EMPLOYEE CONCERNS

SPECIAL PROGRAM

VOLUME 2
ENGINEERING CATEGORY

SUBCATEGORY REPORT 26600
RACEWAY AND CABLE SYSTEM DESIGN

UPDATED

TVA

NUCLEAR POWER

TVA EMPLOYEE CONCERNS
SPECIAL PROGRAM

REPORT NUMBER: 26600

REPORT TYPE: SUBCATEGORY REPORT FOR ENGINEERING

REVISION NUMBER: 5

TITLE: RACEWAY AND CABLE SYSTEM DESIGN

REASON FOR REVISION:

1. Revised text and Attachment B to incorporate SRP and TAS comments.
   Revised Attachment A to add concern IN-86-206-001 to element 239.0.
   Revised Table 3 to add CATDs and corrective actions.

2. Revised text to incorporate SRP and TAS comments.
   Revised Table 3 and Attachment B to add corrective actions.

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   Added Attachment C (References).

4. Revised to incorporate SRP and TAS comments.

5. Revised to incorporate TAS comments.

PREPARATION

PREPARED BY:

SIGNATURE 12/14/87 DATE

REVIEWS

~~PEER~~ REVIEW COMMITTEE:

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CONCURRENCES

		CEG-H:	12-18-87
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APPROVED BY:

ECSP MANAGER 12/18/87 DATE

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

EXECUTIVE SUMMARY

This subcategory report evaluates the issues resulting from 48 employee concerns, which have been addressed previously in the element evaluations in the 23800, 23900, and 24000 series. The issues deal with shortcomings in the design and design control for raceway and cable systems. The computer cable routing program, including the cable status system, is not sufficient for design control. Potential overfill of raceways exists with resultant possibility of cable damage during installation, uncertainties about adequacy of raceway support, pressure/fire seals at tray wall and floor penetrations, and cable ampacities. The adequacy of cable ampacity calculations has also been raised as an issue because conditions for overfilling raceway, cable bundling, and fireproofing have not been addressed.

Evaluation of the issues revealed that the computerized cable routing programs, as well as the Engineering-Construction Monitoring and Documentation (ECM&D) programs, lacked verification detail to assure cable separation, calculation of raceway fill, rejection of erroneous input, and rejection of cables routed in overfilled raceways. The programs were also found deficient in the areas of security, controlling documentation for system maintenance, and program usage procedures.

The evaluation found that the raceway fill status was questionable and that the possibility for overfill exists. These situations occurred because of the lack of verification in the cable routing programs and the lack of QA documentation for cable data. Cable pulling tensions for most cable installations have been calculated without consideration for sidewall pressure, which increases the possibility for cable damage during installation.

In addition, the evaluation found that the information given in early design standards did not have sufficient detail for the proper application of ampacity tables. Cable deratings for the use of tray covers, coating compounds, and Appendix R firewraps were not addressed.

The collective significance of these findings is that the uncertainty in cable routing, problems with raceway overfill, undetected cable damage, and improper cable ampacity all could have adverse implications for safe plant operations. The negative findings for this subcategory center around the lack of proper documentation and procedures. These negative factors must be attributed to a problem in management effectiveness, since documentation and procedures are important management tools for controlling design and construction.

The most frequently identified causes of problems requiring corrective action are about equally split between "Inadequate Procedures" and "Insufficient Verification Documentation" in Table 3. These two categories combined constitute the majority of all causes identified, which indicates management control over cable design, routing, and installation was not effective.

Corrective actions for the major findings can be summarized as follows:

- Regarding the computerized cable program, verified cable data will be reloaded into the verified program with recalculated raceway fill as output. Errors and rejections will be analyzed and corrected.

- To address the raceway overfill problem, some tray inspections will be performed to verify computer-generated fill data. The tray fill tracking system will be verified. Nuclear Regulatory Commission (NRC) concurrence will be sought to responses on cable sidewall pressure and potential cable damage questions.

- To verify cable ampacities and evaluate cable derating in overfilled trays, a sampling program will be implemented.

The evaluation at the subcategory level found the lack of an integrated program for the design and design control of raceway and cable systems to be the broader issue requiring attention. Corrective Action Tracking Document (CATD) 266 00 NPS 01 is issued with this report to track resolution of this finding. Implementation of a Branch Chiefs' design review process and the establishment of the Engineering Assurance organization are expected to enhance TVA's efforts to monitor effectively the technical aspects of Engineering's performance.

The causes identified in this report and other evaluation results are being examined from a wider perspective during the Engineering category evaluation.

Preface

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

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

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

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

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

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

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

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

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

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

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

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

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

ECSP GLOSSARY OF REPORT TERMS*

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

Class A: Issue cannot be verified as factual

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

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

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

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

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

concern (see "employee concern")

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

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

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

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

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

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

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

K-form (see "employee concern")

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

root cause the underlying reason for a problem.

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

Acronyms

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

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

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

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

CONTENTS

TABLES

1. INTRODUCTION

This subcategory report summarizes and examines the results of the ECSP evaluations prepared under the element 23800, 23900, and 24000 series, which deals with raceway and cable system design.

In general, the major issues evaluated cover the computer cable routing program, including the cable status system, uncertainties regarding raceway fill and potential cable damage, and questions concerning adequacy of raceway supports and cable ampacities. Negative findings in these areas could have adverse implications for safe plant operations.

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

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

- Section 2 -- summarizes, by element, the issues stated or implied in the employee concerns and addresses the determination of generic applicability
- Section 3 -- outlines the process followed for the element and subcategory evaluations and cites documents reviewed
- Section 4 -- summarizes, by element, the findings and identifies the negative findings that must be resolved
- Section 5 -- highlights the corrective actions required for resolution of the negative findings cited in Section 4 and relates them to element and to plant site
- Section 6 -- identifies causes of the negative findings
- Section 7 -- assesses the significance of the negative findings
- Attachment A -- lists, by element, each employee concern evaluated in the subcategory. The concern's number is given along with notation of any other element or category with which the concern is shared, the plant sites to which it could be applicable are noted, the concern is quoted as received by TVA, and is characterized as safety related, not safety related, or safety significant
- Attachment B -- contains a summary of the element-level evaluations. Each issue is listed, by element number and plant, opposite its corresponding findings and corrective actions. The reader may trace a concern from Attachment A to an issue in

Attachment B by using the element number and applicable plant. The reader may relate a corrective action description in Attachment B to causes and significance in Table 3 by using the CATD number which appears in Attachment B

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

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

2. SUMMARY OF ISSUES/GENERIC APPLICABILITY

The employee concerns listed in Attachment A for each element and plant have been examined, and the potential problems raised by the concerns have been identified as issues for evaluation by element number, as summarized below. The issues deal with deficiencies or inadequacies in the design of the raceway and cable systems. They apply to all four nuclear plants (Watts Bar [WBN], Sequoyah [SQN], Browns Ferry [BFN], and Bellefonte [BLN]), except for the issue described under element 238.5 (Concern EX-85-151-001), which is specific to a unique location and component at WBN. That issue was determined not to be valid for this plant and, therefore, was not reviewed for the other plants. Similarly, the specific WBN issue in Concern IN-86-206-001, regarding pulling unit 2 cables through unit 1, was found not to be valid for WBN and, therefore, was not reviewed for the other plants. The issues that were found valid (in elements 238.1, 238.3, 239.0, and 240.0) are mostly concerned with control and adequacy of design and require corrective action.

- 238.1, Conduit, Cable Tray, and Wall and Floor Penetration Overfills and Cable Damage - Raceways are overfilled, creating the potential for cable damage during installation and uncertainties about raceway supports and seals for cable tray wall and floor penetrations.

- 238.3, Cable Tray Overfills and Wall and Floor Penetrations - The issues are the same as for 238.1 except that they apply to Sequoyah cable trays only. For the other plants these issues were combined in element 238.1.

- 238.5, Containment Penetration (Cable Damage) - Cable jackets could be damaged on cables that are overflowing the tray and are in direct contact with electrical containment penetration. (Issue is applicable to WBN only)

- 239.0, Cable and Raceway Program Inadequate (Routing) - The computer cable routing program, including the cable status system, is inadequate for design control.

- o 240.0, Cable Derating (Design) and Cable Coating Derating - Cable ampacity calculations do not consider conditions for overfilled raceways, cable bundling, and fireproofing.

3. EVALUATION PROCESS

This subcategory report is based on the information contained in the applicable element evaluations addressing the specific employee concerns related to the issues broadly defined in Section 2. Approximately 1,000 documents were reviewed during the element evaluation for this subcategory report. Selected documents have been listed in Attachment C.

The evaluation process consisted of the following steps:

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

b. Reviewed industry standards and TVA procedures and criteria documents related to the issues to develop an understanding of the design basis (Refs. 6 through 22).

c. Reviewed applicable design documents and conducted facility walkdowns, as appropriate, to develop design understanding and to verify implementation status (Refs. 23 through 42).

d. Reviewed applicable Final Safety Analysis Report (FSAR) sections to determine TVA regulatory commitments related to the raceway and cable system design (Refs. 43 through 49).

e. Reviewed other documents applicable to the issues and determined to be needed for the evaluation such as correspondence, test reports, nonconforming condition reports (NCRs), engineering change notices (ECNs), evaluation reports, etc. (Refs. 50 through 181).

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. Prepared Tables 1, 2, and 3 to classify findings and corrective actions for the four plants as well as to identify causes of negative findings.

i. 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.

4. FINDINGS

The findings from each of the 14 element evaluations for this subcategory are listed in Attachment B by element number and by plant. The summarized findings for each element are given below. They apply to all four plants except where noted otherwise.

4.1 Conduit, Cable Tray, and Wall and Floor Penetration Overfills and Cable Damage - Elements 238.1 and 238.3

The raceway fill status is uncertain due to the lack of QA documentation for the cable and raceway schedule and because of the use of unverified cable data such as diameters and weights. Procedures covering these design activities were found insufficient in providing engineering checks and QA verification. Overfilled raceways could cause cable overheating and result in shortened cable life. The justification of ampacities for instrumentation and control (I&C) cables in 60 percent filled trays, which include cables up to 30 amperes, had insufficient calculation backup to justify assumptions and data used. The use of unverified cable weights leads to uncertainties regarding the adequacy of raceway supports. Engineering judgment used in reviewing the design was not adequately documented. Inconsistencies were found between the FSAR and design standards for conduit fill, thus creating uncertainties about the design basis.

Furthermore, cables that were installed in overfilled raceways, especially conduits that already contain cables, are subject to damage during pullbys. It was found that cable pulling tensions for cable installations have been generally calculated without consideration given to sidewall pressure, thereby increasing the possibility of undetected cable damage. Early procedures written to avoid excessive cable sidewall pressure during cable installation were not followed (BFN). Procedures did not require considering sidewall pressure in calculating cable pulling tensions until the installations were well advanced. Wall and floor cable tray penetrations were not tested or analyzed to establish their effectiveness as firestops and pressure seals under overfilled conditions.

4.2 Containment Penetration (Cable Damage) - Element 238.5

During a plant walkdown, no cables in direct contact with electrical penetrations were found. Possibly the concern was in reference to temporary construction cables. (The employee concern applies to Watts Bar only.)

4.3 Cable and Raceway Program Inadequate (Routing) - Element 239.0

The lack of a requirement that Construction provide Engineering with the installed cable length resulted in the use of inappropriate cable lengths in electrical calculations. The computerized cable routing programs were not adequately verified to assure performance of their intended function of divisional and voltage separation, calculation of raceway fill, rejection of

erroneous input, and rejection of cable routes in overfilled raceways. No procedures were found that track deleted or abandoned cables. Cables for units 1 and 2 of Browns Ferry were manually routed by Engineering without the aid of a computer. However, present records are incomplete for status verification.

Both the cable routing programs and the ECM&D programs were deficient in the areas of security, controlling documentation for system maintenance, documenting revisions, and program usage procedures.

The Engineering-Construction Monitoring and Documentation (ECM&D) programs used at Watts Bar and Bellefonte were not verified. Therefore, the adequacy of the as-built installed cables cannot be determined through the use of the ECM&D program.

The failure of the status system to provide reliable raceway fill information, as well as failure to adhere to maximum allowable raceway fill information, have resulted in the current situation of potentially overfilled raceways and the consequent possible cable damage, adverse effect on cable ampacities and seismic raceway supports.

4.4 Cable Derating (Design) and Cable Coating Derating - Element 240.0

Design standards in effect during the earlier stages of construction did not furnish information necessary for proper application of ampacity tables. Cable deratings for cable tray covers, coating compounds, and Appendix R firewrap were not addressed. Effects of abandoned cables and cable bundling on ampacity were not covered in the design documents. Raceway overfill and its effect on cable ampacity could not be verified by the computerized cable routing programs. No ampacity evaluation or test has been conducted on overfilled cable trays in firestops, and no specific requirements for evaluation of overfilled raceways regarding ampacity were identified for Watts Bar, Sequoyah, and Browns Ferry. Penetration/fire seals at Bellefonte will be installed in accordance with test results and sealing methods shown in Bellefonte drawings. TVA engineering and construction procedures did not control abandoned cables and cable bundling. Several corrective actions of Problem Identification Reports (PIRs) were not implemented.

Where IEEE Standard-383 qualified cables were not used for installation, many cables were coated with fireproofing material thicker than the 1/4 inch stated in design documents. Excessive coating can lead to cable overheating and insulation failure before the end of the design life is reached.

4.5 Summary of Subcategory Findings

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

Findings are summarized by classification in Table 2. Where more than one corrective action is identified in Table 1 for a single finding, Table 2 counts only a single classification. Thus, Table 2 identifies one finding for each issue evaluated. Of the 61 findings identified by a classification in Table 1, 19 require no corrective action. Of the remaining, 3 findings had corrective actions initiated before the ECTG evaluation, 33 required new corrective actions to be identified, and 6 resulted from peripheral issues uncovered during the ECTG evaluation.

5. CORRECTIVE ACTIONS

Table 2 identifies 42 corrective actions. Some of these corrective actions consist of several activities and apply to more than one plant; the exact breakdown is indicated in Table 3. The detailed corrective action descriptions are provided in Attachment B. A condensation of the major corrective actions by element, with the applicable plant identified in parentheses, follows.

5.1 Conduit, Cable Tray, and Wall and Floor Penetration Overfills and Cable Damage - Element 238.1

- Analyze computerized cable routing system program (SQN).
- Revise FSAR regarding maximum allowable conduit fill (SQN, BFN).
- Obtain NRC concurrence on sidewall pressure questions and cable failure trend program (SQN, WBN, BFN, and BLN). Resolution of this cable damage problem at SQN will provide the basis for resolving the problem at the other plants.
- Correct and verify computer-generated fill data (WBN).
- Verify installed cable weights (WBN).
- Provide raceway fill status and QA-level cable data (BFN).
- Revise procedure WBEP-EP43.13 (WBN) and modification and addition instruction MAI-44 (BFN) to include control for raceway fill.
- Address cable tray penetration pressure/firestops as part of existing corrective action for cable trays (WBN, BFN).

5.2 Cable Tray Overfills and Wall and Floor Penetrations - Element 238.3

- Enter actual tray fills from survey data in the computer fill tracking system for future use (SQN).
- Justify limiting the review of tray support adequacy to the control and auxiliary buildings only (SQN).

- o Determine effectiveness of firestops for overfilled trays (SQN).

5.3 Cable and Raceway Program Inadequate (Routing) - Element 239.0

- o Implement software QA plan, create test file to verify the output of the computer program, and reload computer data after program verification (SQN, WBN, BFN).
- o Prohibit increase of raceway fill limits in computer program without approval (SQN, BFN, WBN).
- o Modify and verify the ECM&D program (WBN, BLN).

5.4 Cable Derating (Design) and Cable Coating Derating - Element 240.0

- o Evaluate cable derating in overfilled trays, and analyze effect of cable bundling (SQN).
- o Review ampacity standards against thermolag tests, and establish ampacities for trays in firestops (SQN, WBN, BFN, BLN).
- o Perform sampling program to verify cable ampacities (WBN, SQN).

5.5 Summary of Subcategory Corrective Actions

These corrective actions are also summarized in Table 3, along with their corresponding finding/corrective action classifications. The table indicates the plant or plants to which a corrective action is applicable by the Corrective Action Tracking Document (CATD) column where the applicable plant is identified by the CATD number.

From the Finding/Corrective Action Classification column of Table 3, it can be seen that almost half of all corrective actions require analysis. The next largest group of corrective actions, about one third, requires generation or upgrading of documentation, and the last group of significant size, approximately one quarter, requires changes to or generation of procedures.

6. CAUSES

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

Causes have been indicated for each of the corrective actions listed in Table 3. Totals are shown at the end of the table.

The summary count on the last page of Table 3 shows that "Inadequate Procedures" (for engineering as well as for construction) and "Insufficient Verification Documentation" were identified as the most frequent causes for the problems requiring corrective action. Combined, these categories make up the majority of the causes identified. Many procedures did not give sufficient guidance for implementation of design reviews. The lack of interface requirements between construction and engineering resulted in insufficient feedback from construction to engineering regarding field conditions and construction status. This situation created uncertainities in direction by engineering and poor control of design and design changes. It appears that quality assurance (QA) performed insufficient audits of engineering and construction activities and that conditions adverse to quality (CAQ) often were not resolved in a timely manner. Also, only limited attention seemed to have been paid to applicable experience feedback available from industry sources such as INPO.

The totals from Table 3 show that 27 causes are in the management effectiveness category, 31 are in the design process category, and none are in the technical adequacy category. Thus, shortcomings in management effectiveness and ineffective design process are the underlying causes for the problems requiring corrective action. The causes identified in this report support those identified in the TVA Corporate Nuclear Performance Plan (NPP, Ref. 5), namely, "the lack of a sufficient number of experienced managers to provide leadership and proper direction coupled with the absence of an effective organizational structure to ensure the safe design, construction and operation of TVA's nuclear plants."

7. COLLECTIVE SIGNIFICANCE

Review of the types of corrective action classes identified in Table 1 for the subcategory Raceway and Cable System Design shows that more than three-fourths of the corrective actions are the direct result of evaluation of issues identified in the employee concerns. Seven of the corrective actions, however, were the result of peripheral issues identified during the evaluation process. The remaining corrective actions had been initiated before the evaluation program started and were valid, but the consequences were acceptable.

Because a considerable number of negative findings in this subcategory center around the lack of adequate procedures and documentation, it can be concluded that the raceway and cable system design for the plants evaluated was affected by management ineffectiveness and shortcomings in the design process.

TVA's corrective actions include several evaluations, inspections, and analyses that could result in hardware changes. Until these corrective actions have been completed, problems with raceway overfill, uncertainty in cable routing, undetected cable damage, and improper ampacity cannot be confirmed, and, therefore, the safety significance of the potential changes cannot be determined at this time. Raceway overfill could lead to cable tray

support failure and possibly a common mode failure during a seismic event. Uncertainty in cable routing, in an extreme case, could result in cable separation problems, violating the single failure criterion. Undetected cable damage could lead to a common mode failure if the damage causes redundant cables to fail during exposure to harsh environments such as might be the case during an accident. Finally, improper cable ampacity could invalidate cable qualification and lead to premature and unexpected cable failure.

Although TVA's corrective actions adequately recognize and address the specific findings identified at the element level, a broader underlying issue needs to be addressed. This issue is characterized by the lack of an integrated TVA program for the design and design control of raceway and cable systems. The program is necessary to help avoid similar raceway and cable system problems on future TVA design and construction activities. The program should address questions of effective design review process and emphasize a management structure that facilitates the identification of problems, as well as their successful resolution and closure. The problem is stated in CATD 26600-NPS-01, which is attached to this report. The TVA-developed Corporate Nuclear Performance Plan (CNPP), when properly implemented, is expected to improve corporate-level management of TVA's nuclear activities. The implementation of the Branch Chiefs' design review and auditing process, as well as the establishment of the Engineering Assurance (EA) organization, is a positive step toward supporting, through an independent review process, TVA's monitoring of the technical aspects of Engineering's performance and gives additional assurance for satisfactory results.

TVA's corrective action plan (CAP) responding to CATD 22600-NPS-01, submitted by TCAB-801 dated August 18, 1987, states:

> A program will be initiated to establish engineering and design controls on management of all cable design and design implementation activities at SQN, WBN, BFN, and BLN.
>
> The scope of activities will be addressed in an integrated, project-specific cabling user's manual. This manual will provide guidance in implementing all relevant TVA requirements, design standards, procedures, and methods to create and maintain verified records of the design and installation of the cable and raceway system. This will be an integrated plan to address cable problem areas including cable routing and documentation, raceway overfills, ampacity, and installation feedback and documentation.

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

TABLE 1

CLASSIFICATION OF FINDINGS AND CORRECTIVE ACTIONS

	Element	Finding/ Issue**	Finding/Corrective Action Class* SQN	WBN	BFN	BLN
238.1	Conduit, Cable Tray and Wall and Floor Penetration Overfills (for WBN, BFN, BLN) Conduit Overfills and Cable Damage (for SQN)	a	D6	D3	D3	D3
			-	D5	-	-
		b	D5	A	A	A
		c	A	C2	C2	A
		d	E3	D6	D5	D5
		e	-	A	D5	A
		f	-	D5	D5	A
		g	-	E3	E3	E3
		h	-	E2	-	-
238.3	Cable Tray Overfills and Wall and Floor Penetrations (for SQN)	a	D3	-	-	-
			D5	-	-	-
		b	A	-	-	-
		c	A	-	-	-
		d	C2	-	-	-
		e	A	-	-	-
		f	D5	-	-	-
		g	E3	-	-	-
238.5	Containment Penetration (Cable Damage)	a	-	A	-	-

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

TABLE 1 (Cont'd)

	Element	Issue/ Finding**	Finding/Corrective Action Class* SQN	WBN	BFN	BLN
239.0	Cable and Raceway Program	a	C3	D2	D3	B
		b	D3	D3	D3	D3
		c	D2	D2	D2	D2
			-	D3	D3	D3
		d	-	B	-	-
		e	-	D3	-	-
		f	-	E2	-	-
240.0	Cable Derating (Design) and Cable Coating Derating	a	D3	D5	D3	D5
			D5	-	D5	-
		b	D5	D5	D5	A
		c	A	A	A	A

*Classification of Findings and Corrective Actions

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

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

**Defined in Attachment B.

TABLE 2

FINDINGS SUMMARY

Classification of Findings	Plant SQN	WBN	BFN	BLN	Total
A. Issue not valid. No corrective action required.	5	4	2	6	17
B. Issue valid but consequences acceptable. No corrective action required.	-	1	-	1	2
C. Issue valid. Corrective action initiated before ECTG evaluation.	2	1	1	-	4
D. Issue valid. Corrective action taken as a result of ECTG evaluation.	8	9	9	5	31
E. Peripheral issue uncovered during ECTG evaluation. Corrective action required.	2	3	1	1	7
Total	17	18	13	13	61

ELEM	FINDING/ CORRECTIVE ACTION CLASS.**	CORRECTIVE ACTION	CATD	CAUSES OF NEGATIVE FINDINGS * — MANAGEMENT EFFECTIVENESS: 1 Fragmented Organization	2 Inadequate Q-trng	3 Inadequate Procedures	4 Procedures Not Followed	5 Inadequate Communication	6 Untimely Res of Issues	7 Lack of Mgt Atten	DESIGN PROCESS EFFECTIVENESS: 8 Inadequate Design Bases	9 Inadequate Calcs	10 Inadequate As-blt Reconcil.	11 Lack of Design Detail	12 Engrg Judgmt not Documented	13 Design Crit/ Commit Not Met	14 Insuf. Verif Documentation	TECHNICAL ADEQUACY: 15 Stds Not Followed	16 Engrg Error	17 Vendor Error	Significance of Corrective Actions* O	M	H
238.1	D6	Analyze cable and conduit program regarding ampacity, fill and supports - develop corrective actions.	SQN-01 SQN-02															X				P	P	P
	D5	Inspect trays to verify computer generated fill data. Compare installed cable weight with maximum allowable.	WBN-01 WBN-03			X												X				P	-	P
	D3	Enter calculated cable data into the cable schedule computer program.	WBN-02			X												X				A	-	-
	D3	Provide raceway fill status and QA-level cable data. Implement computerized cable program. Revise FSAR for conduit fill.	BFN-01 BFN-02 BFN-03								X							X				A	-	-
	D3	Revise DS-E12.6.3 if derating factor is required for cables routed through tray crossings.	BLN-01								X							X				A	-	-
	E3	Revise FSAR to match information given in design criteria on conduit fill. Revise calculations to clarify basis for ampacity for 60% filled trays.	SQN-05 NPS-04			X						X										A	-	-
	C2	Revise procedure WBEP-EP43.13 to include requirements for control of raceway fill. Verify fill by using tray profiles. Revise MAI-44.	WBN-05 BFN-04 NPS-09			X																A	-	-

* Defined in the Glossary Supplement.

