

# EMPLOYEE CONCERNS SPECIAL PROGRAM

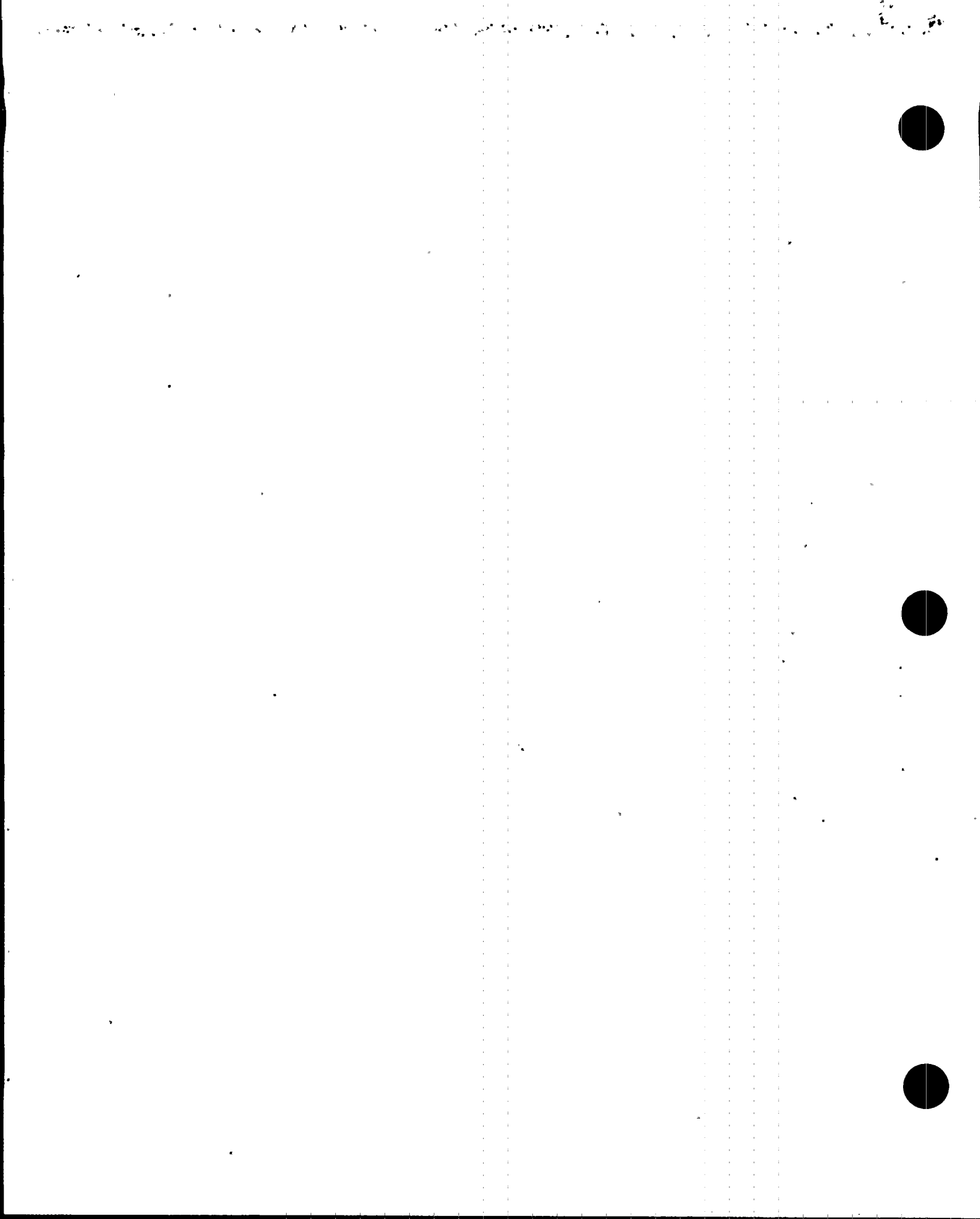
VOLUME 2  
ENGINEERING CATEGORY

SUBCATEGORY REPORT 22800  
UNISTRUT SUPPORT DESIGN

## UPDATED

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TVA EMPLOYEE CONCERNS  
SPECIAL PROGRAM

REPORT NUMBER: 22800

REPORT TYPE: SUBCATEGORY REPORT FOR  
ENGINEERING

REVISION NUMBER: 3

TITLE: UNISTRUT SUPPORT DESIGN

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REASON FOR REVISION:

1. Revised to incorporate initial SRP and TAS comments and BFN and BLN CAPs.
2. Revised to incorporate additional SRP and TAS comments; added Attachment C (References).
3. Revised to incorporate additional SRP and TAS comments.

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EXECUTIVE SUMMARY

This subcategory report summarizes and evaluates the results of the ECSP element evaluations prepared under Engineering Subcategory 22800, Unistrut Support Design. This subcategory addresses employee concerns about the adequacy of supports made of Unistrut members. Unistrut members are cold-formed steel channels that are used as structural elements in component supports. Generally, the employee concerns portray Unistrut to be inherently inadequate for use in Category I applications and that items attached to Unistrut might fall off and damage other items.

The evaluation team found no inherent reason to avoid the use of Unistrut in Category I applications. In fact, this application of Unistrut is commonly used throughout the nuclear industry. However, the evaluation team found that certain deficiencies exist in the calculations intended to document the acceptability of Unistrut, as used in the four TVA nuclear plants: Sequoyah, Watts Bar, Browns Ferry, and Bellefonte.

A total of 31 findings were made in this subcategory. Thirteen required no corrective action. Of the remaining 18, one resulted from a concern raised by a TVA employee and 17 resulted from peripheral findings uncovered during the ECTG review. To resolve the negative findings, Unistrut clamp testing, document and calculation revisions, walkdowns, and broad reevaluation programs all are necessary.

TVA has addressed the 18 negative findings in corrective action plans. Because some of the corrective actions apply to more than one plant, only seven types of corrective actions are required to resolve these findings. The evaluation team reviewed all of the corrective action plans and found them adequate and sufficient to resolve the findings.

The principal causes of the validated issues were a lack of direction from Civil Engineering Branch (CEB) first- and second-line supervision and a lack of Engineering's attention to detail. This lack resulted in inadequate development of design bases, incomplete implementation of design criteria, and the introduction of errors into design calculations.

The ECTG review of TVA's corrective action closure documents found that the problems in CEB first- and second-line supervision persist in the general areas of completeness and compliance.

Although many of the issues addressed in this subcategory were found by the ECTG to be valid, evaluations that have been performed since the concerns were registered indicate that, in general, the existing Unistrut supports are adequate. The corrective actions are expected to result in many documentation changes and possibly minor hardware changes to existing Unistrut supports.

Beyond the specific issues related to design adequacy of Unistrut supports, the negative findings are indicative of broader deficiencies in Engineering's attention to details. The design of nuclear power plants requires the consideration of many items not generally considered in nonnuclear applications. Accordingly, there is a need for first- and second-line engineering supervision to be better trained in the special requirements of nuclear power plant design.

TVA has developed the corporate and plant-specific nuclear performance plans (NPPs) (Ref. 8). These plans identify corrective actions to remedy existing problems and to improve TVA's nuclear program.

The findings of this subcategory are combined with those of other subcategory reports and reassessed in the Engineering category report. The necessary corrective action tracking documents were issued by the evaluation team concurrently with the issue of the Engineering category report, in which the broader issues were assessed.

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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.

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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.



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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.

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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)

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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

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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

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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

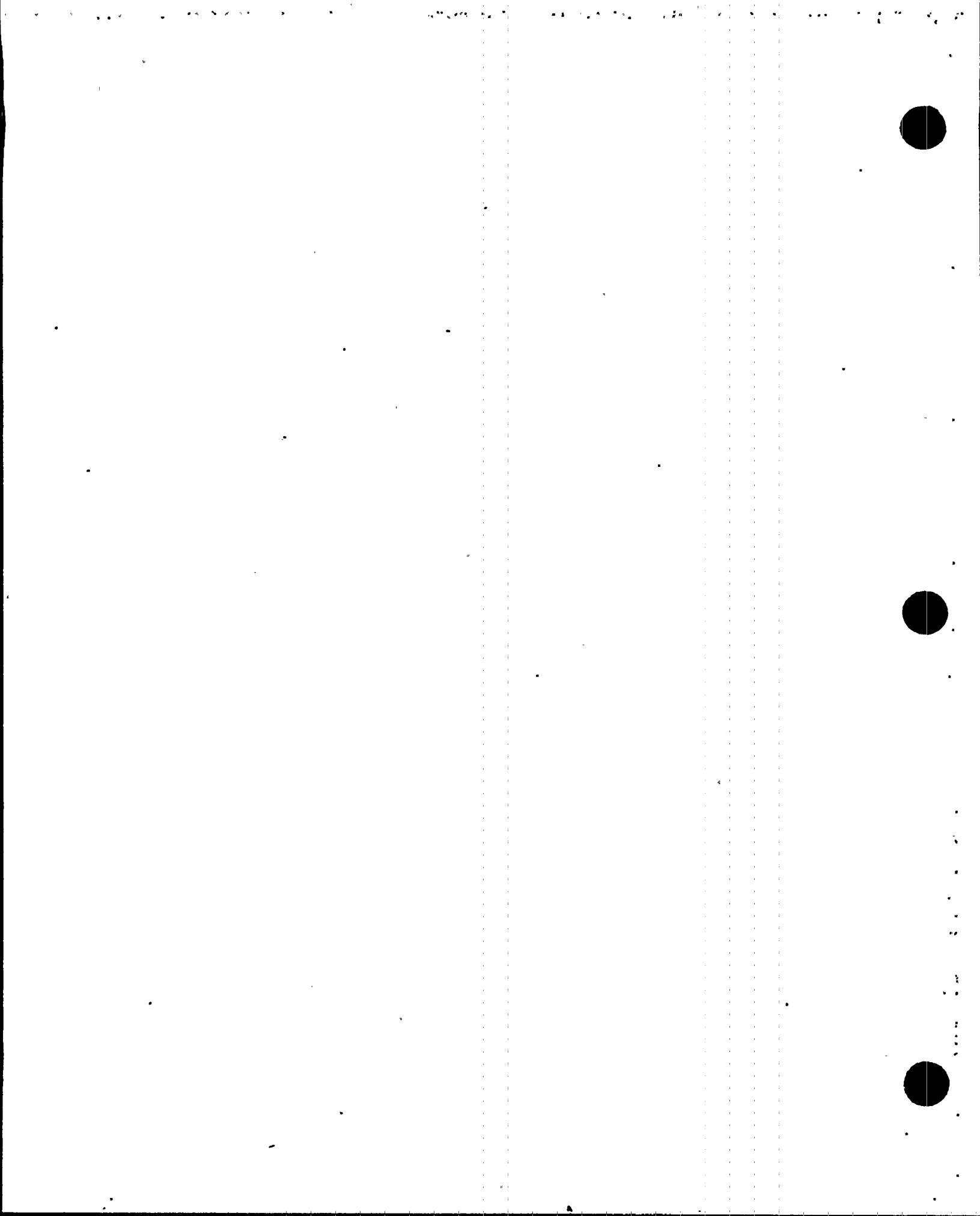
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1. INTRODUCTION

This subcategory report summarizes and evaluates the results of the ECSP element evaluations prepared under Engineering Subcategory 22800, Unistrut Support Design.

The concerns in this subcategory deal with presumed deficiencies or inadequacies in the design of component supports (e.g., instrument tubing supports, conduit supports, pipe supports) made of Unistrut members. Unistrut members are cold-formed steel channels that are used as structural elements (e.g., beams and columns) in component supports. In general, the concerns address the adequacy of using Unistrut as load-carrying elements, the adequacy of clamps used to attach components to Unistrut members, and the adequacy of the design calculations made to document that acceptable safety margins exist for Unistrut supports.

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

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

- o Section 2 -- summarizes, by element, the issues stated or implied in the employee concerns
- o Section 3 -- addresses the determination of generic applicability, cites documents reviewed, and outlines the process followed for the element and subcategory evaluations
- o Section 4 -- summarizes, by element, the findings and identifies the negative findings that must be resolved
- o Section 5 -- highlights the corrective actions required for resolution of the negative findings cited in Section 4 and relates them to element and to plant site; and provides corrective action status
- o Section 6 -- identifies causes of the negative findings
- o Section 7 -- assesses the significance of the negative findings

- o Attachment A -- lists, by element, each employee concern evaluated in the subcategory. The concern number is given, along with notation of any other element or category with which the concern is shared; the plant sites to which it could be applicable are noted; and the concern is quoted as received by TVA, and is characterized as safety related, not safety related, or safety significant
- o Attachment B -- contains a summary of the element-level evaluations. Each issue is listed, by element number and plant, opposite its corresponding findings and corrective actions. The reader may trace a concern from Attachment A to an issue in Attachment B by using the element number and applicable plant. The reader may relate a corrective action description in Attachment B to causes and significance in Table 3 by using the CATD number which appears in Attachment B in parentheses at the end of the corrective action description.

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

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

## 2. SUMMARY OF ISSUES

The ten employee concerns listed in Attachment A for each element and plant have been examined, and the potential problems they raised have been identified in Attachment B as 31 separate issues.

Fourteen of the 31 issues were identified from the ten original employee concerns. The other 17 issues in this subcategory were peripheral findings identified by the ECTG during the review process. Three peripheral findings were identified for WBN, two for SQN, six for BFN, and six for BLN.

A summary of the issues evaluated under this subcategory is given below.

