to the following actions: All installed box anchor welded rear plates will be reinspected for weld fusion to the process pipe and repaired as required. General note 26 on drawing 3GB0067-00-3 will be revised to state that the weld joining the section of rear plates may be terminated 3/8-inch from the surface of the pipe to assure no weld fusion between the process pipe and the rear plate. The evaluation team concurs with this CAP.
b. Box anchor designs do not allow for pipe expansion due to extended welding to the process pipe and may overstress box anchor end plate. NOTE: The following issue from Employee Concern IN-85-405-001 is addressed in Welding Project - Generic Employee Concern Report WP-15-SQN: The overheating caused by a large weld size could produce metal fatigue/in-service failure in circumferential welds.	b. There is a possibility of the rear plate being overstressed if the weld is fused to the process pipe.	b. Corrective action "a" will also evaluate the overstress issue.

Issues	Findings	Corrective Actions
********** Element 222.2 - Box Anchors with Excessive Welding **********		
SQN	SQN	SQN
a. Welding on box anchors for 3/4-inch and 1-inch diameter stainless steel piping is over-engineered. Note: The overheating due to large weld size will affect the pipe material will be addressed in Welding Project - Generic Employee Concern Report WP-15-SQN.	a. The evaluation team's review of the sample of engineered box anchors (Ref. 11) and standard box anchor 478100 series drawings did not find that the welds specified between the process pipe and the front plate were over-engineered. The weld size (full penetration) specified between the process pipe and the front plate on the box anchor drawings (Ref. 11) is consistent with the anchor design criteria (Refs. 12 and 13) and code (Ref. 48) requirements.	a. None required.
b. Peripheral finding.	b. 1/4-inch fillet weld specified between the process pipe and the front plate on box anchor 1-H20-330/R5 is permitted per the TVA anchor design criteria (Refs. 12 and 13). However, the requirement for using the appropriate Stress Intensification Factor (SIF) is not complied with in the pipe stress analysis. No calculation for box anchor 1-H20-330/R5 was available to verify that the fillet weld is adequate.	b. In its corrective action plan (CAP) (TCAB-063) in CATD 222 02 SQN 01, TVA commits to perform calculations to verify the adequacy of the 1/4-inch fillet weld between the process pipe and the front plate for anchor 1-H20-330. Stress levels in the piping system will be verified to ensure that they are within the code allowables when the stress intensification factor (SIF) is applied at the location of anchor 1-H20-330. To establish this occurrence as an isolated case, a random sample of box anchors from various systems (including 2-inch-diameter pipe and smaller) will be examined to verify the as-constructed weld. If a fillet weld is found between the process pipe and the front plate, the use of an appropriate stress intensification factor (SIF) in the piping analysis will be verified. In case the SIF was not considered, further evaluations will be made to determine if the stress levels in the piping system, at the location of the anchor, are within the allowable code limits. In addition, the adequacy of the fillet weld will be verified. The sample size will be expanded if a significant number of cases are found where a full penetration weld

Issues	Findings	Corrective Actions
Element 222.2 - SQN (continued)		between the front plate and the pipe is substituted with a fillet weld and the required SIF is not considered in the piping analysis. The welds found deficient will be strengthened. Changes in pipe supports are now handled by field change requests (FCRs) and variances. This should provide the necessary control by Engineering for this type of design change and should prevent recurrence of the problem. The evaluation team concurs with this CAP.
WBN a. Welding on box anchors for 3/4-inch- and 1-inch-diameter stainless steel and for all sizes of carbon steel piping systems is over-engineered as stated in Employee Concerns OW-85-003-001, WBP-86-007-001, and IN-85-316-005. Note: The overheating caused by large size will affect the pipe material weld as stated in Employee Concerns and will be addressed in Welding Project-Generic Employee Concern Evaluation Report WP-15-SQN. Hanger (box anchor) design is improper and does not allow for pipe expansion as stated in Employee Concern IN-85-405-001, addressed in this subcategory report WBN Element 222.1.	WBN a. The evaluation team's review of the sample of engineered box anchors (Ref. 16) and standard box anchor 478100 series drawings did not find that the welds specified between the process pipe and the front plate were over-engineered. The weld size (full penetration) specified between the process pipe and the front plate on box anchor drawings is consistent with the anchor design criteria (Ref. 13) and the code (Ref. 15) requirement.	WBN a. None required.
BFN (N/A)	BFN	BFN
BLN (N/A)	BLN	BLN

Issues	Findings	Corrective Actions
********** Element 222.3 - Drawings Do Not Always Show Weld Size **********		
SQN a. Pipe support drawings do not always show all details, particularly weld sizes. b. Welds are not detailed properly on pipe support drawings. Note: The issue of the effect of base plate flexibility on anchor bolt design is not being considered; it is discussed in Construction Subcategory 10400.	SQN Issues a and b. The concern is valid as SQN pipe support drawings (Ref. 17) do not always show complete details such as weld size, type, etc. In spite of the above incomplete information, the actual pipe support installations (Ref. 18) are complete and the welds are adequate. SQN has committed to a program plan for conversion to configuration control drawings to correct the problem of incomplete details on design drawings.	SQN Issues a and b. In its corrective action plan (CAP) (TCAB-023) in CATD 222 03 SQN 01, TVA commits to documenting modifications to the supports on configuration control drawings. This will be done in accordance with SQN procedures SQEP-13 and SQEP-17. The evaluation team concurs with the CAP.
WBN a. Pipe support drawings do not always show all details, particularly weld sizes.	WBN a. Review of a sample of 30 Watts Bar pipe support drawings (Ref. 17) indicates that they do not always show required welds for all support component joints; e.g., two pipe supports (47A400-11-48/R3 and 47A464-4-2/R2) were found where required welds for one connection for each support were not shown on the drawings. However, note 99 of Drawing 47A050-1-N2/R3 allows Construction to use a specified joint weld on other similar joints on the support unless otherwise specified. As-built welds for the two supports identified above were verified (Ref. 18) in order to determine that Construction had interpreted note 99 of drawing 47A050-1-N2 correctly. In addition, installation orientation of support components was not specified on two support drawings (47A400-11-47/R3 and 47A400-11-48/R3).	WBN Issues a and b. In its corrective action plan (CAP) (TCAB-252, 03/11/87) in CATD 222 03 WBN 01, TVA commits to revise support drawings 47A400-11-47 and 47A400-11-48 to show the orientation of the lugs and to revise support drawing 47A400-27 to show an all-around weld. The correct installation of the lugs and the all-around weld has been verified by field walkdown. TVA will issue problem identification report (PIR) WBN WBP 8760 for Unit 1 and PIR WBN WBP 8768 for Unit 2 to correct all safety-related engineered pipe support drawings for these types of inadequacies and to make any support modifications and/or drawing changes as required.

Issues	Findings	Corrective Actions
Element 222.3 - WBN b. Welds are not detailed properly on pipe support drawings. NOTE: The following issue from concern OE-QMS-8 is in the scope of the WBN Construction Subcategory 10400: The effect of base plate flexibility on anchor bolt design is not being considered.	WBN b. Welds are generally found to be detailed properly. In one instance, conflicting fillet weld detail (all around and two sides) was found for the same connection on pipe support drawing 47A400-27/R3.	To prevent recurrence of this deficiency, Watts Bar pipe support designers will be made aware of these inadequate detailing practices by a memorandum. The evaluation team concurs with the CAP.
BFN a. Pipe support drawings do not always show all details, particularly weld sizes. b. Welds are not detailed properly on pipe support drawings. NOTE: The following issue from Concern OE-QMS-8 is in the scope of the Construction Subcategory 10400: The effect of base plate flexibility on anchor bolt design is not being considered.	BFN Issues a and b. o Review of a sample of 35 BFN pipe support drawings (Ref. 17) has demonstrated that the weld details are complete. o BFN has implemented a program plan for processing drawing discrepancies (Ref. 49) and for converting to configuration control drawings (Ref. 50) to correct the problem of incomplete details on design drawings. o BFN has implemented the NRC IE Bulletin 79-14 program to verify the as-constructed configuration and create configuration control drawings. This will also correct the problem of incomplete details on design drawings.	BFN Issues a and b. In its corrective action plan (CAP) (TCAB-48b) in CATD 222 03 BFN 01, TVA commits to take the following actions: Pipe supports for seismic class I piping 2-1/2-inches in diameter and larger installed before 1980 will have the drawings generated or verified for all three units at BFN using field walkdown information under the NRC OIE Bulletin 79-14 program. Supports for seismic class I piping less than 2-1/2-inches in diameter and supports for class 2 over class I piping will be evaluated under the small bore program and the class 2 over class I program. Pipe support drawings issued since 1980 for the long term torus integrity program (LTTIP) and the control rod drive (CRD) piping system from all three units are not subject to Bulletin 79-14 verification. A randomly selected sample of support drawings for

Issues	Findings	Corrective Actions
Element 222.3 - BFN (Continued)		LTTIP and CRD piping system from all three units will be reviewed to determine drawing detailing discrepancies. If an engineering evaluation determines that one or more of the discrepancies affect qualification of the corresponding supports, a CAQR will be generated and the sample will be expanded accordingly. A memorandum will be released to all Browns Ferry Engineering Project (BFEP) piping support designers reminding them of the importance of making the drawing details complete and accurate. In addition, the Site Director Practices BF-SDSP-9.1 and BF-SDSP-9.2 for processing drawing discrepancies and configuration control drawings, respectively, have been implemented. These actions are expected to prevent future recurrence of these deficiencies. The evaluation team concurs with the CAP.

