50-259
2/6/89
P

EMPLOYEE CONCERNS

SPECIAL PROGRAM

VOLUME 2
ENGINEERING CATEGORY

SUBCATEGORY REPORT 24600
DESIGN CALCULATIONS

UPDATED

TVA

NUCLEAR POWER

TVA EMPLOYEE CONCERNS
SPECIAL PROGRAM

REPORT NUMBER: 24600

REPORT TYPE: SUBCATEGORY REPORT FOR ENGINEERING

REVISION NUMBER: 5

TITLE: DESIGN CALCULATIONS

REASON FOR REVISION:

1. Revised to incorporate SRP and TAS comments and corrective actions from BFN and BLN.
2. Revised to incorporate SRP comments and corrective actions from BLN.
3. Revised to incorporate TAS comments; added Attachment C (References).
4. Revised to incorporate SRP comments.
5. Revised to incorporate TAS comments.

PREPARATION

PREPARED BY:

D. Chin R.W. Walton — SIGNATURE — 12-24-87 DATE

REVIEWS

~~PEER~~ REVIEW COMMITTEE:

J.J. Griffith C.W. Jordan E.F. Parkinson — SIGNATURE — 12/24/87 DATE

TAS:

James E. Wardlaw III — SIGNATURE — 1/11/88 DATE

CONCURRENCES

CEG-H: George P. McNutt — 1-5-88

SRP: Jimmie W. Gayle — SIGNATURE* — 1-15-88 DATE

SIGNATURE — DATE

APPROVED BY:

W.R. Brown — ECSP MANAGER — 1/15/88 DATE

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

EXECUTIVE SUMMARY

This subcategory report summarizes and evaluates the results of 15 Employee Concerns Special Program (ECSP) element evaluations that address the adequacy and control of design calculations; shortcomings in the management, control, and status listing of ac and dc electrical loads; and diesel generator design margins. The element evaluations document the evaluation of 70 issues related to TVA's four nuclear plant sites, Sequoyah (SQN), Watts Bar (WBN), Browns Ferry (BFN), and Bellefonte (BLN). The issues were derived from a total of 13 employee concerns citing perceived deficiencies in the preparation and control of quality-related design calculations, status of ac and dc electrical loads, as well as diesel generator design margins.

Of the 70 issues evaluated, 20 were found to require no corrective action. For the remainder, 18 corrective actions were identified to remedy the 50 negative findings (those that require corrective action). Eight of the corrective actions were initiated by TVA before the Employee Concerns Task Group evaluations; five are new actions required to resolve specific negative findings, and five are new actions required to resolve peripheral findings identified during the evaluations.

The evaluation team found that some of the issues evaluated were problems that TVA had already acknowledged and was in the process of resolving. The substantiated issues include the need for new calculations to verify approved designs and the revision of various documents to reflect actual "as-configured" plant conditions. In addition, quality-related design computer codes need to be documented and verified.

The identified causes for the negative findings were engineering procedures that were deficient in establishing requirements, failure to follow some procedures, and an apparent lack of training in the use of procedures. The majority of the corrective actions for this subcategory were judged to be significant. A review of the TVA Nuclear Performance Plans (NPPs) by the evaluation team revealed that the restructuring of TVA's organization and the essential calculations review efforts will be beneficial to its nuclear program. This, with the acceptable completion of the currently established corrective actions and the ongoing independent overview by the Division of Nuclear Engineering (DNE) Engineering Assurance (EA) group should provide a reasonable course of action to correct the deficiencies and prevent them from recurring.

The significance of the negative findings is that if TVA had not acknowledged deficiencies in the control of design calculations, either prior to, or as a result of, the ECTG evaluation, and taken appropriate corrective action, plant operations/safety could have been affected. For example, the indeterminate nature of the design margin for the diesel generators at SQN and BFN, while those plants were operating, could have affected the capability of safety systems to perform their design function.

The grouped evaluation at the subcategory level did not find any new or broader issues requiring attention. The identified causes and other evaluation results are being examined from a wider perspective in the Engineering category evaluation.

Preface

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

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

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

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

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

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

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

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

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

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

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

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

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

ECSP GLOSSARY OF REPORT TERMS*

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

Class A: Issue cannot be verified as factual

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

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

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

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

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

concern (see "employee concern")

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

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

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

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

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

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

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

K-form (see "employee concern")

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

root cause the underlying reason for a problem.

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

Acronyms

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

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

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

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

CONTENTS

TABLES

1. INTRODUCTION

This subcategory report summarizes and evaluates the results of the ECSP element evaluations prepared for Engineering elements 205.1, 205.2, 205.3, and 205.4, which address the adequacy and control of design calculations; 213.1, which addresses shortcomings in the management, control, and status listing of ac and dc electrical loads, including diesel generator margins; and 243.0, which addresses diesel generator design margins.

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

The 13 concerns were grouped by subject into the six elements identified. These six elements apply to all four plant sites, but some of the concerns and issues addressed individually in the Sequoyah element evaluations were combined for the Watts Bar, Browns Ferry, and Bellefonte element evaluations to facilitate review and generation of corrective action plans. These combinations are noted in Section 2. There were six element evaluations for Sequoyah, and three each for Watts Bar, Browns Ferry, and Bellefonte. Thus, a total of 15 element evaluations make up this subcategory.

TVA followed industry practice of the period (late 1960s and early 1970s) regarding the development of calculations to support design decisions. Although calculations were performed as the basis for or in support of design output documents, they were performed informally when compared with today's standards. This does not, however, eliminate the need to have the essential calculations required to support the design basis of safety systems. The first procedure to control design calculations on a division-wide basis at TVA was issued in 1974. Formal procedures for the control of computer software for design calculations were initiated at TVA in 1979.

Between September 1973 and the present time, three different sets of engineering department procedures have been used to address such requirements as checking, review, approval, issue, revision, and retention of calculations in a generic manner. The deficiencies described in this subcategory report relating to computer software and availability and quality of calculations, suggest that the existing procedures have not been definitive or complete enough to assure that there has been an effective program for calculation control or verification/documentation of computer software.

In brief, beginning in 1984, TVA attention focused on the failure to ensure that calculations and studies performed by the Electrical Engineering Branch (EEB) were updated and revised to support changes in the design. An internal TVA QA audit (Ref. 57) cited as root causes inadequate procedural controls and a failure of the EEB to receive squadcheck copies of drawings and load changes from project personnel.

TVA established an electrical calculations program in 1985 to correct and resolve deficiencies found in electrical calculations at the four nuclear plants (Ref. 87). In March 1986, the Director of Engineering Technical Services made this effort a requirement for the Mechanical, Nuclear, and Civil engineering branches as well (Ref. 103).

Revision 8 of TVA Topical Report TVA-TR75-1A, which is the Quality Assurance Program Description for the Design, Construction, and Operation of TVA Nuclear Power Plants, was the revision available when the element evaluations for this subcategory were written. Revision 9 of the Topical Report (Ref. 20) has been assessed, but does not alter the findings and conclusions of these evaluations.

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 their generic applicability
- Section 3 -- outlines the process followed for the element and subcategory evaluations and cites documents reviewed
- Section 4 -- summarizes the findings by element 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 each element and to each plant site
- Section 6 -- identifies causes of the negative findings
- Section 7 -- assesses the significance of the negative findings
- Attachment A -- lists, by element, each employee concern evaluated in the subcategory. The concern number is given along with notation of any other subcategory with which the concern is shared and the plant sites to which it could be applicable. The concern is quoted as received by TVA, and is characterized by TVA as safety related (SR), safety significant (SS), or not safety related (NO).
- Attachment B -- contains a summary of the element-level evaluations. Each issue is listed, by element number and plant, along with its corresponding findings and corrective actions. The reader may trace a concern from Attachment A to an issue in Attachment B by using the element number and applicable plant. The reader may relate a corrective action description in Attachment B to causes and significance in Table 3 by using the CATD number which

appears in Attachment B in parentheses at the end of the corrective action description.

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

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

2. SUMMARY OF ISSUES/GENERIC APPLICABILITY

The 13 employee concerns listed in Attachment A for each element and plant have been examined, and the potential problems they raised have been identified as 70 separate issues. Many of these issues were discussed in more detail during an NRC investigative interview with one of the concerned individuals (Ref. 78). This interview did not alter the more broadly stated employee concerns or tne issues derived from them. Evaluation of these issues is presented in 15 element evaluations.

All concerns listed were evaluated for each of the four plants except Concern IN-85-110-001 (element 205.1), which was judged to be unique to WBN. The evaluation of this concern showed that design calculations for most WBN engineered pipe supports from EDS Nuclear, Inc. (EDS) had been destroyed. These were calculations specific to WBN. TVA has committed to recreate all destroyed or missing calculations. Issues from elements 205.2, 205.3, and 213.1 were evaluated in separate element evaluations for SQN. The issues from these three elements were all addressed in Element Evaluation 205.1 for WBN, BFN, and BLN. Elements 205.4 and 243.0 issues were assessed in separate evaluations for each of the four plants.

The issues summarized below deal with perceived deficiencies in the preparation, updating, and records management of design calculations. More specifically, elements 205.1, 205.2, and 205.3 deal with problems in design calculations in that some have never been prepared, some are inadequate in scope and quality, some are not stored as quality records, and some are not easily retrievable. The issues in element 205.4 pertain to verification and documentation of quality-related design computer codes. Elements 213.1 and 243.0 deal with the status of ac and dc electrical load calculations not being kept current as changes occur, and with diesel generator loading and margin records not being adequately maintained. These elements were combined in this report to facilitate review because the identified concerns are closely related.

All of the issues evaluated under this subcategory, except as noted in the preceding paragraph, apply to all four plants. These issues, grouped by element, are summarized below:

- Element 205.1, Calculation Preparation and Updating - There are problems in design calculations, in that some are never prepared and some are inadequate in scope and quality.

  In this report, scope as related to a calculation has been interpreted to mean that a calculation does address the essential parameters required by the calculations. Also in this report quality refers to compliance with procedures as well as to proper treatment of design criteria, assumptions and input data, correct methodology and approach, and reasonableness of results.

- Element 205.2, Calculation Control and Interface Requirements - There is inadequate control and interface coordination of design calculations. There are no procedures to maintain calculations current.

- Element 205.3, Calculation Records Retention - Design calculations are not stored as quality records, and TVA management is not aware of the requirements of ANSI N45.2.9 for retention of design calculations as permanent plant quality records.

- Element 205.4, Verification/Documentation of Quality Related Design Computer Codes - The issue identified in this element refers to programmatic deficiencies in the control of computer programs used in the design process. In addition to computer program verification, the issue was conservatively interpreted to include other types of documentation associated with the control of computer program usage in engineering.

- Element 213.1, Inadequate Management, Control and Status Listing of AC and DC Electrical Loads, Including Diesel Generator Margins - The ac and dc electrical loads and margins are not kept current as changes occur. Also, electrical calculations for loads are inadequately prepared and controlled.

- Element 243.0, Inadequate Diesel Generator Margins - Diesel generator loading and margin records are not properly maintained resulting in inadequate capacity. Because of inadequate capacity, diesel generators were added but licensing documents were not updated.

Each issue evaluated within the element evaluations is stated fully in Attachment B, which also lists corresponding findings and corrective actions discussed in Sections 4 and 5 of this report.

3. EVALUATION PROCESS

This subcategory report is based on the information contained in the applicable element evaluations prepared to address the specific employee concerns related to the issues broadly defined in Section 2.

The element and subcategory evaluation processes are discussed below. The references cited are listed in Attachment C.

3.1 Element Evaluation Process

The steps listed below were followed to evaluate issues for the element evaluations.

a. Defined issues for each element from the employee concerns. Attachment A of this report lists the employee concerns addressed herein.

b. For elements 205.1, 205.2, 205.3, and 213.1, reviewed regulatory requirements (Refs. 2, 4, and 5), industry standards (Refs. 10 and 11), and TVA criteria documents (Refs. 19 through 22, 32, 33, 34, 36, and 38) related to the issues to determine requirements for the development and control of design calculations.

c. For element 205.4, reviewed regulatory requirements (Ref. 2) and industry standards (Refs. 9, 11, 12, and 18) related to the verification and documentation of quality-related design computer programs.

d. For element 243.0, reviewed regulatory requirements (Refs. 1 through 8), industry standards and specifications (Refs. 13 through 17, 66 and 67), and TVA criteria documents (Refs. 19 and 32) related to establishing required load margins (capacity) for diesel generators.

e. For elements 205.1, 205.2, 205.3, and 213.1, reviewed Engineering Department and project procedures (Refs. 24 through 31) that implement design calculation policies; in particular, procedures that relate to the development, control, review, revision, coordination, storage, and retention of calculations.

f. Reviewed the Essential Calculation Programs (Refs. 23, and 103 through 123), the Design Basis Programs (Refs. 23, 129, and 132) and the Design Baseline and Verification Programs (Refs. 23, 28, and 130) to determine if these programs will adequately address these issues.

g. For element 205.4, reviewed TVA procedures and practices for implementing the requirements for verification and documentation of quality-related design computer programs (Refs. 26, 35, and 37).

h. Reviewed applicable design documents to develop design understanding and to verify implementation status.

i. Reviewed applicable FSAR (Ref. 19) and Nuclear Performance Plans (NPPs) (Ref. 23) to understand scope and basis of NRC review, to determine regulatory compliance, and to identify any open issues or TVA commitments related to design calculations.

j. For element 243.0, reviewed applicable FSAR (Ref. 19) and NPPs (Ref. 23) to understand scope and basis of NRC review, to determine regulatory compliance, and to identify any open issues or TVA commitments related to diesel generator margins.

k. For all elements, reviewed other documents applicable to the issues and determined to be needed for the evaluation, such as correspondence (Refs. 76 through 134), transcripts of investigative interviews (Ref. 78), audit results, prior independent verification reviews, procedures, Nonconforming Condition Reports (NCRs), Engineering Change Notices (ECNs), evaluation reports, etc. (Refs. 40 through 62 and 75).

l. For element 205.4, investigated the implementation of the procedures and practices identified in "g" by reviewing the computer program documentation system, examples of computer program verification records (Refs. 68 through 71), and related documentation (Refs. 63, 64, 65, 101, 124, and 125).

m. For element 205.4, interviewed cognizant TVA personnel (Ref. 137), and reviewed evidence from previous investigations (Refs. 50, 51, 52, 97, and 125) and nonconformance reports (Refs. 53, 54, 55 and 102) to develop an understanding of identified problems.

n. Evaluated TVA's committed corrective actions.

Using the results of the element evaluation process, the issues were evaluated for the elements and the findings and corrective actions were documented.

3.2 Subcategory Evaluation Process:

Subsequent to the element evaluation process, the steps listed below were followed for preparing this subcategory report.

a. Tabulated the concerns addressed by this subcategory report in Attachment A.

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

c. Prepared Tables 1, 2, and 3 of this subcategory report to permit comparison and identification of common and unique issues, findings, and corrective actions among the four plants.

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

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

f. Evaluated corrective actions to determine if additional actions are required as a result of the causes found in step "e" of this section.

g. Provided additional judgment and information that may not have been apparent at the element evaluation level.

4. FINDINGS

Past audit reviews by organizations both internal and external to TVA have shown that calculations supporting the design basis for TVA's nuclear power plants have not always been adequately documented. These reviews include documentation for various audits (Refs. 85 though 100 and 125) by TVA's quality assurance organizations, inspections conducted by the NRC (Refs. 76, 77, and 79), and evaluations performed by the Institute of Nuclear Power Operations (INPO). (Refs. 40 through 43). From these reviews, problems were identified regarding calculations needed to support approved designs. Calculations were identified in these reviews as being missing, incomplete, or not updated. Assessment of the condition by TVA management concluded that a review of design calculations should be conducted by all four technical branches in DNE.

To address these findings, DNE initiated calculation review efforts to resolve not only these previous audit findings but also their generic implications. Each engineering discipline within DNE is performing a review to assess the extent of this condition and adequacy of its calculations.

The findings from each of the 15 element evaluations for this subcategory are contained in Attachment B. The findings are listed by element number and by plant. The findings and discussion of the evaluations for each element apply to all four plants (unless otherwise noted) and are summarized in the following subsections.

4.1 Element 205.1 - Calculation Preparation and Updating (All Plants)

Element 205.1 issues "c," "d," and "e" for WBN, BFN, and BLN are addressed as issues "a," "b," and "c," respectively, in Element Evaluation 205.2 for SQN. Element 205.1 issues "f" and "g" for WBN, BFN, and BLN are addressed as issues "a" and "b," respectively, in Element Evaluation 205.3 for SQN. Element 205.1 issues "h" and "i" for WBN, BFN, and BLN are addressed as issues "a" and "b," respectively, in Element Evaluation 213.1 for SQN.

The reports and documents reviewed identified deficiencies in the scope of some design calculations. The Gilbert/Commonwealth (Ref. 62) and NRC (Ref. 76) reviews of Sequoyah plant modifications made to the auxiliary feedwater system since operating license cited TVA failure to systematically address pipe support thermal loads for field routed pipe and failure to consider torsional shear stress effects on weld design for cable tray supports. The Sargent & Lundy reports for SQN, BFN, and WBN indicated deficiencies in the scope of some electrical calculations reviewed including those for cable ampacity, containment electrical penetrations (Ref. 59), auxiliary power system, and the diesel generator load study (Refs. 60 and 61). The Bellefonte Electrical Evaluation Report (Ref. 48) indicated deficiencies in the scope and quality of some electrical calculations reviewed including those for the auxiliary power system and the diesel generator load study. Also, the evaluation team confirmed that some calculations were deficient in scope in reviews for SQN element evaluations 215.2, 215.6, and 220.3.

Deficiencies related to the quality of design calculations (clear statement of purpose, listing of assumptions and indication of unverified assumptions, reasonableness of approach and results, etc.) were documented in both the Gilbert/Commonwealth and Sargent & Lundy reports. Examples include the steam generator access platform design, cable tray support loads, and short circuit and station battery calculations.

An INPO evaluation (Ref. 134) also found that some mechanical calculations were not revised and updated when the design was modified.

Some calculations prepared during the early design phase were not treated by design engineers as permanent plant support documents equally as important as design input or design output documents. Calculations were performed by engineers in personal job books that were sometimes kept by the originator rather than the project records. These records were sometimes taken by the originator when transferred to another project. Many of these calculations were not microfilmed.

The documents reviewed support the validity regarding the deficiencies in scope and quality of some design calculations. The majority of reviewed calculations, however, were found to be adequately prepared.

Due to the deficiencies identified prior to the ECTG evaluations, TVA DNE has established a program to identify, revise or create, and update those calculations required by each discipline to support safety systems for safe shutdown (essential calculations) and others needed to support plant reliability and availability (desirable calculations).

4.2 Element 205.2 - Calculation Control and Interface Requirements (All Plants)

Element 205.2 issue "a" for SQN is addressed as issue "c" in Element Evaluation 205.1 for WBN, BFN, and BLN. Element 205.2 issue "b" for SQN is addressed as issue "d" in Element Evaluation 205.1 for WBN, BFN, and BLN. Element 205.2 issue "c" for SQN is addressed as issue "e" in Element Evaluation 205.1 for WBN, BFN, and BLN.

Several element evaluations prepared by the evaluation team found that there was a lack of adequate coordination between branches and projects. The issues raised by the concerns regarding the adequacy of interface coordination, up-to-date status, and control of calculations have been identified and confirmed in TVA internal audits and investigations (Refs. 47, 48, 50, 51, 52, 56, 57, and 58), as well as in independent examinations by other reviewers (Refs. 40 through 43, and 59 through 62). Therefore, the issue is valid.

There were and are procedures (EN DES EP 3.03, OEP 07, and NEP 3.1) to control and maintain calculations current; therefore, the issue that there are no procedures to maintain calculations current is not valid.

4.3 Element 205.3 - Calculation Records Retention (All Plants)

Element 205.3 issue "a" for SQN is addressed as issue "f" in Element Evaluation 205.1 for WBN, BFN, and BLN. Element 205.3 issue "b" for SQN is addressed as issue "g" in Element Evaluation 205.1 for WBN, BFN, and BLN.

The reports and documents (Refs. 40 through 62) reviewed by the evaluation team substantiate the fact that some design calculations, in particular those that were prepared in the early 1970s, are not currently available or retrievable and, therefore, do not provide support for the design bases. The reports do not necessarily support the allegation, however, that some calculations were never prepared.