### 228.0, Unistrut Support Design

- o Unistrut material may be unacceptable for use in seismic Category I supports.
- o Because Unistrut may fail, components attached to the Unistrut may fail or become missiles that could damage other items.

- 
- o Unistrut may not be capable of supporting pipes subject to thermal loads.
  - o Unistrut clamps containing 3/8-inch-diameter bolts may be inadequate for supporting 6-inch-diameter piping.
  - o Unistrut may be unacceptable for use in Category I applications because unique material traceability is not maintained.
  - o Instrument tubing may not be able to function properly because the tubing supports attached to Unistrut are not guide-type supports.
  - o Instructions for the use of Unistrut are not provided on the design drawings.
  - o Inspection of Unistrut supports may be inadequate because some of the installation criteria are too strict.

A more detailed description of each issue is provided in Attachment B. This attachment also lists findings and corrective actions, which are discussed in Sections 4 and 5 of this report.

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

### 3. GENERIC APPLICABILITY/EVALUATION PROCESS

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

#### 3.1 Generic Applicability Review

As part of the evaluation process, the employee concerns, which originated for specific TVA nuclear plant sites, were evaluated for their generic applicability to other TVA nuclear plant sites. Applicability was determined with consideration of the concerns' plant-uniqueness and their effect on safety-related structures, systems, and components. The employee concerns were categorized by their impact on safety per ECTG determination criteria as identified in Attachment A. The generic applicability review was done as follows.

Employee Concern WI-85-100-024 (Attachment A) questioned the use of Unistrut in seismic Category I supports at WBN. Also, it raised the concern that such use may compromise the ability of safety-related equipment (supported off Unistrut or adjacent to Unistrut) to perform its intended function. Because this concern was of a generic nature without plant-specific details, similar concerns were generated by the employee concern program for SQN, BFN, and BLN (Concerns XX-85-122-033, XX-85-122-034, and XX-85-122-035 in Attachment A). Employee Concerns IN-85-244-001, IN-85-845-002, and IN-85-283-002 (Attachment A) questioned the use of Unistrut in certain specified applications at WBN. ECTG evaluation of these three concerns at WBN did not reveal any valid safety-related findings, and, therefore, none of these concerns were assessed at SQN, BFN, and BLN. Employee Concerns IN-85-947-001, IN-86-164-001, and IN-86-299-002 (Attachment A) questioned the use of Unistrut in some specific, isolated applications at WBN and, therefore, were evaluated only for WBN.

Furthermore the ECTG noted that the concerns contained in WI-85-100-024, which were assessed for all four nuclear plants, envelope all of the other concerns listed in Attachment A. As a result, resolution of negative findings generated from Concern WI-85-100-024 and similar concerns generated by the employee concerns program will resolve the issues raised in all other concerns contained in this subcategory for all four plants.

### 3.2 Element Evaluation

This subsection describes the steps which constituted the evaluation process. A listing of the documents used in the evaluation process is given in Attachment C.

- a. Defined issues for each of the employee concerns.
- b. Reviewed TVA criteria documents related to the issues to develop an understanding of the design basis.
- c. Reviewed applicable FSAR sections to understand design commitments.
- d. Reviewed design criteria and design reports for seismic Category I supports.
- e. Reviewed typical calculations and design drawings for supports using Unistrut.
- f. Reviewed the test results and calculations that established Unistrut clamp allowable loads.

- g. Reviewed nonconformance reports (NCRs) regarding design and installation of supports using Unistrut.
- h. Reviewed two NRC letters from Youngblood to White regarding employee concerns and NRC investigative interview. (References C.1.f, C.1.g, C.2.g, C.2.h, C.3.d, C.3.e, C.4.d, and C.4.e.)
- i. For WBN, reviewed Nuclear Safety Review Staff (NSRS) Investigative Report I-85-478-WBN, regarding traceability requirements for Unistrut material.
- j. For SQN, reviewed TVA Report I-85-979-SQN, "Unistrut acceptability for use on seismic Category I support."
- k. For BFN, performed a walkdown of selected areas of the Reactor Building to determine the uses of Unistrut material.
- l. For BLN, performed a plant walkdown to determine the uses of Unistrut material.

### 3.3 Subcategory Evaluation

This subsection describes the subcategory evaluation process that was used to evaluate the elements under this subcategory.

- a. Using the results from steps a through l above, evaluated the issues at the subcategory level and determined the findings described in Section 4.0.
- b. Tabulated issues, findings, and corrective actions in a plant-by-plant arrangement (see Attachment B).
- c. Prepared other tables, as needed, 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 using the ECSP definitions.
- e. On the basis of ECSP guidelines, analyzed causes and established the collective significance of the findings.

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

#### 4. FINDINGS

The 31 findings for this subcategory are contained in Attachment B. They are summarized as follows:

228.0, Unistrut Support Design - In overview, this element addresses the concern that Unistrut channels are unacceptable for use as structural members in Category I component supports. This element is also concerned with the adequacy of the hardware used to attach components to Unistrut members. The evaluation team found no validity to the concern that Unistrut is an unacceptable material; when properly supported with testing and design calculations, Unistrut and its attachment hardware are acceptable. In general, TVA performed the required testing and calculations to support its usage of Unistrut. However, in this review, errors, omissions, and discrepancies were found in both the test results and the design calculations. The specific findings that led to the aforementioned conclusions are given below.

Regarding the use of Unistrut at WBN, the evaluation team concluded that Unistrut type materials are acceptable for use in supporting seismic Category I items when they are properly designed to ensure that design loads are within the allowable design limits and when they are properly installed to ensure that they can develop their design allowable loads. The specific documents reviewed are listed in Attachment C. A review of WBN design confirmed that the above requirements are fulfilled with the following exceptions:

- o Discrepancy in design load for pipe support 47A450-8-12 exists between the design drawing and the corresponding design calculation.
- o Discrepancy exists between TVA Singleton Lab (Reference C.1.i.) and Unistrut Corp. test data for Unistrut pipe clamps P2558-20 to P2558-50. (Reference C.1.d.)
- o Discrepancy in allowable clamp loads exists between TVA calculations "Unistrut Pipe Strap Load Ratings," Rev. 2, and "Evaluation of NCR WBN SWP 8237," Rev. 1.
- o TVA calculation "Support Loads for Boric Acid Evaporator Skid," Rev. 0, does not evaluate the adequacy of Unistrut channels used for the double cantilever (L-shaped) typical conduit support detail shown in Drawing 47A056-66B.

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At SQN, the evaluation team concluded that Unistrut type materials are acceptable for use in supporting Category I components provided they are properly designed to ensure that stresses in the channel sections, section-to-section connections, and accessories are within allowable design limits. A review of SQN design confirmed that these requirements are fulfilled with the following exceptions:

- o Discrepancy exists between TVA Singleton Lab (Reference C.2.1.) and Unistrut Corp. test data on Unistrut pipe strap P2558-20 to P2558-40. (Reference C.2.c.)
- o Calculation of double cantilevered conduit hanger was unavailable.

At BFN, the evaluation team concluded that Unistrut type materials are acceptable for use in supporting seismic Category I items when they are properly designed to ensure that design loads are within the allowable design limits and when they are properly installed to ensure that they can develop their design allowable loads. A review of BFN design confirmed that these requirements are fulfilled with the following exceptions:

- o Discrepancy exists between TVA Singleton Lab (Reference C.3.g.) and Unistrut Corp. test data for Unistrut pipe clamps P2558-20 to P2558-50. (Reference C.3.c.)
- o There should be a written requirement to use an interaction equation for design of Unistrut pipe clamps subjected to simultaneous loads in more than one direction. TVA did not specify this requirement, although it is a standard engineering practice for this type of application.
- o Reevaluation programs for seismic Category I small bore piping, tubing, and conduit and their supports must be completed for all BFN units in order to verify the adequacy of Unistrut material used for these supports. These reevaluation programs require upgrading the calculations to current design practices and will include computations not previously performed because BFN was designed before many of the current practices were introduced.

At BLN, the evaluation team concluded that Unistrut type materials are acceptable for use in supporting seismic Category I items when they are properly designed to ensure that design loads are within the allowable design limits and when they are properly installed to ensure that they can develop their design allowable loads. Review of BLN design confirmed that these requirements are fulfilled with the following exceptions:

- o No written justification existed for the relatively high damping ratios used to calculate allowable instrument tubing support loads.
- o A discrepancy existed between the design drawings and the associated engineering reports governing the allowable instrument tubing spans.
- o A discrepancy existed between the design criteria and FSAR for the damping ratio to be used for conduit and conduit support design.
- o DNE calculations for the maximum allowable conduit spans for the Auxiliary, Control, and Diesel Generator Buildings were unconservative.
- o DNE calculations did not evaluate the adequacy of allowable alternate Unistrut channel members.
- o A discrepancy existed in the DNE calculation of typical conduit support for the assumed conduit span.

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

A summary of findings by classification is given in Table 2. Table 2 identifies one finding for each issue evaluated. Of the 31 findings identified in Table 1, 13 required no corrective action. Of the remaining 18 findings requiring corrective action, one resulted from an original issue and 17 resulted from peripheral findings (issues) uncovered during the ECTG evaluation. From Table 2, it can be seen that, at Watts Bar, where most of the issues originated, four out of a total of 11 issues were found to be valid and require corrective action. Finally, Table 2 shows that there were 17 peripheral findings that required corrective action.

## 5. CORRECTIVE ACTIONS

Table 2 identifies 18 findings that require corrective action. Because some of the corrective actions apply to more than one plant, only seven different corrective action descriptions (categories) are required to remedy the 18 negative findings.



### 5.1 Detailed Corrective Actions

The detailed corrective actions are described in Attachment B. A condensation of this information, with the applicable plant(s) identified in parentheses, follows:

#### 228.0, Unistrut Support Design

- o Reevaluate Unistrut pipe/conduit clamp allowable loads. If necessary, retest the clamps and evaluate the effect of the revised allowable loads on conduit support designs (SQN, WBN, BFN).
- o Evaluate the adequacy of the double cantilever conduit supports. If required, perform plant walkdowns to identify as-built locations where the supports were used. Revise the drawings to restrict further use of this detail (SQN, WBN).
- o Revise design support calculations to include correct allowable clamp loads, correct bolt ultimate shear strengths, correct conduit spans, and to address all allowed Unistrut member sizes (WBN, BLN).
- o Add an interaction equation for Unistrut pipe clamps to design criteria and evaluate the effect on conduit support designs (BFN).
- o Reevaluate the criteria and calculations used to qualify safety-related small bore supports, CRD insert and withdrawal piping supports, instrument tubing supports, and conduit supports (BFN).
- o Determine appropriate seismic damping values for instrument tubing and conduit supports. If current values are revised, evaluate effect on support designs (BLN).
- o Determine appropriate spans between supports for instrument tubing and conduit. If current span allowables are revised, evaluate effect on support designs (BLN).

The corrective actions above also appear in Table 3, along with their corresponding finding/corrective action classifications. Table 3 also shows the plant(s) to which a corrective action is applicable (Corrective Action Tracking Document [CATD] column; the applicable plant is identified by CATD number).

From the Finding/Corrective Action Classification column of Table 3, it can be seen that no corrective actions have been identified as requiring hardware or plant modification, but all involve evaluation completion to determine whether

hardware changes are necessary. TVA corrective actions that have been implemented since the concerns were registered have revealed the need for many document changes. A few require other types of corrective actions, such as testing and plant walkdowns.

The evaluation team found the corrective action plans for all four TVA nuclear plants to be acceptable to resolve the findings, and their implementation will be adequate to prevent recurrence.

## 5.2 Corrective Action Status

The corrective actions necessary for SQN restart are complete. The ECTG reviewed the verification documents and issued a verification closeout checklist per BLT 416 (08/11/87) (Reference C.2.s). SQN post-restart activities, and the verification closeout of WBN, BFN, and BLN CATDs, are still open as of Revision 2 of this report.

## 6. CAUSES

Table 3 identifies one or more causes for each problem requiring corrective action and is organized into three major groups: management effectiveness, design process effectiveness, and technical adequacy. An attempt was made to identify the most important cause for each corrective action; however, in most instances, it was felt that the problem was the result of a combination of causes, each of which should be identified.

The totals in Table 3 show that five causes are in the management effectiveness category, 14 are in the design process category, and one is in the technical adequacy category. Thus, consideration of cause showed that, in the area of Unistrut support design, the predominant deficiency was in design process effectiveness.

The most frequent causes indicated in Table 3 are those in columns 9 (Inadequate Design Bases) and 14 (Insufficient Documentation). This frequency reflects the nature of the design process errors identified during the ECTG evaluation.

The responsibility for design of Unistrut supports rests primarily within the Civil Engineering Branch (CEB). The errors in the CEB design calculations arose from use of inadequate design criteria, from use of criteria with inadequate technical basis, and to a lesser extent from inadequate translation of the criteria into the design calculations. Development of more comprehensive design criteria and implementation of more thorough design verifications should have been undertaken by CEB. Such design verifications should include, among other elements, assurance of documented and verified

design assumptions used in calculations, documented engineering judgment, examination of analytical methods and reasonableness of the results, and verification that engineers are properly utilizing the analytical methods.

In this subcategory, management refers to first- and second-line supervision. The extent to which management is engaged in the design was examined on the basis of the findings identified. For the most part, management attention was adequate. However, exceptions were noted in the areas of providing thorough design procedures and monitoring the use of existing procedures and the results of that use. The deficiencies identified through the ECTG reviews should have been recognized by the CEB supervisors.

