EMPLOYEE CONCERNS

SPECIAL PROGRAM

VOLUME 2
ENGINEERING CATEGORY

SUBCATEGORY REPORT 25000
CIVIL/STRUCTURAL DESIGN AND PIPE WHIP RESTRAINT DESIGN

UPDATED

TVA

NUCLEAR POWER

TVA EMPLOYEE CONCERNS SPECIAL PROGRAM

REPORT NUMBER: 25000

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TITLE: CIVIL/STRUCTURAL DESIGN (21500) AND PIPE WHIP RESTRAINT DESIGN (22700)

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1. Revised to incorporate initial SRP and TAS comments and to add BFN and BLN Corrective Action Plans.

2. Revised to incorporate additional SRP and TAS comments and to add Attachment C (References).

3. Revised per TLB-085 request, deleted element 215.8, and incorporated SRP and TAS comments.

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TVA has developed corporate and plant-specific nuclear performance plans (NPPs). These plans identify corrective actions to remedy existing problems and to improve TVA's nuclear program.

The findings of this subcategory are combined with those of other subcategory reports and reassessed in the Engineering category evaluation, which has assessed the broader issues identified - effective and thorough design process - and has issued the necessary corrective action tracking documents.

Preface

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

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

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

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

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

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

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

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

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

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

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

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

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

ECSP GLOSSARY OF REPORT TERMS*

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

Class A: Issue cannot be verified as factual

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

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

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

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

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

concern (see "employee concern")

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

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

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

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

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

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

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

K-form (see "employee concern")

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

root cause the underlying reason for a problem.

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

Acronyms

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

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

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

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

CONTENTS

TABLES

1. INTRODUCTION

This subcategory report summarizes and integrates the results of the ECSP element evaluations dealing with civil/structural design and pipe whip restraint design. These element evaluations addressed a variety of topics, which covered seismic criteria, seismic analysis of radiation shielding, cut rebar control, hanger loads on structures, roofing design, crane service, sleeve covers, and whip restraints. Structural steel connection design (element 215.9), as evaluated for SQN and WBN, is assigned to Subcategory Report 25500.

Fourteen employee concerns provide the basis for the element evaluations and are listed by element number in Attachment A. The plant location where each concern was originally identified and the applicability of the concern to other TVA nuclear plants are also shown. The evaluations are summarized in the balance of this report as follows:

- Section 2 -- summarizes, by element, the issues stated or implied in the employee concerns
- Section 3 -- outlines the process followed for the element and subcategory evaluations, cites documents reviewed, and addresses determination of generic applicability
- 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 characterized as safety related, not safety related, or safety significant.

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

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

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

2. SUMMARY OF ISSUES

The employee concerns listed in Attachment A for each element and plant have been examined, and the potential negative findings raised by the 13 concerns have been identified as 42 separate issues. These issues are evaluated as 17 elements.

A summary of the issues evaluated under this subcategory, grouped by element, is listed below:

- 215.1, Seismic Criteria - An earthquake fault extending from Chattanooga to Knoxville runs under SQN and WBN, and plant structures could fail in an earthquake.

- 215.2, Cut Rebar Control - Lack of procedural control and assessment of cut rebar raise questions about the structural integrity of concrete walls and slabs.

- 215.3, Radiation Shielding Seismic Analysis - The present case-by-case approach for seismic analysis of radiation shielding takes more time and money.

- 215.4, Turbine and Service Building Roofing - The Turbine and Service Building roofing design is improper and roofing is leaking.

- 215.6, Hanger Loads on Structures - Structural integrity of concrete walls and slabs is questionable because of the excessive number of hangers and lack of assessment calculations.

- o 215.7, Auxiliary Building Crane Service - DNE does not appreciate the role of field engineering to make the designs work. The Auxiliary Building 125-ton crane can set load on only two out of five floors, and hatch grating is rated only for 100 psf.

- o 215.10, Feedwater Heater Monorail Design - The structural integrity of hangers for the feedwater heater monorails is questionable.

- o 215.11, Floor Sleeve Covers - Metal covers need to be installed over floor sleeve foam seals.

- o 227.1, Pipe Whip Restraint Design - Pipe whip restraints in the unit 1 Reactor Building have problems as shown on drawing 41W1700 series.

- o 227.2, Pipe Whip Restraint Design - Whip restraints are needed on the decay heat removal pipe coming from the borated water storage tank.

The element summaries above deal with perceived deficiencies in the design of the civil/structural components. More specifically, four of the elements are concerned with the quality of the design (215.2, 215.3, 215.6, and 215.11), one deals with the adequacy of design criteria provided (215.1), and five suggest errors or oversights in the design (215.4, 215.7, 215.10, 227.1, and 227.2).

As the following sections show, four of the above 10 elements were found to have valid issues and require corrective action (215.2, 215.6, 215.11, and 227.2). Three of these involve design quality, and the remaining one involves documentation error. Thus, this subcategory contains some valid issues and these are quite diverse in nature.

3. EVALUATION PROCESS

This subcategory report is based on the information evaluated to address the specific employee concerns related to the issues broadly defined in Section 2. The evaluation process is described in the following subsections.

3.1 Generic Applicability Review

As part of the evaluation process, the employee concerns, which originated for specific TVA nuclear plant sites, were evaluated for their generic applicability to other TVA nuclear plant sites. Applicability was determined with consideration of the concerns' plant-uniqueness and their effect on safety-related structures, systems, and components. The employee concerns

were categorized by their impact on safety per ECTG determination criteria as identified in Attachment A. The generic applicability review is summarized for each element as follows.

- 215.1, Seismic Criteria - Both concerns under this element are safety-related and allude to an earthquake fault that runs under the Sequoyah and Watts Bar plant sites. Thus, these two concerns are site-specific and do not apply to other two plants.

- 215.2, Cut Rebar Control - Both concerns under this element originated at WBN and are safety-related. The evaluation team determined that they also applied to the other three plants.

- 215.3, Radiation Shielding Seismic Analysis - The concern under this element is not safety-related. It addresses cost-effective methods of performing seismic analysis of radiation shielding installation. The element evaluation for Watts Bar revealed - as discussed in detail in Section 4 - that TVA, to the degree practicable, was implementing appropriate analytical methods. In view of the foregoing, it was determined that this element is not generically applicable to the other TVA plants.

- 215.4, Turbine and Service Building Roofing - The concern under this element is not safety-related. It addresses leaking roof of Turbine and Service Buildings at Watts Bar. The evaluation established that TVA already had taken corrective measures to alleviate this obvious problem. Therefore, the evaluation team determined that the concern was plant-specific and not applicable to the other plants.

- 215.6, Hanger Loads on Structures - Both concerns under this element originated at WBN and are safety-related. The evaluation team determined that they also applied to the other three plants.

- 215.7, Auxiliary Building Crane Service - The concern under this element is not safety-related. It addresses design engineering/field engineering interface, crane access, and hatch grating capacity. The interface concern focused on the lack of appreciation of field engineering work by design engineers rather than a potential breakdown in communication or coordination. In addition, crane access as designed was deemed adequate at Watts Bar. The hatch grating identified was a temporary construction-period grating. On the basis of the foregoing, the evaluation team determined that the concern was site-specific and did not apply to the other TVA plants.

- o 215.10, Feedwater Heater Monorail Design - The concern under this element identifies monorails which were installed in the Sequoyah Turbine Building to facilitate replacement of its feedwater heaters for operational reasons. The concern is not safety-related and is plant-specific. Therefore, the evaluation team determined it not to be applicable to the other TVA plants.

- o 215.11, Floor Sleeve Covers - The concern under this element is not safety-related. It addresses foam in abandoned large sleeves at Watts Bar. The element evaluation revealed - as discussed in detail in Section 4 - that the concern was valid. Generic applicability was determined before the complete element evaluation was done for Watts Bar. At that time a determination was made that the element was site-specific and did not apply to the other plants. However, in light of the element findings at Watts Bar, it is plausible that similar abandoned sleeves may exist at the other TVA plants. This report does not address plants other than WBN for this element because the evaluation team has not evaluated the other plants. In addition, CATDs have not been issued for other plants to investigate generic applicability because the concern is not safety-related.

- o 227.1, Pipe Whip Restraint Design - The concern under this element is safety-related. It addresses specific welding notes for pipe whip restraints at Watts Bar. Meanwhile, TVA had performed the required inspection and prepared documentation to correct the inconsistencies between the design drawings and the as-built configuration. The inconsistencies were that the welding of the pipe whip restraints was not in accordance with the design drawing requirements. Subsequent inspection and documentation were based on an inappropriate inspection procedure. As a result, no additional corrective action was specified by the evaluation team. Thus, this concern was determined to be an isolated, plant-specific case.

- o 227.2, Pipe Whip Restraint Design - The concern under this element is safety-related. It addresses a need for a specific whip restraint at Bellefonte. Because the concern is specific for a pipe coming from the borated water storage tank, the evaluation team determined that it was plant-specific. Furthermore, the concern was subsequently found to be invalid, and a peripheral finding of a minor drafting error was identified. Therefore, it was determined that the concern did not apply to the other TVA plants.

3.2 General Evaluation Process

This subsection describes the general evaluation process that was used to evaluate the civil/structural elements identified under this subcategory. Additional specific evaluation processes are described in the following subsection by element as applicable.

a. Defined issues for each element from the employee concerns.

b. Determined generic applicability of elements on the basis of their plant-uniqueness and their effects on safety-related structures, systems, and components.

c. Reviewed applicable FSAR, Safety Evaluation Report (SER), and SER supplements to understand TVA's commitments related to the specific design issues.

d. Reviewed applicable industry codes and standards and current regulatory requirements and practices to understand related engineering design requirements.

e. Reviewed relevant TVA design criteria, specifications, procedures, drawings, and calculations to develop an understanding of the design basis.

f. Performed plant walkdowns, as appropriate, to develop a first-hand understanding of the issues.

g. Reviewed issue-related correspondence, test reports, and nonconforming condition reports (NCRs) to evaluate actions taken by TVA.

h. On the basis of this composite review, evaluated the issues for each element and described findings (see Section 4).

i. Reviewed and concurred with corrective action plans prepared by TVA for the issues requiring specific corrective actions.

j. Tabulated the issues, findings, and corrective actions arranged first by elements and then by plants (in Attachment B).

3.3 Specific Evaluation Process

In addition to the general evaluation, as described above, performed by the evaluation team for each element, specific documents also were reviewed for each plant based on their applicability to the issues. These documents and other unique information are identified below.

- 215.1, Seismic Criteria

  a. Reviewed Section 2.5 of both the FSAR and SER of Sequoyah and Watts Bar (Refs. 6, 30 and 31).

  b. Reviewed TVA NSRS Report I-86-110-SQN (Ref. 32) for Sequoyah.

- 215.2, Cut Rebar Control

  a. Sought programs to control jobsite rebar cutting, record cuts, and forward records to engineering for evaluation at all plants.

  b. Reviewed for all plants engineering process of recording and evaluating the effect of such cut rebars, both single cuts and cumulative effects, by selecting a sample of drawings and calculations (Refs. 33 through 36).

- 215.3, Radiation Shielding Seismic Analysis

  Reviewed on-going TVA methodology used in the design of radiation shielding with cost-effectiveness considerations at Watts Bar (Ref. 63).

- 215.4, Turbine and Service Building Roofing

  Reviewed roofing design and performance, and TVA actions taken to correct problems at Watts Bar (Refs. 15, 28 and 62).

- 215.6, Hanger Loads on Structures

  a. Sought procedures for systematic structural review of hangers attached to concrete walls and slabs.

  b. Reviewed live load evaluation for all plants based on as-built hanger installation.

  c. Determined whether structural review considered feedback from cut rebar considerations.

- 215.7, Auxiliary Building Crane Service

  a. Reviewed organizational responsibilities of design and construction engineering. (Ref. 50)

  b. Reviewed crane and hatch cover design bases (Ref. 50).

- 215.10, Feedwater Heater Monorail Design

  a. Reviewed monorail drawings and calculations (Ref. 52).

  b. Determined that monorails were load-tested and obtained related documentation (Ref. 24 and 52).

215.11, Floor Sleeve Covers

a. Reviewed Dow Corning Corp.'s information about "silicone RTV foam (Ref. 37)."

b. Reviewed TVA CEB Report 82-2 covering silicone foam seal testing results (Ref. 38).

227.1, Pipe Whip Restraint Design

a. Reviewed 48W1700 series drawings (Ref. 39) to determine nature of problem.

b. Reviewed NCRs 3001R and 3523R (Ref. 40).

227.2, Pipe Whip Restraint Design

a. Reviewed BLN drawings (Ref. 41) for DHR piping coming from borated water storage tank.

b. Reviewed BLN calculations (Ref. 42) for pipe supports and nozzle design.

4. FINDINGS

The findings from each of the 17 element evaluations for this subcategory are contained in Attachment B, where they are listed by element number and by plant in a matrix form along with corresponding issues and corrective actions.

The discussion and summarized element findings for each element follow.

4.1 Seismic Criteria - Element 215.1

4.1.1 Sequoyah and Watts Bar Plants

The Sequoyah and Watts Bar sites are located in the Valley and Ridge Physiographic Province of the Appalachian Highlands. This province is characterized by highly folded and faulted northeast-trending sedimentary rocks of Paleozoic era (250 to 580 million years old). Both sites are underlain by several thrust faults, one of which is the Kingston fault. It is a major, extensive fault which is exposed at ground surface approximately 1 mile northwest of both sites and underlies the sites at a depth of several thousand feet.

The evidence clearly shows that the Kingston fault and the other thrust faults of similar age and origin under the sites have for decades been considered to be inactive faults, and they are still considered to be inactive by geologists

and seismologists. The evaluation team is not aware of any evidence, or even hypothesis, that the Kingston fault or the other thrust faults that developed near the end of the Paleozoic era are capable faults. On the contrary, the available evidence indicates they are not.

Historically, earthquakes in the Appalachians which have been accurately located as to their hypocentral depth, typically occur below a depth of 7 km (4.3 miles), which is several kilometers below the thrust faults and the decollement zone. Consequently these earthquakes do not furnish any evidence for the existence of "an earthquake fault that runs from around Chattanooga to north of Knoxville," and underlies both the Sequoyah and Watts Bar sites. As stated in the FSAR and the literature, thrust faults exist under the site but the evidence indicates that they are not capable faults, or "earthquake faults."

TVA addressed the geology, seismology, and geotechnical engineering conditions in FSAR Section 2.5, has thoroughly examined the subject (Ref. 6), and has concluded that the 0.18 g Safe Shutdown Earthquake (SSE) seismic response spectra are adequate as the basis for the seismic design of Sequoyah and Watts Bar to ensure a safe shutdown of the plants. In addition, TVA reviewed the existing design employing a 0.22 g site-specific seismic response spectra which uses the 84th percentile of 13 actual earthquake recordings. This review of both plants determined that all Category I structures are adequate for seismic loading associated with this site specific spectra. Further, TVA has concluded that the 0.09 g Operating Basis Earthquake (OBE and sometimes referred to as "1/2 SSE" for SQN) seismic response spectra are adequate as the basis for the seismic design of Sequoyah and Watts Bar to ensure continued operation of the plants.

4.1.2 Summarized Element Findings

The faults at SQN and WBN alluded to in the concerns are thrust faults which are not capable of producing significant earthquakes. As presented in its licensing documents, TVA assessed the seismic significance of these faults. The design of seismic Category I structures has been accepted and documented by NRC in supplements to Safety Evaluation Reports (SER) for SQN and WBN.