Not until the early 1970s were regulatory and industry guidelines for preparing and documenting design calculations developed and issued. The TVA organizations which were involved in the design and construction of nuclear power plants followed industry practice of the period regarding the development of calculations to support design decisions. While calculations were performed as the basis for or in support of design output documents, they were performed informally in comparison with today's standards. This does not, however, eliminate the present requirement to have essential calculations retrieveable in order to demonstrate justification of the design of safety systems.

Before the early 1970s, TVA had no formal requirements for calculation preparation and storage. Therefore, although calculations were prepared, there was no "quality records" storage program. A large number of calculations that TVA or its outside consultants may have produced were not formally documented and are not retrievable or available for review. Calculations were performed by engineers in personal job books that were probably kept by the originator rather than being filed as project records. Engineers sometimes took their records with them when transferred to another project assignment. Many calculations from this period appear not to have been microfilmed as a part of the permanent plant record system.

Design calculations prepared after September 1976, when the Management and Engineering Data System (MEDS) was initiated, were generally stored as quality records but are often difficult to retrieve because of record indexing weaknesses. Completion of the design calculation review program should ensure that essential calculations exist and are retrievable to support the design basis for safety-related systems.

The essential regulations that affect calculation records retention are contained in 10 CFR 50, Appendix B. TVA memo (06/20/72) located in the BFN OEDC-QPM 3-73, R1, (Ref. 136), indicated that TVA did not at the time comply with the requirements of 10 CFR 50, Appendix B. TVA committed to 10 CFR 50, Appendix B, on 07/01/72.

In reviewing the issue of TVA management awareness of requirements to retain design calculations as permanent quality plant records, the evaluation team found that consistent procedural direction was given to engineering personnel for the transfer and storage of final calculations to a central records processing section. Quality Assurance Procedure SQN-QAP-III-1.3 (Ref. 22), which was issued in March 1970, was the earliest such procedure reviewed. The Division of Engineering Design procedure, EP 1.14, "Engineering Records - Retention and Storage," issued 09/17/74, references sections of ANSI N45.2.9

(Ref. 10), which had been issued only three months previously on June 6, 1974. This procedure and EP 3.03, "Design Calculations, R0," issued 08/22/74, clearly call for the storage and retention of final calculations as permanent quality records. These early procedures and successive ones (OEP-16, NEP 3.2) support the conclusion that TVA management has been aware of retention requirements for design calculations.

Although retention requirements were reflected in department procedures, the absence of some calculations and difficulties in retrieving many calculations point to a problem in implementing an effective quality records program. Since a similar problem does not appear to have occurred with design output documents such as drawings, the evaluation team believes that calculation records retention problems resulted from a lack of clear procedures, especially a definition of "final" calculations, and a lack of proper attention to these issues, rather than from ignorance of ANSI N45.2.9 requirements. Deficiences in quality records retention should have been identified by effective QA audits.

The documents and reports (Refs. 40 through 51, 59 through 62, and 76) reviewed by the evaluation team substantiate the issue that some design calculations were not stored as quality records.

4.4 Verification/Documentation of Quality Related Design Computer Codes - Element 205.4 (All Plants)

Formal TVA procedures, such as EN DES EP 3.23 (Ref. 24) and ECB-EP 28.01 (Ref. 35), for the control of verification and documentation of computer software used in design activities were not in place prior to 1979. As a result, computer software developed and used prior to the existence of formal procedures in this area may not have adequate verification and documentation.

There have been numerous TVA documents that indicate there were computer programs used for safety-related design calculations, but they were not properly documented or verified. In particular, the ONE Engineering Assurance (EA) December 1986 audit, Audit 87-06 (Ref. 97), "... noted that several TVA reports of conditions adverse to quality (NCRs/SCRs) documenting deficiencies in the verification of computer codes used in safety-related design activities have been issued..."

In addition, deficiencies regarding the cable routing program verification documentation had previously been identified by TVA, and are the subject of TVA NCR GEN ECB8501, NCR SQN ECB8501, NCR BFN ECB8501, NCR BLN ECB8501, and NCR WBN ECB8501 (Ref. 54). These NCRs reported that there was no verification documentation or controlled user documentation available for the computer programs used in the cable routing system. This condition was apparently the result of these computer programs erroneously being classified as "business" category programs, not subject to quality assurance program requirements. Corrective action for these NCRs is in process and includes procedure modifications and the development of required computer program verification documentation.

The TVA reports, "Quality Assurance Evaluations Report - Evaluation of Computerized Cable Routing Systems" (Refs. 50, 51, and 52) documents an evaluation of the plant-specific computerized cable routing system and confirms the lack of adequate documentation of computer program verification.

The past TVA practices and procedures for verification and documentation of computer programs used in safety-related design provided a system that addresses the essential elements of the governing standards and regulations. However, the composite set of procedures governing DNE computer activities lacked sufficient description of requirements and elements necessary to effectively implement the system for computer program verification and documentation. The following were noted in evaluating this system:

- The formal TVA program, EN DES EP 3.23 (Ref. 24), for computer program verification/documentation was initiated in 1979, after most design activities were under way. It was not apparent that adequate consideration had been given to retrofitting this documentation. Also, it was not apparent that the lack of required computer program verification documentation is isolated to those cases already documented in TVA nonconformance reports (Refs. 50 through 55, and 102).

- The use of unverified and undocumented personal computer software for various calculations was identified by TVA. It was not apparent that these were isolated cases or if they were widespread occurences with significant concerns that would be applicable elsewhere.

- TVA has recently (1984) undergone considerable organizational change with the establishment of the Engineering Computer Methods Branch (ECB) to centralize Division of Nuclear Engineering (DNE) computer activities (Ref. 137). Procedure upgrades have also recently occurred, and additional procedure changes are in process (Ref. 26).

- The documentation of those computer program verifications (Refs. 68, 69, and 71) reviewed by the evaluation team was in general conformance with the requirements of the governing procedure. However, TVA reports document deficiencies regarding the lack of computer program verification documentation for certain programs (Refs. 50 through 55, and 102).

Implementation of the system to control user manuals was also reviewed. In evaluating TVA's control of computer program usage, it was noted that the accuracy (correctness) of the distribution lists for controlled copies of the computer program user manuals is questionable, because of the many recent TVA personnel shifts. A review and updating of these lists is currently in progress.

Because of the existence of these identified cases of lack of verification documentation in calculation packages, elements of the TVA Design Calculation Verification Program (DCVP) were reviewed to determine whether or not that program would identify other similar cases of omission - if they existed. TVA has committed to the DCVP to establish the identification of those calculations required to support safety systems used for safe shutdown (essential calculations). After identification, the essential calculations are to be located and reviewed; and then generated, updated, or superseded as necessary to support the design.

Engineering Branch instructions for accomplishing the DCVP were reviewed to establish whether this program included measures to confirm the existence of computer software verification for those cases where a computer program was utilized in generating an essential calculation. The existing instructions do not include specific measures for confirming this item.

Thus, there were deficiencies in the verification and documentation of quality-related design computer codes in the past.

4.5 Inadequate Management, Control and Status Listing of AC and DC Electrical Loads, Including Diesel Generator Margins - Element 213.1 (All Plants)

Element 213.1 issues "a" and "b" for SQN are addressed as issues "h" and "i," respectively, in Element Evaluation 205.1 for WBN, BFN, and BLN.

There is a lack of management, control and status listing of ac and dc electrical loads, including diesel generator loads. This involves inadequate control of, or preparation of, calculations for loads, as well as shortcomings in the management and control of load margins, including electrical loads, and mechanical loads (heat, BHP, etc.) that translate into electrical loads (all four plants).

The issues raised by these concerns regarding adequacy of preparation, management, and control of calculations for electrical loads have been identified and addressed in several TVA internal audits and investigations (Refs. 45 through 51 and 57), as well as in external evaluations and review programs (Refs. 59 through 62). These programs have substantiated the concern for SQN and that the concern is generic to all TVA plants (Ref. 47).

4.6 Inadequate Diesel Generator Margins - Element 243.0

A review of the SQN diesel generator calculation SQN-E3-002 (Ref. 73) identified the following:

- The design basis event (DBE) loading sequences do not always represent the worst-case diesel loading conditions.
- The diesel generator capacity calculation used loading sequence tables that are different from actual conditions. The plant modifications required to reconcile the "as-built" condition with the analyzed configuration are to be implemented per ECN L6715 prior to restart.
- Long-term loads that may be tripped to keep the loading within the diesel generator's steady state capability have not been incorporated into operating procedures.
- The adequacy of the diesel generator capacity was determined for unit 2 operation assuming unit 1 is in cold shutdown; evidence that the diesel generator capacity is adequate for two-unit operation does not exist.

The diesel generator loading has not been finalized for WBN. In addition, the evaluation team reviewed calculation WB EPVAR 8608001 (Ref. 74) to determine the adequacy of the DG capacity. The calculation contains loading sequence tables corresponding to several Design Basis Events (DBE). However, these tables are based on plant configurations (i.e., physically connected and sequenced loads) that are different from the actual "as-built" condition that existed at the time this calculation was performed. These analyzed plant configurations were considered "unverified assumptions," and plant modifications are required to reconcile the "as-built" condition with the analyzed configuration. No ECNs were identified to implement the changes.

At BFN, diesel generator (DG) rated capacity for required long-term steady-state loads is adequate to support unit 2 operation; however, the capability of the DGs to start, accelerate, and carry all automatically sequenced loads has not been demonstrated to be adequate to support operation of unit 2 with four diesel generators available and units 1 and 3 in cold shutdown. To verify diesel generator adequacy, calculations are being performed to include the automatic starting transient analysis and will indicate load sequencing voltage and frequency responses of the generator. Similarly, DG capacity and automatic starting capability have not been demonstrated to be adequate for three-unit operation with eight DGs.

As part of its investigation, the evaluation team reviewed several documents to establish BFN licensing commitments. Specifically, FSAR Section 8.5.2 (Ref. 19) and a draft copy of BFN Design Criteria BFN-50-7082 (Ref. 32) were reviewed and found to contain similar statements concerning Safety Guide 9 (Ref. 8). Both documents stated "the diesel capacity shall be within the limits of Safety Guide 9." The evaluation team interpreted this to mean.BFN was to comply fully with SG-9. Subsequent conversations with TVA (Ref. 140) revealed this not to be the case but rather TVA BFN is to meet the intent of SG-9 and not the allowable voltage and frequency variation requirements.

BLN has yet to demonstrate the adequacy of diesel generator capacity. There are currently no formal DG load calculations.

Lack of documentation of the diesel generator loads and margins has been substantiated by several reports. An internal TVA audit (Ref. 57) found that there is insufficient design control to ensure that calculations and studies performed by the Electrical Engineering Branch are updated and revised to support design changes. In addition, a Sargent & Lundy (S&L) Report (Ref. 59) on the SQN electrical calculations program found that most of the calculations were prepared informally by TVA during the design period and were not maintained in a manner that would allow easy retrieval over the life of the plant.

The issue regarding the addition of DGs because of inadequate capacity and without updating licensing documents has not been substantiated. The DGs were added at SQN and WBN to increase plant availability when one of the four DGs is taken out of service, not for additional capacity. The problem of inadequate DG capacity was recognized at BFN, and DGs were added before operating licenses were issued. Therefore, updating of licensing documents was not required. No DGs have been added to the BLN design, and, thus, this issue is not valid for BLN.

4.7 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. For example, the designation C5 in Table 1 indicates that the evaluated issue was found to be valid (finding Class C) and that a corrective action involving some type of analysis is required (corrective action Class 5).

When more than one corrective action is identified in Table 1 for a single finding (e.g., element 243.0, Finding a), Table 2 counts only a single classification. Table 2 identifies one finding for each issue evaluated. Of the 70 issues identified by a classification in Table 1, 20 require no corrective action. Of the remaining 50 issues, 37 had corrective actions initiated before the ECTG evaluation, eight required new corrective actions, and five requiring new corrective action resulted from peripheral findings uncovered during the ECTG evaluation.

5. CORRECTIVE ACTIONS

In the past, problems and confusion had developed with respect to TVA's nuclear engineering activities since both the headquarters nuclear engineering organization and TVA's nuclear plants performed engineering activities. The lack of a centralized engineering organization and a duplication of engineering expertise and overlapping of responsibilities contributed to problems in areas such as design control and configuration control. Correction of these problems include organizational changes, program changes, and changes in the evaluation of plant modifications. In addition, an Engineering Assurance (EA) organization has been established to monitor these corrective actions and the implementation of new programs and to provide feedback to management on engineering performance.

TVA has developed a series of nuclear performance plans (NPPs) to correct programmatic and management deficiencies that have contributed to the continued poor direction and control of TVA's nuclear activities. Volume 1 of the NPP describes the measures that TVA has taken and currently intends to take to improve the corporate-level management of its nuclear activities and to correct the problems that have occurred in this area. Volumes 2, 3, and 4 address Sequoyah, Browns Ferry, and Watts Bar, respectively. There is currently no NPP for Bellefonte. The three site-specific nuclear performance plans provide an account of the actions TVA is taking, or will take, to improve its nuclear program. These measures, when completely implemented, should resolve the identified problem areas and prevent their recurrence.

TVA's commitments to resolving past deficiencies in the control of design calculations are addressed in the following sections of the corporate and respective plant nuclear performance plans.

	Corporate (Volume 1)	Sequoyah (Volume 2)	Browns Ferry (Volume 3)	Watts Bar (Volume 4)
Organization Restructuring	IV.E.2	II.1.2	II.1.2	VI.1.2
Configuration Control	VI.E.4	II.3.0	III.2.0	V.7.0
Design Calculations	-	III.4.0	III.4.0	IV.9.0

TVA has committed in the site-specific NPPs (under "Special Programs") for SQN, BFN, and WBN to a design calculation review program. Although BLN does not have an NPP, BLN has committed to this program in its corrective action plan. The calculation reviews have the common objectives of identifying essential calculations, verifying the existence of essential calculations, ensuring the technical adequacy of essential calculations, and ensuring that essential calculations are current. "Essential calculations" are defined as calculations for safety-related plant features. As calculations are reviewed for technical adequacy, significant deficiencies will be identified and tracked with a Condition Adverse to Quality Report. This process includes the identification of appropriate corrective actions.

Program integration will be achieved through a comprehensive calculation status tracking control log. This system is titled the Calculation Cross Reference Information System (CCRIS). It is intended to track calculations supporting engineering changes and interactions between calculations and modifications. Features of the Calculation Cross Reference Information System include integration of the calculations from the four DNE technical branches, identification of analyses required to support design changes, and identification of interface links between calculations.

The calculation review program commits each engineering branch within DNE to reviewing its calculations. Essential electrical calculations which exist will be reviewed to ensure technical adequacy and consistency with the plant design. The essential mechanical, nuclear, and civil calculations which exist will be reviewed to ensure technical adequacy and consistency with the plant design by selecting a sample. When a defect is found in a sample, an evaluation will be made to determine if the sample needs to be expanded to 100 percent coverage in that area. When calculations are found to be missing, procedures require a documented evaluation to be performed to define which of the missing calculations must be regenerated.

Specifically, the design calculation reviews for each of the disciplines are as follows:

- o Electrical

  The electrical calculations program defines the essential minimum set of electrical calculations required to support the design bases of a standardized nuclear plant, and documents it in policy memorandum PM 86-02 (Ref. 117). Further, engineering procedures have been issued which control calculation preparation and which should ensure adequate maintenance of the calculations to reflect ongoing design changes. Finally, the program includes procedures to revise applicable calculations to reflect the "as-constructed" configuration of the plant. As a basis for the program, DNE reviewed the minimum set of electrical calculations required and confirmed this with information received from other architect/engineers and utilities (Ref. 23).

In addition, TVA contracted with Sargent and Lundy (S&L) engineers to perform an independent assessment of the electrical calculation program. This assessment included a review of those calculations deemed by TVA to be required prior to restart or fuel load, the rationale and methodology for identifying those calculations, a review of FSAR commitments, and a sample review of selected electrical calculation documents.

The long-term objective of the electrical calculation program is to correct the root cause of the conditions adverse to quality by development of a program that ensures control of the correctness and completion of electrical calculations. Other objectives of this program are (1) to develop software programs and an electrical data base for all future calculations to establish consistency between nuclear projects, (2) to ensure that all future work is incorporated into the design change process, and (3) to be more responsive and timely in the performance of electrical calculations.

To accomplish the objectives of (1), TVA has purchased a calculation program from Sargent and Lundy (Refs. 82 and 83) that includes electrical procedures, standards, guides and practices, computer software that has been QA approved for nuclear applications, and an employee training program on procedures and how to perform calculations. The program for (2) is being developed and is currently being evaluated to determine how (3) is to be accomplished.

In addition, the long-term program will also complete the electrical calculations that were not required for unit restart.

o Mechanical

The purpose of the mechanical calculation review effort is to have in place a complete set of technically adequate essential mechanical calculations. The ultimate intent is to maintain this complete set of calculations throughout the operating life of the plants.

The Mechanical Engineering Branch (MEB) technical responsibilities include, among others, mechanical design of the following types of systems:

- Heat cycle
- Heat rejection
- Raw water
- Diesel generator

- Heating, ventilation, and air conditioning (HVAC)

- Fire protection

Also, it is noted that branch functional areas where deficiencies are found during the technical adequacy sampling review will have their sample size increased.

The calculations reviewed will be classified as being "acceptable," "acceptable with minor deficiencies," or "unacceptable." Each calculation classified as "acceptable with minor deficiencies" or as "unacceptable" will have an significant condition report (SCR) or a problem identification report (PIR), as appropriate, written to correct the deficiency.

The MEB post-restart calculation effort activity will include following existing procedures to maintain controlling mechanical calculations up-to-date and instituting training in use of procedures for new MEB employees. These are intended to be ongoing activities.

o Nuclear

The Nuclear Engineering Branch (NEB) response to the calculation issue encompassed the overall goals of ONE to establish the list of essential calculations, ensure that these essential calculations exist, ensure that they are up-to-date, and ensure that they are technically adequate.

NEB calculations reviewed as part of this program are reviewed for technical adequacy and to ascertain whether they reflect the latest plant configuration. Each of these reviews will be documented and performed in accordance with governing procedures.

NEB technical responsibilities include:

- Safety evaluations of safety-related systems

- Containment pressure and temperature analyses

- Thermal-hydraulic analyses

- Materials studies

- Radiological-related HVAC systems

- Radwaste systems

- Radiation calculations

The NEB calculation review program will assess essential calculations in each of these specific areas. The sampling process will be directed accordingly. Additionally, branch functional areas where deficiencies are found during the technical adequacy sampling review will have their sample size increased. The long-term goal of the NEB calculation program is to establish and maintain this complete set of calculations throughout the operating life of the plants.

o Civil

The Civil Engineering Branch (CEB) has instituted a program to address design calculations on a generic basis for the civil discipline. The goals of the program are:

- Compilation of a master calculations lists
- Categorization of calculations as essential or desirable
- Identification of essential calculations
- Verification of existence of essential calculations
- Retrievability/regeneration of missing essential calculations
- Technical review of essential calculations
- Establishment of effective calculations maintenance process

The civil discipline has determined that corrective actions are needed in three major areas of its calculations program. These areas are the verification of retrievability, regeneration of essential calculations, and verification of technical adequacy.

The following areas of civil discipline responsibility will specifically be reviewed:

- Piping analysis and supports
- Cable tray supports
- HVAC and conduit supports
- Small bore piping

- Miscellaneous steel
- Platforms
- Geology and geotechnical

Additionally, it is noted that branch functional areas where deficiencies are found during the technical adequacy sampling review will have their sample size increased.

The design calculations review efforts are being reviewed by EA to provide a technical and programmatic assessment. This second review should ensure that necessary actions are identified, tracked, resolved, and implemented as required by the procedures, and that the conclusions drawn and corrective actions taken are acceptable. This quality overview will provide feedback to management on engineering performance.

Control of design analysis and verification analysis processes to comply with regulatory requirements is described in 10 CFR 50, Appendix B, Criterion III, "Design Control." ANSI N45.2 and ANSI N45.2.11 amplify these requirements and are committed to by TVA.

These controlling requirements are reiterated in TVA-specific documents such as the Final Safety Analysis Report (FSAR) (Ref. 19), TVA Topical Report TVA-TR75-1A (Ref. 20), the Sequoyah Quality Assurance Manual (Ref. 22), and the TVA Nuclear Quality Assurance Manual (Ref. 21).