** Defined in Table 1.

ELEM	FINDING/ CORRECTIVE ACTION CLASS.**	CORRECTIVE ACTION	CATD	CAUSES OF NEGATIVE FINDINGS * — MANAGEMENT EFFECTIVENESS 1 Fragmented Organization	2 Inadequate Utilization	3 Inadequate Procedures	4 Procedures Not Followed	5 Inadequate Communication	6 Untimely Resolution of Issues	7 Lack of Mgt Attention	DESIGN PROCESS EFFECTIVENESS 8 Inadequate Design Bases	9 Inadequate Calcs	10 Inadequate As-blt Reconcil.	11 Lack of Design Detail	12 Engrg Judgmt not Documented	13 Design Crit/ Commit Not Met	14 Insuf. Verif Documentation	TECHNICAL ADEQUACY 15 Stds Not Followed	16 Engrg Error	17 Vendor Error	Significance of Corrective Actions* D	M	H
238.1 (cont'd)	05	Obtain NRC concurrence to TVA response on sidewall pressure questions, and concurrence on parameters to be monitored for cable failure trend program.	SQN-03 SQN-04			X											X				-	P	-
	06	Continue implementation of trending program for cable failures. Submitted sidewall bearing pressure calculations to NRC for review.	WBN-07 WBN-08														X				A	-	P
	05	Complete existing SCR (evaluation of sidewall pressure). Show applicability of SQN cable tests for BFN.	BFN-05 BFN-06			X	X														A	-	-
	05	Reinspect conduits. Prepare cable sidewall pressure calculations. Define cable trend parameters for trend analysis program.	BLN-02 BLN-03 BLN-05			X												X				A	-	P
	E2	Revise MAI-3 to clarify use of cable ties.	WBN-09			X																A	-	-
	05	Identify cables outside trays and correct condition.	BFN-07				X															-	-	P
	05	Include statements addressing tray penetration pressure seals and fire stops as part of overfilled trays in corrective action for existing SCR. Evaluate overfilled tray fire stops and correct as needed.	WBN-10 BFN-08								X							X				A	-	-

* Defined in the Glossary Supplement.

** Defined in Table 1.

ELEM	FINDING/ CORRECTIVE ACTION CLASS.**	CORRECTIVE ACTION	CATD	CAUSES OF NEGATIVE FINDINGS * — MANAGEMENT EFFECTIVENESS							DESIGN PROCESS EFFECTIVENESS							TECHNICAL ADEQUACY			Significance of Corrective Actions*		
				1 Fragmented Organization	2 Inadequate Q-trng	3 Inadequate Procedures	4 Procedures Not Followed	5 Inadequate Communication	6 Untimely Res of Issues	7 Lack of Mgt Atten	8 Inadequate Design Bases	9 Inadequate Calcs	10 Inadequate As-blt Reconcil.	11 Lack of Design Detail	12 Engrg Judgmt not Documented	13 Design Crit/ Commit Not Met	14 Insuf. Verif Documentation	15 Stds Not Followed	16 Engrg Error	17 Vendor Error	D	M	H
238.3	D5	Analyze effects of abandoned cable on ampacity. Justify limited review of tray supports or expand review if not justifiable.	SQN-01 SQN-03 SQN-04									X			X						P	-	P
	D3	Verify tray fill tracking system as part of CAP for 239 SQN-01, 02. Enter tray fill data from survey into fill tracking system.	SQN-02 SQN-09			X											X				A	-	-
	E3	Revise cable ampacity calculations to show tray samples are representative for ampacity and fill.	SQN-05									X			X						A	-	-
	C2	Revise SQEP-06 and MEAI-04 to properly define fill requirements for power trays and conduit jumpers.	SQN-06 SQN-07			X															A	-	-
	D5	Identify overfilled tray penetrations and determine effectiveness of firestops.	SQN-10								X						X				A	-	-
239.0	D2	Revise procedure QCP3.05 and 3.06-3 to establish requirements for obtaining actual installed cable lengths.	WBN-01			X															A	-	-
	D2	Complete Calculation Program required by PM 87-26.	BFN-09			X															A	-	-

* Defined in the Glossary Supplement.

** Defined in Table 1.

ELEM	FINDING/ CORRECTIVE ACTION CLASS.**	CORRECTIVE ACTION	CATD	CAUSES OF NEGATIVE FINDINGS * — MANAGEMENT EFFECTIVENESS							DESIGN PROCESS EFFECTIVENESS							TECHNICAL ADEQUACY			Significance of Corrective Actions*		
				1 Fragmented Organization	2 Inadequate Q-trng	3 Inadequate Procedures	4 Procedures Not Followed	5 Inadequate Communication	6 Untimely Res of Issues	7 Lack of Mgt Atten	8 Inadequate Design Bases	9 Inadequate Calcs	10 Inadequate As-blt Reconctl.	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
239.0 (cont'd)	03	Implement software QA plan; create test file to verify the output of the computer program such as tray fill, cable separation and weights. Reload computer data after program verification causing program checks for fill, separation, etc. Analyze and correct errors and rejections.	SQN-01 WBN-02 WBN-04 BFN-01 BFN-03 BLN-01														X				A	-	-
	02	Update computer program to meet full QA requirements, implementing procedure NEP-3.8.	WBN-03 SQN-02 BFN-02			X															A	-	-
	05	Verify the cable data in the computer files and develop and implement method of ongoing verification of the computer files.	BLN-02			X															A	-	-
	03	Abandoned and spared cables have been annotated on unit 1 and 2 cable schedules. Verify unit 3 abandoned and spared cables by required walkdown of CAQR.	BFN-05														X				A	-	-
	03	Reload verified cable data into computer and recalculate raceway fills.	WBN-05 BFN-04 BLN-06 SQN-04			X											X				A	-	-
	02	Prohibit increase of raceway fill limits without approval by modifying computer program. Track future installations by CAQR closure.	WBN-06 BFN-06			X															A	-	-

* Defined in the Glossary Supplement.

** Defined in Table 1.

ELEM	FINDING/ CORRECTIVE ACTION CLASS.**	CORRECTIVE ACTION	CATD	CAUSES OF NEGATIVE FINDINGS * — MANAGEMENT EFFECTIVENESS							DESIGN PROCESS EFFECTIVENESS							TECHNICAL ADEQUACY			Significance of Corrective Actions*		
				1 Fragmented Organization	2 Inadequate Q-trng	3 Inadequate Procedures	4 Procedures Not Followed	5 Inadequate Communication	6 Untimely Res of Issues	7 Lack of Mgt Atten	8 Inadequate Design Bases	9 Inadequate Calcs	10 Inadequate As-blt Reconcil.	11 Lack of Design Detail	12 Engrg Judgmt not Documented	13 Design Crit/ Commit Not Met	14 Insuf. Verif Documentation	15 Stds Not Followed	16 Engrg Error	17 Vendor Error	D	M	H
239.0 (cont'd)	D2	Revise procedure to prohibit manual routing in tray without node numbers.	SQN-03			X															A	-	-
	D3	Complete corrective action for existing CAQ. Develop criteria BFN-50-758	BFN-07 BFN-08			X			X												A	-	-
	D2	Complete corrective action for existing CAQs.	BLN-04			X			X													A	-	-
	D3	Verify ECMLD program using statistical sampling. Write procedure to implement training program for security system.	WBN-07 WBN-08			X												X				A	-	-
	D2	Modify computer program to prohibit the use of deleted cable identifiers. Revise WBEP-EP 43.13 to include cable deletion requirements. Modify the ECMLD program to generate an installation sheet for each card set.	WBN-09 WBN-10			X																A	-	-
240.0	D5	Perform sampling program to verify cable ampacities. Perform calculations or tests to establish ampacities for trays in firestops. Revise ampacity standard in accordance with thermolag tests if needed. Evaluate cable derating in overfilled trays.	WBN-02 SQN-01 SQN-04 MPS-01 MPS-03								X						X				A	-	P

* Defined in the Glossary Supplement.

** Defined in Table 1.

ELEM	FINDING/ CORRECTIVE ACTION CLASS.**	CORRECTIVE ACTION	CATD	CAUSES OF NEGATIVE FINDINGS * — MANAGEMENT EFFECTIVENESS							DESIGN PROCESS EFFECTIVENESS							TECHNICAL ADEQUACY			Significance of Corrective Actions*		
				1 Fragmented Organization	2 Inadequate Utrng	3 Inadequate Procedures	4 Procedures Not Followed	5 Inadequate Communication	6 Untimely Res of Issues	7 Lack of Mgt Atten	8 Inadequate Design Bases	9 Inadequate Calcs	10 Inadequate As-blt Reconcil.	11 Lack of Design Detail	12 Engrg Judgmt not Documented	13 Design Crit/ Commit Not Met	14 Insuf. Verif Documentation	15 Stds Not Followed	16 Engrg Error	17 Vendor Error	D	M	H
240.0 (cont'd)	D3	Revise standard to justify worst case conduit configuration.	SUN-02								X										A	-	-
	D3	Complete corrective action for existing SCR.	BFN-01 BFN-02								X						X				A	-	-
	D5	Complete corrective actions as defined in existing PIRs.	BLN-01				X				X										A	-	-
	D5	Perform ampacity evaluation.	BFN-01 WBN-04														X				A	-	P
	D5	Analyze effect of cable bundling, revise G38.	SUN-03			X															A	-	-
			TOTALS			22	3		2		8	3			2		18						

* 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 engineering design documents with plant as-built condition was lacking or incomplete.

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

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

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

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

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

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

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

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

1. Hardware - physical plant changes

2. Procedure - changed or generated a procedure

3. Documentation - affected QA records

4. Training - required personnel education

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

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

7. Other - items not listed above

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

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

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

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

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

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

ATTACHMENT A

EMPLOYEE CONCERNS
FOR SUBCATEGORY 26600

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

ELEMENT	CONCERN NUMBER	PLANT LOCATION	APPLICABILITY SQN	WBN	BFN	BLN	CONCERN DESCRIPTION*
238.1	IN-85-432-001	WBN	X	X	X	X	"Overfill of cables in conduits Aux. Control Building El. 757 and Reactor Building." (SR)
	IN-86-036-001 (shared with 24000)	WBN	X	X	X	X	"Electrical Conduits in Units 1 and 2 are overfilled. This may cause induction/heat problems. Some cables may also have been damaged by pulling in these tight conditions, and by using excessive force installing the fish tape in the conduits." (SR)
	IN-86-206-001 (shared with 23900)	WBN	X	X	X	X	"Two 2 conductor #14 safety related cables were pulled through overcrowded 3" conduit/condulets with a 1/2 to 3/4 ton come-a-long. The conduit/condulets were so full, it was difficult to get the fish tape in. Conduit located at elevation 737' of Unit #1 Auxiliary Building to the Cable Spreading Room, elevation 742, column lines A3-A4 and "Q" line. The cable was for Unit II, but was being routed through Unit 1. CI does not know if cable was tested after installation. Occurred approximately Feb/March, 1984." (SR)
	IN-86-254-009	WBN	X	X	X	X	"Conduit running from manholes 1 and 2 to the Aux. Bldg. are overfilled with cables." (SR)
	IN-86-262-004 (shared with 19200)	WBN	X	X	X	X	"Elevation 729' (above machine shop) there are four or five 5" to 6" conduits still having the fish tape in them. The conduit is so full the fish tape cannot be removed." (SR)
	IN-86-310-001	WBN	X	X	X	X	"The electrical conduits and jumpers between cable trays are over filled with cables. TVA does not use the National Electrical Codes in construction practices. Due to overfill, the cable may have been damaged when they were pulled." (SR)
	IN-85-313-001-Unit 2	WBN	X	X	X	X	"Overloading of conduits-wire is being pulled through conduit that is loaded with wire such that it is difficult to push a pencil through. Wire is being stretched when pulling through these conduits." (SR)
	OW-85-007-003	WBN	X	X	X	X	"Crossover electrical conduits are grossly overfilled, and this will cause a heat build-up that will degrade cable insulation. This could lead to cable breakdown and failure. This was a routine practice until at least 1984. 4'-6" Crossovers, 737' El, Auxiliary Bldg. CI has no furtner information. Construction Department Concern." (SR)

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

ELEMENT	CONCERN NUMBER	PLANT LOCATION	APPLICABILITY SQN	WBN	BFN	BLN	CONCERN DESCRIPTION*
238.1 (Cont'd)	IN-85-506-001	WBN	X	X	X	X	"A reant [recent?] cable pull (date unknown) was accomplished on a conduit which was overfilled to the point that the 1/8" "Fishsnake" which guides that cable could barely be inserted. The conduit is 100% + full as a result of this cable pull." (SR)
	IN-85-622-001	WBN	X	X	X	X	"Conduit overfilled beyond safe capacity." (SR)
	IN-85-685-001	WBN	X	X	X	X	"Conduits are generally overfilled beyond acceptable limits." (SR)
	IN-85-743-008 (shared with 23900)	WBN	X	X	X	X	"Conduits are generally overfilled and additional cables are routinely scheduled to be added to the conduits. This causes significant expenditures of manhours in attempting to pull cable where there is no more room available." (SR)
	IN-86-034-001-Unit 2	WBN	X	X	X	X	"Cable pull required 1 week to feed fish tape through conduit prior to cable pull. Overload of conduits damages cables." (SR)
	IN-86-266-003-Unit 2	WBN	X	X	X	X	"Many electrical conduits are excessively loaded with cables." (SR)
	IN-85-642-001-Unit 2	WBN	X	X	X	X	"Conduit is 98% full of cable and more cable is to be installed." (SR)
	IN-85-856-003	WBN	X	X	X	X	"Conduit and cable trays are too full." (SR)
	IN-86-028-002 (shared with 238.3)	WBN	X	X	X	X	"National Electrical standards are not being followed. Example cable trays and conduits are overfull." (SR)
	IN-86-262-001 (shared with 238.3)	WBN	X	X	X	X	"Units 1 and 2. The conduits and cable trays are too full. It often takes 4-5 days just to pull the fish tape through. This overcrowding is an un-safe condition." (SR)
	IN-85-832-001 (shared with 238.3)	WBN	X	X	X	X	"Overloaded cable tray penetration El 729' Turbine Bldg. & Control Bldg. El. 737' Aux. Bldg and Control Bldg-741. Conduits being filled beyond National Elec. Code allowance. Possible damage to cables that other cabled are being dragged over." (SR)
	IN-85-312-001 (shared with 238.3)	WBN	X	X	X	X	"Cable trays in (SIC) conduits are overfilled with cable. The cables could be damaged and not discovered until it shorts out." (SR)
	IN-85-734-001 (shared with 238.3)	WBN	X	X	X	X	"Conduits/cable trays/penetrations in Units 1 and 2 are generically overfilled/overloaded." (SR)

* SR/NU/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*
238.1 (Cont'd)	IN-85-367-001	WBN	X	X	X	X	"Cable in conduit damaged by cable pulling practices. (1) conduits are over-filled, (2) fish tapes can damage conduit, especially when they get stuck, (3) Nylon cord 'Parachute' can cut cable insulation." (SR)
238.2					DELETED		
238.3	WI-85-100-015	WBN	X	Now 238.1	Now 238.1	Now 238.1	Cable trays are too heavily filled, and the cables are not properly derated. CI has no further information. Anonymous concern via letter." (SR)
	OW-85-007-002	WBN	X	Now 238.1	Now 238.1	Now 238.1	"Electrical cable in trays runs completely outside of the trays, especially in bends. Many cable trays are grossly over capacity. These conditions work against the cable trays' purpose of supporting and protecting the cable." (SR)
	IN-85-186-003	WBN	X	Now 238.1	Now 238.1	Now 238.1	"Cable trays are over full in the spreading room, Elev. 729 in both units. Other cable trays in other areas may have the same problem." (SR)
	WI-85-100-011	WBN	X	Now 238.1	Now 238.1	Now 238.1	"Cable tray fill criteria of 60% for I&C cables is inadequate. The National Electrical Code allows 40% and 50% fill on an exception basis. TVA violates this code. This industry practice is 40% fill. This situation is made even worse with the addition of spray-on fire retardant materials which take up space in trays." (SR)
	IN-85-798-004	WBN	X	Now 238.1	Now 238.1	Now 238.1	"Cable tray in Aux. Bldg, El. 713 located at the T4 and R line is too full. 5-6 cables are hanging loose, but the tray is being loaded with more cables." (SR)
	IN-86-238-003	WBN	X	Now 238.1	Now 238.1	Now 238.1	"Many cable trays, Unit 1 and 2, are too full of cables." (SR)
	IN-85-432-002	WBN	X	Now 238.1	Now 238.1	Now 238.1	"Over-filled cable trays, trays filled to the maximum, covers can not be installed." (SR)
	IN-85-519-001	WBN	X	Now 238.1	Now 238.1	Now 238.1	"Cable trays overloaded, Aux. Bldg. Units 1 & 2, 713' and 737' Elev." (SR)

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

ELEMENT	CONCERN NUMBER	PLANT LOCATION	APPLICABILITY SQN	WBN	BFN	BLN	CONCERN DESCRIPTION*
238.3 (Cont'd)	IN-85-688-001	WBN	X	Now 238.1	Now 238.1	Now 238.1	"Plant procedures contain no requirement prohibiting overfill of cable trays in safety related installation. Instances where safety related overfills have occurred were not provided." (SR)
	PH-85-003-023	WBN	X	Now 238.1	Now 238.1	Now 238.1	"The cable trays are overfilled plant wide." (SR)
	IN-86-028-002 (shared with 238.1)	WBN	X	Now 238.1	Now 238.1	Now 238.1	"National Electrical standards are not being followed. Example cable trays and conduits are overfull." (SR)
	IN-85-856-003	WBN	X	Now 238.1	Now 238.1	Now 238.1	"Conduit and cable trays are too full." (SR)
	IN-86-262-001 (shared with 238.1)	WBN	X	Now 238.1	Now 238.1	Now 238.1	"Units 1 and 2. The conduits and cable trays are too full. It often takes 4-5 days just to pull the fish tape through. This overcrowding is an unsafe condition." (SR)
	IN-85-832-001 (shared with 238.1)	WBN	X	Now 238.1	Now 238.1	Now 238.1	"Overloaded cable tray penetration El 729' Turbine Bldg. & Control Bldg. El. 737' Aux. Bldg. and Control Bldg. 741. Conduits being filled beyond National Elec. Code allowance. Possible damage to cables that other cables are being dragged over." (SR)
	IN-85-312-001 (shared with 238.1)	WBN	X	Now 238.1	Now 238.1	Now 238.1	"Cable trays in (SIC) conduits are overfilled with cable. The cables could be damaged and not discovered until it shorts out." (SR)
	IN-85-734-001 (shared with 238.1)	WBN	X	Now 238.1	Now 238.1	Now 238.1	"Conduits/cable trays/penetrations in Units 1 and 2 are generically overfilled/overloaded." (SR)
	IN-85-688-N05	WBN	X	Now 238.1	Now 238.1	Now 238.1	"Inspector on Unit 1 reported to CI one instance of cable tray overfilling." (SR)
	IN-86-232-002	WBN	X	Now 238.1	Now 238.1	Now 238.1	"Due to overfilling of cable trays with cable, the penetration seals may not be able to pass a pressure test. The RTV Silicone seal foam was almost (in many instances) impossible to apply due to the number of cables in the penetration." (SR)
	IN-85-919-001	WBN	X	Now 238.1	Now 238.1	Now 238.1	"Electrical cable tray penetrations are full and cable is still being pulled through these penetrations located in the control bldg." "Concerned about possible damage to cables in these penetrations resulting from the cable pulls." (SR)

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

ELEMENT	CONCERN NUMBER	PLANT LOCATION	APPLICABILITY SQN	WBN	BFN	BLN	CONCERN DESCRIPTION*
238.3 (Cont'd)	IN-85-207-001	WBN	X	Now 238.1	Now 238.1	Now 238.1	"Engineering is routing/scheduleing cables to be pulled through "closed" penetrations, due to the amount of cable fill, the cable jackets and conductors are damaged during cable tray through penetration in Auxiliary building Elev. 737'. Q line and A3 also, penetration Q-CTP-290-62, approx. location N line and C-10 elev. 729' in Control Bldg. was full, yet additional cable was routed and pulled through during August 1985. Construction Department concern. CI has no more information." (SR)
238.4			-	-	DELETED		
238.5	EX-85-151-001	WBN	-	X	-	-	"Unit 2 annulus elev. 737' penetration #11 (?) cable overflowing cable tray is in direct contact with penetration. Could cause damage to cable jacket. CI stated that to get to this location, enter annulus at 737', turn left and proceed about 25-30' along ledge. CI has no further information: Construction dept. concern." (SR)
238.6			-	-	DELETED		
238.7			-	-	DELETED		
239.0	IN-85-743-006	WBN	X	X	X	X	"Pull slips relative to cable pulls are generically inaccurate relative to length of pull, which causes delays in production due to craft having to physically 'walk down' system." (SR)
	WI-85-100-014	WBN	X	X	X	X	"Computer Cable Routing Program is inadequate and it's status system is inadequate." (SR)
	IN-85-743-008 (shared with 23800)	WBN	X	X	X	X	"Conduits are generically overfilled and additional cables are routinely scheduled to be added to the conduits. This causes significant expenditures of manhours in attempting to pull cables where there is no more room available." (SR)
	IN-86-206-001 (shared with 23800)	WBN	-	X	-	-	"Two 2 conductor #14 safety related cables were pulled through overcrowded 3" conduit/condulets with a 1/2 to 3/4 ton come-a-long. The conduit/condulets were so full, it was difficult to get the fish tape in. Conduit located at elevation 737' of Unit #1 Auxiliary Building to the Cable Spreading Room, elevation 742, column lines A3-A4 and "Q" line. The cable was for Unit II, but was being routed through Unit I. CI does not know if cable was tested after installation. Occurred approximately Feb/March, 1984." (SR)

