

TVA EMPLOYEE CONCERNS  
SPECIAL PROGRAM

REPORT NUMBER: 10400

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Final Report

REVISION NUMBER: 2

TITLE: Embeds

PAGE 1 OF 121

REASON FOR REVISION:

Revised to incorporate SRP, comments TAS review comments, incorporate line management responses, and finalize report. Revision 1

To incorporate SRP and NRC comments, line management response(s), additional evaluation findings and refinalize report. Revision 2

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2377T/5811T/3250T

Preface, Glossary, and List of Acronyms  
for ECTG Subcategory Reports

HISTORY OF REVISION

REV NUMBER	PAGES REVISED	REASON FOR CURRENT REVISION
3	i	To clarify that one or more attachments will help the reader find where a particular concern is evaluated

### Preface

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

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

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

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

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

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

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

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

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

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

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

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

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

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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.

TVA EMPLOYEE CONCERNS  
SPECIAL PROGRAM

REPORT NUMBER: 10400

FRONT MATTER REV: 2

PAGE iv OF viii

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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)

TVA EMPLOYEE CONCERNS  
SPECIAL PROGRAM

REPORT NUMBER: 10400

FRONT MATTER REV: 2

PAGE vi OF viii

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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



TVA EMPLOYEE CONCERNS  
SPECIAL PROGRAM

REPORT NUMBER: 10400

FRONT MATTER REV: 2

PAGE vii OF viii

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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

TVA EMPLOYEE CONCERNS  
SPECIAL PROGRAM

REPORT NUMBER: 10400

FRONT MATTER REV: 2

PAGE viii OF viii

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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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<u>Outline of Contents</u>	<u>Page Number</u>
<u>SUBCATEGORY EXECUTIVE SUMMARY</u>	
1.0 <u>Characterization of Issues</u>	5
1.1 <u>Introduction</u>	
1.2 <u>Description of Issues</u>	
1.2.1 - 1.2.3 Generic	
1.2.4 - 1.2.6 Watts Bar Nuclear Plant	
1.2.7 Bellefonte Nuclear Plant	
2.0 <u>Summary</u>	8
2.1 <u>Summary of Issues</u>	
2.1.1.1 - 2.1.1.2 Generic	
2.1.1.3 Watts Bar Nuclear Plant	
2.1.1.4 Bellefonte Nuclear Plant	
2.2 <u>Summary of the Evaluation Process</u>	
2.3 <u>Summary of Findings</u>	
2.3.1 - 2.3.3 Generic	
2.3.4 - 2.3.6 Watts Bar Nuclear Plant	
2.3.7 Bellefonte Nuclear Plant	
2.4 <u>Summary of Collective Significance</u>	
2.5 <u>Summary of Causes</u>	
2.6 <u>Summary of Corrective Actions</u>	

---

	<u>Page Number</u>
3.0 <u>EVALUATION PROCESS</u>	18
3.1 General Methods of Evaluation	
3.1.1 - 3.1.3 Generic	
3.1.4 - 3.1.6 Watts Bar Nuclear Plant	
3.1.7 Bellefonte Nuclear Plant	
3.2 Requirements or Criteria Established for Individual Issues	
3.2.1 - 3.2.3 Generic	
3.2.4 - 3.2.6 Watts Bar Nuclear Plant	
3.2.7 Bellefonte Nuclear Plant	
4.0 <u>FINDINGS</u>	35
4.1 Embedded plate design with respect to:	
Errors, omissions, or incorrect assumptions in design calculations identified during 1984 but not corrected, noncompliance with NRC IE Bulletin 79-02 with respect to baseplate flexibility and undocumented loads on supports.	
4.2 Bolt load allowables greater for unit 1 than unit 2.	
4.3 Visual approval for minor loads on embedded plates.	
4.4 Minimum spacing criteria change.	
4.5 Engineering disposition for exemptions of minimum spacing requirements.	
4.6 "Hollow" sounding embedded plates.	
4.7 Verification of anchor load capability when surface mounted plates are deleted.	
5.0 <u>COLLECTIVE SIGNIFICANCE</u>	94
5.1 Collective Significance of Each Issue	

---

	<u>Page Number</u>
5.1.1 Generic	
5.2 Collective Significance of the Subcategory	
5.2.1 Generic	
6.0 <u>CAUSES</u>	97
6.1 - 6.3 Generic	
6.4 - 6.6 Watts Bar Nuclear Plant	
6.7 Bellefonte Nuclear Plant	
7.0 <u>CORRECTIVE ACTIONS</u>	102
7.1 Corrective Actions	
8.0 <u>ATTACHMENTS</u>	121
8.1 Attachment A, "Subcategory Summary Table and List of Concerns"	
8.2 Attachment B, "List of Evaluators"	
8.3 Attachment C, "List of Concerns by Issue"	

## EXECUTIVE SUMMARY

### EMBEDS

Report Number: 10400

#### Summary of Issues

This report addresses 18 concerns relative to the design and installation of embedded plates. The concerns are divided into seven issues which addressed errors, omissions or incorrect assumptions discovered in previously approved design calculations during 1984 that were not corrected, noncompliance with the Nuclear Regulatory Commission Office of Investigation and Enforcement Bulletin 79-02, undocumented loads on embedded plates, changes in the design philosophy that allowed greater bolt loads for unit 1 than unit 2, procedural inadequacies for visually approving minor loads to embeds, minimum spacing criteria changes, engineering approval for minimum spacing violations, "hollow" sounding embedded plates, and lack of verification for the load bearing capacity for welded studs. Seven concerns were generic to TVA plants under design or construction, one concern was pertinent to Watts Bar (WBN) and Sequoyah Nuclear Plants (SQN), one concern was site-specific to Bellefonte Nuclear Plant (BLN), and nine concerns were site-specific to WBN. All concerns were considered safety-related.

#### Major Findings

The Employee Concerns Task Group (ECTG) evaluation found that of the seven issues evaluated the four issues involving bolt load allowables, minimum spacing criteria change, engineering approval for exceptions to minimum spacing and "hollow" sounding embedded plates were factually accurate as addressed by the concern but did not represent a problem or compromise the safe operation of the plant. The generic issue concerning non-compliance with NRC Bulletin 79-02 was identified as factual. TVA had identified and initiated corrective action to resolve these items before the ECTG evaluation of the issues began with the exception of the specific deficiency on the qualification and use of Rawl self-drilling anchors. A CAQR has been initiated for this item. Errors in calculations were found to be factual for WBN only and corrective actions were initiated as a result of the evaluation. In addition, the NRC is requiring SQN to regenerate approximately 5600 calculations for pipe supports on rigorously analyzed piping systems prior to unit 2 restart. Undocumented loads on embedded plates was factual for all plants based on the findings. CAQs have been initiated to correct further problems. The issues involving visual approval of minor loads to embeds was not verified as factual for SQN but resulted in corrective actions being initiated for WBN. The change in bolt load allowables was proven to be factual for WBN only; however what was described does not represent a problem.

#### Collective Significance of Findings

Collectively, this evaluation focuses on TVA's delay in implementing procedurally the requirements of Bulletin 79-02. The investigation concludes that four years elapsed before management implemented procedural changes relative to the 79-02 bulletin and six years elapsed before TVA met

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with the NRC to establish a direct plan of action for WBN that would resolve any outstanding NRC questions concerning their response. CAQs and sampling programs initiated and performed by TVA to verify adequate factors-of-safety have substantiated a 95 percent confidence level that less than 5 percent of the original designs of embedded plates may have factors-of-safety lower than those mandated by the NRC. Results of the sampling programs do not indicate that the design utilized by TVA rendered the plant to be unsafe for operation.