Issues	Findings	Corrective Actions
Element 222.3 - BLN	BLN	BLN
a. Pipe support drawings do not always show all details, particularly weld sizes.	a. Review of a sample of support drawings (Ref. 17) indicates that they show complete details, particularly weld sizes.	a. None required.
b. Welds are not detailed properly on pipe support drawings. NOTE: The following issue from Concern OE-QMS-8 is in the scope of the Construction Subcategory 10400: Effect of base plate flexibility on anchor bolt design is not being considered.	b. Weld symbols for two support drawings (2CK-MPHG-0169/R4 and 1WD-MPHG-1046/R2) were detailed with 2S (two sides)/3S (three sides) notations and do not indicate which two sides/three sides require welding. The evaluation team further reviewed the installation specifications (Ref. 9) to determine whether any interpretation of two sides/three sides weld is provided for Construction. The review of these documents revealed that no such interpretation requirements were provided for Construction. Therefore, there is a possibility of misinterpreting such weld notations shown in support drawings.	b. In its corrective action plan (CAP) (TCAB-618) in CATD 222 03 BLN 01, TVA commits to the following actions: From the supports that have already been installed and inspected, a sample of 64 welded connections, with 2S/3S in the tail of the weld symbols in the design drawing, will be randomly selected for field walkdown to determine the as-built weld configuration. This configuration will be compared with that used in the design calculation to ascertain if misinterpretation of the weld symbol had occurred. If misinterpretations are found, a generic review will be performed to determine additional corrective action. An interpretation of the 2S and 3S in the tail of the weld symbols will be incorporated into the general notes for drawing series 3GA 0059-X2 for supports not yet installed or inspected. The Lead Civil Engineer will instruct Bellefonte civil section personnel to use standard AWS symbols on all future work. The evaluation team concurs with the CAP.
********** Element 222.4 - Modification of Clamps **********		
SQN	SQN	SQN
(N/A)		

Issues	Findings	Corrective Actions
Element 222.4 - WBN	WBN	WBN
a. Proof tests were not performed to assure that the vendor specifications were not compromised for the field modified pipe clamps.	a. The modified pipe clamp (for pipe support 74-1RHR-R61) at WBN, which is similar to the clamp identified by SCR SQNCEB8685, had no documentation existing to qualify it. Evidently, no proof tests were performed following the modification to assure that vendor (Bergen-Paterson) design, fabrication, and specifications were not compromised. Another modified pipe clamp (for pipe support 47A050-3-92) that was unacceptable to the vendor was accepted by TVA by documenting the engineering justification in the calculations [WBP 840127 081]. General Notes 49, 54, 102, and 107 of 47A050 series drawings allowed Construction to substitute components from another manufacturer for Bergen-Paterson (BP) standard hanger components without any further engineering (ONE) approval. As a result, significant Condition Report (SCR) WBN CEB 8654 [B41 860516 007] was issued to address the problem. This issue will be addressed in WBN Construction Subcategory 11100 and, therefore, is not addressed in this report.	a. In its corrective action plan (CAP) (TCAB-254 in CATD 222 04 WBN 01, 03/11/87), TVA commits to take the following actions: Under the Unit 1 Hanger and Analysis Update Program (HAAUP), TVA will ensure that all vendor-supplied standard pipe support components, including pipe clamps, that were modified by welding rear brackets or other parts and by trimming or cutting, will be evaluated. This evaluation will be to qualify or revise these modified components. This corrective action will be performed and tracked under Problem Identification Report (PIR) WBNWBP8758 and will include evaluation of the pipe clamp for pipe support 74-1RHR-R61. A review was performed on Unit 2 (memorandum from W. E. Sirett to Watts Bar Engineering Project Files, 03/09/87, [B26 870309 700]) to identify pipe clamps modified by welding attachments to them. None were found. However, PIR WBNWBP8769 will be issued to evaluate and qualify any modifications to vendor-supplied standard pipe support components. The Pipe Support Design Manual (PSDM) will be revised to require any modifications to vendor-supplied standard pipe support components to be qualified by the vendor or by appropriately qualified TVA designers. This should prevent recurrence of pipe support components being modified without proper qualification. The evaluation team concurs with this CAP.

Issues	Findings	Corrective Actions
Element 222.4 - BFN	BFN	BFN
(N/A)		
BLN	BLN	BLN
(N/A)		
********** Element 222.5 - Structural Steel Connection Design/Bolts Replaced By Welds **********		
SQN	SQN	SQN
a. When a mixed bolt and weld design is made, the weld should be designed to carry the entire shear load.	a. Pipe Support Design Manual Section 7.15.1.1 stipulated that the weld design calculation is to be performed in accordance with the American Institute of Steel Construction(AISC) code. Section 1.15.10 of the AISC code contains the design criteria for the use of bolts in combination with weld. The intent of this code is that, because slippage can occur for shear forces in bearing-type connections, the relative rigid weld will carry the shear load in the case of connections with mixed welding and bearing-type bolts. The review of SQN drawings and calculations for mixed bolted/welded connections revealed the following. Drawings 47A050-1/R2 and 2/R0 permit construction personnel to substitute fillet weld for concrete anchors when a surface-mounted plate overlaps an embedded plate. However, DE approval is required for such substitution. The calculation performed to qualify mixed bolt and weld connections for SCR SQN CtB 8601 (B41 8A0110 021) does not satisfactorily address the instructions of pipe support design criteria. Correct analysis assumptions were not considered in the evaluation of mixed welded/bolted connections. Design calculations for the two supports (Ref. 51) with mixed bolted and welded connections selected for review could not be found in SQN records.	a. In its corrective action plan (CAP) (TCAB-0495) in CATD 222 05 SQN 01, TVA commits to performing a random sampling program of 60 baseplates with combined welds and bolted connections. This random sample will be selected by drawing review and field walkdown for piping, HVAC ducts, cable trays, conduits, and steel platforms in the Auxiliary Building, Control Building, Reactor Building (RB) shield wall, RB crane wall, and reactor cavity wall. The sample will be analyzed by distributing all shear forces applied on the baseplate to the welds. A sample will be considered acceptable if the actual calculated stress in the weld is less than the allowable stress. If no failures are identified in the sample, then a 95 percent confidence level will have been established. If failures are encountered in the sample, then the sample will be expanded until a 95 percent confidence level in 95 percent

Issues	Findings	Corrective Actions
Element 222.5 - SQN (Continued)		conformance is achieved. For example, if one failure is encountered, the sample size would have to be increased to 93 to achieve a 95 percent confidence level in 98 percent conformance, and so on. If additional failures are encountered, the sample size will reach to the size of the population, or in any case, a 100 percent inspection will have to be performed. The connections that are found deficient in welding will be strengthened. In addition, policy memorandum PM-86-17 provides the instructions for designing structural connections that utilize a combination of welds and bolts. This should prevent recurrence of this type of problem in the future. The evaluation team concurs with the CAP.

Issues	Findings	Corrective Actions
Element 222.5 - WBN	WBN	WBN
a. When a mixed bolt and weld design is made, the weld should be designed to carry the entire shear load.	a. Pipe Support Design Manual Section 7.15.1.1 stipulates that the weld design calculation is to be performed in accordance with the American Institute of Steel Construction (AISC) code. Section 1.15.10 of the AISC code contains the design criteria for the use of bolts in combination with weld. The intent of this code is that, because slippage can occur for shear forces in bearing-type connections, the relative rigid weld will carry the shear load in the case of connections with mixed welding and bearing-type bolts. The review of WBN drawings and calculations for mixed bolted/welded connections revealed the following. Note 2/3 of drawing 47A050-1Q R7 allows construction personnel to substitute fillet weld for concrete anchor bolts when a surface-mounted plate overlaps an embedded plate. No additional Engineering approval is required. The proper analysis assumption of shear load distribution was not made in the calculations performed to qualify mixed bolted and welded connections for NCR WBN SWP 8273 [SWP 830111 035]. PIR WBNCEB8573 (B41 851220 016) was issued to provide corrective actions to correct the design deficiency. As a result of this PIR, the following corrective actions are being taken by WBNP. o Conduct a field survey sampling of plates in which this condition exists to determine the worst in-place condition o Evaluate the worst case condition either by an analytical procedure or by testing (if required) o Revise notes on drawing 47A050-1Q as required for future installations	a. No corrective action is required beyond the corrective action provided in PIR WBN CEB 8573 and CATD 215 09 WBN 01 for Watts Bar element 215.9.

Issues	Findings	Corrective Actions
Element 222.5 - WBN (Continued)		
	o Locate, evaluate, and revise all surface-mounted plates for which this condition exists, only if sampling program results are unacceptable o Complete all design work per ECN 6194 (U1) and 6195 (U2) This PIR, together with the corrective action plan for Watts Bar element 215.9 (CAID 215 09 WBN U1), adequately provides the corrective actions to correct this problem. A memo from R. O. Barnett (policy memorandum PM 86-17) [B41 860911 011] provides instructions for designing mixed welded and bolted connections.	
BFN a. When a mixed bolt and weld design is made, the weld should be designed to carry the entire shear load.	BFN a. Drawing 45A800-2/R4 for conduit supports and drawing 47B435 for pipe supports permit Operations/Construction personnel, without DNE approval, to substitute fillet weld for concrete anchors when a surface-mounted plate overlaps an embedded plate. This method, therefore, does not ensure that the weld is designed to carry the total shear load and any associated additional load (bending) as the case may be. In addition, BFN has other component supports with mixed connections which do not have correct calculations (Ref. 30). DNE civil pipe supports section has identified five Category I pipe supports with mixed connections for unit 2 (Ref. 29, Powerhouse-Reactor Building - unit 2 Mechanical). The calculations for these supports concluded that the connections were adequate. The evaluation team has reviewed the calculations for these supports and has concluded that three did not conform to Section 1.15.10 of the AISC specification. DNE performed calculations for a typical enveloping case in accordance with the AISC code to see if conduit supports built after 1984 following the general note are acceptable (Ref. 31). The case addressed an anchor plate overlapping an embedded strip plate where two 3/4-inch-diameter anchors were replaced by welds. The calculation, which appeared generally satisfactory to the	BFN a. The surface mounted baseplates in all safety-related structures at BFN, which have welds to underlying embedded plates substituted for concrete anchors, will be qualified in accordance with policy memorandum PM 86-17, and modified as necessary. As-installed conditions will be used in the evaluation and field walkdowns will be performed as needed to establish the as-built configuration. Any results of previous evaluation activities used as a part of this corrective action will satisfy the above commitments, and have retrievable documentation. To prevent recurrence of conditions stated in SCR BFN CEB 8621, RO policy memorandum PM 86-17 was issued on September 11, 1986 stating requirements for design of baseplates with this type of end condition, and routed to support designers of various structural features at BFN. The requirements of the policy memorandum were incorporated in the Civil Design Guide DG-C1.6.4, R1, "Design of Structural Connections."