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

ELEMENT	CONCERN NUMBER	PLANT LOCATION	APPLICABILITY SQN	WBN	BFN	BLN	CONCERN DESCRIPTION*
240.0	WI-85-100-009	WBN	X	X	X	X	"Cable ampacity problems where cable derating was not properly considered." (SR)
	XX-85-122-027	SQN	X	X	X	X	"Sequoyah: Cable ampacity problems where cable derating was not properly considered." (SR)
	XX-85-122-028	BLN	X	X	X	X	"Bellefonte: Cable ampacity problems where cable derating was not properly considered." (SR)
	XX-85-122-029	BFN	X	X	X	X	"Browns Ferry: Cable ampacity problems where cable derating was not properly considered." (SR)
	IN-85-272-004	WBN	X	X	X	X	"'Valcoat,' used in fireproof electrical cables in both units may cause cables to overheat causing degradation of the cable insulation." (SR)
	IN-85-289-006	WBN	X	X	X	X	"Vermasco was applied to cables prematurely. Penetrations and conduits were sealed. Vermasco was determined to keep heat in and deteriorated the insulation. This application was discontinued 1-1/2 years ago but the Vermasco already applied has not been removed." (SR)
	IN-86-254-005	WBN	X	X	X	X	"Electrical cables are bundled together and then covered with Vamasco. The thick coating of Vamasco potentially causes heat build up which may cause failure. This is a generic condition throughout Units I and II. It effects low, medium, and high voltage cables." (SR)
	IN-86-262-002	WBN	X	X	X	X	"Units 1 and 2, the overcrowding of cables and the application of a fire retardant to the cables causes an overheating condition. Therefore making the instrument readings indeterminate." (SR)
	IN-86-036-001 (shared with 23800)	WBN	X	X	X	X	"Electrical conduits in Units 1 and 2 are overfilled. This may cause induction/heat problems. Some cables may also have been damaged by pulling in these tight conditions, and by using excessive force in installing fish tape in the conduits." (SR)

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

ATTACHMENT B

SUMMARY OF ISSUES, FINDINGS, AND
CORRECTIVE ACTIONS FOR
SUBCATEGORY 26600

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

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

Issues	Findings	Corrective Actions
********** Element 238.1 - Conduit Overfills (SQN), Raceway Overfills (WBN, BFN, BLN) **********		
SQN a. Conduits and jumpers between cable trays are overfilled and cable additions continue to be routinely scheduled. Overfills beyond safe capacities result in an unsafe condition and could cause induction and heating problems (induction and heating or ampacity problems are addressed in this subcategory report, Sequoyah Element 240.0, "Cable additions routinely scheduled" are addressed in this subcategory report, Sequoyah Element 239.0).	SQN a. The evaluation revealed that accurate conduit fill information is not readily available (Refs. 58 and 73) and, therefore, compliance with the FSAR commitment (Ref. 44) for conduit fill is not verifiable through QA documentation. Also, the maximum allowable conduit fill indicated in Electrical Design Standard DS-E13.1.4 (Ref. 138) is not in agreement with the FSAR and Design Criteria No. SQN-DC-V-11.3 (Ref. 139) requirements. The design standard, which is in agreement with the National Electrical Code, specifies maximum fills of 53 percent for conduits containing one cable, 31 percent for conduits containing two cables, and 40 percent for conduits containing three and more cables. The FSAR and the design criteria allow a maximum conduit fill of 40 percent. Furthermore, SQN design engineers used cable weight data from a TVA Design Standard that were taken from non-QA sources (Ref. 83). These uncertainties regarding conduit fill and cable weight raise the question about the adequacy of cable ampacities and conduit supports. To correct the conduit fill situation, a memo from W. S. Raughley (Ref. 67) directs all the nuclear plants to establish a sampling program to determine the adequacy of electrical cables with respect to their ampacity ratings. However, this memo is not specific with regard to evaluation of overfilled raceways. No program that addresses the conduit support adequacy was identified.	SQN a. The CAP for CATD 238 01-SQN-01 and -02 states that TVA has retained the services of United Engineers and Constructors (UE&C) to conduct a full systematic analysis of the SQN cable and conduit scheduling program. Furthermore, UE&C will identify any necessary corrective actions required to establish the accuracy of the conduit and cable schedules. The UE&C effort will include a review of the practices and procedures utilized in routing, installing, and abandoning cables in conduit during SQN's design, construction, and modification phases up to the present. The purpose of this review is to determine potential root causes for discrepancies and to bound any identified problem areas resulting from these root causes. The scope of this review encompasses those procedures and practices applicable to all class 1E conduits. This review is a prerequisite to any further review and shall be completed prior to unit 2 restart. Subsequent to the above review, programs will be developed and implemented to correct all identified discrepancies and to mitigate the effects of programmatic procedural breakdowns. Furthermore, all discrepancies will be evaluated for their impact on: o Conduit fill commitment verification o The worst-case cable pull o Conduit support adequacy o Cable ampacity

Issues	Findings	Corrective Actions
Element 238.1 - SQN (Continued)		THIS ITEM PARTIALLY COMPLETED AT SQN DATE 11/16/87 All corrective actions required to resolve problems identified by the UE&C review will be evaluated against restart criteria and those items meeting these criteria will be implemented before unit 2 restart. The remaining items will be completed as part of a long-term program after restart.
b. Potential cable damage could result from cable pulling in overfilled conduits and other cable pulling practices (e.g., wires are stretched, cables are dragged over other cables, insulation is damaged by fishtapes and nylon parachute cords, mechanical pulls are not monitored, etc.). Damaged cables would not be discovered until they short out.	b. Although the adequacy of past cable pulling practices could not be fully verified because of incomplete records and QA documentation, no trend of cable failures as a result of cable damage due to pulling was identified by the evaluation team. This is supported by a report on "Evaluation of the Adequacy of Installed Class 1E Cable" (Ref. 99) and by the review of the CAQ data base by the evaluation team (Ref. 62). On the basis of this, any failures that might occur during plant normal operating condition are expected to be random failures. Also, completion of DNE Calculation SQN-E2-015, Rev. 1, "Identifying Sidewall Pressure Violations," including consideration of cable pulls in overfilled conduits and pullbys, should help support this assessment, as will implementation of the new trend analysis program, which will track, consolidate, and categorize conditions adverse to quality and, thus, identify any adverse trends associated with cable failures. However, revision 1 of the calculation and the trend program were not available at the time of the review.	b. The CAP for CATD 238 01-SQN-03 states that revision 2 of calculation DNE SQN-E2-015 was prepared and forwarded to the NRC to document the maximum sidewall pressure (SWP) for SQN. This transmittal was in response to NRC questions regarding worst case cable pulls. SWP, jamming, and pullbys are all open items with the NRC and NRC concurrence will constitute acceptable closure of this issue. Furtner, TVA has conducted SWP tests, and plans to conduct further cable tests to ensure that the effects of SWP, pullbys, jamming, and support of cables in vertical conduit has not jeopardized the functional adequacy of cables in conduit. Finally, as discussed in the previous CAP, TVA will review this calculation on the basis of results of the previously described conduit schedule accuracy evaluation and will evaluate any discrepancies for their effect on SWP. Any items identified as potential problems will be evaluated against the restart criteria and those meeting these criteria will be resolved prior to Unit 2 restart. The remaining items will be resolved as part of a long-term program. The CAP for CATD 238 01-SQN-04 addresses the lack of complete implementation details of the Trending Program. [illegible] was to supply implementation details for review by the evaluation team. A preliminary copy of EPI 9.2, "Trending of Conditions Adverse to Quality," has been forwarded to, and reviewed by, the evaluation team and found to be sufficient to accomplish its intended function. However, final concurrence from THIS ITEM COMPLETED DATE 9/29/87

Issues	Findings	Corrective Actions
Element 238.1 - SQN (Continued)		
		THIS ITEM COMPLETED DATE: 5-22-87
		the NRC on parameters to be monitored has not been obtained; therefore, this is an open item pending NRC final concurrence. In addition, a preliminary copy of UNE operating instruction [illegible] was forwarded to the evaluation team. This will provides for the implementation of Rev. 2. Further, the Nuclear Quality Assurance Manual, Part I, Section 2.16, Revision 2 has been issued (01/01/87) and this revision assigns specific responsibility for trending. The program has now been implemented.
• National Electrical Code not followed for conduit fill and construction practices.	c. The National Electric Code (NEC) (Ref. 140) in Section 90-2(b)(5) states that installations such as a generating station under the exclusive control of an electric utility (including TVA) are not covered by the code. Therefore, TVA is not obliged to follow NEC for conduit fills and cable pulling practices unless specific references were made in the design standards.	c. None required.
• Peripheral finding	d. Design Criteria SQN-DC-V-11.3 (Ref. 139) and FSAR Section 8.3.1.4.1 allow a maximum conduit fill of 40 percent, which is in disagreement with Design Standard DS-E13.1.4 (Ref. 138).	d. The CAP for CATD 238 01-SQN-05 calls for the revision of the allowable conduit fills in the FSAR as part of Amendment 5 and the revision of the design criteria to reflect the design standard values (30 to 53 percent) which are typical for the industry. Both of these activities are not required for restart; however, these revised values will be used in the commitment verification required by the CAP in response to corrective action (a).

Issues	Findings	Corrective Actions
Element 238.1 - WBN The following issues, which were addressed by Sequoyah Reports 238.1 and 238.3, are combined in this evaluation to facilitate TVA review.	WBN	WBN
a. Raceways are overfilled. Overfills may result in an unsafe condition, including induction/heating problems (induction/heating problems are addressed in this subcategory report, Watts Bar Element 240.0).	a. The evaluation revealed that uncertainties exist regarding the accuracy of the raceway (conduit, tray, and cable tray penetrations) fill information and, therefore, compliance with FSAR commitments for raceway fill is not verifiable through QA documentation. Raceway fill information cannot be assessed because the raceway fill tracking system has not been verified (Ref. 98), and completeness of records of abandoned cables could not be confirmed, as shown by NCR W-283-P (Ref. 141). (These issues are also addressed in Watts Bar Element Evaluation 239.0.) Also, there is no assurance that current records of raceway fill agree with the actual installation as shown by NCR W-283-P (Ref. 141). This NCR states that records for temporary, spare or abandoned cables are incomplete. However, the corrective action for the NCR does not address the issue of feedback of the data into the computerized raceway and circuit schedule. A sample printout of WBN cable schedule, voltage level 4A (Ref. 30), showed that actual fill in some trays exceeded the maximum allowable. Maximum tray capacities listed in the current WBN cable schedule do not agree in all cases with maximum allowable tray capacities established by a DNE calculation (Ref. 142). Furthermore, a plant walkdown (Ref. 30) by the evaluation team shows possible overfill of some trays (cable fill is above side rails and raised covers were also observed, tray nodes 3A2279 and 3B253) and tray penetrations (cables appear to be jamming into penetration openings, tray nodes 3A2398 and 3A2333). This could not be verified because the installed cables are covered with Vimasco (a cable coating compound).	a. The CAP for CATD 238 01 WBN-01 stipulates that TVA will review the practices and procedures utilized in routing, installing, and abandoning cables in raceways during WBN's design, construction, and modification phases up to the present day. Also, any known inaccuracies in the number or type of cables shown in the cable/conduit schedule identified during this review will be specifically examined. QA values for class 1E and NC cable weights and outside diameters will be used to calculate the conduit and cable tray cross-sectional area fill and seismic loading. Abandoned cables are being documented in FCRs, and these data are being entered into the cable routing program. An inspection of the tray segments identified by the computer as overfilled will be performed. This comparison of the program-generated fill value with the actual field conditions will check the accuracy of the records.

Issues	Findings	Corrective Actions
Element 238.1 - WBN (Continued)		
	Furthermore, WBN design engineers used cable weight and outside diameter data that were taken from non-QA sources (Ref. 51). The non-QA cable data and the uncertainties regarding the accuracy of raceway fills result in uncertainties regarding adequacy of cable derating and raceway supports. Corrective actions concerning cable derating are discussed in this subcategory report, Watts Bar Element 240.0. No corrective action for determining adequacy of raceway supports was identified by the evaluation team.	The CAP for CATD 238 01 WBN 02 states that calculation WBEP VAR 8608003 [826-860825 047] establishes the maximum allowable cable cross-sectional area for all cable tray segments. Input of these data into the cable schedule computer program (CSCP) will be completed in conjunction with modifications to the program itself. The program is required to track and control tray fill. Data entry and modifications to the CSCP will be completed before fuel load of unit 1. In the interim, WBEP 5.31 section 4.4 requires that a "Verification of Cable Record Checklist" be completed for any cable routed. This record ensures that the cross-sectional area limit for any cable tray segment will not be exceeded without justification. The CAP for CATD 238 01 WBN 03 states that raceway support calculations will be performed on any existing overweight condition to assure support integrity during a seismic event. Any overweight condition determined to be technically acceptable will be documented and used as-is. If an overweight condition is determined to be unacceptable, either the cable will be rerouted or the supports will be strengthened.

Issues	Findings	Corrective Actions
Element 238.1 - WBN (Continued)		
b. Raceway fill criteria violate the National Electrical Code and Industry Standards.	b. The National Electric Code (NEC Section 90-2[b][5]) does not require utilities (including TVA) to comply with code requirements for installations under the exclusive control of the utility. Therefore, TVA is not obligated to follow the NEC for raceway fills. The current WBN 40 percent fill criterion for conduit and the 30 percent fill criterion for power trays are consistent with industry practice. Although the 60 percent fill criterion for instrument and control trays (V3) exceeds the industry practice of 50 percent, it is acceptable if adequately justified. (See also Element 238.1 - WBN, item g.)	b. None required.
c. Procedures are lacking to prevent additional cables from being pulled in overfilled raceways and cable tray penetrations.	c. Plant procedures to help avoid overfill of raceways and penetrations have been established only recently in "Installation and Inspection of Insulated Control, Signal, and Power Cables," MAI-3 (Ref. 9); and "Construction Specification for Installing Insulated Cables Rated up to 15,000 Volts Inclusive," Construction Specification G-38 (Ref. 6). Both of these documents require that Construction obtain Engineering's disposition for deviations from cable installation records. However, there is no evidence that adequate procedures were in existence at the time of WBN construction. Similarly, Watts Bar Project Engineering Procedure WBEP-EP 43.13, "Cable Schedule Handling," (Ref. 13) is intended to provide the requirements for Engineering to maintain adequate control of raceway fill and cable routing. However, review of this procedure by the evaluation team indicates that the procedure does not provide guidance to the cable router on how to route a cable, in case it is rejected by the computer.	c. The CAP for CATD 238 01 WBN 05 states that SCR WBN ECB8601 addresses deficiencies in the control of raceway fill and cable routing. It establishes the action required to prevent recurrence as follows: (1) Modify the cable tray update program to prohibit assignment of a maximum allowable cross-sectional area being entered that violates the design criteria WBN DC-30-5. (2) Modify the structure of the tray network file to add a second data field that will provide traceability to the overfill justification document. Also, SCR WBN ECB8604 addresses previously identified deficiencies in WBEP-EP 43.13. However, it will be revised to ensure that WBEP-EP 43.13 includes requirements for future control of raceway fill and cable routing.

Issues	Findings	Corrective Actions
lement 238.1 - WBN (Continued)		
. Potential for cable damage exists for cables pulled in overfilled raceways and cable tray penetrations. Damage will not be discovered until cables short out.	d. The possibility of cable damage exists for cable pulling into overfilled raceways, particularly conduit (pullbys) and cable tray penetrations. At the time of construction, Construction Specification G-38 (Ref. 6) did not address cable pullbys; only recently have these requirements been added. However, these requirements are not clear in their installation instructions for pulling fish tape through conduits that already contain cables. Examination of pull cards (Ref. 29) shows that maximum allowable pull tensions are noted. The pull tensions appear to be calculated using the conductor tensile strength only without considering sidewall pressure. The subject of sidewall pressure was not addressed until 1985, when revision 6 of Construction Specification G-38 (Ref. 6) was issued. Although a calculation (Ref. 143) was issued to demonstrate that sidewall pressure was not exceeded during installation of class 1E cables in conduits, no indications exist that the worst case identified took into consideration aspects such as cable pulling in overfilled conduits and pullbys. However, it was found that actual tensions were kept at, probably, allowable values. The report "Evaluation of the Adequacy of Installed Class 1E Cables" (Ref. 144) identifies only four examples of cable problems that were detected during construction at WBN. The evaluation team also reviewed a printout of the Division of Engineering Design (EN DES) Conditions Adverse to Quality (CAQ) data base for "cable" (Refs. 62 and 100). The document revealed that some cable was damaged during installation. However, the related NCR (Ref. 101) indicates that damage was repaired. Furthermore, because no operating experience exists yet for WBN, surveillance tests per technical specifications requirements and the extensive trending program scheduled for implementation as indicated on TVA letter to the NRC (L44 861031 811) will be important to anticipate or detect trends associated with cable failures.	The CAP for CATD 238 01 WBN 06 states that no attempt has been made by procedures to explain or train crafts personnel in using common industry [illegible]. This knowledge traditionally has been acquired in apprentice training, on-the-job training, and special training classes conducted by the craft supervisor(s), and from literature supplied by the manufacturer of the device. Therefore, it is concluded that, when the possible overfilling of conduit is resolved, any concerns with the use of pulling fish tape through conduit that already contains cables will also be resolved. No corrective action is required. The CAP for CATD 238 01 WBN 07 states that the trending program has been implemented as committed to the NRC. [illegible] that [illegible] are being loaded into a single data base, and [illegible] are being assigned. CATD 238 01 WBN 07 is therefore, satisfied provided that meaningful parameters are trended as pointed out in Franklin Research Institute report TER-C5506-649. The CAP for CATD 238 01 WBN 08 states that a TVA test report concerning cable sidewall pressure has been submitted to the NRC for SQN and will be submitted for WBN. WBN calculation results (WBEP VAR 8603006) have been submitted to the NRC and are presently being reviewed. NRC unresolved items 390/86-01-01 and 391/86-03-01 concerning the impact of pullbys and flexible conduit connections remain open. TVA is continuing resolution with the NRC on this issue.

THIS ITEM COMPLETED DATE 2-12-88

THIS ITEM COMPLETED DATE 2-12-88

Issues	Findings	Corrective Actions
Element 238.1 - WBN (Continued)		
e. As a result of overfills, trays do not provide support (cables hang loose) and protection to cables running outside of them. Tray covers cannot be installed as a result of overfills.	e. The primary purpose of a cable tray is to provide cable support. Tray covers are used to separate cables of different divisions when physical separation cannot be achieved otherwise, and to protect cables from falling objects when required, such as under gratings. During a plant walkdown (Ref. 36), although several instances were identified where raised tray covers were installed, no cases could be found where tray covers cannot be installed on class 1E trays that require covers. Raised tray covers are acceptable as long as separation requirements are maintained (additional discussion in subcategory report 24200, Watts Bar Element 242.0). Also, no permanent plant cables were observed installed outside of the tray side rails, only temporary construction cables.	e. None required.
f. Cable tray penetrations are potentially unqualified as pressure barriers because of difficulty in applying silicone foam in overfilled trays.	f. A plant walkdown (Ref. 36) identified some cable tray penetrations that appear to be overfilled (tray nodes 3A2398 and 3A2333). This could not be confirmed by visual inspection or examination of design documents. No documents were identified defining allowable cable fill in penetrations. The effect of overfilled penetrations on cable derating is discussed in Watts Bar Element 240.0. "Installation and Inspection of Electrical Penetration Pressure Seals, Fire Stop Barriers and Flame Retardant Cable Coatings," MAI-14 (Ref. 145), addresses the installation and repair of electrical penetration pressure seals and firestops. The instruction adequately addresses installation, repair, and inspection of electrical penetration firestops and pressure seals to ensure their integrity. It includes adequate requirements for QA inspection of the installation process. No evidence exists, however, that firestop penetration configurations, as originally tested by TVA and others, will be equally effective under penetration overfilled conditions.	f. The CAP for CATD 238 01 WBN 10 states that Significant Condition Report (SCR) WBNECB8601 1843 860926 910J is tracking the condition of overfilled trays. The corrective action of the SCR will be revised to include a statement to evaluate the effects of overfilled tray penetrations as related to pressure seals and firestops.

Issues	Findings	Corrective Actions
lement 238.1 - WBN (Continued)		
. Peripheral finding	g. Division of Nuclear Engineering (DNE) calculation (Ref. 20) provides justification for filling VJ trays to 60 percent. However, calculations are using assumed cable loadings, the basis of which is not apparent to the evaluation team.	g. The CAP for CATD 238 01 NPS 04 states that the calculation ETB-CSTF-0001 [B43 861230 903] will be revised to document the basis for the assumptions used in justifying 60 percent fill of control level cable trays. A CAQ will be issued if determined to be required.
. Peripheral finding	n. Permanent cables were observed lying loosely on top of fire-proofed cable bundles and not secured. Tie-down of cable ties is optional according to "Construction Specification for Installing Insulated Cables Rated up to 15,000 Volts Inclusive," G-38, R6, (Ref. 6). However, "Installation and Inspection of Insulated Control, Signal, and Power Cables," MAI-3, R7, (Ref. 9) requires these cables to be secured.	h. The CAP for CATD 238 01 WBN 09 states that modifications engineering considers cable [illegible] to be a good construction practice to maintain the arrangement of cables and to provide [illegible] of MAI-3, R7, [illegible] paragraph 4.8.3.6, states that the procedure requires tie-downs at intervals not to exceed 15 feet on horizontal trays. This procedure will be revised to clarify that tie-downs "should" be installed where practical, at intervals not to exceed 15 feet.

THIS ITEM COMPLETED
DATE 2-2-87

NOTE: The following issues from these concerns are addressed in other evaluations.

Cable for Unit 2 was being routed through Unit 1 (discussed in this subcategory report, Watts Bar Element 239.0).

There is no certainty that cables were tested after installation (discussed in subcategory report 26500, Watts Bar Element 241.3).