### Causes of the Major Findings

It can be surmised that poor technical communications existed between TVA and the NRC. TVA's management was negligent in incorporating the 79-02 requirements into procedures after issuance and they failed to establish a direct plan of action with the NRC which would have allowed prompt closure of this bulletin.

### Corrective Actions of the Major Findings

The ECTG evaluation found that corrective actions had been initiated before this evaluation to address procedurally the embedded plate designs for pipe supports. Actions already taken included sampling programs for all sites which provided a 95 percent confidence level that less than five percent of the pipe supports may not meet the intent of Bulletin 79-02. Also, procedures were revised to incorporate the 79-02 requirements and designers were retrained, drawing notes and procedures were revised with respect to the effects of field tolerances and WBN reviewed instrument, process pipe, and civil features attached to embedded items to ensure proper documentation existed. For SQN, the qualification and use of the Rawl self-drilling anchors has resulted in a CAQR being initiated.

The issues involving minimum spacing criteria changes, exemptions to minimum spacing requirements and "hollow" sounding embedded plates did not require corrective actions with respect to conditions adverse to quality. However, during this evaluation, a CAQ was initiated to address baseplate flexibility for cable tray supports and errors in calculations for WBN. For SQN, regeneration of the 5600 (approximate) calculation packages prior to unit 2 restart will serve to verify that baseplate flexibility has been considered in calculations for surface mounted baseplates using concrete anchors. For BLN, CAQs were initiated to address unrestrained embedded nuts during concrete placement and the effects of missing nuts on type 49 plates.

Note: See Executive Summary Table # 1 for Issue Evaluation

Executive Summary Table #1

ISSUES	SR	NS	FINDINGS	CAUSE	CORR ACT.	SIGNIFICANCE	COLLECTIVE SIGN.
Embedded plate design with respect to:	X						
a. Errors, omissions, or incorrect assumptions in approved design calculations			WBN-Factual SQN-Not Factual BLN-Not Factual BFN-Not Factual	Employees failed to demonstrate the quality in their work that is necessary to ensure accuracy in their work.	Sample calculation packages were reviewed and identified. Errors were corrected.		N/A
b. Noncompliance with IE Bulletin 79-02			WBN-Factual SQN-Factual BLN-Factual BFN-Factual	Failure to implement 79-02 requirements into procedures in a timely manner.	Procedures were revised prior to this evaluation and sampling programs were also initiated to ensure TVA's design met the intent of Bulletin 79-02. A CAQR has been initiated on the qualification and use of Rawl anchors.	Programmatic deficiencies	Four years elapsed before management implemented procedural changes relative to the 79-02 bulletin and six years elapsed before TVA met with the NRC to establish a direct plan of action for WBN to resolve any outstanding NRC



Executive Summary Table #1

ISSUES	SR	NS	FINDINGS	CAUSE	CORR ACT.	SIGNIFICANCE	COLLECTIVE SIGN.
Embedded plate design with respect to: (con't)							questions concerning their response. As a result, the bulletin still remains open for BFN, WBN and BLN. The NRC has required a 100-percent review of unit 1 design pipe support calculations to ensure compliance with 79-02 for WBN unit 1. NRC has also required SQN to re-generate calculation packages for seismic pipe supports prior to unit 2 re-start.
c. Undocumented loads or	X		WBN-Factual SQN-Factual	Inadequate procedural	Additional site construction		

## 1.0 CHARACTERIZATION OF ISSUES

### 1.1 Introduction

This subcategory report addresses 18 concerns relative to the design of embedded plates. The concerns are divided into seven issues as described in section 1.2 and are considered safety-related. Seven concerns were generic to TVA nuclear plants under design or construction; one concern was pertinent to both Watts Bar (WBN) and Sequoyah Nuclear Plants (SQN), one concern was site-specific to Bellefonte Nuclear Plant (BLN), and nine concerns were site-specific to WBN.

Two concerns identified additional technical issues that are being addressed in the subcategory reports noted below:

a. Concern OE-QMS-8:

Design methods for detailing welds for pipe supports is addressed in subcategory report EN22200 - Pipe Support Weld Design.

b. Concern IN-85-110-001:

Design calculations for pipe supports from Bergen-Paterson and Engineering Data Systems (EDS) which were intentionally destroyed by the Tennessee Valley Authority (TVA) has been addressed in Subcategory Reports EN20500 - Control of Design Calculations and EN22100 - Pipe Support Design.

One concern HI-85-071-002 addressed nontechnical aspects for the design of plates and is addressed in subcategory IH-00000-Intimidation and Harrassment.

The concerns addressed in this subcategory report with the exception of SCR WBNCEB8623 R1 did not identify deficiencies that had not been previously addressed by TVA. This report will chronologically detail the conditions adverse to quality (CAQ) identified by TVA after the issuance of NRC-IE Bulletin 79-02 as related to this subcategory.

### 1.2 Description of Issues

#### Generic Issues:

#### 1.2.1 Embedded plate design with respect to:

- a. Concern IN-85-031-001 addressed errors, omissions or incorrect assumptions discovered in previously approved design calculations during 1984 that were not corrected.

Executive Summary Table #1

ISSUES	SR	NS	FINDINGS	CAUSE	CORR ACT.	SIGNIFICANCE	COLLECTIVE SIGN.
c. attachments to embedded plates without design review			BLN-Factual BFN-Factual	controls require-ments with respect to attachments to embedded plates.	specifications have been issued for WBN(N3C-928), SQN(N2C-927), and BLN(N4C-935-pending approval). BFN is currently reviewing design under ongoing programs. Site procedures have been revised to require documentation for all attachments to embedded plates.		
Changes in bolt load allowables	X		WBN-Factual SQN-Not Factual BLN-Not Factual BFN-Not Factual	Normalized loading for WBN could result in a factor-of-safety less than four.	DNE reduced the allowables for WBN unit 2 to ensure a minimum factor-of-safety of four was maintained.	A factor-of-safety of less than four could result in anchor bolt failure.	
Visual approval for minor loads attached to a embedded plate.	X		WBN-Factual SQN-Not Factual	Procedures did not provide a standard acceptance criteria or examples of items that could be approved visually.	DNE will revise CEB-21.46 to include standard acceptance criteria and examples of items that could be approved visually.	Potential exists for employees to visually approve a load that may not be classified as a minor load.	
Minimum spacing criteria change	X		WBN-Factual but not a problem	N3C-928 provided a 24-inch minimum clear separation	None required	N/A	

Executive Summary Table #1

ISSUES	SR	NS	FINDINGS	CAUSE	CORR ACT.	SIGNIFICANCE	COLLECTIVE SIGN.
c. (con't)				versus the 18-inch requirement in G-32. The 24-inch requirement is additionally conservative to the 18-inch in effect for other sites.			
Engineering disposition for exemptions of minimum spacing requirements	X		WBN-Factual but not a problem	Acceptable practice	None required	N/A	
"Hollow" sounding embedded plates	X		WBN-Factual but not a problem	The dead or hollow sound indicates a loss of bond or lack of solid contact to the concrete that could be caused by concrete placing voids, warpage of embedded plates, or concrete shrinkage.	None required	N/A	

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- b. Concerns IN-85-103-001 and OE-QMS-8 addressed noncompliance with the Nuclear Regulatory Commission Office of Investigation and Enforcement (OIE) Bulletin - 79-02, "Pipe Support Base Plate Design Using Concrete Expansion Anchor Bolts" in that TVA did not consider baseplate flexibility.
  - c. Concerns HI-85-077-N18, IN-85-110-001, and WBM-86-009-001 dealt with undocumented loads on embedded plates or attachments to embedded plates without the benefit of design review.

1.2.2 Bolt Load Allowables:

Concern IN-85-109-X04 questioned the design philosophy that allowed greater bolt loads (wedge bolts) for unit 1 than unit 2. This concern also addressed baseplate flexibility which is covered in section 1.2.1.