Issues	Findings	Corrective Actions
Element 222.5 - BFN (Continued)	evaluation team, concluded that the installations based on this note are acceptable. However, the evaluation team did not find either calculations addressing the governing case of one anchor replaced by weld or other walkdown-based evidence to justify acceptance of the referenced note in drawing 45A800-2. In addition, the evaluation team found that the corrective action required to qualify as-built mixed bolted and welded connections for SCR BFN CEB 8621 (B41 860623 007) was limited to a drawing review and did not require field walkdowns to determine the as-built configuration. It also did not specify if and when the proposed program will cover all affected seismic Category I components for each BFN unit. The evaluation team also found that Attachment B of the engineering report for SCR BFN CEB 8621 stated that the deficiency affected expansion anchors only; however, undercut anchors were not included in the report.	Evaluations will be performed to document qualification of the substitution of welds for bolts, which is permitted per note 15 on TVA drawing 45A800-2. The evaluations will address all possible loads from multiple attachments transferred from the embedded plate to the concrete. SCR BFN CEB 8621, R0, will be revised to include all types of structures, such as cable trays, HVAC, and piping supports, that have been or will be reviewed for this deficiency. The remedial corrective action for the SCR will be as stated in part a. of CATD 222 05 BFN 01. The Engineering Report (ER) associated with the SCR BFN CEB 8621, R0 will be superseded by the ER for the revised SCR. The SCR BFN CEB 8621, R1 will specify that this deficiency is applicable to surface mounted plates regardless of the concrete anchor type used. TVA's CAP (TCAB-427) in CATD 222 05 BFN 01, as described will meet TVA's FSAR commitment to comply with the American Institute of Steel Construction's (AISC) "Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings" as the design code for the structural steel and its connections. The evaluation team, therefore, concludes that the stated CAP is an acceptable resolution of the concerns and should also preclude their recurrence.

Issues	Findings	Corrective Actions
Element 222.5 - BFN (Continued)		
b. Bolts and welds are used in the same connection to transfer loads from structural steel members to concrete walls. These are not supposed to be mixed.	b. Based on the collective experience of the evaluation team, it is known that occasionally bolts and welds are used in the same connections to transfer loads from structural steel members to concrete walls. However, this may be used only after adequate engineering evaluation. A beam having a welded connection at one end and a bearing type-bolted connection at its other end is acceptable and is not precluded by AISC Section 1.15.10.	b. No corrective action is required. However, the existing designs will be reviewed as a part of corrective action as above.
BLN	BLN	BLN
a. When a mixed bolt and weld design is made, the weld should be designed to carry the entire shear load.	a. Calculations (Ref. 30) reviewed did not address the design of mixed bolt and weld connections in accordance with BLN FSAR commitments (Ref. 54). Also, there were no calculations to justify the generic notes in BLN drawings (Ref. 61), which allow welds to be substituted for bolts. In addition, the subject calculations did not address other design requirements associated with substitution of welds for bolts, such as: o Change of boundary conditions for base plates designed using computer programs was not considered. o A check of load transfer from embedded plates to concrete was not performed. Corrective action for PIR BLN CEB 8011 (B41 860408 015) does not clearly specify revising existing standard detail drawings to prevent recurrence in future installations.	a. 1. CAQR BLF 870125, Rev. 0, addresses items a, b, c, and d of CATD 222 05 BLN 01, and commits TVA to: 1.1 Identify all BLN surface-mounted base plates which utilize mixed bolts and weld in the load transfer to underlying structures. Evaluate all mixed connections applying the American Institute of Steel Construction's (AISC) applicable design requirements. The design calculations will be reviewed for adequate design considerations, especially in the following areas: o Distribution of the acting loads between weld and bolts o Transfer of load from embedded plate to concrete o Change in base plate flexibility because of the revised boundary conditions (when welds are used for bolts)

Issues	Findings	Corrective Actions
Element 222.5 - BLN (Continued)		o Cases where calculations do not exist. (For example, some drawings for mixed connections have generic notes that allow, under certain conditions, welds to be substituted for bolts. Documented calculations for the qualification of these generic notes were not retrievable.) 1.2 Resolve conditions identified in 1.1 above utilizing verifiable methods of load distribution between weld and bolts. Each connection will be examined to pass all specified requirements in the appropriate design criteria. The evaluation can be on a case-by-case basis or through a representative sample of each group (such as cable tray supports, pipe supports, etc.). The sample size and methodology will be similar to that used in the engineering design disposition to Watts Bar Nuclear Plant DIR Number 33. Sample group will be taken from similar type supports; that is, sample taken from cable tray supports will not be mixed with sample taken from piping supports. Sampling will be biased toward critical cases, and it will count all attachments comprising a support as one connection. 1.3 Modify mixed connections that do not meet the applicable design requirements.

Issues	Findings	Corrective Actions
Element 222.5 - BLN (Continued)		1.4 Prevent recurrence of conditions stated in CAQR BLF 870125, Rev. 0 by revising applicable design manuals and alerting design personnel as follows: o TVA will revise the Pipe Support Design Manual to incorporate the AISC's code requirements for mixed connections. o The TVA lead civil engineer will write a memorandum to all Bellefonte civil personnel alerting them of the design requirements for mixed connections. Also, all designers assigned to BLN will be issued a copy of Policy Memorandum (PM) 86-17 (CEB) and a controlled copy of the Pipe Support Design Manual. TVA stated that all mixed connections designed or revised after February 5, 1986 have used verifiable methods of load distribution between anchors and weld. Policy Memorandum PM 86-17 (CEB) was issued in September 1986 stating requirements for design of base plates with mixed bolts and weld connections. These design requirements were incorporated in Civil Design Guide DG-C.1.6.4, Rev. 1, "Design of Structural Connections." 2. CAQR BLF 870090, Rev. 1, addresses item e of CAID 222 05 BLN 01, and commits TVA to:

Issues	Findings	Corrective Actions
Element 222.5 - BLN (Continued)		2.1 Review the design documents of all BLN structures used to mitigate the effects of pipe rupture (jet impingement barrier Mark 1-2 and the additional barriers shown on Design Drawings 4RW 0550-X2-1, -2, -3, and -4 are included) for completeness, correctness, compliance with the applicable acceptance criteria, and consistency between design calculations and drawings. The design calculations will address all applicable loads and load combinations including out-of-plane seismic loads, document the reconciliation of as-installed condition, and provide rationale for judgments that are not intuitively obvious. Design documents will be revised or generated to achieve compliance with the above requirements. 2.2 Modify structures as need to reflect the design requirements from 2.1 above. TVA's CAP (TCAB-612) in CATD 222 05 BLN 01, as described, will meet TVA's FSAR commitment to: (1) comply with the American Institute of Steel Construction's (AISC) "Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings" as the design code for the structural steel and its connections; and (2) provide complete documentation for the qualification of safety-related structures, systems, and components. The evaluation team, therefore, concludes that the stated CAP

Issues	Findings	Corrective Actions
Element 222.5 - BLN (Continued)		
		is an acceptable resolution of the concerns and the peripheral negative findings that were identified during the evaluation process, and should also preclude their recurrence.
b. Bolts and welds are used in the same connection to transfer loads from structural steel members to concrete walls. These are not supposed to be mixed.	b. Based on the collective experience of the evaluation team, it is known that occasionally bolts and welds are used in the same connections to transfer loads from structural steel members to concrete walls. However, this may be done only after adequate engineering evaluation.	b. No corrective action is required. However, the existing designs will be reviewed as a part of corrective action "a" above.
c. Peripheral finding.	c. In addition, design calculations for pipe whip restraints [B21 860401 404] (Ref. 30) under seismic out-of-plane loads need, in some areas, justification for results that are determined by judgment alone.	c. See Corrective Action "a" above.
********** Element 215.9 - Structural Steel Connection Design **********		
SQN	SQN	SQN
a. Bolts and welds are used in the same connection to transfer loads from structural steel members to concrete walls. These are not supposed to be mixed.	a. The issue is valid that a combination of welds and expansion anchor bolts has been used for transferring shear loads from structural steel members to concrete walls. Significant Condition Report (SCR) SQN CEB 8601 [B41 860110 021] was issued for the Sequoyah plant because a similar condition existed at the Watts Bar plant (Ref. 24). Calculations performed for the mixed connections on drawings 47A050, 47A051, 47A052, 47A054, 47A055, and 47A056 (Ref. 62), and for SCR SQN CEB 8601 [B41 860110 021], do not satisfactorily comply with the design commitment (Refs. 21 and 63) and policy memorandum PM86-11 [B41 860911 011]. During a plant walkdown in the SQN Reactor Building, several mixed connection conditions were noted by the evaluation team. These connections support a large duct at El. 710' circling the reactor cavity wall in the annulus area approximately at azimuths 330°, 350°, and 10°. Additional supports with mixed connections were observed during the walkdown.	a. To comply with the design requirements, TVA has committed to the following corrective action plan (CAP) (TCAB-049) in CAP 215-09 SQN 01. TVA will use a statistical method with randomly selected samples to establish adequacy. A minimum of 60 samples will cover a variety of Category I systems located in different structures and will include end plate connections supporting piping, HVAC ducts, electrical conduits and trays, and platforms. The mixed connection samples subject to the actual design loads will be structurally assessed in accordance with the AISC Specification Section 1.15.10.