The difficulties encountered by the ECTG during review of the implementation of the corrective action plans (CAPs) at Sequoyah indicated that the TVA Engineering organization needs to look further for appropriate measures to establish better detailing and monitoring skills. Acceptable CAPs were developed for implementation. When the corrective actions were reported to be complete, the ECTG reviewed the actions taken. In a number of cases, the CAP closures were found to be incomplete. Additional evaluations, clarifications, and a succession of revisions to the CAP closure documents have been required to bring the CAPs to acceptable closure.

The bases for identifying specific causes for each of the seven corrective action descriptions, in the same sequence as in Table 3, are as follows:

- o Review of CEB design of Unistrut conduit clamps found that existing clamp capacity test data were inconsistent, did not support allowable load values given in the design criteria, and did not reflect the surface preparation used on the conduit. For these reasons, "Insufficient Verification Documentation" and "Inadequate Design Bases" were identified as the causes.
- o Review of CEB calculations for double cantilever Unistrut conduit supports found that torsional loading was not evaluated. Follow-up evaluations by CEB, which were reviewed by CEB supervision, were completed, but with recurrence of analytical problems. For these reasons, "Procedures Not Followed," "Lack Of Management Attention," and "Inadequate Calculations" were identified as the causes.
- o Review of CEB conduit support and pipe support calculations found that a number of errors were made in selecting the correct data values from drawings or manuals for items such as allowable bolt shear strengths, allowable clamp loads, and allowable conduit span lengths. For this reason, "Engineering Error" and "Inadequate Calculations" were identified as the causes.

- o Review of BFN design of Unistrut conduit support calculations found that an interaction equation had not been used to combine multidirectional loads acting simultaneously on conduit clamps. This omission left the adequacy of the conduit supports in question. Further evaluation revealed that the design criteria did not contain any requirements for using an interaction equation. For these reasons, "Inadequate Design Bases," "Inadequate Calculations," and "Inadequate Procedures" were identified as the causes.
- o The ECTG found that broad programs were under way at BFN to reevaluate the adequacy of conduit supports, piping supports, and instrumentation supports. The need to implement these broad-based programs indicates that "Inadequate Design Bases," "Inadequate Calculations," and "Insufficient Verification Documentation" were identified as the causes.
- o Review of BLN conduit and instrumentation tubing support designs found that the seismic damping values used in the design calculations were inconsistent both with FSAR commitments and with values given in project design criteria. In addition, in some cases damping values were not stated at all. For these reasons, "Inadequate Calculations," "Inadequate Procedures," "Procedures Not Followed," and "Design Commitment Not Met" were identified as the causes.
- o Review of BLN instrumentation tubing support designs found that allowable tubing span lengths were incorrectly calculated for the Auxiliary Building. Criteria for calculating allowable spans when controlled by tubing clamp strengths were not included in the design criteria. This omission left the adequacy of tubing in the Auxiliary Building in question. For these reasons, "Inadequate Calculations," "Inadequate Procedures," and "Insufficient Documentation" were identified as the causes.

#### 7. COLLECTIVE SIGNIFICANCE

Of the ten concerns expressed in the subcategory Unistrut Support Design, only one led to the need for corrective action as a direct result of the employee concerns. The other corrective actions resulted from peripheral findings uncovered during the ECTG investigation.

When the findings and corrective actions for the four plants are viewed collectively, several overall conclusions emerge:

- o Although many of the issues addressed in this subcategory were found to be valid, evaluations that have been performed since the concerns were registered indicate that the existing Unistrut supports are adequate. Completion of remaining evaluations will determine if any hardware changes are necessary. The corrective actions are expected to result in documentation changes, and the need for plant modifications is expected to be minor.

To a great extent, this adequacy is due to the inherent strength of Unistrut supports, combined with the generally light loads imposed by supported components such as conduit and instrument tubing.

- o Beyond the specific issues related to design adequacy, there is a broader issue of Engineering's lack of attention to details. The design of nuclear power plants requires the consideration of many unique items not generally addressed in non-nuclear applications. Accordingly, there is a significant need for first- and second-line engineering supervisors to be adequately trained in nuclear power plant design requirements.

To address the general broader issues of TVA's past difficulties in the nuclear area, the Corporate Nuclear Performance Plan (CNPP) was created (Ref. 8). In addition, SQN, WBN, and BFN have generated plant-specific nuclear performance plans (NPPs) (Ref. 8) to further define the programmatic actions to be taken for their facilities (BLN is broadly addressed in the CNPP).

In general, TVA senior management has identified the need for strengthening its Engineering organization in responsiveness to the unique requirements of nuclear plant design and quality assurance. The identification of the need for strengthening is based on the previous poor performance in the TVA nuclear program and on the past implementation of the TVA Quality Assurance program. The Engineering organization is responsible for the content and quality of the design documents and ensuring that they conform to sound engineering principles, licensing commitments, and Quality Assurance program requirements. The need for strengthening the Engineering organization, as indicated by the NPPs, is accomplished primarily through additional training of the DNE personnel to the requirements of that program and to basic management principles. DNE Nuclear Engineering Procedure NEP-5.2 (Reference I.2) and policy memo PM 87-35 (Reference I.1) clearly delineate the responsibility, authority, and accountability of the Project Engineers and

Branch Chiefs. The Project Engineer is responsible for work scope, budget, and schedule, and for ensuring that project work is executed according to plan and in conformance with the technical direction of the Branch Chiefs and the requirements of the corporate QA program. The Branch Chiefs are responsible for staffing levels and qualifications of technical personnel on the projects, and for the technical adequacy of the engineering design. The Branch Chiefs are the final technical authority within DNE, and have the authority to stop work that does not conform to established requirements. In the past, Branch Chiefs' authority or resources to fully administer technical reviews was limited. Under the restructured organization, the Branch Chief provides engineers and technical direction for the Project Engineer; the Branch Chief also assesses the need for technical reviews, develops a document review and approval matrix, and schedules reviews as required. These programs have been started but have not, as of Revision 3 of this report, been fully implemented, as evaluation team experience with CAP verifications has indicated. Such experience is discussed in Section 6.0.

An independent audit on the effectiveness of the implementation of the total Quality Assurance program is instituted by Engineering management, as a management tool, to additionally ensure that management policy is being enforced. This audit function is provided by the Engineering Assurance (EA) organization.

The findings of this subcategory are combined with those of other subcategory reports and reassessed in the Engineering Category Report for resolution of the negative findings. That report identifies the necessary corrective actions and provides corrective action tracking documents for their implementation.

TABLE 1  
CLASSIFICATION OF FINDINGS AND CORRECTIVE ACTIONS

Element	Issue/ Finding**	Finding/Corrective Action Class*			
		SQN	WBN	BFN	BLN
228.0 Unistrut Support Design	a	A	A	A	A
	b	A	A	A	A
	c	E6	A	E6	E6
	d	E6	D3	E6	E6
	e	-	A	E6	E6
	f	-	A	E6	E6
	g	-	A	E6	E6
	h	-	A	E6	E3
	i	-	E6	-	-
	j	-	E3	-	-
	k	-	E6	-	-

\*Classification of Findings and Corrective Actions

- |  |                  |
|--|------------------|
| A. Issue not valid.<br>No corrective action required.                                | 1. Hardware      |
| B. Issue valid but consequences acceptable.<br>No corrective action required.        | 2. Procedure     |
| C. Issue valid. Corrective action<br>initiated before ECTG evaluation.               | 3. Documentation |
| D. Issue valid. Corrective action<br>taken as a result of ECTG evaluation.           | 4. Training      |
| E. Peripheral issue uncovered during ECTG<br>evaluation. Corrective action required. | 5. Analysis      |
|  | 6. Evaluation    |
|  | 7. Other         |

\*\*Defined for each plant in Attachment B.

TABLE 2  
FINDINGS SUMMARY

<u>Classification of Findings</u>	<u>Plant</u>				<u>Total</u>
	<u>SQN</u>	<u>WBN</u>	<u>BFN</u>	<u>BLN</u>	
A. Issue not valid. No corrective action required.	2	7	2	2	13
B. Issue valid but consequences acceptable. No corrective action required.	0	0	0	0	0
C. Issue valid. Corrective action initiated before ECTG evaluation.	0	0	0	0	0
D. Issue valid. Corrective action taken as a result of ECTG evaluation.	0	1	0	0	1
E. Peripheral issue uncovered during ECTG evaluation. Corrective action required.	2	3	6	6	17
Total	4	11	8	8	31







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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 licensing and design documents with plant as-built condition was lacking or incomplete.

11. Lack of design detail - Detail in design output documents was insufficient to ensure compliance with design requirements.
12. Failure to document engineering judgments - Documentation justifying engineering judgments used in the design process was lacking or incomplete.
13. Design criteria/commitments not met - Design criteria or licensing commitments were not met.
14. Insufficient verification documentation - Documentation (Q) was insufficient to audit the adequacy of design and installation.
15. Standards not followed - Code or industry standards and practices were not complied with.
16. Engineering error - There were errors or oversights in the assumptions, methodology, or judgments used in the design process.
17. Vendor error - Vendor design or supplied items were deficient for the intended purpose.

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

1. Hardware - physical plant changes
2. Procedure - changed or generated a procedure
3. Documentation - affected QA records
4. Training - required personnel education
5. Analysis - required design calculations, etc., to resolve
6. Evaluation - initial corrective action plan indicated a need to evaluate the issue before a definitive plan could be established. Therefore, all hardware, procedure, etc., changes are not yet known
7. Other - items not listed above

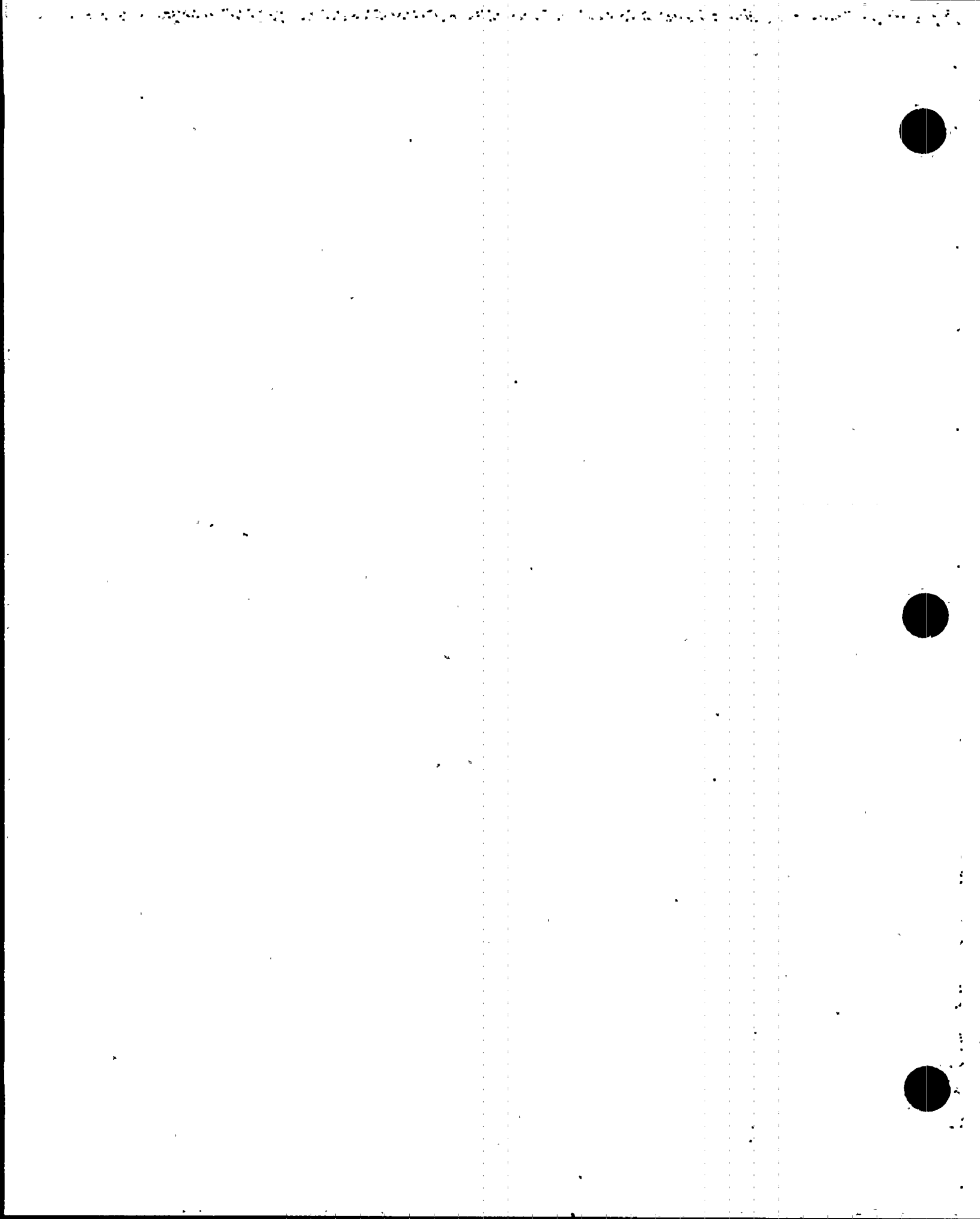
Peripheral Finding (Issue) - A negative finding that does not result directly from an employee concern but that was uncovered during the process of evaluating an employee concern. By definition, peripheral findings (issues) require corrective action.