Issues	Findings	Corrective Actions
Element 238.1 - BFN The following issues, which were addressed by Sequoyah Reports 238.1 and 238.3, are combined in this report to facilitate TVA review.	BFN	BFN
a. Raceways are overfilled. Overfills may result in an unsafe condition.	a. For units 1 and 2, no QA records, as required by "Design Procedures for Routing and Loading Cables on Cable Trays" (Ref. 102), could be identified that would indicate effective control of raceway fill. For unit 3, a computerized routing program exists. However, raceway fill data are not traceable to QA records. Furthermore, the program users raised the maximum allowable tray fill values without approval or documented justification (Ref. 103). Also, the cable outside diameter (OD) used to calculate raceway cross-sectional area fill and the cable weights used to calculate raceway supports were from non-QA sources (Ref. 104). Because of these uncertainties, it is not clear whether the raceway fill commitments as stated in the FSAR are actually met. As a consequence of the uncertainties regarding raceway fill, the adequacy of raceway supports - further complicated by the use of unverified cable weights - and cable ampacities cannot be verified. (The ampacity issue is discussed in this subcategory report, BFN Element 240.0).	a. The CAP for CATD 238 01-BFN-01 states that a review will be performed of the practices and procedures utilized in routing, installing, and abandoning cables in raceways during BFN design, construction, and modification phases up to the present day. The review will address the practices and procedures relating to all raceways in Category I structures. Any inaccuracies in the number or type of cables in the cable/conduit schedule identified during this review will be specifically examined. Subsequent to the above review, programs will be developed and implemented to correct all identified discrepancies, and to mitigate the effects of any generic procedural breakdowns. Furthermore, all discrepancies will be evaluated for their impact on: o Raceway fill commitment verification o The worst-case cable pulls o Raceway support adequacy o Cable ampacity

Issues	Findings	Corrective Actions
lement 238.1 - BFN (Continued)		
	Corrective Action Reports CAR-86-0078, 79, and 80 (one for each unit) were issued stating that the tray fill exceeds FSAR commitments, that the design limits for tray supports have been exceeded, and that ampacity derating due to excessive application of Flamemastic coating is lacking. The report requires as corrective action, "to establish computerized cable programs for Units 1, 2, and 3 which prevent the engineering of cable routes which overfill cable trays." The report further requires that seismic qualification of existing cable tray/supports be performed.	The corrective action for SCR BFNEEB8602 will provide QA level data for cable outside diameters and weights. Also see the corrective action plan for 10900-NPS-05. The corrective action is scheduled for completion prior to restart of each unit for items meeting restart criteria.
	Conduit fill limitations inconsistencies were found between BFN FSAR Section 8.9.2.1 and Design Standard DS-E13.1.4, Table 1. The 53 percent and 31 percent conduit fills allowed by Table 1 of DS-E13.1.4 (Ref. 138) for one or two cables per conduit, respectively, is in agreement with industry practice (NEC), but the 53 percent value does not meet the FSAR (Ref. 47) stated fill limitation of 40 percent for conduits.	The CAP for CATD 238 01-BFN-02 states that the corrective action for CARs 86-0078, -0079, and -0080 and for SCR BFNECB8601 and subsequent closure will resolve this CATD. The corrective action requires that computerized cable programs be established for units 1, 2, and 3. SCR BFNECB8601 is entered into TROI for tracking of its corrective action. The corrective action is scheduled for completion prior to restart of each unit. The CAP for CATD 238 01-BFN-03 states that the BFN FSAR Section 8.9.2.1 will be revised as required to agree with DS-E13.1.4. After revision of the FSAR, all existing installations will comply with the FSAR, NEC, and DS-E13.1.4. Conduits that contain two cables have an allowable fill of 31 percent per DS-E13.1.4. This fill is less than the maximum 40 percent stated in the FSAR. The corrective action is scheduled for completion prior to unit 2 restart.

Issues	Findings	Corrective Actions
Element 238.1 - BFN (Continued)		
b. Raceway fill criteria violate the National Electrical Code and industry practice.	b. The NEC in Section 90-2(b)(5) states that installations such as a generating station under the exclusive control of an electric utility (including TVA) are not covered by the Code. Therefore, TVA is not obligated to follow the NEC for raceway fill. The current BFN 40 percent fill criterion for conduit and the 30 percent fill criterion for power trays are consistent with industry practice. Although the 60 percent fill criterion for instrument and control trays exceeds the industry practice of 50 percent, it is acceptable if adequately justified. (See also Element 238.1-BFN, item g.)	b. None required.
c. Procedures are lacking to prevent additional cables from being pulled in overfilled raceways and cable tray penetrations.	c. Plant procedures to instruct Construction to consult with Engineering in cases where cables cannot be installed exactly as indicated in the design records have been established only recently in General Construction Specification G-38, (Ref. 6), "Installing Insulated Cables Rated Up To 15,000 Volts," and MAI-44 (Ref. 10), "Cable Pulling for Insulated Cables Rated Up to 15,000 Volts." However, MAI-44 and G-38 do not provide guidance in situations where cables are routed in trays, conduits or cable tray penetrations that appear physically overfilled, such as was done in MAI-3, (Ref. 9), Section 5.3, for WBN.	c. The CAP for CATD 238 01-BFN-04 and -NPS-09 states that DNE has a program in place to verify raceway fills at each plant site and to ensure that future additions/deletions are also verified and incorporated in the raceway tracking system. In the interim, any cables being added shall be verified to not create an overfilled condition in accordance with the procedure defined in the W. S. Haughley memo to those listed (B43 870909 908). Adherence to the interim procedure and implementation of the DNE program for raceway tracking will eliminate any need for the installing organization to make any subjective conclusions regarding the appearance of overfilled raceways. MAI-44 is to be revised to basically state that when cables can not be properly installed as routed by drawings because of routing error, full cable penetration or raceway overfill, the cognizant engineer shall notify DNE to resolve the problem. CAQR BFP 870294 (Ref. 147) will be used for tracking and dispositioning this CAP.

THIS ITEM COMPLETED
DATE: 6/14/88

23801-BFN-04 ONLY

Issues	Findings	Corrective Actions
Element 238.1 - BFN (Continued)		
1. Potential for cable damage exists for cables pulled in overfilled raceways and cable tray penetrations. Damage will not be discovered until cables short out.	d. General Construction Specification G-4, "Installing Insulated Cables Rated Up to 15,000 Volts Inclusive" (Ref. 8), in force at the time of BFN construction, did not address sidewall pressure or cable pullbys; no limitations on the degrees of bend in conduit runs were given. Therefore, the possibility of cable damage exists for cables that were pulled into overfilled raceways, particularly conduit (pullbys) and cable tray penetrations. The issues have been identified in SCR BFN EEB 8831 (Ref. 146), and steps have been taken to develop a program for corrective action. CATD 10900-NPS-01, R3, was written to track the sidewall pressure issues. However, the evaluation team agrees with findings of other evaluators (Ref. 179) that the sidewall pressure tests conducted by TVA may only have limited applicability to BFN construction. TVA has implemented a trend analysis program to identify adverse trends associated with cabling at any TVA nuclear plant. However, it is not known what cable parameters are trended and if these parameters consider possible adverse effects of harsh environments during accidents.	d. The CAP for CATD 238 01-BFN-05 states that TVA will define the trend parameters associated with cables as part of the trend analysis program implemented by the TROI program. However, the program does not provide for predictive analysis. The CAP for CATD 238 01-BFN-06 states that the corrective action for this concern will be accomplished by the completion and closure of SCR BFNEEB8831, as follows: The TVA test program that will be used to resolve concerns on SQN cable installation includes assurance that cable damage would not affect reliability when cables are subjected to harsh (including wet) environments. The results of the testing program will be shown to be applicable to BFN and other plants or plant-specific testing will be conducted. The corrective action is scheduled for completion prior to restart of each unit.

Issues	Findings	Corrective Actions
Element 238.1 - BFN (Continued)		
e. As a result of overfills, trays do not provide support (cables hang loose) and protection to cables running outside of them.	e. A walkdown (Ref. 37) performed by the evaluation team did find cables running outside of cable trays (GN-1 and RF-1) and hanging loose from trays (JAQ-11). TVA ECSP Report 10900 has recorded similar findings. The concern that tray covers cannot be installed on class 1E trays that require tray covers is addressed in BFN Element Evaluation 242.0.	e. The CAP for CATD 238 01-BFN-07 states that the cable trays identified in this CATD will be walked down to determine if the cables are a permanent installation and to identify the cable numbers of the cables. If the cables are in a permanently installed condition (e.g., per an ECN or MR), a CAQR will be issued to initiate a corrective action. If numerous cables are identified as conditions adverse to quality, an evaluation for potential generic conditions will be performed. The corrective action is scheduled for completion prior to unit 2 restart.
f. Cable tray penetrations are potentially unqualified as pressure barriers because of difficulty in applying silicone foam in overfilled trays.	f. A plant walkdown (Ref. 37) by the evaluation team identified some cable tray penetrations in the cable spreading rooms that appear to be overfilled (tray nodes KAG-1, KJA, KAF-1, and MD). This could not be confirmed by visual inspection or examination of design documents (computer printout, tray node fills). The effect of overfilled penetrations on cable derating is discussed in this subcategory report, Browns Ferry Element 240.0. MMI-75 (Ref. 148), "Installation and Repair of Penetrations and Fire Stops," addresses the installation and repair of electrical penetration pressure seals and fire stops. Also, Quality Control Inspection (QCI) 5.1 (Ref. 149), "Quality Control Instructions for Pressure Seals and Fire Stops" describes the method used to inspect, test, and document results of installation and test of fire stops and pressure seals. These current procedures adequately address installation, repair, and QA inspection of electrical penetration fire stops and pressure seals to ensure their integrity. Also, Surveillance Instruction (SI) 4.11.E.3 (Ref. 150) covers periodic visual inspection of electrical penetrations in fire barriers. No evidence exists, however, that fire stop penetration configurations, as originally tested by TVA and others, will be equally effective under penetration conditions where tray fill exceeds 50 percent loading, should these conditions exist.	f. The CAP for CATD 238 01 BFN-08 states that an evaluation will be performed of the cable tray fire stops based on the actual fill of cables to determine if the fire stops are affected by the level of fill of cable in the trays. If the percent of fill is determined to be an adverse condition to the effectiveness of the fire stops, a CAQR will be issued to correct the condition. The corrective action is scheduled for completion before restart of each unit for items meeting restart criteria.

Issues	Findings	Corrective Actions
Element 238.1 - BFN (Continued)		
g. Peripheral finding	g. DNE calculations EEB-CSTF-0001, R1 (B43-861230-903) provide justification for filling control trays to 60 percent. These calculations use assumed cable loadings, but the basis of the assumed cable loading is not apparent to the evaluation team. This finding is being addressed by a corrective action plan to CATD 238 01 NPS 04 for WBN. The corrective action plan is being tracked by Problem Identification Report (PIR) WBN WBP8784, R0.	g. For the CAP for CATD 238 01-NPS-04 see WBN item g.
BLN	BLN	BLN
The following issues, which were addressed by Sequoyah Reports 238.1 and 238.3, are combined in this report to facilitate TVA review.		
a. Raceways are overfilled. Overfills may result in an unsafe condition.	a. BLN units 1 and 2 use a computerized routing program. However, raceway fill data are not traceable to QA records because the computer program has not been verified (addressed in this subcategory report, BLN Element 239.0). Also, the cable outside diameter (OD) used to calculate raceway cross-sectional area fill and the cable weights used to calculate raceway supports were from non-QA sources. This fact was documented in PIR BLN EEB8801 (Ref. 151). TVA has indicated that all QA cable sizes and weights have been loaded into the computer program for the circuit and raceway schedules. However, there is still routed cable in the plant that does not have QA values and that has not yet been entered into the computer program. The above issues are being tracked by the CAP for CATD 10900-NPS-05.	a. The CAP for CATD 238 01-BLN-01 refers to the corrective actions for PIR BLN EEB8702, which will be defined as follows: Because a potential loading value of 60 percent for V4 and 120 percent for V3 exists at cable tray crosses, the following actions are required. o Ascertain whether or not an additional derating factor, with respect to ampacity, should be applied to cables routed through tray crosses. o If a derating factor is required, coordinate with EEB-central staff and request a revision to DS-E12.6.3 and its supporting calculation.

Issues	Findings	Corrective Actions
Element 238.1 - BLN (Continued)		
	Because of these uncertainties, it is not clear whether the raceway fill commitments stated in the FSAR actually have been met. Abandoned cables may result in tray and conduit overfill, which may impact raceway supports. The tray, conduit overfill, cable ampacity, and raceway supports, as a result of abandoned cables, are being addressed by CATD 23900-BLN-04 in this subcategory report, Element 239.0 for BLN. (The ampacity issue is discussed in this subcategory report, BLN Element 240.0). PIR BLN EEB8702 (Ref. 152) states that the general design criteria document N4-50-D787 (Ref. 153), "Power, Control, and Signal Cables for Use in Category I Structures," does not provide specific guidance or restrictions when cables are routed in 480V level trays through "crosses." Also, the PIR states that the potential exists to load crosses to 60 percent fill. However, no documents were found showing what corrective action was taken.	o Evaluate all pertinent cables in accordance with the revised DS-E12.6.3 and initiate appropriate corrective actions per NEP-9.1. Corrective action is scheduled for completion prior to unit 1 and unit 2 fuel loading.
b. Raceway fill criteria violate the National Electrical Code and industry practice.	b. The NEC Section 90-2(b)(5) does not require utilities (including TVA) to comply with code requirements for installations under the exclusive control of the utility. Therefore, TVA is not obligated to follow the NEC for raceway fill. The current 40 percent BLN fill criterion for conduit and the 30 percent fill criterion for power trays are consistent with industry practice. Although the 60 percent fill criterion for instrument and control trays exceeds the industry practice of 50 percent, it is acceptable if adequately justified. (See also Element 238.1 - BLN, item g.)	b. None required.

Issues	Findings	Corrective Actions
Element 238.1 - BLN (Continued)		
c. Procedures are lacking to prevent additional cables from being pulled in overfilled raceways and cable tray penetrations.	c. BLN is still under construction. Approximately 80 percent of the unit 1 and common cables have been pulled. General Construction Specification G-38, "Installing Insulated Cables Rated Up To 15,000 Volts," instructs Construction to consult with Engineering in cases where cables cannot be installed exactly as indicated in the design records. Also, G-38 and Quality Control Procedure BLN-QCP-3.34 (Ref. 154), "Electrical Cable Installation (Pulling)," provide the requirements to prevent trays from being filled above their side rails. Procedures for controlling cable routing by Engineering are addressed in this subcategory report, BLN Element 239.0.	c. None required.
d. Potential for cable damage exists for cables pulled in overfilled raceways and cable tray penetrations. Damage will not be discovered until cables short out.	d. During the early phases of BLN construction activities, General Construction Specification G-38 did not address SWP or cable pullbys, and SWP calculations were not required. However, revision 6 of G-38, issued 09/15/85, limits the sum of bends in conduits to 360° between pull points and requires calculation of pulling forces and SWP for cable pulls. An NRC letter (Ref. 155), dated 03/11/86, summarizes results of a site inspection and reviews the cable SWP issue. The letter notes that SWP violations tend to exist where cables are pulled into conduits having bends in excess of 360° between pulling points and the industry practice limiting total bends could reduce SWP problems. As the result of the inspection, the NRC letter notes, that "no violations or deviation were identified within the scope of the inspection." The NRC letter also notes a commitment by the licensee to reinspect approximately 18,000 class 1E conduits. NCR 4254 (Ref. 156) is being used to track the reinspection of the class 1E conduits.	d. The CAP for CATD 238 01-BLN-02 states that the conduits are being reinspected, and this issue is being tracked by NCR 4254. Corrective action is scheduled for completion prior to unit 1 and unit 2 fuel loading. The CAP for CATD 238 01-BLN-03 states that sidewall pressure (SWP) calculations for those cables in VI trained conduits are being prepared and checked in accordance with the corrective action specified in PIR BLN EEB8518. Should those calculations prove a condition adverse to quality, appropriate actions will be initiated in accordance with NEP-9.1. Corrective action is scheduled for completion prior to unit 1 and unit 2 fuel loading.

Issues	Findings	Corrective Actions
Element 238.1 - BLN (Continued)	PIR BLN EEB8518 (Ref. 157) also addresses the SWP issue. The PIR notes that conduits at BLN contain no more than 360° of bends between pull points and that SWP calculations are not necessary for previously installed V-2, V-3, V-4, and V-5 level conduits. However, a limited worst-case sample calculation requirement was imposed for V-1 level conduits. In addition, requirement for SWP calculations was imposed for future cable installations. No follow-up documents were available to the evaluation team regarding sample calculations for V-1 level conduits. NCR 2987 (Ref. 158) stated that cables installed from 10/14/83 until 03/10/84 were accepted by QC without using the break rope requirements of G-38. A TVA memo (Ref. 105) recommended random sampling, by pulling back at least one cable per voltage level. This item was released from nonconforming status on 02/20/86. However, no follow-up documents were available to the evaluation team describing the method and results of the corrective action. TVA has implemented a trend analysis program to identify adverse trends associated with cabling at any TVA nuclear plant. However, it is not known what cable parameters are trended and if these parameters consider possible adverse effects of a harsh environment during accident conditions. TVA has also developed a comprehensive training module covering cable-pulling requirements, including requirements for utilizing break ropes. In addition, R4 of QCP-3.34 incorporates detailed cable pulling requirements, including requirements for pull rope attachment and monitoring of cable pulls.	The CAP for CATD 238 01 BLN-05 states that TVA will define the trend parameters associated with cables as part of the trend analysis program implemented by the TROI program. However, the program does not provide for predictive analysis. The TVA test program which will be used to resolve concerns on SQN cable installation includes assurance that cable damage would not affect reliability when cables are subject to harsh (including wet) environments. The results of the testing program will be shown to be applicable to BLN and other plants, or plant specific testing will be conducted. The corrective action is scheduled for completion prior to unit 1 and unit 2 fuel loading.

Issues	Findings	Corrective Actions
lement 238.1 - BLN (Continued)		
As a result of overfills, trays do not provide support (cables hang loose) and protection to cables running outside of them.	e. During a walkdown (Ref. 107), the evaluation team did not observe any cables running outside of cable trays or hanging loose from trays. This observation was based on the fact that only 80 percent of the unit 1 and common cables have been pulled. The concern that tray covers cannot be installed on class 1E trays that require tray covers is addressed in subcategory report 24200.	e. None required.
Cable tray penetrations are potentially unqualified as pressure barriers because of difficulty in applying silicone foam in overfilled trays.	f. A visual check of penetrations during a recent plant walkdown (Ref. 106) by the evaluation team revealed that no tray penetrations appear to be currently overfilled. However, since control and instrument trays are allowed to be filled up to 60 percent, a potential exists for exceeding the 50 percent fill to which the firestops were tested (Refs. 159, 160, and 161). No evidence exists that firestop penetration configurations, as originally tested by TVA and others, will be equally effective under conditions where tray fill exceeds 50 percent loading, should these conditions exist. BLN is still under construction, and the penetrations either have temporary seals or are left open. Adequate procedures governing installation and inspection of permanent penetration seals currently exist. BLN-QCP-5.18, (Ref. 162) "Quality Control Procedure for Firestops, Moisture, Pressure, and Radiation Seals," describes the methods used to inspect and document penetration firestops and penetration pressure, moisture, and radiation seals. This current procedure adequately addresses installation, repair, and QA inspection of electrical penetration firestops and pressure seals to ensure their integrity. Also, Surveillance Instruction BLSI 4.7.12.a (Ref. 163) covers periodic visual inspection of electrical penetrations in fire barriers.	f. The CAP for CATD 238 01-BLN-06 states that Factory Mutual Research tests were made for trays loaded to 50% by area. Bellefonte trays have a usable depth of 3.75 inches. However, their fill is limited to 60% of cross sectional area based on 3 inch tray depth. Therefore, the tray fill is only 48% based on 3.75 inch depth. This is less than the tested value. No corrective action is required.
j. Peripheral finding	g. UNE calculations EEB-CSTF-0001, R1 [B43 861230 903] provide justification for filling control trays to 60 percent. These calculations use assumed cable loadings, but the basis of the assumed cable loading is not apparent to the evaluation team. This finding is being addressed by a corrective action plan to CATD 238 01 NPS 04 for WBN.	g. For the CAP for CATD 238 01-NPS-04, see WBN item g.

Issues	Findings	Corrective Actions
********** Element 238.3 - Cable Tray Overfills **********		
SQN	SQN	SQN
a. Cable trays are overfilled.	a. Review of cable tray fills (Refs. 14, 71, ~~108, and 109~~) revealed the following: o Power cable trays did not appear to be overfilled. However, no final assessment can be made until the accuracy of the raceway fill tracking system is verified as stated in Element 239.0, SQN, item b. Also, no analysis has been identified to support the TVA assumption that no additional derating is required for power cables when the overfill is the result of abandoned (deenergized) cables. o The raceway fill tracking system, although not verified, indicates that a number of I&C trays are overfilled. This is supported by [illegible] under SCR SQNCEB8622 (Ref. 164). [illegible] determined from the profiles obtained during the walkdowns are generally larger than the fills in the raceway fill tracking system. In addition, review of the current program under SCR SQNCEB8622 to determine the adequacy of cable tray supports indicates that: o Insufficient evidence exists to justify that computed weights of known cables equal to or greater than 14 pounds per foot for vertical trays and 16 pounds per foot for horizontal trays are adequate cut off points to provide an acceptable level of confidence regarding identification of overloaded tray segments. o The program covers only review of cable trays in the Control and Auxiliary Buildings. o Multiple application of Flamemastic cable coating (as is the case at SQN) may result in thicknesses greater than 1/4-inch. The cable coating weight is, however, calculated based on a maximum thickness of 1/4-inch.	a. The CAP for CATD 238 03-SQN-01 commits to perform an analysis to determine the effect of [illegible] cable ampacity in [illegible] trays and conduits. Cable ampacities will be recalculated if the effect is found to be significant. Procedure SQEP-06 Rev 0 of 09/22/86 ensures that future abandoned cables will be accounted for. The condition has been identified by CAQ-document SCR SQN EEB 86178. THIS ITEM COMPLETED DATE: 12/14/87 The CAP for CATD 238 03-SQN-02 indicates that the raceway fill tracking system [illegible] part of the [illegible] for Items 239.00-SQN-01 and 02. This action will verify the proper calculation of known cable weights, allowing identification of overloaded tray segments. THIS ITEM COMPLETED DATE: 12/28/87 The CAP for CATD 238 03-SQN-03 states that TVA plans to justify limiting the review of tray support adequacy to the control and auxiliary buildings only. A telephone conversation of January 13, 1987 clarified this further by establishing that [illegible] requirements for [illegible] in the control and auxiliary buildings are generally higher than in other plant areas due to seismic requirements. Since tray supports for other areas are designed using the same requirements, the supports are designed with sufficient conservatism to obviate review. If this rationale cannot be clearly developed, TVA has committed to expand the review of tray supports to other plant areas until an acceptable level of confidence is reached. THIS ITEM COMPLETED DATE: 12/28/87

Issues	Findings	Corrective Actions
Element 238.3 - SQN (Continued)		
	o Weights for a number of trays exceeded the Design Basis loading criteria in Design Criteria SQN-DC-V-1.3.4 (Ref. 165). Documentation of the analysis for resolution of deficiencies and implementation of needed corrective actions was in progress at time of evaluation.	The CAP for TATD 238 03-SQN-04 states that to close out this issue (weights for a number of trays exceeded the design basis loading criteria) TVA will provide the resolution and corrective actions for the deficiencies that have been identified in SCR SQNECB8622. Multiple Flamemastic applications in trays may have resulted in coatings exceeding 1/4 inch. The extra Flamemastic weight may not have been considered in the calculations for the cable tray supports. The CAP indicates that TVA calculations SQN-E2-016 and SQN-E2-017, in the section that covers assumptions, show that the volume of any excess Flamemastic is assumed to be occupied by cables whose average weight is higher than Flamemastic. Therefore, the calculations are conservative and no corrective action is required. The CAP commits to reflect the actual tray fills in the new CDI tracking system for future use. This condition will also be addressed as part of the followup for Significant Condition Reports SCR SQN-CEB-8610 and SCR SQN-CEB-8622.