Issues	Findings	Corrective Actions
Element 215.9 - SQN (Continued)		The maximum actual design stresses in welding will be computed and compared with the allowable stresses. Connections found deficient in welding will be strengthened. If necessary, the sample size will be expanded until TVA can demonstrate with a 95 percent confidence level that at least 95 percent of the as-built mixed connections at SQN meet the design requirements. To preclude recurrence of this problem, TVA has issued a policy memorandum PM 86-17 instructing engineers to follow the AISC specification section dealing with the mixed connections and explaining its rationale. Application of statistical methods are an acceptable means of assessing as-built installations. TVA's CAP based on this statistical method will provide detailed calculations for establishing the adequacy of the randomly selected samples, which in turn, will give a 95 percent confidence level to the entire population of the mixed connections. As a result, TVA will meet its FSAR commitment for the Category I components at SQN. The evaluation team concludes that the stated CAP is an acceptable resolution of the concern and should also preclude recurrence of the problem.

Issues	Findings	Corrective Actions
Element 215.9 - WBN	WBN	WBN
a. Bolts and welds are used in the same connection to transfer loads from structural steel members to concrete walls. These are not supposed to be mixed.	a. Drawings 48W904-2, R8 and 48W904-3, R14 show structural steel framing for steam generator access platforms between the reactor cavity and the reactor building crane wall. Details MK3, MK3A, MK4, MK5, MK5A, MK6, MK7, and MK8 of the latter drawing show bearing bolts and welds in the same portion of the connections. Drawings 47A050-1K2, R1 and 47A050-1Q, R7 show general notes for supports of components such as HVAC ducts, piping systems, electrical conduits, and instrument lines. Notes 2/3 and 111 allow mixed use of bolts and welds when overlapping an embedded plate. Therefore, combinations of welds and bolts have been used at WBN in the same portion of the connections.. In addition, during the investigation, the evaluation team found that calculation [WBP 830420 001] for the steel framing for steam generator access platforms unconservatively assumes sharing of shear loads between bolts and welds based on equal stiffness. Calculation [WBP 830914 230] for the general notes of 47A050 series drawings is also based on this incorrect assumption. Therefore, these calculations do not comply with the design commitment of FSAR Section 3.8.4.2.1, AISC Code, and TVA Policy Memo PM 86-17. The TVA memo from R. G. Pratt, Lead Civil Engineer, to the civil design technical supervisors under his supervision [820 860519 019] stated that for future evaluations of designs, where anchor bolts and welds are mixed, the weld must be assumed to carry all the shear loads. This memo did not request an evaluation for such mixing of bolts and welds in existing designs. TVA Nuclear Safety Review Staff (NSRS) investigated the same subject for another concern in 11/85 (Ref. 66) and recommended verification analysis to ensure that the bolt-replacement welds are adequate at WBN. As a result, TVA DNE prepared PIR WBN CEB 8573 in 12/85, acknowledging the employee concern. This PIR identified the incorrect design assumption of the related calculations. PIR corrective plan required TVA to investigate existing mixed connections by sampling and evaluating in accordance with the AISC Section 1.15.10. The evaluation team has found that the sample consisted primarily of pipe support connections and did not have an adequate representation of structural steel connections for supporting platforms, HVAC ducts, and electrical cable trays and conduits.	a. To comply with the design requirements, TVA has committed to the following corrective action plan (CAP) (TCAB-219) in CATD 215 09 WBN 01. TVA will use a statistical method with selected samples to establish adequacy. Approximately 69 samples, which will be biased toward worse cases, will cover a variety of safety-related systems located in different structures and will include end plate connections supporting piping, HVAC ducts, electrical conduits and trays, and platforms. In this sampling, TVA will include samples identified as a result of corrective action for the PIR WBN CEB 8573. The mixed-connection samples will be subjected to the actual design loads and will be structurally assessed in accordance with the AISC Specification Section 1.15.10, taking into account the weld eccentricity and plate flexibility, as applicable. The maximum actual or enveloping design stresses in welding will be computed and compared with the allowable stresses. Connections found deficient in welding will be strengthened. If necessary, the sample size will be expanded until TVA can demonstrate with a 95 percent confidence level that at least 95 percent of the as-built mixed connections at WBN meet the design requirements. To preclude recurrence of this problem, TVA has issued a policy memorandum PM 86-17 instructing engineers to follow the AISC specification section dealing with the mixed connections and explaining the rationale of the section.

Issues	Findings	Corrective Actions
Element 215.9 - WBN (Continued)		
		Application of statistical methods is an acceptable means of assessing as-built installations. TVA's CAP based on a statistical method will provide detailed calculations for establishing the adequacy of the selected samples, which, in turn, will give a 95 percent confidence level to the entire population of the mixed connections. As a result of using this methodology, TVA will have adequate confidence in its FSAR commitment to meet the AISC code for the safety-related components at WBN. The evaluation team concludes that the stated CAP is an acceptable resolution of the concern and should also preclude recurrence of the problem.
BFN	BFN	BFN
(Addressed in Element 222.5)		
BLN	BLN	BLN
(Addressed in Element 222.5)		

Issues	Findings	Corrective Actions
********** Element 222.6 - AISC Minimum Weld Criteria **********		
SQN	SQN	SQN
		In its corrective action plans (CAP) (TCAB-005 and TCAB-042) in CATDs 222 06 SQN 01 and 02, TVA commits to the following actions:
a. American Institute of Steel Construction (AISC) minimum weld criteria were not always followed.	a. Specific memo E44011-01 cited in the concern by the CI was reviewed. This memo indicated that TVA had performed weld qualification tests to the requirements of the AWS D1.1 code to qualify the use of fillet weld smaller than the minimum sizes as required by AISC. The review of the TVA weld qualification test results by the evaluation team revealed that not all of the requirements of Section 5.2 of AWS D1.1 were met. Therefore, these test results are not sufficient to qualify the welds that do not meet the AISC minimum weld requirements. From a review of a sample of pipe support drawings (Ref. 34), it was determined that SQN did not, in all cases, meet the AISC minimum weld requirements as committed to in the design criteria and FSAR (Refs. 32 and 33).	a. Revise applicable FSAR sections and design criteria.
b. Peripheral finding.	b. Pipe support calculations (Ref. 34) were not available for review to determine if ASME code case N-413 can be applied.	b. Perform analytical verification of twelve supports whose welds do not meet minimum sizes. The evaluation team concurs with the CAP.

Issues	Findings	Corrective Actions
Element 222.6 - WBN	WBN	WBN
a. American Institute of Steel Construction (AISC) minimum weld criteria were not always followed.	a. Specific memo E44011-01 cited in the concern by the CI was reviewed. This memo indicated that TVA had performed weld qualification tests to the requirements of the AWS D1.1 code to qualify the use of fillet weld smaller than the minimum sizes as required by AISC. The review of the TVA weld qualification test results by the evaluation team revealed that not all of the requirements of Section 5.2 of AWS D1.1 were met. Therefore, these test results are not sufficient to qualify the welds that do not meet the AISC minimum weld requirements. From a review of a sample of pipe support drawings (Ref. 34), it was determined that WBN did not, in all cases, meet the AISC minimum weld requirements as committed to in the design criteria and FSAR (Refs. 32 and 33). For the instances where the AISC minimum weld requirements were not met, it was found that the weld sizing was properly performed using appropriate design loads and allowable weld stresses. This is permitted per ASME code case N-413.	a. In its corrective action plan (CAP) (TCAB-210, 02/25/87) in CAID 222 06 WBN 01, TVA commits to revise the FSAR and applicable design criteria to reflect the use of welds smaller than the AISC minimum. This will eliminate the conflict between design criteria/licensing commitment and actual practice for the adherence to the AISC minimum weld requirements. A Problem Identification Report (PIR) WBN WBP 8736 will be issued to accomplish this corrective action. In addition, TVA plans to obtain concurrence of the Nuclear Regulatory Commission (NRC) for the use of ASME Code case N-413. The evaluation team concurs with the CAP.
BFN (N/A)	BFN	BFN
BLN (N/A)	BLN	BLN

Issues	Findings	Corrective Actions
********** Element 222.7 - Welding on Two Sides of Tubing **********		
SQN	SQN	SQN
(N/A)		
WBN	WBN	WBN
a. Square tubing requires only top and bottom welds. It is implied that all-around welding should be utilized wherever possible, regardless of the loading condition.	a. TVA's Nuclear Safety Review Staff (NSRS) identified and visually inspected the pipe support cited in the concern. A review by the NSRS (I-85-216-WBN) of the support calculation established that the calculated stress levels are conservatively low. The evaluation team verified this NSRS finding. The evaluation team reviewed design drawings and calculations for six other pipe supports (Ref. 35) located in the general area cited in the concern. It was observed that all "top and bottom" welds for structural tubing were qualified, either by analysis or by documented engineering judgment, and meet the design requirements specified in design criteria (Refs. 13 and 36).	a. None required.
b. Peripheral finding.	b. The evaluation team noted that TVA's weld analysis methodology employs an assumption that the top and bottom weld pattern (i.e., two sides of tubing welded) has the same uniform shear resistance over the entire length in both shear directions. This assumption is acceptable provided the weld is performed over the entire length. The evaluation team conducted interviews (Ref. 37) with Construction and Quality Control (QC) to determine what length is provided for "top and bottom" tube welds. Construction stated it was site practice that the weld wrap around the corner of the tube, i.e., weld length equals tube width. QC considers the minimum weld length to be as described above. The evaluation team verified the above welding practice by plant walkdown of four hangers (47A450-26-82, 47A560-4-60, 47A450-25-415, and 47A450-26-108).	b. In its corrective action plan (CAP) (TCAB-278,03/13/87) in CATD 222 07 WBN 01, TVA commits to review all engineered pipe supports with tubes welded on two opposite sides under the Unit 1 Hanger and Analysis Update Program and a similar program for Unit 2. In this review, only the flat length is to be considered in the design calculation for this weld condition. All required support and calculation revisions, and necessary modifications will be performed under these programs. For the specific case of the weld in hanger 47A450-25-415 Rev. 0, TVA has performed new calculations based on the flat length as opposed to the nominal width of the tube which was used in the original calculation. It was determined that the weld stresses do not exceed code allowable values.

