EMPLOYEE CONCERNS

SPECIAL PROGRAM

VOLUME 2
ENGINEERING CATEGORY

SUBCATEGORY REPORT 26500
ELECTRICAL SAFETY AND SYSTEMS DESIGN

UPDATED

TVA

NUCLEAR POWER

TVA EMPLOYEE CONCERNS SPECIAL PROGRAM

REPORT NUMBER: 26500

REPORT TYPE: SUBCATEGORY REPORT FOR ENGINEERING

REVISION NUMBER: 4

TITLE: ELECTRICAL SAFETY AND SYSTEMS DESIGN

REASON FOR REVISION:

1. Revised to incorporate initial SRP and TAS comments and latest element evaluation status.

2. Revised to incorporate additional comments from SRP.

3. Revised text to incorporate comments from TAS; added Attachment C (References).

4. Revised to incorporate comments from SRP and TAS.

PREPARATION

PREPARED BY:

SIGNATURE 12/1/87 DATE

REVIEWS

~~PEER~~ REVIEW COMMITTEE:

SIGNATURE 12/1/87 DATE

TAS:

SIGNATURE 1/4/88 DATE

CONCURRENCES

SIGNATURE DATE

CEG-H: 1-4-88

SRP: SIGNATURE* 1-12-88 DATE

APPROVED BY:

ECSP MANAGER 1/11/88 DATE

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

EXECUTIVE SUMMARY

This subcategory report summarizes and evaluates employee concerns about potential deficiencies in equipment access, electrical safety, electrical protection design, and cable terminations at four Tennessee Valley Authority (TVA) nuclear power plants: Sequoyah (SQN), Watts Bar (WBN), Browns Ferry (BFN), and Bellefonte (BLN). The 27 employee concerns from element evaluations 234.0 series, 235.0 series, 237.0 series and 241.0 series have been grouped for evaluation purposes into the two basic subjects of electrical personnel safety and systems design.

The evaluation did not substantiate the concern that deficiencies exist in the electrical safety area that would endanger personnel performing maintenance activities in or around energized equipment.

With regard to systems design, it could not be established that the thermal overloads have been properly selected for safety-related motor operated valves at Sequoyah and Browns Ferry because of lack of calculations. In addition, none of the four plants had design basis or a controlled valve list to define the particular valves requiring thermal overload protection and torque switch bypass design.

The adequacy of circuit overcurrent protection design cannot be determined until calculations are completed. Also, the trip ratings of numerous circuit breakers at WBN were found to be incorrectly set. TVA's design standard and design guide lacked clear definition of requirements for protection of small motors, and this factor had contributed to the circuit protection problem.

Plant modifications and their status at SQN and WBN were not well established to confirm whether or not commitments to the Nuclear Regulatory Commission (NRC) regarding W-2 switch malfunctions have been met.

There is insufficient documentation at all four plants to demonstrate that cable splices located underground have been properly installed to preclude failures as the result of flooding.

The use of terminal lugs designed for stranded conductors but installed on solid conductors was found by TVA to be a problem at SQN and WBN, and corrective actions were initiated. BFN only recently initiated a review to determine if the problem exists in that facility.

WBN and BFN were found to have loose Amphenol connectors in the diesel generators after this problem was initially identified and corrected by TVA at SQN.

The findings indicate that there is a potential for failures of safety-related systems and components. This problem is attributed to the lack of documentation demonstrating that circuit protective devices, including thermal overload relays, and cable termination materials were properly selected. TVA's corrective actions address these problems.

A number of broader issues emerge from a collective review of this subcategory. TVA's fragmented organization, which did not have clear lines of responsibility, authority, and accountability, led to a lack of effective control and monitoring of the electrical discipline design process, inability to identify problems and to implement timely and effective corrective action, and ineffective response to licensing issues. However, the TVA Corporate Nuclear Performance Plan (CNPP) addresses all of these broader issues through the restructuring of TVA's organization and the implementation of a number of specific programs (such as Design Basis and Verification, Engineering Assurance, Corporate Commitment Tracking System, Management Information System) that should correct the performance deficiencies. The implementation of the Calculation Cross Reference Information System (CCRIS) by Division of Nuclear Engineering (DNE) will improve the design coordination between the four DNE technical branches. These issues are being examined from a wider perspective at the Engineering category level.

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 report summarizes and evaluates the results of the Employee Concerns Special Program (ECSP) element evaluations prepared under element number series 23400, 23500, 23700, and 24100. These element evaluations address issues that relate to equipment access, electrical safety, electrical protection design, and cable termination and splices, respectively. Together, they comprise 20 elements, which are identified in Table 1.

Collectively, the issues point to potential personnel safety hazards and deficiencies in electrical systems design and related equipment installations that may reduce plant safety to an unacceptable level. This subcategory report consolidates the issues under the heading of electrical safety and systems design because engineering of an adequate design includes, but is not limited to, specifying and/or using proper equipment and components to form an integrated system(s) with consideration given to safety during plant construction, operation, and maintenance.

The employee concerns provide the basis for the element evaluations and are listed by element number in Attachment A. The plant location where the concern was originally identified and the applicability of the concern to other TVA nuclear plant sites are also shown. The reasons for nonapplicability of some concerns to specific plants are given in Section 4.

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.
- Section 4 -- summarizes, by element, the findings; identifies the negative findings that must be resolved; and addresses the determination of generic applicability.
- Section 5 -- highlights the corrective actions required for resolution of the negative findings cited in Section 4 and relates them to element and to plant site.
- Section 6 -- identifies causes of the negative findings.
- Section 7 -- assesses the significance of the negative findings.
- Attachment A -- lists, by element, each employee concern evaluated in the subcategory. The concern number is given, along with notation of any other element or category with which the concern is

shared; the plant sites to which it could be applicable are noted; and the concern is quoted as received by TVA, and is characterized as safety related, not safety related, or safety significant.

- Attachment B -- contains a summary of the element-level evaluations. Each issue is listed, by element number and plant, opposite its corresponding findings and corrective actions. The reader may trace a concern from Attachment A to an issue in Attachment B by using the element number and applicable plant. The reader may relate a corrective action description in Attachment B to causes and significance in Table 3 by using the Corrective Action Tracking Document (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 problems they raised have been identified as 119 separate issues. These issues are reviewed in 55 element evaluations.

The issues evaluated under this subcategory, grouped by element, are summarized below:

- 234.0, Access to Equipment - Space for removing a chiller motor is inadequate.

- 235.1, 480 V Power Receptacles Unsafe - No means of disconnect are provided for 480 V receptacles, and their operation can cause personnel injury.

- 235.2, Exposed 480 V Bus at Panel Top - Cable entries to the 480 V shutdown boards or motor control centers (MCCs) are sealed improperly.

- 235.3, Hand Switch Location Violates Regulatory Requirements - A local valve control station controlling two valves is not in the direct line of sight of the valves.

- 235.4, Exposed High Voltage (HV) Cable Routed Without Raceway - High voltage cables are laid in such a way that insulation damage and flooding may occur which could cause shock hazards.

- 235.5, Low Voltage and High Voltage Termination - High and low voltage wiring is located in the control rod drive (CRD) motor generator cooler control box, creating a personnel safety problem.

- 235.6, Exposed 480 V Bus Inside Unlocked Panel Door - 480 V MCCs do not have proper personnel protection features .

- 235.7, Emergency Lighting Improperly Wired - The emergency lighting system has improper wiring.

- 235.8, PVC Jacketed Flexible Conduit - PVC jacketed flexible conduits are not suitable for use in the containment and valve rooms.

- 235.10, 480V Power Receptacles Use of Incorrect Wire Size, Unsafe - 480 V power receptacles are unsafe to personnel.

- 235.11, Malfunction of Westinghouse W-2 Switch - Malfunction of Westinghouse type W-2 control switch results in a misleading indication of valve position.

- 237.1, Bypass of Thermal Overload and Over-Torque Limit Switches and
  237.4, Bypass of Over-Torque Limit Switches - Selection or bypass of thermal overloads and torque switches in motor operated valve control units is improper.

- 237.2, 400 to 500 Breakers Unacceptably Set - Circuit breaker trip ratings are improperly set, and fuses are improperly selected.

- 237.6, Gassing of Current Transformers - Gassing of current transformers requires outages that may reduce plant safety.

- 241.1, Inadequate Splicing and Termination Practices and Procedures - Cable splice failures resulting from floods reduce plant safety.

- 241.2, Crimp Connections - Terminal lugs on solid conductors are used improperly.

- 241.3, Megger Tests on Low Voltage Cables - Insulation resistance testing is not performed on low voltage cables.

- o 241.4, Amphenol Connectors - Amphenol connectors are not properly installed in the standby diesel generator system.

- o 241.5, Wire Corrosion in Containment Penetrations - There is breakdown in the integrity of containment penetrations because of wire corrosion and deterioration of sealant material.

A complete statement of each issue evaluated is provided in Attachment B.

The issues summarized above fall into two groups for the purposes of this subcategory. The first group, Electrical Safety, deals with presumed personnel safety hazards. The second group, Systems Design, deals with perceived deficiencies in systems design and equipment installations. Generic applicability of the element evaluations for the different plants is discussed in Section 4 of this report.

As a result of the subcategory evaluation process, the task group found that some issues were not valid, or were valid but the problems identified did not require corrective action. However, several valid issues have been identified that require corrective actions. In addition, problems (peripheral findings) were identified as a result of the evaluation process, though not stated in the concerns. Table 1 presents the applicability of the issues to the plants and the findings. Each finding has been classified in accordance with the finding classifications defined in the Glossary Supplement.

3. EVALUATION PROCESS

This subcategory report is based on the information contained in the applicable element evaluations prepared to address the specific employee concerns related to the issues defined in Section 2. The references noted here and listed in Attachment C are part of the evaluation process. The evaluation process consisted of the following steps:

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

- b. Reviewed current industry standards, and TVA procedures and criteria documents related to the issues to develop an understanding of the design basis (Refs. 3.0 and 8.0).

- c. Reviewed applicable design documents and conducted facility walkdowns, as appropriate, to develop design understanding and to verify implementation status (Refs. 7.0 and 9.0).

d. Reviewed applicable Final Safety Analysis Report (FSAR) sections and NRC documents to determine regulatory commitments related to the design (Refs. 1.0 and 2.0).

e. Reviewed any other documents applicable to the issues and determined to be needed for the evaluation, such as correspondence, test reports, Nonconformance Reports (NCRs), Engineering Change Notices (ECNs), evaluation reports, etc. (Refs. 4.0, 5.0, 6.0, 9.0, and 10.0).

f. Using the results from steps a through e above, evaluated the issues for each element.

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

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

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

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

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

Steps a through f were applied to perform the element evaluations, and steps g. through k were used to complete the subcategory report. The applicable steps for each element are identified in Section 4.

4. FINDINGS/GENERIC APPLICABILITY

The findings from the element evaluations for this subcategory are contained in Attachment B. The findings are listed in Attachment B by element number and by plant. The process steps used in the evaluation and report development are listed at the end of each element in this section. The references listed at each element, to support the findings, are identified in Attachment C.

The summarized findings for each element are grouped under the basic subjects of electrical safety and systems design, as follows.

4.1 Electrical Safety

4.1.1 480 V Power Receptacles Unsafe - Element 235.1

Proper 480 V power receptacles and their mating plugs are in use at all four plants, and no means of disconnect are required above the receptacle. As an isolated documentation problem (peripheral finding), SQN did not document the required mating plugs in the master bill of material. [Evaluation process steps used: a, b, c, f, g, h]

References to support the findings:

SQN: 3.09, 9.13
WBN: 3.09, 9.22
BFN: 3.09, 9.31
BLN: 3.09, 9.36

4.1.2 Exposed High Voltage Cable Routed Without Raceway - Element 235.4

High voltage cables were installed at SQN and WBN in such a way that the cables cannot be damaged or subject to floods. The actual cables of concern are temporary construction cables. TVA has adequate safety standards and housekeeping requirements, monitored and enforced by the safety staffs at the plant sites, to preclude unsafe working conditions when temporary cables are needed during plant construction or maintenance phases. On this basis, no additional evaluations were necessary for BFN and BLN. [Evaluation process steps used: a, b, c, f, g, h]

References to support the findings:

SQN: 3.16, 3.27, 3.55, 9.43, 9.44, 9.45
WBN: 3.14, 3.28, 3.55, 9.39, 9.46

4.1.3 Low Voltage and High Voltage Termination - Element 235.5

Although high and low voltage wiring is located within the WBN control box of the CRD motor generator cooler, the particular vendor design is not contrary to industry practices and does not present safety problems to personnel performing maintenance inside the control box. The actual voltage level of the wiring is considered low according to industry standards, and no special separation or barriers between wires are needed in this case. The issue regarding improper locations of thermostats in the control box has been confirmed, but TVA implemented corrective actions to resolve the problem before this evaluation. The findings did not indicate that similar problems

might exist in other control boxes at WBN or other plants because vendor supplied equipment was built to applicable industry standards. On this basis, no evaluations for the other plants were necessary. [Evaluation process steps used: a, b, c, e, f, h]

Reference to support the finding:

WBN: 4.26, 6.20, 7.10, 8.01

4.1.4 480 V Bus Inside Unlocked Panel Door - Element 235.6

The design and construction features of 480 V motor control centers (MCCs) at WBN are in accordance with industry standards. These features combined with existing TVA procedures for equipment access are sufficient to prevent unauthorized personnel access to energized equipment. The concerns were evaluated for WBN and were found not to be valid. Because the MCCs of the other plants were constructed in accordance with the same industry standards as those at WBN, and the concern was found not to be valid at WBN, no evaluations were necessary for the other plants. [Evaluation process steps used: a, b, c, f, h].

References to support the finding:

WBN: 3.15, 8.01, 8.02, 8.03, 9.51

4.1.5 Emergency Lighting Improperly Wired - Element 235.7

The design of the WBN emergency lighting system allows for sufficient illumination levels should one or more of its circuit conductors be de-energized. During such an event, the lighting level is adequate for safe personnel egress, in agreement with FSAR Section 9.5.3 (Ref. 1.04). The concern was specific to WBN and was found not to be valid. Because there was no indication that the concern would be valid at any of the other plants, no further evaluations were necessary. [Evaluation process steps used: a, b, c, d, f, h]

Reference to support the finding:

WBN: 1.04, 4.27, 7.11

4.1.6 480 V Power Receptacles Use of Incorrect Wire Size, Unsafe - Element 235.10

It was verified for WBN that the terminals of the receptacles accept #2 AWG wire and that the correct wire size was used. The concern was found not to be valid. Because of the generic nature of the termination capability of the

receptacle, and on the basis of the result of verification at WBN, no evaluations were necessary for the other plants. [Evaluation process steps used: a, b, c, e, f, g, h]

References to support the findings:

WBN: 3.08, 3.09, 8.01, 9.22, 9.52

4.2 Systems Design

4.2.1 Access to Equipment - Element 234.0

Equipment accessibility is part of engineering's design activities that require coordination between the engineering discipline and construction organizations to avoid potential problems in installing, testing, maintaining, and removing equipment. The issue evaluated for WBN involves electrical equipment because the employee concern indicates that a cable tray and its hangers had to be cut out to remove a chiller motor. The evaluation team confirmed that there is congestion where all the chiller motors are located. The general condition of maintenance accessibility problems, resulting from design inadequacies, was substantiated. This evaluation was based on Concern EX-85-140-001, which specifically addressed WBN. For a generic evaluation of the accessibility issue, refer to Subcategory Report 30500 (Ref. 9.29). [Evaluation process steps used: a, c, e, f, h]

4.2.2 Exposed 480 V Bus at Panel Top - Element 235.2

Lack of proper cable entrance seals could permit water from fire suppression systems to enter energized equipment and cause a loss of function or power to equipment required for safe shutdown, thus jeopardizing plant safety. Cable entries to the 480 V MCCs are properly sealed at SQN but not at BFN and BLN. The WBN MCCs did not initially have the proper sealing as stated in the employee concern; however, this condition was corrected by TVA before this evaluation. At BFN, there was at least one MCC without the cable seals. The BLN MCCs have temporary covers and/or no covers where the cable entries are; however, this is acceptable for a plant under construction because BLN has requirements for permanently sealing when construction is completed. [Evaluation process steps used: a, b, c, f, g, h]

References to support the findings:

SQN: 3.05, 3.21, 6.04, 7.03, 9.47
WBN: 3.05, 3.21, 6.04, 7.03, 9.48
BFN: 3.05, 3.21, 5.23, 7.03, 9.49
BLN: 3.05, 3.21, 7.03, 7.09, 9.50

4.2.3 Hand Switch Location - Element 235.3

The WBN design of local control stations that control two or more valves is acceptable even though one or more of the valves is not visible to the operator at the station. There are sufficient controls and indications at the stations for the operators to determine the valve's status without the need to confirm this visually. Because the concern was specific to WBN and was found not to be valid, and because such design is equally acceptable at any of the other plants, no evaluations were necessary for the other plants. [Evaluation process steps used: a, b, c, d, f, h]

References to support the finding:

WBN: 3.15, 9.23

4.2.4 PVC Jacketed Flexible Conduit - Element 235.8

Polyvinyl chloride (PVC) jacketed flexible conduits are used (in harsh environment) at SQN, WBN, and BFN. TVA needs to provide additional documentation to demonstrate suitability of the PVC jacketed conduit for use inside the containment and valve rooms. In addition, the WBN environmental qualification (EQ) cable documentations contained several open items regarding radiation qualification levels (peripheral finding). The documentation problems are safety-related because cable qualification affects the adequacy of the plants' EQ program. The concern is not applicable to BLN, which uses stainless steel flexible conduit inside containment. [Evaluation process steps used: a, b, c, e, f, g, h]

References to support the findings:

SQN: 3.21, 4.12, 5.09, 5.10, 5.11, 5.14, 5.16, 7.04, 9.06, 9.09, 9.24
WBN: 3.21, 4.12, 4.22, 5.09, 5.10, 5.11, 5.14, 5.16, 7.04, 9.06, 9.24, 9.25
BFN: 3.21, 4.12, 5.14, 5.16, 5.21, 5.22, 7.04, 9.06, 9.24

4.2.5 Malfunction of Westinghouse W-2 Switch - Element 235.11

The problem of the misleading indication of valve position when the Westinghouse type W-2 switch malfunctions was created as a result of implementing design changes at SQN and WBN to address NRC IE Bulletin 80-20. The evaluation indicated that no such problems exist at BFN and BLN. A review of TVA's actions taken to resolve the problem indicates that TVA must take additional steps to provide assurance that all safety-related circuits using such switches have been identified and modified, if necessary. In addition, plant(s) modifications and their status were not well established to confirm

whether or not commitments to the NRC have been met; this problem also indicates a weakness in the organization for tracking NRC commitments. The lack of an effective program to prevent recurrence of the misleading valve indication problem was also identified because no NCR was written to cover the extensive work required to correct the problem. The findings are safety-related because the W-2 switches are used in many safety-related control circuits and a switch malfunction can prevent automatic operation of equipment or mislead the operators regarding the status of motor operated valves. [Evaluation process steps used: a, c, through k]

References to support the findings:

SQN: 2.12, 2.14, 4.01, 4.02, 4.28, 4.29, 6.02, 7.01, 7.06, 9.01, 9.02, 9.15, 9.16, 9.17, 9.53
WBN: 2.01, 2.12, 2.14, 2.18, 4.01, 4.02, 4.23, 4.24, 4.30, 4.31, 5.24, 6.07, 6.11, 6.12, 6.13, 7.01, 7.06, 7.12, 9.01, 9.02, 9.15, 9.16, 9.17, 9.54, 9.55
BFN: 2.12, 2.14, 4.01, 4.04, 4.07, 9.01, 9.02
BLN: 2.12, 2.14, 4.08, 7.19, 9.01, 9.02

4.2.6 Bypass of Thermal Overload and Over-Torque Limit Switches - Elements 237.1 and 237.4

These two element evaluations were performed separately for SQN, and the single element number, 237.1, was used for WBN, BFN, and BLN to address both issues. The issues relate to the adequacy of thermal overload protective devices and torque switch settings in motor operated valve (MOV) control circuits, and compliance with NRC Regulatory Guide (RG) 1.106 which deals with MOV thermal overload protection. The review of each plant's design approach for thermal overload protection indicated that BFN and SQN do not bypass this protective device in safety-related MOV circuits under accident conditions as is the case in WBN and BLN. Either approach can be acceptable. All four plants have included design provisions for bypassing the torque switches in safety-related MOVs. The design approaches are consistent with TVA policies and NRC guidance, in effect during the plant licensing phase, to ensure that functions of MOVs are not impaired by misapplication and/or improper setting of the thermal overload and torque switch components. However, problems were found in each plant's design process for implementing and satisfying TVA's requirements and commitments to NRC. In the licensing area, the design was not accurately reflected in the SQN, WBN, and BLN FSARs concerning conformance with RG 1.106. At BFN, a design change was initiated to add the thermal overload relay bypass to meet RG 1.106, which is not committed by BFN; however, the status and basis for the change could not be established. It is noted that the FSARs for SQN and BLN now indicate conformance with the NRC

branch technical position document that preceded RG 1.106, and recent TVA documents have referenced the RG 1.106 for design requirements. Therefore, TVA needs to clarify the FSAR on the applicability of, and the degree of conformance with, RG 1.106. Further, discrepancies were found between valves listed in the SQN and WBN Technical Specifications and those in other associated documents. BFN and SQN did not have documented design basis to verify adequacy of existing thermal overload relays. Design basis documents were not found at BFN, SQN, and BLN to define requirements and identify valves requiring bypass of thermal overload relays and/or switches. Although WBN issued a design criteria document before the ECSP evaluation, the design criteria and the associated calculation did not include requirements for the torque switch bypass. Lack of a design basis document contributed to the employee concern that valves 332 and 333 at SQN and WBN did not have the torque switch bypass. These findings are significant because it cannot be established that all control circuits for MOVs required to function for accident mitigation have been properly designed. [Evaluation process steps used: a through k]

References to support the findings:

237.1 (SQN):	1.01, 1.03, 2.16, 3.18, 3.41, 4.05, 4.16, 4.19, 4.32, 5.13, 7.05, 9.14, 9.16
237.1 (WBN):	1.05, 1.06, 1.09, 2.05, 2.07, 2.13, 2.16, 3.03, 4.16, 4.17, 4.19, 4.20, 4.21, 4.33, 4.34, 4.35, 5.02, 5.12, 5.13, 6.01, 6.24, 6.25, 6.26, 6.27, 7.07, 7.08, 7.13, 7.14, 9.14, 9.16, 10.8
237.1 (BFN):	1.07, 2.05, 2.07, 2.13, 2.16, 3.56, 4.03, 4.10, 4.11, 4.16, 4.18, 4.19, 4.36, 5.13, 5.26, 6.22, 6.28, 9.14, 9.16
237.1 (BLN):	1.08, 2.05, 2.07, 2.13, 2.16, 2.17, 4.16, 4.19, 4.37, 5.13, 6.23, 6.29, 7.15, 9.14, 9.16, 9.34
237.4 (SQN):	1.02, 2.05, 2.07, 2.13, 6.01, 6.06, 7.13

4.2.7 400 to 500 Breakers Unacceptably Set - Element 237.2

The basic issue that circuit breaker trip ratings were improperly set is valid for all plants. At WBN, where the problem was identified, a significant number of circuit breakers had to be reset and a few circuit breakers were replaced. The extent of the problem at SQN, BFN, and BLN cannot be assessed because calculations were underway but not completed at the time of the ECSP evaluation. Completion of the calculations by the plants as required by TVA policy memos PM86-02 and PM86-18 (both documents were issued subsequent to the employee concern), will determine if circuit breakers need to be reset or replaced. TVA's design standard and/or design guide lack application information for fault protection of small motors and contain ambiguous directions on the applicability of the National Electrical Code (NEC) for

small motor circuit protection. This lack of guidance and verifying calculations support the employee concern that the selection and methods of circuit breaker settings were poor. Compliance with the NEC is not mandatory for utilities; however, because TVA documents reference this code in whole or part, a clear definition of compliance is essential to provide guidance to designers.

The related issue that fuses are improperly selected for valve operators was reviewed for all plants and found valid at SQN, WBN, and BFN. The fuse selection process was not documented to provide a basis for the selection or to demonstrate that the full range of short circuit protection exists for the valve motor circuits.

The findings require corrective actions and are significant in that improper settings and selection of circuit protective devices can cause unacceptable consequences in the electric power system and in the loads they serve. The results can be unacceptable when one or more protective devices (circuit breaker or fuses) in a circuit operate prematurely or, in the other case, fail to operate during abnormal and fault conditions, thus causing loss of equipment served or challenges to the integrity of the power supply. [Evaluation process steps used: a through k]

References to support the findings:

SQN: 1.01, 2.16, 3.01, 3.06, 3.07, 3.13, 4.16, 4.19, 7.02, 7.05, 8.01, 9.03, 9.04, 9.05, 9.08
WBN: 2.04, 2.16, 3.06, 3.07, 3.13, 4.16, 4.19, 5.06, 5.17, 5.18, 5.19, 6.08, 6.09, 6.10, 6.16, 6.17, 6.21, 7.02, 8.01, 9.03, 9.05, 9.15
BFN: 2.16, 3.06, 3.07, 3.13, 4.16, 4.19, 5.20, 5.25, 5.26, 8.01, 9.03, 9.05, 9.26, 9.27
BLN: 2.16, 3.04, 3.06, 3.07, 3.13, 3.17, 3.57, 4.15, 4.16, 4.19, 5.05, 5.07, 5.17, 7.16, 7.17, 7.18, 8.01, 9.03, 9.05, 9.32, 9.33, 9.35

4.2.8 Gassing of Current Transformers - Element 237.6

TVA and other utilities are experiencing gassing in high voltage, oil-filled, current transformers (CTs). This type of equipment is used in the switchyards at SQN, WBN, BFN, and BLN. Although there has not been a significant number of destructive failures at the four plants, WBN has implemented steps to replace the equipment with a non-oil-filled type CT to preclude occurrence of the gassing problem. TVA also has implemented an on-line monitoring program to detect gas levels within the oil-filled CT and a safety program to establish precautions to be followed by personnel working near or monitoring the equipment. Oil sampling of CTs requires planned outages and switchyard

configuration changes to provide safe access to the CTs; thus the specific employee concern regarding outages is valid. However, these preplanned activities are permissible during plant operations for a limited period without a reduction in plant safety, if they are conducted in accordance with the plant's technical specifications. In addition, these high voltage CTs are nonsafety-related equipment and failure of one does not affect the plant's ability to safely shut down with power from the remaining onsite power source(s). Therefore, the issue is not safety related and TVA's CT monitoring program is an acceptable solution for preventing destructive failures of the oil-filled CTs. [Evaluation process steps used: a, b, and e through h]

References to support the findings:

SQN: 2.19, 3.29, 4.06, 6.05, 9.21, 9.56, 9.57
WBN: 2.19, 3.30, 4.06, 6.18, 6.19, 9.21, 9.56, 9.57
BFN: 2.19, 4.06, 4.14, 4.38, 9.21, 9.56, 9.57
BLN: 2.19, 3.31, 4.06, 4.38, 9.21, 9.56, 9.57

4.2.9 Inadequate Splicing and Termination Practices and Procedures - Element 241.1

This element addresses issues relating to cable splices located underground. The issues are safety-related because improper splices can cause failures of safety-related cables located in manholes when flooding occurs, thereby causing a loss of function of safety-related equipment served. A review of TVA documents indicates that current procedures, standards, and instructions on making qualified cable splices are sufficient. However, not all of the current requirements were in place at BFN because its construction preceded the development of some requirements. The few requirements that were put in place then are considered acceptable. It was found that SQN, BFN, and BLN have inadequate records on splices made and their locations for verification of proper installation. NRC IE Information Notice 86-53 notifies licensees of improper installation of heat shrinkable tubing (Raychem) over electrical splices. The evaluators found that SQN, WBN, and BLN had not established a program to review the adequacy of installed splices in manholes as a part of the information notice review. TVA had identified the heat shrink tubing problem at BFN as a restart item, and closure of corrective action there will resolve the potential problem of inadequately installed splices. In addition, it was found that WBN used improper connectors in 6.9 kV cable splices, and a nonconformance report was issued to address the problem. Although each plant is designed to accommodate a single failure through use of redundant cables in separate underground duct banks or cable runs, multiple cable splice failures could occur because of improper splices. For that reason, and because records on splices made for verification of proper splice installations are

inadequate, there is no assurance that multiple cable splice failures cannot occur. Thus, corrective action is required. [Evaluation process steps used: a through i]

References to support the findings:

SQN: 1.01, 2.15, 3.02, 3.10, 3.11, 3.12, 3.20, 3.23, 3.34, 3.53, 3.58, 4.39, 9.12, 9.24
WBN: 2.15, 3.10, 3.11, 3.12, 3.20, 4.13, 5.03, 5.29, 9.28, 9.58
BFN: 2.15, 3.10, 3.11, 3.12, 3.20, 3.37, 9.28
BLN: 2.15, 3.10, 3.11, 3.12, 3.20, 3.39, 3.50, 3.52, 5.08, 5.27, 5.30, 9.28

4.2.10 Crimp Connections - Element 241.2

The basic issue is that the use of terminal lugs designed for stranded conductors but installed on solid conductors results in reduced current-carrying capacity of the connection. This condition was found at SQN, WBN, and BFN, but not at BLN. TVA had identified the problem and initiated corrective action before this evaluation. TVA discovered that a vendor had incorrectly used the terminal lugs in some instrument racks and that TVA's procedures did not provide sufficient guidelines in the application of crimp terminal lugs. The procedure problem had been corrected by TVA, but corrective action, consisting of reworking the terminal lugs, is not yet complete at SQN and WBN. BFN was required by existing procedures to perform a review of the problem, but the review has not been completed. The findings are safety-related and potentially affect the performance of safety-related circuits, unless corrective actions are completed. [Evaluation process steps used: a, b, c, e, f, g, h]

References to support the findings:

SQN: 3.20, 3.23, 3.32, 3.35, 5.04, 5.14, 5.15, 6.03, 9.07, 9.10, 9.20, 9.59
WBN: 3.20, 3.22, 3.23, 3.36, 3.59, 5.04, 5.15, 6.14, 6.15, 9.18, 9.20
BFN: 3.20, 3.32, 3.38, 5.04, 5.15, 5.28, 9.18, 9.20
BLN: 3.20, 3.32, 4.09, 5.04, 5.15, 9.07, 9.20

4.2.11 Megger Tests on Low Voltage Cables - Element 241.3

Megger or insulation resistance tests are performed on low voltage cables at all plants. Although there are no industry requirements for such tests, TVA has established appropriate requirements for the tests during construction and subsequent modification work in operating plants. Furthermore, a review of existing records at each plant shows that testing has been performed as required by TVA. Therefore, the issue is not valid. [Evaluation process steps used: a, b, e, f, g, h]

References to support the findings:

SQN: 3.19, 3.20, 3.23, 3.24, 3.33, 3.60
WBN: 3.20, 3.22, 3.46, 3.47, 3.48, 3.60
BFN: 3.20, 3.25, 3.26, 3.49, 3.60
BLN: 3.20, 3.39, 3.50, 3.51, 3.52, 3.60

4.2.12 Amphenol Connectors - Element 241.4

The connectors were furnished as part of the standby diesel generators (D/Gs) at SQN, WBN, and BFN. TVA discovered that the installation method of the connectors was inadequate at SQN, as the result of mismatched pipe threads, resulted in loose electrical connections causing one D/G to respond incorrectly during testing. This deficiency was corrected by TVA by installing adapters at SQN, and when TVA notified them of the problem, the manufacturer issued a service bulletin to advise other users. A review of the actions taken by BFN and WBN, in light of SQN's problem and the service bulletin, revealed several instances where connectors could be worked loose with a slight movement or with hand turning of the connector assemblies. This condition exists despite the fact that correct adapters, as recommended in the service bulletin, have been installed at BFN and WBN. The work to install the recommended adapters was not documented. Therefore, additional corrective actions are required at BFN and WBN to prevent the occurrence of the problem of the D/Gs not performing as required. The vendor of the diesel generator for BLN is not the same as for SQN, WBN, and BFN. Therefore, the concern is not applicable to BLN. [Evaluation process steps used: a through h]

References to support the findings:

SQN: 2.02, 2.03, 3.23, 3.40, 3.61, 9.19
WBN: 2.02, 3.42, 3.43, 9.19, 9.39, 9.41, 9.63
BFN: 2.02, 3.44, 3.45, 9.19, 9.40, 9.42

4.2.13 Wire Corrosion in Containment Penetrations - Element 241.5

This element addresses the concern that corrosion of penetration wiring and deterioration of sealant material could result from environmental effects and this could cause a breakdown in the integrity of electrical containment penetrations. The concern was not substantiated at WBN, SQN, and BLN because existing documents and walkdowns did not indicate that the plants' containment penetrations have the described problem. However, TVA discovered a problem at WBN not directly related. This problem involves crazing or cracking of sealant material in penetrations manufactured by Conax. The manufacturer (Ref. 9.60) has determined that this problem does not affect the performance

of penetrations and, therefore, no corrective action is required. TVA has implemented an inspection on unit 1 penetrations at WBN to address environmental qualification (EQ) deficiencies not related to the concern, and the absence of unit 2 inspection has been identified for TVA resolution (peripheral finding). In addition, the evaluators found that BFN has EQ deficiencies requiring corrective action; these are (1) the lack of thermal and radiation test data to demonstrate qualification of connectors used with Physical Sciences Corp. penetrations, (2) failure to include in the EQ program the nonclass 1E penetrations that are part of the containment pressure boundary, and (3) the EQ binders to date do not cover unit 1 and 3 penetrations (peripheral finding). These additional findings are safety related. [Evaluation process steps used: a, and c through g]

References to support the findings:

SQN: 2.11, 5.01, 9.11, 9.60
WBN: 2.11, 5.01, 5.31, 9.11, 9.61, 9.62
BFN: 2.06, 2.08, 2.09, 2.10, 5.01, 5.22, 9.11, 9.30
BLN: 2.11, 5.01, 9.11

4.3 Summary of Subcategory Findings

A list 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 237.4, Finding b), Table 2 counts only a single classification. Thus Table 2 identifies one finding for each issue evaluated. Of the 119 findings identified in Table 1, 59 require no corrective action. Of the remaining 60 findings, ten had corrective actions initiated before the ECTG evaluation, 42 had new corrective actions identified, and eight were peripheral findings that required corrective action. From this table, it can be seen that at Watts Bar, where all of the findings were originated, 20 findings out of a total of 37 were found to be valid and required corrective action, and five of those 20 had corrective action initiated before the ECTG evaluation.