Revised and improved Nuclear Engineering Procedures (NEPs) were issued in mid-1986 (Ref. 84) to govern the reorganized Division of Nuclear Engineering design engineering activities. These NEPs describe the verification, review, issuance, and revision process of TVA design or vendor calculations. These procedures include tracking unverified assumptions, notifying users when previously unverified assumptions have been verified, processing calculation revisions in the same manner as the original, and evaluating calculations for inconsistencies, errors, omissions, etc.

The NEPs also specify that a review be done to ensure such things as proper application of design input; incorporation of feedback data; compatibility of system, structure, and component interfaces; technical adequacy; quality; economy; and conformance with general project concepts. Both the preparer and the checker are, and have been, required to sign off the record copy of a calculation.

NEP-3.1 (Ref. 26) provides guidance as to the significance of signature/initials in the signature blocks of the calculation cover sheet. The checker's responsibility is to check the calculation for accuracy. For a safety-related calculation, a design verifier (independent reviewer) must also review the calculation.

The following requirements must be addressed by the preparer/verifier of calculations:

- Design inputs, including information such as loads, temperatures, and pressures originated within DNE or supplied by vendors, and codes, standards, and regulatory requirements will be correctly selected and current, referenced, and applied.
- Assumptions will be based on sound engineering principles and will be adequately identified and documented; inputs/assumptions that require subsequent confirmation will be identified.
- Applicable construction and operating experiences will be considered.
- Appropriate calculation methods will be used.
- Output will be verified to be reasonable compared with inputs.
- Adequate system performances, safety margins, etc., will be considered.

In addition, the design verifier ensures that the calculation has been design verified. As stated in NEP 5.2 (Ref. 26), acceptable methods of design verification include, but are not limited to, the following:

- Design Review - Critical reviews to provide assurance that design documents, such as drawings, calculations, analyses, or specifications, are correct and satisfactory.
- Alternate Calculations - A second valid approach to calculations, including simplified methods, done by a person(s) other than the one who performed the original calculations in order to verify the correctness of the original calculations. The alternate calculations are added to the original calculations and cross-referenced for record purposes.
- Qualification Tests - Tests which demonstrate that structures, systems, or components will function as necessary to meet design requirements; they include performance tests, seismic tests, and tests of prototype units which qualify a line or type of equipment. They may consist of a complete functional test or a test to confirm a specific design feature.

In addition to the NEPs, site-specific requirements such as the project organization, interfaces, and variances from the NEPs are identified, approved, and controlled in the site-specific engineering project manual.

Both past and current TVA engineering procedures require review of calculations that may be affected by or that support changes in design output documents. The fact that TVA failed to update and revise calculations (i.e., DG load margins) to support design changes indicates that some procedures were not followed, possibly due to personnel not being fully trained in the established procedures.

Past procedures (EN DES EP 3.23 and ECB-EP 28.01) governing DNE computer activities lacked sufficient descriptions of requirements and elements necessary to effectively implement the system for computer program verification and documentation. Also, formal TVA procedures for the control of verification and documentation of computer programs used in design activities were not in place before 1979. A new procedure (NEP 3.8) for the control of DNE computer activities has been issued, which is intended to correct these deficiencies.

Section IV of TVA's revised Corporate Nuclear Performance Plan (CNPP) (Ref. 23) sets forth the new TVA nuclear power organization that should correct deficiencies in corporate support activities. Consistent with the restructuring of TVA's corporate nuclear organization to provide for effective management of its nuclear activities, the site organization has also been restructured as stated in the site-specific NPPs (Section II for SQN, BFN and Section VI for WBN). The organizational changes are intended to accomplish a strengthening of corporate support and site line activities and achieve consistency between corporate and site functions. In addition, these changes should provide a clear focus for the DNE and help develop clear lines of responsibility and accountability.

With respect to monitoring of compliance with procedures that are developed as part of a corrective action plan, it should be noted that the Engineering Assurance (EA) organization was established as an integral part of the Division of Nuclear Engineering in early 1986 (see the revised Corporate Nuclear Performance Plan (CNPP), Revision 4, March 1987, Section IV.E.2.d.). In matters relating to implementation of the Nuclear Quality Assurance Program, the Manager of Engineering Assurance reports directly to the Director of Nuclear Quality Assurance. This new organizational structure focuses management attention on development of adequate procedures and on training personnel in the use of the procedures. The CNPP charges EA with the responsibility of providing training for DNE employees in the use of quality-related Nuclear Engineering Procedures. In addition, the independent EA overview authority (audit function) should be sufficient to effectively detect noncompliance with engineering procedures, and to better assure compliance through feedback to management on engineering performance.

The substantiated issues indicate the need for increased and continued management attention to the engineering design processes and for increased Division of Nuclear Engineering (DNE) involvement in plant modifications. Engineering Assurance (EA) auditing will provide some assurance of compliance with various practices by providing feedback to management on engineering performance. Monitoring of the engineering products on a day-to-day basis is the responsibility of engineering line management. The latest DNE procedures are augmented by site-specific procedures that, when properly followed, provide a means to mitigate many of the engineering design process problems of the past. Management attention should also be directed to provide adequate staffing to allow careful review and checking of the engineering work and the design documents as they evolve. The organizational changes that have been made, especially to strengthen the Branch Chiefs' technical review responsibilities and the Quality Assurance and EA organization, provide a reasonable means to monitor the engineering design process and adherence to procedures.

In general, TVA senior management has identified the need for strengthening its Engineering organization in response to the requirements of nuclear plant design. The Engineering organization is responsible for the content and quality of the design documents and for ensuring that they conform to sound engineering principles, licensing commitments, and Quality Assurance program requirements. This need for strengthening is based, in part, on deficiencies in design process effectiveness. This need is also partially based on past implementation of the TVA Quality Assurance program. Thus, the need for strengthening the Engineering organization, as indicated by the NPPs, is accomplished primarily through additional training of the DNE personnel to th requirements of that program and to basic management principles. DNE Nuclear Engineering Procedure NEP-5.2 and policy memo PM 87-35, "(DNE) - Project/Branch Responsibilities," dated January 23, 1987 [RIMS B01 870123 002], clearly delineate the responsibility, authority, and accountability of the Project Engineers and Branch Chiefs. The Project Engineer is responsible for work scope, budget, and schedule, and for ensuring that project work is executed according to plan and in conformance with the technical direction of the Branch Chiefs and the requirements of the corporate QA program. The Branch Chiefs are responsible for staffing levels and qualifications of technical personnel on the projects, and for the technical adequacy of the engineering design. The Branch Chiefs are the final technical authority within DNE, and have the authority to stop work that does not conform to established requirements. In the past, Branch Chiefs' authority or resources to fully administer technical reviews was limited. Under the restructured organization, the Branch Chief provides engineers and technical direction for the Project Engineer; the Branch Chief also assesses the need for technical reviews, develops a document review and approval matrix, and schedules reviews as required. These programs have been started but have not been fully implemented.

The EA organization adds another dimension to DNE's design review process by performing in-depth technical audits using qualified engineering expertise and having the authority to stop work that does not conform to established requirements. The manager of EA reports to the director of DNE on all matters other than QA. At present, EA is actively reviewing the output of ONP's major technical programs. In reviewing EA's audits of the DBVP at SQN, the evaluation team finds that the methodology and performance appear to have been effective in identifying problems and implementing corrective actions.

Table 2 identifies 50 findings that require corrective action. Since some of the corrective actions apply to more than a single plant, only 18 different corrective actions are required to remedy the 50 negative findings. The detailed corrective action descriptions are contained in Attachment B. A condensation of this information by element, with the applicable plant identified in parentheses, follows:

- Element 205.1, Calculation Preparation and Updating (All Plants) - Element 205.1 issues "c," "d," and "e" for BFN, BLN, and WBN are issues "a," "b," and "c," respectively, in Element 205.2 for SQN. Element 205.1 issues "f" and "g" for BFN, BLN, and WBN are issues "a" and "b," respectively, in Element 205.3 for SQN. Element 205.1 issues "h" and "i" for BFN, BLN, and WBN are issues "a" and "b," respectively, in Element 213.1 for SQN.

  The TVA Essential Calculation Program (ECP) takes an initial step in correcting past deficiencies. Calculations are being reviewed for unverified assumptions, reasonable method/approach, etc., and are monitored in calculation logs in accordance with engineering procedures. Each engineering discipline is to provide a detailed schedule for the post-restart, long-term completion of the ECP.

  In addition, WBN and BLN essential electrical calculations will be prepared prior to fuel load using the long-term electrical calculation program developed by S&L; SQN and BFN essential calculations will be prepared using existing TVA methods. After restart, SQN and BFN essential calculations will be evaluated under the S&L program and will be revised or superseded as required.

- Element 205.2, Calculation Control and Interface Requirements (All Plants) - Element 205.2 issue "a" for SQN is issue "c" in Element 205.1 for BFN, BLN, and WBN. Element 205.2 issue "b" for SQN is issue "d" in Element 205.1 for BFN, BLN, and WBN. Element 205.2 issue "c" for SQN is issue "e" in Element 205.1 for BFN, BLN, and WBN.

All engineering disciplines are to implement the Essential Calculation Program (ECP). The ECP addresses design calculations of plant systems and features that are important to nuclear safety. The program objective is to identify essential calculations, verify their existence and retrievability, assure their technical adequacy, and assure they are maintained current with the plant design (all plants).

o Element 205.3, Calculation Record Retention (All Plants) - Element 205.3 issue "a" for SQN is issue "f" in Element 205.1 for BFN, BLN, and WBN. Element 205.2 issue "b" for SQN is issue "g" in Element 205.1 for BFN, BLN, and WBN.

The current Essential Calculation Program (ECP) has focused management attention on the need to comply with improved engineering practices in preparation of calculations and to enforce requirements for the retention, storage, and retrieval of calculations.

NEP-3.1, Section 4.1.7, required all calculations be issued in accordance with NEP-1.3, "Records Control," which addresses storage, retrievability, and retention of calculations. All calculations issued as part of the ECP are to be issued as QA records in accordance with NEP-1.3. Calculations generated prior to 1976 (when RIMS was initiated) are required to be entered into RIMS as they are entered into the Calculation Cross Reference Information System (CCRIS) as part of the CCRIS input procedure.

As outlined in NEP-1.2, personnel involved in design calculations have been or will be trained. This will include training in NEPs 3.1 and 1.3 for those preparing calculations. For those involved in the retention, storage, and retrieval of calculations, training will be provided in Branch, Project, or RIMS procedures as appropriate.

Lower-tier procedures will be written to supplement the NEPs that control calculation records (SQN, BFN, BLN). These procedures will be a site-specific engineering project administrative instruction that will address the following topics in more detail.

- Collection, filing, and storage requirements for completed or approved calculations
- Schedule requirements for the routine microfilming of approved calculations
- Definition of a final calculation

- Element 205.4, Verification/Documentation of Quality-Related Design Computer Codes (All Plants) - Until 1979, many of the programs used to generate design calculations within DNE were listed in the FSAR, including a sample problem with the results of hand calculations showing how the program was being used to generate design output. At that time, many programs used by DNE were recognized in the "public domain," and the NRC recognized "public domain" as an acceptable verification mechanism. Personal computer (PC) programs were nonexistent, and calculations produced by calculators were checked as part of the design calculation checking process (Ref. 135).

  ECB is responsible for and has provided a plan for the evaluation of all DNE quality-related computer software (Ref. 125). A survey (Ref. 124) of all DNE organizations is under way to provide information on computer software used to generate or handle design output. When the survey is completed, each computer software will be evaluated to determine level of usage, documentation, and verification. Appropriate corrective action will be initiated for any problems identified in accordance with established procedures. PC software will be evaluated, along with all other computer software that are reviewed for adherence to QA program requirements (all plants).

  The recent release of NEP-3.8 (Ref. 26), in February 1987, addresses past deficiencies in the verification and documentation of quality-related computer software. This NEP covers the development, documentation, qualification (verification and validation), and control of computer software systems suitable for use to (a) qualify a safety-related design, (b) generate output to be used as input to a safety-related design, and (c) handle design output or design control information used as a basis for safety-related activities.

  ECB is responsible for controlling and maintaining software system documentation and for helping branches, projects, and staffs train personnel in the use of computer software systems.

- Element 213.1, Inadequate Management, Control and Status Listing of AC & DC Electrical Loads, Including Diesel Generator Margins (All Plants) - Element 213.1 issues "a" and "b" for SQN are issues "h" and "i," respectively, in Element 205.1 for BFN, BLN, and WBN.

  The completion of the minimum required set of electrical calculations required to support design prior to restart (SQN, BFN), completion of the long-term calculation program, and adherence to the new procedures should correct the problems and prevent recurrence in the future.

- o Element 243.0, Inadequate Diesel Generator Margins (All Plants) - The corrective actions include performing a thorough diesel generator load study and loading analysis (all plants), modifying the plants (SQN, WBN), changing operator procedures (SQN), and implementing a long-term electrical calculation program to ensure that diesel generator load records are adequately maintained in the future.

These corrective actions also appear 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 of the 18 corrective actions identified, five involve a revision or addition of procedures, four involve some type of documentation remedy, and three each involve either some type of evaluation or additional analysis to validate the design. The remaining require either hardware changes or personnel training. In addition, the CATD column of the table shows that, in most cases, a particular corrective action is applicable to all of the plants.

The evaluation team found the above corrective action plans to be acceptable to resolve the findings.

6. CAUSES

Table 3 also identifies one or more causes of the negative findings 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. In those cases, more than one cause is identified for some of the corrective actions. Whenever direct evidence linked a cause to a problem requiring corrective action, such evidence was taken into account.

For the 18 corrective actions described in Table 3, five causes have been indicated. These are shown in the table and totaled at the end. The most frequent cause is "Inadequate Procedures." The next most frequent are "Inadequate Q Training" and "Procedures Not Followed." The inadequacy of procedures and cases where procedures were not followed led to specific instances where design calculations were missing, not prepared, or inadequate, and not stored as quality records and where computer codes were not verified or documented.

Most of the problems associated with these issues can be attributed to lack of adequate procedures and to procedures not followed. These are the causes for the concern regarding insufficient verification and documentation of quality-related computer software. These are also the causes for the concern regarding the adequacy of calculation controls.

The problems associated with the design calculation activity indicate a breakdown in the design process and a weakness in Engineering management's ability to furnish procedural guidance and training. Neither did Engineering management carry out overview activities to ensure that the work was being performed at an acceptable quality level and was being properly documented and controlled. Collectively, these causes suggest shortcomings in management effectiveness at the levels where responsibility resides for assurance that design bases are clearly communicated and that procedures are properly developed and implemented.

The totals from Table 3 show that 34 causes are in the management effectiveness category and seven are in the design process category. Thus, the primary causes for these concerns are in the area of "lack of management effectiveness," which probably led to poor control of the design process and the delay in resolving the problems.

7. COLLECTIVE SIGNIFICANCE

The fact that 37 of the total 50 findings requiring corrective action had corrective action initiated before the ECTG evaluation indicates that TVA is aware of the problems. The acceptable completion of the currently established corrective actions (i.e., implementation of TVA's Essential Calculations Program, verification/ documentation of computer codes) are intended to correct the problems and prevent future recurrence.

TVA has acknowledged problems in the area of design control and configuration control in its nuclear performance plans, and has committed to procedure revisions at both the corporate and plant-site levels to reflect TVA's new organization, to correct documented deficiencies, and to reflect installed plant modifications. Calculations must address the as-constructed plant configuration.

In addressing the existence and updating of calculations required to support safety systems, the TVA Essential Calculation Program takes an initial step in correcting past deficiencies. All plants, except BLN, have submitted to the NRC their Nuclear Performance Plan which describes this program in detail. Even though BLN has not prepared an NPP, due primarily to length of time before its projected fuel load date, it has committed to completion of the Essential Calculation Program. When completed, the essential calculation program should provide reasonable evidence and assurance that adequate calculations do exist for safety-related plant features.

Of particular significance is the fact that the need for strengthening the TVA Engineering organization in response to the requirements of nuclear plant design has been identified, as noted in Section 5 of this report. To additionally ensure that management policy is being enforced, an audit function is provided by the Engineering Assurance (EA) organization, which provides feedback to management on engineering performance. This subject will be reassessed in the Engineering category evaluation.

The ECTG evaluation team determined that the majority of the corrective actions for this subcategory were significant. An example of this significance is the diesel generator load calculations. TVA discovered that, under certain conditions, there could be a potential overloading of the diesel generators for a design basis event at SQN, BFN, and WBN. This possibility is being evaluated and any required modifications will be implemented prior to restart of SQN and BFN. A review of such a vital system is to be performed before fuel load of WBN to ensure its adequacy. However, the consequence of this condition is that the margins available for the diesel generators were indeterminate for SQN and BFN while these plants were in operation. Whether they were capable of performing their design function is, therefore, also indeterminate. TVA reported this to the NRC under 10 CFR 50.55(e) for WBN (Refs. 81 and 133) and by letter of notification for BFN (Ref. 80). Reportability was evaluated for SQN, but the condition was determined not to be reportable.

The lack of satisfactory verification/documentation of quality-related design computer codes was classified as significant because incorrect results may be generated by an improperly verified computer code. In addition, the computer code may be used for an application it was not intended for if proper documentation is not available (e.g., required input, basis of code, assumptions used, range of applicability, etc.). This concern represents a significant problem regarding the ability to design safety-related systems, components, or structures properly. As an example, the number of significant condition reports that were written against TVA's cable routing computer programs indicated an underlying quality problem that required evaluation. The result of this is the initiation by TVA of an evaluation of current capabilities and future direction for this software.

Although no additional cases of nonexistent calculations or lack of computer program verification documentation were identified in the evaluation, the fact that this documentation does not exist for certain calculations or computer programs identified by TVA dictates that further actions are necessary. It cannot be concluded that the lack of this documentation is isolated to the identified cases, without further justification and/or investigation.

Because of the number of negative findings in this subcategory and the significance level of the corrective actions, it can be concluded that the control of design calculations and computer codes for the four plants investigated indicates that there have been significant problems. The ECTG evaluation confirmed that TVA is aware of these problems and has taken steps to resolve them.

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

ELEM	FINDING/ CORRECTIVE ACTION CLASS.**	CORRECTIVE ACTION	CATD	CAUSES OF NEGATIVE FINDINGS *																		Significance of Corrective Actions*		
				MANAGEMENT EFFECTIVENESS							DESIGN PROCESS EFFECTIVENESS							TECHNICAL ADEQUACY					
				1 Fragmented Organization	2 Inadequate Q-trng	3 Inadequate Procedures	4 Procedures Not Followed	5 Inadequate Communication	6 Untimely Res of Issues	7 Lack of Mgt Atten	8 Inadequate Design Bases	9 Inadequate Calcs	10 Inadequate As-blt Reconcil.	11 Lack of Design Detail	12 Engrg Judgmt not Documented	13 Design Crit/ Commit Not Met	14 Insuf. Verif Documentation	15 Stds Not Followed	16 Engrg Error	17 Vendor Error	D	M	H
205.1	C3	Index and categorize calculations in accordance with the Civil Design Calculation Program. Prepare written justification for those essential calculations not needed for the restart phase.	SQN 01			X															A	-	-
205.1 205.2 213.1	C5	Implement the Essential Calculation Program. Complete the programs and the review of calculations that support modifications to safety systems.	205.1 SQN 02 WBN 01 WBN 02 BFN 01 BFN 02 BLN 01 BLN 02 205.2 SQN 01 213.1 SQN 02		X	X	X														A	P	P
205.1 205.3	C4	Provide training of personnel in the retention, storage, and retrieval of design calculations.	205.1 WBN 03 BFN 04 BLN 04 205.3 SQN 02		X	X	X														-	-	-

* Defined in the Glossary Supplement.

** Defined in Table 1.

TABLE 1

CLASSIFICATION OF FINDINGS AND CORRECTIVE ACTIONS

	Element	Issue/ Finding**	Finding/Corrective Action Class* SQN	WBN	BFN	BLN
205.1	Calculation Preparation and Updating	a	C3	C5	C5	C5
		b	C5	C5	C5	C5
		c	C5	C5	C5	C5
		d	(2)	C5	C5	C5
		e	(2)	A	A	A
		f	(3)	C4	C4	C4
		g	(3)	A	A	A
		h	(4)	C5	C5	C5
		i	(4)	C5	C5	C5
205.2	Calculation Control and Interface Requirements	a	C5	(1)	(1)	(1)
		b	C5	(1)	(1)	(1)
		c	A	(1)	(1)	(1)
205.3	Calculation Records Retention	a	C4	(1)	(1)	(1)
		b	A	(1)	(1)	(1)
205.4	Verification/Documentation of Quality Related Design Computer Codes	a	D6	D6	D6	D6
		b	D3	D3	D3	D3
		c SQN only	E2	-	-	-
		c BFN, BLN	-	-	B	B
		d SQN only	E4	-	-	-
		d BFN, BLN	-	-	B	B
		e SQN only	E3	-	-	-
		f SQN only	E2	-	-	-

(1) Issue evaluated as part of element 205.1.
(2) Issue evaluated in element 205.2.
(3) Issue evaluated in element 205.3.
(4) Issue evaluated in element 213.1.