Issues	Findings	Corrective Actions
Element 222.7 - WBN (Continued)		
	During the plant walkdown, the evaluation team found that, out of the sampling of seven "top and bottom" weld joints examined, one weld (between items 3 and 5, hanger 47A450-25-415, R0) was not performed over the entire length as specified in the hanger drawing. The evaluation team performed a weld calculation (Ref. 58) considering the flat weld length and found the weld adequate for the applied loads. Similar cases of weld not provided for the entire length may exist elsewhere.	While it is anticipated that the identified (two opposite side) weld condition applies specifically to pipe supports, TVA will implement a sampling program which covers all other areas where structural tubing is used. A random statistical sample of 60 tube joints welded on two opposite sides will be taken to establish with a 95 percent confidence level that 95 percent of such joints will satisfy design requirements if the flat lengths are used in the design calculations. To prevent further recurrence of this deficiency, TVA commits to revise the Pipe Support Design Manual (PSDM) to require designers to consider only the flat length for welding a tube on two opposite sides. In addition, all Watts Bar designers and checkers of miscellaneous steel will be notified by memorandum of this identified weld design requirement. The work identified in corrective action plan (CAP) ICAB-278 in CATD 222 0/ WBN 01, will be initiated and tracked by Problem Identification Report PIR WBN WBP8782 Rev. 0 for Unit 1 and PIR WBN WBP8783 Rev. 0 for Unit 2. Condition Adverse to Quality report CAQR BLF 870098 [805 870612 318] was issued to determine generic applicability to other TVA plants. The evaluation team concurs with this CAP.
BFN (N/A)	BFN	BFN
BLN (N/A)	BLN	BLN

Issues	Findings	Corrective Actions
********** Element 222.10 - Verification of Weld Securing the Pads to the Inner Shell **********		
SQN (N/A)	SQN	SQN
WBN a. If it is deemed necessary to increase the size of a pipe support frame member and its associated welds which connects it to a dome pad, then the weld that connects the affected pad to the inner shell of the dome should also be strengthened accordingly.	WBN a. The evaluation team reviewed the original design calculations prepared by Chicago Bridge & Iron for the supports attached to the pads, as well as the revised calculations prepared by TVA (Refs. 40 and 41). It was concluded that TVA's evaluation of the increased design loads on the affected supports correctly established that an increase in size for the 5/16-inch all-around pad welds is not required. There was adequate strength margin in the initial design.	WBN a. None required.
BFN (N/A)	BFN	BFN
BLN (N/A)	BLN	BLN

Issues	Findings	Corrective Actions
********** Element 222.11 - Undersized Weld Specified for a Support **********		
SQN	SQN	SQN
(N/A)		
WBN	WBN	WBN
a. An undersized weld specified for a hanger located in Unit 2 will not support the component.	a. Based on the review of 102 welded connections in 25 sample pipe supports (Ref. 43) from various systems in different areas of the plant, no problem of undersized welds that might not be able to support the design loads was found. Also, TVA's Pipe Support Design Criteria and Pipe Support Design Manual were found to contain proper code allowables and requirements for weld design.	a. None required.
BFN	BFN	BFN
(N/A)		
BLN	BLN	BLN
(N/A)		

Issues	Findings	Corrective Actions
********** Element 222.12 - Support Tube Distortion **********		
SQN	SQN	SQN
(N/A)		
WBN	WBN	WBN
a. Distortion in the pipe stanchion of B001 type supports is caused by the welding process. Testing is required to determine if this distortion caused overstressing of the instrument/drain line.	a. Reviewed B001-type supports and design criteria and standards (Refs. 45, 56, and 57) used to support drain, instrument sensing, sampling radiation monitoring, and test lines. This type of support consists of a stanchion pipe welded either directly to the process pipe or to a clamp that is fastened in turn to the process pipe. The branch line is either clamped to the stanchion or is routed through the stanchion and welded at both ends. A note on a WBN B001 sketch from an expurgated file indicated a 5/16-inch distortion in a pipe stanchion. Distortions of this magnitude were not observed during a visit to the Watts Bar site. The evaluation team observed a slight ovaling in the order of 1/32 inch at the free end of some of the B001 stanchions used for the auxiliary feedwater (AFW) piping system. No distortion of instrument/drain lines was observed. Secondly, the observed distortions are not due solely to welding-related heat effects, but could have been caused partially by the stanchion fabrication process. Furthermore, the slight ovalness (elliptical shape) at the free end of a stanchion will not cause any stresses at the connections between the process pipe and the stanchion. The calculations (Ref. 46) performed to evaluate the axial stresses that might be induced in the instrument/drain line due to differential thermal expansion indicates that such axial stresses would not result in a fatigue-induced pipe failure during the expected operating life of the plant (over 7,000 cycles).	a. None required.

Issues	Findings	Corrective Actions
Element 222.12 - BFN	BFN	BFN
(N/A)		
BLN	BLN	BLN
(N/A)		

ATTACHMENT C

REFERENCES

1. 47B100 Standard Box Anchor Drawings:

47B100-1/R7, R0	47B100-7/R1, R0
47B100-1A/R0	47B100-8/R1, R0
47B100-2/R6, R0	47B100-9/R1, R0
47B100-2A/R1, R0	47B100-10/R1
47B100-2B/R2, R0	47B100-11/R1, R0
47B100-3/R5, R0	47B100-12/R0
47B100-3A/R5, R0	47B100-12A/R1, R0
47B100-3B/R2, R0	47B100-13/R0
47B100-3C/R1, R0	47B100-14/R1, R0
47B100-4/R1, R0	47B100-15/R0
47B100-5/R1, R0	47B100-16/R1, R0
47B100-6/R1, R0	47B100-16A/R1, R0
47B100-6A/R1, R0	

2. OE Box Anchor Evaluation; CEB-CAS-173, Rev. 0, [841 860117 004]

   Nonconformance Report (NCR) 6264, (08/20/85)

3. Mechanical general notes for pipe anchor load transfer unit: 3GB0067-00-3, Rev. 6, and mechanical load transfer units seismic anchor: 3GB0068-01, Rev. 4, and 3GB0068-02, Rev. 0

4. BFN Box Anchor Drawings:

47B456-80/R5	47B455-108/R2	47B1349-31/R0
47B3349-27/R1	47B452-195/R3	47B3349-29/R2
47B452-149/R3	47A2349-17/R0	47B452-196/R2
47B452-150/R2	47B2349-15/R4	47B452-151/R0
47B456-69/R1	47A455-415/R2	
47B458-433/R5	47B452-83/R1	
47B455-42/R2	47B452-158/R3	
47B452-146/R1	47B452-168/R1	
47B452-190/R1	47B452-157/R2	
47B458-58/R0	47B1349-35/R1	

5. BLN Box Anchor Drawings:

1RF-MPHG-G001/R4	1NV-MPHG-0089/R1	2KE-MPHG-1539/R2
1CA-MPHG-0435/R0	1RK-MPHG-0123/R3	2ND-MPHG-0907/R5
1CR-MPHG-1604/R1	1SV-MPHG-0135/R1	2NK-MPHG-0187/R1
1GC-MPHG-0072/R0	1WD-MPHG-0274/R0	2NL-MPHG-0032/R1
1GC-MPHG-0198/R1	0NM-MPHG-0200/R1	2NS-MPHG-0136/R3
1KE-MPHG-1088/R0	0NM-MPHG-0651/R2	2NV-MPHG-1250/R1
1ND-MPHG-0694/R5	0SA-MPHG-0553/R2	2RF-MPHG-8860/R2
1NK-MPHG-0306/R3	0WD-MPHG-0358/R0	2RK-MPHG-0120/R3
1NL-MPHG-0205/R0	2CR-MPHG-0032/R1	2SV-MPHG-2070/R1
1NS-MPHG-0012/R3	2GC-MPHG-0137/R1	2WD-MPHG-0291/R1

6. Detailed Design Criteria BFN-50-724, "Class 1 Seismic Pipe Support Design," Rev. 0, [B05 861002 500]

7. Detailed Design Criteria N4-50-D703, "BLN Piping System Anchors Installed in Category I Structures," Rev. 1, [B42 850501 504]

8. Modifications and Additions Instruction MAI-23, "Support and Installation of Piping Systems in Category I Structures," Rev. 0

   General Construction Specification G-29C, Rev. 7, [ESS 811123 202]

9. General Construction Specification G-43, Rev. 8, [B42 850712 505]

   BLN Construction Specification N4C-913, Rev. 4, [B42 850712 002]

   BLN Notes (3GA0059-00 Series), "Field Fabrication and Installation of Pipe Supports in Category 1 Structures," (09/01/72)

10. BFN plant trip report (03/27/87) (BLT-166)

    Walkdown of BLN box anchors (IND-MPHG-0694/R5, ONM-MPHG-0200/R1, ISV-MPHG-0135/R1, and INK-MPHG-0306/R3 (06/07/87) (IOM 1287)