4.2 Cut Rebar Control - Element 215.2

4.2.1 Sequoyah Plant

The evaluation team's review of TVA procedure AI-17 (Ref. 7) found that it required engineering review for only electrical and mechanical disciplines; civil review was not required prior to concrete drilling and chipping. The review also found that AI-17 did not reference specification G-2 requirements (TVA specification G-2, Section 8.3 (Ref. 43) contains DNE requirements for cutting of rebar), did not require prior DNE approval for cutting rebar or

caution against cutting without it, and did not reference a procedure or instruction addressing how such ONE approval is obtained (Ref. 7). NCRs 2975 and 2836 are examples of lack of Civil Engineering Branch (CEB) prior approval (Ref. 44).

The NRC issued Deficiency Report D4.3-1 in 04/86 which indicated that there was no documented evidence of CEB evaluation in the structural calculations of cut rebar effect for ECNs L6495 and L5202 (Ref. 8). The evaluation team determined that the rebar cuts were reviewed and approved by engineering judgment by engineers familiar with the design. However, calculations were not made and drawings were not always updated.

4.2.2 Watts Bar Plant

The issue that cutting of rebar in reactor containment and the crane walls inside the reactor building could have weakened the structure, has been addressed by TVA. TVA has documented individual cut rebar by use of Quality Control Procedure WBNP-QCP 1.7 (Ref. 9) and the FCR/ECN/NCR process, and has satisfactorily assessed the cumulative effects of such cut rebar in concrete calculations.

Since the start of construction there are approximately 1,400 bar cuts in both Unit 1 and 2 reactor buildings. Each has been investigated, and they do not impair the structural integrity of the reactor building concrete structures.

TVA has an effective program to control and document rebar cuts. This TVA program is in place and in use. In addition, based on its inspections, the NRC has concluded that the design evaluation program, as established, is adequate to ensure structural integrity (Ref. 10).

4.2.3 Browns Ferry Plant

In a letter to NRC (Ref. 11), TVA indicated that Deficiency D4.3-1 identified at SQN is also applicable to BFN. The stated corrective action in "Browns Ferry Applicability to D4.3-1" attached in the TVA's letter to NRC is that an evaluation will be performed to identify areas where unevaluated rebar cuts exist and determine if a loss of function or reduction in capability of the concrete resulted from cut rebar. The evaluation team found that the BFN cut rebar evaluation program had already been planned as a result of the NRC audit at SQN (Browns Ferry Applicability to Deficiency D4.3-1).

4.2.4 Bellefonte Plant

Discussions with cognizant TVA engineers and a review of drawings, procedures, and other documents (Refs. 36, 46 and 47) disclosed that the following methods are being used by TVA to control cutting and damage of rebar. Drilling and chipping operations are controlled by notes on drawings and are enforced by BLN Quality Control Procedure BNP-QCP-10.6, "Work Release," Section 6.2, which requires a written engineering release before drilling or chipping of permanent structures (Ref. 12). If drawings do not permit cutting rebar without engineering approval, then permission is obtained from TVA DNE, and a field change request (FCR) is issued to identify rebar to be cut.

NRC performed a special inspection of the BLN facilities in 04/82 (Ref. 13) and, among other subjects, reviewed design controls for evaluations of rebar cutting. The inspector examined the program for documentation and evaluation of cut rebar. His review disclosed that the locations of cut rebar are being shown on the drawings, but that the design evaluation may not be documented in accordance with the requirements of 10 CFR 50, Appendix B. Therefore, NRC identified these factors as Unresolved Items 438/82-10-01 and 439/82-10-01. TVA has not furnished evidence to the evaluation team that these items are closed.

The sample calculations (Ref. 36) reviewed by the evaluation team were found perfunctory and lacking in sufficient detail for complete assessment. Moreover, they do not address cumulative effects of multiple cuts. DNE has already identified the lack of documents for rebar cut evaluation and accpetability in BLN CAQR BLF 870073 (Ref. 47).

4.2.5 Summarized Element Findings

WBN has an effective program to control, document, and assess the effect of cut rebar, including cumulative effect, on concrete calculations. On the basis of its inspection, the NRC has concluded that the design evaluation program as established is adequate to ensure structural integrity. SQN and BFN do not have a documented procedure or program for processing, evaluating, and controlling cut rebar. BLN Division of Nuclear Construction (DNC) has an effective program to control and document rebar cuts in the field, but BLN Division of Nuclear Engineering (DNE) does not have an engineering procedure for processing, evaluating, and controlling the cumulative effects of cut rebar. Assessment calculations of Category I concrete elements for cut rebar are not complete at SQN, BFN, and BLN.

4.3 Radiation Shielding Seismic Analysis - Element 215.3

4.3.1 Watts Bar Plant

Major radiation shielding is provided in the plant layout and is based on conservative source term models. This layout generally consists of normal

weight concrete walls and slabs. These permanent plant features are installed as a part of normal plant design completion which includes ALARA programs. These shielding provisions are verified, and modified as required, during the design, testing, startup, and plant operation phases of a nuclear plant's life.

As indicated in the concern, this is not a plant safety concern. This concern relates to cost-effectiveness of radiation shielding used during plant operation. It is not practicable to perform a generic seismic analysis as there are many locations with different physical geometry, radiation sources, and radiation levels that need to be evaluated. TVA is involved in improving the cost-effectiveness of its radiation shielding program. One approach being pursued by DNE and Plant Operations is the implementation of a computer program, Pb SHIELDING, and/or the implementation of a set of tables or nomographs defining acceptable loadings versus different pipe sizes or configurations (Ref. 14).

4.3.2 Summarized Element Finding

At WBN, generic seismic analysis of required radiation shielding during plant operation and maintenance is not practical. TVA is actively improving the cost-effectiveness of its existing approach of designing shielding on a case-by-case basis.

4.4 Turbine and Service Building Roofing - Element 215.4

4.4.1 Watts Bar Plant

The Turbine and Service Buildings are non-Category I structures. The original built-up roofing was installed in accordance with TVA Specification 2600 (Ref. 58) with minor substitutions. The TVA architectural roof plans and sections indicate walkway over both buildings.

There is an indication that the turbine building roofing had sustained some damage during the construction phase as evidenced by the TVA memo from Touchstone to Liakonis (Ref. 28) where the need for reroofing is stated as follows:

> "Apparently, due to poor workmanship and heavy construction traffic that occurred during construction, the membrane was punctured in many places thereby permitting water to enter the system, thus resulting in a short lifespan requiring the roof to be replaced."

Protective boards are provided in foot traffic areas as delineated in TVA drawings (Ref. 15). This design will mitigate leakage caused by foot traffic on walkways. Since construction in now complete and access to the roof is limited and controlled, further damage to the roofing is not anticipated.

4.4.2 Summarized Element Finding

At WBN, the leaking of the original roofing was not caused by improper design, but by poor workmanship and uncontrolled heavy foot traffic during construction.. The roofing always had designed walkways in foot traffic areas.

4.5 Hanger Loads on Structures - Element 215.6

4.5.1 Sequoyah and Watts Bar Plants

SQN Design Criteria V-1.3.3.1 and WBN Design Criteria 20-1.1 state:

> "A review and reevaluation for loads estimated or assumed during the design and construction process shall be made. . . . The review/ reevaluation shall be made after the total plant design and construction has progressed to a point where the actual loads can be determined with a reasonable degree of certainty. A live load to be used by the plant operating personnel shall be ascertained and documented on a drawing for use during the operating plant life." (Refs. 16 and 18)

There was an implicit recognition that some areas of the plant might have greater loads than originally assumed. However, reevaluation was not performed. NCR SQN CEB 8403 and NCR WBN WBP 8338 identified that, during a postulated seismic event, two 8-inch thick reinforced concrete partition walls were overstressed because of the attachment of conduits and fire protection piping supports. TVA's review of the NCR concluded that originally it had designed these walls for the weight of the walls only and had not considered any attachment loadings. As a result, the corrective action required additional steel braces to qualify the partition walls (Refs. 17 and 19).

TVA Engineering Procedure, EN DES-EP 4.04 entitled "Squadcheck Process," described how to submit drawings for the purpose of review and comment. The evaluation team determined that compliance with these procedures was not always achieved.

All elevated concrete floors in the Auxiliary Control Building and Reactor Building were originally designed using the working stress design method of ACI 318-63 as described in SQN and WBN FSARs (Ref. 48). However, the current assessment is based on the ultimate strength design method (ACI 318-77) permitted by SQN and WBN design criteria, and this method has resulted in higher floor load capacities. Furthermore, moments in slabs are redistributed using ACI 318-77 code instead of the 318-63 code stated in the FSAR. Although the use of either code version is technically acceptable, such differences indicate that TVA's licensing commitments are not fully met.

4.5.2 Browns Ferry Plant

Generally, in early stages of structural design, principal loads for major equipment and structures are reasonably well defined; but other loads, including hanger loads, are conservatively estimated to allow for various components, e.g., process piping, electrical raceways, HVAC ducts, and small equipment. This approach is necessary since final locations and exact loads are unknown for these components until their detailed analyses are performed. The final loads are then compared with the estimated loads to assure margins of safety meet FSAR commitments. This iterative process is normally satisfactory unless significant design additions have been made. The additions can be particularly significant at plants such as BFN, since the concrete structures have been subjected to many additional new systems and components. TVA Engineering Procedure, EN DES-EP 4.04 entitled, "Squadcheck Process," described how to submit hanger drawings for the purpose of review and comments (Ref. 20). The evaluation team did not find evidence of compliance with these procedures at BFN.

The evaluation team reviewed BFN design drawings covering general notes for pipe supports. The drawings do not require coordination and transfer of hanger design information to concrete design engineers nor do BFN procedures require such coordination. Neither could the evaluation team identify any samples of informal coordination. Furthermore, BFN has design drawings specifying design floor live load in a note (Ref. 21). However, the evaluation team has not found any calculations to demonstrate that the stated allowable live load is still unimpaired after numerous component additions since the original design.

4.5.3 Bellefonte Plant

Section 3.10.5 of criterion N4-50-0702 states:

> "A review and reevaluation for loads estimated or assumed during the design and construction process shall be made. . . . The review/reevaluation shall be made prior to initial plant operation. Prior to commercial operation, a live load to be used by the plant operating personnel shall be ascertained and documented on a drawing for use during the operating plant life." (Ref. 22)

TVA stated that it has not performed the reevaluation based on walkdowns yet but is planning to do so before fuel load date. However, there is no documented evidence that TVA plans this to be a comprehensive review for the effects of accumulated loading based on the as-built conditions at BLN for Category I concrete structures.

The evaluation team reviewed BLN design drawings (Ref. 49) covering general notes for component supports. The drawings do not require coordination and transfer of hanger design information to concrete design engineers nor do BLN procedures require such coordination. Neither could the evaluation team identify any samples of informal coordination. Furthermore, BLN has design drawings specifying design floor live load. However, the calculations are not available to demonstrate that the stated allowable live load is still unimpaired after numerous component additions since the original design. The evaluation team observed that the civil engineering discipline neither has a formal procedure for nor a practice of evaluating cumulative effects of hanger loads.

4.5.4 Summarized Element Finding

TVA design calculations have not evaluated all individual and cumulative effects of as-built hangers on concrete walls and slabs of Category I structures to establish structural integrity for all four plants. At present, for SQN and WBN, there are differences between the FSARs and the final design bases for Category I concrete elements. TVA does not have formal programs to coordinate and evaluate the effects of cumulative loading from different commodities, or to consider feedback from cut rebar effects.

4.6 Auxiliary Building Crane Service - Element 215.7

4.6.1 Watts Bar Plant

A TVA memo from Cantrell and Bonine which received wide distribution throughout TVA's engineering and construction organizations, establishes policy to clearly define the role and responsibilities of the two organizations as follows:

> "It is the responsibility of the Office of Engineering (OE) to provide all requirements in the design output documents to ensure that the final product, when constructed in accordance with these requirements, will comply with and perform in accordance with the design criteria and specifications. . . . All of the requirements necessary for construction activities are not specified by the design output documents. In those areas where the necessary requirements to control the fabrication, installation, or testing are not defined, it is the responsibility of the Construction Engineering Organization (CEO) to provide the requirements." (Ref. 23)

The main hook of the 125-ton crane services floor elevations 729'-0" and 757'-0" with a hook reaching down to elevation 722'-0" for maneuvering the fuel cask in the cask loading area at elevation 709'-0". The auxiliary hook

services floor elevations 676'-0", 692'-0", 713'-0", 737'-0", and 757'-0" with a hook reach down to elevation 677'-6". TVA drawings (Ref. 50) show the service areas of the auxiliary hook which is through hatch openings approximately 8'-0" by 10'-0". Materials are hoisted or lowered through this shaft to the desired elevation and then moved into position horizontally with come-alongs or similar devices.

Section 1.3.4 of the AISC Specification for the Design, Fabrication and Erection of Structural Steel for Buildings specifies that the crane runways be designed for a lateral force of 20 percent of the sum of the weights of the lifted load (crane rated load) and of the crane trolley. In addition, the crane runway is to be designed for a longitudinal force of 10 percent of the maximum wheel loads. Such design is industry standard practice for construction and operation of industrial facilities (including nuclear power plants) throughout the country. This provision more than adequately ensures safe crane operation when come-alongs or similar devices are used to horizontally move the lifted load attached to, and freely suspended from, the cable and hook.

The subject of crane side pulls is addressed in Subcategory Report 30800, R2 (Ref. 61), (09/04/87). American National Standards Institute (ANSI) B30.2.0-1976 (Ref. 60), Section 2-0.2.2.45 defines a side pull as: "The portion of the hoist pull acting horizontally when the hoist lines are not operated vertically." Section 2-3.2.3(d) of the ANSI standard states:

> "Cranes shall not be used for side pulls except when specifically authorized by a qualified person who has determined that the stability of the crane is not thereby endangered, and that various parts of the crane will not be overstressed."

When qualified personnel act in an intelligent and prudent manner to perform the work described above, the crane operation will meet any implied or stated ANSI requirements given above. Further, when such personnel act as described there is no necessity to evaluate the structures to which the come-alongs are attached. Such practice is industry standard for construction and operation of industrial facilities including nuclear power plants.

The grating on the floor rated at 100 psf cited in the concern is the one located at elevation 692'-0". It is for temporary construction access. This grating is used during the construction stage for easy access to the lower floors. This grating will carry approximately 100 psf live load based on the 8-foot span. This grating will be replaced by the permanent plant grating with a design live load capacity of 200 psf.

4.6.2 Summarized Element Finding

The interface between engineering and construction organizations is properly coordinated through published documents. The TVA specifications and design

requirements applicable to the 125-ton Auxiliary Building crane at WBN are satisfactory. The 3-1/2-inch-opening grating at elevation 692 feet is temporary. The final grating is specified on the applicable design drawing and will be installed according to the current plan.

4.7 Feedwater Heater Monorail Design - Element 215.10

4.7.1 Sequoyah Plant

TVA decided to replace a total of 12 out of 42 feedwater heaters in late 1984 on both of the SQN units because of mechanical problems encountered. The feedwater heater replacement involved moving large, heavy (89,000 lb) equipment over long distances through confined spaced. The replacement, therefore, required additional monorails at various locations in the turbine building to transport the heaters.

The SQN turbine building and monorail supports are not Category I structures. The AISC specification (Ref. 51) covers design, fabrication, and erection of structural steel. The evaluation team reviewed the feedwater heater drawings, and confirmed that the correct lifting weights were used in the design calculations. The design calculations and drawings (Ref. 52) were reviewed for assumptions, logic, analysis, code interpretations, member selections, connections, and clarity of presentations. The evaluation team found the design documents well organized, complete, and meeting the AISC requirements. The team also performed a field walkdown of the as-built installation including connections. The installation appeared satisfactory.