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

TABLE 1 (Cont'd)

	Element	Issue/ Finding**	Finding/Corrective Action Class* SQN	WBN	BFN	BLN
213.1	Inadequate Management, Control and Status Listing of AC and DC Electrical Loads, Including Diesel Generator Margins	a	C5	(1)	(1)	(1)
		b	C5	(1)	(1)	(1)
243.0	Inadequate Diesel Generator Margins	a	C1	C6	C6	C6
			C2	-	-	-
		b	C5	C5	C5	C5
		c	B	A	A	A
		d	A	A	B	A
		e	-	-	E3	-

(1) Issue evaluated as part of element 205.1.

*Classification of Findings and Corrective Actions

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

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

**Defined for each plant in Attachment B.

TABLE 2

FINDINGS SUMMARY

Classification of Findings	Plant SQN	WBN	BFN	BLN	Total
A. Issue not valid. No corrective action required.	3	4	3	4	14
B. Issue valid but consequences acceptable. No corrective action required.	1	0	3	2	6
C. Issue valid. Corrective action initiated before ECTG evaluation.	10	9	9	9	37
D. Issue valid. Corrective action taken as a result of ECTG evaluation.	2	2	2	2	8
E. Peripheral issue uncovered during ECTG evaluation. Corrective action required.	4	0	1	0	5
Total	20	15	18	17	70

TABLE 3
MATRIX OF ELEMENTS, CORRECTIVE ACTIONS, AND CAUSES
SUBCATEGORY 246(N)

FLEM	FINDING/ CORRECTIVE ACTION CLASS.**	CORRECTIVE ACTION	CAID	CAUSES OF NEGATIVE FINDINGS *																	Significance of Corrective Actions*		
				MANAGEMENT EFFECTIVENESS							DESIGN PROCESS EFFECTIVENESS							TECHNICAL ADEQUACY					
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17			
				Fragmented Organization	Inadequate Oversight	Inadequate Procedures	Procedures Not Followed	Inadequate Communication	Untimely Res of Issues	Lack of Mgt Attn	Inadequate Design Bases	Inadequate Calcs	Inadequate As-bl Reconcil.	Lack of Design Detail	Engrg Judgmt not Documented	Design Crit/ Commit Not Met	Insuf. Verif Documentation	Stds Not Followed	Engrg Error	Vendor Error	D	M	U
205.1 213.1	C5	Initiate the long-term electrical calculations program that TVA has purchased from S&L. This program includes electrical procedures, standards, guides and practices, computer software for nuclear applications and inhouse employee training program.	205.1 NPS 04 (WBN) (BFN) (BLN) 213.1 SQN 01			X	X														A	P	P
205.1	D2	Upgrade the project procedures manual to incorporate requirements (including PM86-16) issued since the original issue of the manual.	BFN 05 BLN 05			X															A	-	-
	D6	Perform evaluation on calculations to determine if calculations are in compliance with procedures. Those that fail will be returned for correction. Train personnel in requirements of procedures.	BLN 06		X		X														P	-	-

* Defined in the Glossary Supplement.

** Defined in Table 1.

TABLE 3
MATRIX OF ELEMENTS, CORRECTIVE ACTIONS, AND CAUSES
SUBCATEGORY 246MO

ELEM	FINDING/ CORRECTIVE ACTION CLASS.**	CORRECTIVE ACTION	CATD	CAUSES OF NEGATIVE FINDINGS *																		Significance of Corrective Actions*		
				MANAGEMENT EFFECTIVENESS							DESIGN PROCESS EFFECTIVENESS							TECHNICAL ADEQUACY					
				1 Fragmented Organization	2 Inadequate Q-trng	3 Inadequate Procedures	4 Procedures Not Followed	5 Inadequate Communication	6 Untimely Res of Issues	7 Lack of Mgt Atten	8 Inadequate Design Bases	9 Inadequate Calcs	10 Inadequate As-blt Reconcil.	11 Lack of Design Detail	12 Engrg Judgmt not Documented	13 Design Crit/ Commit Not Met	14 Insuf. Verif Documentation	15 Stds Not Followed	16 Engrg Error	17 Vendor Error	D	N	H
205.1 205.3	D2	A Project Specific Engineering Project Administrative Instruction will be written to address the following topics: o Collection, filing, and storage requirements for completed or approved calculations. o Schedule requirements for the routine microfilming of approved calculations. o Definition of a final calculation.	205.1 BFN 03 BLN 03 205.3 SQN 01		X	X	X															A	-	-
205.4	D6	Each computer program will be evaluated to determine the level of usage, documentation, and verification. Corrective actions will be taken in accordance with established procedures, to resolve any problems identified in the evaluation process.	SQN 01 SQN 02 NPS 01 (WBN) (BFN) (BLN) NPS 03 (WBN) (SQN) (BFN) (BLN)			X											X					A	-	-

* Defined in the Glossary Supplement.

** Defined in Table 1.

TABLE 3
MATRIX OF ELEMENTS, CORRECTIVE ACTIONS, AND CAUSES
SUBCATEGORY 2460

ELEM	FINDING/ CORRECTIVE ACTION CLASS.**	CORRECTIVE ACTION	CATD	CAUSES OF NEGATIVE FINDINGS *																	Significance of Corrective Actions*		
				MANAGEMENT EFFECTIVENESS							DESIGN PROCESS EFFECTIVENESS							TECHNICAL ADEQUACY					
				1 Fragmented Organization	2 Inadequate Q-trng	3 Inadequate Procedures	4 Procedures Not Followed	5 Inadequate Communication	6 Untimely Res of Issues	7 Lack of Mgt Atten	8 Inadequate Design Bases	9 Inadequate Calcs	10 Inadequate As-blt Reconcil.	11 Lack of Design Detail	12 Engrg Judgmt not Documented	13 Design Crit/ Commit Not Met	14 Insuf. Verif Documentation	15 Stds Not Followed	16 Engrg Error	17 Vendor Error	D	M	H
205.4	D3	Perform verification, documentation, and security provisions for computer programs where problems have been identified in the past.	SQN 03 NPS 02 (WBN) (BFN) (BLN)			X											X				A	P	P
	F2	Generate or revise procedures to include the requirement for the DNF Computer System Library to verify the legibility of microfilm copies of computer system documentation (existing and future submittals).	SQN 05			X															A	-	-
	F4	Provide training in computer software development and control requirements to DNF personnel.	SQN 04		X	X	X														-	-	-

* Defined in the Glossary Supplement.

** Defined in Table 1.

ELEM	FINDING/ CORRECTIVE ACTION CLASS,**	CORRECTIVE ACTION	CATD	CAUSES OF NEGATIVE FINDINGS *																	Significance of Corrective Actions*		
				MANAGEMENT EFFECTIVENESS							DESIGN PROCESS EFFECTIVENESS							TECHNICAL ADEQUACY					
				1 Fragmented Organization	2 Inadequate Control	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
205.4	F3	Each computer program will be evaluated to determine the level of usage, documentation, and verification. Corrective actions will be taken in accordance with established procedures, to resolve any problems identified in the evaluation process.	SQN 01			X											X				A	-	-
	F2	Prepare a procedural requirement for the ONF Computer System Library to periodically verify the distribution lists for user's manuals.	SQN 06 NPS 04 (WBN) (BFN) (BLN)			X																	
241.0	C6	Finalize and document diesel generator (DG) loading, identify any required changes, and perform any additional analysis required to show compliance to regulations.	WBN 01 BFN 01 BLN 01		X		X					X									A	A	P

* Defined in the Glossary Supplement.

** Defined in Table 1.

TABLE 3
MATRIX OF ELEMENTS, CORRECTIVE ACTIONS, AND CAUSES
SUBCATEGORY 24600

FINDING/ CORRECTIVE ACTION				CAUSES OF NEGATIVE FINDINGS *																		
				MANAGEMENT EFFECTIVENESS							DESIGN PROCESS EFFECTIVENESS							TECHNICAL ADEQUACY			Significance of Corrective Actions*		
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17			
ELEM	CLASS.**	CORRECTIVE ACTION	CATD	Fragmented Organization	Inadequate Q-trng	Inadequate Procedures	Procedures Not Followed	Inadequate Communication	Untimely Res of Issues	Lack of Mgt Atten	Inadequate Design Bases	Inadequate Calcs	Inadequate As-blt Reconcil.	Lack of Design Detail	Engrg Judgmt not Documented	Design Crit/ Commit Not Met	Insuf. Verif Documentation	Stds Not Followed	Engrg Error	Vendor Error	D	M	H
243.0	C1	Perform plant modifications.	SQN 01		X		X					X									A	A	A
	C2	Revise operator instruction to reflect additional long-term loads that may be tripped to keep DG loading within acceptable limits.	SQN 03		X		X					X									A	-	-
	C5	Review DG calculation ensure assumptions have been validated (including multi-unit operation limitations).	SQN 01 SQN 02 SQN 03 WBN 01 BFN 01		X		X					X									P	P	P
	F3	Update FSAR and associated documents to reflect current DG loading and regulatory commitment.	BFN 02 BFN 03		X		X														A	-	-
			TOTALS		11	12	11					4					3						

* Defined in the Glossary Supplement.

** Defined in Table 1.

GLOSSARY SUPPLEMENT
FOR THE ENGINEERING CATEGORY

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

1. Hardware - physical plant changes

2. Procedure - changed or generated a procedure

3. Documentation - affected QA records

4. Training - required personnel education

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

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

7. Other - items not listed above

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

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

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

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

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

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

ATTACHMENT A

EMPLOYEE CONCERNS
FOR SUBCATEGORY 24600

Attachment A -- lists, by element, each employee concern evaluated in the subcategory. The concern's number is given, along with notation of any other subcategories with which the concern is shared and the plant sites to which it could be applicable. The concern is quoted as received by TVA, and characterized by TVA as safety related (SR), safety significant (SS); or not safety related (NO).

ELEMENT	CONCERN NUMBER	PLANT LOCATION	APPLICABILITY SQN	WBN	BFN	BLN	CONCERN DESCRIPTION*
205.1	WI-85-100-043 (shared with 24500)	WBN	X	X	X	X	"There are problems in design calculations, in that some are never prepared, some are inadequate in scope and quality, and some are not stored as quality records. There is inadequate interface and control of design calculations, which impacts traceability of design requirements." (SR)
	I-85-128-NPS (shared with 24500, 20400, 20600, 80300, and 80500)	BFN	X	X	X	X	An individual from BFN wrote NSRS expressing his concern that the control and quality of OE's design effort is inadequate. The CI sent several roughly written pages detailing and summarizing his evaluation and conclusion of three major areas: (1) Design Calculations (2) NCRs, and (3) Management Policies (SS)
	WI-85-100-010	WBN	X See 213.1	X	X	X	"Inadequate management, control and status listing of ac & dc electrical loads, including diesel generator loads. This involves inadequate control of, or preparation of, calculations for loads, and inadequate management and control of load margins, including electrical loads and mechanical loads (heat, BHP, etc.) that translate into electrical loads." (SR)
	XX-85-122-030	SQN	X See 213.1	X	X	X	"Inadequate management, control and status listing of ac & dc electrical loads, including diesel generator loads. This involves inadequate control of, or preparation of, calculations for loads, and inadequate management and control of load margins, including electrical loads and mechanical loads (heat, BHP, etc.) that translate into electrical loads." (SS)
	XX-85-122-031	BLN	X See 213.1	X	X	X	"Inadequate management, control and status listing of ac & dc electrical loads, including diesel generator loads. This involves inadequate control of, or preparation of, calculations for loads, and inadequate management and control of load margins, including electrical loads and mechanical loads (heat, BHP, etc.) that translate into electrical loads." (SR)
	XX-85-122-032	BFN	X See 213.1	X	X	X	"Inadequate management, control and status listing of ac & dc electrical loads, including diesel generator loads. This involves. inadequate control of, or preparation of, calculations for loads, and inadequate management and control of load margins, including electrical loads and mechanical loads (heat, BHP, etc.) that translate into electrical loads." (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*
205.1 (Cont'd)	IN-85-110-001 (shared with 10400 and 22100)	WBN		X			"Potential for failure of concrete anchors supporting critical pipe supports of primary safety systems inside the Primary Containment (eg: Safety Injection System, Component Cooling System, Main Steam System, etc.) in WBNP Unit 1, due to lack of proper evaluation and documentation (design calcs.) of their load carrying capabilities. Design calculations for most engineering pipe supports from Bergen-Patterson and EDS have been intentionally destroyed per TVA direction." (SR)
	IN-85-110-004 (shared with 21200)	WBN	X See 205.3	X	X	X	"Lack of awareness by TVA OE Management (names given) of requirements to document the load carrying capabilities of pipe supports for future reference. TVA Management ignorant of requirements of design calculations as permanent plant records." (SR)
205.2	WI-85-100-043 (shared with 24500)	WBN	X	X See 205.1	X See 205.1	X See 205.1	"There are problems in design calculations, in that some are never prepared, some are inadequate in scope and quality and some are not stored as quality records. There is inadequate interface and control of design calculations which impacts traceability of design requirements. CI has no further information. Anonymous concern via letter." (SR)
	1-85-128-NPS (shared with 24500, 20400, 20600, 80300 and 80500)	BFN	X	X See 205.1	X See 205.1	X See 205.1	An individual from BFN wrote NSRS expressing his concern that the control and quality of OE's design effort is inadequate. The CI sent several roughly written pages detailing and summarizing his evaluation and conclusion of three major areas: (1) Design Calculations (2) NCR's, and (3) Management Policies NOTE: The description of 1-85-128-NPS included here and in issue "c" was developed from a review by the evaluation team of the expurgated interview files for this employee concern. (SS)
205.3	WI-85-100-043 (shared with 24500)	WBN	X	X See 205.1	X See 205.1	X See 205.1	"There are problems in design calculations, in that some are never prepared, some are inadequate in scope and quality, and some are not stored as quality records. There is inadequate interface and control of design calculations, which impacts traceability of design requirements." (SR)
	IN-85-110-004 (shared with 21200)	WBN	X	X See 205.1	X See 2205.1	X See 205.1	"Lack of awareness by TVA OE Management (names given) of requirements to document the load carrying capabilities of pipe supports for future reference. TVA Management ignorant of requirements of ANSI N45.2.9 for retention of design calculations as permanent plant records." (SR)

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

ATTACHMENT A

EMPLOYEE CONCERNS FOR SUBCATEGORY 24000

ELEMENT	CONCERN NUMBER	PLANT LOCATION	APPLICABILITY SQN	WBN	BFN	BLN	CONCERN DESCRIPTION*
205.4	HI-85-077-N15	WBN	X	X	X	X	"NRC identified the following concern from review of the QTC file: 'Inadequate verification/documentation of quality-related design computer codes.'" (SR)
213.1	WI-85-100-010	WBN	X	X See 205.1	X See 205.1	X See 205.1	"Inadequate management, control and status listing of ac & dc electrical loads, including diesel generator loads. This involves inadequate control of, or preparation of, calculations for loads, and inadequate management and control of load margins, including electrical loads and mechanical loads (heat, BHP, etc.) that translate into electrical loads." (SR)
	XX-85-122-030	SQN	X	X See 205.1	X See 205.1	X See 205.1	"Inadequate management, control and status listing of ac & dc electrical loads, including diesel generator loads. This involves inadequate control of, or preparation of, calculations for loads, and inadequate management and control of load margins, including electrical loads and mechanical loads (heat, BHP, etc.) that translate into electrical loads." (SS)
	XX-85-122-031	BLN	X	X See 205.1	X See 205.1	X See 205.1	"Inadequate management, control and status listing of ac & dc electrical loads, including diesel generator loads. This involves inadequate control of, or preparation of, calculations for loads, and inadequate management and control of load margins, including electrical loads and mechanical loads (heat, BHP, etc.) that translate into electrical loads." (SR)
	XX-85-122-032	BFN	X	X See 205.1	X See 205.1	X See 205.1	"Inadequate management, control and status listing of ac & dc electrical loads, including diesel generator loads. This involves inadequate control of, or preparation of, calculations for loads, and inadequate management and control of load margins, including electrical loads and mechanical loads (heat, BHP, etc.) that translate into electrical loads." (SR)
243.0	WI-85-100-010	WBN	X	X	X	X	"Inadequate management, control and status listing of ac and dc electrical loads, including diesel generator loads. This involves inadequate control of, or preparation of, calculations for loads, and inadequate management and control of load margins, including electrical loads and mechanical loads (heat, BHP, etc.) that translate into electrical loads." (SR)
	XX-85-122-030	SQN	X	X	X	X	"Inadequate management, control and status listing of ac and dc electrical loads, including diesel generator loads. This involves inadequate control of, or preparation of, calculations for loads, and inadequate management and control of load margins, including electrical loads and mechanical loads (heat, BHP, etc.) that translate into electrical loads." (SS)

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

ELEMENT	CONCERN NUMBER	PLANT LOCATION	APPLICABILITY SQN	WBN	BFN	BLN	CONCERN DESCRIPTION*
243.0 (Cont'd)	XX-85-122-031	BLN	X	X	X	X	"Inadequate management, control and status listing of ac and dc electrical loads, including diesel generator loads. This involves inadequate control of, or preparation of, calculations for loads, and inadequate management and control of load margins, including electrical loads and mechanical loads (heat, BHP, etc.) that translate into electrical loads." (SR)
	XX-85-122-032	BFN	X	X	X	X	"Inadequate management, control and status listing of ac and dc electrical loads, including diesel generator loads. This involves inadequate control of, or preparation of, calculations for loads, and inadequate management and control of load margins, including electrical loads and mechanical loads (Heat, BHP, etc.) that translate into electrical loads." (SR)
	WI-85-100-002	WBN	X	X	X	X	"Diesel generator margins are inadequate. TVA has added diesel generators to Browns Ferry, Sequoyah and Watts Bar. Each time a question is raised, TVA must conduct another study. TVA adds diesel generators without upgrading licensing documents." (SR)
	XX-85-122-006	SQN	X	X	X	X	"Diesel generator margins are inadequate. TVA has added diesel generators to Browns Ferry, Sequoyah and Watts Bar. Each time a question is raised, TVA must conduct another study. TVA adds diesel generators without upgrading licensing documents." (SS)
	XX-85-122-007	BFN	X	X	X	X	"Diesel generator margins are inadequate. TVA has added diesel generators to Browns Ferry, Sequoyah and Watts Bar. Each time a question is raised, TVA must conduct another study. TVA adds diesel generators without upgrading licensing documents." (SR)
	I-85-132-SQN-01	SQN	X	X	X	X	"Diesel generator margins are inadequate. TVA has added diesel generators to Browns Ferry, Sequoyah and Watts Bar. Each time a question is raised, TVA must conduct another study. TVA adds diesel generators without upgrading licensing documents." (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 24600

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

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

Issues	Findings	Corrective Actions
********** Element 205.1 - Calculations Preparation and Updating **********		
SQN	SQN	SQN
a. Some design calculations are never prepared.	a. INPO evaluations at Bellefonte (March 1984) (Ref. 41) and Watts Bar (May 1985) (Ref. 42) first identified to TVA that some electrical calculations were not available. This discrepancy was also confirmed at Sequoyah in November 1985 (Ref. 23) where calculations could not be retrieved to support voltage levels, acceptable maximum cable lengths and diesel generator loads. The lack of calculation documents to support the plant design bases was not limited to the electrical discipline. As part of the essential calculation program, the Sequoyah mechanical group identified missing calculations for a number of plant systems including the main and auxiliary feedwater, chemical cleaning, essential raw cooling water, main steam, plant [illegible] and steam generator blowdown systems. Also, evaluation team members were advised by TVA that some Civil calculations were not available for review.	a. All engineering disciplines are implementing the Essential Calculation Programs. Their programs and the review of calculations that support modifications to safety systems within the pre-restart phase of the Design Baseline and Verification Program will be completed by plant restart. (CATD 205 01 SQN 02) The Sequoyah Civil discipline is indexing [illegible] calculations in accordance with [illegible] program for implementation of the essential calculation program. The Civil group is preparing written justification for those essential calculations not needed for the restart phase. (CATD 205 01 SQN 01)
b. Some design calculations are inadequate in scope.	b. The reports and documents reviewed also identified deficiencies in the scope of some design calculations. The Gilbert/Commonwealth (G/C) and NRC reviews of Sequoyah plant modifications made to the auxiliary feedwater system since operating license cited TVA failure to systematically address pipe support thermal loads for field routed [illegible] failure to consider torsional shear stress effects on weld design for cable tray supports. The Sargent & Lundy (S&L) report indicated deficiencies in the scope of some electrical calculations reviewed including those for cable ampacity and containment electrical penetrations. Also, reviews by evaluation team members confirmed that some calculations were inadequate in scope.	b. All engineering disciplines are implementing the Essential Calculation Programs. Their programs and the review of calculations that support modifications to safety systems within the [illegible] phase of the Design Baseline and Verification Program will be completed by plant restart. (CATD 205 01 SQN 02)