5. CORRECTIVE ACTIONS

The general areas of corrective action are described below for each element reviewed for this subcategory. Table 1 identifies the elements that have findings requiring corrective action. The corrective action descriptions in Table 3 are a condensation of the more detailed information provided in Attachment 8. The plant requiring corrective action is indicated by the Corrective Action Tracking Document (CATD) column, where the applicable plant is identified within the CATD number. This section presents the required corrective actions only to provide an overview of the resolutions of the problems that were identified.

5.1 Access to Equipment - Element 234.0

The corrective actions required for the resolution of the generic accessibility problems are discussed in Subcategory Report 30500 (Ref. 9.29).

5.2 480V Power Receptacles Unsafe - Element 235.1

TVA revised the master bill of materials to specify acceptable mating plugs. No further corrective action is required.

5.3 Exposed 480V Bus at Panel Top - Element 235.2

As a result of the employee concern, WBN sealed cable entry area openings to prevent water from entering 480 V motor control centers through the cable entry area, and issued a detailed drawing to cover the installation. BFN has committed to performing similar actions before restart and has documented the deficiency in a CAQR (Ref. 5.23).

5.4 PVC Jacketed Flexible Conduit - Element 235.8

WBN has stated in its corrective action plan that the PVC jacketed conduit is not required to be qualified for the harsh environment and no beta radiation reduction by the conduit is taken into account for qualifying cables. The evaluation team finds the WBN position acceptable after review of the EQ cable binder. To resolve open items found in the WBN cable binders, WBN has issued a new procedure that controls the EQ program and resolution of open items. SQN completed an analysis to justify the use of PVC jacketed flexible conduit in a harsh environment. The analysis takes into account the beta radiation reduction by the flexible conduit with PVC jacket. BFN will complete an environmental qualification documentation package (EQDP) to justify that beta radiation reduction by the PVC jacket of the flexible conduit is not required; however, it may take into account the radiation reduction by the flexible conduit without the PVC jacket.

5.5 Malfunction of Westinghouse W-2 Switch - Element 235.11

Before restart, SQN will: (1) identify all W-2 switches used in safety-related circuits; (2) review each application to ensure switch malfunction will be detectable by the operators; (3) advise operators of effect on control board status lights due to switch malfunction; and (4) revise drawings to prevent recurrence of the misleading indication problem. After restart, SQN will: (1) update, if required, the response to NRC Bulletin 80-20 (Ref. 2.12); (2) ensure that all W-2 switch circuits are identified and modified; and (3) prevent recurrence of the problem by closing the CAQR issued in response to the findings. WBN's action will be similar to SQN's except that SQN's before-restart items (1) and (2) are not applicable.

5.6 Bypass of Thermal Overload and Over-Torque Limit Switches - Elements 237.1 and 237.4

To accurately reflect the design in the FSAR, SQN, WBN, and BLN have committed to provide an FSAR update for compliance with Regulatory Guide 1.106 (Ref. 2.16). Design basis documents will be issued for SQN, BFN, and BLN to define requirements for compliance with the regulatory guide and for the torque switch bypass design. The documents have been issued at WBN, but one (a calculation), while establishing requirements for thermal overload relay bypass, did not include torque switch bypass, and this will be corrected. SQN and WBN will take action to ensure that the valves listed in the Technical Specifications are consistent with those in the design documents for thermal overload protection. BFN will cancel ECN L2071, which was initiated to add the thermal overload relay bypass to meet the regulatory guide (BFN is not committed to the regulatory guide). Also, BFN indicates that valves required for accident mitigation will have a hardwired bypass of the thermal overload relay and other active valves will have oversized thermal overload heaters installed. The adequacy of existing thermal overload heaters at SQN and BFN will be demonstrated by calculations; at BFN, this demonstration will be part of the action required by SCR BFNEEB8536 (Ref. 5.26). In addition, both SQN and WBN will perform a drawing review to verify that all the valves that require torque switch bypass do have them, and WBN will include verification of thermal overload relay bypass as well. BFN indicates that a review was performed in 1983 and the NRC inspections of this review in 1985 determined that no additional followup is needed. BLN will issue a design basis document to resolve the present discrepancies on torque switch and thermal overload relay bypasses, and will revise design output documents as appropriate to comply with the established design basis. TVA will revise the standard drawings to clarify the torque switch bypass for MOVs.

5.7 400 to 500 Breakers Unacceptably Set - Element 237.2

All plants will have calculations to document the adequacy of breaker trip settings and/or thermal overload relays in circuits to verify proper coordination of the overcurrent protective devices. The calculations are being or will be prepared as required by recently established TVA Electrical Engineering Branch policies. TVA will revise the applicable design standard and design guide to provide criteria for fault protection of small motors and will clarify conformance with the NEC (Ref. 8.01). SQN and BLN will revise applicable design criteria to require that exceptions to established criteria have documented justifications. In addition, SQN, WBN, and BFN will have calculations to document the adequacy of fuses used in circuits such as for valves to demonstrate that the full range of short circuit protection exists.

5.8 Gassing of Current Transformers - Element 237.6

TVA will complete the previously established diagnostic testing and monitoring programs. WBN is in the process of replacing the oil-filled CTs with SF_6 insulated CTs. This replacement is to be completed before the unit 1 fuel load date.

5.9 Inadequate Splicing and Termination Practices and Procedures - Element 241.1

To provide assurance that all splices subject to flooding are adequate, each plant has committed to verify the adequacy of such splices. This would include a review for improperly installed splices as noted in NRC Information Notice 86-53 (Ref. 2.15). To provide records of splices made, SQN, BFN, and BLN have committed to document the cable splice materials and identify all splices and their locations. WBN has indicated that the inspection for inadequate 6.9 kV cable splices will include units 1 and 2, and systems common to both units. SQN, WBN, and BLN will correct the deficiencies regarding the operation of sump pumps and will improve the maintenance of electrical manholes.

5.10 Crimp Connections - Element 241.2

The problem of using incorrect terminal lugs on solid conductors is addressed by reworking (replacing or soldering) the lugs at SQN, WBN, and BFN. SQN intends to rework all installations except where engineering analysis shows that a failure would not be a safety concern. WBN indicates that rework is already in process to correct installations in both units. BFN indicates that rework will be dependent on the results of the walkdown inspections to be performed on solenoid valve circuits, and that other types of circuits were found not to have this problem. No corrective action is required at BLN.

5.11 Amphenol Connectors - Element 241.4

To ensure that the connectors in the BFN and WBN diesel generators will not become loose, TVA commits to: (1) investigate reasons for the looseness including review for possible deficiencies in design or procurement requirements for safety-related equipment subject to vibration and (2) document in a condition adverse to quality report any deficiencies found.

5.12 Wire Corrosion in Containment Penetrations - Element 241.5

To complete resolution of environmental qualification deficiencies found in containment penetrations, WBN has committed to complete the inspection of unit 2 penetrations. To resolve the problem of a lack of qualification data on the connectors associated with the Physical Science Corp. penetrations, BFN committed to replace such penetrations in safety-related service with qualified penetrations. Therefore, a supplementary response to IE Bulletin 77-05/77-05A (Refs. 2.08 and 2.09) will not be required. BFN indicates that all electrical penetrations, including those made by Physical Sciences, have been qualified to maintain the containment pressure boundary integrity under design basis event and documentation is in the files. BFN also committed to include the units 1 and 3 penetrations in the EQ program which has been started to meet all 10 CFR 50.49 requirements.

5.13 Corrective Action Plans

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

6. CAUSES

Table 3 identifies the cause for each problem requiring corrective action. In general, for each corrective action, the most important cause is identified; however, in some instances it was felt that if the problem was the result of a combination of causes, each cause should be identified. The totals from Table 3 show that the causes are diverse in the management and design process effectiveness areas, with a few in the technical adequacy area. The basis for this observation is discussed below.

6.1 Management Effectiveness

"Fragmented Organization," "Inadequate Communications," and "Lack of Management Attention" are identified in Table 3 as frequent contributors to the findings. For example, these causes led to a fragmented approach to the

review for compliance with commitments made on IE Bulletin 80-20 and licensing documents not reflecting design; delays in actions taken to resolve cable splicing and connectors; and the lack of management attention regarding environmental qualification problem of penetrations. In particular, "Fragmented Organization," though it is not the sole cause identified for the findings in elements 235.11 and 237.1, is viewed as a problem in the licensing area because it could not be established that TVA commitments relative to IE Bulletin 80-20 have been reflected in the actual design and that the thermal overload protection design for MOVs is reflective of the commitments made in the plants' FSARs and technical specifications. The corrective actions committed to should aid in improving this area.

6.2 Design Process Effectiveness

In general, the design process was not well documented. Instances were found where lack of design basis, calculations, and documentation contributed to some uncertainty regarding the design process. For example, these instances appeared in the elements concerning thermal overload protection of motor-operated valves (237.1) and circuit breakers (237.2). In addition, the lack of proper sealing of cable entrances (235.2) is viewed as not meeting TVA's electrical design standard requirements for protection of electrical equipment from water damage. Completion of TVA's corrective actions should remove the uncertainty and provide the needed direction to have design requirements accurately reflected in design output documents.

As a result of the fragmented engineering organization, there was no centralized/uniform tracking or logging system for electrical calculations. This condition significantly reduced the effectiveness of design and design verification to ensure compliance with the established design basis. It also caused the lack of proper coordination between design basis documents (standards, guides, design criteria, project instructions, quality information request/release (QIR), special engineering procedures, etc.). The applicability of these design basis documents to a particular electrical system was not well organized. The lack of complete interface references in these documents made it difficult and ineffective to ensure complete design verification. In particular, this condition significantly hindered the designer in listing properly all the essential references in the calculations needed to identify design basis and commitments.

6.3 Technical Adequacy

In general, the system designs and related equipment installations were not adequately documented to verify that the design basis and commitments have been met in the actual installations. This inadequacy was found in the review

of the issues relating to Westinghouse W-2 switches, thermal overload selection, and torque switch bypass design for MOVs, selection of overcurrent protective devices, and cable splices. This resulted mostly from the lack of design process effectiveness discussed in Section 6.2.

6.4 Generic Causes

Supplementary to the causes of negative findings identified in Table 3, the following generic causes provide additional linkage from the findings to the corrective actions.

6.4.1 Design and Design Basis Development

The electrical design period of the individual units of the four nuclear plants extends to more than 20 years. Within this time span, significant changes were adopted to the licensing requirements and to the design basis documents controlled inside and outside the TVA organization. The actual design of the units implemented the design basis valid at that time, but the adjustment to the changing requirement had its limitation. At the earliest time of design development, a very limited number of TVA controlled design basis documents (design standards, criteria, guides) were available for nuclear design. The original design was mostly based on general industry standards and engineering practices. Documentation of conformance to the design basis was very limited.

6.4.2 Design Basis Documentation

On the basis of the above reasons, it is not possible to support the original design with adequate documentation, as required today, without reevaluating the present plant configuration, and reconstructing the past design basis and evaluating their validity in view of the present requirements. A significant number of findings were caused by the lack of this documentation.

6.4.3 Fragmented Engineering

The evolution of nuclear power plant electrical design during the past 20 years in TVA made it unavoidable that the designs of the individual plant units do not follow the same design basis. The responsibilities of Project Engineering personnel and the Engineering Branches were not well defined. This made the engineering design basis fragmented. TVA had no centralized organization to provide uniform design basis or properly document significant deviations from a uniform design basis, as represented by the DNE design standards and guides. This fragmented engineering method is reflected in a

significant number of findings. It also surfaces in having different corrective actions to resolve the basically same finding for each plant, in line with the applicable design basis.

6.4.4 Fragmented Design Basis Documents

TVA design basis documents were developed at more than one organization level and over a long time period. The number of design basis documents applicable to a specific design area increased to such a level (design standard, criteria, guide, project instruction, quality information request/release, policy memo, etc.), that without centralized coordination (from a designer's point of view) it is hardly possible to identify all design basis documents applicable to a specific design. The fragmented nature of this document group makes it difficult for the designer to identify all applicable design basis to a specific calculation, assure conformance, and proper reference. These design basis documents do not have coordinated interfacing references to establish applicability and assure traceability. In addition, deviations by the individual plant unit design from the generic DNE design basis documents were not adequately documented in the original/early design period.

7. COLLECTIVE SIGNIFICANCE

7.1 Collective Significance of Causes

As can be seen from the significance columns of Table 3, a number of actions are judged to have potential design margin or hardware changes. The lack of clear documentation that the PVC-jacketed conduit and its cables are qualified for the harsh environment of the containment, raises questions whether the safety-related components connected to them can perform, after long-term exposure, to mitigate potential accidents. The lack of a clear demonstration that motor-operated valves have the proper thermal overload protection and torque switch bypass design indicates that there is a potential for more than one valve of different safety-related systems to fail to operate properly for accident mitigation. Similarly, improperly selected circuit breakers and fuses create the potential for losing more than one safety-related power system and its loads. Problems in the cable termination and splicing areas are associated with safety-related systems, and inadequate cable connections could affect more than one safety-related system's performance during normal and abnormal plant operations. The safety significance of these issues cannot be determined until the associated identifications and inspections are completed.

The lack of a centralized/uniform logging and tracking system for calculations and the incomplete interface referencing and coordination of design basis documents reduced the effectiveness of the design and design verification processes. It also decreased the assurance that the completed design was in full compliance with the design basis and commitments, and caused delays in closing out problems by timely corrective action.

The personnel safety issues were found not to be problems that would endanger personnel performing maintenance activities in or around energized equipment, provided established safety procedures are adhered to.

Several of the systems design issues were found to be technically significant and could have impacted plant safety. These are being resolved by TVA's corrective actions. Although TVA's corrective actions adequately address the specific findings identified at the element level, it is believed that broader issues need to be addressed. These issues relate to: the adequacy of technical guidance from the Electrical Branch chief engineer to the project design personnel; monitoring of the design process to determine if design standards, criteria, and guides are coordinated properly and used effectively; whether the design verification is satisfactory; exchange of experience among sites or projects and outside industry groups; and managing the interface with NRC to assure identification and appropriate action on safety issues.

7.2 Resolutions of Causes

The significant findings and their corrective actions indicate improvements are needed in the areas of design basis, design process, and licensing. TVA has developed a Corporate Nuclear Performance Plan (CNPP, Ref. 9.37) to correct programmatic and management deficiencies that have contributed to the poor direction and control of TVA's nuclear activities.

The following paragraphs highlight established CNPP programs which are expected to resolve the inadequacies identified in this report and, when properly implemented, to prevent recurrence.

- Consolidation of Responsibility - The responsibility for all nuclear engineering activities has been consolidated in the Division of Nuclear Engineering (DNE); the division is accountable for all technical adequacy. The engineering for each nuclear plant is assigned to a project engineer, located at the plant site, who ensures that technical direction provided by the chief discipline engineers is followed for project work. This establishes clear lines of authority and responsibility for nuclear engineering activities. Technical direction and reviews for all projects will emanate from one source, the responsible technical branch of DNE.

- Design Basis and Verification - The development of the design basis document (DBD) as a single source is established by NEP-3.2. Its technical adequacy, correctness, and completeness are ensured by the Design Baseline and Verification Program.

- Engineering Assurance (EA) - The EA organization is established within the ONE. Its functions include:

  - Issuing and controlling quality-related NE procedures
  - Verifying that engineering procedures properly interface
  - Conducting audits to assess compliance with NE procedures
  - Conducting in-depth audits to assess the technical adequacy of engineering work, including design basis and verification

- Nuclear Procedures - The Nuclear Procedures Branch (NPB) will restructure the procedure system and assure that nuclear procedures are in place. It will revise procedures at each site to correct document deficiencies to reflect the new organization and the installed plant modifications.

- Management Information System - The responsibility of the Management Information System is to develop and maintain a data base for design and configuration control, technical and construction information, testing, maintenance, and operation support. The system will ensure that nuclear activities will be adequately integrated and performed in a timely manner.

- Commitment Tracking - The Corporate Commitment Tracking System (CCTS) will provide an integrated data base to track all formal commitments made to the NRC in order to ensure that all licensing commitments will be met.

- Corrective Action Program - The Tracking and Reporting of Open Items (TROI) system contains provisions for timely resolution of conditions adverse to quality (CAQ); it is implementing a centralized system to track CAQs and assess their significance. This will ensure that each CAQ will be individually analyzed to determine its root cause and to recommend action to remedy that cause. It informs the management of any significant CAQ and any adverse trend.

- Nuclear Operating Experience Review Program - Under this program, significant problems or events identified at other nuclear plants by NRC, INPO, NSSS vendors, and others, and significant events identified at TVA's nuclear plants will be made the subject of an experience review report. A corporate nuclear experience data base is being developed to interface with all facets of the TVA nuclear organization. The program will provide means for developing remedial or preventive action for those problems which are determined to be applicable to TVA's nuclear plants.

In addition to the above programs established by the CNPP, TVA-ONE implemented (Refs. 3.54 and 4.25) a comprehensive calculation status tracking system, the Calculation Cross Reference Information System (CCRIS). The system will track calculations supporting engineering design outputs and interactions between calculations and modifications. Features of the CCRIS include integration of calculations from the four ONE technical branches, identification of analyses required to support design changes, and identification of interface links between calculations.

7.3 Summary

Consolidating and centralizing nuclear engineering activities with clearly defined responsibility and authority should assure improved technical direction and design reviews. In addition, TVA will strengthen the licensing process for assuring timely, complete, and technically adequate licensing submittals for all plants, and will improve communications with the NRC. The strengthened role of QA and the Engineering Assurance organizations will improve the monitoring of technical performance, identification of problems, and bringing about of resolutions through feedback to Engineering Management. The TVA CNPP (Ref. 9.37) addresses all of these issues through the restructuring of TVA's organization and the implementation of the above-listed programs. These issues will be re-examined from a wider perspective at the Engineering Category level.

TABLE 1

CLASSIFICATION OF FINDINGS AND CORRECTIVE ACTIONS

	Element	Issue/ Finding**	Finding/Corrective Action Class* SQN	WBN	BFN	BLN
234.0	Access to Equipment	a	-	B	-	-
235.1	480 V Power Receptacles Unsafe	a	A	A	A	A
		b	E3	-	-	-
235.2	Exposed 480 V Bus at Panel Top	a	A	C1	D1	B
235.3	Hand Switch Location Violates Regulatory Requirements	a	-	B	-	-
235.4	Exposed HV Cable Routed without Raceway	a	A	A	-	-
235.5	Low Voltage and High Voltage Termination	a	-	A	-	-
		b	-	C1	-	-
235.6	Exposed 480 V Bus Inside Unlocked Panel Door	a	-	A	-	-
		b	-	A	-	-
235.7	Emergency Lighting Improperly Wired	a	-	A	-	-
235.8	PVC Jacketed Flexible Conduit	a	D5	D5	B	-
		b	E6	E2	E5	-
235.10	480 V Power Receptacles Use of Incorrect Wire Size, Unsafe	a	-	A	-	-
235.11	Malfunction of Westinghouse W-2 Switch	a	D3	D3	A	A
			D4	D6	-	-
			D6		-	-

* Explanation of classes is on last page of table.
** Defined for each plant in Attachment B.

TABLE 1 (Cont'd)

	Element	Issue/ Finding**	Finding/Corrective Action Class* SQN	WBN	BFN	BLN
237.1	Bypass of Thermal Overload and Over-Torque Limit Switches	a	D3	D3	A	D3
		b	D3	C1	A	A
			D5	-	-	-
		c	D5	D3	D3	D3
			-	D5	D5	-
			-	D6	D6	-
237.2	400-500 Breakers Unacceptably Set	a	D6	D6	D6	D6
			D3	D3	D3	D3
		b	D3	D6	D3	D3
		c	D6	D6	D6	A
		d	D6	D3	-	-
237.4	Bypass of Over-Torque Limit Switches (SQN only)	a	C1	-	-	-
		b	D3	-	-	-
			D5	-	-	-
			D6	-	-	-
237.6	Gassing of Current Transformers	a	B	B	B	B
		b	B	B	B	B
		c	B	B	B	B
		d	B	B	B	B
		e	A	A	A	A
		f	C6	C1	C6	C6
			-	C6	-	-
241.1	Inadequate Splicing and Termination Practices and Procedures	a	D6	D6	D6	D6
		b	D6	D6	B	D6
		c	D6	D6	B	D6
241.2	Crimp Connections	a	C1	C1	D1	A
241.3	Megger Tests on Low Voltage Cables	a	A	A	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	WBN	BFN	BLN
241.4	Amphenol Connectors	a	B	D2	D2	-
		b	B	D2	D2	-
241.5	Wire Corrosion in Containment Penetrations	a	A	A	A	A
		b	A	A	A	A
		c	-	E6	E6	-
		d	-	-	E6	-
		e	-	-	E6	-

*Classification of Findings and Corrective Actions

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

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

**Defined for each plant in Attachment B.

TABLE 2

FINDINGS SUMMARY

Classification of Findings	Plant				Total
	SQN	WBN	BFN	BLN	
A. Issue not valid. No corrective action required.	7	11	8	9	35
B. Issue valid but consequences acceptable. No corrective action required.	6	6	7	5	24
C. Issue valid. Corrective action initiated before ECTG evaluation.	3	5	1	1	10
D. Issue valid. Corrective action taken as a result of ECTG evaluation.	13	13	9	7	42
E. Peripheral issue uncovered during ECTG evaluation. Corrective action required.	2	2	4	0	8
Total	31	37	29	22	119

ELEM	FINDING/ CORRECTIVE ACTION CLASS.**	CORRECTIVE ACTION	CATD	CAUSES OF NEGATIVE FINDINGS *																	Significance of Corrective Actions*		
				MANAGEMENT EFFECTIVENESS							DESIGN PROCESS EFFECTIVENESS							TECHNICAL ADEQUACY					
				1 Fragmented Organization	2 Inadequate Q-trng	3 Inadequate Procedures	4 Procedures Not Followed	5 Inadequate Communication	6 Untimely Res of Issues	7 Lack of Mgt Atten	8 Inadequate Design Bases	9 Inadequate Calcs	10 Inadequate As-blt Recon-ctl.	11 Lack of Design Detail	12 Engrg Judgmt not Documented	13 Design Crit/ Commit Not Met	14 Insuf. Verif Documentation	15 Stds Not Followed	16 Engrg Error	17 Vendor Error	D	M	H
235.2	C1	Seal MCC cable openings, issue sealing detail drawing	WBN action completed													X		•			A	-	A
	D1	(Same as above)	BFN 01																				
235.8	D5	Justify use of PVC jacketed flexible conduit	SQN 01 WBN 01 BFN 01														X				A	P	-
	E5	(Same as above)																					
	E2	Resolve cable qualification open items	WBN 02			X				X											A	P	P
	E6	Clarify purpose of PVC conduit	SQN 02														X				A	-	-
235.11	D3	Update IE Bulletin 80-20 response	SQN 01 WBN 01	X												X					A	-	-
	D6	Complete review and ensure all M-2 switch circuits are identified and appropriately modified	SQN 02 SQN 04 WBN 03	X												X					A	-	-
	D4	Advise operators on effect of M-2 switch malfunction	SQN 01	X																	A	-	-
	D3	Prevent recurrence of valve indication problem	SQN 03 SQN 05 WBN 02 WBN 04											X		X					A	-	-
237.1 237.4	D3	Update FSAR and/or issue design basis to reflect compliance with Regulatory Guide 1.106 and/or to define requirements for torque switch bypass	SQN 01 SQN 02 SQN 01 (237.4) WBN 01 WBN 02 BFN 04 BLN 01 BLN 02	X							X										A	-	-

* Defined in the Glossary Supplement.

** Defined in Table 1.

TABLE 3
MATRIX OF ELEMENTS, CORRECTIVE ACTIONS, AND CAUSES
SUBCATEGORY 26500

ELEM	FINDING/ CORRECTIVE ACTION CLASS.**	CORRECTIVE ACTION	CATD	CAUSES OF NEGATIVE FINDINGS * — MANAGEMENT EFFECTIVENESS 1 Fragmented Organization	2 Inadequate Q-Prog	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.	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	H	H
	05	Ensure valves listed in NRC Technical Specifications are consistent with the design	SQN 04 SQN 01 (237.4) WBN 04	X							X										A	-	-
	05	Ensure existing thermal overload heaters are adequate	SQN 03 BFN 01 BFN 02									X			X						A	P	P
	03	Revise drawings to clarify torque switch bypass design	SQN 02 (237.4)					X						X							A	-	-
	06	Verify required valves have thermal overload bypass (WBN) and/or torque switch bypass (SQN, WBN, BFN)	SQN 02 (237.4) WBN 03 BFN 05								X						X				A	P	P
	03	Establish status of ECN L2071	BFN 03					X													A	-	-
237.2	06	Verify adequacy of existing trip settings of circuit breakers and/or thermal overloads	SQN 01 SQN 02 WBN 02 WBN 05 BFN 01 BFN 02 BFN 04 BLN 01 BLN 02 BLN 03									X						X				A	P	P
	03	Provide criteria for fault protection of small motors and clarify conformance with National Electric Code (NEC)	SQN 03 WBN 01 NPS 03 NPS 05								X							X				A	-	P
	03	Revise design criteria to require exceptions be justified and documented	SQN 05 BLN 04				X															A	-	-
	06	Document adequacy of fuses for full short circuit protection	SQN 04 WBN 03 WBN 04 BFN 06									X						X				A	P	P

* Defined in the Glossary Supplement.
** See [illegible] in Table 1.