Issues	Findings	Corrective Actions
Element 238.3 - SQN (Continued)		
b. Cable tray fill criteria for cables violate the National Electrical Code and industry practice.	b. The NEC in Section 90-2(b)(5) states that installations such as a generating station under the exclusive control of an electric utility (including TVA) are not covered by the code. Therefore, TVA is not obliged to follow NEC for tray fills. Current SQN fill criterion of 30 percent for power trays is consistent with industry practice. Although 60 percent tray fill criterion for I&C trays exceeds the industry practice of 50 percent, it is acceptable if adequately justified. (See also Element 238.3 - SQN, item g.)	b. None required.
c. Trays do not provide support (cables hang loose) and protection to cables running outside of them as a result of overfill. Tray covers cannot be installed as a result of overfill.	c. A walkdown (Ref. 108) performed by the evaluation team did not find cables running outside of cable trays. However, TVA ECSP Report 10900-SQN identified "some" cables routed outside trays. The issue is being tracked by CATD-10900-SQN-01. The concern that tray covers cannot be installed on class 1E trays that require tray covers was not verified by the walkdowns performed.	c. No further corrective action required.
d. Plant procedures contain no requirement prohibiting overfilling of cable trays. More cables are being added to overfilled trays.	d. Plant procedures to prohibit overfill of trays and penetrations have only recently been established in SQEP-06 (Ref. 14) and MAI-04 (Ref. 11) [illegible] conduit jumpers and power trays. However, [illegible] procedures are not clear. Also, no evidence exists that the actual tray fills identified as part of SQN's [illegible] programs (refer to Element 238.3 SQN item a) will be [illegible] reflected in the raceway fill tracking system for future use.	d. The CAP for CATD 23H 03-SQN-06 and -07 states that TVA will review both SQEP-06 and [illegible] documents to ensure they define the fill requirements of power trays and prevent overfill of conduit jumpers. TVA has also committed to a field inspection to determine if conduit jumpers are overfilled.

THIS ITEM COMPLETED
DATE: 1/6/88

Issues	Findings	Corrective Actions
Element 238.3 - SQN (Continued)		
e. Cable tray penetrations are overfilled. More cables are pulled through already overfilled penetrations. Possible cable damage may result from cable pulling through overfilled penetrations (addressed in Sequoyah Element Report 238.1).	e. The concerns that cable tray penetrations are overfilled could not be confirmed by the evaluation team through walkdowns (Ref. 38) or examination of the design documents. Also, no documents were identified defining allowable cable fill in penetrations. Overfilled penetrations may affect cable derating (discussed in Sequoyah Element 240.0) and may result in cable damage (discussed in this subcategory report Sequoyah Element 238.1). However, current procedures that will prevent overfills in cable trays should automatically prevent overfills in cable tray penetrations.	e. None required.
f. Overfilled tray penetrations may not be qualified as a pressure boundary as it is almost impossible to apply the RTV silicone foam.	f. Modifications and Additions Instruction MAI-13 (Ref. 166), "Electrical Pressure Seal, Firestop Barrier and Flame Retardant Cable Coating," addresses the installation and repair of electrical penetration pressure seals and fire stops. Current procedures adequately address installation, repair, and inspection of electrical penetration fire stops and pressure seals to ensure their integrity; and includes adequate requirements for QA inspection of the installation process. SI-233.2 (Ref. 180) covers periodic surveillance inspection of fire stops. No evidence, however, exists that fire stop penetration configurations, as originally tested by TVA and others, and approved for use at SQN based on these tests, will be equally effective under penetration overfilled conditions.	f. The CAP for CATD 238 03-SQN-10 states that TVA will review the firestop test configuration to determine the effect of overfilled conditions on its effectiveness. A maximum allowable fill [illegible] penetration fill at which the [illegible] qualification can be maintained. TVA committed to identify all overfilled trays that pass through a fire stop and justify or, where necessary, modify the existing configuration to assure acceptable conditions. Other trays which pass through firestops will have their fill limited to established values in the cable program.
g. Peripheral finding	g. The current approach to justify 60 percent tray fill agrees with acceptable practices; however, no evidence exists that the representative tray sections were properly selected to assure that control power cables do not account for more than 30 percent of the tray fill and that an acceptable power dissipation level per linear foot is not exceeded. Furthermore, the ampacity sampling program to determine cable adequacy with respect to ampacity rating does not clearly address the evaluation of overfilled raceways.	g. The CAP for CATD 238 03-SQN-05 states that TVA will revise Electrical Engineering Calculation EEB-CSTF-0001 to [illegible] the tray sections selected are [illegible] tray fill and for cable ampacities. The subject of raceway overfill and its effect on cable ampacity is part of element 240.0.

THIS ITEM COMPLETED
DATE: 11/19/87

Issues	Findings	Corrective Actions
Element 238.3 - WBN	WBN	WBN
(Now 238.1)		(Now 238.1)
BFN	BFN	BFN
(Now 238.1)		(Now 238.1)
BLN	BLN	BLN
(Now 238.1)		(Now 238.1)
********** Element 238.5 - Containment Penetration (Cable Damage) **********		
SQN	SQN	SQN
(Not to be evaluated)		
WBN	WBN	WBN
a. Cable jacket could be damaged as a result of cables overflowing a cable tray and being in direct contact with electrical containment penetration 11 at elevation 737 feet in the Unit 2 annulus.	a. To investigate the employee concern, on 4/23/86 and on 1/30/87, the evaluation team conducted a field walkdown (Ref. 36) of the Units 1 and 2 reactor building annulus area at penetration 11 and other penetrations in the vicinity of penetration 11. No evidence was found of cables in direct contact with the penetrations. During the walkdown, it was observed that the cables connected to the penetrations were well within the side rails of the tray and did not completely fill the bottom of the tray. Possibly the concern was referring to temporary construction cables, which no longer exist in the vicinity of the penetrations.	a. None required.
BFN	BFN	BFN
(Not to be evaluated)		
BLN	BLN	BLN
(Not to be evaluated)		

Issues	Findings	Corrective Actions
********** Element 239.0 - Cable and Raceway Program Inadequate (Routing) **********		
SQN	SQN	SQN
a. Cable pull slips have inaccurate information as to the length of the pulls. Inaccurate length of pulls delays production because field is required to walk down the pull.	a. Cable length inaccuracies in the past resulted from inadequate feedback from Construction (Ref. 84). This problem has currently been resolved; for future installations adherence to SQEP-06 will prevent recurrence. The effect of inaccurate cable lengths on electrical calculations has been recognized and the actual cable lengths incorporated as required. Current procedures and the long-term calculation program currently under way should prevent recurrence of the problem, as addressed in Sequoyah Element 213.1.	a. No further action required.
b. Computer Cable Routing Program is inadequate.	b. The Computerized Cable Routing System program has not been properly verified in accordance with ECB EP-28:01 (Ref. 17) for performing divisional and voltage level separation, calculating raceway fills, rejecting erroneous inputs, and refusing cable routing in full trays (Refs. 82 and 86). Therefore, the adequacy of the [illegible] cables cannot be determined and to the program [illegible] have been verified (other factors contributing to the current as-built uncertainties are addressed in this subcategory report in Sequoyah Elements 213.1 and 240.0). The program is also deficient in the areas of security, controlling documents for system maintenance, documenting revisions, and program usage procedures (Ref. 85). However, actions to correct the above-described deficiencies have been initiated.	b. In the CAP for CATD 239 00-SQN-01 and -02, TVA indicates that the implementation of its Software Quality Assurance Plan will ensure compliance with ECB EP-28:01 in the future. Completion of this plan will not be prior to restart. As an interim measure prior to restart, a test file will be created to verify the proper functioning of the computer program for its key parameters (tray fill, separation, weight, voltage level, etc.). If discrepancies are found the root cause and extent will be determined and all problems resolved prior to restart. If no discrepancies are found implementation of the SQAP will continue. The CAP for CATD 239 00-SQN-04 states that TVA indicates further that following the verification of the existing program through the use of a sample test file all data will be reloaded. This will cause the program to perform all of its built-in checks [illegible] segregation, raceway fill, etc. If none of the cables are rejected it will demonstrate adequacy of past revisions. Any cables which are rejected will be investigated for the cause and the installation reconciled accordingly.

THIS ITEM COMPLETED
DATE 8-12-88

Issues	Findings	Corrective Actions
Element 239.0 - SQN (Continued)		
c. Cable routing status systems are inadequate. Cables are routinely scheduled to be added to overfilled conduits.	c. Inadequate status systems in the past, primarily for providing reliable raceway fill information, along with nonadherence to maximum allowable raceway fills, has resulted in the current situation of potentially overfilled raceways and the consequent effect on fire damage, seismic supports and cable ampacities (Refs. 83, 110, and 111). This situation is further complicated by the use of unverified cable diameters and weights (Ref. 83), by the fact that no records exist for all the abandoned cables (Ref. 111), and because Engineering hand routed cables inputted into the computer data base were not calculated into the total cable tray fill (Ref. 76). TVA has stated that current programs (Refs. 14 and 167) directed at resolving these problems have been initiated. However, to date, there is no program to address the Engineering hand routed cables without node numbers.	c. In the CAP for CATD 239 00-SQN-03, TVA indicates that "SQN will perform a manual review of the conduit routing field for [illegible] manually routed cables in trays. These trays node numbers will then be entered [illegible] computer routing and the effect on tray fill, weight, and cable ampacity will be evaluated. SQEP-06 will be revised to prohibit manual routing of cables in trays." This action is an acceptable solution to the problem.
d. Conduits are overfilled. [Addressed in this subcategory report Sequoyah Element 238.1]		
WBN	**WBN**	**WBN**
a. Cable pull slips have inaccurate information as to the length of the pulls. Inaccurate length of pulls delays production because the field is required to walk down the pull.	a. Cable length inaccuracies in the past resulted from inadequate feedback from Construction (Ref. 80). The length of the cable pulled (cut) by Construction is entered into the Engineering-Construction Monitoring and Documentation (ECM&D) file controlled by Construction. This file cannot be accessed by the Cable Schedule Computer Program (CSCP) controlled by Engineering. Therefore, for use in calculations Engineering has no method other than through requests to determine whether a cable has been installed and whether the cut length is longer or shorter than the Engineering-scheduled length of the cables. This problem has been recognized, and ECM&D files are also being updated to reflect the actual (terminated) lengths of the cable for Engineering use in calculations. This problem should not recur; the ECM&D User's Guide was issued on 01/01/87 to ensure that actual terminated lengths are entered in the ECM&D. However, no provisions were identified for transmitting this information back to Engineering and reflecting it in the CSCP.	a. In the CAP for CATD 239 00-WBN-01, TVA's Electrical Engineering Branch has requirements establishing the methods to be used for choosing values of cable lengths to be used in voltage drop and short circuit current calculations. This requirement applies to all essential calculations which utilize cable footages and will be used in the performance of electrical calculations. There are no program requirements or capabilities for Engineering to extract the installed cable lengths from the ECM&D data files into the CSCP. This data is presently available on cable pull records. The ECM&D has been modified to establish an on-line application system which provides the user (UNC, DNE, or ONP) the

THIS ITEM COMPLETED
DATE 12/16/87

Issues	Findings	Corrective Actions
Element 239.0 - WBN (Continued)		
	The effect on electrical calculations of using inaccurate cable lengths has also been recognized. The evaluation team's review of calculation WBPE 0018601004 (Ref. 168), "125 V dc Vital Control Power System Design Verification Voltage Analysis," indicates that actual terminated cable lengths have been reflected. Although the review did not cover other calculations, current procedures and the long-term calculation program currently under way should ensure that appropriate cable lengths are reflected in all calculations. These procedures should prevent recurrence of the problem, as addressed in subcategory report 24600 Watts Bar Element 205.1. A field walkdown by Construction of cable pulls is a common procedure consistent with good construction practice.	capability to inquire on all cable records and related design/construction data, via on-line screens. Therefore, Engineering will be able to obtain the cable lengths to be used in calculations without having to reflect and address this information on the CSCP and procedures respectively. DNC will revise procedure QCP 3.05 and QCP 3.06-3 to establish the requirements for obtaining the actual installed lengths for future installations at the time of termination. DNC has absolute responsibility (under their QA program) for compilation, encoding, and verification of the data to be entered in the ECHAD data files.
a. The "Computer Cable Routing Program" (the Cable Schedule Computer Program) is inadequate.	b. The CSCP has not been properly verified in accordance with Engineering Computer Methods Branch (ECB) procedure EP 28.01 for performing divisional and voltage level separation, calculating raceway fills, rejecting erroneous inputs, and refusing cable routing in full trays (Ref. 81). Therefore, the adequacy of the as-built installed cables through the use of CSCP cannot be confirmed until the program and input data have been verified. (Other factors contributing to the current as-built uncertainties are addressed in this subcategory report, Watts Bar Element 238.1 and 240.0.) However, modifications/revisions to the CSCP have not been documented and, therefore, verification of the adequacy of the current program will not necessarily demonstrate the adequacy of past revisions. The program is also deficient in the areas of controlling documents for system maintenance, documenting revisions, and program usage procedures (Refs. 78, 79, 86). However, actions to correct the above-described deficiencies have been initiated.	b. The CAP for CATD 239 00-WBN-02 states that the problem will be reconciled by the implementation of the attached "Software Quality Assurance Plan." Adherence to this plan will ensure compliance with ECB EP 28.01 in the future. Completion of this plan will be prior to Unit 1 operation. In addition, a test file will be created to verify the proper functioning of the computer program for its key parameters, (i.e., Divisional separation of redundant cables, voltage level separation, calculation of conduit and cable tray fill, auto cable sizing, auto tray route, ampacity derating, Appendix R documentation, etc.). This test file will consist of the following: 1) Develop test specification - Establish a listing of the feature that the Cable Schedule Computer Program is capable of doing (some were mentioned above). Predict the results for each feature.

Issues	Findings	Corrective Actions
Element 239.0 - WBN (Continued)		2) Create a test file - Produce a series of cable testing inputs that will execute all phases of the program features. Some of these inputs will even contain erroneous data for special feature testing purposes. Detailed execution results of all the testing inputs will be predicted and documented for verification purposes after the test is completed. 3) Testing - ECB will run files through the computer program. 4) Documentation of test results - The test results (computer print-outs, error message reports, update reports, etc.) will be compared with predicted results. Comparison will be documented. If discrepancies are found, the root cause and extent of the problem will be determined. All problems will be resolved prior to Unit 1 operation. A documentation manual will be created which will be updated and maintained with each software revision or modification. 5) Independent verification.

Issues	Findings	Corrective Actions
Element 239.0 - WBN (Continued)		
		The CAP for CATD 239 00-WBN-03 states that the WBN cable routing system files are secured under TVA's Resource Access Control Facility (RACF). The protection placed on the files will allow only authorized cable routing Time Share Option (TSO) users to access and update their specific jobs and related files. RACF will provide protection against unauthorized modification, as well as deliberate or inadvertent deletion of the protected files. All source and executable modules have been placed in the ECB computer libraries and these libraries are under the protection of RACF. Only cable routing TSO users and cable routing system development staff will have authority to access these libraries. This protection system has been established as results of the corrective actions for SCRWBNECB8602, RO. In addition, the computer routing program is presently being upgraded to meet full quality assurance requirements. This effort includes development of system specifications, user's manuals, and maintenance manuals. The CAP for CATD 239 00-WBN-04 states that following verification of the existing program through the use of a sample test file, all data will be reloaded. This will cause the program to perform all of its built in checks for separation, voltage segregation, raceway fill, etc. If none of the cables are rejected it will demonstrate adequacy of past revisions. Any cables which are rejected will be investigated for the cause and the installation reconciled accordingly.

Issues	Findings	Corrective Actions
Element 239.0 - WBN (Continued)		
c. Cable routing status systems are inadequate. Cables are routinely scheduled to be added to overfilled conduits.	c. Inadequate status system in the past, primarily for providing reliable raceway fill information, along with nonadherence to maximum allowable raceway fills, has resulted in the current situation of potentially overfilled raceways and the consequent effect on cable integrity (damage), seismic supports, and cable ampacities (Refs. 78 and 112). These aspects are also addressed in this subcategory report, Watts Bar Elements 238.1 and 240.0. This situation is further complicated by the use of unverified cable diameters and weights (Ref. 51), and by the fact that completeness of records for all the abandoned cables could not be verified (Ref. 141). TVA has stated that current programs directed at resolving these problems have been initiated (addressed further in this subcategory report, Watts Bar Element 238.1). However, no evidence could be found that actual raceway fills identified as part of these programs will be included in the raceway fill tracking system for future use.	c. The CAP for CATD 239 00-WBN-05 states that QA values for class 1E and non-class 1E cable weights and outside diameters, which are used in Category I structures, have been established and documented. These values have been incorporated into Engineering Design Standards DS-E12.1.13 and DS-E12.1.14 for use in performing calculations for cable minimum bend and training radius, and sidewall pressure. In addition, these QA values will be used for the calculation of conduit and cable tray cross-sectional area fill and seismic loading. QA values for new cable mark numbers and/or outstanding cable mark numbers will be established and documented. Modification/improvement requests to modify the conduit and cable schedule computer program have been initiated. These modifications provide for tracking and controlling both cable weight and fill. Entry of the QA values for cable weights and outside diameters into the computer program will be completed BFL1 (before fuel load Unit 1) and in conjunction with modifications to the computer program. Abandoned cables are being documented on FCRs with their assigned cable identifier number and are being entered into the cable routing program to insure the accuracy of raceway fill calculations. The CAP for CATD 239 00-WBN-06 states that actual raceway fills identified as part of the program to verify adequacy of raceway fill criteria, raceway supports, and ampacity for SCRs WBNEEB8589, WBNEEB8590, and WBNECB8601 will be reflected in the raceway fill tracking system for future use.

Issues	Findings	Corrective Actions
Element 239.0 - WBN (Continued)		
d. Unit 2 cables are routed through Unit 1.	d. It is common industry practice to route cables between units; this creates no safety problem as long as proper channel and voltage separation is maintained. Further, WBN FSAR (Ref. 45) and design criteria WB-DC-30-4, "Separation of Electrical Equipment and Wiring," and WB-DC-30-5, "Power, Control, and Signal Cables for use in Category I Structures" (Ref. 170), impose no unit separation requirements, and, therefore, there is no reason for the CSCP to provide for unit separation.	d. None required.
e. Peripheral finding	e. In addition, the ECM&D program has not been properly verified for printing class 1E cable pull slips which indicate the cable routing, the to-from location, and the type of cable to be used (Ref. 113). Therefore, the adequacy of the as-built installed cables through the use of the ECM&D program cannot be confirmed until the program has been verified. The program is also deficient in the areas of security, controlling documents for system maintenance, documenting revisions, and program usage procedures (Refs. 113 and 114). The User's Guide for the ECM&D program was issued on 01/01/87 and addresses security, documenting revisions, system maintenance, and program usage. However, procedures for implementing the security system have not been issued, and there is no procedure available for verifying the ECM&D program.	e. The CAP for CATD 239 00-WBN-07 states that engineering and construction monitoring and documentation program will be verified in accordance with a memorandum from H. C. Parker to H. C. Johnson (Ref. 169). The verification will be completed by December 1, 1987. The corrective action plan implementation responsibility is being reassigned to Division of Nuclear Quality Assurance (DNQA). Also, the verification of the ECM&D program will be based on a statistical sample and will be performed in accordance with the guidelines in the DNE Nuclear Engineering Procedure (NEP) 5.2. The CAP for CATD 239 00-WBN-08 states that the security system for the ECM&D program consists of the following steps: New programs going on-line are tested (CICST) by Management Information Service (MIS) and DNC personnel to verify the software specifications. Personnel using CRTs are authorized in writing by their unit supervisor. The limits of this authorization are specified in this document. Authorized personnel are assigned user IDs and password codes by the MIS unit after receiving applicable training by MIS personnel.

Issues	Findings	Corrective Actions
Element 239.0 - WBN (Continued)		
		ECM&D programs such as conduit, cable, etc., that are safety-related are designed, modified, and controlled in accordance with the Nuclear Quality Assurance Manual (NQAM) part I, sec. 2.2.1 "Quality Assurance for Computer Software Systems." The ECM&D programs applicable to NQAM part I sec. 2.2.1 are protected from unauthorized transactions by the IBM Resource Access Control Facility (RACF) the software program for security access control. A procedure will be written and implemented for upgrading CRT personnel training including certification and periodic recertification training, and designating ECM&D users guides as QA controlled documents.
NOTE: The following issues from these concerns are addressed in other reports: Conduits are overfilled (addressed in this subcategory report, Watts Bar Element 238.1). Potential for cable damage exists for cables pulled in overfilled raceways and cable tray penetrations. Damage will not be discovered until cables short out. (addressed in this subcategory report Watts Bar Element 238.1). There is no certainty that cables were tested after installation (addressed in subcategory report 26500, Watts Bar Element 241.3).		

Issues	Findings	Corrective Actions
Element 239.0 - WBN (Continued)		
f. Peripheral finding.	f. Corrective actions for the following problems identified in various Environmental Qualification Project (EQP) SCRs have not been completed: o Current practice by Engineering of reusing cable identifiers of deleted cables on new cables results in two pull slips with the same cable identifier number (Refs. 115, 116, 117, and 118). This is confusing for Construction because the revision level on the new pull slip may be lower than the old. Also, confusion arises in determining which card must be installed when both cards have the same revision level. o Current Engineering practice is to assign one cable identifier number to a spliced cable (Ref. 119). This results in cables on both sides of the splice with the same identifier. This may be a problem when different cable types/sizes (mark numbers) are used because the ECM&D program does not sort by mark number. The ECM&D program issues a pull slip only for the first card in a multiple card set of cables with the same identifier but different mark numbers. This may result in the installation of incorrect cable sizes for the different segments of a spliced cable and, therefore, impact circuit ampacity and raceway fill calculations.	f. The CAP for CATD 239 00-WBN-09 states that DNE will address the problem identified under the corrective action developed for SCR WBNEQP8624 which identifies among others, the DNE's failure to control the cable revision level. The Cable Schedule Computer Program will be modified to inhibit the reuse of cable identifiers of deleted cables. WBEP EP 43.13 has been superseded by WBEP 5.31 to control this process. WBEP 5.31 has been issued to establish the requirements of the reuse of deleted cables. Section 4.2.2.3 permits the reuse of a deleted cable number only when that number is used for its original circuit function. The requirements of selecting the cable numbers (in accordance with Section 4.1.1.1) also inhibits the use of deleted cables. The CAP for CATD 239 00-WBN-10 states that the problem will be resolved under the corrective action and action required to prevent recurrence (ARPR) for SCRs WBNEQP8624, 8625, and 8648. These SCRs identified cables for which DNE used the multi-card set feature to document the use of different mark numbers for each cable segment, and the inability of DNC's ECM&D Program to read and print all cable mark numbers of the multiple card set. SCR WBN EQP8635 will address this problem for the remaining class 1E cables not covered by the above SCRs.