The SQN site director had requested a monorail load test prior to lifting the heaters to ascertain the soundness of the system design. The test was considered successful by visual observations (Ref. 24). Following the test, the feedwater heaters were replaced successfully.

4.7.2 Summarized Element Finding

At SQN, the hangers are structurally adequate for the rated load. Other reviews, the load test, and the successful heater replacement operation confirm adequate design.

4.8 Floor Sleeve Covers - Element 215.11

4.8.1 Watts Bar Plant

All mechanical floor sleeve seals in the Auxiliary Building are tabulated in drawing 47W472 series (Ref. 53). A review of these drawings indicated that all spare sleeve penetration seals are Type III seal, made of Dow Corning 3-6548 silicon RTV foam with a minimum thickness of 8 inches. All Type III penetration seals are fire-barrier seals with no air-pressure requirement.

The sleeves protrude 4 inches above the floor slab and are filled with silicon foam fire-proofing material. The top surfaces of the silicon foam are dished (concave) and appear as though someone has stepped on them. The outside surfaces of the sleeves are covered with yellow and black striped reflective tape which identifies a hazard.

The protruding spare sleeves may create a safety hazard if they are located along, across, or in aisles and passageways because workers may trip on the protruding sleeves. OSHA Standards require aisles and passageways to be kept clean and in good repair, with no obstruction across or in aisles that could create a hazard (Ref. 25). In addition to the tripping hazard, a larger abandoned floor sleeve may also create a hazard if the seal is accidentally stepped on and is unable to support the weight of a worker.

4.8.2 Summarized Element Finding

The potential safety hazard caused by protruding sleeves requires a worker safety evaluation for compliance with OSHA standards. (The documents are not available to ensure the adequacy of seal foam to support the weight of a person.)

4.9 Pipe Whip Restraint Design - Element 227.1

4.9.1 Watts Bar Plant

The concern indicates that the problems can be identified by examination of the drawing series 48W1700 (Ref. 39) and further indicates that this is a construction department concern. Therefore special emphasis was given to the changes required to complete construction of the pipe whip restraints. From a review of the drawings and documents, it is observed that the general engineering design requirements as issued for construction are similar to those used widely in the nuclear power industry.

Review of the original notes provided on these drawings indicates that adequate tolerance and flexibility were provided to construction in the area of welding by notes. However, a further review of documents such as ECNs, NCRs, and FCRs (Refs. 39 and 40) indicates that a deficiency existed in the area of weld inspection and documentation. This deficiency was discovered by TVA in February 1981 during the review of the turnover package for the pipe whip restraints after the transfer of site engineering and inspection responsibility to the Civil Engineering Design Unit. After the location and review of all existing documentation and a random inspection of the as-built pipe whip restraints, a nonconforming condition was determined to exist. Based on this, NCR-3001R was initiated by TVA to determine the full extent of the deficiency and to evaluate its impact on the safety of the plant. As a result of this evaluation, TVA reported that a significant deficiency existed which could have affected plant safety. Therefore, the above information was conveyed to the NRC in April 1981.

Subsequently, TVA reviewed, evaluated, and corrected any weld deficiency that might have existed for all affected pipe whip restraints as described in TVA memo from Cantrell to Wilkins (Ref. 56 and 57) dated 1981 and January 1982 and further documented in NCRs 3001R and 3523. Final TVA closure of pipe whip restraint welding and inspection issues was November 1985 (Ref. 58).

NRC I&E Inspection Reports 50-390/83-27 and 50-391/83-19 (August 1983) indicate that the NRC has reviewed documentation and inspection sheets for NCRs 3001R and 3523 and has found them and the corrective action to be acceptable for NRC closure of pipe whip restraint welding and inspection issues (Ref. 26).

4.9.2 Summarized Element Finding

The concern is related to reconciliation of the as-built condition with the design requirements regarding the welding of pipe whip restraints. Construction Engineering Department used incorrect inspection procedures, which resulted in improper inspection and insufficient documentation. This condition was corrected. The NRC reviewed the applicable correction documents and found them and the corrective action to be acceptable.

4.10 Pipe Whip Restraint Design - Element 227.2

4.10.1 Bellefonte Plant

The stated concern indicates that whip restraints are needed on the 36-inch decay heat removal (DHR) piping coming from the borated water storage tank (BWST). Pipe whip restraints are structural protective devices that permit some pipe motion and rotation but limit or prevent unrestricted pipe whip. Pipe whip is the movement of a pipe caused by the jet thrust resulting from a pipe failure.

The postulated types of pipe failure and the criteria for corresponding applicable piping are (Ref. 27):

- Circumferential ruptures and longitudinal splits, which necessitate pipe whip restraints in high energy lines
- Through-wall leakage cracks, which do not require provision of pipe whip restraints, in moderate energy lines

The criteria for establishing high and moderate energy system classification are governed by the maximum operating temperatures and pressures in the system. According to BLN FSAR the DHR is a moderate energy system (Ref. 27).

In addition, the review indicated that there is no 36-inch DHR piping coming from the BWST. BLN design criteria diagram drawing shows that the DHR pipe

coming from the BWST has a 36-inch diameter at the nozzle location with a reducer to 24-inch-diameter pipe. The detailed section at the nozzle in the drawing used for construction shows a 30-inch diameter nozzle.

4.10.2 Summarized Element Finding

The problem relates to the decay heat removal piping, which is a moderate energy line at BLN and therefore does not require whip restraints. In addition, a discrepancy was noted between the design documents and the FSAR regarding the nozzle size.

4.11 Summarized Subcategory Findings

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

The summary of findings by classification is given in Table 2. Where more than one corrective action is identified in Table 1 for a single finding (e.g., element 215.11, Finding "a"), Table 2 counts only a single classification. Thus, Table 2 identifies one finding for each issue evaluated. Of the 42 findings identified by a classification in Table 1, 16 require no corrective action. Of the remaining 26 that required corrective actions, eight resulted from peripheral issues uncovered during the ECTG evaluation.

Even though TVA had initiated some corrective actions before ECTG evaluation that relate to two findings each for BFN and BLN of element 215.2 addressing cut rebar, its original scope was very limited, requiring only a cursory review. Similarly, TVA was also conducting floor live load evaluations for SQN and WBN that relate to one finding each of element 215.6, which addresses hanger loads on structures. Again, TVA's initial scope was not comprehensive enough to address the findings. Therefore, for the purposes of Tables 1 and 2, complete corrective actions are considered taken as a result of the ECTG evaluation. From Table 2, the ratios of issues or findings requiring corrective action to the total number of issues evaluated, by plant, are as follows:

	WBN	SQN	BFN	BLN
Issues or findings requiring corrective action	5	7	6	8
Total number of issues evaluated	17	10	6	9

The apparent differences between the ratio for WBN and the ratios for the other plants are due to the sequence of evaluation and the utilization of the results obtained from WBN. The Employee Concern Special Program started at WBN and was then expanded to cover all other plants. Through the general approach review process, those issues that were site-specific, and not safety-related, were not evaluated at the other plants.

5. CORRECTIVE ACTIONS

The evaluation team reviewed the corrective action plans for all four plants and found them acceptable to resolve the findings. The corrective action plans are described in Attachment B.

The general areas of corrective action are described below for each element reviewed for this subcategory. Following this is a summary discussion of the information presented in Table 3.

5.1 Cut Rebar Control and Hanger Loads on Structures - Elements 215.2 and 215.6

TVA plans to combine the corrective actions for these two elements at SQN, BFN, and BLN, as follows:

- Perform document search and compile relevant information on drawings
- Supplement with field walkdowns and reconcile with drawings
- Select the most critical concrete elements for detailed evaluation to verify their adequacy to meet the design commitments
- Revise FSAR as needed to identify the design methods used in the evaluation
- Develop procedures to control construction and operation activities and to provide engineering direction for evaluation to address future plant modifications

TVA also plans to follow the corrective actions described above for element 215.6 at WBN. Corrective action plan detail is provided in Attachment B to this Subcategory Report.

5.2 Floor Sleeve Covers - Element 215.11

To comply with personnel safety requirements, TVA has committed to the following actions at WBN:

- Perform personnel safety inspection of the plant area to identify and eliminate tripping hazards

- Evaluate adequacy of floor sleeve seals to determine if they can support anticipated loads

Corrective action plan detail is provided in Attachment B to this Subcategory Report.

5.3 Pipe Whip Restraint Design - Element 227.2

TVA has committed to the following actions at BLN:

- Review all safety-related piping/tank interfaces for consistency between the design criteria diagrams and all other applicable design documents

- Identify all discrepancies among the documents and correct them as appropriate

5.4 Summary of Corrective Actions

Table 2 identifies 26 findings that require corrective action. Because some of the findings were combined and were common for more than one plant, there are eight corrective action descriptions in this subcategory. Table 3 shows these eight corrective action descriptions, along with finding/corrective action classifications. The corrective action descriptions are a condensation of the more detailed corrective action information provided in Attachment B. Table 3 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.

From the Finding/Corrective Action Classification column of Table 3, it can be seen that of the eight corrective action descriptions identified, three involve additional evaluation to determine if plant modifications are necessary, two require changes to procedures, and the remaining three require some type of documentation remedy. In addition, the CATD column of Table 3 shows that, in most cases, a particular corrective action description is applicable to more than a single plant. Finally, with respect to corrective actions, Table 3 shows that, of the ten elements in this subcategory, only four require corrective actions, and elements 215.2 and 215.6 require most of the corrective actions.

The "significance of corrective actions" column of Table 3 shows that the primary activity to be performed by TVA is documentation change as a result of the eight corrective action descriptions. This activity requires preparing new calculations, drawings, and procedures. Two of the eight corrective action descriptions will result in reductions in design margins and, as Table 3 shows, three of the eight could potentially require physical modifications of the plant. The necessary evaluations which have not been

completed for all plants will determine the extent of physical modifications. However, on the basis of experience with other nuclear plants, this possibility seems remote.

5.5 Corrective Action Status

The following is the current (September 1987) status of the corrective actions for this subcategory:

- o 215.2 and 215.6, Cut Rebar Control and Hanger Loads on Structures
  - The corrective actions necessary for SQN restart are complete, were reviewed by the evaluation team in June 1987, and were deemed acceptable (Ref. 29).
  - As discussed in Section 4, WBN already had an acceptable cut rebar control program. And the corrective actions to assess cumulative effects of hanger attachments at WBN are based on comparison with SQN because WBN is a sister plant to SQN. The related work is essentially complete.
  - BFN awarded a contract in the summer of 1987 to an architect/engineer company to verify the structural adequacy of its Class I concrete elements. The related work is in progress.
  - BLN has initiated appropriate corrective actions for this substantial task because of the large number of cut rebar releases and hanger attachments that have undocumented engineering judgments (CAQR BLF 870073).
- o 215.11, Floor Sleeve Covers (at WBN only) and 227.2, Pipe Whip Restraint Design (at BLN only) - The required corrective actions for these two elements are not complete.

6. CAUSES

Table 3 identifies one or more main causes for each problem requiring corrective action. For each corrective action, the most important cause is identified; however, in many instances it was observed that the problem resulted from a combination of causes, each of which should be identified. Therefore, more than one cause is identified for those corrective actions.

The following discussion describes the causes identified in Table 3 and the associated element evaluations with negative findings identified in Section 4.

6.1 Cut Rebar Control - Element 215.2

The evaluation team found that assessment calculations (Refs. 34, 35, and 36) of Category I concrete elements for cut rebar were either incomplete or unavailable at SQN, BFN, and BLN because engineering judgments were often made without performing detailed calculations. In addition, updated as-built cut rebar drawings were not available for an overall assessment of the concrete structures. This subject was not adequately addressed by Engineering because of lack of sufficient involvement in technical matters by responsible first-line and second-line engineering supervisors.

Also, SQN did not have documented procedures for monitoring and evaluating cut rebar. This deficiency occurred because practices then current within the industry were not followed. In addition, at all plants except WBN, communication/coordination was not adequate between Engineering, Construction, and Operations to assess the effects of cut rebar, resulting in a degree of compartmentalization for this subject.

At BLN, NRC 1982 inspection items have remained open. This lack of resolution of items occurred because of a lapse in communication between Engineering and Licensing.

6.2 Hanger Loads on Structures - Element 215.6

TVA did not evaluate cumulative effects of as-built hangers on Category I concrete walls and slabs and establish structural integrity for all four nuclear plants. This resulted from the practice of exercising engineering judgment by engineers designing hanger supports for various Category I components. Furthermore, complete as-built drawings showing all major hanger attachments were not available to facilitate overall assessment. The main cause for this practice continuing at all four plants was lack of sufficient leadership in technical matters by the first- and second-line engineering supervisors. A contributing cause was a lack of consistent policy and procedure to address as-built information requirements.

TVA does not have formal procedures requiring coordination and evaluation of cumulative effects of hanger attachments. This deficiency at all four plants resulted from inadequate interaction and communication among Engineering disciplines as well as among Engineering, Construction, and later, Operations. Also, prevailing nuclear industry practice was not followed in this regard.

For SQN and WBN, at present, there are differences between the governing building codes identified in the FSARs and the codes used in the final assessment calculations. The lack of timely resolution of differences resulted from inadequate training in the procedures established for design process control. This deficiency also resulted from lack of communication between the design engineers and their supervisors regarding technical matters.

6.3 Floor Sleeve Covers - Element 215.11

The evaluation team determined that abandoned protruding sleeves at WBN were not documented as to whether they created industrial safety hazards. Clearly, compliance to OSHA regulations was not evident. The abandoned sleeves resulted from inadequate coordination among the responsible mechanical, electrical, and civil engineers. In addition, the structural adequacy of seal foam within the sleeves was not documented as to whether it met physical separation requirements of a nuclear power plant. TVA ONE apparently had accepted the adequacy of sleeve foam based on engineering judgment but without documenting the logic and rationale.

6.4 Pipe Whip Restraint Design - Element 227.2

The tank nozzle size for the decay heat removal piping at BLN was found to be incorrect on a drawing. This discrepancy resulted from engineering error in transcribing the information on the BLN design criteria diagram.

6.5 Summary of Causes

The consideration of main cause showed that, for this subcategory, three major groups of causes were represented - management effectiveness, design process effectiveness, and technical adequacy. Using these groups, the unweighted totals from Table 3 show that 12 causes are in the management effectiveness category, five are in the design process category, and four are in the technical adequacy category. Thus, the management effectiveness category, covering supervisory effectiveness, dominates in evaluating the summation of main causes.

The following observations apply to all four nuclear plants. The extent to which supervision is engaged in design work was examined on the basis of the negative findings identified. The responsibility of first- and second-line engineering supervision usually includes the overall review of the design and document control, and establishing and maintaining procedures that ensure compliance with the FSAR commitments. However, the combination of unclear design bases, undocumented design judgments and practices, lack of design commitment compliance, and absence of design verification documentation contributed to uncertainty regarding the design control process in this area of review. The observation of insufficient technical design and document control, which was encountered in the findings related to the cut rebar and hanger supports, indicates there was insufficient involvement on the part of engineering supervision in the design and control process in these two areas. The errors that occurred for this subcategory are those of omission. Inadequate procedures and lack of supervisory attention led to oversight in both verifying the design and properly controlling and directing construction regarding installation and modification in these two areas.

However, evaluation of the other findings in this subcategory indicated that there were adequate procedures and acceptable supervisory control of the associated design process.