SQL and WBN Issues:

1.2.3 Visual Approval for Minor Loads:

Concern IN-85-033-001 addressed problems with Engineering Procedure (EP)-4.03, Appendix 4. This allows visual acceptance of minor loads to embedded plates. However, a minor load is not defined; therefore, there is no limit to what can be accepted. Embedded plate Field Change Request (FCR) 3784 is an example.

WBN

1.2.4 Minimum Spacing Criteria Change:

Concern IN-85-595-002 stated procedural requirements became more stringent in 1982. Minimum spacing criteria changed from 18 inches to 24 inches and 8 nominal bolt diameters to 10 nominal bolt diameters. Previous installations did not require re-evaluation or rework.

1.2.5 Engineering Approval for Minimum Spacing:

Concern IN-85-672-005 dealt with the engineering disposition and approval of attachments to embedded plates that do not meet the minimum allowable spacing as shown in N3C-928.

1.2.6 "Hollow" Sounding Embedded Plates:

Seven concerns addressed the "hollow" sounding embedded plates as follows:

- a. IN-86-305-001 addressed the fan bases on the second story of the Additional Diesel Generator Building.
- b. IN-85-693-006 identified the Reactor Building unit 1, cavity wall elevation 728, azimuth 222 degrees, missile ledge attachment plate.
- c. IN-85-693-007 addressed the Reactor Building unit 2, elevation 730, azimuth 135 degrees, (by the strip heater) inside the crane wall.
- d. IN-85-678-001 addressed the Reactor Building unit 2, embedded plates that hold the polar crane in place.
- e. IN-85-439-002 stated the existence of these plates throughout units 1 and 2 and specifically identified:
  1. Auxiliary Building, elevation 713, near A and T lines unit 1 (near double doors) 10 feet high on the wall.
  2. Auxiliary Building, elevation 713, 15-20 feet through the double doors, 12-14 feet high on the wall.
  3. Auxiliary Building, elevation 726, at A-13 and U line.
- f. Hollow plates with no given locations:

Concern IN-85-410-003 expressed that some embedded plates at WBN are hollow without giving a specific location.

Concern HI-85-071-002 expressed that personnel were told not to report hollow embedded plates encountered in the course of their work. No specific location was given.

BLN

1.2.7 Verification of Load Capacity:

Concern XX-85-097-001 stated that several pipe support hangers attached to embedded plates (inside containment, east-west

walls, Reactor Building unit 1) have only 1 or 2 welded studs to hold the plate to the concrete. They are cast-in-place anchors but there is no documentation for these anchors verifying their ability to support the loads to which they are subjected. These plates were originally designed for high pressure injection restraints.

## 2.0 SUMMARY

### 2.1 Summary of Issues

2.1.1 The 18 concerns relative to the design of embedded plates were divided into seven issues. These issues are summarized below:

#### 2.1.1.1 Generic (WBN, SQN, BLN, Browns Ferry (BFN))

- a. Errors, omissions or incorrect assumptions discovered in design calculations during 1984 that were identified but not corrected (1 concern)
- b. Noncompliance with NRC IE Bulletin 79-02 with respect to baseplate flexibility (2 concerns)
- c. Undocumented loads on embedded plates or supports (3 concerns).
- d. Wedge bolt allowables are greater for unit 1 than unit 2 (1 concern)

#### 2.1.1.2 Generic (WBN, SQN):

- a. Visual approval for minor loads on embedded plates (1 concern)

#### 2.1.1.3 Site-Specific (WBN):

- a. Minimum spacing criteria changed from 18 inches to 24 inches and 8 nominal bolt diameters to 10 nominal bolt diameters in 1982 (1 concern)
- b. Exemptions to the minimum spacing requirements (1 concern)
- c. Hollow sounding embedded plates when tapped (7 concerns)

2.1.1.4 Site-Specific (BLN):

- a. Embedded plates with welded studs and cast-in-place anchors supporting loads for which no documentation exists to verify their ability to support the loads (1 concern)

2.2 Summary of Evaluation Process

The methodology utilized to evaluate the concerns in this subcategory consisted of the following:

- a. Reviewed the construction specifications relative to embedded plates. The construction specifications were compared to the site implementing procedures for compliance in areas relative to the issues.
- b. Reviewed the WBN ECTG files for additional information.
- c. Performed informal walkdowns as required to verify the as-built condition of pertinent features.
- d. Researched CAQ reports and related correspondence.
- e. Reviewed NRC IE Bulletin 79-02 with respect to the requirements concerning pipe support baseplate designs using concrete expansion anchor bolts.

2.3 Summary of Findings

The seven issues contained in this subcategory report addressed items that had been previously identified by TVA. The exception to this is the issue concerning baseplate flexibility with respect to cable tray supports and the qualification/use of Rawl anchors at SQN. Corrective actions are in place relative to the concerns in this subcategory. One issue (hollow plates) resulted in a corrective action which would inform the employees of the engineering significance of the hollow sounds associated with the embedded plate.

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The following is a summary of the findings and conclusions for each of the seven issues:

- 2.3.1 Errors, omissions or incorrect assumptions discovered in design calculations during 1984 that were identified but not corrected, noncompliance with NRC IE Bulletin 79-02 with respect to baseplate flexibility, and undocumented loads on embedded plates and supports.



2.3.1.1 Generic - WBN

This issue was determined to be factual. TVA correspondence with the NRC and existing CAQ reports support this finding. With the exception of the issues addressed on SCR WBNCEB8623R1, TVA had identified to the NRC the problems addressed in the concerns before the investigation of the issues. Corrective actions are in place.

SON, BLN, BFN

With the exception of errors, omissions, or incorrect assumptions discovered in design calculations during 1984 which were uncorrected, the issue was determined to be factual. CAQ reports have been initiated that will specify the corrective actions for the concerns.

2.3.2 Wedge Bolt Allowables for Unit 1 Are Greater Than Unit 2

2.3.2.1 Generic - WBN

This concern was determined to be factual. The service load allowables did not change, however, for those designs based on normalized loads, the allowables for unit 2 were reduced to maintain a factor-of-safety of four.

SON, BLN, BFN

The concern was not factual for these projects. No changes were made in the methodology used to calculate wedge bolt allowables.

2.3.3 Visual Approval for Minor Loads on Embedded Plates

2.3.3.1 Generic - WBN

This concern was determined to be factual based on DNE approval for FCRs that did not fall within the acceptance guidelines for minor loads. Procedures will be revised to list standard acceptance criteria for minor loads. The sampling program performed by DNE did not identify any areas where plates were overstressed that were visually approved.

SQN

EP-4.03 Appendix 4 is site-specific to WBN. The visual approval program is not utilized by DNE SQN.

- 2.3.4 Minimum spacing criteria change from 18 inches to 24 inches and 8 nominal bolt diameters to 10 nominal bolt diameters in 1982.

2.3.4.1 Site-Specific - WBN

This concern was determined to be factual. Minimum spacing requirements were changed without re-evaluation or rework being performed. However, changes were not made because of inadequate procedures but were revised to allow the field to use smaller minimum spacings for plates for which the welded stud spacing is less than 12-inches. The 18-inch minimum requirement is still utilized by SQN, BLN and BFN.

- 2.3.5 Exemptions to the Minimum Spacing Requirements

2.3.5.1 Site-Specific - WBN

The concern is factual in that DNE can approve violations to the minimum spacing criteria. However, procedures are in place to avoid overloading of the embedded plate.

- 2.3.6 Hollow Sounding Embedded Plates

2.3.6.1 Site-Specific - WBN

The concern is factual in that portions of an embedded plate may sound hollow when tapped. However, the hollow sound (produced by small gaps under the embedded plate) does not have a significant effect on the structural performance of the embedded plates.