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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:

- o 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.
- o 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.
- o 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 22800

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

## ATTACHMENT A

## EMPLOYEE CONCERNS FOR SUBCATEGORY 22800

REVISION NUMBER: 3

PAGE A-2 OF 3

ELEMENT	CONCERN NUMBER	PLANT LOCATION	APPLICABILITY				CONCERN DESCRIPTION*
			SQN	WBN	BFN	BLN	
228.0	WI-85-100-024	WBN	X	X	X	X	"Unistrut material is used to support instruments, pipe, conduit, control stations and panels, fluid piping on skids, instrument lines, CO <sub>2</sub> fire protection lines, fire protection water piping, lighting, etc. Unistrut is unacceptable for use as seismic Category I supports and items so supported may either fail or become missiles to cause other safety related equipment to fail. . . ." (SR)
	XX-85-122-033	SQN	X	X	X	X	"Unistrut material is used to support instruments, pipe, conduit, control stations and panels, fluid piping on skids, instrument lines, CO <sub>2</sub> fire protection lines, fire protection water piping, lighting, etc. Unistrut is unacceptable for use as seismic Category I supports and items so supported may either fail or become missiles to cause other safety related equipment to fail. . . ." (SS)
	XX-85-122-034	BLN	X	X	X	X	"Unistrut material is used to support instruments, pipe, conduit, control stations and panels, fluid piping on skids, instrument lines, CO <sub>2</sub> fire protection lines, fire protection water piping, lighting, etc. Unistrut is unacceptable for use as seismic Category I supports and items so supported may either fail or become missiles to cause other safety related equipment to fail. . . ." (SR)
	XX-85-122-035	BFN	X	X	X	X	"Unistrut material is used to support instruments, pipe, conduit, control stations and panels, fluid piping on skids, instrument lines, CO <sub>2</sub> fire protection lines, fire protection water piping, lighting, etc. Unistrut is unacceptable for use as seismic Category I supports and items so supported may either fail or become missiles to cause other safety related equipment to fail. . . ." (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.

(11/18/87)



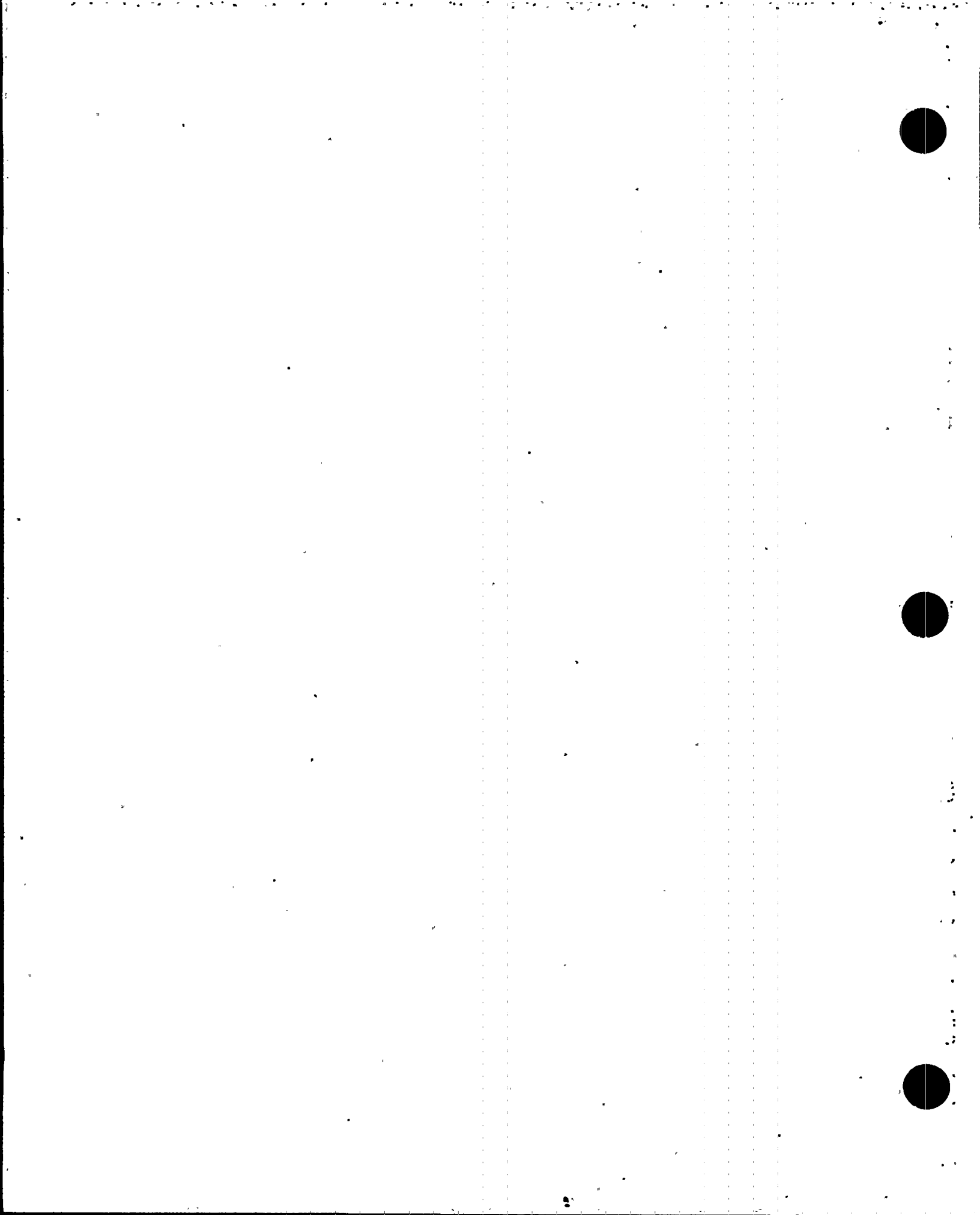
## ATTACHMENT A

## EMPLOYEE CONCERNS FOR SUBCATEGORY 22800

REVISION NUMBER: 3  
PAGE A-3 OF 3

ELEMENT	CONCERN NUMBER	PLANT LOCATION	APPLICABILITY				CONCERN DESCRIPTION*
			SQN	WBN	BFN	BLN	
228.0 (Cont'd)	IN-85-244-001	WBN		X			"TVA uses Type 10A pipe attachment (Ref: Dwg. 053-10A) which utilize Unistrut channel and straps. The supports do not appear strong enough to support the seismic loads associated with 6" stainless steel pipe runs." (SR)
	IN-85-845-002	WBN		X			"Questionable hanger design on System 43 (sampling). Unistrut is used and not uniquely identified. Fasteners that secure tubing to hanger have no guides installed and existing condition will not work under operation. Dwg. 47WA050, there is no mention of Unistrut. There is no documentation to support the use of Unistruts." (SR)
	IN-85-947-001	WBN		X			"Large hangers located throughout Unit #2 and the Aux. Bldg. utilize 3/8" Unistrut bolts to support pipe up to 6". This appears to be under designed in relation to other pipe supports." (SR)
	IN-86-164-001	WBN		X			"Acceptance criteria for Unistrut hangers is too strict. These hangers are being rejected for a deviation of as little as 1/32" in the 1" (typical) dimension between the drilled hole and the edge of the hanger. The hangers are fabricated in accordance with the 'TYPICAL BOOK,' Notes 51-12 and 54-4. This tight tolerance has only recently been enforced, and if the dimension is really this critical, TVA needs to institute a reinspection program to identify previously installed hangers not inspected per the current criteria." (SR)
	IN-86-299-002	WBN		X			"The use of a piece of Unistrut and a bolt on clamp to attach an item to a tube steel/structural shape fabricated hanger appeared to be a 'weak link' in the hanger design, when compared to hangers utilized at other TVA sites." (SR)
	IN-85-283-002	WBN		X			"Pipe at Watts Bar rides on Unistrut which is not sturdy during heat changes. . . ." (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 22800

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

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

ATTACHMENT B  
SUMMARY OF ISSUES, FINDINGS, AND CORRECTIVE ACTIONS  
FOR SUBCATEGORY 22800

REVISION NUMBER: 3  
Page B-2 of 18

Issues

Findings

Corrective Actions

\*\*\*\*\*  
Element 228.0 - Unistrut Support Design  
\*\*\*\*\*

SQN

SQN

SQN

a. Unistrut is unacceptable for use as seismic Category I supports for instruments, pipe, conduit, control stations, panels, fluid piping on skids, instrument lines, CO<sub>2</sub> fire protection lines, fire protection water piping, lighting, etc.

a. Unistruts and their connections are structurally acceptable as seismic Category I supports provided adequate design conditions are utilized. Unistrut material has been used for seismic Category I supports on many licensed nuclear power plants. Therefore, this issue is not valid.

a. None required.

b. Items supported by Unistrut may become missiles and endanger other safety-related equipment if the support fails.

b. When Unistrut material is adequately designed for use as seismic Category I supports, the items supported will not become missiles; therefore, this issue is not valid.

b. None required.

A bolt tightening program undertaken by IVA assures adequate bolt torque of Unistrut type clamps to secure the said commodities firmly to their Unistrut type supports.

ATTACHMENT B  
SUMMARY OF ISSUES, FINDINGS, AND CORRECTIVE ACTIONS  
FOR SUBCATEGORY 22800

REVISION NUMBER: 3  
Page B-3 of 18

Issues

Findings

Corrective Actions

Element 228.0 - SQN (Continued)

c. Peripheral finding.

c. A discrepancy between results from the TVA Singleton Lab and Unistrut Corp. test data needs reconciliation. The allowable loads for Unistrut pipe strap 2 to 4 inches in diameter (P2558-20 to 40) were based on TVA test data which were two to three times higher than Unistrut Corporation's corresponding test data.

TVA will retest the Unistrut standard pipe straps P2558-20 to P2558-40 in the slip-through section to verify the adequacy of the pipe straps. Three samples each of cold-rolled pipe and galvanized conduit will be tested for the cold pipe straps. This test will be performed in accordance with Test Plan CEB-BN-1010 which has been reviewed by the evaluation team and is considered adequate. If test results do not confirm the adequacy of the pipe straps, TVA will identify the extent and nature of the problem and perform further evaluation such as considering the actual design loadings and conditions.  
(CATD SQN 02)

d. Peripheral finding.

d. Design calculations do not exist for double cantilevered conduit supports. TVA EN DES calculations for mechanical seismic supports and an instrumentation rack made of Unistrut materials were reviewed for their adequacy to meet design requirements. The evaluation team found them adequate with the exception that no calculation was made available for review of the double cantilevered conduit hanger shown on Drawing 47A056-668, Rev. 0, where the Unistrut P1000 member may be subjected to torsion.

d. Because of limited use of the double cantilevered conduit hanger as shown on Drawing 47A056-668, Rev. 0, TVA will evaluate the adequacy of the as-built support configurations by performing calculations. If the evaluation shows that the as-built supports do not meet design requirements, TVA will modify supports as required to ensure adequacy. Rev. 1 of Drawing 47A056-668, issued in 11/22/86, has already reaffirmed the future use of the double cantilevered conduit hanger without prior TVA DE approval. Further, the same drawing has been replaced by a new drawing 47A056-1066, R0, in 11/22/86, allowing use of single cantilevered conduit hanger only.  
(CATD SQN 03)

ATTACHMENT B  
SUMMARY OF ISSUES, FINDINGS, AND CORRECTIVE ACTIONS  
FOR SUBCATEGORY 22800

REVISION NUMBER: 3  
Page B-4 of 18

Issues	Findings	Corrective Actions
<p>Element 228.0 - WBN</p> <p>a. Unistrut is unacceptable for use as seismic Category I supports for instruments, pipe, conduit, control stations, panels, fluid piping on skids, instrument lines, CO<sub>2</sub> fire protection lines, fire protection water piping, lighting, etc. Unistrut appears to be a "weak link" in the hanger design when compared to hangers at other TVA plants.</p> <p>b. Items supported by Unistrut may become missiles and endanger other safety-related equipment if the support fails.</p>	<p style="text-align: center;">WBN</p> <p>a. Unistruts and their connections are structurally acceptable as seismic Category I supports provided adequate design conditions are utilized. Unistrut material has been used for seismic Category I supports on many licensed nuclear power plants. Therefore, this issue is not valid.</p> <p>b. When Unistrut material is adequately designed for use as seismic Category I supports, the items supported will not become missiles; therefore, this issue is not valid.</p> <p>For WBN, the adequacy of Unistrut channels and clamps used for seismic Category I supports is assured by the use of allowable loads based on test results and applying the appropriate safety factor. In addition, WBN Drawing Sheets 47A050-1J, -1J1, -1J2, -1J3, and -1K provide installation requirements for Unistrut clamps, including bolt tightening requirements, to assure that the installed clamps will perform their design function.</p>	<p style="text-align: center;">WBN</p> <p>a. None required.</p> <p>b. None required.</p>

ATTACHMENT B  
SUMMARY OF ISSUES, FINDINGS, AND CORRECTIVE ACTIONS  
FOR SUBCATEGORY 22800

REVISION NUMBER: 3  
Page 8-5 of 18

Issues

Findings

Corrective Actions

Element 228.0 - WBN

WBN

c. Unistruts are not sturdy enough to be used for supports for pipes subjected to temperature changes.

c. Review of TVA pipe stress and pipe support calculations by the evaluation team in response to other action concerns has shown that pipe support loads include loads due to piping temperature changes as applicable. c. None required.