Issues	Findings	Corrective Actions
Element 239.0 - WBN (Continued)		The ECM&D program has been modified to read all the data of each card set of a multiple card set record and generate an installation sheet for each card in a set. DNC procedures QCP 3.05 and QCI 3.05 will be revised to specify documentation requirements for cable identifiers with more than one installation sheet. Project Procedure WBEP 5.31 has been revised to establish the requirements of using multiple card sets for cable identifiers with different mark numbers.
BFN a. Cable pull slips have inaccurate information as to the length of the pulls. Inaccurate length of pulls delays production because field is required to walk down the pull.	BFN a. The lack of any requirement for Construction to provide Engineering with actual installed raceway lengths resulted in inaccuracies in the computer-generated engineering cable lengths (Ref. 120). Also, the manually routed cable drawings reviewed did not indicate any engineering scaled lengths in the appropriate columns on the drawings. However, field walkdown of cable pulls is a common procedure consistent with good construction practice. Cable length inaccuracies in the past resulted from inadequate feedback from Construction (Ref. 120). The effect of inaccurate cable lengths on electrical calculations has been recognized and the actual cable lengths are being incorporated as required. However, no evidence could be found that this effort is complete. The long-term calculation program currently under way should prevent recurrence of the problem, as addressed in subcategory report 24600, Browns Ferry Element 205.1.	BFN a. The CAP for CATD 239 00-BFN-09 states that PM 87-26 establishes a Branch Policy for choosing values of cable length to be used in voltage drop and short circuit calculations. PM 87-26 does not implement or require an ongoing program of incorporating cable lengths (into calculations). PM 87-26 is being followed for all Browns Ferry Nuclear Plant calculations. TVA's minimum calculation program shall be completed as required by Project Memorandum PM 86-02. PM 87-26 shall be followed during the implementation of this program. This CATD (239-BFN-09) does not require (further) corrective action.

Issues	Findings	Corrective Actions
Element 239.0 - BFN (Continued)		
b. Computer Cable Routing Program is inadequate.	b. The CCRS program has not been properly verified in accordance with ECB EP-28.01 for performing divisional and voltage level separation, calculating raceway fills, rejecting erroneous inputs, and refusing cable routing in full trays (Refs. 86 and 88). Therefore, the adequacy of the as-built installed cables cannot be determined until the program and input data have been verified. (Other factors contributing to the current as-built uncertainties are addressed in this subcategory report Browns Ferry Element 238.1 and 240.0.) The program is also deficient in the areas of controlling documents for system maintenance, documenting revisions, and program usage procedures (Refs. 89 and 90). Corrective actions in the areas described above have been initiated as the result of a Quality Assurance Evaluation Report. However, no evidence could be found that this program will verify adequacy of past revisions of the CCRS.	b. The CAP to CATD 239 00-BFN-01 states that the implementation of Corrective Action and closure of the following documents will satisfy the concerns identified: o CAQRBFF870031 - develop system capabilities, prepare system test specification and test files to verify the system software, verify and document all systems software, and compile system verification manual and revise the program users' manual. o CAQRBFF870067 - verify cable, conduit, and tray network data by performing walkdown; issue verified cable data for computer input; enter previous data into cable routing program. The CAP to CATD 239 00-BFN-02 states that ECB-EP 28.01 has been superseded by NEP 3.8. Implementation of Corrective Action and closure of the following documents will satisfy the concern identified: o CAQRBFF87031 - see corrective action for CATD 239 00-BFN-01 outlined above. o SCR BFN ECB8602 and SCR BFN ECB8603 - develop and issue a procedure to control the development and maintenance of the cable and conduit scheduling computer program to comply with NEP-5.1. The CAP for CATD 239 00-BFN-03 states that implementation of Corrective Action and closure of CAQRBFF870067 and CAQRBFF870031 will satisfy the concerns identified. For description of corrective action see CATD 239 00-BFN-01 above.

Issues	Findings	Corrective Actions
Element 239.0 - BFN (Continued)		
c. Cable routing status systems are inadequate. Cables are routinely scheduled to be added to overfilled conduits. NOTE: The following issues from these concerns are addressed in other reports: Conduits are overfilled (addressed in this subcategory report, Browns Ferry Element 238.1).	c. An inadequate status system in the past, primarily for providing reliable raceway fill information, along with nonadherence to maximum allowable raceway fills, has resulted in the current situation of potentially overfilled raceways and the consequent effect on cable damage, seismic supports, and cable ampacities (Refs. 104 and 121). (These issues are further discussed in this subcategory report, BFN Element 238.1 and 240.0.) This situation is further complicated by the use of unverified cable diameters and weights (Ref. 104). TVA memo W. S. Raughley to Those Listed (Ref. 171) recommends corrective actions to resolve these problems. However, this memo does not address manually routed cables in trays and conduits. Furthermore, although corrective actions have been initiated, this program has not been completed. The fact that there are no cable and conduit schedule development procedures and no records for tray fill for manually routed cables contributed to the uncertainty regarding the adequacy of the manually routed cables. In addition, engineering routed cables entered into the computer data base without node numbers were not calculated into the total cable tray fill (Refs. 89 and 122). Also contributing to the uncertainty were engineering deleted cables that were not removed from the raceway calculation or that were deleted from the tray fill but not removed from the raceway. (Memorandum from L. W. Jones to W. J. Mullin, Ref. 172). Therefore, the adequacy of the computer-generated tray fill quantity can not be assured.	c. The CAP for CATD 239 00-BFN-04 states that the Corrective Action for SCR BFNECB8601 shall provide present status of Raceway Fill and a method of tracking and controlling Cable Tray Fill. The Corrective Action for SCRBFNEEB8602 shall provide QA level data for cable outside diameters and weights. UE&C Interim Evaluation of Cable Tray/Supports, Document No. 7841.008-S-E-001 Volume 1-5 (R25860303017) provides an evaluation of all Cable Trays and Supports for Seismic considerations which are required for unit 2 restart. A continuation of this type of program shall be implemented for the unit 1 and unit 3 drywell trays prior to the restart of each respective unit. The CAP for CATD 239 00-BFN-05 states that abandoned and spared cables have been consistently annotated as such on cable schedules on the computer cable program in the past. These are records of the abandoned and spared cables. Implementation of the walkdown inspection required by CAQRBFFB870067 shall satisfy any concerns regarding verification of Raceway Fill for unit 3. Units 1 and 2 cable schedules have been checked and issued under an approved QA level document control procedure. This provides QA level documentation for Units 1 and 2 abandoned and spared cables.

Issues	Findings	Corrective Actions
Element 239.0 - BFN (Continued)		
	No procedures are given to Construction for recording and tracking cable data (pull slips) for installation. Also, there are no procedures for providing feedback of this information to Engineering (Ref. 20). Therefore, there is no assurance that the field installed the cable in accordance with the routing drawings and pull slips or that routing changes made by Construction were approved and incorporated into the cable schedule. No evidence could be found that corrective action to resolve these deficiencies has been initiated.	The CAP for CATD 239 00-BFN-06 states that conduit overfill has been identified for some specific conditions, SCRBFNEEB8542 was issued for this specific condition and corrective action has been identified and performed. No other cases of conduit overfill have been identified for Browns Ferry Nuclear Plant. Tray overfill will be addressed by SCRBFNECB8601. Tracking for future installations will be accomplished within the scope of the corrective action and action to prevent recurrence for CAQR BFF870067(U3), CAR-86-078(U1), and CAR-86-079(U2). Tracking of tray fill (interim) will be accomplished within the scope of CAQRs BFP870434U01, D02, D03, and D04. (Develop and implement a program to track weight added to cable trays and supports since the UE&C report was issued, as well as weight from all future cables added after the UE&C report. If weight limit has been exceeded, a seismic evaluation must be performed on the affected tray and support). The existing conditions of cable trays will be determined by a walkdown. This information will be documented in QA level documentation and entered into the new program. This new program will be used to recalculate all current tray fill values. All tray segments in overfill status will be justified and documented in a QA level document or the cables will be rerouted to bring the tray system into compliance with the fill requirements.

Issues	Findings	Corrective Actions
Element 239.0 - BFN (Continued)		
		The CAP for CATD 239 00-BFN-07 states that the design issue (design output) process for the development of the conduit and cable schedules is controlled by NEP 5.1. The design revision process (change process) is controlled by NEP 6.1. Cable schedules are controlled by these NEP's as are all of Browns Ferry Nuclear Plant's Design Drawings. Browns Ferry Nuclear Plant Design Criteria BFN-50-758 is being developed to provide additional Design Input. Also, the implementation of SCRBFNECB8602 and SCRBFNECB8603 (develop a procedure to control the development and maintenance of the cable and conduit scheduling computer program to comply with NEP-5.1) shall correct this concern. The CAP for CATD 239 00-BFN-08 states that corrective actions for this CATD shall be accomplished within the scope of CAQRBFF870067. This CAQR's corrective action shall modify the present U3 computer cable program to provide QA level verification of the cable conduit and tray network data. Unit 1 and 2 cable schedules have been checked and issued under an approved QA level Document Control Procedure, therefore verification for Units 1 and 2 is not required. Present procedures (BF MAI-44) require documentation of installed length for each cable on plant documents (Cable Pull Data Sheet) at the time of installation. Also, BFEP-PI-86-03 (which applies to U1, U2 and U3) implements a program to incorporate as constructed conditions into configuration control drawings, and shall correct this condition for future plant modifications.

Issues	Findings	Corrective Actions
Element 239.0 - BLN	BLN	BLN
a. Cable pull slips have inaccurate information as to the length of the pulls. Inaccurate length of pulls delays production because field is required to walk down the pull.	a. The lack of any requirement for Construction to provide Engineering with actual installed raceway lengths may result in inaccuracies in the computer-generated engineering cable lengths. However, field walkdown of cable pulls is a common procedure consistent with good construction practice. Inaccurate cable lengths used in voltage drop calculations may result in inadequate voltage to safety-related components. The actual cable lengths are being incorporated as required in the electrical voltage drop calculations. This effort will be completed under the current BLN calculation program discussed in subcategory report 24600, BLN Element 205.1. TVA has revised procedure BLEP-01 to require as-built actual cable lengths to be used in voltage drop calculations. The use of the procedure and policy memorandum PM 87-26 (Ref. 173) should ensure that the proper cable lengtns are used for future calculations.	a. No further corrective action required.
b. Computer Cable Routing Program is inadequate.	b. The CCRS program has not been properly verified in accordance with NEP-3.8 for performing divisional and voltage level separation, calculating raceway fills, rejecting erroneous inputs, and refusing cable routing in full trays (Refs. 86 and 91). Therefore, the adequacy of the as-built installed cables cannot be determined until the program and input data have been verified. (Other factors contributing to the current as-built uncertainties are addressed in this subcategory report, Bellefonte Elements 238.1 and 240.0.) The program is also deficient in the areas of verifying, checking, and documenting the conduit schedule data (Refs. 123 and 124). Since there are no records of previous program revisions for the Engineering CCRS, the adequacy of the current program revision level will not demonstrate the adequacy of previous revisions (Ref. 86). No evidence could be found that corrective action has been initiated to resolve these deficiencies.	b. The CAP for CATD 239 00-BLN-01 states that corrective actions in accordance with PIR BLNECB8605 will resolve and demonstrate the adequacy and accuracy of the computerized cable routing system (CCRS) including all active computer output data. Plans are being developed to "QA" Bellefonte's CCRS data base and have the system brought into compliance with the latest requirements of ECB-EP-28.01 (now NEP 3.8) and determine what modifications would be required to bring the system in-line with the cable ampacity standard DS-E12.6.3. No additional actions are required as this issue (computer program verification) is being tracked by PIR BLNECB8605.

Issues	Findings	Corrective Actions
Element 239.0 - BLN (continued)	The ECM&D program has not been properly verified for printing of class 1E pullslips which indicate the cable routing, the to-from location, and the type of cable to be used (Ref. 125). Therefore, the adequacy of the as-built cables installed through the use of the ECM&D program cannot be confirmed until the program has been verified. Also, Procedure DNC-GCP-4.5.16-01 (Ref. 174), "Control of Safety-Related Software," for verifying the ECM&D has not been issued for implementation.	The CAP for CATD 239 00-BLN-02 states that the corrective action specified on PIR BLNECB8603 (conduit input sheets not verified), although not yet incorporated into the procedure, is and has been the normal practice of the Bellefonte raceway design section. This issue will be completely reexamined during the corrective action process defined on PIR BLNECB8605/CATD 239 00-BLN-01 which includes: o Verifying that the data in the computer data files (cable, tray, and conduit) are in agreement with the design drawings, etc. and o Developing and implementing methods for ongoing verification of those computer data files. No additional actions are required as this issue (verification of conduit input sheets) is being tracked by PIR BLNECB8603 and also PIR BLNECB8605. The CAP for CATD 239 00-BLN-05 states that regarding the lack of verification for the ECM&D program, no additional actions are required as this issue is being tracked by NCR DNC-FSB-87-01.

Issues	Findings	Corrective Actions
Element 239.0 - BLN (Continued)		
c. Cable routing status systems are inadequate. Cables are routinely scheduled to be added to overfilled conduits. NOTE: The following issues from these concerns are addressed in other reports: Conduits are overfilled (addressed in this subcategory report, Bellefonte Element 238.1).	c. Although the CCRS program prohibits the routing of cables in raceways that would become overfilled, Engineering may raise the maximum allowable percent fill figure to permit the routing of additional cables in trays, thus creating deliberate overfills. However, it is the responsibility of the Program Coordinator to submit a Design Criteria Exception Request (NEP 3.2), since the program coordinator is the only individual who has authority to revise this column. Since all changes in the percent-fill column are tracked by the computer, any change made with or without the Design Criteria Exception Request can be tracked, and recorded. Conduit fill quantity is controlled by a computerized program which calculates the maximum allowable fill based upon the number of cables routed within the conduit. Engineering cannot revise this fill quantity. The computer cannot route a cable in a conduit that would be overfilled. The present conduit overfill list was created by revising the existing cable diameters of cables that are routed through the conduits. Although the cable data shown in design standards DS-E12.1.13, "Cable, Class 1E OD and Weights," and DS-E12.1.14, "Cable, Class NC Cable OD and Weights" (Ref. 175), have been loaded into the program, BLN has not completed the loading of all cables routed in the plant to complete the raceway fill analysis (Ref. 126). TVA has indicated that they are presently reviewing all overfilled raceways and either rectifying or providing justification for the overfill. There are no procedures for the justification and tracking of the overfills (Ref. 126). Cables deleted by Engineering are intended to be removed from the raceway, if installed. However, there are no procedures to provide guidance and instruction for the removal and documentation of such cables, nor is there evidence that all deleted cables have been removed as required.	c. The CAP for CATD 239 00-BLN-04 states that Bellefonte is presently investigating this issue. Should the investigation find abandoned cables or conclude that the documentation is inadequate, the following actions will be initiated. A CAQ will be generated describing this condition. o The corrective action will be to: a. Identify those cables deleted by design that were installed but not removed by construction. b. Either remove the cables or request an exception on a cable by cable basis. Should the exception be approved by design, the cable will be re-identified and accounted for in all pertinent documentation. o The action required to prevent recurrence will be to: a. Revise procedures/computer programs (ECM&D, CCRS) to ensure deleted cables are accounted for until and including removal. The CAP for CATD 239 00-BLN-06 states that no additional actions are required. PIR BLNEEB8601 is tracking this issue and will remain open until all overfilled and overweight raceways are identified and appropriate corrective actions taken. For corrective action regarding verification of conduit schedule input data, see item "b" above.

Issues	Findings	Corrective Actions
Element 239.0 - BLN (Continued)		
	Finally, SCR BLN EEB8603 corrective action to revise BLN procedure BLEP-02 for verifying conduit schedule input data has not been implemented and the SCR has not been closed.	
********** Element 240.0 - Cable Derating (Design) and Cable Coating Derating **********		
SQN	SQN	SQN
a. Cable ampacity and cable derating were not properly considered (e.g., overcrowding of cables, penetration, and conduit sealing were not considered in cable derating). Overfilled conduits may cause induction/heat problems.	a. Although TVA has demonstrated by test (Ref. 127) that no additional cable derating is required for cables transitioning firestops, no evaluation or test has been conducted on overfilled cable trays in firestops. In view of the current uncertainty regarding adequacy of deratings of installed cables, TVA has initiated a sampling program (Ref. 132) to determine the extent and effect of tray covers and fire wraps on cable ampacity. No specific requirements were identified for the sampling program to include evaluation of overfilled raceways. The originally issued Design Standards DS-E12.1.1, E12.1.2, E12.1.3, and E12.1.4 did not furnish the definition and information necessary for proper application of the ampacity tables. In September 1986, TVA issued Design Standard DS-E12.6.3 (Ref. 12), "Ampacity Tables for Auxiliary and Control Power Cables (0-15,000V)," which voided these existing design standards. The new standard reflects the new QA cable data shown in Design Standards DS-E12.1.13 and DS-E12.1.14 as well as application for derating cables for tray covers, coating compound, and Appendix R fire wrap. The new design standard, however, does not justify why a conduit configuration of six wide horizontally and one deep vertically was established for ampacity tables for V4 and V5 (480 V and 6.9 kV) cables.	a. The CAP for CATD 240 00-SQN-01 states that fire stop test configurations will be reviewed to determine [illegible] with the restrictions on fill [illegible] ampacity of the cables. An appropriate derating factor will be determined to ensure that cables [illegible] overfilled fire stop do not exceed their qualified insulation temperature rating. All SQN power cable trays which pass through a fire stop and exceed the maximum established fill will be determined. The ampacity of all cables (safety-related and nonsafety-related routed with safety-related [associated]) in these trays will be verified using the established derating and DS-E12.6.3. All other power cable trays which pass through fire stops will have their tray fill frozen at or below the maximum established value. The CAP for CATD 240 00-SQN-02 states that ONE calculation EEB-CSTE-0001 titled "[illegible] Application of TVA Electrical Design Standard DS-E12.6.3" will be revised to add an appendix title "Documentation and Justification of Assumed Worst Case Conduit Grouping (1 Vertical 6 Horizontal, 0.80 Multiplying Factor)."

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

THIS ITEM COMPLETED DATE 12/22/87

Issues	Findings	Corrective Actions
Element 240.0 - SQN (Continued)		The CAP for CATD 240 00-SQN-04 states that determination of the effects of overfilled tray raceways will be limited to V4 level cables. Cables in V5 level trays, above size 2/0 are installed with maintained spacing. The ECTG verified by field inspection that V5 level cables were properly installed. Cables in V3 trays were shown in calculation EEB-CSTF-001 to have sufficient margin to be independent of the expected variations in tray fill. The ampacities of cables in V4 trays in DS-E12.6.2 are based on a maximum fill of 30 percent. All safety-related and associated nonsafety-related cables routed in V4 trays which exceed 30 percent will be individually reviewed to ensure that they will not operate above their qualified insulation temperature rating. The technical basis for this evaluation will be DS-E12.6.2, IPCEA P-54-440 and IEEE Transactions Paper 70 TP-557-PWR. In order to have an accurate database on which to evaluate tray fill, corrective action for the following must be completed before this effort can begin. 1. ECTG CATD 239 00-SQN-01 2. ECTG CATD 239 00-SQN-03 3. PIR SQNEEB8754 4. ECTG CATD 109.00-NPS-05 for verified cable O.D.'s Design standard DS-E12.6.3 will be revised to include the derating effects of overfilled trays in firestops. Completion of items 1-4 above will ensure that an accurate database exists by which to limit tray fills to the predetermined maximum.

Issues	Findings	Corrective Actions
Element 240.0 - SQN (Continued)		
b. Bundling of cables and fireproof coating applied to cables may cause cable overheating and insulation degradation.	b. The use of Flamemastic cable coating compound on cables has been tested by an independent laboratory (Refs. 133 and 134), and cable derating values have been established. TVA has incorporated the derating values into Design Standard DS-E12.6.3 to be used for cable sizing. Since the values used in the design standard are similar to the values established by test, the implementation of the design standard values represents acceptable practice. Therefore, cables coated with Flamemastic will not be degraded by overheating, provided the design standard is properly implemented. As noted during a field walkdown at the SQN plant (Ref. 41), some V4 (480 V) cables were bundled in the center of the tray and coated with Flamemastic. Therefore, the adequacy of applying ICEA standards for the derating of bundled V4 (480 V) cables cannot be determined.	b. The CAP for CATD 240 00-SQN-03 states that an analysis will be performed to determine the effect on the ampacity of a cable due to bundling the cables in a portion of the tray, as opposed to spreading them out over the full width, as well as the application of multiple coats of fire retardant cable coatings. The analysis will be based on data on overfilled trays in calculation SQN-E2-017 which was prepared for SCR SQNEEB8620 and SCR.SQNEEB8622. Installation specification G-38 will be revised to mandate installation over the full tray width. All discrepancies discovered during this review will be documented on an SCR.
c. Overheating of cables makes instrument readings indeterminate.	c. Because they have low current levels, instrument cables are not overheated. Therefore, no effect is imposed on instrument readings by cable heating.	c. None required.
d. Potential cable damage could result from cable pulling in overfilled conduits, and insulation is damaged by fishtapes. (Addressed in Sequoyah Element Report 238.1.)		