ELEM	FINDING/ CORRECTIVE ACTION CLASS.**	CORRECTIVE ACTION	CATD	CAUSES OF NEGATIVE FINDINGS *																	Significance of Corrective Actions*		
				MANAGEMENT EFFECTIVENESS							DESIGN PROCESS EFFECTIVENESS							TECHNICAL ADEQUACY					
				1 Fragmented Organization	2 Inadequate Utilization	3 Inadequate Procedures	4 Procedures Not Followed	5 Inadequate Communication	6 Untimely Res of Issues	7 Lack of Mgt Atten	8 Inadequate Design Bases	9 Inadequate Calcs	10 Inadequate As-blt Reconcil.	11 Lack of Design Detail	12 Engrg Judgmt not Documented	13 Design Crit/ Comnlt Met	14 Insuf. Verif Documentation	15 Stds Not Followed	16 Engrg Error	17 Vendor Error	D	M	H
	03	Establish completion of changes for replacing and/or resetting circuit breakers and fuses	WBN 06					X													A	-	-
237.6	C1	Replace oil-filled CTs	WBN 01								X										-	-	A
241.1	06	Verify adequacy of cable splices subject to flooding	SQN 01 WBN 02 BFN 02 BLN 01						X				X				X				A	P	P
	06	Document cable splice materials and identify all splices and their locations	SQN 02 SQN 03 BFN 01 BLN 02										X								A	-	-
	06	Complete inspection for inadequate 6.9 kV cable splices	WBN 01 BLN 03				X														A	-	P
241.2	C1	Rework terminal lugs used in solid conductors	SQN 01 SQN 02 WBN 01			X														X	A	P	A
	01		BFN 01																				
241.4	02	Ensure connectors in diesel generators will not become loose	WBN 01 WBN 02 BFN 01						X											X	A	P	P
241.5	E6	Inspect unit 2 containment penetrations for environmental qualification deficiencies	WBN 01							X											A	P	P
	E6	Ensure environmental qualification of all containment penetrations	BFN 01 BFN 02 BFN 03							X						X					A	P	P
			TOTALS	5	-	2	2	3	2	3	5	3	2	2	1	5	6	1	-	2			

* Defined in the Glossary Supplement.
** Defined in Table 1.

GLOSSARY SUPPLEMENT
FOR THE ENGINEERING CATEGORY

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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.

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

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 26500

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

ATTACHMENT A

EMPLOYEE CONCERNS FOR SUBCATEGORY 26500

ELEMENT	CONCERN NUMBER	PLANT LOCATION	APPLICABILITY SQN	WBN	BFN	BLN	CONCERN DESCRIPTION*
234.0	EX-85-140-001	WBN		X			"A cable tray and hangers had to be cut out to allow enough room to remove a chiller motor which burned out. Poor design. Motor has been replaced. 737' level of Aux. Bldg., Unit 2, close to column 2 or 3." (NO)
235.1	WBM-85-002-003	WBN	X	X	X	X	"There are no means of disconnect provided immediately above 480 V receptacles to prevent flash burns caused by insertion, or removing." (NO)
	EX-85-154-007 (shared with 90000)	WBN	X	X	X	X	"Personnel safety is seriously endangered by lack of disconnect switches at 480 volt welding outlets. Many personnel who connect and disconnect welding conductors to these outlets might not know if circuits are energized. Removing or inserting the plug while energized could cause an explosion and could embed small metallic particles in the arms, face and torso of the person." (NO)
235.2	IN-85-064-002	WBN	X	X	X	X	"480V shutdown boards (El. 757 A2R and A14T) feeders to bus bar compartments. The cabinets are open on top where the conduits enter the MCC." (SR)
235.3	IN-85-425-003	WBN		X			"Hand switches in Unit 2 are often paired in a single junction box. This box is placed near one of the valves, but 18'-20' from the other one which is often out of the direct line of sight. Regulatory requirements are violated. Valve #3 in the 692' pipechase and valve #11 in the 713' pipechase, both in System 63 "B-Train," are provided as specific examples. Systems 62, 63, 72 and 74 in the Unit 2 pipechases are identified as generic examples." (SR)
235.4	IN-85-749-001	WBN	X	X			"High voltage cables are laid around edge of rooms (such as raceway in Reactor #2) without protection from damage to insulation. These areas are often flooded, and could pose a threat of shock hazard to workers if insulation were damaged." (NO)
235.5	IN-85-772-004	WBN		X			"Low voltage controls for control rod drive motor generator coolers are located in high voltage box. Location: auxiliary building, motor generator cooling room, elevation 786' Unit 1 side: A4 & 5 line. For reaching the controls in high voltage box for troubleshooting purposes, a safety hazard occurs. Also, thermostats are improperly mounted on equipment instead of a wall or fixed surface." (NO)

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

ELEMENT	CONCERN NUMBER	PLANT LOCATION	APPLICABILITY SQN	WBN	BFN	BLN	CONCERN DESCRIPTION*
235.6	IN-85-902-001	WBN		X			"MCC's elevation 772' in Aux. bldg. The 480 volt feed cabinets should be locked or in some way protected against easy access to exposed bus bars. Also, if the door is caved in, the hot bar is only 5" inside the door. Directions: Unit 2 Aux. Bldg., 772' elev. (coming up stairs from 757" ele.) go through door, turn left, then go down long hallway on right through first set of doors (Now on Unit 1 side). There is a feed cabinet for each of 4 rows. Construction dept. concern." (NO)
	IN-85-794-001	WBN		X			The M.O.V. board cabinet (Elev 772') has a 480V bus approx. 3" inside the door which is not protected. The door to this cabinet is not locked and the bus is energized. This situation has been reported to the safety department but no action has been taken." (NO)
235.7	IN-85-942-001	WBN		X			"Problem exist in the wiring design in the emergency lighting system in parts of the plant, especially the Auxiliary Building. Example: Emergency lights are fed from the 277 Volt lighting in the Aux. Building on El. 713. If a hot leg is lost, the back feed from the remaining hot leg will not allow the emergency light to come on. Location of lighting panel in approx. A3R line, elev. 713, Aux. Bldg and specific emergency light with this problem is located at approx. A5R line on the westward stairwell, elev. 713, Aux. Bldg." (NO)
235.8	IN-85-973-003	WBN	X	X	X		"Plastic type flex conduit installed between instruments and for all floor mounted panels (Units 1 and 2) cannot withstand heat generated in containment and valve rooms. CI stated a friend (known) said that all such installations had to be changed at Sequoyah. CI could not provide specific panel/conduit I.D. #'s. Engineer (known) has been contacted, as has Knoxville engineering, but no action has been taken. Construction department concern. Both units. 1985." (SR)
235.9		DELETED					
235.10	IN-85-913-003	WBN		X			"480V welding receptacles located throughout the plant (particularly Auxilliary Diesel Generator Building) are designed to accept a maximum wire size of #4 and a minimum of #6 wire. TVA has installed #2 wire which creates a personnel safety hazard." (NO)
235.11	ECTG-3	NPS	X	X	X	X	"Valve wiring circuits allow red and green lights to operate at reduced voltage and light dimly, if at all, upon a malfunction of the P-auto contact of the Westinghouse W-2 control switch on the unit control board." (SR)

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

ATTACHMENT A

EMPLOYEE CONCERNS FOR SUBCATEGORY 26500

ELEMENT	CONCERN NUMBER	PLANT LOCATION	APPLICABILITY SQN	WBN	BFN	BLN	CONCERN DESCRIPTION*
237.1	WI-85-100-008	WBN	X	X	X	X	"Thermal overload bypass and indication problems involving Regulatory Guide 1.97. CI has no further information. Anonymous concern via letter." (SR)
	XX-85-122-024	SQN	X	X	X	X	"Thermal overload bypass and indication problems involving Regulatory Guide 1.97. CI has no further information. Anonymous concern via letter." (SR)
	XX-85-122-025	BLN	X	X	X	X	"Thermal overload bypass and indication problems involving Regulatory Guide 1.97. CI has no further information. Anonymous concern via letter." (SR)
	XX-85-122-026	BFN	X	X	X	X	"Thermal overload bypass and indication problems involving Regulatory Guide 1.97. CI has no further information. Anonymous concern via letter." (SR)
	XX-85-020-001	SQN	See 237.4	X	X	X	"An ECN #5971 was issued at Sequoyah in 1979 that required a bypass of the over-torque limit switches on certain limitorque operators. It was recently discovered (3-4 months ago) that this had not been accomplished for SIS valve #332 and 333. CI is concerned about ECN's applicability to WBNP." (SR)
237.2	WI-85-100-021	WBN	X	X	X	X	"Between 400 and 500 breakers were unacceptable set. EN DES practices and attitudes concerning these breakers were poor. The National Electrical Code and good engineering practices were violated." (SR)
	IN-85-332-001	WBN	X	X	X	X	"Limitorque valve operators are found without enough margin to provide for emergency operation. They are fused to protect motor, not the circuit. Example: ERCW valves in 5th diesel generator building are fused at 5.2 amps while running current is 4 amps. Generic to both units." (SR)
237.3			DELETED				
237.4	XX-85-020-001	SQN	X	See 237.1	See 237.1	See 237.1	"An ECN #5971 was issued at Sequoyah in 1979 that required a bypass of the over-torque limit switches on certain limitorque operators. It was recently discovered (3-4 months ago) that this had not been accomplished for SIS valve #332 and 333. CI is concerned about ECN's applicability to WBNP." (SR)
237.5			DELETED				
237.6	WI-85-060-N02	WBN	X	X	X	X	"TVA's problem with gasing of current transformers has led to outages of line and bus ties to obtain oil samples and determine gasing condition." (SR)

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

ATTACHMENT A

EMPLOYEE CONCERNS FOR SUBCATEGORY 26500

ELEMENT	CONCERN NUMBER	PLANT LOCATION	APPLICABILITY SQN	WBN	BFN	BLN	CONCERN DESCRIPTION*
241.1	IN-85-392-001	WBN	X	X	X	X	"What would happen with the large number of electrical splices located underground if the system became flooded? 1. Would the splice hold up under long exposure to moisture? 2. If the splice failed would a safety-related problem occur? 3. Would a back-up system be activated?" (SR)
241.2	PH-85-003-003	WBN	X	X	X	X	"The practice of terminating diodes and rectifiers without soldering the wiring but only splicing by crimping to the lead-ins needs to be reevaluated for quality construction. Control room 757' elev." (SR)
	JLH-85-004	SQN	X	X	X	X	"PIDG lugs have apparently been used for making crimps on solid conductors resulting in reduced current capacity for CSSC fire dampers." (SR)
241.3	XX-85-094-006	BLN	X	X	X	X	"Electrical terminations do not have low voltage megger tests." (SR)
241.4	BMP-85-001	SQN	X	X	X		"Installation method of amphenol connectors on actuators of standby diesel generator could contribute to unreliable operation of diesels." (SR)
241.5	ECTG-6	WBN	X	X	X	X	"Corrosion of wiring through the the penetration, breakdown of the sealant that is potted around the conductors as part of the penetration, resulting from breakdown because of the environment, they either violated -- used the wrong one, wrong application -- a breakdown of insulation, wrong application." (SR)

* SR/ND/SS indicates safety related, not safety related, or safety significant per determination criteria in the ECTG Program manual and applied by TVA before evaluations.

ATTACHMENT B

SUMMARY OF ISSUES, FINDINGS, AND
CORRECTIVE ACTIONS FOR
SUBCATEGORY 26500

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.

Issues	Findings	Corrective Actions
********** Element 234.0 - Access to Equipment **********		
SQN (Not to be evaluated)	SQN	SQN
WBN	WBN	WBN
a. Poor design resulted in inadequate space for removal of a chiller motor (which had burned out) resulting in the need to cut out a cable tray and some hangers.	a. The evaluation team confirmed by arrangement and composite drawing review and by walkdowns that there is congestion where all the chiller motors are located. Based on the findings of Subcategory Report 30500 (Ref. 9.29), the general condition of maintenance accessibility problem resulting from design inadequacies was substantiated.	a. Corrective action for this issue is covered by Subcategory Report 30500, Accessibility (Ref. 9.29). (CATDs 305 01 WBN 01, 02, and 03)
BFN (Not to be evaluated)	BFN	BFN
BLN (Not to be evaluated)	BLN	BLN

Issues	Findings	Corrective Actions
********** Element 235.1 - 480 V Power Receptacles Unsafe **********		
SQN	SQN	SQN
a. No means of disconnect provided at 480 V receptacles. Connect or disconnect of plugs from 480 V receptacles could cause flash burns and other injuries.	a. Electrical Design Standard DS-E-12.5.2 (Ref. 3.09) and the Master Bill of Materials (Ref. 9.13) do not specify the type of mating plug to be used with the specified receptacles. A field walkdown by the evaluation team identified the use of Crouse-Hinds (C-H) receptacles with Appleton plugs. Discussions with Underwriters Laboratories (UL), Tenn-OSHA, and Occupational Safety and Health Administration - Construction Industry Standards and Interpretations (OSHA) indicate that this type of product interchangeability is a general practice and no safety concerns or problems have been identified. Based on the construction of the assembly, the plug manufacturer (Appleton) lists it as an interchangeable part with the C-H plug. The interchangeability has been widely accepted by the industry, and because of its "circuit-breaking" capability it does not require a means of disconnect above the receptacle. The present installation of 480 V receptacles and mating plugs is acceptable and will not present any hazard to personnel safety.	a. None required.
b. Peripheral finding.	b. Without specified mating plugs required by the Electrical Design Standard and the Master Bill of Materials, there is no assurance that only acceptable "circuit breaking" plugs have been purchased and used.	THIS ITEM COMPLETED DATE: 8-17-88 There is assurance that receptacles will not accept mating plugs with a different rating. TVA revised the master bill of materials to specify acceptable mating plugs. [825 870717 009, 825 870612 010]. (CAIDs 235 01 SQN 01 and 02)
WBN	WBN	WBN
a. No means of disconnect provided at 480 V receptacles including welding outlets. Connect or disconnect of plugs from 480 V receptacles could cause flash burns and other injuries.	a. The Watts Bar Master Bill of Materials (Ref. 9.22) specifies the type of mating plug or equal to be used with the specified receptacles. A field walkdown by the evaluation team identified the use of C-H receptacles with Appleton plugs. This type of assembly is widely accepted by the industry and because of its "circuit-breaking" capability it does not require a means of disconnect above the receptacle. Furthermore, this assembly fully meets the requirements specified in the Master Bill of Materials.	a. None required.

Issues	Findings	Corrective Actions
Element 235.1 - BFN	BFN	BFN
a. No means of disconnect provided at 480 V receptacles. Connect or disconnect of plugs from 480 V receptacles could cause flash burns and other injuries.	a. The Browns Ferry Master Bill of Materials (Ref. 9.31) specifies the type of mating plug or equal to be used with the specified receptacles. A field walkdown by the evaluation team identified the use of C-H receptacles with Appleton plugs. This type of assembly is widely accepted by the industry and because of its "circuit-breaking" capability it does not require a means of disconnect above the receptacle. Furthermore, this assembly fully meets the requirements specified in the Master Bill of Materials.	a. None required.
BLN	BLN	BLN
a. No means of disconnect provided at 480 V receptacles including welding outlets. Connect or disconnect of plugs from 480 V receptacles could cause flash burns and other injuries.	a. The BLN Master Bill of Materials (Ref. 9.36) specifies the type of mating plug or equal to be used with the specified receptacles. A field walkdown by the evaluation team identified the use of C-H receptacles with Appleton and Russellstoll plugs. This type of assembly is widely accepted by the industry, and because of its "circuit-breaking" capability, it does not require a means of disconnect above the receptacle. Furthermore, this assembly fully meets the requirements specified in the Master Bill of Materials.	a. None required.
********** Element 235.2 - Exposed 480 V Bus at Panel Top **********		
SQN	SQN	SQN
a. Top of 480 V shutdown boards are open at conduit (cable) entry.	a. Based on the evaluation conducted, it was determined that construction specifications reflecting design requirements were observed in a walkdown (Ref. 9.47) to be correctly implemented at SQN for the concern identified. The sealing requirements are specified in General Construction Specification G-40 (Ref. 3.21) and Electrical Design Standard DS-E1.3.1 (Ref. 3.05) ("Electric equipment required for safe shutdown of the unit and subject to dripping condensation, water spray or jet impingement shall be protected [by shielding, sealing, pipe guards, etc.] to minimize damage to redundant equipment")	a. None required.

Issues	Findings	Corrective Actions
Element 235.2 - WBN	WBN	WBN
a. Top of 480 V shutdown boards (MCCs) are open at conduit (cable) entry.	a. DS-E1.3.1 and Specification G-40 indicate that openings for conduit entry are to be sealed or protected to prevent water from dripping above. However, engineering did not provide details for moisture and dust seals of cable entries into panels, boxes, etc., when cut-outs (openings) are required for cable entry. Therefore, Construction did not have guidelines for closure of the openings, and Quality Control (QC) did not have an inspection item to ensure compliance. However, WBN has corrected this problem by incorporating ECNs 5821 and 5822 (Ref. 6.04) which closed and sealed the openings and added a closure detail to design drawing 45N202-2. (Ref. 7.03). The evaluation team verified the proper sealing of conduit entries by a walkdown (Ref. 9.48).	a. None required.
BFN	BFN	BFN
a. The top of the 480 V shutdown boards (motor control centers) are open at conduit (cable) entry.	a. On the basis of the walkdown conducted (Ref. 9.49), it was determined that, for the most part, top entries into cabinets such as motor control centers, shutdown boards, and switchgears were properly sealed. However, the three instances where this requirement was not satisfied could be attributed to a lack of specific details provided by DS-E1.3.1 and Specifiction G-40 for sealing the top cable entries into cabinets.	a. TVA has issued CAQR BFP870249 (Ref. 5.23) which recommends corrective action to Division of Nuclear Engineering (DNE) to issue an ECN to provide details of sealing top cable entries. (CATD 235 02 BFN 01)
BLN	BLN	BLN
a. The tops of the 480 V shutdown boards (motor control centers) are open at conduit (cable) entry.	a. During the walkdown (Ref. 9.50), it was observed that cable access openings at the top of the shutdown boards were either temporarily covered (unit 1) or not covered at all (unit 2). Bellefonte is currently under construction, and therefore, no immediate requirements exist for permanently sealing these openings. However, future safe operation of the plant will require the installation of permanent seals per existing procedures (DS-E1.3.1, Specification G-40, and Drawing 5GW0850-KU-3 (Ref. 7.09). It was verified that Drawing 5GW0850-KU-3 provides adequate detail for conduit entry sealing.	a. None required.

Issues	Findings	Corrective Actions
********** Element 235.3 - Hand Switch Location Violates Regulatory Requirements **********		
SQN (Not to be evaluated)	SQN	SQN
WBN	WBN	WBN
a. A person operating a valve from a local control station, i.e., a control station adjacent to or in close proximity to the valve, cannot see the valve being operated at some locations. This is considered to be a violation of regulatory requirements.	a. A walkdown (Ref. 9.23) was performed of local control stations for a sample set of valves including systems 63 and 72. Each control station provides local control of up to three valves. The evaluation team observed that these valves were not always visible to control station personnel; however, all stations had adequate controls and position indicating lights that clearly identified a particular valve. The evaluation team could not identify any inadequacies in the current design or installation. The team found that: o The local control stations are adequately furnished with controls and indications. No violations of separation requirements were identified in the control stations. Each station controls valves of the same train. o There are no regulatory requirements that require valves to be in the direct line of sight of their control stations. o Valves controlled from a remote control room and valves in "not" areas cannot be in the direct line of sight of their respective control station. o For personnel safety during maintenance, the current design allows the power supply to the valves to be disconnected at the motor control center in accordance with established tag-out procedures. o A review of the relevant clearance procedure (Ref. 3.15) did not reveal any violation of regulatory requirements.	a. None required.

Issues	Findings	Corrective Actions
Element 235.3 - BFN	BFN	BFN
(Not to be evaluated)		
BLN	BLN	BLN
(Not to be evaluated)		
********** Element 235.4 - Exposed HV Cable Routed Without Raceway **********		
SQN	SQN	SQN
a. High voltage cables laid unprotected around the edges of rooms could suffer damage to insulation. Flooding in such a situation may pose a personnel safety hazard.	a. The concern that high voltage cables are lying unprotected around the edges of rooms could not be confirmed at SQN. The evaluation revealed that safety standards (Refs. 3.27 and 3.55) and housekeeping requirements (Ref. 3.16) conforming to industry standards have been issued, and are being monitored and enforced by the SQN Safety Staff. During the field walkdowns (Refs. 9.43, 9.44, and 9.45), the concern that cables with damaged insulation lying in flooded areas may present a personnel hazard as discussed, could not be verified at SQN since temporary cables were not lying on floors and there was no evidence of flooding.	a. None required.
WBN	WBN	WBN
a. The insulation of high-voltage cables laid unprotected around the edges of rooms could suffer damage. Flooding in such a situation may pose a personnel safety hazard.	a. The concern that high-voltage cables are lying unprotected around the edges of rooms could not be confirmed at WBN. The high-voltage cables referenced in the concern were identified by a WBN Investigation/Evaluation Report as 230 V and 480 V temporary construction cables. To promote safety and prevent the occurrence of such problems as cited in the employee concern, TVA has in place safety standards (Refs. 3.28 and 3.55) and housekeeping procedures (Ref. 3.14) conforming to industry standards. The evaluation team verified that the procedures include documentation and filing of records of periodic housekeeping inspections. Also, these requirements are being monitored and enforced by the WBN Safety Staff.	a. None required.

Issues	Findings	Corrective Actions
Element 235.4 - WBN (Continued)		
	The concern that cables with damaged insulation lying in flooded areas may present a personnel hazard could not be verified at WBN. During a walkdown of Units 1 and 2 (Refs. 9.39 and 9.46), the evaluation team found no instances of unprotected temporary cables on the floors, and no evidence of flooding.	
BFN	BFN	BFN
(Not to be evaluated)		
BLN	BLN	BLN
(Not to be evaluated)		
********** Element 235.5 - Low Voltage and High Voltage Termination **********		
SQN	SQN	SQN
(Not to be evaluated)		
WBN	WBN	WBN
a. High and low voltages located in the control rod drive motor generator cooler control box make the control box unsafe when carrying out required maintenance functions.	a. Voltages in the control box for the control rod drive (CRD) motor-generator cooler are 480 Vac and 120 Vac. Also a 120 Vac/24 Vac transformer that controls the wall-mounted thermostat is mounted in a separate box attached to the outside of the control box. The insulation for each conductor in the control box is rated at the highest voltage, i.e., 600 Vac, in accordance with the National Electrical Code (Ref. 8.01). A review of design documents (Ref. 7.10) and a walkdown inspection performed by the evaluation team did not reveal any deficiency in the design or construction of the control box for the CRD motor generator cooler as described in the employee concern. o The CRD motor generator cooler control box was designed and manufactured in accordance with applicable industry standards.	a. None required.

Issues	Findings	Corrective Actions
Element 235.5 - WBN (Continued)		
	o Voltages can be distinguished by wire tag numbers which a maintenance worker would use to identify the circuit being worked on in conjunction with a drawing permanently affixed to the door. o There are no industry standards or recommended practices that require any specific form of voltage identification for voltages up to 600 V. According to the National Electrical Code, voltages up to 600 V are considered "low voltage." Barriers are required only if voltage levels above 600 V also exist in common enclosures.	
b. Thermostats are improperly mounted on equipment instead of on a wall or fixed surface away from the control box to monitor ambient air temperature.	b. A review of the memo (Ref. 4.26) and ECNs (Ref. 6.20) shows that the thermostats were improperly installed as indicated in the employee concern. However, the problem has been acknowledged and the thermostats have been properly relocated. Current location satisfies the following: o Trane Company drawings and instructions show the thermostat mounted away from the control box. o Good engineering practice requires the thermostat to be mounted on an independent structure in free air, not influenced by equipment or an enclosure such as the control box.	b. Corrective action is complete, according to ECNs 6068 and 6069 (Ref. 6.20)
BFN (Not to be evaluated)	BFN	BFN
BLN (Not to be evaluated)	BLN	BLN
********** Element 235.6 - 480 V Bus Inside Unlocked Panel Door **********		
SQN (Not to be evaluated)	SQN	SQN

Issues	Findings	Corrective Actions
Element 235.6 - WBN	WBN	WBN
a. The access door to the incoming feeder cables in the 480 V motor control centers should be properly constructed and locked or protected against easy access.	a. As verified by walkdown-inspection (Ref. 9.51), the access door and bus bar design and construction are in accordance with the applicable standards (Refs. 8.02 and 8.03) and code (Ref. 8.01). Furthermore, current WBN procedures for equipment access contained in AI-2.12, Clearance Procedure (Ref. 3.15), including the warning sign posted on the access door, are intended to ensure that only authorized personnel have access to energized equipment. ACC bus arrangements were observed during field walkdown (Ref. 9.51).	a. None required.
b. The bus bars inside the 480 V motor control centers are not protected.	b. The motor control centers are standard ITE design for this type of equipment. The design is in agreement with applicable industry standards and code (Refs. 8.01, 8.02, and 8.03). Therefore, no additional protection of bus bars inside the motor control centers is required.	b. None required.
BFN	BFN	BFN
(Not to be evaluated)		
BLN	BLN	BLN
(Not to be evaluated)		

Issues	Findings	Corrective Actions
********** Element 235.7 - Emergency Lighting Improperly Wired **********		
SQN	SQN	SQN
(Not to be evaluated)		
WBN	WBN	WBN
a. Improperly designed wiring for emergency lighting system will not allow emergency lights to be activated if one of the hot legs is lost.	a. The evaluation team reviewed the related design drawings (Ref. 7.11) and the associated TVA memo (Ref. 4.27), and verified that the self-contained battery-powered emergency lights in the auxiliary building are connected phase-to-neutral in a 208/120 Vac, 3 phase, 3 pole circuit which also supplies the normal 208 Vac lighting system. Failure or fault in any of the three phases in any circuit would trip the 3 pole breaker, thus activating the emergency lights connected to that circuit. Should a single-phase open-circuit failure occur without the breaker tripping (employee concern), the current design configuration allows one-third of the lights in that circuit to remain on. The illumination level under these conditions is adequate for an emergency exit, in agreement with FSAR Section 9.5.3 (Ref. 1.04). Therefore, activation of the emergency lights is not required.	a. None required.
BFN	BFN	BFN
(Not to be evaluated)		
BLN	BLN	BLN
(Not to be evaluated)		

Issues	Findings	Corrective Actions
********** Element 235.8 - PVC Jacketed Flexible Conduit **********		
SQN a. Plastic flex conduits installed in containment and valve rooms are not qualified for use because of the heat generated in these areas and had to be changed at SQN.	SQN a. The documents reviewed (Refs. 3.21, 4.12, 5.04, 5.10, 5.11, 5.14, 5.1b, 7.04 and 9.09) discuss the use and adequacy of PVC-jacketed flexible conduit inside the containment without substantiating the reason or source for the conclusion. In addition, radiation and temperature tests were performed by Wyle Laboratories (Ref. 9.24) and TVA, (Ref. 9.0b) respectively, to demonstrate the acceptability of PVC-jacketed flexible conduit used inside containment. None of the documents and tests performed singly makes an adequate assessment of the acceptability of PVC-jacketed flexible conduits taking into consideration the environmental conditions inside containment.	SQN a. The corrective action plan indicates a [illegible] to provide justification for the acceptability of the existing PVC-jacketed flexible conduit used inside the containment. The calculation will be completed by 04/20/87. (CAID 235-08-SQN-01) THIS ITEM COMPLETED DATE 7/21/87
b. Peripheral finding.	b. There is an inconsistency between the documents referenced under (a) defining the purpose of the PVC jacket as a beta radiation shield for cable qualification.	b. The corrective action plan indicates [illegible] will be reviewed and modified to be consistent with the Sequoyah EQ program. This task will be completed before restart of SQN unit 2. (CAID 235-08-SQN-02) THIS ITEM COMPLETED DATE 7/22/87
WBN a. Plastic flex conduits installed in containment and valve rooms are not qualified for use because of the heat generated in these areas. All such installations had to be changed at SQN.	WBN a. PVC-jacketed flexible conduit was used on 17 instrument racks furnished by contract 72C33-92800, 15 instrument racks are located inside the containment and two instrument racks are located in the main steam valve rooms (MSVR). The documents reviewed (Refs. 3.21, 4.12, 4.22, 5.09, 5.10, 5.11, 5.14, 5.1b, 7.04, and 9.25) discuss the use and adequacy of PVC-jacketed flexible conduit inside the containment and the MSVR. In addition, radiation and temperature tests were performed by Wyle Laboratories (Ref. 9.24) and TVA (Ref. 9.0b), respectively, to demonstrate the acceptability of PVC-jacketed flexible conduit used inside the containment and the MSVR.	WBN a. The corrective action plan indicates that no credit is taken at WBN for the PVC-jacketed flexible conduit for qualifying class 1E cables and equipment and, therefore, the PVC-jacketed flexible conduit for inside containment and MSVR use does not require environmental qualification. Review of the EQ cable binder by the evaluation team confirmed this because no evidence was found that the PVC jacket on flexible conduits was

Issues	Findings	Corrective Actions
Element 235.8 - WBN (Continued)		
	None of the documents and tests makes an overall assessment demonstrating the adequacy of PVC-jacketed flexible conduit used inside containment and the MSVR.	considered for the environmental qualification of cables at WBN. Taking this into consideration, the evaluation team concurs with the response in the CAP and with the conclusions for WBN provided in QIR EQP86032 [B71 860328 250], QIR WBN EQP86046 [B71 860429 250], SCR WBN EEB8548 R2 [B43 860522 908], and disposition memorandum from Raughley to Those Listed dated 05/07/86 [B43 860522 907]. As indicated in the CAP, QIR WBN EQP86046 will be reviewed and modified as required to be consistent with the Sequoyah EQ program. Completion of this effort is not required before WBN Unit 1 fuel load. (CATD 235 08 WBN 01)
b. Peripheral finding.	b. In addition, during the review of various environmental qualification (EQ) cable binders, it was noted that for signal cables (EQ binders CABL-005, 006, 008, 012, and 017; Ref. 9.25), the "demonstrated" radiation dose does not meet the "specified" radiation dose. This fact is recognized as an open item and qualification deficiency in the respective EQ binder. With the exception of EQ binder CABL-017, this open qualification issue has not been addressed in the other binders referenced above.	b. The corrective action plan indicates that all open items are identified and documented. These open items have also been evaluated and the responsibilities for resolving them have been assigned. Those responsible have been notified that resolution of these items is needed before Unit 1 fuel load (refer to H. B. Bounds memo to M. C. Brickey, K. A. Cruikshank and P. D. Metcalf [B26 870223 018]). Furthermore, resolution of all items requiring completion before Unit 1 fuel load will be resolved and documented in accordance with WBEP-EP 43.06. WBEP-EP 43.06 will replace WBEP-SEP 82-02 and WBN-EQP-01 and will control the environmental qualification program and the resolution of open items. (CATD 235 08 WBN 02)
BFN	BFN	BFN
a. Plastic flex conduits installed in containment and valve rooms are not qualified for use because of the heat generated in these areas and had to be changed at SQN.	a. The documents reviewed (Refs. 3.21, 4.12, 5.14, 5.16, 5.21, 5.22, 7.04, 9.06 and 9.24) and the evaluation performed demonstrate that the installed PVC-jacketed conduit in the drywell is acceptable.	a. None required.