7. COLLECTIVE SIGNIFICANCE

Evaluation of the civil/structural design issues raised by 13 TVA employee concerns that were identified in this subcategory indicated that a generic problem that would affect design margins of concrete components existed because of lack of assessment and documentation of construction completion and design modification. Two common elements indicating this were the cut rebar control (element 215.2) and the hanger loads on structures (element 215.6). The construction completion and modification control methods and procedures for these elements were found to be insufficient to document the as-installed design margins. Issues raised in four of the 13 concerns addressed this problem.

Another concern dealt with a potential violation of standards and improper coordination (element 215.11) and was seen as an isolated instance. Moreover, a documentation error, which does not directly relate to the expressed concern and had no effect on the design margins, was identified (element 227.2). Issues raised in the other seven concerns were found by the evaluation team to be invalid, and therefore, no further corrective action was needed.

In investigating the specific reasons of the identified problems, the evaluation team found a broader issue of insufficient attention to detail and thoroughness in reviewing calculations. The design of nuclear power plants requires the consideration of many unique items not generally considered in nonnuclear applications. Therefore, it is essential that the first-line engineering supervision be cognizant with nuclear power plant design in order to anticipate and address all the design needs in a logical manner.

Corrective action plans for the four nuclear plants for this subcategory, as well as for a CAP closure program for the SQN restart were prepared by TVA and submitted to the evaluation team for concurrence. Generally, the team observed that the documents submitted initially by cognizant engineers of all four plants were incomplete and required several resubmittals before they were deemed acceptable. This activity is indicative of lack of appreciation by first-line supervisors for the documentation needs of nuclear power plants, and reinforces the need for more attention toward ensuring that programs required for an effective and thorough design process are established and implemented.

One observation of the first-line engineering supervisors is that their actions in this area appeared to be a continuation of past practices when documentation requirements for nuclear power plants were not as extensive. In light of the major events that have transformed the nuclear industry, TVA, to some degree, has demonstrated a failure to document the collective needs of a

complex multidiscipline effort. Indeed, a compelling close relationship between commitments, engineered design, and constructed plant is essential for these discrepant issues.

To address the general broader issues of TVA's past difficulties in the nuclear area, the Corporate Nuclear Performance Plan (CNPP) was created (Ref. 5). In addition, SQN, WBN, and 3FN have generated plant-specific nuclear performance plans (NPPs) to further define the programmatic actions to be taken for their facilities (BLN is broadly addressed in the CNPP).

In general, TVA senior management has identified the need for strengthening its Engineering organization in response to the requirements of nuclear plant design. The Engineering organization is responsible for the content and quality of the design documents and for ensuring that they conform to sound engineering principles, licensing commitments, and Quality Assurance program requirements. This need for strengthening is based, in part, on deficiencies in design process effectiveness, which are partially illustrated by the cause discussion in Section 6. This need is also partially based on past implementation of the TVA Quality Assurance program. Thus, the need for strengthening the Engineering organization, as indicated by the NPPs, is accomplished primarily through additional training of the DNE personnel to the requirements of that program and to basic management principles. DNE Nuclear Engineering Procedure NEP-5.2 (Ref. 54) and policy memo PM 87-35 (Ref. 55) clearly delineate the responsibility, authority, and accountability of the Project Engineers and Branch Chiefs. The Project Engineer is responsible for work scope, budget, and schedule, and for ensuring that project work is executed according to plan and in conformance with the technical direction of the Branch Chiefs and the requirements of the corporate QA program. The Branch Chiefs are responsible for staffing levels and qualifications of technical personnel on the projects, and for the technical adequacy of the engineering design. The Branch Chiefs are the final technical authority within DNE, and have the authority to stop work that does not conform to established requirements. In the past, Branch Chiefs' authority or resources to fully administer technical reviews was limited. 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 have been started but have not, as of Revision 2 of this report, been fully implemented.

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 focus of this report has been on related negative findings. However, it is important to emphasize that employee concerns in this subcategory

identified only a fraction of the total technical scope of the TVA civil/structural design group. In addition, as discussed earlier in this section, out of a total of 13 employee concerns, five were found to be valid, and there is remote potential for plant modifications. The resulting corrective actions are mainly to compile and to prepare documentation. The TVA design process addressed within the limited area of this subcategory was determined to be generally sound with a few exceptions, as discussed, for cut rebar control and the cumulative effects of hanger loads.

The findings of this subcategory are combined with those of other subcategory reports and reassessed in the Engineering category evaluation, which has assessed the broader issues identified and has issued necessary corrective actions tracking documents.

TABLE 1

CLASSIFICATION OF FINDINGS AND CORRECTIVE ACTIONS

	Element	Issue/ Finding**	Finding/Corrective Action Class* SQN	WBN	BFN	BLN
215.1	Seismic Criteria	a	A	A	-	-
		b	A	A	-	-
215.2	Cut Rebar Control	a	D6	A	D6	D6
		b	D6	A	D6	D6
		c	D2	A	D2	D2
		d	-	-	-	E3
215.3	Radiation Shielding Seismic Analysis	a	-	A	-	-
		b	-	A	-	-
215.4	Turbine and Service Building Roofing	a	-	A	-	-
215.6	Hanger Loads on Structures	a	D6	D6	D6	D6
		b	D6	D6	D6	D6
		c	E3	E3	E2	E2
		d	E2	E2	-	-
215.7	Auxiliary Building Service Crane	a	-	A	-	-
		b	-	A	-	-
		c	-	B	-	-
215.10	Feedwater Heater Monorail Design	a	A	-	-	-

* Explanation of classes is on the next page.
**Defined for each plant in Attachment B.

TABLE 1 (Cont'd)

	Element	Issue/ Finding**	Finding/Corrective Action Class* SQN	NBN	BFN	BLN
215.11	Floor Sleeve Covers	a	-	D6	-	-
			-	D7	-	-
227.1	Pipe Whip Restraint Design	a	-	A	-	-
227.2	Pipe Whip Restraint Design	a	-	-	-	A
		b	-	-	-	E3

*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 (Compliance with OSHA)

**Defined for each plant in Attachment B.

TABLE 2

FINDINGS SUMMARY

Classification of Findings	Plant SQN	WBN	BFN	BLN	Total
A. Issue not valid. No corrective action required.	3	11	0	1	15
B. Issue valid but consequences acceptable. No corrective action required.	0	1	0	0	1
C. Issue valid. Corrective action initiated before ECTG evaluation.	0	0	0	0	0
D. Issue valid. Corrective action taken as a result of ECTG evaluation.	5	3	5	5	18
E. Peripheral issue uncovered during ECTG evaluation. Corrective action required.	2	2	1	3	8
Total	10	17	6	9	42

TABLE 3
MATRIX OF ELEMENTS, CORRECTIVE ACTIONS, AND CAUSES
SUBCATEGORY 25000

ELEM	FINDING/ CORRECTIVE ACTION CLASS.**	CORRECTIVE ACTION	CATD	CAUSES OF NEGATIVE FINDINGS* — MANAGEMENT EFFECTIVENESS: 1 Fragmented Organization	2 Inadequate Q-trng	3 Inadequate Procedures	4 Procedures Not Followed	5 Inadequate Communication	6 Untimely Res of Issues	7 Lack of Mgt Atten	DESIGN PROCESS EFFECTIVENESS: 8 Inadequate Design Bases	9 Inadequate Calcs	10 Inadequate As-blt Recon-cil.	11 Lack of Design Detail	12 Engrg Judgmt not Documented	13 Design Crit/ Commit Not Met	14 Insuf. Verif Documentation	TECHNICAL ADEQUACY: 15 Stds Not Followed	16 Engrg Error	17 Vendor Error	Significance of Corrective Actions* D	M	N
215.2	D6	Review, evaluate, and document cut rebar condition.	215 02 SQN 01 215 02 BFN 01 215 02 BLN 01							X			X		X							A	A	P
	D2	Develop/revise procedures to control rebar cuts.	215 02 SQN 01 & 02 215 02 BFN 01 215 02 BLN 01			X		X										X				A	-	
	E3	Address NRC 1982 open items.	215 02 BLN 01					X	X													A	-	-
215.6	D6	Review, evaluate, and document cumulative hanger load assessments.	215 06 SQN 01 215 06 WBN 01 215 06 BFN 01 215 06 BLN 01							X			X		X							A	A	P
	E2	Develop/revise procedures to control hanger attachments.	215 06 SQN 02 215 06 WBN 02 215 06 BFN 02 215 06 BLN 02			X		X										X				A	-	-
	E3	Revise FSAR to reflect design methods used.	215 06 SQN 03 215 06 WBN 03		X			X	X													A	-	-
215.11	D6	Perform worker safety evaluation of the protruding floor sleeves for compliance with OSHA standards, and design evaluation of the adequacy of sleeve foam seals.	215 11 WBN 01 215 11 WBN 02					X								X			X			A	-	P
227.2	E3	Revise a drawing and FSAR to reflect correct nozzle size.	227 02 BLN 01																	X		A	-	-
			TOTALS	-	1	2	-	5	2	2	-	-	2	-	3	-	-	3	1	-			

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

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

If the change resulting from the corrective 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 25000

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

ATTACHMENT A

EMPLOYEE CONCERNS FOR SUBCATEGORY 25000

ELEMENT	CONCERN NUMBER	PLANT LOCATION	APPLICABILITY SQN	WBN	BFN	BLN	CONCERN DESCRIPTION*
215.1	OO-85-005-009	SQN	X	X			"Sequoyah Nuclear Plant is sited on an earthquake fault that runs from around Chattanooga to north of Knoxville. If there were an earthquake power plant structures could fail." (SS)
	OW-85-007-007	WBN	X	X			"Watts Bar is sited on an earthquake fault that runs from around Chattanooga to north of Knoxville. If there were an earthquake power plant structures could fail." (SR)
215.2	IN-85-297-005	WBN	X	X	X	X	"Structural integrity of containment and crane walls in the reactor building is in question because of over 2000 known released to core drill/cut rebar. . . ." (SR)
	IN-85-868-004	WBN	X	X	X	X	"CI stated that cutting of rebars in crane walls RB-I and RB-II for penetration of ducts,conduits and pipes could have weakened the overall structure. CI declined to provide additional information. . . ." (SR)
215.3	IN-85-319-007	WBN		X			"Need generic seismic analysis - plant wide - to expedite installing radiation shielding. Present approach requires case-by-case analysis which is more costly over the life of the plant." (NO)
215.4	IN-85-821-001	WBN		X			"Roofing on Turbine and Service Bldgs. not properly designed - has already been replaced once, and is still subject to spring leaks everywhere that someone steps on it. Designer omitted a critical layer of protective board between insulation and fiberglass 3-4 - ply matting. People told TVA Management that this would happen, but TVA ignored them. No further details available." (NO)
215.6	IN-85-220-003 (shared with 10200)	WBN	X	X	X	X	"In Unit 2, due to excessive number of hangers being used in reactor bldg. annulus areas and air pockets in concrete walls in annulus area from azimuth 292 to 358, the structural integrity of the supporting walls/floors is questionable...." (SR)
	IN-86-173-001	WBN	X	X	X	X	"CI is concerned that design calculations have not considered the weight of all 'extra' hangers added with respect to concrete structures (walls & ceilings)...." (SR)

* SR/NO/SS indicates safety related, not safety related, or safety significant per ECTG 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*
215.7	IN-86-291-003	WBN		X			"The TVA design organization has an 'inflated' idea of their abilities, due to their not realizing the amount of field engineering which is required to make the designs work at all. CI stated, as a typical example, the Auxiliary Building 125 ton crane, which can only set a load on 2 out of 5 floors due to the floor opening design. Also, on one floor, design has used 3 1/2" opening grating, which is only rated at 100 lbs. per square feet load. Nuclear Power concern. CI has no further information." (NO)
215.10	LDA-85-001	SQN	X				"Structural integrity of the feedwater heater monorail-hangers." (NO)
215.11	WBN-0283	WBN		X			"Metal covers need to be installed over sleeves in the floors of the Auxiliary Building which have been foamed. An example would be in Security on the west side of the elevator on elevation 713." (NO)
227.1	EX-85-037-001-R1	WBN		X			"Protective devices (P.D.O's) also known as pipe whip restraint structures in reactor building Unit 1 have problems. The drawings 48W1700 series can be referred to for identification of the problems. . . ." (SR)
227.2	SMP-QCP-10.35-8-6	BLN				X	"Whip restraints needed on 36" SS DHR piping coming from BWST." (SR)

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

ATTACHMENT B

SUMMARY OF ISSUES, FINDINGS, AND
CORRECTIVE ACTIONS FOR
SUBCATEGORY 25000

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

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 215.1 - Seismic Criteria **********		
SQN	SQN	SQN
a. SQN is on an earthquake fault that runs from Chattanooga to Knoxville.	a. The Sequoyah Nuclear Plant is located in an area with several thrust faults, which trend northeast-southwest. None of these thrust faults are considered earthquake faults (i.e., faults capable of producing significant earthquakes which could adversely affect the Sequoyah Nuclear Plant).	a. No corrective action is required.
b. Plant structures could fail in an earthquake.	b. TVA investigations of the geology, seismology, and geotechnical engineering conditions as presented in FSAR Update, Section 2.5 through Amendment 3 have thoroughly examined the subject and have concluded that the seismic response spectra used in the design for Sequoyah are adequate to ensure safe shutdown of the plant. In the SER through Supplement 6, the NRC has concluded that: o The present design basis for SQN is adequate to withstand the effects of earthquakes without loss of capability to perform the required safety functions. o The seismic category I structures are acceptable for seismic loadings calculated on the basis of the 84th percentile site-specific response spectra and meet the objective of SRP Section 3.7.	b. No corrective action is required.
WBN	WBN	WBN
a. WBN is on an earthquake fault that runs from Chattanooga to Knoxville.	a. The Watts Bar Nuclear Plant is located in an area with several thrust faults which trend northeast-southwest. These thrust faults are not considered earthquake faults (i.e., faults capable of producing significant earthquakes which could adversely affect the Watts Bar Nuclear Plant).	a. No corrective action is required.
b. Plant structures could fail in an earthquake.	b. TVA investigations of the geology, seismology, and geotechnical engineering conditions as presented in the FSAR, Section 2.5 through Amendment 54 have thoroughly examined the subject and have concluded that the seismic response spectra used in the design for Watts Bar are adequate to ensure safe shutdown of the plant.	b. No corrective action is required.

Issues	Findings	Corrective Actions

Element 215.1 - WBN (Continued)

In the WBN SER through Supplement 4, the NRC has concluded that based on review comparison of the geology, seismology, and structural similarities of WBN and SQN, TVA has provided the staff with all information necessary to evaluate, assess, and support TVA's conclusions concerning the safety of the Watts Bar site.

In the SQN SER through Supplement 6, the NRC has concluded that:

- o The present design basis for SQN is adequate to withstand the effects of earthquakes without loss of capability to perform the required safety functions.
- o The SQN seismic Category I structures are acceptable for seismic loadings calculated on the basis of the 84th percentile site-specific response spectra and meet the objective of Standard Review Plan (SRP) Section 3.7.

BFN

(N/A)

BLN

(N/A)

BFN

(N/A)

BLN

(N/A)

BFN

(N/A)

BLN

(N/A)

****
Element 215.2 - Cut Rebar Control
****

SQN

a. Cutting of rebar in reactor containment and the crane walls inside the reactor building could have weakened the structure.

SQN

a. The issue that cutting of rebar in reactor containment and the crane walls inside the reactor building could have weakened the structure is a valid issue that needs to be addressed. The evaluation team, however, could not determine if such cutting has adversely weakened the structure because of the lack of procedural controls and cumulative assessments implemented by TVA.