11. Engineered SQN Pipe Anchor Drawings:

47A053-702/R1	1-H20-330/R5
47A053-704/R1	2-H20-330/R3
47A053-711/R0	2-H20-368/R2
47A053-1047/R0	2-H20-492/R2
47A053-411/R0	1-H20-116/R2
	1-H20-117/R3

12. Detailed Design Criteria SQN-DC-V-2.14, "Piping System Anchors Installed in Category 1 Structures," Rev. 0, [B05 860716 500]

13. Detailed Design Criteria WB-DC-40-31.15, "Piping Anchors Installed in Category 1 Structures," Rev. 2, [no RIMS number]

    WBN Pipe Support Design Manual (PSDM) Section 7.11, "Pipe Anchors," Rev. 3, [no RIMS number], (06/12/85)

14. SQN Box Anchor Calculations:

47A053-702/R2 (B25 860707 820)	47A053-411/R2 (SWP 820302 012)
47A053-704/R2 (B25 860707 820)	2-H20-330/R0 (SWP 820108 101)
47A053-711/R2 (B25 860707 820)	2-H20-368/R0 (SWP 810828 048)
47A053-1047/R2 (SWP 820218 083)	2-H20-492/R0 (SWP 810323 073)

15. ASME Boiler and Pressure Vessel Code - Section III - 1974 Edition

    WBN FSAR Section 3.9.3.4, "Component Supports," Amendment 26

16. Engineered WBN Pipe Anchor Drawings:

47A060-67-13/R2	47A060-62-10/R5	47A060-3-4/R2
47A060-72-8/R1	47A060-77-2/R1	47A060-3-24/R2
47A060-67-14/R2	47A060-67-89/R3	47A060-72-5/R2
47A060-67-43/R3	47A060-67-2/R2	47A060-72-6/R3
47A060-67-9/R4	47A060-62-22/R5	47A060-72-20/R4
47A060-67-15/R6	47A060-62-122/R0	47A060-74-1/R3
47A060-67-26/R5	47A060-67-79/R3	47A060-74-7/R0
47A060-67-48/R5	47A060-63-39/R0	47A060-68-19/R0
47A060-67-52/R4	2-63-250/R902	
47A060-63-5/R6	47A060-74-21/R1	
47A060-62-118/R0	47A060-3-23/R2	
47A060-3-3/R5		

17. SQN Pipe Support Drawings:

1-MSH-77(H1-17)/R2	2-CCH-372(2-H10-372)/R2
1-MSH-130(H1-77,78)/R1	2-CCH-374(2-H10-374)/R1
1-MSH-165(H1-120)/R4	1-CSH-44(1-H21-44)/R904
1-MSH-300(1-H1-300)/R905	2-CSH-14(2-H21-14)/R906
1-MSH-301(1-H1-301)/R906	2-CSH-15(2-H21-15)/R905
1-MSH-357(1-H1-357)/R905	1-FPCH-505(H50-505)/R901
1-MSH-503(H1-503)/R4	1-FPCH-527(H50-527)/R2
1-AFDH-270A(H3-280A)/R5	1-RCH-134(1-H36-134)/R905
1-AFDH-369(H3-424)/R906	1-RCH-136(1-H36-136)/R4
1-FDH-45(H4-43)/R1	1-RCH-138(1-H36-138)/R1
1-FDH-201(1-H4-201)/R1	2-RCH-242(2-H36-242)/R903
2-UHIH-144(2-H45-144)/R02	1-SIH-365(1-SIH-365)/R2
2-UHIH-145(2-H45-145)/R905	1-CH-78(H6-78)/R2
2-SGBH-70(2-H47-70)/R1	2-CVCH-614(2-H34-614)/R904
2-SGBH-72(2-H47-72)/R1	2-CVCH-615(2-H34-615)/R4
2-H10-352(2-H10-352)/R1	2-CVCH-806(2-H34-806)/R902
2-CCH-367(2-H10-367)/R1	2-CVCH-813(2-H34-813)/R0

WBN Pipe Support Drawings:

47A400-6-332/R1
47A400-6-333/R0
47A400-6-337/R1
47A400-6-340/R1
47A400-6-356/R1
47A400-6-365/R0
47A400-6-238/R4
47A400-6-376/R0
47A400-6-198/R1
47A400-6-102/R1
47A400-6-303/R0
47A400-6-309/R0
47A400-6-308/R0
47A400-6-307/R0
47A400-6-335/R0
47A400-6-358/R0
47A400-11-48/R3
47A400-11-47/R3
47A400-11-5/R4
47A400-27/R3
47A400-1-27/R0
47A400-7-17/R0
47A400-7-93/R1
47A465-2-38/R1
1-6-404/R904
1-74-11/R907
47A464-4-2/R2
47A060-3-23/R2
47A427-8-38/R1
1-01A-309/R907

BFN Pipe Support Drawings:

47B452-711/R1
47B452-708/R1
47B452-182/R0
1754-5/R3
2003-3/R2
47B452-159/R1
47B458-91/R0
47B458-58/R0
47B458-42/R1
47B456-34/R1
1756-5/R3
47A406-21/R2
47A455-415/R2
47A920-86/R3
47B452-454/R1
47B452-987/R3
47B2349-15/R4
47B2349-17/R0
397/R0
2006-1/R3
47B455-51/R1
47B455-58/R1
47B455-75/R1
47B452-134/R1
47B452-102/R0
47B452-797/R1
47B920-39/R2
47B920-52/R0
47B456-106/R0
47B3349-27/R1
47A406-14/R1
47B590-102/R1
47B465-436/R0
47B408-11/R0
47A2349-33/R2

BLN Pipe Support Drawings:

2ND-MPHG-1011, Sh. 2/R0
2KC-MPHG-0322, Sh. 1/R2
2KD-MPHG-0016, Sh. 1/R901
2CR-MPHG-0107, Sh. 2/R0
2CA-MPHG-0050/R3
1KC-MPHG-0036/R901
1KE-MPHG-1538/R2
1GN-MPHG-0054/R0
1CF-MPHG-0310/R2
1WD-MPHG-1046/R2
0WD-MPHG-0040/R901
2WE-MPHG-0060/R901
0SA-MPHG-4372/R1
2CF-MPHG-0026/R3
2CF-MPHG-0027/R2
2CF-MPHG-0300/R0
2CF-MPHG-0410/R0
2KC-MPHG-0351/R2

1CA-MPHG-0116, Sh. 1/R4
1CA-MPHG-0090/R902
0KC-MPHG-0125, Sh. 2/R902
2SV-MPHG-0302, Sh. 2/R1
2NV-MPHG-0738/R2
2CF-MPHG-0239/R4
1RK-MPHG-0026, Sh. 2/R3
1ND-MPHG-0580, Sh. 1/R901
0NB-MPHG-0030/R2
2CR-MPHG-0169/R4
1CA-MPHG-0438/R0
1NK-MPHG-0130/R1
1SV-MPHG-0320, Sh. 1/R0
1WD-MPHG-0420, Sh. 1/R1
2CA-MPHG-0155/R901
2SV-MPHG-0062/R3
2ND-MPHG-0013, Sh. 1/R2
2ND-MPHG-0052/R2
2ND-MPHG-0549/R1
2ND-MPHG-0605/R2
2KC-MPHG-0381/R6
2KC-MPHG-0391/R6

18. As-built information for missing welds on SQN pipe support drawings (1-MSH-77/R2, 1-AFDH-369/R906, 1-FDH-45/R1, and 1FPCH-527/R2) (10/09/86)

    As-built information for missing information on WBN pipe support drawings (47A400-11-48/R3, 47A400-27/R3, and 474464-4-2/R2) (06/13/86)

19. Detailed Design Criteria BFN-50-D706, "The Torus Integrity Long-Term Program," Rev. 1, [ESB 840621 205]

    General Design Criteria N4-50-D717, "Design of Safety-Related Piping Supports and Supplemental Steel," Rev. 4, [B42 851112 525]

20. WBN 47A050 series hanger drawings for general notes:

    47A050-1J3/R2
    47A050-1H/R7
    47A050-1V1/R1

21. American Institute of Steel Construction (AISC) Manual, 7th Edition, Section 1.15.10

    Pipe Support Manual, Section 7.15.1 "Design of Welded Connections," Rev. 2 (07/23/84)

22. EN DES Calculations, "Evaluation of NCR WBN SWP8273," Rev. 1, [WBP 830914 230]

    TVA DNE Calculations, "For SCR SQN CEB 8601," [B24 860906 300]

23. TVA Problem Identification Report PIR WBN CEB 8573, [B41 851220 016]

24. Significant Condition Report (SCR) SQN CEB 8601, [B41 860110 021]

25. TVA SQN Drawings:

48N905 (R24) Reactor Building Units 1 & 2 - Misc. Steel - S.G., R.C. Pump and Press. Rel. Tnk. - Access Platform - Sh. 1

48N906 (R12) Reactor Building Units 1 & 2 - Misc. Steel - S.G., R.C. Pump and Press. Rel. Tnk. - Access Platform - Sh. 2

48N908 (no sheet number) (R10) Reactor Building Units 1 & 2 - Misc. Steel - Steam Generator - Access Platform

48N908-1 (R7) Reactor Building Units 1 & 2 - Misc. Steel - Steam Generator - Access Platform

48N908-2 (R6) Reactor Building Units 1 & 2 - Misc. Steel - Steam Generator - Access Platform

48N908-3 (R3) Reactor Building Units 1 & 2 - Misc. Steel - Steam Generator - Access Platform

48N908-4 (R1) Reactor Building Units 1 & 2 - Misc. Steel - Steam Generator - Access Platform

48N908-6 (R0) Reactor Building Units 1 & 2 - Misc. Steel - Steam Generator - Access Platform

TVA WBN Drawings:

48W904 (no sheet number) (R36) Miscellaneous Steel - Lower Ice Condenser - Access Platform El. 745.0