THIS ITEM COMPLETED
DATE: 3-21-88

THIS ITEM PARTIALLY COMPLETED
AT SQN
DATE: 3-21-88

Issues	Findings	Corrective Actions
Element 205.1 - SQN (Continued)		
c. Some design calculations are inadequate in quality. NOTE: In issue "c," quality is defined as compliance with procedures as opposed to technically error-free calculations.	c. Deficiencies related to the quality of design calculations (clear statement of purpose, listing of assumptions and indication of unverified assumptions, reasonableness of approach and results, etc.) were documented in both the G/C and S&L reports. Examples include the steam generator access platform design, cable tray support loads, short circuit and station battery calculations.	c. See Corrective Actions for issue "b" for this element.
WBN	WBN	WBN
a. Some design calculations are never prepared.	a. An Institute of Nuclear Power Operations (INPO) evaluation at Watts Bar (May 1985) (Ref. 42) identified to TVA that some electrical calculations were not available and others had not been updated to reflect actual design. Calculations could not be retrieved to support voltage levels, acceptable maximum cable lengths, and diesel generator loads. The lack of calculation documents to support the plant design bases was not limited to the electrical discipline. A pre-INPO design evaluation (Ref. 134) performed April 15-17, 1985 documented civil/structural and pipe support calculation deficiencies. The INPO evaluation also found that some mechanical calculations were not revised and updated when the design was modified. TVA DNE has established a program to identify, revise or create, and update those calculations required by each discipline to support safety systems used for safe shutdown (essential calculations)and others needed to support plant reliability and availability (desirable calculations).	a. TVA has committed to: o Identify all essential calculations o Locate all existing calculations o Compare existing calculations with the list of those identified as essential o Prepare and issue any missing calculations in accordance with NEP-3.1, "Calculations." o Check existing calculations on a sample basis for adequacy o Complete the essential calculation program for each discipline before fuel loading of each unit o Establish a schedule for developing nonessential calculations prior to fuel load (CATD 205 01 WBN 01) In addition, TVA provides the following responses: o Documented criteria for the classification of essential calculations are spelled out in policy memoranda issued by each Branch.

Issues	Findings	Corrective Actions
Element 205.1 - WBN (Continued)		
		o Verification of technical accuracy will be performed in accordance with NEP-3.1 with existing calculations checked on a sample basis. o Essential calculation lists will receive independent review in accordance with individual Branch policy as detailed in Branch policy memoranda. o Detailed essential calculation completion schedules are provided in the Branch policy memoranda. Corrective action is scheduled for completion prior to unit 1 fuel load. (CATD 205 01 WBN 02)
b. Some design calculations are inadequate in scope and quality. Note: In Issue "b," quality is defined as compliance with procedures as opposed to technically error-free calculations.	b. The S&L Watts Bar electrical calculation program assessment report (Ref. 60) indicated deficiencies in the scope and quality of some electrical calculations reviewed including those for the auxiliary power system and the diesel generator load study.	b. See Corrective Actions for Issue "a" for this element.
c. There is inadequate control of design calculations.	c. Some calculations prepared during early design phase of the Watts Bar plant were not treated by design engineers as permanent plant support documents equally as important as design input or design output documents.	c. See Corrective Actions for Issue "a" for this element.
d. There is inadequate interface coordination with design calculations (e.g., Branch/project, NUC PR/DNE).	d. The lack of adequate coordination between branch and project for electrical design changes was documented in several reports (Refs. 42, 57, 60, and 85) and resulted in electrical load calculations that did not reflect current design.	d. See Corrective Actions for Issue "a" for this element.
e. There are no procedures to maintain calculations current.	e. Both past and current TVA engineering procedures (EN DES-EP 3.03, OEP-07, NEP-3.1) require review of calculations that may be affected by, or that support changes in, design output documents. Additionally, EEB is in the process of issuing new branch procedures to improve electrical calculation preparation and control.	e. No further corrective action required.

Issues	Findings	Corrective Actions
Element 205.1 - WBN (Continued)		
f. Some design calculations are not stored as quality records.	f. Reports and audits (Refs. 42, 50, and 60) document the lack of a program to systematically collect, microfilm, and store approved calculations prepared prior to the mid-1970s and deficiencies in retrievability of calculations.	f. The TVA corrective action plan provides the following statements: o The current essential calculation program has focused management attention on the need for compliance with improved engineering practice for the preparation and storage of calculations. o Personnel involved in the preparation or storage of calculation documents have received training or will be trained in applicable Nuclear Engineering, branch, project, and RIMS procedures. o The ongoing EA audit program will assure that calculation-related activities are effectively controlled. (CATD 205 01 WBN 03)
g. TVA management is not aware of requirements of ANSI N45.2.9 for retention of design calculations as permanent plant records.	g. TVA procedures (EN DES-EP 1.14, OEP-16, NEP-3.2) and FSAR commitments demonstrate TVA management's awareness of ANSI N45.2.9.	g. None required.
h. Ac and dc electrical loads and margins are not kept current as changes occur (additions or deletions of loads). i. Electrical load calculations are inadequately prepared and controlled.	h., i. NSRS Report I-85-992-SQN reported that the inadequate management, control, and status listing of ac and dc electrical loads, although investigated at SQN only, were generic to all TVA plants. Currently, an electrical calculation long-term program is under way to upgrade all electrical calculations.	h., i. To address this finding, TVA has committed to the long-term electrical calculation program that TVA has purchased from S&L. This program includes: electrical procedures, standards, guides, and practices; computer software that has been QA'd for nuclear applications; and inhouse employee training program on procedures and performance of calculations. Essential calculations will be prepared prior to fuel load using the S&L program. (CATD 205 01 NPS 04)

Issues	Findings	Corrective Actions
Element 205.1 - BFN	BFN	
a. Some design calculations are never prepared.	a. An Institute of Nuclear Power Operations (INPO) evaluation at Watts Bar (05/85) (Ref. 42) identified to TVA that some electrical calculations were not available and others had not been updated to reflect actual design. Calculations could not be retrieved to support voltage levels, acceptable maximum cable lengths, and diesel generator loads. The lack of calculation documents to support the plant design bases was not limited to the electrical discipline. A pre-INPO design evaluation (Ref. 134), performed 04/15-17/85, documented civil/structural and pipe support calculation deficiencies. The INPO evaluation also found that some mechanical calculations were not revised and updated when the design was modified. TVA DNE has established a program to identify, revise or create, and update those calculations required by each discipline to support safety systems used for safe shutdown (essential calculations) and others needed to support plant reliability and availability (desirable calculations). When completed, the essential calculation program, which is a restart condition for each BFN unit, should provide reasonable evidence and assurance that adequate calculations do exist for safety-related plant features.	BFN a. All engineering disciplines are implementing the Essential Calculation Programs. Their programs and the review of calculations that support modifications to safety systems within the pre-restart phase of the Design Baseline and Verification Program will be completed by plant restart. (CATDs 205 01 BFN 01, 02, 05)

Issues	Findings	Corrective Actions
Element 205.1 - BFN (Continued)		
b. Some design calculations are inadequate in scope and quality. Note: In Issue "b," quality is defined as compliance with procedures as opposed to technically error-free calculations.	b. The S&L Browns Ferry electrical calculation program assessment report (Ref. 61) indicated deficiencies in the scope and quality of some electrical calculations reviewed including those for the auxiliary power system and the diesel generator load study.	b. See Corrective Actions for Issue "a" for this element.
c. There is inadequate control of design calculations.	c. Some calculations prepared during early design phase of the Browns Ferry plant were not treated by design engineers as permanent plant support documents, equally as important as design input or design output documents.	c. Prior to restart, each engineering discipline is establishing criteria for classifying calculations as essential, desirable, or obsolete which are identified in their Essential Calculation Program. (CATD 205 01 BFN 01)
d. There is inadequate interface coordination with design calculations (e.g., Branch/project, NUC·PR/ONE).	d. The lack of adequate coordination between branch and project for electrical design changes was documented in several reports (Refs. 57, 61, and 85) and resulted in electrical load calculations that did not reflect current design.	d. Calculations are being reviewed for unverified assumptions, reasonable method/approach, etc., and are monitored in calculations logs in accordance with engineering procedures (NEP-3.1). This is to be accomplished before restart. (CATD 205 01 BFN 01)
e. There are no procedures to maintain calculations current.	e. Both past and current TVA engineering procedures (EN DES-EP 3.03, OEP-07, NEP-3.1) require review of calculations that may be affected by, or that support changes in, design output documents. Additionally, EEB is in the process of issuing new branch procedures to improve electrical calculation preparation and control.	e. No further corrective action required.

Issues	Findings	Corrective Actions
Element 205.1 - BFN (Continued)		
f. Some design calculations are not stored as quality records.	f. Reports and audits (Ref. 52, 56, and 61) document the lack of a program to systematically collect, microfilm, and store approved calculations prepared prior to the mid-1970s and deficiencies in retrievability of calculations.	f. Calculations will be stored in accordance with the microfilm storage system (RIMS). Storage, retrievability, and retention of calculations are addressed in NEP-1.3, "Records Control." All calculations issued as part of the Essential Calculation Program will be issued as QA records in accordance with NEP-1.3. Calculations generated prior to 1976 will be entered into RIMS and into the Calculation Cross Reference Information System (CCRIS) calculation status tracking control log. (CATD 205 01 BFN 03)
g. TVA management is not aware of requirements of ANSI N45.2.9 for retention of design calculations as permanent plant records.	g. TVA procedures (EN DES EP-1.14, DEP-16, NEP-3.2) and FSAR commitments demonstrate TVA management's awareness of ANSI N45.2.9.	g. None required. However, ONE is providing training and placing additional controls on performance of engineering work to ensure that the essential calculations are performed, are technically adequate, and are maintained current. This activity includes utilization of improved procedures and verification, through Engineering Assurance (EA) technical audits, to ensure that the procedures are implemented as intended and the products are technically adequate. Storage and retention of the microfilm record (RIMS) is currently addressed in NEP-1.3. (CATD 205 01 BFN 04)

Issues	Findings	Corrective Actions
Element 205.1 - BFN (Continued)		
h. Ac and dc electrical loads and margins are not kept current as changes occur (additions or deletions of loads).	h. The issue that ac and dc electrical loads and margins are not being kept current has been substantiated (Refs. 41, 42, 47, and 61). However, TVA DNE has established a program to identify, revise or create, and update those calculations required by each discipline to support safety systems for safe shutdown (essential calculations) and others needed to support plant reliability and availability (desirable calculations).	h., i. Browns Ferry is committed to these actions: 1. Completion of electrical calculations required for restart of BFN, in accordance with the TVA procedures on calculations, from the minimum set of electrical calculations required to support the design for TVA's nuclear plants. After restart, these calculations will be evaluated under the S&L program and will be revised and/or superseded as applicable. 2. Maintenance of BFN electrical calculations in accordance with established procedures for electrical changes. 3. Performance of the remaining calculations in the long-term electrical calculations program (Sargent & Lundy program). Action "1" is to be completed prior to restart; action "2" is to be a continuous effort; and action "3" is to be initiated but not completed prior to restart. (CATDs 205 01 BFN 01, 05) (CATD 205 01 NPS 04)
i. Electrical load calculations are inadequately prepared and controlled.	i. The issue relating to inadequate preparation and control of electrical load calculations was found to be true. However, review of TVA's current commitments and corrective actions (Policy Memo PM 86-02) and of the new procedures (NEP-3.1, -6.1) indicates that BFN has an adequate program for future preparation and control of calculations, and for their revision.	

Issues	Findings	Corrective Actions
Element 205.1 - BLN	BLN	BLN
a. Some design calculations are never prepared.	a. An Institute of Nuclear Power Operations (INPO) evaluation (Ref. 41) at Bellefonte (03/84) identified to TVA that some electrical calculations were not available and others had not been updated to reflect actual design. Calculations could not be retrieved to support voltage levels, acceptable maximum cable lengths, and diesel generator loads. The lack of calculation documents to support the plant design bases was not limited to the electrical discipline. An INPO evaluation (Ref. 41) for Bellefonte documented pipe stress calculation deficiencies. TVA DNE has established a program to identify, revise or create, and update those calculations required by each discipline to support safety systems used for safe shutdown (essential calculations) and others needed to support plant reliability and availability (desirable calculations).	a. TVA has committed to: o Identify all essential calculations o Locate all existing calculations o Compare existing calculations with the list of those identified as essential o Prepare and issue any missing calculations in accordance with NEP-3.1, "Calculations." o Check existing calculations on a sample basis for adequacy o Complete the essential calculation program for each discipline before fuel loading of each unit o Establish a schedule for developing nonessential calculations prior to fuel load (CATDs 205 01 BLN 01, 06) In addition, TVA provides the following responses: o Documented criteria for the classification of essential calculations are spelled out in policy memoranda issued by each Branch.

Issues	Findings	Corrective Actions
Element 205.1 - BLN (Continued)		
		o Verification of technical accuracy will be performed in accordance with NEP-3.1 with existing calculations checked on a sample basis. o Essential calculation lists will receive independent review in accordance with individual Branch policy as detailed in Branch policy memoranda. o Detailed essential calculation completion schedules are provided in the Branch policy memoranda. Corrective action is scheduled for completion prior to Unit 1 fuel load. (CATD 205 01 BLN 01)
b. Some design calculations are inadequate in scope and quality. Note: In Issue "b," quality is defined as compliance with procedures as opposed to technically error-free calculations.	b. The Bellefonte Electrical Evaluation report (Ref. 48) indicated deficiencies in the scope and quality of some electrical calculations reviewed including those for the auxiliary power system and the diesel generator load study.	b. See Corrective Actions for Issue "a" for this element.
c. There is inadequate control of design calculations.	c. Some calculations prepared during early design phase of the Bellefonte plant were not treated by design engineers as permanent plant support documents, equally as important as design input or design output documents.	c. See Corrective Actions for Issue "a" for this element.

Issues	Findings	Corrective Actions
Element 205.1 - BLN (Continued)		
d. There is inadequate interface coordination with design calculations (e.g., Branch/project, NUC PR/DNE).	d. The lack of adequate coordination between branch and project for electrical design changes was documented in several reports (Refs. 48, 57, and 85), and it resulted in electrical load calculations that did not reflect current design.	d. See Corrective Actions for issue "a" for this element.
e. There are no procedures to maintain calculations current.	e. Both past and current TVA engineering procedures (EN DES-EP 3.03, OEP-07, NEP-3.1) require review of calculations that may be affected by, or that support changes in, design output documents. Additionally, LEB is in the process of issuing new branch procedures to improve electrical calculation preparation and control.	e. No further corrective action required.
f. Some design calculations are not stored as quality records.	f. Reports and audits (Refs. 48 and 50) document the lack of a program to systematically collect, microfilm, and store approved calculations prepared prior to the mid-1970s, as well as deficiencies in retrievability of calculations.	f. BLEP project procedure on calculations (BEI 3.1-1) is currently being prepared. It will address the storage and control of hard copy files, the issuance of calculations, the assignment of retrieval numbers, and the assignment of unique identifiers. Storage and retention of the microfilm record (RIMS) is currently addressed in NEP-1.3. All calculations issued as part of the Essential Calculation Program will be issued under these procedures. The project procedure will be issued and training provided to all personnel, including managers. In addition, the DNE Engineering Assurance organization conducts periodic audits. Project compliance with these procedures is included in the audit scope. (CATDs 205 01 BLN 03, 04)
		g. None required.
g. TVA management is not aware of requirements of ANSI N45.2.9 for retention of design calculations as permanent plant records.	g. TVA procedures (EN DES-EP 1.14, OEP-16, NEP-3.2) and FSAR commitments demonstrate TVA management's awareness of ANSI N45.2.9.	

Issues	Findings	Corrective Actions
Element 205.1 - BLN (Continued)		
h. Ac and dc electrical loads and margins are not kept current and calculations are not reviewed as changes occur (additions or deletions of loads).	h. The issue that ac and dc electrical loads and margins are not being kept current has been substantiated (Refs. 41, 42, 47, and 48). However, TVA DNE has established a program to identify, revise or create, and update those calculations required by each discipline to support safety systems for safe shutdown (essential calculations) and others needed to support plant reliability and availability (desirable calculations).	h., i. To address this finding, TVA has committed to the long-term electrical calculation program that TVA has purchased from S&L. This program includes: electrical procedures, standards, guides, and practices; computer software that has been QA'd for nuclear applications; and inhouse employee training program on procedures and performance of calculations. Essential calculations will be prepared prior to fuel load using the S&L program. (CATDs 205 01 BLN 01, 02, 05, and 205 01 NPS 04)
i. Electrical load calculations are inadequately prepared and controlled.	i. The issue relating to inadequate preparation and control of electrical load calculations was found to be true. However, review of TVA's current commitments and corrective actions (Policy Memo PM 86-02), and of the new procedures (NEP-3.1, -6.1) indicates that BLN has an adequate program for future preparation and control of calculations, and for their revision.	
********** Element 205.2 - Calculations Control and Interface Requirements **********		
SQN	SQN	SQN
a. There is inadequate control of design calculations.	a. The reports and documents (Refs. 42, 47, 59, 62, and 85) reviewed by the evaluation team support the concern that some calculations prepared during the design phase of the Sequoyah plant were not treated by the design engineers as permanent project/plant support documents/equipment important as design input or design output documents. Consequently, they were not controlled in the same degree and manner as design input/design output documents.	a. Prior to restart, each engineering discipline is establishing criteria for classifying calculations as essential, desirable, or obsolete which are identified in their Essential Calculation Program. (CATD 205 02 SQN 01)
b. There is inadequate interface coordination with design calculations (e.g., Branch/project, ONP/OE).	b. The lack of adequate coordination between branch and project for electrical design changes was documented in several reports (Refs. 42, 57, 59, and 85) and resulted in inadequately prepared and controlled electrical load calculations.	b. Calculations are being prepared for [illegible] assumptions, reasonable [illegible] approach, etc., and are entered in calculations logs in accordance with engineering procedures. Issues to be accomplished before restart. (CATD 205 02 SQN 01)

THIS ITEM PARTIALLY COMPLETED BY S&L DATE 6-88

Issues	Findings	Corrective Actions
Element 205.2 - SQN (Continued)		
c. There are no procedures to maintain calculations current.	c. Both past and current TVA engineering procedures (EN DES-EP 3.03, OEP-07, NEP-3.1) require review of calculations that may be affected by or that support changes in design output documents.	c. None required.
WBN	WBN	WBN
(See Element 205.1, issues "c," "d," and "e")	(See Element 205.1)	(See Element 205.1)
BFN	BFN	BFN
(See Element 205.1, issues "c," "d," and "e")	(See Element 205.1)	(See Element 205.1)
BLN	BLN	BLN
(See Element 205.1, issues "c," "d," and "e")	(See Element 205.1)	(See Element 205.1)
********** Element 205.3 - Calculations Record Retention **********		
SQN	SQN	SQN
a. Some design calculations are not stored as quality records.	a. INPO evaluations at Bellefonte in March 1984 (Ref. 41) and at Watts Bar in May 1985 (Ref. 42) found that some electrical calculations were not available. This same deficiency was confirmed at Sequoyah where calculations could not be retrieved to support voltage levels, cable lengths, and diesel generator loads. In the transcript of the NRC investigative interview (Ref. 78), the concerned individual discussed the informal preparation and lack of a quality records storage program for calculations prior to the mid-1970s. The Sargent & Lundy SQN electrical calculation program assessment report (Ref. 59) in April 1986 also concluded that "the majority of calculations, excluding	a. A lower-tier procedure (SQEP-AI-10) is written to supplement the Nuclear Engineering Procedures that control calculation records. This procedure addresses collection, filing, and storage requirements for completed or approved calculations in more detail. The retention, storage, and retrieval of design calculations will be enforced by the implementation of the engineering discipline's calculation program, by audits of calculations performed by Engineering Assurance, by training and by implementation of the lower-tier procedure. (CATD 205 03 SQN 01)