THIS ITEM COMPLETED
DATE

Issues	Findings	Corrective Actions
Element 240.0 - WBN	WBN	WBN
a. Cable ampacity and cable derating were not properly considered (e.g., overcrowding of cables, penetration, and conduit sealing were not considered in cable derating). Overfilled conduits may cause induction/heat problems.	a. Although TVA demonstrated by test (Ref. 127) that no additional cable derating is required for cables transitioning firestops, no evaluation or test has been conducted on overfilled cable trays in firestops. As a result of the current uncertainty regarding adequate derating of installed cables, a TVA memo from W. S. Raughley to Those Listed (Ref. 96) provided direction for implementing a program to evaluate cable ampacity adequacy of all class 1E and nonclass 1E power cables routed in class 1E raceways. No specific requirements are identified in this memo for evaluation of overfilled raceways. Furthermore, no program for implementing the direction in the memo was identified for WBN. The originally issued Design Standards DS-E12.1.1, DS-E12.1.2, DS-E12.1.3, and DS-E12.1.4 did not furnish the definition and information necessary for proper application of the ampacity tables. In September 1986, TVA issued Design Standard DS-E12.6.3 (Ref. 12), "Ampacity Tables for Auxiliary and Control Power Cables (0-15,000V)," which voided these existing design standards. The new standard reflects the new QA cable data shown in Design Standards DS-E12.1.13 and DS-E12.1.14 as well as application for derating cables with coating compounds. DS-E12.6.3, also addresses derating of cables with tray covers, and provides multiplying factors for derating of cables enclosed in Appendix R fire wrap materials (Thermo-Lag 330 and 3M). However, a test (Ref. 128) conducted by Thermal Science, Inc. at Underwriters Laboratory (UL) determined that fire protection material Thermo-Lag 330 may require derating factors greater than those indicated in the memo. At this point, Thermal Science, Inc. has not evaluated the test or made the results official. Furthermore, the completeness of records of abandoned cables in raceways has not been verified (adduressed in this subcategory report, Watts Bar Element 239.0), and the related effect of abandoned cables on ampacity is not specifically addressed in WBN design documents.	a. The CAP for CATD 240 00-NPS-01 states that TVA will review the fire stop configuration and available calculations of fire stop temperature rise to determine if the effects of overfill can be calculated or if additional fire stop testing is required to establish ampacity derating. An appropriate derating factor will be determined to ensure that cables in an overfilled fire stop do not exceed their qualified insulation temperature rating. All power cable trays that pass through a firestop and exceed the maximum established fill will be determined. The ampacity of all cables, safety-related and nonsafety-related routed with safety-related (associated), in these trays will be verified using the established derating and DS-E12.6.3. All other power cable trays that pass through fire stops will have their tray fill frozen at or below the maximum established value. Abandoned cables will be addressed when the ampacity study for installed cables is performed per corrective action for PIR GENEEB8605. Because these abandoned cables will contribute no heat to the mass, they will add conservatism to our study. If TVA chooses to remove this conservatism by removing the abandoned cables from the raceway fill data, a study will be performed on the effect of the insulating properties of the abandoned cables on other cables in the raceway, and DS-E12.6.3 will be revised if abandoned cables are found to have a significant adverse effect on cable ampacity.

Issues	Findings	Corrective Actions
Element 240.0 - WBN (Continued)		
		The CAP for CATD 240 000-WBN-02 states that TVA has developed a plan to implement the direction given in the memorandum to Those Listed from W. S. Raughley (B43 861008 909). This plan is documented in a memorandum from J. D. Collins to Those listed dated 10/31/86 (B26861031008). TVA presently plans to have this work performed by separate contract to an A/E firm in conjunction with the Electrical Engineering Branch's calculation program being performed as corrective action for SCRWBNEEB8571. Although not specifically mentioned in Mr. Raughley's memorandum, the overfilled raceway problem was identified in SCRWBNECB8601 and will be resolved as part of the corrective action for that SCR.
		The CAP for CATD 240 00-NPS-03 states that the final test results from thermo-lag 330 will be evaluated against the derating factors shown in DS-E12.6.3 and the derating factors will be revised as needed. If the derating factors must be revised in a manner that casts doubt on the adequacy of cables already installed per DS-E12.6.3, a CAQR will be written and the questionable cables will be evaluated as part of the corrective action for the CAQR. (Testing is being conducted by UL for TSI.)

Issues	Findings	Corrective Actions
Element 240.0 - WBN (Continued)		
b. Bundling of cables and fireproof coating applied to cables may cause cable overheating and insulation degradation.	b. The use of Vimasco cable coating compound on cables has been tested by an independent laboratory (Ref. 129), and cable derating values have been established. TVA has incorporated the derating values into Design Standard DS-E12.6.3 to be used for cable sizing. As the result of multiple applications on many cables at WBN, the Vimasco coating was applied in excess of the 1/4-inch thickness recommended; however, the Design Standard provides derating values only up to 1/4-inch of Vimasco coating. Bundling of voltage levels V1, V2, and V3 cables (control and instrumentation) for ease in application of the fire-retardant coating was approved by OE in 1981 (Ref. 130), but not for V4 (480 V) and V5 (6.9 kV) power cables (Ref. 131). A walkdown by the evaluation team of 480 V and 6.9 kV cable trays provided reasonable assurance that V4 and V5 cables are not bundled in trays.	b. The CAP for CATD 240 00-WBN-04 states that TVA will evaluate the cable derating under the EEB's calculation program using the verified Computer Cable Routing Program. Verification of the computer program will require tray fill to be verified by the closure of SCR WBNECB8601. The cable coating thickness will be determined upon verification of the tray fill. Evaluation and allowances for cable derating will be resolved by PIR GENECB8605 and by SCR WBNEEB8571. Once the actual plant configuration has been established, those configurations not covered by Design Standard DS E12.6.3 will be incorporated into the standard or documentation provided in the WBNP calculation. As required, appropriate controls will be established by revision of design output documents.
c. Overheating of cables makes instrument readings indeterminate.	c. Because of low current levels, instrument cables are not overheated. Instrumentation circuits are designed to be insensitive to any temperature effects. Therefore, instrument readings are not affected by cable heating.	c. None required.
i. Potential cable damage could result from cable pulling in overfilled conduits, and insulation is damaged by fishtapes. (Addressed in this subcategory report, Watts Bar Element 238.1.)		

Issues	Findings	Corrective Actions
Element 240.0 - BFN	BFN	BFN
a. Cable ampacity and cable derating were not properly considered (e.g., overcrowding of cables, penetration, and conduit sealing were not considered in cable derating). Overfilled conduits may cause induction/heat problems.	a. The TVA program to evaluate, redesign, and test fire barriers following the 1975 fire at BFN (Ref. 135) resulted in tray penetration seals using silicone foam with a minimum depth of 6 inches, but no maximum depth was given. Therefore, no evidence exists that a 12-inch optimum depth of silicone foam was not exceeded. In a separate ampacity test of firestop penetrations conducted for SQN and WBN (Ref. 127), using 12 inches of silicone foam, TVA demonstrated that no additional cable derating is required; however, no evaluation or test has been conducted on overfilled cable trays in firestops. The TVA memo (Ref. 132) issued to all nuclear plants, provided direction for implementing a program to evaluate cable ampacity adequacy of all power cables routed in class 1E raceways. No specific requirements are identified in this memo for evaluation of overfilled raceways. The evaluation team found no evidence that the corrective actions identified in PIR GEN EEB8605 which will include corrective action "c" (effect of Flamemastic coating on cable ampacity) as defined in CAR-86-0078, 0079, and 0080 have been implemented. Also, no records were identified that show that the program as defined in the Project Instruction BFEP-PI-87-22 (Ref. 176), "EQ Project Cable Derating Program," has been initiated. Although TVA's original design intent and practice were to incorporate general industry practices in sizing and installation of cable, the originally issued Design Standards DS-E12.1.1, DS-E12.1.2, DS-E12.1.3, and DS-E12.1.4 did not furnish the definition and information necessary for proper application of the ampacity tables. To incorporate subsequent additional derating requirements identified and accepted by the industry, in 09/86, TVA issued Design Standard DS-E12.6.3, (Ref. 12), "Ampacity Tables for Auxiliary and Control Power Cables (0-15,000V)," which voided these existing design	a. The CAP for CATD 240 00-BFN-01 states that implementation of Corrective Action and subsequent closure of SCRBFNEEB8711 will resolve the concerns identified in the problem description. Corrective Action for SCRBFNEEB8711 imposes Cable Ampacity Evaluation/Calculations in compliance with DS-E12.6.3, which addresses all known Ampacity Derating Conditions and considerations including those addressed by this Employee Concern (cable/cable raceway penetrations, Flamemastic and overfilled raceways). Any unrelated nonconformance identified during the Ampacity Evaluation will be addressed by separate CAQR. For further corrective action, also see WBN item "a" (240.00 NPS-01 and -03).

Issues	Findings	Corrective Actions
lement 240.0 - BFN (Continued)		
	standards. The new standard reflects the new QA cable data shown in Design Standards DS-E12.1.13 and DS-E12.1.14 as well as application for derating cables with coating compounds. DS-E12.6.3 also addresses derating of cables with tray covers and provides multiplying factors for derating cables enclosed in Appendix R fire wrap materials (Thermo-Lag 330 and 3M). However, a test conducted by Thermal Science, Inc. (TSI) at Underwriters Laboratory (UL) (Ref. 128) determined that fire protection material Thermo-Lag 330 may require derating factors greater than those indicated in DS-E12.6.3. At this point, TSI has not evaluated the test or made the results official. Studies and calculations on wrapping of raceways performed for BFN, including engineering change notices issued, may not reflect the revised TSI Thermo-Lag 330 derating values. The extent of abandoned cables in raceways could not be verified (addressed in this subcategory report, Browns Ferry Element 239.0), and the related effect of abandoned cables on ampacity is not specifically addressed in the Browns Ferry design documents.	
Bundling of cables and fireproof coating applied to cables may cause cable overheating and insulation degradation.	b. Flamemastic cable coating compounds on cables have been tested by an independent laboratory (Ref. 134), and cable derating values have been established. TVA has incorporated the derating values into Design Standard DS-E12.6.3. Since the values used in the design standard are in agreement with the values established by test, the implementation of the design standard values represents acceptable practice for derating cables covered with Flamemastic. The result of multiple applications on many cables at BFN, the Flamemastic coating was applied in excess of the 1/4-inch thickness recommended; however, the revised standard provides derating up to 2 inches of Flamemastic coating and it is very unlikely that this thickness was ever exceeded even with multiple applications of the material. Therefore, review of cable ampacities for installed cables in accordance with current derating factors in DS-E12.6.3 for Flamemastic should satisfy the concern.	b. The CAP for CATD 240 00-BFN-02 states that implementation of Corrective Action and subsequent closure of SCRBFNEEB8711 will resolve the concerns identified in the problem description. Corrective Action for SCRBFNEEB8711 imposes Cable Ampacity Evaluation/Calculations in compliance with DS-E12.6.3 R1 which addresses all known Ampacity Derating Conditions and considerations including those addressed by this Employee Concern (Flamemastic and overfilled raceway). Any unrelated nonconformance identified during the Ampacity Evaluation will be addressed by separate CAQR.

Issues	Findings	Corrective Actions
Element 240.0 - BFN (Continued)		
	The extent of the effect of the Flamemastic coating on existing cable ampacity has also been evaluated by an independent contractor (Ref. 136); however, no detailed verification of the accuracy of the contractors report was performed by the evaluation team. Furthermore, no corrective action for resolving the findings of the report was identified. Bundling of voltage levels V1, V2, and V3 cables (control and instrumentation) for ease in application of the fire-retardant coating was approved by OE in 1981, but not for V4 (480 V) and V5 (4 kV) power cables. A walkdown (Ref. 137) by the evaluation team of 480 V and 4 kV cable trays provided no evidence of bundled cables in trays; however, because of physical access restrictions and the excessive Flamemastic coating of the cables, this could not be verified.	
c. Overheating of cables makes instrument readings indeterminate. NOTE: The following issues from these concerns are addressed in another report: Potential cable damage could result from cable pulling in overfilled conduits, and insulation is damaged by fishtapes (addressed in this subcategory report, Browns Ferry Element 238.1.)	c. Because of low current levels, instrument cables are not overheated. Instrumentation circuits are designed to be insensitive to any temperature effects. Therefore, instrument readings are not affected by cable heating.	c. None required.

Issues	Findings	Corrective Actions
lement 240.0 - BLN . Cable ampacity and cable derating were not properly considered (e.g., overcrowding of cables, penetration, and conduit sealing were not considered in cable derating). Overfilled conduits may cause induction/heat problems.	BLN a. TVA demonstrated by test (Ref. 127) that no additional cable derating is required for penetration/fire seals using 12 inches of silicone foam. C. Sudduth confirmed (Ref. 178) that penetration/fire seals at BLN will be installed in accordance with those tests and the sealing methods shown on current BLN drawings. A TVA memo from W. S. Raughley to Those Listed (Ref. 177) provided direction to all nuclear plants for implementing a program to evaluate cable ampacity adequacy of all power cables routed in class 1E raceways. The evaluation team found no evidence that the corrective actions identified in PIR GEN EEB8605 have been implemented. The originally issued Design Standards DS-E12.1.1, DS-E12.1.2, DS-E12.1.3, and DS-E12.1.4 did not furnish the definition and information necessary for proper application of the ampacity tables. In 09/86, TVA issued Design Standard DS-E12.6.3 (Ref. 12), "Ampacity Tables for Auxiliary and Control Power Cables (0-15,000V)," which voided these existing design standards. The new standard reflects the new QA cable data shown in Design Standards DS-E12.1.13 and DS-E12.1.14 as well as application for derating cables with coating compounds. DS-E12.6.3 also addresses derating of cables with tray covers and provides multiplying factors for derating cables enclosed in Appendix R fire wrap materials (Thermo-Lag 330 and 3M). However, a test conducted by TSI at UL (Ref. 128) determined that fire protection material Thermo-Lag 330 may require derating factors greater than those indicated in DS-E12.6.3. At this point, TSI has not evaluated the test or made the results official.	BLN a. The CAP for CATD 240 00-BLN-01 states that the memo from W. S. Raughley to Those Listed [B43 861008 909] and PIR GEN EEB8605 and PIR BLN EEB8628 referred to in the CATD address the cable ampacity issue on the basis of Design Standard DS-E12.6.3 requirements. Plans have been developed to address this issue along with other cable issues. See memo from E. O. Massey to W. S. Raughley, dated 07/15/87 [B21 870715 001]. This memo requests that BLN be exempt from walkdowns to determine cable profiles of each cable tray segment or conduit, as stated in the memo from W. S. Raughley to Those Listed, dated 04/03/87 (B43 870409 908). The Bellefonte Computerized Cable Routing System (CCRS) data base agrees with the design drawings and meets all requirements related to tray and conduit fill. All other cable ampacity related corrective actions will be carried out as stated in the referenced documents. PIR GEN EEB8605, PIR BLN EEB8605, and PIR BLN EEB8628 will track this issue until it is resolved.

Issues	Findings	Corrective Actions
Element 240.0 - BLN (Continued)		
	PIR BLN EEB8628 (Ref. 181) states that a review of class 1E power cables at BLN identified some pulled cables that are not in compliance with the ampacity tables of DS-E12.6.3, R1. An analysis of cable ampacities will be performed by TVA to resolve this problem. The number of cables deleted from the cable schedule, but not removed from the raceways, could not be verified (addressed in this subcategory report, BLN Element 239.0). In addition, the related effect of abandoned cables on ampacity is not specifically addressed in the BLN design documents. The potential overfill of V4 (480 V) cable tray crosses and its possible effect on cable ampacity is not addressed in BLN documents. The statements made in the unissued advance PIR BLN EEB8702, R1, could not be verified. No documents with instructions for cable routing through cable tray crosses or with restrictions on the use of cable tray crosses were identified (addressed in this subcategory report BLN Element 238.1, item a).	
b. Bundling of cables and fireproof coating applied to cables may cause cable overheating and insulation degradation.	b. TVA has replaced cable types CPJ and CPSJ, which were installed in cable trays in Category I structures, with cables that are qualified to IEEE 383-1974 flame test requirements. Fire-retardant cable coatings will not be used at BLN, because installed cables meet the requirements of IEEE 383-1974. A walkdown (Ref. 137) conducted by the evaluation team of V4 (480 V) and V5 (6.9 kV) cable trays provided no evidence of bundled cables in trays.	b. None required.
c. Overheating of cables makes instrument readings indeterminate.	c. Because of low current levels, instrument cables are not overheated. Instrumentation circuits are designed to be insensitive to any temperature effects. Therefore, instrument readings are not affected by cable heating.	c. None required.

ATTACHMENT C

REFERENCES

1. Element Report 238.1, "Conduit Overfills and Cable Damage" for Sequoyah, Rev. 3 (04/30/87)

2. Element Report 238.3, "Cable Tray Overfills and Wall and Floor Penetrations" for Sequoyah, Rev. 3 (04/17/87)

3. Element Report 239.0, "Cable and Raceway Program Inadequate (Routing)" for Sequoyah, Rev. 1 (01/23/87)

4. Element Report 240.0 "Cable Derating (Design) and Cable Coating Derating" for Sequoyah, Rev. 2 (04/17/87)

5. TVA Nuclear Performance Plan:

   Revised Corporate Nuclear Performance Plan, Volume 1 (03/87)
   Revised Sequoyah Nuclear Performance Plan, Volume 2 (03/87)
   Browns Ferry Nuclear Performance Plan, Volume 3 (08/86)
   Watts Bar Nuclear Performance Plan, Volume 4 (03/87)

6. General Construction Specification G-38, "Installing Insulated Cables Rated up to 15,000 Volts," Rev. 6, (09/15/85), and Rev. 8, (03/17/86)

7. General Construction Specification G-40, "Installing Electrical Conduit Systems and Conduit Boxes," Rev. 8, (10/10/85); Rev. 9, (12/19/85)

8. General Construction Specification G-4, "Installing Insulated Cables Rated up to 15,000 Volts Inclusive," revisions of 01/09/73 and 12/15/69

9. WBN Modifications and Additions Instruction MAI-3, "Installation and Inspection of Insulated Control, Signal, and Power Cables," Rev. 7, (10/10/86)

10. BFN Modifications and Additions Instruction 44 MAI-44, "Cable Pulling and Insulated Cables Rated up to 15,000 Volts," Rev. 0, (09/04/86)

11. SQN Modifications and Additions Instruction M&AI-4, "Control, Power and Signal Cables," Rev. 8, (12/31/85)

12. Electrical Design Standard DS E12.6.3, "Ampacity Tables for Auxiliary and Control Power Cables (0-15,000 V)," Rev. 1, (11/07/86)

13. WBN Project Manual WBEP-EP 43.13, "Cable Schedule Handling," Rev. 0, (09/27/85)

14. TVA, DNE, Sequoyah Engineering Procedure - SQEP-06 Rev. 0, "Cable and Conduit Procedure for Sequoyah Nuclear Plant," (09/22/86)

15. Nuclear Engineering Procedure NEP-3.8, "Computer Software System Development, Qualifications, and Control," Rev. 0, [no RIMS number], (02/13/87)

16. Nuclear Engineering Procedure 9.2, Draft, "Trending of Conditions Adverse to Quality (CAQs)"

17. Engineering and Computer Methods Branch (ECB) Procedure - ECB-EP 28.01, "Computer Activities Requiring Quality Assurance - Computer Usage, Computer Program Documentation, and Computer Resident Data," [B42 850710 510], (07/01/85)

18. Bellefonte Engineering Project Procedure BLEP-01, "Detail Instructions for Design/Check of Cable Schedule," Rev. 1, [no RIMS number], (10/22/86)

19. TVA, Office of Engineering Design Criteria BFN-50-794, Browns Ferry Nuclear Plant, "Physical Independence of Electrical Systems," [B42 851126 501], (11/16/85)

20. Browns Ferry Cable Schedule System Users Manual, (02/28/86)

21. Bellefonte Nuclear Plant, Engineering-Construction Monitoring & Documentation (ECM&D) User's Guide, Rev. 2, (11/22/85)

22. Insulated Cable Engineers Association ICEA Pub. No. P-54-440, "Ampacity, Cables in Open-Top Cable Trays, August 1979"

23. OE Calculation, "Sidewall Pressure of Class 1E Cables in Conduits," Rev. 1, [B43 860310 936], (03/10/86)

24. DNE Calculation, SQN-E2-015, "Identifying Sidewall Pressure Violations," Rev. 0, [B25 860724 801], (07/24/86)

25. OE Calculation "Class 1E and Non-Class 1E Electrical Cable Weight/Foot and Outside Diameter," Rev. 0, [B26 860425 137], (04/25/86)

26. DNE Calculation, "Methodology Used as Basis for Cable Ampacities Shown in TVA Electrical Design Standard DS-E12.6.3," EEB-CSTF-0001, Rev. 1, [B43 861230 903], (12/24/86)

27. Office of Engineering Calculation B43 860117 924, "Justification For Use of TVA's Ampacity Tables," (01/16/86)

28. WBN cable schedule sample printout, (01/29/87)

29. TVA cable pull card samples, (07/06/78)

30. Sample printout of WBN cable schedule, voltage level 4A, page 17, (01/29/87)

31. Review of cable installation records (e.g., pull slips, cable tests) and personnel interview (including electricians and former QC inspectors) at SQN by D. Knudsen, Bechtel, between 10/13/86 and 10/24/86, IOM 521 and 522

32. Sample printout of conduit and cable schedule for BFN unit 3 KXBFROUT, (11/13/86)

33. Cable Trays and Conduit (Partial) Schedule Bellefonte Nuclear Plant - Computer Printout Cable Tray Segment with Cross-Sectional Area Tray Fill, and Printout of Cable Trays with Included Cables, (05/26/87); Conduit Overfill and Conduits with Included Cables, (05/29/87)

34. Conduit and Cable Schedule Sequoyah Nuclear Plant - Computer Printout Cable Tray Segment with Cross-Sectional Area Tray Fill - Received 08/14/86. (Printout does not have date or revision)

35. Conduit and Cable Schedule Browns Ferry Nuclear Plant - Computer Printout Cable Tray Segment with Cross-Sectional Area Tray Fill - (11/13/86)

36. Field walkdown performed by J. Wheeler, Bechtel, trip report BLT 177, (01/29/87)

37. Field walkdown performed by J. Wheeler, Bechtel, trip report BLT 168, (03/11/87 through 03/13/87)

38. Field walkdown of cable tray penetrations, performed by D. Knudsen, Bechtel, between 11/04/86 and 11/06/86, IOM 565, (11/10/86)

39. Additional information on field walkdown conducted by J. Wheeler (Bechtel), reported by trip report BLT 177, (04/16/87), IOM 909, (06/16/87)

40. Field walkdown for Element 240.0 BLN conducted by S. Mabie, Bechtel, IOM 1026, (05/27/87)

41. Field walkdown for Element 240.0 SQN conducted by J. Wheeler (Bechtel) and G. Bell (TVA), BLT 106, (10/09/86)

42. Field walkdown conducted by J. Wheeler (Bechtel), and D. Vinediver and K. Bishop (TVA), trip report BLT 168, (03/11/87 through 03/13/87)

43. SNP FSAR, Section 8.3.1.4.4, "Fire Detection and Protection in Areas Where Cables are Installed," Amendment 3

44. SNP FSAR, Section 8.3.1.4.1, "Cable Derating and Cable Tray Fill," Amendment 1

45. WBN FSAR, Section 8.3.1.4.1, "Cable Derating and Cable Tray Fill," Amendment 54

46. BLN FSAR, Section 8.3.3.1, "Cable Derating and Cable Tray Fill," Amendment 16

47. BFN FSAR, Section 8.9.2, "Raceway," Amendment 0

48. BFN FSAR, Section 8.9.6, "Cable Routing," Amendment 0

49. BFN FSAR, Section 8.9.1, "Cable Insulation, Coatings, and Floor and Wall Penetrations," Amendment 0

50. TVA memo from W. S. Raughley to Those Listed, "To All Nuclear Projects - Coordinated Response to Cable Routing SCRs," [B43 860929 904], (09/29/86)

51. Significant Condition Report WBN EEB8589, Rev. 0 and SCR WBN EEB8590, Rev. 0, "Cable Weights and Outside Diameters Not Available From QA Sources," [B43 851231 925], and [B43 851231 928], (12/31/85)

52. TVA memo from W. S. Raughley to J. A. Raulston, "WBN Non-QA Cable Data Used in Calculations," [B43 860602 907], (05/29/86)