One issue questions the adequacy of Unistrut to support pipes subjected to temperature changes. The following TVA design criteria and design reports for seismic Category I supports require that thermal loads be considered for piping analysis:

WB-UC-40-31.3, "Assignment of Responsibility for Analysis, Support, and Fabrication of Piping Systems," Rev. 2

WB-UC-40-31.7, "Analysis of Category I and I(L) Piping Systems," Rev. 7, including a TVA memo from R. O. Barnett to CEB Files, [CEB 841015 015], (10/15/84)

WB-UC-40-31.9, "Location and Design of Piping Supports and Supplemental Steel in Category I Structures," Rev. 5 including a TVA memo from R. O. Barnett to CEB Files [CEB 850123 004], (01/23/85)

WD-UC-40-36, "The Classification of Piping, Pumps, Valves, and Vessels," Rev. 3

CEB Report 75-9, "Design Data for Support of Category I Stainless Steel and Copper Tubing," (10/17/75)

CEB Report 76-5, "Alternate Criteria for Piping Analysis and Support," Rev. 5, (12/14/82)

A review of TVA pipe stress and pipe support calculations by the evaluation team in response to other concerns (e.g., Element evaluations 218.1[A] and 218.4[A]) showed that piping thermal loads have been considered:

Memo (no names, telecopied 01/28/87 14:24), attachment captioned: "3.0 Unit 1 Hanger and Analysis Update Program," [no RIMS number], (no date)

ATTACHMENT B  
SUMMARY OF ISSUES, FINDINGS, AND CORRECTIVE ACTIONS  
FOR SUBCATEGORY 22800

REVISION NUMBER: 3  
Page B-6 of 18

Issues

Findings

Corrective Actions

Element 228.0 - WBN

WBN

Bechtel Plant Design Calculation Number PD-218-10,  
Rev. 0, Job Number 16985-026, (08/18/87)

TVA memo from Bill Carson to Nick Liakonis, drawings  
attached from problems 26030, 67019, N3-67-A18A,  
31023, N3-40-A11C, and N3-59-A01A, [no RIMS number],  
(05/28/86)

TVA, marked copy telecopied 06/11/86 12:26, with  
attachments, [no RIMS number], (no date)

"Corrective Action Response Evaluation" (marked:  
"NSRS reply"), [no RIMS number], (08/05/85)

OE-SEP 82-18, TVA, WBN, "Program for Alternate  
Analysis Fix - Coordinating, Documenting, and  
Verifying," Rev. 3, [no RIMS number], (no date),  
Rev. 2, [B26 850503 001], (05/03/83)

TVA memo from R. O. Barnett to J. A. Raulston, "Watts  
Bar Nuclear Plant Units and 2 - Program Deficiency:  
Alternately Analyzed Piping - . . . ."  
[CEB 850123 008], (01/23/85)

TVA memo from J. A. Raulston to J. W. Huffam, "Watts  
Bar Nuclear Plant Unit 2 - Program Deficiency:  
Alternately Analyzed Piping - . . . ."  
[B45 851219 264], (12/19/85)

NCR WBN SWP 8231, [SWP 820616 006], (prepared 06/16/82)

ECH 3213, [SWP 830120 526], (01/20/83)

Therefore, the Unistrut channels and clamps used for pipe  
supports have been designed for loads due to piping  
temperature changes.



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Element 228.0 - WBN

WBN

d. Unistrut with 3/8-inch-diameter bolts appears to be underdesigned for use as seismic Category I supports for 6-inch-diameter pipe in relation to other pipe supports.

d. Evaluation of 6-inch-diameter seismic Category I pipe supports using Unistrut pipe clamps with 3/8-inch-diameter bolts is included in TVA calculation "NCR WBN 8501 Tightening of P2558 Unistrut Clamp," RO. The evaluation team found that this calculation uses an incorrect value for the design load for support 47A450-8-12.

Initial element evaluation indicated that Support 47A050-8-15 also did not meet design criteria. However, subsequent evaluation team review indicates that this support is adequate. CATD 228 00 WBN 01 has not been revised to reflect this change, but it is appropriately addressed in the associated CAP.

d. TVA ONE (Knoxville) will revise calculation "NCR WBN CEB 8501 Tightening of P2558 Unistrut Clamp," RO [841 850305 945] to reflect the current support design loads parallel to the Unistrut axis for Support 47A450-8-12. TVA ONE (Knoxville) will also revise calculation "Unistrut Clamp Pipe Support - NCR WBN CEB 8501," RO [841 850307 008] to demonstrate the adequacy of the Unistrut clamp for this support.  
(CATD WBN 01)

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<b>Element 228.0 - WBN (Continued)</b>		
<p>e. The hanger design on Sampling System 43 is questionable since Unistrut used as support material is not uniquely identified.</p>	<p>e. Nuclear Safety Review Staff (NSRS) Investigation Report No. I-85-478-WBN addresses the issues of Unistrut material traceability and unique identification of instrument line supports for Sampling System 43. The DNE response to the NSRS report states that physical marking of Unistrut material is not required since it is identifiable by its unique shape and that unique identification of instrument line supports is not necessary to meet regulatory requirements or WBN licensing commitments. The evaluation team concurs that physical marking of Unistrut material, for traceability is not required and notes that this has not been required for other nuclear power plants.</p>	<p>e. None required.</p>
<p>f. Fasteners securing instrument sampling line tubing to supports do not have guides installed. Therefore, the existing configuration will not work properly during plant operation.</p>	<p>f. Guides or shims are used for 2-way or nonaxial supports. NSRS Investigation Report I-85-478-WBN states that NSRS walked down several supports for Sampling System 43 and found that guides had been furnished in accordance with the corresponding support detail drawings.</p>	<p>f. None required.</p>
<p>g. Drawing 47A050 does not cover the use of Unistrut. (Note: Dwg. 47MA050 is believed to be 47A050. The "H" and "A" designations are drawing sizes only.) No documentation exists approving or supporting the use of Unistrut.</p>	<p>g. Drawings 47A050-1J, -1J1, -1J2, -1J3, and -1R provide general notes regarding the use of Unistrut channel and clamps for supports for all systems including Sampling System 43.</p>	<p>g. None required.</p>

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Element 228.0 - WBN (Continued)

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|---|--|--|
| <p>h. Acceptance criteria in the "TYPICAL BOOK" for Unistrut hangers are too strict. Strict acceptance criteria for Unistrut hangers have only recently been enforced. If the dimension is critical, previously installed hangers need to be reinspected.</p> <p>i. Peripheral finding.</p> | <p>h. For typical support detail Drawing 47A051-12 the tolerance for location of drilled holes in Unistrut channel is <math>\pm 1/8</math> inch rather than <math>\pm 1/32</math> inch as stated in the concern. The evaluation team does not consider this tolerance to be too strict. Since the dimension is not critical, reinspection of previously installed supports is not required.</p> <p>i. Unistrut pipe strap capacities determined in tests performed by TVA Singleton Labs and Unistrut Corp. are not consistent for all clamp sizes. The evaluation team found that results from the TVA Singleton Lab tests conducted in 1975 and the Unistrut Corp. tests conducted in 1977 on Unistrut pipe strap P2558 series were in general agreement. However, for straps 2 to 5 inches in diameter (P2558-20 to 50) and load-tested in the direction parallel to the pipe axis, the ultimate load obtained from Singleton's test was two to three times higher than Unistrut's. The allowable loads for Unistrut pipe strap given in the WBN Pipe Support Design Manual (PSDM) are based on the TVA Singleton test results.</p> | <p>h. None required.</p> <p>i. TVA DNE (Knoxville) will reevaluate Unistrut clamp test data from tests made by TVA Singleton Laboratories and Unistrut Corporation including the new data from Singleton for SQN [B46 870109 001] for Unistrut P2558-20 to P2558-40 clamps for load parallel to the pipe axis. For the P2558-50 clamp, the SQN test data will be extrapolated if a reasonable data curve fit can be obtained. If not, the clamp will be tested to establish appropriate data values. If, on the basis of this evaluation, TVA determines that the allowable clamp loads given in the PSDM are not conservative, the PSDM will be revised to include the correct values and a CAQ will be initiated. The corrective action to resolve this potential CAQ could include a sampling of installed supports, a design evaluation, and modifications to installed supports as necessary.<br/>(CATD WBN 02)</p> |
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Element 228.0 - WBN (Continued)

j. Peripheral finding.

j. The evaluation team found that DNE calculations "NCR WBN SWP 8230 Evaluation," R1, and "NCR WBN CEB 8501 Tightening of P2558 Unistrut Clamp," RU, do not contain any documented justification for using clamp test capacities without a factor of safety. TVA agreed to revise the calculations to add the necessary justification as documented in telecon IOM 639.

In a subsequent telecon documented in IOM 692, TVA informed the evaluation team that a DNE calculation "Unistrut - Clamp Pipe Support NCR-WBN CEB 8501," RO, justifies using clamp test capacities without a factor of safety. A review of this calculation by the evaluation team confirmed that justification is adequate. As DNE calculation "NCR WBN CEB 8501 Tightening of P2558 Unistrut Clamp," RU, refers to this calculation, no further justification needs to be added to DNE calculation "NCR WBN CEB 8501 Tightening of P2558 Unistrut Clamp," RO. CATD 228 00 WBN 03 has not been revised to reflect this change, but it is appropriately addressed in the associated CAP.

The evaluation team also found that DNE calculation "Unistrut Pipe Strap Load Ratings," R2 used allowable clamp loads for Condition 1 (load parallel to Unistrut) which are more than twice the values used in TVA calculation "Evaluation of NCR WBN SWP 8237," R1. TVA agreed to revise the calculation(s) to reconcile this discrepancy as documented in telecon IOM 639.

j. TVA DNE (Knoxville) will revise calculation "NCR WBN SWP 8230 Evaluation," R1, to include justification for a factor of safety of one against slip. This will include a reference to calculation "Unistrut Clamp Pipe Support NCR WBN CEB 8501," RO. (CATD WBN 03)

TVA DNE (Knoxville) will revise calculation "Evaluation of NCR WBN SWP 8237," R1, [WBP 840629 003] to correct the bolt ultimate shear strength value used in this calculation. (CATD WBN 04)

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Element 228.0 - WBN (Continued)

k. Peripheral finding.

k. Design calculations do not exist for double cantilevered conduit-supports. The evaluation team found that WBN uses a typical conduit support detail with a double cantilever (L-shaped) configuration in Drawing 47A056-66B similar to the drawing for SQN. SQN Element Report 228.0(B) includes corrective action for this item. WBN ONE calculation "Support Loads for Boric Acid Evaporator," RU addresses one specific use of this detail. However, this calculation only tabulates the reactions at the base of the conduit supports and does not check the adequacy of the Unistrut channels. The adequacy of the Unistrut channel members subjected to torsion due to the double cantilever configuration has not been demonstrated.

k. TVA previously identified the questionable adequacy of the conduit support detail shown on Drawing 47A056-66B. This is documented by SCR WBN CEB 8675, R1 which was upgraded from PIR WBN CEB 8675. TVA has placed hold H-233 on Drawing 47A056-66 (including sheets 66A and 66B) to prevent future use of this detail. The corrective action from this CAQ is presently under development but will include at least one of the following:

- o Appropriate revisions to existing support designs
- o A walkdown to gather data for installed support evaluation
- o Following an assessment of the quantities of this support type actually installed, a determination will be made as to further action to resolve this issue by:
  - Performing structural calculations
  - Conducting physical tests
  - Modifying supports

(CATD WBN 05)



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Element 228.0 - BFN (Continued)

c. Peripheral finding.

c. Unistrut pipe strap capacities determined in tests performed by TVA Singleton Labs and Unistrut Corp. are not consistent for all clamp sizes. The evaluation team found that the allowable loads used for Unistrut P2558-20 to P2558-50 pipe clamps for the load direction parallel to the pipe axis ("slip through" direction) are based on test values from Singleton Lab tests which are two to three times the values obtained from tests by Unistrut Corporation.

c. TVA will retest the Unistrut standard pipe strap P2558-20 to P2558-40 in the slip-through direction to verify the adequacy of the pipe straps. Three samples each of carbon pipe and galvanized conduit will be tested for the said pipe straps. This test will be performed in accordance with Test Plan CEB-BN-1019 which has been reviewed by the evaluation team and is considered adequate. For the P2558-50 clamp, the test data will be extrapolated if a reasonable data curve fit can be obtained. If not, the clamp will be tested to establish appropriate data values. If test results do not confirm the adequacy of the pipe straps, TVA will identify the extent and nature of the problem and perform further evaluation such as considering the actual design loadings and conditions. The corrective action relies on/takes credit for SCR BFN CEB 8701 RO and SCR BFN CEB 8702 RO that address the load capacity inconsistency for Unistrut P2558-Series. Revise QIR-CEB-87-099 to incorporate available allowables for B-Line B2400-Series clamps. Incorporate the QIR in the BFN Pipe Support Design Handbook. Review existing calculations for Unistrut P2558-Series or similar clamps using allowables given in QIR-CEB-87-099.  
(CATD BFN 01)

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Element 228.0 - BFN (Continued)

d. Peripheral finding.

d. The evaluation team found that there is no written requirement to use an interaction equation for design of Unistrut pipe clamps. (Standard engineering practice utilizes applicable interaction equations when designing structural fasteners subjected to simultaneous loads in more than one direction; thus, there is no referenceable source document.) Although each of the calculations reviewed by the evaluation team properly used an interaction equation, since the evaluation team reviewed only several calculations, it is unable to conclude that an interaction equation has been properly used in all existing calculations. Therefore, Unistrut clamps subjected to simultaneous loads in more than one direction may not have been designed properly.

d. Revise the Calculation Review Program to include verification of the proper use of interaction equations to qualify Unistrut type clamps. Include the use of an interaction equation to qualify these clamps in the Pipe Support Design Handbook for BFN as a normal design practice. Modify or exclude interaction equations when justified in calculations for specific cases.  
(CATD BFN 02)

e. Peripheral finding.