- 2.3.7 Verification of Load Capacity

2.3.8.1 Site-Specific - BLN

The concern is factual and corrective actions have been taken by BLN that will verify the stud anchor and/or plate integrity.

#### 2.4 Summary of Collective Significance

The following comments are specifically directed towards the design considerations of TVA's concrete anchor program, and; therefore, TVA's handling of issues related to NRC OIE Bulletin 79-02.

Management effectiveness was exemplary in the development of programs which proved to be economical and time efficient. Anchor spacing tolerances were relaxed where possible and engineering expertise was utilized to visually approve minor loads on embeds. Management also displayed consistency in their willingness to initiate sample programs for field installations to prove the adequacy of design and construction methods for NRC OIE Bulletin 79-02.

Management was ineffective in their willingness and ability to communicate with the NRC on 79-02 issues. The initial TVA response to the NRC on this subject was based on design methods and criteria which they were confident met or exceeded the intent of the bulletin. However, correspondence between TVA and the NRC was limited and additional information requests by the NRC should have indicated to management that the NRC was not totally satisfied with the TVA response. Instead of establishing a definitive policy of communication with the NRC on bulletin issues, management's philosophy was to further justify TVA's existing methodology instead of incorporating 79-02 requirements. Failure to establish definitive communication with the NRC and an attitude of "justify" instead of "incorporate and comply" has resulted in the bulletin remaining open for BFN, WBN, and BLN eight years after initial issuance.

Management was also deficient in the area of employee training and failed to ensure that adequate procedures were in place to effectively control the required work, or stress the need for high quality and accurate work by employees. A large number of CAQ's have been identified in this area where effective management could have, as a minimum, curtailed these occurrences. Management was also ineffective in communicating with employees on specific technical issues as evidenced by the large number of employee concerns expressed on similar subjects.

NOTE: The findings with respect to TVA management's performance on NRC OIE Bulletin 79-02 are less than adequate. Therefore, a generic evaluation at the Category and Final Report level of TVA's method for handling NRC Bulletins on other issues is warranted.

Employee effectiveness was impacted by inadequate procedural requirements and a lack of adequate training. However, a lower quality of work than required was identified, as both errors and inaccurate information were found to have occurred more often than was acceptable.

From another perspective employee effectiveness could be regarded as positive when consideration is given to the lack of effective management, inadequate procedures and training.

Technical adequacy has shown a marked improvement during the mid-1980's. Program changes and enhancements have increased the overall adequacy of design criteria, construction specifications and site procedures. The resolution of generic technical issues identified during the late 1970s and very early 1980s has revealed TVA was effective in identifying and implementing corrective action for significant program inadequacies. However, the number of changes and enhancements implemented is indicative of the overall lack of technical adequacy during that time period.

#### 2.5 Summary of Causes

The cause of the problems identified in this subcategory can be attributed to a time delay in implementing the 79-02 requirements into design procedures, failure to adequately address all aspects of loading which could affect plate capacity, poor technical communications between TVA and the NRC, and failure of employees to demonstrate the quality in their work that is necessary to ensure all procedural and drawing requirements are implemented.

#### 2.6 Summary of Corrective Action

##### 2.6.1 Corrective Actions Already Taken

- Sampling programs were initiated that provided a high confidence level that expansion anchor designs met the intent of 79-02 and results were submitted to the NRC.
- The 1982 memorandum instructing designers to consider only rigid plate analysis was revised to refer designers to the requirements of DS-C1.7.1

- DS-C1.7.1 was revised to clarify limitations and applicability of rigid plate analysis.
- DS-C1.7.1 was revised to provide a method for accounting for the effects of construction tolerances on calculated anchor bolt loads and baseplate stresses.
- The 47A050 notes for WBN and SQN were revised to assure that field changes to baseplates did not result in unacceptable increases in baseplate stresses or anchor bolt loads.
- G-43 was revised to change the allowable tolerances for fabrication dimensions for baseplates.
- Revised WBN EP-FCRs which referenced the wrong plate number or incorrect drawing revision level.
- CEB issued an explanation as to why some embedded plates sound hollow when tapped and information will be presented to DNC employees in their Employee Involvement Program.
- An addendum to QCI-3.09 R2 was issued to require a work release for any rework or additions to any conduit support which was already inspected and documented.
- Designers were trained in methods for considering baseplate tolerances in design and evaluation of supports.
- Performed sampling programs on EP-FCRs, to ensure compliance with 10CFR50 Appendix B and verify visual approval program.
- MAI-13 R3 was revised to have existing supports evaluated when new conduits are added.
- DNC completed a 100 percent review of Instrumentation SVSs and EP-FCRs issued for unit 2. Two supports were identified that required new SVSs. These have been issued and submitted to DNE for approval. QCP-3.11-1 R8 was revised to clarify inspection requirements to prevent recurrence.

- Modifications has reviewed all instrument, process pipe, and civil features attached to embedded items to ensure proper documentation exists.
- Procedure revisions to QCP-1.14, and QCP-3.11-1 have been incorporated to require documentation for attachments to an embed.
- DNC has revised QCI-1.13 to require an FCR when attachments are made to building and miscellaneous steel (except embedded plates).
- Modifications has reviewed engineered supports installed or modified by the Modifications Branch or Nuclear Services Branch since system transfer from DNC that did not have an FCR showing the exact installed location of the attachment to building steel. One support was identified and FCR 86-28 was initiated to show the exact installed location. DNE issued ECN 6420 to add appropriate notes to the 47A050 general notes which will require FCRs to be written when an engineered support is installed on building or platform structural steel in order to document the actual as-built locations of the supports.
- SQN has evaluated calculation packages for the thirty worst case supports which could have affected qualification of embeds. A field survey was also performed to obtain "as-constructed" information and supports will be evaluated for design capacity. This is required for interim operation.

#### 2.6.2 Corrective Actions to be Taken

- MAI-2 is being issued by ONP to address the evaluation of existing supports for load requirements when fire barrier insulation is added.
- DNE will review past installations for situations when a new attachment was added to an existing documented conduit support.

- DNC is currently reviewing documentation for all hangers, instrument supports, and miscellaneous steel attachments to embedded plates to ensure proper documentation exists.
- A field review of attachments to building and miscellaneous steel, cable tray supports and baseplates will be performed at WBN. DNC will provide DNE with marked structural drawings showing attachment locations to potentially overstressed structures and identification of pipe support members. DNE will be notified of additional attachments and will evaluate loading. Changes will be made if necessary.
- DNE initiated a verification program for WBN embedded plates used for anchorages of cable tray supports.
- Review WBN cable tray supports on surface mounted baseplates which use expansion anchors to determine if baseplate flexibility and construction tolerances were adequately considered in the design.
- Review documentation for identified WBN embedded plates which do not have a required FCR.
- Review WBN embedded plate drawings for spacing deficiencies between adjacent embedded plates and for embedded plates installed adjacent to concrete edges.
- Revise WBN N3C-928 to incorporate spacing requirements between adjacent plates and concrete edges to require a new or revised FCR on the embedded plate if attachments to the support were previously approved by an FCR, and to require a location description for all EP-FCRs.
- Revise CEB-21.46 to list some standard acceptance criteria with respect to the visual approval program used for EP-FCRs.
- SQN will conduct a random sampling program for typical supports to determine their adequacy.