Issues	Findings	Corrective Actions
Element 235.8 - BFN (Continued)		
b. Peripheral finding.	b. In addition, documentation was not available to demonstrate that the PVC jacket is not required for establishing environmental qualification of the cables used in the drywell at BFN.	b. Verification by analysis, included in the EQDP (under SCR BFN EQP8601, R3) (Ref. 5.22), that no credit is taken for beta radiation attenuation by the PVC jacket of flexible conduit, based on the Wyle Report furnished under Contract TV-56071A (Ref. 9.24). (CATD 23508 BFN 01)
BLN	BLN	BLN
(Not to be evaluated)		
********** Element 235.10 - 480 V Power Receptacles Use of Incorrect Wire Size, Unsafe **********		
SQN	SQN	SQN
(Not to be evaluated)		
WBN	WBN	WBN
a. There is a personnel safety problem because of the incorrect (larger) wire used to supply the receptacle.	a. WBN specified in the WBN Master Bill of Materials (Ref. 9.22) and in DS-E12.5.2 (Ref. 3.09) Crouse-Hinds type AEQ1648, a 600 V, 60 amp, continuous rated 3-wire, 4-pole receptacle with a pressure-type pin. The inside diameter of the opening for the wire termination is 0.312 inch (Ref. 9.52). The outside diameter of a #2 copper strand wire is 0.292 inch (Ref. 8.01). Therefore, the pressure-type pin is adequate for terminating #2 wires. In addition, no personnel safety hazard has been identified as all the components in the circuit are adequately sized and protected. (#2 wire is rated at 101 amp [Ref. DS-E12.1.1] [Ref. 3.08]. Receptacles are rated at 60 amp and the protective devices are 70 and 100 amp breakers. Each 100 amp breaker feeds up to six receptacles.)	a. None required.
BFN	BFN	BFN
(Not to be evaluated)		
BLN	BLN	BLN
(Not to be evaluated)		

Issues	Findings	Corrective Actions
********** Element 235.11 - Malfunction of Westinghouse W-2 Switch **********		
SQN	SQN	SQN
a. Control switch malfunction causes red and green indicating lights to be dark or partially illuminated.	a. Control switch malfunction, through the sneak circuit path inadvertently introduced by implementation of IE Bulletin 80-20 (Ref. 2.12), caused the valve position indicating lights to be dark or partially illuminated. In addition, during the investigation the evaluation team identified the following findings: o Although a proposed revised response was attached to a TVA internal memo (Ref. 4.02) eliminating the option for replacement of the original W-2 switches with new W-2 switches, no evidence could be found that a revised final response to NRC IE Bulletin 80-20 had been submitted to the NRC. Also absent from the record are documentation of an option that was exercised, the replacement of certain of the original W-2 switches with new switches manufactured by Electroswitch, and a final revised response to the NRC describing this replacement. Concurrence by the TVA Sequoyah Task Force for Review of Black and Veatch Findings 112 (Ref. 9.02) with the final evaluation by TVA EEB could not be found. The absence of concurrence is not considered significant and requires no corrective action. o The TVA Quality Management Staff (QMS) report in 1985 (Ref. 4.28) noted that ECN L5591 (Ref. 6.02) had not been closed indicating the possibility of additional design and construction work. The evaluation team could find no documentation confirming completion of construction work or of closure of the ECN.	a. TVA's corrective actions to address the findings are as follows: o TVA will evaluate the problems below and, if required, will submit appropriate response to the NRC: - Reversal by Westinghouse of its position on corrective action as discussed in TVA memo from Raulston to Mills [NEB 820405 266] (04/05/82) - Replacement of W-2 switches with switches manufactured by Electroswitch. (CAID 235 11 SQN 01) o TVA will: - Establish as-designed and as-constructed status of [illegible] switch circuits - Revise ECN L5591 to ensure inclusion of all applicable safety-related switches - Close ECN L5591 following design completion and construction implementation according to applicable engineering procedures. (CAID 235 11 SQN 02)

THIS ITEM IS COMPLETED AT SQN - 11-16-87

Issues	Findings	Corrective Actions
Element 235.11 - SQN (Continued)		
	o The wiring change to the indicating lights and the later correction of the sneak circuits in indication wiring were significant Conditions Adverse to Quality (CAQs), which should have required NCRs. No NCRs could be found by the evaluation team.	o TVA will issue SCR SQNEEB8792 to address the following CAQs: - Malfunction of Westinghouse W-2 switches, identified by IE Bulletin 80-20 - Sneak circuits in indication wiring identified by Black and Veatch finding V4 The SCR also reports the problems identified in CATD 235 11 SQN 01, 02, 04, and 05. (CATD 235 11 SQN 03)
	o There are discrepancies in the count of W-2 switches found by comparing several listings: ECN L5591 (Ref. 6.02), the TVA list (Ref. 9.53), and a TVA memo (Ref. 4.29). There is no evidence that W-2 switch listings used in the IE Bulletin 80-20 review and as a basis for design have been consistently produced or that all W-2 switches requiring changes have been identified and their circuits corrected.	o TVA will: - Create a definitive list, to be used as a design input, of all applicable switches in the plant - Review the design basis of the circuit change before implementation Verify that there are no applicable switch circuits with a sneak circuit path. (CATD 235 11 SQN 04)
	o In addition, no program was found which would prevent recurrence of the problem in the event of future circuit modifications required use of unused W-2 switch spare contacts or spare W-2 switches now in stock.	o TVA will add a cautionary note to the switch contact development drawing to avoid problems in future applications of the remaining W-2 switches or in the introduction of new circuit paths. (CATD 235 11 SQN 05)

THIS ITEM COMPLETED
DATE: 7-8-88

THIS ITEM COMPLETED
DATE: 7-8-88

THIS ITEM COMPLETED
DATE: 7-8-88

Issues	Findings	Corrective Actions
Element 235.11 - SQN (Continued)		TVA indicates that the corrective actions are required to be completed after restart of Sequoyah except for CATD 235 11 SQN 05 which is a restart item. This is documented in TVA letter 1CAN-087 dated March 31, 1987, which provides Revision 1 to the CAP. The revised CAP also provides for the following TVA corrective actions to be completed before restart: - Identify all W-2 switches used in safety-related circuits - Review each type W-2 switch application to ensure that all failures which could result from spring return to neutral or sneak circuits will be detectable by the operators - All plant operators must be notified of the possible failure mode of the W-2 switches and the effect on control board status light indication.

Issues	Findings	Corrective Actions
Element 235.11- WBN	WBN	WBN
a. A control switch malfunction causes red and green indicating lights to partially illuminate or be dark.	a. Control switch malfunction, through the sneak circuit path inadvertently introduced by implementation of ECN 3306 (Ref. 6.07), caused the valve position indicating lights to be dark or partially illuminated. Although this ECN, as well as subsequent corrective actions described below, was directed at resolving the problems identified in NRC IE Bulletin 80-20, the evaluation team has identified the following outstanding issues: o The last response letters to the NRC regarding IE Bulletin 80-20 are dated June 2, 1982 (Ref. 2.01), and March 30, 1983 (Ref. 2.18). These letters provide TVA commitments to complete corrective actions on 67 M-2 switches per unit by October 1984. Subsequent TVA internal memos (Refs. 4.30 and 4.31), however, indicate the number of switches and the completion date have changed. However, no records were found that the NRC has been advised of these changes. o TVA's Task Force Report (Ref. 9.15) on the Black and Veatch (B&V) Finding Report F112 (Ref. 9.02) regarding the sneak circuit indicates that modifications per ECN 3306 (Ref. 6.07) did not satisfy licensing requirements. According to this TVA report, 28 valve control circuits were identified as having the sneak circuit problem. Although this condition was corrected for 28 valves in ECNs 4591 (Ref. 6.11) and 4592 (Ref. 6.12), the evaluation team considers the rework to correct the problem as significant. However, no nonconformance or significant condition report (SCR) could be found by the evaluation team. The evaluation team notes that SCR WBNEEB8526 (Ref. 9.53) and PIR WBNEEB8533 (Ref. 9.54) were issued for similar modifications performed under ECN 5640 for six additional valves.	a. TVA's corrective actions to address the findings are as follows: o TVA indicates that the actual number of switches requiring modification per the intent of the bulletin was not a required response. However, this number was incorrectly stated as 67 per unit in the June 2, 1982 letter. The latest expected completion date was forwarded to the NRC by TVA letter dated September 16, 1985. However, the modification was not completed as expected. TVA's corrective actions are the issuance of PIR WBNWBP8776 (Ref. 5.24) and another submittal to the NRC. (CATD 235 11 WBN 01). o TVA indicates that the sneak circuit problem was analyzed by engineering design and determined not to require the initiation of an NCR. This is documented in the Test Deficiency Report PT-301 Form 3. The test deficiency report was the basis for initiation of ECNs 4591 and 4592 (Refs. 6.11 and 6.12). The problem was approached generically at that time, and circuits for systems 1, 3, and 62 were determined to need correction. In addition, PIR WBNWBP8776 has been issued to correct documentation related to this problem. (CATD 235 11 WBN 02)

Issues	Findings	Corrective Actions
Element 235.11 - WBN (Continued)		
	o The evaluation team could not establish that TVA's review and basis for design modifications to meet IE Bulletin 80-20 commitments have been adequately documented to demonstrate that all W-2 switches with safety-related applications are identified for review and appropriately modified. A vast difference exists in the number of switches originally identified in TVA memo dated October 23, 1980, from J. A. Raulston to L. M. Mills (Ref. 4.01) and in ECN 3306 (Ref. 6.07). This memo identified 146 switches whereas ECN 3306 (closed by Engineering in 1983) covered only 60 switches. This difference is still significant even when considering that some of the 146 switches have no electrical function in the neutral positions, and, thus, monitoring of the contact is not needed. Furthermore, calculation E27885081201, issued on August 23, 1985 (Ref. 7.06), documents only the main control board W-2 switches reviewed for modification. However, there are discrepancies between the switches shown in the calculation and those shown in the October 23, 1980 memo. In addition, the calculation identifies 69 switches for Unit 1 and 33 switches for Unit 2 that have been modified, whereas 67 switches per unit are identified in the June 2, 1982, letter from TVA to the NRC (Ref. 2.01). No documentation could be found to justify the differences or to establish that W-2 switches located outside the main control board have been reviewed.	o TVA indicates that PIR WBNWBP8776 (Ref. 5.24) has been initiated to define and resolve the problem in this CATD as well as in CATD 235 11 WBN 01. (CATD 235 11 WBN 03)
	o Finally, the evaluation team could not establish that an effective TVA program exists to prevent recurrence of the sneak circuit problem if spare W-2 switches in stock or spare neutral position contacts of existing switches were required to be used in the future. The evaluation team notes that the index sheet of contact development drawing 458640 (Ref. 7.12) does provide a cautionary note on making modifications to W-2 switches; however, no specific guidelines are included for preventing sneak circuit paths as discussed in IE Information Notice 82-01 (Ref. 2.14).	o TVA indicates an ECN will be initiated to supplement the cautionary note on the switch development sheet of drawing 458640 by adding a reference to IE Information Notice 82-01. (CATD 235 11 WBN 04)

Issues	Findings	Corrective Actions
Element 235.11 - BFN	BFN	BFN
a. Control switch malfunction causes red and green indicating lights to dim or to go out entirely.	a. Browns Ferry does not use Westinghouse type W-2 control switches (the subject of IE Bulletin 80-20 and the Black and Veatch Finding F112) in safety-related applications.	a. None required.
BLN	BLN	BLN
a. Control switch malfunction causes red and green indicating lights to dim or to go out entirely.	a. BLN does not use Westinghouse type W-2 control switches on the unit control board (the subject of IE Bulletin 80-20 and the Black and Veatch Finding F112). These switches are used in safety-related low-voltage switchgear boards, but the applications do not require use of the switches' neutral position contacts. Also, a note has been added on the low-voltage vendor drawing (Ref. 7.19) to prevent future use of the neutral position contacts.	a. None required.

Issues	Findings	Corrective Actions
********** Element 237.1 - Bypass of Thermal Overload and Over-Torque Limit Switches **********		
SQN	SQN	SQN
a. Inadequate design compliance with NRC Regulatory Guide 1.97. (This is being interpreted as inadequate compliance with Regulatory Guide 1.106, which deals with the thermal overload bypass for motor operated valves.)	a. NRC R.G. 1.97 addresses "Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Plant and Environs Condition During and Following an Accident." Since Regulatory Guide 1.106 (Ref. 4.40) covers thermal overload protection for electric motor-operated valves, this issue is interpreted as inadequate compliance with Regulatory Guide 1.106. No formal records were identified for the Sequoyah Nuclear Plant documenting licensing commitments for the extent of compliance to Regulatory Guide 1.106. It should be noted, however, that the Task Force Report (Ref. 4.05) to B&V findings and the Nuclear Safety Review Staff (NSRS) investigation report (Ref. 4.32) concluded the conformance to Regulatory Position 2.	a. The FSAR will be revised to document compliance to Regulatory Guide 1.106. (CATD 237 01 SQN 01)
b. Peripheral finding.	b. No design basis for compliance with NRC Regulatory Guide 1.106 has been established through design criteria or other design basis documents. This results in an unclear definition of the valves that must meet the regulatory position which, in turn, results in inconsistencies among the different lists of valves included in the Technical Specification, Surveillance Instructions SI-251.1 and SI-251.2 (Ref. 3.41), and Technical Instruction 87-7 (Ref. 3.18) documents.	b. A design criteria document will be issued to provide the basis for TVA design. (CATD 237 01 SQN 02). An active valve list will be prepared with justification for listing only active valves instead of all safety-related valves. In addition, the valve listings in the Technical Specification, SI-251.1, SI-251.2, and TI-76 will be reviewed and revised so that the valve lists will agree with each other. (CATD 237 01 SQN 03)

TASK FORCE PARTIALLY COMPLETED AT SQN DATE: 11-9-87

THIS ITEM PARTIALLY COMPLETED AT SQN DATE: 11-9-87

THIS ITEM COMPLETED DATE: 8-23-88

Issues	Findings	Corrective Actions
Element 237.1 - SQN (Continued)		
c. Peripheral finding.	c. No design basis has been documented which supports the motor operated valve thermal overload settings of 16 to 30 seconds at locked rotor current and demonstrates that they satisfy Position 2 requirements of NRC Regulatory Guide 1.106.	c. Calculation SQN-APS-003, Revision 0 (Ref. 7.05) issued 11/24/86, will be reviewed for possible revision. This calculation documents the evaluation of thermal overload heaters used to protect class 1E MOV motors. The calculation identifies the 11/04/85 TVA policy memo PM86-1B (EEB) (Ref. 4.6) for requirements in overload heater selection. The evaluation team's review of the two documents raised a few questions on the calculation, and these were discussed with TVA which provided clarifying remarks and an appropriate resolution by committing to review the calculation for possible revision. The possible revision of the calculation will not change the thermal overload heater selection methodology and results as it is intended to provide clarification. Essentially, the existing heaters are evaluated to satisfy TVA criteria that the selected heaters will trip for a locked rotor condition between 10 to 15 seconds and will not trip at motor full load current for at least 200 percent of the valve stroke time. The design basis for the locked rotor time criterion is based on the IEEE Paper No. PCI 669-3 as indicated in the TVA policy memo; the evaluation team finds this acceptable. In addition, the evaluation team finds the methodology for selecting the heaters to be conservative in that the trip times of the heaters are based on the manufacturer's data for maximum trip time characteristic of the heaters. This is viewed as establishing thermal set point of the thermal overload protection device in favor of completing the Motor Operated Valve (MOV) safety-related function, thus satisfying Position 2 of Regulatory Guide 1.106. (CAID 237.01-SQN-3)

Issues	Findings	Corrective Actions
Element 237.1 - WBN	WBN	WBN
a. Inadequate design compliance with NRC Regulatory Guide 1.97. (This is being interpreted as inadequate compliance with Regulatory Guide 1.106, which deals with the thermal overload bypass for motor operated valves.)	a. NRC R.G. 1.97, addresses "Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Plant and Environs Condition During and Following an Accident." Since R. G. 1.106 (Ref. 2.16) covers thermal overload protection for electric motors on motor operated valves, this issue is interpreted as inadequate compliance with Regulatory Guide 1.106. Watts Bar's design basis of the thermal overload bypass on safety-related MOVs is intended to be in compliance with Regulatory Position C.1(b) of Regulatory Guide 1.106. This design basis is documented in the recently issued Design Criteria WB-DC-30-15 (Ref. 3.03). In Amendment 52 of the WBN FSAR Section 8.1.5.3 (Ref. 1.09), TVA has stated full compliance with the regulatory guide. However, the regulatory guide applies to all safety-related MOVs and contains two positions whereas the design criteria indicate conformance with the intent of Regulatory Position C.1(b) for active valves only. Therefore, the design basis does not accurately reflect the FSAR statement. To provide clarification, TVA has proposed an FSAR update (12/29/86 memo from W.S. Raughley to H.B. Bounds) (Ref. 4.17) whereby Note 10 will be added to said section. The proposed change, however, has not yet been submitted to the NRC.	a. TVA has previously recognized the problem and committed to revising the FSAR as part of resolving NCR W-367-P (Ref. 5.02) and as stated in the corresponding 10 CFR 50.55(e) Report No. 2 Final. The specific FSAR update is documented in the TVA memo dated 12/29/86, from Raughley to Bounds (Ref. 4.17). Completion of this update will be reflected in the 10 CFR 50.55(e) Report No. 3 Final. (CATD 237 01 WBN 01)

Issues	Findings	Corrective Actions
Element 237.1 - WBN (Continued)		
b. Torque switch bypass modification for SIS valve nos. 332 and 333 per 1979 Engineering Change Notice (ECN) 1842 was not performed.	b. ECN 1842 (WBN, Ref. 6.24) is equivalent to ECN 2257 (SQN Ref. 6.01). For clarification on ECN 5971 (SQN) see element 237.4, Issue a (Ref. 10.08). The torque switch bypass modification for valve nos. FCV-68-332 and -333 was not in the 1979 ECN 1842 (Ref. 6.24). The two valves were intended to be modified by ECNs 4551 (Unit 1, Ref. 6.25)) and 4552 (Unit 2, Ref. 6.26). The Unit 1 valves were modified, but the Unit 2 valves were found to be wired improperly. This condition was reported in NCR W-367-P (Ref. 5.02) and in a 10CFR50.55(e) report. ECN 6296 (Unit 2, Ref. 6.27) was issued to correct the wiring problem on these two valves and other valves having the same problem. The design work has been completed for the ECNs.	b. None required.
c. Adequacy of design compliance with the thermal overload and torque switch bypass requirements for motor operated valves (MOVs) is in question.	c. TVA has established the need for the thermal overload and torque switch bypass on active valves. This need was established by memos in 1977 (Ref. 4.33) and 1979 (Refs. 4.34 and 4.35), respectively. Also, in 1979, electrical standard drawings (Ref. 7.13) were issued to provide wiring details for use in torque seated and position seated MOVs. However, these drawings contained two configurations for each type of valve, and no guidance was provided on the drawings for using a particular configuration. On December 31, 1986, TVA revised the standard drawings pertaining to safety-related valves to provide the needed guidance. Additional findings of this issue are: TVA has formalized the requirements for the thermal overload and torque switch bypass design by issuance of Design Criteria WB-DC-30-15 (12/30/86) (Ref. 3.03). This document references calculation no. WBN-OSG4-095 for the list of MOVs requiring the bypass design. A review of calculation no. WBN-OSG4-095 (Ref. 7.08) shows that the criteria for selection and tabulation of MOVs requiring thermal overload bypass have been established. However, there is no indication that this calculation establishes similar criteria for MOVs requiring torque switch bypass	c. No corrective action is required for this part of the finding. TVA indicates that the calculation was intended to address both thermal overload and torque switch requirements stated in Design Criteria WB-DC-30-15. The problem was recognized by TVA during a design review concerning NCR W-367-P, and consequently, the QIR was issued. Closure of the QIR will resolve the problem. (CATD 237 01 WBN 02)

Issues	Findings	Corrective Actions
Element 237.1 - WBN (Continued)		
	or that the tabulated MOVs require the torque switch bypass in addition to the thermal overload bypass. A TVA Quality Information Request (QIR) No. EEB 87 066 (Ref. 5.12) has been issued to document this problem and to request resolution by February 20, 1987. Because the action required by the QIR is underway, the evaluation team cannot judge its effectiveness. A comparison of the valves listed in calculation WBN-0SG4-095 (Ref. 7.08) with those shown on drawing 45W760-270-2, R15 (Ref. 7.14) shows that several valves have not been designed with the required thermal overload bypass feature. The valves are: Valve No. 0-FCV-67-144 1,2-FCV-67-72, -73, -143 1,2-FCV-70-183, -215 2-FCV-67-458, -478	TVA indicates that the problem is being addressed as part of the actions committed in the 10 CFR 50.55(e) Report No. 2 Final to prevent recurrence of the condition cited in NCR W-367-P. The committed action requires that a design review be performed to ensure that all valves requiring thermal overload and torque switch bypass will have them, and that the switches are selected and wired properly. Completion of this activity, together with the necessary revision of affected drawings, including 45W760-270-2, is sufficient to resolve the problem. (CATD 237 01 WBN 03)
	Of these valves, the Unit 1 valves and the valves common to both units are not listed on the Watts Bar - Unit 1 Technical Specification Table 3.8-2 (Ref. 1.06). The Unit 2 Technical Specification was not available for review. Also missing from this table and required by calculation no. WBN-0SG4-095 are: Valve No. 1-FCV-67-9A, -9B, -10A, -10B, -458 0-FCV-67-205, -208 0-FCV-70-194, -197 1-FCV-74-8, -9	TVA indicates that, as part of the review and resolution to NCR W-367-P, TVA memos from Bounds to McDonald, dated 02/12/87 (Ref. 4.20), and from Brickey to Metcalf, dated 03/09/87 (Ref. 4.21) have been issued to address corrections necessary to bring the FSAR, design documents, and technical specifications into agreement. With formal submittal of the committed changes to the NRC, the problem is adequately resolved. (CATD 237 01 WBN 04)

Issues	Findings	Corrective Actions
Element 237.1 - BFN	BFN	BFN
a. Inadequate design compliance with NRC Regulatory Guide 1.97. (This is being interpreted as inadequate compliance with Regulatory Guide 1.106, which deals with the thermal overload bypass for motor operated valves.)	a. NRC R.G. 1.97 addresses "Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Plant and Environs Condition During and Following an Accident." Since Regulatory Guide 1.106 (Ref. 2.1b) covers thermal overload protection for electric motors on motor operated valves, this issue is interpreted as inadequate compliance with Regulatory Guide 1.106. Browns Ferry is not required nor has committed to meet Regulatory Guide 1.106 because this regulatory guide was issued subsequent to the licensing of the plant. The initial design does not require bypass of the thermal overload protection device for safety-related MOVs. A design change to implement the bypass feature was initiated by ECN L2071 (Ref. 6.22).	a. None required.
b. Torque switch bypass modification for SIS valve nos. 332 and 333 per 1979 Engineering Change Notice (ECN) 1842 was not performed.	b. ECN 1842 (WBN) is equivalent to ECN 2257 (SQN). For clarification on ECN 5971 (SQN), see SQN element 237.4, issue a. The torque switch bypass modification for Sequoyah and Watts Bar valves 332 and 333 is considered not required on Browns Ferry because its comparable valves are air operated. This is determined by the evaluation team from the review of drawing 47W610-1-1 (Ref. 6.28).	b. None required.

Issues	Findings	Corrective Actions
Element 237.1 - BFN (Continued)		
c. Adequacy of design compliance with the thermal overload and torque switch bypass requirements for safety-related motor operated valves (MOVs) is in question.	c. The evaluation of design compliance with thermal overload and torque switch bypass requirements reveals the following:	c. The design drawing changes to reflect the thermal overload element ratings will be completed by implementing ECNs P0975, P0987, and P0988. (CATD 237 01 BFN 01)
	o Design drawings do not reflect the thermal overload element ratings. SCR BFNEEB8850 (Ref. 5.26) has been initiated to resolve the problem, but the corrective action has not been completed.	
	o Calculations and/or analyses are underway, but they have not been issued to demonstrate that the installed thermal overload heaters are sized properly as required by EEB Policy Memo PMJ6-18. No surveillance or technical specification requirements were identified for periodic testing to demonstrate adequacy of installed thermal overload heaters.	To demonstrate that the thermal overload heaters installed in safety-related MOV circuits are properly sized, calculations were issued (BFEP-E1-8649-62, 66 to 74, 76, 78, and BFEP-E1-87002-4, 7 and 8). Overload heaters deemed inadequate will be replaced under CCB 870021. Operability of the MOVs will be tested in accordance with the Technical Specifications on safety-related MOVs (BF-3.2.1 and SI-4.5.A.1.C). (CATD 237 01 BFN 02)
	o ECN L2071 (Ref. 6.22) data sheets were revised several times to implement the thermal overload bypass design. No design basis review nor completeness review of the unreviewed safety question determination could be found to be current with the ECN revisions as required by EP 2.03 (Ref. 3.56). The complete engineering or construction status of this ECN could not be established.	ECN L2071 will be cancelled and drawings which were revised or originated by this ECN will be revised to remove all changes made by this ECN. To establish a design basis for compliance with the intent of Regulatory Guide 1.106, the following documents will be issued and requirements developed:
	o No design basis document could be found to control the design or to establish requirements for the bypass of the MOV thermal overload and torque switch when needed. Inconsistencies were found between the number of MOVs requiring the bypass design and those implemented by ECNs or used for the review of IE Circular 81-13 (Ref. 2.07) and Bulletin 85-03 (Ref. 2.13).	o Guidelines (QA level) for determining the active safety-related MOVs, the method of overload protection for motor and feeder cable during normal operation and during MOV testing, application of oversized circuit protection, and procedure for MOV testing.