SQN

a. TVA's corrective action plan (CAP) assesses cut rebar to ensure structural integrity of concrete members in general and of the Reactor Building shield wall and crane wall in particular. This CAP addresses [illegible] during commercial operation of the plant). Present, and future assessment of cut rebar. This CAP, along with that for Seismic Category I Element Reanalysis of "Hanger Loads on Structures," constitute the total action to evaluate the effect of cut rebar and takes into consideration

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Issues	Findings	Corrective Actions

Element 215.2 - SQN (Continued)

the reduction of member capacity as well as increases due to additional hanger loads. This CAP is for both pre restart and post restart activities.

Pre Restart

These activities will include reviews, evaluations, and criteria changes or hardware fixes as required. In addition, plant procedures will be revised and developed to describe the process for review, approval, and documentation of cut rebar.

Reactor Building

Cut rebar within the Reactor Building will be documented by a series of IVA memoranda during the construction phase of SQN prior to plant turnover to operational personnel. A baseline map of these cuts will be developed based on this information and in-plant inspection to form a basis for the assessment of the cumulative effects of rebar cuts. As the Reactor Building shield wall and crane wall are specifically noted in the employee concern and are the structural features most likely to be significantly affected by cut rebar, they have been selected for detailed evaluation prior to plant restart. The evaluation team considers the selection of these two walls to be appropriate for the reasons stated above.

A field walkdown will be made to verify general consistency between the baseline map and the as-built plant configuration for these walls.

Issues	Findings	Corrective Actions

Element 215.2 - SQN (Continued)

These walls will then be evaluated for combined effects of cut rebar (215.2) and hanger loads (215.6) to ensure and document that they meet the design criteria and FSAR commitments.

Auxiliary Building Slabs

TVA has reviewed the floor slabs of Category I structures at SQN and has concluded that Auxiliary Building floor elevations 714, 734, and 749 are the most critical slabs for evaluating cut rebar as they are sized for the prescribed loadings rather than shielding and are most likely to have cut rebar. The evaluation team concurs with this selection for the reasons stated and because these slabs represent the majority of Auxiliary Building slabs which are typically the most heavily loaded and reinforced slabs and are susceptible to have cut rebar.

TVA will compare drawings of SQN and WBN to utilize WBN completed cut rebar data. A general field walkdown of SQN will be made to verify data compatibility and make data modifications as necessary. This approach will establish a gross percentage of cut rebar and location for use in the detailed assessment to ensure and document conformance to design criteria and FSAR commitments. If the results of this first assessment do not meet these requirements, the analytical techniques will be refined, the applicable floor live load will be lowered or hardware [illegible] provided. However, results of TVA's evaluations to date, though not finalized, indicate favorable results. Thus there is reasonable assurance that this assessment is a documentation effort rather than a structural integrity issue. This is consistent with evaluation team experience on other nuclear power plant applications.

Issues	Findings	Corrective Actions
Element 215.2 - SQN (Continued)		Auxiliary Building Structural Walls TVA reviewed the structural walls of the SQN Auxiliary Building for the most critical structural elements and selected the U-line wall between columns A13 and A15 for detailed evaluation. This wall has heavy loads magnified by the seismic events and is most likely to have cut rebar. The evaluation team concurs with this selection for the reasons stated. TVA will compare drawings of SQN and WBN to utilize WBN completed cut rebar data. A field walkdown of SQN will be made to verify data compatibility and make data modifications as necessary. This approach will establish a gross percentage of cut rebar for use in the detailed assessment to ensure and document conformance to design criteria and FSAR commitments. If the results of this first assessment do not meet these requirements, analytical techniques will be refined, hardware fixes will be provided and additional walls will be assessed. Auxiliary Building Shield Walls TVA reviewed the shield walls of the SQN Auxiliary Building and found that there are approximately 240 walls in ten size groupings of such walls from 12 inches thick up to 80 inches thick and greater. The majority of the walls are in the larger size groupings with approximately 173 are 24 inches thick or greater. TVA will base the critical shield wall for each size grouping on boundary conditions, spans, and loadings. For each critical wall of each size, TVA will use the same process as described for structural walls.

Issues	Findings	Corrective Actions

Element 215.2 - SQN (Continued)

The evaluation team concurs with this selection and evaluation process. However, the evaluation team cannot reach any general conclusions as to the results of this process except to note that previous experience indicates that relatively thicker walls generally become a documentation effort rather than a structural integrity issue. Thinner walls may be both.

Post Restart

TVA SQN will perform a detailed review of WBN cut rebar data and evaluations because of extensive plant similarities and because this activity is complete for WBN. This review will be performed for Category I structural elements other than the Auxiliary Building floor slabs for which an adequate data baseline will have been completed during prerestart activities, and the Reactor Building for which the rebar pattern of SQN differs from that for WBN. The baseline for these other structural elements will be based on available SQN data in addition to the WBN data. For the Reactor Building additional information will be gathered for cut rebar after building turnover to plant operations. All such gathered information will be formally documented, evaluated in a manner as described for prerestart activities, and used as a basis for future cut rebar requests.

COMPLETED 8/87

Issues	Findings	Corrective Actions
Element 215.2 - SQN (Continued)		
		TVA will also revise the SQN FSAR to clarify Section 3.8 on the use of later ACI code editions which contain newer design or assessment methodologies which are appropriate for use in cut rebar and change-out evaluations. This revision will [illegible] with design criteria [illegible]. TVA will base evaluation of future rebar cut requests on procedures developed during the prerestart effort and will document such information on calculations and design drawings. (CAID 215 02 SQN 01)
b. There are over 2,000 known releases for core drills.	b. The issue that there are over 2000 known releases for core drills is a valid issue that needs to be addressed. The evaluation team, however, could not determine the extent of rebar cutting that has taken place or adversely weakened the structure because of the lack of procedural controls and cumulative assessments implemented by TVA.	b. Same as "a" above.
c. Procedural control/assessment of cut rebar to ensure structural integrity of concrete is in question.	c. o No documented procedure or program for processing, evaluating, documenting, and controlling cut rebar was found within SQN DNE. o Rebar cuts during the construction phase of SQN (pre-1982) are not included on the cumulative assessment of the effects of rebar cuts. o Administrative Instruction AI-17, "Drilling, Cutting, Chipping and Excavating" release form does not require review by a Civil Engineer prior to concrete excavation. AI-17 does not require prior DNE/OE approval for cutting reinforcing steel or caution against cutting without it. o Neither Administrative Instruction AI-17 nor [illegible] Additions Instruction MSAI-10 [illegible] which provides [illegible] requirements for [illegible] procedure or instruction which addresses how such [illegible] approval is obtained, [illegible] other.	c. Existing plant procedures MSAI-6, MSAI-10, MSAI-21, and AI-17 will be [illegible] to [illegible] between [illegible] and DNE to ensure that cut rebar are reported to DNE for its subsequent evaluation. A new documented procedure for processing, evaluating, documenting and controlling cut rebar will be developed by SQN DNE. (CAIDs 215 02 SQN 01 and 215 02 SQN 02)

THIS ITEM PARTIALLY COMPLETED AT SQN DATE: 7-8-87

THIS ITEM COMPLETED DATE: 8-28-88

21502-SQN-02 ONLY

THIS ITEM PARTIALLY COMPLETED AT SQN DATE: 7-8-87

Issues	Findings	Corrective Actions
Element 215.2 - WBN	WBN	WBN
a. Cutting of rebar in reactor containment and the crane walls inside the reactor building could have weakened the structure.	a. The issue that cutting of rebar in reactor containment and the crane walls inside the reactor building could have weakened the structure has been addressed by TVA. TVA has documented individual cut rebar by use of Quality Control Procedure WBNP-QCP 1.7 and the FCR/ECN/NCR process, and has satisfactorily assessed the cumulative effects of such cut rebar in concrete calculations.	a. No corrective action is required.
b. There are over 2,000 known releases for core drills.	b. Since the start of construction there are approximately 1,400 bar cuts in both Unit 1 and 2 Reactor Buildings. Each has been investigated and they do not impair the structural integrity of the reactor building concrete structures.	b. No corrective action is required.
c. Procedural control/assessment of cut rebar to ensure structural integrity of concrete is in question.	c. TVA has an effective program to control and document rebar cuts. This TVA program is in place and in use. In addition, based on their inspections, the NRC has concluded that the design evaluation program, as established, is adequate to ensure structural integrity.	c. No corrective action is required.
BFN	BFN	BFN
a. Cutting of rebar in the Reactor Building could have weakened the structure.	a. The issue that cutting of rebar in the Reactor Building could have weakened the structure is a valid issue that needs to be addressed. The evaluation team, however, could not determine if such cutting has adversely weakened the structures because of the lack of procedural controls and cumulative assessments by TVA.	a. The subject CAP as transmitted by TCAQ-[illegible] and 459, both dated 07/26/37, responds to Corrective Action Tracking Documents 215 07 BFN 01, 215 06 BFN 01, and 215 06 BFN 02 and commits TVA to the following actions: TVA, with the help of a consulting engineering organization, has committed to the following corrective action plan (CAP) to comply with the design requirements. The CAP will assess cut rebar effects, along with the cumulative effects of hanger loads, to ensure structural integrity of as-built class 1 concrete elements. This CAP will also establish effective procedural controls to monitor future rebar cutting and future additional hanger loads. The initial plan is for Unit 2; Units 1 and 3 will be evaluated later, but prior to their respective restarts.

Issues	Findings	Corrective Actions
Element 215.2 - BFN (Continued)		TVA will review the original design calculations, which used the "working stress" design method and will use, as necessary, the alternate "ultimate strength" design method and the revised moment distribution method permitted by later versions of American Concrete Institute (ACI) codes. The current FSAR will be revised, as necessary, to document these aspects of new design. A sampling program will be performed to establish a reasonable assurance that the as-built concrete elements subjected to cut rebar and hanger loads satisfy design requirements. The representative sample of 64 or 10% of the total, whichever is less, will be biased toward worst case, and the sampling program will be in accordance with the applicable methodology sections of Nuclear Construction Issues Group (NCIG) - 02, "Sampling Plan for Visual Reinspection of Welds." The selected slabs and walls will be the most unfavorable structural elements. They will have relatively large span-to-thickness ratios and numerous hangers supporting piping, cable trays, conduits, and HVAC ducts. TVA will compile cut rebar information based on the available cut rebar reports and marked-up prints. Based on the revision history of drawings, TVA will also identify openings and hangers added since the initial construction. TVA will perform field walkdowns to verify general consistency between the documented data and the as-built plant configuration. When data is incomplete, conservative assumptions will be made.

Issues	Findings	Corrective Actions
Element 215.2 - BFN (Continued)		
		TVA will perform detailed calculations on these elements. It will consider cut rebars and the cumulative effects of hangers, in addition to all other design loads, such as seismic, tornado depressurization, and pipe break loads. Correct hanger loads/reactions to concrete elements based on the as-built conditions will be either calculated or obtained from other groups. For the selected samples, calculations will be prepared to verify the structural adequacy of the concrete elements under applicable loading conditions. Should a condition of overstress develop, TVA will perform a thorough evaluation of the extent of the condition and will design a modification to ensure structural adequacy. (CAID 215 02 BFN 01)
b. There are an unknown number of releases for core drills at BFN.	b. The issue that there are an unknown number of releases for core drills at BFN is a valid issue that needs to be addressed. The evaluation team, however, could not determine the extent of rebar cutting that has taken place or adversely weakened the structure because of the lack of procedural controls and cumulative assessments by TVA.	b. Same as "a" above.
c. Procedural control/assessment of cut rebar to ensure structural integrity of concrete is in question.	c. There is no documented procedure or program for processing, evaluating, and controlling cut rebar. Also, there are no assessment calculations of Class I concrete elements for cut rebars other than the recent calculation on N-line wall of the Reactor Building. TVA Division of Nuclear Engineering is developing a program for cut rebar evaluation for BFN. This proposed assessment program will incorporate updated as-built hanger loads and include a procedure for the evaluation of future cut rebar and additional hanger loads on structures (element 215.6 for Browns Ferry).	c. Plant procedures will be developed to ensure coordination between plant operations and DNE and to require cognizant concrete design engineers to monitor and control rebar cutting and hanger attachment loads. (CAID 215 02 BFN 01)

Issues	Findings	Corrective Actions
Element 215.2 - BLN	BLN	BLN
a. Cutting of rebar in the Reactor Building could have weakened the structure.	a. Cutting of rebar in the Reactor Building could weaken the structure. The evaluation team could not determine if such cutting has weakened the structure because of the lack of detailed calculations for cumulative assessment by TVA.	a. TVA has committed to the following corrective action plan (CAP) to comply with the design requirements. The CAP will assess cut rebar effects, along with the cumulative effects of hanger loads, to ensure structural integrity of as-built Category I concrete elements. This CAP will also establish effective procedural controls to monitor future rebar cutting and future additional hanger loads. BLN project civil group will complete this effort in two stages of analysis, current analysis and final analysis in accordance with CAQR BLN 870073. The current effort will be performed in the near future, and the final effort will be completed prior to BLN unit 1 fuel loading. Because the unit 1 fuel loading date is approximately five years away, TVA will perform the required activities during the appropriate stage. TVA will compile cut rebar information based on the available "drilling releases" generated by construction due to FCRs, NCRs, and ECNs and place the data on drawings. TVA will perform field walkdowns to verify consistency between the documented data and the as-built plant configuration. When the data is incomplete, conservative assumptions will be made. TVA will select critical concrete elements to ensure that all the elements are structurally adequate. They will have relatively large span-to-thickness ratios and numerous hangers supporting piping, cable trays, conduits, and HVAC ducts. TVA will analyze these elements in detail. It will consider cut rebars and the cumulative effects of hangers, in addition to all other design loads, such as seismic, tornado depressurization, and pipe break loads.