Issues	Findings	Corrective Actions
Element 205.3 - SQN (Continued)		
	those necessary to support restart, were prepared informally by TVA during the design period and were not maintained in a manner, as required by today's standards, that would allow easy retrieval over the life of the plant." The NRC inspection of Sequoyah's design control practices in February 1986 identified the lack of some calculations to support original design. The Sequoyah mechanical group identified missing calculations for a number of plant systems as part of the program to identify essential calculations. Also, some Civil calculations were not available for review by evaluation team members.	The Sequoyah Civil discipline is indexing and categorizing calculations in accordance with its program for implementation of the essential calculation program. The Civil group is preparing written justification for those essential calculations not needed for the restart phase. (CATD 205 01 SQN 01)
b. TVA management is not aware of the requirements of ANSI N45.2.9 for retention of design calculations as permanent plant records	b. In August 1974 TVA committed to Regulatory Guide 1.88, RO, which endorses ANSI N45.2.9-1974. The earliest version of the Engineering Records procedure referenced provisions of the standard in September 1974. Thus, TVA management was indeed aware of the requirements ANSI N45-2.9. Although retention requirements were reflected in department procedures, the absence of some calculations and the difficulties in retrieving many calculations point to a problem in implementing an effective records program. Because a similar problem does not appear to have occurred with design output documents such as drawings, the evaluation team believes that calculation records retention problems resulted from a lack of clear procedures, especially a definition of "final" calculations, and from a lack of management attention to these issues, rather than from ignorance of ANSI N45.2.9 requirements.	b. None required. There is direct evidence that sufficient management attention has been placed on engineering practices and to enforcement of requirements for the retention, storage, and retrieval of design calculations. This evidence can be witnessed by the emphasis placed on the implementation of the engineering discipline's calculation program, by the audits performed by Engineering Assurance (EA) of calculations, by training in accordance with the Nuclear Engineering Procedure (NEP) 1.2, "Training," and by the implementation of Sequoyah Engineering Procedure (SQEP) Administrative Instruction (AI) 10, "Processing and Control of Calculations." (CATD 205 03 SQN 02)
WBN (See Element 205.1; issues "f" and "g") BFN (See Element 205.1; issues "f" and "g") BLN (See Element 205.1; issues "f" and "g")	WBN (See Element 205.1) BFN (See Element 205.1) BLN (See Element 205.1)	WBN (See Element 205.1) BFN (See Element 205.1) BLN (See Element 205.1)

Issues	Findings	Corrective Actions
********** Element 205.4 - Verification/Documentation of Quality Related Design Computer Codes **********		
SQN a. Verification and documentation of quality-related design computer programs are inadequate.	SQN a. The current TVA practices and procedures (NEP-3.8) for verification and documentation of computer programs used in safety-related design on SQN provide a system that addresses the essential elements of the governing standards and regulations. However, the following observations were made in evaluating this system: o The formal TVA program for computer program documentation is recent (1979) relative to design activities for SQN. It is not apparent that retrofit considerations for this documentation have been adequately addressed. o The system has recently undergone considerable organizational change with the establishment of the Engineering Computer Methods Branch (ECB) to centralize DNE computer activities. Procedure upgrades have also recently occurred, and additional procedure changes are apparently in process. o Although recent changes to certain procedures provide upgrades to address computer program verification, the composite set of procedures governing DNE computer activities lack sufficient description of requirements and elements necessary to effectively implement the system for computer program verification and documentation. Program elements such as reporting, Engineering Computer Program Library functions for documentation control, and controls for release of computer programs into production status, are examples of areas where additional coverage could be of benefit.	SQN a. A complete list of computer programs used (past and present) for the generation of design output on SQN will be established by TVA. The process will include a survey of all DNE organizations, to provide information on computer programs used to generate or handle design output. Each identified computer program will be evaluated to determine the level of usage, documentation, and verification. Corrective actions will be taken in accordance with established procedures (ECB EP 28.01, NEP-3.8), to resolve any problems identified in the evaluation process. ECB will have the lead responsibility for this corrective action, and will coordinate activities with the discipline branches. (CATDs 205 04 SQN 01, 02)

Issues	Findings	Corrective Actions
Element 205.4 - SQN (Continued)		
b. There is inadequate control of quality-related design computer programs.	b. The documentation of those computer program verifications reviewed by the evaluator was in general conformance to the requirements of the governing procedure (EP [illegible] EP 3.23 and ECB EP 28.01). However, TVA nonconformance reports document deficiencies regarding the lack of computer program verification documentation for certain programs: o CORAD o STPISOTP o QADISOTP o Various computer programs for the SQN computerized cable routing system and the TVA "Quality Assurance Evaluation Report - Sequoyah Nuclear Plant Computerized Cable Routing System."	b. The TVA corrective action plan will resolve the deficiencies identified in various reports, including: o Update software as required o Review system data files o Develop test files o Document and verify software ECB has lead responsibility for this action and will coordinate with the other disciplines. Appropriate corrective action will be initiated for any problems identified. Any CAQs will be handled as in NEP-9.1. (CATD 205 04 SQN 03)
c. Peripheral finding.	c. In addition to the cases noted in b. of lack of verification documentation, the documentation file for one computer program verification (RESPONSE), was of insufficient legibility to be considered an adequate QA record.	c. DNE/ECB will generate a legible microfilm copy of the RESPONSE computer program verification documentation, as a replacement for the existing record copy. In addition, Procedures will include the requirement for the DNE Computer System Library to verify the legibility of microfilm copies of computer system documentation (existing and future submittals). (CATD 205 04 SQN 05)
d. Positive peripheral finding.	d. As an additional finding, documentation such as user manuals and error reports, necessary for proper control of the computer program activities in the design process, was in general conformance to the requirements of the governing procedure. (With the exception of those cases identified in b.). No major deficiencies were identified in a review of user manuals (Ref. 137) content other than a few administrative anomalies (i.e., no sign-offs on revision/signature sheet, program not identified as "safety-related QA").	d. Procedure NEP-3.8, "Computer Software System Development, Qualification, and Control," includes adequate coverage of such elements as error reporting and DNE Computer System Library functions for documentation and production library controls. Training on the NEP-3.8 requirements will be provided to DNE personnel. (CATD 205 04 SQN 04)

Issues	Findings	Corrective Actions
Element 205.4 - SQN (Continued)		
e. Peripheral finding.	e. In addition, the SQN restart program for review of the essential calculations, referred to as the design calculation verification program (DCVP), does not presently include measures to confirm the existence of computer program verification for those cases where a computer program was utilized in generation an essential calculation.	e. See Corrective Actions for Issue "a" for this element.
f. Peripheral finding.	f. As an additional finding, the accuracy (correctness) of the lists used for distribution of controlled copies of the computer program user manuals is questionable, due to the many TVA personnel shifts occurring since the organization/revision of the lists.	f. DNE/ECB will verify the current user's manual distribution lists and will include the [illegible] requirement for the DNE Computer System Library to periodically verify the distribution lists. (CAID 205 04 SQN 86)
WBN	WBN	WBN
a. Verification and documentation of quality-related design computer programs are inadequate.	a. The current TVA practices and procedures (NEP-3.8) for verification and documentation of computer programs used in safety-related design on WBN provide a system that addresses the essential elements of the governing standards and regulations. However, the following were noted in evaluating this system: o The formal TVA program for computer program verification/ documentation is recent (1979) relative to design activities for WBN. It was not apparent that adequate consideration had been given to retrofitting this documentation. Also, it was not apparent that the lack of required computer program verification documentation is isolated to those cases already documented in TVA nonconformance reports.	a. TVA committed to generate a complete list of computer programs used (past and present) for the generation of design output. The process will include a survey of all DNE organizations to provide information on computer programs used to generate or handle design output. Each identified computer program will be evaluated to determine the level of usage, documentation, and verification. Corrective actions will be taken in accordance with established procedures to resolve any problems identified in the evaluation process. ECB will have the lead responsibility for this corrective action, and will coordinate activities with the discipline branches.

THIS ITEM COMPLETED
DATE 2-18-88

Issues	Findings	Corrective Actions
Element 205.4 - WBN (Continued)		
	o TVA has recently (1984) undergone considerable organizational change with the establishment of the Engineering Computer Methods Branch (ECB) to centralize Division of Nuclear Engineering (DNE) computer activities. Procedure upgrades have also recently occurred, and additional procedure changes are in process.	The TVA corrective action plan will resolve the deficiencies identified in various reports. Corrective actions will be taken in accordance with established procedures to resolve any problems identified in the evaluation process. (CATDs 205 04 NPS 01, 02)
	o The documentation of the computer program verifications reviewed by the evaluator was, in general, in conformance with the requirements of the current governing Nuclear Engineering Procedure (NEP-3.8). However, TVA nonconformance reports document deficiencies in computer program verification/ documentation for various computer programs. In addition, DNE Engineering Assurance (EA) audit 87-06 (12/15-19/86), Sargent & Lundy (S&L) Report on Watts Bar's Electrical Calculation Program (06/03/86) and a Problem Identification Report, PIR GENNEB 8601 (Ref. 55), also document deficiencies in verification/documentation.	PC software will be evaluated to the same procedural requirements as other level 1 and level 2 software since NEP-3.8 also applies to PC software. (CATD 205 04 NPS 03)
	o Documentation necessary for proper control of the computer program activities in the design process, such as user manuals and error reports, was generally in conformance with the requirements of NEP-3.8, "Computer Software System Development, Qualification, and Control."	
	o The use of unverified and undocumented personal computer software for various calculations was identified by TVA. It was not apparent if these are isolated cases or significant concerns that would be applicable elsewhere.	

Issues	Findings	Corrective Actions
Element 205.4 - WBN (Continued)		
b. There is inadequate control of quality-related design computer programs.	b. In evaluating TVA's control of computer program usage, the evaluation team noted that the accuracy and effectiveness of the lists used for distribution of controlled copies of the computer program user manuals is questionable, due to the many recent TVA personnel shifts that have occurred. The evaluator was advised by cognizant TVA personnel that a review and updating of these lists is currently in progress.	DNE/ECB will verify the current user's manual distribution lists and include periodic verification of the distribution lists as a procedural requirement for the DNE Computer System Library. (CATD 205 04 NPS 04)
BFN	BFN	BFN
a. Verification and documentation of quality-related design computer programs are inadequate.	a. The current TVA practices and procedures (NEP-3.8) for verification and documentation of computer programs used in safety-related design on BFN provide a system that addresses the essential elements of the governing standards and regulations. However, the following were noted in evaluating this system: o The formal TVA program for computer program verification/ documentation is recent (1979) relative to design activities for BFN. It was not apparent that adequate consideration had been given to retrofitting this documentation. Also, it was not apparent that the lack of required computer program verification documentation is isolated to those cases already documented in TVA nonconformance reports. o TVA has recently (1984) undergone considerable organizational change with the establishment of the Engineering Computer Methods Branch (ECB) to centralize Division of Nuclear Engineering (DNE) computer activities. Procedure upgrades have also recently occurred, and additional procedure changes are in process. o The documentation of the computer program verifications reviewed by the evaluator was, in general, in conformance with the requirements of the current governing Nuclear Engineering Procedure.	a. TVA committed to generate a complete list of computer programs used (past and present) for the generation of design output. The process will include a survey of all DNE organizations to provide information on computer programs used to generate or handle design output. Each identified computer program will be evaluated to determine the level of usage, documentation, and verification. Corrective actions will be taken in accordance with established procedures to resolve any problems identified in the evaluation process. ECB will have the lead responsibility for this corrective action, and will coordinate activities with the discipline branches. The TVA corrective action plan will resolve the deficiencies identified in various reports. Corrective actions will be taken in accordance with established procedures to resolve any problems identified in the evaluation process. (CATDs 205 04 NPS 01, 02)

THIS ITEM COMPLETED
DATE: 6/14/88

Issues	Findings	Corrective Actions
Element 205.4 - BFN (Continued)		
	However, TVA nonconformance reports document deficiencies in computer program verification/ documentation for various computer programs. In addition, DNE Engineering Assurance (EA) audit 87-06 (12/15-19/86), Sargent and Lundy (S&L) Report on Browns Ferry's Electrical Calculation Program (07/02/86) and a Problem Identification Report, PIR GENNEB 8601 (Ref. 55), also document deficiencies in verification/documentation. o Documentation necessary for proper control of the computer program activities in the design process, such as user manuals and error reports, was generally in conformance with the requirements of NEP-3.8, "Computer Software System Development, Qualification, and Control." o The use of unverified and undocumented personal computer software for various calculations was identified by TVA. It was not apparent if these are isolated cases or a significant concern that would be applicable elsewhere.	PC software will be evaluated to the same procedural requirements as other level 1 and level 2 software since NEP-3.8 also applies to PC software. (CAID 205 04 NPS 03)
b. There is inadequate control of quality-related design computer programs.	b. In evaluating TVA's control of computer program use, the evaluation team noted that the accuracy (currentness) of the lists used for distribution of controlled copies of the computer program user manuals is questionable, due largely to the many recent TVA personnel shifts that have occurred. The evaluator was advised by cognizant TVA personnel that a review and updating of these lists is currently in progress.	DNE/ECB will verify the current user's manual distribution lists and include periodic verification of the distribution lists as a procedural requirement for the DNE Computer System Library. (CAID 205 04 NPS 04) THIS ITEM COMPLETED DATE: 4-88
c. Positive peripheral finding.	c. As an additional finding, corrective action plans are already in place to resolve the deficiencies and concerns noted in the BFN Element Evaluation 205.4. Computer programs where there were problems with verification/documentation for various design calculations were identified. However, it is not necessary to update these calculations unless a need to do so is identified by the required verification/documentation process for the computer programs.	c. No further corrective action required.

Issues	Findings	Corrective Actions
Element 205.4 - BFN (Continued)		
d. Positive peripheral finding.	d. As an additional finding, ECB's reply to DNE's assurance audit 87-06 contains the corrective action plans for the deficiencies identified in the referenced audit. As part of its reply, ECB states: "In addition, ECB is taking the following steps to resolve the issue regarding inadequate verification and documentation of quality-related design computer software: "o Performing a generic evaluation of all level 1 and 2 software systems for adherence to QA program requirements. "o Maintaining and updating the DNE software inventory to contain current descriptions and status on software systems used by DNE. "o Preparing, or assisting in preparation, and reviewing the following documents governing computer software: (a) ONP Standards, (b) DNE procedures, and (c) ECB Branch Instructions. "o Providing additional resources and emphasis on the DNE Computer System Library which includes the control and distribution of DNE's computer systems and associated documentation. "o Staffing to provide DNE support and direction for meeting software system quality assurance requirements."	d. No further corrective action required.

Issues	Findings	Corrective Actions
Element 205.4 - BLN	BLN	BLN
a. Verification and documentation of quality-related design computer programs are inadequate.	a. The current TVA practices and procedure (NEP-3.8) for verification and documentation of computer programs used in safety-related design on BLN provide a system that addresses the essential elements of the governing standards and regulations. However, the following were noted in evaluating this system: o The formal TVA program for computer program verification/ documentation was initiated in 1979, after design activities for BLN were underway. It was not apparent that adequate consideration had been given to retrofitting this documentation. Also, it was not apparent that the lack of required computer program verification documentation is isolated to those cases already documented in TVA nonconformance reports. o TVA has recently (1984) undergone considerable organizational change with the establishment of the Engineering Computer Methods Branch (ECB) to centralize Division of Nuclear Engineering (DNE) computer activities. Procedure upgrades have also recently occurred, and additional procedure changes are in process. o The documentation of the computer program verifications reviewed by the evaluator was, in general, in conformance with the requirements of the current governing Nuclear Engineering Procedure.	a. TVA committed to generate a complete list of computer programs used (past and present) for the generation of design output. The process will include a survey of all DNE organizations to provide information on computer programs used to generate or handle design output. Each identified computer program will be evaluated to determine the level of usage, documentation, and verification. Corrective actions will be taken in accordance with established procedures to resolve any problems identified in the evaluation process. ECB will have the lead responsibility for this corrective action, and will coordinate activities with the discipline branches. The TVA corrective action plan will resolve the deficiencies identified in various reports. Corrective actions will be taken in accordance with established procedures to resolve any problems identified in the evaluation process. (CATDs 205 04 NPS 01, 02)

Issues	Findings	Corrective Actions
Element 205.4 - BLN (Continued)		
	However, TVA nonconformance reports document deficiencies in computer program verification/ documentation for various computer programs. In addition, DNE Engineering Assurance (EA) audit 87-06 (12/15-19/86) and a Problem Identification Report, PIR GENNEB 8601 (Ref. 55), also document deficiencies in verification/documentation. o Documentation necessary for proper control of the computer program activities in the design process, such as user manuals and error reports, was generally in conformance with the requirements of NEP-3.8, "Computer Software System Development, Qualification, and Control." o The use of unverified and undocumented personal computer software for various calculations was identified by TVA. It was not apparent if these are isolated cases or a significant concern that would be applicable elsewhere.	PC software will be evaluated to the same procedural requirements as other level 1 and level 2 software since NEP-3.8 also applies to PC software. (CATD 205 04 NPS 03)
b. There is inadequate control of quality-related design computer programs.	b. In evaluating TVA's control of computer program usage, the evaluation team noted that the accuracy (correctness) of the lists used for distribution of controlled copies of the computer program user manuals is questionable, due largely to the many recent TVA personnel shifts that have occurred. The evaluator was advised by cognizant TVA personnel that a review and updating of these lists is currently in progress.	b. DNE/ECB will verify the current user's manual distribution lists and include periodic verification of the distribution lists as a [illegible] requirement for the DNE [illegible] (CATD 205 04 NPS 04)

THIS ITEM COMPLETED
DATE: 6-14-88

Issues	Findings	Corrective Actions
Element 205.4 - BLN (Continued)		
c. Positive peripheral finding.	c. As an additional finding, corrective action plans are already in place to resolve the deficiencies and concerns noted in the BLN Element Evaluation 205.4. Computer programs where there were problems with verification/documentation for various design calculations were identified. However, it is not necessary to update these calculations unless a need to do so is identified by the required verification/documentation process for the computer programs. EA Audit finding 87-06-04 noted that during implementation of corrective actions to NCR SQN ECB 8501, R0, (similar NCRs were written for BFN and WBN), new conditions adverse to quality were identified which were not documented on the appropriate PIR/SCR form. In response to EA Audit 87-06-04, CAQRs were written for BFN, SQN, and WBN. No CAQR was written for BLN since PIR BLN ECB 8605 (Ref. 55) is a CAQ document and it identified these conditions prior to EA Audit finding 87-06-04.	c. No further corrective action required.
d. Positive peripheral finding.	d. As an additional finding and a positive note, ECB's reply to DNE's EA Audit 87-06 contains the corrective action plans for the deficiencies identified in the referenced audit. As part of its reply, ECB states: "In addition, ECB is taking the following steps to resolve the issue regarding inadequate verification and documentation of quality-related design computer software:	d. No further corrective action required.

Issues	Findings	Corrective Actions
Element 205.4 - BLN (Continued)		
	"o Performing a generic evaluation of all level 1 and 2 software systems for adherence to QA program requirements. "o Maintaining and updating the DNE software inventory to contain current descriptions and status on software systems used by DNE. "o Preparing, or assisting in preparation, and reviewing the following documents governing computer software: (a) ONP Standards, (b) DNE procedures, and (c) ECB Branch Instructions. "o Providing additional resources and emphasis on the DNE Computer System Library which includes the control and distribution of DNE's computer systems and associated documentation. "o Staffing to provide DNE support and direction for meeting software system quality assurance requirements."	