Issues	Findings	Corrective Actions
Element 237.1 - BFN (Continued)		
		o Calculations (QA level) to list all active safety-related valves at BFN. (CATDs 237 01 BFN 03 and 04)
	o Verification, as recommended by IE Circular 81-13 (Ref. 2.07), that all valves required by the design to have the torque switch bypass are in fact installed and that all applicable electrical drawings correctly reflect the bypass have not been established. In addition, verification that the torque switches have been removed or bypassed for specified MOVs as recommended by GE (Ref. 4.3b) and for other safety-related MOVs could not be established.	Verification to have torque switch bypass circuits installed was performed and documented and inspected by NRC. Item is closed, no additional followup is required. (CATD 237 01 BFN 05)
BLN	BLN	BLN
a. Inadequate design compliance with NRC Regulatory Guide 1.97. (This is being interpreted as inadequate compliance with Regulatory Guide 1.106, which deals with the thermal overload bypass for motor operated valves.)	a. NRC R.G. 1.97 addresses "Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Plant and Environs Condition During and Following an Accident." Since Regulatory Guide 1.106 (Ref. 2.16) covers thermal overload protection for electric motors on motor operated valves, this issue is interpreted as inadequate compliance with Regulatory Guide 1.106. No formal records were identified for the Bellefonte Nuclear Plant documenting licensing commitments regarding the extent of compliance to NRC Regulatory Guide 1.106. Although commitment to comply with Regulatory Position C.1(b) is implied in the TVA evaluations of the B&V findings for applicability to BLN documented in the Task Force Report on Category 38 (Ref. 9.34), the FSAR reference to the obsolete Branch Technical Position (BTP) EICSB 27 (Ref. 2.17), and the Chandler to Raulston memo (Ref. 4.37), no design basis documents were found to justify the extent of BLN compliance to RG 1.106.	a. To clarify TVA's position for BLN regarding compliance with Regulatory Guide 1.106, R1, BLN-FSAR Chapter B, Table B.1.4-1, "Compliance with Criteria, Regulatory Guides, Standards, and Branch Technical Positions," is being revised by Draft Amendment 34 as part of BLN's FSAR reverification effort. This amendment will also delete referenced compliance with BTP EICSB27. (CATD 237 01 BLN 01)

Issues	Findings	Corrective Actions
Element 237.1 - BLN (Continued)		
b. Torque switch bypass modification for SIS valve nos. 332 and 333 per 1979 Engineering Change Notice (ECN) 1842 was not performed.	b. ECN 1842 (WBN) is equivalent to ECN 2257 (SQN). For clarification on ECN 5971 (SQN), see SQN element 237.4, Issue a. SIS valves 332 and 333, as identified for SQN, have one equivalent valve at BLN. ECN 639 (Ref. 6.23) indicates that MOV NC-1FCV-057-A, the equivalent valve, has the open and close torque switches bypassed with limit switches as required.	b. None required.
c. Adequacy of design compliance with the thermal overload and torque switch bypass requirements for safety-related motor operated valves is in question.	c. The design requirements for bypass of thermal overloads and torque switches are defined in drawings only. There is no design basis document to identify safety-related MOVs requiring the bypass design. Drawing 2GW0900-IL-1 (Ref. 7.15) lists only valves requiring thermal overload bypass. No similar drawing that shows all the valves requiring torque switch bypass could be found. However, they are shown on each system Functional Control Logic Diagram (FCLD) (Ref. 7.15). Finally, discrepancies were identified between the valves requiring thermal overload bypass and torque switch bypass, and between FSAR Table 3.9.3-24 (Ref. 1.08), ECN 639 (Ref. 6.29), and Drawing 2GW0900-IL-1.	c. To resolve the existing discrepancies and establish a design basis regarding the application of torque switch and thermal overload relay bypasses for MOVs, BLN will issue a design basis document for design input. Design output documents will be revised as appropriate to comply with the established design basis. (CATD 237 01 BLN 02)

Issues	Findings	Corrective Actions
Element 237.2 - 400-500 Breakers Unacceptably Set.		
SQN a. Unacceptable trip ratings were selected for a large number of molded case breakers.	SQN a. TVA is preparing new calculations to verify the existing trip ratings. The majority of the molded case breaker trip ratings were acceptably selected, according to an initial assessment by TVA of FSAR Section 8.3.1.1 (Ref. 1.01), Design Criteria SQN-DC-V-11.4.1 (Ref. 3.01), Design Standard DS-E9.2.1 (Ref. 3.07). Circuit breakers with trip ratings found to be unacceptable will be replaced prior to restart. A preliminary draft of the calculation (Ref. 7.05) did not completely address the issue and did not include results that could be compared with trip ratings shown on Motor Control Centers single lines (Reference 3.02). The design criteria has incomplete analysis of ~~circuit breaker~~ circuit fault protection, including protection of the thermal overload heaters, was lacking. A questionable interpretation of the NEC was found in the preliminary calculations which stated that circuit breakers should be set at 1300 percent of full load currents where the NEC requires thermal magnetic circuit breakers to be rated 400 percent maximum. Design criteria and guidance were not found for the application of thermal magnetic circuit breakers for fault protection of small motor circuits. Exceptions to Design Criteria SQN-DC-11.4.1 (Ref. 3.01) are permitted without documented justification or approval.	SQN a. TVA will review issued TVA DNE Calculation SQN-APS-003, R0 (11/24/86) (Ref. 7.05), which covers circuit breaker selection, to verify that design criteria and design guides that specify requirements for protection device coordination have been properly referenced, that protection for small motor circuits have been evaluated, that results of the calculation permit direct comparison with values shown on design documents, and that NEC requirements for setting of fault protection at 1,300 percent of full load current are clearly identified. Calculations will be revised as required, and protective devices that are determined to be inadequate will be replaced. (CATD 237 02[B] SQN 01 and 02) TVA will revise Design Criteria SQN-DC-V-11.4.1 to require that all exceptions to SQN-DC-V-11.4.1 be justified and documented. (CATD 237 02 SQN 06) TVA will review design criteria, design standards, and design guides to verify adequate technical requirements for the application of thermal magnetic circuit breakers, alternative means, for the fault protection of small motors. (CATD 237 02 SQN 03)

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NOT CONCURRED
DATE 8/28/88

Issues	Findings	Corrective Actions
Element 237.2 - SQN (Continued)		
b. Engineering practices and attitudes in the selection of molded case breaker trip ratings were poor. The National Electrical Code and good engineering practices were violated.	b. No direct evidence was found that engineering practices and attitudes in the selection of molded case breaker trip ratings were poor, since the original selection process cannot be documented. However, the absence of documentation itself and the lack of systematic design procedures are subjects of a number of employee concerns and are addressed in more detail in the Appendix to this report (205.1 and 205.3. The NEC, although not mandatory for utility generating stations, was referenced in design criteria (Ref. 3.01) currently in force. Pending completion of the review of final calculations, the degree of conformity of the protection design to the NEC or to good engineering practices is not clear. Criteria documents do not state clearly where the NEC should be followed and where not.	b. Addressed in "a" above. In verification walkdown of CATD 237 02 SQN 04, it was noted that the interpretation of the NEC is contained in QIR EEB 87031 (Ref. 5.13), which is properly referenced in calculation (Ref. 7.05)
c. Fuse size selection for valve operators does not allow enough margin for emergency operation.	c. Fuse size for valve operators was found to allow sufficient margin for emergency operation, as concluded by Generic Concern Task Force Report GOR 29-29 (Ref. 9.08). However, the fuse selection process is not documented.	c. TVA will review the fuse selection process presently in use to determine adequacy and to identify design criteria, design standards, or design guides needed to control the process. If necessary, TVA will revise documents reviewed above or create new documents. (CATD 237 02 SQN 04)
d. Fuse sizes are selected to protect the valve operator motors and not the circuits (e.g., ERCW valves in fifth diesel generator building).	d. Fuse sizes were selected to provide short circuit protection for motors and the circuits. Overload protection for motors and circuits was provided by thermal overload relays. No basis could be found to demonstrate that the fuses provide adequate full range short circuit protection for motor starter, cable, and motor.	d. TVA will prepare calculations to confirm adequacy of electrical protection and margin for emergency operation of the fifth diesel ERCW valve operators. Protection devices that are determined by the calculations to be inadequate will be replaced. (CATD 237 02 SQN 04) Requirements of Nuclear Engineering Procedure NEP-9.1, Corrective Action, will be considered in the reviews listed above to evaluate any deficiencies found.

THIS ITEM PARTIALLY COMPLETED
SQN DATE 11-18-87

Issues	Findings	Corrective Actions
Element 237.2 - WBN	WBN	WBN
a. Unacceptable trip settings were selected for a large number of molded case circuit breakers.	a. As a result of Black and Veatch Finding 137, (Ref. 9.03) TVA identified a total of 444 circuit breakers with trip settings higher than permitted by criteria. Of this total, 16 circuit breakers were replaced and 369 were reset to correct the deficiency. The remaining 59 circuit breakers with high trip settings were not replaced or reset. These circuit breakers protect motor operated valves with motors smaller than 1/2 hp. Also, six adjustable instantaneous circuit breakers were replaced with thermal magnetic circuit breakers so that cables in motor operated valve circuits would be protected against overloads in the event of bypass of the thermal overload relays. Design criteria and guidance were not found for the application of adjustable instantaneous circuit breakers for fault protection of small motor circuits including protection of thermal overload heaters. The 444 circuit breakers with trip settings higher than permitted by criteria were considered to have generic implications for other TVA nuclear plants. The evaluation team considers this to be a significant condition adverse to quality (CAQ) which should have required an NCR or SCR. No NCR or SCR could be found by the evaluation team.	a. Electrical Design Guide DG-E2.3.5 has been revised and issued to incorporate the application requirements for motors less than 2 HP. This includes the option of documented rationale to give reasonable assurance that the devices not protected in accordance with NEC requirements will not cause a fire. TVA commits to revise Electrical Design Standard E2.3.2 (Ref. 3.06) to include the application criteria for motors smaller than 1/2 HP. (CATD 237 02 WBN 01) TVA states that all subject findings and associated corrective actions were tracked by Black and Veatch Task Force Category 35 (Ref. 9.15) and TVA ECNs 3904, 3905, and 4251 (Refs. 6.08, 6.09, and 6.10). To ensure that all corrective actions are acceptable, TVA commits to perform the necessary calculations as part of the long-term electrical calculation program, associated with SCR WBNEEB8571 (Ref. 5.19) and identified in CATDs 237 02 WBN 02 and 03 that will be scheduled BFL 1. (CATD 237 02 WBN 05)
b. Engineering practices and attitudes in the selection of molded case circuit breaker trip settings were poor. The National Electrical Code (NEC) and good engineering practices were violated.	b. No direct evidence was found that engineering attitudes in the selection of molded case circuit breaker trip settings were poor, since the original selection process was not documented. No calculations or other basis for the current settings could be found to demonstrate that the circuit breaker settings provide adequate full-range short circuit protection for motor starter, cable and motor. Moreover, the absence of documentation itself and the lack of systematic design procedures are subjects of a number of employee concerns and are addressed in more detail in Subcategory 24500, WBN element 205.1.	b. TVA commits to provide corrective action to resolve the condition adverse to quality (CAQ) as identified in SCR WBNEEB8571 and also action to prevent its recurrence. Electrical Engineering Branch (EEB) contracted for a long-term electrical calculation program and detailed training in the use of QA-assured computer calculation programs. (CATD 237 02 WBN 02).

Issues	Findings	Corrective Actions
Element 237.2 - WBN (Continued)		
	Requirements of the NEC, good engineering practices, and the circuit breaker manufacturer's recommendations were violated, which necessitated replacing and resetting circuit breakers. The NEC, although not mandatory for utility generating stations, was referenced in design criteria currently in force. Criteria documents do not state clearly where the NEC should be followed and where not.	In verification closeout, the design criteria will be reviewed to ensure that this document clearly states where the NEC should be followed.
c. Fuse size selection for valve operators does not allow enough margin for emergency operation.	c. Fuse size selection for valve operators did not allow sufficient margin for emergency operation, as concluded in Problem Identification Report PIR WBNEEB8638 (Ref. 5.06). The corrective action for this PIR increased the fuse rating from 0.6 ampere to 1.0 ampere. However, the fuse selection process is not documented, and the evaluation team could not establish that the additional margin provided by the larger fuse would be sufficient.	c. TVA commits to provide corrective action to resolve the condition identified in PIR WBN EEB8638 as part of SCR WBNEEB8571 (Ref. 5.19). EEB contracted for a long-term electrical calculation program and detailed training in the use of QA-assured computer calculation programs. (CATD 237 02 WBN 03)
d. Fuse sizes are selected to protect the valve operator motors and not the circuits (e.g., ERCW valves in fifth diesel generator building).	d. Fuse sizes were selected to provide short circuit protection for motors and the circuits. Overload protection for motors and circuits was provided by thermal overload relays. No calculations or other basis could be found to demonstrate that the fuses provide adequate full range short circuit protection for motor starter, cable, and motor. The design work to replace 16 circuit breakers and to reset 369 was completed to correct trip settings that were higher than permitted by criteria. In addition, design work was completed to replace fuses which did not allow sufficient margin for emergency operation and to replace circuit breakers for motor operated valves so that cables would be protected against overloads in the event of bypass of the overload relays. However, the evaluation team could find no documentation confirming completion of construction work related to the above design changes.	d. TVA commits to provide calculations to demonstrate that fuses provide adequate short circuit protection for motors, starters, and cables. This will be performed as part of an electrical calculation program to resolve the condition adverse to quality, identified in SCR WBNEEB8571, and act to prevent its recurrence. EEB contracted for a long-term electrical calculation program and detailed training in the use of a QA-assured computer calculation program. (CATD 237 02 WBN 04) o TVA identifies the applicable documentation and commits completion as follows for these activities: (a) Replacement of 16 and resetting of 369 breakers were completed by ECN E 4251 (Ref. 6.10) and Workplan 3933. Documentation is on file in the vault.

Issues	Findings	Corrective Actions
Element 237.2 - WBN (Continued)		
		(b) Replacement of fuses to provide margin sufficient for emergency operation will be completed under ECN 6391 (Ref. 6.21) and Workplan 6391. (c) Replacement of breakers for motor operated valves to provide cable protection when the overload relays are bypassed was completed under ECNs 5912 (Ref. 6.16) and 5913 (Ref. 6.17) and Workplan E5912-1. Documentation is on file in the vault. (CATD 237 02 WBN 06)
BFN a. Unacceptable trip ratings were selected for combination starter molded case breakers. Engineering practices and attitudes were poor in the selection of molded case breaker trip ratings.	BFN a. As specified in Policy Memoranda PM 86-02 R1 (EEB) (Ref. 4.19) and PM 86-18 (EEB) (Ref. 4.10), BFN was requested to review and evaluate all electrical calculations necessary to ensure plant safety and to mitigate the results of design basis events. Memo PM 86-02 included a list of calculations that must be performed before plant restart. Memo PM 86-18 provided specific details and methodology for the selection of thermal overload heaters of the combination starters.	BFN a. The calculations to document the trip sizing of circuit breakers for motor branch circuit protection will be performed (or revisions made) under SCR BFNEEB8529, R2 and R3 (Ref. 5.25). (CATD 237 02 BFN 01) The calculations to document the proper sizing of thermal overload heaters (TOL) for motor branch circuits will be performed (or present size verified) under SCR BFNEEB8536, R2 (Ref. 5.26). The corrective action will include: o Walkdown for identification o Establishment of sizing criteria o Evaluation for conformance with sizing criteria o Incorporation of TOL sizes on drawings o Documentation of future TOL changes (CATD 237 02 BFN 02)

Issues	Findings	Corrective Actions
Element 237.2 - BFN (Continued)		
	The recent issue of DG-E2.3.5 (Revision 3), Section 5.0 (Ref. 3.13) includes requirements for the verification of existing circuit protection adequacy for motors rated less than 2 horsepower; however, it does not give details (sample calculation) for the selection and sizing of circuit protection devices for motors rated less than 1/2 horsepower. Also, the design guide does not provide differentiation between motor circuit protectors and magnetic only circuit breakers.	Design Guide DG E2.3.5, R3, will be reviewed and revised as appropriate to provide guidance for sizing motor branch circuit protection devices for motors rated less than 1/2 horsepower, and for differentiating between magnetic-only breakers and motor circuit protectors (MCP). (CATD 237 02 NPS 03)
	SCR BFNEEB8524 (Ref. 5.20) identified the probability that the circuit breakers (as originally designed) serving MOVs with added overload relay bypass, do not adequately protect the feeder cables to the subject motors. The evaluation team could not find documented calculations to ensure that circuit breaker trip ratings, connected motor, related circuit devices, and feeder cable sizes are properly coordinated.	The calculations to document the proper coordination between branch circuit breaker trip rating, motor, related circuit devices, and feeder cable size will be performed under SCR BFNEEB8529, R2 and R3 (Ref. 5.25). (CATD 237 02 BFN 04)
b. The National Electrical Code and good engineering practices were violated.	b. DS-E2.3.2 (Ref. 3.06) does not refer to the NEC or establish the extent of NEC applicability to TVA design and does not specify that in case of conflict between the NEC and the manufacturer's requirements which one rules.	b. Design Standard DS-E2.3.2 will be reviewed and revised as appropriate to identify level of conformance with NEC and establish governing positions in case of conflict between NEC and manufacturer's requirements. (CATD 237 02 NPS 05)
c. Fuse size selection for valve operators does not allow enough margin for emergency operation. Fuse sizes are selected to protect the motor, not the circuit.	c. The issue regarding fuse selection for valve operators was found not to be applicable to BFN since all valve operators are equipped with thermal-magnetic breakers for circuit protection, not with fuses. The evaluation team identified one group of motor branch circuits using fused combination starters. Although the functions of the associated loads are not safety related, these loads are energized from class 1E 480 V diesel auxiliary board B.	c. The calculations to document the proper fuse sizing in the starters of CCW discharge sampling pumps A, B, and C will be performed under SCR BFNEEB8529, R2 and R3. (CATD 237 02 BFN 06)

Issues	Findings	Corrective Actions
Element 237.2 - BLN	BLN	BLN
a. Unacceptable trip ratings were selected for combination starter molded case breakers. Engineering practices and attitudes were poor in the selection of molded case breaker trip ratings.	a. "Low Voltage System Protective Device Selection and Setting" section of BLN Minimum Set of Calculations log (Ref. 3.17), and "Auxiliary Power" section of the list of additional required calculations/ design justifications, are incomplete. In addition, the "Existing Calculations" column of the log (current) is inaccurate. The adequacy and completeness of BLN Minimum Set of Calculations is addressed in Subcategory 24500, BLN Element 205.1. o No specific calculation was included to document the original sizing of MCC motor circuit protection devices. o Calculation N4-CG-KP-003 (Ref. 7.17) analyzes only the overload heater elements of HVAC system related motors. o Calculation N4-CG-KP-004 (Ref. 7.16) (justifying the acceptance of 20 MOV circuit breaker settings) is not listed. o Calculations N4-WI-KP-001 (Ref. 7.18) and 5GB0741-KP (Ref. 4.15) are associated with 480 V switchgear, not with MCC motor circuit protection devices. o Calculations for MCC motor starter overload heater selection, as requested by PM 86-18 (EEB, Ref. 4.16), and for circuit protection of MOVs with bypassed overload relays, as identified by SCR WBN EEB 8540 (Ref. 5.17), (PIR BLN EEB8521; Ref. 5.07) are not included in the required calculation lists. The recent issue of DG-E2.3.5 (Revision 3), Section 5.0, includes requirements for the verification of existing circuit protection adequacy for motors rated less than 2 horsepower; however, it does not give details (sample calculation) for the selection and sizing of circuit protection devices for motors rated less than 1/2 horsepower. Also, the design guide does not provide differentiation between motor circuit protectors and magnetic only circuit breakers.	a. The calculations to document proper trip sizing of the circuit breakers for MCC branch circuit protection will be performed under the PM 86-02, R1 (EEB) program. These calculations are also part of the corrective action identified in BLSEP-07 (Ref. 3.17) and PIR BLN EEB8521 (Ref. 5.07). (CATD 237 02 BLN 01) The calculations to document the proper sizing of thermal overload heaters for MCC motor branch circuits will be performed in accordance with PM 86-18 (EEB) and PM 86-02, R1 (EEB). (CATD 237 02 BLN 02) Design Guide DG E2.3.5, R3, will be reviewed and revised as appropriate to provide guidance for sizing motor branch circuit protection devices for motors rated less than 1/2 horsepower, and for differentiating between magnetic-only breakers and motor circuit protectors (MCP). (CATD 237 02 NPS 03)

Issues	Findings	Corrective Actions
Element 237.2 - BLN (Continued)		
	General Design Criteria N4-RP-D775A (Ref. 3.04) permit exceptions to the codes and standards mandated by the criteria themselves without documented justification or approval (Section 5.1). This is in conflict with TVA Nuclear Engineering (NE) Procedure NEP-3.2 (Ref. 3.57). Note that a similar statement exists in Section 5.1 of General Design Criteria N4-RP-D775 (Normal AC Auxiliary Power).	GDC N4-RP-D775A will be revised to clarify the documentation requirements for exception to the D.C. itself and for significant deviations from the standards, codes, guides, and other governing documents referenced for conformance in the D.C. (CATD 237 02 BLN 04)
	The condition described in SCR WBN EEB 8540 for WBN was stated to be identified for resolution in PIR BLN EEB 8521 applicable to BLN. However, the PIR was issued only for tracking calculations included (but not completed) in the Minimum Set of Calculations list. The PIR does not reference directly the conditions presented in the subject SCR.	The calculations to document the proper coordination between branch circuit trip rating, motor, related circuit devices, and feeder cable for MOVs with overload relay bypass will be performed in accordance with PM 86-02, R1 (EEB, Ref. 4.19)). (CATD 237 02 BLN 03)
b. The National Electrical Code and good engineering practices were violated.	b. DS-E2.3.2 does not refer to the NEC or establish the extent of NEC applicability to TVA design and does not specify that in case of conflict between the NEC and the manufacturer's requirements which one rules. General Design Criteria N4-RPD 775A permit exception to the NEC without documented approval.	b. Design Standard DS-E2.3.2 (Ref. 3.06) will be reviewed and revised as appropriate to identify level of conformance with NEC and establish governing positions in case of conflict between NEC and manufacturer's requirements. (CATD 237 02 NPS 05)
c. Fuse size selection for valve operators does not allow enough margin for emergency operation. Fuse sizes are selected to protect the motor, not the circuit.	c. The issue regarding fuse selection for valve operators was found not to be applicable to BLN. At BLN motor branch circuits using fused combination starters have not been used.	c. None required.

Issues	Findings	Corrective Actions
********** Element 237.4 - Bypass of Over-torque Limit Switches **********		
SQN a. Torque switch bypass modification for SIS valve nos. 332 and 333 per 1979 ECN 2257 was not performed. (The ECN 5971 number quoted in the concern was found to be incorrect. The correct number was identified as ECN 2257.)	SQN a. All valves requiring modification per ECN 2257 (Ref. 6.01) were so modified. Valves 332 and 333 were later identified as active valves and were modified per ECN L6416 (Ref. 6.06).	SQN a. None required.
b. Adequacy of design compliance with the torque switch bypass requirement for motor operated valves (MOVs) is in question.	b. The evaluator's investigation determined that no design bases currently exist for the MOV torque switch bypass design. This results in an unclear definition of which valves are required to meet this torque switch bypass design. This, in turn, results in inconsistencies among the different lists of valves. Also, standard drawings (Ref. 7.13) do not provide a clear definition for selecting torque and limit switch configurations.	b. The corrective action plan includes: o Issuance of design criteria providing design basis for MOV torque switch bypass design o Preparation of an active valve list, including justification for listing active valves only o Revision of FSAR to clarify TVA design basis o Revision of standard drawings for MOV to clarify and define design o Drawing review on all active valves to verify compliance with MOV torque switch bypass design (CATDs 237 04 SQN 01 and 02)
WBN See Element 237.1, issues "b" and "c"	WBN.	WBN
BFN See Element 237.1, issues "b" and "c"	BFN	BFN
BLN See Element 237.1, issues "b" and "c"	BLN	BLN

Issues	Findings	Corrective Actions
********** Element 237.6 - Gassing of Current Transformers **********		
SQN	SQN	SQN
a. Current transformers (CT) are "gassing" (generating explosive gasses within).	a. TVA and other utilities are experiencing gassing of their high voltage CTs (Ref. 9.56 and 9.57)	a. See issue "f" for corrective action.
b. Outages are required to obtain oil samples to monitor the gassing conditions.	b. Power circuit breakers (PCBs) must be tripped to de-energize CTs so that oil samples can be taken for analysis of gas (usually hydrogen) content of the insulating oil.	b. None required.
c. If gas content of oil exceeds recommended levels, the CT must remain out of service.	c. When the gas content of the CT insulating oil is above the recommended maximum (i.e., 200 ppm hydrogen), (Ref. 9.21) that CT must remain out of service until it is degassed or replaced. This also means the PCB will remain out of service.	c. None required.
d. Outages of CTs may lead to switchyard configuration changes.	d. Switchyard configuration changes are made, as necessary, to accommodate oil sampling and, if need be, out-of-service equipment.	d. None required.
e. Changes in switchyard configuration may reduce plant security (safety).	e. The issue that switchyard configuration changes (due to outages or failures) could jeopardize the safety of the plant has not been substantiated for the following reasons: o None of the suspect high voltage CTs are part of the class 1E safety-related power system. o The switchyard changes are a planned and coordinated activity, and sufficient equipment exists so that multiple sources are available to the plant. o The two independent preferred power sources required by 10 CFR 50 Appendix A, General Design Criterion 17 (Ref. 2.19) are physically separated in their routing. They terminate in the SQN 161 kV switchyard in bays, which are more than 300 feet apart; therefore, failure of a single CT will not affect the alternate preferred source.	e. None required.

Issues	Findings	Corrective Actions
Element 237.6 - SQN (Continued)		
f. Peripheral finding.	f. Furthermore, during its investigation, the evaluation team established that TVA has taken steps to determine the cause of the gassing/failures of the CTs, has implemented procedures to protect personnel, and is establishing programs to prevent catastrophic failures. Specifically, TVA has taken, or is in the process of taking, the following actions: o SQN Hazard Control Instruction HCI-E9, "Safety Precautions for Operations in Switchyards" (Ref. 3.29), has been implemented. This instruction establishes minimum safety precautions to be taken when working in switchyards and oil sampling requirements. o TVA performed system studies and monitoring at Raccoon Mountain (Ref. 4.06), where most of the failures have taken place. The results were inconclusive, and these efforts were abandoned. o TVA PSU is in the process of developing an on-line monitoring system to detect excessive gassing of CTs in time to remove them from service prior to failure. Monitor testing is currently being conducted at Raccoon Mountain. o In cooperation with an outside vendor TVA has contracted for: - A diagnostic test program where CTs will be subject to partial discharge (corona) tests and impulse voltage tests - A subsequent dismantling and inspection program	f. TVA commits to the completion of the previously established programs, as identified in the CATD. No completion date is forecasted or necessary as this is a continuing effort. Furthermore, the described problems are nonquality-related (NQR) and are therefore not required to be completed prior to restart. (CATD 237 06 NPS 02)
WBN	WBN	WBN
a. Current transformers (CT) are "gassing" (generating explosive gases within).	a. TVA and other utilities are experiencing gassing of their high voltage CTs (Ref. 9.56 and 9.57)	a. See issue "f" for corrective action.
b. Outages are required to obtain oil samples to monitor the gassing conditions.	b. Power circuit breakers (PCBs) must be tripped to de-energize CTs so that oil samples can be taken for analysis of gas (usually hydrogen) content of the insulating oil.	b. None required.

Issues	Findings	Corrective Actions
Element 237.6 - WBN (Continued)		
c. If the gas content of oil exceeds recommended levels, the CT must remain out of service.	c. When the gas content of the CT insulating oil is above the recommended maximum (i.e., 200 ppm H_2), (Ref. 9.21), then that CT must remain out of service until it is degassed or replaced. This also means the PCB will remain out of service.	c. None required.
d. Outages of CTs may lead to switchyard configuration changes.	d. Switchyard configuration changes are made to accommodate oil sampling and, if need be, out-of-service equipment.	d. None required.
e. Changes in switchyard configuration may reduce plant "security" (safety).	e. The issue that switchyard configuration changes (due to outages or failures) could jeopardize the safety of the plant has not been substantiated for the following reasons: o None of the suspect high voltage CTs are part of the class 1E safety-related power system. o The switchyard changes are a planned and coordinated activity, and sufficient equipment exists so that multiple sources are available to the plant. o The two independent preferred power sources required by 10CFR50 Appendix A, General Design Criterion 17 (Ref. 2.19) are physically separated in their routing. They terminate in the Watts Bar Hydro switchyard in bays, which are more than 300 feet apart; therefore, failure of a single CT will not affect the alternate preferred source. o WBN generates on a transmission network separate from the network from which preferred power is supplied. Therefore, a CT failure causing a generator trip leading to a reactor trip will not affect the preferred power sources.	e. None required.

Issues	Findings	Corrective Actions
Element 237.6 - WBN (Continued)		
f. Peripheral finding.	f. Furthermore, during its investigation, the evaluation team established that TVA has taken steps to determine the cause of the gassing/failures of the CTs, has implemented procedures to protect personnel and is establishing programs to prevent catastrophic failures. Specifically, TVA Power Systems Operations (PSO) has taken, or is in the process of taking, the following actions: o WBN Hazard Control Instruction HCI-E5, "Safety Precautions for Operations in Switchyards" (Ref. 3.30), has been implemented. This instruction establishes minimum safety precautions to be taken when working in switchyards. o TVA has performed system studies and monitoring at Raccoon Mountain (Ref. 4.06) where the majority of the failures have taken place. The results were inconclusive and these efforts have been abandoned at this time. o TVA PSO is in the process of developing an on-line monitoring system to detect excessive gassing of CTs in time to remove them from service prior to failure. Monitor testing is currently being conducted at Raccoon Mountain. o TVA is procuring 18 qualified (explosion proof) SF_6 CTs to be installed in the Unit 1 500 kV switchyard at Watts Bar Nuclear Plant. o In cooperation with an outside vendor TVA has contracted for: - A diagnostic test program where CTs will be subject to partial discharge (corona) tests and impulse voltage tests - A subsequent dismantling and inspection program	f. The CAP transmitted via TCAB-280 responds to the described problem of CATD 237 06 WBN 01 which was: "SF_6 CTs have been procured for the WBN Unit 1 500 kV switchyard but not yet installed." The action committed to is the installation of these CTs per ECNs 5959 and 5960 (Refs. 6.18 and 6.19). This effort is to be completed prior to Unit 1 fuel load, with a current forecasted completion date of 10/30/87. The second CAP, transmitted via TCAB-316, responds to CATD 237 06 NPS 02 which had the following problem description: "The CT monitoring program has not been fully implemented nor has the diagnostic testing and subsequent dismantling of a CT been completed." This CATD is non-plant specific (NPS) and is applicable to all TVA plants. The CAP commits to the completion of the previously established programs, as identified in the CATD. No completion date is forecasted nor is necessary as this is a continuing effort. Furthermore, the described problems are nonquality-related (NQR) and are therefore not required to be completed prior to fuel load. (CATDs 237 06 WBN 01 and 237 06 NPS 02)

Issues	Findings	Corrective Actions
Element 237.6 - BFN	BFN	BFN
a. Current transformers (CT) are "gassing" (generating explosive gases within).	a. TVA and other utilities are experiencing gassing of their high voltage freestanding, oil-filled CTs (Ref. 9.56 and 9.57)	a. See issue "f" for corrective action.
b. Outages are necessary so the samples for monitoring the gassing condition can be obtained.	b. Power circuit breakers (PCBs) must be tripped to de-energize CTs so that oil samples can be taken for analysis of gas content (usually hydrogen) of the insulating oil.	b. None required.
c. If gas content of oil exceeds recommended level, the CT must remain out of service.	c. When the gas content of the CT insulating oil is above the permissible maximum (200 ppm H_2), (Ref. 9.21), the associated PCB must remain out of service until the CT is degassed or replaced.	c. None required.
d. Outages of CTs may lead to switchyard configuration changes.	d. Switchyard configuration changes are required to accommodate CT oil sampling and out-of-service switchyard equipment.	d. None required.
e. Changes in switchyard configuration may reduce plant security (safety).	e. The issue that switchyard configuration changes (due to CT oil sampling or failure) could jeopardize the safety of the plant has not been substantiated for the following reasons: o None of the suspect high-voltage CTs is part of the Class 1E safety-related power system. o The switchyard configuration changes are planned and coordinated activities, and enough equipment exists to utilize the multiple power sources available to the plant. o The failure of a single CT will not prevent conformance with 10 CFR 50, Appendix A, GDC-17 (Ref. 2.19). The auxiliary power system of BFN has crossfeed capabilities (at 4 kV level) between the three generating units and with the common station service supplied from the 161 kV offsite power sources. The use of generator breakers, the multiplicity of lines feeding the 500 kV and 161 kV switchyard buses, and the adequate physical separation between the CTs and offsite power-related equipment ensure that one CT failure will not prevent the selected switchyard configuration from supplying the necessary offsite shutdown power.	e. None required.