e. TVA has not completed a reevaluation program regarding the design of safety-related small bore piping. The evaluation team found that TVA is developing a program to reevaluate all safety-related small bore piping systems excluding the CRU insert and withdrawal system. The evaluation team reviewed the proposed scope of this program and considers that the completion of the program for all BFN units will demonstrate the adequacy of Unistrut material used for supports for safety-related small bore piping systems, excluding the CRU insert and withdrawal system.

e. Walkdown and evaluate the small bore piping required for plant shutdown to assure their seismic adequacy. Prepare calculations to document installation adequacy. Perform any necessary modifications resulting from these walkdown evaluations. Evaluate supports using Unistrut-type materials. Provide future modifications based on valid design output documents followed by appropriate verification to prevent recurrence.  
(CATD BFN 03)



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Element 228.0 - BFN (Continued)

f. Peripheral finding.

f. TVA has not completed a reevaluation program regarding the design of CRU insert and withdrawal piping. The evaluation team found that a reevaluation program for the CRU insert and withdrawal system piping and supports for unit 2 is in progress. The evaluation team reviewed examples of typical engineering calculations and design drawings for required pipe support modification and found them to be generally adequate. The evaluation team considers that the completion of the program for all BFN units will demonstrate the adequacy of Unistrut material used for supports for the CRU insert and withdrawal system.

f. Completed walkdown, established geometry, and finalized evaluation for seismic adequacy for the unit 2 CRU insert and withdrawal system piping and its supports using Unistrut type materials. Issued required modifications under ECN P0859. Evaluate unit 1 and 3 CRU systems required similar to unit 2. Produce unique support drawings and pipe routing drawings for each unit CRU system to prevent recurrence.  
(CATD BFN 04)

g. Peripheral finding.

g. TVA has not completed a reevaluation program regarding the design of Category I tubing. The evaluation team found that TVA plans to perform a walkdown and an engineering evaluation and to implement all necessary modifications for all seismic Category I tubing for all BFN units. The evaluation team considers that the completion of these actions will demonstrate the adequacy of Unistrut materials used for supports of seismic Category I tubing.

g. Review all design drawings to identify all seismic Class I tubing installations and walkdown the tubing installations identified. Document the tubing configurations and support type and locations. Prepare calculations to document the installation adequacy. Perform any required modifications to establish seismic adequacy. Prepare design output documents routing isometrics and support details or calculations or both to document installed adequacy. Use BFEP PI 86-39 to prevent recurrence.  
(CATD BFN 05)

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<b>Element 228.0 - BFN (Continued)</b>		
h. Peripheral finding.	h. IVA has not completed a reevaluation program regarding the design of conduit supports. The evaluation team found that a reevaluation program for all conduit and conduit supports installed in Class I structures before 05/84 is in progress. The evaluation team reviewed examples of typical engineering calculations for conduit supports for unit 2 and common and found them to be generally adequate. The evaluation team considers that the completion of the program for all BFN units will demonstrate the adequacy of Unistrut materials used for conduit supports in Class I structures.	h. Completed walkdowns and evaluations for the conduit and conduit supports installed before May 1984 in accordance with BFEPI-PI 85-02 for unit 2 and common. Issued support and support modification drawings. Complete implementation of required modifications. Conduct walkdowns and evaluations to complete units 1 and 3 in accordance with approved procedures before the respective unit restart. Prevent recurrence of any non-engineered conduit support being installed in the plant by implementing current design procedures and implementing Site Director Standard Practice (SDSP 6.1), which prohibits any alteration to conduits and/or conduit supports without DNE approval. (CATD BFN 06)
<b>BLN</b>	<b>BLN</b>	<b>BLN</b>
a. Unistrut is unacceptable for use as seismic Category I supports for instruments, pipe, conduit, control stations, panels, fluid piping on skids, instrument lines, CO <sub>2</sub> fire protection lines, fire protection water piping, lighting, etc.	a. Unistruts and their connections are structurally acceptable as seismic Category I supports provided adequate design conditions are utilized. Unistrut material has been used for seismic Category I supports on many licensed nuclear power plants. Therefore, this issue is not valid.	a. None required.
b. Items supported by Unistrut may become missiles and endanger other safety-related equipment if the support fails.	b. When Unistrut material is adequately designed for use as seismic Category I supports, the items supported will not become missiles; therefore, this issue is not valid.	b. None required.
	In addition, Unistrut bolt-tightening requirements for BLN will ensure that the bolted connections will develop their design loads.	

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Element 228.0 - BLN (Continued)		
c. Peripheral finding.	c. The evaluation team found that no written justification exists in ONE calculation "Instrument Line Tubing Supports - Allowable Loads" for the use of relatively high damping ratios to calculate allowable tubing support loads.	c. Revise calculations "Instrument Line Tubing Supports - Allowable Loads" [B21 850809 422] and "Instrument Tubing Support Seismic Capacity Determination" [B21 850401 417] to include justification for the relatively high damping ratios used for instrument tubing supports.  Also revise FSAR Section 3.7 to document the use of variable damping ratios used for instrument tubing. TVA has prepared proposed FSAR revisions which include this change as documented by a TVA memo from Barnett to Raulston (06/10/85) [B41 850610 018] and by a TVA memo from Raulston to Huffman (07/03/85) [B45 850703 260]. (CATD BLN 01)
d. Peripheral finding.	d. The evaluation team found a significant discrepancy between the maximum allowable tubing spans given on Drawing 5GB0925-10-28 and in CEB Report 78-11.	d. Calculation "Documentation for CEB Report 78-11, Design Data for Support of Category I Stainless Steel & Copper Tubing," RO [B41 850419 001] supersedes CEB Report 78-11, R4, and provides maximum allowable instrument tubing spans that agree with values given on Drawing 5GB0925-10-28, R7. Therefore, no corrective action is required. (CATD BLN 01)
e. Peripheral finding.	e. The evaluation team found a discrepancy in the damping ratio used for conduit and conduit support design between Design Criteria N4-50-D718 and FSAR Subsection 3.10.3.	e. Revise Design Criteria N4-50-D718 and FSAR Subsection 3.10.3 to include conduit and conduit support damping ratios measured in dynamic tests. Revise calculations and modify installations, if necessary. (CATD BLN 01)

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Element 228.0 - BLN (Continued)		
f. Peripheral finding.	f. The evaluation team found that the maximum allowable conduit spans for the Auxiliary, Control, and Diesel Generator Buildings given in ONE calculation "Auxiliary, Control and Diesel Generator Building, Conduit Support Typical Seismic" result in conduit clamp loads that exceed the allowable clamp loads.	f. Revise design documents as required to reflect the Unistrut P2558 clamp allowable loads and the interaction equation specified in QIR CEB-87-099 [B41 870710 250]. Revise calculations and modify installations, if necessary. (CATD BLN 01)
g. Peripheral finding.	g. The evaluation team found that ONE calculation "Reactor Building, Typical Seismic Conduit Supports" did not evaluate the adequacy of Unistrut P3300 channel for the typical conduit support detail shown on Drawing 4RA0560-X2-58.	g. Revise calculation volume 4R2-560C, titled "Reactor Building Typical Seismic Conduit Supports," [B21 851115 401] to include an evaluation of the adequacy of Unistrut channel P3300 for typical seismic conduit support details shown on Drawings 4RA0560-X2-58 and 4RA0560-X2-76. Since the use of Unistrut channel as a structural member for reactor building typical seismic conduit support details is limited to these two drawings, no revisions of other calculations are required. (CATD BLN 01)
h. Peripheral finding.	h. The evaluation team found a discrepancy in the assumed conduit span in ONE calculation "Reactor Building, Typical Seismic Conduit Supports" for the typical conduit support detail shown on Drawing 4RA0560-X2-58.	h. Revise calculation volume 4R2-560C, titled "Reactor Building Typical Seismic Conduit Supports" [B21 851115 401] to delete the incorrect 7 foot conduit span for the typical seismic conduit support detail shown on Drawing 4RA560-X2-58. No revisions of other calculations are required for the same reason as stated in the above item. Modify conduit installations, if required. (CATD BLN 01)

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ATTACHMENT C

REFERENCES

A. FSAR [no RIMS numbers]

1. WBN FSAR through Amendment 54, (01/09/85):
  - Section 2.5, "Geology, Seismology, and Geotechnical Engineering Summary of Foundation Conditions"
  - Section 3.1, "Conformance with NRC General Design Criteria"
  - Section 3.2, "Classification of Structures, Systems, and Components"
  - Section 3.7, "Seismic Design"
2. SQN FSAR Update through Amendment 3:
  - Section 2.5, "Geology and Seismology"
  - Section 3.1, "Conformance with NRC General Design Criteria"
  - Section 3.2, "Classification of Structures, Systems, and Components"
  - Section 3.7, "Seismic Design"
3. BFN FSAR Update through Amendment 4:
  - Appendix A, "Conformance to AEC Proposed General Design Criteria," (submitted to NRC on 08/06/86)
4. BLN FSAR through Amendment 27:
  - Section 2.5, "Geology, Seismology, and Geotechnical Engineering"
  - Section 3.1, "Conformance with NRC General Design Criteria"
  - Section 3.2, "Classification of Structures, Components, and Systems"
  - Section 3.7, "Seismic Design"
  - Table 3.7.1-2, "Damping Ratios Used in Analysis of Category I Structures, Systems, Components, and Soil"

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Subsection 3.10.3, "Methods and Procedures of Analysis or Testing of Supports of Electrical Equipment and Instrumentation"

B. Design Criteria [no RIMS numbers]

1. For Watts Bar:

- a. WB-DC-40-31.3, "Assignment of Responsibility for Analysis, Support, and Fabrication of Piping Systems," Rev. 2
- b. WB-DC-40-31.7, "Analysis of Category I and I(L) Piping Systems," Rev. 7, including a TVA memo from R. O. Barnett to CEB Files, [CEB 841015 015], (10/15/84)
- c. WB-DC-40-31.9, "Location and Design of Piping Supports and Supplemental Steel in Category I Structures," Rev. 5, including a TVA memo from R. O. Barnett to CEB Files [CEB 850123 004], (01/23/85)
- d. WB-DC-40-31.10, "Seismically Qualifying Conduit Supports," Rev. 3
- e. WB-DC-40-31.11, "Support of Lighting Fixtures in Category I Structures," Rev. 0
- f. WD-DC-40-36, "The Classification of Piping, Pumps, Valves, and Vessels," Rev. 3
- g. Pipe Support Design Manual (PSDM), Section 9.4, "Unistrut Data," Rev. 3, (06/12/85)
- h. Pipe Support Design Manual (PSDM), Section 9.4, "Unistrut Data," Rev. 0, (05/18/82)

2. For Sequoyah:

- a. TVA SQN Design Criteria SQN-DC-V-3.0, "The Classification of Piping, Pumps, Valves, and Vessels," Rev. 2
- b. TVA SQN Design Criteria SQN-DC-V-13.7, "Alternate Piping Analyses and Support Criteria for Category I Piping Systems," Rev. 2
- c. TVA SQN Design Criteria SQN-DC-V-24.1, "Location and Design of Piping Supports and Supplemental Steel in Category I Structures," Rev. 0

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- d. SNP General Design Criteria for Seismically Qualifying Conduit Supports, SQN-DC-V-13-10, Rev. 2
  - e. SNP General Design Criteria for Support of Lighting Fixtures in Category I Structures, SQN-DC-V-13.11, Rev. 1
  - f. Appendix F of Sequoyah Nuclear Plant Quality Assurance Manual, "Design Criteria for Qualification of Seismic Class I and Class II Mechanical and Electrical Equipment," Rev. 2
  - g. TVA Civil Engineering Branch Report CEB 75-9, "Design Data for Support of Category I Stainless Steel and Copper Tubing," Rev. 1
  - h. TVA SQN Pipe Support Design Manual, Volume 3, Section 9.4, Rev. 1, (07/22/86)
  - i. TVA WBN Pipe Support Design Manual, Volume 3, Section 9.4, Rev. 3 (06/12/85)
3. For Browns Ferry:
- a. Design Criteria BFN-50-712, "Seismically Qualifying Field Run Piping, (sizes 1/2 through 2 inches)," Rev. 4, (11/27/85)
  - b. Design Criteria BFN-50-713, "Seismically Qualifying Field Run Tubing (sizes 1/4 through 1-1/2 inches)," Rev. 2, (08/27/84)
  - c. Design Criteria BFN-50-714, "Conduit Support Seismic Design," Rev. 0, (01/14/71)
  - d. Project Instruction BFEP-PI 85-02, "Seismic Qualification of Existing Electrical Conduit and Conduit Supports," Rev. 3, (10/15/86)
  - e. Design Criteria BFN-50-723, "Seismically Qualifying Conduit Supports," Rev. 0, (03/28/86)
  - f. WBN Pipe Support Design Manual, Section 9.4, Rev. 0, (05/18/82)
4. For Bellefonte:
- a. Design Criteria N4-50-D718, "Seismically Qualifying Conduit Supports," Rev. 1, (09/12/84)

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C. Reports, Letters, and Memos