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- SQN will review all Type II embeds and do a sampling of 40 "worst case" embeds to determine the effect of adjacent concrete edges on the embedded plate capacity. These items are to be performed before SQN restart.
  - SQN to regenerate 5600 (approximate) calculation packages for seismic pipe supports on rigorously analyzed systems prior to unit 2 restart. Calculation packages for affected pipe supports on alternately analyzed/small bore piping systems will be regenerated after unit 2 restart. |  
|
  - SQN will establish guidelines for minor load attachments and establish procedural controls for the evaluation method of attachments to embedded plates.
  - CAQR-SQF870101 documents the deficiency on the qualification and use of Rawl self-drilling anchors. Corrective action(s) for this CAQ is being developed. |  
|R2  
|
  - DNE will issue BLN N4C-935 to control attachments to embedded plates and revise conduit support drawings to delete free area requirements after N4C-935 is issued.
  - DNE will conduct a sampling program to evaluate the effects of the free area requirements for BLN.
  - DNE will review BLN conduit and instrumentation support calculations to determine actual loadings.
  - BLN-CEU will assign unique identifiers to type 49 plates to ensure all shims and nuts are installed and inspected.
  - DNE will review BLN's embedded plate drawings and calculation packages for plates located adjacent to concrete edges and the effects on the embedded plate's capacity.
  - DNE will evaluate the BLN type 49 plates for possible overload conditions.
  - DNE to evaluate past installations for BLN where no requirements existed for restraining nuts on embedded bolts during concrete pours.



- DNE will verify that the factor-of-safety has not been compromised for BLN when the effects of base plate flexibility on the welded stud capacity is considered.
- DNE will establish a method for restraining bolts for future installations.
- DNE will verify that for BFN the required minimum spacing is maintained when the effects of multiple attachments to embeds are considered.
- A walkdown will be performed to verify the qualification of BFN baseplates and concrete anchors as required in BFN-50-712.
- BFN DNE will determine any corrective action required to assure that construction tolerances will not affect anchor bolt loads and baseplate stresses.
- BFN DNE will determine any corrective action necessary to account for the effects of adjacent concrete edges on the embedded plate's capacity.

### 3.0 EVALUATION PROCESS

#### 3.1 General Methods of Evaluation

The following addresses the summary of the specific evaluation methodology utilized in the evaluation of the seven issues in the embedded plate subcategory.

##### Generic Evaluation Process

- 3.1.1 This section discusses the evaluation procedure utilized for the issue described in section 1.2.1. This issue addressed errors, omissions or incorrect assumptions in design calculations during 1984, which were identified but left uncorrected, noncompliance with NRC IE Bulletin 79-02 with respect to baseplate flexibility, and undocumented loads on supports.

This element was evaluated utilizing the following methodology:

- a. Reviewed Nuclear Engineering Procedures, General Construction Specifications, Site Construction Specifications and site procedures to address:
  1. Adequacy of calculation procedures with respect to technical reviews of calculations.
  2. Procedural requirements for baseplate flexibility.
  3. Controls to prevent inadvertent overloading of embedded plates.
- b. Compiled and reviewed Problem Identification Reports (PIRs), Nonconformance Condition Reports (NCRs), Significant Condition Reports (SCRs), Corrective Action Reports (CARs), Engineering Reports (ERs), Field Change Requests (FCRs), NRC-IE Bulletin 79-02, NRC correspondence, NSRS reports, QTC reports, and related memorandums.
- c. Reviewed DNE responses to employee concerns.
- d. Interviews with knowledgeable personnel in responsible organizations as required concerning procedures and possible causes of perceived problems associated with embedments.
- e. Reviewed QTC expurgated files and WBN ECTG files for additional information.
- f. Reviewed SQN Generic Concerns Task Group (ECTG) report for content, adequacy and findings.
- g. Reviewed WBN ECTG Element report on embedments and generic applicability to SQN, BLN and BFN.

Generic Evaluation Process:

- 3.1.2 This section discusses the evaluation methodology used for the issue stated in 1.2.2. This issue addresses concrete anchor bolt (wedge bolts) allowables are greater in unit 1 than unit 2.

- a. The WBN ECTG files were reviewed for additional information regarding this issue.
  - b. Reviewed NRC-IE Bulletin 79-02 and TVA responses to the NRC concerning this issue.
  - c. Reviewed Civil Design Standards and General Construction Specifications relative to this issue.
  - d. Compiled and reviewed condition adverse to quality reports.
- 3.1.3 This section discusses the evaluation methodology used for the issue stated in section 1.2.3. This issue addresses visual approval of minor loads on embedded plates.

WBN:

- a. The WBN ECTG files were reviewed for additional information regarding this issue.
- b. Design and site procedures were reviewed relative to the programs in place for visual approval.
- c. Evaluated the following NSRS report for details of their investigation relative to this issue:

I-85-265-WBN

- d. Reviewed 10 CFR 50, Appendix B "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants, Criterion III".
- e. Reviewed DNE responses to employee concerns.
- f. Compiled and reviewed SCRs, ERs, and related correspondence.
- g. Interviewed knowledgeable personnel with respect to the visual approval program.

SQN

- a. Design and site procedures were reviewed relative to the programs in place for visual approval and preliminary approval.

- b. Reviewed the SQN Generic Concerns Task Group (ECTG) Report for content, adequacy and findings.
- c. Reviewed the SQN Element Report for content, adequacy, and findings.
- d. Interviewed knowledgeable personnel with respect to the visual approval program and preliminary approval program.

WBN Evaluation Process:

- 3.1.4 This section discusses the evaluation methodology used for the issue stated in section 1.2.4. This issue addresses the minimum spacing criteria change.
  - a. The WBN ECTG files were reviewed for additional information regarding this issue.
  - b. Design and site procedures, General Construction Specifications and Site Construction Specifications were compiled and reviewed.
  - c. Reviewed NCRs and DNE correspondence relative to the concern.
- 3.1.5 This section discusses the evaluation methodology used for the issue stated in 1.2.5. This issue addresses engineering disposition of exemptions from minimum spacing requirements.
  - a. The WBN ECTG files were reviewed for additional information regarding this issue.
  - b. Reviewed General Construction Specifications, Site Construction Specification, Design and site procedures relative to minimum spacings.
  - c. Reviewed DNE memorandums related to sampling programs for EP-FCRs.
- 3.1.6 This section discusses the evaluation methodology used for the issue stated in section 1.2.6. This issue addresses hollow sounding embedded plates.
  - a. The WBN ECTG files were reviewed for additional information regarding this issue.

- b. Reviewed the following NSRS reports for adequacy in determining the validity and potential resolution of the concerns:
  - 1. NSRS I-85-666-WBN
  - 2. NSRS I-85-665-WBN
  - 3. NSRS I-85-692-WBN
- c. Reviewed nonconforming condition reports related to concerns.
- d. Reviewed the DNE response to hollow sounding embedded plates.
- e. Interviewed a DNE Lead Civil Engineer for the following:
  - 1. Potential causes for the hollow sound.
  - 2. Effect on the structural integrity of the plate.

BLN Evaluation Process:

- 3.1.7 This section discusses the evaluation methodology used for the issue stated in section 1.2.7. This issue addresses the lack of documentation to verify anchor load capacity when surface mounted plates are deleted.
- a. The WBN ECTG files were reviewed for additional information regarding this issue.
  - b. Reviewed site drawings and procedural requirements for original design of the plates in question.
  - c. Reviewed FCR-0-4866 which changed the original design.
  - d. Performed a field walkdown of the type of plates questioned for installed configuration.
  - e. Interviewed CEU-BLN supervisor, DNE CEB lead engineer, and DNE-BLN unit supervisor concerning plate installation, plate integrity and probability of a nut backing off the anchor stud.