48W904-1 (R10) Miscellaneous Steel - Steam Generator Access Platforms

48W904-2/R8 and R9 Reactor Building - Units 1 and 2 - Miscellaneous Steel - Steam Generator Access Platform

48W904-3/R14 Reactor Building - Units 1 and 2 - Miscellaneous Steel - Steam Generator Access Platform

26. Walkdown in the Sequoyah Unit 1 Reactor Building, by the evaluation team (09/18/86)

27. SQN Calculations:

TVA EN DES Calculations, "Typical Supports 47A051-21, 47A054-3," [PWP 840904 661]

TVA DNE Calculations, "Calculations for ER for SCR SQN CEB 8601," [B25 860904 300]

TVA DNE Calculations, "Support 47A 920-8-2," [B25 860811 323] Prelim. Rev. 1, (09/20/86)

TVA DNE Calculations, "Attachment to AB Emb. MKICPLI 48N1277, El. 748'-0," Preliminary, (09/20/86)

TVA DNE Calculations, "Qual. Attach. to Aux. Bldg. Embed MK 23 C Below El. 749'," Preliminary, (09/20/86)

TVA DNE Calculations, "Cable Tray Support Qualifications MK-3 Aux. Bldg. El. 734'," Preliminary, (09/20/86)

WBN Calculations:

TVA EN DES Calculations, "Reactor Building - Miscellaneous Steel Steam Generator Platforms," WCG-2-40 Volume 6, Rev. 1, [B41 860614 969]

TVA EN DES Calculations, "Evaluation of NCR WBN SWP8273," WMG 3100, [WBP 830914 230]

TVA DNE Calculations, "For PIR WBN CEB 8573," [B41 860828 900]

28. TVA BFN "Class I Seismic Pipe Support Design," Design Criteria BFN-50-724, Rev. 0, (09/26/86)

TVA BFN "Miscellaneous Steel Components for Class I and II Structures," Design Criteria BFN-50-754, Rev. 0, (11/10/86)

TVA, "Design of Structural Connections," Civil Design Guide DG-C1.6.4, Rev. 0

TVA BLN "Design of Civil Structures," Design Criteria N4-50-D702, Rev. 5

TVA General Construction Specification G-32, "Bolt Anchors Set in Hardened Concrete," Rev. 11

29. TVA BFN Drawings:
Powerhouse - Reactor Building - Units 1-3 Mechanical General Notes - Pipe Supports 47B435-1 through -6, the latest revisions as of February 1987

Class I Structures - Electrical Seismic Supports - Conduit 45A800-2/R4

Reactor Building Units 1, 2, and 3
Structural Steel - Drywell Floor Framing

- 48N442/R6 - El. 563' - 0-1/2" (no sheet number)
- 48N443/R7 - El. 584'- 9-1/2" (no sheet number)

Powerhouse - Reactor Building - Unit 2 Mechanical

- RCIC Mechanical System Pipe Supports 47B456-120/R1
- RHR System Pipe Supports 47B452-195/R3
- Core Spray System Pipe Supports 47A458-377/R3 (Drawing is "A" size)
- Core Spray System Pipe Supports 47B458-424/R2
- Core Spray System Pipe Supports 47B458-94/R1

TVA BLN Drawings:

TVA BLN Drawings: Reactor Building, Typical Seismic Conduit Support 4RA0560-X2-2B, R3; 4RA0560-X2-10, R3; 4RA0560-X2-14, R4; and 4RB 0560-X2-78C, R1

TVA BLN Drawing: Aux. Bldg. and Intake Pumping Station Typical Seismic Instrument Tubing Support, 4BA0570-X2-1, R2

TVA BLN Drawing: Aux., Control, & DG Bldg. Typical Seismic Instrument Tubing Support, 4BA0895-X2-1, R0

TVA BLN Drawing: Aux., Control, & DGB Typical Seismic Conduit Support Anchor Plate, 4BA0892-X2-20, R3

TVA BLN Drawing: Aux., Control, & DG Bldg; Miscellaneous Steel Seismic Conduit Supports, Notes - Sheet 1, 4BB0892-X2-1, R6

TVA BLN Structural Steel Drawings:

Primary Piping Jet Impingement Barriers 4RW0550-X2-01, R6, and 4RW0550-X2-02, R7

Valve Room A Pipe Supports Plan Elevation 649'-0", 4AW0805-X2-23, R10

Cable Tray Supports Elevation 667'-0", 4AW0887-X2-9, R6

Makeup & Purification Pipe Whip Protection Devices, 4RW0552-X2-06, R6

TVA BLN Miscellaneous Steel Drawings:

H&V Support Details 4AW0870-X2-01, R24, & 4AW0871-X2-04, R1

Cable Tray Support Details Sheet 5, 4AW0885-X2-13, R13

Access Platforms El. 649'-4-1/2" RC Pumps P1A2, P1B2, P2A1, P2B1, 4RW0512-X2-25, R4

H&V Equipment Support Details, 4DW0759-X2-1, R15

H&V Duct Support Typical Details, 4RW0532-X2-21, R14

Cable Tray Supports & Walkway Details & Schedule, 4RW0540-X2-18, R21

Access Platforms El. 643'-0" Reactor Coolant Pumps P1B1 & P1A2, 4RW0512-X2-14,R5

Access Platforms El. 650'-6-1/2" Steam Generators A & B 4RW0512-X2-33, R6

Access Platform El. 656'-1-1/2" RC Pumps 1P1B1 & 2P1B2, 4RW0512-X2-35, R6

Access Platforms El. 640.25' Reactor Coolant Pump 2RC-P1A1, 4RW0512-X2-45, R0

30. TVA - EN DES Calculations (BFN):

BWP C21071 R61, RCIC Support R-61, R1, [B22 860113 101]

BWP C20995 R195, RHR Anchor R-195, R2, [B22 850423 102]

BWP C30266 R15, Core Spray Pipe Support R-15, R2, [B22 851210 140]

BWP C30303 R15A, Core Spray System; Support R15A, R2, [B22 851210 122]

TDP C20336 R13, Core Spray - R13, R1, [BWP 830926 106]

TVA-EN DES Calculations (BLN):

4R2-512L, R0, "Access Platforms Reactor Coolant Pumps," [BLP 840611 426]

4R2-512H, R2, "Access Platforms Steam Generators A&B," [BLP 840627 406]

4RW0512 B, R2, "Reactor Coolant Pumps Access Platforms," [BLP 840806 402]

4R2-512D, R2, "Reactor Coolant Pumps Access Platforms," [BLP 840926 402]

TVA-OE Calculation 4RW-0550-X2, R6, "Jet Impingement Barriers," [B21 860401 404]

31. TVA-OE Calculations, Typical Conduit Supports - General Notes, BFEP C2E081, R1, [B22 860527 109]

32. General Construction Specification G-29C, Rev. 7, [ESS 811123 202]

SQN FSAR Section 3.8.4.5.2, Paragraph 1, Amendment 2; Section 3.8-29, Paragraph 4, Amendment 2; and Section 3.5-54, Paragraph 5, Amendment 2

SQN Pipe Support Design Manual (PSDM), Section 7.15, Rev. 0, (04/22/83)

WBN Pipe Support Design Manual (PSDM), Section 7.15, Rev. 2, (07/23/84)

WBN FSAR Sections 3.8.4.2.1(2) and 3.8.4.2.1(5), Amendment 47

33. American Institute of Steel Construction Manual, 7th Edition, Structural Welding Code - Steel, AWS D1.1, (1984)

34. SQN Pipe Support Drawings

1-MSH-77(H1-17)/R2
1-MSH-130(H1-77,78)/R1
1-MSH-165(H1-120)/R4
1-MSH-300(1-H1-300)/R905
1-MSH-301(1-H1-301)/R906
*1-MSH-357(1-H1-357)/R905
1-MSH-503(H1-503)/R4
1-AFDH-270A(H3-280A)/R5
1-AFDH-369(H3424)/R906
1-FDH-45(H4-43)/R1
1-FDH-201(1-H4-201)/R1
2-UHIH-144(2-H45-144)/R02
*2-UHIH-145(2-H45-145)/R905
*2-SGBH-70(2-H47-70)/R1
*2-SGBH-72(2-H47-72)/R1
2-H10-352(2-H10-352)/R1
*2-CCH-367(2-H10-367)/R1
2-CCH-372(2-H10-372)/R2
2-CCH-374(2-H10-374)/R1
1-CSH-44(1-H21-44)/R904
2-CSH-14(2-H21-14)/R906
*2-CSH-15(2-H21-15)/R905
1-FPCH-505(H50-505)/R901
1-FPCH-527(H50-527)/R2
*1-RCH-134(1-H36-134)/R905
*1-RCH-136(1-H36-136)/R4
*1-RCH-138(1-H36-138)/R1
*2-RCH-242(2-H36-242)/R903
1-SIH-365(1-SIH-365)/R2
1-CH-78(H6-78)/R2
2-CVCH-614(2-H34-614)/R904
*2-CVCH-615(2-H34-615)/R4
2-CVCH-806(2-H34-806)/R902
*2-CVCH-813(2-H34-813)/R0

* Pipe support drawings with an asterisk do not meet AISC minimum weld criteria.

WBN Pipe Support Drawings:

*67-1ERCW-R212, R903
1-01A-309, R907
47A920-38-3, R6
47A437-2-22, R1
47A400-6-333, R0
47A400-6-337, R1
47A450-21-128, R3
47A400-6-356, R1
47A400-11-47, R3

47A465-2-38, R1	47A400-1-27, R0	47A400-11-5, R4
2-70-804, R901	1-63-404, R904	47A400-6-238, R4
*1-70-867, R901	48A060-3-23, R2	47A464-4-2, R2
*1-68-131, R904	47A427-8-38, R1	47A400-11-48, R3

* Pipe support drawings with an asterisk do not meet AISC minimum weld criteria.