Issues	Findings	Corrective Actions
********** Element 213.1 - Inadequate Management, Control, and Status Listing of AC and DC Electrical Loads ... **********		
SQN a. Ac and dc electrical loads and margins, including diesel generators, are not kept current as changes (additions or deletions of loads) occur.	SQN a. The issue regarding ac and dc electrical loads and margins, has been substantiated as a valid concern. However, actions have been taken by TVA to correct the problem. Specific to the diesel generators, calculation SQN-E3-002 has been issued to document the diesel generator loads. TVA has committed to and is in the process of updating the ac and dc load lists for all electrical systems. The load lists for each system will be incorporated as part of the calculation for the respective system. Updating loads contained in calculations required for restart will be completed prior to Unit 2 restart, and the remaining will be completed as part of the long-term calculation program. Additionally, the evaluation team concurs with the list of required calculations identified by S&L and adopted by TVA.	SQN a. Sequoyah is committed to these actions: 1. Completion of electrical calculations required for restart of SQN, in accordance with the TVA procedures (NEP-3.1 and -6.1, SQEP-Tasks 12, 13, and 15) on calculations from minimum set of electrical calculations. After restart, these calculations will be evaluated under the SQN program and will be revised and/or superseded as applicable. 2. Maintenance of SQN electrical calculations in accordance with the Sequoyah procedures for the review plan for electrical changes. 3. Performance of the remaining calculations in the long-term electrical calculations program (Sargent & Lundy program). 4. Revision of SCR SQNEEB8628 to include reference to CATD 213.01 SQN 01 and Actions "1" and "4" are to be completed prior to Unit 2 restart; action "2" is to be a continuous effort; and action "3" is to be initiated but not completed prior to Unit 2 restart. (CATDs 213 01 SQN 01, 02, and 205 01 NPS 04)

THIS ITEM COMPLETED AT SQN PRIOR TO FUEL LOAD '88 ONLY

Issues	Findings	Corrective Actions
Element 213.1 - SQN (Continued)		
b. Electrical calculations for loads are inadequately prepared and controlled.	b. The issue relating to inadequate preparation and control of electrical load calculations was verified to be a valid concern. However, review of TVA's commitments and corrective actions and of the new procedures indicates that SQN has an adequate program for preparation and control of calculations, and for their revision.	b. See Corrective Actions for Issue "a" for this element.
WBN	WBN	WBN
(See Element 205.1, issues "h" and "i")	(See Element 205.1)	(See Element 205.1)
BFN	BFN	BFN
(See Element 205.1, issues "h" and "i")	(See Element 205.1)	(See Element 205.1)
BLN	BLN	BLN
(See Element 205.1, issues "h" and "i")	(See Element 205.1)	(See Element 205.1)

Issues	Findings	Corrective Actions
********** Element 243.0 - Diesel Design Margins, Inadequate Diesel Generator Margins **********		
SQN	SQN	SQN
a. Diesel generator capacity/margins are inadequate.	a. Diesel generator capacity margin is adequate for restart of Unit 2 with four diesel generators available and Unit 1 in cold shutdown. However, modifications must be made to the load configurations per ECN L6715 (Ref. 75), and operating procedure (AOI-35) require updating to reflect the additional long-term loads that may be tripped.	a. TVA has committed, prior to Unit 2 restart, to complete ECN L6715 (Ref. 75) which implements the design changes required to verify the unverified assumption of the diesel generator (DG) calculation. In addition, after the closure of the ECN, the calculation will be reviewed to ensure all changes necessary to validate the unverified assumptions have been made. These actions should ensure that adequate DG capability for operation of Unit 2 exists. TVA has committed (CATD 243 00 SQN 03) to the revision of "Abnormal Operating Instruction 3[illegible] of Offsite Power" to reflect the additional long-term loads that maybe tripped. This is to be done prior to Unit 2 restart. An action of continued adherence to NEP-3.1, "Calculations," and NEP 9, "Review Plan for Electrical Changes," to ensure that future changes are evaluated for DG loading and that the calculation is revised when necessary, thereby preventing recurrence of the concerns. The former action is to be completed prior to restart of Unit 2 and the latter is to be a continuous effort. (CAIDs 243 00 SQN 01, 03) SQN to revise DNE DG calculation SQN-E3-0002 to reflect two unit operation prior to Unit 2 restart. (CAID 243 00 SQN 02)

THIS ITEM COMPLETED
DATE: 9-30-88

Issues	Findings	Corrective Actions
Element 243.0 - SQN (Continued)		
b. Diesel generator (DG) loading and margin records are inadequately maintained, resulting in a new study every time a question is raised regarding current loads and margins.	b. Diesel generator loading and margin records had not been adequately maintained. To rectify this, TVA has implemented a program to identify, update, and maintain the minimum calculation set. These calculations will be controlled per Nuclear Engineering Procedure on calculations.	b. See Corrective Actions for Issue "a" for this element.
c. Diesel generators were added without updating licensing documents.	c. The fifth DG is not presently included in the SQN licensing documents and is not a licensing issue until it is to be put into operation.	c. None required.
d. Because of inadequate capacity, diesel generators were added.	d. The fifth diesel generator is being added to increase plant availability when one of the four DGs is taken out of service, not for additional capacity.	d. None required.
WBN	WBN	WBN
a. Diesel generator (DG) capacity/ margins are inadequate.	a. TVA has performed calculations which show that the DG loading can be maintained within the capacity/capability of the DGs if plant modifications, currently in the form of unverified assumptions, are implemented. However, the current DG calculation is not final and is subject to further revision. Furthermore, the current DG calculation has loads in excess of those used in the previous voltage study; therefore, a new voltage study will be necessary if the current loads are not reduced such that they are enveloped by the loads used in the previous voltage analysis.	a. TVA has committed to complete the following actions prior to Unit 1 fuel load: o Finalize and document the DG loading as part of the EEB-WBEP long-term calculation program. o Identify any modification required to implement the aforementioned finalized DG loading, document these modifications as part of the corrective action and perform the required design changes per engineering change notice (ECN) 6633. o Perform a new voltage/frequency analysis should the finalized DG loading not be bounded (completely enveloped) by the loading used in the previous voltage/frequency analysis. (CATD 243 00 WBN 01)

Issues	Findings	Corrective Actions
Element 243.0 - WBN (Continued)		
b. DG loading and margin records are inadequately maintained, resulting in a new study every time a question is raised regarding current loads and margins.	b. DG loading calculations were inadequately maintained. Retrievable calculations prior to calculation 285-DS-555RP, R0 (05/14/84) are not available. However, since that time, this calculation has been twice revised and subsequently superseded by WB EPVAR 8608001 (10/01/86), which reflects the current design approach. Furthermore, the current calculation (WB EPVAR 8608001) conforms to and has been controlled by NEP-3.1, "Calculations." In addition, new procedures and programs, as discussed in Watts Bar Element Evaluation 205.1, are now being implemented to ensure that all required electrical calculations are kept up to date as part of the long-term calculation program.	b. See Corrective Action for Issue "a" for this element.
c. DGs were added without updating licensing documents.	c. The additional DG unit (ADGU) was not added without updating licensing documents. TVA first notified the NRC, by letter on 02/16/85 (Ref. 81), of its intent to add a fifth DG and incorporated the design into the FSAR via amendment 57, which was submitted to the NRC on 01/31/86 (Ref. 19).	c. None required.
d. Because of inadequate capacity, DGs were added.	d. The ADGU was not added to increase the auxiliary power system (APS) capacity. WBN design criteria explicitly state that the purpose of the fifth diesel generator is to increase plant availability by functioning as a swing DG that can replace any one of the four primary DGs. The FSAR and design drawings support these design criteria.	d. None required.
BFN	BFN	BFN
a. Diesel generator capacity/margins are inadequate.	a. Diesel generator capacity for long-term steady-state load is adequate (Ref. 139) for unit 2 operation; however, the ability of the DGs to start and run required loads (the intent of Safety Guide 9) has not been demonstrated to be adequate for restart of unit 2 with four diesel generators available and units 1 and 3 in cold shutdown. Similarly, DG capacity and capability has not been demonstrated to be adequate for three-unit operation with eight DGs.	a. The BFN calculations to demonstrate diesel generator adequacy for unit 2 restart including unit 1 and 3 loads necessary for unit 2 restart are being performed and will be complete before unit 2 restart. The calculation to support the simultaneous operation of all three units will be performed before the third unit is restarted. (CATD 243 00 BFN 01)

Issues	Findings	Corrective Actions
Element 243.0 - BFN (Continued)		
		NRC will review the calculations. The calculations include transient analysis and will indicate automatic load sequencing voltage and frequency responses of the generator. The results of the calculation will be used to evaluate compliance with manufacturer specifications for safety related loads. In addition to analysis, restart testing will be performed and NRC will be informed of the results of these tests. (CATD 243 00 BFN 03)
b. Diesel generator (DG) loading and margin records are inadequately maintained, resulting in a new study every time a question is raised regarding current loads and margins.	b. Diesel generator loading and margin records had not been adequately maintained. To rectify this, TVA has implemented a program to identify, update, and maintain the minimum calculation set which includes a DG load study.	b. See Corrective Actions for Issue "a" for this element.
c. Diesel generators were added without updating licensing documents.	c. Licensing documents (the FSAR) do reflect the current standby diesel generator system design.	c. None required.
d. Because of inadequate capacity, diesel generators were added.	d. Diesel generators were added to BFN because of inadequate capacity. However, this was done before operating licenses were issued (Ref. 138).	d. None required.
e. Peripheral finding.	e. As an additional finding, the FSAR does not reflect current DG loading, nor is the extent of compliance to Safety Guide 9 (Ref. 8) clearly stated. The extent of compliance to SG-9 is also ambiguous in the reviewed standby diesel generator system design criteria.	e. CAQR BFF 870088, Rev. 0, has been written to correct FSAR statements including diesel generator loading statements. The commitment to Safety Guide 9 is defined by statements in the FSAR section 8 and as clarified by the response to AEC question 8.2 (03/25/71). Design Criteria (BFN-50-7082 R0) for the standby diesel generator system will be evaluated to determine if TVA's commitments to Safety Guide 9 have been adequately incorporated. A CAQR will be initiated if the commitments to Safety

Issues	Findings	Corrective Actions
Element 243.0 - BFN (Continued)		
		Guide 9 did not get adequately incorporated into the diesel generator design criteria. This action will be tracked in IROI. This is to be done prior to restart of each unit. (CATD 243 00 BFN 02)
BLN	BLN	BLN
a. Diesel generator capacity/margins are inadequate.	a. Diesel generator margins are indeterminate because formal DG load calculations are lacking. A review of the APS load list and the qualification test results indicates that the DG capacity may not be adequate. Furthermore, current design compliance with Regulatory Guide (RG) 1.9 (Ref. 7) is not documented. Both the FSAR and the standby ac APS design criteria were found to commit BLN to full compliance with RG 1.9, R2.	a. Diesel generator loading calculations will be completed and maintained in accordance with Electrical Branch policy memoranda and will have the common loads assigned to the proper generator. Existing preoperational test scoping documents and test instructions will be revised. A preop test will be performed that will require loading in established sequences for LOP and DBE with voltage and frequency response to meet the requirement of RG 1.9, R2. The loading table in the FSAR will be revised to reflect the calculation results. PIR BLNEEB8701 has been written to revise FSAR to comply with RG 1.9, R2. If it is found that significant loads are added after the preop tests, an analysis of preop test data, vendor qualification test and characteristic of the added load will be made to determine what, if any, additional testing is required. If it is found that under certain conditions, loads may exceed generator capability, operator actions to selectively remove optional loads will be incorporated into plant procedures. This is to be done prior to fuel load of each unit. (CATD 243 00 BLN 01)

Issues	Findings	Corrective Actions
Element 243.0 - BLN (Continued)		
b. Diesel generator (DG) loading and margin records are inadequately maintained, resulting in a new study every time a question is raised regarding current loads and margins.	b. There is currently no formal DG calculation. In fact, it appears that there never has been one. This situation has increased the difficulty of determining whether additional loads can be added safely. Furthermore, because there is no DG calculation, the basis for any loading judgment is not defined. This basis would include such factors as assumptions, references, lists of design inputs, etc.	b. See Corrective Actions for Issue "a" for this element.
c. Diesel generators were added without updating licensing documents.	c. Diesel generators have not been added to the BLN design, nor is there any plan to add additional diesel generator units.	c. None required.
d. Because of inadequate capacity, diesel generators were added.	d. Because no diesel generators have been added to the BLN design, this issue is not applicable to BLN.	d. None required.

ATTACHMENT C

REFERENCES

1. 10 CFR 50, Appendix A, "General Design Criteria 17 and 18," (07/07/71)

2. 10 CFR 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants:"

   Criterion III, "Design Control"
   Criterion IV, "Document Control"
   Criterion V, "Instructions, Procedures and Drawings"
   Criterion XVII, "Quality Assurance Records"

3. 10 CFR 50.71, "Maintenance of Records, Making of Reports" (05/03/76)

4. Regulatory Guide 1.64, "Quality Assurance Requirements for the Design of Nuclear Power Plants," Rev. 2, (06/76)

5. Regulatory Guide 1.88, "Collection, Storage, and Maintenance of Nuclear Power Plant Quality Assurance Records," Rev. 2, (10/76)

6. Regulatory Guide 1.81, "Shared Emergency and Shutdown Electric Systems for Multi-Unit Power Plants," Rev. 1

7. Regulatory Guide 1.9, "Selection of Diesel Generator Set Capacity for Standby Power Supplies," Rev. 0

8. Safety Guide 9, "Selection of Diesel Generator Set Capacity for Standby Power Supplies," (03/10/71)

9. ANSI N45.2-1971, "Quality Assurance Program Requirements for Nuclear Power Plants"

10. ANSI N45.2.9-1974, "Requirements for Collection, Storage, and Maintenance of Quality Assurance Records for Nuclear Power Plants"

11. ANSI N45.2.11-1974, "Quality Assurance Requirements for the Design of Nuclear Power Plants"

12. ANSI/ASME NQA-1 (1986 Edition) "Quality Assurance Program Requirements for Nuclear Facilities;" Supplement 3S-1, "Supplementary Requirements for Design Control" (Reference only - not a TVA commitment)

13. IEEE 279-1971, "Criteria for Protection Systems for Nuclear Power Generating Stations"

14. IEEE 308-1971, "Criteria for Class 1E Power Systems for Nuclear Power Generating Stations"

15. IEEE 308-1974, "Criteria for Class 1E Power Systems for Nuclear Power Generating Stations"

16. IEEE 387-1972, "Standard Criteria for Diesel Generator Units Applied as Standby Power Supplies for Nuclear Power Generating Stations"

17. IEEE 387-1977, "Standard Criteria for Diesel Generator Units Applied as Standby Power Supplies for Nuclear Power Generating Stations"

18. IEEE 730-1984, "Software Quality Assurance Plans," (Reference only - not a TVA commitment)

19. Safety Analysis Reports (SARs):

    Sequoyah Final Safety Analysis Report (FSAR) updated through Amendment 3 (04/86)

    Watts Bar Final Safety Analysis Report (FSAR) updated through Amendment 57 (01/31/86)

    Browns Ferry Final Safety Analysis Report (FSAR) Amendment 31, and Updated FSAR (UFSAR), through Amendment 4 (08/86)

    Bellefonte Final Safety Analysis Report (FSAR) updated through Amendment 27 (06/20/86)

20. TVA Topical Report, TVA-TR75-1A, "Quality Assurance Program Description for the Design, Construction, and Operation of TVA Nuclear Power Plants," Rev. 9, (04/17/86)

21. TVA NQAM, Part IV, Section 2, "Design Services," (12/31/84)

22. Sequoyah Nuclear Plant Quality Assurance Manual (SQN QAM) SQN-QAP-III-1.3, "Preparation, Review and Records of Design Computations," Rev. 1 (03/08/70)

23. TVA Nuclear Performance Plans (NPP):

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

24. TVA Division of Engineering Design (EN DES), Engineering Procedures Manual. This evaluation refers to the following:

Volume 1, Section 1.0, Category: General
Volume 2, Section 3.0, Category: Engineering
Volume 3, Section 4.0, Category: Design

TVA, EN DES, Engineering Procedures (EP) reviewed were:

EP 1.14, Rev. 10, "Engineering Records - Retention and Storage," (05/13/83)

EP 2.01, Rev. 6, "Safety Analysis Reports (Amendments and Revisions) - Preparation, Review, and Approval," [ESB 840426 206], (04/24/84)

EP 3.01, Rev. 6, "Design Criteria Documents - Preparation, Review and Approval," [ESB 840514 201], (05/22/84)

EP 3.03, Rev. 8, "Design Calculations," (04/24/84)

EP 3.10, Rev. 7, "Design Verification Methods and Performance of Design Verification," (04/25/85)

EP 3.21, Rev. 2, "Auxiliary Power Load Information System - Development, Review, Verification, Maintenance, and Use," [B42 850326 502], (04/01/85)

EP 3.23, Rev. 3, "EN DES Computer Activities Requiring Quality Assurance - Computer Usage, Computer Program Documentation, and Computer Resident Data," (01/03/84)

EP 3.24, Rev. 1, "Developing and Maintaining Control Power Data Bases," [B42 850326 503], (03/20/85)

EP 4.04, Rev. 9, "Squadcheck Process," (04/24/84)

25. TVA Office of Engineering (OE) Procedures Manual:

OEP-06, Rev. 0 "Design Input," (04/26/85)
OEP-07, Rev. 0 "Calculations," (04/26/85)
OEP-10, Rev. 0 "Review," (04/26/85)
OEP-11, Rev. 0 "Change Control," (04/26/85)
OEP-16, Rev. 0 "Design Records Control," (04/26/85)

26. TVA Division of Nuclear Engineering (DNE) Procedures Manual:

NEP-1.2, Rev. 1	"Training," (01/19/87)
NEP-1.3, Rev. 0	"Records Control," (07/01/86)
NEP-3.1, Rev. 1	"Calculations," (09/27/87)
NEP-3.2, Rev. 0	"Design Input," (07/01/86)
NEP-3.8, Rev. 0	"Computer Software Sys. Development, Qualification, & Control," (02/13/87)
NEP-5.1, Rev. 0	"Design Output," (07/01/86)
NEP-5.2, Rev. 0	"Review Output," (07/01/86)
NEP-6.1, Rev. 0	"Change Control," (07/01/86)
NEP-4.1, Rev. 0	"Procurement," (07/01/86)

27. EEB Engineering Procedures

EP 22.25 (Info. System - Aux. Pwr.), [B42 850702 502], (07/01/85)

EP 22.28 (Info. System - Control Pwr.), [B42 850702 505],(07/01/85)

28. SQN Site Procedures:

Sequoyah Engineering Project (SQEP) - Project Manual, Rev. 0: Section VII, "Project Specific Requirements (Variances/Expansions)," (09/27/85)

Sequoyah Unit 1 Tech. Spec. 3/4.8.1, Amendment 12, "Auxiliary Power Systems (APS)," (03/25/82)

Sequoyah Nuclear Plant, "Design Baseline and Verification Program," Rev. 0, (05/01/86)

SQEP 9, Unissued Rev. 0, "Review Plan for Electrical Changes," (12/09/86)

SQEP 11 - Rev. 4, "Procedure for Identifying and Assembling Change Documentation," (08/18/86)

SQEP 12 - Rev. 2, "Procedure for Evaluating Engineering Change Notice and Field Change Notice Documents," (07/23/86)

SQEP 13 - Rev. 0, "Procedure for Transitional Design Change Control," (07/25/86)

SQEP 15 - Rev. 0, "Procedure for DNE Interface with Change Control Board (CCB)," (05/15/86)

SQEP AI-10 Rev. 0, "Processing and Control of Calculations," (04/29/87)

29. BFN Site Procedures:

Browns Ferry Engineering Project (BFEP) - Project Manual, Rev. 4 (09/29/86)

Browns Ferry Nuclear Plant, "Design Baseline and Verification Program," Rev. 0, [B22 860714 017], (05/01/86)

BFN Site Director Standard Practice (SDSP) 9.1, "Processing Drawing Discrepancies," Rev. 1, (09/22/86)

BFN Site Director Standard Practice (SDSP) 9.2, "Configuration Control Drawings," Rev. 1, (05/09/86)

30. WBN Site Procedures:

Watts Bar Engineering Project Manual, Rev. 1, (01/09/86)

Watts Bar Nuclear Plant, "Design Baseline and Verification Program," Rev. 1, (07/21/86)

31. Bellefonte Engineering Project Manual, Rev. 4, (09/29/86)

32. Design Criteria:

SQN-DC-V-11.1.1 Rev. 0, "Design Criteria for the Additional Diesel Generator," (05/16/80)

WB-DC-40-28.1 Rev. 0, "Design Criteria for the Additional Diesel Generator," (01/19/81)

WB-DC-30-1 Rev. 0, "Emergency Auxiliary AC Power System," (01/15/72)