3.2 Requirements or Criteria Established for Individual Issue

Historical Background

3.2.1 Embedded Plate Design as noted in paragraph 1.2.1:

- a. NRC IE Bulletin 79-02, "Pipe Support Baseplate Designs Using Concrete Expansion Anchor Bolts," dated March 8, 1979, Revision 0 (MEB 790313 383)
- b. NRC IE Bulletin 79-02, "Pipe Support Baseplate in Designs Using Concrete Expansion Anchor Bolts," dated June 21, 1979, Revision 1 (MEB 790625 393)
- c. NRC IE Bulletin 79-02, "Pipe Support Baseplate in Designs Using Concrete Expansion Anchor Bolts," dated August 20, 1979, Revision 1, Supplement 1 (NEB 790824 122)
- d. NRC IE Bulletin 79-02, "Pipe Support Baseplate in Designs Using Concrete Expansion Anchor Bolts," dated November 8, 1979, Revision 2 (NEB 791116 100)
- e. Memorandums
  1. To H. S. Fox from R. H. Dunham, dated May 25, 1979 (CEB 790525 042)
  2. To D. R. Patterson from R. G. Domer, dated July 3, 1979 (CEB 790703 029)
  3. To W. F. Willis from E. A. Belvin, dated August 17, 1979 (DES 79082 022)
  4. To H. G. Parris from C. E. Murphy, dated September 6, 1979 (A02 790910 015)
  5. To G. G. Stack from R. M. Pierce, dated October 18, 1979 (CEB 791018 003)
  6. To D. R. Patterson from R. G. Domer, dated November 28, 1979 (CEB 791128 022)
  7. To J. P. O'Reilly from L. M. Mills, dated December 6, 1979 (A27 791207 001)

TVA EMPLOYEE CONCERNS  
SPECIAL PROGRAM

REPORT NUMBER: 10400

REVISION NUMBER: 2

PAGE 24 OF 121

---

8. To L. M. Mills from G. F. Dillworth, dated December 21 1979 (NEB 791221 256)
9. To L. M. Mills from D. R. Patterson, dated December 6, 1979 (NEB 791206 129)
10. To J. P. O'Reilly from L. M. Mills, dated January 2, 1980 (A27 800102 006)
11. To L. M. Mills from G. F. Dillworth, dated February 1, 1980 (NEB 800201 250)
12. To M. N. Sprouse from R. O. Barnett, dated May 14, 1980 (CEB 800514 005)
13. To J. P. O'Reilly from L. M. Mills, dated April 3, 1981 (A27 810403 011)
14. To Those listed from M. N. Sprouse, dated April 30, 1981 (CEB 810430 021)
15. To R. W. Cantrell from R. O. Barnett, dated June 16, 1981 (CEB 810616 007)
16. To J. P. O'Reilly from L. M. Mills, dated June 20, 1984 (A27 840620 001)
17. To L. M. Mills from J. A. Raulston, dated October 10, 1984 (NEB 841010 256)
18. To J. P. O'Reilly from L. M. Mills, dated October 24, 1984 (L44 841024 302)
19. To H. G. Parris from D. M. Verrelli, dated February 25, 1985 (A02 850226 001)
20. To J. N. Grace from J. W. Huffham, dated May 17, 1985
21. To W. T. Cottle from J. C. Standifer, dated February 14, 1986

TVA EMPLOYEE CONCERNS  
SPECIAL PROGRAM

REPORT NUMBER: 10400

REVISION NUMBER: 2

PAGE 25 OF 121

- 
- f. Civil Design Standard DS-C6.1, R0, R1, "Concrete Anchorages"
  - g. Civil Design Standard, DS-1.7.1, R0-R3, "General Anchorage to Concrete"
  - h. Nuclear Engineering Procedure NEP-9.1, R0, "Corrective Action"
  - i. "Attribute Sampling - Tables and Explanations" by Herman Burstein, 1971
  - j. Conditions Adverse to Quality (CAQs)
    - 1. NCR WBNCEB8203
    - 2. NCR GENCEB8208
    - 3. NCR GENCEB8205
    - 4. NCR GENQAB8203
  - k. Construction Specifications
    - 1. WBN N3C-928, "Locating attachments on Embedded Plates," R0-R2
    - 2. SQN N2C-937, "Locating Attachments on Embedded Plates," R0

WBN

a. Memorandums

- 1. To J. C. Standifer from R. O. Barnett, dated May 21, 1982 (CEB 820521 003)
- 2. To Guenter Wadewitz from J. C. Standifer, dated January 14, 1983 (SWP 830114 020)
- 3. To H. G. Parris from NRC Region II, dated February 29, 1984
- 4. To H. G. Parris from NRC Region II, dated May 3, 1984
- 5. To J. P. O'Reilly from TVA, dated October 30, 1984 (L44 841030 002)



6. To J. P. O'Reilly from TVA, dated April 4, 1984  
(A72 840402 025)
  7. To L. M. Mills from J. A. Raulston, dated  
October 11, 1984 (NEB 841011 261)
  8. To Guenter Wadewitz from R. W. Dibeler dated  
August 9, 1985 (C03 850809 001)
  9. To W. T. Cottle from J. C. Standifer, dated  
February 14, 1986
- b. General Construction Specification G-32, R8-R11, "Bolt  
Anchorages Set in Hardened Concrete"
  - c. General Construction Specification G-43, R7, R9, "Support  
and Installation of Piping Systems in Category I  
Structures"
  - d. Construction Specification N3C-928, R0-R2, "Locating  
Attachments on Embedded Plates"
  - e. Procedures
    1. WBN-QCP-1.14, R12-R18, "Inspection and Testing of  
Bolt Anchors Set in Hardened Concrete and Control of  
Attachments to Embedded Plates"
    2. WBN-QCI-1.13, R8-R14, "Preparation and Documentation  
of Field Change Requests"
    3. Engineering Procedure EP 4.03, R8-R11, "Field Change  
Requests Initiated by Construction"
    4. CEB 21.46, R0 "Field Change Requests Initiated by  
the Office of Construction as a Result of WBN  
Construction Specification N3C-928"
    5. Civil Design Standard DS-C6.1, R0-R1, "Concrete  
Anchorages"
    6. Civil Design Standard DS-C1.7.1, R0, "General  
Anchorage to Concrete"

7. WBN-QCP-3.09, R0-R3, "Inspection of Supports for Electrical Conduit and Junction Box"
  8. Engineering Procedure EP-4.03, R8-R11, "Field Change Requests Initiated by Construction:
  9. CEB 21.46, R0, "Field Change Request Initiated by the Office of Construction as an Result of WBN Construction Specification N3C-928"
  10. Civil Design Standard DS-C6.1, R0-R1, "Concrete Anchorages"
  11. Civil Design Standard DS-C1.7.1, R0, "General Anchorage to Concrete"
- f. Significant Condition Reports (SCRs)
1. SCR WBNCEB8623
  2. SCR WBNCEB 8650
  3. SCR 6498-S
  4. SCR 6597-S
- g. Nonconforming Condition Reports (NCRs)
1. NCR WBNWBP8402
  2. NCR WBNCEB8419
  3. NCR 3659
  4. NCR 6498
  5. NCR 6564
  6. NCR 6735
  7. NCR W-403-P
  8. NCR W-435-P

h. Problem Identification Reports

1. PIR WBNCEB8543
2. PIR WBNCEB8601
3. PIR WBNCEB8602
4. PIR WBNCEB8635

i. Field Change Requests

1. EP 3784
2. H-10917
3. EP-9458
4. EP-9574
5. EP-9549
6. EP-9550
7. EP-7316
8. FCR 86-28

j. EIP-CEO-238

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- a. Memorandum to J. C. Standifer from R. O. Barnett, dated May 21, 1982 (CEB 820521 003)
- b. Civil Design Standard DS-C6.1, R0, R1, "Concrete Anchorages"
- c. Civil Design Standard DS-C1.7.1, R0-R3, "General Anchorage to Concrete"
- d. Civil Design Standard DS-C1.8.1, R0, "Standard Calculation for Evaluating Type II Embedded Plates"
- e. Construction Specification N2C-937, R0, "Locating Attachments on Embedded Plates"