Issues	Findings	Corrective Actions
Element 237.6 - BFN (Continued)		
f. Peripheral finding.	f. During the review, the evaluation team verified that TVA has taken steps, through the activities of the CT-Failure Task Force to determine the cause of the gassing/failures of the CTs. TVA has implemented procedures to protect personnel and is in the process of establishing programs to prevent catastrophic CT failures. TVA Power System Operation (PSO) has taken, or is in the process of taking, the following actions: o Issued "Safety Procedures for Freestanding Oil-Filled CTs" on 05/23/85 (Ref. 4.38). These procedures establish minimum safety precautions to be followed when working in the vicinity of CTs identified as potentially dangerous. They also provide instructions on monitoring hydrogen and taking oil samples. o TVA has performed power system studies and failure monitoring at Raccoon Mountain (Ref. 4.0b), where the majority of the CT failures have taken place. The results of the study were inconclusive and these efforts have been abandoned for the time being. o Currently, TVA is in the process of developing an on-line monitoring system to detect deterioration in the CT so that the CT can be removed before destructive failure occurs. Monitor testing is currently being conducted at Raccoon Mountain. A power factor monitor is the most likely type to be used, because its response time is much less than that of a gas-in-oil monitor. o TVA contracted with a vendor for: - A diagnostic test program for subjecting CTs in deteriorated condition to partial discharge (corona) tests and impulse voltage tests to investigate the theory that the insulation was breaking down, thereby causing the gassing. - The subsequent dismantling of CTs and an inspection program	f. TVA has previously submitted a corrective action plan (CAP) that addresses the findings of this report. The CAP was transmitted via ICAB-316 on 03/16/87 in response to corrective action tracking document (CATD) 237 06 NPS 02, which was issued as part of WBN element evaluation 237.6 (see issue "f" of Element 237.6-WBN). (CATD 237 06 NPS 02)

Issues	Findings	Corrective Actions
Element 237.6 - BLN	BLN	BLN
a. Current transformers (CT) are "gassing" (generating explosive gases within).	a. TVA and other utilities are experiencing gassing of their high voltage freestanding, oil-filled CTs (Ref. 9.56 and 9.57)	a. See issue "f" for corrective action.
b. Outages are necessary so that oil samples for monitoring the gassing condition can be obtained.	b. Power circuit breakers (PCBs) must be tripped to de-energize CTs so that oil samples can be taken for analysis of gas content (usually hydrogen) of the insulating oil.	b. None required.
c. If gas content of oil exceeds recommended level, the CT must remain out of service.	c. When the gas content of the CT insulating oil is above the permissible maximum (200 ppm H_2), (Ref. 9.21), the associated PCB must remain out of service until the CT is degassed or replaced.	c. None required.
d. Outages of CTs may lead to switchyard configuration changes.	d. Switchyard configuration changes are required to accommodate CT oil sampling and out-of-service switchyard equipment.	d. None required.

Issues	Findings	Corrective Actions
Element 237.6 - BLN (Continued)		
e. Changes in switchyard configuration may reduce plant security (safety).	e. The issue that switchyard configuration changes (due to CT oil sampling or failure) could jeopardize the safety of the plant has not been substantiated for the following reasons: o None of the suspect high-voltage CTs is part of the Class 1E safety-related power system. o The switchyard configuration changes are planned and coordinated activities, and enough equipment exists to utilize the multiple power sources available to the plant. o The failure of a single CT will not prevent conformance with 10 CFR 50, Appendix A, GDC-17 (Ref. 2.19). The auxiliary power system of BLN has crossfeed capabilities (at 6.9 kV level) between the two generating units. The use of generator load break switches, the multiplicity of lines feeding the 500 kV and 161 kV switchyard buses, and the adequate physical separation between the CTs and offsite power-related equipment ensure that one CT failure will not prevent the selected switchyard configuration from supplying the necessary offsite power.	e. None required.
f. Peripheral finding.	f. During the review, the evaluation team verified that TVA has taken steps, through the activities of the CT-Failure Task Force to determine the cause of the gassing/failures of the CTs. TVA has implemented procedures to protect personnel and is in the process of establishing programs to prevent catastrophic CT failures. TVA Power System Operation (PSO) has taken, or is in the process of taking, the following actions: o Issued safety procedure (Ref. 4.38) and hazard control instruction (Ref. 3.31) to establish minimum safety precautions to be followed when working in the vicinity of CTs identified as potentially dangerous. They also provide instructions on monitoring hydrogen and taking oil samples. o TVA has performed power system studies and failure monitoring at Raccoon Mountain (Ref. 4.00), where the majority of the CT failures have taken place. The results of the study were inconclusive and these efforts have been abandoned for the time being.	f. TVA has previously submitted a corrective action plan (CAP) that addresses the findings of this report. The CAP was transmitted via TCAB-316 on 03/16/87 in response to corrective action tracking document (CATD) 237 06 NPS 02, which was issued as part of WBN element evaluation 237.6 (see issue "f" of Element 237.6 - WBN). (CATD 237 06 NPS 02)

Issues	Findings	Corrective Actions
Element 237.6 - BLN (Continued)		
	o Currently, TVA is in the process of developing an on-line monitoring system to detect deterioration in the CT so that the CT can be removed before destructive failure occurs. Monitor testing is currently being conducted at Raccoon Mountain. A power factor monitor is the most likely type to be used because its response time is much less than that of a gas-in-oil monitor. o TVA contracted with a vendor for: - A diagnostic test program for subjecting CTs in deteriorated condition to partial discharge (corona) tests and impulse voltage tests to investigate the theory that the insulation was breaking down, thereby causing the gassing. - The subsequent dismantling of CTs and an inspection program	

Issues	Findings	Corrective Actions
********** Element 241.1 - Inadequate Splicing and Termination Practices and Procedures **********		
SQN a. The adequacy of cable splices is questioned should underground cable systems become submerged from flooding in manholes or cable ducts.	SQN a. Review of the design and construction documents revealed that current procedures, standards, and inspection instructions provide sufficient information to make qualified cable splices on medium voltage (5 to 15 kV) and low voltage (600 V or less) cables. Documentation review (G-38, Rev. 0 and Raychem tests, References 9.64, 9.65, 9.66, and 9.67) and interviews conducted by the evaluation team also suggests that, prior to the issue of the "Criteria and Procedures for Making Splices of Insulated Cables in Manholes and Handholes" (Ref. 4.39) and the electrical standard drawings (Ref. 3.10) (medium voltage) and SD-E12.5.6 (Ref. 3.11) SD-E 12.5.3 and SD-E12.5.8 (Ref. 3.12) (low voltage), submersible cable splices, including Raychem heat shrinkable tubing, were installed. However, no evidence supporting adequacy of installation or installation records of submersible cable splices could be identified. Furthermore, G-38 (Ref. 3.20) does not address splices for medium voltage cables prior to Rev. 2.	SQN a. TVA will correct sump pump deficiencies (including power supply, controls, and discharge piping) in all class 1E/CSSC manholes and handholes (MH/HHs) having sump pumps, except MH41 (MH41 is for the additional diesel generator): 37 of the 56 class 1E/CSSC MH/HHs have sump pumps (see EE CATD 240503-QN-03). Pump dry the 36 submerged class 1E/CSSC MH/HHs to provide access for the sampling program discussed below. TVA will determine the number of class 1E/CSSC cable splices in the 36 MH/HHs noted above. TVA will also: record the number of class 1E/CSSC cable splices that have been submerged in these MH/HHs; assuming a similar average number of splices in the remaining MH/HHs, establish the total number of estimated class 1E/CSSC splices; and, using an appropriate sampling procedure, such as MIL-STD-105D, establish whether a large enough number of splices has been submerged to provide a representative sample. Only those splices in circuits which are frequently energized will be included in the sample. Submerged cable splices in circuits frequently energized demonstrate the adequacy of the cable splices. If the number of submerged class 1E/CSSC splices is large enough to establish a 95 percent confidence level that the splices are 95 percent reliable, no further action is required before unit 2 restart.

Issues	Findings	Corrective Actions

Element 241.1 - SQN (Continued)

If the sample as stated in the paragraph above is not large enough to establish a 95 percent confidence level that the splices are 95 percent reliable, verify the proper installation of the splices in the sleeves on all class 1E/CSSC medium and low voltage splices installed in the 36 MH/HHs noted above, except those that have been submerged. TVA will evaluate the available high pot and megger test data for the class 1E/CSSC medium and low voltage power cables routed through the remaining MH/HHs. Write a CAQ for any inadequate class 1E/CSSC cable splices (see EC CATD 304.03-SQN-03).

(CATD 241 01 SQN 01)

THIS ITEM PARTIALLY COMPLETED
AT SQN BY 12-10-87

No splice cards for cable splices prior to 1977 were identified, and the reviewed splice cards do not record materials used. In addition, the evaluation team found that existing records are insufficient to determine the type, number, and location of cable splices in manholes. Neither could the evaluation team identify use of cable splices as tested by Raychem for TVA, prior to the issue of the current electrical standard drawings (Refs. 3.10, 3.11, 3.12) for splicing procedures.

TVA will document the type of material used to waterproof the splices, and determine the number and location of all class 1E/CSSC splices in the manholes and handholes. Also, M&AI-7, currently under revision, will require unique identification and documentation of location, cable number, materials used, etc., for future installations of class 1E/CSSC splices.
(CATD 241 01 SQN 02)

Improper installation of heat shrinkable tubing over electrical splices, as stated in the NRC IE Information Notice 86-53 (Ref. 2.15), has been identified in CAR SQ-CAR-86-058 (Ref. 9.12). The current program under SMI-0-317-42 (Ref. 3.53) is, however, limited to correcting the problem only for splices on equipment covered under 10 CFR 50.49. No program is currently in place to review the adequacy of splice installation for cables in manholes.

TVA will:

- Prepare a special maintenance instruction (SMI) to inspect all class 1E/CSSC cable splices in manholes and handholes to determine if they are adequate for their application.
- Write a CAQ for inadequacies and work requests (WR) to replace all inadequate class 1E/CSSC splices identified.

THIS ITEM PARTIALLY COMPLETED
AT SQN BY 12-10-87

(CATD 241 01 SQN 03)

Issues	Findings	Corrective Actions
Element 241.1 - SQN (Continued)		
b. Plant safety is questioned as a result of a splice(s) failure because of flooding.	b. The evaluation team determined that cables of redundant class 1E trains are routed through independent conduit banks to the remote buildings in conformance with the design criteria (Refs. 3.58 and 1.01). Although the class 1E cables have been in service under operating conditions for some time, existing records are insufficient to verify the adequacy of the cable splices. Due to possible simultaneous flooding of redundant class 1E manholes, a potential common mode failure of redundant class 1E cable splices cannot be ruled out. A limited walkdown of six manholes identified in ECTG Report No. 304.03 confirmed that manholes are currently flooded, resulting in cables coated with mud, and debris lying on the floor.	b. Addressed above in a.
c. Adequacy of the current design for availability of redundant (back-up) systems is questioned in case of cable splice failure(s).	c. The design of class 1E cable systems is based on requirements for preserving the independence of redundant class 1E systems. However, because of insufficient cable splice records and the potential common mode failure as stated above, the availability of a redundant class 1E train for safe shutdown of the plant cannot be guaranteed.	c. Addressed above in a.

Issues	Findings	Corrective Actions
Element 241.1 - WBN	WBN	WBN
a. Adequacy of cable splices is questioned should underground cable systems become submerged from flooding in manholes or cable ducts.	a. A review of the design and construction documents revealed that the procedures, standards, and inspection instructions provide sufficient information to make qualified cable splices on medium voltage (5 to 15 kV) and low voltage (600 V or less) in underground cable systems. The evaluation team reviewed a large number (approximately 80-90) of splice cards and found that the splices were performed in accordance with applicable procedures (General Construction Specification G-38 (Ref. 3.20) and Electrical Standard Drawing SD-E12.5.3 [Ref. 3.10]). Material used and locations of splices are properly documented on the splice cards. The cable splices installed in manholes, as recorded on splice cards, are qualified for submersion.	a. No corrective action is required for this part of the finding.
	However, an occurrence of using 600 volt rated 2-way cable connectors in 6.9 kV cable splices was identified through NCR 6536, (Ref. 5.29). Work plan N6536-1 (Ref. 9.58) (Unit 1) entails an extensive plan to inspect all the safety-related 6.9 kV splices and correct any deficiencies discovered. A recent walkdown conducted by the evaluation team observed significant progress in implementation of this work plan. The evaluation team is not aware of any similar work plan for Unit 2.	TVA states that workplan N6536-1 does encompass work on unit 2 and common systems as well as unit 1. The CAP also states that as of 03/10/87 corrective action relative to workplan N6536-1 was in progress with a scheduled completion date of 05/01/87. (CATD 241 01 WBN 01)
	NRC IE information notice 86-53 (Ref. 2.15) addresses improper installation of heat shrinkable tubing over electrical splices. Deficiencies cited in this IE information notice were identified as part of NCR W-353-P R1 (Ref. 5.03). The review under element 241.1 was limited to splices located in underground raceway systems. The problem pertaining to Conax cables of containment penetrations is covered under element 241.5 (WBN), finding "c" (peripheral). The evaluation team has been unable to identify any program to review the adequacy of splice installation for class 1E cables in manholes.	TVA states that applicability of IE Information Notice 86-53 (Ref. 2.15) to cable splices located within manholes will be evaluated. Acceptable installation of splices in manholes will be determined, any deficiencies found will be documented via CAQ, and corrected as necessary. Additionally, TVA has committed to implement corrective actions relative to CATD 304 03 NPS 01 regarding preventive maintenance of electrical manholes at WBN as part of CATD-2. (CATD 241 01 WBN 02) The corrective action regarding splicing problems in Conax penetration enclosures is covered under element 241.5(WBN) finding "c".

Issues	Findings	Corrective Actions
Element 241.1 - WBN (Continued)		
b. Plant safety is questioned as a result of a splice(s) failure because of flooding.	b. A postulated failure of a cable splice in one class 1E train due to flooding will not affect the function of the redundant train if the cable splices have been installed correctly in accordance with existing procedures and design criteria for cables routed in conduit banks. However, because of possible simultaneous flooding of redundant class 1E manholes, a potential common mode failure of redundant class 1E cable splices cannot be ruled out if improperly installed.	b. Addressed above in a.
c. Adequacy of the current design for availability of redundant (back-up) systems is questioned in case of cable splice failure(s).	c. The design of class 1E cable systems is based on requirements of preserving the independence of redundant class 1E systems. The redundant (backup) system is designed to respond to any single failure (caused by failure of a cable splice) to mitigate a design basis event. However, concurrent failure of improperly installed cable splices due to simultaneous flooding of redundant cables may affect availability of redundant (backup) equipment.	c. Addressed above in a.
BFN	BFN	BFN
a. The adequacy of cable splices is questioned should underground cable systems become submerged from flooding in manholes or cable ducts.	a. In the underground tunnel between the intake structure and the Turbine Building, the evaluation team observed that: o A small number of splices on nonclass 1E control cables have Raychem heat shrinkable tubing over them. o Class 1E control cables are generally heavily covered with Flamemastic and, therefore, splices could not be identified or verified. o A limited number of spliced medium voltage cables exist in a class 1E tray. Because of the lack of identification and the heavy Flamemastic coating, the evaluation team could not determine their safety classification.	a. TVA commits to identify and locate all splices of safety-related cables in harsh environment and to replace those not meeting the requirements of GCS-G3B (Ref. 3.20). Furthermore, a tracking list will be developed for these splices (SCR BFN EEB 8649). The identification and walkdown will also include safety-related cables located at the intake pumping station. A CAQR will be issued for any nonconforming splices. The walkdown generated data will be issued on a QIR for input to the computer based splice tracking program. (CATDs 241 01 BFN 01 and 02)

Issues	Findings	Corrective Actions
Element 241.1 - BFN (Continued)		
	o No installation details nor information on the materials used could be identified to verify adequacy of splices on the medium voltage cables. No documentation identifying splice locations could be found by the evaluation team. No splices were identified in handholes 15 and 26 for the underground duct bank that contains cables that are redundant to the cables run in the tunnel. Although the adequacy of cable splices in underground installations could not be verified by the evaluation team, several deficient installations of Raychem tubing in other parts of the plant were identified by the EQ staff (TVA ECSP Report 30200, R0) (Ref. 9.28).	
b. Plant safety is questioned should a splice(s) fail because of flooding.	b. The evaluation team did not identify any cable splices in handholes 15 and 26. Because of this and in spite of the uncertainty regarding the existence of class 1E splices in the tunnel, in the event of simultaneous flooding of the underground tunnel and the duct bank, a potential common mode failure of redundant class 1E splices can be ruled out.	b. None required.
c. Adequacy of the current design for availability of redundant (back-up) systems is questioned in case of cable splice failure(s).	c. At present, there are no class 1E splices in the class 1E underground duct bank between handholes 15 and 26. The cable system of the duct bank is redundant to the underground tunnel and, therefore, designed per single failure requirements to mitigate a design basis event including failure of one of the cable splices in the tunnel.	c. None required.

Issues	Findings	Corrective Actions
Element 241.1 - BLN	BLN	BLN
a. The adequacy of cable splices is questioned should underground cable systems become submerged from flooding in manholes or cable ducts.	a. A review of design and construction documents revealed that current procedures, standards, and inspection instructions provide enough information to make qualified cable splices on medium voltage (5 to 15 kV) and low voltage (600 V or less) cables. The evaluation team reviewed documentation and conducted interviews. It found that medium voltage splices were performed in accordance with applicable procedures (General Construction Specification G-38 [Ref. 3.20], Quality Control Procedures BNP-QCP-3.34 [Ref. 3.52] and BNP-QCP-3.4 [Ref. 3.50], and Electrical Standard Drawing SD-E12.5.3 [Ref. 3.10]. However, low voltage splices were performed before Electrical Standard Drawings SD-E12.5.6, (Ref. 3.11) and SD-E12.5.8, (Ref. 3.12) were originally issued (03/20/81 and 02/27/84, respectively). These drawings provide splicing details for low voltage insulated cables. No separate splice records were used at BLN before Quality Control Procedure BNP-QCP-3.34 was issued, in late 1984. Previous splicing information was recorded on "Cable Installation Slips" (pull cards), with only location and any crimp tools used being logged; splicing materials used were not recorded. In addition, the evaluation team found that no centralized record (such as a splice schedule or list) exists to show the type, quantity, materials used, and location of cable splices for BLN. There are a few spliced cables in a medium voltage cable tray in manhole ZA13-A. Because there are no identification marks, the evaluation team could not determine the cables' functions, voltage levels, or safety classification. The evaluation team found no procedure or instruction for a preventive maintenance or housekeeping program for electrical manholes at BLN. During walkdowns to inspect seven of the 40 manholes at BLN, the evaluation team observed manholes containing various amounts of water. Cables in all manholes were coated with mud. At several locations, sump pumps or their controls were not in an operational condition.	a. The corrective actions consist of the following: The action initiated by PIR BLN EEB 8611. (Ref. 5.08), Rev. 0, will be completed, including actions to specifically address NRC IE-IN 86-53 (Ref. 2.15), in accordance with the commitments documented in the IRDI program. (CATD 241 01 BLN 01) A master list of class 1E and non-class 1E cable splices will be established and maintained. (CATD 241 01 BLN 02) BLN will add, as part of the preventive maintenance program, periodic inspection requirements. Additionally, an NCR has been formulated (NCR 5154, R0; Ref. 5.27) for a design reevaluation delineating the problems associated with water accumulation inside electrical manholes, sump pump failures, etc. The action will be entered into the IRDI program. (CATD 241 01 BLN 03)

Issues	Findings	Corrective Actions
Element 241.1 - BLN (Continued)		
	NRC IE information notice 86-53 (Ref. 2.15) addresses improper installation of heat shrinkable tubing over electrical splices and terminations. Deficiencies cited in this IE information notice are already identified as part of NCR 2494, (Ref. 5.30). This problem pertains to termination of solenoid valve cable-to-conduit mounts on walls. Additionally, PIRBLNEEB8611 has initiated action at BLN to evaluate class IE cable splices using Raychem heat shrinkable products in harsh environment areas. TVA indicated that this evaluation will include the manholes of the conduit banks between the Diesel Generator Buildings and the Intake Pumping Station.	1
b. Plant safety is questioned should a splice(s) fail because of flooding.	b. The evaluation team determined that cables of redundant class IE trains are routed through independent conduit banks between the Diesel Generator Buildings and the intake pumping station, in conformance with the design criteria. A postulated failure of a cable splice in one class IE train due to flooding will not affect the function of the redundant train if the cable splices have been installed correctly, in accordance with existing procedures and design criteria for cables routed in conduit banks. However, because of possible simultaneous flooding of redundant class IE manholes, a potential common mode failure of redundant class IE cable splices cannot be disregarded if the cable splices were improperly installed.	b. None required in addition to (a.) above.
c. Availability of redundant (back-up) systems is questioned in case of cable splice failure(s).	c. The design of class IE cable systems is based on the requirements of preserving the independence of redundant class IE systems. However, because of insufficient cable splice records and the potential for common mode failure as mentioned above in Finding "b," the availability of a redundant class IE train for safe shutdown of the plant cannot be guaranteed.	c. None required in addition to (a.) above.

Issues	Findings	Corrective Actions
Element 241.4 - BFN (Continued)		
b. Inadequate installation could contribute to unreliable operation of the diesels.	b. The condition of the loose assemblies has not been reviewed for safety implications at BFN.	b. Addressed above in a.
BLN	BLN	BLN
(Not to be evaluated)		
********** Element 241.5 - Wire Corrosion in Containment Penetrations **********		
SQN	SQN	SQN
a. Corrosion of wiring in feedthroughs (modules) of the electrical cable containment penetrations caused by breakdown of insulation or wrong application.	a. The evaluation team reviewed the CAQ data for "Electrical Penetrations," (12/10/86), the Licensee Event Reports, and the data sheets covering the verification walkdown of the environmental qualification field program (1985). No indication of deficiencies similar to those outlined in the concern was found at SQN.	a. None required.
b. Deterioration of sealant material in the feedthroughs (modules) of the electrical cable containment penetrations.	b. NCR W-356-P (Ref. 5.01) issued for WBN identified deficiencies similar to those outlined in the employee concern. In a review of documents listed under (a), the evaluation team found no deficiencies as described in the NCR and the employee concern regarding the SQN penetrations. On the basis of this review and the results of the Conax inspection (Ref. 9.60) at WBN, the NCR is not applicable to SQN.	b. None required.

Issues	Findings	Corrective Actions
Element 241.2 - WBN	WBN	WBN
a. The use of pre-insulated diamond grip (PIDG) lugs to make crimps on solid conductors may result in reduced current capacity. The practice of crimping on solid conductors requires reevaluation.	a. General Construction Specification G-38, Rev. 2, Section 2.2.1 (Ref. 3.20), was deficient in not providing clear guidelines for the application of crimp terminal lugs. This lack of clear definition and guidelines permitted construction to use incorrect terminal lugs. Construction also did not follow the specified vendor requirements in the application of terminal lugs. The following corrective actions have since been implemented: o Specification Revision Notice (SRN) G-38-6, was issued on 11/20/85 to revise General Construction Specification G-38, Section 2.2.1. o Engineering Change Notice (ECN) 5879 dated 09/26/85 (B26 851007 506) for Unit 1 and ECN 5880 dated 09/26/85 (B26 851007 510) for Unit 2 (Refs. 6.14 and 6.15) were issued to rework the existing PIDG terminal lugs on solid conductors. ECNs 5879 and 5880 were closed on 02/27/86 (B26 860227 501 and B26 860227 502) indicating completion of design work. o Unit 1 rework of existing PIDG terminal lugs on solid conductors was completed. No records indicating completion of rework for Unit 2 were identified. The following procedures have been revised to prevent a recurrence of the problem. o General Construction Specification G-38, (Ref. 3.20), (incorporating Specification Revision Notice [SRN] G-38-6) o Maintenance and Additions Instructions MAI-4, (Ref. 3.22), and MAI-5, (Ref. 3.36) o Quality Control Procedure QCP-3.06-3, (Ref. 3.59)	a. The corrective action plan (03/16/87) states that ECN 5880 (Ref. 6.15) is still being worked in Systems 292 and 293 in various work plans. The ECN will be signed off by the Division of Nuclear Construction Unit 2 prior to system transfer. The rework will be completed prior to fuel load of Unit 2. (CATD 241 02 WBN 01)

Issues	Findings	Corrective Actions
Element 241.2 - BFN a. The use of pre-insulated diamond grip (PIDG) lugs to make crimps on solid conductors may result in reduced current capacity. The practice of crimping on solid conductors requires reevaluation.	BFN a. Improper use of AMP PIDG terminals on solid conductors was identified at WBN. SCR WBN EEB8537 (Ref. 5.15) stated that the problem was potentially generic to SQN and BFN. Each plant was instructed to conduct and document a review to determine any misapplication of PIDG terminal lugs on solid conductors. The evaluation team finds that such a review was not completed for Browns Ferry units 1, 2, and 3.	BFN a. TVA commits to the following actions: o Conduct a walkdown inspection of 28 arc suppression network circuits, which represent 27% of the solenoid valve suppression circuits found in units 1, 2, and 3. Because all the circuits were installed under the same process controls, this sampling is considered representative. Results of the walkdown inspection are not expected until December 1987. After the walkdown inspection, a CAQR and corrective action will be initiated to rectify any misuse of PIDG terminals, if required. (CATD 241 02 BFN 01) o After completion of the walkdown and corrective action, a final response to SCR WBNEEB8537 will be issued. This is scheduled for completion in January 1988. Other actions have already been completed as discussed herein. TVA has conducted interviews with various personnel at BFN from Materials Administration, Power Stores, Electrical Maintenance, Procurement, and Electrical Modifications, and has searched through design documents in an effort to determine whether PIDG terminals have been used at BFN. Both of these efforts (the interviews and the document searches) indicated that PIDG terminals have not been used at BFN. Furthermore, a walkdown was performed of two Foxboro control room panels on each unit (panels 9-7 and 9-52), because Foxboro panels were specifically cited in SCR WBNEEB8537

Issues	Findings	Corrective Actions
Element 241.2 - BFN (Continued)		
		as potential sources of this problem. No discrete devices terminated with PIDG terminals were found in these panels during these walkdowns. Refer to QIR EQP87066 (Ref. 5.28). (CATD 241 02 BFN 01)
BLN	BLN	BLN
a. The use of preinsulated diamond grip (PIDG) lugs to make crimps on solid conductors may result in reduced current capacity. The practice of crimping on solid conductors requires reevaluation.	a. Improper use of AMP PIDG terminals on solid conductors was identified at WBN. SCR WBN EEB8537 stated that the problem was potentially generic to SQN and BFN. Each plant was instructed to conduct and document a review to determine any misapplication of PIDG terminal lugs on solid conductors. BLN replied that the activities were examined at BLN, and it was found that the condition "does not exist" (TVA memo [B21 851022 004]). Since no documentation was found covering the review and walkdown, the evaluation team contacted the offices of ONP-DN-Construction and ONE-EEB, who participated in the review. They confirmed that PIDG terminals are used at BLN only where clearances prohibit the use of uninsulated lugs and only on stranded conductors.	a. None required.

Issues	Findings	Corrective Actions
********** Element 241.3 - Megger Tests on Low Voltage Cables **********		
SQN a. No megger tests are performed on low voltage cables.	SQN a. Although there are no industry requirements for testing low voltage cables, IEEE Standard 422 and 690, (Ref. 3.60), provide guidance for cable testing, and SQN Construction Test Instruction No. 10 and Inspection Instruction No. 10 established requirements for such testing procedures and documentation during construction. These test procedures and requirements were also incorporated in M&AI-12 (Ref. 3.24) and then M&AI-7 (Ref. 3.23) to verify insulation integrity of cables installed after completion of construction. The evaluation team determined that existing records indicate megger tests were performed on low voltage cables and that records of these tests are on file at SQN.	SQN a. None required.
WBN a. No megger tests are performed on low voltage cables.	WBN a. TVA Quality Control Procedures QCP-3.5, Rev. 0 (03/22/86) (Ref. 3.46) and QCP-3.6, Rev. 0 (12/05/75) (Ref. 3.47) established requirements for low voltage insulation testing and documentation during construction. Megger test requirements as stated in the above QCPs were superseded on 07/26/82 by the Quality Control Test Procedure QCT-3.06-1 (Ref. 3.48), which addresses megger testing of medium voltage (6.9 kV) cables, but not low voltage (480 V) cables. The evaluation team determined from reviewing samples that test records indicate megger tests were performed on low voltage cables until 1981, in conformance with the quality control procedures. There are no industry requirements for testing low voltage cables. However, IEEE standard 422 and 690, (Ref. 3.60), provide guidance for insulation resistance testing prior to connecting cables to equipment or functional testing as part of the check-out of the equipment system. Functional testing of equipment (including connecting cables) is performed as part of TVA's testing program.	WBN a. None required.

Issues	Findings	Corrective Actions
Element 241.3 - WBN (Continued)		
	Furthermore, TVA incorporated insulation test requirements for low voltage cables in the Modifications and Additions Instruction M&AI-4, issued 02/14/84 (Ref. 3.22), to verify insulation integrity of cables installed after completion of construction.	
BFN	BFN	BFN
a. No megger tests are performed on low voltage cables.	a. Although there are no industry requirements for testing low voltage cables, IEEE Standard 422 and 690, (Ref. 3.60), provide guidance for cable testing, and BFN Construction Quality Control Procedure BF-17, Rev. 4 (Ref. 3.49), established requirements for such testing procedures and documentation. These test procedures and requirements were also incorporated in M&AI-13 (Ref. 3.25) and then M&AI-45(Ref. 3.26) to verify insulation integrity of cables installed for modifications after construction is completed. The evaluation team determined from reviewing samples that cable termination data sheets and test records, beginning in 1972, indicate megger tests performed on low voltage cables and that records of these tests are on file at BFN.	a. None required.
BLN	BLN	BLN
a. No megger tests are performed on low voltage cables.	a. Although there are no industry requirements for megger testing of low voltage cables, IEEE Standard 422 and 690, (Ref. 3.60), provide guidance for cable testing, and BLN Quality Control Procedure BNP-QCP-3.18, Rev. 8 (Ref. 3.51), established requirements for such testing procedures and documentation. Test procedures and requirements were incorporated in BLEMI-2704 (Ref. 3.39) to verify insulation integrity of cable splices installed in signal, control, low voltage (0-600 V) power, and medium voltage (5-15 kV) power cables. Additionally, Quality Control Procedures BNP-QCP-3.4 (Ref. 3.50) and BNP-QCP-3.34 (Ref. 3.52) require insulation resistance testing and documentation during cable termination and pulling (if splices are required during installation) on low voltage cables.	a. None required.