BFN-50-7200F, "Standby AC Power Supply and Distribution System," Draft D, (01/16/87)

BFN-50-7082, "Standby Diesel Generator System," Draft C, (01/16/87)

33. Division of Engineering Design (EN DES) Electrical Design Standard DS-E-2.2.2 "Performance and Equipment Application Criteria - Medium Voltage Auxiliary Power System Standard," Rev. 0, (12/01/82)

34. TVA OE General Design Criteria, N4-RPD775A, Rev. 5, "Bellefonte Nuclear Plant General Design Criteria for Standby AC Auxiliary Power System," [B05 860703 503], (06/30/86)

35. ECB-EP 28.01, "OE Computer Activities Requiring Quality Assurance - Computer Usage, Computer Program Documentation, and Computer Resident Data," Rev. 0, (07/01/85)

36. Office of Engineering, Special Engineering Procedure, OE-SEP 85-03, "Establishment of Minimum Set of Electrical Calculations," [843 850617 908], (06/17/85)

37. TVA Office of Engineering procedure, OE-OI 2000, "Computer Facilities and Equipment - Administration and Control," (09/27/85)

38. TVA Records Description Handbook, 1985

39. Abnormal Operating Procedure 35, Rev. 7, "Loss of Offsite Power," (10/22/86)

40. INPO Review (WBN-1984), Findings, DC 1.1, "Some calculations have not been performed and some needed design criteria have not been established;" 3.1, "A number of design calculations have not been updated to reflect the actual design"

41. INPO Report, "Construction Project Evaluation, Bellefonte Nuclear Plant units 1 and 2, Tennessee Valley Authority," (03/84)

42. INPO Report, "Evaluation of Watts Bar Nuclear Plant Construction Project, Tennessee Valley Authority," (06/85)

43. TVA memo from Beasley to Those Listed, INPO Final Draft, "Design Calculation," [805 851211 001], (12/11/85)

44. TVA NSRS Report I-84-33-BFN, "Investigation of BFNP Piping and Support Design," (06/07/85)

45. TVA NSRS Report I-85-132-SQN, Diesel Generator Loads, (03/06/86)

46. TVA NSRS Interim Report I-85-992-SQN, "Control of AC and DC Electrical Loads," (03/17/86)

47. TVA NSRS Final Report I-85-992-SQN, "Control of AC and DC Electrical Loads," (04/07/86)

48. OE Bellefonte Electrical Evaluation (BEE) Report, [TAS 850122 001], (01/22/85)

49. Engineering Report, SCR WBNEEB8538 [845 850920 258], (09/16/85)

50. TVA Quality Assurance Evaluation Report, "Evaluation of Computerized Cable Routing Systems - Final report," [B42 861229 006], (12/29/86)

51. TVA Quality Assurance Evaluation Report, "SQN Computerized Cable Routing System" [No RIMS Number], (10/28/86)

52. TVA Quality Assurance Evaluation Report, "BFN Computerized Cable Routing System," [No RIMs Number], (10/28/86)

53. TVA Significant Condition Reports (SCRs):

SCR BFN EEB8511, Rev. 0, "APS Calculations Do Not Reflect As Constructed Conditions," [B43 850801 901], (07/24/85)

SCR BFN EEB8528, Rev. 0, "Failure to Follow Procedures for Calculations," [B43 851031 912], (10/28/85)

SCR BFN EEB8529, Rev. 0, "Failure to Identify the Minimum Set of Calculations Necessary to Document Systems," [B43 851101 921], (10/28/85)

SCR BFN EEB8601, Rev. 0, "Inadequate Documentation of Cable Lengths Used in Calculations," [B43 860115 940], (01/15/86)

SCR BFN EEB8605, Rev. 0, "Inaccurate Transformer Loading Assumptions made in Electrical Calculations," (02/11/86)

SCR BFN EEB8607, Rev. 0, "Calculation Was Approved Without Interface Review," [B43 860214 937], (02/10/86)

SCR SQN EEB8629 Rev. 3, Subject: Violation of Voltage and Frequency Variance

SCR SQN EEB8646 Rev. 1, Subject: Violation of Voltage and Frequency Variance

SCR GEN EEB8606, [B43 861120 905], (11/07/86)

SCR GEN NEB8706, [B45 870128 851], (01/26/87)

SCR GEN ECB8601, Rev. 0, [B42 860203 004], (01/27/86)

SCR WBN EEB8641, Indicates that the FSAR does not correctly reflect the implemented automatic/manual control for the diesel generators during loss of off-site power, [B43 860421 905]

SCR WBN EEB8538, significant conditions report related to diesel generator loading, [B43 850830 902], (08/28/85)

SCR BFN EEB 8604, Rev. 0, "OE Calculation Determines DGs 3A, 3B and 3C Are Overloaded," [B43 860214 905], (02/12/86)

SCR BFN EEB 8630 Rev. 0, "Unanalyzed Loading of the DGs," [B43 860703 914], (06/24/86)

54. TVA Nonconformance Reports (NCRs):

NCR SQN ECB8501, [B45 850422 259], (04/11/85)

NCR GEN ECB8501, [B42 850313 004], (03/13/85)

NCR GEN NEB8501, Rev. 1, [B45 860512 851], (05/13/86)

NCR WBN ECB8501, [B42 850408 001], (04/08/85)

NCR BFN ECB8501, [B42 850415 001], (04/10/85)

NCR BLN ECB8501, [B42 850412 002], (04/10/85)

55. TVA Problem Identification Reports (PIRS):

PIR GEN NEB8601, [B45 860310 852], (03/11/86)

PIR GEN NEB8611, [B45 861230 851], (12/29/86)

PIR BLN ECB8605, Rev. 0, [B42 861016 005], (09/22/86)

PIR BLN EEB 8520 Rev. 0, "Process Loads Not Properly Analyzed for Impact on DG Loading," [B43 851001 910], (09/26/85)

56. TVA report, M. Bender, et al., "Assessment of Engineering Design Control for the Browns Ferry Nuclear Plant," [No RIMS Number], (09/85)

57. Office of Quality Assurance (OQA) Audit Deviation Report D51-A-84-0006, [OQA 840801503], (07/02/84)

58. Division of Quality Assurance, Deviation Report POE-A-85-0003-D03, [No RIMS number], (03/28/85)

59. Sargent and Lundy Final Report, "Sequoyah Nuclear Plant, Nuclear Plant Electrical Calculation Program Assessment," [No RIMS number], (04/08/86)

60. Sargent & Lundy Final Report, "Watts Bar Nuclear Plant, Nuclear Plant Electrical Calculation Program Assessment," [No RIMS number], (06/03/86) TTB-216

61. Sargent and Lundy Final Report, "Browns Ferry Nuclear Plant, Nuclear Plant Electrical Calculation Program Assessment," [B43 860710 001], (07/02/86)

62. Gilbert/Commonwealth Report 2614, "Technical Review of SQN SNP Modifications for TVA," (03/03/86)

63. SQN Supplier Evaluation Data Sheet, Control Data Corp., [L10 860612 809], (06/12/86)

64. TVA Supplier Audit 85V-47, Control Data Corp., [L19 860618 800], (06/18/86)

65. TVA Supplier Audits 83V-17 and 92V-25, Control Data Corp. (Various correspondence and data provided by TVA Transmittal 148)

66. Specification 7500, Rev. A, "General Motors Model 999 System Generating Plant," (06/68)

67. TVA Contract No. 76K61-86181, Specification 2411, "Qualification Testing Procedure for Delaval Engine Generator Set," Rev. 1, (06/30/77)

68. TVA EN DES Calculation TI-ANL-169, "Installation and Verification of MONSTER Version 2.0A," [NEB 841231 235], (12/28/84)

69. EN DES Calculation, TI-ANL-170, "Implementation of RELAP5/MOD2" [B45 850529 235], (05/27/85)

70. DNE Computer System Inventory Current Through 9/12/86 (Draft - Provided by TVA Transmittal 140)

71. TVA DNE Computer System Library Files for Computer Programs: SPIPE, TPIPE, CONAN, FAAST, STP, CH1224, Cable Routing, RESPONSE, HEATING, BASEPLATE II, SPRINKL, FLANGE, BIGIF, FRAP-T6, BBWOLF, CIP

72. TVA OE Calculations:

D286S-DGLDS 50 Rev. 1, without Appendices," Diesel Generator Load Study," [B43 860326 903], (03/26/86)

BFEP-E1-85033, Rev. 1, "Appendix R - Design Load Study for APS," [B22 861002 201], (10/01/86)

73. DNE calculation: Diesel Generator Load Margins SQN-E3-002, Rev. 2, [B43 860827 909], (08/27/86)

74. DNE calculation: Diesel Generator Loading Margins WBPEVAR 8608001, Rev. 0, [B43 861001 915], (10/01/86)

75. Engineering Change Notice, ECN L6715, (09/86)

76. Letter from J. M. Taylor, NRC, to S. A. White, TVA, "NRC Reports 50-327/86-27 and 50-328/86-27," [L44 860506 542], (04/22/86)

77. Letter from J. M. Taylor, NRC, to S. A. White, TVA, "SQN Units 1 and 2, Procurement Inspection, September 15-19, 1986, September 29-October 3, 1986," [A02 861023 019], (10/21/86)

78. Letter from B. J. Youngblood, NRC, to S. A. White, TVA, with the attached transcript of the investigative interview conducted by the NRC on 02/21/86 at the First Tennessee Bank Building in Knoxville, TN [B45 860714 832], (06/23/86)

79. Letter from R. Gridley, TVA, to J. Nelson Grace, NRC, "NRC-OIE Region II Inspection 50-327/86-27 and 50-328/86-27 - Response to Deficiencies and Unresolved Items," [L44 860729 801], (07/28/86)

80. Letter from R. Gridley, TVA, to J. Nelson Grace, NRC, "BFN Units 1, 2 and 3 - Significant Condition Report (SCR) BFN EEB 8511 dated July 24, 1985," [L44 861117 803], (11/17/86)

81. Letter from Shell to NRC (Adensam), Notifies NRC of fifth diesel addition for WBN, [NEB 850220 609], (02/16/85)

82. Letter from W. S. Raughley, TVA, to Carmen Chiappetta, S&L, "Electrical Calculation Program," [No RIMS number], (05/30/86)

83. TVA memo from J. P. Fenton to J. Q. Webber, "Sargent & Lundy Engineers Proposed Services for Electrical Calculations Program," [B43 860827 901], (08/27/86)

84. TVA memo from W. C. Drotleff to Those Listed, "Transition to Division of Nuclear Engineering Procedures" [B05 860410 008], (04/14/86)

85. TVA memo from Chandler to Beasley, "Audit Deviation Report D51-A-84-0006-D01," [B43 851126 936], (11/26/85)

86. TVA memo from J. F. Weinhold to W. S. Raughley and D. W. Wilson, "Office of Engineering (OE) Engineering Assurance Audit 86-17 - Electrical Design Project (SQEP)," [B05 860428 005], (04/28/86)

87. TVA memo from E. G. Beasley to F. W. Chandler, "Audit Deviation Report D51-A-84-0006-D01, Inadequate System to Ensure Calculations Are Updated to Support Design Change Made after Plant Operation," [B05 85 1107 003], (11/07/85)

88. TVA memo from E. G. Beasley to J. A. Crittenden, "Evaluation Report POE-A-85-0003-Control of Design Interfaces," [B05 850531 008], (05/31/85)

89. TVA memo from E. G. Beasley to T. W. Roberts, "OE QMS Audit 85-30 - ECB Methods, Planning, and Development Group," [B05 850614 002], (06/14/85)

90. TVA memo from E. G. Beasley to T. W. Roberts, "OE QMS Audit 85-31 - ECB Technical Services Group," [B05 850729 001], (07/29/85)

91. TVA memo from E. G. Beasley to Quality Management Staff Files, "Deviation Report POE-A-85-0003-D03," [B05 851217 001], (12/17/85)

92. TVA memo from T. W. Roberts to E. G. Beasley, "Response to OE QMS Audit 85-30 - ECB Methods, Planning, and Development Group," [B42 850716 001], (07/16/85)

93. TVA memo from T. W. Roberts to E. G. Beasley, "OE QMS Audit 85-31 ECB TSG," [B42 850916 001], (09/16/85)

94. TVA memo from T. W. Roberts to E. G. Beasley, "Deviation Report POE-8-85-0003-D03," [B42 860110 004], (01/10/86)

95. TVA memo from Cooney to Beasley, "Office of Quality Assurance Audit Report No. D51-A-84-0006," [ESB 840907 003], (09/07/84)

96. TVA memo from J. F. Weinhold to D. W. Wilson, "Division of Nuclear Engineering (DNE) Engineering Assurance Audit 86-23 - Sequoyah Electrical Calculation Restart Issue," [B05 860916 001], (09/16/86)

97. TVA memo from J. F. Weinhold to S. B. Johnston, "Division of Nuclear Engineering (DNE) Engineering Assurance (EA) Audit 87-06 - Engineering and Computer Methods Branch (ECB)," [B05 870129 004], (01/29/87)

98. TVA memo from J. F. Weinhold to E. Chitwood, "Office of Engineering, Engineering Assurance Audit 86-16, Browns Ferry Engineering Project, Electrical Design Project," [B05 860414 003], (04/14/86)

99. TVA memo from J. A. Crittenden to R. W. Cantrell, "OE Response to Deviation POE-A-85-0003-D03," [L19 860114 861], (01/14/86)

100. TVA memo from R. W. Cantrell to R. J. Mullin, "OE Response to Deviation POE-A-85-0003-D03," [B05 860129 001], (01/29/86)

101. TVA memo from W. Zobel to D. T. Clift, "Computer Code COROD," [B45 860505 235], (12/24/86) (TTB 185-4)

102. TVA memo from T. W. Roberts to J. P. Vineyard, "Sequoyah Nuclear Plant Units 1 and 2 - NCR SQNEC88501 - Verification of Computer Cable and Raceway Programs and Data," [B42 851021 004], (10/21/85)

103. TVA memo from Kirkebo to Those Listed, "Design Calculations," [B05 860307 006], (03/07/86)

104. TVA memo from Key to Chandley, "Sequoyah Nuclear Plant - Design Calculation Review," [B44 860729 012], (07/29/86)

105. TVA memo from Chandley to Kirkebo, "SQN - Review of Existing Calculations," [B44 860814 014], (08/14/86)

106. TVA memo from C. A. Chandley to Those Listed, "Policy Memorandum (MEB) - Mechanical Calculations - MPM 86-04," [B44 860625 002], (06/25/86)

107. TVA memo from C. A. Chandley to Those Listed, "All Nuclear Plants - Design Calculation Review," [B44 870522 001], (05/22/86)

108. TVA memo from Raulston to Those Listed, "Design Calculation Verification," [B45 860909 258], (09/09/86)

109. TVA memo from J. A. Raulston to J. A. Kirkebo, "Design Calculations," [B45 860619 252], (06/19/86)

110. TVA memo from J. A. Raulston to Those Listed, "Design Calculation Verification," [B45 861010 259], (10/10/86)

111. TVA memo from Barnett to Kirkebo, "Design Calculations," [B41 860811 013], (08/11/86)

112. TVA memo from R. O. Barnett to Those Listed, "Policy Memorandum PM 86-02 (CEB) - Civil Discipline Policy for Design Calculations," [B41 860616 011], (06/16/86)

113. TVA memo from R. O. Barnett to Those Listed, "Policy Memorandum PM 86-02 (CEB) Rev. 1 - Civil Discipline Policy for Design Calculations," [B41 861202 002], (12/02/86)

114. TVA memo from Johnson to Barnett, "SQN - Policy Memorandum PM 86-02 (CEB) Civil Discipline Policy for Design Calculations," [B25 860819 499], (08/19/86)

115. TVA memo from Johnson to Hernandez, "SQN - Implementation of Sequoyah Civil Discipline Calculation Action Plan," [B25 861117 304], (11/13/86)

116. TVA memo from Raughley to Those Listed, "Policy Memorandum PM 86-15 (ECB) Electrical Calculations Checklist," [B43 860811 903], (08/06/86)

117. TVA memo from W. S. Raughley to Those Listed, "Policy Memorandum PM 86-02 (EEB) - Electrical Calculations," [B05 860508 902], (05/08/86)

118. TVA memo from W. S. Raughley to Those Listed, "Policy Memorandum PM 86-16 (EEB) - Control of Electrical Calculations," [B43 870212 903], (02/11/87)

119. TVA memo from Beasley to Those Listed, "Design Calculation," [B05 851211 001], (12/11/85)

120. TVA memo from D. W. Wilson to R. L. Gridley, [B25 860613 023] Subject: SQN-Electrical Calculation Program

121. TVA memo from C. G. Peterson to Bellefonte Engineering Project Files "BLN, Minimum Set of Calculations," with attached matrix, [B21 860916 004], (09/16/86)

122. TVA memo from R. W. Cantrell to Those Listed, "Bellefonte Nuclear Plant - Electrical Evaluation Plan," [DET 840918 001], (09/18/84)

123. TVA memo from R. W. Cantrell to Those Listed, "Bellefonte Nuclear Plant - Electrical Evaluation Report," [TAS 850122 001], (01/22/85)

124. TVA memo from S. B. Johnston to Those Listed, "Development of an Accurate DNE Software Inventory," [B42 861128 001], (11/28/86)

125. TVA memo from S. B. Johnston to A. P. Capozzi, "Division of Nuclear Engineering (DNE) Engineering Assurance Audit 87-06, Engineering and Computer Methods Branch (ECB)," [B42 870226 005], (02/26/87)

126. TVA memo from R. C. Weir to Those Listed, "Browns Ferry, Sequoyah, Watts Bar, and Bellefonte Nuclear Plant - All Units - NCR - GEN NEB8501, Rev. 1," [B45 870317 252], (03/17/87)

127. TVA memo from J. P. Stapleton to E. P. Schlinger, "Browns Ferry Nuclear Plant - Units 1, 2, and 3 - Engineering Report for CAQ Report SCR GENECB 8601 Rev. 0," [B22 86 0514 001], (05/14/86)

128. TVA memo from J. P. Stapleton to R. L. Lewis, "Browns Ferry Nuclear Plant - Unit 3, SCRBFNECB 8601," [B22 860723 009], (07/23/86)

129. TVA memo from W. C. Drotleff to Those Listed, "Design Basis Program for TVA Nuclear Plants," [B44 860402 007], (04/08/86)

130. TVA memo from M. L. Rayfield to Those Listed, "Watts Bar Nuclear Plant - Program Description for the Watts Bar Design Baseline and Licensing Verification Program, [B26 860721 014], (07/21/86)

131. TVA memo from J. P. Stapleton to Those Listed, (T. L. Brothers, et al), "Browns Ferry Nuclear Plant - Baseline Program Plan, Revision 0, July 7, 1986," [B22 860714 017], (07/07/86)

132. TVA memo from Stapleton to Those Listed, "Browns Ferry Nuclear Plant - Design Basis Effort to Support Restart," [B22 080515 010], (05/15/86)

133. TVA memo Raughley to Raulston, "Watts Bar Nuclear Plant Units 1 and 2 - 10 CFR 50.55(e) - Revised Final report SCR WBN EEB8538," [B43 860423 918], 04/23/86

134. TVA memo from J. R. Lyons II to J. W. Coan, "Watts Bar Nuclear Plant - Pre-INPO Design Evaluation," [B49 851106 001], (11/06/85)

135. TVA memo from H. L. Abercrombie to W. R. Brown, Jr., "Sequoyah Nuclear Plant (SQN) - Employee Concerns Task Group (ECTG) Element Report 205.04 SQN-Engineering Category - Corrective Action Plan (CAP)," [S03 861217 804], (12/19/86)

136. TVA memo from J. R. Parrish to Those Listed, "Browns Ferry Nuclear Plant - Quality Assurance Program," (06/20/72), located in BFN OEDC-QPM 3-73, R1

137. Meetings with DNE Personnel at Knoxville, Tenn. (10/07/86 and 10/08/86), BLT 060

138. Supplement 4 to the Safety Evaluation by the Directorate of Licensing, U.S. Atomic Energy Commission, in the matter of TVA BFNP Units 1, 2, and 3, Dockets 50-259, 260, and 296, (09/10/73)

139. Bechtel calculation, "Diesel Load Study," 2-E9-451, Rev. 3, (03/14/87) TTB-331

140. Teleconference between T. Sarver, Bechtel, and D. Loveless, TVA, (05/06/87), IOM 971