TVA EMPLOYEE CONCERNS  
SPECIAL PROGRAM

REPORT NUMBER: 10400

REVISION NUMBER: 2

PAGE 29 OF 121

- 
- f. General Construction Specification G-32, R8-R11, "Bolt Anchorages Set in Hardened Concrete"
  - g. Problem Identification Reports
    - 1. PIR-SQNCEB-8658
  - h. Nonconforming Condition Reports
    - 1. NCR SQNCEB8404, R1
    - 2. NCR SQNCEB8502, R2
  - i. Significant Condition Reports
    - 1. SCR SQNCEB8607, R0
    - 2. SCR SQNEEB8620, R1
    - 3. SCR SQNCEB8622, R1
  - j. Condition Adverse to Quality Reports
    - 1. CAQR-SQF870101, R0

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BLN

- a. General Construction Specification G-32, R8-R11, "Bolt Anchorages Set in Hardened Concrete"
- b. Civil Design Standard, DS-C1.7.1, R0, "General Anchorage to Concrete"
- c. Memorandum to R. M. Hodges from J. R. Lyons, dated June 19, 1885 (B49 850619 002)
- d. Memorandum to J. F. Weinhold from R. O. Barnett, dated June 3, 1986 (B41 860603 004)
- e. Memorandum to R. O. Barnett from C. W. Hatmaker, dated November 19, 1985 (B21 851119 008)
- f. Memorandum to R. O. Barnett from J. P. Wooten, dated January 14, 1986 (B21 860114 003)

TVA EMPLOYEE CONCERNS  
SPECIAL PROGRAM

REPORT NUMBER: 10400

REVISION NUMBER: 2

PAGE 30 OF 121

---

- g. Memorandum to R. O. Barnett from J. P. Wooten, dated May 16, 1986 (B21 860516 002)
- h. Nonconforming Condition Report NCR BLNCEB8421
- i. Problem Identification Reports (PIRs)
  - 1. PIR BLNCEB8518
  - 2. PIR BLNCEB8610
  - 3. PIR BLNCEB8612
  - 4. PIR BLNCEB8616
- g. Significant Condition Report SCR BLNCEB8518

BFN

- a. General Construction Specification G-32, R8-R11, "Bolt Anchors Set in Hardened Concrete"
- b. Significant Condition Reports (SCRs)
  - 1. SCR BFNCEB8520
  - 2. SCR BFNCEB8614
  - 3. SCR BFNCEB8617
- c. Memorandum to G. R. Hall from N. R. Beasley, dated February 19, 1986 (B22 860219 001)
- d. J. D. Cowart's 45D to S. A. Thibadoix, dated January 16, 1986
- e. Engineering Procedure 3.03, Revision 0, "Design Calculations"
- f. Unresolved Item Numbers 50-259/85-21, 50-260/85-21, 50-296/82-21
- g. Corrective Action Report (CAR) 85-059

h. Memorandums

1. To R. O. Barnett from J. M. Marshall, dated January 23, 1986 (B22 860123 013)
2. To R. O. Barnett from J. M. Marshall, dated January 23, 1986 (B22 860123 012)
3. To R. O. Barnett from J. M. Marshall, dated March 13, 1986 (B22 860313 007)
4. To R. O. Barnett from J. M. Marshall, dated April 10, 1986
5. To R. O. Barnett from T. M. Brothers, dated May 28, 1986 (B22 860528 009)

- i. BFNP-PI 85-02, Revision 3, "Seismic Qualification of Existing Electrical Conduit and Conduit Supports"

3.2.2 Bolt Load Allowables as noted in paragraph 1.2.2:

- a. NRC IE Bulletin 79-02, "Pipe Support Baseplate Designs Using Concrete Expansion Anchor Bolts," dated November 8, 1979, R2
- b. Memorandum to J. N. Grace from J. W. Huffman, dated May 17, 1985 (L44 850517 803)
- c. General Construction Specification G-32, R5-R11, "Bolt Anchors Set in Hardened Concrete"
- d. Civil Design Standard DS-C6.1, R0, R1, "Concrete Anchorages"
- e. Civil Design Standard DS-C1.7.1, R0, "General Anchorage to Concrete"
- f. Nonconformance Condition Report NCR WBNCEB8402

3.2.3 Visual Approval for Minor Loads as stated in paragraph 1.2.3:

WBN

- a. Nuclear Safety Review Staff (NSRS) Investigation Report I-85-265-WBN
- b. 10 CFR 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants, Criterion III"
- c. Memorandum to W. T. Cottle from J. C. Standifer, dated February 14, 1986
- d. Construction Specification N3C-928, R0-R2, "Locating Attachments on Embedded Plates"
- e. Engineering Procedure EP-4.03, Appendix 4, R8-R11, "Field Change Requests Initiated by Construction"
- f. CEB 21.46, R0, "Field Change Requests Initiated by the Office of Construction as a Result of WBN Construction Specification N3C-928"
- g. Field Change Request (FCR) H-10917
- h. Significant Condition Report SCR WBNCEB8623R1

SQN

- a. SQN Generic Concerns Task Group Report on Employee Concern IN-85-033-001
- b. Engineering Procedure EP-4.03, R11, "Field Change Requests Initiated by Construction"
- c. Construction Specification N2C-937, R0, "Locating Attachments on Embedded Plates"
- d. Modifications and Additions Instruction M&AI-11, Revision 12, "Fabrication, Installation, and Documentation of Seismic Supports and Supports Attached to Seismic Category I Structures"

3.2.5 Engineering Approval for Minimum Spacing as stated in paragraph 1.2.5:

- a. Construction Specification N3C-928, R0-R2, "Locating Attachments on Embedded Plates"
- b. WBN-QCI-1.13, R14, "Preparation and Documentation of Field Change Requests"
- c. CEB-21.46, R0, "Field Change Requests Initiated by the Office of Construction as a Result of WBN Construction Specification N3C-928"
- d. General Construction Specification G-32, R8-R11, "Bolt Anchors Set in Hardened Concrete"
- e. Memorandum to W. T. Cottle from J. C. Standifer, dated February 14, 1986
- f. Significant Condition Report SCR WDNCEB8623, R1

3.2.6 "Hollow" Sounding Embedded Plates as stated in paragraph 1.2.6:

- a. Nuclear Safety Review Staff (NSRS) Investigation Reports
  1. I-85-692-WBN
  2. I-85-665-WBN
  3. I-85-666-WBN
- b. Memorandum to W. R. Brown from K. C. Gandhi, dated September 24, 1986 (B26 860924 045)
- c. Nonconformance Condition Report NCR 6470
- d. General Construction Specification G-2, R5, "Plain and Reinforced Concrete"
- e. General Construction Specification G-32, R-11, "Bolt Anchors Set in Hardened Concrete"
- f. WBN-QCP-2.02, R10, "Concrete Placement and Documentation"



3.2.7 Verification of Load Capacity as stated in paragraph 1.2.8:

- a. Construction Specification G-32, R-11, "Bolt Anchors Set in Hardened Concrete"
- b. TVA Design Drawings
  - 1. 4RW0425-X2-10
  - 2. 4RW0507-X2-02
  - 3. 4RW0516-X2-02
- c. Field Change Request 0-4866

4.0 FINDINGS

Historical Outline

- March 8, 1979 The NRC issued IE Bulletin 79-02, "Pipe Support Base Plate Designs Using Concrete Expansion Anchor Bolts." A written response was required from all holders of a construction permit or operating license.
- June 19, 1979 TVA submitted their response to Bulletin 79-02 for BFN.
- June 21, 1979 The NRC issued IE Bulletin 79-02 R1. The purpose of the revision was to identify acceptable ways of satisfying the original Bulletin requirements and provide additional information and clarification as requested by utilities.
- July 5, 1979 TVA issued to the NRC a generic response for their design program and individual responses for SQN, WBN, BLN, HNP, PBN, and YCN.
- August 3, 1979 TVA met with IE Region II to discuss their proposal for BFN concerning pre 1973 anchor installations. NRC had informed TVA that the response to 79-02 for installations prior to 1973 did not meet IE Bulletin 79-02 requirements. This did not require a reactor shutdown; however, an inspection and evaluation program for pre 1973 anchors was to be performed.