53. TVA Nuclear Safety Review Staff Report I-85-06-WBN, "Investigation of An Employee Concern Regarding Cable Routing, Installation and Inspection at WBN," [Q01 850709 051], (07/08/85)

54. TVA memo from R. L. Gridley to W. C. Drotleff, "NRC Request for Information Concerning Cable Pulling and Cable Bending Radii," [L44 860808 803], (08/08/86)

55. TVA letter from R. L. Gridley to NRC, "Sequoyah - Cable Pulling Questions," [L44 861031 811], (10/31/86)

56. TVA memo from F. W. Chandler to Those Listed, "Potential Generic Condition, NCR 6347, Excessive Conduit Bends," [B25 851031 008], (10/31/85)

57. Franklin Research Institute, Technical Evaluation Report, "Evaluation of Sequoyah Unit 1 and 2 Cable Pulling and Bend Radii Concerns," TER-C5506-649, (early 1987)

58. TVA, SQN, Generic Concern Task Force Report, "Overfill of Cable Trays and Conduits, R1," (26 concerns), (05/20/86)

59. WBN NCR 6347, "Excessive Conduit Bends," Rev. 0, (09/27/85)

60. TVA memo from McCloud to Those Listed, "Cable Pulling Practices at Sequoyah Nuclear Plant (SQN)," [L33 861020 800], (10/20/86)

61. TVA memo from Denise to Abercrombie, Sequoyah Nuclear Plant (SQN) Generic Concern Task Force (GCTF) Report "IEEE Standards Not Included in Electrical Procedures," Employee Concern IN-86-259-X11, [T25 860604 984], (06/04/86)

62. Review of the Engineering Design Condition Adverse to Quality (CAQ) Database, search for "Cable" as of 10/31/86 by M. Ibanez, Bechtel, IOM 567, (10/31/86)

63. Corrective Action Reports BF CAR 86-0078, -0079, and -0080, (04/17/86)

64. Corrective Action Report (CAR) 81-35, (02/18/81)

65. TVA memo from J. E. Law to Those Listed, CAR 86-0078, -79, -80, "Potential Generic Condition Evaluation," [L16 860527 828], (05/27/86)

66. Report of the Bellefonte Electrical Evaluation (BEE) team (01/85)

67. TVA memo from W. S. Raughley to Those Listed, "Corrective Action and Sampling Program for Electrical Cable Ampacity," [B43 861008 909], (10/07/86)

68. TVA memo from W. S. Raughley to Electrical Engineering Files, "Summation of Cable Pressure Issue," [B43 860710 905], (07/08/86)

69. TVA Employee Concern Special Program Report 10900, Rev. 0, [T25 870206 832], (01/23/87)

70. TVA memo from J. C. Standifer to L. S. Cox, "Bellefonte Nuclear Plant - Sidewall Pressure Concerns of Presently Installed Cables," [B21 851016 002], (10/16/85)

71. TVA memo from H. L. Abercrombie to Those Listed, "Sequoyah Nuclear Plant (SQN) - Loading of Cable Trays and Fire Stops/Pressure Seals," [L04 850220 930], (02/21/85)

72. TVA, SQN, GCTF Report, "Overfill of Cable Trays and Conduits," Rev. 1, (05/20/86)

73. NSRS Report No. I-86-251-SQN, Attachment 1, Review of Generic Concern Issue, "Electrical Cables," (02/18/86)

74. TVA memo from J. S. Wigington to Electrical Engineering Files, Factory Mutual Research Report No. J.I. OFOQ5 AF, "Examination of the Effect of Vimasco Cable Coating No. 2-B on Ampacity in Cable Trays," (12/19/80), [B43 860121 947], (01/22/86)

75. Letter from R. L. Gridley, TVA, to B. J. Youngblood, NRC, "In the Matter of the Tennessee Valley Authority Docket Nos. 50-327 and 50-328," cable pulling questions [L44 861031 811], (10/31/86)

76. Telecon between J. Wheeler, Bechtel, and J. Prince, TVA, SQN, Review of actual tray fill quantities versus cable schedule printouts, IOM 320, (10/16/86)

77. Bechtel memos from D. Knudsen to I. Don-Doncow regarding review of cable installation records and personnel interviews, "Summary of Interviews Conducted with Responsible Individuals Concerning Cable Pulling Practices Past and Present at the Sequoyah Nuclear Plant," IOM 521 (12/04/86); "Megger Test Records," IOM 522 (01/09/87)

78. Condition Adverse to Quality Report (CAQR) WBT870152, "Computer Resident Cable Mark Number Data Not Verified and Controlled," Rev. 0, [T42 870410 960], (04/09/87)

79. Significant Condition Report - SCR WBNECB8602, "Data Files Have No Protection From Deliberate/Inadvertent Deletion," Rev. 0, [B42 860707 008], (07/03/87)

80. Problem Identification Report (PIR) WBNEEB8605, "Computer-Routed Cable Lengths Are Inadequate for OE Calculations Required to Support Electrical Design for Watts Bar Nuclear Plant," [B43 860117 915], (01/15/86), [B43 860305 905]

81. Condition Adverse to Quality Report (CAQR) WBF870030, Watts Bar Nuclear Plant - Units 1 and 2, "Computer Software Not Verified," Rev. 0 [B05 870408 001], (04/07/87)

82. TVA memo from Roberts to Vineyard [B42 851021 004], "Sequoyah Nuclear Plant Units 1 and 2 - NCR SQNECB8501 - Verification of Computer Cable and Raceway Programs and Data," (10/21/85), [attachment NCR SQNECB8501 - (B42 850412 004), (04/11/85)]

83. Significant Condition Report SCR SQNEEB8601 R0, "Cable Weights and Outside Diameters Not Available from a QA Source," [B43 860117 919], (01/17/86)

84. Significant Condition Report SCR SQNEEB8602 R0, "Computer-Routed Cable Lengths Are Inadequate for OE Calculations Required to Support Electrical Design for Sequoyah Nuclear Plant," [B43 860123 902], (01/23/86)

85. TVA memo from Roberts to Wilson, [B42 860707 005], "Sequoyah Nuclear Plant Unit 1 and 2 - Significant Condition Report (SCR) - SQNCEB8602 RO," [B42 860707 006] "Data Files Have No Protection From Deliberate/Inadvertent Deletion," (07/07/86)

86. TVA memo from Johnson to Raughley, "Evaluation of Computerized Cable Routing Systems Final Report," [B42 861229 006], (12/29/86), and attached "Evaluation of Computerized Cable Routing System Final Report," (11/01/86).

87. TVA memo from W. S. Raughley to Those Listed, "All Nuclear Projects - Coordinated Response to Cable Routing SCRs," [B43 860929 904], (09/29/86)

88. TVA memo from Roberts to Beasley, Browns Ferry Nuclear Plant Unit 3 - NCR BFNECB8501 - Verification of Computer Cable and Raceway Programs and Data," [B42 851021 005], (10/21/85), [attachment NCR BFNECB8501 - (B42 850415 002), (04/12/85)]

89. Significant Condition Report - SCR BFNECB8602, "No Engineering Procedure For Cable Schedule Development," Rev. 1, [B22 870202 004], (02/01/87)

90. Significant Condition Report (SCR) - BFNECB8604, "Data Files Have No Protection From Deliberate/Inadvertent Deletion," Rev. 0, [B42 860707 004], (07/27/86)

91. Problem Identification Report PIR BLNECB8605, "Data Files and Controlling Documentation Do Not Comply With The QA Requirements of Procedure ECB-EP 28.01," Rev. 0 [B42 870501 008], (04/29/87)

92. Significant Condition Report SCR BLNEEB8548, "Computer-Routed Cable Lengths Are Inadequate for OE Calculations Required to Support Electrical Design for Bellefonte Nuclear Plant," [B43 851224 930], (12/24/85)

93. Black & Veatch Finding Report G901, (11/02/82)

94. Nuclear Safety Review Staff Report I-85-569-WBN, "Cable Overheating and Fire Retardant Coating," (11/20/85)

95. TVA memo from W. S. Raughley to Those Listed, "All Nuclear Plants - Problem Identification Report PIR GENEEB8605," [B42 860808 908], (08/06/86)

96. TVA memo from W. S. Raughley to Those Listed, "All Nuclear Plants - Corrective Action and Sampling Program For Electrical Cable Ampacity," [B43 861008 909], (10/07/86)

97. Nuclear Safety Review Staff Report I-85-766-SQN, "Proper Cable Derating," (03/07/86)

98. Nonconformance Report WBN ECB8501, "Computer Programs Used to Update Electrical Cable, Conduit and Tray Computer Files, No Documentation Available," [B42 850408 001], (04/08/85)

99. TVA memo Cantrell to Mason, "Evaluation of the Adequacy of Installed Class 1E Cables," [B43 851203 915], (12/02/85)

100. TVA computer printout, "Cable and Damages," for RIMS file (1976 to present)

101. Nonconforming Condition Report 1463R, "Cable Insulation Damaged During Pulling Operation," [WBN 830417 025], (04/02/79)

102. Design Procedure for Routing and Loading Cables on Cable Trays, (no procedure number), [B70 851005 102], (10/01/70)

103. Significant Condition Report (SCR) BFN ECB8601, "Cable Tray Fill Design Criteria Exceeded," Rev. 0, [B42 860707 010], (07/08/86)

104. Significant Condition Report (SCR) BFN EEB8602, "Use of QA Design Input Data to Develop Design of Structures and Systems," Rev. 0, [B43 860128 916], (01/28/86)

105. TVA memo from W. S. Raughley to Those Listed, "Cable Sidewall Pressure (SWP)," [B43 860626 931], (06/23/86)

106. Telecon from S. M. Mabie, Bechtel, to R. Haggerty, Bechtel, penetrations/fire seals, IOM 1044 (05/29/87)

107. Telecon from S. M. Mabie, Bechtel, to R. Haggerty, Bechtel, cables routed outside tray siderail, IOM 1073, (06/01/87)

108. Field walkdown for Element 240.0 SQN performed by J. Wheeler, Bechtel, and G. Bell, TVA, BLT-106, (10/09/86)

109. SQN Drawing 45N881-12, "Conduit & Grounding Cable Tray Single Line Node Voltage Level 10, 11," Rev. 5, (05/01/85)

SQN Drawing 45N881-17, "Conduit & Grounding Cable Tray Single Line Node Voltage 4, 12, & 13 (480V)," Rev. 4, (05/01/85)

SQN Drawing 45N881-18, "Conduit & Grounding Cable Tray Single Line Node Voltage Level 4, 12, & 13 (480V)," Rev. 3, (05/01/85)

SQN Drawing 45N881-21, "Conduit & Grounding Cable Tray Single Line Node Voltage Level 3, 10, & 11," Rev. 6, (05/01/85)

SQN Drawing 45N881-22, "Conduit & Grounding Cable Tray Single Line Node Voltage Level 3, 10, & 11," Rev. 3, (05/01/85)

110. Significant Condition Report SCR SQNECB8601, "Cable Tray Fill Design Criteria Exceeded," Rev. 0, [B42 860707 014], (06/27/86)

111. Significant Condition Report - SCR SQNEEB8620, Rev. 1, "Cable Tray Loading" (No method of tracking or identifying abandoned cables in cable trays), [B43 860410 910], (04/10/86)

112. Significant Condition Report (SCR) WBNECB8601, Rev. 0, "Cable Tray Fill Design Criteria Exceeded," Rev. 0, [B42 860707 016], (07/03/86)

113. TVA memo Beasley to Chandler, Myers, Raulson, "DQA/PEB Audit POE-A-85-0003," [B05 850417 005], (04/17/85)

114. TVA memo Bonine to Crittenden, "Deviation Report (DR) POE-A-85-0003-004," [C01 860128 002], (01/28/86)

115. Significant Condition Report (SCR) WBNEQP8624, "Identification and Control of Material, Parts, and Components," [B71 860619 004], (06/18/86)

116. Significant Condition Report (SCR) WBNEQP8625, "Identification and Control of Material, Parts, and Components; and Environmental Qualification of 1E Devices," [B71 860617 002], (06/18/86)

117. Significant Condition Report (SCR) WBNEQP8626, Rev. 1, "Identification and Control of Material, Parts, and Components; and Environmental Qualification of 1E Devices," [B71 860619 002], (06/18/86)

118. Significant Condition Report (SCR) WBNEQP8627, "Environmental Qualification of 1E Devices," [B71 860619 007], (06/18/86)

119. TVA memo from Rayfield to Cottle, "Watts Bar Nuclear Plant - Units 1 & 2 Significant Condition Reports WBNEQP8624, WBNEQP8625, WBNEQP8626, WBNEQP8627, WBNEQP8628," [B26 860718 001], (07/18/86)

120. Significant Condition Report SCR BFNEEB8601, Rev. 0, "Computer-Routed Cable Lengths Are Inadequate for OE Calculations Required to Support Electrical Design for Browns Ferry Nuclear Plant," [B43 860115 940], (01/15/86)

121. TVA memo from Stapleton to Lewis, Engineering Report BFNECB8601, "Cable Tray Design Criteria Exceeded," [B22 860723 009], (07/23/86)

122. Significant Condition Report SCR BFNECB8602, Rev. 0, "No Engineering Procedure for Cable Schedule Development," [B42 860707 011], (07/03/86)

123. Significant Condition Report SCR BLNECB8603, Rev. 0, "No Requirements for Verification of Conduit Schedule Input Sheets," [B42 860707 020], (07/07/86)

124. Significant Condition Report SCR BLNECB8604 Rev. 0, "Verification and Documentation for the Bellefonte Cable Routing System," [842 860829 004], (08/27/86)

125. TVA memo Beasley to Chandler, Myers, Raulson, "DQA/PEB Audit POE-A-85-0003," [805 850417 005], (04/17/85)

126. Telecon from J. Wheeler, Bechtel, to D. Evans, TVA, Element 239.0 BLN, IOM 1100, (06/02/87)

127. TVA memo from Killian to Chandler, "Watts Bar Nuclear Plant - Sequoyah Nuclear Plant Units 1 and 2 - Cable Sleeve Penetration Tests," [WBN 761111 013], (11/09/76)

128. Mailgram R. Feldman to Bechtel Power Corp. Re: Thermo-Lag 330, (10/02/86)

129. TVA memo from J. S. Wigington to Electrical Engineering Files, Factory Mutual Research Report J. I. OFOQ5.AF, "Examination of the Effect of Vimasco Cable Coating No. 2-8 on Ampacity in Cable Trays," (12/19/80), [843 860121 947], (01/22/86)

130. TVA Design Information Request, from J. E. Wilkins to R. W. Cantrell, "Cable Grouped in Tray and Coated with Vimasco - Design Information Request (DIR) - No. E-55," [WBN 810427 101], (04/27/81)

131. TVA Design Information Request - Wilkins to Cantrell [WBN 810729 162], "V4 Voltage Level Cable Grouped - Designed Information Request (DIR) - No. E-56" (07/29/81). Response to DIR [SWP 810902 028]

132. TVA memo from W. S. Raughley to Those Listed, "All Nuclear Plants - Corrective Action and Sampling Program for Electrical Cable Ampacity," [843 861008 909], (10/07/86)

133. Joslyn Research Center, "Test Report - The Effect of Flamemastic 77 Fire Protective Coating on the Ampacity of A Grouped Power and Control Cable Assembly Tested for the Flamemaster Corporation, Sun Valley, California, Test Number 77-098," (09/09/77)

134. Joslyn Corporation, "Test Report of The Effect of Flamemastic 71A and Flamemastic 77 Fire Protective Coatings on the Ampacity of a Grouped Power and Control Cable Assembly Tested for the Tennessee Valley Authority, Knoxville, Tennessee, Test Number 85-033," [843 860407 903], (04/08/86)

135. TVA, BFN, Recovery Plan (Procedure) "Design Changes for the Recovery from the Fire of March 22, 1975," Rev. 4, (01/07/76)

136. United Engineers and Constructors, Inc., letter to W. S. Raughley of TVA, "Evaluation of the Effect of Flamemastic Coating on Cable Ampacity for TVA, BFN, Units 1, 2, and 3," [822 870226 016], (02/25/87)

137. Field walkdown for Element 240.0 BFN, by S. Mabie (Bechtel), IOM 906, (04/18/87)

138. Electrical Design Standard, DS-E13.1.4, Rev. 1, "Conduit - Maximum Cable Diameter for Various Rigid Steel Conduits," (08/24/83)

139. Design Criteria SQN-DC-V-11.3, "Power, Control and Signal Cables For Use in Category 1 Structures," Section 6.1.2, "Conduit Loading," Rev. 5, (09/30/86)

140. National Electric Code

141. TVA memo from E. R. Ennis to D. N. Lake, "WBN NCR W-283-P," [T01 860909 915], (09/08/86)

142. DNE Calculation WB EPVAR 8608003, "Resident Data - Cable Trays; Maximum Allowable Cross Sectional Area and Cable Weight," [B26 860825 047], (08/25/86)

143. OE Calculation WB EPVAR 8603006, "Sidewall Pressure of Class 1E Cables in Conduits," Rev. 1, [B26 860828 001], (08/28/86)

144. TVA memo from C. H. Sudduth to Electrical Engineering Files, "Evaluation of Adequacy of Installed Class 1E Cables," [B43 860331 916], (02/28/86)

145. WBN Modifications and Additions Instruction MAI-14, "Installation and Inspection of Electrical Penetration Pressure Seals, Fire Stop Barriers, and Flame Retardant Cable Coatings," Rev. 6, (02/25/86)

146. Significant Condition Report (SCR) BFN EEB 8631, Rev. 0, [B22 860703 004], (07/03/86)

147. Condition Adverse to Quality Report (CAQR) BFP 870294, "No Provision to Prevent Cables from Being Installed in Raceways and/or Cable Tray Penetration that Appear to be Full of Cables," Rev. 0, [R76 870807 927], (08/07/87)

148. BFN Mechanical Maintenance Instruction 75 (MMI-75), Rev. 2, "Installation and Repair of Penetrations and Fire Stops," (01/30/87)

149. BFN Quality Control Instruction (QCI-5.1), "Quality Control Instructions for Pressure Seals and Fire Stops," Rev. 0, (01/13/87)

150. BFN Surveillance Instruction (SI.4.11.E.3), "Visual Inspection of Electrical Penetrations in Fire Barriers," Rev. 1, (10/29/86)

151. Problem Identification Report PIR BLN EEB8601, [B43 860116 934], (01/31/86)

152. Problem Identification Report PIR BLN EEB 8702, [B21 870327 014], (03/27/87)

153. BLN General Design Criteria N4-50-D787, "Power, Control, and Signal Cables for Use in Category I Structures," Rev. 2, (03/09/84)

154. BLN Quality Control Procedure QCP-3.34, "Electrical Cable Installation (Pulling)," Rev. 4, (04/06/87)

155. NRC letter to S. A. White, "Report Nos. 50-438/86-01 and 50-439/86-01," [A02 860317 016], (03/11/86)

156. Nonconforming Condition Report (NCR) 4254, [C20 860402 132], (03/20/86)

157. Problem Identification Report PIR BLN EEB8518, [B43 850927 902], (09/18/85)

158. Nonconforming Condition Report (NCR) 2987, [BLN 840412 109], (03/19/84)

159. Chemtrol Corporation Test Report, "Floor Slab Fire Test," (10/28/75)

160. Factor Mutual Research, "Fire Endurance Test on Penetration Seal Systems in Precast Concrete Floor Utilizing Silicone Elastomers," (10/28/75)

161. TVA "Browns Ferry Nuclear Plant Design Changes for the Recovery from the Fire of March 22, 1975;" Rev. 0, (06/09/75); Rev. 1, (07/10/75); Rev. 2, (08/14/75); Rev. 3, (12/09/75); and Rev 4, (01/07/76)

162. BLN Quality Control Procedure QCP-5.18, "Firestops, Moisture, Pressure and Radiation Seals," Rev. 10, (06/14/85)

163. Surveillance Instruction BLSI-4.7.12.a, "Fire Barrier Penetration - 18 Month Inspection," Draft, (01/11/85)

164. SQN Significant Condition Report (SCR) SQNCEB8622, Rev. 1, [B25 860925 004], (03/10/86)

165. Design Criteria SQN-DC-V-1.3.4, "Category I Cable Tray Support Systems," Rev. 0, (08/20/75)

166. SQN Modifications and Additions Instruction M&AI-13, "Electrical Pressure Seal, Firestop Barrier and Flame Retardant Cable Coating," Rev. 6, (01/28/85)

167. TVA memo from Raughley to Those Listed, "All Nuclear Projects - Coordinated Response to Cable Routing SCRs," [B43 860929 904], (09/29/86)

168. OE Calculation, WBPE 0018601004, "125V DC Vital Control Power System Design Verification Voltage Analysis," [B26 860228 012], (02/28/86)

169. Memorandum from R. C. Parker to H. C. Johnson, "Engineering and Construction Monitoring and Documentation (ECM&D) Program," [L17 870203 802], (02/04/87)

170. Design Criteria WB-DC-30-4, "Separation of Electrical Equipment and Wiring," Rev. 4, [B42 851030 508], (10/03/85); Design Criteria WB-DC-30-5, "Power, Control and Signal Cables for Use in Category I Structures," Rev. 2, [B42 850619 502], (06/05/85)

171. TVA memo from W. S. Raughley to Those Listed, "All Nuclear Projects - Coordinated Response to Cable Routing SCRs," [B43 860929 904], (09/29/86)

172. TVA memo from Jones to Mullin, "Browns Ferry Nuclear Plant - Corrective Action Report (CAR) BF-CAR-81-035-0T," [B32 860207 946], (02/06/86)

173. TVA memo from W. S. Raughley to Those Listed, "Policy Memorandum PM 87-26(EEB) R1-Cable Length Values Used in Electrical Calculations," [B43 870316 905], (03/11/87)

174. Division of Nuclear Construction Procedure Manual DNC-GCP-4.5.16-01, "Control of Safety-Related Software," Rev. 0-Bb, [Preliminary], (no date)

175. Electrical Design Standard DS-E12.1.13, "Cable, Class 1E Cable ODs and Weights," Rev. 0, [B05 860423 501], (04/15/86); Electrical Design Standard DS-E12.1.14, "Cable, Class NC Cable ODs and Weights," Rev. 0, [B05 860429 505], (04/15/86)

176. TVA Project Instruction BFEP-PI-87-22, "EQ Project Cable Derating Program," Rev. 0, (03/18/87)

177. TVA memo from W. S. Raughley to Those Listed, "All Nuclear Plants - Corrective Action and Sampling Program For Electrical Cable Ampacity," [B43 861008 909], (10/07/86)

178. Telecon between S. Mabie, Bechtel, and C. Sudduth, TVA, Information on Firestop Tests Applicable to BLN, IOM 1019, (05/21/87)

179. Franklin Research Institute, Technical Evaluation Report, "Evaluation of Sequoyah Unit 1 and 2 Cable Pulling and Bend Radii Concerns," TER-C5506-649, (early 1987)

180. Surveillance Instruction SI-233.2, "Visual Inspection of Penetration Fire Barriers - Electrical," Rev. 0, (10/02/85)

181. Problem Identification Report PIR BLN EEB8628, [B21 870220 012], (02/20/87)