Issues	Findings	Corrective Actions
Element 215.2 - BLN (Continued)		
		Correct hanger loads/reactions to concrete elements based on the as-built conditions will be either calculated or obtained from other groups. If a condition of overstress develops in this analysis, TVA will perform a thorough evaluation of the extent of the condition and will design a modification to ensure structural adequacy of the concrete elements. As a part of an as-built evaluation, TVA will address all floor slabs as to their reserve live load capacity in accordance with Section 3.10.5 of BLN Design Criteria N4-50-0702. (CATD 215 02 BLN 01)
b. There are an unknown number of releases for core drills at BLN.	b. There are an unknown number of releases for core drills at BLN. The evaluation team, however, could not determine the extent of rebar cutting that has taken place or that has weakened the structure, because of the lack of procedural controls before 05/78 and the incompleteness of drawing records by TVA.	b. Same as "a" above.
c. Procedural control/assessment of cut rebar to ensure structural integrity of concrete is in question.	c. TVA has an effective program to control and document rebar cuts in the field. However, there is no documented procedure by DNE for processing, evaluating, and controlling cut rebar. Also, assessment calculations of Category I concrete elements for cut rebar are not complete.	c. Plant procedures will be developed to ensure coordination between Construction and DNE and to require cognizant concrete design engineers to monitor and control rebar cutting and hanger attachment loads. The procedure will address receipt of data from Construction, method of tracking by DNE, placing of data on drawings, and analysis of concrete members for reinforcing bar cuts. The procedure will also address the review and approval of future hanger attachments (loads of which may exceed a threshold value) to concrete elements and their continuous tracking. (CATD 215 02 BLN 01)
d. Peripheral finding.	d. In addition, the evaluation team found that NRC Unresolved Items 438/82-10-01 and 439/82-10-01 remain open.	d. NRC 1982 Unresolved Items 438/82-10-01 and 439/82-10-01 will be resolved and closed with appropriate correspondence transmitted to NRC. (CATD 215 02 BLN 01)

Issues	Findings	Corrective Actions
********** Element 215.3 - Radiation Shielding Seismic Analysis **********		
SQN	SQN	SQN
(N/A)	(N/A)	(N/A)
WBN	WBN	WBN
a. Need generic seismic analysis of radiation shielding to expedite installation.	a. The evaluation team finds that this issue is the cost-effectiveness of radiation shielding used during plant operation and maintenance to protect workers from piping-originated source terms. A generic seismic analysis of this type of radiation shielding is not practical due to the many variables associated with each case.	a. No corrective action is required.
b. Present case-by-case approach is too costly.	b. The evaluation team finds that TVA is actively involved in improving the cost-effectiveness of its existing case-by-case evaluations of its radiation shielding program.	b. No corrective action is required.
BFN	BFN	BFN
(N/A)	(N/A)	(N/A)
BLN	BLN	BLN
(N/A)	(N/A)	(N/A)

Issues	Findings	Corrective Actions
********** Element 215.4 - Turbine/Service Building Roofing **********		
SQN	SQN	SQN
(N/A)	(N/A)	(N/A)
WBN	WBN	WBN
a. Turbine and service building roofing was not properly designed, has been replaced once, and is still leaking.	a. The evidence shows that both the original roof and the reroofing were designed in accordance with the TVA specifications and industry standards and there is no justification of the CI's statement that the "Roofing on Turbine and Service Buildings [is] not properly designed." The original roof had leaks. However, these leaks do not appear to be caused by improper design but by poor workmanship and damage from uncontrolled heavy foot traffic during construction. Protective boards were provided in foot traffic areas. This provision will mitigate leakage from foot traffic on walkways. Since construction is now complete, access to the roof is limited and controlled.	a. No corrective action is required.
BFN	BFN	BFN
(N/A)	(N/A)	(N/A)
BLN	BLN	BLN
(N/A)	(N/A)	(N/A)
********** Element 215.6 - Hanger Loads on Structures **********		
SQN	SQN	SQN
a. Structural integrity of concrete walls and slabs in the annulus area of the Unit 2 Reactor Building is questionable due to excessive number of hangers.	a. TVA DNE, at present, has not completed assessment calculations to establish structural integrity of concrete walls and slabs in the annulus area of the Unit 2 Reactor Building by considering all hanger loads. Therefore, the issue of structural integrity is valid.	a. To comply with the design requirements, TVA has committed to the following corrective action plan (CAP).

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AT SQN DATE: 7-8-87

Issues	Findings	Corrective Actions

Element 215.6 - SQN (Continued)

IVA is presently comparing the final as-built hanger loads with the assumed loads used during the earlier design process for various Category I floor slabs. These selected slabs are the most unfavorable structural elements having relatively large span-to-depth ratios and with numerous hangers supporting piping, cable trays, conduits, and HVAC ducts. IVA will perform detailed calculations on these elements and will consider cumulative effects of hangers in addition to all other design loads. Hanger load data will be compiled by reviewing drawings and calculations and by performing field walkdown inspections.

The effects of shrinkage on structural strength of slabs will also be evaluated and incorporated in the final analysis. This slab assessment is nearly complete and indicates that TVA had originally designed concrete structures sufficiently and conservatively so that addition of as-built hanger loads does not impair the structural integrity of the slabs. The results of this assessment of the most unfavorable elements should provide reasonable assurance that all Category I concrete structures satisfy SQN's FSAR commitment.

Further, IVA will also select most unfavorable structural walls and shielding walls for cumulative effects of as-built hangers and supporting bars in addition to other design loads. The selected walls will include shield wall and crane wall in the annulus area of the Reactor Building as identified in the employee concerns. The "D" line wall of the Auxiliary Building will also be included since, in addition to other design loads, it is also subjected to tornado depressurization and pipe break loads.

Issues	Findings	Corrective Actions
Element 215.6 - SQN (Continued)		
		Structural assessment of the selected walls will be performed in detail similar to that outlined for the slabs. IVA has committed to establishing that the actual design stresses are less than the allowable stresses. If necessary, design modifications will be issued to meet the FSAR design commitment and sample sizes will be increased to establish an appropriate confidence level. The results of the assessment of the most unfavorable walls should provide reasonable assurance that all Category I concrete walls meet the SQN FSAR commitment. IVA's CAP as described will meet its FSAR commitment for the Category I concrete structures at SQN. The evaluation team, therefore, concludes that the stated CAP is an acceptable resolution of the concerns and should also preclude their recurrence. (CAID 215 06 SQN 01)
b. Design calculations have not evaluated individual and cumulative effects of hangers on concrete walls and slabs.	b. IVA design calculations have not evaluated all individual and cumulative effects of hangers on concrete walls and slabs of Category I structures. An assessment is currently either in the planning stage or in progress, and some calculations are being finalized. The assessment, when final, will determine the adequacy of the structures. Thus, the issue of design calculations is valid.	b. Same as "a" above.

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Issues	Findings	Corrective Actions
Element 215.6 - SQN (Continued)		
c. Peripheral finding.	c. SQN FSAR Sections 3.8.4.3.2 and 3.8.4.4.1 as well as Tables 3.8.3-1 and 3.8.4-1 for Category I concrete design commit to ACI 318-63 code using the working stress design method. Moreover, [illegible] 3.8.4.3.2 state that, "In some instances, [illegible] of the latest documents were used where design safety was not compromised." SQN's current assessment program, however, uses the ultimate strength design method and the ACI 318-77 code. Therefore, the FSAR and the final design basis are not in agreement at present. TVA plans to revise the FSAR to clarify TVA's position.	c. As a post-restart item, TVA will revise Section 3.8 of the FSAR to incorporate the ultimate strength design method used for the assessment of Category I concrete structures. Moreover, TVA will identify in the FSAR the latest code used in the final calculations. (CATD 215 06 SQN 03)
d. Peripheral finding.	d. A definitive procedure/program to formally coordinate and evaluate final hanger loads due to piping, raceways, and ductwork, etc., imposed on concrete structures under various loading conditions has not been found. Local load transfer at points of attachment is generally evaluated; however, cumulative effects of attachments as well as the effects of cut rebars need to be evaluated for concrete floors, walls, and partitions. DNE Procedure NEP-5.2 defines general requirements for interfacing and detailed step-by-step procedures to follow. However, 47A050 series drawings covering mechanical seismic supports, or similar document(s), do not have specific notes requiring coordination of hanger support reactions with other engineering groups.	d. TVA will revise all applicable plant procedures to require DNE-CEB review of significant [illegible] attachment loads. Additionally, TVA will issue a new engineering procedure for SQN to ensure interface review of cumulative hanger attachment loads by the cognizant concrete design engineers. (CATD 215 06 SQN 02)
WBN	WBN	WBN
a. Structural integrity of concrete walls and slabs in the annulus area of the Unit 2 Reactor Building is questionable due to excessive number of hangers.	a. At present, WBN has not completed assessment calculations to establish structural integrity of concrete walls and slabs in the annulus area of the Unit 2 Reactor Building by considering all hanger loads.	a. To comply with the design requirements, TVA has committed to the following corrective action plan (CAP). TVA is presently comparing the final as-built hanger loads with the assumed loads used during the earlier design process for various Category I floor slabs. The selected slabs are the most unfavorable structural elements having relatively large span-to-depth ratios and with numerous hangers supporting piping, cable trays, conduits, and HVAC ducts. TVA will perform detailed calculations on these elements and will consider

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Issues	Findings	Corrective Actions

Element 215.6 - WBN (Continued)

cumulative effects of hangers in addition to all other design loads. Hanger load data will be compiled by reviewing drawings and calculations and by performing field walkdown inspections. The effects of cut rebar on structural strength of slabs will also be incorporated in the final analysis. The slab assessment performed to date indicates that TVA had originally designed concrete structures sufficiently and conservatively so that addition of as-built hanger loads should not impair the structural integrity of the slabs. The results of this assessment of the most unfavorable elements should provide reasonable assurance that all Category I concrete slabs meet WBN FSAR commitments.

Further, TVA will assess selected most unfavorable structural walls and shielding walls for cumulative effects of as-built hangers and cut reinforcing bars in addition to other design loads. The selected walls will include shield wall and crane wall between azimuths 292° and 358° in the annulus area of the Reactor Building as identified in the employee concern. The "U" line wall of the Auxiliary Building will also be included since, in addition to other design loads, it is also subjected to tornado depressurization and pipe break loads.

Structural assessment of the selected walls will be performed in detail similar to that outlined for the slabs. TVA has committed to establishing that the actual design stresses are less than the allowable stresses. If necessary, design modifications will be issued to meet the FSAR design commitment and sample sizes will be increased to establish an appropriate confidence level. The results of this assessment of the most unfavorable wall elements should provide reasonable assurance that all Category I concrete walls meet the WBN FSAR commitment.

Issues	Findings	Corrective Actions
Element 215.6 - WBN (Continued)		
		TVA's CAP as described will meet its FSAR commitment for the Category I concrete structures at WBN. The evaluation team, therefore, concludes that the stated CAP is an acceptable resolution of the concerns and should also preclude their recurrence. (CATD 215 06 WBN 01)
b. Design calculations have not evaluated individual and cumulative effects of hangers on concrete walls and slabs.	b. WBN design calculations have not evaluated cumulative effects of hangers on concrete walls and slabs of Category I structures. An assessment is currently in progress with calculations being finalized for SQN. Because the plants are similar, the final SQN assessment will then be a basis for WBN. The WBN assessment, when final, will determine the adequacy of the structures.	b. Same as "a" above.
c. Peripheral finding.	c. In addition, during the investigation, the evaluation team found that WBNP FSAR Sections 3.8.4.2.2 and 3.8.4.4.1 as well as Tables 3.8.3-1 and 3.8.4-1 for Category I concrete design commit to ACI 318-63 and 318-71 codes using the working stress design method. Moreover, Sections 3.8.3.? and 3.8.4.2 state that, "In some instances, later revisions of the listed documents were used where design safety was not compromised." WBN's current assessment program, however, uses the ultimate strength design method and the ACI 318-77 code. Therefore, the FSAR and the final design basis are not in agreement at present.	c. TVA will also revise Section 3.8 of the FSAR to incorporate the ultimate strength design method used for the assessment of Category I concrete structures. Moreover, TVA will identify in the FSAR the later ACI code used in the final calculations. (CATD 215 06 WBN 03)
d. Peripheral finding.	d. Evaluation of Employee Concerns for cut rebar (element 215.2 for Watts Bar) has stated that TVA has an effective program to control and document rebar cuts in Category I concrete structures. But a definitive integrated procedure/program has not been found to formally coordinate and evaluate final hanger loads due to piping, raceways, and ductwork, etc., imposed on concrete structures under various loading conditions. Local load transfer at points of attachment has been generally evaluated; however, cumulative effects of attachments combined with the effects of cut rebar have not been evaluated for concrete floors and walls.	d. TVA will revise applicable plant procedures to require ONE-CEB review of significant hanger attachment loads. Additionally, TVA will write a new engineering procedure for WBN to ensure interface review of cumulative hanger attachment loads by the cognizant concrete design engineers. (CATD 215 06 WBN 02)

Issues	Findings	Corrective Actions
Element 215.6 - WBN (Continued)		
	DNE Procedure NEP-5.2 defines general requirements for interfacing and gives detailed step-by-step procedures to follow. However, 47A050 series drawings covering mechanical seismic supports, or similar document(s), do not have specific notes requiring coordination of hanger support reactions with Civil Design Section.	
BFN	BFN	BFN
a. Structural integrity of concrete walls and slabs in the Reactor Building is questionable due to excessive number of hangers.	a. TVA DNE BFN, at present, has not completed assessment calculations to establish structural integrity of concrete walls and slabs in the Reactor Building and other Category I structures by considering all hanger loads.	a. Same as "a" for element 215.2 for BFN, "Cut Rebar Control." (CATD 215 06 BFN 01)
b. Design calculations have not evaluated individual and cumulative effects of hangers on concrete walls and slabs.	b. TVA design calculations have not evaluated all individual and cumulative effects of as-built hangers on concrete walls and slabs of Category I structures.	b. Same as "a" for element 215.2 for BFN, "Cut Rebar Control." (CATD 215 06 BFN 01)
c. Peripheral finding.	c. In addition, a definitive procedure/program has not been found to formally coordinate and evaluate final hanger loads imposed by piping, raceways, and ductwork, etc., on concrete structures under various loading conditions. Local load transfer at points of attachment has been generally evaluated; however, cumulative effects of attachments as well as the effects of cut rebar need to be evaluated for concrete floors, walls, and partitions. DNE Procedure NEP-5.2 defines general requirements for interfacing and detailed step-by-step procedures to follow. However, 47B435 series drawings covering mechanical seismic supports, or similar document(s), do not have specific notes requiring coordination of hanger support reactions with other engineering groups.	c. Same as "c" for element 215.2 for BFN, "Cut Rebar Control." (CATD 215 06 BFN 02)
BLN	BLN	BLN
a. Structural integrity of concrete walls and slabs in the Reactor Building is questionable due to excessive number of hangers.	a. TVA DNE BLN, at present, has not completed assessment calculations to establish structural integrity of concrete walls and slabs in the Reactor Building and other Category I structures by considering all hanger loads. There is no evidence of a tracking activity for this completion.	a. Same as "a" for element 215.2 for BLN, "Cut Rebar Control." (CATD 215 06 BLN 01)

Issues	Findings	Corrective Actions
Element 215.6 - BLN (Continued)		
b. Design calculations have not evaluated individual and cumulative effects of hangers on concrete walls and slabs.	b. TVA design calculations have not evaluated all individual and cumulative effects of as-built hangers on concrete walls and slabs of Category I structures.	b. Same as "a" for element 215.2 for BLN, "Cut Rebar Control." (CATD 215 06 BLN 01)
c. Peripheral finding.	c. In addition, a definitive procedure/program is not available to formally coordinate and evaluate final hanger loads imposed by piping, raceways, and ductwork, etc., on concrete structures under various loading conditions. Local load transfer at points of attachment has been generally evaluated; however, cumulative effects of attachments as well as the effects of cut rebar need to be evaluated for concrete floors, walls, and partitions. DNE Procedure NEP-5.2 defines general requirements for interfacing and detailed step-by-step procedures to follow. However, drawings covering seismic supports do not have specific notes requiring coordination of hanger support reactions with other engineering groups.	c. Same as "c" for element 215.2 for BLN, "Cut Rebar Control." (CATD 215 06 BLN 02)
********** Element 215.7 - Auxiliary Building Crane Service **********		
SQN	SQN	SQN
(N/A)	(N/A)	(N/A)
WBN	WBN	WBN
a. The TVA design organization does not fully appreciate the importance of field engineering to implement the design.	a. TVA memo from Cantrell and Bonine to Those Listed (11/23/84) received wide distribution throughout TVA's engineering and construction organizations, and established policy to clearly define the role and responsibilities of the two organizations. Temporary construction needs have been coordinated between the two organizations as indicated by details shown in drawing 4wM502-5.	a. No corrective action is required.
b. The auxiliary building 125-ton crane can only set a load on two out of five floors.	b. TVA Specification 2120 clearly defines the design requirements for the 125-ton auxiliary building crane including both the 125-ton main hook and the 10-ton auxiliary hook. TVA drawings 44N300, R3 and 44N301, R2 show the crane and trolley arrangement and clearance requirements. The main hook is designed to serve three floors at elevations 709'-0", 729'-0", and 757'-0". The hook reaches down to elevation 722'-0" for maneuvering	b. No corrective action is required.