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- August 8-10, 1979 The NRC conducted a scheduled inspection at BFN in the area of concrete expansion anchor installation (79-02) and identified no items of noncompliance or deviations. The NRC agreed that the operation of BFN could continue simultaneously with the visual inspection and evaluation program of the concrete anchors installed before 1973.
- August 20, 1979 The NRC issued IE Bulletin 79-02 Supplement 1 to R1. This supplement established criteria for the evaluation of interim acceptability of plant operation. This was for plants that did not conform to the design factors-of-safety for piping supports due to as-built problems, base plate flexibility, or anchor bolt deficiencies.
- September 21, 1979 Region II contacted TVA and requested TVA to re-examine their response to 79-02 for SQN and investigate additional areas concerning a factor-of-safety of five for expansion anchors. The NRC also requested confirmation that baseplate flexibility was considered in the design analysis and that a program be initiated to visually inspect embeds with respect to G-32 requirements.
- October 18, 1979 Sampling programs of safety-related piping systems concrete expansion anchors were conducted at SQN and revealed areas where the thread engagement of some anchors did not meet the requirements of G-32. Tests had previously been conducted by Singleton Materials Engineering Lab to establish for BFN acceptable anchor load capacities. The inspected anchors at SQN fell within the established limits for BFN. The NRC inspectors stated that the BFN criteria were also acceptable for SQN. Therefore anchors installed before October 29, 1979 were adequate. Installations after October 29, 1979 were required to meet the G-32 criteria.
- November 8, 1979 The NRC issued IE Bulletin 79-02 R2. This revision was intended to further clarify the intent of the Bulletin and establish the NRC positions on the minimum factor-of-safety, anchor bolt proofload, and expected date of completion for certain Bulletin requirements.

TVA EMPLOYEE CONCERNS  
SPECIAL PROGRAM

REPORT NUMBER: 10400

REVISION NUMBER: 2

PAGE 37 OF 121

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- December 6, 1979 TVA provided to the NRC the results of the investigations for Bulletin 79-02 Revision 2. TVA included in their response, the inspection and testing schedule for anchor pull tests for BFN. For the remaining TVA nuclear plants, TVA stated that the previous response submitted July 5, 1979 remained valid.
- January 2, 1980 TVA responded to additional information requested verbally from the NRC concerning anchor bolt safety factors and thread engagement for SQN.
- February 1, 1980 TVA responded to additional information requested by the NRC concerning SQN.
- May 14, 1980 Memorandum from R. O. Barnett to M. N. Sprouse concerning Bulletins 79-02 and 79-14. This addressed the need for programs to be revised or developed by TVA that would ensure requirements established by the NRC were met concerning the Bulletins. Programs were to be developed to verify TVAs position prior to NRC inspections and verifications. It was stated in the memorandum that to date, the NRC had not formally responded to TVA's submittals on the subject bulletins.
- April 3, 1981 TVA submitted to the NRC the complete SQN response for Bulletin 79-02.
- April 30, 1981 TVA issued a notice of advanced changes to Design Standard DS-C6.1 ("Concrete Anchorages") concerning revised factors-of-safety for expansion anchor design as required per IE Bulletin 79-02.
- September 24, 1981 WBN identified that attachments to building or miscellaneous steel (except embedded plates) were being performed without the benefit of an FCR.  
  
CAQ: NCR 3659
- March 4, 1982 DNE discovered that multiple supports had been attached to embedded plates without the benefit of a design review.  
  
CAQ: WBNCEB8203-WBN  
GENCEB8208-SQN, BLN, BFN

TVA EMPLOYEE CONCERNS  
SPECIAL PROGRAM

REPORT NUMBER: 10400

REVISION NUMBER: 2

PAGE 38 OF 121

May 21, 1982

Policy memorandum issued instructing designers to complete the analysis of WBN with the rigid plate method. The design instructions were also utilized for SQN.

January 17-20 1984

The NRC conducted an evaluation of TVAs design organization's implementation of the requirements for concrete expansion anchor bolts in their anchorage designs.

Unresolved Items and Violations Initiated:

- a. 390, 391/84-05-01: Minimum factors-of-safety in DS-C1.7.1 do not meet requirements of IE Bulletin 79-02.
- b. 390, 391/84-05-02: Base plate designs have not accounted for plate flexibility when determining the maximum anchor design loads and factor-of-safety required by Bulletin 79-02.
- c. 390, 391/84-05-03: Failure to follow procedure in area of base plate designs.
- d. 390, 391/84-05-04: Portions of design calculations were not performed per procedure.
- e. 390, 391/84-05-05: Static friction loading during DBA was not considered in pipe support designs.

October 24, 1984

TVA provided the NRC with supplemental information concerning concrete expansion anchor bolts for WBN Unit 1.

CAQs 1984

Baseplate flexibility not considered in original design.

CAQs: WBNWBP8402 (closed)  
SQNCEB8404

Cumulative effects of field tolerances not considered in original design.

CAQs: WBNCEB8419  
SQNCEB8404  
BLNCEB8421  
BFNCEB8614

January 1985

TVA met with the NRC Region II to discuss WBN unit 1. One major topic of discussion involved Bulletin 79-02.

February 15, 1985

The NRC documented the January technical meeting with TVA and stated TVA's commitment to perform a 100 percent review of design calculations for engineered pipe supports to assure expansion anchor factor-of-safety requirements are met before the first refueling outage of WBN unit 1.

May 17, 1985

TVA responded to the February 15, 1985 technical meeting notes and stated a procedure will be prepared to establish the program to be used to evaluate safety-related systems and associated supports. This program will render further evidence that TVA is currently in compliance with NRC IE Bulletin 79-02.

CAQs 1985

Cable tray support baseplate flexibility not considered in original design.

CAQs: PIRWBNCEB8523 (superceded by SCR WBNCEB8623)

Conduit supports that exceed design allowable stresses

CAQ: SQNCEB8502

Qualification of some baseplates and concrete anchors in typical support details cannot be verified and some supports have undersized welds.

TVA EMPLOYEE CONCERNS  
SPECIAL PROGRAM

REPORT NUMBER: 10400

REVISION NUMBER: 2

PAGE 40 OF 121

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CAQs: BFNCEB8520  
BFNMEB8400

February 14, 1986 TVA documented the results of the findings evaluated during sampling programs for visually approved and office approved FCRs initiated in response to employee concerns IN-85-31-001 and IN-85-33-001.

CAQs 1986: Baseplate flexibility not considered for cable tray supports.

CAQs: WBNCEB8623  
SQNCEB8622  
BLNCEB8616

Effects of insulations on conduit and variances of typical supports.

CAQs: WBNCEB8601  
WBNCEB8602  
NCR 6735  
NCR W-403-P  
BLNCEB8610

Attachments to embedded features without proper documentation.

CAQs: NCR 6498, 6498-S  
SCR 6567-S  
NCR W-435-P  
NCR 6564

Attachments to building or miscellaneous steel without an FCR.

CAQs: WBNCEB8650  
CAR 86-059

Embedded plates installed with a plate edge adjacent to a concrete edge or free edge violations.

CAQs: WBNCEB8623 (EIP-CEO-238)  
SQNCEB8607  
BLNCEB8518  
BLNCEB8612  
BFNCEB8617