Issues	Findings	Corrective Actions
Element 241.3 - BLN (Continued)		
	The evaluation team determined from reviewing samples that cable termination inspection and test records indicate megger tests performed on low voltage cables and that records of these tests are on file at BLN.	
********** Element 241.4 - Amphenol Connectors **********		
SQN	SQN	SQN
a. Vendor supplied amphenol connectors are inadequately installed on actuators of the standby diesel generator.	a. The installation method of amphenol connectors on actuators by the D/G manufacturer was inadequate. The connectors were installed with a thread mismatch between the amphenol connector and the conduit fitting resulting in loose electrical connections causing one D/G to respond incorrectly during testing. TVA took the necessary corrective actions. The replacement wiring harness and the connector adapter were installed per manufacturer's Service Bulletin SB-0027-1 (Ref. 9.19).	a. None required.
b. Inadequate installation could contribute to unreliable operation of the diesels.	b. Although the incorrect installation of connectors could have contributed to an unreliable operation of the D/Gs, the problem was identified during a surveillance test (Ref. 3.61) [plant standard procedure required per Technical Specification] and corrected in a timely manner.	b. None required.

Issues	Findings	Corrective Actions
Element 241.4 - WBN	WBN	WBN
a. Vendor-supplied Amphenol connectors are inadequately installed on actuators of the standby diesel generator.	a. During a walkdown, the evaluation team noted that the action recommended by Morrison-Knudsen in Service Bulletin SB-0027-1 regarding the mismatched thread problem between the conduiet and the plug connecting to the diesel generator governor were installed as recommended by Morrison-Knudsen. This mismatch is a problem, as indicated in the service bulletin, for all diesel generators supplied by this manufacturer prior to 1976. Although an adapter, P.N. 802020, appears to have been installed as the result of the Service Bulletin, no documents were found to document the work performed as recommended in the corrective action. In addition, the following observations were made during the walkdowns (Refs. 9.39 and 9.41): o On diesel generator engine 1A-2, all joints were tight with the exception of the threaded connection between the coupling and the adapter bushing. This was observed when slight pressure was applied to the 90° elbow. o On diesel generator engines 1B-2, 2A-1, and 2A-2, all joints were tight with the exception of the threaded connection between the 90° elbow and the adapter bushing. The coupling can be rotated with slight clockwise or counterclockwise pressure on the coupling.	a. The corrective action plan indicates that design system engineers involved with the safety-related items were contacted and no documentation was found to support that the adapters were installed on site. TVA concluded that the adapters were installed by the vendor before delivery; therefore, no further corrective action is required. (CATD 241 04 WBN 01) TVA will investigate the reason(s) for the loose couplings, including the possibility that design or procurement requirements for safety-related equipment under vibration conditions are deficient. In addition, any deficiencies in the requirements defined will be investigated to determine if hardware deficiencies have resulted. Furthermore, if conditions adverse to quality are found, CAQs will be written (CATD 241 04 WBN 02).

Issues	Findings	Corrective Actions
Element 241.4 - WBN (Continued)		
	o On diesel generator engines 1B-1, 1A-1, 2B-1, and 2B-2, all joints were tight with the exception of the connection between the backshell nut and base nut. On this connection, movement was observed when slight pressure was applied to the condulet. o On the fifth diesel generator engine, 3-1, all connections were tight. However, on diesel generator engine 3-2, the threaded joint between the adapter bushing and the backshell extension was loose. Movement was observed with slight pressure on the condulet.	
b. Inadequate installation could contribute to unreliable operation of the diesels.	b. With the exception of maintenance request (MR) A-503909, (Ref. 9.63) issued to reinstall a sleeve lock to the connector for diesel generator engine 1A-2, no other corrective actions have been identified to resolve the deficiencies identified in Finding "a" above. This could contribute to unreliable operation of the diesels.	b. Addressed above in a.
BFN	BFN	BFN
a. Vendor-supplied Amphenol connectors are inadequately installed on actuators of the standby diesel generator.	a. No document could be identified to determine who installed the adapters. The evaluation team concluded that the correct adapters were used for the installation of the Amphenol connectors. However, during the walkdowns (Refs. 9.40 and 9.42), the evaluation team identified several instances of loose assemblies associated with these connectors.	a. IVA will investigate the reason(s) for the loose couplings, including the possibility that design or procurement requirements for safety-related equipment under vibration conditions are deficient. In addition, any deficiencies in the requirements defined will be investigated to determine if hardware deficiencies have resulted. Furthermore, if conditions adverse to quality are found, CAQs will be written (CATD 241 04 BFN 01).

Issues	Findings	Corrective Actions
Element 241.4 - BFN (Continued)		
b. Inadequate installation could contribute to unreliable operation of the diesels.	b. The condition of the loose assemblies has not been reviewed for safety implications at BFN.	b. Addressed above in a.
BLN	BLN	BLN
(Not to be evaluated)		
********** Element 241.5 - Wire Corrosion in Containment Penetrations **********		
SQN	SQN	SQN
a. Corrosion of wiring in feedthroughs (modules) of the electrical cable containment penetrations caused by breakdown of insulation or wrong application.	a. The evaluation team reviewed the CAQ Data Base, the Licensee Event Reports, and the data sheets covering the verification walkdown of the environmental qualification field program (1985). No indication of deficiencies similar to those outlined in the concern was found at SQN.	a. None required.
b. Deterioration of sealant material in the feedthroughs (modules) of the electrical cable containment penetrations.	b. NCR W-356-P (Ref. 5.01) issued for WBN identified deficiencies similar to those outlined in the employee concern. In a review of documents listed under (a), the evaluation team found no deficiencies as described in the NCR and the employee concern regarding the SQN penetrations. On the basis of this review and the results of the Conax inspection (Ref. 9.60) at WBN, the NCR is not applicable to SQN.	b. None required.

Issues	Findings	Corrective Actions
Element 241.5 - WBN	WBN	WBN
a. Corrosion of wiring in feedthroughs (modules) of the electrical cable containment penetrations is caused by a breakdown of insulation or the wrong application.	a. The review of CAQ Data Base "Electrical Penetration," NCR W-356-P, Rev. 1, NRC-IEB 77-07 (Ref. 2.11), NCR W-353-P, (Ref. 5.31), and Environmental Qualification Binders (Ref. 9.61), and two penetrations inspected (Ref. 9.62) by the evaluation team did not reveal any deficiency similar to the issue of corrosion of wiring in feedthroughs (modules) of the electrical cable containment penetrations.	a. None required.
b. Sealant material in the feedthroughs (modules) of the electrical cable containment penetrations is deteriorating.	b. With the exception of NCR W-356-P (crazing and/or cracking of sealant material), the documents reviewed and two penetrations inspected (refer to [a] above) by the evaluation team did not reveal any deficiency similar to the issue of deterioration of sealant material in the feedthroughs (modules) of the electrical cable penetrations. Conax, the manufacturer of the penetrations, inspected approximately 53 percent of the Unit 1 penetrations and determined that the deficiencies identified in NCR W-356-P do not affect the performance of the penetrations and that no corrective action is required.	b. None required.
c. Peripheral finding.	c. During the TVA environmental qualification verification walkdown of the Unit 1 containment penetrations, numerous deficiencies (not related to the issues outlined in the employee concern) were identified and documented in NCR W-353-P. The inspection program to close out NCR W-353-P has been expanded to cover inspection of each penetration for any additional problems. This will ensure that any deficiency associated with the employee concern will be identified. The rework effort and inspection of the Unit 1 containment penetrations are in progress. No similar inspection program is currently in place for Unit 2.	c. The corrective action plan (CAP) indicates that most of the unit 1 penetrations have been inspected under the expanded inspection program and that wire corrosion in feedthroughs has not been substantiated. No similar inspection has been performed for unit 2 because this unit is still under construction and activities involving unit 2 penetrations are incomplete. However, the CAP indicates that a similar walkdown will be completed before unit 2 fuel load as part of the equipment qualification program, and any problems including issues outlined in the employee concern, if they exist, will be identified at that time. (CATD 241 05 WBN 01)

Issues	Findings	Corrective Actions
Element 241.5 - BFN	BFN	BFN
a. Corrosion of wiring in feedthroughs (modules) of the electrical cable primary containment penetrations caused by breakdown of insulation or wrong application.	a. The assessed documents (CAQ Data Base "Electrical Penetrations," Preliminary EQ Binder, NRC-IEB 77-05/ 77-05A, NRC-IEB 77-06 [Refs. 2.08, 2.09, and 2.10], and NRC-OEB Information Report [June 30, 1978; Ref. 2.06]) did not reveal any deficiency similar to the issue of wiring corrosion in feedthroughs (modules) of the electrical cable primary containment penetrations.	a. None required.
b. Deterioration of sealant material in the feedthroughs (modules) of the electrical cable primary containment penetrations.	b. The assessed documents listed under (a) did not reveal any deficiency similar to the issue of deterioration of sealant material in the feedthroughs (modules) of the electrical cable primary containment penetrations.	b. None required.
c. Peripheral finding.	c. In addition, the evaluators found the following: A potential problem involving electrical connectors/cable assemblies was identified in NRC IE Bulletin 77-05. This type of connector assembly is used as an integral part of Physical Science Corp. (PSC) penetrations. Many of these penetrations are used at BFN. TVA submitted a partial response to this IEB which included test results which reported that the electrical connectors satisfactorily passed the steam environmental test. However, the test did not account for thermal and radiation aging. TVA stated in the response that additional tests would be made to account for these factors. The additional tests are not required because TVA will replace all safety-related PSC penetrations (see corrective actions).	c. No supplementary response to NRC IEB 77-05 is required because: o Unit 1 does not have PSC penetrations. o At unit 2, TVA will replace the three safety-related PSC penetrations in response to SCR BFNEQP 8601 (Ref. 5.22) and QIR EQP 86-001 before unit startup. o At unit 3, TVA will replace all safety-related PSC penetrations as recommended in CAQR BFP 870216 before unit startup. (CATD 241 05 BFN 01)

Issues	Findings	Corrective Actions
Element 241.5 - BFN (Continued)		
d. Peripheral finding.	d. An EQ program at BFN has been developed and is in progress for unit 2. The program covers only penetrations that have been designated class 1E (defined as penetrations that carry class 1E circuits). However, all penetrations must be capable of retaining their pressure boundary integrity after any design basis event regardless of the circuits they carry. Physical Science penetrations for nonclass 1E applications are in service on unit 2.	d. All electrical penetrations were purchased as ASME Section III equipment. Qualification test reports, which verify the penetration's ability to maintain containment pressure boundary under worst case design basis event conditions, are in TVA files. Pressure boundary will also be tested before startup by containment pressure test and integrated leak rate test (ILRT). (CATD 241 05 BFN 02)
e. Peripheral finding.	e. To date, no EQ program has been developed for units 1 and 3. Physical Science penetrations are used in nonclass 1E applications and possibly class 1E applications in these units.	e. TVA will implement the Environmental Qualification Project for units 1 and 3, as a follow-on action to the existing project for unit 2 (SCR BFN EQP8601), to meet all 10 CFR 50.49 requirements. (CATD 241 05 BFN 03)
BLN	BLN	BLN
a. Corrosion of wiring in feedthroughs (modules) of the electrical cable containment penetrations caused by breakdown of insulation or wrong application.	a. The assessed documents (CAQ Data Base "Electrical Penetrations," BLN FSAR Section 3.11, and NCR W-356-P [WBNJ) did not reveal any deficiency similar to the issue of corrosion of wiring in feedthroughs (modules) of the electrical cable containment penetrations at BLN.	a. None required.
b. Deterioration of sealant material in the feedthroughs (modules) of the electrical cable containment penetrations.	b. The assessed documents under (a) did not reveal any deficiency similar to the issue of deterioration of sealant material in the feedthroughs (modules) of the electrical cable penetrations at BLN.	b. None required.

ATTACHMENT C

REFERENCES

1.0 FSAR/Tech. Spec.

1.01 SQN FSAR, Chapter 7 (Amendment 3), Chapter 8, (Amendment 2) and Chapter 8.3.1.4.2 (Amendment 1), "Cable Routing and Separation Criteria"

1.02 SQN FSAR, Appendix 6.8c, "Sequoyah Nuclear Plant Valve Program," (Amendment 3)

1.03 SQN Technical Specifications for Units 1 and 2, Sections 3.8.3.2 and 4.8.3.2, and Table 3.8-2 (Amendment 33, 03/29/84 for unit 1 and Amendment 25, 03/29/84 for unit 2)

1.04 WBN FSAR, Chapter 9.5.3, Amendment 46

1.05 WBN FSAR, Chapters 3, 6, 7, and 8 (Amendment 59, 10/86)

1.06 WBN Unit 1 Technical Specifications, Chapters 3.8.4.2 and 4.8.4.2 and Table 3.8-2, (Final Draft 05/09/85)

1.07 BFN FSAR, Chapters 4, 7, and 8 (Amendment 4)

1.08 BLN FSAR, Chapters 3, 7, and 8 (Amendment 27)

1.09 WBN FSAR, Chapter 8.1.5, Amendment 52

2.0 NRC Documents

2.01 Letter from L. M. Mills, TVA, to J. P. O'Reilly, NRC, "Watts Bar Nuclear Plants Units 1 and 2 - IE Bulletin 80-20 - Failures of Westinghouse Type W-2 Spring Return to Neutral Control Switches - Revised Response," [A27 820602 002], (06/02/82)

2.02 Morrison-Knudson letter to NRC concerning reportable condition from diesel generator manufacturer facility, (04/06/85)

2.03 Notification from Power System to NRC Under 10 CFR Part 21, "TVA-Sequoyah Engine Governor Actuator Electrical Connecting Plug," [LTR-QTS-85-013], (09/06/85)

2.04 TVA Final Report to NRC, "WBNP Units 1 and 2, Inadequate Overcurrent Protection for Cables," [L44 851114 081], (11/14/85)

2.05 Letter from Shell, TVA, to Grace, NRC, "IE Bulletin 85-03 - Motor Operated Valve Common Mode Failures During Plant Transients Due to Improper Switch Settings - Sequoyah Nuclear Plant," (05/12/86), [L44 860512 803], and attached enclosure 1, Sequoyah Nuclear Plant, Response to IE Bulletin 85-03

2.06 NRC Operating Experience Bulletin Information Report, "Problems With Containment Low Voltage Control Penetration Assemblies," (06/30/78)

2.07 NRC IE Circular 81-13, "Torque Switch Electrical Bypass Circuit for Safeguard Service Valve Motors," (09/27/81)

2.08 NRC IE Bulletin 77-05, "Electrical Connector Assemblies," (11/08/77)

2.09 NRC IE Bulletin 77-05A, "Supplement to IE Bulletin 77-05, Electrical Connector Assemblies," (11/15/77)

2.10 NRC IE Bulletin 77-06, "Potential Problems with Containment Electrical Penetration Assemblies," (11/22/77)

2.11 NRC IE Bulletin 77-07, "Containment Electrical Penetration Assemblies at Nuclear Power Plants Under Construction," (12/19/77)

2.12 NRC IE Bulletin 80-20, "Failures of Westinghouse W-2 Spring Return to Neutral Control Switches," (07/31/80)

2.13 NRC IE Bulletin 85-03, "Motor Operated Valves Common Mode Failures During Plant Transients Due to Improper Switch Settings," (11/15/85)

2.14 NRC IE Information Notice 82-01, "Auxiliary Feedwater Pump Lockout Resulting from Westinghouse W-2 Switch Circuit Modification," (01/22/82)

2.15 NRC IE Information Notice 86-53, "Improper Installation of Heat Shrinkable Tubing," (06/26/86)

2.16 NRC Regulatory Guide 1.106, "Thermal Overload Protection for Electric Motors on Motor-operated Valves," Rev. 1, (03/77)

2.17 NRC Branch Technical Position EIC SB27, "Design Criteria for Thermal Overload Protection for Motors of Motor-Operated Valves," (11/24/75)

2.18 Letter from L. M. Mills, TVA, to J. P. O'Reilly, NRC, "Watts Bar Nuclear Plant Units 1 and 2 - Office of Inspection and Enforcement - Bulletin 80-20 - Failures of Westinghouse Type W-2 Spring Return to Neutral Control Switches - Supplemental Information," [A27 830330 012], (03/30/83)

2.19 10 CFR 50, Appendix A, General Design Criteria 17, "Electric Power Systems"

3.0 Procedures/Standards/Criteria/Guides

3.01 TVA Design Criteria SQN-DC-V-11.4.1, "Normal and Emergency AC Auxiliary Power System," Rev. 2, (07/22/86)

3.02 TVA Design Criteria SQN-DC-V-12.4, "Design Criteria for Cable Support Systems for Capability of Testing Cables for the Design Basis Flood," Rev. 1, (04/26/74)

3.03 TVA Detailed Design Criteria WB-DC-30-15, "Motor Operated Valve Thermal Overload and Torque Switch Bypass," Rev. 0, (12/30/86)

3.04 TVA BLN General Design Criteria N4-RP-0775A, "Standby AC Auxiliary Power System," Rev.5 (06/30/86)

3.05 TVA Electrical Design Standard DS-E1.3.1, "Protection of Electric Equipment Susceptible to Failure from Fluid from Fluid Spray and Condensation," Rev. 2, (04/17/86)

3.06 TVA Electrical Standard DS-E2.3.2, "480-Volt Ac Auxiliary Power System Performance and Equipment Application Criteria," Rev. 2, (03/12/85)

3.07 TVA Electrical Design Standard DS-E9.2.1, "460 Volt Circuit Design - Motor Control Center," Rev. 1, (03/13/78)

3.08 TVA Electrical Design Standard DS-E12.1.1, "Cable Conductor Current Carrying Capacity Polyethylene Insulated (0-8000V)," Rev. 0, (09/28/76)

3.09 TVA Electrical Design Standard DS-E12.5.2, "Cable, 480 V Power Receptacles," Rev. 1, (11/23/82)

3.10 TVA Electrical Standard Drawing SD-E12.5.3, "Cable Splicing Medium Voltage (5-15 kV) Insulated Conductors," Rev. 0, (09/13/77); Rev. 2, (05/03/84); Rev. 3, (05/20/86)

3.11 TVA Electrical Standard Drawing SD-E12.5.6, "Cable Splicing 600 V (or less) Insulated Cable," Rev. 6, (03/20/81); Rev. 8, (09/19/86)

3.12 TVA Electrical Standard Drawing SD-E12.5.8, "Cable Splicing and Term. 600 V (or less) Multi-conductor Insulated Cable," Rev. 2, (02/27/84); Rev. 4 (07/31/86)

3.13 TVA Electrical Design Guide DG-E2.3.5, "480 Volt Motor Branch Circuit Design and Protection," Rev. 2, (06/19/85), Rev. 3, (03/10/87)

3.14 TVA WBN Administrative Instruction AI-1.8, "Plant Housekeeping," Rev. 11, (01/10/87)

3.15 TVA WBN Administrative Instruction AI-2.12, "Clearance Procedure," Rev. 15, (12/12/86)

3.16 TVA SQN Standard Practice SQA66, "Plant Housekeeping," Rev. 8

3.17 TVA BLN Special Engineering Procedure BLSEP-07, "Establishment of Minimum Set of Electrical Design Calculations and Studies for BLNP," Rev. 0, (06/17/85)

3.18 TVA SQN Technical Instruction TI-76, "Electrical Maintenance Post-Maintenance Testing," Rev. 4 (11/01/85)

3.19 TVA SQN Construction Test Instruction 10, "Interconnecting Cable Termination and Insulation Checks," Rev. 0, [SQN 840322 010], (08/08/73)

3.20 TVA General Construction Specification G-38, "Installing Insulated Cables Rated Up to 15,000 Volts," Rev. 0, (07/25/73); Rev. 1, (10/22/75); Rev. 2, (08/03/78); Rev. 7, (01/15/86); and Rev. 8, (03/17/86)

3.21 TVA General Construction Specification G-40, "Installing Electrical Conduit Systems and Conduit Boxes," Rev. 9, (01/15/86)

3.22 TVA WBN Modifications and Additions Instruction MAI-4, "Installation and Inspection of Cable Terminations," Rev. 0, (02/14/84), Rev. 3, (01/23/86)

3.23 TVA SQN Modifications and Additions Instruction MAI-7, "Inspection Criteria of Cables or Internal Panel Wiring," Rev. 0, (11/09/79); Rev. 6, (08/07/85); Rev. 8, (07/24/86)

3.24 TVA SQN Modifications and Additions Instruction MAI-12, "Interconnecting Cable Termination and Insulation Inspection," Section 8.0, Rev. 0, (10/30/79)

3.25 TVA BFN Modifications and Additions Instruction MAI-13, "Control, Power, Signal, and Ground Cables," Rev. 1; (06/27/86); initial issue (08/24/83)

3.26 TVA BFN Modifications and Additions Instruction MAI-45, "Cable Terminating and Splicing for Insulated Cables Rated Up to 15,000 Volts," Rev. 1, (02/03/87); initial issue, (09/30/86)

3.27 TVA SQN Employee Safety Handbook

3.28 TVA WBN Employee Safety Handbook

3.29 TVA SQN, Hazard Control Instruction (HCI) E9, "Safety Precautions for Operations in Switchyards," (07/29/85)

3.30 TVA WBN, Hazard Control Instruction (HCI) E-5, "Safety Precautions for Operations in Switchyards," (01/08/86)

3.31 TVA BLN, Hazard Control Instruction BLHCI-E7A, (08/30/85)

3.32 TVA SQN, Special Test Instruction STI-3, "Pull Test of Solid Conductor Crimped Connections," Rev. 0, (10/02/85)

3.33 TVA SQN Inspection Instruction 10, Sections 7 and 8, "Interconnection Cable Termination and Insulation Inspection," Rev. 7, (05/26/77), [SQN 840322 018], Rev. 16, (03/30/83)

3.34 TVA, Special Maintenance Instruction SMI-0-317-4, Rev. 0, (1979)

3.35 TVA SQN, Special Maintenance Instruction SMI-2-317-25, "Solder or Replacement of AMP (PIDG) Lugs Terminated on Solid Wire in CSSC Equipment, Unit 2," Rev. 0, (01/24/86); Rev. 1, (03/17/86)

3.36 TVA Modifications and Additions Instruction MAI-5, Installation of Internal Wiring and Inspection of Electrical Equipment, Rev. 5, (02/03/86)

3.37 TVA BFN Electrical Maintenance Instruction EMI-58, "Splicing of Medium- and Low-Level Signal, Low- and Medium-Voltage Power, and Control Cables - Critical and Noncritical," (no revision number), (02/26/80)

3.38 TVA BFN Electrical Maintenance Instruction 8F EMI-58.2, "Terminating of CSSC Low-Level Signal and Control Low-Level Voltage Power Cables and Internal Panel Wiring," Rev. 4, (01/20/87)

3.39 TVA BLN Electrical Maintenance Instruction BLEMI-2704, "Splicing of Medium and Low Level Signal, Low and Medium Voltage Power, and Control Cables - Critical and Noncritical," Rev. 1, (02/12/87)

3.40 TVA SQN Surveillance Instruction (SI-7.1), "Diesel Generator AC Electrical Power Source Operability Verification," Rev. 7, (07/14/86)

3.41 TVA SQN Surveillance Instructions SI-251.1, Rev. 3 (05/31/85) for unit 1 and SI-251.2, Rev. 3 (10/09/85) for unit 2, "Channel Calibration of Class 1E Motor Operated Valve Overload Relay Heaters"

3.42 TVA WBN Surveillance Instruction SI-8.1, "Diesel Generator Start and Load Test, Units 1 and 2," Rev. 17, (03/27/87)

3.43 TVA WBN Surveillance Instruction SI-8.7, "Diesel Generator - AC Electrical Power Source Operability Verification," units 1 and 2, Rev. 4, (08/22/85)

3.44 TVA BFN Surveillance Instruction SI 4.9.A.1, "Diesel Generator Operability Check," Rev. 1

3.45 TVA BFN Surveillance Instruction SI 4.9.A.1.a, "Diesel Generator Monthly Test," Rev. 0

3.46 TVA WBN Quality Control Procedure QCP-3.5, "Installation, Inspection, and Testing of Insulated Control, Signal, and Power Cables," (03/22/76)

3.47 TVA WBN Quality Control Procedure QCP-3.6, "Electrical and Instrumentation Equipment Inspection, Testing, and Documentation," Rev. 0, (12/05/75)

3.48 TVA WBN Quality Control Test Procedure QCT-3.06-1, "Insulation Tests for Electrical Equipment," Rev. 0, (07/26/82)

3.49 TVA BFN Construction Quality Control Procedure BF-17, "Quality Assurance Program for Control, Power, and Signal Cables," Rev. 4, (04/11/73); Rev. 5, (12/09/74); Rev. 6, (06/16/76)

3.50 TVA BLN Quality Control Procedure BNP-QCP-3.4, "Electrical Cable Preparation (Termination) 600 Volts or Less and Jumpers Installation," Rev. 0, (09/30/77); Rev. 1, (03/05/79); Rev. 15, (04/06/87)

3.51 TVA BLN Quality Control Procedure BNP-QCP-3.18, "Insulation Resistance," Rev. 8, (07/09/86)

3.52 TVA BLN Quality Control Procedure BNP-QCP-3.34, "Electrical Cable Installation (Pulling)," Rev. 0, (12/05/84); Rev. 3, (04/04/86)

3.53 TVA SQN Special Maintenance Instruction SMI-0-317-42, "Walkdown Procedure for 10 CFR 50.49 Splices," Rev. 2, (01/06/87)

3.54 TVA ONE - NE Procedure, NEP-3.1, "Calculations," Rev. 1, (09/27/87)

3.55 TVA Occupational Health and Safety Manual, Volume 3, (10/30/81)

3.56 TVA Division of Engineering Design Engineering Procedure, EN DES-EP 2.03, Rev. 6, "Unreviewed Safety Question Determination - Handling and Preparation," (04/24/84)

3.57 TVA Nuclear Engineering Procedure NEP-3.2, "Design Input," Rev. 0, (07/01/86)

3.58 Design Criteria SQN-DC-V-12.2, "Separation of Electrical Equipment and Wiring," Rev. 3, (08/23/74)

3.59 Quality Control Procedure, QCP-3.06-3, Inspection of Cable Termination, Rev. 8, (11/26/85)

3.60 The Institute of Electrical and Electronics Engineering, Inc., Standard 422-1977 and 1986; IEEE Guide for the Design and Installation of Cable Systems in Power Generating Stations, The Institute of Electrical and Electronics Engineers, Inc., Standard 690-1984; IEEE Standard for the Design and Installation of Cable Systems for Class 1E Circuits in Nuclear Power Generating Stations

3.61 Surveillance Instruction (SI-7.1), "Diesel-Generator AC Electrical Power Source Operability Verification," Rev. 7, (07/14/86)

4.0 TVA Memos

4.01 TVA memo from J. A. Raulston to L. M. Mills, "IE Bulletin 80-20 - Failures of Westinghouse Type W-2 Spring Return to Neutral Control Switches," [NEB 801023 283], (10/23/80)

4.02 TVA memo from J. A. Raulston to L. M. Mills, "Sequoyah and Watts Bar Nuclear Plants - Failures of Westinghouse Type W-2 Spring Return to Neutral Control Switches - IE Bulletin 80-20," [NEB 840405 266], (04/05/82)

4.03 TVA memo from F. W. Chandler to H. L. Jones, "Black and Veatch Findings - Task Force Category 38," [EEB 840111 914], (01/11/84) and attached "Evaluation Sheet Rev. 0 (04/20/83) for Review of Black and Veatch Findings - Task Force Category 38 for Browns Ferry Nuclear Plant - Units 1, 2, and 3"

4.04 TVA memo from F. W. Chandler to H. L. Jones, "Browns Ferry Nuclear Plants Units 1, 2, and 3 - Evaluation of Black and Veatch Findings for Category 37," [EEB 840106 911], (01/05/84) and attached "Evaluation Sheet, Rev. 0 (04/20/83) for Review of Black and Veatch Findings - Task Force Category 37 for Browns Ferry Nuclear Plant - Units 1, 2, and 3"

4.05 TVA memo from F. W. Chandler to H. L. Jones, "Sequoyah Nuclear Plant Units 1 and 2 - Black and Veatch Findings - Task Force Category 38," [EEB 840110 906], (01/11/84) and attached "Evaluation Sheet Rev. 0 (04/23/83) of the TVA Task Force for Review of Black and Veatch Findings - Task Force Category 38 for Sequoyah Nuclear Plant - Units 1 and 2"

4.06 TVA memo from R. C. St. Clair to Those Listed, "Report on Test Program to Investigate 161 kV CT Failures at Raccoon Mountain Pumped Storage Plant," [G04 8412 31001], (12/28/84)

4.07 TVA memo from J. W. von Weisenstein to Quality Management Staff Files, "Assessment of Adequacy of Corrective Action for Black and Veatch Task Force Category 37 - Browns Ferry Nuclear Plant Units 1, 2, and 3," [QMS 850128 202], (01/28/85)

4.08 TVA memo from J. W. von Weisenstein to Quality Management Staff Files, "Assessment of Adequacy of Corrective Action for Black and Veatch Task Force Category 37 - Bellefonte Nuclear Plant Units 1 and 2," [QMS 850128 201], (01/28/85)

4.09 TVA memo from J. C. Standifer to F. W. Chandler responding to "Potential Generic Condition Evaluation," [821 851022 004], (10/22/85)

4.10 TVA memo from F. W. Chandler to Those Listed, "Significant Condition Report (SCR) - SCRBFNEEB8536, RO," [843 8510206 909], (12/10/86)

4.11 TVA memo from N. R. Beasley to G. R. Hall, "Engineering Report for CAQ Report SCR BFNEEB8536 RO" [822 851224 014], (12/24/85)

4.12 TVA memo from W. S. Raughley to Those Listed, "Watts Bar Nuclear Plant - Significant Condition Report SCR WBNEEB8548 R2," [843 860522 907], (05/07/86)