1. For Watts Bar:

- a. CEB Report 75-9, "Design Data for Support of Category I Stainless Steel and Copper Tubing," [no RIMS number], (10/17/75)
- b. CEB Report 76-5, "Alternate Criteria for Piping Analysis and Support," Rev. 5, [no RIMS number], (12/14/82)
- c. TVA Topical Report TVA-TR75-1A, "Quality Assurance Program Description for the Design, Construction, and Operation of TVA Nuclear Power Plants," [no RIMS number], Rev. 8
- d. Unistrut Corporation Test Report C-36-A, "P-2558 Series Pipe or Conduit Clamps," [no RIMS number], (05/13/77)
- e. NSRS Report I-85-478-WBN, "Unapproved Use of Unistrut Hangers on System 43, Sampling and Water Quality," [no RIMS number], (11/20/85)
- f. Letter from B. J. Youngblood, NRC, to S. A. White, TVA, "Concerns Regarding TVA Nuclear Program," [L44 860226 001], (02/18/86)
- g. 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)
- h. Letter from R. D. Walker, NRC, to H. G. Parris, TVA, "Meeting Summary - Watts Bar Nuclear Plant, Unit 1, Docket 50-390," [A02 850717 002], (07/15/85)
- i. TVA Singleton Laboratory Clamp Test Report; TVA memo from R. O. Lane to G. G. Stack, "Sequoyah Nuclear Plant - Units 1 and 2 - Requisition 79211 - Unistrut P2558 Pipe Clamps," [no RIMS number], (07/28/75)
- j. TVA memo from J. C. Standifer to Those Listed, "Watts Bar Nuclear Plant Units 1 and 2 - Nonconformance Report WBNSWP8237," [SWP 830128 053], (01/25/83)
- k. TVA memo from R. O. Barnett to J. C. Standifer, "Watts Bar Nuclear Plant Units 1 and 2 - Nonconformance Report WBNCEB8408 (CEB 840427 021)" [CEB 840806 010], (08/06/84)



1. TVA memo from D. G. Domer to W. T. Cottle, "Watts Bar Nuclear Plant Units 1 and 2 - Requirements for Traceability of Materials and Identification of Supports - Employee Concern IN-85-845-002," [no RIMS number], (02/05/86)
- m. Telephone call from R. Roberts (Bechtel) to F. L. Ginn, A. Manzano (TVA), IOM 639, [no RIMS number], (02/12/87)
- n. Telephone call from F. L. Ginn (TVA) to R. Roberts (Bechtel), IOM 692, [no RIMS number], (02/23/87)
2. For Sequoyah:
  - a. CAQ Engineering Report for SCR SQN CEB 8612, [no RIMS number], (06/03/86)
  - b. TVA Nuclear Safety Review Staff NSRS Investigation Report I-85-979-SQN, "Unistrut Acceptability for Use on Seismic Category I Supports," [no RIMS number], (03/11/86)
  - c. Unistrut Corporation Test Report C-36-A, "P-2558 Series Pipe or Conduit Clamps," [no RIMS number], (5/13/77)
  - d. TVA Employee Concerns Sequoyah Element Report 223.1(B), "Instrument Support Design," [no RIMS number], Rev. 1
  - e. NSRS Report I-85-478-WBN, "Unapproved Use of Unistrut Hangers on System 43, Sampling and Water Quality," [no RIMS number], (11/20/85)
  - f. TVA Test Plan CEB-BN-1019, "SQN-Axial Load Capacity of Unistrut P-2558 Clamps," Rev. 0, [no RIMS number], (12/18/86)
  - g. Letter from B. J. Youngblood, NRC, Director PWR Project Directorate #4, NRR to S. A. White, TVA, Manager of Nuclear Power, "Concerns Regarding TVA Nuclear Program," [L44 860226 001], (02/18/86)
  - h. Letter from B. J. Youngblood, NRC, Director PWR Project Directorate #4, NRR to S. A. White, TVA, Manager of Nuclear Power, "Transcript of Interview ...," [B45 860714 832], (06/23/86)
  - i. TVA letter from G. R. McNutt to G. L. Parkinson, "Employee Concern Evaluation Program - SQN Restart Program - Corrective Action Plan," TCAB-019, [no RIMS number], (12/05/86)

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- j. TVA memo from R. O. Barnett to J. P. Vineyard, "NCR SQN SWP 8305 - Bolt Tightening Requirements," [B41 851009 001], (10/09/85)
  - k. TVA memo from J. C. Standifer to Those Listed, "NCR WBN SWP 8237," [SWP 830128 053], (01/25/83)
  - l. TVA Singleton Laboratory Clamp Test Report; TVA memo from R. O. Lane to G. G. Stack, "Transmittal of Unistrut Clamp Load Test Data," [no RIMS number], (07/28/75)
  - m. TVA memo from R. O. Barnett to J. P. Vineyard, "SCR SQN CEB 8612 Specific Bolt Tightening Instructions," [B41 860220 005], (02/19/86)
  - n. TVA memo from R. E. Field, Jr., and W. J. Kagay to SQN Engineering Project Files, "SQN SCR SQN CEB 8612 - Technical Justification for Bolt Tightening Recommendations," [B25 860815 019], (08/15/86)
  - o. TVA WBN memo from R. G. Domer, Acting Director of Engineering Projects Nuclear, to W. T. Cottle, Site Director, WBN, [no RIMS number], (02/05/86)
  - p. TVA memo from J. A. Raulston to R. O. Barnett, "SQN Unistrut One- and Two-Piece Tubing Clamps with Stainless Steel Tubing," [B46 860612 001], (06/16/86)
  - q. TVA memo from J. P. Vineyard to Those Listed, "NCR SQN SWP 8213," [PWP 830803 009], (08/03/83)
  - r. TVA letter to Bechtel (TLB-044), "WBN-Employee Concerns Evaluation Program - Job 16985-026," [U10 861010 801], (10/10/86)
  - s. Letter from G. L. Parkinson, Bechtel, to G. R. McNutt, TVA, "CATD 228 00 SQN 02 and 03 Verification," BLT-416, [no RIMS number], (08/11/87)
3. For Browns Ferry:
- a. NSRS Report I-85-478-WBN, "Unapproved Use of Unistrut Hangers on System 43, Sampling and Water Quality," [no RIMS number], (11/20/85)
  - b. Test Plan CEB-BN-1002, "Seismic Testing of Selected Configuration Groups of Aluminum Electrical Conduits for the Browns Ferry Nuclear Plant," Rev. 0, included in Test Report 17743-1, [B41 861028 009], (10/28/86)

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- c. Unistrut Corp. Test Report C-36-A, "P-2558 Series Pipe or Conduit Clamps," [no RIMS number], (05/13/77)
  - d. Letter from B. J. Youngblood, NRC, to S. A. White, TVA, "Concerns Regarding TVA Nuclear Program," [L44 860226 001], (02/18/86)
  - e. 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)
  - f. Letter from TVA to Gilbert/Commonwealth, Inc., requesting proposal for reevaluation of small bore piping and supports, [B41 861124 013], (11/24/86)
  - g. TVA Singleton Laboratory Clamp Test Report; TVA memo from R. O. Lane to G. G. Stack, "Sequoyah Nuclear Plant - Units 1 and 2 - Requisition 79211 - Unistrut P2558 Pipe Clamps," [no RIMS number], (07/28/75)
  - h. TVA memo from G. R. Hall to R. O. Barnett, "Browns Ferry Nuclear Plant Units 1-3 - NRC IE Bulletin 79-14 - Qualification of Unistrut Pipe Clamps," [BWP 831207 011], (12/07/83)
  - i. TVA memo from R. O. Barnett to G. R. Hall, "Browns Ferry Nuclear Plant - Qualification of Unistrut Pipe Clamps - Standalone Quality Information," [CEB 840124 007], (01/24/84)
  - j. Telecon memo from J. Marshall, TVA, to J. L. Boulay, Impell, regarding award of contract for reevaluation of CRD insert and withdrawal piping and supports, [no RIMS number], (10/31/85)
  - k. TVA memo from W. T. Cottle to K. W. Whitt, "Watts Bar Nuclear Plant - Response to Employee Concern Investigation Report I-85-478-WBN (Employee Concern Number IN-85-845-002)," [no RIMS number], (02/11/86)
  - l. TVA memo from N. R. Beasley to E. P. Schlinger, "Browns Ferry Nuclear Plant - Discontinuing Use of Typical Conduit Support Drawings," [822 860301 004], (03/01/86)
  - m. TVA memo from N. R. Beasley to E. P. Schlinger, "Browns Ferry Nuclear Plant - Discontinuing Use of Typical Conduit Support Drawings," [822 860417 014], (04/17/86)

4. For Bellefonte:

- a. CEB Report 78-11, "Design Data for Support of Category I Stainless Steel and Copper Tubing," Rev. 4, [no RIMS number], (01/23/84)
- b. Unistrut Corporation Test Report C-36, "Test of P2558 Series Pipe Clamps," [no RIMS number], (04/24/73)
- c. NSRS Report I-85-478-WBN, "Unapproved Use of Unistrut Hangers on System 43, Sampling and Water Quality," [no RIMS number], (11/20/85)
- d. Letter from B. J. Youngblood, NRC, to S. A. White, TVA, "Concerns Regarding TVA Nuclear Program," [L44 860226 001], (02/18/86)
- e. 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)
- f. TVA memo from R. M. Hodges to Those Listed, "Bellefonte Nuclear Plant - Nonconformance Report No. BLN BLP 8224," [BLP 830228 037], (02/25/83)
- g. TVA memo for F. Van Meter to R. M. Hodges, "Bellefonte Nuclear Plant - Testing of Instrument Tubing Supports - Phase I," [CSB 821110 302], (11/09/82)
- h. TVA memo from F. Van Meter to R. M. Hodges, "Bellefonte Nuclear Plant - Testing of Instrument Tubing Supports - Phase II," [CSB 821216 301], (12/16/82)
- i. TVA memo from F. Van Meter to R. M. Hodges, "Bellefonte Nuclear Plant - Testing of Instrument Tubing Clamps and Fittings," [CSB 830525 301], (05/25/83)
- j. TVA memo from J. A. Raulston to R. M. Hodges, "Bellefonte Nuclear Plant - Instrument Tube Clamp Load Testing," [B46 850411 002], (04/12/85)
- k. TVA memo from W. T. Cottle to K. W. Whitt, "Watts Bar Nuclear Plant - Response to Employee Concern Investigation Report I-85-478-WBN (Employee Concern Number IN-85-845-002)," [no RIMS number], (02/11/86)

D. Specifications and Procedures [no RIMS numbers]

1. For Watts Bar:

General Construction Specification G-43, "Support and Installation of Piping Systems in Category I Structures," Rev. 8, (08/08/85)

2. For Sequoyah:

TVA SQN Construction Specification N2C-946, "Requirements for Tightening of Non-high Strength Bolts in Friction-type Connections," Rev. 0

3. For Browns Ferry:

(None)

4. For Bellefonte:

Quality Control Procedure BNP-QCP-4.3, "Instrument Tubing Installation," Rev. 13, (06/25/86)

E. NCRs and SCRs

1. For Watts Bar:

a. NCR WBN SWP 8237, [SWP 820630 013], (06/30/82)

b. NCR WBN CEB 8408, [CEB 840427 021], (04/27/84)

c. "NCR WBN SWP 8230 Evaluation," Rev. 1, [B26 850305 076]

d. "NCR WBN CEB 8501 Tightening of P2558 Unistrut Clamp," Rev. 0 [B41 850305 945]

e. "Unistrut - Clamp Pipe Support NCR-WBN CEB 8501," Rev. 0 [B41 850307 008]

2. For Sequoyah:

(None)

3. Browns Ferry:

a. NCR WBN SWP 8237, Rev. 0, [SWP 820630 013], (06/30/82)

b. SCR BFN CEB 8520, Rev. 0, [B41 851112 016], (11/12/85)

- c. SCR BFN EEB 8543, Rev. 0, [B43 851224 908], (12/24/85)
- d. SCR BFN EEB 8543, Rev. 1, [B22 861117 033], (11/17/86)
- e. SCR BFN CEB 8701, Rev. 0, [B41 870213 011], (02/13/87)
- f. SCR BFN CEB 8702, Rev. 0, [B41 870213 008], (02/13/87)

4. For Bellefonte:

(None)

F. Calculations

1. For Watts Bar:

- a. "Unistrut Pipe Strap Load Ratings," Rev. 2 [WBP 840801 037]
- b. "Evaluation of NCR WBN SWP 8237," Rev. 1 [WBP 840629 003]
- c. "Calculations for Pipe Support 47A051-51," Rev. 1  
[B41 861106 903]
- d. "Calculations for Pipe Support 47A051-52," Rev. 0  
[B41 860409 907]
- e. "Typical Pipe Support 47A052-24," Rev. 0 [B41 860519 918]
- f. "Typical Pipe Support 47A052-30," Rev. 0 [B41 860519 911]
- g. "Calculations for Pipe Support 47A054-25," Rev. 1  
[B41 860507 920]
- h. "Support Loads for Boric Acid Evaporator Skid," Rev. 0  
[B41 860521 900]
- i. "Typical 47A061-13," Rev. 0 [B41 860506 908]
- j. "NCR WBN SWP 8230 Evaluation," Rev. 1 [B26 850305 076]
- k. "NCR WBN CEB 8501 Tightening of P2558 Unistrut Clamp," Rev. 0  
[B41 850305 945]
- l. "Unistrut - Clamp Pipe Support NCR-WBN CEB 8501," Rev. 0  
[B41 850307 008]

2. For Sequoyah:

- a. SWP 820218 087, "Instrument Sampling Line Typical Support Calculation," Rev. 3
- b. SWP 820302 017, "Control Air Typical Support Calculation," Rev. 2
- c. SWP 800107 044, "Conduit Support Calculations," Rev. 1
- d. SWP 800107 049, "Lighting Fixture Typical Support Calculation," Rev. 0
- e. TVA Calculation, "Seismic Analysis of Instrumentation Rack Frame of Drawing 47W352," (06/29/72)
- f. TVA Calculation, "Evaluation of NCR WBN SWP 8237, R1," [WBP 840629 003], (07/06/84)
- g. TVA Calculation, "Unistrut Pipe Strap Load Ratings," Rev. 0, [SWP 820728 004], (10/27/82); Rev. 1, [WBP 840629 002], (07/06/84); Rev. 2, [WBP 840801 037], (08/23/84)
- h. TVA Calculation, "Tightening of Non-High Strength Bolted Connections for Conduit, Piping and Tubing," SQCG 1006 [B25 861021 800], (10/21/86)