Issues	Findings	Corrective Actions
Element 215.7 - WBN (Continued)		
	the fuel cask in the cask loading area at elevation 709'-0." The auxiliary hook serves five floors at elevations 676'-0", 692'-0", 713'-0", 737'-0", and 757'-0". Although, because of the floor opening design, the auxiliary hook can "set" a load on only two (757'-0" and 676'-0") of the five floors after construction of both units is complete, access to the remaining floors is provided through the use of come-alongs or similar devices and the hatch grating or temporary framing. Preoperational tests have confirmed that the installed 125-ton auxiliary building crane conforms to its design.	
c. On one floor, 3-1/2-inch opening grating has been used, which is only rated for 100 psf.	c. The hatch grating rated at 100 psf load that the CI cited in the concern is probably the one located at elevation 692'-0". As shown in drawing 46W502-5 R5, it is now used for temporary construction access. As stated in the TVA memo from Cantrell dated 1/26/85, 1-1/2-inch-thick grating (with approximately 1 by 3-1/2-inch openings) is used during the construction stage for easy access to the lower floor. This grating will carry approximately 100 psf live load based on the 8-foot span. However, the permanent hatch grating size, dimensions, and design live loads are stated in design calculation WBP 840424 024, R1 and drawing 48N1250-1 R6. The permanent plant grating is 2-1/4 inches thick and will support a live load of at least 200 psf. TVA has planned to install the permanent grating at the end of the construction stage.	c. No corrective action is required.
BFN	BFN	BFN
(N/A)	(N/A)	(N/A)
BLN	BLN	BLN
(N/A)	(N/A)	(N/A)

Issues	Findings	Corrective Actions
********** Element 215.10 - Feedwater Heater Monorail Design **********		
SQN	SQN	SQN
a. The structural integrity of hangers for the feedwater heater monorails is questionable.	a. The evaluation team found the hangers for the feedwater heater monorails in the turbine building structurally adequate for the rated load. This was confirmed by other reviews, the load test, and, ultimately, by the successful heater replacement operation.	a. No corrective action is required.
WBN	WBN	WBN
(N/A)	(N/A)	(N/A)
BFN	BFN	BFN
(N/A)	(N/A)	(N/A)
BLN	BLN	BLN
(N/A)	(N/A)	(N/A)
********** Element 215.11 - Floor Sleeve Covers **********		
SQN	SQN	SQN
(N/A)	(N/A)	(N/A)
WBN	WBN	WBN
a. Metal covers need to be installed over floor sleeve foam seals.	a. The concerned employee is possibly concerned that metal covers need to be installed over floor sleeve foam seals in the auxiliary building to preclude a breach of security between Unit 1 and Unit 2 or to eliminate a safety hazard for the workers or permanent operating personnel.	a. To comply with safety requirements, TVA has committed to the following corrective action plans (CAPs).

Issues	Findings	Corrective Actions

Element 215.11 - WBN (Continued)

- The WBN-Physical Security Contingency Plan, R14, states that within the security boundary area between Unit 1 and Unit 2, security grilles are provided for sleeves in accordance with NUREG-908.

- All mechanical floor sleeves in the auxiliary building extend 4 inches above the floor slab unless otherwise noted according to Note 2 of drawing 47W471-1. Therefore, protruding sleeves may create a safety hazard if located along, across, or in aisles and passageways because workers may accidentally trip on the protruding sleeves. According to OSHA Standards, Part 1910 Subpart D 1910.22(b)(1) change 22, aisles and passageways must be kept clear and in good repair, with no obstruction across or in aisles that could create a hazard.

On 02/09/87 and 02/10/87 (IOMs 619 and 627), TVA indicated that Type III sleeve penetration seals are used for spare sleeve penetrations and that personnel should not step on them. TVA has no requirements to use grilles or covers for nonsafeguard sleeves.

TVA-ONE will request Industrial Safety personnel, as a part of the next scheduled quarterly safety inspection in all plant areas, to perform a walkdown of corridors and walkways in accordance with Section V of Hazard Control Instruction (HCI)-G1 to detect any protruding spare floor sleeves in traffic areas that have not been identified as tripping hazards and marked to increase visibility in accordance with Watts Bar Standard Practice WB 9.46, "Warning Colors and Labeling." The quarterly safety inspection is scheduled for 03/23-27/87.

TVA stated that the ability of spare floor sleeve seals to support the weight of a person can be demonstrated by reviewing the results of CEB Report 82-2 (Ref. 59). TVA will perform an engineering evaluation of 10-inch-diameter or larger spare floor sleeves sealed with RTV silicon foam to determine the adequacy of the seal to support the weight of a person. CEB Report 82-2, which documented previous test results to determine the spring rates of RTV foam seals for piping analysis, will be used for the re-evaluation of the [illegible]

TVA will perform a walkdown of the 10-inch-diameter and larger spare floor sleeves to evaluate the need for covers to protect the foam from physical abuse to ensure that the seal will continue to perform its intended safety function.

TVA's CAPs as described will meet its safety requirements. The evaluation team, therefore, concludes that the stated CAPs are an acceptable resolution of the concern and should also preclude recurrence of the findings. (CATDs 215 11 WBN 01 and 215 11 WBN 02)

THIS ITEM PARTIALLY COMPLETED AT WBN DATE 6/9/88

Issues	Findings	Corrective Actions
Element 215.11 - BFN	BFN	BFN
(N/A)	(N/A)	(N/A)
BLN	BLN	BLN
(N/A)	(N/A)	(N/A)
********** Element 227.1 - Pipe Whip Restraint Design **********		
SQN	SQN	SQN
(N/A)	(N/A)	(N/A)
WBN	WBN	WBN
a. Pipe whip restraints (protective devices) in the Unit 1 reactor building have problems, as identified by drawings 47W1700 series.	a. Based on discussion and review and evaluation of documents, the evaluation team finds that: o The problem was identified by TVA during the normal course of work in February, 1981 prior to the initiation of this concern. o The concern indicates that the problems can be identified by examination of drawing series 48W1700 and further indicates that this is a Construction Department concern. Therefore, evaluation team emphasis was given to the changes required to complete construction of the pipe whip restraints. Welding notes 26 through 38 of this drawing series are of a type not commonly provided in civil/structural work unless required to reconcile the as-built condition of the structures with the design requirements. On the basis of review of the associated documentation, the evaluation team found that the problem was limited to welding of pipe whip restraints identified by drawings 14W1700, 48W1701, and 48W1703 series not being in accordance with the design requirements. Subsequent improper inspection and insufficient documentation of welds for these pipe whip restraints resulted from the use of incorrect inspection procedures by the Construction Engineering Department as reflected in NCRs 3001R and 3523 and reported to the NRC under 10CFR50.55(e).	a. No corrective action is required.

Issues	Findings	Corrective Actions
Element 227.1 - WBN (Continued)		
	o The problem was addressed by TVA as described in TVA memos from Cantrell to Wilkins and closed as described in TVA memo from Standifer to Widewitz. o NRC ISE Inspection Reports 50-390/83-27 and 50-391/83-19 indicate that the NRC inspector has reviewed documentation and inspection sheets for NCRs 3001R and 3523 and has found them and the corrective action to be acceptable.	
BFN	BFN	BFN
(N/A)	(N/A)	(N/A)
BLN	BLN	BLN
(N/A)	(N/A)	(N/A)
********** Element 227.2 - Pipe Whip Restraint Design **********		
SQN	SQN	SQN
(N/A)	(N/A)	(N/A)
WBN	WBN	WBN
(N/A)	(N/A)	(N/A)
BFN	BFN	BFN
(N/A)	(N/A)	(N/A)
BLN	BLN	BLN
a. Whip restraints are needed on 36-inch stainless steel decay heat removal (DHR) piping coming from borated water storage tank (BWST).	a. The DHR piping is a moderate energy line. Per FSAR commitments and applicable design criteria, moderate energy lines do not require whip restraints, because the mode of failure does not impose whip loads on the supports.	a. No corrective action is required.

Issues	Findings	Corrective Actions
Element 227.2 - BLN (Continued)		
b. Peripheral finding.	b. The fitting of the BHR piping coming from the BWST at the nozzle location is shown as 30-inch diameter on one drawing, which is a part of the FSAR, and as 30-inch diameter on other design documents, which were used for construction.	b. The subject CAP as transmitted by TCAB-626 dated 08/03/87 responds to Corrective Action Tracking Document 227 02 BLN 01, and commits TVA to a plan for the following actions: 1. Review all BLN safety-related piping-tank interfaces for consistency between the design criteria diagrams and all other pertinent applicable documents. 2. Identify all cases of discrepancy between documents corresponding to the same component. An example of such discrepancy is that the decay heat removal piping interface with the borated water storage tank is shown on the BLN Design Criteria Diagram 3BW0612-ND-01, R13 (BLN FSAR Figure 5.4.7.1) as 36-inch diameter while the other BLN design documents, which were used for construction, show a 30-inch flow diameter (ECTG Report 227 02(B), App. 5.b and 5.h). 3. Evaluate results from paragraph 2. above and correct design documents in accordance with the applicable Nuclear Engineering Procedures (NEPs). TVA's CAP as described will meet its FSAR commitment regarding the design and document control of safety-related components at BLN. The evaluation team, therefore, concludes that the stated CAP is an acceptable resolution of the peripheral negative finding that was identified during the evaluation process, and should also preclude its recurrence. (CAID 227 02 BLN 01)

ATTACHMENT C

REFERENCES

1. Sequoyah Element Report 215.1, "Seismic Criteria," Rev. 0 (12/23/86)

2. Sequoyah Element Report 215.2, "Cut Rebar Control," Rev. 1 (01/20/87)

3. Sequoyah Element Report 215.6, "Hanger Loads on Structures," Rev. 1 (01/15/87)

4. Sequoyah Element Report 215.10, "Feedwater Heater Monorail Design," Rev. 0 (12/02/86)

5. TVA Nuclear Performance Plans:

   Revised Corporate Nuclear Performance Plan, Volume 1, Rev. 4 (03/87)
   Revised Sequoyah Nuclear Performance Plan, Volume 2, Rev. 1 (03/87)
   Browns Ferry Nuclear Performance Plan, Volume 3, Rev. 1 (06/87)
   Watts Bar Nuclear Performance Plan, Volume 4, Draft (03/87)

6. SNP FSAR update through Amendment 3 and WBN FSAR through Amendment 54, Section 2.5, "Geology and Seismology," Section 3.7, "Seismic Design

7. TVA Procedure: Administrative Instruction, AI-17, R10, "Drilling, Cutting, Chipping, and Excavating"

8. Letter from J. M. Taylor, NRC, to S. A. White, TVA, "NRC Reports . . .," [L44 860506 542], (04/22/86)

9. TVA Quality Control Procedure WBNP-QCP 1.7, "Release for Drilling, Chipping, Cutting of, or Welding to Permanent Structures or Components," Rev. 8, [WQA 800922 042]

10. Letter from D. M. Verrelli, NRC, to H. G. Parris, TVA, transmitting NRC Inspection Reports, [no RIMS number], (02/16/84)

11. Letter from R. L. Gridley; TVA, to J. M. Taylor, NRC, "BFN Applicability to SQN Design Deficiencies," [L44 861110 804], (11/10/86)

12. TVA Quality Control Procedure BNP-QCP 10.6, "Work Release," Rev. 18, [C20 860512 457]

13. Letter from F. J. Long, NRC, to H. G. Parris, TVA, "NRC Report. . .," [NEB 820528 220], (05/20/82)

14. TVA memo from J. C. Standifer to D. W. Wilson, [B26 860303 016], (03/03/86)

15. TVA Drawings:

    46W403-1 R6
    46W422-2 R6
    46W422-3 R2

16. TVA SQN, "Design Criteria for Additions after November 14, 1979 - Reinforced Concrete, Structural, and Miscellaneous Steel," SQN-DC-V-1.3.3.1, Rev. 4

17. SQN NCR SQNCEB8403 - Attachments to Reinforced Concrete Partition Walls, [CEB 841113 002], (11/13/84)

18. TVA WBN, "Design Criteria for Additions after July 23, 1979 - Reinforced Concrete, Structural, and Miscellaneous Steel," WBN-DC-20-1.1, Rev. 6

19. WBN NCR WBN WBP 8338 - Live Loads Not Considered in Design of Concrete Partition Walls, [WBP 840214 031], (02/14/84)

20. TVA Engineering Procedure, EN DES-EP 4.04, "Squadcheck Process," Rev. 9

21. TVA BFN Drawing: Reactor Building - Concrete Floor Slab, 41N785, Rev. 11

22. TVA BLN General Design Criteria N4-50-D721, "Design of Civil Structures," Rev. 5

23 TVA memo from R. W. Cantrell and C. Bonine, Jr., "All Nuclear Plants - Responsibilities," [OEN 841123 001], (11/23/84)

24 TVA OE Calculations, SCG-1S5 "Load Tests for the Feedwater Heater Monorails," [B25 850912 805], (09/11/85)

25. Occupational Safety and Health Administration (OSHA) Standards and Interpretations, Part 1910, Subpart D - Walking Surfaces, Section 1910.22(b)(1), Change 22

26. Letter from D. M. Verrelli, NRC, to H. G. Parris, TVA, transmitting I&E inspection reports, [A02 830829 001], (08/25/83)

27. BLN FSAR through Amendment 27, Section 3.6, "Protection Against Dynamic Effects Associated with the Postulated Rupture of Piping"

28. TVA memo from W. D. Touchstone to N. A. Liakonis, [no RIMS number], (05/30/86)

29. Letter from G. L. Parkinson, Bechtel, to G. R. McNutt, TVA, BLT-277, (07/02/87)

30. WBN Safety Evaluation Report (SER), NUREG-0847, issued 06/82, and including Supplements 1 through 4 (03/85)

31. SQN Safety Evaluation Report (SER), NUREG-0011, issued 03/79, and including Supplements 1 through 6 (12/82)

32. Nuclear Safety Review Staff (NSRS) Report I-86-110-SQN (03/03/86)

33. TVA calculation [WBP 830923 027], Sheets 1-17 and 17A (General Criteria) - "Rebar Cuts - Book I - Auxiliary and Associated Buildings" and [B41 860425 950], Sheets 1-17 and 17A - "Rebar Cuts - Book III - Auxiliary Building, Control Building, Reactor Building and Diesel Generator Building"

    TVA calculation [WBP 830923 027], Sheets 2, 35, 36, 37, 211 and 212 (Detail Evaluations) - "Rebar Cuts - Book I - Auxiliary and Associated Bldgs"

    TVA calculation [B41 860425 950], for FCR 3461 R1 [C24 850327 300] and NCR 5950 [B26 850301 054] relating to TVA drawing 41W722-4

    TVA Drawings

    - 41N319-4, R8, "Floor El 729.0 and 737.0"
    - 41W722-4, R10, "Crane Wall"

    TVA Engineering Change Notices

    - 3130, R12 [WBP 850130 508]
    - 5508, R10 [b26 860212 503]

    TVA calculation [B41 860522 954] - "Program for Documenting Reinf. Bar Cuts and Damage to Bars"

34. TVA FCRs:

    - SNP FCR 3923 and ECN L5599. (Reference from memo J. P. Vineyard to H. B. Rankin, [B25 860321 013]) (03/21/86)
    - SNP FCR 1464 (Ref. from NCR 2836, [SQN 830404 600])

    TVA ECNs:

    - SNP ECN No. L6439 and FCR 4018 [B25 860117 507 and S07 860306 888]
    - SNP ECN No. L6495 and FCR 3915 [B25 860404 517 and S07 851209 989]

Mark Adam's personal log for rebar cut evaluations (Mark is the responsible civil engineer on SQNP for documenting and evaluating cut rebar.)