4.13 TVA memo from M. L. Rayfield to G. Wadewitz, "Watts Bar Nuclear Plant - Significant Nonconformance Condition Report - (NCR) W-353-P R1," [826 860530 004], (05/30/86)

4.14 TVA memo from J. C. Crowell to Section Supervisors, "BFN - Potential Hazard of Switchyard Oil-Filled CTs," [R39 850805 071], (08/05/85)

4.15 TVA memo from C. G. Peterson to Bellefonte Engineering Project Files, "BNP - Minimum Set of Calculations," [821 860916 004], (09/16/86)

4.16 TVA memorandum from W. S. Raughley to Those Listed, "Policy Memorandum PM 86-18(EEB)-MCC Motor Starter Overload Heater Selection," [843 861107 908], (11/04/86)

4.17 TVA memo from W. S. Raughley to H. B. Bounds, "Watts Bar Nuclear Plant - FSAR Update," [843 861229 906], (12/29/86)

4.18 TVA memo from W. S. Raughley to T. G. Chapman, "Significant Condition Report (SCR) SCR BFNEEB8536 R2," [822 870121 001], (01/21/87)

4.19 TVA memo from W. S. Raughley to Those Listed, "Policy Memorandum PM 86-02 R1 (EEB) - Revision 1 - Electrical Calculations," [B43 870204 903], (02/04/87)

4.20 TVA memo from H. B. Bounds to J. McDonald, "OE Calculation - Reg. Guide 1.48 Active Component List - WBN-OSG4-029 R4 and DNE Calculation - Selection Criteria for MOVs Requiring Thermal Overload Bypass - WBN-OSG4-095 R1," [B26 870212 012], (02/12/87)

4.21 TVA memo from M. C. Brickey to P. D. Metcalf, "Watts Bar Nuclear Plant Unit 1 - Technical Specification - Table 3.8-2 Motor Operated Valves, Thermal Overload Bypass," [B26 870309 431], (03/09/87)

4.22 TVA memo from H. B. Bounds to M. C. Brickey, K. A. Cruikshank, and P. D. Metcalf, "Environmental Qualification Punchlist of Work Items Required to be Completed Before Unit 1 Fuel Load," [B26 870223 018], (02/23/87)

4.23 TVA memo from F. W. Chandler to J. W. Coan, "SCR WBN EEB 8526," [B43 850909 909], (09/06/85)

4.24 TVA memo from F. W. Chandler to J. W. Coan, J. A. Raulston, "PIRWBNEEB8533," [B43 850923 908], (09/23/85)

4.25 TVA memo from J. A. Kirkebo to Those Listed, "DNE Interim Order - Supplement to NEP-3.1," [B05 870604 510], (06/04/87)

4.26 TVA memo from E. R. Ennis to W. H. Thompson, "Response to Request for Investigation/Evaluation of Employee Concern IN-85-772-004," (11/15/85)

4.27 TVA memo from R. W. Contrell to K. W. Whitt, "Investigation/Evaluation of Employee Concerns," [no RIMS number], (09/24/85)

4.28 TVA memo from J. W. von Weisenstein to Quality Management Staff Files, "Assessment of Adequacy of Corrective Action for Black and Veatch Task Force Category 37 - SQN Units 1 and 2," [QMS 850128 200], (01/28/85)

4.29 TVA memo from J. A. Raulston to F. W. Chandler, "SQN - IE Bulletin 80-20, Failures of Westinghouse Type W-2 Spring Return to Neutral Control Switches," [NEB 820514 254], (05/14/82)

4.30 TVA memo from J. A. Raulston to L. M. Mills, "Watts Bar Nuclear Plant Units 1 and 2 - Failure of Westinghouse Type W-2 Spring Return to Neutral Control Switches - OIE Bulletin 80-20," [NEB 831227 255], (12/23/83)

4.31 TVA memo from J. A. Raulston to J. W. Hufham, "Watts Bar Nuclear Plant Unit 2 - NRC - OIE Bulletin 80-20 - Failures of Westinghouse Type W-2 Spring Return to Neutral Control Switches (Supplemental Information)," [B45 860117 257], (01/17/86)

4.32 TVA memo from Whitt to Abercrombie, [no RIMS number], "Nuclear Safety Review Staff Investigation Report Transmittal," (03/07/86), and attached NSRS Investigation Report I-85-129-SQN, "Thermal Overload Bypass and Indication Problems," dates of investigation 02/03/86 through 02/07/86

4.33 TVA memo from R. H. Dunham to H. S. Fox, "Browns Ferry, Sequoyah, and Watts Bar Nuclear Plants - Modification to Motor-Operated Valve Control Circuits," [EEB 770812 902], (08/11/77)

4.34 TVA memo from D. R. Patterson to F. W. Chandler, "Sequoyah Nuclear Plant - Recommendation to Modify the Control Circuits of Specified Motor-Operated Valves," [MEB 790112 390], (01/12/79)

4.35 TVA memo from F. W. Chandler to R. M. Pierce, "Sequoyah Nuclear Plant - Recommendation to Modify the Control Circuits of Specified Motor-Operated Valves," [EEB 790201 921], (01/31/79)

4.36 TVA memo from D. R. Patterson to F. W. Chandler, "Recommendation to Modify the Control Circuits of Specified Motor-Operated Valves," [MEB 790115 390], (01/12/79)

4.37 TVA memo from F. W. Chandler to J. A. Raulston, "Bellefonte Nuclear Plant Response to NRC Questions, Request for Additional Information," [EEB 801220 919], (12/19/80)

4.38 TVA memo from Parris to Those Listed, "Freestanding Oil-Filled CTs Safety Program," [A40 850524 001], (05/30/85).

4.39 TVA memo from F. W. Chandler to R. M. Pierce, "Sequoyah and Watts Bar Nuclear Plants, Units 1 and 2, Waterproof Splice for 8-kV Cable - SQN-127A and WBN-127A," [EEB 761116 932], (11/15/76), and attached "Criteria and Procedures for Making Splices and Insulated Cables in Manholes and Handholes"

5.0 NCR/PIR/QIR/SCR

5.01 SQN NCR W-356-P, Conax Penetration Sealant Damage, [826 860407 018], (02/28/83)

5.02 WBN NCR W-367-P, System 26, 68, and 74 Valves, Rev. 0, (03/13/86)

5.03 WBN NCR W-353-P, Conax Penetration Enclosure Problems, Rev. 1, (03/18/86)

5.04 WBN NCR 6076, Use of AMP Diamond Grip Lugs on Solid Wire, [C24 850513 103], (05/13/85)

5.05 NCR BLN EEB 8417, HVAC Motor Overload Heater Sizing, [B43 850402 907], (03/28/85)

5.06 PIR WBN EEB 8638, ERCW MOV Fuse Sizing, [B43 860418 926], (04/07/86)

5.07 PIR BLN EEB 8521, Electrical Calculation Documentation, [B43 851003 911], (09/30/85)

5.08 PIR BLN EEB 8611, Cable Splicing and Raychem Heat Shrinking Product Use, [B43 860414 910], (04/11/86)

5.09 QIR WBNEEB86007, Flexible Conduit Inside Containment, [B26 860123 009], (01/23/86)

5.10 QIR EQP86032, Flexible Conduit Inside Containment, [B71 860328 250], (03/27/86)

5.11 QIR WBNEQP86046, Flexible Conduit Inside Containment, [B71 860429 250], (04/29/86)

5.12 QIR EEB 87066, Motor Operated Valve Thermal Overload and Torque Switch Bypass, [B43 870212 905], (02/10/87)

5.13 QIR EEB 87031, Motor Overload Heater Selection, [B43 870203 903], (01/30/87)

5.14 SCR SQNEEB8526, Conduit PVC Jacket Is Not Qualified for Environment It Is to Operate In, Rev. 0, [B25 851113 810], (11/07/85); Rev. 1 [B25 851120 820], (11/18/85)

5.15 SCR WBNEEB8537, AMP Terminal Lugs Recommended for Stranded Wire Only Were Used on Solid Wire, [B43 850819 928], (08/19/85)

5.16 SCR WBNEEB8548, Conduit PVC Jacket Is Not Qualified for Environment It Is To Operate In, Rev. 1, [B43 860121 924], (01/13/86)

5.17 SCR WBN EEB 8540, unit 1, Cable Protection for MOVs with TOL Bypass, [B43 850917 923], (09/05/85)

5.18 SCR WBN EEB 8541, unit 2, Cable Protection for MOVs with TOL Bypass, [B43 850917 921], (09/05/85)

5.19 SCR WBN EEB 8571, Minimum Set of Electrical Calculations, [B43 851126 939], (11/23/85)

5.20 SCR BFN EEB 8524, Rev. 2, Short Circuit Protection for MOVs with TOL Bypass, [B43 860225 925], (02/24/86)

5.21 SCR BFN EEB 8530, No Documentation is Available to Indicate the PVC Jacket is Qualified, [B43 851101 920], (12/30/85)

5.22 SCR BFNEQP8601, Improper Design Control Over BFN EQP Program, Rev. 3, [R01 861230 863], (12/18/86)

5.23 CAQR BFP870249, Cable Entry to Boards Not Sealed, Rev. 1, [R76 870518 808], (5/18/87)

5.24 PIR WBNWBP8776, Number of W2 Spring Return Switches in Safety Circuits for WBN, [B26 870507 005], (03/09/87)

5.25 SCR BFNEEB8529, Minimum Set of Electrical Design Calculations, Rev. 3, [B22 870507 037], (04/21/87)

5.26 SCR BFNEEB8536, Design Drawings Do Not Reflect OL-Element Rating, Rev. 2, [B22 870121 002], (01/20/87)

5.27 OC-NCR 5154, Cleanliness of Electrical Manholes, [T41 870306 052], (02/26/87)

5.28 QIR EQP87066, Verification of Installation of AMP "PIDG" Terminals in Control Room Boards, [B22 870331 052], (03/27/87)

5.29 TVA memo from J. C. Standifer to G. Wadewitz, "Watts Bar Nuclear Plant - Non-ASME Significant Nonconforming Condition Report - NCR 6536, R0, and Significant Condition Report 6536-S, R0," [B26 860218 147], (02/18/86; NCR 6536, Rev. 0, and SCR 6536, Rev. 0, Attached

5.30 NCR 2494, "Splice Kit Was Not Installed According to Manufacturer Instruction," Rev. 1, [BLN 840406 107], (10/12/83)

5.31 TVA memo from G. Wadewitz to J. C. Standifer, NCR W-353-P, Rev. 1, [B26 860411 017], (04/10/86)

6.0 ECNs

6.01 SQN ECN 2257, Cover Sheet dated 03/12/79 [SWP 790312 500] and Data Sheet [SWP 790402 532], (03/31/79)

6.02 SQN ECN L5591, [SWP 820608 519] (06/07/82)

6.03 SQN ECN L5773, [B25 851107 514], (11/07/85)

6.04 SQN ECNs 5821 and 5822 [B26 850730 500 and 502], "Modify Tops of 480V Shutdown Boards to Enclose Cable Openings Made for Cable Entrances," (07/30/85)

6.05 SQN ECN L6338, "Installation of Hydrogen Monitors," [B25 850315 513], (02/27/85)

6.06 SQN ECN L6416, Cover Sheet dated 05/08/85 [B25 850508 585] and Data Sheet [B25 850619 502], (06/19/85)

6.07 WBN ECN 3306, Cover Sheet dated 04/07/82, [SWP 820407 517]; Data Sheet 1, Rev. 3, [SWP 830126 547]; Data Sheet 2, Rev. 4, [SWP 830017 530]

6.08 WBN ECN 3904, [WBP 830715 531], (06/14/83)

6.09 WBN ECN 3905, [WBP 830715 543], (06/14/83)

6.10 WBN ECN 4251, [WBP 840109 525], (10/18/83)

6.11 WBN ECN 4591, Cover Sheet dated 02/13/84, [WBP 840217 517]; Data Sheet 1, Rev. 1, [WBP 840223 547]; Data Sheet 2, Rev. 1 [WBP 840229 500]; attached Test Deficiency Report PT-301, (01/26/84)

6.12 WBN ECN 4592, Cover Sheet dated 02/13/84, [WBP 840222 516]; Data Sheet 1, Rev. 0, [WBP 840222 517]; Data Sheet 2, Rev. 1, [WBP 840229 501]; attached Test Deficiency Report PT-301, (01/26/84)

6.13 WBN ECN 5840, Cover Sheet dated 08/12/85, [WBP 850816 516]; Data Sheet 1, Rev. 1, [B26 850819 507]

6.14 WBN ECN 5879, [B26 851007 506], (10/07/85)

6.15 WBN ECN 5880, [B26 851007 510], (10/07/85)

6.16 WBN ECN 5912, [B26 851022 515], (10/22/85)

6.17 WBN ECN 5913, [B26 851022 513], (10/22/85)

6.18 WBN ECN 5959, "Replacement of 16 500 kV Oil Filled CTs at WBN," [B26 860321 514], (03/21/86)

6.19 WBN ECN 5960, "Replacement of 12 500 kV Oil Filled CTs at WBN," [B26 860321 517], (03/21/86)

6.20 WBN ECNs 6068, [B26 860131 522], (01/31/86) and 6069, [B26 860131 527], (01/31/86)

6.21 WBN ECN 6391, [B26 860717 505], (07/10/86)

6.22 BFN ECN L2071, Cover Sheet dated 08/22/77 and Data Sheets 1, 2, and 3, [TDP 780911 503]

6.23 BLN ECN 639, Cover Sheet dated 02/27/79, [BLP 790227 004], Data Sheet 1, Rev. 3 [BLP 800221 007]; Data Sheet 2, Rev. 0, [BLP 790321 016]; Data Sheet 3, Rev. 4, [BLP 800822 021]

6.24 WBN ECN 1842, Cover Sheet dated 03/08/79, [SWP 790312 506], Data Sheet 1, [SWP 790503 528]

6.25 WBN ECN 4551, Cover Sheet dated 02/09/84, [WBP 840209 522], Data Sheet 1, Rev. 2, [WBP 840424 506]

6.26 WBN ECN 4552, Cover Sheet dated 02/09/84, [WBP 840209 524], Data Sheet 1, Rev. 3, [WBP 840424 507]

6.27 WBN ECN 6296, Cover Sheet dated 08/25/86, [826 860825 538], Data Sheet 1, Rev. 3, [826 861126 505]

6.28 BFN Mechanical Control Diagram 47W610-1-1, Rev. 21

6.29 BLN ECN 639, Cover Sheet dated 02/27/79, [BLP 790227 004], Data Sheet 1, Rev. 3 [BLP 800221 007], Data Sheet 2, Rev. 0 [BLP 790321 016], Data Sheet 3, Rev. 4, [BLP 800822 021]

7.0 Calculations/Drawings

7.01 TVA EN DES Calculations, "Black and Veatch Task Force Category 37 Safety Evaluation of Indicating Light Sneak Circuits," Watts Bar Units 1 and 2 [NEB 840207 221], (02/07/84)

7.02 TVA EN DES Calculations, "Black and Veatch Task Force Category 35 Safety Evaluation of High Instantaneous Current Circuit Breaker Settings," [NEB 840207 222], (02/07/84)

7.03 TVA WBN Drawing 45N282-2, "Electrical Equipment 480V Shutdown Board 1A2B and 1B2B Board Arrangement," Rev. 31 (08/15/85)

7.04 TVA QE Calculation GENNAL3-003, "Beta Dose Reduction by PVC-Covered Conduit Inside Primary Containment," Rev. 3, [845 860624 236], (06/24/86)

7.05 TVA DNE Calculation SQN-APS-003, "480 V Ac APS Class 1E Load Coordination Study," Rev. 0, [843 861124 906], (11/24/86); Rev. 7, [843 871013 901]

7.06 TVA OE Calculation E27885081201, "Main Control Board W-2 Switches - Monitoring Neutral Position Contacts Per NRC IE Bulletin 80-20," [826 850826 001], (08/23/85)

7.07 TVA Calculation WBN-OSG4-087, "Torque Switch and Thermal Overload Bypasses on Active Motor Operated Valves," Rev. 1, [B45 860910 218], (09/04/86)

7.08 TVA Calculation WBN-OSG4-095, "Selection Criteria for MOVs Requiring Thermal Overload Bypass," Rev. 0, [B45 861209 218], (12/08/86)

7.09 TVA BLN Drawing 5GW0850-RU-3, "Conduits and Grounding Conduit and Cable Tray Penetration Sealing Details," Rev. 9, (11/28/86)

7.10 TVA-WBN Drawing 47W920-10, Rev. 32 and Rev. 33, "Powerhouse Auxiliary Building Heating, Ventilating and Air Conditioning," and 47W921-1, Rev. 0 and Rev. 7, 47W921-2, Rev. 0 and Rev. 5, "Auxiliary Building Units 1 and 2 Additional Equipment Building Testing and Air Conditioning"

7.11 TVA-WBN Drawings 47B1411-9, "Lighting Circuit Schedule LC 152," Rev. 9; 45B1414-11, "Lighting Circuit Schedule LC 154," Rev. 8; 47W1414-1, "Lighting, Floor El. 713.0 Plan and Details," Rev. 18

7.12 TVA-WBN Drawing 45B640, Sheet 1, Rev. 7, "Contact Development of Selector Switches and Pushbottons - Index Sheet No. 1.97"

7.13 TVA Electrical Standard Drawing SD-E15.5.1-1, Rev. 0; SD-E15.5.1-2, Rev. 1; SD-E15.5.1-3, Rev. 0; and SD-E15.5.1-4, Rev. 1

7.14 TVA WBN Schematic Wiring Diagram 45W760-270-2, Rev. 15

7.15 TVA Functional Control Logic Diagram 2GW0900-1L-1, Rev. 6

7.16 TVA EEB/BLP Calculation N4-CG-RP-04, "Instantaneous Trip Settings for MOV Circuit Breakers" for BLN Units 1 and 2, [BLP 841203 400], (12/03/84)

7.17 TVA EEB/BLP Calculation N-4-CG-RP-03, "HVAC Thermal Overload Analysis," for BLN Units 1 and 2, [BLP 841106 400], (11/06/84)

7.18 TVA EEB/BLP Calculation N4-WI-RP-001, "480 V LVSG Breaker Settings," for BLN Units 1 and 2 [B21 851223 401]

7.19 TVA Bellefonte Nuclear Plant, LVME 'DS' SWGR 480V SWGR - Westinghouse Electric Corporation - Drawing No. 1245F02, Rev. 2

8.0 Industry Codes/Standards

8.01 National Electrical Code (NEC), ANSI/NFPA 70 (1971, 1975, 1984, and 1987)

8.02 NEMA Publication ICS 2-1983, Standards for Industrial Control Devices, Controllers and Assemblies

8.03 Underwriters Laboratory (UL) 845, Standard for Motor Control Centers (1980)

9.0 Miscellaneous Reports/Documents

9.01 Westinghouse Technical Bulletin NSD-TB-80-9, "W-2 Switches with Spring Return to Neutral," Rev. 1, (02/16/81)

9.02 Black and Veatch Findings Report, Findings 112, (10/27/82)

9.03 Black and Veatch Findings Report - Findings F-136 and F-137, (10/30/82)

9.04 TVA Task Force for Review of Black and Veatch Findings - Task Force Category 35 for Sequoyah Nuclear plant - Units 1 and 2 Evaluation Sheet, Rev. 1, (11/09/83)

9.05 TVA Nuclear Safety Review Staff Report R-84-19-WBN, "NSRS Assessment of the Results of the Black and Veatch Independent Design Review of the Watts Bar Nuclear Plant Auxiliary Feedwater System," [GNS 840705 054], (01/10/84 through 06/15/84)

9.06 TVA's Central Laboratories Report C186-86-1155, "Heat Exposure of PVC Jacketed Flexible Conduit," [843 851223 002], (12/16/85)

9.07 TVA SQN Generic Concern Task Force, "Crimp On Connectors On Diodes and Rectifiers," Rev. 1, (05/06/86)

9.08 TVA SNP Generic Concern Task Force Report GOR 29-29, Rev. 1, (06/06/86)

9.09 TVA Environmental Qualification (EQ) binder SQNEQ-CABL-009, Tabs B and C, Rev. 1, (08/01/86)

9.10 TVA Engineering Report CAQ SQNEQP8618, [S56 860822 862], (08/22/86)

9.11 TVA Condition Adverse to Quality data base for "Electrical Penetrations," (12/10/86 Eng. Assurance Data Base)

9.12 SQN Corrective Action Report SQ-CAR-86-058, (12/19/86)

9.13 SQN Master Bill of Materials, (no date)

9.14 WBN Black & Veatch Finding F-108 (10/27/82), Finding Response Form 1 (12/08/82) and Form 2 (02/01/83); Finding F-122 (10/28/82), Finding Response Form 1 (12/08/82) and Form 2 (02/01/83); Finding F-133 (10/29/82), Finding Response Form 1 (01/11/83) and Form 2 (02/01/83)

9.15 TVA Task Force Report, "Evaluation of B&V Findings - Task Force Category 35 for WBNP - Units 1 and 2," (03/19/84)

9.16 TVA Nuclear Safety Review Staff Report R-84-19-WBN, "NSRS Assessment of the Results of the Black and Veatch Independent Design Review of the Watts Bar Nuclear Plant Auxiliary Feedwater System," [GNS 840705 054], (01/10/84 through 06/15/84)

9.17 TVA Task Force for Review of Black and Veatch Findings, Task Force Category 37 for Watts Bar Nuclear Plant, Unit 1 Evaluation Sheet, Rev. 2, (10/31/84)

9.18 TVA Engineering Report (ER) SCR WBNEEB8537, AMP PIDG Terminal Lugs Used on Solid Conductors, [845 850909 260], (09/09/85).

9.19 Morrison-Knudsen Service Bulletin SB-0027-1, regarding Diesel Generator received before 1976 (09/11/85)

9.20 TVA NSRS Report I-85-101-WBN, Improper Termination Techniques, (09/23/85)

9.21 Report "TVA Experience and Action Plans with Free-standing Oil-filled Current Transformers," by John R. Boyle. TVA, presented to the Southeast Region NERC Operating Committee Meeting, Chattanooga, TN (10/16/85)

9.22 WBN Master Bill of Materials, (02/28/86)

9.23 WBN Field Walkdown, Don-Doncow, Wheeler (Bechtel)/Trentham, Hoffer, Vinson, Crutchfield (TVA), IOM 1263, (04/23/86)

9.24 Wyle Laboratories Test Report 17513-1, Testing of Cables and Splices to Evaluate the Adequacy to Perform Class 1E Functions at BFN

9.25 TVA Environmental Qualification (EQ) binders, WBNEQ-CABL-005, -006, -008, -012, and -017

9.26 TVA Task Force for Review of Black and Veatch Findings - Task Force Category 35 for Browns Ferry Nuclear Plant - Units 1-3, Evaluation Sheet, Rev. 1, (04/02/84)

9.27 Sargent and Lundy Report, "Browns Ferry Nuclear Plant Electrical Calculation Program Assessment," (07/02/86)

9.28 TVA ECSP Subcategory Report 30200, Electrical and Communications, Rev. 0, (02/05/87)

9.29 TVA ECSP Subcategory Report 30500, Accessibility, Draft for Rev. 1, (08/12/87)

9.30 TVA Environmental Qualification Package, Tab J, Binder BFN2EQ-PENE-001, Rev. A

9.31 BFN Master Bill of Materials, (no date)

9.32 INPO Report, Evaluation of Bellefonte Nuclear Plant - Construction Project, (03/84)

9.33 TVA Task Force for Review of Black & Veatch Findings - Task Force Category 35 for Bellefonte Nuclear Plant (Bellefonte Design Project) - Units 1 and 2, Evaluation Sheet, Rev. 0, (05/10/83)

9.34 TVA Task Force Report, "Evaluation of Black & Veatch Findings," (03/19/84) and attached "Evaluation Sheet, Rev. 1, (08/25/83) (11/28/83) for Review of Black & Veatch Findings - Task Force Categories 23 and 38, respectively, for Bellefonte Nuclear Plant - Units 1 and 2"

9.35 TVA Task Force for Review of Black and Veatch Findings - Task Force Category 35 for Bellefonte Nuclear Plant (EEB) - Units 1 and 2, Evaluation Sheet, (11/07/84)

9.36 BLN Master Bill of Materials, (05/27/86)

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

9.38 TVA ECSP Subcategory Report 19100, Electrical Equipment, Rev. 3, (05/18/87)

9.39 WBN Trip Report, Elements 235.4, 235.5, 235.8, 238.1, 241.1, and 241.4; 01/28/87 through 01/31/87, BLT-177 (04/16/87)

9.40 BFN Trip Report, Elements 235.1, 235.2, 238.1, 239.0; 240.0, 241.1, and 241.4; 03/11/87 through 03/13/87, BLT-168 (04/27/87)

9.41 WBN Field Walkdown, S. Mabie (Bechtel), IOM 1933 (02/18/87)

9.42 BFN Field Walkdown, S. Mabie (Bechtel), IOM 894 (03/28/87)

9.43 SQN Trip Report, Elements 235.1, 235.2, 235.4, 238.1, 238.3, 239.0, 240.0, and 242.0; 08/20/87 through 08/25/87, BLT-080 (12/17/87)

9.44 SQN Field Walkdown, D. Knudsen (Bechtel), IOM 560 (11/11/86)

9.45 SQN Field Walkdown, D. Knudsen (Bechtel), IOM 404 (11/13/86)

9.46 WBN Field Walkdown, S. Mabie (Bechtel), IOM 675 (02/20/87)

9.47 SQN Field Walkdown, J. Wheeler (Bechtel)/N. Black (TVA), (08/23/86), BLT-080

9.48 WBN Field Walkdown, J. Wheeler (Bechtel), 01/29/87), BLT-177

9.49 BFN Walkdown Report, J. Wheeler (Bechtel), (02/11-12-13/87), BLT-168

9.50 BLN Walkdown Report, S. Mabie (Bechtel), IOM 992, (05/09/87)

9.51 WBN Field Walkdown, J. Wheeler (Bechtel)/J. Behm (TVA), IOM 909 (07/23/87) with reference to BLT-177 (04/16/87)

9.52 Crouse-Hinds Guide to Selection, Installation, Use and Maintenance of Plugs, Receptacles and Cord Connectors (1982)

9.53 TVA List by T. E. Kidd, "Sequoyah and Watts Bar, W-2 Switches, IE Bulletin 80-20," [no RIMS number], (03/05/82)

9.54 TVA memo from F. W. Chandler to J. W. Coan/J. A. Raulston, "Watts Bar Nuclear Plant Units 1 and 2 - Problem Identification Report (PIR) WBNEEB8533," [843 850923 908], (09/23/85) and Attached PIR

9.55 TVA memo from F. W. Chandler to J. W. Coan, "Watts Bar Nuclear Plant - Significant Condition Report WBNEEB8526," [843 850909 909], (09/06/85) and Attached SCR with Completion Verification Sheet

9.56 Doble, Technical Questionnaire 52AIC85, "Instrument Transformer Troubles and Failures," (1985)

9.57 Electric Utility Weekly, "Transformer Failure at Palo Verde Plant Site," pp. 4 and 5, (05/06/85)

9.58 WBN Workplan N6536-1, Rev. 0 (10/06/86); Rev. 1, (10/24/86); Rev. 2 (12/15/86); Rev. 3, (12/15/86), Rev. 4, (12/17/86); Rev. 5, 12/18/86)

9.59 Letter from J. J. Naples, AMP Products Corporation to F. W. Chandler, TVA, "Use of AMP Diamond Grip Insulated Terminal Lugs with Copper Wire," [843 850408 021], (04/03/85)

9.60 Letter from Conax to W. S. Raughley, TVA, "Evaluation of Cable Coating in Conjunction with Conax Feedthroughs," [826 860710 002], (06/30/86)

9.61 Environmental Qualification (EQ) Binders Tab J, WBNEQ-PENT-001, 002, 003, and 004

9.62 Bechtel memo from S. Mabie to I. Don-Doncow, "Wire Corrosion and Sealant Deterioration in CONAX Containment Penetrations," IOM 665, (02/05/87)

9.63 Maintenance Request Form, WBN A-503909, (02/10/87)

9.64 Raychem, Immersion Tests for TVA, Interim Report, TSL4618, (02/14/75)

9.65 Raychem, Immersion Tests for TVA, Report #2, (Raychem WCSF-N Cable Splices), TSL4618, (06/27/75)

9.66 Raychem, Water Immersion Testing, Interim Report #1, TVA Cable 5-8 kV Splice Testing, TVA 8 kV Shielded Power Cables, (06/18/76)

9.67 Raychem, Water Immersion Testing of 5-8 kV Raychem Splice on TVA 8 kV Shielded Power Cable, (10/15/76)

10. SQN Element Reports

10.01 235.1, "480V Power Receptacles Unsafe," Rev. 1, (02/20/87)

10.02 235.2, "Exposed 480 V Bus at Panel Top," Rev. 0, (12/19/86)

10.03 235.4, "Exposed HV Cable Routed Without Raceway - Personnel Hazard," Rev. 0, (12/22/86)

10.04 235.8, "PVC Liquid-tight Flex Conduit," Rev. 1, (04/21/87)

10.05 235.11, "Malfunction of Westinghouse W-2 Switch," Rev. 2, (04/07/87)

10.06 237.1, "Bypass of Thermal Overload and Over-Torque Limit Switches," Rev. 2, (01/24/87)

10.07 237.2, "400 to 500 Breakers Unacceptably Set," Rev. 2, (01/20/87)

10.08 237.4, "Bypass of Over-torque Limit Switches," Rev. 2, (01/16/87)

10.09 237.6, "Gassing of Current Transformers," Rev. 0, (04/21/87)

10.10 241.1, "Inadequate Splicing and Termination Practices and Procedures," Rev. 2, (04/09/87)

10.11 241.2, "Crimp Connections," Rev. 2, (01/28/87)

10.12 241.3, "No Megger Test on Low Voltage Cables," Rev. 0, (01/19/87)

10.13 241.4, "Amphenol Connector," Rev. 0, (12/22/86)

10.14 241.5, "Wire Corrosion and Deterioration of Sealant Material in Containment Penetrations," Rev. 0, (02/03/87)