WBN Pipe Support Calculations:

67-1ERCW-R212, R2 [WBP 840329 013]
1-70-867, Rev. 0 [WBP 841123 002]
1-68-131, Rev. 2 [WBP 841109 025]

35. Pipe Support Drawings and Calculations

Support Number	Drawing Revision	Calculation RIMS Number
47A462-12-27	0	CEB 850226 987
47A560-4-60	2	WBP 831019 008
47A450-26-168	0	B41 860210 913
47A450-26-82	1	B41 851010 901
47A450-25-415	0	B41 860111 900
47A450-25-415A	0	B41 860111 900

36. WB-DC-40-31.9, "WBN Detailed Design Criteria for Location and Design of Piping Supports and Supplemental Steel in Category I Structures," [ESB 840411 209], (08/29/85), Rev. 5, (04/09/84)

WBN Pipe Support Design Manual (PSDM), Vols 1 to 4, Rev. 5, (02/24/86)

37. Interview and walkdown by S. Mabie and E. Croft of Bechtel (02/28/87, 03/04/87, and 03/06/87)

38. Telecon from C. Jordan, K. Wiedner, G. Shah, M. Stafford, S. Chitnis, and A. Pang of Bechtel to G. M. McNutt, N. Liakonis, W.Sirrett, and J. Louis of TVA, (03/09/87)

39. Bechtel Calculation: PD-222-17, Rev. 0, (08/11/87), (Job Number 16985-026) [no RIMS number]

40. Package of calculations prepared by Chicago Bridge & Iron (CBI) for Roof Support for RHR Spray Header JE0-JE-12, (12/03/74) [no RIMS number]

Package of calculations prepared by Chicago Bridge & Iron (CBI) for Roof Support for Containment Spray Header JF0-JF-12, (12/03/74) [no RIMS number]

41. TVA Calculation Package [B41 850924 005] (page 1-257) to qualify RHR and CSS spray support for load provided by Piping Analysis Group. These supports were originally designed by CBI (Ref. 40)

42. WBN Pipe Support Design Manual, Section 7.15, Rev. 2, (07/23/86)

43. WBN Pipe Support Drawings and Design Calculations:

Support/Rev	Cal. RIMS Number	Support/Rev	Cal. RIMS Number
47A400-1-1/R1	[CEB 850119 809]	1-62A-328/R1	[WBP 841114 115]
47A400-1-32/R1	[B41 850417 953]	1-63-320/R2	[WBP 841108 005]
47A400-6-96/R0	[WBP 831027 085]	1-68-131/R904	[WBP 841109 025]
47A400-6-97/R1	[WBP 840510 016]	1-70-005/R1	[WBP 841029 403]
47A400-6-176/R1	[WBP 840311 016]	1-70-867/R901	[WBP 841123 002]
47A400-6-202/R0	[WBP 830427 010]	1-01A-309/R907	[WBP 840809 153]
47A400-6-333/R0	[B41 850509 955]	1-87-068/R906	[WBP 840725 019]
47A400-6-361/R0	[B41 850509 967]	2-70-804/R901	[B41 860213 954]
47A427-8-38/R1	[B41 850827 802]	63-1SIS-V132/R1	[CEB 850228 956]
47A435-10-21/R3	[WBP 841123 001]	1-63-404/R904	[WBP 840110 044]
47A437-2-22/R1	[B41 860807 854]	67-1ERCW-R212/R902	[WBP 840329 013]
47A465-2-38/R1	[CEB 850126 833]		
1-03A-586/R901	[WBP 841109 006]		
1-03A-587/R1	[WBP 841109 005]		

44. B001 Type Standard Supports (WBN):

47B001-1/R3	47B001-98/R0
47B001-2/R2	47B001-10/R1
47B001-3/R3	47B001-11/R4
47B001-4/R3	47B001-12/R5
47B001-5/R1	47B001-13/R4
47B001-6/R1	47B001-13A/R3
47B001-7/R1	47B001-14/R4
47B001-8/R5	47B001-15/R2
47B001-9/R2	47B001-16/R0
47B001-9A/R1	47B001-17/R1

45. Pipe Support Design Manual, Volume 1, Rev. 1, Lecture 122, (08/16/82) and Volume 2, Rev. 3, Section 7.4, (06/12/85), Design Guide for Category I Component Supports

46. Bechtel Calculation PD-222-09, Rev. 0, (07/11/86), (Job Number 16985-026) [no RIMS number]

47. Nuclear Safety Review Staff (NSRS) Investigation Report I-85-560-SQN (11/19/85)

48. ANSI B31.1 - Power Piping Code - 1974 Edition

USA Standard B31.7, Nuclear Power Piping Code (1969 Edition), Paragraph 1-727.4.7(d)

ASME Boiler and Pressure Vessel Code, Section III (1974 Edition), NB-4433 and NC-4433

SQN FSAR Tables 3.2.2-1 and 3.2.2-2, Rev. 3

49. BF-SDSP-9.1, "Processing Drawing Discrepancies," Rev. 2 (09/22/86)

50. BF-SDSP-9.2, "Configuration Control Drawings," Rev. 1 (05/09/86)

51. Support Drawings:

    1-FPCH-505 (H50-505), Rev. 1
    2-CCH-367 (2-H10-367), Rev. 902

52. TVA Corporate Nuclear Performance Plan Volume 1, Rev. 4

    TVA Nuclear Performance Plans, Volume 2, Rev. 1; Volume 3, Rev. 0; and Volume 4, (Draft, 03/19/87)

53. TVA Welding Project Review Plan, Volumes 1 through 4 (no revision/date)

54. BFN FSAR Chapter 12, "Structures and Shielding," Amendment 3

    BLN FSAR Chapter 3, "Design of Structures, Components, Equipment, and Systems," Amendment 27

55. SQN Pipe Support Drawings:

    1-FPCH-505 (H50-505), Rev. 1
    2-CCH-367 (2-H10-367), Rev. 902

56. CEB Report 75-18, Small Line Attachment Details to Class 2 and 3 Piping Equal to or Larger than 2-1/2-inch diameter, Rev. 3, [CEB 840522 001]

57. EN DES-SEP 82-13, Program for NRC-OIE Bulletin 79-14, Phase 1, Inspection at WBN Unit 1, Rev. 4, [B41 850702 004]

58. Bechtel Calculation PD-222-17, Rev. 0 (08/11/87) for support 47A450-25-415, Rev. 0, [no RIMS number]

59. TVA memo (E44011-01) from J. A. Raulston to J. C. Standifer, "Clarification of Welding Requirements," [NEB 840120 275]

60. Bellefonte Nuclear Plant, "Welding Procedure Qualification to Weld to Embedded Plates Using Preheat Lower than AWS Prequalified Values - Test Result," [CSB 821210 301]

    Memo from Frank V. Meter to Lonnie S. Cox, "Bellefonte Nuclear Plant, Request for Welding Procedure Qualification to Weld to Embedded Plates Using Preheat Lower than AWS Prequalified Values," [BLN 821029 551]

61. TVA BLN Drawings: Reactor Building, Typical Seismic Conduit Support 4RA0560-X2-2B, Rev. 3; 4RA0560-X2-10, Rev. 3; 4RA0560-X2-14, Rev. 4; and 4RB0560-X2-78C, Rev. 1

    TVA BLN Drawing: Aux. Bldg. and Intake Pumping Station Typical Seismic Instrument Tubing Support, 4BA0570-X2-1, Rev. 2

    TVA BLN Drawing: Aux., Control, & DG Bldg., Typical Seismic Instrument Tubing Support, 4BA0895-X2-1, Rev. 0

    TVA BLN Drawing: Aux., Control, & DG Bldg., Typical Seismic Conduit Support Anchor Plate, 4BA0892-X2-20, Rev. 3

    TVA BLN Drawing: Aux., Control, & DG Bldg, Miscellaneous Steel Seismic Conduit Supports, Notes - Sheet 1, 4BB0892-X2-1, Rev. 6

62. TVA SQN Drawings:

    47A050-1 (Revs. 2, 3, and 6) Seismic Class I Structures - Mechanical Hanger Drawing General Notes

    47A050-16 (Rev. 1) Seismic Class I Structures - Mechanical Hanger Drawing General Notes

    47A050-16A (Rev. 1) Seismic Class I Structures - Mechanical Hanger Drawing General Notes

    47A051-21A (Rev. 1) Seismic Class I Structures - Mechanical Seismic Support Instr. Sensing Lines

    47A052-1 (Rev. 9) Seismic Class I Structures - Mechanical Seismic Supports - Radiation Monitoring and Sampling

    47A054-1 (Rev. 7) Seismic Class I Structures - Mechanical Seismic Supports - Control Air Lines

    47A055-1B (Rev. 3) Seismic Class I Structures - Mechanical Heating, Ventilating, and Air Conditioning Duct Supports

47A056-1A (Rev. 14) Seismic Class I Structures - Mechanical Seismic Supports - Conduits

63. SNP FSAR update through Amendment 3

Section 3.8.4.5.2 "Structural Steel" and Tables 3.8.4-1 through 3.8.4-18

TVA SQN, "Detailed Design Criteria for Miscellaneous Steel Components for Class I Structures," No. SQN-DC-V-1.3.2, Rev. 8

TVA, "Design of Structural Connections," Civil Design Guide DG-C1.6.4, Rev. 0

64. BFN Response to Potential Generic Condition Evaluation [B22 851224 019]

65. Welding Project - Generic Employee Concern Report WP-15-SQN, Rev. 0, [no RIMS number], (04/07/86)

66. TVA NSRS Investigation Report I-85-246 WBN, "Bolt Replacement Welding to Embedded Plates," [no RIMS number], (11/07/85)