TVA Drawings:

- SNP Drawings 41N721-1 R18, 41N721-2 R7, 41N721-3 R0, and 41N721-4 R1 (Concrete Crane Wall Outlines)
- SNP Drawings 41N722-1 R8, 41N722-2 R6, 41N722-3 R7, 41N722-4 R2, 41N722-5 R12, 41N722-6 R7, 41N722-7 R3, 41N722-8 R1 (Concrete Crane Wall Reinforcement)
- SNP Drawing Nos. 41N700-1 R6 and 41RS722-1 through -12

35. TVA EN DES Calculation:, "HVAC Duct Penetrations N-Line Wall," [B22 850613 102], (06/13/85)

TVA BFN Drawings:

41N785, R14 "Powerhouse Reactor Building - Units 1 & 2 - Concrete Floor Slab - El. 593.0 & Walls Outline - Sheet 1"

41N786, R16 "Powerhouse Reactor Building - Units 1 & 2 - Concrete Floor Slab - El 593.0 & Walls Outline - Sheet 2"

41N339, R8 "Powerhouse Reactor Building - Unit 2 - Concrete Control Bay - Walls & Slabs Outline - Sheet 1"

41N980, R4 "Powerhouse Reactor Building - Unit 2 - Concrete Bay Walls Reinforcement - Sheet 1"

41N981, R4 "Powerhouse Reactor Building - Unit 2 - Concrete Bay Walls Reinforcement - Sheet 2"

36. TVA BLN drawings:

4GA0055-XI-1, R5 Category I Structures - Damaged Reinforcing Acceptance Criteria

TVA BLN concrete and reinforcement drawings:

4AW0305-XI-1, R25
4AW0307-XI-1, R21
4AW0308-XI-1, R10
4AW0311-XI-1, R22
4AW0312-XI-3, R12
4AW0312-XI-6, R11

4AW0312-XI-15, R11
4AW0315-XI-1, R19
4AW0318-XI-1, R16
4AW0322-XI-1, R17
4AW0323-XI-1, R11
4AW0354-XI-1, R13
4AW0355-XI-1, R9
4AW0358-XI-1, R14

4CW0455-XI-2, R12
4CW0457-XI-1, R10
4CW0461-XI-1, R21
4CW0466-XI-1, R12
4CW0467-XI-6, R6
4CW0469-XI-1, R16
4CW0473-XI-1, R12

4RW0715-XI-2, R7
4RW0725-XI-1, R13
4RW0730-XI-1, R1
4RW0735-XI-1, R11
4RW0761-XI-4, R7
4RW0764-XI-1, R5
4RW0766-XI-1, R1

TVA ON Calculations - BLN units 1 and 2 - "Calculation for Reinforcement Cuts," 4XI-RECUT-I, R1, [821 861029 201], (12/23/86), selected calculations for FCRs 0-4849, 0-4881, 0-4887, and 0-4903

TVA ONE Calculations - BLN - Reinf. Cuts by Work Releases - Auxiliary Building Slab El. 629.0 D4 RECUAN i2 [no RIMS number], 5 sheets

37. "Information about Silicon RTV Foam," "Form 61-320C-82, Dow Corning Corporation, Midland, Michigan, 1982

38. TVA CEB Report 82-2, "Testing of Silicon Foam Seals," RO [CEB 820408 005], (04/08/82)

39. Drawing series 48W1700 sheets 1 through 30 for MS and FW line rupture restraints inside containment

Documents resulting in revisions to drawing series 48W1700 sheets 1 through 30 are listed below:

Sht. 1, ECN 2707 [SWP 810508 510]
Sht. 2, ECN 1633 [SWP 780906 053]
Sht. 3, Documents resulting in Rev. 2

Sht. 4, ECNs 3131 [SWP 821026 503], 4376 [WBP 831115 529] and S1 including all FCRs, NCRs, etc., associated with these ECNs. Also FCRs incorporated in Revs. 3, 4, 6, and 7 of this sheet
Sht. 5, ECN 2931 [SWP 810821 518]
Sht. 6, FCR-F-2804 and F-1968
Sht. 7, Copies of NRC bulletin 79-14 discrepanices IR63-0600200-09-01/36P and IR63-0600200-09-01/104P
Sht. 8, FCR-F-2848
Sht. 10, FCRs F-3492, F-2949, F2424, and F-1153
Sht. 11, FCR-F-1948, ECN 2801 [SWP 810325 516]
Sht. 14, ECN 3703 [WBP 830614 507]
Sht. 15, FCRs, F-3261, F-1934, and F-1601
Sht. 16, FCRs, F-1843, F-1885, and F-1626
Sht. 17, FCRs, F-3103, F-3137, F-2821, F-2424, and F-1749
Sht. 18, FCRs, F-1946, F-1783, and F-1688
Sht. 19, FCRs, F-1855, and F-1877
Sht. 20, FCRs, F-3243, F-3088, F-2941, F-2949, F-2593, F-2401, F-1891, F-1684, F-1731, and F-1743
Sht. 21, FCRs, F-3269 R1, F-2659, F-1877, F-1778, and F-1685
Sht. 22, FCR, F-1768 R1
Sht. 23, FCRs, F-2983, F-2940, F-1621, and NRC-3523
Sht. 24, FCRs, F-3209, F-3085, F-2949, F-1796 R1, F-1855, F-1703, F-1753, F-1641, F-1655, F-1558, and F-1505
Sht. 25, FCR, F-1766 R1
Sht. 26, FCRs, A-10454, F-1662, and F-1621
Sht. 27, FCRs, F-3219, F-3061, F-2973, F-2974, F-2420 R1: F-1871 R1; F-1850, F-1711, and F-1505
Sht. 28 FCR's, F-1984, F-1547, and F-1572
Sht. 30 F-3009, F-2644, F-2680, and F-2780

40. TVA memo from J. C. Standifer to G. Wadewitz [SWP 821105 163], (11/04/82) transmitting NCR 3001R, R3

Nonconformance Report 3523R - WBN Units 1 and 2 [WBN 810807 136]

41. TVA BLN Drawing: Design Criteria Diagram, Decay Heat Removal System, 3BW0612-ND-01, R13

TVA BLN Drawings: Mechanical Decay Heat Removal System, Series 3AW0412 Drawings ND-02, R10; ND-10, R8; ND-03, R11; ND-05, R14.

ITT Grinnell Sketches, series 1ND-MPHG:

		Revision
		4
	[illegible]s)	TVA 902
	[illegible]s)	TVA 902
0568		TVA [illegible]
		VA [illegible]
0570		
	2 Sheet	TVA 9[illegible]
0572	1	TVA 901
	2	TVA 902
0574	1 (3 Sheets)	4
	2	TVA 901
0577	1	TVA 902
0579	1	TVA 902

TVA BLN Drawings. Concrete, Borated Water Storage Tank Outline, Series 8YW[illegible]319-X1 Drawings 01, R8; 02, R5

4 TVA-EN DES Calculations: Design Calculations for Pipe Supports

IND-0565, sheet 1 [MEB 821206 481], IND-0565, sheet 2 [B21 850305 273],
IND-0565, sheet 3 [MEB 830623 458], IND-0568, sheet [illegible] [B21 850305 274],
IND-0568, sheet 2 [B21 850305 275], IND-0570, sheet [illegible] [BLP 820913 456],
IND-0570, sheet 2 [B21 850305 276], IND-0572, sheet 1 [B21 850305 277],
IND-0572, sheet 2 [B21 850305 278], IND-0574, sheet 1 [B44 850501 453],
IND-0574, sheet 2 [B21 850305 279], IND-0577 [B21 850520 205],
IND 0579, [B21 850305 282]

TVA-EN DES Calculation N4-IND-A/1, R1, "Analysis of Decay Heat Removal System CEB Problem N4-IND-A/1," [BLP 850107 200]

TVA-EN DES Calculation N4-2ND-A/1, R0, "Analysis of Decay Heat Removal System CEB Problem N4-2ND-A/1," [B21 850812 200]

TVA-EN DES Calculation BLN-ND-D053, 3-M4-RRH-092375, "BLP-DHR System - BWST Outlet Nozzle Calculations," [BLP 790410 007]

43. TVA Specification G-2, R5, "General Construction Specification for Plain and Reinforced Concrete," [B42 851030 501], (11/01/85)

44. TVA NCRs:

- o TVA NCR 2975, Rev. 0 [SQN 841015 606]
- o TVA NCR 2836, Rev. 0 [SQN 830404 600]

45. TVA Specification G-32, "Bolt Anchors Set in Hardened Concrete," R11, (01/31/86)

46. TVA - Division of Construction - BLN Quality Control Procedure BNP-QCP-2.1, "Rebar, Embedments, and Concrete Formwork," R16, [C20 860424 464], (05/08/86)

TVA - Division of Construction - BLN Quality Control Procedure BNP-QCP-10.6, "Work Release," R18, [C20 860512 457], (05/23/86)

TVA - Division of Construction - BLN Quality Control Procedure BNP-QCP-10.4, "Control of Nonconformances and Significant Condition Reports," R14, [C20 860311 464], (03/25/86)

47. TVA Quality Control Investigation Report 30210, (02/04/83)

TVA BLN NCR 1281, [BLN 801023 108]
TVA BLN NCR 1766, [BLN 820308 108]
TVA BLN NCR 2280, [BLN 830228 118]
TVA BLN NCR 2592, [BLN 840126 704]
TVA BLN NCR 3225, [BLN 840622 707]
TVA BLN NCR 3499, [BLN 841116 705]
TVA BLN NCR 3521, [BLN 841128 703]
TVA BLN NCR 4750, [no RIMS number] (03/05/86)
TVA BLN CAQR BLF 870073, [B05 870515 306]

48. WBNP FSAR update through Amendment 56, Section 3.8, "Design of Category I Structures"

SQN FSAR update through Amendment 3, Section 3.8 "Design of Category I Structures"

49. TVA BLN Drawings:

4BN0701-X1-1 4BN0701-X1-2	R1 and) R1)	Auxiliary and Control Buildings Units 1 and 2 -- Concrete Floor Design Data
4BB0892-X2-2	R6	Aux., Control, and DG Bldg; Misc. Steel Seismic Conduit Supports - Notes - Sh. 1
3GA0059 Series (the latest revisions as of 05/87)		Notes for Field Fabrication & Installation of Pipe Supports in Cat. I Structures

50. TVA calculation on "Aux. Bldg. Blowout Panels, Cable Tray Frames, Hatch Frames and Covers," R1, [WBP 840424 024], (04/24/84)

TVA memo from R. W. Cantrell, Manager of Engineering, and Charles Bonine, Jr., Manager of Construction, to Those Listed. Subject: "All Nuclear Plants - Responsibilities," [OEN 841123 001], (11/23/84)

TVA Specification 2126, "125-Ton Overhead Traveling Crane for Aux. Bldg. at WBNP Units 1 and 2"

TVA Drawings:

47W200-1 "Equipment Plans - Roof," R9, (11/09/79)
47W200-2 "Equipment Plan - El 772.0 and Above," R11, (09/28/84)
47W200-3 "Equipment Plan - El 757.0 and El. 755.0," R16, (04/09/83)
47W200-4 "Equipment Plan - El 757.0 and El. 729.0," R17, (10/09/85)
47W200-5 "Equipment Plan - El 713.0 and El. 708.0," R19, (10/09/85)
47W200-6 "Equipment Plan - El 692.0 and El. 685.5," R13, (03/09/86)
47W200-7 "Equipment Plan - El 750.5 and El. 730.5, El. 676.0 and El. 666.0," R7, (03/04/86)
47W200-8 "Equipment Transverse Section A8-A8," R6, (03/04/86)
47W200-9 "Equipment Longitudinal Section A9-A9," R5, (05/14/84)
48N1250-1 Miscellaneous Steel Hatch Frames and Covers," R6, (01/23/86)
41N704-1 "Concrete Floor Design Data," R1, (03/31/78)
46W502-5 "Architectural Plan El. 676.0 and 692.0 Temporary Barrier," R5, (05/06/83)
44N300 "125-ton Crane Arrangement," R3, (09/26/85)
44N301 "125-ton Crane Trolley Arrangement," R2, (07/01/75)

51. American Institute of Steel Construction (AISC), "Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings," effective 11/01/78

52. TVA EN DES Calculations, [B25 850912 800], "Feedwater Heater Replacement, Turbine Building, Monorail From Rail Bay to Center Aisle, Above El. 706," SCG-1S2, R1, (09/06/85)

TVA EN DES Calculations, [B25 850912 805], "Feedwater Heater Replacement - Monorail - Diagnonal Above El. 706," SCG-1S5, R1, (09/06/85)

TVA OE Calculations, [B25 850912 801], "Load Tests for the Feedwater Heater Monorails," SCG-1S15, (09/11/85)

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M-83825, R3, Feedwater Heaters 1A1, 1B1, and 1C1
M-83826, R3, Intermediate Feedwater Heaters 1A2, 1B2, and 1C2

Yuba Heat Transfer Corporation Drawings:
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84-H-891-2-1, R2, Intermediate Pressure Heater Nos. 1A2, 1B2, and 1C2

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TVA memo from J. P. Vineyard to H. B. Rankin, [B25 850819 013], "SQN - Design Review of Monorail Structure," (08/19/85)

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53. TVA Drawings:

47W472-1, R35, "Mechanical Sleeve Seals"
47W472-2, R34, "Mechanical Sleeve Seals"
47W472-3, R20, "Mechanical Sleeve Seals"
47W472-4, R29, "Mechanical Sleeve Seals"
47W472-5, R33, "Mechanical Sleeve Seals"
47W472-6, R51, "Mechanical Sleeve Seals"
47W472-7, R5, "Mechanical Sleeve Seals"
47W472-8, R7, "Mechanical Sleeve Seals"
47W472-9, R25, "Mechanical Sleeve Seals"
47W472-10, R30, "Mechanical Sleeve Seals"

54. TVA DNE Nuclear Engineering Procedure, "Review," NEP-5.2, R0 (07/01/86)

55. TVA Policy Memorandum PM 87-35 (DNE) from R. W. Cantrell, "Project/Branch Responsibilities," [B01 870123 002] (01/23/87)

56. TVA memo from R. W. Cantrell to J. E. Wilkins, [SWP 810916 010], (09/14/81)

57. TVA memo from R. W. Cantrell to J. E. Wilkins, [SWP 820128 017], (01/26/82)

58. TVA memo from J.C. Standifer to G. Wadewitz, [SWP 851126 007], (11/26/85)

59. TVA CEB Report 82-2, "Testing of Silicon Foam Seals, "R0 [CEB 820408 005], (04/08/82)

60. American National Standards Institute (ANSI) Standard ANSI B30.2.0 - 1976, "Overhead and Gantry Cranes"

61. TVA Employee Concerns Special Program Subcategory Report 30800, Revision 2, "Maintenance," (09/04/87)

62. TVA Invitation, Bid, and Acceptance, Oakridge Roofing Co., Inc., Built-up Roofing and Related Materials, Installed [TVA Ref. No. 75K52-86697], (05/12/75)

TVA Specification 2600 for Built-up Composition Roofing and Related Materials for the Watts Bar Nuclear Plant [TVA Ref. No. 75K52-86697]

63. TVA memo from D. W. Wilson to J. C. Standifer, [T15 850430 955], (04/30/85)

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TVA informal memo from T. C. Cruise to R. O. Hernandez and W. A. English, (07/17/85)

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