3. For Browns Ferry:

- a. Calculation "RPV Sensing Line Support R-267," Rev. 0, [B22 861205 111], (12/05/86)
- b. Drawings for modifications to unit 2 CRD Insert and Withdrawal Pipe Support 47W2468-101
- c. Calculation "Qualification of the CRDH System Insert and Withdrawal Piping Support Frames," Rev. 0, [B22 861110 113], (11/07/86)
- d. Calc. I.D. BFEP80267, Rev. 0, [B22 860729 136], (07/29/86)
- e. Calc. I.D. BFEP80256, Rev. 0, [B22 860801 164], (08/01/86)
- f. Calc. I.D. NDB4800-11, Rev. 1, [B22 860926 107], (09/24/86)
- g. Calc. I.D. 4882800-165, Rev. 0, [B22 860926 104], (09/24/86)

4. For Bellefonte:

- a. Calculation "Instrument Line Tubing Supports - Allowable Loads," Rev. 6, [B21 850809 422], (10/04/85)
- b. Calculation "Reactor Building Conduit Supports," Rev. 5, [BLP 830706 006], (07/06/83)
- c. Drawing 4BA0892-X2-3, Rev. 2, "Aux., Cont., & DGB, Maximum Allowable Conduit Support Spacing"
- d. Calculation "Auxiliary, Control, and Diesel Generator Building, Conduit Support Typical Seismic," Rev. 7, [B21 860825 412], (08/25/86)
- e. Calculation "Reactor Building, Typical Seismic Conduit Supports," Rev. 3, [B21 851115 401], (12/02/85)
- f. Calculation "Electrical Conduit Supports," Rev. 7, [B21 850715 416], (07/15/85)

G. Drawings

1. For Watts Bar:

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|----------------|--|
| 47A050-1J, R13 | - "Mechanical Hanger Drawing General Notes"                        |
| 47A050-1J1, R2 | - "Mechanical Hanger Drawing General Notes"                        |
| 47A050-1J2, R4 | - "Mechanical Hanger Drawing General Notes"                        |
| 47A050-1J3, R4 | - "Mechanical Hanger Drawing General Notes"                        |
| 47A050-1R, R5  | - "Mechanical Hanger Drawing General Notes"                        |
| 47A051-1, R3   | - "Mechanical Seismic Category I Support Instrument Sensing Lines" |
| 47A051-12, R4  | - "Mechanical Category I Support Instrument Sensing Lines"         |
| 47A051-51, R1  | - "Mechanical Category I Support Instrument Sensing Lines"         |
| 47A051-52, R0  | - "Mechanical Category I Support Instrument Sensing Lines"         |



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- 47A052-24, R4 - "Mechanical Category I Support Instrument Sampling Lines"
  - 47A052-30, R2 - "Mechanical Category I Support Instrument Sampling Lines"
  - 47A053-1A, R10 - "Mechanical Seismic Support Process Pipe 2 Inch and Less"
  - 47A054-1, R2 - "Mechanical Seismic Category I Support Control Air Lines"
  - 47A054-25, R8 - "Mechanical Category I Support Control Air Lines"
  - 47A054-25A, R1 - "Mechanical Category I Support Control Air Lines"
  - 47A056-66, R5 - "Mechanical Category I Conduit Support"
  - 47A056-66A, R1 - "Mechanical Category I Conduit Support"
  - 47A056-66B, R2 - "Mechanical Category I Conduit Support"
  - 47A061-13, R0 - "Mechanical Seismic Category I and I(L) Instrument Supports"
  - 47A061-13A, R0 - "Mechanical Seismic Category I & I(L) Instrument Supports"
  - 47A450-3-15, R6 - "Mechanical Unit 1 Seismic Support for ERCW Support Detail 3-15"
  - 47A450-3-15A, R1 - "Mechanical Unit 1 Seismic Support for ERCW Support Detail 3-15A"
  - 47A450-3-16, R5 - "Mechanical Unit 1 Seismic Support for ERCW Support Detail 3-16"
  - 47A450-3-16A, R1 - "Mechanical Unit 1 Seismic Support for ERCW Support Detail 3-16"
  - 47A450-8-2, R1 - "Mechanical Unit 1 Category I Support for ERCW Support Detail 8-2"
  - 47A450-8-8, R4 - "Mechanical Unit 1 Category I Support for ERCW Support Detail 8-8"

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- 47A450-8-12, R4 - "Mechanical Unit 1 Category I Support for ERCW Support Detail 8-12"
  - 47A450-8-13, R1 - "Mechanical Unit 1 Category I Support for ERCW Support Detail 8-13"
  - 47A450-8-14, R4 - "Mechanical Unit 1 Category I Support for ERCW Support Detail 8-14"
  - 47A450-8-15, R1 - "Mechanical Unit 1 Category I Support for ERCW Support Detail 8-15"
2. For Sequoyah:
- 47A050-17, R0 - "Mechanical Hanger Drawing General Notes"
  - 47A050-18, R0 - "Mechanical Hanger Drawing General Notes"
  - 47A051-2, R3 - "Mechanical Seismic Support Instrument Sensing Lines"
  - 47A051-2A, R1 - "Mechanical Seismic Support Instrument Sensing Lines"
  - 47A052-8, R0 - "Mechanical Seismic Support Radiation Monitoring Lines"
  - 47A052-8A, R0 - "Mechanical Seismic Support Radiation Monitoring Lines"
  - 47A052-7, R4 - "Mechanical Seismic Support Radiation Monitoring Lines"
  - 47A053-10A, R1 - "Mechanical Seismic Support Process Pipe 2-inch diameter and less"
  - 47A053-61, R0 - "Mechanical Seismic Support Process Pipe 2-inch diameter and less"
  - 47A054-1A, R4 - "Mechanical Seismic Support Control Air Lines"
  - 47A054-2, R2 - "Mechanical Seismic Support Control Air Lines"
  - 47A054-2A, R2 - "Mechanical Seismic Support Control Air Lines"

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47A056-66, R4 & 5 - "Mechanical Seismic Support Conduit"  
47A056-66A, R5 & 6 - "Mechanical Seismic Support Conduit"  
47A056-66B, R0 & 1 - "Mechanical Seismic Support Conduit"  
47A057-7, R2 - "Mechanical Seismic Support Lighting  
Fixtures Mercury Type/Ballast"  
47W600-14, R4 - "Mechanical Instrument and Controls"  
47W600-23, R11 - "Mechanical Instrument and Controls"

3. For Browns Ferry:

48B810-1, R2, (12/11/86) Miscellaneous Steel Seismic Conduit Supports  
48B800-1, R5, (01/28/87) Typical Conduit Supports  
48B800-2, R6, (12/19/86) Typical Conduit Supports  
47W2468-101-1, R0, (11/07/86) General Note Drawings  
47W2468-101-2, R1, (01/31/87) General Note Drawings  
47W2468-101-3, R1, (01/31/87) General Note Drawings  
47W2468-100-1, R5, (01/14/87) CRD Insert and Withdrawal Pipe Supports  
47W2468-100-2, R2, (11/08/86) CRD Insert and Withdrawal Pipe Supports  
47W2468-100-3, R4, (01/14/87) CRD Insert and Withdrawal Pipe Supports  
47W2468-100-4, R1, (12/03/86) CRD Insert and Withdrawal Pipe Supports  
47W2468-100-5, R1, (01/14/87) CRD Insert and Withdrawal Pipe Supports  
47B2650-340, R0, (12/08/86) Mechanical RPV Sensing Lines Pipe  
Supports

4. For Bellefonte:

Series 4BA0570-X2, "Aux. Bldg. and Intake Pumping Station, Typical  
Seismic Instrument Tubing Support"  
Series 4BA0895-X2, "Aux., Control, and DG Bldg., Typical Seismic  
Instrument Tubing Support"

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5GB0925-I0-02, R14, "Instruments and Controls, General Installation Notes"

5GB0925-I0-43, R3, "Instruments and Controls, Tubing Hangers"

5GB0925-I0-44, R8, "Instruments and Controls, Tubing Hangers"

5GB0925-I0-45, R7, "Instruments and Controls, Tubing Hangers"

5GB0925-I0-46, R5, "Instruments and Controls, Tubing Hangers"

5GB0925-I0-47, R6, "Instruments and Controls, Tubing Hangers"

5GB0925-I0-48, R5, "Instruments and Controls, Tubing Hangers"

5GB0925-I0-49, R8, "Instruments and Controls, Tubing Hangers"

5GB0925-I0-11, R4, "Instruments and Controls, Tube Clamp Assemblies"

5GB0925-I0-22, R5, "Instruments and Controls, Thermal Expansion - Table 2"

5GB0925-I0-23, R4, "Instruments and Controls, Allowable Motion vs. Sx and Wm - Table 1"

5GB0925-I0-28, R7, "Instruments and Controls, Allowable Tubing Spans"

4RA0560-X2-13, R7, "Reactor Bldg., Typical Seismic Conduit Support"

4BA0892-X2-9, R9, "Aux., Cont., & DGB, Typical Seismic Conduit Connection to Embedded Unistrut"

4RA0560-X2-2B, R3, "Reactor Bldg., Typical Seismic Conduit Support"

4BB0892-X2-2, R13, "Aux., Control, & DG Bldg., Miscellaneous Steel, Seismic Conduit Supports, Notes - Sheet 2"

4RA0560-X2-2, R7, "Reactor Building, Maximum Allowable Conduit Support Spacing"

4RA0560-X2-58, R0, "Reactor Building, Typical Seismic Conduit Support"

H. Nuclear Performance Plans [no RIMS numbers]

1. For Watts Bar:

Revised Corporate Nuclear Performance Plan, Volume 1, Rev. 4, (03/86)

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Watts Bar Nuclear Performance Plan, Volume 4, Draft (03/87)

2. For Sequoyah:  
Revised Corporate Nuclear Performance Plan, Volume 1, Rev. 4, (03/86)  
Revised Sequoyah Nuclear Performance Plan, Volume 2, Rev. 1, (03/87)
3. For Browns Ferry:  
Revised Corporate Nuclear Performance Plan, Volume 1, Rev. 4, (03/86)  
Browns Ferry Nuclear Performance Plan, Volume 3, Rev. 1, (08/86)
4. For Bellefonte:  
Revised Corporate Nuclear Performance Plan, Volume 1, Rev. 4, (03/86)

I. General

1. TVA memorandum from R. W. Cantrell, Acting Director of Nuclear Engineering, to Those Listed, "Policy Memo PM 87-35 (DNE) - Project/Branch Responsibilities," [B01 870123 002], (01/23/87)
2. TVA Division of Nuclear Engineering - Nuclear Engineering Procedure (NEP), NEP-5.2, Rev. 0, "Review," [no RIMS number], (07/01/86)

J. Watts Bar: IN-85-283-002

1. WB-DC-40-31.3, "Assignment of Responsibility for Analysis, Support, and Fabrication of Piping Systems," Rev. 2
2. WB-DC-40-31.7, "Analysis of Category I and I(L) Piping Systems," Rev. 7, including a TVA memo from R. O. Barnett to CEB Files, [CEB 841015 015], (10/15/84)
3. WB-DC-40-31.9, "Location and Design of Piping Supports and Supplemental Steel in Category I Structures," Rev. 5, including a TVA memo from R. O. Barnett to CEB Files [CEB 850123 004], (01/23/85)
4. WD-DC-40-36, "The Classification of Piping, Pumps, Valves, and Vessels," Rev. 3

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5. CEB Report 75-9, "Design Data for Support of Category I Stainless Steel and Copper Tubing," (10/17/75)
6. CEB Report 76-5, "Alternate Criteria for Piping Analysis and Support," Rev. 5, (12/14/82)
7. Memo (no names, telecopied 01/28/87 14:24, attachment captioned: "3.0 Unit 1 Hanger and Analysis Update Program," [no RIMS number], (no date)
8. Bechtel Plant Design Calculation Number PD-218-10, Rev. 0, Job Number 16985-026, (08/18/87)
9. TVA memo from Bill Carson to Nick Liakonis, drawings attached from problems 26030, 67019, N3-67-A18A, 31023, N3-40-A11C, and N3-59-A01A, [no RIMS number], (05/28/86)
10. TVA, marked copy telecopied 06/11/86 12:26, with attachments, [no RIMS number], (no date)
11. "Corrective Action Response Evaluation" (marked "NSRS reply"), [no RIMS number], (08/05/85)
12. QE-SEP 82-18, TVA, WBN, "Program for Alternate Analysis Fix - Coordinating, Documenting, and Verifying," Rev. 3, [no RIMS number], (no date); Rev. 2, [B26 850503 001], (05/03/85)
13. TVA memo from R. O. Barnett to J. A. Raulston, "Watts Bar Nuclear Plant Units 1 and 2 - Program Deficiency: Alternately Analyzed Piping - . . ." [CEB 850123 008], (01/23/85)
14. TVA memo from J. A. Raulston to J. W. Hufham, "Watts Bar Nuclear Plant Unit 2 - Program Deficiency: Alternately Analyzed Piping - . . ." [B45 851219 264], (12/19/85)
15. NCR WBN SWP8231 (reply, RFI 064), [SWP 820616 006], (prepared 06/16/82)
16. ECN 3213 (TTB 219-3) [SWP 830120 526], (01/20/83)